NATIONAL SERVICE MANUAL

1936 SUPPLEMENTS

MECHANICAL SECTION

INFORMATION "FINDING" DIRECTIONS

For Complete ENGINE DATA on each Model see Car Model "M" Pages.

For BRAKE, CLUTCH, STEERING, FRONT END SUSPENSION, etc., applied to each particular model see Car Model "M" Pages.

For COMPLETE INFORMATION on EACH TYPE of EQUIPMENT see the COMPLETE ARTICLES in applicable section, that is, BRAKES on "B" Pages, CLUTCH on "CL" Pages, STEERING on "S" Pages.

SPECIAL INDEXES direct you to the particular Data you desire.

NOTE:—For ELECTRICAL & TUNE UP information see "T&E" Pages.

MECHANICAL EQUIPMENT INDEX

* Equipment Section. Page numbers correct for latest edition manual. For earlier editions see manual Equipment Section Index.
† Electrical Equipment Section—1936 supplement.

1936 CAR MODEL INDEX – MECHANICAL

* See car page in 1935 Supplement.

BENDIX MECHANICAL TYPE. SINGLE ANCHOR.

Used On:

LINCOLN ZEPHYR, MODEL H (1936).
LINCOLN V-12, MODEL K (1936).
PACKARD EIGHT, MODELS 1400, 1, 2, SUPER EIGHT MODELS 1403, 4, 5 (1936).
PACKARD TWELVE, MODELS 1407, 8 (1936).
WILLYS MODEL 77 (1936).

NOTE—Bendix Vacuum Power operation used on Lincoln V-12 and all Packard Models. See separate article on this unit and note under adjustment below.

DESCRIPTION AND OPERATION:—Wheel Brakes—Two shoes per wheel, connected together by turn buckle type adjusting screw at one end and bearing against single anchor pin at other end. Cable actuated lever concentric with anchor pin forces anchor end of primary shoe against drum when brakes applied. Primary shoe applies secondary. Shoes returned to off position by independent spring hooked to lever and brake shoe. Shoes held in position by coiled springs and clips hooked to backing plate. Adjustments consist of eccentric screw (brake shoe stop) to centralize shoes, and adjusting screw (between shoes) to control clearance between shoes and drum.

Brake Linkage:—Wheel brakes actuated by cables from single cross-shaft on frame. Brake cables protected by flexible conduits between frame and wheel. Brake pedal linked to cross-shaft with Vacuum Power Cylinder Control Valve (when used) incorporated in pedal linkage.

Hand Brake:—Hand brake lever linked to cross-shaft applies all four service brakes.

ADJUSTMENT:—Jack up all four wheels, disconnect cables at cross-shaft, remove adjusting screw hole covers on backing plates and inspection hole covers on drums (remove wheels if disc type). Check pedal position with cross-shaft levers against stops. Pedal should clear underside of toeboard by ½". Adjust by disconnecting pedal link and changing length. Then proceed as follows:

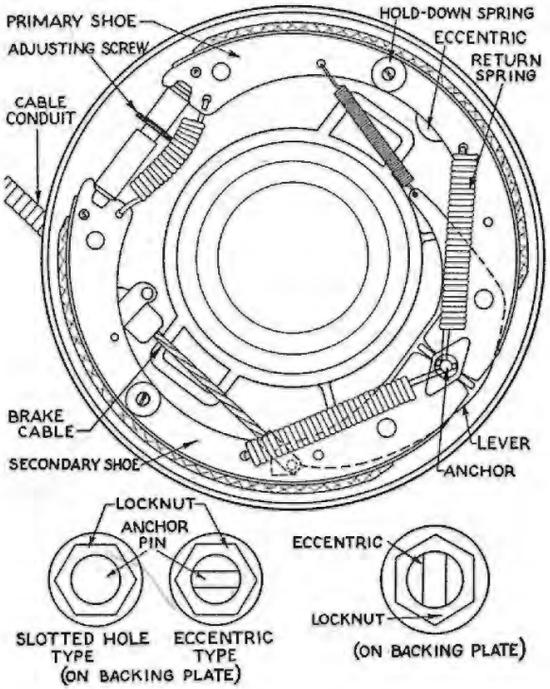
Minor Adjustment (For Wear):—1—At each wheel—loosen eccentric locknut, turn eccentric in direction of forward wheel rotation until .010" feeler is snug at both ends of this shoe. Hold eccentric from turning, tighten locknut. Clearance at both ends must be the same within .003" with smaller clearance preferably at anchor end. If variation greater than .003", anchor pin must be relocated (see Major Adjustment below).

2—At each wheel—insert tool or screwdriver in adjusting screw hole, turn notched adjusting screw toward backing plate rim (move outer end of tool up toward center of wheel) until shoes are expanded so that drum can just be turned, pull brake cables toward cross-shaft to remove all slack, adjust clevis position (loosen locknut, turn clevis, tighten locknut) until pins just enter clevises at cross-shaft lever freely, reconnect brake cables.

3—Back off adjusting screws same number of notches at each wheel until wheels are free. Apply brakes with hand lever or use pedal jack until wheel with least drag can just be turned, equalize brakes by backing off adjusting screws on tight wheels not more than two or three notches. Do not tighten loose wheels.

4—Check pedal reserve (distance from pedal to floorboard with brakes applied). This should be one half total travel (minimum). Recheck adjustment if less than this amount. Then check hand lever position (below).

NOTE—On Packard Models, brake lining for left front wheel is of narrower width (see Car Specifications) so that if brakes checked on tester, difference in pull should be in ratio of 6.5-6.75 (right front wheel) to 5.0 (all other wheels).



Major Adjustment (New Shoes or Relined Brakes):—1—At each wheel loosen anchor pin nut one turn, tap anchor pin out toward drum (slotted hole type with plain end) or turn anchor pin in direction of forward wheel rotation (eccentric type with slotted end). Loosen locknut, turn eccentric in direction of forward wheel rotation until .010" feeler snug at both ends of this shoe, hold anchor pin, tighten locknut securely with 16" wrench, hold eccentric from turning, tighten eccentric locknut. Then proceed with (2) and (3) under Wear Adjustment above.

NOTE—On Packard 8 and Super 8, vacuum unit control valve, mounted on brake pedal, adjustable to provide more or less vacuum booster action. Brake pedal vertical lever is connected to vertical arm through link engaged in one of three holes in lever. On new cars or with new lining requiring minimum booster action, engage link in lower hole in lever (factory setting on new cars). Engage link in center hole for softer pedal after linings are run in. Upper hole used only for very soft pedal action. This adjustment not provided on Packard Twelve.

On Lincoln V-12, separate vacuum regulating valve mounted on steering gear and controlled by lever on instrument panel used to control vacuum booster action. This is an operating adjustment.

Hand Lever Adjustment:—With hand lever in released position, and cross-shaft levers against stops, adjust length of hand lever cable or rod to eliminate all slack (see note on Lincoln Zephyr).

Lincoln Zephyr—On this model, hand lever adjusted by moving cable conduit forward or backward at support bracket at cross-shaft until free movement or lash at extreme end of hand brake lever is ¼-½". Conduit end is threaded and positioned by adjusting nut on each side of support bracket. Loosen locknuts, back off front adjusting nut (to decrease lash) or rear nut (to increase lash), turn up second adjusting nut until conduit clamped in support, tighten locknuts.

RELINING BRAKES:—Manufacturer recommends use of replacement shoes furnished with new linings installed and ground concentrically. If shoes relined, use same type lining as fitted originally (see Car Model article). Lining on primary and secondary shoes may be of different types (woven on primary, moulded on secondary, etc.), or of different lengths. Shoes may be identified by 'P' (primary) 'S' (secondary) stamped on rib at adjusting screw end.

SERVICING:—Brake Linkage—Whenever adjustment made, lubricate brake pedal hand lever, cross-shaft, overrunning linkage and all clevis pins. See that linkage operates freely and returns sharply to stops when pedal and hand lever released.

Cable Conduits:—Lubricate cable and conduit assemblies through fittings (when so equipped) or disconnect cable at both ends, clean thoroughly, pull cable out at wheel end to expose portion normally in conduit, clean and coat with Bendix Cable Lubricant, or graphite grease such as Gredag #213½, pull cable back and forth to spread lubricant in conduit. See that conduit is bottomed firmly in abutment brackets and that bracket bolts are tight.

Wheel Brakes:—With shoes removed, coat brake cam, anchor pin, cable ramps, eccentric, backing plate shoe edges and all other contact points with Bendix Lubriplate. Examine shoe return springs and see that heavier spring it attached to shoe which covers cable end of brake lever.

BENDIX VACUUM CYLINDER. PLAIN TYPE—EXTERNAL VALVE.

Used On:

LINCOLN V-12, MODEL K (1936).
PACKARD 8 MODELS 1400, 1, 2, SUPER 8 MODELS 1403, 4, 5 (1936).
PACKARD TWELVE, MODEL 1407, 8 (1936).
PIERCE ARROW 8, MODEL 1601 (1936).
PIERCE ARROW 12, MODELS 1602, 3 (1936).

DESCRIPTION:—Consists of vacuum cylinder mounted on frame with piston rod linked to brake cross-shaft or pedal. Rod or boot end of piston chamber open to atmosphere (through air cleaner in cover) and opposite chamber behind piston connected to engine manifold through control valve. Piston normally held in outer position against boot end by brake linkage return springs with brakes 'off' when both chambers are open to atmosphere.

BENDIX VACUUM CYLINDER CONT.

OPERATION:—Control valve connected in pedal linkage is two-way diaphragm type. With brakes 'off' and no tension on valve rods, atmospheric valve is bottomed in chamber so that air is admitted through cleaner in cover is free to flow to power unit balancing pressure on both sides of piston. Vacuum connection to manifold is cut off by seating of diaphragm. When brakes are applied, atmospheric valve moves forward and contacts diaphragm, cutting off air intake. Further movement unseats diaphragm opening manifold vacuum connection, and makes connection with power unit line so that air in chamber in exhausted. Air pressure on boot face of piston forces piston in, applying brakes. Vacuum, and consequently booster action of power unit, is directly proportional to pedal application. When atmospheric valve stop bottoms in housing (total travel approximately 3/32″), pedal pressure is transmitted directly through control valve housing to brake cross-shaft so that brakes are applied both by pedal and vacuum power unit. When pedal is released, movement of atmospheric valve first seats diaphragm cutting off vacuum, and then admits air to cylinder allowing power unit piston to move off position.

ADJUSTMENT:—Control Valve Setting—Pedal linkage should be adjusted so that there is no load on control valve (atmospheric valve should be bottomed in chamber) with pedal released and against its stop, and cross-shaft levers against stops. Any tension on control valve in this position will cause dragging brakes. On Packard Eights, this adjustment is made by taking out clevis pin in link under control valve, loosening locknut and turning link in or out.

Power Unit:—With brakes 'off', and cross-shaft levers against stop, disconnect piston cable, pull piston all the way out (against boot end stop) adjust cable length to remove all slack, reconnect cable.

TROUBLE SHOOTING:—Engine misses and stalls when brakes applied:—

1—Loose hose connection between control valve and power unit. Check connections. Replace hose.

2—Dry Piston Seal in Power Unit cylinder. Check by disconnecting piston cable and hose connection at cylinder. Push piston all the way in. Hold finger over hose nipple on end of cylinder, pull on piston rod. If piston can be pulled out, piston seal is leaking. Lubricate as directed in Servicing below, repeat test. If operation still unsatisfactory piston seal should be replaced.

3—Cracked Diaphragm in Control Valve or dirt between valve and diaphragm seat. To check, disconnect all connections and remove valve from car. Apply suction to nipple from which manifold connection removed. If air can be drawn through valve, diaphragm does not seat or is cracked. Disassemble and inspect unit.

Engine misses or stalls when idling:—

1—Loose connections or leaky hose between control valve and manifold. Examine connections, replace hose.

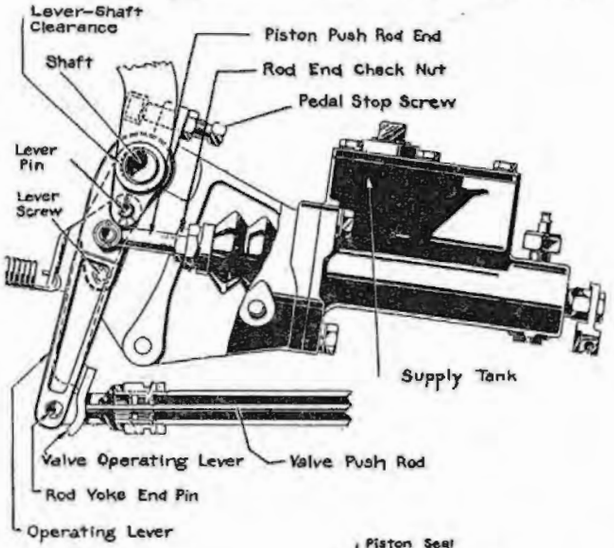
SERVICING:—Piston Seal Lubrication—Remove Power Unit from car, hold unit vertical with piston rod down, inject approximately 2 ounces Bendix Vacuum Oil through hose nipple in upper end of cylinder, work piston up and down and around to spread oil. Test as directed in Trouble Shooting (2).

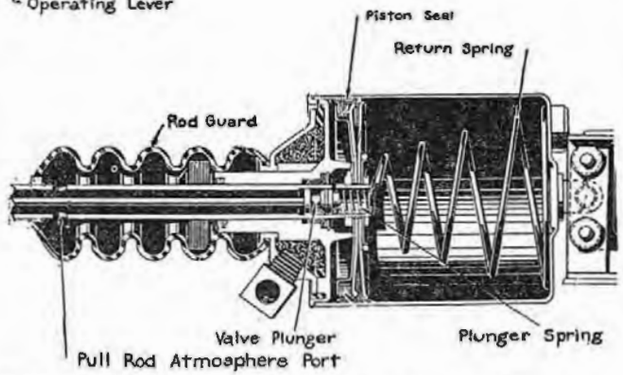
BENDIX VACUUM CYLINDER. INTERNAL VALVE TYPE.

Used On:

CADILLAC V-16, SERIES 90 (1936).
CHRYSLER AIRFLOW EIGHT, MODEL C-9 (1936)
CHRYSLER AIRFLOW IMP. & CUST. IMP. MODELS C-10, 11 (1936).
DUESENBERG, MODEL J (1936).

DESCRIPTION:—Vacuum cylinder mounted on frame with hollow pull rod connected directly to brake pedal extension lever. Spring loaded piston type control valve located within hollow pull rod and operated by push-rod which extends out through pull rod to pedal lever. Vacuum line from manifold connected directly to rear end of cylinder so that vacuum always present in rear chamber behind piston. Front chamber controlled by control valve.





OPERATION:—Control valve push-rod setting provides slight clearance at brake pedal lever with brakes 'off' so that valve is seated in forward position by spring. This cuts off air passage (air inlet is through air cleaner in cover and boot to hole in piston pull rod and through pull rod to atmospheric valve). Vacuum passage from rear chamber through push-rod stem and front chamber port in side of pull rod uncovered by valve is open so that both piston chambers are evacuated (pressure equal) and piston will be held in 'off' position (forward against boot end) by spring in cylinder. When brake pedal depressed, pull rod clevis pin contacts valve push-rod, moving valve to rear, cutting off vacuum and connecting front chamber port to atmosphere so that air pressure forces piston to rear applying brakes. When pedal travel is stopped, control valve cuts off air so that no further movement of piston takes place, and when pedal is released, further travel of control valve forward opens vacuum connection to front chamber, balancing pressure and piston is returned to 'off' position by spring.

ADJUSTMENT:—Cadillac—Make adjustments in following order:

1—Disconnect brake pedal pull rod and vacuum power unit from pedal lever, reinstall clevis pin in upper end of valve lever, loosen locking screw in upper end of pedal lever and turn eccentric bushing clockwise to bring rear edge of hole in lower end of pedal lever in line with rear edge of hole in valve lever bushing, tighten locking screw.

2—Loosen locknut, adjust brake pedal stopscrew so that clearance between pedal and underside of toeboard is ¼-⅜″, tighten locknut.

3—See that spring between valve lever and pedal lever has sufficient tension to separate levers as far as clevis pin at top of levers permits. Spring cotter pin should have ⅛″ clearance at valve lever.

4—Check length of Power Unit pull rod. Distance from face of boot and flange to center of clevis pin must be 8 3/16″ with pull rod pulled out until piston contacts front end of cylinder.

5—Adjust length of control valve clevis or fork by loosening locknut and turning fork out until it contacts clevis pin, then turn fork in 1½ turns and tighten locknut.

6—Connect Power Unit, readjusting pedal stopscrew if necessary to allow Power Unit pull rod clevis to enter levers without disturbing position of piston.

7—Connect brake pedal pull rod and see that clearance between front end of clevis and clevis pin is 1/32″ with brake pedal and cross-shafts against stops.

Chrysler Models:—Adjust in following order:

1—Adjust brake pedal stopscrew so that pedal just clears underside of toeboard.

2—Remove clevis pin connecting Power Unit pull rod and lever. Hold operating lever so that clearance between lever and brake pedal shaft is at front side of shaft (hole is larger than shaft), check master cylinder push-rod length. Adjust by taking out push-rod clevis pin, adjust length of rod so that pin can be entered with master cylinder piston at forward end of stroke against stop without disturbing position of operating lever.

3—Without disturbing position of operating lever (clearance at front of shaft) pull on Power Unit pull rod until piston is against stop, loosen frame bracket mounting bolt, move bracket on frame until pull rod clevis pin can be entered in operating lever without disturbing lever or Power Unit piston, tighten bracket bolt.

4—Loosen Power Unit control valve push-rod lever screw on operating lever, position lever so that it just contacts push-rod with brakes released and push-rod in extreme forward position, tighten screw.

SERVICING:—Power Unit—At 6000 mile intervals, remove plug on boot end of cylinder, inject 2 ounces of Bendix Vacuum Cylinder Oil, work piston around and up and down to spread oil in cylinder.

BENDIX HYDRAULIC TYPE. SINGLE ANCHOR.

Used On:

AUBURN 654, 852, Schgd. 852 (1936).
BUICK 40, 60, 80, 90, (1936).
CADILLAC V-8, 60, 70, 75, V-12, 80, 85, (1936).
HUDSON 63 (Six), 64, 5, 6, 7 (Eight) (1936).
LAFAYETTE 3610 (1936).
LA SALLE 50 (1936).
NASH 3620, 40-A, 80 (1936).
OLDSMOBILE F-36 (6), L-36 (8), (1936).
PACKARD 120-B (1936).
PONTIAC 36-26A, B (6), 36-28 (8), (1936).
TERRAPLANE 61, 62 (1936).

NOTE—Hudson-Terraplane models equipped with mechanical 'follow-up' by which rear wheel brakes are applied by pedal after hydraulic application, as a reserve. See section at end for adjustment.

DESCRIPTION AND OPERATION:—Wheel Brakes— Brake shoes used in this type are entirely similar to those used in mechanically operated brakes (see previous article). A rigid type hydraulic cylinder with double opposed pistons is mounted on the backing plate below the anchor bolt. The opposed pistons are connected to the brake shoes through short struts or studs and force the anchor ends of the brake shoes against the drum when the brake fluid, displaced from the master cylinder by depressing the pedal, flows through the lines to the wheel cylinders. The primary shoe applies the secondary shoe in the usual manner. Shoes are returned to the 'off' position by retracting springs hooked to the shoes and the anchor pin in the same manner as mechanical brakes. Adjustments are the same as on mechanical brakes.

Hand Brake:—When incorporated in wheel brakes (rear wheels only), consists of cable actuated lever pivoted on one shoe and linked to other shoe by a strut so that the shoes are expanded against drums at anchor ends when brake is applied. Hand brake adjustment is part of service brake adjustment (see directions below).

Master Cylinder:—Compensating type similar to design used on Lockhead brakes. See Lockhead Brake article.

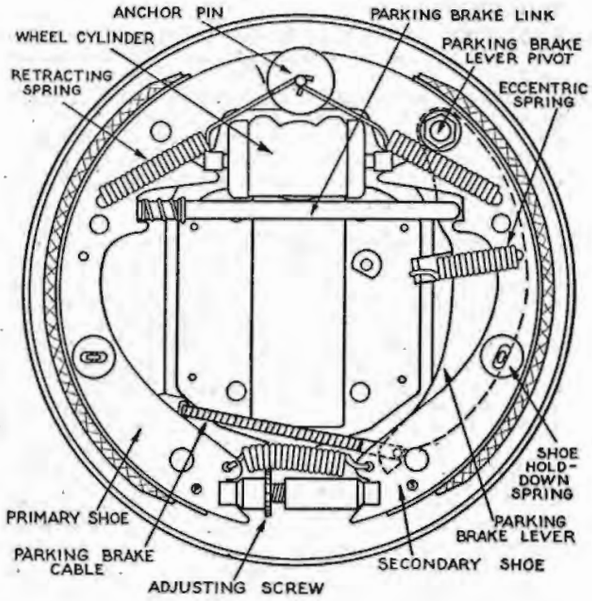
NOTE—Wheel cylinder must be 'bled' whenever brake line to that particular wheel is disconnected, and entire system (all four wheels) must be bled whenever brake lines are disconnected at master cylinder to remove all air in system and correct springy brake action.

ADJUSTMENT:—Bleeding Brake System—Procedure same as for Lockhead Brakes. See Lockhead Brake article.

Brake Pedal Clearance:—Brake pedal must have ⅜" free travel before master cylinder piston begins to move. To adjust, loosen locknut at outer end of master cylinder boot, change length of brake pedal rod, tighten locknut. By-pass port between master cylinder and supply tank must be uncovered when piston is in 'off' position to provide compensating action.

Minor Adjustment (For Wear):—Jack up all four wheels, disconnect parking brake (hand lever) cables at cross-shaft, take off adjusting screw hole cover on backing plate, and feeler gauge hole cover on drum (remove wheels if disc type).

1—At each wheel, loosen eccentric locknut, turn eccentric screw in direction of forward wheel rotation until .010" feeler is snug at both ends of this shoe, hold eccentric from turning, tighten locknut.



Clearance at both ends of shoe must be alike within .003" with smaller clearance preferably at anchor end. If variation greater than .003" anchor bolt must be relocated (see Major Adjustment below).

2—At each wheel, insert tool or screwdriver in adjusting screwhole, turn adjusting screw (move outer end of tool up toward center of wheel) until shoes are expanded so that drum can just be turned, pull parking brake cables toward cross-shaft to remove all slack, adjust clevis position (loosen locknut, turn clevis, tighten locknut) until pins just enter clevises at cross-shaft levers freely, with cross-shaft levers against stops and hand lever in released position, and hand lever cable or rod at cross-shaft clevis adjusted to eliminate all slack (except as noted below). Reconnect cables.

Hudson-Terraplane—Hand lever should be pulled on until equalizer bar ⅛" from stop. Rear face of equalizer must be parallel to stop after cables connected.

La Fayette-Nash—Cables cannot be disconnected (equalized by pulley coupling on lever). Loosen lever bracket-to-frame screws, place hand lever in third notch, move bracket forward until cables are tight, tighten mounting screws, release lever.

Oldsmobile Six and Eight—Equalizer link (connection between intermediate or cross lever and cables) must be parallel with propellor shaft with cables connected.

Packard 120-B—After removing all slack with hand lever off, set lever in first notch, see that equalizer bar is at right angles to propellor shaft, clamp in this position while adjusting and reconnecting cables.

Pontiac Six and Eight—Place hand lever in first notch while adjusting and reconnecting cables.

3—Back off adjusting screws same number of notches at each wheel until wheels are free, use pedal jack to apply brakes until wheel with least drag can just be turned, equalize by backing off adjusting screws in tight wheels not more than two or three notches. Do not tighten loose wheels.

Major Adjustment (For new shoes or relined brakes):—If brake shoes removed for service work, do not disturb wheel cylinder or pistons, and do not depress brake pedal with shoes off (pistons can be retained by special clamp fitted over ends of cylinder). This will make it unnecessary to bleed lines when shoes replaced. Jack up all four wheels, disconnect parking brake cables at cross-shaft, remove adjusting screw hole cover on backing plate, and feeler gauge hole cover on drum (remove wheels if disc type).

1—At each wheel, loosen anchor pin nut one turn, tap anchor pin out toward drum (slotted hole type with plain end) or turn anchor pin in direction of forward wheel rotation (eccentric type with slotted end). Loosen locknut, turn eccentric in direction of forward wheel rotation until .010" feeler snug at both ends of this shoe, hold anchor pin, tighten locknut securely with 16" wrench, hold eccentric, tighten eccentric locknut. Then proceed with (2) and (3) under Wear Adjustment above.

RELINING BRAKES:—Manufacturer recommends use of replacement shoes furnished with new linings installed and ground concentrically. If shoes relined, use same type lining as fitted originally (see Car Model article). Lining on primary and secondary shoes may be of different types (woven on primary, moulded on secondary, etc.), or of different lengths. Shoes may be identified by 'P' (primary), 'S' (secondary) stamped on rib at adjusting screw end.

SERVICING:—Linkage—Lubrication of cables same as for mechanical brakes. See previous article on Bendix Mechanical Brakes.

Master Cylinders and Wheel Cylinders:—Same as for Lockhead. See article on Lockhead Hydraulic Brakes.

TROUBLE SHOOTING:—Brake Pedal goes down to floor.

1—Excessive shoe clearance due to wear—Adjust brakes. If adjusting screw must be turned up more than 50 clicks or notches, examine lining for replacement.

2—Leaks in system. Minor leaks evident by gradual slacking off of brakes when applied with pedal depressor. Examine lines and wheel cylinders. When caused by contraction of piston cups due to extreme cold, correct by installing special expanders (between cup and spring) and special springs (shorter than standard).

3—Air in Brake System—when present in considerable quantity (smaller amount evidenced as 'springy' pedal). Bleed system.

4—No fluid in supply tank. Lines must be bled if supply tank allowed to become empty.

BENDIX HYDRAULIC—CONT.

Brakes drag at all wheels:—
1—Mineral oil in system—causes rubber piston cups to expand. Wash out master cylinder, lines and wheel cylinders with alcohol, replace rubber piston cups, refill with genuine brake fluid.
2—By-Pass port in master cylinder clogged or covered by piston. See that port is uncovered with piston in extreme off or outer position to allow fluid return to supply tank (see brake pedal adjustment above).

Brakes drag at one wheel:—
1—Weak or broken return spring. Replace springs. See that stronger spring is attached to secondard shoe.
2—Improper adjustment (shoe clearance too small).
3—Cylinder cups distorted or incorrectly installed. Lip of cup must point in.

Car pulls to one side:—
1—Oily linings. Replace shoes or reline.
2—Improper adjustment (shoe clearance too small).
3—Loose dust shield or backing plates.
4—Incorrect lining type or length. See specifications in Car articles.

Brake Pedal Springy:—
1—Air in system. Bleed lines.

Brake Pedal 'Hard':—
1—Improper adjustment.
2—Incorrect lining type.
3—Oily linings—replace or install new shoes.
4—Partial contact—high spots. Linings should be ground concentrically.

Brake Pedal 'Soft':—
1—Improper adjustment.
2—Dust shield or backing plate loose.
3—Oily linings.

HUDSON MECHANICAL FOLLOW-UP.

DESCRIPTION AND OPERATION:—Consists of overrunning mechanical linkage between brake pedal and hand lever rotary equalizer by which rear wheel brakes are set mechanically through hand lever or parking linkage after movement of pedal sufficient to operate brakes hydraulically has taken place. Acts as reserve if hydraulic application fails or when pedal travel excessive.

ADJUSTMENT:—See that master cylinder operating lever is against stop (brake pedal stop) and that rear wheel brake cable rotary equalizer is against stop on bracket, loosen locknut on threaded follow-up rod below brake pedal, turn adjusting nut until clearance between face of nut and front end of push-rod tube is 1 29/64", tighten locknut. This will provide correct lag between hydraulic application and mechanical follow-up.

CHEVROLET HYDRAULIC TYPE. OWN MAKE.

DESCRIPTION AND OPERATION:—Wheel Brakes—Two shoes per wheel similar to previous design in that shoes are mounted on articulating links at anchor pin end with upper end bearing directly on wheel cylinder piston adjusting screws. Rigid type hydraulic wheel cylinder mounted on backing plate between shoes. Shoes are forced out in contact with drum by piston movement when fluid displaced from master cylinder by pedal application flows through lines to wheel cylinder. Articulating links result in uniform shoe contact with drum and only one adjustment (at piston) provided. Shoes returned to off position when pedal released by single retracting spring linked between shoes.

Hand Brake:—Hand lever applies rear wheel service shoes through cable actuated lever pivoted on one shoe and linked to other shoe by strut (passenger cars) or lever and link (1½ ton truck).

Master Cylinder:—Compensating type similar in design to type used on Lockhead Brakes. See Lockhead Brake article.

ADJUSTMENT:—Bleeding Brake System—Procedure same as for Lockhead Brakes. see Lockhead Brake article.

Brake Pedal Clearance:—Pedal stop located in brake master cylinder. See that pedal operates freely and retracting spring returns pedal to off position. Loosen checknut on push-rod, turn shaft as required ¼" clearance between pedal and underside of toeboard with push-rod against stop, tighten checknut.

Adjustment for Wear:—Jack up all four wheels, disconnect emergency brake pull rods at brake cables, remove adjusting hole covers on backing plate at each end of master cylinder (except for rear brakes on 1½ ton models), remove wheels on Knee-Action models. If brake drum has been previously removed, apply brake by depressing pedal firmly to align articulating pins before making adjustment.
1—At at each wheel, insert screwdriver in each adjusting hole to engage teeth of adjusting cover at outer end of wheel cylinder, turn adjusting cover clockwise until shoe drags slightly, back off adjusting cover four notches (all models except 1½ ton truck front brakes), five notches (1½ ton truck), evidenced by 'click' of cover plate spring so that wheel is free. On 1½ ton truck rear brakes, turn hexagonal-headed pinion shafts at each end of master cylinder clockwise until shoe drags, then back off ¾ turn (these pinion shafts engage adjusting covers). Then adjust hand brake.

Hand Brake Adjustment:—Place lever in released position, pull on hand brake cables to remove all slack, turn up adjusting clevis on end of brake rod until clevis pin can just be inserted in clevis and cable end hole, connect cables. Equalize by applying brake and slacking off on tight cable. Do not change wheel cylinder adjustment.

Toggle Lever Adjustment—This adjustment must be made whenever new rear brake shoes installed. After adjusting service (hydraulic) brakes, remove brake drum, loosen eccentric bolt locknut (lever pivot on shoe web below right end of hydraulic cylinder), hold toggle lever against shoe, turn eccentric bolt until only slight clearance between lever and bottom of slot in right brake extension link, tighten locknut, recheck clearance. Adjust hand brake as directed above.

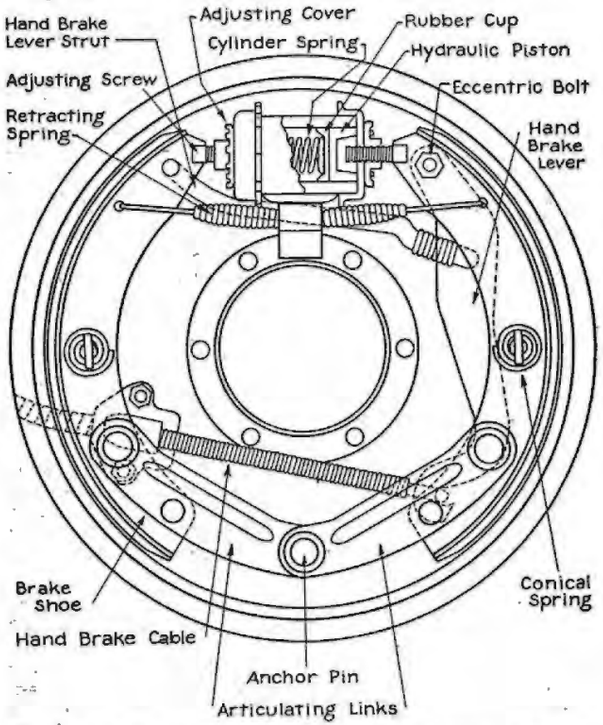
RELINING BRAKES:—Manufacturer recommends installation of new replacement shoes furnished with linings. Hard (semi-moulded or moulded) lining used which will have glazed appearance when burnished. See Car Model page for specifications for each model. Wheel cylinder piston clamp should be installed on piston when shoes removed.

To Remove Shoes:—Remove brake shoe return spring and conical hold-down springs. On rear brakes only remove toggle lever eccentric bolt and nut from rear brake shoe. Remove articulating link friction spring pin lock, pin and spring. Take out pin lock and pin on each shoe and remove articulating links.
NOTE—In assembling toggle lever on new shoes, see that high side of eccentric bolt is toward shoe in minimum adjustment position (high side indicated by flat ground in bolt head). Toggle lever adjusted as directed above under Hand Brake.

SERVICING:—Brake Linkage—Brake cables on passenger cars and 1½ ton truck must not be lubricated. Rear brake cables on Master Model identical (left and right). Cables on Standard Model and truck not interchangeable and identifed by spring tracer woven under cable wire shield in left hand cable. Cables should be set for tire clearance as follows:

1½ Ton Truck—Wind up cables ½ turn (counterclockwise for left hand, clockwise right hand) before clamping cable in frame bracket.

Standard Model—Each rear brake cable should have spring, Part No. 592681 with clip installed 1 7/8" from front of flange plate bracket to hold cable away from wheel. Install spring on cars not equipped.



Master Cylinder:—Serviced in same manner as Lockhead cylinders. Piston clearance in cylinder should be .001-.005". When reassembled clearance between lip on primary piston cup and center of compensating by-pass port should be .035".

Wheel Cylinders:—To disassemble wheel cylinders, with brake line disconnected and return spring on shoes removed, take out two mounting screws on backing plate. Remove cylinder, lift off adjusting cover and screw assemblies, withdraw pistons, piston cups and return spring. Examine bore. Piston clearance in cylinder should be .002-.004". Line must be bled when reinstalled.
NOTE—Wheel cylinders for front and rear wheels are of different bore and must be replaced in same wheel. No part of assembly interchangeable (see Car Model page for specifications).

Used On:

CHRYSLER 6, MODEL C-7 (1936).
CHRYSLER 8, MODELS C-8, 9, 10, 11 (1936).
(1) **CORD, MODEL 810 (1936).**
DE SOTO MODELS S-1, 2 (1936).
DODGE 6, MODEL D-2 (1936).
GRAHAM 6, MODELS 80, 80-A, 90, 90-A (1936).
GRAHAM SUPERCHARGER, MODEL 110 (1936).
HUPMOBILE, MODELS 618-G, 621-N (1936).
PLYMOUTH 6, MODELS P-1, 2 (1936).
REO FLYING CLOUD, MODEL 6-D (1936).
(2) **STUDEBAKER DICT., MODELS 3-A, 4-A, PRES. MODEL 2-C (1936).**

(1) Cord brakes are 'Single Anchor' type with both brake shoes on a single eccentric anchor pin. Adjustments are same as for other models.
(2) Hill-holder optional on all Studebakers. See separate article following, for adjustment.

DESCRIPTION AND OPERATION:—Wheel Brakes—Two shoes per wheel, mounted on independent eccentric anchor pins at lower or 'heel' end (except Cord) and bear directly against opposed pistons of stationary wheel cylinder at the upper or 'toe' end. Shoes are forced out against drum at toe end by fluid displaced from master cylinder and flowing through brake lines to wheel cylinder when brake pedal is depressed. No self-energizing action is employed and self-energizing effect of forward brake shoe ordinarily offset by using shorter length lining on this shoe or by using 'stepped' wheel cylinders with smaller diameter forward shoe piston and larger diameter piston for rear shoe. Brakes are returned to 'off' position against eccentric stops by retracting spring connected between shoes at toe end.

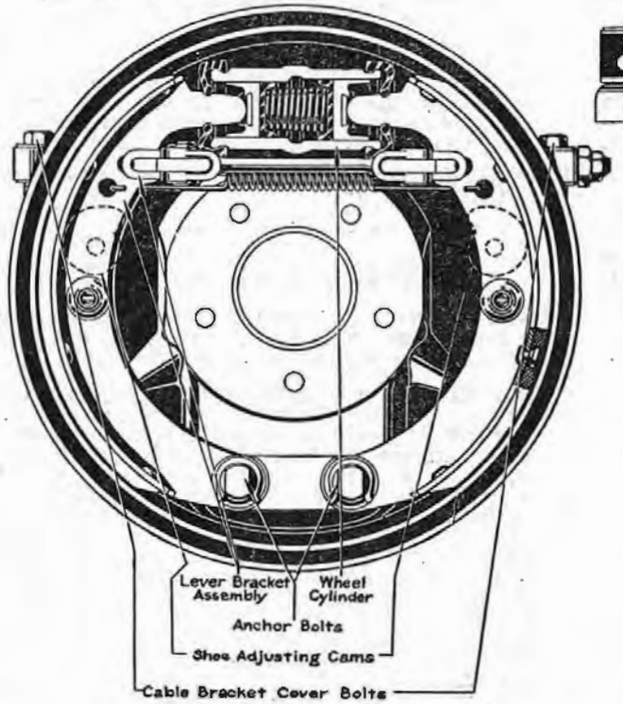
Wheel Cylinder:—Rigid type mounted on backing plate with opposed pistons bearing directly on toe ends of brake shoes. Pistons sealed by rubber caps held against piston head by central spring.

Master Cylinder:—Compensating type with integral supply tank. Supply tank is directly above master cylinder and is connected to it by two ports (1) bypass port uncovered when piston is in 'off' position so that fluid may flow freely in or out of master cylinder to compensate for any loss, and to prevent back-pressure due to expansion of fluid in system and (2) supply port by which additional fluid is drawn down and through holes in the piston and past the lip of the piston packing cup when brake pedal is released so that cylinder is always full of fluid and ready for repeated brake action even before fluid in system is returned to master cylinder by retracting wheel cylinder pistons caused by shoe springs. Master cylinder requires no attention other than keeping supply tank more than one half full of fluid at all times. Brake pedal clearance should be checked (see directions below) but will not change in service.

NOTE—Wheel cylinder must be 'bled' whenever brake line to that particular wheel is disconnected, and entire system (all four wheels) must be 'bled' whenever brake lines are disconnected at master cylinder to remove all air in system and correct springy brake action.

Hand Brake:—When incorporated in rear wheels consists of cable operated lever pivoted on one brake shoe and connected to other shoe through link or strut so that toes of both shoes are forced out against drum when hand lever is applied. Adjustment should be checked whenever brake adjustments are made.

ADJUSTMENT:—Bleeding Brake System—Fill master cylinder supply tank with genuine brake fluid, remove bleeder capscrew on backing plate directly above hose coupling, screw in standard bleeder drain tube (combination valve wrench and tube connection), allow tube to hang in clear jar, unscrew bleeder connection ¾ turn, depress brake pedal slowly ¾ of travel, return slowly to off position, repeat operation until flow of fluid from wheel cylinder is free from all air bubbles, usually six strokes. Keep supply tank filled with fluid (entire system must be 'bled' if supply tank drained). Do not use fluid bled from system. Remove bleeder connection and replace capscrew. Repeat at other wheels to bleed entire system.



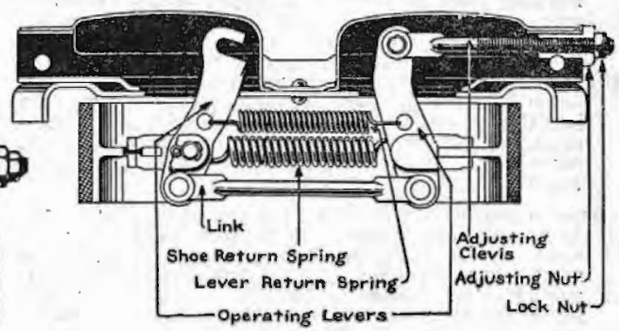
Brake Pedal Clearance:—Pedal clearance or free travel before master cylinder piston begins to move should be aproximately ⅜" to insure piston return to extreme 'off' position with by-pass port uncovered when pedal released. To adjust, hold master cylinder push rod from turning with wrench on hexagonal end, loosen locknut, screw push rod extension pedal link in (to increase free travel), tighten locknut.

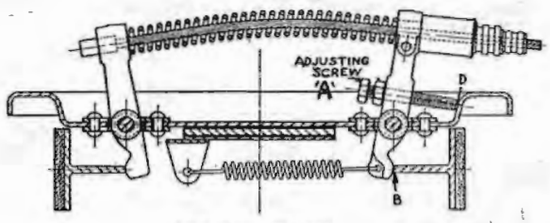
NOTE—See article on Bendix Power Unit for lever position when making adjustments on Chrysler Models with Vacuum Power assister.

Minor Adjustment (For Wear):—Jack up all four wheels, release hand lever, see that rear wheels are free. At each wheel, turn up eccentric on each shoe (move wrench toward wheel rim when installed on eccentric nut upward) until shoe contacts drum, then back off eccentric slightly until wheel rotates freely in both directions with no drag. Eccentric held in position by spring tension. Check hand brake setting and adjust if necessary.

Major Adjustment (For New Linings):—Dummy drum with cut-away section, ring gauge or other type adjusting tool must be used. Release hand lever and check hand brake clearance or disconnect hand brake cables, install dummy drum or ring gauge, turn eccentric out until clearance at toe is .010-.012" (see Car Model page for specific setting) as measured with feeler gauge inserted between lining and gauge 1" back from toe of shoe. Loosen eccentric anchor pin locknut, turn anchor pin (individual anchor pin for each shoe except Cord with single anchor) until heel clearance (measured as above) is .005-.006" (see Car Model page), hold anchor pin from turning, tighten locknut securely. Then adjust hand brake.

Hand Brake:—Adjust whenever service brakes adjusted or new shoes installed. For all models except as noted below, pull hand lever up three notches. Shorten each brake cable by turning turnbuckle at forward end until slight drag felt on rear wheels. Release hand lever, check to see that wheels rotate freely without drag. Brakes can be equalized by pulling up lever until wheel with least drag can just be turned and then slacking off on cable to tight wheel.





PARKING BRAKE

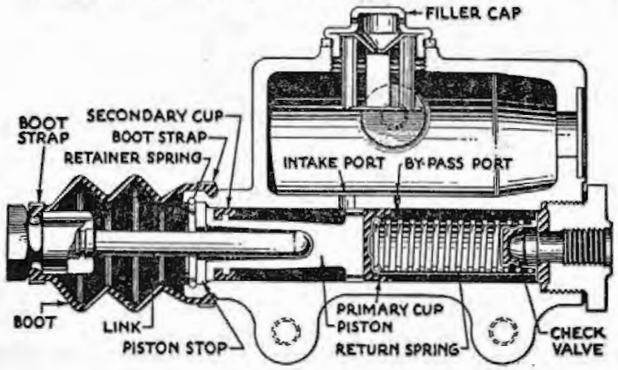
All Chrysler, De Soto, Dodge and Plymouth Models—On these models, when hand lever applies rear wheel service brakes, adjust at each wheel as follows: Place hand lever in released position, loosen support cable bracket cover bolt nut, and adjusting clevis locknut, turn up adjusting nut on clevis (under locknut) until slight drag felt when wheel turned, back off adjusting nut until wheel is free, tighten locknut and support cable bracket cover bolt nut, equalize by setting hand brake so that wheel with least drag can just be turned, slack off adjustment on tight wheeel slightly. With correct adjustment wheels should be free with hand lever released and should have slight drag with lever in second notch.

LOCKHEED HYDRAULIC—CONT.

Graham Model 80—Adjust forward lever at each wheel with hand lever released and cables slack. Loosen locknut and turn adjusting screw 'A' up until clearance between inner end of lever and shoe at 'B' is barely perceptible. Tighten locknut. Then adjust rear levers with hand lever placed in first notch. Loosen locknut and turn up turnbuckle at forward end of cable conduit until all slack is taken up and tension in cable is sufficient to move backing plate end of adjusting screw 'A' away from backing plate at point 'D' slightly. Tension must be same on both rear wheel cables to insure equalization. Release hand lever and check rear wheels. Wheels should rotate freely with no drag.

RELINING BRAKES:—All shoes should be lined with same type lining. See Car Model page for type and length and special instructions where lining of unequal lengths used on forward and rear shoes in same wheel. Linings should be faced or ground concentrically after installation.

Shoe Removal:—Shoes held in place by coil spring retained by plain washer and 'C' type washer on each shoe. To remove shoes, pull out 'C' washer, disassemble plain washer and spring, take off return spring freeing shoes at toe end (use piston clamp on wheel cylinder and do not depress pedal with shoes disconnected). Remove 'C' washers on anchor pins, slide shoes off. If strap used on anchor pins, remove anchor pins and strap.



SERVICING:—Wheel Cylinders—To disassemble wheel cylinders, remove shoes (above), take out wheel cylinder mounting screws, withdraw cylinder through backing plate. Disconnect brake line, remove piston boots, withdraw pistons. Examine cylinder bore. If corroded or scored, cylinders can be lapped or honed and oversize pistons fitted. Piston clearance (metal piston) in cylinder should be .001-.003" and must never exceed .005". In assembling wheel cylinder, wash all parts in alcohol, dip rubber piston cups in Brake Fluid, and insert ahead of piston with lip in. Central return spring in step-cut cylinders is tapered and should be installed with small end toward piston in smaller bore. Reconditioned cylinders should be tested for leakage in fixture under alcohol with 8 lbs. and 80 lbs. air pressure. Wheel must be bled when wheel cylinder reinstalled.

NOTE—See section below for assembly of units fitted with Piston Cup Expanders.

Piston Cup Expanders:—Should be used with special return spring in wheel cylinders to correct leakage caused by piston cup contraction in extreme cold temperatures. Expander should have .005" clearance in cylinder and should fit into open end of piston cup with slight clearance. Install expanders with cupped face in and use special return spring which is ½ turn shorter than standard spring.

Master Cylinder:—To disassemble master cylinder, remove rubber boot and push rod or link, take out retainer spring and piston stop, withdraw piston. Examine cylinder. If corroded or scored, cylinder can be lapped or honed and oversize piston fitted. Clearance should be .001-.003". In reassembling, wash all parts in alcohol, dip in Brake Fluid, see that check valve is installed correctly and that thin washer is in place between piston and primary piston cup. Insert piston with lips on both primary and secondary cups in (see illustration). Test for leaks in same manner as wheel cylinders and bleed entire system when installed in car.

TROUBLE SHOOTING:—See section in article in Bendix Hydraulic Brakes.

STUDEBAKER HILL-HOLDER

DESCRIPTION:—Hill-holder consists of a ball check valve connected in the brake line at the master cylinder and controlled by the clutch pedal.

OPERATION:—The valve cage with the rubber seal orifice is normally held away from the valve seat by the clutch pedal controlled camshaft (with the clutch engaged) so that the valve is open and brake operation is conventional. When the clutch is disengaged, the rotation of the camshaft permits the spring behind the valve cage to force the cage back so that the rubber seal seats against the valve seat. If the car is pointed uphill, the ball within the valve cage rolls down against the rubber seal, closing the orifice within the seal so that the brake fluid in the lines is prevented from returning to the master cylinder and brakes are held 'on' even though brake pedal is released. When the clutch is engaged, the valve cage is pulled away from the valve seat uncovering the return passage to the master cylinder and releasing the brakes. If the car is on a level road or pointing downhill, the ball will not close the rubber seal orifice and fluid will be free to return to the master cylinder through the orifice when the brake pedal is released.

ADJUSTMENT:—Operating lever position must be checked (to insure correct timing of brake release when clutch is engaged) whenever clutch pedal is adjusted. See Clutch pedal adjustment instructions on car model page.

Mounting—Hill-holder must be mounted in level position on car frame. To check, place spirit level on bosses on top of hill-holder body casting with car standing on level floor.

SERVICING:—Before dismantling unit mark shaft and lever and replace in same position. Remove ball chamber head plug and spring, withdraw camshaft being careful not to lose camshaft spring, withdraw ball cage assembly. In reassembling unit, see that ball cage is installed with two large ball rail rods underneath camshaft, and that camshaft spring is in place at inner end of camshaft (spring action can be felt by pressing on end of shaft).

DUESENBERG—LOCKHEED.

DESCRIPTION AND OPERATION:—Wheel Brakes—Two shoes per wheel, mounted on anchor pins on lower support bracket at lower end and operated through reducing lever or toggle (linked by toggles to each shoe) by single piston in wheel cylinder. Adjustment provided on toggle lever at toe of shoe. Shoes returned to 'off' position by single retracting spring hooked between shoes.

Wheel Cylinder:—Cylinder mounted vertically (integral with steering knuckle pivot pin casting in front wheels) with single acting piston which is forced up when brake fluid, displaced from master cylinder by pedal operation, flows through lines. Toggle arm lever contacts piston directly.

Master Cylinder:—Compensating type mounted within supply tank and operated through crank on shaft linked to brake pedal. Similar to other Lockhead designs (see Lockhead article) except that secondary piston cup and bleeder holes in piston not used. Compensating action secured by free flow of fluid between master cylinder and supply tank through by-pass port with piston in 'off' position.

Hand Brake:—Independent type mounted at rear of transmission. See adjustment instructions below.

ADJUSTMENT:—Bleeding Lines—See Lockhead article for complete instructions.

Pedal Clearance:—With pedal released and against toeboard, disconnect pedal linkage by taking out clevis pins and see that master cylinder piston is in fully returned position. Adjust by shifting position of master cylinder lever (attached to adjusting plate to which pedal links are connected).

Brake Shoe Clearance:—Jack up all four wheels. Remove plates on inside dust cover on front wheels marked 'Adjust Brakes Here', remove upper section of inside dust cover on rear wheels by taking off 2 nuts and removing 2 capscrews for each section. 1—At each wheel, loosen locknut on long toggle link, turn adjusting screw in opposite direction to expand shoes until brake drags slightly. With all wheels set for slight drag, depress foot pedal firmly. This will centralize shoes and wheels should be free. Repeat this operation until slight drag remains after pedal is released. Then back off adjusting nut exactly ½ turn at each wheel, tighten locknut.

Hand Brake Adjustment:—Loosen screw in equalizer sleeve at center of cross-shaft above brake at rear of transmission. Tighten adjusting nut until hand lever locks brakes when placed in fifth notch, tighten equalizer screw before releasing brake.

SERVICING:—Removing Brake Shoes—Remove brake drums (rear drums removed as unit with axles), remove inside dust covers, removing toggle pins at both ends of each shoe, disconnect retracting spring.

Wheel Cylinders:—Remove brake drums, use lever and lift toggle arm up and to rear shifting brake assembly slightly. Piston may then be withdrawn from cylinder (removal will be easier if bleed screw opened). Bleed lines when wheel cylinder reassembled.

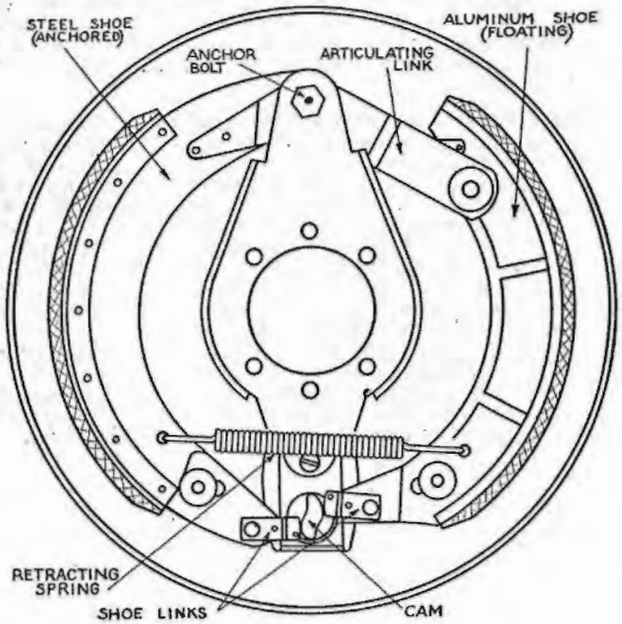
RELINING BRAKES:—If ring gauge or dummy shoe used to check clearance when shoes with new lining installed, shoe clearance should be .005-.008" at toes.

CADILLAC V16—OWN MAKE.

DESCRIPTION:—Wheel Brakes—Two shoes per wheel, identical with design used on previous models. Shoes mounted on articulating links at anchor (forward) end and actuated by cam through links pivoted on shoes at rear end. Upper (self-energizing) shoe does major portion of forward car braking and is aluminum with thicker lining than lower (steel) shoe. Shoes returned to 'off' position by single retracting spring hooked between shoes. Adjustment provided at cam lever on backing plate at each wheel.

Linkage:—Brakes actuated by rods and cables from double cross-shaft (rear brakes front shaft, front brakes rear shaft). Brake pedal linked to equalizer between shafts for 60% front, 40% rear braking.

Hand Brake:—Hand brake lever linked to front cross-shaft and applies rear service brakes.



ADJUSTMENT:—Check linkage if not known to be OK. before adjusting brakes at each wheel.

Linkage Adjustment:—See separate article on Bendix self-contained type Vacuum Power Unit for adjustment of brake pedal and lever, and valve lever. With pedal position correct and 1/32" clearance between end of clevis and pin at forward end of pedal pull-rod, and cross-shaft levers against stops, check cam lever position on each wheel by measuring distance from nearest face of cable clamp bracket to center of cable link pin in cam lever (rear wheels) or auxiliary lever (front wheels). Adjust clevises at cross-shaft ends of cables so that these distances are 3⅝" (front), 3 13/16" (rear).

Brake Adjustment:—

1—At each wheel, loosen cam bracket locking nut, apply brakes firmly to centralize cam bracket, tighten nuts before releasing brakes.

2—Check wheel equalization between wheels. If braking action equal in all wheels, turn down all 4 cam lever adjusting nuts equal number of turns until pedal travel to apply brakes is 2¼" 1 1/6 turns of adjusting screw equal to 1" pedal travel). If braking action not equal, turn down each cam lever adjusting nuts until brakes drag, then back off all nuts same number of turns for correct pedal travel of 2¼". Recheck equalization.

Hand Brake Adjustment:—With hand lever in 'off' position, brakes released, and cross-shaft levers against stops, adjust length of hand brake cable at cross-shaft end to eliminate all slack.

RELINING BRAKES:—See Car Model article for special lining specifications for each shoe. New linings should be chamfered 1/32" for distance of ¾" back at each end of shoe and rivet hole burrs should be removed.

SERVICING:—Brake Cables—Fittings provided for lubrication of cable conduits.

Brake Cams:—Lubricated by removing cotter pin in cam lever, withdrawing cam, packing the bearing behind cam with grease.

FORD—OWN MAKE.

DESCRIPTION AND OPERATION:—Wheel Brakes—Two shoes per wheel, anchored at one end and expanded by brake operating wedge through rollers at other end. Shoe wedges actuated directly by crank lever on backing plate (rear wheels) or by lever on spring hanger through operating pin extending down through hollow king pins (front wheels). Shoes returned to 'off' position by retracting springs hooked between shoes at both anchor and wedge ends.

Linkage:—Rod to each wheel from cross-shaft mounted on rear of 'X' member center connector. Linkage adjustment (clevis and locknut) at wheel end of each rod.

Hand Brake:—Hand lever connected to cross-shaft and actuates all service brakes (passenger and commercial cars) or connected to second cross-shaft and actuates independent internal expanding brake bands in each rear wheel (trucks). Hand brake must be adjusted separately on trucks (instructions below).

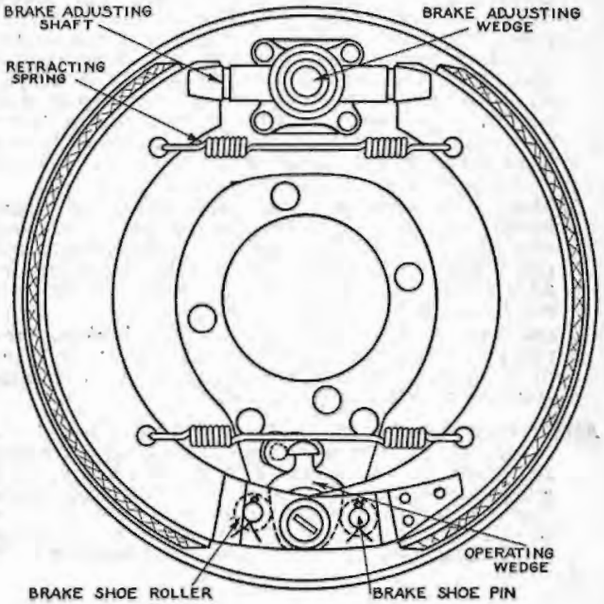
ADJUSTMENT:—For Wear—Jack up all four wheels, check front wheel bearings, spindle bearings, spring shackle studs, shock absorber links, and radius mountings for looseness. Release hand lever, disconnect brake rods by taking out clevis pins at each wheel.

1—At each wheel, screw in adjusting screw all the way then back off until wheels are just free of drag. Brakes must be cold.

2—Disconnect pedal to cross-shaft rod, adjust length by turning clevis until clearance between rear of hand lever clevis and rear face of cross-shaft lever pin is ⅛" (passenger and commercial cars), or until rear face of pedal rod lever in service brake cross-shaft is 1 29/32" (trucks). Reconnect pedal.

3—Adjust length of each brake rod at wheel so that rods are 1/32" short (levers must be pulled in 1/32" to insert clevis pins). Reconnect brake rods.

4—Set hand lever in first notch (passenger and commercial cars) or apply brakes with pedal jack (trucks). Turn each wheel at least one revolution and equalize by backing off adjusting screw on tight wheels slightly. Check tire inflation and road test car.



New Shoes or Relined Brakes:—When installing shoes, use brake gauge to check shoe clearance. Clearance at all points (except chamfered ends) must be .010" minimum and must not exceed .030" at any point. Turn up adjusting screws until clearance at adjusting screw end is .010". Check wedge end clearance. If less than .020", install new brake shoe pins with oversize heads which raise shoe .010" and increase clearance by this amount. Adjust brakes as directed above.

Hand Brake (Trucks):—Take up brake rods to rear wheels equal amount so that wheels are just free of drag with hand lever released. Equalize by applying brakes and slacking off rod to tight wheel slightly.

RELINING BRAKES:—New lining should be ground concentrically on special fixture and linings should be chamfered for distance of 1¼" back from each end.

Used On:

PIERCE ARROW EIGHT 1601 (1936).
PIERCE ARROW TWELVE 1602, 3 (1936).

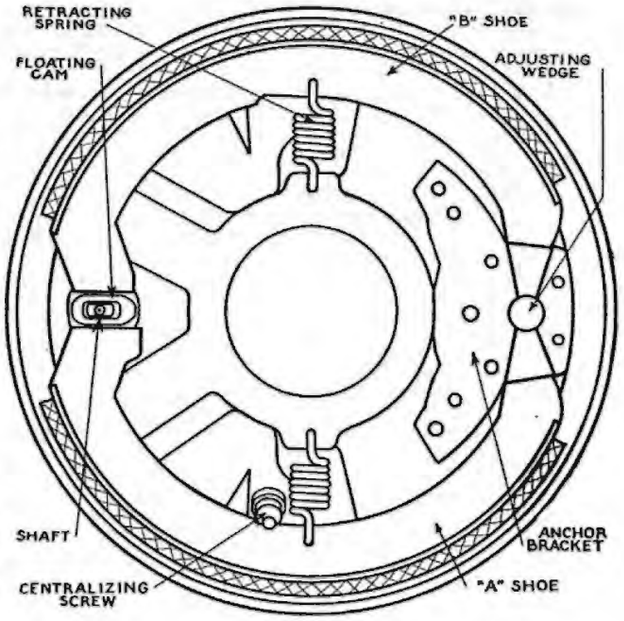
NOTE—Wheel brakes and linkage similar to Stewart-Warner design used on previous Pierce Arrow models. Power Unit (mechanical-servo unit at rear of transmission) has been discontinued and pedal is now linked directly to brakes with vacuum power operation. See separate article for data on Bendix Vacuum Power Cylinder. Reserve tank in vacuum line provides for three complete brake applications with engine not running.

DESCRIPTION AND OPERATION:—Wheel Brakes—Two shoes per wheel anchored at adjusting screw end (heel) and operated by floating cam on brake shaft at opposite end (toe). Front brake shoes released proportionally to turning angle when turned from straight-ahead position. Shoes held in off position by short retracting spring hooked to shoe at center. Adjustments consist of centralizing screw (set angularly on backing plate so that tapered head contacts web of one shoe) and adjusting nut at anchor end which expands shoe.

Linkage:—Consists of single cable in conduit from brake lever forward to front brake cross-shaft and rearward to rear brake cross-shaft. Brake operating cams float on ends of cross-shafts. Cables require adjustment only when chassis units serviced or after long periods of operation.

Hand Lever:—Applies all four service brakes. Provided with 'overrun' which provides automatic take-up in service. Overrun must be reset in lower position when brakes are adjusted.

ADJUSTMENT:—For Wear—Set hand lever in off position, see that pin is engaged in lower slot of brake rod overrun and that pin does not contact forward end of slot. Set front wheels in straight-ahead position (important). Jack up all 4 wheels, at each wheel, turn hexagonal adjusting screw clockwise until wheel can just be turned by hand, then back



off adjusting nut 9 notches (front wheels), and 12 notches (rear wheels), tap nut snugly toward backing plate. One notch on nut moves shoe .001" (measured at center) and there are 6 notches per revolution of the nut. If wheel does not turn freely after adjusting, turn centralizing screw on backing plate in or clockwise until brake drags appreciably, then back screw off until wheel is free. Road test car and equalize wheels. Braking force is 54% front wheels, 46% rear wheels.

Hand Lever Adjustment:—After adjusting brakes (above), loosen locknut and adjust clevis at rear of hand lever brake rod until only slight clearance remains between lever pin and end of lower slot in overrun at forward end of brake rod.

Linkage Adjustment:—When cable adjustment required, see that cable conduit support springs are in place and fastened so that cable does not sag, place hand lever in 'off' position with pin engaging lower slot of rod overrun, set front wheels in straight-ahead position, loosen both cable adjustment locknuts and adjusting nuts at brake lever, turn up adjusting nut at each wheel until wheel can just be turned by hand, back off nut 2 notches, tap nut against backing plate. Tighten cable adjustment nuts until wheel can just be turned, tighten cable adjustment locknuts. Adjust wheel brakes as directed above.

RELINING BRAKES:—Manufacturer recommends installation of factory-lined shoes which are accurately ground. Shoes are interchangeable in pairs but the 'A' shoe (centralizer screw shoe) must not be interchanged with the 'B' shoe for the same wheel.

SERVICING:—Removing and Installing Shoes—Use special spring tool to extend retracting spring permitting removal of shoe. If tool not used, pull 'A' shoe out radially until it hooks over two embossed shoe rests on backing plate, repeat with 'B' shoe, slide cam off shaft. Pull 'B' shoe away from backing plate to free it from rests, pull anchor end out of anchor bracket, holding cam end out so that it is free to overlap 'A' shoe, swing cam end against spindle, unhook spring, remove 'B' shoe. Then remove 'A' shoe in same manner.

Pull adjusting nut and wedge assembly out of anchor bracket, wipe all parts clean, lubricate bearing surfaces with graphite grease. See that tapered grooves in adjusting wedge assembly lines up with openings in anchor bracket when reassembling.

DESCRIPTION:—In this type suspension, steering knuckle or kingpin support is pivoted vertically on the outer ends of two wishbone shaped control arms; a lower arm pivoted at its inner end and on the frame cross member near the center line of the car, and an upper arm (shock absorber arm) pivoted at the shock absorber mounting near the frame side rail. The coil spring is located between a lower spring seat on the lower control arm and an upper spring seat on the cross member. Rubber bumpers are located within the spring (to limit spring compression) or on frame brackets to contact the control arms and limit movement.

Double tie rods are used on all models and are connected to an intermediate steering arm on cross member at center of car, or directly to the steering gear arm where no intermediate steering arm is used.

ADJUSTMENT:—Caster and Camber—Adjustments designed to change knuckle support position with regard to control arms. Procedure for each car model given below. When checking and adjusting these points, car should be placed on level floor (without load but ready for road with gasoline, oil, etc.), frame should be bounced up and down several times to allow car to assume normal height, front wheels should be checked for runout and bearings adjusted, tires checked for equal tread wear and proper inflation, wheels should be turned to straight ahead position (check by measuring from center of tire tread to center of lower control arm inner shaft on each side—these distances should be equal, or see special directions for each car), kingpins and tie rod ends should be checked for looseness. Kingpin inclination should be checked before camber is changed.

Intermediate Steering Arm—Must be checked when steering gear adjusted to insure full swing of wheels without binding. See separate articles on steering gear adjustment for each model.

DISASSEMBLY:—When disassembling suspension on models with hydraulic brakes, see that front wheel is not allowed to hang on brake hose. If hose is left connected and wheel is tied up to frame when work is being done on front end, brake system will not require bleeding when reassembled.

BUICK 40, 60, 80, 90.

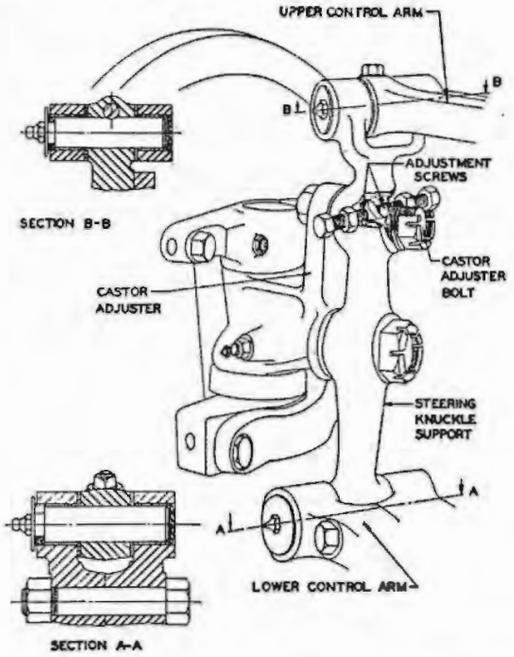
CHECKING AND ADJUSTMENT:—Check following points first:

Tire Inflation—26 lbs. (40), 28 lbs. (60, 80, 90).

Frame Height—Measured on each side of car from lower face of rubber bumper flange (40) or cross member at side of bumper flange (60, 80, 90) to top surface of lower control arm. Should be 4 9/16" (40), 4¾" (60), 4 9/16" (80, 90) and must be equal within ¼". If difference greater than ¼", disconnect one stabilizer link. If this does not level car, remove and check front springs, install shims or replace springs (see Springs below).

Toe In:—Roll car on floor one full revolution, then check by measuring to marks in center of tire tread at rear, roll car ½ wheel revolution, reapeat measurement to same marks. Correct toe in determined by 'average' camber (½ sum of camber for both wheels) and should be 7/32" for camber of 2° decreasing 1/32" for each ¼° to 0" for 0° camber (except ½°—1/16" and ¼°—1/32").

To Adjust—Turn each tie rod equally. Tie rod lengths should be equal and intermediate steering arm must be on center-line of car (equidistant from rear lower control arm inner brackets) when wheels straight-ahead (except 40 when steering arm thrown off center to correct steering wheel spoke location—see Steering Gear article). Correct steering arm position by increasing length of one tie rod and decreasing other.



Caster:—Machined bosses provided on each end of steering knuckle bosses (40) or caster adjuster (60, 80, 90) for protractor mounting when measuring caster. Caster should be 3-3½° (40), 1¾-2¼° (60, 80), ¾-1¼° (90).

To Adjust—Jack up front end, loosen nuts on caster adjuster bolt and pivot bolt (on inner surface of steering knuckle support) one turn, loosen locknuts on adjusting screws which locate caster adjuster bolt in slotted hole. Back off one screw and turn up other screw an equal amount so that caster bolt is held tight (turn front screw in to increase or rear screw in to decrease caster). One turn of the screw changes caster 1°. Total range of adjustment 6°. Tighten adjusting screw locknuts and caster adjuster bolt nuts securely, recheck caster with car weight on wheels.

Camber:—Can be checked with protractor held against machined surface of bearing hub (with hub cap and dust cap removed). Should be from negative ¼° to positive ¾°. No adjustment provided.

CONTROL ARM ASSEMBLY:—Lower Knuckle Support—Pin is .0005-.002" (40), .0005-.0015" (60, 80, 90) press fit in knuckle support and is locked by clamp bolt. Use arbor press to remove and install pins—do not drive pins in or out. Pin clearance in control arm bushings should be .001-.0025". Side thrust of knuckle support taken by hardened bronze thrust washers on each side selected to give .000-.006" side clearance.

Upper Knuckle Support:—Pin clearance in support is .0015-.004" and pin should assemble easily by hand. Pin locked by clamp bolt. Pin clearance in control arm bushings should be .0015-.003" (40), .001-.0025" (60, 80, 90). Side thrust washers and clearance same as above.

Lower Control Arm:—Pivots on shaft bolted to cross member. Control arm carried on bushing threaded on shaft (front) and threaded on both shaft and in control arm end (rear). To assemble place control arm on shaft so that distance from center of shaft bracket bolt to outer face of rear control arm is 2 7/16" (40), 2 15/16" (60, 80, 90), thread rear bushing in arm and on shaft. Turn up tight and recheck distance. Thread front bushings on shaft, turn up until shoulder contacts face of arm, tighten clamp bolt.

Entire assembly should move up and down freely (with spring not in place). Faulty alignment may be corrected by turning control arm shaft one turn in either direction to throw lower arm backward or forward. More than one turn will be in excess of caster adjustment.

SPRINGS:—Springs are paired and should have same free height. If not equal install ⅛" thick service washer and insulating washer on top of coil spring. Do not use more than two washers. If this does not correct car sag (unequal frame heights), check rear springs and frame alignment. Standard springs (identified by color) as follows:

	(Spare at rear)		(Fender wells)	
Car Model	**Part No.**	**Color**	**Part No.**	**Color**
41	1286635	Yellow	1292367	Green
46, 46C, 46S, 48	1286635	Yellow	1293210	White
61, 66C, 66S, 68	1294664	Red	1294663	Yellow
81, 81C	1293553	Orange	1284760	Blue
90, 90L, 91			1293663	Green

NOTE—Springs on 40 are smaller diameter and can be readily identified.

SHOCK ABSORBERS:—Front shocks mounted on frame by 4 special heat treated bolts and located by reaming out two bolt holes to close limits. Standard calibrations for shock absorber valves as follows:

Model	**Front**			**Rear**	
	Rebound	**Comp.**	**Static**	**Rebound**	**Comp.**
41, 46, 46S, 48	1E	1B	none	2J2	none
46C	3F	2CX	none	2F2	none
61, 61C, 61S, 68	1G	1B	none	2G	BO
81, 90, 90L, 91	5G	1B	3B	2G	BO
81C	5G	1DX	3B	3J	BO

CADILLAC—LA SALLE.

NOTE—On all La Salle cars and on Cadillac V-8, 36-60 (after first 4008 cars), camber adjustment incorporated with caster in knuckle support upper pin (eccentric pin). Adjustments not made in same manner as on other models—separate directions below.

CHECKING AND ADJUSTMENT:—Check these points first:

Tire Inflation—26 lbs. minimum (36-50, 60), 28 lbs. (70), 32 lbs. (75, 80, 85).

Frame Height—Should be 3 3/16" (36-50, 60), 5 3/16" (36-70, 75, 80, 85) plus or minus ¼" measured between lower face of frame side rail and upper surface of lower spring seat. Must be same on both sides of car. Check spring length and suspension unit assembly if car sags.

Wheel Runout—Must not exceed 3/32" with wheels in place on car. Mark high spot on tire and place wheel with mark at top vertically (to check toe in) or at one side (to check caster and camber).

Toe In:—Should be 0-1/16" (all cars). Adjusted by changing length of both tie rods equally.

Caster (All Models except La Salle and Cadillac 36-60 later cars:—Should be 1½-2° (first 36-60), ¾-1¼° (all others). Must be equal within ½° for both wheels.

To Adjust—Loosen nuts on knuckle support upper and lower yokes, loosen clamp screw in upper end of knuckle support, remove lubrication fitting from front bushing of knuckle support upper pivot pin, insert Allen wrench, turn wrench clockwise to increase or counter-clockwise to decrease caster, tighten clamp screw and yoke nuts.

Caster (La Salle and Cadillac 36-60 after first 4008 cars):—Should be 1½-2°.

To Adjust—Loosen clamp bolt in upper end of knuckle support, take out lubrication fitting in front bushing, insert Allen wrench, turn wrench in complete revolutions only clockwise to increase or counter-clockwise to decrease caster, tighten clamp bolt. Camber will be affected unless wrench turned complete revolution. Check camber after making this adjustment.

Camber (All Models except La Salle and Cadillac 36-60 later cars):—Should be ¼-1° (first 36-60), 0-½° (all others). Must be equal within ½° for both wheels.

To Adjust—Remove retaining nut and spacers from lower control arm yoke at knuckle support, pull out yoke and arrange spacers to secure correct camber (shift spacers to outer face of arm at yoke to decrease camber, or inner face of arm under nut to increase camber), reinstall yoke, tighten nut securely.

Camber (La Salle and Cadillac 36-60 after first 4008 cars:—Should be ¼-1°.

To Adjust—Adjusted in same manner as Caster for these models except that wrench turned not more than ½ revolution. Knuckle support section of pivot pin eccentric and entire range of adjustment secured by ½ turn of wrench. Caster affected by camber adjustment but not outside limits if correctly set first.

CONTROL ARM ASSEMBLY:—All Models except La Salle and Cadillac 36-60 later cars.

Lower Control Arm:—One piece type mounted on shaft on cross member by plain bushing threaded on shaft (front) and threaded bushing screwed on shaft and in control arm (rear). To assemble, place bracket shaft in position centered in control arm, thread rear bushing in arm and on shaft, turn in until tight with shoulder contacting arm, thread front bushing on shaft, turn up until tight, install clamp bolt in control arm. Arm should move freely on shaft without binding.

Knuckle Support Pivot Pins:—On these models, upper and lower control arm yoke nuts can be taken off, and knuckle support, pivot pins and yokes removed as an assembly. If disassembled further, mark position of pins and bushings, when reassembling turn pins and bushings in to same point to maintain front end alignment. Check caster and camber.

CONTROL ARM ASSEMBLY:—(La Salle and Cadillac 36-60 after first 4008 cars).

Lower Control Arm:—Arms screwed on ends of mounting shaft directly (no bushings). Must be assembled separately with spring seat and jack pad removed. To assemble, screw arms on shaft equally until distance on shaft between inner faces of arm eyes is 11". Assemble spring seat and jack pad, tightening nuts securely. Distance between inner faces of arms at outer end must be 2⅜".

Knuckle Support Lower Pivot Pin:—Note position of threaded bushing in lower end of knuckle support on threaded pin before disassembling so it can be assembled in same position. With knuckle support positioned in lower control arm, screw threaded pin in from rear through arm and knuckle support bushings until tight (locking washer gripped under pin head), assemble locking washer and nut on forward end.

Knuckle Support Upper Pivot Pin:—Note position of threaded pin in support before disassembling so that it can be reassembled in same position. With knuckle support positioned in upper control arm, screw threaded pin in from rear through support and in plain bushing in front upper control arm. Screw rear threaded bushing in on pin and in rear control arm. Insert clamp bolts in control arm and knuckle support. Entire assembly should move up and down freely without binding.

SPRINGS:—Part No. stamped on flat surface of end coil. Replace coils if sagged more than ¼".

Model	(Spare at Rear) Part No.	Length	(Fender wells) Part No.	Length
36-50	407558	13½"	407559	13¾"
36-60 (first 4008)	1413232	14⅛"	1413233	14⅛"
36-60 (after 4008)	1418331	14⅛"	1413232	14⅛"
36-70	1413788	14⅞"	1413789	14⅞"
36-75, 80	1413789	14⅞"	1413790	14⅞"
36-85	1413790	14⅞"	1413791	14⅞"

SHOCK ABSORBERS:—Shock absorber valve number stamped on outside cap. Valve calibrations changed after first cars.

Model	Type No.	Reb. Valve	Cp. Valve
36-50 (first 5025)	1944	2-G	2-D
36-50 (after 5025)	1944	1-C	1-CX
36-60 (first 4008)	1942	5-E	2-C
36-60 (after 4008)	1944	1-D	1-DX
36-70,75,80,85 (first 300)	1951	5-C+	5-A+
36-70,75,80,85 (after 300)	1951	5-DX	5-BX

CHRYSLER-DE SOTO

CHECKING AND ADJUSTMENT:—Check these points first:

Tire Inflation—28 lbs. (all models).

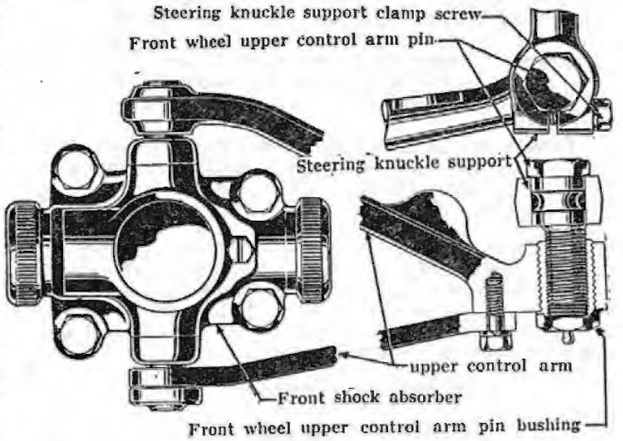
Frame Height—Should be 7¼-7⅜" measured from center of lower control arm yoke pin (knuckle support lower pivot pin) to top of frame cross-member. Allowable variation ⅛" plus or minus but both sides of car must be equal within ⅛". Adjusted by inserting spacer washer Part No. 657770 under spring on driver's side.

Toe In:—Measure to marks on center of tire tread hub high, at rear, roll car ahead ½ revolution, repeat measurement. Toe in should be 0-⅛".

To Adjust—Loosen tie rod end clamp bolts, set long tie rod to standard length, adjust length of shorter tie rod for toe in. Ball studs must be centered in tie rod slots when tightening clamp bolts to assure sufficient angular rotation of tie rod for extreme turns.

Caster:—Should be 1½°. Controlled by distance upper pivot pin screwed in bushing in upper (shock absorber) arm.

To Adjust—Loosen clamp bolt in knuckle support upper end, turn eccentric pin (hexagonal head at rear) in or out of bushing until clearance is exactly ⅜", tighten clamp bolt, check caster. This adjustment affects camber and should be made first.



Camber:—Should be +¼° and within limits of —¼° to +½°. Controlled by position of eccentric shoulder of upper pivot pin in knuckle support.

To Adjust—Loosen clamp bolt at upper end of knuckle support, and with correct Caster (⅜" clearance—see above), turn eccentric pin less than ½ revolution in either direction, recheck camber. Total adjustment obtained by ½ revolution of pin. Caster affected only slightly by this adjustment. Toe in is changed and must be checked after Camber adjustment made.

CONTROL ARM ASSEMBLY:—First screw knuckle support lower pin in support centrally (equal projection at each end), drive in taper lock pin and peen in place in support. Center support in lower control arms, screw threaded bushings on pivot pin and in control arm eyes loosely until shoulders contact outer faces of control arm. Center frame bracket shaft or bar in eyes on inner end of control arm.

CHRYSLER-DE SOTO CONT.

screw threaded bushings on bar and in control arm eyes loosely until shoulders contact outer faces of control arm. Tighten all bushings with approximately 100 lbs. force on 24" lever. Tighten spring seat bolts securely, striking bolt heads with 2 lb. hammer to seat serrated washers. Check assembly to see that it moves up and down freely without binding.

OLDSMOBILE F-36, L-36

CHECKING AND ADJUSTMENT:—Check these points first:

Tire Inflation—25 lbs. min. (all front), 28 lbs. (F-36 rear only).

Wheel Runout—Must not exceed ⅛". Mark high spot on tire and place wheel with mark at top vertically (to check toe in) or at side (to check caster and camber).

Toe In:—Roll car forward one revolution, check between tires 10" up from floor. Should be ⅛-3/16". Adjust by changing length of each tie rod equally (wheel distance from center gauge plate should be 26¼" (F-36), 25¾" (L-36) right and left with wheels straight ahead).

Caster:—Machined bosses provided on steering knuckle support front face for protractor mounting. Caster should be 1½-2¼°. If measured from vertical line, top boss should be 3/32-9/32" behind lower boss.

To Adjust—Loosen steering knuckle support clamp bolt, remove lubrication fitting in upper pivot pin front bushing, insert Allen wrench (J-720), turn pivot pin to thread support forward or backward on pin. Camber affected by this adjustment unless pin turned in complete revolutions only (start and stop at same point). Check camber.

Camber:—Should be ⅛-1°. If measured from vertical line at side of wheel, felloe at bottom of wheel should be 1/32-9/32" inside felloe at top.

To Adjust—Same as Caster Adjustment (above) except that pin should be turned less than 180°. Pin is eccentric and maximum adjustment secured with one half turn. This adjustment changes Caster but not outside limits as given above if Caster set first to 1¾-2°.

CONTROL ARM ASSEMBLY:—Lower Control Arm—Control arm threaded in ends of shaft bolted to cross-member. Spring seat and jack pad must be removed and arms turned on shaft separately until distance from inner face to center line of shaft bracket bolt holes is 1 23/32" (front arm), 1 7/32" (rear). With spring seat and jack pad in place distance between eyes at outer end of arm should be 2⅜".

Knuckle Support Lower Pivot Pin:—Knuckle support threaded in bushing which is threaded in pivot pin. Pin threaded through control arm eyes and held by nut in rear end. To assemble, screw bushing in support lower end from rear until tight, hold support midway between lower control arms, thread pivot pin in from front through bushing and rear arm. Clearance in arms at either end of bushing must be ⅛" and exactly equal within 1 thread. Install lock washer and nut in pin.

Knuckle Support Upper Pivot Pin:—Eccentric upper pivot pin threaded in support, in plain bushing in front shock absorber arm and in threaded bushing in rear arm. Pin held by clamp bolt in arm. To install, hold support in place between shock absorber arms, thread eccentric pivot in support until shoulder formed by eccentric section is flush with rear face of suport. Screw plain bushing in through front end in pin until distance from front face of support to head of bushing is 1 5/16". Turn eccentric pin until support is centralized in center section, if necessary pull support back until bushing lines up with lock, install clamp bolt in front arm. Clearance between head of plain bushing and arm must be 1/32". Thread rear bushing on pin and in arm, turn up until tight. Tighten support clamp bolt. Entire assembly should move freely with no bind.

SPRINGS:—Not interchangeable between models. May be identified by 3 daubs of paint and length as follows:

Model	Free Length	Color
F-36 (Spare at rear)	13 11/16"	Blue
F-36 (Fender wells)	13 15/16"	Green
L-36 (Spare at rear)	13 1/2"	Red
L-36 (Fender wells)	13 13/16"	Yellow

SHOCK ABSORBERS:—Front shocks located on frame by close fitting bolts. Standard valve calibrations as follows:

	Front		Rear	
Model	Rebound	Comp.	Rebound	Comp.
F-36, L-36 (except conv.)	2J	1D	5L	E1
F-36, L-36 (convertibles)	2J	1B	5L	E2

PACKARD MODEL 120B.

DESCRIPTION:—Consists of vertical wheel support arm pivoted at upper end on outer end of double shock absorber arm (shock absorber mounted on frame siderail at wheel), and at lower end on outer end of triangular arm mounted on frame cross member near center line of car (forward arm) and on frame side rail in front of cowl (rear or torque arm). Coil spring located between spring seat on lower control arm and upper seat on cross member. All control arm pivot points on frame are rubber bushed.

CHECKING AND ADJUSTMENT:—Check these points first:

Tire Inflation—22 lbs. (Conv.Coupe) 24 lbs. (others).

Frame Height—Load car so that top of frame side rail is 18" above floor and parallel to it.

Front Wheels—Check for runout, adjust bearings, turn wheels to straight ahead position.

Caster:—Should be 2° plus or minus ½°. Must be equal for both front wheels within ½°. Machined bosses provided on vertical wheel support for checking.

To Adjust—Jack up front end, take out 3 screws in torque arm rear socket, take off 2 nuts at forward end of torque arm freeing arm from forward or load carrying arm. Pull torque arm to rear until free, install wedge shim on torque arm studs, reinstall. Shims provided in two sizes; Part No. 0304699—½° taper, 0304698—1° taper. Install shims with thick end up to decrease, or down to increase caster. See that entire suspension unit moves up and down freely without binding after shims installed.

Camber:—Should be 1° plus or minus ¼°.

To Adjust—Jack up front end, support wheel, remove shock absorber link bushing bolt and pilot. Replace pilot with service pilot which throws top of wheel farther out to increase, or farther in to decrease, camber. Pilots furnished in four types with increasing offset as follows: Part No. 303075—0 offset, 303076—1/16 offset, 303077—⅛ offset, 303078—3/16 offset.

Toe In:—Should be 1/16-⅛". Check by measuring to center of tire tread at front and rear of wheels (spin wheel and chalk mark center of tread).

To Adjust—Loosen tie rod clamps, turn each tie rod equal amount. Check lengths after adjusting. If not equal, correct by shortening long rod and lengthening short rod to secure equal lengths with correct toe in. Clamp bolts should be vertical and at rear of tie rods.

SPRINGS:—Coiled helical type. All springs 5¼" diameter. Spring Rates as follows:

Model	Spring Rate (lbs. per in.)
120-B Std.	75 lbs.
120-B Export	110 lbs.
120-BA (Comm.)	130 lbs.

STUDEBAKER PLANAR TYPE.

DESCRIPTION:—Consists of vertical steering knuckle support pivoted at lower end on outer end of transverse cantilever spring and at upper end on tubular support arm which is pivoted on frame siderail. An additional spring control link is linked to the support and the frame cross member directly below the spring to insure control and act as a jack pad in raising the car. Control link is rubber bushed at both ends and upper support arm is rubber bushed at frame end.

CHECKING AND ADJUSTMENT:—Check these points first:

Tire Inflation—33 lbs. (all models).

Frame Height—Bounce car up and down several times to insure frame assuming normal position.

Caster:—Should be minus ½° to plus ¾°. Caster angle determined by front spring and is not adjustable.

Camber:—Should be 1-1½°. Controlled by eccentric upper support pin.

To Adjust—Loosen all clamp bolts in knuckle support upper end. Install wrench vertically on hexagonal head of support pin, move wrench toward car frame to increase, or toward wheel to decrease camber. Tighten clamp bolts. Neutral position of pin is with wrench flats vertical.

Toe In:—3/16" plus 1/32" or minus 1/16". Controlled by length of longer (right hand) reach rod or tie rod. Adjusted in usual manner by loosening clamp bolts and turning rod. Short (left hand) rod is not adjustable.

STUDEBAKER—CONTINUED.

CONTROL ARM ASSEMBLY:—Upper Support Arm Inner Bushing—Support arm should be centered in frame brackets, straight rubber bushings pushed in from each end until they contact shoulder on arm, washer installed on outer end of bushing, and retainer screw turned up until it is tight (washer against shoulder on shaft). This will squeeze rubber out at each end forming flange at bracket. Bushings should not turn, all pivoting action being through elasticity of bushings.

Upper Support Outer Pivot Pin:—Eccentric pin clamped in upper end of knuckle support by two clamp bolts. Assembled by placing knuckle support in position in upper support arm, installing eccentric pin in support, threading support pin bushings in on pin through support arm yoke from front and rear and tightening all clamp bolts.

FRONT SPRING:—To remove—Jack up front end with jacks placed under each frame side rail at rear of front wheels. Raise car approximately 3". Remove cotters, nuts and washers on outer ends of spring control link, drive bolts out (use brass drift). Remove threaded spring bolts at each end of spring. Take out 10 bolts attaching spring plate to spring retaining channel, remove plate and control link assembly. Spring may then be taken out.

To Install—See that grease retainers at each end of spring channel are in place, coat spring channel and fill spring plate with fibrous grease before installing spring. Center spring eyes in spring support of knuckle support when installing spring bolts (⅛" minimum clearance between face of spring and inner face of support when entering bolt in threaded spring bushing). See that lock is in place under spring bolt head.

CHEVROLET—PONTIAC.

DESCRIPTION:—Entire suspension unit (wheel support arm, coil springs, shock absorber) pivoted on king-pin at outer end of frame cross-member and turns with wheel. Wheel support arm mounted on support arm shaft carried on needle bearings in housing. Crank in inner end of shaft has a needle bearing mounted roller pin on end which engages spring guide. Two coil springs (outer main spring, inner control spring) mounted between guide and upper spring seat which is positioned in housing by adjusting plug at upper end. Shock absorber units (independent compression and rebound units) mounted in front of case act directly on support arm lever. Entire unit filled with oil. An additional radius rod linked to wheel and support housing used to guide wheel.

CHECKING:—Place car on level, with weight on wheels (roll ahead several revolutions if front wheels previously jacked up). Check these points first:

Tire Inflation—Front wheels not less than 25 lbs. Rear wheels not less than 30 lbs.

Front Wheel Bearings—Adjust bearings, check king pins and tie rod ball ends for looseness.

Frame Leveling—Frame must be level from front to rear. On Pontiac, check height of front tubular cross-member lower face at center (15 11/16") and lower face of rear frame horns (19") level with jacks. If frame not level crosswise, see Suspension Unit Height Adjustment below.

King-Pin Inclination—7¾° (Chevrolet), 8¾° (Pontiac).

Camber:— —¼° (Chevrolet), —¼ to +¼° (Pontiac). No adjustment provided. Replace tubular cross-member if bent.

Caster:—King-pin caster 0° with frame level. Caster effect obtained by trailing wheel behind center line of king-pin. No adjustment provided other than bending cross-member.

Toe In:—1/16-3/32" (Chevrolet), 0-1/16" (Pontiac). Measured 9" up from floor. Adjusted in usual manner by changing length of tie rod.

SERVICING:—To Remove Suspension Unit—Jack up car, remove wheel, disconnect brake hose at frame (wheel brake must be 'bled' when replaced), remove hub and brake assembly, disconnect radius rod bracket at lower end of suspension unit, turn suspension unit outward, lift off brake assembly supporting radius rod, remove steering arm nut, drive steering arm out using special brass drift, remove king-pin lockpin and plug lockrings, blow out upper plug using special plug remover J-746, drive king-pin and lower plug out through bottom using brass drift (Pontiac king-pins supported in bronze bushings—on Chevrolet models loose needle bearings will fall out at this point).

Disassembly:—Clean outside of unit thoroughly and clamp in vise at radius rod bracket boss. Remove capscrew from adjusting plug, lift out plug lock, install special K-477 adjusting nut wrench in plug slot securing wrench with capscrew, remove adjusting plug (this relieves tension on outer spring), remove housing cover, lift spring upper seat assembly out, remove outer spring (if spacer forward under spring this must be reinstalled if old spring used again—spacer for new spring furnished attached to spring), lift out inner spring, drain fluid from case, back off shock absorber capscrews slowly and evenly and remove shock absorber units (shock absorber units matched pairs and must be reinstalled in same position in same unit). Remove lockscrew from support arm shaft cover, loosen hexagonal nut, pull shaft out of spring seat and shaft lever assembly catching loose needle bearings which will drop out at this point. Insert brass drift through housing, drive off shaft end packing cover, lift lower spring seat and shaft assembly out.

Servicing:—Clean all parts with gasoline, replace any worn parts.

Assembly:—Reverse disassembly directions above and note special points as follows: To assemble support arm shaft lever pin, place one spacer on pin, apply light film of grease, insert pin in lever, insert 32 loose rollers or needle bearings, place second spacer on pin. To assemble support arm shaft, place bearing spacer on shaft level side out, insert rubber packing in packing cover, then cork packing, use special support shaft seal and packing inserter to install this assembly on support arm shaft, apply light film of grease on shaft, assemble 49 rollers or needle bearings on shaft holding them in place with rubber band which can be removed after shaft started in housing, see that lockscrew hole in shaft lines up with hole in lever, tighten lockscrew securely and peen metal around screw hole to prevent screw working loose. When installing end cover (after 42 needle bearings and bearing retainer inserted at small end of shaft), use new cork packing, coat with Farmagasket #1 (not shellac) drive into place. To install shock absorber units, line up holes in piston and cylinder by compressing spring, insert cotter pin loosely, install capscrews loosely using new lead washers under screw head, raise support arm to relieve spring tension, pull out cotter pin, tighten capscrews evenly and securely. Coat housing cover gasket, adjusting plug threads and locking plate capscrew with gasket cement, coat threads in housing with white lead, coat bottom of adjusting plug with grease before installing these parts. Fill unit with shock absorber oil, turn adjusting plug down flush with top of housing (adjust after installation in car).

Installing:—King-pin ball thrust washer installed at top of support. If endplay more than .006" insert steel shim above bearing. See Adjustment for Radius Rod Bracket Installation.

ADJUSTMENT:—Radius Rod—Screw radius rod up tight against brake backing plate, then back off not more than ½-1 turn so that wheel moves freely. Screw radius rod bracket on rod until tight, then back off not more than ½-1 turn until free, mount bracket in suspension unit, turning screws in loosely, roll car ahead several revolutions and bounce frame up and down, tighten screws securely, note wheel action. If wheel action stiff, file bracket boss slightly so that bracket can be placed in position by hand, install shim #496974—.010", #496910—.025" under screws. Wheel action must be free throughout range with bracket screws tight. Lock screws by turning up edge of lockplate under screwhead.

Frame Leveling:—Turn adjusting plug in housing cover not more than ⅛" in or out (Chevrolet), 2 turns in or 5 turns out from flush position (Pontiac), so that distance from bottom of cross tube to bottom of brake drum is 5⅜" (plus or minus ¼") and equal on both sides of car. Install lock and lock capscrew after this adjustment.

SHOCK ABSORBERS:—Standard calibrations as follows:

Car Model	Compression Valve	Rebound Valve
Pontiac	GO	3C

WORM-AND-ROLLER TYPES.

Used On:

CHRYSLER SIX, MODEL C-7 (1936).
CHRYSLER EIGHT, MODEL C-8 (1936).
CHRYSLER AIRFLOW MODELS C-9, 10, 11 (1936).
CORD, MODEL 810 (1936).
DE SOTO SIX, MODEL S-1 (1936).
DE SOTO AIRFLOW MODELS S-2 (1936).
DODGE SIX, MODEL D-2 (1936).
HUPMOBILE 8, MODEL 621-N (1936).
LAFAYETTE, MODEL 3610 (1936).
LINCOLN ZEPHYR, MODEL H (1936).
NASH 3620, 3640-A, 3680 (1936).
PACKARD, MODEL 120-B (1936).
PACKARD 8, MODELS 1400, 1, 2, Super 8, MODELS 1403, 4, 5 (1936).
PACKARD TWELVE, MODELS 1407, 8 (1936)
PLYMOUTH SIX, MODELS P1, 2 (1936)

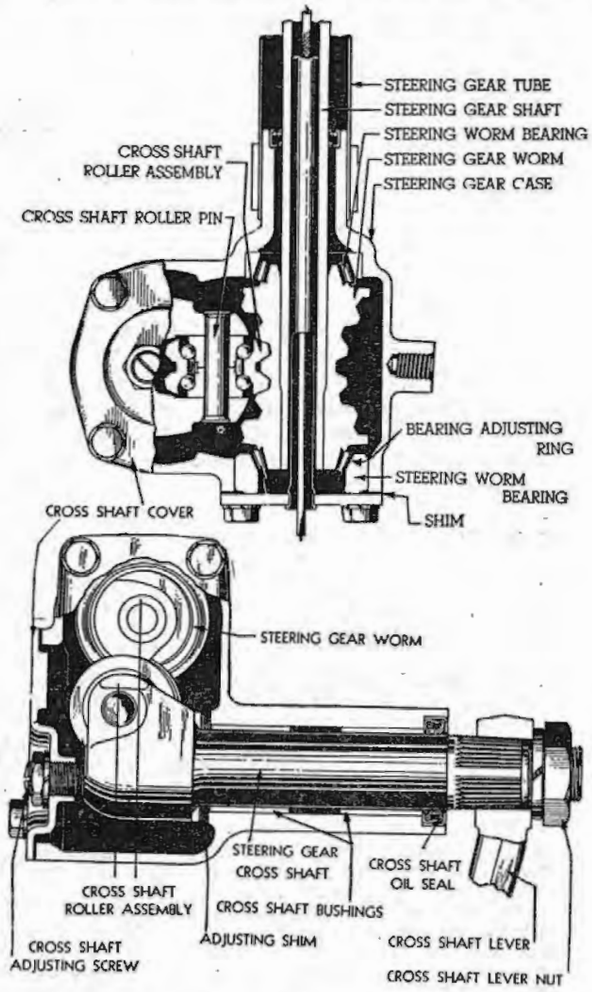
DESCRIPTION:—Consists of 'hour glass' type worm mounted on steering shaft and carried on roller bearings at top and bottom. Bearings provided with shim adjustment under cover at lower end of case. A double-tooth roller on the cross-shaft engages the worm. Roller is mounted on double-ball bearing or on needle bearings and is free to turn at point of contact with worm. Cross-shaft mounting is integral with housing and endplay adjustment provided by adjusting screw on side cover. Roller mesh with worm adjustable by shims on cross-shaft.
NOTE—Cross-shaft on some 330 and all 370 gears is straddle mounted with roller bearing on end of cross-shaft under housing cover. All adjustments same as for other models.

ADJUSTMENT:—Before making adjustments jack up front wheels and disconnect drag link to free steering gear (front wheels should turn freely with not more than 10 lbs. pull on drag link in either direction). Align steering column by loosening frame bracket bolts to allow gear to shift in frame, then loosen instrument board bracket bolts to allow bracket to shift, tighten bracket bolts. Make adjustments in order as follows:

Worm Bearing Endplay:—Evidenced as up-and-down play of steering wheel. Check by turning wheel one turn to right from center 'straight ahead position', secure wheel, shake front wheels, note endplay. Loosen four screws on lower cover, separate top shim, clip shim and remove. Tighten cover screws and check adjustment. Wheel should turn freely without stiffness.

Roller Shaft (Cross-Shaft) Endplay:—Turn steering wheel to extreme end position and then back 1/8 turn. Check cross-shaft endplay at steering arm hub. To adjust, loosen locknut, turn up adjusting screw in inner cover until shaft turns freely with no endplay, tighten locknut.

Roller Mesh in Worm:—Turn steering wheel to center 'straight ahead position,' shake steering arm to determine play or backlash. If this exceeds 1/32", steering gear must be removed from car and roller shaft position adjusted. With gear out of car and



held in vise, take off steering arm nut, remove steering arm, take off side cover, remove roller shaft bearing. Be careful that all shims on shaft behind roller are removed from housing. Remove steering jacket, replace wheel on steering shaft, check worm shaft bearing adjustment. Remove one shim, reinstall roller shaft, assembling roller shaft thrust washer with chamfered side next to roller shaft thrust face. Check by turning steering wheel nearly to extreme left position, hold roller shaft in against worm, turn wheel to center position, check play at splined end of roller shaft. If play apparent, remove additional shim and repeat test. Replace housing cover, reassemble steering arm (drive arm in roller shaft), adjust roller shaft endplay (see above). If adjustments have been made correctly, play at ball end of steering arm should be .006" and wheel should turn throughout range without heavy drag. Lubricate jacket bushing with Castor Oil when replacing jacket.

GEMMER LINCOLN V12 MODEL

NOTE:—This model similar in design and operation to other Gemmer models. Adjustments are not similar and are given below.

ADJUSTMENTS:—Make adjustments in order as follows:

Worm Bearing Endplay:—Take out worm adjusting nut lockscrew and plug on top of steering gear housing at upper end. Insert punch through plug hole, engage notches in adjusting nut, turn adjusting nut clockwise (down) until all endplay removed. If notch in worm adjusting nut does not coincide with lockscrew hole, back adjustment off slightly (do not tighten excessively to permit lockscrew to be entered). Insert lockscrew and tighten securely, replace plug.

Roller Shaft Endplay:—Remove locking screw on housing at inner end of cross-shaft (do not remove locking plate). Turn adjusting screw clockwise until all endplay removed. If hole in locking plate does not register with locking screw hole, back adjusting screw off slightly (do not tighten excessively to permit entry of locking screw), insert locking screw and tighten securely.
NOTE—Adjusting screw can be removed and locking plate turned over to secure better position of locking screw hole if necessary.

Roller Mesh in Worm:—Turn steering wheel to straight ahead position, disconnect connecting rod ball from steering gear connecting rod arm. Take out lock bolt in eccentric bushing plate on outside of frame side rail, turn plate clockwise until all play taken up (test by moving steering arm), insert lock bolt and tighten securely. Check adjustment by turning wheel off the straight ahead position. Small amount of play should be noted in all positions except straight ahead.

Final Check:—After adjustments completed, steering wheel should turn freely from one end position to the other without binding at any point. No play should be noticeable in center straight ahead position but small amount of play should exist at other points.

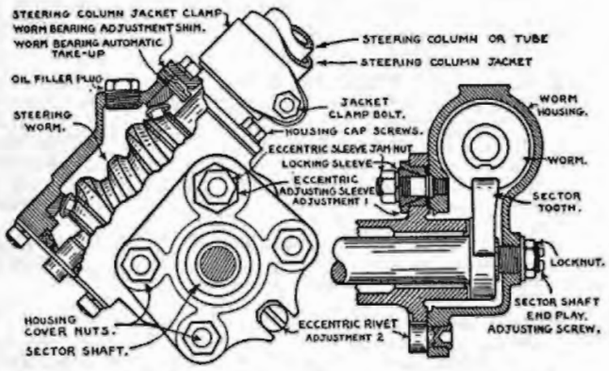
GEMMER WORM-AND-SECTOR TYPES

Used On:

FORD V-8, MODELS 68, 67, 51 (1936).
HUDSON SIX, MODEL 63 (1936).
HUDSON EIGHT, MODELS 64, 65, 66, 67 (1936).
TERRAPLANE SIX, MODELS 61, 62 (1936).

DESCRIPTION:—Consists of 'hour glass' type worm mounted on steering shaft and carried on roller bearings at top and bottom. Bearings are provided with an automatic take-up under housing cover at upper end which eliminates necessity for adjustment except after considerable wear. The three-tooth sector on the cross-shaft engages the worm. Cross-shaft is provided with endplay adjustment. Housing cover in which cross-shaft is mounted is provided with eccentric adjusting sleeve and eccentric rivet adjustments to adjust sector clearance in worm.

ADJUSTMENT:—Before making adjustments, jack up front wheels and disconnect drag link to free steering gear (front wheels should turn freely with not more than 10 lbs. pull on drag link in either direction). Align steering column by loosening frame bracket bolts to allow gear to shift in frame, tighten bolts, then loosen instrument board bracket bolts to allow bracket to shift in alignment with column, tighten bracket bolts. Make adjustments in order as follows:



Worm Bearing Endplay:—Evidenced as up and down movement of steering wheel. Adjust when this exceeds .010" (to check, turn wheel 1 turn off center, hold wheel, shake front wheels). To adjust, loosen jacket clamp bolt above housing upper cover, shift clamp up 3/8" above lower end of jacket, loosen instrument board bracket clamp, work jacket down until lower end is against housing arm, remove housing capscrews, work jacket up as far as possible. This will provide approximately 3/8" clearance between housing cap and housing. Clip and remove one shim, reassemble gear, locating jacket clamp as near bottom end of jacket as possible. Check adjustment. Wheel should turn freely without stiffness.

Cross-shaft Endplay:—See that housing cover nuts and jam nut are securely tightened. Turn steering wheel to extreme end position and then back 1/8 turn. Loosen locknut and turn adjusting screw in housing at inner end of cross-shaft until shaft rotates freely with no endplay, tighten locknut.

Sector Tooth Mesh in Worm:—Turn steering wheel to 'straight ahead position' midway between end points, loosen housing cover nuts 1/4 turn and eccentric sleeve jam nut 1/2 turn. Turn eccentric adjusting sleeve slowly clockwise until backlash can just be felt at ball end of steering arm. Check by turning steering wheel throughout full travel. If wheel is too tight in any position, turn eccentric sleeve counter-clockwise until wheel is free and then readjust. Sleeve must be turned clockwise to finish adjustment. Tighten eccentric sleeve jam nut, then tighten cover nuts. With correct adjustment sector should have minimum clearance at center position and gradually increased clearance toward ends.

Centralization of Tooth Contact:—Check clearance or backlash between sector teeth and worm at points 1/3 turn of steering wheel each side of center position. If clearance is not equal, note at which point (right or left) backlash is greatest, loosen cover nuts and eccentric sleeve jam nut, turn eccentric rivet in notch in edge of cover slightly clockwise (if greater clearance with wheel turned to right) or counter-clockwise (if greater clearance with wheel turned to left). Tighten cover nuts and jam nut securely, repeat test.

Steering Wheel Position (Hudson-Terraplane):—On these models, steering wheel spoke with trademark on underside must point straight down with wheels in 'straight ahead position'. If this spoke more than 2" on either side (position affected by Caster adjustment), steering gear pitman arm should be bent (first cars) or drag link adjusted (later cars) as follows:

To Bend Pitman Arm—Wrap hardened pitman arm ball in wet rags, drip water on ball, heat arm 2" above ball with torch until color begins to show, bend arm with bending bar approximately 3/64" backward (if spoke to right of center) or forward (if spoke to left of center) to correct each 1" that spoke is off center. Drag link must be disconnected and ball protected as directed to prevent destroying hardened finish.

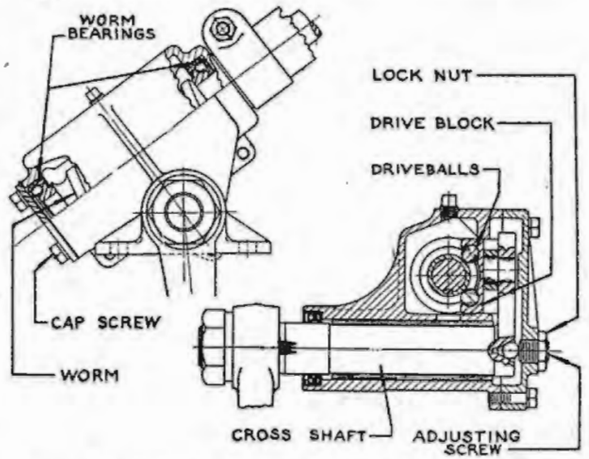
To Adjust Drag Link—See Car Pages for serial numbers of cars on which adjustable drag link used. Adjustment consists of shims placed at both ends of pitman arm ball seats at rear end of drag link. Transfer shims from one position to the other to throw pitman arm back (wheel spoke to right) or forward (wheel spoke to left).

LAVINE MODELS.

USED ON WILLYS MODEL 77.

DESCRIPTION:—Steering worm on steering wheel shaft mounted on ball thrust bearings at top and bottom. Rotating nut or drive block on cross-shaft lever engages worm through two balls which are free to turn in block and worm. Adjustments provided for cross-shaft endplay (lash or play in steering wheel) and for worm shaft endplay (up and down movement of shaft and wheel).

ADJUSTMENT:—Before making any adjustment, jack up front end of car, turn wheels to straight ahead position, disconnect drag link at steering gear ball arm. See that front wheels turn freely without drag and without excessive looseness at drag link and tie rod ends. With steering wheel in straight ahead position, adjust as follows:



Cross-Shaft Endplay (Backlash between Drive Block and Worm):—Loosen locknut on adjusting screw on cover plate at inner end of cross-shaft, turn adjusting screw clockwise until all steering wheel play is eliminated, hold screw and tighten locknut. Check by rotating wheel through range from right to left extreme end positions. Wheel should be free at all positions. If wheel binds at any point, back off adjustment screw slightly.

Worm Shaft Endplay:—Check endplay by grasping steering wheel rim and noting movement when wheel pulled up. To adjust, take out four capscrews in housing lower end cover, take off cover, remove sufficient shims under cover to eliminate endplay, replace cover and tighten cover screws securely, check by rotating wheel through range from right to left extreme end position. Worm shaft should not bind at any point.

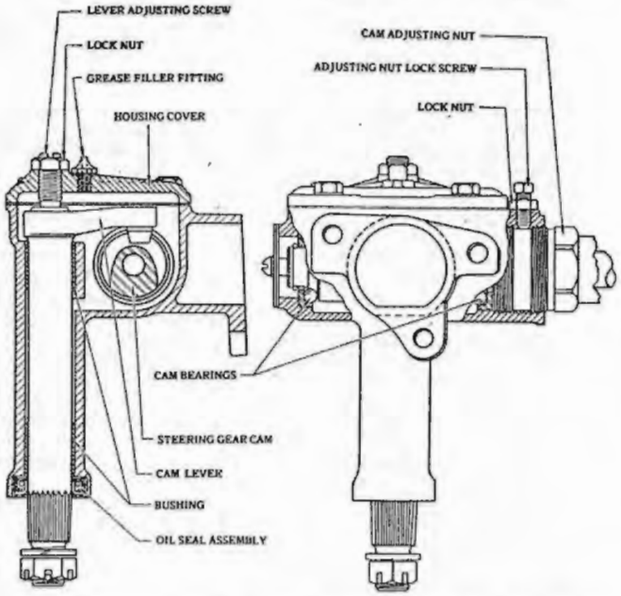
Note:—When adjustments completed, steering wheel should have no appreciable lash at center straight ahead position and should turn freely throughout range.

CAM-AND-LEVER TYPES.

Used On:

140—AUBURN SIX, MODEL 654 (1936).
S-14—GRAHAM CRUSADER, MOD. 80, 80-A (1936).
140—GRAHAM CAVALIER, MOD. 90, 90-A (1936).
S-14—HUPMOBILE SIX, MODEL 618-G (1936).
T-14—STUDEBAKER DICT., MODS. 3-A, 4-A (1936)
140—STUDEBAKER DICT., MODS. 3-A, 4-A (1936).

DESCRIPTION:—Consists of a worm-like cam mounted on steering wheel shaft engaging a tapered stud mounted on inner end of cross-shaft lever. Cross-shaft is carried in plain bushings and is adjustable for endplay. Cam is carried on ball thrust bearings at upper and lower end and bearing clearance or



endplay is adjustable. Stud track in cam is grooved deeper at each end to provide minimum clearance at center. Adjustments must be made with wheel turned to 'straight ahead position' so that stud is at center of cam groove .

ADJUSTMENT:—Free steering gear from load by disconnecting drag link or jacking up front end of car. Loosen instrument board bracket clamp, loosen jacket tube clamp screw (if no clamp screw used, jacket tube is press-fit in adjusting plug and will turn with plug). Make following adjustments in order:

Cam Endplay Model 140:—Evidenced by up and down movement of steering wheel. Loosen housing plate adjusting screw and locknut (to free stud in cam groove). Loosen adjusting plug lockscrew locknut and back off lockscrew. Turn adjusting plug in until slight drag felt when turning wheel, then back off plug about 1/6 turn until wheel turns freely without any up-and-down movement, tighten lockscrew and locknut. Tighten instrument board bracket, check wheel. If movement is stiff steering column is sprung or out of alignment and must be corrected.

Cam Endplay Models S-14, T-14:—Unscrew four clamp screws in upper cover, move cover up as far as possible (about ¼"). Separate top (.003") shim from remainder, clip and remove. Replace upper cover screws and tighten securely. Check adjustment. Wheel should turn freely (with light grip on rim) without any up-and-down movement with barely perceptible drag at mid-point. Remove additional shims, if necessary, until this adjustment secured. Shims are .003" (top), .010" (middle), .030" (bottom) thick with paper gaskets between. Do not destroy or remove gaskets between remaining shims.

Steering Column Alignment:—Loosen frame bracket bolts to permit gear to shift into alignment with instrument board bracket, tighten frame bolts. Loosen instrument board bracket bolts to allow bracket to shift to position of column, tighten bracket bolts. If bracket position not adjustable, change bracket mounting holes so that bracket is aligned with column, do not spring column to bracket.

Lever Shaft Endplay (Steering Wheel Backlash):—Turn wheel to 'straight-ahead position' so that stud is at center of cam. Never adjust with stud at either end of cam as this will cause binding at center position. Loosen locknut on side cover adjusting screw (on inner cover plate), turn screw up until slight drag felt at center position when wheel turned from one extreme to other, tighten locknut. Drag must be slight and perceptible only in mid-position.

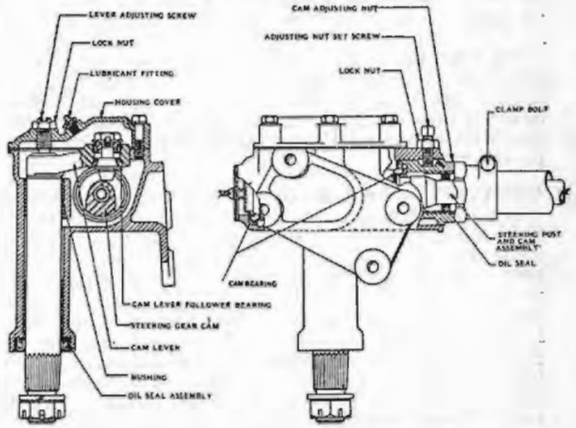
Steering Wheel Position:—With drag link disconnected at steering arm, count number of wheel revolutions from extreme right to extreme left, turn wheel back ½ this number of turns so that stud is on midpoint of cam. Place wheels in 'straight-ahead position', note whether drag link can be engaged with ball on steering arm without turning steering wheel. If not, take off nut, pull steering arm, replace arm in position to engage drag link, tighten nut.

CAM-AND-ROLLER TYPES.

Used On:

615—AUBURN EIGHT, MODEL 852 (1936)
615—AUBURN SUPERCH'D EIGHT, MOD. 852 (1936)
660—DUESENBERG MODEL J (1936).
540—GRAHAM SUPERCHARGER, MOD. 110 (1936).
660—PIERCE ARROW 8, MODEL 1601, 12, MODEL 1602, 3 (1936).
540—REO FLYING CLOUD, MODEL 6-D (1936).
620—STUDEBAKER PRESIDENT, MOD. 2-C (1936).

DESCRIPTION:—Similar in design to 140 (see previous article) except that tapered stud in lever shaft is mounted on double-row roller bearing and is free to turn at point of contact with lever.



ADJUSTMENT:—Cam Endplay, Steering Column Alignment, Lever Shaft Endplay or Steering Wheel Backlash, and Front Wheel Position adjusted in same manner as 140 (see previous article). If these adjustments do not result in satisfactory performance, check and adjust stud roller bearing unit on lever shaft.

Stud Roller Bearing Adjustment:—Stud should have no perceptible end play and should turn with a slight drag when stud nut is gripped with the fingers (slightly tighter with new bearings). To adjust, straighten out prong in locking washer, tighten nut. If stud clamped to prevent turning, be careful not to mar or burr bearing surface of stud. Tap stud lightly to check adjustment, turn prong of locking washer up against nut (use new washer or different prong of old washer and remove prongs which have been used previously). Wash all grease out of bearing with gasoline and recheck adjustment.

WORM-AND-ROLLER TYPES.

Used On:

BUICK MODELS 40, 60, 80, 90 (1936).
CADILLAC MODELS 60, 70, 75, 80, 85, 90 (1936).
CHEVROLET MASTER MODELS FA, FD (1936).
LA SALLE MODEL 36-50 (1936).
OLDSMOBILE MODELS F-36, L-36 (1936).
PONTIAC MODELS 36-26A, B, 36-28 (1936).

NOTE—On Cadillac 70, 75, 80, 85, 90 steering gear is mounted on top of frame and is connected to steering wheel through offset shaft with universal joint at each end. Adjustments same as for other types.

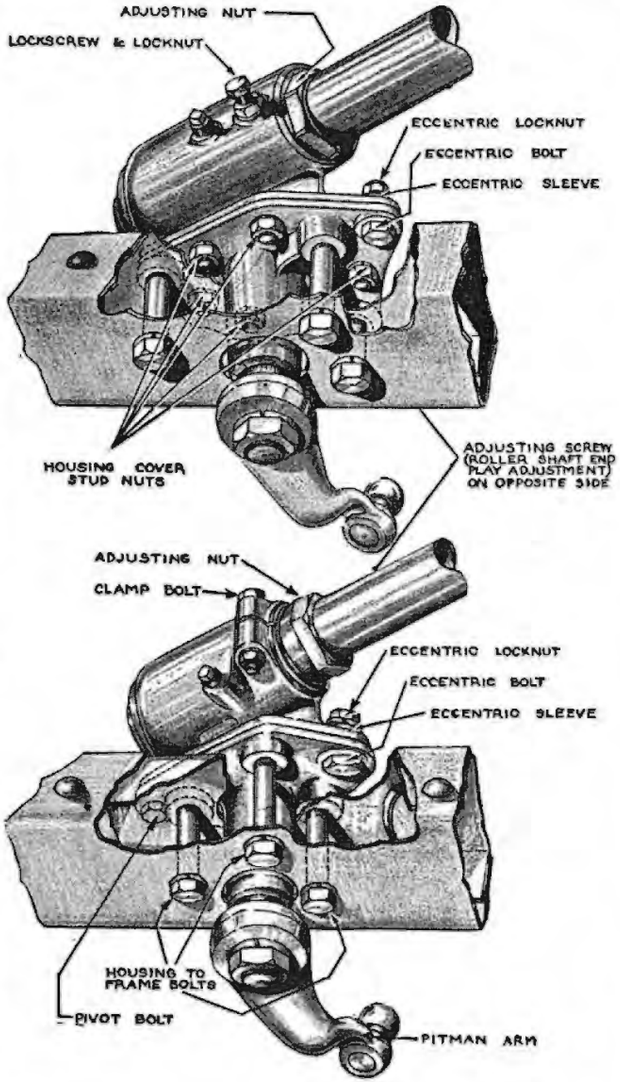
DESCRIPTION:—Consists of 'hour-glass' type worm on steering shaft and carried on roller bearings in housing. Worm engages double tooth roller carried on ball bearings in cross-shaft lever. Roller is free to turn at point of contact with worm. Worm provides minimum clearance at center 'straight-ahead position' with greater clearance at ends. Adjustments provided at upper end of housing (worm bearing adjustment), inner end of cross-shaft (cross shaft endplay) and for housing cover (roller mesh in worm).

ADJUSTMENT:—Jack up front wheels, turn steering wheel to 'straight-ahead position' (wheel turned halfway back from either end position), disconnect drag link at steering gear pitman arm, note ball seat, washer and spring assembly so that they may be reassembled in same order. See that reference mark on pitman arm and shaft are lined up, if pitman arm removed, replace in correct position and tighten nut securely with 18" wrench. Loosen steering post bracket, check column alignment (shim bracket out to column if necessary) tighten bracket bolts. Make following adjustments in order:

Cross-Shaft (Roller Shaft) Endplay:—See that frame mounting bolts are tight, loosen locknut, turn adjusting screw on side of housing at inner end of cross-shaft up until all endplay removed, tighten locknut. Check by turning shaft to extreme end positions (just clear of stops) and noting that pitman arm does not drag when turned through backlash clearance.

Worm Shaft Endplay:—Evidenced as up-and-down movement of steering wheel. To adjust, turn wheel to extreme right position, loosen clamp bolt at upper end of housing one turn or loosen locknut and back off lockscrew, and loosen column jacket clamp screw so that large adjusting nut at top of housing may be turned. Turn down adjusting nut until force required to turn wheel (measured by spring scale hooked to spoke at wheel rim and tangent to rim) is 1 lb. (Buick), 1¾-2¼ lbs. (Chevrolet), 1-1¼ lbs. (Cadillac), 1-1½ lbs. (Oldsmobile). ½-1 lbs. at center on Pontiac. Nut must be turned down only to complete adjustment. Pressure in excess of these figures indicate bearings too tight and adjustment should be backed off slightly.

Worm and Roller Backlash:—Turn wheel to 'straight-ahead position' (½ total number of turns back from end position or with wheel in position noted below). Check backlash by moving pitman arm back and forth. Loosen housing to frame bolts and pivot bolt ¼ turn, or loosen housing cover stud nut ¼ turn and loosen eccentric locknut ¼ turn, turn eccentric bolt clockwise and eccentric sleeve counter-clockwise slowly and simultaneously until backlash is taken up (approximately ⅛ turn should be sufficient). Tighten all nuts. Check by turning wheel to right and left. Back off adjustment slightly if excessive binding is encountered at high spots. Force required to turn wheel through center measured on spring scale at wheel rim should be 2 lbs. maximum (Buick), 2¼-2¾ lbs. (Cadillac), 1½-2½ lbs. (Oldsmobile), 2½ lbs. maximum (Pontiac) and there should be no appreciable backlash in pitman arm.



WORM-AND-SECTOR TYPES.

USED ON CHEVROLET STD. & TRUCK.

DESCRIPTION:—Consists of 'hour-glass' type worm on steering gear mounted on roller bearings in steering gear case. Worm engages sector teeth on cross-shaft lever to which pitman arm is attached. Worm provides minimum clearance at center straight ahead position with greater clearance at end positions. Adjustments provided for worm shaft endplay (steering mast adjustment), cross-shaft endplay (adjusting screw and locknut on housing), and for sector tooth mesh in worm (housing cover adjustment).

ADJUSTMENT:—Jack up front wheels, turn steering gear to 'straight-ahead position', disconnect drag link at steering gear pitman arm, disconnect horn wire from steering post jacket or mast. Make following adjustments in order:

Worm Shaft Endplay:—Evidenced as up-and-down movement of steering wheel. To adjust, turn steering wheel to extreme end position (right or left), loosen housing clamp bolt, loosen bracket bolt nuts at instrument panel, see that mast jacket clamp bolt drawn up tightly. Turn mast to right or clockwise slowly until pressure required to turn wheel is 1¾-2½ lbs. measured by spring scale attached to rim of wheel. Mast must not be turned past the point of correct adjustment as it can not be backed off and steering gear must be dismantled to correct a too-tight setting. Tighten housing clamp bolt and instrument panel bracket bolts. Horn wire can be reconnected at this point if desired.

Cross-Shaft Endplay:—Loosen locknut on adjusting screw on housing at inner end of cross-shaft, turn adjusting screw in until all endplay removed from cross-shaft, tighten locknut.

Worm and Sector Backlash:—Be sure that steering wheel turned to 'straight ahead position' (wheel turned back ½ of total travel from either end position). Check backlash by moving pitman arm back and forth. Loosen the three cover stud nuts, loosen nut on eccentric bolt and sleeve exactly ½ turn, turn eccentric bolt and eccentric sleeve in opposite directions simultaneously and slowly until all backlash of pitman arm has been eliminated. This adjustment must be made slowly and bolt and sleeve should not be turned past the point where backlash has been eliminated but pitman arm moves freely. Tighten eccentric bolt nut and cover stud nuts.

NOTE:—Check steering wheel after all adjustments have been made. Wheel should turn freely throughout entire range. There should be no appreciable backlash in pitman arm at center straight ahead position and slight backlash at extreme right and left end positions.

Used On:

9A6—LA FAYETTE MODEL 3610 (1936).
NASH '400' MODEL 3640-A (1936).
OLDSMOBILE SIX, MODEL F-36 (1936).
PLYMOUTH SIX, STANDARD AND DE LUXE MODELS P1, P2 (1936).
STUDEBAKER DICTATOR, MODELS 3A, 4-A (1936).

10A4—LA SALLE MODEL 36-50 (1936).
OLDSMOBILE EIGHT, MODEL L-36 (1936).

10A6—CHRYSLER SIX, MOD. C-7, EIGHT, MOD. C-8 (1936).
DE SOTO AIRSTREAM AND AIRFLOW MODELS S-1, 2 (1936).
DODGE SIX, MODEL D-2 (1936).
HUPMOBILE SIX, MODELS 618-G (1936).
NASH AMBASSADOR SIX, MODEL 3620, EIGHT, MODEL 3680 (1936).
REO FLYING CLOUD, MODEL 6-D (1936).

11A6—CHRYSLER AIRFLOW MODEL C-9, IMPERIAL MODELS C-10, 11 (1936).

NOTE—Manufacturer recommends use of Borg-Warner UF-300 fixture for servicing clutch. Fixture consists of surface plate, which duplicates driving surface of flywheel, clamp screws to clamp clutch cover against plate, arbor press to compress springs in dismantling clutch, and gauge standard for use in setting up release levers.

NOTE—La Salle clutch fitted with Type 10CF-CI driven plate. See article on Long Model 'CF' clutches for driven plate data on this model.

Borg & Beck driven plates used on Buick 40 and Willys 77 (1936). Driven Plate data below applies to these models.

DESCRIPTION:—Single plate, dry disc type. Three release levers mounted on bolts piloted in pressure plate and held in clutch cover, actuate clutch through struts which provide 'knife-edge' action. Servicing directions below apply to pressure plate assembly. See Driven Member Section if pressure plate not to be dismantled and rebuilt.

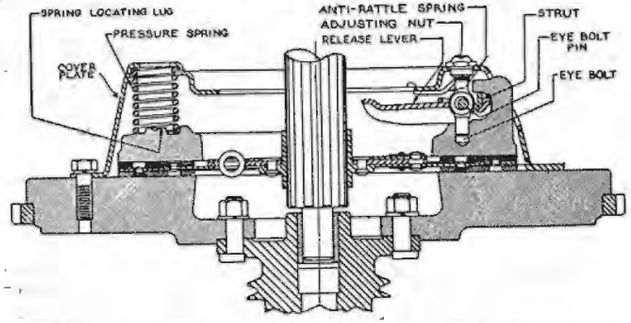
SERVICING:—Mark all parts before dismantling clutch and reassemble in same position (necessary to maintain balance). Replace grooved, checked or warped pressure plates. Replace springs when pressure plate discolored from heat (test springs as directed below).

Dismantling:—Place clutch on fixture or arbor press supporting driven plate under release levers, place block across cover resting on spring bosses, compress cover slightly, remove metal staking in adjusting nuts by running hacksaw blade through slot, remove nuts, release pressure slowly, remove cover and springs. Remove release levers by grasping lever and eyebolt between thumb and forefinger, so that inner end of lever and upper end of eyebolt are pressed together. Lift strut over ridge in end of lever (press lower end back against lug), lift lever and eyebolt out.

Clutch Springs:—Release springs should check with table below. Replace springs if weak or burned or if clutch has been subjected to excessive heat.

Part No.	Color	Pressure & Length
2958	Black or White	160 lbs. @ 1 11/16"
2994	Yellow or Brown	140 " " "
3031	Red or Blue	180 " " "
3534	Pink or Gray	200 " " "
3814	Purple	135 " " "
3817	Green	110 " " "

Assembling:—Place pressure plate on fixture or arbor press, supporting plate under release lever lugs. Install lever, eyebolt and strut assemblies by reversing removal procedure. Place pressure springs in seats on plate, assemble anti-rattler springs inside clutch cover, place cover on pressure plate. Make certain that pressure springs are seated and that anti-rattler springs are in place on release levers. Compress cover slowly guiding eyebolts through bolt holes in cover. If assembly made on fixture use clamps to clamp cover flange to plate at mounting holes. Assemble eyebolt nuts, turn nuts down until flush with head of bolt. Compress and release clutch levers several times to seat all working parts. Then adjust release lever heights.



Release Lever Adjustment (on Fixture):—Use lever indicating plate (all models except 11A6, on 10A4 remove release lever plate and use sleeves under clutch cover flang), placing plate on clutch levers with counterbored side up, assemble adjusting sleeve and adjusting arm, set arm 2 5/16" (9A6, 10A6) 2 1/16" (10A4) from end of sleeve and lock in place with thumbnut. Swing adjusting arm over each release lever in turn, turn release lever eyebolt nut until lever just touches lever indicating plate; lock nuts by staking or peening metal of nut into bolt slot, recheck settings. When release lever plate used, set plate in place on end of levers, attach retainer wires by placing loop of wire over lug on lever plate, hook wire ends over end of release lever.

On Model 11A6, lever setting height is 1 11/16". Set by adjusting nut until lever just contacts adjusting arm (do not use lever indicating plate).

Release Lever Adjustment (without Fixture):—Use Borg & Beck A1 type gauge plate, assemble plate in clutch on flywheel in place of driven plate, positioning gauge lugs under release levers. Place short scale or straightedge on edge on boss in center of gauge, adjust release levers until they just contact edge of scale.

DRIVEN MEMBER:—Manufacturer recommends installation of new driven member with new clutch facings rather than relining clutch. Driven plate hub (spring dampener) cannot be serviced in the field. Two types of plates used: (1) cushioning secured by slotting plate into concave and convex segments, (2) Separate cushioning springs under one facing. Type used can be determined by inspection. Instructions on relining each type given below.

Segmented Type Plate:—Driven plate slotted radially and segments alternately convex and concave. Tongue formed in each section by 'U' shaped cutaway. Each facing riveted individually at outer holes on convex side of segments (alternate segments) and to inner point of tongue on intervening concave segments.

To Remove Facings—Drill out rivets to remove old facings. Do not punch out rivets as this will distort disc and damage tongues.

Installing Facings—Insert rivets on facing side (head in countersunk hole of facing). Roll rivets on plate side—do not use split rivets. Each facing must be riveted individually with facing drilled to permit working through facing to head rivets for facing in opposite side.

Installing Driven Member—Plate marked 'Flywheel side'. Install with this side toward flywheel.

Cushion Spring Type Plate:—Facing on pressure plate side riveted only to series of individual cushion springs by two short rivets at tongue end of each spring. Cushion springs riveted to plate together with facing for flywheel side by two long rivets on each spring.

To Remove Facings—Drill out rivets when removing old facings to avoid danger of distorting disc and damaging cushion springs.

Installing Facings—Use complete new set of cushion springs if necessary to replace any of the springs. Install lining of flywheel side, inserting long rivets with heads in countersunk holes in facing, place cushion springs on opposite side of plate concave side down lining up springs so that tongue of one spring enters notch in next, roll rivets on spring side. If properly installed, holes in spring for pressure plate facing will line up with slot in plate. Install facing on cushion springs inserting short rivets with head in countersunk holes in facing, roll rivets on cushion spring side (work through holes in flywheel facing).

Car Model	Clutch Model	Facings Type	Inside Dia.	Outside Dia.	Thick.
Chrysler C-7, C-8	10A6	†	6⅛"	9⅞"	⅛"
Chrysler C-9,10,11	11A6	†	6⅛"	11"	⅛"
DeSoto S-1, 2	10A6	†	6⅛"	9⅞"	⅛"
Dodge 6, D-2	10A6	§	6⅛"	9⅞"	.133"
Hupmobile 6	10A6	*	6⅛"	9⅞"	⅛"
LaFayette 3610	9A6	*	5¾"	9"	.133"
LaSalle 36-50	10A4	†	6"	10"	.123-.127"
Nash 3640-A	9A6	§	5⅝"	9¼"	.133"
Nash Amb. 6 & 8	10A6	*	6⅛"	9⅞"	⅛"
Oldsmobile 6	9A6	†	5⅝"	9"	.133"
Oldsmobile 8	10A4	†	6⅛"	9⅞"	.125"
Plymouth 6	9A6	§	5⅝"	9¼"	.133"
Reo 6-D	10A6	§	6"	9⅞"	.133"
Studebkr 3-A, 4-A	9A6	§	5⅝"	9¼"	.133"

†Woven type. *Moulded type.
§Woven on pressure plate side, moulded on flywheel side.

Installing Driven Member—Plate marked 'Flywheel Side'. Install with this side toward flywheel.

LONG MODEL 9AB.

Used On:

9AB-CS — AUBURN SIX, MODEL 654 (1936).

9AB-6CI — AUBURN EIGHT & SUPERCHARGED EIGHT, MODEL 852 (1936).

9AB-10CI— STUDEBAKER PRESIDENT, MOD. 2-C (1936).

NOTE:—Manufacturer recommends use of Borg-Warner UF-300 fixture for servicing clutch. Fixture consists of surface plate, which duplicates driving surface of flywheel, clamp screws to clamp clutch cover against plate, arbor press to compress springs in dismantling clutch, and gauge standard for use in setting up release levers.

DESCRIPTION:—Single plate, dry disc type. Six release levers pivoted on release bolts at rim of pressure plate with edge of cover at lever hole serving as fulcrum to actuate clutch. Servicing directions below apply to pressure plate assembly. See Driven Member Section if pressure plate not to be dismantled and rebuilt.

SERVICING:—Mark all parts before disassembling and reassemble in same position. Replace grooved, warped, or checked pressure plates. Replace springs when pressure plate discolored from heat (see Spring Testing below).

Dismantling:—Break release lever bolt nut locks by running hacksaw blade through bolt slots. Place clutch in fixture or arbor press, compress cover slightly, take off release lever bolt nuts, release pressure slowly, lift off cover plate. This will expose all parts of pressure plate assembly. Remove and test clutch springs.

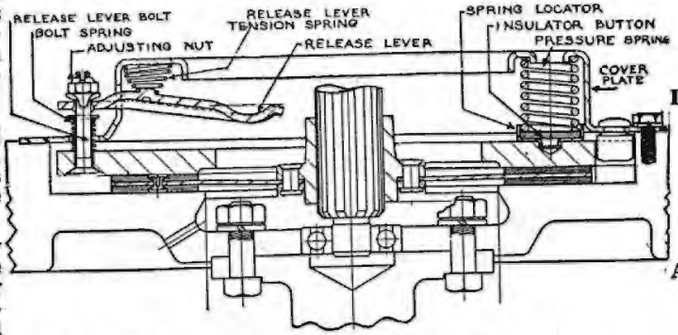
Clutch Springs:—Pressure springs should check with table below. Replace springs if weak or burned or if clutch has been subjected to excessive heat. Twelve springs used on all models.

Spring No.	Pressure @ 1 9/16"	Free Length	No. Coils
C-1965	90-100 lbs.	2¼"	8¾
C-2045	110-120 lbs.	2⅜"	8½
C-2096	120-130 lbs.	2½"	8½
C-2141	130-140 lbs.	2¾"	8½
C-3097	110-120 lbs.	2⅜"	8½
C-3098	110-120 lbs.	2⅜"	8½
C-3410	120-130 lbs.	2 15/32"	8½

Release Lever Assembly:—Place cover plate upside down on bench, place lever tension springs on cover, install levers forcing springs into place under lever. Cover is then ready to assemble to pressure plate (lever bolts enter through plate).

Assembling:—Place pressure plate on fixture or arbor press, insert release lever bolts through plate, install springs on bolts, assemble spring locators, locator buttons and pressure springs on pressure plate. Install cover, compress cover about ½ until release bolts are just short of entering holes in levers, place flat washers on release lever bolt springs (washers must not be placed on springs before cover is installed or cover will bind and be distorted). Place No. 5 height sleeves on fixture at levers, compress cover until it rests on height sleeves, guiding release lever bolts through holes in levers, use clamps to hold cover plate down on height sleeves. Assemble rocker-washers and nuts in release lever bolts turning nuts down until they are flush with tops of bolts. Compress and release clutch several times to seat all parts (use weight on release levers). Then adjust release lever heights.

Release Lever Adjustment (on Fixture):—Assemble lever adjusting arm and sleeve setting bottom of adjusting arm 1 17/32" above bottom of sleeve, lock with thumbnut. Swing arm over each lever in turn, set lever by turning release lever bolt until end of lever contacts arm. Lock adjustment by peening metal of nut into bolt slot.



Release Lever Adjustment (without Fixture):—Use aligning shaft and adjustment sleeve (Studebaker Parts HMJ-278, 278-2). Insert shaft in splined hub of driven member (clutch installed in flywheel) place sleeve on shaft so that it contacts hub, place straightedge across top edge of sleeve, turn adjusting screws up until they contact straightedge. Lever heights must be equal within .020". Lock adjusting screws by peening metal into slots.

DRIVEN MEMBER:—Manufacturer recommends use of new driven member with new facings installed. Driven plate hub (spring dampener) cannot be serviced in the field. Cushioning springs used under facing on pressure plate side.

To Remove Facings:—Drill out twelve iron rivets mounting cushion springs on plate (two rivets radially at center of each spring), remove spring and facing assembly, drill out rivets to remove springs from facing (replace springs as complete set). Then drill out rivets mounting other facing on plate. Do not punch out rivets.

To Install Facings:—Install facing on flywheel side of driven plate, inserting brass rivets with heads in countersunk holes in facing and rolling rivets on plate side. Rivets are staggered in inner and outer rows around plate. Place cushion springs on second facing with clearance between spring and plate at center. Insert brass rivets with head in countersunk holes in facing, roll rivets on spring side (rivets installed in inner and outer holes alternately around plate in opposite order to those on other facing). Brass rivets must not extend through plate or springs more than 1/32" (plate end spring cutaway to provide clearance). Place facing and cushion spring assembly on plate, insert iron rivets through holes in plate and cushion springs, roll rivets (working through holes in facings). Driven member should be balanced after new facings installed.

Car Model	Clutch Model	Type	In Dia.	Out Dia.	Thick.
Auburn 6	9AB-CS	Moulded	5¾"	9"	.137"
Auburn 8 & SC8	9AB-6CI	Moulded	5½"	9¾"	.137"
Studebaker Prs.	9AB-10CI	Moulded	6"	10"	.137"

Installing Driven Member:—Install with hub bolt nuts on flywheel side and cushioned facing toward transmission.

ILLINOIS (GRAHAM).

DESCRIPTION:—Single plate dry disc type. Three release levers pivoted on eccentric pins in pressure plate lugs at flywheel brackets actuate clutch. Single large spiral clutch spring located between release lever plate and pressure plate. Pressure plate is heavy ribbed casting and is mounted on flywheel by three lugs engaging brackets bolted on flywheel independently (no conventional clutch cover used).

ADJUSTMENT:—When range of clutch pedal engagement has been used up, bracket mounting bolts on flywheel should be loosened one or two turns and the bracket shim pulled out from between the bracket and the face of the flywheel (shim holes slotted, not necessary to completely remove bolts). Adjust one bracket at a time, tighten bracket bolts before loosening next bracket. Shims can be discarded (new shims furnished with new lined clutch plates).

SERVICING:—No service operations required. Clutch lever adjustment consists of eccentric pivot pin on levers in pressure plate lugs. This adjustment correctly set at factory. Pins locked by being peened over in lugs and should not be disturbed.

Removal—Take out two bolts in each bracket. Entire clutch assembly may then be removed from flywheel.

NOTE—When installing clutch with new clutch plate see that shims furnished with plate are installed under each bracket on flywheel.

DRIVEN MEMBER:—Spring dampening device incorporated in driving plate hub. Driving plate segmented and facings riveted to plate individually. Manufacturer recommends use of new driven member with lining selected to maintain even thickness at all points under pressure.

Facing Specifications

Model	Type	Inside Diam.	Outside Diam.	Thickness
80, 80A	Moulded	5⅛"	7⅞"	⅛"
90, 90A, 110	Moulded	5½"	8⅞"	⅛"

MODELS 9CF, 10CF, 11CF.

Used On:

9CF-CI—FORD V-8, MODELS 68, 67 (1936).
10CF-CI—CORD, MODEL 810 (1936).
HUPMOBILE EIGHT, MOD. 621-N (1936).
LINCOLN ZEPHYR, MODEL H (1936).
PACKARD, MODEL 120-B (1936).
11CF-CI—CADILLAC V-8, MODELS 60, 70, 75 (1936)
CADILLAC V-12, MODELS 80, 85 (1936).
FORD V-8, TRUCK MODEL 51 (1936).

NOTE—Long driven plate used with other type clutches on following Car Models: 10CF-CI—La Salle 36-50, Pontiac Six 36-26A, 36-26B, Pontiac Eight 36-28; 11CF-CI—Buick 60, 80, 90. Driven Plate data below applies to these models.

NOTE—Manufacturer recommends use of Borg-Warner UF-300 fixture for servicing clutch. Fixture consists of surface plate, which duplicates driving surface of flywheel, clamp screws to clamp clutch cover against plate, arbor press to compress springs in dismantling clutch, and gauge standard for use in setting up release levers.

DESCRIPTION:—Single plate, dry disc type. Release levers formed with weight on outer end which increase pressure on driven member as engine speed increases. Levers pivoted on pressure plate on needle bearings with fulcrum located in yoke support on cover plate. Hardened-steel screw contact provided on lever tips. These screws staked in place and should be disturbed only when release lever adjustment (for new or relined driven plate) is to be made. Servicing directions below apply to pressure plate assembly. See Driven Member Section below if pressure plate not to be dismantled and rebuilt.

SERVICING:—Mark all parts before dismantling and reassemble in same position. Replace grooved, warped, or checked pressure plates. Replace springs when pressure plate discolored from heat (see Spring Testing below).

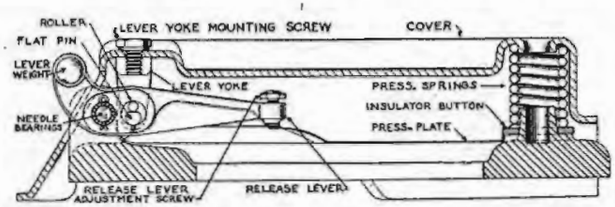
Dismantling:—Place clutch on fixture (supporting pressure plate on special lands under lugs) or arbor press. Compress cover plate slightly, take out assembly screws (lever yoke mounting screws) on cover, release pressure on cover plate slowly, lift off plate. Note whether washers used on yokes under assembly screws (these washers must be reinstalled if old pressure plate used again). See special directions below on removing and reinstalling release levers. Remove and test clutch springs.

Clutch Springs:—Pressure springs should check with table below. Replace springs if weak or burned or if clutch has been subjected to excessive heat. Six springs used on 9CF, nine springs on 10CF, 11CF.

Spring No.	Pressure @ 1 9/16"	Free Length	No. Coils
C-1445	130-140 lbs.	2 3/8"	8 3/4
C-2045	110-120 lbs.	2 3/8"	8 1/4
C-3431	150-160 lbs.	2 1/2"	9

Release Lever Assembly:—Mount lever yoke on release lever, fasten by inserting flat-sided lever pin (flat side out or toward cover) and roller (place roller on flat side of pin). Insert lever in pressure plate lug, use roller pin sawed off to length of lever width as a guide and insert needle bearings, insert roller pin, pushing guide pin out, lock both lever pins with cotter pins. Thread release lever adjusting screws in ends of levers, turning screws down completely.

Assembling:—Place pressure plate on fixture or arbor press. Assemble pressure springs, locator washers or insulator washers on plate, place washers on lever yokes (if washers used previously and old pressure plate being used). Place cover plate in position (lining up marks made before dismantling), compress cover slowly guiding lever weights through holes in cover and lining up yokes under cover plate holes. See that pressure springs are seated, insert cover screws in yokes, using lockwasher under screw head, tighten screws down securely. Compress and release clutch several times (using weight on release levers) to seat all parts. Then adjust release lever heights.



Release Lever Adjustment (on Fixture):—Place special lands on fixture under pressure plate lugs, assemble lever adjusting arm and sleeve setting bottom of adjusting arm 2 1/16" above bottom of sleeve, lock with thumbscrew. Swing arm over each release lever in turn, back off adjusting screw on tip of lever until rounded screw head just contacts arm, lock screws by inverting clutch so that screw head is supported and stake or peen lever into adjusting screw slot. Do not disturb lever yoke screws when making this adjustment.

Release Lever Adjustment (without Fixture):—Assemble lever setting disc or gauge (Cadillac No. J-685) on flywheel in place of driven member, placing gauge so that lugs are under release levers and gauge is centered in clutch. Tighten all clutch cover bolts evenly. Place short straightedge on edge on top of gauge shoulder, turn adjusting screws at tips of release levers up or down until they contact straightedge, lock screws by peening metal of lever into screw slot. Lever heights must be equal within .005".

DRIVEN MEMBER:—Manufacturer recommends use of new driven member with new facings installed. Driven plate hub (spring dampener) cannot be serviced in the field. Cushioning springs used under facing on pressure plate side.

To Remove Facings:—Drill out 12 iron rivets mounting cushion springs on plate (two rivets radially at center of each spring), remove spring and facing assembly, drill out rivets to remove springs from facing (replace springs as complete sets). Then drill out rivets mounting other facing on plate. Do not punch out rivets.

To Install Facings:—Install facings on flywheel side inserting brass rivets with heads in countersunk holes in facing and roll rivets on plate side (rivets staggered in inner and outer holes alternately around facing or placed two in a row radially). Place cushion springs on second facing with clearance at center between spring and facing, insert brass rivets with head in countersunk holes in facing and roll on spring side. Rivet layout same as for first facing except that rivets staggered in opposite direction or radial rows offset from rivets for first facing. Brass rivets must not project more than 1/32" when rolled (plate and spring cutaway to provide clearance). Place cushion spring and facing assembly on plate, insert iron rivets through holes in plate and spring, roll rivets (work through holes in facing). Driven member should be balanced after new facings installed.

Installing Driven Member:—Install with hub nuts on flywheel side and cushioned facing toward transmission (plate on Cadillac V-12, 80, 85 is solid hub type with no dampening device).

Facing Specifications

Car Model	Clutch Model	Type	In. Diam.	Out. Diam.	Thick.
Cadillac V-8, 12	11CF-CI	Woven	6 1/2"	11"	.135-.139"
Cord 810	10CF-CI	Woven	6"	10"	.137"
Ford V-8, 68	9CF-CI	Moulded	5.76"	9"	.140"
Ford V-8 Truck	11CF-CI	Moulded	5.76"	11"	.140"
Hupmobile 8	10CF-CI	Moulded	6"	10"	.137"
Lincoln Zephyr	10CF-CI	Moulded	6"	10"	.140"
Packard 120-B	10CF-CI	Woven	6"	10"	.140"

MODEL 12CB.

12CB-CL—LINCOLN V-12, MODEL K (1936).
PACKARD 8, MODELS 1400, 1, 2, SUPER 8 MODELS 1403, 4, 5 (1936).
PACKARD TWELVE, MOD. 1407, 8 (1936)
PIERCE ARROW 8 MODEL 1601, 12 MODELS 1602, 3 (1936).

NOTE—Manufacturer recommends use of Borg-Warner UF-300 fixture for servicing clutch. Fixture consists of surface plate, which duplicates driving surface of flywheel, clamp screws to clamp clutch cover against plate, arbor press to compress springs in dismantling clutch, and gauge standard for use in setting up release levers.

DESCRIPTION:—Single plate, dry disc type. Six release levers pivoted on pressure plate lugs with fulcrum on yoke on cover. Needle bearings used at both pivot

LONG MODEL 12CB CONT.

points. Servicing directions below apply to pressure plate assembly. See Driven Member Section if pressure plate not to be dismantled and rebuilt.

SERVICING:—Mark all parts before dismantling, and reassemble in same position. Replace grooved, warped, or checked pressure plates. Replace springs when pressure plate discolored from heat (see Spring Testing below).

Dismantling:—Break release lever yoke bolt nuts by running hacksaw blade through bolt slots. Place clutch in fixture or arbor press, supporting pressure plate on special lands under release levers, compress cover slightly, take off release lever yoke bolt nuts, release pressure slowly, lift off cover plate. This will expose all parts of assembly. Remove and test clutch springs.

Clutch Springs:—Double release springs used in some models (Type C-2727 springs inside heavier outer spring). Check springs separately, replace all springs which do not test up to figures below or which appear burned or warped.

Spring No.	Pressure @ 1 9/16"	Free Length	No. Coils
C-2727	50-54 lbs.	2⅞"	14
C-2096	120-130 lbs.	2½"	8½
C-2972	100-105 lbs.	2¾"	10¼
C-3347	112-118 lbs.	2½"	9½
C-3431	150-160 lbs.	2½"	9

Release Lever Assembly:—Use lever pin sawed off to lever width as a guide, install needle bearings in inner hole of lever, install adjusting yoke, insert short lever pin (pushing guide pin out as pin inserted) install pin locks. First type pins locked by hair-pin type lockwire at each end. Later type has head on one end and is held by cotter pin at other. First type pins should be replaced by later type whenever encountered. Repeat operation above at outer lever hole and install lever in pressure plate lugs using long lever pin.

Assembling:—Place pressure plate on fixture or arbor press supporting on special lands under release levers, assemble pressure spring locators, locator buttons and springs on plate, place cover on plate, compress slowly guiding lever yoke adjusting bolts through holes in cover, see that springs seat properly, clamp cover down placing clamps at cover clamp bolt holes. Assemble release lever bolt nuts and turn nuts down flush with tops of bolts. Compress and release clutch several times (using weight or release levers) to seat all parts. Then adjust release levers.

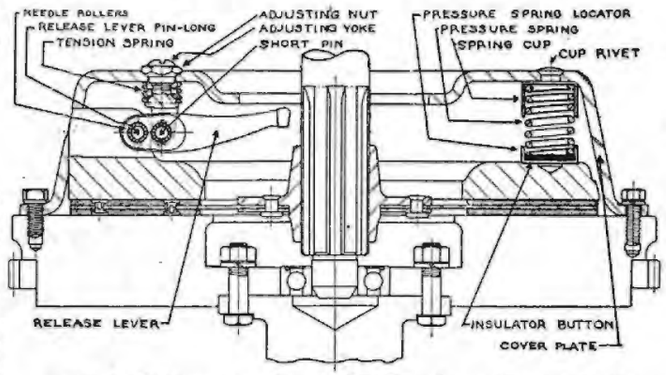
Release Lever Adjustment (on Fixture):—Assemble lever adjusting arm and sleeve setting bottom arms 2 1/32" above bottom of sleeve, lock with thumbscrew. Swing arm over each release lever in turn, turn adjusting nut until lever just contacts arm, lock nuts by peening metal of nut into bolt slot.

Release Lever Adjustment (without Fixture):—If gauge plate or dial indicator used to set up release levers, lever heights must be equal within .005". Lock adjustment by peening metal of nut into bolt slot.

DRIVEN MEMBER:—Manufacturer recommends use of new driven member with new facings installed. Driven plate hub (spring dampener) cannot be serviced in the field. Cushioning springs used under facing on pressure plate side.

To Remove Facings:—Drill out iron rivets mounting cushion springs on plate, remove spring and facing assembly, drill out rivets to remove springs from facing (replace springs as complete sets). Then drill out rivets mounting other facing on plate. Do not punch out rivets.

To Install Facings:—Install facing on flywheel side inserting brass rivets with heads in countersunk holes in facing and roll rivets on plate side. Place cushion springs on second facing with clearance at



center between spring and facing, insert brass rivets with heads in countersunk holes in facing and roll on spring side. Brass rivets must not project more than 1/32" when rolled (plate and spring cutaway to provide clearance). Place cushion spring and facing assembly on plate, insert iron rivets through holes in plate and spring, roll rivets (work through holes in facing). Driven member should be balanced after new facings installed.

Facing Specifications

Car Model	Clutch Model	Type	In. Dia.	Out. Dia.	Thick.
Lincoln V-12	12CB-CL.	Woven	9"	12"	.137"
Packard Eight	12CB-CL.	Moulded	7"	12"	.140"
Packard Super 8	12CB-CL.	Moulded	7"	12"	.140"
Packard Twelve	12CB-CL.	Moulded	7"	12"	.137"
Pierce Arrow 8	12CB-CL.	Moulded	7"	12"	.137"
Pierce Arrow 12	12CB-CL.	Moulded	7"	12"	.137"

PONTIAC—ALL MODELS. (OWN MAKE).

NOTE—Driven plate used with this clutch is Long Type 10-CF-CI. See article on Long Type 9, 10, 11CF Clutches for complete instructions on replacing or relining this clutch plate.

DESCRIPTION:—Single plate, dry disc type. Clutch mounted in recess in flywheel with cover bolted to flywheel rim. Clutch actuated by 3 release levers pivoted on lug or ridge on cover and linked to pressure plate by adjustable trunion screws (release lever height adjustment).

SERVICING:—Pressure plate assembly need not be dismantled when replacing driven member unless pressure springs are to be tested or replaced or other service work performed.

Dismantling:—Place pressure plate in arbor press, compress cover (not levers) slightly, unhook release lever springs, lift off bearing plate, loosen locknut, unscrew release lever trunion screw, lift off levers, release cover pressure slowly, lift off cover.

Clutch Springs:—Check springs and replace weak or burned. Spring pressure should be 145-150 lbs. compressed to 1 9/16".

Assembling:—With pressure plate on arbor press, place nine pressure springs in spring seats on plate, see that spring cups in place on cover, put cover on springs, compress cover slightly. Insert trunion screws in holes in ends of lever, thread locknut on screw, position levers on cover, turn screw into screw holes in pressure plate, turning all screws down evenly (do not tighten locknut) place release lever plate on levers, see that one end of release lever springs hooked in holes in rim of plate, hook other end of springs over lever plate lugs. Then adjust lever heights.

Release Lever Adjustment:—Use gauge plate J-285B and adapter, assembling gauge plate on flywheel in place of driven member with gauge plate centered so that adapter does not contact bearing plate and turned so that lugs are under release levers (in mounting clutch in flywheel, turn all cover screws down to avoid distorting cover). Loosen release lever trunion screw locknut, turn trunion screw until clearance between adapter lug and bearing plate is .009-.011" (.009" feeler 'go', .011" feeler 'no go'), holding adapter down while checking clearance. Tighten locknut, and recheck clearances.

DRIVEN MEMBER:—See article on Long Model 9, 10, 11CF clutches for complete data.

Facings—Woven type 6¼" inside diameter, 10" outside diameter, ⅛" thick (all models).

NOTE—Facings furnished with cushion springs attached.

BUICK—ALL MODELS. (OWN MAKE).

NOTE—Design of clutches used on all models similar (slight differences in pressure plate and cover plate on Model 40) and instructions below apply to all types.

DESCRIPTION:—Single plate, dry disc type. Clutch mounted in slight recess in face of flywheel with pressure plate lugs in grooves cut in flywheel rim so that drive transmitted directly from flywheel to plate. Clutch actuated by three release levers pivoted in pressure plate lugs and linked to cover plate by adjusting bolts. Nine pressure springs used on Model 40 (three groups of 3 between levers), twelve springs used on Models 60, 80, 90 (four groups of three). Servicing directions below apply to pressure plate assembly and need not be followed unless pressure plate, springs or release levers to be examined and replaced.

SERVICING:—Mark all parts before dismantling and replace in same position to maintain balance.

Dismantling:—Place pressure plate assembly on arbor press, place block on cover (clearing release lever adjusting nuts) to take pressure, compress cover slightly, remove adjusting nuts, release pressure slowly. Lift off cover. This will expose all parts for inspection. Replace worn parts, check clutch springs.

Clutch Springs:—Check pressure springs and replace if weak or burned. Spring pressure should be 145-150 lbs. at 1 13/16" (Model 40), 130-135 lbs. (Models 60, 80, 90).

Assembling:—Place pressure plate on arbor press. Install pressure springs on plate. Place cover in position on springs, install guide pins on release lever adjusting bolts. Compress cover slightly guiding adjusting bolts through holes in cover, install adjusting nuts on bolts, remove assembly from arbor press.

Release Lever Height Adjustment:—Assemble gauge plate (J-285-B—Model 40, J-685—Models 60, 80, 90) in flywheel in place of driven member, centering gauge in clutch with lugs on plate under release levers. Place short straightedge on top of gauge hub, turn adjusting nut until release lever just contacts straightedge, lock adjusting nut by peening metal into slots. Remove gauge plate and install driven member.

DRIVEN MEMBER:—Borg & Beck driven member (with separate cushioning springs used on Model 40, Long type driven member on Models 60,80,90). See articles on these clutch types for complete data on removing and installing facings. Spring dampener used in clutch hub on all models.

Facing Specifications

Model	Type	In. Diam.	Out. Diam.	Thick.
40	Woven	6⅛"	9½"	.133"
60,80,90	Woven	6½"	11"	.137"

CADILLAC V16 (OWN MAKE).

DESCRIPTION:—Double plate, dry disc type. Three driving plates mounted as an assembly (center plate bolted on flywheel rim by 4 studs and nuts, front and rear plates mounted on 4 pins which are press-fit in center plate and free sliding fit on others). Driven member consists of two driving discs mounted on opposite ends of clutch hub so that each disc clamped between two pressure plates when engaged. Twelve pressure springs (mounted in 4 groups of 3 on rear driving plate) under spring pressure plate which is mounted on release lever yoke bolts. Release lever is double type consisting of short outer lever pivoted on yoke on rear end of driving plate pin (yoke bolt extends through pin with nut on forward end) and actuating spring pressure plate through yoke bolt extending through plate (forward motion of spring plate when clutch disengaged transmitted to front driving plate by stud at each side of each release lever) and an inner long lever which actuates rear pressure plate (lever contacts bracket bolted on plate). The two levers are pinned together at a point near the throw-out bearing end.

SERVICING:—No adjustment for wear required other than pedal adjustment. To check condition of plates, measure distance from spring pressure ridge to tip of release levers. When this distance is less than 1 13/32", new driven discs should be installed (do not replace facings, discs should be installed in matched pairs). Other parts not furnished separately and clutch should be replaced as a complete assembly. Do not disturb position of release lever yoke adjusting nuts on spring pressure plate or adjusting screws in brackets on rear driving plate.

INSTALLING NEW DRIVEN DISCS:—Clutch Removal—Take off 4 nuts mounting center driving plate on flywheel rim (these nuts accessible through holes in rim of rear driving plate). Entire unit may then be removed.

Dismantling Clutch:—Lift off front driving plate. Take off nuts on release lever pivot bolts at forward end of center plate driving pins. Lift off rear driving plate. Take off 6 nuts on driven member hub bolts, dismantle driven member and take out driven discs separately. Replace discs if worn to thickness of less than .260".

Assembling Driven Member:—New driven discs with woven type facings must not be less than .335" thick. Assemble discs on center driving plate entering hub bolts from flywheel side. Check clearance by supporting assembly on blocks on bench placing blocks under lower driven disc so that all clearance thrown between plate and upper disc. Clearance should be .030" and must be within .025-.040". Correct by installing spring washer Part No. 873860 between driven disc and clutch hub (if more than one used, divide total between both discs and hub).

Assembling and Installing Clutch:—Clearance between driving pin and driving plates should be .001-.0025" (new) and must not exceed .008" (worn limit). Reverse dismantling and removal instruction given above. Balance marks (circle which may have letter inside) on each driving plate should be lined up when assembling plates.

Facing Specifications:—Woven type, four required (double plate clutch). Inside diameter—6¼". Outside diameter—11". Thickness—.135-.145".

CHEVROLET—ALL MODELS. (OWN MAKE).

NOTE—Clutch design (including driven plate) now identical on all models. Driven plate on 1½ ton truck is 10" in diameter (all other models 9") and plates should not be interchanged.

DESCRIPTION:—Single plate, dry disc type. Clutch assembled in flywheel recess with flat cover bolted to flywheel rim by 3 bolts at each release lever. Three release levers pivoted on cover plate actuate pressure plate by engaging brackets bolted on pressure plate bosses extending through holes in cover. Nine pressure springs mounted in spring cups on cover.

SERVICING:—Mark all parts before disassembling clutch, replace in same position to maintain balance. Servicing directions below apply to pressure plate assembly when dismantled for inspection or overhaul. It is not necessary to dismantle assembly when replacing driven member unless required for release lever adjustment.

Dismantling:—Take out six capscrews mounting lever plates on pressure plate bosses, turning all screws out evenly to relieve pressure spring tension. Lift off cover and lever assembly. This will expose all parts for inspection. To remove levers, take off lever springs, pull out lever pivot pins, lift levers out.

Clutch Springs:—Replace weak or burned springs. Spring pressure should be 90-100 lbs. at 1 13/16". Special colored springs assembled in center of each spring group on Standard models. All center springs must be same color on this model.

Release Lever Assembly:—Install levers in place in cover plate brackets, insert lever pivot pins. Install hairpin shaped lever spring with loop on lever, engage spring eyes in lever pin grooves (push pin through and loop spring under pin, repeat at opposite end).

Assembling:—Place pressure plate on arbor press, assemble nine pressure springs on plate (see Springs above), place spring cups on springs, place cover plate in position guiding spring cups through holes in plate and pressure plate bosses through holes in lever brackets. Compress cover slightly, place lever plates over levers and start plate screws in pressure plate bosses. Turn all screws up evenly.

Release Lever Adjustment:—After clutch assembled to flywheel with driven member in place (use pilot shaft to center plate), mount dial indicator on clutch housing and check lever and bearing plate runout. If runout exceeds .020", install shims under lever plate of high lever, using shim of equal thickness at mounting screw at each end of plate.

DRIVEN MEMBER:—Driven plate for all models segmented with alternate segments waved in opposite directions. Spring dampener incorporated in driven plate hub on all models.

Models	Clutch Size	Facings			
		Type	Inside Diam.	Outside Diam.	Thick
FA, B, C, D	9"	woven	6¼"	9"	⅛"

To Remove Facings:—Drill out old rivets from head side. Do not punch out rivets or plate will be distorted.

To Install Facings:—Rivets must be reversed in pairs (install two each way). Use special rivets furnished by manufacturer.

CADILLAC VALVE TAKE-UP

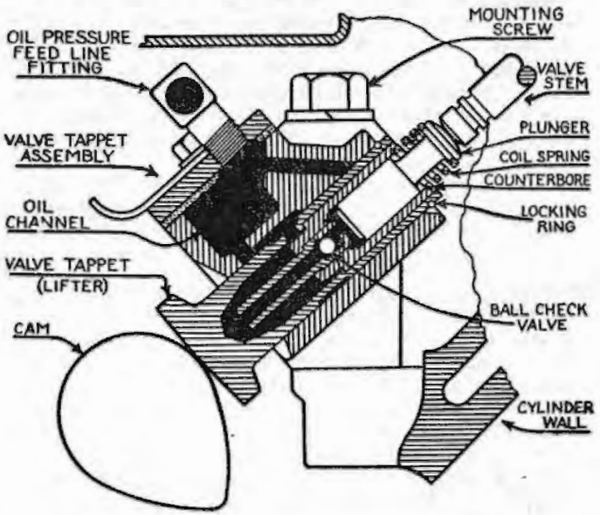
DESCRIPTION:—This type automatic take-up is hydraulically operated and is built inthe valve lifter or tappet (engines are 'L' head type). The conventional tappet clearance adjusting screw is not used and the lifter plunger contacts the end of the valve stem directly. The lifter is made in two parts; a lower or lifter body section with mushroom head which contacts the camshaft cam, and an upper or plunger section which contacts the end of the valve stem. The plunger fits into a cylinder in the head of the lifter body and is raised to contact the valve stem end by a spring under the plunger head. Oil from the pressure lubricating system of the engine flows through the oil reservoir in the lifter bracket and the oil passage in the lifter body to fill the cylinder below the lifter plunger. When the lifter is raised by the cam to open the valve, the ball check valve in the bottom of the cylinder closes, preventing the escape of oil from the cylinder and the cam motion is transmitted directly through the lifter to open the valve. The combination of plunger spring (to take up any clearance between lifter and valve stem end) and oil trapped in the plunger cylinder by the check valve (so that cam pressure is transmitted solidly through the lifter assembly) result in an entirely automatic take-up with positive valve opening action.

SERVICING:—Removal—To remove lifter assemblies, disconnect oil line supply tube, take out two capscrews in each lifter bracket (complete assembly for two cylinders on same side of engine), lift bracket out being careful that lifters do not fall out (held by locking ring at upper end above bracket).

Disassembly—Remove locking ring at upper end of lifter body, withdraw complete lifter unit from below. Pull plunger and cylinder assembly out of lifter body. Unlock plunger spring by twisting plunger, pull plunger and spring out of cylinder (plunger is selective fit in cylinder and must be re-installed in same cylinder). Ball check valve in bottom of cylinder may be unseated if necessary by using small blunt tool.

Servicing—Wash all parts in gasoline, wipe with soft cloth or dry with air (air hose must not be held closer than 2″). If plunger or cylinder scored or clearance excessive, replace as a unit (old lifter body may be caused if clearance in bracket less than .005″—clearance for new unit should be .001-.0025″).

See that ball check valve rattles when cylinder is shaken. Check plunger clearance and check-valve tightness by noting whether plunger bounces back when pressed into cylinder quickly and released (plunger spring not in place). Clean oil reservoir and oil passages in bracket by taking out three capscrews in cover and lifting off cover and gasket.



Reassembly—Place plunger spring on plunger, insert plunger in cylinder, lock spring in cylinder by twisting plunger. Make certain that same plunger and cylinder used together (plungers must not be interchanged). Install plunger and cylinder assembly in lifter, insert lifter assembly in bracket and install locking ring at upper end of lifter body above bracket.

Installation—Valve lifters should be installed without oil in the cylinder (mechanical clearance must be checked if new parts installed or valves serviced) and engine should be run to quiet valve action. Use special tool J-827 when installing bracket assemblies on engine, see that mounting screws drawn down tight and that oil supply tube connection is tight.

Checking Clearance—When new parts installed or valves reseated, check clearance between plunger and valve stem with plunger held down at bottom of stroke (no oil in cylinder). Clearance must be .030-.070″. If clearance less than .030″, grind off lower end of valve stem slightly.

TROUBLE SHOOTING:—If operation not satisfactory, check as follows:

All Valves are Noisy.

NOTE—Hydraulic lifters should be installed without oil and operation will not be quiet until engine has been run for a short time. Oil in lifters when installed will hinder this quieting operation.

1. Oil Level Low—Oil level in crankcase must not be more than one quart below the full '7' line on the indicator. Lower level will permit air to enter pump inlet.

2. Oil Level High—Must not be above the full '7' line on the indicator. Higher level will cause foaming. See note below on installation of new type oil baffle in crankcase if foaming is encountered.

3. Oil Pressure Low—Oil supply to lifters will be inadequate. Must be sufficient to replace normal relief leakage between plunger and cylinder. Check oil pressure (see engine specifications).

4. Oil Pressure High—High pressure may lift entire hydraulic unit against plunger spring tension causing excessive wear. If noise particularly noticeable when oil is hot, check pressure in oil supply line at lifter assembly. Pressure should be 3-5 lbs. with 12-15 lb. reading on instrument panel gauge.

One or More Valves Noisy.

1. Incorrect Clearance—Check mechanical clearance for particular unit (see directions above). Check clearance between plunger and cylinder (if parts interchanged, replace as a unit), check clearance between cylinder and lifter body.

2. Sticking Caused by Dirt or Grit—Disassemble and clean units as directed above. Drain crankcase, clean oil pan, flush engine, refill crankcase with new oil to prevent repetition of trouble.

NOTE:—First type oil pan baffle (spot-welded to pan) should be replaced with second type mounted on brackets on main bearings on all engines equipped with the first type baffle. This new baffle reduces any tendency of oil to foam. To remove old baffle, cut spot-welds on pan with a thin sharp chisel. Install brackets on center and rear main bearing caps, install new type baffle.

ENGINE NUMBER:—First number—6601. Stamped on front left hand upper half of crankcase.

ENGINE SPECIFICATIONS:—Lycoming Model WF. Six cylinder 'L' head type.

Bore—3 1/16". **Stroke**—4¾".

Displacement—210 cubic inches.

Rated Horsepower—22.5 (SAE).

Developed Horsepower—85 at 3500 R.P.M.

Compression Ratio and Pressure—6.2-1 Std. aluminum head. No optional ratios. Pressure approximately 105 lbs. at cranking speed.

Vacuum Reading—Gauge should show steady reading of approx. 20" with engine idling at 7-8 M.P.H.

PISTONS:—Nelson Bohnalite, aluminum alloy, split skirt, Invar Strut type.

Length—3¾".

Weight—16 ozs. (stripped), 21.92 ozs. (with rings and pin).

Removal—Pistons and rods removed from below.

Clearance—Top .020". Skirt .0015". See Fitting Pistons.

Replacement Pistons:—Pistons furnished .003" and .005" oversize.

Fitting New Pistons:—Use .0015" feeler stock ½" wide. Pull required to withdraw feeler from between piston and cylinder wall on side opposite slot must be between 5-10 lbs.

Installing Pistons:—Slot should be toward left or camshaft side of engine.

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Lower ring grooves drilled with eight 1/16" oil drain holes (#3), eight 1/8" holes and oil holes to piston pin bosses (#4).

Ring	Width	End Gap	Side Clearance
Comp. (all)	⅛"	.006-.012"	.0015-.003"
Oil Cont. (3)	⅛"	.010-.013"	.001-.0025"
Oil Cont. (4)	3/16"	.010-.013"	.001-.0025"

PISTON PIN:—Diameter—.8750-.8748". **Length**—2.52-2.50". Pin is locked in rod. No bushing used in pist'n.

Pin Fit in Piston—Tight push fit at 70° F. (selective).

CONNECTING ROD:—Length—9½" (center-to-center).

Weight—37.4 ozs. with bushings and caps.

Crankpin Journal Diameter—2⅛".

Lower Bearing—Spun babbitt-lined. No shims. **Clearance**—.001-.0025" (total), .004-.009" (total side-play).

Bearing Adjustment:—Adjust by filing bearing caps when wear exceeds .004". No shims used.

Installing Rods:—Rods are numbered and must be installed in same numbered cylinders. Lower bearings are offset. Install rods with narrow half of bearing toward nearest main bearing. Oil jet holes in upper half of lower bearing must be toward camshaft side of engine.

CRANKSHAFT:—Four bearing. Integral counterwgts.

Journal Diameters—2⅜" all bearings.

Bearing Type—Bronze-backed, babbitt-lined.

Clearance—.001-.00162".

Bearing Adjustment:—Take up bearings when wear exceeds .003". Check adjustment by assembling .002" feeler ½" wide between bearing and shaft. Crankshaft should turn by hand with feeler in place and bearing caps tight.

End Thrust:—Taken by #3 intermediate bearing. Endplay .005" minimum, .010" maximum.

CAMSHAFT:—5 Bearing. Non-adjustable chain drive.

Bearing Type—Bronze and cast-iron.

Clearance—.0025-.0035".

End Thrust:—Taken by thrust button riveted to inside face of chain case cover. Endplay .015".

Timing Chain:—Whitney. Width 1¼". Pitch ½". Length 24½" or 49 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so there are 12 links on lower side of chain between marks. This is equal to 13 teeth inclusive of teeth meshed opposite marks. With sprockets in this position, pistons 1 and 6 will be on top dead center with dead center mark on flywheel at indicator on housing. This setting correct for all engines.

VALVES:—	Head Diameter	Stem Diameter	Length
Intake	1 9/16"	.3424-.3425"	5¼"
Exhaust	1 13/32"	.3420-.3425"	5¼"

	Seat Angle	Lift	Stem Clearance
Intake	30°	5/16"	.0045-.008"
Exhaust	45°	5/16"	.0045-.008"

Tappet Clearance—.008-.010" all valves—running clearance with engine hot.

Valve Guides:—Pressed in block and finish reamed to size providing correct stem clearance.

Valve Springs:—Springs have 'closed coils' at one end. Install springs with closed coil end up.

	Spring Pressure	Spring Length
Valve Closed	42-47 lbs.	2 3/16"
Valve Open	88-94 lbs.	1⅞"

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 7½° BTDC. Close 37½° ALDC.

Exhaust Valves—Open 50° BLDC. Close 5° ATDC.

NOTE—Figures correct with .012" tappet clearance.

To Check Valve Timing—Set tappet clearance #1 intake valve at .012". This valve should open with piston #1 .0253" before top dead center when flywheel mark '1/6' (dead center mark) is approximately 2.29 teeth before the indicator on the flywheel housing. Reset tappet clearance at .008-.010" with engine hot.

Motor Gauge—Weidenhoff Adapter #114, Rod #42.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Pressure:—15 lbs. idling, 40 lbs. maximum engine R.P.M. with warm oil.

Oil Pressure Relief Valve:—Located in bracket bolted on left hand side of crankcase. Operates at 30 lbs. Adjustable by changing spacer washers between plug and relief valve spring (plug at lower end of bracket).

Crankcase Capacity:—6 quarts (refill).

CLUTCH:—Long Model 9AB-CS. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal must be 1". To adjust, loosen transverse bolt at lower end of clutch pedal, change position of pedal (bolt hole is slotted).

Removal:—Drop drive shaft by disconnecting front universal, remove transmission, take off pan on underside of clutch housing. Take out capscrews mounting clutch on flywheel, turning all screws out evenly to relieve spring tension, remove clutch from below through pan opening.

STEERING:—Steering Gear—Ross Model 140 Cam-and-Lever type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliot ends and semi-elliptic springs.

Kingpin Inclination—7½° crosswise.

Camber—1½°. No adjustment.

Caster—3½-4°. Adjust by using wedge shims between spring and spring pad on axle.

Toe In—⅛-3/16". Adjust in usual manner by changing length of tie rod.

Tread—59" (front), 62" (rear).

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, single anchor type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—12".

Lining—Moulded type. Width 1½". Thickness 3/16". Length 24 9/32" per wheel.

Clearance—.010" at heel and toe of each shoe.

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—Stamped on left hand upper half of crankcase at front of engine. First serial number (on right hand side of cowl under hood) 4501 (852), 34501 (Schgd. 852).

ENGINE SPECIFICATIONS:—Type—Lycoming Model GG and GH (Supercharged). 8 cylinder In Line, 'L' head.

Bore—3 1/16". **Stroke**—4¾".

Displacement—279.92 cubic inches.

Rated Horsepower—30.01 (SAE).

Developed Horsepower—115 at 3600 R.P.M., 150 at 4000 R.P.M. (Supercharged).

Compression Ratio and Pressure—6.2-1 Std. aluminum head. Pressure approximately 105 lbs. at cranking speed.

Vacuum Reading—Gauge should show steady reading of 20" with engine idling at 5-6 M.P.H.

PISTONS—852:—Bohn, aluminum alloy, Invar strut, split skirt type. Length—3¾".

Weight—16 ozs. stripped, 21.92 ozs. with rings and pin.

Removal—Pistons and rods removed from below.

Clearance—Top .00975-.00825", Skirt .0015".

Replacement Pistons:—Pistons furnished in .003" and .005" oversizes.

Fitting New Pistons:—Use .0015" feeler stock ½" wide inserted between piston and wall on side opposite slot to check clearance. Pull required to withdraw feeler must be between 5-10 lbs.

Installing Pistons:—Slot should be toward left or camshaft side.

PISTONS—SCHGD. 852:—Ray Day, Ray Day metal alloy type. Length—3¾".

Weight—14.40 ozs. stripped, 19.84 ozs. with rings and pins.

Removal—Pistons and rods removed from below.

Clearance—Top .01125-.01325". Skirt .002-.0025".

Fitting New Pistons:—Use .002" feeler ½" wide inserted between piston and cylinder wall at right angles to pin bosses to check clearance. Pull required to withdraw feeler should be 2½ lbs.

PISTON RINGS—852 (BOHN PISTONS):—Two compression, two oil control rings per piston, all above pin. Oil ring grooves drilled with eight 1/16" oil drain holes (#3), eight ⅛" oil holes and oil holes to piston pin bosses (#4).

Ring	Width	End Gap	Side Clearance
Comp. (all) ..	⅛"	.008-.013"	.0015-.003"
Oil (#3)	⅛"	.008-.013"	.001-.0025"
Oil (#4)	3/16"	.008-.013"	.001-.0025"

PISTON RINGS—SCHGD. 852 (RAY DAY PISTONS):—Two compression, one oil control ring per piston, all above pin. Rings are Perfect Circle #70 (comp.), #85 (oil control).

NOTE—Compression rings are stepped or grooved and must be installed with the groove downward.

Ring	Width	End Gap	Side Clearance
Comp. (all) ..	⅛"	.008-.013"	.0015-.003"
Oil Cont.	3/16"	.007-.015"	.001-.0025"

PISTON PIN:—Diameter—.8750-.8748". **Length**—2.520-2.500". Pin is locked in rod. No bushing used in piston. Pins furnished for service standard and .003" oversize.

Pin Fit in Piston—Tight push fit at 70° F. (selective).

CONNECTING ROD:—Length—9½".

Weight—2.34 lbs. (852 only).

Crankpin Journal Diameter—2⅛".

Lower Bearing—Spun babbitt-lined type. No shims.

Clearance—.001-.0025" (total), .004-.009" (total side-play).

Bearing Adjustment:—Adjust by filing bearing caps when wear exceeds .004".

Installing Rods:—Rods are numbered and must be installed in same numbered cylinders. Lower bearings are offset. Install rod with narrow half of bearing toward nearest main bearing. Oil jet holes in upper half of lower bearing must be toward camshaft side of engine on all rods.

CRANKSHAFT:—Five bearing. Counterweights used on Schgd. 852 only. Lanchester type vibration dampener used on both models.

Journal Diameters—2⅝" all bearings.

Bearing Type—Bronze-backed, babbitt-lined.

Clearance—.001-.00162".

Bearing Adjustment:—Take up bearings by filing bearing caps when wear exceeds .003". Check adjustment by assembling .002" feeler ½" wide between bearing and shaft. Crankshaft should turn by hand with feeler in place and bearing cap tight.

End Thrust:—Taken by center (#3) bearing. Endplay .005" minimum, .010" maximum.

CAMSHAFT:—Six bearing. Non-adjustable chain drive.

Bearing Type—Bronze and cast-iron (852), steel-backed, babbitt-lined bushings (Schgd. 852).

Clearance—.0025-.0035".

End Thrust:—Taken by thrust pin riveted on inside face of chain case cover. Endplay .015".

Timing Chain:—Whitney. Width 1" (852), 1¼" (Schgd. 852), Pitch ½". Length 24½" or 49 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that there are 12 links or 13 teeth (inclusive of teeth meshed opposite marks) between marks. With sprockets in this position, pistons #1 and 8 will be on top dead center with dead center mark on flywheel lined up with indicator on housing.

SUPERCHARGER:—Centrifugal type mounted at left of engine and driven through accessory sprocket and shaft by separate chain in chain case. Chain is adjustable.

Chain Adjustment:—Accessory sprocket mounted on eccentric with slotted mounting holes. Adjusted by loosening screws and rotating eccentrlc to take up chain slack.

VALVES:—	Head Diameter	Stem Diameter	Length
Intake	1 9/16"	.3420-.3425"	5¼"
Exhaust	1 13/32"	.3420-.3425"	5¼"

	Seat Angle	Lift	Stem Clearance
Intake	30°	5/16"	.0045-.008"
Exhaust	45°	5/16"	.0045-.008"

Tappet Clearance.—008-.010" all valves, engine hot.

Valve Guides:—Pressed in block and finish reamed to provide correct stem clearance (see table above).

Valve Springs:—Springs have 'closed coils' at one end. Install springs with closed coil end up.

	Spring Pressure	Spring Length
Valve Closed	42-47 lbs.	2 3/16"
Valve Open	88-94 lbs.	1⅞"

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 7½° BTDC. Close 37½° ALDC.

Exhaust Valves—Open 50° BLDC. Close 5° ATDC.

To Check Valve Timing—Set tappet clearance #1 intake valve at .012". This valve should open with piston #1 .0253" before top dead center when flywheel mark '1/8' (dead center mark) is approximately 2.29 teeth before the indicator on the flywheel housing. Reset tappet clearance at .008-.010" with engine hot.

Motor Gauge—Weidenhoff Adapter #105, Rod #5.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Pressure:—15 lbs. idling, 40 lbs. at maximum engine R.P.M. with warm oil.

Oil Pressure Relief Valve:—Located in bracket bolted on left hand side of crankcase. Operates at 30 lbs. Adjustable by changing spacing washer between plug and relief valve spring (plug at lower end of bracket).

Crankcase Capacity:—8 quarts (refill).

CLUTCH:—Long Model 9AB-6CI. Single plate, dry disc type. See article in Clutch Section for relining and assembling data.

Adjustment—Free movement of clutch pedal should be 1". To adjust, loosen transverse bolt at lower end of clutch pedal, change position of pedal (bolt is slotted).

Removal—Drop drive line (disconnect at front universal), remove transmission, take off pan under clutch housing, take out screws mounting clutch on flywheel, turning all screws out evenly, remove transmission from below through pan opening in housing.

STEERING:—Steering Gear—Ross Model 615 Cam-and-lever type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliot ends and semi-elliptic springs.

Kingpin Inclination—7½° crosswise.

Caster—2° maximum without load, 3° maximum loaded. Adjusted by inserting wedge shims between spring and spring pad on axle.

Camber—1½°. No adjustment.

Toe In—⅛-3/16". Adjust in usual manner by changing length of tie rod.

Tread—59" (front), 62" (rear).

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, single anchor type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—12".

Lining—Moulded type. Width 2". Thickness 3/16". Length 24 9/32" per wheel.

Clearance—.010" at heel and toe of each shoe.

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—First number—4-2,995,239. Stamped on right front of engine block above oil filler.

ENGINE SPECIFICATIONS:—**Type**—8 cylinder 'T' head.
Bore—3 3/32". **Stroke**—3 7/8".
Displacement—233 cubic inches.
Rated Horsepower—30.63 (AMA).
Developed Horsepower—93 at 3200 R.P.M.
Compression Ratio & Pressure—5.55-1 Std. cast-iron head. Pressure 118 lbs. at 1000 R.P.M. or approximately 98 lbs. at cranking speed of 135 R.P.M.
Vacuum Gauge—Steady reading of 18-20" of HG. with engine idling at 400-450 R.P.M. or 7-8 M.P.H.
NOTE—To drop oil pan for work on engine, first remove front stabilizer by disconnecting frame brackets and stabilizer links at lower control arms.

PISTONS:—Buick Anolite, Aluminum alloy, 'T' slot, cam ground type with anodized finish (special hard oxide bearing surface). Pistons cannot be ground. Recondition cylinders to take finished replacement pistons.
NOTE—These pistons may be installed on Series 40 (1934-35) engines.
Weight—13.75 ozs. (stripped), 19.6 ozs. (with rings).
Length—3 4/5".
Removal—Pistons and rods removed from above.
Clearance—Top of skirt .0021", Limits .0018-0024".
Replacement Pistons:—Finished pistons furnished in following sizes: .001", .005", .010", .015", .020", .030" oversize.
Fitting New Pistons:—Check piston with micrometer gauge at point just below 'T' slot junction on both sides of vertical slot and below lower end of slot.
Finish cylinder bore to size giving correct clearance. Feeler gauge ½" wide can be used on side opposite slot. Piston should fall of own weight with .0015" feeler and hold on .00225" feeler with engine temperature of 65-75° F.
Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression, two oil control rings per piston all above pin. Both oil ring grooves drille radially with ten ⅛" drain holes.
NOTE—Narrow heat deflector groove located above top ring groove. No ring fitted in this groove.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.010-.015"	.002-.0035"
Oil Cont.	5/32"	.010-.018"	.0015-.003"

NOTE—Compression rings must be placed with undercut corner down. Service rings furnished .010", .020", .030" oversizes.

PISTON PIN:—Diameter 13/16". **Length** 2 11/16".
Pin is clamped in rod. Oversize pins not furnished. Pins are fitted and furnished with all replacement pistons.
Pin Fit in Piston—.0003-.0004" clearance at 70° F. or a hard push thumb fit.
NOTE—Use only 5½" wrench in tightening pin bolt to avoid damage to hollow pin.

CONNECTING ROD:—Weight 29.37 ozs. **Length** 7¼".
Crankpin Journal Diameter—2".
Lower Bearing—Spun-babbitt lined type.
Clearance—.0008-.0018". Sideplay .005-.010".
Bearing Adjustment:—Shims. Do not file rods or caps.
Installing Rods:—Cap and rod must line up. Install rod with mark toward rear of engine and oil spray hole in lower bearing upper half toward camshaft.
NOTE—Special diameter ground bolts used for cap and rod assembly. Common bolts must not be used.

CRANKSHAFT:—Five bearing. Integral counterweights.
Journal Diameters—#1, 2 5/16"; #2, 2⅜"; #3, 2 7/16"; #4, 2½"; #5, 2 9/16".
Bearing Type—Steel-backed, babbitt-lined. Bearings dowelled in crankcase and cap and assembled with .000-.002" projection. Line-ream new bearings.
Clearance—.0007-.0022". 1/32" clearance at each end.
Bearing Adjustment:—Shims provided. Do not file caps.
End Thrust:—Taken by #3 (center) bearing. Endplay .004-.007".

CAMSHAFT:—Five bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2 5/32"; #2, 2⅛"; #3, 2 3/32"; #4, 2 1/16"; #5, 1 25/32".
Bearing Type—Steel-backed, babbitt-lined.
Clearance—.0005-.0035". Endplay .002-.006".
End Thrust:—Taken by thrust plate assembled between front bearing and camshaft sprocket.
Timing Chain:—Link-Belt. Width 1". Pitch .500". Length 24½" or 49 links.
Installing Chain—Install chain (new) with ¼"-⅜" slack midway between sprockets. Replace when sideplay exceeds 2" or chain becomes noisy.
Camshaft Setting:—Sprockets marked. Mesh chain on sprockets so that brass washers on link pins are opposite marked teeth on each sprocket. These chain markers are 10 links apart.

VALVES:—Head Diameter Stem Diameter Length
Intake ....1 17/32" ....3715-.3725" ....4.5"
Exhaust ....1 11/32" ....3711-.3719" ....4.037"

	Seat Angle	Lift	Stem Clearance
Intake	45°	.332-.338"	.0015-.0035"
Exhaust	45°	.332-.338"	.0021-.0039"

NOTE—Exhaust valve stems are copper-plated.
Tappet Clearance—.015" all valves. Engine hot.
Valve Guides:—Press fit in block. Install with undercut end up and finish ream to size for correct clearance.
Valve Springs:—Double springs on all valves.

Inner Spring	Pressure	Length
Valve Closed	21½-26½ lbs.	1 21/32"
Valve Open	53-59 lbs.	1 5/16"
Outer Spring	**Pressure**	**Length**
Valve Closed	31-36 lbs.	1 15/16"
Valve Open	81½-87½ lbs.	1 19/32"

Total Spring Pressure
Closed—52½-62½ lbs. Open—134½-146½ lbs.
NOTE—Tapers on valve keys and spring caps have been increased.
Valve Lifters—Single piece cast-iron. Lifter guide holes reamed in crankcase. Clearance .0005-.0025".
Rocker Arms:—Drop-forged fitted with steel-backed, babbitt-lined bushings.
Clearance—.0005"-.0025".
NOTE—When installing bushings see that oil hole to push rod ball lines up with hole in bushing.
Valve Timing:—See Camshaft Setting above. 'Timing Point' when valve .004" off seat with .015" tappet clearance or lash customarily listed instead of actual opening and closing points.

Timing Points
Intake Valves ....Open 8° BTDC.....Close 58° ALDC.
Exhaust Valves ..Open 58° BLDC.....Close 23° ATDC.

Opening and Closing Points
Intake Valves ..Open 21½° BTDC..Close 71° ALDC.
Exhaust Valves Open 71° BLDC..Close 36½° ATDC.
Valve Timing Check—#2 or #7 exhaust valve should be .150" open (actual opening as measured by dial indicator contacting valve spring cap), with #1 and 8 pistons on top dead center and flywheel mark 'TDC/1-8' at indicator in inspection hole in right front face of flywheel housing above starter.

LUBRICATION:—Pressure system from oil pump in crankcase through main oil channel in right side of crankcase.
Oil Pump:—Helical gear type in crankcase driven through tongue-and-slot coupling from camshaft gear. Ignition timing not disturbed by removal of oil pump.
Oil Pump Drive Clearances—Drive shaft bearing .001-.0025". Drive gear backlash .003-.005".
Oil Pump Gear Clearances—Idler gear bearing .001-.0025". Backlash .003-.006". End clearance .0005-.004".
Normal Oil Pressure:—10 lbs. idling, 45 lbs. maximum at 35 M.P.H. and above.
Oil Pressure Regulator:—Operates at 45 lbs. Mounted on oil pump. Not adjustable.
Crankcase Capacity:—7 qts. (dry), 5 qts. (refill).

CLUTCH:—Own Make. Borg & Beck Driven Member. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Clearance between pedal and underside of toeboard must be ⅜-⅝". To adjust, loosen locknut and turn setscrew at rear of pedal above pedal stop. Free movement of clutch pedal must be ¾-1". To adjust, take out clevis pin connecting clutch rod and clutch fork, turn clevis on rod. One full turn of clevis changes pedal free movement 7/16".
Removal—Remove transmission and transmission support (support at rear end while being withdrawn), take off clutch pan, take out clutch cover mounting screws turning all screws out evenly to release strain on clutch springs.
NOTE—When installing transmission support which is bolted to universal joint flange and frame, see that centering shims are in place at each end and that cross member is positioned so that rubber insulation is not compressed (bolt holes are slotted).

STEERING:—Steering Gear—Saginaw Worm-and-Double Roller type with center steering. See article in Steering Section for adjustments.
Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section for description and adjustment procedure.
NOTE—To avoid damage to brake assembly when work is being done on front suspension, disassemble as follows: Remove wheel, disconnect tie rod ball stud, loosen one caster adjuster capscrew one-half turn (do not disturb second capscrew or caster adjustment will be lost), remove upper and lower caster adjuster bolt nuts, remove complete steering knuckle, hub and brake drum assembly and wire to frame to prevent damage to brake hose.
King Pin Inclination—3½-4½° crosswise.
Camber—Minus ¼ to plus ¾°. No adjustment.
Caster—3-3½°. Adjustable.
Toe In—1/16-⅛". Adjustable.
Steering Geometry (Toe Out)—Outer wheel turned 20°, inner wheel 23¼° plus or minus ¾°. Check tie rod ends, steering arms, kingpin, or wheel bearings for loosesness.

BRAKES:—Service—Buick (Bendix) Hydraulic Single-anchor four-wheel type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.
NOTE—Wheel cylinder diameters are 1 1/16" (front wheels), 1" (rear wheels) and no part of assembly is interchangeable between front and rear wheels.
Brake Drum Diameter—12".
Brake Lining—Ferodo BZ-10 Woven type. Width 1¾". Thickness 3/16". Length 9 15/16" (primary shoe), 12¾" (secondary shoe) or 22 11/16". per wheel.
Brake Clearance—.010" plus or minus .002" at heel and toe of each shoe.
Hand Brake Adjustment:—See Service Brake Adjustment.

ENGINE NUMBER:—First number (60) 6-3001000, (80) 8-3001000, (90) 9-3001000. Stamped on right front of engine block above oil filler.

ENGINE SPECIFICATIONS:—**Type** 8 cylinder 'T' head. **Bore**—3 7/16". **Stroke**—4 5/16". **Displacement**—320.2 cubic inches. **Rated Horsepower**—37.81 (AMA). **Developed Horsepower**—120 at 3200 R.P.M. **Compression Ratio & Pressure**—5.45-1 Std. cast-iron head. Pressure 108 lbs. at 1000 R.P.M. or approximately 95 lbs. at cranking speed of 135 R.P.M. **Vacuum Gauge**—Steady reading of 18-20" of HG. with engine idling at 400 R.P.M. or 7-8 M.P.H.
NOTE—To drop oil pan for work on engine, first remove front stabilizer by disconnecting frame brackets and stabilizer links at lower control arms.

PISTONS:—Buick Anolite, Aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide bearing surface). Pistons cannot be ground. Recondition cylinders to take finished replacement pistons.
NOTE—These pistons may be installed on Series 50 ('32-35), 60('31-35), 80 ('31-33), 90 ('31-35). On Series 50 ('32-33) and 60 ('31-32) bore must be increased 1/16" to take standard size Anolite pistons. **Weight**—18.26 ozs. (stripped), 25.81 ozs. (with rings). **Length**—4.16". **Removal**—Pistons and rods removed from above. **Clearance**—Top of Skirt .0023". Limits .0020-.0026". **Replacement Pistons:**—Finished pistons furnished in .001", .005", .010", .015", .020", .030" oversizes. **Fitting New Pistons:**—Check piston with micrometer gauge at point just below 'T' slot junction on both sides of vertical slot and below lower end of slot. Finish cylinder bore to take replacement pistons. Feeler gauge ½" wide can be used on side opposite slot. Piston should fall of own weight with .0015" feeler and lock on .00225" feeler. Engine at 65-75° F. **Installing Pistons:**—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression, two oil control rings per piston all above pin. Both oil ring grooves drilled radially with ten ⅛" drain holes.
NOTE—Narrow heat deflector groove located above top ring groove. No ring fitted in this groove.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.010-.015"	.002 -.0035"
Oil Cont.	5/32"	.010-.018"	.0015-.003"

NOTE—Install compression rings with undercut corner down. Rings furnished .010", .020", .030" oversize.

PISTON PIN:—**Diameter** ⅞". **Length** 2 31/32". Pin is clamped in rod. Oversize pins not furnished. Pins fitted and furnished with all new pistons. **Pin Fit in Piston**—.0003-.0004" clearance at 70°F. or a hard thumb push fit.
NOTE—Use only a 5½" wrench in tightening pin bolt to avoid damage to hollow pin.

CONNECTING ROD:—**Weight** 36.49 ozs. **Length** 8¼". **Crankpin Journal Diameter**—2¼". **Lower Bearing**—Spun-babbitt lined type. **Clearance**—.0008-.0018". Sideplay .005-.010". **Bearing Adjustment:**—Shims. Do not file rods or caps. **Installing Rods:**—Cap and rod must line up. Install rod with mark toward rear and oil spray hole in lower bearing upper half toward camshaft.
NOTE—Special diameter ground bolts used for cap and rod assembly. Common bolts must not be used.

CRANKSHAFT:—Five bearing. Integral counterweights. **Journal Diameters**—#1, 2 9/16"; #2, 2⅝"; #3, 2 11/16", #4, 2¾"; #5, 2 13/16". **Bearing Type**—Steel-backed, babbitt-lined. Bearings dowelled in crankcase and cap and assembled with .000-.002" projection. Line ream new bearings. **Bearing Adjustment:**—Shims. Do not file caps. **End Thrust:**—Taken by #3 (center) bearing. Endplay .004-.007".
NOTE—Torsion balancer mounted ahead of fan pulley. Dynamically balanced before assembling and must be replaced as a complete assembly.

CAMSHAFT:—Five bearing. Non-adjustable chain drive. **Journal Diameters**—#1, 2 5/32"; #2, 2⅛"; #3, 2 3/32"; #4, 2 1/16"; #5, 1 25/32". **Bearing Type**—Steel-backed, babbitt-lined. **Clearance**—.0005-.0035". Endplay—.002-.006". **End Thrust:**—Taken by thrust plate assembled between front bearing and camshaft sprocket. **Timing Chain:**—Link-Belt. Width 1¼". Pitch .500". Length 50 links or 25". **Installing Chain**—Install new chain with ¼"-⅜" slack midway between sprockets. Replace when sideplay is over 2" or chain becomes noisy. **Camshaft Setting:**—Sprockets marked. Mesh chain on sprockets so that brass washers on link pins are opposite marked teeth on each sprocket. These chain markers are 10 links apart.

VALVES:

Head Diameter	Stem Diameter	Length
Intake 1 25/32"	.3715-.3725"	4 ⅝"
Exhaust 1 7/16"	.3711-.3719"	4 1/5"

Seat Angle	Lift	Stem Clearance
Intake 45°	.347-.348"	.0015-.0035"
Exhaust 45°	.347-.348"	.0021-.0039"

NOTE—Exhaust valve stems are copper-plated. **Tappet Clearance**—.015" all valves engine hot. **Valve Guides:**—Press fit in block. Installed with undercut end up and finish reamed to size for correct stem clearance.

Valve Springs:—Double springs on all valves.

Inner Spring	Pressure	Length
Valve Closed	21½-26½ lbs.	1 21/32"
Valve Open	53-59 lbs.	1 5/16"
Outer Spring	**Pressure**	**Length**
Valve Closed	31-36 lbs.	1 15/16"
Valve Open	81½-87½ lbs.	1 19/32"

Total Spring Pressure
Closed—52½-62½ lbs. **Open**—134½-146½ lbs.
NOTE—Tapers on valve keys and spring caps have been increased and parts are now copper-plated. **Valve Lifters:**—Single piece cast-iron. Lifter guide holes reamed in crankcase. Clearance—.0005-.0025". **Rocker Arms:**—Drop-forged fitted with steel-backed babbitt-lined bushings. **Clearance**—.0005-.0025".
NOTE—When installing bushings, see that oil hole to push rod ball lines up with hole in bushing. Water connections at each end of oil temperature regulator must be drawn down at same time rocker arm shaft brackets are bolted down. Run engine and check fittings for water leaks before replacing rocker arm valve cover.

Valve Timing:—See Camshaft Setting above. 'Timing Point' when valve .004" off seat with .015" tappet clearance or lash customarily listed instead of actual opening and closing points.

Timing Points

Intake Valves	Open 14° BTDC.....Close 71° ALDC.
Exhaust Valves	Open 56° BLDC.....Close 25° ATDC.

Opening and Closing Points

Intake Valves	Open 27° BTDC....Close 84½° ALDC.
Exhaust Valves	Open 69° BLDC....Close 38½° ATDC.

Valve Timing Check—#2 or #7 exhaust valve should be .155" open (actual opening is measured by dial indicator contacting valve spring cap), with #1 and 8 pistons on top dead center and flywheel mark 'TDC/1-8' at indicator in inspection hole in right front face of flywheel housing above starter.

LUBRICATION:—Pressure system with oil pump in crankcase and main oil channel on right side. **Oil Pump:**—Helical gear type in crankcase. Driven through tongue-and-slot coupling from camshaft. Ignition timing not disturbed by oil pump removal. **Oil Pump Drive Clearances**—Drive shaft bearing .001-.0025". Drive gear backlash .003-.005". **Oil Pump Gear Clearances**—Idler gear bearing .001-.0025". Backlash between pump gears .003-.006". End clearance .0005-.004". **Normal Oil Pressure:**—10 lbs. idling, 45 lbs. maximum at 35 M.P.H. and above. **Oil Pressure Regulator:**—Operates at 45 lbs. Mounted on oil pump. Not adjustable. **Oil Temperature Regulator:**—Consists of water tube running through rocker arm shaft. Disassemble and remove oil deposit in tube after considerable mileage. See Rocker Arms above for assembly directions. **Crankcase Capacity:**—10 qts. (dry), 8 qts. (refill).

CLUTCH:—**Own Make. Long Driven Member.** Single plate, dry disc type. See article in Clutch Section for relining and assembling directions. **Adjustment**—Clearance between pedal and underside of toeboard must be ⅜-⅝". To adjust, loosen locknut and turn setscrew at rear of pedal above pedal stop. Free movement of clutch pedal must be ¾-1". To adjust, turn adjusting nut on rod connecting pedal and clutch throwout yoke. One full turn of adjusting nut changes pedal lash 5/16". **Removal**—Remove transmission and transmission support (support at rear end while being withdrawn), take off clutch pan, take out clutch cover mounting screws turning all screws out evenly to release strain on clutch springs.
NOTE—When installing transmission support which is bolted to universal joint flange and frame, see that centering shims are in place at each end and that cross member is positioned so that rubber insulation is not compressed (bolt holes are slotted).

STEERING:—**Steering Gear**—Saginaw Worm-and-Double Roller type with center steering. See article in Steering Section for adjustments. **Front Suspension:**—Independent, linked parallelogram type with coil springs. See article in Steering Section for description and adjustment procedure.
NOTE—To avoid damage to brake assembly when work is being done on front suspension, disassemble as follows: Remove wheel, disconnect tie rod ball stud, loosen one caster adjuster capscrew one-half turn (do not disturb second capscrew or caster setting will be lost), remove upper and lower caster adjuster bolt nuts, remove complete steering knuckle, hub and brake drum assembly and wire to frame to prevent damage to brake hose. **Kingpin Inclination**—4½-5½° crosswise. **Camber**—Minus ¼° to plus ¾°. No adjustment. **Caster**—1¾-2¼°. Adjustable. **Toe In**—1/16-⅛". **Steering Geometry**—Outer wheel turned 20°, inner wheel (60, 80) 23¾°, (90) 24° plus or minus ¾°.

BRAKES:—Buick (Bendix) Hydraulic, Single Anchor, four-wheel type. Hand lever applies rear brakes. See article in Brake Section for complete data.
NOTE—Wheel cylinder diameters are 1¼" (front), 1 3/16" (rear) and no part of assembly is interchangeable between front and rear wheels. **Brake Drum Diameter**—12". **Brake Lining**—Ferodo BZ-10 Woven type. Width 2". Thickness 3/16". Length 9 15/16" (primary shoe), 12¾" (secondary shoe) or 22 11/16" per wheel. **Brake Clearance**—.010" plus or minus .002" at heel and toe of each shoe. **Hand Brake Adjustment:**—See Service Brakes.

ENGINE NUMBER:—First number—36-60, 6010001; 36-70, 75, 3110001. Stamped on top of crankcase, behind fan support.

ENGINE SPECIFICATIONS:—8 cylinder, 90 degree 'Vee' 'L' head type.

Bore—3⅜" (60), 3½" (70, 75). **Stroke**—4½".

Displacement—322 cu. in. (60), 346 cu. in. (70, 75).

Rated Horsepower—36.45 (60), 39.20 (70, 75).

Developed Horsepower—125 (60), 135 (70, 75) at 3400 R.P.M. Std. 6.25-1 head.

Compression Ratio—6.25-1 Std. cast-iron head. Optl. 5.75-1 cast-iron head.

Compression Pressure—155 lbs. (60), 170 lbs. (70, 75) at 1000 R.P.M. or approx. 105-110 lbs. at cranking speed for std. 6.25-1 head.

Vacuum Reading—Gauge should show steady reading of 20-21" with engine idling at 6 M.P.H.

NOTE—Upper crankcase and two cylinder blocks cast in one piece. Two cylinder head capscrews for water outlet elbow ½" longer than others and must be used for this purpose only. Cylinder head gaskets Part No. 1412661 (60), 1412662 (70, 75) are interchangeable (left and right banks) and must be installed with triangular hole on inner edge to rear.

PISTONS:—Lynite, Lo-Ex aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface).

Length—4⅛". Weight—16.88 ozs. (60), 18.304 ozs. (70, 75).

Removal—Pistons and rods removed from above.

Clearance—Top .023" (60), .025" (70, 75). Bottom of skirt .0019" (60), .0021" (70, 75). See Fitting Pistons.

Replacement Pistons:—Finished anodized pistons furnished as follows:

	Model 36-60	36-70 ,75
Standard	3.3726-3.3746"	3.4979-3.4999"
.003" Oversize	3.3761-3.3776"	3.5014-3.5029"
.005" Oversize	3.3781-3.3796"	3.5034-3.5049"
.010" Oversize	3.3831-3.3846"	3.5084-3.5099"
.015" Oversize	3.3881-3.3896"	3.5135-3.5149"

NOTE—Cylinder bores in same block held within .002" limits. Max. cylinder bore out-of-round .0005".

Fitting New Pistons:—Check piston diameter with micrometer gauge at right angles to pin hole just below lower ring groove and ½" above lower edge. Using ½" feelers inserted between piston and cylinder wall on side opposite slot, piston should drop of its own weight with .002" feeler and hold its own weight on .0025" feeler.

Installing Pistons:—Slot should be toward left as viewed from drivers seat on all pistons.

CRANKSHAFT:—3 bearing, 6 counterweights, #2 and 5 held by capscrews, all others integral.

Journal Diameters—2½" all bearings.

NOTE—Journal out-of-round .002" maximum.

Bearing Type—Removable steel-backed, babbitt-lined shells. New bearings require no line-reaming.

Clearance—.0015" (new), .004" (worn).

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. Upper halves rotated in and out with 'T' shaped cotter pin in oil passage.

NOTE—When reinstalling rear main bearing cap use new wooden plugs in grooves.

End Thrust:—Taken by center (#2) bearing. Endplay .001-.005" (new), .010" (worn).

CAMSHAFT:—3 bearing. Non-adjustable chain drive.

Journal Diameters—#1 and 2, 2.4076-2.4083"; #3, 2.0014-2.0021".

Bearing Type—Removable steel-backed, babbitt-lined bushings.

Clearance—.002-.004" (new), .005" (worn limit).

NOTE—Use Tool J-829 to remove and install bearings. Bearing out-of-round must not exceed .002".

End Thrust:—Taken by thrust plate behind sprocket. No endplay permissible.

Timing Chain:—Morse #3377. Width 1¼". Pitch ⅜". Length 23¼" or 62 links.

Installing Chain—Install chain 'endless' as an assembly with both sprockets. Use Tool J-836 to pilot camshaft sprocket when installing on shaft.

Camshaft Setting:—Sprockets are marked. Install chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1.876-1.886"	.3415-.3425"	5 33/64"
Exhaust	1.626-1.636"	.3405-.3415"	5 33/64"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.006" (worn limit)
Exhaust	45°	11/32"	.005" (worn limit)

NOTE—Valve lifter assemblies must be removed before valve springs can be compressed to remove spring keepers and free valves. Use Tool J-827 to hold plungers down when re-installing lifters.

Tappet Clearance—None. (Automatic take-up.)

Valve Guides:—Removable. Pressed in block with long stepped end down and finish reamed to provide clearance of .001-.0023" Int., .002-.0033" Exh.

Valve Springs:—Free length 2.210".

	Spring Pressure	Length
Valve Closed	62-69 lbs.	1 15/16"
Valve Open	140-151 lbs.	1 9/16"

Valve Lifters:—Mushroom type with Automatic valve tappet takeup. See article in Equipment Section.

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Lower ring grooves drilled radially with oil drain holes.

NOTE—A narrow heat deflector groove located above top compression groove. No ring fitted.

Ring	Width	End Gap	Side Clearance
Compression	⅛"	.007-.012"	.0015-.0028"
Oil Control	5/32"	.007-.015"	.0013-.0026"

NOTE—Worn limits on all rings .025" (End Gap) and .004" (Side Clearance).

PISTON PIN:—Diameter ⅞". Length 2 15/16" (60), 3 1/16" (70, 75). Pin floats in piston and rod. Held by retaining rings. Split-type bushing used in pin hole in rod. See Note below.

Pin Fit in Piston—.0004" press fit (rib end), .0001" clearance or free fit at 70° F. (other end).

Pin Fit in Rod Bushing—.0002-.0008" (new), .0015" max. (worn).

Removal:—Remove snap rings, place piston in boiling water for one minute, then push pin out by hand from rib end (piston boss ribbed on under side for identification). Install pin by same procedure except that pin is pushed in from opposite end. Install snap ring with opening down.

NOTE—In removing and installing split-type bushing an arbor press and special tool kit (Tool No. HM-250) are necessary. Bushings must be pressed in, expanded, then burnished to give correct clearance.

CONNECTING ROD:—Weight 41.26 ozs. Length 8¾".

Crankpin Journal Diameter—2.4590-2.4595".

Lower Bearing—Removable steel-backed, babbitt-lined shell type. No shims.

Clearance—.001-.0025" (new), .006" max. (worn). Sideplay .003-.006".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps.

NOTE—New lock washers (Part No. 1415487) must be used under connecting rod bolts. Wrench for tightening bolts must not be longer than 12". Tool No. J-835 recommended by manufacturer.

Installing Rods:—Numbers on bearing cap and rod must correspond and must point toward oil pan.

NOTE—Crankpin out-of-round .002" maximum.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open at TDC. Close 42° ALDC.

Exhaust Valves—Open 52° BLDC. Close 10° ATDC.

To Check Valve Timing—Intake valve for cylinder #1 (front cylinder—left bank) should open with piston on top dead center when mark 'C.1/6' on crankshaft pulley lines up with pointer.

Motor Gauge—Weidenhoff #114 Adapter, #42 Rod.

LUBRICATION:—Pressure system with main oil channel located in left hand crankcase wall.

Oil Pump:—Gear type located in oil pan at rear of engine. Driven through idler gear from camshaft.

Oil Pump Drive Clearances—Drive shaft bushing .001-.0025" (new), .010" (worn). Endplay in accessory idler gear .002-.006" (new), .010" (worn). Endplay in spiral gear on drive shaft .003-.010" (new), .015" (worn). Backlash in spiral drive gears .018" max.

Oil Pump Gear Clearances—Pump body and gears .0025-.0085" (new), .010" (worn). Pump gear endplay .002-.004" (new), .015" (worn).

Normal Oil Pressure:—15 lbs. idling, 30 lbs. at 60 M.P.H.

Oil Pressure Regulator:—Operates at 30 lbs. Located on oil pump. Not adjustable.

Crankcase Capacity:—7 qts. refill.

CLUTCH:—Long Model 11CF-CI (60), 11CF-CL (70, 75). Semi-centrifugal single plate, dry disc type. See article in Clutch Section for complete data.

Adjustment—Free movement of clutch pedal should be ⅞-1⅛". Adjust by turning nut on forward end of pedal rod directly below pedal equalizer link.

Removal—Disconnect front universal joint, remove from propeller shaft, remove cross member carrying transmission rear support; remove front propeller shaft housing and propeller shaft (70, 75 only); disconnect clutch release mechanism (70, 75 only); remove transmission (pull straight back to avoid distortion to clutch disc), drop clutch housing pan and remove clutch release yoke retaining screw (60 only). Prick punch clutch cover, spring pressure plate and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly. Remove clutch.

NOTE—On Series 36-60 cars keep transmission in high gear or install brace across face of case to hold clutch connection in position, preventing high-speed synchronizing drum from pulling out of splines.

STEERING:—Steering Gear Saginaw worm-and-double roller type. See article in Steering Section.

Front Suspension:—Independent linked perallelogram type with coil springs. See article in Steering Section for description and adjustments.

Kingpin Inclination—4°51' (60), 5°38' (70, 75) crosswise. **Caster**—1½-2° (60). ¾-1¼° (70, 75). **Camber**—¼-1° (60). 0-½° (70, 75). **Toe In**—O-1/16". **Steering Geometry**—Inner wheel turned 21¾-23¼° (60), 22-23½° (70, 75), outer wheel turned 20°.

BRAKES:—Bendix Hydraulic, single anchor type. Hand lever applies rear wheel service brakes. See article in Brake Section for complete data.

Wheel Cylinders—Diameters: front 1 1/16" (60), 1¼" (70, 75), rear 15/16" (60), 1 1/16" (70, 75). No part of assembly is interchangeable.

Drum Diameter—11.995-12.005" (60), 13.995-14.005" (70, 75). Out-of-round .007" max. Run out (installed) .010" maximum.

Lining—Moulded (primary), woven (secondary). Width 2" (60), 2¼" (70, 75). Thickness 3/16" (60), ¼" (70, 75). Length 10⅛"-60, 12¼"-70, 75 (frt. wh. primary), 13"-60, 15"-70, 75 (all others).

Clearance—.010" between lining and drum.

Hand Brake Adjustment:—See Service Brake.

ENGINE NUMBER:—First number—4110001 (80, 85), 5110001 (90). On right hand side of chain case in front of generator.

ENGINE SPECIFICATIONS:—12 cylinder (80, 85), 16 cylinder (90), 45° Vee, 'I' or overhead valve type. Cylinder blocks for each bank cast enbloc and separate from crankcase.

Bore—3⅛" (80, 85), 3" (90). **Stroke**—4".

Displacement—368 cu. ins. (80, 85), 452 cu. ins. (90).

Rated Horsepower—46.9 (80, 85), 57.5 (90).

Developed Horsepower—150 at 3600 R.P.M. (80, 85), 185 at 3800 R.P.M. (90). Std. 6.00-1 head.

Compression Ratio—6.0-1 Std. cast-iron head. Optl, ratio of 5.65-1 (80, 85), 5.57-1 (90) for special operating conditions may be secured by installing special thick head gaskets.

Compression Pressure—145 lbs. (80, 85), 154 lbs. (90), at 1000 R.P.M. or approximately 100-105 lbs. at cranking speed.

Vacuum Reading—Gauge should show steady reading of 20-21" with engine idling at 320 R.P.M.

PISTONS:—Lynite, Lo-Ex aluminum alloy. 'T' slot, Cam gound type with anodized finish (special hard oxide formed on bearing surface).

Length—3 15/16". **Weight**—11.712 ozs. (80, 85), 12.038 ozs. (90).

Removal—Pistons and rods removed from below.

Clearance—Top .019" (80, 85), .018" (90). Bottom .0020" (80, 85), .0018" (90). See Fitting New Pistons.

Replacement Pistons:—Finished anodized pistons furnished .005", .015" oversize or reground blocks with pistons fitted furnished .015", .030" oversize on 'exchange' basis.

NOTE Cylinder bores in same block held within .002" limits. Max. cylinder bore out-of-round .0005".

Fitting New Pistons:—Check piston with micrometer gauge at point just below and to left of 'T' slot junction midway between pin holes with piston at 70° F. Check cylinder bore with micrometer, finish to size giving correct clearance. Feeler gauges ⅜-½" wide can be used on side opposite slot. Piston should fall of own weight with .0015" feeler and lock on .002" feeler.

Installing Pistons:—Install pistons with slot to left as viewed from the driver's seat.

PISTON RINGS:—Three compression, one oil control ring per piston, all above pin. Lower ring groove drilled radially with oil drain holes.

NOTE—A narrow heat deflector groove located above top compression groove. No ring fitted.

Ring	Width	End Gap	Side Clearance
Comp (80, 85)	⅛"	.007-.012"	.0015-.0028"
Comp (90)	3/32"	.007-.012"	.0015-.0028"
Oil Cont	5/32"	.007-.015"	.0013-.0026"

NOTE—Worn limits on all rings .025" (End Gap) and .004" (Side Clearance).

PISTON PIN:—Diameter ⅞". Length 2.810-2.815". Pin is locked in piston by locking screw in one boss. Heat piston in boiling water and push pin out from lockscrew end (in from opposite end to install).

Pin Fit in Piston—Locking screw end .0004" press fit or hand push fit with piston at 200-210° F. Free end .0001" clearance or hand push fit at 70° F.

Pin Fit in Rod Bushing—.0002-.0008" (new), .0015" (worn).

NOTE—To remove and install split-type bushing manufacturer recommends special tool kit (No. HM-250). Bushings must be pressed in with an arbor press, expanded, then burnished to correct clearance.

CONNECTING ROD:—**Weight** 31.856 ozs. **Length** 9¼".

Crankpin Journal Diameter—2½".

Lower Bearing—Spun babbitt. No shims. Clearance—.001-.0025". Sideplay .004-.007".

Bearing Adjustment:—None (no shims). Do not file caps. Replace rods.

Installing Rods:—Numbers on rods and caps must correspond and must be toward bottom of engine.

CRANKSHAFT:—4 (80, 85), 5 (90) bearing type with integral counterweights.

Journal Diameters—2⅝" (all bearings).

NOTE—Journal out-of-round .002" maximum.

Bearing Type—Removable steel-backed, babbitt-lined shells. New bearings require no line reaming.

Clearance—.001" (new), .004" (worn) (80, 85). .002-.004" (90).

Bearing Adjustment:—None (no shims). Replace bearings (upper halves rotated in or out with 'T' shaped cotter pin in oil passage). Do not file caps.

NOTE—Use new wooden plugs with rear bearing cap.

End Thrust:—Taken by #3 main bearing. Endplay .001-.005".

CAMSHAFT:—Four (80, 85), five (90) bearings. Duplex chain drive with automatic take-up.

Journal Diameters—#1, 2"; all others 2⅛".

Clearance—.0011-.0026" (new), .005" (worn limit).

End Thrust:—Taken by thrust plate at rear of camshaft sprocket. Endplay .005-.015". Replace plate if endplay exceeds .015".

Timing Chain:—Morse #766 Duplex. Width 1½". Pitch ⅜". Length 41¼" or 110 links. See Equipment Section for complete data on Morse automatic idler sprocket.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:—	Head Diam.	Stem. Diam.	Length
Intake	1.509-1.515"	.3392-.3397"	6 9/64"
Exhaust	1.384-1.390"	.3392-.3397"	6 9/64"

	Seat Angle	Lift	Stem Clearance
Intake (80, 85)	45°	11/32"	.001-.0015"
All others	45°	11/32"	.001-.0025"

Tappet Clearance—None (automatic take-up).

Valve Guides:—One piece, removable. Install with long stepped end up and finish ream to correct clearance.

Valve Springs:—Double springs used on all valves.

Inner Spring	Spring Pressure	Length
Valve Closed	18-21 lbs.	1¾"
Valve Open	49-54 lbs.	1 7/16"
Outer Spring	**Spring Presure**	**Length**
Valve Closed	48-52 lbs.	1 15/16"
Valve Open	111-120 lbs.	1 9/16"

Valve Lifters:—Roller type lifters or cam slides operating in individual removable guides. Clearance in guide .001-.0025" (new), .005" (worn limit). Roller clearance on pin .0017-.003" (new), .004" (worn).

NOTE—Automatic valve tappet take-up should not require attention in service but must be reset to initial clearance of .030" when replacing or grinding valves. See Equipment Section for complete data.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open at TDC. Close at 44° ALDC.

Exhaust Valves—Open at 39° BLDC. Close at 5° ATDC.

To Check Valve Timing—No. 1 intake valve should open with piston on top dead center when flywheel mark '1C/11' lines up with indicator.

Motor Gauge—Weidenhoff #113 Adapter, #33 Rod.

LUBRICATION:—Pressure system from oil pump in crankcase through oil tube in oil pan.

Oil Pump:—Gear type in crankcase. Driven through tongue-and-slot coupling by gear on camshaft.

Oil Pump Drive Clearances—Drive shaft bushing .001-.0025" (new), .010" (worn limit). Drive gear endplay .009-.015" (new), .020" (worn limit). Drive gear backlash .018" maximum.

Oil Pump Gear Clearances—Pump body and gears .0025-.0085" (new), .010" (worn limit). Pump gear endplay .002-.004" (new), .015" (worn limit).

Normal Oil Pressure—30 lbs. at 60 M.P.H.

Oil Presure Regulator—Operates at 14 lbs. Not adjustable. Located under plug on front face of chain case cover.

Crankcase Capacity:—9 qts. (80, 85), 10 qts. (90).

CLUTCH—SERIES 80, 85:—**Long Model 11CF-C.** Semi-centrifugal, single plate, dry disc type. See article in Clutch Section.

Adjustment—Free movement of clutch pedal should be ⅞-1⅛". Adjust by turning nut on forward end of pedal rod directly below pedal equalizer link.

Removal—Clutch removed in same manner as on Series 70, 75 except that clutch housing is integral with transmission case so that clutch is exposed when transmission is removed and no pan is used. See previous page for complete directions.

CLUTCH—SERIES 90:—**Own Make.** Double plate, dry disc type. See article in Clutch Section.

Adjustment—Clearance between pedal and underside of toeboard should be ¼" with clutch engaged. Adjust by loosening locknut and turning stopscrew at lower end of pedal at rear of bracket on outside of frame. Free movement of clutch pedal must be 1½". To adjust, remove clevis pin in lower end of pedal, loosen locknut and turn clevis on connecting link.

Removal—Disconnect rear universal joint, remove drive shaft, remove transmission rear support (as unit with cross member on which support is mounted), remove front propeller shaft and shaft housing, disconnect clutch release mechanism, take out transmission mounting screws and pull transmission straight back until clutch connection shaft is free, take off four nuts on studs mounting clutch center driving plate on flywheel (accessible through holes in rear driving plate), remove clutch assembly.

STEERING:—**Steering Gear**—Saginaw Worm-and-Double-Roller type. See article in Steering Section.

Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section for description and adjustments.

Kingpin Inclination—5°38' (80, 85), 4° (90).

Caster—¾-1¼° (80, 85), 1½° (90).

Camber—0-½° (80, 85), ¾-1½° (90).

Toe In—0-1/16" (all models).

Steering Geometry—Inner wheel turned 22-23½°, outer wheel 20° (all models).

NOTE—When checking camber, springs must be compressed sufficiently so that distance from lower face of frame sidemember to top face of spring lower support is 5 3/16" on all models.

BRAKES—SERIES 80, 85:—Bendix Hydraulic, Single Anchor type. All specifications and adjustments same as for Series 70, 75. See previous page.

BRAKES—SERIES 90:—**Service**—Own Make. Internal-expanding, self-energizing, mechanically operated, vacuum power type. Hand lever applies rear service brakes. See article in Brake Section.

Drum Diameter—15.995-16.005". Out-of-round .007" maximum. Run-out (installed) .010" maximum.

Lining—Woven type. Width 2" (all shoes).

	Thickness	Length per Shoe
Top (aluminum) Shoe	.245-.260"	15 19/32"
Lower (steel) Shoe	.183-.198"	14¼"

Clearance—.007" (approximate).

Hand Brake Adjustment:—See Service Brakes.

Power Unit:—Bendix internal valve type vacuum cylinder mounted on frame 'X' member and linked to equalizer lever between front and rear wheel brake cross shafts. See article in Brake Section.

FLEET 'ECONOMY' MODEL NOTE:—All models available with special economy engine which may be identified by prefix 'V' on engine number and plate on Valve Rocker Arm Cover listing special tune up specifications. Engine is standard except for these tune up specifications (see Tune up page), special carburetor (painted gray) which has stop pin designed to limit throttle to half-throttle opening, manifold cover, and passenger car intake manifold riser sleeve used on FB and R models.

NOTE:—To remove oil pan for work on engine, drop right hand tie rod. On Master Model FD with conventional axle it may be necessary to bend lip of front cross member or hoist engine so that oil pan will clear.

ENGINE NUMBER:—First number—5500179. Prefixed by letter indicating model as follows: M—FC passenger cars. K—FB commercial cars. T—R Trucks. No prefix used on Master FA, FD passenger cars. Economy engines indicated by 'V' (V, VM, VK, VT). Number is stamped on boss on right side of block back of fuel pump.

ENGINE SPECIFICATIONS:—6 cylinder, 'I' head.
Bore—3 5/16". **Stroke**—4".
Displacement—206.8 cubic inches.
Rated Horsepower—26.3 (AMA).
Developed Horsepower—79 at 3200 R.P.M.
Compression Ratio & Pressure—6.0-1 Std. cast-iron head. Pressure 102 lbs. at cranking speed or 90 lbs. min. and equal within 5-10 lbs. for all cylinders.
Vacuum Gauge Reading—Should show steady reading of 20-22" with engine idling at 400 R.P.M.

PISTONS:—Cast iron, tin-plated, cam ground type with greater clearance across pin bosses. Pistons are tin-plated to thickness of .0005-.001" after finishing and cannot be ground. Use finished replacement pistons.
Weight—28¾ ozs. (stripped). **Length**—3 11/16".
Removal—Pistons and rods removed from above.
Clearance—.0145" Top. .0015-.003" Skirt.
Replacement Pistons:—Finished pistons furnished .003", .010", .020", .030", .040" oversize.
Fitting New Pistons:—Use feeler gauge at right angles to pin bosses to check clearance. Piston should pass through bore on .002" feeler and lock on .003" feeler.

PISTON RINGS:—Two compression, one oil control ring per piston all above pin. Lower ring groove drilled radially with oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.005-.015"	.0015-.003"
Oil Cont.	3/16"	.013-.021"	.0015-.0025"

NOTE—Compression ring face tapered and marked 'Top' on upper side. Install rings with this mark toward top of piston. Rings furnished .005", .010", .015", .020", .030", .040", oversize.

PISTON PIN:—Diameter .990-.9895". Length 2 29/32". Pin is locked in rod. Pin bosses in piston bronze-bushed. New pistons furnished with bushings and pins fitted. Pins furnished standard and .003", .005", .010" oversize.
Pin Fit in Piston Bushing—Light thumb push fit.

CONNECTING ROD:—Weight 31⅝ ozs. Length 7½".
Crankpin Journal Diameter—2⅛".
Lower Bearing—Spun-babbitt lined type.
Clearance—.0005-.002". Sideplay .004-.011".
Bearing Adjustment:—Solid shims. Remove shims from each side equally to secure 'snap fit' (rod should snap from one side to the other with a light tap of 8 oz. ball pein hammer). Bearing loose if rod can be moved by hand.
Installing Rods:—Install rods in same numbered cylinders as indicated by numbers stamped on rod and cap with these numbers together and toward camshaft side of engine. Oil hole in cap should be away from camshaft. Assemble oil dippers on rod caps with mouth of dipper toward camshaft.

CRANKSHAFT:—3 bearing. Integral counterweights.
Journal Diameters—#1, 2 1/16"; #2, 2⅛"; #3, 2 3/16".
Bearing Type—Steel-backed, babbitt-lined removable type.
Clearance—.001-.003".
Bearing Adjustment:—Shims. Remove shims until there is a heavy drag on the crankshaft, then replace one .002" shim.
End Thrust:—Taken by center bearing. Endplay .004-.007". Flanges on center main bearing should be turned down to provide this clearance.

CAMSHAFT—Three bearing. Gear driven.
Journal Diameters—#1, 1 13/16"; #2, 1 25/32"; #3, 1⅜".
Bearing Type—#1 machined in crankcase. #2, 3 steel-backed, babbitt-lined type pressed in crankcase and staked to prevent movement.
Clearance—.002-.0035". Check at center bearing.
NOTE—When replacing center bearing manufacturer recommends use of special driver and alignment pin to align oil holes and distributor drive. Ream distributor hole and line-ream bearings. #1 bearing serviceable only by using special reamer to ream hole in crankcase and then installing bearing and new standard camshaft.
End Thrust:—Taken by thrust plate in back of camshaft bear. Endplay—Free to .003". Adjusted by changing gear position on shaft. See Timing Gear Note.
Timing Gears:—Steel (crankshaft), Bakelite-Fabric (camshaft). Backlash between gears .002-.005".
NOTE—Camshaft gear press fit on shaft. Remove and install gear in arbor press with camshaft out of engine using special sleeve to support hub. Use new thrust plate and press gear on shaft until no endplay (between gear and thrust plate) is perceptible but gear is free to turn.
Camshaft Setting:—Mesh marked tooth on crankshaft gear with marked space between teeth on camshaft gear. Marked tooth on crankshaft gear is third counter-clockwise from space in line with key way. Marked space on camshaft gear is thirteenth space clockwise from space in line with keyway. (12 teeth between these points.)

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 45/64"	11/32" (nom.)	5 7/32"
Exhaust	1 15/32"	11/32" (nom.)	4 1/32"

	Seat Angle	Lift	Stem Clearance
Intake	30°	.316"	.001-.003"
Exhaust	30°	.319"	.002-.004"

NOTE—Stem sizes nominal. Check with special 'No-go' gauge.
Tappet Clearance (Std. Engine)—.006" Min. (.006-.008") Int., .013" Min (.013-.015") Exh. with eng. hot.
Tappet Clearance (Economy Engine)—.010" Int., .016" Exh. with engine hot.
Valve Guides:—Use special tool to press out old guides and install new guides. Assemble collars on guides with open face up (intake), down toward cylinder head (exhaust). Exhaust guides counter-bored ¼" on lower end. Rough-ream these guides to .341", counter-bore with special reamer (KMO-33). Finish ream all guides to .343" after installing.
Valve Springs:—Variable spaced coil type. Install with close-coil end toward cylinder head (down).

	Spring Pressure	Length
Valve Closed	45 lbs.	1 ⅞"
Valve Open	98 lbs.	1 9/16"

Valve Lifters:—Single piece cast-iron with ground contact face. Oversize lifters not furnished.
Pushrod Springs:—Spring mounted on each pushrod above valve lifter. To remove pushrods, take out three bolts in spring retainer to release spring tension, remove 'C' washer under spring, withdraw pushrod. Install in same manner.
Rocker Arms:—Intake arms have left and right hand angles. Intake arm with left hand angle must be installed on #2, 4, 6 cylinders, right hand angle on #1, 3, 5 cylinders.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 4° BTDC. Close 34° ALDC.
Exhaust Valves—Open 47° BLDC. Close 4° ATDC.
To Check Timing—No flywheel marks. With intake valve tappet clearance set at .006" (hot), #1 intake valve should begin to open with piston 4° or .0061" before top dead center when point on flywheel approximately 1½ teeth before dead center mark lines up with pointer on inspection hole in right front face of flywheel housing.
Motor Gauge—Weidenhoff #113 Adapter with #152 Attachment. #33 Rod.

LUBRICATION:—Pressure and positive splash system used. Rifle-drilled passages in block to main bearings.
Oil Pump:—Vane type in crankcase driven through tongue-and-slot coupling from camshaft gear.
Normal Oil Pressure:—12 lbs. at 50 M.P.H.
Oil Distributor:—On left side of crankcase. Proportions oil between high pressure points (crankshaft, camshaft bearings, timing gears) and low pressure points (oil troughs, rocker arm shaft). Overflow pipe returns excess oil from rocker arm shaft.
NOTE—Oil pipe to rocker arm shaft passes through water jacket in center of block. When replacing check for water leaks at block connections.
Crankcase Capacity—5 qts. refill.
NOTE—SAE #10-W oil recommended for Economy engine. Oil heavier than #20 must not be used at any time in this engine.

CLUTCH:—Own make. Single plate, dry disc type. See article in Clutch Section for relining and assembly directions.
Adjustment—Clearance between pedal and underside of floor board must be ½". To adjust, loosen two nuts at side of pedal, move pedal stop forward or backward. Free movement of pedal must be 1". To adjust, loosen checknut (upper), and turn adjusting nut (lower) on clutch fork connecting link.
Removal—To remove clutch, disconnect universal joint, remove transmission under pan and transmission rear cross member, lift propeller shaft and slide transmission out using pilot studs to hold transmission. Disconnect clutch linkage, take out capscrew holding throwout fork in flywheel housing, take out fork, force springs holding sleeve to throw-out levers over ends of levers and remove sleeve. Take out nine capscrews mounting clutch cover on flywheel, turning out screws evenly until spring pressure is released.

SEE PAGE M-121 FOR STEERING AND BRAKE DATA.

ENGINE NUMBER:—First number—Chrysler C-7-1001, De Soto S1-1001. Stamped on boss on left side of cylinder block between #1 and 2 cylinders. Letter 'A' following number indicates that cylinder bore is .020" larger than standard. Letter 'B' indicates that main and connecting rod bearings are .010" smaller than standard. Letters 'AB' indicate that bore and bearing sizes are as above.

ENGINE SPECIFICATIONS:—6 cylinder 'L' head.
Bore—3⅜". **Stroke**—4½".
Displacement—241.5 cubic inches.
Rated Horsepower—27.34 (AMA).
Developed Horsepower—93 HP. (Std. 6.0-1 Head), 100 HP. (Optl. 6.5-1 head) at 3400 R.P.M.
Compression Ratio—6.0-1 Std. Cast-iron head, 6.5-1 Optl. Aluminum head.
Compression Pressure—6.0-1 Std. Head 120-130 lbs. at 1000 R.P.M. or approx. 103 lbs. at cranking speed. **6.5-1 Optl. Head** 125-135 lbs. at 1000 R.P.M. or approx. 110 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 16-18" with engine idling at 6 M.P.H.
NOTE—Aluminum heads should be tightened cold.

PISTONS:—Aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface). **Length**—3⅞". **Weight**—Held to two gram max. variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Skirt .002". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard and .003", .005", .010", .015", .020", .023", .025", .030", .040", .050", .060" oversizes. Semi-finished pistons furnished: (1) standard to .023" oversize, (2) .025-.050" oversize, not interchangeable. Pistons should be slotted and then finished on cam grinding equipment.
Fitting New Pistons:—Micrometer gauge recommended. Using feeler gauge (.002") inserted between piston and cylinder wall on side opposite slot, pull required to withdraw feeler must be 3-4 lbs.
Installing Pistons:—Slot should be toward left.

PISTON RINGS:—Two compression, one undercut oil wiper ring (#3), one oil control ring per piston, all above pin. Lower ring grooves drilled radially with twelve ⅛" oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp. all	⅛"	.007-.015"	.002-.003"
Oil (both)	5/32"	.007-.015"	.002-.003"

Replacement Rings:—Furnished in standard and .003", .010", .020", .030", .040" .050", .060" oversizes.
NOTE—Install undercut compression and oil wiper ring with step down.

PISTON PIN:—Diameter 55/64". Length 2⅞".
Pin floats in piston and rod. Held by locking rings at each end. Pin hole in rod is bronze bushed.
NOTE—Heat piston in boiling water to remove or install pins.
Pin Fit in Piston—Tight thumb push fit with piston heated to 120° F.
Pin Fit in Rod Bushing—Tight thumb push fit with pin and rod at 70° F.
Replacement Pins:—Pins furnished in standard and .003", .005", .008" oversizes. Ream rod bushing and pin holes in piston bosses for correct fit.

CONNECTING ROD:—Weight—Held within limits.
Length—8¾" (center-to-center).
Crankpin Journal Diameter—2⅛".
Lower Bearing—Removable steel-backed, copper-lead lined. Furnished standard and .010" undersize.
Clearance—.0005-.0025". Sideplay .0055-.0115".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps. Install new bearings so small bosses engage grooves in rod and cap.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5) or toward front (#2, 4, 6). Oil hole in lower bearing upper half must be toward camshaft on all rods.

CRANKSHAFT:—4 bearing. Integral counterweights.
Journal Diameters—2½" all bearings.
Bearing Type—Removable steel-backed, babbitt-lined. Furnished standard and .010" undersize.
Clearance—.001-.002".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. No fitting or reaming necessary for new bearings.
End Thrust:—Taken by flange faces on rear (#4) bearing. Endplay .003-.007".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2"; #2, 1 31/32"; #3, 1 15/16"; #4, 1⅜".
Bearing Type—Removable steel-backed, babbitt-lined (except #4, machined in crankcase).
Clearance—.001-.003" (#1), .0015-.0035" (all others).
NOTE—New bearings require no line-reaming.
End Thrust:—Taken by thrust plate at rear of sprocket hub. Endplay .003-.005".
Timing Chain:—Morse. Width 1". Pitch ½". Length 24" or 48 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across shaft centers.
NOTE—Engine must be supported under front end of oil pan and front engine support removed for work on timing chain and camshaft.

VALVES—	Head Diameter	Stem Diameter	Length
Intake	1 17/32"	.340-.341"	5 5/8"
Exhaust	1 15/32"	.340-.341"	5 5/8"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.001-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" Int., .008" Exh., (hot). .010" Exh. recommended for sustained high speed.
NOTE—Exhaust valve seat inserts used.
Valve Guides:—Use special tool to remove and install guides. Insert guides with taper end up (intake) and down (exhaust). Top of guide must be 13/16" below top of block. After installing finish ream new guides to inside diam. of .342-.343" (Int.), .344-.345" (Exh.).
Valve Springs:—Variable pitch type. Install springs with close coil at top. Do not compress springs to over all length of less than 1½".

	Spring Pressure	Length
Valve Closed	46-50 lbs.	2 1/32"
Valve Open	104-110 lbs.	1 11/16"

Valve Lifters:—Mushroom type. Ream guides to take following oversizes: .001", .008", .030", .060".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open TDC. Close 50° ALDC.
Exhaust Valves—Open 48° BLDC. Close 2° ATDC.
To Check Valve Timing—Set tappet clearance #6 intake valve at .010". Intake valve should open at top dead center when 'O' mark on impulse neutralizer at front of engine lines up with pointer on chain case cover. Reset tappet clearance at .006".
Motor Gauge—Weidenhoff Adapter #103, Rod #12. Gauge plug hole over #6 cylinder.

LUBRICATION:—Pressure. Gear type oil pump located at right of crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure:—30-40 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Under plug on left hand side of crankcase. Operates at 40 lbs. Adjustable by changing spring. Standard spring unpainted. Heavy spring (to increase pressure) painted green. Lighter spring (to decrease pressure) painted red.
Crankcase Capacity:—6 qts. (refill).

CLUTCH:—Borg & Beck Model 10A6. Single plate, dry disc type. See article in Clutch Section.
Adjustment—Clutch pedal should just clear underside of toe board with clutch engaged. To adjust, turn stopscrew located just above clutch pedal shaft. Free movement of pedal should be 1 1/16". To adjust, loosen locknut and turn adjusting nut (clevis) on clutch fork adjusting rod.
Removal—Disconnect clutch pedal linkage, remove fork pivot screw, take out clutch fork. Remove transmission (release bearing and spring are withdrawn with transmission), remove clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly to release spring tension and avoid distortion of clutch cover. Remove clutch from below. Use pilot studs when removeing and installing transmission to avoid springing clutch plate.
Automatic Clutch:—See article in Clutch Section.

STEERING:—Steering Gear—Gemmer Model Worm-and-Roller type. See article in Steering Section.
Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section. All specifications below apply with car weight on springs but not on wheels.
Wheel Setting (Front Suspension Height)—Distance from center line of lower control arm yoke pin to top of frame cross member should be 7¼-7 3/8" with car weight on wheels but no load in car.
Kingpin Inclination—10° plus or minus ½° (including camber angle), 8¾-10¼° (without camber).
Camber—¼°. Limits minus ¼°-plus ½°.
Caster—1½°. **Toe In**—0-⅛".

BRAKES:—Service—Lockheed Hydraulic, double anchor type. Hand lever applies brake at rear of transmission or rear wheel service brakes (on cars with overdrive). See article in Brake Section.
Wheel Cylinders—Diameters, Front Wheel (Front end 1¼", Rear 1⅜"), Rear Wheel (Front end 1⅛", Rear 1¼").
NOTE—Wheel cylinders marked 'R'—right side of car, 'L'—left side of car and not interchangeable.
Drum Diameter—10" (DeSoto S1 Del.), 11" (Chrysler C7) (DeSoto S1 Cst.).
Lining—Moulded type. Width 2" (all cars). Thickness 13/64" (DeSoto S1 Del.), 3/16" (Chrysler C7) (DeSoto S1 Cst.). Length per wheel, 19 13/16" (DeSoto S1 Del.), 22 5/32" (Chrysler C7) (DeSoto S1 Cust.).
Clearance—.012" toe, .006" heel, for each shoe.
Hand Brake:—External type on drum at rear of transmission (cars without overdrive). See Service Brake for hand brake adjustment on cars with overdrive.
Adjustment—With lever in released position, remove anchor screw locking wire, turn anchor screw so that clearance between lining and drum is 1/16", lock anchor screw with wire. Adjust brake band guide bolt nut to give 1/16" clearance (as above) for lower portion of band, secure with locknut. Finally, adjust brake adjusting bolt nut to give 1/16" clearance (as above).
Drum Diameter—6" (Chrysler), 7-13/16" (DeSoto). **Lining**—Width 2" (all cars). Thickness 5/32" (Chrysler C7), ¼" (DeSoto S1). Length 18 13/32" (Chrysler C7), 24 3/16" (DeSoto S1).
NOTE—When relining, cut out lining adjacent to anchor and chamfer ends. Clearance between anchor and sides of anchor saddle .005" maximum.

ENGINE NUMBER:—First number—C8-1001. Stamped on left side of block between #1 and 2 cylinders.
NOTE—Engine bore and bearing dimensions indicated by letter immediately following engine number. See Chrysler C7 for explanation.

ENGINE SPECIFICATIONS:—8 cylinder, 'L' head.
Bore—3¼". Stroke 4⅛".
Displacement—273.8 cubic inches.
Rated Horsepower—33.80 (AMA).
Developed Horsepower—105 HP. at 3400 R.P.M. (Std. 6.2-1 head.)
Compression Ratio—6.2-1 Std. Cast-iron head, 7.0-1 Optl. aluminum head.
Compression Pressure—6.2-1 Std. Head 125-135 lbs. at 1000 R.P.M. or approx. 106 lbs. at cranking speed. **7.0-1 Optl. Head** 130-140 lbs. at 1000 R.P.M. or approx. 117 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 16-18" with engine idling at 7-8 M.P.H.
NOTE—Aluminum heads should be tightened cold. Special head studs, head gaskets and spark plugs used with aluminum heads.

PISTONS:—Aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface. **Length—3⅞".**
Weight—Held to two gram maximum variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Skirt .002". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard and .003", .005", .010", .015", .020", .023", .025", .030", .040", .050", .060" oversize. Semi-finished pistons furnished in two sizes: (1) standard to .023" oversize; (2) .025-.050" oversize (not interchangeable). Pistons should be slotted and then finished on cam grinding equipment.
Fitting New Pistons:—Micrometer gauge recommended. Using feeler gauge (.002") inserted between piston and cylinder wall on side opposite slot, pull required to withdraw feeler must be 3-4 lbs.
Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression, one undercut oil wiper (#3), one oil control ring per piston, all above pin. Lower ring grooves drilled radially with twelve ⅛" oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.007-.015"	.002-.003"
Oil (both)	.5/32"	.007-.015"	.002-.003"

Replacement Rings:—Rings furnished standard and .003", .010", .020", .030", .040", .050", .060" oversize.
NOTE—Install undercut compression and oil wiper ring with step down.

PISTON PIN:—Diameter—55/64". Length—2¾".
Pin floats in piston and rod. Held by locking rings at each end. Pin hole in rod is bronze bushed.
NOTE—Heat piston in boiling water to remove or install pins.
Pin Fit in Piston—Tight thumb push fit with piston heated to 120° F.
Pin Fit in Rod Bushing—Tight thumb push fit with pin and rod at 70° F.
Replacement Pins:—Pins furnished in standard and .003", .005" and .008" oversizes. Ream rod bushing and pin holes in piston bosses for correct fit.

CONNECTING ROD:—Weight—All rods held within limits.
Length—9 3/16" (center-to-center).
Crankpin Journal Diameter—2 3/16".
Lower Bearing—Removable steel-backed, copper-lead lined. Furnished standard and .010" undersize.
Clearance—.001-.003". Sideplay—.006-.011".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps. Install new bearings so small bosses engage grooves in rod and cap.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5, 7) or toward front (#2, 4, 6, 8). Oil hole in lower bearing must be toward camshaft on all rods.

CRANKSHAFT:—5 bearing. Integral counterweights.
Journal Diameters—2 45/64" all bearings.
Bearing Type—Removable steel-backed, babbitt-lined. Furnished standard and .010" undersize.
Clearance—.001-.002".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. No fitting or reaming necessary for new bearings.
End Thrust:—Taken by flange faces on rear (#5) bearing. Endplay .003-.007".

CAMSHAFT:—6 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2 1/16"; #2, 2 1/32"; #3, 2"; #4, 1 31/32"; #5, 1 15/16"; #6, 1⅜".
Bearing Type—Removable steel-backed, babbitt-lined (except #6 which is machined in crankcase).
Clearance—.0015-.0025" all bearings.
End Thrust:—Taken between the face of the removable cast-iron sleeve which carries the front bearing and the face of the camshaft sprocket. Adjusted by replacing sleeve. Endplay .003-.005".
Timing Chain:—Morse. Width 1¼". Pitch ½". Length 24" or 48 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across shaft centers.
NOTE—Engine must be supported under front end of oil pan and front engine support removed for work on timing chain and camshaft.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 15/32"	.340-.341"	5½"
Exhaust	1 13/32"	.340-.341"	5½"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.001-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" int., .008" exh., (hot). .010" exh., recommended for sustained high speed.
NOTE—Exhaust valve seat inserts used.
Valve Guides:—Use special tool to remove and install guides. Insert guides with taper end up (intake) and down (exhaust). Top of guide must be 13/16" below top of block. Finish ream guides after installation to inside diameter of .342-.343" Int., .344-.345" Exh.
Valve Springs:—Variable pitch type. Install springs with close coil at top. Do not compress springs to over all length of less than 1½".

	Spring Pressure	Spring Length
Valve Closed	46-50 lbs.	2 1/32"
Valve Open	104-110 lbs.	1 11/16"

Valve Lifters:—Mushroom type. Ream guides to take following oversizes: .001", .008", .030", .060".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 2° BTDC. Close 44° ALDC.
Exhaust Valves—Open 46° BLDC. Close 4° ATDC.
To Check Valve Timing—Install timing gauge in timing plug hole over #8 piston. Set tappet clearance #8 intake valve at .011" (cold). This valve should open with piston 2° or .0015" BTDC. when 2° line BTDC. on impulse neutralizer at front of engine lines up with pointer on chain case cover. Reset tappet clearance at .006" with engine hot.
Motor Gauge—Weidenhoff Adapter #103, Rod #12.

LUBRICATION:—Pressure. Gear type oil pump on right side of crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure:—30-45 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Located under cap at left side of crankcase. Operates at 40-45 lbs. To adjust, remove cap, withdraw locking wire, turn slotted plug clockwise to increase pressure, counter-clockwise to decrease, replace locking wire and cap.
Crankcase Capacity:—6 qts. (refill).

CLUTCH:—Borg & Beck Model 10A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Clutch pedal should just clear underside of toe board with clutch engaged. To adjust, turn stopscrew located just above clutch pedal shaft. Free movement of pedal should be 1/16". To adjust, lossen locknut and turn adjusting nut (clevis) on clutch fork adjusting rod.
Removal—Disconnect clutch pedal linkage, remove fork pivot screw, take out clutch fork. Remove transmission (release bearing and spring are withdrawn with transmission), remove clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly to release spring tension and avoid distortion of clutch cover. Remove clutch from below. Use pilot studs when removing and installing transmission to avoid springing clutch plate.
Automatic Clutch:—See article in Clutch Section.

STEERING:—Steering Gear—Gemmer Model Worm-and-Roller type. See article in Steering Section.
Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section.
Wheel Setting (Front Suspension Height)—Distance from center line of lower control arm yoke pin to top of frame cross member should be 7¼-7⅜" with car weight on wheels but no load in car. Heights must be equal on both sides within ⅛".
Kingpin Inclination—4¾-6° (incl. camber angle).
Camber—Minus ¼°. Limits minus ¼ to plus ½°.
Caster—1½°. **Toe In**—0-⅛".

BRAKES:—Service—Lockhead Hydraulic, double anchor type. Hand lever applies brake at rear of transmission or rear wheel service brakes (on cars with overdrive). See article in Brake Section for complete adjustment procedure.
Wheel Cylinders—Diameters, Front Wheel (Front end 1¼", Rear 1⅜"), Rear Wheel (Front end 1⅛", Rear 1¼").
NOTE—Wheel cylinders marked 'R'—right side of car, 'L'—left side of car and not interchangeable.
Drum Diameter—11".
Lining—Moulded type. Width 2". Thickness 3/16". Length per wheel 22 5/32".
Clearance—.012" toe, .006" heel, for each shoe.
Hand Brakes:—External type on drum at rear of transmission. See Service Brake for Hand Brake on cars with overdrive.
Adjustment—With lever in released position, remove anchor screw locking wire, turn anchor screw so that clearance between lining and drum is 1/16", lock anchor screw with wire. Adjust brake band guide bolt nut to give 1/16" clearance (as above) for lower portion of band, secure with locknut. Finally, adjust brake adjusting bolt nut to give 1/16" clearance (as above), making sure that groove in bolt nut is lined up with ridge on lockwasher.
Drum Diameter—6".
Lining—Width 2". Thickness 5/32". Length 18 13/32".
NOTE—When relining, cut out lining adjacent to anchor and chamfer ends. Clearance between anchor and sides of anchor saddle .005" maximum.

ENGINE NUMBER:—First number—C9, C10, or C11-1001. Stamped on boss back of water pump.
NOTE—See Model C7 for explanation of bore and bearing dimensions indicated by letter following engine number.

ENGINE SPECIFICATIONS:—8 cylinder, 'L' head.
Bore—3¼". **Stroke**—4⅞".
Piston Displacement—323.5 cubic inches.
Rated Horsepower—33.80 (AMA).
Developed Horsepower—For each model as follows:

Model	Comp. Ratio	HP. and R.P.M.
C9 Std.	6.2-1	105 at 3400
C9 Optl.	6.5-1	110 at 3400
C10, 11 Std.	6.5-1	130 at 3400
C10, 11 Optl.	7.45-1	138 at 3400

Compression Ratio—See above.
Compression Pressure—6.2-1 Cast-iron head 120-130 lbs. at 1000 R.P.M. or approx. 106 lbs. at cranking speed. **6.5-1 Al. head** 145-155 lbs. at 1000 R. P. M. or approx. 117 lbs. at cranking speed, **7.45-1 Al head** 160-170 lbs. at 1000 R.P.M. or approx. 124 lbs at cranking speed.
Vacuum Reading—Gauge should show steady reading of 16-18" with engine idling at 7-8 M.P.H.
NOTE—Aluminum heads should be tightened cold.

PISTONS:—Aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface). **Length**—3⅞".
Weight—Held to two grams maximum variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Skirt .002". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard and .003", .005", .010", .015", .020", .023", .025", .030", .040", .050", .060" oversizes. Semi-finished pistons furnished in two sizes: (1) Standard to .023" oversize, (2) .025"-.050" oversize, not interchangeable. Pistons should be slotted and finished on cam grinding equipment.
Fitting New Pistons:—Micrometer gauge recommended. Using feeler gauge (.002") inserted between piston and cylinder wall on side opposite slot, pull required to withdraw feeler must be 3-4 lbs.
Installing Pistons:—Slot should be toward left

PISTON RINGS:—Two compression, one undercut oil wiper (#3), one oil control ring per piston, all above pin. Lower ring groove drilled radially with twelve ⅛" oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp. all	⅛"	.007-.015"	.002-.003"
Oil cont. all	5/32"	.007-.015"	.002-.003"

Replacement Rings:—Rings furnished in standard and .003", .010", .020", .030", .040", .050", .060" oversize.
NOTE—Install undercut compression and oil wiper ring with step down.

PISTON PIN:—**Diameter**—55/64". **Length**—2¾".
Pin floats in piston and rod. Held by locking rings at each end. Pin hole in rod is bronze bushed.
NOTE—Heat piston in boiling water to remove or install pins.
Pin Fit in Piston—Tight thumb push fit with piston heated to 120° F.
Pin Fit in Rod Bushing—Tight thumb push fit with pin and rod at 70° F.
Replacement Pins:—Pins furnished in standard and .003", .005", and .008" oversizes. **Ream rod bushing** and pin holes in piston bosses for correct fit.

CONNECTING RODS:—**Weight**—Held within limits.
Length—9". (center-to-center).
Crankpin Journal Diameter—2 3/16".
Lower Bearing—Removable steel-backed, copper-lead lined. Furnished standard and .010" undersize.
Clearance—.001-.003". Sideplay .006-.011".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps. Install new bearings so small bosses engage grooves in rod and cap.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5, 7), or toward front (#2, 4, 6, 8). Oil hole in lower bearing must be toward camshaft on all rods.

CRANKSHAFT:—5 bearing. Integral counterweights.
Journal Diameters—2 45/64" all bearings.
Bearing Type—Removable steel-backed, babbitt-lined. Furnished standard and .010" undersize.
Clearance—.001-.002".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. No fitting or reaming necessary for new bearings.
End Thrust:—Taken by flange faces on rear (#5) bearing. Endplay .003-.007".

CAMSHAFT:—6 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2 1/16"; #2, 2 1/32"; #3, 2"; #4, 1 31/32"; #5, 1 15/16"; #6, 1⅜".
Bearing Type—Removable steel-backed, babbitt-lined (except #6 which is machined in crankcase).
Clearance—.0015-0025" all bearings.
NOTE—New bearings need not be line-reamed.
End Thrust:—Taken between the face of the removable cast-iron sleeve which carries the front bearing and the face of the camshaft sprocket. Adjusted by replacing sleeve. Endplay .003-.005".
Timing Chain:—Morse. Width 1¼". Pitch ½". Length 24" or 48 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across shaft centers.
NOTE—Engine must be supported under front end of oil pan and front engine support removed for work on timing chain and camshaft.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 15/32"	.340-.341"	5½"
Exhaust	1 13/32"	.340-.341"	5½"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.001-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" Int., .008" Exh. (hot). .010" Exh. recommended for sustained high speed.
NOTE—Exhaust valve seat inserts used.
Valve Guides:—Use special tool to remove and install guides. Insert guides with taper end up (intake) or down (exhaust). Top of guide must be 13/16" below top of block. Finish ream guides after installing to inside diameter of .342-.343" Int., .344-.345" Exh.
Valve Springs:—Variable pitch type. Install springs with close coil at top. Do not compress springs to over all length of less than 1½".

	Spring Pressure	Spring Length
Valve Closed	46-50 lbs.	2 1/32"
Valve Open	104-110 lbs.	1 11/16"

Valve Lifters:—Mushroom type. Ream guides to take following oversizes: .001", .008", .030", .060"
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 2° BTDC. Close 44° ALDC.
Exhaust Valves—Open 46° BLDC. Close 4° ATDC.
To Check Valve Timing—Install timing gauge in timing plug hole over #1 piston. Set tappet clearance #1 intake valve at .011" (cold). This valve should open with piston 2° or .0019" before top dead center when 2° line BTDC on impulse neutralizer at front of engine lines up with pointer on chain case cover. Reset tappet clearance at .006" hot.
Motor Gauge—Weidenhoff Adapter #103, Rod #12.
NOTE—Right front wheel and cover plate under fender should be removed for work on valves.

LUBRICATION:—Pressure. Gear type oil pump on right side of crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure:—30-40 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Located under cap at left side of crankcase. Operates at 40-45 lbs. To adjust, remove cap, withdraw locking wire, turn slotted plug clockwise to increase pressure, counter-clockwise to decrease, replace locking wire and cap.
Crankcase Capacity:—6 qts. (refill).

CLUTCH:—**Borg & Beck Model 11A6.** Single plate, dry disc type. See article in Clutch Section.
Adjustment—Clutch pedal should just clear underside of toeboard with clutch engaged. To adjust, turn pedal stopscrew located above clutch pedal shaft. Free movement of clutch pedal must be 1 1/16". To adjust, turn clutch shaft collar adjusting screw at right hand end of clutch pedal shaft.
Removal—Disconnect clutch linkage, remove transmission (rotating clutch release fork shaft so that release bearing and spring are withdrawn with transmission), remove clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly. Remove clutch from below.
Automatic Clutch:—See article in Clutch Section.

STEERING:—**Steering Gear**—Gemmer Model Worm-and-Roller type. See article in Steering Section.
Front Suspension:—Conventional tubular section front axle with Reverse-Elliott ends and semi-elliptic springs.
Kingpin Inclination—4½-5½° crosswise.
Caster—2° plus or minus 1°. Adjust by inserting wedge shims between spring and axle pad on axle. Shims or angle plates furnished ½, 1, 2°.
Camber—½° plus or minus ¼°. No adjustment. Manufacturer recommends that no attempt be made to correct camber by bending tubular axle.
Toe In—0-5/16" measured at hub height on center of tire tread. Adjust in usual manner by changing length of tie rod.

BRAKES:—**Service**—Lockhead Hydraulic, double anchor type. Bendix Vacuum Power unit optional on Model C9 and standard on Models C10, C11. See article in Brake Section.
Wheel Cylinder—Diameters—Front Wheel (Front end 1¼", Rear end 1⅜"), Rear wheel (Front end 1", Rear end 1⅛").
NOTE—Wheel cylinders marked 'R'—right side of car, 'L'—left side of car and not interchangeable.
Drum Diameter—13".
Lining—Moulded type. Width 2". Thickness ¼". Length 24 27/32" per wheel.
Clearance—.012" toe, .006" heel for each shoe.
Hand Brake:—External at rear of transmission.
Adjustment—With lever in released position remove anchor screw locking wire, turn anchor screw so that clearance between lining and drum is 1/32", lock anchor screw with wire. Back off adjusting bolt nut until free. Adjust bracket bolt nuts for each end of brake band to 1/32" clearance (as above), secure with locknuts. Finally tighten adjusting bolt nut until tension on bracket bolt nuts is just relieved at either end.
Drum Diameter—7".
Lining—Woven type. Width 2½". Thickness 3/16". Length 21 5/8".
NOTE—When relining band, cut out lining adjacent to anchor and chamfer ends. Clearance between anchor and sides of anchor saddle .005" maximum.
Power Brake Unit:—Bendix Internal Valve type. See article in Brake Section.

NOTE:—Engine hood is hinged at the cowl and is held down by latch under top louvre of radiator grill at center in front. To free hood, place hand on latch and lift. See that hood is latched in place when down. Complete engine and drive unit (including steering gear) mounted on separate assembly which is bolted to main body side members in front of cowl.

ENGINE NUMBER:—First number—FB-100. Stamped on left side at front of engine block.

ENGINE SPECIFICATIONS:—Lycoming Model FB. Eight cylinder, 90° Vee, 'L' head type.

NOTE—Engine is reversed in chassis with flywheel and clutch at forward end and timing chain at rear. Crankshaft rotation is clockwise at timing chain end (rear) so that rotation as viewed from front of car is counter-clockwise.

Bore—3½". **Stroke**—3¾".

Piston Displacement—288.6 cubic inches.

Rated Horsepower—39.2 (AMA).

Developed Horsepower—125 at 3500 R.P.M.

Compression Ratio—6.5-1 Std. aluminum head.

Compression Pressure—Approximately 110 lbs. at cranking speed of 130 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 6 M.P.H.

NOTE—Capscrews used to hold down the aluminum cylinder head are of unequal length and must be installed in correct position. 6 long screws (2 1/32") used in top or inner row on head, fourteen medium screws (1 21/32") in two rows across middle of head, four short screws (1 5/16") in lower or outer row on head.

PISTONS:—Ray Day, aluminum alloy, Expansion type with Dome head.

Weight—1.65 lbs. with rings and pin.

Removal—Pistons and rods removed from above.

Clearance—.002-.0025" skirt. See Fitting Pistons.

Replacement Pistons:—Pistons furnished 005", .010", .015" oversize.

Fitting New Pistons:—Check piston diameter and cylinder bore with micrometers. Clearance must be .002-.0025".

Installing Pistons:—Slot should be toward camshaft for pistons in both banks.

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Lower ring grooves drilled with eight 1/16" oil drain holes (#3), eight ⅛" oil drain holes and holes to pin bosses (#4).

Ring	Width	End Gap	Side Clear.
Comp. (top)	3/32"	.0075-.0155"	.002"
Comp. (2nd)	3/32"	.0075-.0155"	.0015-.002"
Oil (top)	⅛"	.0075-.0155"	.0015-.003"
Oil (2nd)	3/16"	.0075-.0155"	.0015-.003"

PISTON PIN:—Diameter ⅞". Length 2 19/32". Pin floats in piston and rod. Held by locking ring at each end.

Pin hole in connecting rod bronze bushed.

Pin Fit in Piston—Palm push fit with piston at 70°F.

Pin Fit in Rod Bushing—.0003-.0005" clearance.

CONNECTING ROD:—Weight 30¾ ozs. **Length** 7⅝".

Crankpin Journal Diameter—2".

Lower Bearing—Spun babbitt. No shims.

Clearance—.001-.0025". Sideplay .006-.010" (total).

Bearing Adjustment:—No shims. Rods serviced on exchange basis. Do not file bearing caps.

Installing Rods:—Rods mounted side-by-side on crankpin with right hand rods to front and left hand rods to rear. Install rods with large chamfer on counterbore against shaft (toward crankshaft cheek).

CRANKSHAFT:—3 bearing. Integral counterweights.

Journal Diameters—2½" all bearings.

Bearing Type—Removable bronze-backed, babbitt-lined. No shims.

Clearance—.0015-.00375".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. Check clearance by assembling .002" feeler ½" wide between bearing and shaft. Shaft should turn freely by hand with shim in place and cap tight.

End Thrust:—Taken by #2 (center) bearing. Endplay .004-.009". Serviced by replacing bearing.

CAMSHAFT:—5 bearing. Non-adjustable chain drive.

Bearing Type—Removable bushings.

Clearance—.002-.003".

Adjustment—Replace bushings.

End Thrust:—Taken by flange on front bushing. Endplay .003-.007". Serviced by replacing bushing.

Timing Chain:—Whitney. Width 1¼". Pitch ½". Length 29" or 58 links.

Camshaft Setting:—Sprockets are punch-marked. Camshaft sprocket located by dowel and bolted on camshaft flange. Turn engine to #4L top dead center position with punch mark on camshaft sprocket approximately 100° from vertical. Mesh chain so that there are 15 chain teeth between marks.

VALVES:—Valves actuated by rocker arm which contacts cam through roller mounted on arm. Rocker arms carried on twin rocker shafts.

	Head Diameter	Stem Diameter	Length
Intake	1 23/32"	.3420-.3425"	5 17/64"
Exhaust	1 33/64"	.3420-.3425"	5 9/32"

	Seat Angle	Lift	Stem Clear.
Intake	30°	11/32"	.0025-.001"
Exhaust	45°	11/32"	.0025-.001"

NOTE—Stem clearance measured at bottom of guide.

Tappet Clearance—.008" all valves, engine cold. Adjusting screw located on end of rocker arm.

Valve Guides:—Press fit in block.

Valve Rockers:—Shaft hole in rocker arm bronze-bushed.

Clearance—.0005-.0025".

Rocker Arm Roller—Mounted on pin at middle of rocker arm. Clearance on pin .002-.003". Sideplay .005-.008".

Valve Springs:—Single spring type.

	Spring Pressure
Valve Closed	42-47 lbs.
Valve Open	88-94 lbs.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 7½° BTDC. Close 37½° ALDC.

Exhaust Valves—Open 50° BLDC. Close 5° ATDC.

To Check Valve Timing—Set tappet clearance #4L (rear cylinder—left bank) intake valve at .016". This valve should be about to open (with clearance not yet taken up) with piston 7½° or .0200" before top dead center when point on flywheel approximately 3 teeth before mark '4L' lines up with pointer in inspection hole in right hand side of clutch housing. Reset tappet clearance at .008".

LUBRICATION:—Pressure system with gear type oil pump mounted in crankcase.

NOTE—Ignition timing not disturbed by oil pump removal.

Normal Oil Pressure:—40 lbs.

Oil Pressure Regulator:—Mounted on oil pump. Operates at 40 lbs. Adjustable by turning screw.

Crankcase Capacity:—8 qts.

CLUTCH:—Long Mod. 10CF-CI. Semi-centrifugal, single plate, dry disc type. See article in Clutch Section for complete relining and assembling directions.

Clutch Pedal Adjustment—Free movement of clutch pedal should be 1". Pedal adjustment located at fulcrum lever on frame.

Removal—Remove kingpins, remove drive shaft at inner universal by knocking out taper pin in shaft, remove both inner universals attached to side of transmission case, then remove driving unit. Remove clutch bell housing, take out capscrews mounting clutch on flywheel (turning all screws out evenly), lift clutch out.

STEERING:—Steering Gear—Gemmer Worm-and-Roller type. See article in Steering Section for complete adjustment procedure.

Front Suspension:—Independent type. Each front wheel carried on rear end of longitudinal arm pivoted at front and linked to end of transverse spring.

Kingpin Inclination—6° crosswise.

Caster—1-2½° positive. Adjusted by changing length of suspension bolts on longitudinal arm at end of spring. Tighten nut to increase caster.

Camber—1°. No adjustment provided.

Toe In—0-⅛" **toe out** (wheels point out at front). Adjusted by changing length of each tie rod equally (loosen clamp bolts and turn tie rod).

BRAKES:—Lockheed Hydraulic, Two shoe, Single anchor type. Hand lever applies rear wheel brakes. See Brake Section for complete adjustment procedure.

Wheel Cylinders—Stepped or two stage bore type. Installed with small end of cylinder toward front of car and not interchangeable.

Drum Diameter—11".

Lining—Moulded type. Width 2¼". Thickness 3/16". Length 19" per wheel (front), 11" (rear).

Clearance—.010" toe, .005" heel on each shoe.

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—First number—S2-1001. Stamped on boss above water pump. Letter 'A' following number indicates bore .020" larger than standard. 'B' indicates main and connecting rod bearings .010" smaller than standard. 'AB' indicates that bore and bearing sizes are as above.

ENGINE SPECIFICATIONS:—6 cylinder, 'L' head.
Bore—3⅜". **Stroke**—4½".
Displacement—241.5 cubic inches.
Rated Horsepower—27.34(AMA).
Developed Horsepower—100 HP. (Std. 6.5-1 head), 105 HP. (Optl. 7.0-1 head) at 3400 R.P.M.
Compression Ratio—6.5-1 Std. aluminum head, 7.0-1 Optl. aluminum head.
Compression Pressure—6.5-1 Std. head, 125-135 lbs. at 1000 R.P.M. or approx. 110 lbs. at cranking speed. **7.0-1 Optl. head** 130-140 lbs. at 1000 R.P.M. or approx. 117 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 16-18" with engine idling at 6 M.P.H.
NOTE—Aluminum heads should be tightened cold. Special head studs, head gaskets and spark plugs used on aluminum head engines.

PISTONS:—Aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface). **Length**—3⅞".
Weight—Held to two gram max. variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Skirt .002". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard and .003", .005", .010", .015", .020", .023", .025", .030", .040", .050", .060" oversizes. Semi-finished pistons furnished: (1) standard to .023" oversize, (2) .025-.050" oversize, not interchangeable. Pistons should be slotted and then finished on cam-grinding equipment.
Fitting New Pistons:—Micrometer gauge recommended. Using ½" feeler gauge (.002") inserted between piston and cylinder wall on side opposite slot, pull required to withdraw feeler must be 3-4 lbs.
Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression, one undercut oil wiper ring (#3), one oil control ring per piston, all above pin. Lower ring grooves drilled radially with twelve ⅛" oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp. all	⅛"	.007-.015"	.002-.003"
Oil (both)	5/32"	.007-.015"	.002-.005"

Replacement Rings:—Furnished in standard and .003", .010", .020", .030", .040", .050", .060" oversizes.
NOTE—Install undercut compression and oil wiper ring with step down.

PISTON PIN:—Diameter 55/64". **Length** 2⅞". Pin floats in piston and rod. Held by locking rings at each end. Pin hole in rod is bronze bushed.
NOTE—Heat piston in boiling water to remove or install pins.
Pin Fit in Piston—Tight thumb push fit with piston heated to 130° F.
Pin Fit in Rod Bushing—Tight thumb push fit with pin and rod at 70° F.
Replacement Pins:—Pins furnished in standard and .003", .005", .008" oversizes. Ream rod bushing and pin holes in piston bosses for correct fit.

CONNECTING ROD:—Weight—All rods held within limits.
Length—8¾" (center-to-center).
Crankpin Journal Diameter—2⅛".
Lower Bearing—Removable steel-backed, copper-lead lined. Furnished standard and .010" undersize.
Clearance—.0005-.0025". Sideplay .0055-.0115".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps. Install new bearings with small bosses engaging grooves in rod and cap.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5) or toward front (#2, 4, 6). Oil hole in lower bearing upper half must be toward camshaft on all rods.

CRANKSHAFT:—4 bearing. Integral counterweights.
Journal Diameters—2½" all bearings.
Bearing Type—Removable steel-backed, babbitt-lined. Furnished standard and .010" undersize.
Clearance—.001-.002".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. No fitting or reaming necessary for new bearings.
End Thrust:—Taken by flange faces on rear (#4) bearing. Endplay .003-.007".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2"; #2, 1 31/32"; #3 1 15/16"; #4, 1⅜".
Bearing Type—Removable steel-backed, babbitt-lined (except #4 machined in crankcase).
Clearance—.001-.003" (#1), .0015-.0035" (all others).
NOTE—New bearings require no line-reaming.
End Thrust:—Taken by thrust plate at rear of sprocket hub. Endplay .003-.005".
Timing Chain:—Morse. Width 1". Pitch ½". Length 24" or 48 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across shaft centers.
NOTE—Engine must be supported under front end of oil pan and front engine support removed for work on timing chain and camshaft.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 17/32"	.340-.341"	5⅝"
Exhaust	1 15/32"	.340-.341"	5⅝"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.001-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" Int., .008" Exh., (hot). .010" Exh. recommended for sustained high speed.
NOTE—Exhaust valve seat inserts used.
Valve Guides:—Use special tool to remove and install guides. Insert guides with taper end up (intake) and down (exhaust). Top of guide must be 13/16" below top of block. After installing finish ream new guides to inside diameter of .342-.343" (Int.) .344-.345" (Ex.)
Valve Springs:—Variable pitch type. Install springs with close coil at top. Do not compress springs to over all length of less than 1½".

	Spring Pressure	Length
Valve Closed	46-50 lbs.	2 1/32"
Valve Open	104-110 lbs.	1 11/16"

Valve Lifters:—Mushroom type. Ream guides to take following oversizes: .001", .008", .030", .060".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open TDC. Close 50° ALDC.
Exhaust Valves—Open 48° BLDC. Close 2° ATDC.
To Check Valve Timing—Set tappet clearance #1 intake valve at .010". Intake valve should open at top dead center when 'O' mark on impulse neutralizer at front of engine lines up with jointer on chain case cover. Reset tappet clearance at .006" hot.
Motor Gauge—Weidenhoff Adapter #103, Rod #12. Gauge plug hole over #1 cylinder.

LUBRICATION:—Pressure. Gear type oil pump located at right of crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure:—30-40 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Under plug on left hand side of crankcase. Operates at 40 lbs. Adjustable by changing spring. Standard spring unpainted. Heavy spring (to increase pressure) painted green. Lighter spring (to decrease pressure) painted red.
Crankcase Capacity:—6 qts. (refill).

CLUTCH:—Borg & Beck Model 10A6. Single plate, dry disc type. See article in Clutch Section for relining and assembly directions.
Adjustment—Clutch pedal should just clear under side of toeboard. To adjust, turn stopscrew located above clutch pedal shaft. Free movement of clutch pedal should be 1 1/16". To adjust, turn clutch shaft collar adjusting screw at right hand end of clutch pedal shaft.
Removal—Disconnect clutch linkage, remove transmission (rotating clutch release fork shaft so that release bearing and spring are withdrawn with transmission), remove clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly to release spring tension and avoid distortion of clutch cover. Remove clutch from below. Use pilot studs when removing and installing transmission to avoid springing clutch plate.
Automatic Clutch:—See article in Clutch Section.

STEERING:—Steering Gear—Gemmer Model. Worm-and-Roller type. See article in Steering Section for adjustments.
Front Suspension:—Conventional tubular section front axle with Reverse-Ellittt ends and semi-elliptic springs.
Kingpin Inclination—9½° plus or minus ½°. Crosswise.
Caster—2°. Limits 1-3°. Adjust by wedge shims inserted between springs and spring pad on axle. Shims or angle plates furnished ½, 1, 2°.
Camber—½°. Limits ¼-¾°. No adjustment. Manufacturer recommends that no attempt be made to correct camber by bending tubular axle centers.
Toe In—0-⅛" measured at hub height. Adjust as usual by changing length of tie rod.

BRAKES:—Service—Lockheed Hydraulic, double anchor type. Hand lever applies brake at rear of transmission. See artcle in Brake Section for complete adjustment procedure.
Wheel Cylinders—Diameters, Front Wheel (Front end 1¼", Rear end 1 3/8"). Rear Wheel (Front end 1", Rear end 1⅛").
NOTE—Wheel cylinders marked 'R' right side of car, 'L' left side of car. Not interchangeable.
Drum Diameter—11".
Lining—Moulded type. Width 2". Thickness 3/16". Length 22 5/32" per wheel.
Clearance—.012" toe, .006" heel, for each shoe.
Hand Brake:—External type on drum at rear of transmission.
Adjustment—With lever in released position remove anchor screw locking wire, turn anchor screw so that clearance between lining and drum is 1/32", lock anchor screw with wire. Back off adjusting bolt nut until free. Adjust bracket bolt nuts for each end of brake band to 1/32" clearance (as above), secure with locknuts. Finally, tighten adjusting bolt nut until tension on bracket bolt nuts is just relieved at either end.
Drum Diameter—7".
Lining—Width 2½". Thickness 3/32". Length 21⅝".
NOTE—When relining, cut out lining adjacent to anchor and chamfer ends. Clearance between anchor and sides of anchor saddle .005" maximum.

ENGINE NUMBER:—First Number—D2-1001. Stamped on boss on left side of cylinder block between #1 and 2 cylinders. Letter 'A' following number indicates that cylinder bore is .020" larger than standard. Letter 'B' indicates that main and connecting rod bearings are .010" smaller than standard. Letters 'AB' indicate that bore and bearing sizes are as above.

ENGINE SPECIFICATIONS:—6 cylinder, 'L' head.
Bore—3¼". **Stroke**—4⅜".
Displacement—217.8 cubic inches.
Rated Horsepower—25.35 (AMA).
Developed Horsepower—87 HP at 3600 R.P.M.
Compression Ratio—6.5-1 Std. cast-iron head. No optl. ratios.
Compression Pressure—135-145 lbs. at 1000 R.P.M. or approx. 110 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 16-18" with engine idling at 7-8 M.P.H.

PISTONS:—Aluminum alloy, Invar strut, slotted skirt type.
Length—3 11/16".
Weight—Held to two gram max. variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Bottom .0015-.002". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard and .003", .005", .010", .015", .020", .023", .025", .030", .040", .050", .060" oversizes. Semi-finished pistons furnished: (1) standard to .023" oversize, (2) .025-.050" oversize, not interchangeable. Pistons should be slotted and then finished to correct fit.
Fitting New Pistons:—Micrometer gauge recommended. Using feeler gauge (.002") inserted between piston and cylinder wall on side opposite slot, pull required to withdraw feeler must be 7-10 lbs.
Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two undercut compression rings, two oil control rings per piston, all above pin. Lower ring grooves drilled with oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp. all	⅛"	.007-.015"	.001-.003"
Oil (both)	5/32"	.007-.015"	.003-.005"

Replacement Rings:—Furnished in standard and .003", .010", .020", .030", .040", .050", .060" oversizes.
NOTE—Install compression rings with step down.

PISTON PIN:—Diameter—55/64". **Length**—2¾". Pin floats in piston and rod. Held by retaining rings. Pin hole in rod is bronze bushed.
NOTE—Heat piston in boiling water to remove or install pins.
Pin Fit in Piston—Tight thumb push fit with piston heated to 160° F.
Pin Fit in Rod Bushing—Tight thumb push fit with piston and rod at 70° F.
Replacement Pins:—Pins furnished in standard and .003", .005", .008" oversizes. Ream rod bushing and pin holes in piston bosses for correct fit.

CONNECTING ROD:—Weight All rods held to ¼ oz. maximum variation. **Length** 7 15/16" (center-to-center).
Crankpin Journal Diameter—2 1/16".
Lower Bearing—Steel-backed, copper-lead lined, interchangeable. Furnished standard and .010" undersize.
Clearance—.001-.003". Sideplay .0055-.0115".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps. Install new bearings with small bosses engaging groves in rod and cap.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5) and toward front (#2, 4, 6). Oil hole in lower bearing upper half must be toward camshaft on all rods.

CRANKSHAFT:—4 bearing. Integral counterweights.
Journal Diameters—2¼" (all bearings).
Bearing Type—Removable steel-backed, babbitt-lined (#1 and 4), copper-lead or cadmium-nickel (#2 and 3). Furnished standard and .010" undersize.
Clearance—(#1 and 4) .001-.002". (#2 and 3) .0015-.0025".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. No fitting or reaming necessary for new bearings.
End Thrust:—Taken by flange faces on rear (#4) bearing. Endplay .003-.007".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2"; #2, 1 13/32"; #3, 1 15/16"; #4, 1¼".
Bearing Type—Removable steel-backed, babbitt-lined (except #4 machined in crankcase).
Clearance—.001-.003" (#1), .0015-.0035" (all others).
NOTE—New bearings require no line-reaming.
End Thrust:—Taken by thrust plate at rear of sprocket hub. Endplay .002-.006".
Timing Chain:—Morse. Width 1". Pitch .500". Length 24" or 48 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across shaft centers. Install chain endless.
NOTE—Engine must be supported under front end of oil pan and front engine support removed for work on timing chain and camshaft.

VALVES:—

	Head diam.	Stem diam.	Length
All valves	1 15/32"	.340-.341"	4 25/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	5/16"	.001-.003"
Exhaust	45°	5/16"	.003-.005"

Tappet Clearance—.006" Int., .008 Exh. (hot). .010" Exh. recommended for sustained high speed.
NOTE—Exhaust valve seat inserts used.
Valve Guides:—Use special tool to remove and install guides. Insert guides with taper end up (intake) and down (exhaust). Top of guide must be ⅞" below top of block. Finish ream new guides to inside diameter of .342-.343" (Int.), .344-.345" (Exh.).
Valve Springs:—Variable pitch type. Install springs with close coil at top. Do not compress springs to over all length of less than 1⅜".

	Spring Pressure	Spring Length
Valve Closed	34-38 lbs.	1¾"
Valve Open	77-83 lbs.	1 7/16"

Valve Lifters:—Mushroom type. Ream guides to take following oversizes: .001", .008", .030", .060".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 6° ATDC. Close 46° ALDC.
Exhaust Valves—Open 42° BLDC. Close 8° ATDC.
To Check Valve Timing—Install regular timing gauge in timing plug hole over #6 piston, set tappet clearance #6 valves at .011" (intake), .012" (exhaust). Intake valve should open with piston .015" past top dead center, and exhaust valve close with piston .027" past top dead center. Reset tappet clearance at .006" (intake), .008" (exhaust) with engine hot.
Motor Gauge—Weidenhoff Adapter #103, Rod #12.

LUBRICATION:—Pressure. Gear type oil pump located at right of crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure—30-40 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Under plug on left hand side of crankcase. Operates at 40 lbs. Adjustable by changing spring. Stand. spring unpainted. Heavy spring (to increase pressure) painted green. Lighter spring (to decrease pressure) painted red.
Crankcase Capacity—5 qts. (refill).

CLUTCH:—Borg & Beck Model 10A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Clutch pedal should just clear underside of toe board with clutch engaged. To adjust, turn stopscrew located just above clutch pedal shaft. Free movement of pedal should be 1 1/16". To adjust, loosen locknut and turn adjusting nut (clevis) on clutch fork adjusting rod.
Removal—Disconnect clutch pedal linkage, remove fork pivot screw, take out clutch fork. Remove transmission (release bearing and spring are withdrawn with transmission), remove clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly to release spring tension and avoid distortion of clutch cover. Remove clutch from below. Use pilot studs when removing and installing transmission to avoid springing clutch plate.
Automatic Clutch:—See article in Clutch Section.

STEERING:—Steering Gear—Gemmer Worm-and-Roller type. See article in Steering Section for adjustment.
Front Suspension:—Conventional tubular section front axle with Reverse-Elliott ends and semi-elliptic springs.
Kingpin Inclination—9½° crosswise. Limits 9-10°.
Caster—2° (1-3°). Adjust by inserting wedge plates between springs and axle pads. Wedges available in ½, 1, 2° angles.
Camber—½° (¼-¾°). No adjustment. Replace tubular axle if camber is out more than ½°.
Toe In—0-⅛". Adjust in usual manner by loosening tie rod end clamps and rotating tie rod.

BRAKES:—Service—Lockhead Hydraulic, double anchor type. Hand lever applies brake at rear of transmission or rear wheel service brakes (on 7 pass. sedan). See article in Brake Section for complete adjustment procedure.
Wheel Cylinders—Diameters, Front Wheel (Front end 1¼", Rear end 1⅜"). Rear Wheel (Front end 1⅛", Rear end 1¼").
NOTE—Wheel cylinders marked 'R' right side of car, 'L' left side of car. Not interchangeable.
Drum Diameter—10".
Lining—Moulded type. Width 2". Thickness 13/64". Length per wheel 19 13/16".
Clearance—.012" toe, .006" heel, for each shoe.
Hand Brake:—External type on drum at rear of transmission. See Service Brake (above) for cars with Rear wheel hand brake.
Adjustment—With lever in released position, remove anchor screw locking wire, turn anchor screw so that clearance between lining and drum is 1/16", lock anchor screw with wire. Adjust brake band guide bolt nut to give 1/16" clearance (as above) for lower portion of band, secure with locknut. Finally, adjust brake adjusting bolt nut to give 1/16" clearance (as above), making sure that groove in bolt nut is lined up with ridge lockwasher.
Drum Diameter—6".
Lining—Width 2". Thickness 5/32". Length 18 13/32".
NOTE—When relining, cut out lining adjacent to anchor and chamfer ends. Clearance between anchor and sides of anchor saddle .005" maximum.

NOTE:—Engine changes made during year as follows: New type steel-alloy piston (requiring special cylinder head) superseding aluminum alloy pistons. Heavier crankshaft with removable main bearings, new oil pump, new oil pan. Data on all types given below. Engines with each type equipment identified as follows:

Aluminum Alloy Pistons—Block not marked. Head marked '40'.

Steel-alloy Pistons—Black marked 'SP' or 'SPG' on upper front end of left cylinder block near water coupling. Head marked '46' on top.

Heavier Crankshaft—Engine not marked but new pan with greater bearing clearance used.

ENGINE NUMBER:—First number—68-2,207,111 (Sept. 4, 1935). Stamped on top of clutch housing, and on left frame side member in front of dash bracket.

ENGINE SPECIFICATIONS MODEL 68 and 67:—Own Model 68. Eight cylinder, 90° Vee, 'L' head type with both cylinder blocks and crankcase cast enbloc.

Bore—3.062". **Sroke**—3.75".

Piston Displacement—221 cubic inches.

Rated Horsepower—30.

Developed Horsepower—90 at 3800 R.P.M.

Compression Ratio—6.3-1 Std. aluminum head.

Compression Pressure—140 lbs. at 2500 R.P.M. or 105 lbs. at cranking speed of 100 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 5-7 M.P.H.

NOTE—To remove oil pan, remove oil level indicator and tube, remove right front engine splash shield, attach hoist to front bumper bars and raise front of car, push radius rods down and insert 12" block between bolt and cross member. Take out screws and maneuver pan off.

ENGINE SPECIFICATIONS MODEL 51 (TRUCK):— Same as above model except as follows:

Developed Horsepower—80 at 3800 R.P.M.

Compression Ratio—5.32-1 Std. cast-iron head.

Compression Pressure—110 lbs. at 2500 R.P.M. or 90 lbs. at cranking speed of 100 R.P.M.

PISTONS—ALUMINUM ALLOY TYPE:—Split skirt, Cam ground type. Length 2.97". Recondition engines to take finished replacement pistons.

Weight—287-291 grams (stripped), 389.5-396.5 grams with rings and pin.

Removal—Pistons and rods removed from above.

Clearance—.002" Min., .003" Max. See Fitting New Pistons.

Replacement Pistons:—Finished pistons furnished .0025", .005", .010", .015", .030", .045", .060" oversize.

Fitting New Pistons:—Use .002" feeler ½" wide inserted between piston and cylinder wall at right angles to pin on side opposite slot. Pull to withdraw feeler must be within 5-10 lbs.

Installing Pistons:—Slot to left (viewed from driver's seat) for all pistons.

PISTONS—STEEL ALLOY TYPE:—Heat treated, steel-alloy, Cam ground type with domed head and cut-away skirt. Recondition cylinders to take finished replacement pistons.

NOTE—Pistons furnished as an assembly with fitted pins and connecting rods.

Replacement Pistons:—New pistons furnished in std. and following oversizes: 'A' .0005", 'B' .001", 'C' .002", 'D' .003".

Fitting New Pistons:—Finish cylinder bores to size for .0022-.0026" clearance at right angles to pin bosses (difference between micrometer gauge readings for piston and cylinder bore). If V-512 piston fitting gauge is used, piston pull should be 5-8 lbs.

Installing Pistons: See rod data.

PISTON RINGS—ALL PISTONS:—Two compression, one oil control ring per piston, all above pin. Oil ring groove drilled with eight ⅛" oil drain holes (slot on each side also used on aluminum pistons).

Ring	Width	End Gap	Wall Thick.
Comp.	.0915-.092"	.009-.015"	.140"
Oil Cont.	.1545-.155"	.005-.009"	.140"

PISTON PIN—ALUMINUM PISTONS:—Diam.—.7501-.7504". **Length**—2.77". Pin floats in piston and rod and is held by retaining ring in connecting rod. Heat piston to 200° F. (dip in boiling water for one minute) to remove or install pins.

Pin Fit in Piston—.0001" clearance.

Pin Fit in Rod—.0002" clearance. Rod should just rock on piston of own weight but piston should not rock on rod (retainer not installed).

Installing Pins:—Use tapered pilot inserted ahead of pin to expand retainer in rod.

PISTON PIN—STEEL PISTONS:—Fitted and furnished with new piston assembly.

NOTE—Retaining plugs expanded into groove in piston bosses. Cannot be removed in the field.

CONNECTING ROD—ALL PISTONS:—Length 7".

Weight—469-473 grams.

Crankpin Journal Diameter—2".

Lower Bearing—Copper-lead, Cadmium-nickel, or Cadmium-silver type. Bearing surface on outer face (in rod), and inner face (on crankpin). Bearing halves float in rods (side-by-side rod mounting).

Bearing Dimensions—2" inside diameter, 2.218" outside diameter, 1.937" length on crankpin.

Clearance—.0015-.0035" (total diametrical), .010-.022" (total endplay).

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. Use tool, Part No. V-131, to check bearing fit. Bearings should rotate freely with bearing caps tight.

Installing Rods:—Rods and caps marked 'R1', 'L1' etc. Install rods in same numbered cylinder with mark on rod and cap together and pointing down.

Note on Steel Piston Rods:—Rods are furnished as part of assembly with new steel pistons and pins.

CRANKSHAFT—FIRST TYPE:—Three bearing, integral counterweights. Weight 56.5 lbs.

Journal Diameters—2.000" (1.998-1.999").

Bearing Type—Babbitt bearing surface integral with crankcase and bearing caps.

Clearance—.001-.003".

Bearing Adjustment:—None (no shims). Do not file bearing caps. Engine must be taken down and new bearings poured in crankcase and caps.

End Thrust:—Taken by #3 (rear) main bearing. Endplay .002-.006". Adjusted by replacing bearing.

CRANKSHAFT—SECOND TYPE:—Larger journal diameters and heavier than first type.

Journal Diameters—2.400" (2.398-2.399").

Bearing Type—Removable steel-backed, copper-lead lined. Bearings furnished for service std., .003", .010" undersize.

NOTE—Install bearings with tongue or lug in groove and assemble caps so that groove in block and cap are on same side.

Clearance—.001-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust:—Same as for first type above.

NOTE—New design oil pan with greater clearance for main bearing studs used with this crankshaft. Interchangeable with old pan. Old pan can be used with new crankshaft by denting pan with ball-pein hammer to increase clearance.

CAMSHAFT:—Three bearing. Hellical gear drive.

Journal Diameters—1.800" all bearings.

Bearing Type—Steel-backed, babbitt-lined.

Bearing Clearance—.001-.002".

End Thrust:—Taken by gear hub and front bearing and by hub and cover plate. Endplay .005". Adjusted by replacing bearing or cover plate.

Timing Gears:—Crankshaft gear alloy steel. Camshaft gear Bakelized Fabric. Backlash between gears .004" maximum.

Camshaft Setting:—Mesh crankshaft gear tooth marked 'O' with camshaft gear space marked '/'.

VALVES:—	Head. Diam.	Stem.Diam.	Length
All Valves	1.537"	.3105-.3115"	4.750-4.751"

	Seat Angle	Lift	Stem Clearance
All Valves	45°	.292"	.0015-.0035"

NOTE—High tungsten chrome alloy steel exhaust valve seat inserts are used.

Tappet Clearance—.0125-.0135" all valves. No adjustment. Grind off valve stem end if clearance insufficient or replace valves if excessive.

Valve Guides:—Split type. See Valve Assembly Removal.

Valve Lifters:—Alloy-iron type operating in reamed holes in block. Serviced by installing oversize lifters. **Diameter**—.999-.9995". **Clearance**—.0005-.001".

Valve Springs:—Free length 2.42". See Valve Assembly removal below.

	Spring Pressure	Spring Length
Valve Closed	32-36 lbs.	2.13"
Valve Open	62-66 lbs.	1.84"

Valve Assembly Removal:—Insert end of V-78 bar type valve lifter between spring coils to engage flanged lower end of guide, pry down on guide until 'C' washer at upper end can be removed, remove assembly from above. Use special fixture V-130 to compress spring and remove spring retainer. Install valves in same manner.

VALVE TIMING:—See Camshaft Setting above.

Intake Valves—Open 9°30' BTDC. Close 54°30' ALDC.

Exh. Valves—Open 57°30' BLDC. Close 6°30' ATDC.

To Check Valve Timing—No flywheel marks or other means provided to check valve timing. If dead center point for any piston is established on flywheel, intake opening for valve in this cylinder will be approximately 2.96 teeth before this point with piston .0327" before top dead center.

Motor Gauge—Weidenhoff #104 Adapter, #40 Rod.

LUBRICATION:—Pressure System. Gear type oil pump located in oil pan at rear of engine.

NOTE—Two types of oil pump have been used. Interchangeable except that oil return pipe from rear main bearing must be removed when new type oil pump installed.

Normal Oil Pressure—30 lbs. at 55 M.P.H.

Oil Pressure Regulator—Located under plug directly above front camshaft bearing. Operates at 30 lbs. Not adjustable.

Oil Pressure Gauge—King-Seeley Electric type. Ford Part No. 48-9273 (dash unit—68 Deluxe and 51 Truck), 48-9278 (engine unit for above).

NOTE—Model 68 Std. and 67 Comm. not regularly equipped. Part No. 68-18426 gasoline gauge and oil pressure gauge assembly may be installed replacing regular gasoline gauge. Same engine unit as above.

Crankcase Capacity—5 qts.

CLUTCH:—Long Mod. 9CF-CI. Semi-centrifugal, single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Clutch Pedal Adjustment—Free movement of pedal must be 1½-2". To adjust, remove clevis pin in end of clutch lever adjusting rod, turn clevis.

CONTINUED ON NEXT PAGE.

ENGINE NUMBER:—First number—305,001. Stamped on right side of engine and on serial number plate.

ENGINE SPECIFICATIONS:—6 cylinder, 'L' head.

Bore—3". **Stroke**—4".

Displacement—169.6 cubic inches.

Rated Horsepower—21.6 (AMA).

Developed Horsepower—70 at 3500 R.P.M.

Compression Ratio—6.8-1 Std. aluminum head. No optional ratios.

Compression Pressure—115 lbs. at cranking speed.

Vacuum Reading—Gauge should show steady reading of 15-17" with engine idling at 5-7 M.P.H.

PISTONS:—Bohn Bohnalite, aluminum alloy, Invar strut, split skirt type.
Length—3 11/16".
Weight—14 ozs. Held to two gram variation.
Removal—Pistons and rods removed from above.
Clearance—Skirt .002". See Fitting New Pistons.

Replacement Pistons:—Finished replacement pistons furnished 2.997" to 3.006" (in .001" steps), 3.006" to 3.030" (in .002" steps). Semi-finished pistons also furnished.

FORD V8 MODELS.

CONTINUED FROM PREVIOUS PAGE.

Removal:—Disconnect rear spring at frame connection in center, take out clutch housing screws, slide rear end and transmission to rear as a unit exposing clutch, take out capscrews mounting clutch on flywheel.

STEERING:—Steering Gear—Gemmer Worm-and-Sector type. See article in Steering Section.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and transverse cantilever spring.

Kingpin Inclination—8¼° crosswise.
Caster (68 and 67)—7° loaded (9° max., 4½° min.). Must be alike within ½° for both wheels. No adjustment. **(51 Truck)**—3-3½° empty (5° max., 3° min.). Increase ¾° for each ton of load.
Camber (all models)—¾° (¾° max., ¼° min.). Must be alike within ¼° for both wheels and camber of right wheel must not exceed left wheel. No adjustment.

Toe In (68, 67 Comm.)—1/16" (1/16" min., ⅛" max.). **(51 Truck)**—0° empty. Increases with load and must be set with truck empty. All models adjusted by loosening tie rod end clamp bolts and turning tie rod.

Steering Geometry—Inner wheel turned 23 1/3° (68, 67), 22 2/3° (51—131½" W.B.), 22¼° (51—157" W.B.), outer wheel turned 20° (all models).

BRAKES:—Service—Own make. Mechanical type. Hand lever applies all four service brakes (68, 67), or operates independent rear wheel brake (51). See article in Brake Section for adjustment.
Drum Diameter—12" (68, 67), 14" (51).
Lining (68, 67)—Semi-moulded type. Width 1.75", Thickness .185", Length 26.5" per wheel.
Lining (51)—Width 2.5". Thickness .25", Length 17.5" per shoe (all shoes interchangeable).

Hand Brake:—See Service Brake adjustment.
Lining (51)—Width 1.5", Thickness .187", Length 41.1" per band.

Fitting New Pistons:—Use .002" feeler ½" wide inserted between piston and cylinder wall on side opposite slot. Pull required to withdraw feeler should be 10-17 lbs.
Installing New Pistons:—Slot should be toward left or away from valves.

PISTON RINGS:—Two compression, one oil control ring per piston, all above pin. Lower ring groove drilled radially with eight 9/64" oil drain holes.

Ring	Width	End Gap
Comp. all	⅛"	.008-.012"
Oil Cont.	3/16"	.008-.012"

NOTE—Side clearance for all rings .0005-.001".

Replacement Rings:—Rings furnished standard and .010", .020", .030" oversizes.

PISTON PIN:—Diameter 13/16". Length 2⅝".
Pin is locked in connecting rod with clamp screw.
Pin Fit in Piston—.0005" clearance.

Replacement Pins:—Pins furnished standard and .002", .005", .010" oversizes.
NOTE—Pin oiled by four 5/32" oil holes in upper part of piston bosses.

CONNECTING ROD:—Weight All rods held within limits.
Length—7" (center-to-center).
Crankpin Journal Diameter—1 15/16".
Lower Bearing—Removable steel-backed, cadmium-nickel lined type, no shims.
Clearance—.002". Sideplay .002".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps or rode.

Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5) and toward front (#2, 4, 6). Oil hole in lower bearing upper half must be toward camshaft on all rods.

CRANKSHAFT:—4 bearing. Integral counterweights.
Journal Diameters—2¼" (all bearings).
Bearing Type—Removable steel-backed, cadmium-nickel lined type. No shims.
Clearance—.002".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps.

End Thrust:—Taken by thrust plate at front (#1) bearing. Adjusted by adding or removing shims. Endplay .004-.006".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 1⅞"; #2, 1 13/16"; #3, 1¾"; #4, 1¼".
Bearing Type—Bronze.

End Thrust:—Taken by thrust plate behind camshaft sprocket. Adjusted by adding or removing shims.

Timing Chain:—Link-Belt. Width 1". Pitch .500". Length 23" or 46 links.

Camshaft Setting:—Sprockets are marked. Mesh chain so there are exactly 9 links between marks on sprockets or 10 pins inclusive of pins meshed opposite marks.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 33/64"	.3125"	5 3/16"
Exhaust	1 13/64"	.3125"	5 3/16"

	Seat Angle	Lift	Stem Clearance
Intake	30°	5/16"	.001-.0026"
Exhaust	45°	5/16"	.002-.0036"

Tappet Clearance—.010" all valves. Engine hot.

Valve Guides:—Single piece, removable, cast-iron, press-fit in block.

Valve Springs:—	Spring Pressure	Length
Valve Closed	32.2-34.2 lbs.	1 21/32"
Valve Open	71-75 lbs.	1⅜"

Valve Lifters:—Single piece cast-iron, cylindrical type 1" diameter. Lifter guides 1 21/32" long, integral with block. Finished to give .0005-.0015" clearance for lifters.

Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 4½° BTDC. Close 47½° ALDC.
Exh. Valves—Open 47½° BLDC. Close 4½° ATDC.
To Check Valve Timing—Set tappet clearance #1 exhaust valve at .012". This valve should close with #1 piston .0079" past top dead center when flywheel mark 'EC-1' lines up with indicator in right front face of flywheel housing. Reset tappet clearance at .010" with engine hot.
Motor Gauge—Weidenhoff Adapter #114, Rod #2.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure:—50 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Operates at 40-45 lbs. Under plug on right hand side of crankcase. Adjustable by adding or removing shims or washers in plug above spring.
Crankcase Capacity:—5 quarts (refill).

CLUTCH:—Illinois. Single plate, dry disc type. See article in Clutch Section for servicing directions.
Adjustment—Free movement of clutch pedal must be 1¼". To adjust, take out cotter pin at each end of clutch pedal connecting link, turn turnbuckle to secure correct lash, replace cotter pin, tighten turnbuckle locknut. When limit of adjustment is reached, loosen two capscrews in clutch mounting bracket slightly (reached through hand opening in bottom of clutch bell housing), pull out shim under bracket (shim holes are slotted—not necessary to take out capscrews completely), tighten bracket screws. This will provide new range of adjustment on connecting link. Shims can be discarded. New shims of correct thickness are supplied with new driven plate.
Removal—Disconnect clutch linkage, drop driveshaft, remove transmission, supporting engine at rear of oil pan, remove clutch bell housing, take out clutch mounting bolts, turning all bolts out evenly to release spring tension and avoid distortion of clutch cover. Remove clutch assembly.

STEERING:—Steering Gear—Ross Model S-14. Cam-and-Lever type. See article in Steering Section for adjustments.
Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.
Kingpin Inclination—7½° crosswise.
Caster—2½°. Use wedge shims inserted between spring and spring pad on axle to correct caster.
Camber—1°. Axle can be bent cold for minor corrections.
Toe In—⅛-3/16". Adjust in usual manner by changing length of tie rod.

BRAKES:—Service—'Graham' Hydraulic, double anchor type. Hand lever applies rear wheel service brakes. See article in Brake Section for complete adjustment procedure.
Drum Diameter—9".
Lining—Moulded type. Width 1¾". Thickness .200". Length 18" per wheel.
Clearance—.008" between lining and drum.
Hand Brake:—See Service Brake (above).

ENGINE NUMBER:—First number—205,001 (90), 210,001 (90-A), 105,001 (110). On plate on right side of crankcase and on chassis serial number plate.

ENGINE SPECIFICATIONS:—6 cylinder, 'L' head.
Bore—3¼". **Stroke**—4" (90-A), 4⅜" (90, 110).
Displacement—199.1 cu. in. (90A), 217.8 cu. in. (90, 110).
Rated Horsepower—25.35 (AMA).
Developed Horsepower—90 (85 @ 3300 R.P.M.), 90-A (80 @ 3300 R.P.M.), 110 (112 @ 4000 R.P.M.).
Compression Ratio—6.7-1 Std. aluminum head. No optional ratios.
Compression Pressure—115 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 15-17" with engine idling at 5-7 M.P.H.

PISTONS:—Bohn Bohnalite, aluminum alloy, Invar strut, Cam-ground type. Pistons are not slotted.
Length—3⅝".
Weight—17 ozs. Held to two gram variation.
Removal—Pistons and rods removed from above.
Clearance—Skirt .0025". See Fitting New Pistons.
Replacement Pistons:—Finished replacement pistons furnished 3.247" to 3.277" (in .002" steps). Semi-finished pistons also furnished.
Fitting New Pistons:—Use .0025" feeler ½" wide inserted between piston and cylinder wall. Pull required to withdraw feeler should be 5-12 lbs.

PISTON RINGS:—Two compression (#2 grooved), two oil control rings per piston, all above pin. Lower ring grooves drilled radially with twelve 9/64" oil drain holes.

Ring	Width	End Gap
Comp (top)	3/32"	.010-.017"
Comp (#2)	⅛"	.010-.017"
Oil Cont. (all)	5/32"	.010-.017"

NOTE—Side clearance for all rings .0005-.001".
Replacement Rings:—Furnished in standard and .010", .020", .030" oversizes.
NOTE—Install #2 compression ring with groove down.

PISTON PIN:—Diameter 13/16". **Length** 2 13/16".
Pin is locked in rod with clamp screw.
Pin Fit in Piston—.0005" clearance.
Replacement Pins:—Pins furnished standard and .002", .005", .010 oversizes.
NOTE—Pin oiled by four 5/32" oil holes in upper part of piston bosses.

CONNECTING ROD:—Weight—All rods held within limits.
Length—7" (center-to-center).
Crankpin Journal Diameter—1 15/16".
Lower Bearing—Removable steel-backed, cadmium-nickel lined type, no shims.
Clearance—.002". Sideplay .004-.006".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps or rods.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5) and toward front (#2, 4, 6). Oil hole in lower bearing upper half must be toward camshaft on all rods.

CRANKSHAFT:—4 bearing. Integral counterweights.
Journal Diameters—2¼" (all bearings).
Bearing Type—Removable steel-backed, cadmium-nickel lined type. No shims.
Clearance—.002".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps.
End Thrust:—Taken by thrust plate at front (#1) bearing. Adjusted by adding or removing shims. Endplay .004-.006".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 1⅞"; #2, 1 13/16"; #3, 1¾"; #4, 1¼".
Bearing Type—Bronze.
End Thrust:—Taken by thrust plate behind camshaft sprocket. Adjusted by adding or removing shims.
Timing Chain:—Link-Belt. Width 1". Pitch .500". Length 23" or 46 links.
Camshaft Setting:—Sprockets marked. Mesh chain so that there are nine links between marks on sprockets or ten pins inclusive of pins meshed opposite marks.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 13/64"	.3125"	5 3/16"
Exhaust	1 21/64"	.3125"	5 3/16"

	Seat Angle	Lift	Stem Clearance
Intake	30°	5/16"	.001-.0026"
Exhaust	45°	5/16"	.002-.0036"

Tappet Clearance—.010" all valves. Engine hot.
Valve Guides:—Single piece, removable, cast-iron, press-fit in block.

Valve Springs:—	Spring Pressure	Spring Length
Valve Closed	34 lbs.	2 3/16"
Valve Open	87 lbs.	1⅞"

Valve Lifters:—Single piece cast-iron, cylindrical type 1" diameter. Lifter guides 1 21/32" in length, integral with block. Finished to give .0005-.0015" clearance for lifters.
Valve Timing:—See Camshaft Setting above.

Models 90 and 110

Intake Valves—Open 4½° BTDC. Close 47½° ALDC.
Exhaust Valves—Open 47½° BLDC. Close 4½° ATDC.

Model 90-A

Intake Valves—Open 2° ATDC. Close 54° ALDC.
Exhaust Valves—Open 41° BLDC. Close 11° ATDC.
To Check Valve Timing—Set tappet clearance #1 exhaust valve at .012". This valve should close with #1 piston .0088" past top dead center (90 & 110) and .0472" past top dead center (90-A) when flywheel mark 'EC-1' lines up with indicator in right front face of flywheel housing. Reset tappet clearance at .010" with engine hot.
Motor Gauge—Weidenhoff Adapter #114, Rod #2.

SUPERCHARGER:—Model 110 only. Centrifugal type supercharger located between carburetor and manifold (downdraft carburetor is mounted on top of supercharger).
Supercharger Drive Chain:—Link-Belt. Width 1½". Pitch ⅜". Length 27" or 72 links.
Chain Adjustment—Chain adjusted by shifting accessory sprocket (water pump bracket). To adjust, loosen flange mounting screws, back off adjustment setscrew locknut, turn up adjustment setscrew until chain hums with engine running, back off screw until chain runs noiselessly, tighten locknut and mounting screws. This is the only adjustment necessary for supercharger operation.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.
Normal Oil Pressure:—50 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Located on right hand side of crankcase under plug. Maintains pressure in crankcase at 50 lbs. Adjustable by adding or removing shims or washers in plug above spring.
Crankcase Capacity:—5 quarts (refill).

CLUTCH:—Illinois. Single plate, dry disc type. See article in Clutch Section for servicing directions.
Adjustment—Free movement of clutch pedal must be 1-1¼". To adjust, take out cotter pin at either end of clutch pedal connecting link, turn turnbuckle to secure correct lash, replace cotter pin, tighten turnbuckle locknut. When limit of adjustment is reached, loosen two capscrews in clutch mounting bracket slightly (reached through hand opening in bottom of clutch bell housing), pull out shim under bracket (shim holes are slotted—not necessary to take out capscrews completely), tighten bracket screws. This will provide new range of adjustment on connecting link. Shims can be discarded. New shims of correct thickness are supplied with new driven plate.
Removal—Disconnect clutch linkage, drop driveshaft, remove transmission supporting engine at rear of oil pan, remove clutch bell housing, take out clutch mounting bolts, turning all bolts out evenly, then remove clutch assembly.

STEERING—Steering Gear. Ross Model 540 (90 & 110) Cam-and-Roller type. Ross Model 140 (90-A) Cam-and-Lever type. See article in Steering Section for adjustments.
Front Suspensions:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.
Kingpin Inclination—7½° crosswise.
Caster—2½°. Use wedge shims inserted between spring and spring pad on axle to correct caster.
Toe In—⅛-3/16". Adjust in usual manner by changing length of tie rod.

BRAKES:—Service—Lockheed Hydraulic, double anchor type. Hand lever applies brake at rear of transmission (90 & 110), rear wheel service brakes (90-A). See article in Brake Section for complete adjustment procedure.
Drum Diameter—11" (90 & 110), 9" (90-A).
Lining—Moulded type. Width 1¾". Thickness ¼" (90 & 110), .200" (90-A). Length per wheel 23" (90 & 110), 18" (90-A).
Clearance—.006" heel, .010" toe, for each shoe (90 & 110); .008" between lining and drum (90-A).
Hand Brake:—External type on drums at rear of transmission (90 & 110).
Adjustment—With lever in released position, remove anchor screw locking wire, turn anchor screw to give 1/32" clearance between lining and drum, lock anchor screw with wire. Adjust brake band bolt nut to give 1/32" clearance for lower half of band, secure with locknut. Finally, adjust brake adjusting bolt nut to give 1/32" clearance (as above) for upper portion of band.
Drum Diameter—6".
Lining—Width 2". Thickness 5/32". Length 17¾". NOTE—Hand Brake data above for Models 90 & 110 only. See Service Brake (above) for Model 90-A Hand Brake.

ENGINE NUMBER:—First number—79,000. Stamped on left side of cylinder block opposite #6 cylinder.

ENGINE SPECIFICATIONS:—Type—6 cyl .'L' head.
Bore—3". **Stroke**—5".
Displacement—212 cubic inches.
Rated Horsepower—21.6 (AMA).
Developed Horsepower—93 at 3800 R.P.M. (Std. 6.25-1 head), 100 at 3800 R.P.M. (Optl. 7.0-1 head).
Compression Ratio & Pressure—To check pressures, remove spark plugs, crank engine with throttle wide open.
Std. 6.25-1 Head.....116 lbs. at 219 R.P.M.
Optl. 7.0-1 Head.....127 lbs. at 207 R.PM..
Vacuum Reading—Gauge should show steady reading of 18-19" of HG. with engine idling at 350 R.P.M. or 7 M.P.H.
NOTE—High Octane fuel must be used in engines with optional high compression 7.0-1 head.

PISTONS:—Own Lo-Ex aluminum alloy, "T' slot, Cam ground type. Use finished replacement pistons when reconditioning engine. See Reconditioning paragraph.
Weight—10.5 ozs. stripped. Stamped on piston head.
Length—3 3/16".
Removal—Pistons and rods removed from above.
Clearance—Top .016". Skirt .002". See Fitting new Pistons.
NOTE—These pistons interchangeable with 1935 and may be installed in complete sets on 1934 model.
Reconditioning Cylinders:—Size of original bore indicated by letter stamped on lower edge of valve chamber opposite cylinder as follows: A-3.000", B-3.0005", C-3.001", D-3.0015", E-3.002", AO-3.010", BO-3.0105", CO-3.011", DO-3.0115", EO-3.012". Recondition cylinder to standard oversize for which replacement piston and rings are available (see piston and ring data below).
Replacement Pistons:—Standard and oversize pistons marked by letter on head available for **cylinder bores** of size indicated: 'B'-3.000 & 3.0005", 'D'-3.001 & 3.0015", 'F'-3.002 & 3.0025", 'J'-3.004", 'L'-3.005". 'BO-3.010 & 3.0105", 'DO'-3.011 & 3.0115", 'FO'-3.012 & 3.0125", 'LO'-3.015", 'BB'-3.020", 'DD'-3.021, 'FF'-3.022". All pistons installed in engine must be of same weight as indicated by mark on head.
Fitting New Pistons:—Use .0015" feeler ½" wide on side opposite slot at right angles to pin bosses to check clearance. Tension to withdraw feeler must be 3-4 lbs.
Installing Pistons:—Slot toward left or away from camshaft.

PISTON RINGS:—Two compression, one oil ring above pin, one oil ring below pin per piston. Upper oil ring groove drilled with twelve 5/16" oil drain holes and two 5/16" holes to pins. Lower oil ring groove drilled with four 5/16" holes and two oil drain slots. Rings are straight cut and are positioned by pin in piston ring groove.

Ring	Width	End Gap	Wall Thickness
Comp.	3/32"	.005" Min.	.123"
Oil (both)	3/16"	.005" Min.	.128"

NOTE—Use standard or oversize rings of size indicated for replacement pistons (see replacement piston section above): 3.000"—B, D, F; 3.003"—J; 3.005"—L; 3.010"—BO, DO, FO; 3.015"—LO; 3.020"—BB, DD, FF. If rings are filed, clearance at pin must be kept uniform with end gap.

PISTON PIN:—Diameter ¾". **Length** 2 7/16".
Pin floats in piston and rod. Held by locking ring at each end. Pin hole in rod is bronze-bushed. Pins furnished standard, .002", .005", .010" oversize.
Pin Fit in Piston—Hand push fit with piston heated to 200° F.
Pin Fit in Rod Bushing—.0003" clearance. With this clearance rod will just turn of own weight.

CONNECTING ROD:—Weight 29.4 ozs. **Length** 8 3/16".
Crankpin Journal Diameter—1 15/16".
Lower Bearing—Spun-babbitt lined type. Rods serviced on 'exchange' basis.
Clearance—.001". **Sideplay**—.006-.010".
Bearing Adjustment:—Laminated shims. Do not file rods or caps.
Installing Rods:—Lower bearings are offset. Install rods with right hand offset (widest half of bearing toward rear) in cylinders #1, 2, 4, and rods with left hand offset (widest half of bearing toward front) in cylinders #3, 5, 6. Oil scoop on bearing must be toward camshaft on all rods.

CRANKSHAFT:—Three bearing. Integral counterw'ts.
Journal Diameters—#1, 2 11/32"; #2, 2⅜"; #3, 2 13/32".
Bearing Type—Removable bronze-backed, babbitt-lined. Bearings furnished for service reamed to standard size or unfinished with 1/32" stock to permit reaming to desired size.
Clearance—.001".
Bearing Adjustment:—Laminated shims. Do not file bearing caps.
End Thrust:—Taken by flanges on #2 (center) main bearing. Endplay .006-.012". Adjusted by replacing bearing.

CAMSHAFT:—Three bearing. Gear driven.
Journal Diameters—#1, 2"; #2, 1 31/32". #3, 1½".
Bearing Clearance—.0015".
End Thrust:—Taken by spring loaded plunger in end of camshaft and thrust plate on gear case cover.
NOTE—If gear case cover removed, see that spring and plunger are in place when cover replaced.
Timing Gears:—Crankshaft gear cast-iron. Camshaft gear GE. or Continental Diamond Fibre Bakelite.
Camshaft Setting:—Gears are marked. Mesh marked tooth of crankshaft gear between two marked teeth on camshaft gear.

VALVES:—Head Diameter Stem Diameter Length
All Valves .....1 ⅜"..... ⅜"..... 5 11/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.0015-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" intake, .008" exhaust with engine hot.
Valve Guides:—Removable type. Pressed in block. Finish ream guides after installation to size giving correct clearance.
Valve Springs:—Cages installed on bottom of all springs. Springs should be installed with open side of cage toward cylinder.

	Spring Pressure	Spring Length
Valve Closed	44 lbs.	2"
Valve Open	102 lbs.	1 21/32"

Valve Lifters:—Slipper type operating in individual removable guides. Lifter is prevented from turning by pin in guide.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 10°40' BTDC. Close 60° ALDC.
Exhaust Valves—Open 50° BLDC. Close 18°44' ATDC.
These figures correct with .010" tappet clearance.
To Check Timing—Set tappet clearance #1 intake valve at .010". This valve should open with piston 10°40' or .0562" before top dead center when point on flywheel appoximately 3.94 teeth before 'UDC. 1-6/' mark lines up with indicator in hole in left front face of flywheel housing. Reset tappet clearance at .006" hot.
Motor Gauge—Weidenhoff #114 Adapter, #44 Rod.

LUBRICATION:—Duo-flow (splash) system. Force feed by oil pump to connecting rod troughs and timing gears. Splash to all other bearing points from troughs.
Normal Oil Pressure—3 lbs.
Oil Pressure Regulator—Operates at 3 lbs. Located on right side of crankcase. Not adjustable.
Crankcase Capacity—6 qts. refill.
Oil Pump:—Oscillating plunger type pump mounted on right side of crankcase and driven by gears from the camshaft.
Oil Pressure Indicator:—Consists of signal light on instrument panel and switch built in oil pressure regulator. See article in Equipment Section for complete data.

CLUTCH:—Own Make—Single plate, cork insert type operating in oil. Driven plate can be recorked but is customarily replaced.
Clutch Plate—Thickness .203". Inside diameter 5.375". Outside diameter 8.625". Facing consists of 90 cork inserts.
Adjustment—Free movement of clutch pedal must be 1½" at all times. To adjust, remove clevis pin in clutch pedal link rod (between frame and leg of 'X' member below clutch pedal shaft), loosen locknut at top of clevis, turn clevis to shorten or lengthen rod as required, tighten locknut, replace clevis pin. On cars with automatic clutch control, check linkage whenever clutch is adjusted.
Automatic Clutch Linkage Adjustment—Hold accelerator pedal in depressed position, pull backward on clutch control power unit rod at left of engine. With rod in extreme rear position check clearance between back of slot in rod yoke and clevis pin which attaches it to operating lever. Clearance at this point must be ⅞".
Servicing:—Oil in clutch should be renewed at 5000 mile intervals. See Hndson Eight (next page).

STEERING:—Steering Gear—Gemmer Model Worm-and-Sector type. See article in Steering Section for adjustments.
NOTE—An adjustable drag link with ¾" adjustment (made by shifting shims from front to rear of pitman arm ball seat) is used on cars after #633110 (except 633153 to 633185 inclusive).
Front Suspension:—Conventional 'I' beam section front axle with Elliott type ends and semi-elliptic springs. Torque arm at each end of axle connected to frame at rear by rubber-bushed bolt maintains axle alignment.
Specifications & Adjustment—Kingpin inclination, Caster, Camber, Toe In, Steering Geometry, and Kingpin thrust bearing specifications and adjustment same as for Hudson Eight (see next page).

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, Single Anchor type. Brake pedal connected to rear wheel brakes through cable linkage for additional reserve mechanical application of brakes. Hand lever applies rear wheel brakes through this same linkage. See article in Brake Section for complete adjustment procedure.
Brake Drum Diameters—10 1/16".
Brake Lining—Moulded & Woven type. Width 1¾". Thickness 7/32". Length 22⅛" per wheel.
Brake Clearance—.010" heel and toe of each shoe.
Brake Pedal Adjustment:—For correct mechanical follow-up feature, adjust position of nut on connecting rod so that clearance between face of nut and end of push rod is 1 29/32" with equalizer against stop.
Hand Brake Adjustment:—See Service Brake Adjustment.

ENGINE NUMBER:—First number—1000 (all models). Stamped on left side of engine block near top.

ENGINE SPECIFICATIONS:—Type—8 cyl., 'L' head.
Bore—3". **Stroke** 4½".
Displacement—254 cubic inches.
Rated Horsepower—28.8 (AMA).
Developed Horsepower—113 at 3800 R.P.M. (Std. 6.0-1 head), 124 at 4000 R.P.M. (Optl. 7.0-1 head).
Compression Ratio & Pressure—To check pressures, remove spark plugs, crank engine with throttle wide open.

Std. 6.0-1 Head	110 lbs. at 150 R.P.M.
Optl. 7.0-1 Head	128 lbs. at 150 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-19" of HG. with engine idling at 350 R.P.M. or 7 M.P.H.
NOTE—High Octane fuel must be used in engines with high compression 7.0-1 heads.

PISTONS:—Own Lo-Ex aluminum alloy, 'T' slot, Cam ground type. Use finished replacement pistons when reconditioning engine. See Reconditioning Section.
Weight—10.88 ozs. stripped. Stamped on piston head.
Length—3 3/16".
Removal—Pistons and rods removed from above.
Clearance—Top .016". Skirt .0015". See Fitting New Pistons.
NOTE—These pistons interchangeable with 1935 and may be installed in complete sets on 1932-33-34 models.
Reconditioning Cylinders:—Original cylinder size marking same as for Hudson Six and should be reconditioned in same manner (see previous page).
Replacement Pistons:—Furnished in same sizes as for Hudson Six (see previous page).
Fitting New Pistons:—Pistons fitted in same manner as on Hudson Six (see previous page).
Installing Pistons:—Slot toward left or away from camshaft.

PISTON RINGS:—Two compression, one oil ring above pin, one oil ring below pin per piston. Upper oil ring groove drilled with twelve 5/16" oil drain holes and two 5/16" holes to pins. Lower oil ring groove drilled with four 5/16" holes and two oil drain slots. Rings are straight cut and positioned by pin in groove.

Ring	Width	End Gap	Wall Thickness
Comp.	3/32"	.005" Min.	.123"
Oil (both)	3/16"	.005" Min.	.128"

NOTE—See Hudson Six (previous page) for ring oversizes and pistons for which used. If rings are filed, clearance at pin must be kept uniform with end gap.

PISTON PIN:—Diameter ¾". Length 2 7/16".
Pin floats in piston and rod. Held by locking ring at each end. Pin hole in rod is bronze-bushed. Pins furnished standard, .002", .005", .010" oversize.
Pin Fit in Piston—Hand push fit with piston heated to 200° F.
Pin Fit in Rod Bushing—.0003" clearance. With this clearance rod will just turn of own weight.

CONNECTING RODS:—Weight 29.4 ozs. **Length** 8 3/16".
Crankpin Journal Diameter—1 15/16".
Lower Bearing—Spun-babbitt lined type. Rods serviced on 'exchange' basis.
Clearance—.001". **Sideplay**—.006-.010".
Bearing Adjustment:—Laminated shims. Do not file rods or caps.
Installing Rods:—Lower bearings are offset. Install rods with right hand offset (widest half of bearing toward rear) in cylinders #1, 3, 5, 7 and rods with left hand offset (widest half of bearing toward front) in cylinders # 2, 4, 6, 8. Oil scoop on bearing cap must be toward camshaft on all rods.

CRANKSHAFT:—Five bearing. Integral counterweights.
Journal Diameters—#1, 2 9/32"; #2, 2 5/16"; #3, 2 11/32"; #4, 2⅜"; #5, 2 13/32".
Bearing Type—Removable bronze-backed, babbitt-lined. Bearings furnished for service reamed to standard size or unfinished with 1/32" stock to permit reaming to desired size.
Clearance—.001".
Bearing Adjustment:—Laminated shims. Do not file bearing caps.
End Thrust:—Taken by flanges on #3 center bearing. Endplay .006-.012". Adjusted by replacing bearing.

CAMSHAFT:—Five bearing. Gear driven.
Journal Diameters—#1, 2 1/32"; #2, 2"; #3, 1 31/32"; #4, 1 15/16"; #5, 1½".
Bearing Clearance—.0015".
End Thrust:—Taken by spring loaded plunger in end of gear and thrust plate on gear case cover.
NOTE—If gear case cover removed, see that spring and plunger are in place when cover replaced.
Timing Gears:—Crankshaft gear cast-iron. Camshaft gear GE. or Continental Diamond Fibre Bakelite.
Camshaft Setting:—Gears are marked. Mesh marked tooth of crankshaft gear between two marked teeth on camshaft gear.

VALVES:—

	Head Diam.	Stem Diam.	Length
Intake	1½"	⅜"	5 3/32"
Exhaust	1⅜"	⅜"	5 3/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.0015-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" intake, .008" exhaust hot.
Valve Guides:—Removable. Pressed in block. Finish ream after installation to size for correct clearance.
Valve Springs:—Cages installed on bottom of all Springs. Install springs with open side of cage toward cylinder.

	Spring Pressure	Spring Length
Valve Closed	44 lbs.	2"
Valve Open	102 lbs.	1 21/32"

Valve Lifters:—Slipper type operating in individual removable guides. Lifter is prevented from turning by pin in guide.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 10°40' BTDC. Close 60° ALDC.
Exhaust Valves—Open 50° BLDC. Close 18°44' ATDC.
To Check Valve Timing—Set tappet clearance #1 intake valve at .010".' This valve should open with piston 10°40' or .0494" BTDC. when point on flywheel approximately 3.97 teeth before 'UDC. 1-8/' mark lines up with indicator in hole in left front face of flywheel housing. Reset tappet clearance at .006".
Motor Gauge—Weidenhoff #114 Adapter, #44 Rod.

LUBRICATION:—Duo-flow (splash) system. Force feed by oil pump to connecting rod troughs and timing gears. Splash to all other points from troughs.
Normal Oil Pressure—3 lbs.
Oil Pressure Regulator—Operates at 3 lbs. Not adjustable. Located on right side of crankcase at rear.
Crankcase Capacity—9 qts.
Oil Pump:—Oscillating plunger type pump mounted on right side of crankcase and driven by gears from camshaft.
Oil Presure Indicator:—Consists of signal light on instrument panel and switch built in oil pressure regulator. See article in Equipment Section.

CLUTCH:—Own Make—Single plate, cork insert type operating in oil. Driven plate can be recorked but is customarily replaced.
Clutch Plate—Thickness .203". Inside diameter 6.375". Outside diameter 9.75". Facing consists of 108 cork inserts.
Adjustment:—Free movement of clutch pedal must be 1½" at all times. To adjust, remove clevis pin in clutch pedal link rod (between frame and leg of 'X' member below clutch pedal shaft), loosen locknut at top of clevis, turn clevis to shorten or lengthen rod as required, tighten locknut, replace clevis pin. On cars with automatic clutch control, check linkage whenever clutch is adjusted.
Automatic Clutch Linkage Adjustment—Hold accelerator pedal in depressed position, pull backward on clutch control power unit rod at left of engine. With rod in extreme rear position check clearance between back of slot in rod yoke and clevis pin which attaches it to operating lever. Clearance at this point must be ⅞".
Servicing:—Oil in clutch should be renewed at 5000 mile intervals. Turn engine over until hexagonal drain plug in front face of flywheel is visible in inspection hole in left front face of housing. Remove plug, turn engine over until star on flywheel is at inspection hole, allow engine to stand in this position for several minutes to drain old oil, turn engine over until filler plug hole is again at inspection hole, insert 1/3 pint Hudsonite, replace filler plug.
Capacity & Oil—1/3 pt. Hudsonite Clutch Lubricant.

STEERING:—Steering Gear—Gemmer Model Worm-and Sector type. See article in Steering Section.
NOTE—An adjustable drag link with ¾" adjustment made by shifting shims from front to rear of pitman arm ball seat is used on cars after #641008 (except 641134 to 641135 inclusive), #65374, #661791, and #671681.
Front Suspension:—Conventional 'I' beam section front axle with Elliott type ends and semi-elliptic springs. Torque arm at each end of axle connected to frame by rubber-bushed bolt used to maintain axle alignment.
King Pin Inclination—7° crosswise.
NOTE—Kingpin end thrust taken by five loose balls in upper bushing above king pin. Ball seat formed in bushing and on king pin end. To install king pin, assemble sufficient shims to allow .006-.010" endplay below spindle, insert king pin until it enters top bushing, drop 5 loose balls through lubrication fitting hole on top of bushing, insert driver J-479-1 in hole to position balls, drive king pin up into place.
Caster—3½-4½°. To adjust, loosen nut on horizontal arm attaching torque arm to axle yoke, take out capscrew between arm and yoke at top, decrease shim thickness between arm and yoke to increase caster, or increase shim thickness to decrease caster. .060" difference in shim thickness changes caster 1°. Shim thickness on both sides of car must be kept equal.
Camber—1-1½°. No adjustment. Axle may be bent cold for minor corrections.
Toe In—⅛" (0-⅛"). Adjusted in usual manner by loosening clamp nuts and turning tie rod.
Steering Geometry—Inner wheel turned 20°, outer wheel 17°. Check tie rod ends and steering arms for looseness, replace steering arms if bent.

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, Single Anchor type. Brake pedal connected to rear wheel brakes through cable linkage for additional reserve mechanical application of brakes. Hand lever applies rear wheel brakes through this same linkage. See article in Brake Section.
Brake Drum Diameters—11 1/16".
Brake Lining—Moulded & Woven type. Width 1¾". Thickness 7/32". Length 23 15/16" per wheel.
Brake Clearance—.010" heel and toe of each shoe.
Brake Pedal Adjustment:—For correct mechanical follow-up feature. See article in Brake Section.
Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—First number—'G'-5001. Stamped on left side of crankcase.

ENGINE SPECIFICATIONS:—6 cylinder, 'L' head.

Bore—3½". **Stroke**—4¼".

Displacement—245.3 cubic inches.

Rated Horsepower—29.42 (AMA).

Developed Horsepower—101 at 3600 R.P.M.

Compression Ratio—5.75-1 std. cast-iron head, 6.2-1 optl. aluminum head.

Compression Pressure—5.75 Std. head, 141 lbs. at 3000 R.P.M. or 107 lbs. at 160 R.P.M. (crank'g speed).

Vacuum Reading—Gauge should show stead reading of 18-20" at idling speed.

PISTONS:—Bohn, aluminum alloy, Invar strut, split skirt type. **Length**—4 3/32".

Weight—21.7 ozs. (stripped).

Removal—Pistons and rods removed from above.

Clearance—Top .020". Skirt .002". See Fitting New Pistons.

Replacement Pistons:—Finished replacement pistons furnished in standard and .001", .002", .003", .005", .010", .020", .022", .025", .032" oversizes.

NOTE—Second standard cylinder bore size .020" larger than above.

Fitting New Pistons:—With .002" feeler stock, pull required to withdraw feeler from between piston and cylinder wall on side opposite slot must be between 10-13 lbs.

Installing Pistons:—Slot should be toward left or away from camshaft side. Pin hole in piston offset 1/16" toward camshaft.

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Both oil ring grooves drilled radially with oil drain holes.

Ring	Width	End Gap	Wall Thickness
Comp (all)	⅛"	.007-.012"	.150"
Oil Cont (all)	5/32"	.007-.015"	.150"

PISTON PIN:—**Diameter** ⅞". **Length** 2 15/16". Pin floats in piston and rod. Held by retaining rings.

Pin Fit in Piston—Hand push fit with piston heated to 150° F.

Pin Fit in Rod Bushing—.0005" clearance.

CONNECTING ROD:—**Weight** 35 ozs. **Length** 8¼".

Crankpin Journal Diameter—2⅛".

Lower Bearing—Removable steel-backed, babbitt-lined type.

Clearance—.0015-.002". Sideplay .005-.010".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps.

Installing Rods:—Lower bearings are offset. Install rods with narrow half of bearing toward nearest main bearing or pointing toward front of engine for #1, 3, 5 and toward rear for #2, 4, 6.

CRANKSHAFT:—4 bearing. Integral counterweights.

Journal Diameters—2.560" (all bearings).

Bearing Type—Removable, steel-backed, babbitt-lined.

Clearance—.001-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust:—Taken by #2 bearing. Endplay .004-.008". No adjustment. Replace bearing.

CAMSHAFT:—4 bearing. Non-adjustable chain drive.

Bearing Type—Bronze.

Clearance—.0015-.002".

End Thrust:—Taken by thrust plate at rear of sprocket hub. Replace plate if endplay excessive.

Timing Chain:—Morse #1886. Width 1". Pitch .500". Length 25½" or 51 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:—	Head Diameter	Stem Diameter	Length
Intake	1 21/32"	.3405-.3415"	4 7/16"
Exhaust	1 17/32"	.3405-.3415"	4 7/16"

	Seat Angle	Lift	Side Clearance
Intake	45°	11/32"	.0015" max.
Exhaust	45°	11/32"	.0015" max.

Tappet Clearance—.010" Int., .013" Exh., running clearance with engine warm. Clearance for timing is .014" Int. opening, .018" Int. closing, .017" Exh. opening, .021" Exh. closing.

Valve Guides—Single piece, removable type.

Valve Springs:—	Spring Pressure	Length
Valve Closed	40 lbs.	1 13/16"
Valve Open	100 lbs.	1 15/32"

Valve Lifters:—Mushroom type, removable.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 2° BTDC. Close 51° ALDC.

Exhaust Valves—Open 44° BLDC. Close 3° ATDC.

To Check Valve Timing—Set tappet clearance of #1 valves at .014" Int., .021" Exh. With #6 piston on top dead center entering power stroke and flywheel mark 'DC"1-6' lined up with finished bosses on right front face of flywheel housing, #1 intake and exhaust valves should be closed. Reset tappet clearance at .010" Int., .013" Exh.

Motor Gauge—Weidenhoff Adapter #104, Rod #2.

LUBRICATION:—Pressure. Gear type oil pump located on right hand side of crankcase.

NOTE—Whenever oil pump is removed, turn engine over until #1 piston is at firing position (see ignition timing), mesh oil pump drive gear so that tongue and slot connection meshes without disturbing position of distributor shaft, recheck ignition timing.

Normal Oil Pressure:—3-5 lbs. idling, 30 lbs. at 30 M.P.H.

Oil Pressure Relief Valve:—Located on oil pump cover. Operates at 35-45 lbs. Adjustable by turning screw on relief valve cover in or clockwise to increase pressure, and out or counter-clockwise to decrease pressure.

Crankcase Capacity:—6 quarts (refill).

CLUTCH:—**Borg & Beck Model 10A6.** Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal should be ¾-1". Adjustment provided on connector link. Turn screw in or out for proper clearance.

Removal—Disconnect clutch linkage, remove transmission, drop clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts turning all bolts out evenly to release spring tension. Remove clutch from below. Use pilot studs when removing and installing transmission to avoid springing clutch plate.

STEERING—Steering Gear—Ross Model S14. Cam-and-lever type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.

Kingpin Inclination—7½° crosswise.

Caster—1½° plus or minus ½°. Adjust by installing wedge shims between spring and spring pad on axle.

Camber—1°. No adjustment provided.

Toe In—1/16" plus or minus 1/16" measured at hub height.

BRAKES:—**Service**—Lockheed Hydraulic, double anchor type. Hand lever applies rear service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—10".

Lining—Moulded type. Width 2". Thickness 3/16". Length per wheel 20⅞".

Clearance—.010" toe, .005" heel, for each shoe.

Hand Brake Adjustment:—See Service Brake.

ENGINE NUMBER:—First number—'N'-5001. Stamped on left side of crankcase.

ENGINE SPECIFICATIONS:—8 cylinder, 'L' head.

Bore—3 3/16". **Stroke** 4¾".

Displacement—303.2 cubic inches.

Rated Horsepower—32.51 (AMA).

Developed Horsepower—120 at 3500 R.P.M.

Compression Ratio—5.80-1 Std. cast-iron head. No optional ratios.

Compression Pressure—5.80-1 Std. head, 142 lbs. at 2000 R.P.M. or 113 lbs. at 160 R.P.M. (cranking speed).

Vacuum Reading—Gauge should show steady reading at 18-20" at idling speed.

PISTONS:—Bohn, aluminum alloy, Invar strut, split skirt type. **Length**—3⅞".

Weight—18.4 ounces (stripped).

Removal—Pistons and rods from below.

Clearance—Skirt .002". See Fitting New Pistons. NOTE—Second standard cylinder bore size .020" larger than above.

Fitting New Pistons:—Use .002" feeler stock to check clearance. Pull required to withdraw feeler from between piston and cylinder wall on side opposite slot must be between 6-8 lbs.

Installing Pistons:—Slot should be toward left or away from camshaft side. Pin hole in piston is offset 1/16" toward camshaft.

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Both oil ring grooves drilled radially with oil drain holes.

Ring	Width	End Gap	Wall Thickness
Comp (all)	⅛"	.007-.012"	.140"
Oil Cont (all)	5/32"	.007-.015"	.140"

PISTON PIN:—Diameter ⅞". Length 2 23/32".

Pin floats in piston and rod. Held by retaining rings.

Pin Fit in Piston—Hand push fit with piston heated to 150° F.

Pin Fit in Rod Bushing—.0005" clearance.

CONNECTING ROD:—Weight 39.4 ozs. **Length** 9½".

Crankpin Journal Diameter—2⅜".

Lower Bearing—Removable steel-backed, babbitt-lined type.

Clearance—.0015-.002". Sideplay .005-.010".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

Installing Rods:—Lower bearings are offset. Install rods with narrow half of bearing toward nearest main bearing or pointing toward front of engine for #1, 3, 5, 7 rods and toward rear for #2, 4, 6, 8.

CRANKSHAFT:—5 bearing. Integral counterweights.

Journal Diameters—2.665" (all bearings).

Bearing Type—Removable steel-backed, babbitt-lined type.

Clearance—.001-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust:—Taken by #3 bearing. Endplay .004-.008". No adjustment. Replace bearing.

CAMSHAFT:—6 bearing. Non-adjustable chain drive.

Bearing Type—Bronze.

Clearance—.0015-.002".

End Thrust:—Taken by thrust plate at rear of sprocket hub. Replace plate if endplay excessive.

Timing Chain:—Morse Type 766. Width 1¼". Pitch .375". Length 24¾" or 66 links.

Camshaft Setting:—Sprockets are marked. Mesh chain so there are exactly 15 links between marks on sprockets or 16 teeth inclusive of teeth meshed opposite marks.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 17/32"	.3405-.3415"	5⅛"
Exhaust	1 13/32"	.3405-.3415"	5⅛"

	Seat Angle	Lift	Stem Clearance
Intake	45°	.325"	.0015" max.
Exhaust	45°	.325"	.0015" max.

Tappet Clearance—.006" Int., .013" Exh., running clearance with engine warm. Clearance for timing is .010" Int., .017" Exh.

Valve Guides:—Single piece, removable type.

Valve Springs:—	Spring Pressure	Length
Valve Closed	40 lbs.	1-13/16"
Valve Open	100 lbs.	1 15/32"

Valve Lifters:—Removable mushroom type.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 1° ATDC. Close 49° ALDC.

Exhaust Valves—Open 45° BLDC. Close 3° ATDC.

To Check Valve Timing—Set tappet clearance of #1 valves at .010" Int., .017" Exh. With #8 piston on top dead center entering power stroke and flywheel mark '1°8' lined up with indicater in inspection hole in right hand top face of flywheel housing, #1 intake and exhaust valves should be closed. Reset tappet clearance at .006" intake, .013" exhaust, engine warm.

Motor Gauge—Weidenhoff Adapter #104, Rod #2.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

NOTE—Whenever oil pump is removed, turn engine over until #1 piston is at firing position (see ignition timing), mesh oil pump drive gear so that tongue-and-slot connection meshes without disturbing position of distributor shaft, recheck ignition timing.

Normal Oil Pressure:—3-5 lbs. idling, 30 lbs. at 50 M.P.H. with engine warm.

Oil Pressure Relief Valve:—Operates at 35-45 lbs. Located on left side of engine approximately center of crankcase. Adjustable by turning screw in or clockwise to increase pressure and out or counter-clockwise to decrease pressure.

Crankcase Capacity:—8 quarts (refill).

CLUTCH:—Long Model 10-CF-CI. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal should be 1¼-1½". Adjustment provided on connector link. Turn screw in or out for proper clearance.

Removal—Disconnect clutch linkage, remove transmission, take off clutch bell housing, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts turning all bolts out evenly to release spring tension. Remove clutch. Use pilot studs when removing and installing transmission to avoid springing clutch plate.

STEERING:—Steering Gear—Gemmer Model Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.

Kingpin Inclination—8½° crosswise.

Caster—1½° plus or minus ½°. Adjust by installing wedge shims between spring and spring pad on axle.

Camber—1¼° plus or minus 1/16°. No adjustment.

Toe In—1/16" plus or minus 1/16". Adjust in usual manner by changing length of tie rod.

Kick Shackle—Clearance between spring eye and stopscrew on kick shackle should be .125" or 2½ turns. Check if steering is unsteady or car wanders.

BRAKES:—Service—Lockheed Hydraulic, double anchor type. Hand lever applies rear service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—12".

Lining—Moulded type. Width 2". Thickness 3/16". Length per wheel 24⅜".

Clearance—.010" heel, .005" toe, for each shoe.

Hand Brake Adjustment:—See Service Brake.

ENGINE NUMBER:—On plate on right side of crankcase at front of engine below valve cover plate. Serial number (L-23101 up) on right frame side member under engine hood.

ENGINE SPECIFICATIONS:—Type—6 cyl., 'L' head.

Bore—3¼". **Stroke**—4⅜".

Displacement—217.7 cubic inches.

Rated Horsepower—25.35 (SAE).

Developed Horsepower—83 at 3200 R.P.M.

Compression Ratio and Pressure—5.54-1 std. cast-iron head. Pressure—125 lbs. at 350 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 5-7 M.P.H.

PISTONS:—Nelson Bohnalite, aluminum alloy, Invar strut, split skirt type.

Length—3⅞".

Weight—18¼ ounces.

Removal—Pistons and rods removed from above.

Clearance—Skirt .002". See Fitting New Pistons.

Fitting New Pistons:—Use .002" feeler stock inserted between piston and cylinder wall on side opposite slot to check clearance.

Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression rings, two oil control rings per piston, all above pin.

Ring	Width	End Gap
Comp. All	⅛"	.010-.025"
Oil Cont. (#3)	⅛"	.010-.025"
Oil Cont. (#4)	3/16"	.010-.025"

PISTON PIN:—Diameter—⅞". Pin floats in piston and rod. Pin hole in rod is bronze bushed. Pins furnished for service standard, .001", .003", .005" oversize.

Pin Fit in Piston—Light push fit with piston heated.

Pin Fit in Rod Bushing—.0001" or light push fit with both parts at normal temperature.

CONNECTING ROD:—Length—8¾".

Weight—36¼ ounces.

Upper Bearing (Piston Pin Bushing)—Bronze.

Crankpin Journal Diameter—2".

Lower Bearing—Interchangeable steel-backed, copper-lead lined type. Shims used.

Clearance—.002-.003". Sideplay .008-.012".

Bearing Adjustment:—Shims. Do not file rods or caps. Replace bearings when necessary.

CRANKSHAFT:—7 bearing. Integral counterweights.

Journal Diameters—2 31/64" all bearings.

Bearing Type—Interchangeable steel-backed, copper-lead lined. Shims used.

Clearance—.002-.0025".

Bearing Adjustment:—Shims. Do not file caps. Replace bearings when necessary. Bearing upper halves can be removed without removing crankshaft.

End Thrust:—Taken by center bearing. Endplay .004-.007".

CAMSHAFT:—6 bearing. Non-adjustable chain drive.

Bearing Type—Removable steel-backed, babbitt-lined type.

Timing Chain:—Diamond 'double strand' roller chain. Width 9/16". Pitch ⅜". Length 22½" or 60 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers. Remove and install chain 'endless.' Use special gear pullers and pushers, keep sprockets lined up so as to avoid sidestrain on chain or sprockets

VALVES:—	Head Diam.	Stem Diam.	Seat Width
Intake	1 21/32"	.341"	1/16"
Exhaust	1 17/32"	.341"	1/16"

	Seat Angle	Lift	Stem Clearance
Intake	45°	5/16"	.002"
Exhaust	45°	5/16"	.002"

Tappet Clearance—.015" all valves—engine hot or cold.

Valve Timing:—See Camshaft Setting Above.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Presure:—25 lbs., 10 lbs. idling.

Oil Pressure Relief Valve:—Located on oil pump. Operates at 25 lbs. Adjustable by turning screw.

Crankcase Capacity:—7 quarts (full).

CLUTCH:—Borg & Beck Model 9A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal must be ½-1". Adjust whenever free movement is less than ½". To adjust, loosen nut on lower end of clutch pedal. Setscrew on throwout shaft at right end of clutch housing should not contact stop on case.

Removal—Disconnect driveshaft at rear of transmission, remove transmission, drop clutch housing underpan, take out capscrews mounting clutch on flywheel turning all screws out evenly to release spring pressure. Clutch assembly can then be removed from below without removing flywheel housing.

STEERING:—Steering Gear—Gemmer Model. Worm-and Roller type. See article in Steering Section for complete adjustment procedure.

Front Suspension:—Conventional 'I' beam front axle with Reverse-Elliott ends and semi-elliptic springs.

Kingpin Inclination—7° crosswise.

Camber—0-1½°. No adjustment.

Caster—2-4° according to car load. Adjust by inserting wedge shims between spring and spring pad on axle.

Toe In—0-⅛". To adjust, loosen clamp at right end of tie rod, turn tie rod in or out of this end joint, tighten clamp.

Tread—59" (front), 62" (rear).

BRAKES:—Service—Bendix Hydr., Duo-Servo, single anchor type. Hand lever applies rear service brakes. See article in Brake Section for complete adjustment and relining procedure.

Drum Diameter—10".

Lining—Moulded type. Width 2". Thickness 3/16". Length 22 1/16" per wheel.

Clearance—.010" between drum and lining.

Hand Brake Adjustment:—Should be adjusted whenever service brakes adjusted. Turn adjusting screw in wheel to that shoes are tight in drum. Loosen two bracket bolts, pull hand brake lever 'on' three notches, pull bracket forward removing all slack in cables and tighten bolts. Then with lever in released position readjust shoes to give .010" clearance in drums by checking with feeler gauge through slot in drum.

CHEVROLET MODELS FA, FB, FC, FD, R.

CONTINUED FROM PAGE M-107

STEERING:—Steering Gear—Saginaw Worm-and-Sector (Std. FC) Worm-and-Roller (Mstr, FA, FD). See article in Steering Section for adjustments.

Front Suspension Std. FC., Mstr. FD:—Conventional 'I' beam front axle with semi-elliptic springs.

Kingpin Inclination—7°10' plus or minus 1°. Angle on both wheels must be same within ½°.

Caster—2¾° (St.FC), 1¾° (FB), 2¾° (R), 3° (Mstr. FD) plus or minus ½°. Must be same within ¼° on both wheels. Adjusted by inserting wedge shims between spring and spring pad.

Camber—1° plus or minus ½°. Must be same within ¼° on both wheels. No adjustment. Axle may be bent cold for minor corrections.

Toe In—5/64-⅛". Adjusted in usual manner by turning tie rod to increase or decrease length.

Steering Geometry—Inner wheel turned 23°, outer wheel 20°. Check tie rod ends and kingpin for looseness, replace steering arms.

Front Suspension Master Model FA:—Independent 'Knee Action' Type. See article in Steering Section for adjustments. Specifications below correct with car weight supported by horses at wheel spindle inner bearing cone.

Wheel Setting (Suspension Unit Height)—5⅜" from bottom of kingpin support to bottom of brake flange plate.

Kingpin Inclination—7¾° crosswise.

Camber—¼°. No adjustment provided.

Kingpin Caster—0°. Caster effect secured by trailing wheel behind suspension unit.

Toe In—1/16-3/32" measured at hub height on center of tire tread.

Steering Geometry—Inner wheel 23°, outer 20°

BRAKES:—Own design. Four-wheel hydraulic type. Hand brake lever applies rear wheel brakes. See article in Brake Section for complete adjustment instructions.

Wheel Cylinders—Diameters, (Mstr. FA, FD & FB) Front wheel 1¼", Rear wheel 1 3/16". (Std.FC) Front wheel 1⅛", Rear wheel 1 1/16". (R) Front wheel 1¼", Rear wheel 1½". Not interchangeable.

Brake Drum Diameter—11".

Lining—Semi-moulded (Std.FC), Moulded (Mstr. FA, FD), (FB). Width 1¾". Thickness 3/16". Length 22⅝" per wheel.

Brake Clearance—Adjusting cover backed off 4 notches from slight drag position.

Hand Brake Adjustment:—See Service Brake.

ENGINE NUMBER:—First number—2210001. On left hand top front corner of cylinder block (below head).

ENGINE SPECIFICATIONS:—8 cylinder, 'L' head.
Bore—3". **Stroke**—4⅜".
Displacement—248 cubic inches.
Rated Horsepower—28.8.
Developed Horsepower—105 at 3600 R.P.M. (Std. 6.25-1 head).
Compression Ratio—6.25-1 Std. cast-iron head.
NOTE—Shims for reducing compression ratio to 5.75-1 available for special operating conditions.
Compression Pressure—160 lbs. at 1000 R.P.M. or approximately 105-110 lbs. at cranking speed for std. 6.25-1 head.
Vacuum Reading—Gauge should show steady reading of 20-21" with engine idling at 6 M.P.H.

PISTONS:—Lynite, Lo-Ex aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface). Pistons cannot be ground.
Length—3 11/16". **Weight**—12.128 ozs.
Removal—Pistons and rods removed from below.
Clearance—Top .015". Bottom of Skirt .0011-.0015". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard (2.9982-3.0002") and .003" (3.0012-3.0032"), .005" (3.0032-3.0052"), .010" (3.0082-3.0102"), .015" (3.0142-3.0152") oversizes. Cylinder bores should be finished with a 500 grit wet stone.
NOTE—Cylinder bores held within .002" limits. Maximum cylinder bore out-of-round .0005".
Fitting New Pistons:—Check piston with micrometer gauge at vertical slot 1¼" below top of head and ½" above lower edge of skirt. Using ⅜-½" feeler gauges inserted between piston and cylinder wall on side opposite slot to check clearance, piston should drop of its own weight with .0015" feeler and should hold its own weight with .002" feeler.
Installing Pistons:—Slot should be toward left or away from camshaft

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Lower ring grooves drilled radially with oil drain holes.
NOTE—A narow heat deflector groove located above top compression groove. No ring fitted in this groove.

Ring	Width	End Gap	Side Clear.
Comp. (all)	⅛"	.007-.012"	.0015-.0028"
Oil Cont (#3)	⅛"	.007-.015"	.0013-.0026"
Oil Cont. (#4)	5/32"	.007-.015"	.0013-.0026"

NOTE—Worn limits on all rings .025" (End gap) and .004" (Side Clearance).

PISTON PIN:—**Diameter** 55/64". **Length** 2 11/16". Pin is locked in one piston boss by locking screw. Split-type bushing used in pin hole in rod. See Note below.
Pin Fit in Piston—.0001" clearance or free fit (no play) at room temperature 70° F. (free end), .0003" press fit (locking pin end).
Pin Fit in Rod Bushing—.0002-.0008" (new), .0015" maximum (worn).
Removal:—Remove lockscrew, place piston in boiling water for one minute, then push pin out by hand from locking screw side (to install, proceed as mentioned, except that the pin is pushed in from the opposite direction).
NOTE—In removing and installing split-type bushing an arbor press and special tool kit (Tool No. HM-250) are necessary. Bushings must be pressed in, expanded, then burnished to give correct clearance.

CONNECTIND ROD:—**Weight** 32.336 ozs. **Length** 9".
Crankpin Journal Diameter—2¼".
Lower Bearing—Removable steel-backed, babbitt-lined type. No shims.
Clearance—.001-.0025" (new), .006" max. (worn). Sideplay .003-.006".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps.
Installing Rods:—Oil hole in lower bearing upper half must be toward right or camshaft side on all rods.
NOTE—Crankpin out of round .002" maximum.

CRANKSHAFT—5 bearing. Integral counterweights.
Journal Diameters—#1, 2⅜"; #2, 2 9/16"; #3, 2⅝"; #4, 2 11/16"; #5, 2¾".
NOTE—Journal out-of-round .002" maximum.
Bearing Type—Removable steel-backed, babbitt-lined shells. New bearings need no line-reaming.
Clearance—.002" (new), .004" (worn).
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. Upper halves of bearings can be removed and installed by rotating crankshaft with 'T' shaped cotter pin installed in oil passage.
NOTE—When reinstalling rear main bearing cap use new wooden plugs in grooves.
End Thrust:—Taken by flange on front (#1) bearing and steel washer behind timing sprocket. Endplay .001-.004" (new), .010 max. (worn).

CAMSHAFT:—6 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2.3095-2.3100"; #2, 2.2470-2.2475"; #3, 2.1845-2.1850"; #4, 2.1220-2.1225"; #5, 2.0595-2.0600"; #6, 1.8095-1.8100".
Bearing Type—Removable bronze bushings.
Clearance—.002-.004" (new), .005" (worn limit).
End Thrust:—Taken by spring-loaded plunger or thrust button in forward end of camshaft. No end-play permissible.
Timing Chain:—Whitney #CL-205. Width 1¼". Pitch ½". Length 23" or 46 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:—

	Head Diam.	Stem Diam.	Length
Intake	1.562"	.3415-.3425"	5 9/32"
Exhaust	1.421"	.3405-.3415"	5 9/32"

	Seat Angle	Lift	Stem Clearance
Intake	30°	5/16"	.006" (worn limit)
Exhaust	45°	5/16"	.005" (worn limit)

Tappet Clearance—.006" Int., .009" Exh. Hot.
Valve Guides:—Removable. Pressed in block with long stepped end down and finish reamed to provide clearance of .001-.002" Int., .001-.003" Exh.
Valve Springs:—Install springs with close coils below. Free spring length 2 9"16".

	Spring Pressure	Length
Valve Closed	40-46 lbs.	2¼"
Valve Open	112-120 lbs.	1 15/16"

Valve Lifters:—Mushroom type. Clearance in Lifter Guide .0003-.0008" (new), .005" (worn).
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 6° ATDC. Close 37° ALDC.
Exhaust Valves....Open 34° BLDC. Close 5° ATDC.
To Check Valve Timing—No. 1 intake valve opens with piston on top dead center with .0118" tappet clearance.
Motor Gauge—Weidenhoff Adapter #114, Rod #40.

LUBRICATION:—Pressure system from oil pump in crankcase through main oil channel in right hand crankcase wall.
Oil Pump:—Gear type located in crankcase. Ignition timing not disturbed by oil pump removal.
Oil Pump Drive Clearances—Drive gear endplay .003-010" (new), .015" (worn limit). Drive gear backlash must not exceed .018". Clearance between bushing and drive shaft .001-.0025" (new), .010" (worn limit).
Oil Pump Gear Clearances—Clearance between pump gears and pump housing .0025-.0085" (new), .010" (worn limit). Pump gear endplay .0025-.0055" (new), .015" (worn limit).
Normal Oil Pressure:—15 lbs. idling, 25 lbs. at 60 M.P.H.
Oil Pressure Regulator:—Operates at 25 lbs. Mounted on oil pump. Not adjustable.
Crankcase Capacity:—7 qts. (refill).

CLUTCH:—**Borg & Beck Model 10A4 with Long Driven Member (10CF-CI).** Single plate dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Free movement of clutch pedal should be ⅞-1⅛". Adjust by loosening locknut and turning stopscrew on auxiliary cross shaft. Clearance between pedal and underside of toeboard should be ⅜-⅝". Adjust by changing length of clutch release rod. Free rod at front end, turn rod in or out. Pedal should touch toeboard when clutch fully released. Adjust clutch release rod (as above) if necessary.
Removal—Disconnect front universal joint, remove transmission, drop clutch housing pan, remove clutch release yoke retaining screw, prick punch clutch cover, spring pressure plate and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly to release spring tension. Remove clutch from below.
NOTE—Keep transmission in high gear or install brace across face of case to hold clutch connection in position, preventing high-speed synchronizing drum from pulling out of splines in main shaft.

STEERING:—**Steering Gear:** Saginaw worm-and-double roller type with center steering. See article in Steering Section for adjustments.
Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section for description and adjustment procedure.
Kingpin Inclination—4°51' crosswise.
Caster—1½-2°.
Camber—¼-1° with car weight on wheels.
Toe In—0-1/16".
Steering Geometry—Inner wheel turned 21¾-23¼°, outer wheel 20°. Check tie rod ends and kingpins for looseness.

BRAKES:—Bendix Hydraulic, single anchor type. Hand lever applies rear wheel service brakes. See article in Brake Section for complete data.
Wheel Cylinders—Diameters: front 1 1/16", rear 15/16". No part of assembly is interchangeable between front and rear wheels.
Drum Diameter—11.995-12.005". Out-of-round .007" maximum. Run out (installed) .010" maximum.
Lining—Primary (front) shoe moulded. Secondary (rear) shoe woven. Length front wheel (front shoe 10⅛", rear shoe 13"), rear wheel (each shoe 13"). Width 2". Thickness 3/16". Length per wheel 23⅛" (front), 26" (rear).
Clearance—.010" between lining and drum.
Hand Brake Adjustment:—See Service Brake.

NOTE:—Engine hood is hinged at the cowl and is held down by latch at forward end. Radiator ornament serves as handle for latch and should be turned to free hood. All maintenance work except main bearings and crankshaft can be performed with engine in chassis. Remove radiator, shroud, and grille for on front of engine.

ENGINE NUMBER:—First number H-1. Stamped on top of clutch housing and on left side of front frame cross member (on frame channel on first cars).

ENGINE:—Own Model H. Twelve cylinder, 75° Vee, 'L' head type. Both cylinder banks and crankcase cast enbloc.

Bore—2.75". **Stroke**—3.75".

Piston Displacement—267.28 cubic inches.

Rated Horsepower—36.3 (SAE).

Developed Horsepower—110 at 3900 R.P.M.

Compression Ratio—6.7-1 Std. aluminum head.

Compression Pressure—146 lbs. at 1000 R.P.M. or 105 lbs. at cranking speed of 100 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 5 M.P.H.

NOTE—To remove oil pan for work on engine, disconnect radius rod rear connection, hoist car frame at front end.

NOTE:—Piston, pin, and rod are serviced as an assembly on an exchange basis as the floating piston pin is held in the piston by expansion plugs at each end which cannot be successfully removed in the field.

PISTONS:—Heat-treated steel-alloy, cam ground type. Recondition cylinders to take finished replacement pistons. Piston length—2.97".

Weight—325-327 grams (stripped), 389.5-396.5 grams with rings and pin.

Removal—Pistons and rods removed from above.

Clearance—See fitting new pistons.

Replacement Pistons:—Finished pistons furnished as a unit with fitted pins and rod in standard size 'A' and .002"—'B', .004"—'C', .006"—'D' oversizes.

Fitting New Pistons:—Use special feeler gauge, Part No. V-512. Fit pistons to clearance for 6-8 lb. pull on this gauge.

PISTON RINGS:—Two compression, one oil control ring per piston all above pin. Oil ring groove drilled radially with eight oil drain holes.

Ring	Width	End Gap	Wall Thickness
Comp.	.093 -.0935"	.008-.013"	.125"
Oil Cont.	.1545-.155"	.008-.013"	.125"

PISTON PIN:—Diameter .7501-.7504". **Length** 2.482". Pin floats in piston and rod. Held by retaining plug expanded in piston at each end. Retainers cannot be removed and pins are furnished as part of assembly with new pistons.

Pin Fit in Piston—.0001" clearance or minus .0001" press fit. Pin hole in piston diamond-bored.

Pin Fit in Rod Bushing—.0002-.0009" clearance.

CONNECTING ROD:—Weight 585-587 grams. **Length** 7.400".

Crankpin Journal Diameter—2.125".

Lower Bearing—Steel-backed, copper-lead lined type with bearing surface on outer face (in rod), and inner face (on crankpin). Bearing consists of two halves which float between rod and crankpin and extend through both rods (rods mounted side-by-side).

Bearing Dimensions—2.128" inside diameter, 2.298" outside diameter, .787" length on crankpin.

Clearance—.0015-.003" (total diametrical), .010-.022 (total endplay).

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps. With correct clearance bearings should turn freely with caps tight.

Installing Rods:—Rods and caps marked 'R1', 'L1', etc., and should be assembled with these marks together and installed in same numbered cylinders with marks pointing down on all rods.

CRANKSHAFT:—Four Bearings. Integral counterwgts.

Journal Diameters—2.400" (all bearings).

Bearing Type—Steel-backed, copper-lead lined.

Clearance—.001-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearings caps.

End Thrust:—Taken by #4 (rear) main bearing. Endplay .002-.006". Adjusted by replacing bearing cap.

CAMSHAFT:—Four Bearing. Helical Gear drive.

Journal Diameters—1.797" (all bearings).

Bearing Type—Steel-backed, babbitt-lined bushings.

Clearance—.002".

End Thrust:—Taken by front bearing and gear hub and by gear hub and cover plate. Endplay .005". Adjusted by replacing bearing or front plate.

Timing Gears:—Crankshaft gear steel forging. Camshaft gear Bakelized Fabric.

Camshaft Setting:—Gears are marked. Mesh tooth marked 'O' on crankshaft gear opposite space between teeth marked '/' on camshaft gear.

VALVES:—

	Head Diameter	Stem Diameter	Length
All Valves	1.537"	.3105-.3115"	4.750-4.751"
	Seat Angle	**Lift**	**Stem Clearance**
All Valves	45°	.292"	.0015-.0035"

NOTE—High tungsten chrome alloy steel exhaust valve seat inserts are installed.

Tappet Clearance—.0125-.0135" all valves. No adjustment provided. Use special two-step feeler as 'Go' and 'No-Go' gauge. First step (.0125") should pass between valve stem and lifter with lifter on heel of cam. Second step (.0135") should be no-go. Replace valves if clearance is excessive or grind off end of valve stem if clearance is insufficient.

Valve Guides:—Cast iron split type bushings held in place in block by 'C' washer and valve spring. See Valve Assembly Removal below.

Valve Lifters:—Light weight hollow-cast alloy iron operating in reamed holes in block. Serviced by installing oversize lifter.

Diameter—.999-.9995".

Clearance—.0005-.001".

Valve Springs:—See Valve Assembly Removal below. Valve spring free length 2.42".

	Spring Pressure	Spring Length
Valve Closed	32-36 lbs.	2.13"
Valve Open	62-66 lbs.	1.84"

Valve Assembly Removal:—Remove valve, guide, spring and spring retainer as an assembly. Insert bar type valve lifter between spring coils so as to engage flanged end of valve guide, pry down on guide slightly and withdraw 'C' washer on upper end. Remove assembly from above. Use special fixture to compress valve spring and remove spring retainer. Assembly can then be dismantled. Install valves in same manner.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 19°30' BTDC. Close 54°30' ALDC.

Exhaust Valves—Open 57°30' BLDC. Close 16°30' ATDC.

To Check Valve Timing—No flywheel marks or other means provided to check timing. If top dead center point for any piston is established on flywheel, intake opening for this cylinder is approximately 6⅔ teeth before this point with piston .1268" before top dead center.

Motor Gauge:—Weidenhoff Adapter #114. Rod #40.

LUBRICATION:—Pressure system. Gear type oil pump mounted in oil pan at rear of engine.

Normal Oil Pressure—30 lbs. at 55 M.P.H.

Oil Pressure Regulator—Mounted at front of engine between cylinder banks. Operates at 30 lbs. Not adjustable. Timing gears lubricated by overflow from regulator.

Oil Pressure Gauge:—King-Seeley Electric type, K-S Part No. 5760 (dash unit), 5460 (motor unit). Dash unit identified by letter 'O' stamped on edge.

Crankcase Capacity—6 qts.

CLUTCH:—Long Model 10CF-CI. Semi-centrifugal, single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Clutch Pedal Adjustment—Clutch pedal free movement should be 1-1½". To adjust, take out pin in clutch pedal shaft lever, loosen locknut, turn clevis on clutch rod (counter-clockwise to increase free movement), tighten locknut and replace pin.

Removal—Disconnect rear spring at mounting on body, take out clutch housing flange mounting screws (housing integral with transmission case), slide entire drive unit to rear to expose clutch. Take out capscrews mounting clutch on flywheel turning all screws out evently to release clutch spring tension without springing clutch cover.

STEERING:—Steering Gear—Gemmer Worm-and-Double-Roller type. See article in Steering Section for complete adjustment directions.

Front Suspension:—Conventional 'I' beam section front axle with Reverse Elliott ends and transverse cantilever spring.

Kingpin Inclination—8¼° crosswise.

Caster—7° loaded (9° max., 4½° min.). Must be alike within ½° for both wheels. No adjustment.

Camber—¾° (¾° max., ¼° min.). Must be alike within ¼° for both wheels and camber for right must not exceed left wheel. No adjustment.

Toe In—1/16" (1/16" min., ⅛" max.). Adjusted in usual manner by loosening tie rod end clamp bolts and turning tie rod.

Steering Geometry (Toe Out)—Inner wheel turned 23°, outer wheel 20°. Allowable variation ½°. Check tie rod ends and kingpins for looseness.

BRAKES:—Service—Bendix mechanical, Duo-Servo, Single anchor type. Hand lever applies all service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—12". Cast alloy iron type.

Lining—Moulded type. Width 1.75". Thickness .21". Length 23.9" per wheel.

Clearance—.010" at toe and heel of each shoe.

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER—Stamped on left hand side of crank case below center of block. First number 5501.

ENGINE SPECIFICATIONS:—12 cylinder, 67° Vee, 'L' head type. Cylinder block for each bank cast enbloc and separate from crankcase.

Bore—3.125". **Stroke**—4.50".

Displacement—414 cubic inches.

Rated Horsepower—46.8 (SAE).

Developed Horsepower—150 at 3400 R.P.M.

Compression Ratio—6.38-1 Std. aluminum head.

Compression Pressure—138 lbs. at 1000 R.P.M. or 105-110 lbs. at 100 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" at idling speed.

PISTONS:—Lynite, aluminum alloy, 'T' slot, Cam ground with oxidized bearing surface (special hard oxide deposited on skirt). Pistons cannot be ground.

Weight—12½ ozs. (without rings, pin or locking screw).

Length—3.87".

Removal—Pistons and rods removed at bottom.

Clearance—Top land .025". Bottom .002". See Fitting New Pistons (below).

Replacement Pistons:—Finished replacement pistons furnished in standard and .0025", .015", .030" oversizes.

Fitting New Pistons:—Use .002" feeler gauge to check clearance when fitting new pistons. Pull required to withdraw feeler from between piston and cylinder wall on side opposite slot must be between 3-4 lbs.

Installing Pistons:—Install pistons with slot to left (viewed from driver's seat) in both banks.

PISTON RINGS:—Two compression rings, two oil control rings per piston, all above pin. Lower ring groove drilled with oil drain holes.

Ring	Width	End Gap	Wall Thick.
Comp. (all)	.1235-.1240"	.008-.015"	.125"
Oil Cont. (all)	.1545-.1550"	.007-.015"	.140"

PISTON PIN:—Diameter—.875". **Length**—3".

Pin is locked in piston.

Pin Fit in Rod Bushing—.0005" clearance.

CONNECTING ROD:—Weight—38 ounces.

Length—10.875" (center-to-center).

Crankpin Journal Diameter—2.500".

Lower Bearing—Removable copper-lead type.

Clearance—.0015-.003". Sideplay .006-.015". (Total for both rods).

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps.

Installing Rods:—Number on rod and cap must correspond and should be installed in same numbered cylinder with marks pointing down toward pan.

CRANKSHAFT:—4 bearing. Integral counterweights.

Journal Diameters—2.625" (all bearings).

Bearing Type—Bohn copper-lead type.

Clearance—.001-.003".

Bearing Adjustment:—Solid shims are used. Do not file caps.

End Thrust:—Taken by rear (#4) main bearing. End-play .004-.007". No adjustment. Replace bearing.

CAMSHAFT:—5 bearing. Duplex chain drive with automatic idler sprocket take up. See Equipment Section for data on Morse automatic take-up idler.

Journal Diameters—#1, 1.500"; #2, 3, 4, 2.250"; #5, 1.250".

Bearing Type—Babbitt-lined type.

Clearance—.002".

NOTE—Front bearing must be removed to remove camshaft.

End Thrust:—Taken by front bearing. Replace bearing.

Timing Chain:—Morse Duplex. Width 1½". Pitch ⅜". Length 104 links or 39".

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:—

	Head Diameter	Stem Diameter	Length
All Valves	1.687"	.3125"	6.750"

	Seat Angle	Lift	Stem Clearance
All Valves	45°	.343"	.003-.004"

Tappet Clearance—.004" Int., .006" Exh., cold.

NOTE—High tungsten chrome alloy steel inserts used in exhaust valve seats.

Valve Guides:—Press-fit. Finish ream to give correct stem clearance (above).

Valve Springs:—	Spring Pressure	Length
Valve Closed	60-66 lbs.	2.687"
Valve Open	187-199 lbs.	2.343"

Valve Lifters:—Roller type, cylindrical. Diameter 1.122-1.1225". Lifter guides single piece, flanged top, removed from above.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 21° BTDC. Close 49° ALDC.

Exhaust Valves—Open 57° BLDC. Close 11° ATDC.

To Check Valve Timing—No flywheel marks are provided. No. 2 intake valve opens when a point on the flywheel approximately 6.77 teeth before dead center mark 'D2/12C' lines up with indicator on housing.

Motor Gauge—Weidenhoff Adapter #113, Rod #37.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Pressure:—40 lbs. at 50 M.P.H.

Oil Pressure Relief Valve:—Located on outlet pipe from temperature regulator at right of crankcase. Operates at 40 lbs. Not adjustable. A second bypass valve is located in the crankcase on the oil header.

Oil Temperature Regulator:—Harrison. Located on right hand side of crankcase.

Oil Pressure Gauge:—King-Seeley Electric type, K-S Part No. 5760 (dash unit), 5460 (motor unit). Dash unit identified by letter 'O' stamepd on edge.

Crankcase Capacity:—12 quarts (refill).

CLUTCH:—Long Model 12 CB-CL. Single plate, dry disc type. See Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal should be 1". To adjust, losen locknut and turn pedal adjusting screw on clutch throwout fork below pedal shaft. Clearance between pedal and underside of toeboard is controlled by pedal stopscrew on bracket above pedal shaft.

Removal—Slide rear end and transmission to rear as a unit (clutch housing unit with transmission case). Take out capscrews mounting clutch on flywheel, turning all screws out evenly to release clutch spring tension. Remove clutch assembly.

STEERING:—Steering Gear—Gemmer Worm-and-Double-Roller type. See article in Steering Section for complete adjustment directions.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends. Left spring shackled both front and rear.

Kingpin Inclination—7½° crosswise.

Caster—1½° (normal load). Limits 1-2°. Use wedge shims inserted between spring and spring pad on axle to correct caster.

Camber—1°. Limits ½-1°. Bending of axle to correct camber not recommended.

Toe In—1/16-⅛". To adjust, loosen clamps at each end of tie rod, turn rod (right and left hand thrds.).

Steering Geometry—Inner wheel turned 22¾° (136"), 22⅓° (145"), outer wheel turned 20° both cars). Allowable variation ½°. Check tie rod ends and kingpins for looseness.

BRAKES:—Service—Bendix Mechanical, Duo-Servo, Single anchor type, mechanically operated, Vacuum power Brake. Hand lever applies all four service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—15.125". Forged steel type.

Lining—Moulded type. Width 2.50". Thickness .25". Length 33.50" per wheel.

Clearance—.010" at heel and toe of each shoe.

Hand Brake Adjustment:—See Service Brakes.

Power Unit:—Bendix plain type vacuum cylinder mounted on right front leg of 'X' member and linked to brake cross-shaft. Control valve connected in brake linkage between pedal and cross-shaft. Regulating valve located at base of steering column and controlled by lever on instrument board. See article in Brake Section for complete data.

ENGINE NUMBER:—On plate on right hand side of crankcase. Serial number (R-303301 up) on right hand frame side rail under engine hood.

ENGINE SPECIFICATIONS:—Type—6 cylinder, valve-in head, twin-ignition type.

Bore—3⅜". Stroke—4⅜".

Displacement—234 cubic inches.

Rated Horsepower—27.34 (SAE).

Developed Horsepower—93 at 3400 R.P.M.

Compression Ratio and Pressure—5.25-1 std. cast-iron hd., no optl. **Pressure**—125 lbs at 350 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 5-7 M.P.H.

PISTONS:—Nelson Bohnalite, aluminum alloy, Invar strut, split skirt type.

Length—3⅞".

Weight—19⅛ ounces.

Removal—Pistons and rods removed from above.

Clearance—Skirt .002". See Fitting Pistons.

Fitting New Pistons:—Use .002" feeler stock inserted between piston and cylinder wall on side opposite slot to check clearance.

Installing Pistons:—Slot should be toward left hand side of engine or away from camshaft.

PISTON RINGS:—Two compression rings, two oil control rings per piston, all above pin.

Ring	Width	End Gap
Comp. All	⅛"	.010-.025"
Oil Cont. (3)	⅛"	.010-.025"
Oil Cont. (4)	3/16"	.010-.025"

PISTON PIN:—Diameter—⅞". Length—2 51/64". Pin floats in piston and rod. Pin hole in rod is bronze-bushed. Pins furnished for service standard, .001", .003", .005" oversize.

Pin Fit in Piston—Light push fit with piston heated.

Pin Fit in Rod Bushing—.0001" or light push fit with both parts at normal temperature.

CONNECTING ROD:—Length—8¾". Weight—36¼ ozs.

Upper Bearing (Piston Pin Bushing)—Bronze.

Crankpin Journal Diameter—2".

Lower Bearing—Interchangeable steel-backed, copper-lead lined type. Shims used.

Clearance—.002-.0025". Sideplay .006-.012".

Bearing Adjustment:—Shims. Do not file rods or caps. Replace bearings when necessary.

CRANKSHAFT:—7 bearing. Integral counterweights.

Journal Diameters—2 31/64" all bearings.

Bearing Type—Interchangeable steel-backed, copper-lead lined. Shims used.

Clearance—.002-.0025".

Bearing Adjustment:—Shims. Do not file caps. Replace bearings when necessary.

End Thrust:—Taken by center (#4) bearing. Endplay .004-.007".

CAMSHAFT:—Non-adjustable double-roller chain drive.

End Thrust:—Taken by front bearing. Adjusted by replacing bearing.

Timing Chain:—Diamond double roller chain. Width ⅞". Pitch ⅜". Length 22½" or 60 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers. Chain should be removed and installed endless. Use special pullers and pushers, keep sprockets lined up to avoid sidestrain on chain and sprockets.

VALVES:—	Head Diam.	Stem Diam.	Length
Intake	1¾"	.372"	5 17/32"
Exhaust	1 19/32"	.372"	5 17/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.002"
Exhaust	45°	11/32"	.002"

Tappet Clearance—.015" with engine hot. Set clearance with engine idling.

Valve Timing:—See Camshaft Setting above.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Pressure:—25 pounds.

Oil Pressure Relief Valve:—Located on oil pump cover. Operates at 25 lbs. Adjustable by turning screw.

Crankcase Capacity:—7 qts. (refill).

CLUTCH:—Borg & Beck Model 10A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal must be ½-1½". Adjust by loosening transverse bolt in link directly behind pedal and above clutch pedal shaft and shifting position of pedal. Setscrew on lever end of throw-out shaft at right of transmission must not contact stop on clutch housing. Check starting switch cable adjustment after adjusting clutch pedal.

Starting Switch Cable Adjustment—Starting switch should make contact just after clutch is released. To check, engage transmission gears, depress clutch pedal, note when starter engages. If clutch is not completely released (car will tend to move) or if pedal travel is excessive, adjust by loosening two clamp bolts on clutch throw-out shaft lever to which switch cable is attached and move cable clamp in (for later engagement) or out (for earlier engagement) of starter.

Removal—Disconnect driveshaft at rear of transmission, remove transmission, drop clutch housing underpan, take out capscrews mounting clutch on flywheel turning all screws out evenly to release spring pressure. Clutch assembly can then be removed from below without removing flywheel housing.

STEERING:—Steering Gear—Gemmer Model. Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends, or 'Articulated' type independent springing. Semi-elliptic springs used with both axles. Specifications for both types are the same.

Kingpin Inclination—7° crosswise.

Camber—0-1½°. No adjustment.

Caster—0-1½°. Adjusted by inserting wedge shims between spring and spring pad on axle.

Toe In—0-⅛". Adjust in usual manner by changing length of tie rod.

Tread—58" (front), 60" (rear).

BRAKES:—Service—Bendix Hydr., Duo-Servo, single anchor type. Hand lever applies rear service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—11".

Lining—Moulded type. Width 1¾". Thickness 3/16". Length 23 13/16" per wheel.

Clearance—.010" between drum and lining.

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—On plate on right front side of crankcase below valve cover plate. Serial number (C-1001 up) on right frame side member under engine hood and on caution plate on left front door corner plate.

ENGINE SPECIFICATIONS:—Own 'Monitor Sealed Motor.' Six cylinder, 'L' head type. Cylinders cast enbloc. No intake manifold is used and intake passage is formed within the head and block castings. NOTE—Some models equipped with engine hood and radiator grille in one unit which is hinged at the cowl. It is lifted up at the front end to expose the motor.

Bore—3⅜". **Stroke**—4⅜".

Displacement—234 cubic inches.

Rated Horsepower—27.34 (SAE).

Developed Horsepower—90 at 3400 R.P.M.

Compression Ratio and Pressure—5.58-1 std. cast-iron head. Presure—125 lbs. at 350 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 5-7 M.P.H.

PISTONS:—Bohnalite, aluminum alloy, Invar strut, split skirt type.

Length—3⅞".

Weight—19⅛ ounces.

Removal—Pistons and rods removed from above.

Clearance—Skirt .002". See Fitting New Pistons.

Fitting New Pistons:—Use .002" feeler stock inserted between piston and cylinder wall on side opposite slot to check clearance.

Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression rings, two oil control rings per piston, all above pin.

Ring	Width	End Gap
Comp. All	⅛"	.010-.025"
Oil Cont. (#3)	⅛"	.010-.025"
Oil Cont. (#4)	3/16"	.010-.025"

PISTON PIN:—Diameter—⅞". Pin floats in piston and rod. Pin hole in rod is bronze-bushed. Pins furnished for service standard, .001", .003", .005" oversize.

Pin Fit in Piston—Light push fit with piston heated.

Pin Fit in Rod Bushing—.0001" or light push fit with piston and rod cold.

CONNECTING ROD:—Length—8¾" (center-to-center).

Weight—36¼ ounces.

Upper Bearing (Piston Pin Bushing)—Bronze.

Crankpin Journal Diameter—2".

Lower Bearing—Interchangeable steel-backed, copper-lead lined type. Shims used.

Clearance—.002-.003". Sideplay .008-.012".

Bearing Adjustment:—Shims. Do not file rods or caps. Replace bearings when necessary.

CRANKSHAFT:—7 bearing. Integral counterweights.

Journal Diameters—2 31/64" all bearings.

Bearing Type—Interchangeable steel-backed, copper-lead lined. Shims used.

Clearance—.002-.0025".

Bearing Adjustment:—Shims. Do not file caps. Replace bearings when necessary.

End Thrust:—Taken by center (#4) bearing. Endplay .004-.007".

CAMSHAFT:—6 bearing. Non-adjustable chain drive.

Journal Diameters—#1, 1⅞"; #2, 2 13/64"; #3, 2 11/64"; #4, 2 9/64"; #5 2 7/64; #6, 1¾".

End Thrust:—Taken by front bearing (shoulder formed on shaft behind bearing, and shoulder in front of bearing formed by sprocket hub when bolted on camshaft). Adjusted by replacing bearing.

Timing Chain:—Whitney. Double strand roller chain. Width 9/16". Pitch ⅜". Length 22½" or 60 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers. Install chain endless with camshaft sprocket off engine.

VALVES:—	Head Diam.	Stem Diam.	Seat Width
Intake	1 21/32"	.341"	1/16"
Exhaust	1 17/32"	.341"	1/16"

	Seat Angle	Lift	Stem Clearance
Intake	45°	5/16"	.002"
Exhaust	45°	5/16"	.002"

Tappet Clearance—.015" all valves with engine hot or cold.

Valve Timing:—See Camshaft Setting above.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Pressure:—25 lbs. (10 lbs. idling).

Oil Pressure Relief Valve:—Located on oil pump. Operates at 25 lbs. Adjustable by turning screw.

Crankcase Capacity:—7 qts. (refill).

CLUTCH:—Borg & Beck Model 9A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal must be ½-1". Adjust whenever free movement is less than ½". To adjust, loosen transverse bolt at lower end of clutch pedal, shift pedal position, tighten bolt.

Removal—Disconnect driveshaft at rear of transmission, remove transmission, drop clutch housing underpan, take out capscrews mounting clutch on flywheel turning all screws out evenly to release spring pressure. Clutch assembly can then be removed from below without removing flywheel housing.

STEERING:—Steering Gear—Gemmer Model. Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.

Kingpin Inclination—7° crosswise.

Camber—0-1½°. No adjustment.

Caster—0-1°. Adjust by inserting wedge shims between spring and spring pad on axle.

Toe In—0-⅛". Adjust by loosening clamp bolt at right end of tie rod and screwing tie rod in or out of end joint. Tighten clamp bolt.

Tread—58" (front), 60¼" (rear).

BRAKES:—Service—Bendix Hydr., Duo-Servo, single anchor type. Hand lever applies rear service brakes. See article in Brake Section for relining and complete adjustment procedure.

Drum Diameter—10".

Lining—Moulded type. Width 2". Thickness 3/16". Length 22 1/16" per wheel.

Clearance—.010" between drum and lining.

Hand Brake Adjustment:—Should be adjusted whenever service brakes adjusted. Turn adjusting screw in wheel so that shoes are tight in drum. Loosen two bracket bolts, pull hand brake lever on three notches, pull bracket forward removing all slack in cables and tighten bolts. Then with lever in released position readjust shoes to give .010" clearance in drums by checking with feeler gauge through slot in drum.

ENGINE NUMBER:—On plate on right hand side of crankcase. Serial number (B-77325) on right hand frame side rail under engine hood.

ENGINE SPECIFICATIONS:—Type—8 cylinder, valve-in head, twin ignition type.

Bore—3⅛". Stroke—4¼".

Displacement—260.8 cubic inches.

Rated Horsepower—31.25 (SAE).

Developed Horsepower—102 at 3400 R.P.M.

Compression Ratio and Pressure—5.25-1 std. cast-iron hd., no optl. **Pressure**—110 lbs. at 350 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18-20" with engine idling at 5-7 M.P.H.

PISTONS:—Nelson Bohnalite, aluminum alloy, Invar strut, split skirt type.

Length—3 11/16".

Weight—19 ounces.

Removal—Pistons and rods removed from above.

Clearance—Skirt .002". See Fitting New Pistons.

Fitting New Pistons:—Use .002" feeler stock inserted between piston and cylinder wall on side opposite slot to check clearance.

Installing Pistons:—Slot should be toward left or away from camshaft.

PISTON RINGS:—Two compression rings, two oil control rings per piston, all above pin.

Ring	Width	End Gap
Comp. All	⅛"	.010-.025"
Oil Cont. (#3)	⅛"	.010-.025"
Oil Cont. (#4)	3/16"	.010-.025"

PISTON PIN:—Diameter—⅞". Length—2 9/16".

Pin floats in piston and rod. Pin hole is bronze-bushed. Pins furnished for service standard, .001", .003", .005" oversize.

Pin Fit in Piston—Light push fit with piston heated.

Pin Fit in Rod Bushing—.0001" or light push fit with both parts at normal temperature.

CONNECTING ROD:—Length—8¾". Weight—34 ozs.

Upper Bearing (Piston Pin Bushing)—Bronze.

Crankpin Journal Diameter—2".

Lower Bearing—Interchangeable steel-backed, copper-lead lined type. Shims used.

Clearance—.002-.0025". Sideplay .006-.012".

Bearing Adjustment:—Shims. Do not file rods or caps. Replace bearings when necessary.

CRANKSHAFT:—9 bearing. Integral counterweights.

Journal Diameters—2 31/64" all bearings.

Bearing Type—Interchangeable steel-backed, copper-lead lined. Shims used.

Clearance—.002-.0025".

Bearing Adjustment:—Shims. Do not file caps. Replace bearing when necessary.

End Thrust:—Taken by center (#5) bearing. Endplay .004-.007".

CAMSHAFT:—Non-adjustable roller chain drive.

Timing Chain:—Diamond double roller chain. Width 9/16". Pitch ⅜". Length 62 links or 23¼".

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers. Chain should be removed and installed endless. Use special pullers and pushers, keep sprockets lined up to avoid sidestrain on chain and sprockets.

VALVES:—	Head Diam.	Stem Diam.	Seat Width
Intake	1 21/32"	.372"	1/16"
Exhaust	1 15/32"	.372"	1/16"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.002"
Exhaust	45°	11/32"	.002"

Tappet Clearance—.015" with engine hot. Set clearance with engine idling.

Valve Timing:—See Camshaft Setting above.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Pressure:—25 pounds.

Oil Pressure Relief Valve:—Located on oil pump cover. Operates at 25 lbs. Adjustable by turning screw.

Crankcase Capacity:—7 quarts (refill).

CLUTCH:—Borg & Beck Model 10A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Free movement of clutch pedal must be ½-1½". Adjust by loosening transverse bolt directly behind pedal and above clutch pedal shaft and shifting position of pedal. Setscrew on lever end of throw-out shaft at right of clutch housing must not contact stop on housing. Check starting switch cable adjustment after adjusting clutch pedal.

Starting Switch Cable Adjustment—Starting switch should make contact just after clutch is released. To check, engage transmission gears, depress clutch pedal, note when starter engages. If clutch is not entirely released (car will tend to move), or if pedal travel is excessive, adjust by loosening two clamp bolts on clutch throw-out shaft lever to which switch cable is attached and move cable clamp in (for later engagement) or out (for earlier engagement of starter).

Removal—Disconnect driveshaft at rear of transmission, remove transmission, drop clutch housing underpan, take out capscrews mounting clutch on flywheel turning all screws out evenly to release spring pressure. Clutch assembly can then be removed from below without removing flywheel housing.

STEERING:—Steering Gear—Gemmer Model. Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends, or 'Articulated' type independent springing. Semi-elliptic springs used on both axles. Specifications for both axles are the same.

Kingpin Inclination—7° crosswise.

Camber—0-1½°. No adjustment.

Caster—0-1½°. Adjust by inserting wedge shims between spring and spring pad on axle.

Toe In—0-⅛". Adjust in usual manner by changing length of tie rod.

Tread—58" (front), 60" (rear).

BRAKES:—Service—Bendix Hydr., Duo-Servo, single anchor type. Hand lever applies rear service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—11".

Lining—Moulded type. Width 2¼". Thickness 3/16". Length 23 13/16" per wheel.

Clearance—.010" between drum and lining.

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—First number—F506,001. Stamped on ledge on top of block beside head at left front corner.

ENGINE SPECIFICATIONS:—Type—6 cyl. 'L' Head.
Bore—3 5/16". **Stroke**—4⅛".
Displacement—213.3 cubic inches.
Rated Horsepower—26.3 (SAE).
Developed Horsepower—90 at 3400 R.P.M.
Compression Ratio & Pressure—6.0-1 Std. cast-iron head. No optl. ratios. Pressure 106-116 lbs. at cranking speed of 100 R.P.M.
Vacuum Reading—Gauge should show steady reading of 17" of HG. minimum with engine idling at 350 R.P.M. or 6 M.P.H.

PISTONS:—Aluminum alloy, 'T' slot, Cam Ground type with Electrolite (hard oxide) bearing surface. Skirt is elliptical with .007-009" greater diameter at right angles to pin bosses. Pistons cannot be ground. Use finished replacement pistons.
Weight—15.4 ozs. (stripped). **Length**—3 5/16".
Removal—Pistons and rods removed from above.
Clearance—.0013-.0018" measured ⅜" up on skirt and ⅜" below lower ring groove at right angles to pin holes for new pistons. See Fitting new Pistons.
Replacement Pistons:—Finished pistons with pins fitted furnished in .003", .005", 010", .015" and .030" over size. Oversize pistons held to same weight as standard.
Fitting New Pistons:—With pin removed, check clearance by inserting .002" feeler ½" wide between piston and cylinder wall on pressure or camshaft side at right angles to pin hole. Piston should be inverted with slot away from camshaft. Pressure to withdraw feeler must be 4-11 lbs. with piston and block at 70° F.
Installing Pistons:—Mark 'V-S' on piston head must be toward valves (slot on side away from valves). Pin hole in piston offset 3/32" toward left (slotted side).

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Both oil ring grooves drilled radially with oil drain holes. Piston rings furnished in .010", .020", .030" oversizes.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.007-.012"	.0015-.003"
Oil Cont.	3/16"	.007-.015"	.001 -.0025"

NOTE—Install compression rings with groove or step downward.

PISTON PIN:—Diameter—.8554-.8557". **Length**—3 1/32". Pin is locked in piston by lock screw in one boss. Opposite end slotted to allow boss to slide freely on pin.
Pin Fit in Piston—.0001" loose to .0002" tight in plain boss end, .0002-.0005" tight in lock boss end.
Pin Fit in Rod Bushing—Clearance .0002"-.0005". Pins selected to give this clearance. New rod bushings are burnished and reamed to inside diameter of .8557-.8561".
NOTE—Replacement pistons furnished with pins fitted. Pin bosses in piston are Electrolited and cannot be reamed. Pins not furnished oversize.
Fitting Pins—Place piston and pin in boiling water for one minute. With special tool HM-535 insert pin in plain boss end and push lightly until lockscrew hole in pin and boss are aligned. Install lockscrew. Skirt taper with pin installed must not exceed. 0005".

CONNECTING ROD:—Weight—29½ozs.
Length—7 13/16".
Crankpin Journal Diameter—1 9/64".
Lower Bearing—Steel-backed, babbitt-lined, interchangeable type.
Clearance—.001-.003". Sideplay .0055-.0105".
Bearing Adjustment:—None (no shims). Replace bearing shells. Do not file rod or cap faces. Bearings assembled with slight projection above faces to insure contact.
Installing Rods:—Oil spit hole in lower bearing upper half must be toward camshaft. Grooves in rod and cap bolt boss must be on same side as part number. NOTE—Ground bolts used for cap and rod assembly. Common bolts must not be used.

CRANKSHAFT:—Four bearings. Integral count'rw'ghts.
Journal Diameters — #1, 2.478-2.479"; #2, 2.5405-2.5415"; #3, 2.6655-2.6665"; #4, 2.728-2.729".
Bearing Type—Interchangeable steel-backed, babbitt-lined. Bearing halves interchangeable (upper and lower) except #4 (rear).
Clearance—.001-.003".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. Bearing upper halves can be removed without removing crankshaft by using tool HM-J-173. This is a flat headed plug which is slipped into oil hole in crankshaft. The head engages the edge of the bearing and turns it out as crankshaft is rotated. Install bearings in same manner (insert plain edge of bearing on indented side of upper bearing support).
End Thrust:—Taken by #1 (front) bearing. Endplay .004-.008". A bronze thrust plate .1205-.1235" thick is assembled at each end of front main bearing and is dowelled to bearing cap. There is a steel thrust collar on the crankshaft behind the crankshaft gear.

CAMSHAFT:—Four bearing. Non-adjust'ble chain drive.
Journal Diameters—#1, 1.9970-1.9975"; #2, 1.9345-1.9350; #3, 1.8720-1.8725"; #4, 1.8095-1.8100".
Bearing Type—Metal-backed, babbitt-lined.
Clearance—.002-.004".
End Thrust:—Taken by spring-loaded plunger in forward end of camshaft and thrust plate on chain case cover.
Timing Chain:—Whitney. Width—1¼". Pitch—.500". Length 47 links or 23½".
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers. Use Sprocket Guage HM-408-0.

VALVES:—Head Diameter Stem Diameter Length

Intake	1 9/16"	.3415-.3425"	5 51/64"
Exhaust	1 27/64"	.3405-.3415"	5 51/64"

	Seat Angle	Lift	Stem Clearance
Intake	30°	.300"	.00125-.00325"
Exhaust	45°	.300"	.00225-.00425"

Tappet Clearance—.008" Int., .010" Exh., warm.
Valve Guides:—Cast-iron. Install with turned portion below and finish ream to .34375-.34475" (inside diameter) after assembly. Guide must be 15/16" below top of block.
Valve Springs:—Free length 2 9/16". Install springs with three close-coils at top. No spring cages used.

	Spring Pressure	Spring Length
Valve Closed	43 lbs.	2 9/32"
Valve Open	116 lbs.	1 15/16"

NOTE—Springs are interchangeable (intake and exhaust, and for 6 and 8 engines) and can be used on '33-'35 engines. Discard spring cages on '33-'34 engines.
Valve Lifters:—Single piece cast-iron with core openings in side wall. Operate directly in reamed holes in block. Clearance .0008". Serviced by reaming out holes and installing new lifters furnished standard, .002", .005" oversize.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 5° BTDC. Close 45° ALDC.
Exhaust Valves—Open 45° BLDC. Close 5° ATDC.
To Check Valve Timing—Check tappet clearance #1 intake valve. This valve should open with piston 5° or .0163" before top dead center when point on flywheel approximately 2 teeth before top dead center mark (steel ball insert) on flywheel lines up with pointed end of inspection hole cover screw in left front face of housing.
Motor Gauge—Weidenhoff #104 Adapter, #40 Rod.

LUBRICATION:—Pressure type. Gear type oil pump located on right side of crankcase.
NOTE—Use new gasket whenever oil pump taken off engine. See that holes in gasket line up with oil leads in block.
Normal Oil Pressure:—25-30 lbs.
Oil Pressure Regulator:—On oil pump cover. Operates at 27 lbs. Not adjustable.
Crankcase Capacity:—6 qts. refill.

CLUTCH:—Borg & Beck Model 9A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Free movement of clutch pedal must be 1-1½". To adjust, loosen locknut and turn adjusting screw at lower end of inner lever on clutch throwout auxiliary shaft in front of clutch pedal.
Removal—Disconnect propeller shaft, remove transmission, take off clutch housing pan, take out six capscrews mounting clutch on flywheel turning all screws out evenly to release spring pressure. Clutch can be removed from below without removing flywheel housing.
NOTE—A locating dowel is mounted on the flywheel and the second clutch mounting screw hole on each side is counterbored deeper than the remaining holes. When mounting clutch, use the two screws with short thread and longer shank in these holes.

STEERING:—Steering Gear—Saginaw Worm-and-Roller type with center steering. See article in Steering Section for adjustments.
Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section for description and adjustment procedure.
NOTE—Before checking front end, check tire inflation, front wheel balance, front wheel and tire runout (not to exceed ⅛"), bounce car up and down several times to allow frame to assume normal height.
King Pin Inclination—5°51' crosswise.
Caster—1½-2¼°. Adjustable. Caster affected by camber adjustment but not outside limits as given.
Camber—⅛-1°. Adjustable.
Toe In—⅛-3/16". Adjustable. Both tie rods must be turned equally.
Steering Geometry—Inner wheel turned 23° 10', outer wheel 20°.

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, Single anchor type. Hand lever applies rear brakes. See article in Brake Section for complete adjustment procedure.
Brake Drum Diameter—11 1/16".
Brake Lining—Moulded and woven type. Width 2". Thickness 3/16". Length 23.7" per wheel.
Brake Clearance—.008" toe, .010" heel on each shoe.
Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER—First number—L202,001. Stamped on ledge on top of block beside head at left front corner.

ENGINE SPECIFICATIONS:—Type—8 cyl., 'L' head.
Bore—3". **Stroke**—4¼".
Displacement—240.3 cubic inches.
Rated Horsepower—28.8 (SAE).
Developed Horsepower—100 at 3400 R.P.M.
Compression Ratio & Pressure—6.2-1 Std. cast-Iron head. Pressure 116-126 lbs. at cranking speed of 100 R.P.M.
Vacuum Reading—Gauge should show steady reading of 17" of HG. minimum with engine idlIng at 300 R.P.M. or 6 M.P.H.

PISTONS:—Aluminum alloy, 'T' slot, Cam Ground type with Electrolite (hard oxide) bearing surface. Skirt is elliptical with .006-.008" greater diameter at right angles to pin bosses. Pistons cannot be ground. Use finished replacement pistons.
Weight—12.8 ozs. (stripped). **Length**—3¾".
Removal—Pistons and rods removed from below. Rotate crankshaft so that counterweights are crosswise and on opposite side from camshaft.
Clearance—.0013-.0018" measured ⅜" up on skirt and ⅜" below lower ring groove at right angles to pin hole for new pistons. See Fitting New Pistons.

Replacement Pistons:—Finished pistons with pins fitted furnished in .003", .005", .010", .015", .030" oversizes. Oversize pistons held to same weight as standard.

Fitting New Pistons:—With pin removed, check clearance by inserting .002" feeler ½" wide between piston and cylinder wall on pressure or camshaft side at right angles to pin hole. Piston should be inverted with slot away from camshaft. Pressure to withdraw feeler must be 4-11 lbs. with piston and block at 70° F.

Installing Pistons:—Mark 'V-S' on piston head must be toward valves (slot away from valves). Pin hole In piston offset 3/32" toward left (slotted side).

PISTON RINGS:—Two compression, two oil control rings per piston, all above the pin. Both oil ring grooves drilled radially with oil drain holes. Piston rings furnished in .010", .020", .030" oversizes.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.007-.012"	.0015-.003"
Oil Cont.	3/16"	.007-.015"	.001-.0025"

NOTE—Install compression rings with groove or step downward.

PISTON PIN:—Diameter .8554-.8557". **Length** 2 23/32". Pin is locked in piston by lockscrew in one boss. Opposite end slotted to allow boss to slide freely on pin.
Pin Fit in Piston—.0001" loose to .0002" tight in plain boss end, .0002-.0005" tight in lock boss end.
Pin Fit in Rod Bushing—Clearance .0002-.0005". Pins selected to give this clearance. New rod bushings burnished and reamed to inside diameter of .8557-.8561."
Fitting Pins—Place piston and pin in boiling water for 1 minute. With special tool HM-535 insert pin in plain boss end and push lightly until lockscrew hole in pin and boss are aligned. Install lockscrew. Skirt taper with pin installed must not exceed .0005".
NOTE—Replacement pistons furnished with pins fitted. Pin bosses in piston are Electrolited and cannot be reamed. Pins not furnished oversize.

CONNECTING ROD:—Weight 33 ozs. **Length** 9".
Crankpin Journal Diameter—1 9/64".
Lower Bearing—Steel-backed, babbitt-lined, interchangeable type.
Clearance—.001-.003". Sideplay—.0055-.0105".
Bearing Adjustment:—None (no shims). Replace bearing shells. Do not file rod or cap faces. Bearings assembled with slight projection above faces to insure contact.
Installing Rods:—Oil spit hole in lower bearing upper half must be toward camshaft. Grooves in rod and cap bolt boss must be on same side as part number
NOTE—Ground bolts used for cap and rod assembly. Common bolts must not be used.

CRANKSHAFT:—Five bearing. Integral counterweights.
Journal Diameters—#1, 2.373-2.374"; #2, 2.5605-2.5615"; #3, 2.623-2.624; #4, 2.6855-2.6865; #5, 2.748-2.749".
Bearing Type—Interchangeable steel-backed, babbitt-lined. Upper and lower halves not interchangeable.
Clearance—.001-.003".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. Bearing upper halves can be removed without removing crankshaft by using tool HM-J-173. This is a flat headed plug which is slipped into oil hole in crankshaft. The head engages the edge of the bearing and turns it out as crankshaft is rotated. Install bearings in same manner (insert plain edge of bearing on indented side of upper bearing support).
End Thrust:—Taken by #1 (front) bearing. Endplay .004-.008". A bronze thrust plate .1205-.1235" thick is assembled at each end of front main bearing and is dowelled to bearing cap. There is a steel thrust collar on the crankshaft behind the crankshaft gear.
NOTE—In removing fan drive pulley sheet metal rim on hub must not be damaged.

CAMSHAFT:—Six bearings. Non-adjustable chain drive.
Journal Diameters—#1, 2.3095-2.3100"; #2, 2.2470-2.2475"; #3, 2.1845-2.1850"; #4, 2.1220-2.1225; #5, 2.0595-2.0600"; #6, 1.8095-1.8100".
Bearing Type—Metal-backed, babbitt-lined.
Clearance—.002-.004".
End Thrust:—Taken by spring-loaded plunger in forward end of camshaft and thrust plate on chain case cover.
Timing Chain:—Whitney. Width 1¼". Pitch .500". Length 46 links or 23".
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straigtedge across the shaft centers. Use Sprocket Gauge HM-408-0.

VALVES:—Head Diameter Stem Diameter Length

Intake	1 9/16"	.3415-.3425"	5 9/32"
Exhaust	1 27/64"	.3405-.3415"	5 9/32"

	Seat Angle	Lift	Stem Clearance
Intake	30°	.300"	.00125-.00325"
Exhaust	45°	.300"	.00225-.00425"

Tappet Clearance—.008" Int., .010" Exh., warm.
Valve Guides:—Cast-iron. Install with turned portion below and finish ream to .34375-.34475" (inside diameter) after assembly. Guide must be 15/16" below top of block.
Valve Springs:—Free length 2 9/16". Install springs with three close-coils at top. No spring cages used.

	Spring Pressure	Spring Length
Valve Closed	43 lbs.	2 9/32"
Valve Open	116 lbs.	1 15/16"

NOTE—Springs are interchangeable (intake and exhaust, and 6 and 8 engines). Can be used on '33-35 engines. On '33 and '34 engines discard spring cages.
Valve Lifters:—Single piece cast-iron with core openings in sidewalls. Operate in removable guides in block. Clearance .0008". Serviced by renewing guides and installing standard lifters.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open at TDC. Close 42° ALDC.
Exhaust Valves—Open 40° BLDC. Close 10° ATDC.
To Check Valve Timing—Check tappet clearance #6 intake valve. This valve should open with piston on top dead center when flywheel mark 'TDC/' lines up with pointed end of inspection hole cover screw in left front face of housing.
Motor Gauge—Weidenhoff #104 Adapter, #2 Rod.
NOTE—Steel ball insert in flywheel does not indicate top dead center point as on the six cylinder engine.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase. Ignition timing not disturbed by removal of oil pump.
Normal Oil Pressure—25-30 lbs.
Oil Pressure Regulator—Mounted on oil pump. Operates at 27 lbs. Not adjustable.
Crankcase Capacity—7 qts. refill.

CLUTCH:—Borg & Beck Model 10A4. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Free movement of clutch pedal must be 1-1½". To adjust, loosen locknut and turn adjusting screw at lower end of inner lever on clutch throwout auxiliary shaft in front of clutch pedal.
Removal—Disconnect propeller shaft, remove transmission, take off clutch housing pan, take out six capscrews mounting clutch on flywheel turning all screws out evenly to release spring pressure. Clutch can be removed from below without removing flywheel housing.
NOTE—A locating dowel is mounted on the flywheel and the second clutch mounting screw hole on each side is counterbored deeper than the remaining holes. When mounting clutch, use the two screws with short thread and longer shank in these holes.

STEERING:—Steering Gear—Saginaw Worm-and-Roller type with center steering. See article in Steering Section for adjustments.

Front Suspension:—Independent, linked parallelogram type with coil springs. See article in Steering Section for complete data.
NOTE—Before checking front end, check tire inflation, front wheel balance, front wheel and tire runout (not to exceed ⅛"), bounce car up and down several times to allow frame to assume normal height.
King Pin Inclination—5°51' crosswise.
Caster—1½-2¼°. Adjustable. Caster affected by camber adjustment but not outside limits as given.
Camber—⅛-1°. Adjustable.
Toe In—⅛-3/16". Adjustable. Both tie rods must be turned equally.
Steering Geometry—Inner wheel turned 23°, outer wheel 20°.

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, Single anchor type. Hand lever applies rear wheel brakes. See article in Brake Section for complete data.
Brake Drum Diameter—12".
Brake Lining—Molded & woven type. Width 2". Thickness 3/16". Length 25.9" per wheel.
Brake Clearance—.008" toe, 010" heel, each shoe.

Hand Brake Adjustment:—See Service Brake Adjustment.

ENGINE NUMBER:—First number—X-27900. Stamped on boss on upper left hand corner of cylinder block (obscured by oil filter when filter installed).

ENGINE SPECIFICATIONS:—8 cylinder, 'L' head.

Bore—3¼". **Sroke**—4¼".

Displacement—282.04 cubic inches.

Rated Horsepower—33.8 (AMA).

Developed Horsepower—120 at 3800 R.P.M.

Compression Ratio and Pressure—6.5-1 Aluminum head, 110 lbs. at cranking speed (125 R.P.M.).

Vacuum Reading—Gauge should show steady reading of 18-19" with engine idling at 300 R.P.M. or 6 M.P.H.

PISTONS:—Nelson Bohnalite, aluminum alloy, Invar Strut, split skirt type. Recondition cylinders to take finished replacement pistons.

Weight—17.5 ozs. (stripped), 23 ozs. (with rings and pin).

Removal—Pistons and rods removed from above.

Clearance—Skirt .0015". See Fitting New Pistons.

Replacement Pistons:—Finished replacement pistons furnished standard size and .005", .010", .020", .030", .040" oversize.

Fitting New Pistons:—Use feeler gauge .0015" thick ½" wide to check clearance. Pull required to withdraw feeler from between piston and cylinder wall on side opposite slot must be within 5-7 lbs.

Installing Pistons:—Slot toward left or away from valves.

PISTON RINGS:—Two compression, one oil ring per piston above pin. Lower ring groove drilled with twelve 5/32" oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp. (top)	⅛"	.007-.012"	.002"
Comp. (2nd)	⅛"	.007-.012"	.0015"
Oil	3/16"	.007-.015"	.0015"

NOTE—Ring tension when compressed to cylinder size with .007" minimum gap must be 6¼ lbs. (compression), 4½-7½ lbs. (oil ring).

PISTON PIN:—Diameter—⅞". **Length**—2 51/64". Pin floats in piston and rod. Held by retaining ring at each end. Pin hole in connecting rod is bronze-bushed. Pins furnished .003", .006" oversize.

Pin Fit in Piston—Palm push fit with piston at 160° F. Holes finish reamed to .87515-.87485".

Pin Fit in Rod Bushing—.00025" clearance or thumb push fit with both parts at room temperature (70° F.). See Connecting Rod Upper Bearing.

CONNECTING ROD:—Weight 32½ ozs. **Length** 7 11/16".

Upper Bearing (Piston Pin Bushing)—Formed by two bushings pressed in rod from opposite sides so as to form oil groove in center. Rifle-drilled oil passage in rod must open into this groove.

Crankpin Journal Diameter—2 3/32".

Lower Bearing—Interchangeable steel-backed, babbitt-lined type. No shims.

Clearance—.0005-.0025". **Sideplay** .003-.006".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps.

Installing Rods:—Identification mark on side of rod should be toward front of engine with oil bleed hole in lower bearing toward camshaft side.

CRANKSHAFT:—Five bearing Integral counterweights.

Journal Diameter—2.746" all bearings.

Bearing Type—Interchangeable steel-backed, babbitt-lined type. No shims.

Clearance—.001-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust—Taken by center (#3) bearing. Endplay .003-.008". Adjusted by replacing or building up bearing.

CAMSHAFT:—5 bearing. Non-adjustable chain drive.

Journal Diameters—#1, 2"; #2, 1 31/32"; #3, 1 15/16"; #4, 1 29/32"; #5, 1⅞".

Bearing Type—Steel-backed, babbitt-lined.

Clearance—.001-.003".

End Thrust:—Taken by thrust plate in back of camshaft sprocket. Endplay .002-.004".

Timing Chain:—Morse #1866 RX. Width 1¼". Pitch .375". Length 58 links.

Camshaft Setting:—With #1 piston on top dead center (when center line above mark '#1 UP D.C.' lines up with indicator in inspection hole in left front face of flywheel housing under starter) and #1 exhaust valve just closing, mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across the shaft centers.

NOTE—Radiator and front assembly must be removed as a unit when work is done on front of engine and engine must be supported at front end and front engine support removed for work on timing chain, camshaft or sprockets. To remove front assembly, take out bolts to body (3 each side), bolts to running board (3 each side), fender brace bolts (1 each side), radiator tie rod nuts, center bolt in front cross-member, and running board moulding clips (4 each side).

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 17/32"	11/32"	5⅝"
Exhaust	1 13/32"	11/32"	5⅝"

	Seat Angle	Lift	Stem Clearance
Intake	30°	.300"	.0005-.00175"
Exhaust	45°	.300"	.0005-.00175"

NOTE—Stem clear'ce in guides measured at bottom.

Tappet Clearance—.007" Int., .010 Exh. Engine hot.

NOTE—Splasher in right front fender should be removed when valve adjustments are made.

Valve Guides:—Cast-iron, one piece, removable with exhaust longer than intake. New guides are finish reamed with a taper reamer after installation with .0035" greater clearance at top. Exhaust valve guides are counterbored ⅜" deep at top to provide .015" greater clearance.

Valve Springs:—Intake and exhaust springs are interchangeable.

	Spring Pressure	Length
Valve Closed	40 lbs.	1⅝"
Valve Open	110 lbs.	1 5/16" approx.

Valve Lifters—Single piece barrel-type with openings in side walls.

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 5° BTDC. Close 39° ALDC.

Exhaust Valves—Open 45° BLDC. Close 5° ATDC.

To Check Valve Timing—See Camshaft Setting above. Use gauge to measure #1 piston travel. Set tappet clearance #1 exhaust valve .006". This valve should be fully closed with piston .006" ATDC when 5° point on flywheel (midpoint between second and third graduation to the left of line marked '#1 UP D.C.') lines up with indicator in inspection hole in left front face of flywheel housing under starter. Reset tappet clearance at .010" with motor warm.

Motor Gauge—Weidenhoff Adapter #114, Rod #5.

LUBRICATION:—Pressure. Gear type oil pump mounted on right side of crankcase.

NOTE—Whenever oil pump is to be removed turn engine over until distributor rotor in #1 position (#1 piston 7° BTDC.). When installing pump turn oil pump shaft so that tongue-and-groove connection to distributor shaft meshes. Recheck ignition timing.

Normal Oil Pressure:—35 lbs. at 1000 R.P.M.

Oil Pressure Relief Valve:—Located on pump cover. Not adjustable. Replace relief valve spring if defective. Tension 6 lbs. compressed to 2".

Crankcase Capacity:—7 qts. (full).

CLUTCH:—Long Mod. 10CF-CI. Semi-centrifugal, single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Clearance between clutch pedal and toeboard must be ½" with clutch engaged. Free movement of clutch pedal must be 1½". To adjust, loosen locknut and turn adjusting nut on clutch pedal-to-lever connecting rod.

Removal—Remove floor boards and front seat, disconnect front universal joint, support engine at rear and remove rear engine mountings, remove transmission, remove clutch housing bottom cover, and clutch pedal linkage. Loosen capscrews mounting clutch cover on flywheel turning all screws out evenly to release springs. Remove clutch from below without removing housing.

STEERING:—Steering Gear—Gemmer Model Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Independent 'Safe-T-Flex' type with Coil springs. All specifications below apply with car weight on wheels. See article in Steering Section for adjustments.

King Pin Inclination—1°30' crosswise.

Camber—1° plus or minus ¼°. Adjustable.

Caster—2° plus or minus ½°. Adjustable.

Toe In—1/16-⅛". Adjustable by turning tie rods equally (check for equal lengths after adjustment).

Steering Geometry—Inner wheel turned 23°, outer wheel turned 20°. Check tie rod ends and kingpin for looseness.

BRAKES:—Service—Bendix Hydr'lic, Duo-Servo, Single anchor type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.

Wheel Cylinders—1 1/16" (front—painted white), 15/16" (rear—painted brown).

Drum Diameter—12".

Lining—Primary U.S. Asbestos 714, Secondary U.S. Asbestos 589. Width 1¾". Thickness 3/16". Length per wheel 26".

Clearance—.010" at heel and toe of each shoe.

Spring Pressure—63 lbs. on primary return spring (No. 303837-red), 70 lbs. on secondary return spring (No. 303836-yellow).

Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—First number 390000 (1400, 1, 2), 757000 (1403, 4, 5). Stamped on left side of block at front of engine near oil filler.

ENGINE SPECIFICATIONS:—Type—8 cylinder In Line, 'L' head type.

Bore—3 3/16" (1400, 1, 2), 3½" (1403, 4, 5).

Stroke—5" (all models).

Displacement—320 cubic inches (1400, 1, 2), 384.4 cubic inches (1403, 4, 5).

Rated Horsepower—32.5 (1400, 1, 2), 39.2 (1403, 4, 5).

Developed Horsepower—130 at 3200 (1400,1,2), 150 at 3200 (1403, 4, 5).

Compression Ratio—6.5-1 Std. head (1400, 1, 2), 6.3-1 Std. head (1403,4, 5), 6.0-1 Optl. low comp. head, 7.0-1 Optl. high comp. head (both models).

Compression pressure—110 lbs. at cranking speed of 125 R.P.M. (std. head—both models).

Vacuum Readng—Gauge should show steady reading of 18-19" with engine idling at 350 R.P.M. or 7 M.P.H.

PISTONS:—Nelson Bohnalite, aluminaum alloy, Invar Strut, split skirt type. Recondition cylinders to take finished replacement pistons.

Weight—18.7 ozs. (1400, 1, 2), 21.9 ozs. (1403, 4, 5).

Removal—Pistons removed from top, rods from bottom on Model 1400, 1, 2 (push piston up until piston pin is exposed, remove locking ring and push out pin, remove piston, lower rod and remove from below. Use new locking rings when replacing pistons). Pistons and rods removed from above on Model 1403, 4, 5.

Clearance—Skirt .0015". See Fitting New Pistons.

Replacement Pistons:—Finished replacement pistons furnished in standard size and .003", .005", .010", .015", .020", .025", .030", .035", .045" oversize

Fitting New Pistons:—Use .0015" feeler stock ½" wide to check clearance. Pull required to withdraw feeler from between piston and cylinder wall on side opposite slot should be 3-5 lbs.

Installing Pistons:—Slot should be on valve side of engine.

PISTON RINGS:—Three compression, one oil control ring per piston, all above pin. Lower ring groove drilled with twelve ⅛" oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp (Top)	⅛"	.007-.012"	.002"
Comp (2nd)	⅛"	.007-.012"	.0015"
Oil	5/32"	.007-.015"	.0015"

NOTE—Ring tension when compressed to cylinder size with .007" minimum gap should be 6¼ lbs. (1400, 1, 2 comp. ring), 6¾ lbs. (1403, 4 5 comp. ring), 4½-7½ lbs. (oil ring—all models).

PISTON PIN:—Diameter ⅞". **Length** 2 47/64" (1400, 1, 2) 3 3/64" (1403, 4, 5). Pin floats in piston and rod. Held by locking ring at each end. Pin hole in rod is bronze-bushed. Pins furnished for service .003", .006" oversize.

Pin Fit in Piston—Palm push fit with piston heated to 160° F. Pin holes in piston finished to inside diameter of .87515-.87485".

Pin Fit in Rod Bushing—.0002" clearance or thumb push fit with both parts at room temperature (70°F)

CONNECTING ROD:—Weight 40 1/16 ozs. (1400, 1, 2), 47¾ ozs. (1403, 4, 5). **Length** 10⅞".

Crankpin Journal Diameter—2.1875".

Lower Bearing—Removable steel-backed, babbitt-lined type. No shims. Bearings furnished for service .001", .002", .003", .015" undersize.

Clearance—.0005-.002". Sideplay .003-.006".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or bearing caps.

Installing Rods:—Install with oil hole toward camshaft.

CRANKSHAFT:—9 bearing. Integral counterweights.

Journal Diameter—2.625".

Bearing Type—Removable steel-backed, babbitt-lined type. No shims.

Clearance—.001-.002".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust:—Taken by #7 bearing. Endplay .003-.005"

CAMSHAFT:—8 bearing. Adjustable chain drive.

Bearing Type—Steel-backed, babbitt-lined.

Clearance—.001-.003".

Endplay—.001-.004".

Timing Chain:—Morse #1866. Width 1½". Pitch .500". Length 32" or 64 links.

Chain Adjustment—Loosen generator flange mounting screws, pull generator out or away from engine until sideplay as measured at chain inspection plug hole in top face of chain case is ¼", tighten mounting screws. Adjust chain whenever sideplay exceeds ½".

Camshaft Setting:—Sprockets are marked Mesh chain with sprockets turned so that 'OO' marks are adjacent and are centered on a straitedge across the shaft centers.

VALVES:—

	Head Diam.	Stem. Diam.	Length
Intake (1400, 1, 2)	1 21/32"	.3405"	7 13/32"
Exhaust " "	1 15/32"	.3405"	7 13/32"
Intake (1403, 4, 5)	1 13/16"	.3405"	7 13/32"
Exhaust " "	1 11/16"	.3405"	7 13/32"

	Seat Angle	Lift	Stem Clear.
Intake	45°	.358"	.0025" min.
Exhaust	45°	.358"	.004" min.

Tappet Clearance—.004" Int., .006" Exh., eng. warm.

Valve Guides:—Pressed in block. Reamed to size for correct stem clearance (see table above).

Valve Rocker Arms:—Consist of pivoted arms mounted on bracket on crankcase which transmit motion from cam to valve pushrod (valve lifter).

Removal—Take out screws in bracket on left side of crankcase, withdraw bracket and pushrod assembly.

Valve Springs:—Double springs used on all valves.

	Spring Pressure	Spring Length
Valve Closed	73 lbs.	3 1/16"

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 30° BTDC. Close 65° ALDC.

Exhaust Valves—Open 65° BLDC. Close 30° ATDC.

To Check Valve Timing—Check tappet clearance #1 intake valve. This valve should open with piston 30° or .4070" before top dead center when flywheel mark 'INT' (visible through starter mounting hole in flywheel housing with starter removed) lines up with indicator on housing within case.

Motor Gauge—Weidenhoff #114 Adapter, #5 Rod.

LUBRICATION:—Pressure type. Gear type oil pump mounted in crankcase. Oil temperature regulator mounted on left side of engine.

Normal Oil Pressure—35 lbs. at 1000 R.P.M.

Oil Pressure Regulator—Located under plug on left side of crankcase. Operates at 35 lbs. Adjustable by turning adjusting screw.

Crankcase Capacity—8 qts. (1400, 1, 2), 9½ qts. (1403, 4, 5).

CLUTCH:—Long Model 12 CB-CL. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions. No adjustment for wear required.

Adjustment—Clearance between pedal and toeboard should be ½-1". Free movement of pedal should be 1½". Adjust by turning turnbuckle on connecting rod at lower end of pedal.

Removal—Disconnect drive shaft at front universal, remove transmission and bell housing, take out screws mounting clutch on flywheel turning all screws out evenly to release clutch spring pressure.

STEERING:—Steering Gear—Gemmer Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.

King Pin Inclination—9° crosswise.

Camber—1°.

Caster—2½°. Adjustable by installing wedge shims between spring and spring pad on axle.

Toe In—1/16-⅛" at rim. Adjustable in usual manner by changing length of tie rod.

Tread—60".

Steering Geometry—Inner wheel turned 22½°-23°, outer wheel turned 20°. Check tie rod ends and king pins for looseness.

BRAKES:—Bendix Duo-Servo, Single Anchor, mechanically operated, vacuum power brakes. Hand lever applies all four brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—14".

Lining—Primary (Raybestos 451), Secondary (Hyco DV 1391). Width 2¼" (except left front which is 1¾"). Thickness ¼". Length 30¼".

Clearance—Free—at heel and toe of each shoe.

Hand Brake Adjustment:—With hand brake lever fully released and cross shaft against stop, remove all slack in cable by adjusting clevis position at cross shaft end of cable until clevis pin can just be inserted in cross lever. Check brakes making sure they are fully released with hand brake in off position. Adjustment for wheel equalization should be made after drum lining has been worn in.
NOTE—By removing glove compartment and changing brake latch piece (#228705) operating position of hand brake lever may be moved 2" to the rear.

Power Unit:—Bendix plain type vacuum cylinder mounted on frame and linked to cross shaft lever. Controlled by valve built in brake pedal mechanism. See article in Brake Section for complete data.

ENGINE NUMBER:—First number—904000. Stamped on front of left cylinder block below head.

ENGINE SPECIFICATIONS:—Type—12 cyl. 67° Vee, modified 'L' head. Both blocks and upper crankcase cast enbloc.

Bore—3 7/16". **Stroke**—4¼".

Displacement—473 cubic inches.

Rated Horsepower—56.7 (AMA).

Developed Horsepower—175 at 3200 R.P.M. Std. 6.4-1 head.

Compression Ratio & Pressure—6.4-1 Std. head, 6.0-1 Optl. low comp. head, 7.0-1 Optl. high comp. head. Pressure 110 lbs. at cranking speed of 125 R.P.M. Std. 6.4-1 head.

Vacuum Reading—Gauge should show steady reading of 18-19" with engine idling at 375 R.P.M. or 8 M.P.H.

PISTONS:—Nelson Bohnalite, aluminum alloy, Invar Strut, split skirt type. Recondition cylinders to take finished replacement pistons.

Weight—21.7 ounces.

Removal—Pistons removed through top, rods thru bottom of engine (push pistons up until piston pin is exposed, take out locking rings, push out pin, lift out piston, lower rod and remove from below). Use new locking rings when installing pistons.

Clearance—Skirt .0015". See Fitting New Pistons.

Replacement Pistons:—Furnished in standard size and .003", .005", .010", .015", .020", .030", .045" oversize.

Fitting New Pistons:—Use .0015" feeler stock ½" wide to check clearance. Pull required to withdraw feeler from between piston and cylinder wall on side opposite slot should be 3-5 lbs.

Installing Pistons:—Slot should be toward camshaft on all pistons.

PISTON RINGS:—Three compression, one oil control ring per piston, all above pin. Lower ring groove drilled radially with twelve ⅛ oil drain holes.

Ring	Width	End Gap	Side Clear.
Comp. (Top)	⅛"	.007-.012"	.002"
Comp. (2nd)	⅛"	.007-.012"	.0015"
Oil	5/32"	.007-.015"	.0015"

NOTE—Ring tension when compressed to cylinder size with .007" minimum gap should be 6½ lbs. (compression), 4½-7½ lbs. (oil ring).

PISTON PIN:—Diameter ⅞". Length 2 63/64". Pin floats in piston and rod. Held by locking ring at each end. Pin hole in rod is bronze-bushed. Pins furnished for service .003", .006" oversize.

Pin Fit in Piston—Palm bush fit with piston heated to 160° F. Pin holes in piston finished to inside diameter of .87515-.87485".

Pin Fit in Rod Bushing—.0002" clearance or thumb push fit with both parts at room temp. (70° F.).

CONNECTING ROD:—Weight 40⅝ ozs. **Length** 9".

Crankpin Journal Diameter—2½".

Lower Bearing—Removable, steel-backed, babbitt-lined type. Bearings furnished for service .001", .002", .003", .015" undersize.

Clearance—.0005-.002". **Sideplay** .005-.013".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rod or caps.

Installing Rods:—Install all rods with oil bleed hole in lower bearing toward right or starter side of engine.

CRANKSHAFT: 4 bearing. Integral counterweights.

Journal Diameters—2¾" all bearings.

Bearing Type—Removable, steel-backed babbitt-lined. No shims.

Clearance—.001-.002".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust:—Taken by #1 front bearing. Endplay .003-.005".

CAMSHAFT:—Four bearing. Mounted between cylinder banks directly above crankshaft. Non-adjustable chain drive.

Bearing Type—Steel-backed, babbitt-lined.

Clearance—.001-.003".

Endplay—.002-.006".

Timing Chain:—Morse #1866. Width 1¾". Pitch .500". Length 28" or 56 links.

NOTE—Engine must be supported at front end and engine front casting (engine support, timing chain cover, generator and water pump mounting) removed for work on timing chain, sprockets, or camshaft.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that '00' marks are adjacent and in line with a straightedge across the shaft centers (vertical).

VALVES:—	Head Diameter	Stem Diameter	Length
Intake	1 21/32"	.3405"	6 35/64"
Exhaust	1 21/32"	.338"	6 35/64"

	Seat Angle	Lift	Stem Clearance
Intake	45°	5/16"	.0025"
Exhaust	45°	5/16"	.005"

Tappet Clearance—None in service. (auto. take-up).

Automatic Tappet Take-up (Valve Silencer):—Consists of eccentric take-up on rocker arm shaft. Rocker arms contact valve stem ends and cams directly and are mounted on roller bearings. See article in Equipment Section for complete data.
NOTE—Initial clearance of take-up mechanism must be checked when valves are installed and take-up must be bled when valves are ground. See Equipment Section for instructions.

Valve Springs:—Install springs with japanned end down and close-spaced first coil up.

	Spring Pressure	Length
Valve Closed	70 lbs.	2 7/32"

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open at TDC. Close 45° ALDC.

Exhaust Valves—Open 35° BLDC. Close 10° ATDC.

To Check Valve Timing—Intake valve in #1 cylinder of right hand bank (1R) should begin to open with piston No. 6R on top dead center entering power stroke when mark '1R-UDC' on vibration dampener at front of engine lines up with pointer on chain case cover.

Motor Gauge—Weidenhoff #114 Adapter, #2 Rod.

LUBRICATION:—Pressure system. Gear type oil pump located in crankcase. Oil temperature regulator mounted on right side of crankcase.

Normal Oil Pressure—35 lbs. at 1000 R.P.M.

Oil Pressure Regulator—Under plug on right hand side of crankcase. Adjustable by turning adjusting screw.

Crankcase Capacity—10 qts.

CLUTCH:—Long Model 12 CB-CL. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions. No adjustment for wear required.

Adjustment—Clearance between pedal and toeboard should be ½-1". Free movement of pedal should be 1½". To adjust, turn turnbuckle on connecting rod at lower end of clutch pedal.

Removal—Disconnect drive shaft at front universal, remove transmission and bell housing, take out screws mounting clutch cover on flywheel, turning all screws out evenly to release clutch spring tension.

STEERING:—Steering Gear—Gemmer Worm-and-Roller type. See article in Steering Section for adjustments.

Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliot ends and semi-elliptic springs.

King Pin Inclination—9° crosswise.

Camber—1°.

Caster—1½°. Adjustable by installing wedge shims between spring and spring pad on axle.

Toe In—1/16-⅛" at rim. Adjustable in usual manner by changing length of tie rod.

Tread—60".

Steering Geometry—Inner wheel turned 22½°, outer wheel turned 20°. Check tie rod ends and king pins for looseness.

BRAKES:—Service—Bendix Duo-Servo, Single anchor, mechanically operated, vacuum power brakes. Hand lever applies all four brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—15".

Lining—Primary (Raybestos 451), Secondary (Hyco DV 1391). Width 2½" (except left front which is 1⅞"). Thickness ¼". Length 32¼".

Clearance—Free—at heel and toe of each shoe.

Hand Brake Adjustment:—With hand brake lever fully released and cross shaft against stop, remove all slack in cable by adjusting clevis position at cross shaft end of cable until clevis pin can just be inserted in cross lever. Check brakes making sure they are fully released with hand brake in off position. Adjustment for wheel equalization should be made after lining has been worn in.

NOTE—By removing glove compartment and changing brake latch piece (#228705) operating position of hand brake lever may be moved 2" to the rear.

Power Unit:—Bendix plain type vacuum cylinder mounted on frame and linked to cross shaft lever. Controlled by valve in brake rod between brake pedal and cross shaft. See Brake Section for complete data.

ENGINE NUMBER:—First number—2,215,000. Stamped on left side of cylinder block below head at center.

ENGINE SPECIFICATIONS:—8 cylinder, In Line, 'L' hd.
Bore—3½". **Stroke**—5".
Displacement—385 cubic inches.
Rated Horsepower—39.2 (AMA).
Developed Horsepower—150 at 3400 R.P.M.
Compression Ratio—6.4-1 Std. aluminum head, no optional ratios.
Compression Pressure—148 lbs. at 2500 R.P.M. or 75-80 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 19-20" with engine idling.

PISTONS:—Bohn, Bohnalite aluminum alloy, Invar Strut, split skirt type. See Replacement Pistons below for standard oversizes.
Weight—22.71 ozs. (stripped). **Length**—4¼".
Removal—Pistons and rods removed from above.
Clearance—Top .024". Bottom .002". See Fitting New Pistons.

Replacement Pistons:—Pistons furnished in standard oversizes of .002", .004", .010", .020".

Fitting New Pistons:—Pistons should be snug on .0015" feeler and locked on .002" feeler.

Installing Pistons:—Slot should be toward left viewed from driver's seat.

PISTON RINGS:—Four rings per piston, three compression rings, one oil control ring, all above pin. Oil ring groove drilled radially with oil drain holes.

Ring	Width	End Gap	Side Clear.
Comp. all	.1235-.1240"	.013-.018"	.001-.002"
Oil Cont.	.1860-.1865"	.013-.018"	.001-.002"

PISTON PIN:—Diameter .8749". **Length** 3.031".
Pin floats in piston and rod. Held by retaining rings.

CONNECTING ROD:—Weight 34.82 ozs. **Length** 8.999".
Crankpin Journal Diameter—2.251-2.2515".
Lower Bearing—Centrifugally cast, babbitt-lined type. No shims used.
Clearance—.001-.0025". Sideplay .004-.006".

Bearing Adjustment:—None (no shims). Replace rods. Do not file caps.
NOTE—Oil spray holes in both sides of connecting rod lower bearing upper half.

CRANKSHAFT:—9 bearing. Integral counterweights.
Journal Diameters—2⅝" all bearings.
Bearing Type—Removable bronze-backed, babbitt-lined. No shims.
Clearance—.0015-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps.

End Thrust:—Taken by front bearing. Endplay .002-.004". Adjustable by adding or removing shims.

CAMSHAFT:—6 bearing. Non-adjustable chain drive.
Bearing Type—Steel-backed, babbitt-lined.
Clearance—.002". Endplay .003-.009".

Timing Chain:—Whitney #CL-206. Width 1½". Pitch ½". Length 25" or 50 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that a straightedge across shaft centers splits the 'O' mark on the crankshaft sprocket and is midway between the two 'O' marks on the camshaft sprocket.
NOTE—Special puller tool necessary to install timing chain. Timing chain must be installed 'endless.'

VALVES:—	Head Diameter	Stem Diameter	Length
Intake	1 9/16"	.3725-.3735"	4¾"
Exhaust	1 9/16"	.3715-.3725"	4¾"

	Seat Angle	Lift	Stem Clear.
Intake	45°	.355"	.0015-.0025"
Exhaust	45°	.343"	.0025-.0035"

Tappet Clearance—None in service. See data below on Hydraulic Valve Lifters.

Valve Springs:—	Spring Pressure	Spring Length
Valve Closed	60-65 lbs.	2 3/32"
Valve Open	120-128 lbs.	1 25/32"

Valve Lifters:—Hydraulic type providing automatic tappet take-up. See article in Equipment Section for complete data on servicing these units.
NOTE—Hydraulic lifters have been redesigned. Service instructions as given for previous types apply to the new type but new type lifters are not interchangeable in part or as a unit with previous lifters. Lifters used on eight and twelve cylinder engines not interchangeable (longer body used on eight). Cannot be adapted to twelve engine as previously (by changing plunger cap).

Installing Hydraulic Valve Lifters—Install this type lifter without oil. Oil in lifter will retard escape of air and delay quieting of lifter when engine is operated. Remove plunger from lifter body, wash out all oil with gasoline. Do not interchange plungers—they are selective fit in lifter bodies—this is important.

Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 5° ATDC. Close 45° ALDC.
Exhaust Valves—Open 40° BLDC. Close 12° ATDC.
To Check Valve Timing—Remove #1 intake hydraulic valve lifter, pull out plunger, remove spring, wash lifter assembly in gasoline, replace plunger, install lifter in bracket. Check clearance between end of plunger and valve stem (valve closed—clearance will be about .070"). Insert sufficient feeler stock to take up all except .010" clearance. Turn engine over until piston #1 is .0123" past top dead center, stop when flywheel mark 'IN.OP./1-8' lines up with indicator on housing. #1 intake valve should begin to open at this point. Remove feeler stock, re-assemble hydraulic valve lifter as directed above.
Motor Gauge—Weidenhoff #114 Adapter, #29 Rod.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.
Normal Oil Pressure:—40-45 lbs. at 40 M.P.H.
Oil Pressure Relief Valve:—Located at pump. Adjustable by adding or removing spacer washers.
Oil temperature Regulator:—Harrison Radiator Co. type.
Crankcase Capacity:—9 qts. (refill). 10 qts. (dry).

CLUTCH:—Long Model 12CB-CL. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions. No adjustment for wear required.
Adjustment—Free movement of clutch pedal must be ¾-1¼". Screw adjustment provided at bell housing. Pedal should have free clearance at underside of toeboard.
Removal—Disconnect front universal joint, drop propeller shaft, remove transmission (pull straight back to avoid distortion to clutch disc), take off clutch housing allowing clutch to be removed in usual manner.

STEERING:—Steering Gear—Ross Model 660. Cam-and-lever type. See article in Steering Section for adjustments.
Front Suspension:—Conventional 'I' beam section axle with Reverse-Elliott ends and semi-elliptic springs.
Caster—¾° (plus or minus ¼°) for axles with plain bearings, 1° (plus or minus ¼°) for axles with needle bearings. Spring seat on axle should tilt down at rear 4°15' (axles with plain bearings), 4° (axles with needle bearings). Correct caster by inserting wedge shims between spring and spring seat on axle.
Camber—1° (plus or minus ½°). Wheel felloe at top of wheel should be not more than 15/32" or less than 5/32" outside felloe at bottom. No adjustment provided.
Toe In—3/16" (plus 0 or minus 1/16"). Adjusted in usual manner by loosening clamp bolts and turning tie rod.
Steering Geometry—Inner wheel turned 40°, outer wheel 30°.

BRAKES:—Service—Stewart-Warner mechanical four wheel type with vacuum power operation. Hand lever applies all four service brakes. See article in Brake Section.
Drum Diameter—16".
Lining—Moulded type. Width 2¼". Thickness ¼". Length per wheel 38".
Clearance—.009" (front wheels), .012" (rear wheels), at heel and toe of each shoe.

Hand Brake Adjustment:—See Service Brakes.

Power Unit:—Bendix vacuum power unit. See article in Brake Section.

ENGINE NUMBER:—First number— (1602) 3,140,000. (1603) 3,150,000. Stamped on left cylinder block below head at center of engine.

ENGINE SPECIFICATIONS:—12 cylinder, 80° included angle Vee, 'L' head type. Cylinders cast en bloc for each bank.

Bore—3½". Stroke—4".

Displacement—462 cubic inches.

Rated Horsepower—58.8 (AMA).

Developed Horsepower—185 at 3400 R.P.M.

Compression Ratio—6.4-1 Std. aluminum head. No. optional ratios.

Compression Pressure—140 lbs. at 2500 R.P.M. or 80-85 lbs. at cranking speed.

Vacuum Reading—Gauge should show steady reading of 19-20" with engine idling.

PISTONS:—Bohn, Bohnalite aluminum alloy. Invar Strut, split skirt type.

Weight—22.70-22.82 ozs. (stripped).
Length—4¼".

Removal—Pistons and rods removed from above.

Clearance—Top .019-.026". Bottom .000-.005" at right angles to bosses, .001-.007" across bosses. See Fitting New Pistons.

Replacement Pistons:—Pistons furnished in standard oversizes of .002", .004", .010", .020".

Fitting New Pistons:—Pistons should be snug on .0015" feeler and locked on .002" feeler.

Installing Pistons:—Slot should be toward left on both banks (viewed from driver's seat).

PISTON RINGS:—Four rings per piston, three compression, one oil control ring, all above pin. Lower ring groove drilled radially with oil drain holes.

Ring	Width	End Gap	Side Clear.
Comp. all	.1235-.1240"	.013-.018"	.001-.002"
Oil Cont.	.1860-.1865"	.013-.018"	.001-.002"

PISTON PIN:—Diameter—.8749-.8751".

Length—3.031-3.041".
Pin floats in piston and rod. Held by retaining rings. Pin hole in rod is bronze-bushed.

Pin Fit in Rod Bushing:—.0004-.0006" clearance.

CONNECTING ROD:—Weight—35.62 ounces.

Length—9.936-9.939" (center-to-center).

Crankpin Journal Diameter—2.126-2.1265".

Lower Bearing—Centrifugally-cast, babbitt-lined type. No shims used.

Clearance—.001-.0025". Sideplay .006-.009".

Bearing Adjustment:—None (no shims). Replace rods. Do not file caps. Bearings .010" and .020" undersize furnished for service.

NOTE—Oil spray holes are drilled in both sides of connecting rod lower bearing upper half. Rods are installed at factory with chamfer in crankpin bore next to crankshaft cheek (rods mounted side by side).

CRANKSHAFT:—7 bearing. Integral counterweights.

Journal Diameters—2½" all bearings.

Bearing Type—Removable bronze-backed, babbitt-lined. No shims used.

Clearance—.0015-.003".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps.

End Thrust:—Taken by front bearing. Endplay .002-.004" Adjustable by adding or removing shims.

CAMSHAFT:—4 bearing. Non-adjustable chain drive.

Bearing Type—Steel-backed, babbitt-lined.

Clearance—.002". Endplay .003-.009".

Timing Chain:—Whitney CLG-206. Width 1½". Pitch ½". Length 26½" or 53 links.

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers.

NOTE—Special puller tool necessary to install timing chain. Install timing chain 'endless.'

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 21/32"	.3725-.3735"	4¾"
Exhaust	1 9/16"	.3715-.3725"	4¾"

	Seat Angle	Lift	Stem Clear.
Intake	45°	.324"	.0015-.0025"
Exhaust	45°	.324"	.0025-.0035"

Tappet Clearance—None in service. See data below on hydraulic valve lifters.

Valve Springs:—Install springs with small end up. Flat coil spring type dampener installed on all springs at top.

	Spring Pressure	Length
Valve Closed	60-65 lbs.	2 3/32"
Valve Open	120-128 lbs.	1 25/32"

Valve Lifters:—Hydraulic type, providing automatic tappet take-up. See article in Equipment Section for complete data on servicing these units.

NOTE—Hydraulic lifters have been redesigned. Service instructions as given for previous types apply to the new type but new type lifters are not interchangeable in part or as a unit with previous lifters. Lifters used on eight and twelve cylinder engines not interchangeable (longer body used on eight). Cannot be adapted to twelve engine as previously (by changing plunger cap).

Valve Timing:—See Camshaft Setting above.

Intake Valves—Open 19° BTDC. Close 69° ALDC.

Exhaust Valves—Open 56° BLDC. Close 28° ATDC.

To Check Valve Timing—Remove #1 intake hydraulic valve lifter, pull out plunger, remove spring, wash lifter assembly in gasoline to remove all oil, replace plunger, install lifter in bracket, check clearance between end of plunger and valve stem (valve closed—clearance will be about .070"). Insert sufficient filler stock to take up all except .004" clearance, turn engine over with #11 piston on compression, stop when flywheel mark 'IN.OP.#1/' lines up with indicator on housing, #1 intake valve should begin to open at this point. Remove feeler stock, reassemble hydraulic valve lifter.

Motor Gauge—Weidenhoff #114 Adapter, #42 Rod. Piston position should be .1303" BTDC.

LUBRICATION:—Pressure. Gear type oil pump located in crankcase.

Normal Oil Presure:—45 lbs. at 53 M.P.H.

Oil Pressure Relief Valve:—Located at oil pump. Operates at 50 lbs. Adjustable by adding or removing spacing washers.

Oil Temperature Regulator:—Harrison Radiator Co. type.

Crankcase Capacity:—11 qts. (refill).

CLUTCH:—Long Model 12CB-CL. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions. No adjustment for wear required.

Adjustment—Free movement of clutch pedal must be ¾-1¼". Screw adjustment provided at bell housing. Pedal must have free clearance at underside of toeboard.

Removal—Disconnect front universal joint, remove transmission (pull straight back to avoid distortion to clutch disc), take off bell housing and remove clutch assembly in usual manner.

STEERING:—Steering Gear—Ross Model 660. Cam-and-lever type. See article in Steering Section for adjustments.

Front Suspension:—Conventional axle with Reverse-Elliott ends and semi-elliptic springs.

Kingpin Inclination—8° crosswise.

Caster—¾° (plus or minus ¼°) for axles with plain bearings, 1° (plus or minus ¼°) for axles with needle bearings. Spring seat on axle should tilt down at rear 4°15' (axles with plain bearings), 4° (axles with needle bearings). Correct caster by inserting wedge shims between spring and spring seat on axle.

Camber—1° (plus or minus ½°). Wheel felloe at top of wheel should be not more than 15/32" or less than 5/32" outside felloe at bottom. No adjustment provided.

Toe In—3/16" (plus 0 or minus 1/16"). Adjusted in usual manner by loosening clamp bolts and turning tie rod.

Steering Geometry—Inner wheel turned 40°, outer wheel 30°.

BRAKES:—Service—Stewart-Warner mechanical four wheel type with vacuum power operation. Hand lever applies all four service brakes. See article in Brake Section.

Drum Diameter—16".

Lining—Moulded type. Width 2¼". Thickness ¼". Length per wheel 38".

Clearance—.009" (front wheels), .012" (rear wheels), at heel and toe of each shoe.

Hand Brake Adjustment:—See Service Brakes.

Power Unit:—Bendix vacuum power unit. See article in Brake Section.

NOTE—The letter 'E' inserted in engine number, thus: P2-E-1001 indicates that engine is equipped with smaller carburetor and intake manifold and 3.7-1 ratio rear axle.

ENGINE NUMBER:—First number—P2-1001 (see note above). Stamped on left side of cylinder block between #1 and 2 cylinders. Letter 'A' following number indicates bore .020" larger than standard. 'B' indicates main and connecting rod bearings .010" smaller than standard. 'AB' indicates that bore and bearing sizes are as above. 'C' indicates main and connecting rod bearings standard, but outside diameter of connecting rod bearings .005" larger than standard.

ENGINE SPECIFICATIONS:—6 cylinder, 'L' head.
Bore—3⅛". **Stroke**—4⅜".
Displacement—201.31 cubic inches.
Rated Horsepower—23.44 (AMA).
Developed Horsepower—82 at 3600 R.P.M.
Compression Ratio—6.7-1 Std. cast-iron head. No optional ratios.
Compression Pressure—140-150 lbs. at 1000 R.P.M. or approximately 113 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of 16-18" with engine idling at 6 M.P.H.

PISTONS:—Aluminum alloy, 'T' slot, Cam ground type with anodized finish (special hard oxide formed on bearing surface). **Length**—3 11/16".
Weight—Held to two gram max. variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Skirt .0005". Limits .0005-.001". See Fitting New Pistons.
Replacement Pistons:—Finished anodized pistons furnished in standard and .003", .005", .010", .015", .020", .023", .025", .030", .040", .050", .060" oversizes. Semi-finished pistons furnished: (1) standard to .023" oversize. (2) .025-.050" oversize, not interchangeable. Pistons should be slotted and then finished on cam grinding equipment.
Fitting New Pistons:—Micrometer gauge recommended. Check cylinder bore and piston diameter. Measurement on piston made at bottom of skirt at right angles to piston pin (pin must be removed).
Installing Pistons:—Slot should be at left or away from valves.

PISTON RINGS:—Two undercut compression rings, two oil control rings per piston, all above pin. Lower ring groove drilled with oil drain holes.

Ring	Width	End Gap	Side Clearance
Comp (all)	⅛"	.007-.015"	.002-.003"
Oil (both)	5/32"	.007-.015"	.002-.003"

Replacement Rings:—Furnished in standard and .003" .010", .020", .030", .040", .050", .060" oversizes.
NOTE—Install compression rings with step down.

PISTON PIN:—**Diameter** 55/64". **Length** 2⅝". Pin floats in piston and rod. Held by retaining rings. Pin hole in rod is bronze-bushed.
NOTE—Heat piston in boiling water to remove or install pins.
Pin Fit in Piston—Tight thumb push fit with piston heated to 130° F.
Pin Fit in Rod Bushing—Tight thumb push fit with piston and rod at 70° F.
Replacement Pins:—Pins furnished in standard and .003", .005", .008" oversizes. Ream rod bushing and pin holes in piston bosses for correct fit.

CONNECTING ROD:—**Weight**—All rods held to ¼ oz. maximum variation. **Length** 7 15/16" (center-to-center).
Crankpin Journal Diameter—1 15/16".
Lower Bearing—Steel-backed, copper-lead lined, interchangeable. Furnished standard and .010" undersize.
Clearance—.001-.003". Sideplay .0055-0115".
Bearing Adjustment—None (no shims). Replace bearings. Do not file rods or caps. Install new bearings so small bosses engage grooves in rod and cap.
Installing Rods:—Lower bearings are offset. Install rods with widest half of bearing toward rear (#1, 3, 5) and toward front (#2, 4, 6). Oil hole in lower bearing upper half must be toward camshaft on all rods.

CRANKSHAFT—4 bearing. Integral counterweights.
Journal Diameters—2¼" (all bearings).
Bearing Type—Removable steel-backed, babbitt-lined (#1 and 4), copper-lined or cadmium-nickel (#2 and 3). Furnished standard & .010" undersize.
Clearance—(#1 & 4) .001-.002". (#2 & 3) .0015-.0025"
Bearing Adjustment:—None (no shims). Replace bearings. Do not file caps. No fitting or reaming necessary for new bearings.
End Thrust:—Taken by flange faces on rear (#4) bearing. Endplay .003-.007".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2"; #2, 1 31/32"; #3, 1 15/16"; #4, 1¼".
Bearing Type—Removable steel-backed, babbitt-lined (except #4 machined in crankcase).
Clearance—.001-.003" (#1), .0015-.0035" (all others).
NOTE—New bearings require no line-reaming.
End Thrust:—Taken by thrust plate at rear of sprocket hub. Endplay .002-.006".
Timing Chain:—Morse. Width 1". Pitch .500". Length 24" or 48 links.
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across shaft centers. Install chain endless.
NOTE—Engine must be supported under front end of oil pan and front engine support removed for work on timing chain and camshaft.

VALVES:—

	Head Diameter	Stem Diameter	Length
All valves	1 15/32"	.340-.341"	4 25/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	5/16"	.001-.003"
Exhaust	45°	5/16"	.003-.005"

Tappet Clearance—.006" Int., .008" Exh. (hot). .010" Exh. recommended for sustained high speed.
NOTE—Exhaust valve seat inserts used.
Valve Guides:—Use special tool to remove and install guides. Insert guides with taper end up (intake) and down (exhaust). Top of guide must be ⅞" below top of block. After installing finish ream new guides to give correct stem clearance.
Valve Springs:—Variable pitch type. Install springs with close coil at top. Do not compress springs to over all length of less than 1⅜".

	Spring Pressure	Spring Length
Valve Closed	34-38 lbs.	1¾"
Valve Open	77-83 lbs.	1 7/16"

Valve Lifters:—Mushroom type. Ream guides to take following oversizes: .001", .008", .030", .060".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 6° ATDC. Close 46° ALDC.
Exhaust Valves—Open 42° BLDC. Close 8° ATDC.
To Check Valve Timing—Install regular timing gauge in timing plug hole over #6 piston, set tappet clearance #6 valves at .011" (intake), .012" (exhaust). Intake valve should open with piston .015" past top dead center, and exhaust valve close with piston .027" past top dead center. Reset tappet clearance at .006 (intake), .008" (exhaust) with eng. hot.
Motor Gauge—Weidenhoff Adapter #103, Rod #12.

LUBRICATION:—Pressure. Gear type oil pump located at right of crankcase.
NOTE—Ignition timing should be checked whenever oil pump is installed in engine.
Normal Oil Pressure:—30-40 lbs. at 30 M.P.H.
Oil Pressure Relief Valve:—Under plug on left hand side of crankcase. Operates at 40 lbs. Adjustable by changing spring. Standard spring unpainted. Heavy spring (to increase pressure) painted green. Lighter spring (to decrease pressure) painted red.
Crankcase Capacity:—5 qts. (refill).

CLUTCH:—Borg & Beck Model 9A6. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Clutch pedal should just clear under side of toe board with clutch engaged. To adjust, turn stopscrew located just above clutch pedal shaft. Free movement of pedal should be 1 1/16". To adjust, loosen locknut and turn adjusting nut (clevis) on clutch fork adjusting rod.
Removal—Disconnect clutch pedal linkage, remove fork pivot screw, take out clutch fork. Remove transmission (release bearing and spring are withdrawn with transmission), remove clutch housing pan, prick punch clutch cover and flywheel (install in same position to maintain balance), take out clutch mounting bolts, turning all bolts out evenly to release spring tension and avoid distortion of clutch cover. Remove clutch from below. Use pilot studs when removing and installing transmission to avoid springing clutch plate.
Automatic Clutch:—See article in Clutch Section.

STEERING:—Steering Gear: Gemmer Model Worm-and-Roller type. See article in Steering Section.
Front Suspension:—Conventional tubular section front axle with Reverse-Elliott ends and semi-elliptic springs.
Kingpin Inclination—9½° crosswise. **Limits 9-10°.**
Caster—2° (1½-2½°). Adjust by inserting wedge plates between springs and axle pads. Wedges available in ½, 1, 2° angles.
Camber—½° (¼-¾°). No adjustment, Replace tubular axle if camber is out more than ½°.
Toe In—0-⅛". Adjust in usual manner by loosening tie rod end clamps and rotating tie rod.

BRAKES:—Service—Lockheed Hydraulic, double anchor type. Hand lever applies brake at rear of transmission or rear wheel service brakes (special equipment). See article in Brake Section.
Wheel Cylinders—Diameters, Front Wheel (Front end 1¼", Rear end 1⅜"). Rear Wheel (Front end 1⅛", Rear end 1¼").
NOTE—Wheel cylinders marked 'R' right side of car, 'L' left side of car. Not interchangeable.
Drum Diameter—10".
Lining—Moulded type. Width 2". Thickness 13/64". Length per wheel 19 13/16".
Clearance—.012" toe, .006" heel for each shoe.
Hand Brake:—External type on drum at rear of transmission. See Service Brake (above) for cars with rear wheel hand brake.
Adjustment—With lever in released position, remove anchor screw locking wire, turn anchor screw so that clearance between lining and drum is 1/16", lock anchor screw with wire. Adjust brake band guide bolt nut to give 1/16" clearance (as above) for lower portion of band, secure with locknut. Finally, adjust brake adjusting bolt nut to give 1/16" clearance (as above), making sure that groove in bolt nut is lined up with ridge lockwasher.
Drum Diameter—6".
Lining—Width 2". Thickness 5/32". Length 18 13/32".
NOTE—When relining, cut out lining adjacent to anchor and chamfer ends. Clearance between anchor and sides of anchor saddle .005" maximum.

NOTE:—Models 36-26A Deluxe Six and 36-26B Master Six are similar except that Knee Action standard on Model 36-26A only. All other data below applies to both models.

ENGINE NUMBER:—First number—6-84,001. Stamped on top left hand corner of block.

ENGINE SPECIFICATIONS:—Type—6 cyl. 'L' head.
Bore—3⅜". **Stroke**—3⅞".
Displacement—208 cubic inches.
Rated Horsepower—27.4 (SAE).
Developed Horsepower—80 at 3600 R.P.M.
Compression Ratio & Pressure—6.2-1 Std. cast-iron head. Pressure 149 lbs. at 1000 R.P.M. or approximately 106 lbs. at cranking speed.
NOTE—Special thick head gasket which reduces comp. ratio to 5.7-1 may be installed if desired.
Vacuum Reading—Gauge should show steady reading of 18-20" of HG. with engine idling at 360 R.P.M. or 6 M.P.H.

PISTONS:—Electro-plated cast-iron. Tin-plated to thickness of .00075-.00125" after finishing and cannot be ground. Use finished replacement pistons.
Length—3½".
Weight—Held to 1/16 oz. maximum variation.
Removal—Pistons and rods removed from above
Clearance—Top .022". Bottom .0015". See Fitting New Pistons.
Replacement Pistons:—Finished pistons furnished in three standard sizes (marked by letter stamped on head) as follows: 'A'—3.3720", 'B'—3.3730", 'C'—3.3740", and .005", .010", .015", .020", .030" oversize. Pistons up to .030" oversize held to same weight as standard.
Fitting New Pistons:—Check clearance by inserting .002" feeler ½" wide between piston and cylinder wall at right angles to pin hole. Pressure to withdraw feeler must be 10-25 lbs. Piston taper allowance .0005".

PISTON RINGS:—Two compression rings above pin, one oil control ring below pin per piston. Lower ring groove drilled radially with ten ⅛" oil drain holes. Piston also has two ⅛" drain holes drilled on each side above pin hole.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.007-.017"	.001-.0025"
Oil Cont.	3/16"	.007-.017"	.001-.0025"

NOTE—Install compression rings with groove or step downward.

PISTON PIN:—Diameter 15/16". **Length** 3 1/16".
Pin is locked in piston by lock screw in one boss. Opposite end slotted to allow boss to slide freely on pin.
Pin Fit in Piston—Press fit (see below).
Pin Fit in Rod Bushing—.0003-.0005" clearance. See Connecting Rod Upper Bearing.
Fitting Pins—Use special tool HM-412 to install pins (tool checks pressure required to press pin into place). Coat bosses with graphite grease, insert slotted end of pin in lockpin boss. Pressure should be 200-350 lbs.

CONNECTING ROD:—Length—7 11/16" (center-to-center). **Weight**—Held to 1/16 oz. maximum variation.
Upper Bearing (Piston Pin Bushing)—Split bushed type 15/16" diameter. Two bushings used with 3/32" gap at center forming oil groove. Use special tool to install bushings (shoulder on tool prevents closing up gap). Drilled oil passage in rod must open into this groove. New bushings should be burnished and then reamed to size giving correct clearance.
Crankpin Journal Diameter—2".
Lower Bearing—Interchangeable steel-backed, cadium-silver alloy lined type. Bearings furnished .0005" undersize for service.
Clearance—.0005-.0015". Sideplay .005-.010".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. Clearance must be kept below .0015".
Installing Rods:—Rods not offset. Install rods in same cylinders from which removed.

CRANKSHAFT:—Four bearing. Integral counterw'ts.
Journal Diameters—#1, 2¼"; #2, 2 9/32"; #3, 2 15/16"; #4, 2⅜".
Bearing Type—Interchangeable steel-backed, cadium-silver lined type. Upper and lower bearing halves interchangeable. Bearings furnished standard and .001" undersize.
Clearance—.001-.003".
Bearing Adjustment:—None (no shims). Replace berings. Do not file bearing caps. Bearing upper halves can be removed without removing crankshaft by turning bearing out as crankshaft is rotated.
End Thrust:—Taken by #3 rear center bearing. Endplay .003-.008". Adjusted by replacing bearing.

CAMSHAFT:—Four bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2"; #2, 1 31/32"; #3, 1 15/16"; #4, 1 29/32".
Bearing Type—Steel-backed, babbitt-lined.
Clearance—.0015-.0025". Endplay .002-.005".
End Thrust:—Taken by steel thrust plate assembled behind camshaft sprocket. Endplay .002-.005". Adjusted by replacing thrust plate.
Timing Chain:—Morse. Width 1". Pitch ⅜". Length 56 links or 21".
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:—Head Diameter Stem Diameter Length

Intake	1 17/32"	.310-.311"	4 15/16"
Exhaust	1 15/32"	.310-.311"	4 15/16"

	Seat Angle	Lift	Stem Clearance
Intake	30°	19/64"	Free fit to .0006"
Exhaust	45°	19/64"	Free fit to .0006"

Tappet Clearance—.009-.011" all valves (hot). For sustained high speed driving .011" exhaust setting is recommended. Use .009" and .011" feelers as 'go' and 'no go' gauges. Hood sill must be removed to adjust clearance of front valves.
Valve Guides:—One piece removable. Install with smallest end below. Taper ream giving correct clearance.
Valve Springs:—Install with one closed coil at bottom two closed coils at top. Dampners installed on top of each spring. Use new dampner whenever dampner is removed.

	Spring Pressure	Spring Length
Valve Closed	52 lbs.	1 29/32"
Valve Open	82 lbs.	1 19/32"

Valve Lifters:—Single piece cast-iron. Furnished .005" oversize. Use special piloted reamer (J-551) when installing oversize lifter. Clearance .0005-.0015".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 5° BTDC. Close 39° ALDC.
Exhaust Valves—Open 45° BLDC. Close 5° ATDC.
NOTE—Figures correct with .0125" lash.
To Check Valve Timing—Set tappet clearance on #6 intake valve at .0125". This valve should open with piston 5° (.0092") before top dead center and first straight line of ignition mark '/IGN. 1&6/' slightly past indicator (left front face of housing). Reset tappet clearance .010".
Motor Gauge—Weidenhoff Adapter #114 Rod # 42.

LUBRICATION:—Pressure. Gear type oil pump on right hand side of crankcase.
NOTE—Whenever oil pump is to be removed turn engine over until #1 piston is at top dead center on compression stroke. On cars with conventional front springs, jack up frame until pump will clear spring. Dip pump gears in oil before installing. Prick punch mark on pump is down when gears are correctly meshed and distributor rotor in #1 position. After installing reset ignition timing.
Oil Pump Drive Clearances—Shaft bearing .0005-.002". Drive gear backlash .003-.004".
Oil Pump Gear Clearances—Idle gear bearing .0005-.002". Backlash .006-.008". End clearance .002-.006".
Normal Oil Pressure:—35-45 lbs. with oil warm.
Oil Pressure Regulator:—In oil pump, non-adjustable.
Crankcase Capacity:—6 qts. (full).

CLUTCH:—Own Make with Long 10CF-CS driven member. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Clearance between clutch pedal and underside of toeboard should be ⅝". Adjust by loosening locknut and turning stopscrew at lower end of pedal under shaft. Free movement or lash of pedal should be 1". Adjust by turning link screw at clutch fork end of link.
Removal—Remove floor and toeboards and front seat, disconnect universal joint, support engine at rear and remove rear engine support cross member, block up support tube against body cross sill and slide universal joint yoke and ball back as far as possible with yoke horizontal, remove transmission lowering engine slightly at rear if necessary to clear support tube. Then remove clutch housing bottom cover, clutch control countershaft, unhook clutch pedal pull-back spring, remove clutch fork ball support, clutch fork and throwout bearing. Loosen capscrews mounting clutch cover on flywheel turning all screws out evenly to release springs. If clutch cover sticks in flywheel strike cover plate sharply on radius outside spring cups before removing screws completely. Remove clutch from below without taking off housing.

STEERING:—Steering Gear—Saginaw Worm-and-Roller type. See article in Steering Section.
Front Suspension Model 36-26A:—Independent 'Knee Action' type. See article in Steering Section.
NOTE—All specifications are identical with those given for eight cylinder Model 36-28 on next page.
Front Suspension Model 36-26B:—Conventional 'I' beam section front axle with reverse-elliott ends and semi-elliptic springs.
Kingpin Inclination—7°10' crosswise.
Caster—1¼° plus or minus ¼°. Adjustable by inserting wedge shims between axle and spring.
Camber—1½° plus 0° or minus 1°. No adjustment. Bending of axle to correct camber not recommended.
Toe In—0-⅛" measured 9" above floor. Adjustable in usual manner by changing length of tie rod.
Steering Geometry—Inner wheel turned 38°, outer wheel 29°. Check tie rod ends and kingpin for looseness, replace steering arms.

BRAKES:—Service—Bendix Hydraulic, Duo-Servo, Single anchor type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.
Wheel Cylinders—(36-26A) 1" diameter on front wheels, 15/16" rear wheels, (36-26B) 15/16" diameter all wheels.
Drum Diameter—12".
Lining—Woven & Moulded type. Width 1¾" Thickness 3/16". Length 23 1/16" per wheel.
Clearance—.010" at heel and toe of each shoe.
Hand Brake Adjustment—See Service Brakes.

ENGINE NUMBER:—First number—8-44,001. Stamped on boss on left hand top corner of block.

ENGINE SPECIFICATIONS:—**Type**—8 cyl., 'L' head
Bore—3¼". **Stroke**—3½".
Displacement—232.3 cubic inches.
Rated Horsepower—33.8 (SAE).
Developed Horsepower—87 at 3800 R.P.M.
Compression Ratio & Pressure—6.2-1 Std. Cast-iron head. Pressure 144 lbs. at 1000 R.P.M. or approximately 106 lbs. at cranking speed.
NOTE—Special thick head gasket which reduces comp. ratio to 5.7-1 may be installed if desired.
Vacuum Reading—Gauge should show steady reading of 18-20" of HG. with engine idling at 360 R.P.M. or 6 M.P.H.

PISTONS:—Electro-plated cast-iron. Tin-plated to thickness of .00075-.00125" after finishing and cannot be ground. Use finished replacement pistons.
Length—3 9/16".
Weight—All pistons held to 1/16 oz. max. variation.
Removal—Pistons and rods removed from above.
Clearance—Top .022". Bottom .0015". See Fitting New Pistons.
Replacement Pistons:—Finished pistons furnished in three standard sizes (marked by letter stamped on head) as follows: 'A'—3.247", 'B'—3.248", 'C'—3.249" and .005", .010", .015", .020", .030" oversize. Pistons up to .030" oversize held to same weight as standard.
Fitting New Pistons:—Check clearance by inserting .002" feeler ½" wide between piston and cylinder wall at right angles to pin hole. Pressure required to withdraw feeler must be 10-25 lbs. Piston taper allowance .0005".

PISTON RINGS:—Two compression rings above pin, one oil control ring below pin per piston. Lower ring groove drilled radially with ten ⅛" oil drain holes. Piston also has two ⅛" drain holes drilled on each side above pin hole.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.007-.017"	.001-.0025"
Oil Cont.	3/16"	.007-.017"	.001-.0025"

NOTE—Install compression rings with groove or step downward.

PISTON PIN:—**Diameter** 15/16". **Length** 2⅞".
Pin is locked in piston by lock screw. Opposite end slotted to allow boss to slide freely on pin.
Pin Fit in Piston—Press fit (see below).
Pin Fit in Rod Bushing—.0003-.0005" clearance. See Connecting Rod Upper Bearing (below).
Fitting Pins—Use special tool HM-412 to install pins (tool checks pressure required to press pin into place). Coat bosses with graphite grease, insert slotted end of pin in lockpin boss. Pressure should be 200-350 lbs.

CONNECTING ROD:—**Length**—7 11/16" (center-to-center). **Weight**—Held to 1/16 oz. max. variation.
Upper Bearing (Piston Pin Bushing)—Split bushed type 15/16" diameter. Two bushings used with 3/32" gap at center forming oil groove. Use special tool to install bushings (shoulder on tool prevents closing up gap). Drilled oil passage in rod must open up into this groove. New bushings should be burnished and then reamed to size giving correct clearance.
Crankpin Journal Diameter—2".
Lower Bearing—Interchangeable steel-backed, cadium-silver alloy lined type. Bearings furnished .0005" undersize for service.
Clearance—.0005-.0015". Sideplay .005-.010".
Bearing Adjustment:—None (no shims) Replace bearings. Do not file bearing caps. Clearance must be kept below .0015".
Installing Rods:—Connecting rod lower bearings are offset. Install rods with narrow half of bearing toward nearst main bearing (widest half of bearing toward front on #2, 4, 6, 8 or toward rear on #1, 3, 5, 7).

CRANKSHAFT:—Five bearing. Integral counterweights.
Journal Diameters—#1, 2¼"; #2, 2 9/32"; #3, 2 5/16"; #4, 2 11/32"; #5 2⅜".
Bearing Type—Interchangeable steel-backed, cadium-silver lined type. Upper and lower bearing halves interchangeable. Bearings furnished standard and .001" undersize.
Clearance—.001-.003".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. Bearing upper halves can be removed without removing crankshaft by turning bearing out as crankshaft is rotated.
End Thrust:—Taken by #3 (center) bearing. Endplay .003-.008". Adjusted by replacing bearing.

CAMSHAFT:—Five bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2"; #2, 1 31/32"; #3, 1 15/16"; #4, 1 29/32"; #5, 1⅞".
Bearing Type—Steel-backed babbitt-lined.
Clearance—.0015-.0025". Endplay .002-.005".
End Thrust:—Taken by a thrust plate assembled behind camshaft sprocket. Endplay .002-.005". Adjusted by replacing thrust plate.
Timing Chain:—Morse. Width 25/32". Pitch ⅜". Length 56 links or 21".
Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that 'O' marks are adjacent and in line with a straightedge across the shaft centers.

VALVES:

Head Diameter	Stem Diameter	Length
Intake 1 13/32"	.310-.311"	4¾"
Exhaust 1 11/32"	.310-.311"	4¾"

Seat Angle	Lift	Stem Clearance
Intake 30°	19/64"	Free fit to .0006"
Exhaust 45°	19/64"	Free fit to .0006"

Tappet Clearance—.009-.011" all valves (hot). For sustained high speed driving .011" exhaust setting recommended. Use .009" and .011" feelers as 'go' and 'no go' gauges. Hood sill must be removed to adjust clearance of front valves.
Valve Guides:—One piece removable. Install with smallest end below. Taper ream giving correct clearances.
Valve Springs:—Install with one closed coil at bottom, two closed coils at top. Dampners installed on top of each spring. Use new dampner whenever dampner is removed.

	Spring Pressure	Spring Length
Valve closed	52 lbs.	1 29/32"
Valve Open	82 lbs.	1 19/32"

Valve Lifters:—Single piece cast-iron. Furnished .005" oversize. Use special piloted reamer (J-551) when installing oversize lifter. Clearance .0005-.0015".
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 5° BTDC. Close 39° ALDC.
Exhaust Valves—Open 45° BLDC. Close 5° ATDC.
NOTE—Figures corect with .0125" lash.
To Check Valve Timing—Set tappet clearance on #8 intake valve at .0125". This valve should open with piston 5° (.0082") before top dead center and first straight line of ignition mark '/IGN. 1&8/' slightly past indicator (left front face of housing). Reset tappet clearance .010".
Motor Gauge—Weidenhoff Adapter #114 Rod #42.

LUBRICATION:—Pressure. Gear type oil pump on right hand side of crankcase.
NOTE—Whenever oil pump is to be removed, turn engine over until #1 piston at top dead center on compression stroke. On cars with conventional front springs jack up frame until pump will clear spring. Dip pump gears in oil before installing. Prick punch mark on pump is down when gears are correctly meshed and distributor rotor in #1 position. After installing reset ignition timing.
Oil Pump Drive Clearances—Shaft bearing .0005-.002". Drive gear backlash .003-.004".
Oil Pump Gear Clearances—Idle gear bearing .0005-.002". Backlash .006-.008". End clearance .002-.006".
Normal Oil Pressure:—35-45 lbs. with oil warm.
Oil Pressure Regulator:—In oil pump, non-adjustable.
Crankcase Capacity:—7 qts. (full).

CLUTCH:—Own make with Long 10CF-CS driven member. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.
Adjustment—Clearance between clutch pedal and underside of toeboard should be ⅝". Adjust by loosening locknut and turning stopscrew at lower end of pedal under shaft. Free movement or lash of pedal should be 1". Adjust by turning link screw at clutch fork end of link.
Removal—Remove floor and toeboards and front seat, disconnect universal joint, support engine at rear and remove rear engine support cross member, block up support tube against body cross sill and slide universal joint yoke and ball back as far as possible with yoke horizontal, remove transmission lowering engine slightly at rear if necessary to clear support tube. Then remove clutch housing bottom cover, clutch control countershaft, unhook clutch pedal pull-back spring, remove clutch fork ball support, clutch fork and clutch throwout bearing. Loosen capscrews mounting clutch cover on flywheel turning all screws out evenly to release springs. If clutch cover sticks in flywheel strike cover plate sharply on radius outside spring cups before removing screws completely. Remove clutch from below without taking off housing.

STEERING:—**Steering Gear**—Saginaw Worm-and-Roller type. See article in Steering Section for adjustments.
Front Suspension:—Independent 'Knee Action' type. See article in Steering Section. All specifications below apply with car weight on wheels.
Wheel Setting (Front Suspension Height)—5⅜" from bottom of cross tube to bottom of brake drum.
King Pin Inclination—8¾° crosswise.
Camber—Minus ¼° to plus ¼°. Not adjustable.
Caster—0°. Caster effect secured by trailing wheel behind suspension unit.
Toe In—0-1/16". Adjustable in usual manner by changing length of tie rod.
Tread—58 13/32".
Steering Geometry—Inner wheel turned 38°, outer wheel 29°. Check tie rod ends and kingpin for looseness.

BRAKES:—**Service**—Bendix Hydraulic, Duo-Servo, Single anchor type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.
Wheel Cylinders—1" diameter (front), 15/16" diameter (rear).
Drum Diameter—12".
Lining—Woven & Moulded type. Width 1¾". Thickness 3/16". Length 23 1/16" per wheel.
Clearance—.010" at heel and toe of each shoe.
Hand Brake Adjustment:—See Service Brake Adjustment.

ENGINE NUMBER:—First number—6D-100. Stamped on upper left hand corner of cylinder block.

ENGINE SPECIFICATIONS:—**Type**—6 cyl., 'L' head.
Bore—3⅜". **Stroke**—4¼".
Displacement—228 cubic inches.
Rated Horsepower—27.3 (SAE).
Developed Horsepower—90 at 3400 R.P.M.
Compression Ratio—6.5-1 Std. Aluminum head.
Compression Pressure—110 lbs. at 1000 R.P.M. or 85 lbs. at cranking speed.
Vacuum Reading—Gauge should show steady reading of approximately 17" with engine idling at 350 R.P.M.

PISTONS:—Own Lo-ex aluminum alloy, 'T' slot, cam ground type. Use finished replacement pistons (see Replacement Pistons).
Length—4".
Weight—12.96 ounces (stripped).
Removal—Pistons removed from above, rods from below. To remove assemblies, take off rod bearing caps, install brass guards on rod bolts (necessary to avoid marring crankpin surface), push piston up in cylinder until pin is exposed, remove retaining rings, push pin out, remove piston from above, remove rod from below. Use new retaining rings when installing pistons.
Clearance—Top .027-.033", bottom .0024-.0032".

Replacement Pistons:—Refinish cylinders to take standard replacement pistons furnished .005", .010", .020", .030", .040" oversize and also semi-finished. Exact size of piston stamped on head.

Fitting New Pistons:—Use standard oversize piston (size stamped on top), refinish cylinder bore to size giving correct clearance.

Installing Pistons:—Slot should be at left. Pistons stamped with arrow and word (Front). Arrow must point toward front of engine on all pistons.

PISTON RINGS:—Two compression, two oil control rings per piston, all above pin. Lower ring grooves drilled radially with oil drain holes.

Ring	Width	End Gap	Side Clear.
Comp. (#1, 2)	3/32"	.009-.014"	.0015-.0025"
Oil (#3)	3/32"	.009-.014"	.0015-.0025"
Oil (#4)	¼"	.009-.014"	.0015-.0025"

PISTON PIN:—Diameter—63/64". **Length**—2.903-2.898". Pin floats in piston and rod. Held by retaining rings at each end. See Piston Removal above.

Pin Fit in Piston—.0000-.0003" tight with piston at room temperature of 70° F. Heat piston to 160° when installing pin.
Pin Fit in Rod Bushing—.000-.0003" clearance.

CONNECTING ROD:—Length—10½" (cent.-to-cent.).
Weight—41.02 ounces (assembled).
Upper Bearing (Piston Pin Bushing)—Bronze.
Crankpin Journal Diameter—2.1875".
Lower Bearing—Removable steel-backed, babbitt-lined type.
Clearance—.0015-.0025". Sideplay .005-.010".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file rods or caps.

Installing Rods:—Rods are marked. Install with marks and oil spray hole in lower end toward camshaft side of engine.

CRANKSHAFT:—Seven bearing. Integral and removable counterweights.
Journal Diameters—2⅝" all bearings.
Bearing Type—Precision type, removable steel-backed, babbitt-lined.
Clearance—.001-.003".

Bearing Adjustment:—Replace bearings. Do not file caps.

End Thrust:—Taken by rear (#7) bearing. Endplay .003-.007".

CAMSHAFT:—4 bearing. Non-adjustable chain drive.
Journal Diameters—#1, 2 3/16"; #2, 2⅛"; #3, 2 1/16"; #4, 1½".
Bearing Type—Steel-backed, babbitt-lined.
Clearance—.0015".

End Thrust:—Taken by spring-loaded hardened steel plunger in camshaft hub and thrust plate on chain case cover. See that spring and plunger are in place when replacing cover.

Timing Chain:—Morse. Type DO-7654. Width 1". Pitch .500". Length 48 links or 24".

Camshaft Setting:—Sprockets are marked. Mesh chain with sprockets turned so that marks are adjacent and in line with a straightedge across the shaft centers. Install chain with camshaft sprocket off engine. Insert dowel-type capscrew with ground shoulder first (in hole with reamed top) to center camshaft sprocket. Capscrew holes are offset so that sprocket cannot be assembled incorrectly.

VALVES:—

	Head Diameter	Stem Diameter	Length
All valves	1 13/16"	.34475"	6.078"

	Seat Angle	Lift	Stem Clearance
All valves	45°	5/16"	.001-.0035"

NOTE—Alloy steel exhaust valve seat inserts used.
Tappet Clearance—.007" Int., .008" Exh. engine hot.

Valve Guides:—Pressed in block and finish reamed for correct stem clearance.

Valve Springs:—	Spring Pressure	Spring Length
Valve Closed	50-54 lbs.	2⅜"
Valve Open	135-145 lbs.	2 1/16"

Valve Lifters:—One piece nickel-iron and steel, mushroom type. Diameter ⅝". Clearance in guides .0005-.001". Serviced by replacing guides.

Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 5° BTDC. Close 45° ALDC.
Exhaust Valves—Open 35° BLDC. Close 5° ATDC.
To Check Valve Timing—Set tappet clearance #1 intake valve at .012". This valve should open with piston 5° or .0100" before top dead center when flywheel mark 'Intake Opens' lines up with pointer in inspection hole in right front of flywheel housing. Reset tappet clearance at .007" hot.
Motor Gauge—Weidenhoff #104 Adapter, #2 Rod.

LUBRICATION:—Pressure. Gear type oil pump located in oil pan.
Normal Oil Pressure:—40 lbs. at 40 M.P.H.
Oil Pressure Relief Valve:—Operates at 35 lbs. when engine is hot. Located under nut on left hand side of crankcase. Adjustable by turning nut. Turn nut in or clockwise to increase pressure and out or counter-clockwise to decrease.
Crankcase Capacity:—6 qts. (refill).

CLUTCH:—Borg & Beck Model 10-A6. Single plate, dry disc type. See article in Clutch Section for relining and asembling directions.
Adjustment—Free movement of clutch pedal must be 1". To adjust, loosen transverse bolt which clamps pedal to shaft, move pedal forward to provide 1" free movement, tighten bolt.
Removal—Disconnect drive shaft and remove transmission (jack up rear of engine if necessary). Remove throwout bearing and collar assembly, loosen pedal bolt on shaft and drop flywheel under-pan. Take out short (right) shaft and yoke by turning shaft until capscrews can be removed from below. Pry and block release levers in disengaged position. Then take out capscrews in pressure plate and remove clutch disc and pressure plate from below.

STEERING:—Steering Gear—Ross Model 540, Cam-and-lever type. See article in Steering Section for adjustment procedure.
Front Suspension:—Conventional 'I' beam section front axle with Reverse-Elliott ends and semi-elliptic springs.
Kingpin Inclination—8° crosswise.
Camber—1½°. Axle may be bent cold for minor corrections.
Caster—1½°. Use wedge shims inserted between spring and spring seat to correct caster.
Toe In—0-1/16". Adjust in usual manner by loosening clamp bolts and turning tie rods.
Tread—59 3/16" (front), 61¼" (rear).

BRAKES:—Service—Lockheed Hydraulic, double anchor type. Hand lever applies separate brake at rear of transmission. See article in Brake Section for complete adjustment procedure.
Drum Diameter—11".
Lining—Moulded type. Width 1¾". Thickness ¼". Length 28¼" per wheel.
Clearance—.010" at heel, .005" at toe.
Hand Brake:—Drum diameter 6". Woven type lining. Width 2". Thickness 5/32". Length 18 9/16".
Clearance—1/32-3/64".
Adjustment—With lever in fully released position, adjust position of brake band lever on pull link so that clearance at ends of brake band is 1/32-3/64".

ENGINE NUMBER:—First number—D-63,001. Stamped on left center of engine block.

ENGINE SPECIFICATIONS:—**Type**—6 cyl., 'L' head.
Bore—3¼". **Stroke**—4⅜".
Displacement—217.8 cubic inches.
Rated Horsepower—25.4 (NACC).
Developed Horsepower—90 at 3400 R.P.M.
Compression Ratio & Pressure—6.3-1 Std. cast-iron head. Pressure 105 lbs. at cranking speed of 150 R.P.M.
Vacuum Reading—Gauge should show steady reading of 18" with engine idling at 450 R.P.M. or 8 M.P.H.

PISTONS:—Lynite, aluminum alloy, 'T' slot, Cam Ground type with .00825-.01075" greater diameter at right angles to piston pin bosses.
Weight—15.2 ozs. **Length**—3¾".
Removal—Pistons and rods removed from above.
Clearance—.0005" as measured ¼" up on skirt at right angles to pin bosses for new pistons. See Fitting New Pistons.
Replacement Pistons:—Finished pistons with fitted pins furnished .002", .004", .010", .015", .020", .030" oversize. Exact size of all new pistons as measured ¼" up on skirt at right angles to pin bosses is stamped on head.
NOTE—Bore size of individual cylinders on all production engines is stamped on side of block opposite bore as follows: Std. 3.250" bore—'O'. 3.2495" or .0005" undersize bore—'95'. 3.249" or .001" undersize bore—'9' etc.
Fitting New Pistons:—Check clearance by inserting .002" hardened feeler 1" wide between piston and cylinder wall on pressure or camshaft side at right angles to pin bosses. Piston should be inserted in inverted position with slot away from camshaft. Pressure required to withdraw feeler must be between 7-15 lbs.
Installing Pistons:—Slot should be on minimum pressure side or away from camshaft.

PISTON RINGS:—Two compression, one oil control ring per piston, all above pin. Lower ring groove drilled with ten 5/32" oil drain holes.
NOTE—Narrow heat deflector groove located above top ring groove. No ring fitted in this groove.

Ring	Width	End Gap	Wall Thickness
Comp.	⅛"	.013-.018"	.135"
Oil Cont.	3/16"	.013-.018"	.145"

NOTE—Compression rings are undercut. Install these rings with step or groove down.

PISTON PIN:—Diameter ⅞". **Length** 2⅞".
Pin is locked in connecting rod.
Pin Fit in Piston—.0002" clearance or light push fit.
NOTE—New pins fitted and furnished with all new replacement pistons.

CONNECTING ROD:—Weight 33.2 ozs. **Length** 8⅛".
Crankpin Journal Diameter—2.18675-2.18775".
Lower Bearing—Integral spun-babbitt lined type.
Clearance—.0005-.002". **Sideplay** .005-.009".
Bearing Adjustment:—None (no shims). Replace rods on exchange basis. Do not file rods or caps. Rods furnished with bearings standard and .010", .020" undersize.
Installing Rods:—Lower bearings are offset. Install rods with narrow half of bearing toward front in cylinders #1, 3, 5 and toward rear in #2, 4, 6. Marks on rods and caps must be together and oil escape hole in upper half of rod lower bearing must be toward right or camshaft side of engine on all rods.

CRANKSHAFT:—Four bearing. Integral counterweights.
Journal Diameters—2½" all bearings
Bearings—Interchangeable steel-backed, babbitt-lined type. No shims.
Clearance—.0005-.0025".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. No fitting or line reaming necessary for new bearings.
End Thrust:—Taken by thrust plate assembled between front main bearing and crankshaft gear. Adjusted by adding or removing shims between thrust plate and bearing. Endplay should be .003-.006".

CAMSHAFT:—Four bearing. Helical gear drive.
Bearings—Split, steel-backed, babbitt-lined type.
Clearance—.00075-.00225" (front), .002-.00375" (all others).
NOTE—When bushings installed see that oil holes in bushing and block line up.
End Thrust:—Taken by steel thrust washer and spacer between gear hub and front bearing. Endplay .006" maximum.
Timing Gears:—Cast-iron (crankshaft), Celoron Fabric (camshaft). Camshaft gears furnished in three sizes marked 'S'—standard, 'H'—high limit, 'L'—low limit. Use next largest size to take up backlash when replacing gears.
NOTE—Screw thread for gear puller and pusher formed in camshaft gear hub recess. Gear must not be driven on or off of shaft.
Camshaft Setting:—Gears are marked. Mesh marked tooth on crankshaft gear between two marked teeth on camshaft gear.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 15/32"	11/32"	5 7/32"
Exhaust	1 9/32"	11/32"	5 7/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.001-.003"
Exhaust	45°	11/32"	.001-.003"

Tappet Clearance—.016" all valves (cold).
Valve Guides:—Pressed in block from upper end.
Valve Springs:—No damper used. Install springs with closed-coil end at top. Replace springs if more than 10% weaker than specifications given below.

	Spring Pressure	Spring Length
Valve Open	1¾"	125-135 lbs.

NOTE—Valve spring will not clear tappet adjusting screw when extended. To install spring, place spring seat in position on spring, compress spring slightly with compressor so that it clears tappet adjusting screw, insert valve, compress spring fully and install valve spring seat locks.
Valve Lifters:—Barrel type operating directly in cylinder block (no separate guides). Lifters are same diameter throughout and can be removed from top or bottom.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open at 15° BTDC. Close 49° ALDC.
Exhaust Valves—Open 54° BLDC. Close 10° ATDC.
To Check Valve Timing—Set tappet clearance #1 intake valve at .020". This valve should open with piston 15° or .0942" before top dead center when mark 'IN.OP/1-6' on vibration dampener at front of engine lines up with pointer on chain case cover. Reset tappet clearance at .016".
Motor Gauge—Weidenhoff #114 Adapter, #2 Rod.

LUBRICATION:—Pressure type. Gear type oil pump located on right side of crankcase.
Normal Oil Pressure—40 lbs. min. at 40 M.P.H.
Oil Pressure Regulator—Located at right front corner of engine. Operates at 40 lbs. Not adjustable. Timing gears lubricated by overflow from regulator.
Crankcase Capacity—6 qts.
NOTE—Whenever oil pump is taken off engine, drive gear must be properly remeshed when pump is replaced so that distributor rotor position will be correct. To install pump, remove distributor, turn engine over until mark 'UDC/1-6' on vibration dampener lines up with pointer on chain case cover, sight down distributor shaft hole, mesh oil pump gear so that distributor drive slot is horizontal and offset toward top.

CLUTCH:—Borg & Beck Model 9A6. Single plate dry disc type. See article in Clutch Section for relining and assembling instructions.
Adjustment—Free movement of clutch pedal must be 1" minimum. To adjust, loosen locknut and turn adjustment lever setscrew on left side of clutch housing. Check Hill-Holder after adjusting clutch.
Hill-Holder Adjustment:—On cars with Hill-Holder, check action after adjusting clutch to see that brakes release just before clutch engages. Adjust by loosening locknut and turning adjusting nut at end of hill holder control rod. Shorten rod for earlier brake release or lengthen rod for later release.
Clutch Removal:—Disconnect drive shaft at front universal, support engine at rear end, remove transmission and clutch cover, take out screws mounting clutch on flywheel turning all screws out evenly to release clutch spring tension.

STEERING:—Steering Gear: Ross Cam-and-Lever type. Model 140—first cars, Model T-14—later cars beginning with following serial numbers—**3A** 5526354 (South Bend), 5851960 (Pacific Coast) except 5526359-5526376 inc., **4A** 5246240 (South Bend), 5801504 (Pacific Coast) except 5801547, 5801655, and 5801657. See article in Steering Section.
Front Suspension Model 3A—Conventional 'I' beam section front axle with semi-elliptic springs.
King Pin Inclination—9½° crosswise.
Caster—1-1½°. Adjusted by inserting wedge shims between spring and spring pad on axle. Spring pad should incline 1½° toward rear (see Spring Camber)
Camber—1-1½°. No adjustment. Axle may be bent cold for minor camber adjustments.
Toe In—1/16-⅛". Adjust in usual manner by changing length of tie rod. On cars with no tie rod adjust length of each reach rod equally.
Spring Camber—⅛" minimum. Measure by stretching cord between spring eye centers and noting distance from cord to top of spring main plate at center. Camber must be positive (cord above spring)
NOTE—Reach rod or drag link is spring loaded (spring located at end and covered by rubber boot). No adjustment required but if rod ends are disassembled, adjusting nuts must be turned up until spring length including washers (washers assembled between each spring and bearing) is 1⅜".
Front Suspension Model 4-A:—Planar type independent suspension with transverse spring. See article in Steering Section for complete description and adjustment procedure.
NOTE—All specifications for this type same as for President Model 2C (see next page).

BRAKES:—Service—Lockhead Hydraulic, four wheel type. Hand lever applies rear wheel brakes. See article in Brake Section.
Wheel Cylinders—Stepped or two-stage bore type: Front Wheels—Front Shoe Cyl. 1⅜". Rear—1".
Rear Wheels—Front Shoe Cyl. 1¼". Rear—1".
NOTE—Wheel cylinder bore size marked on casting. Cylinders not interchangeable.
Brake Drum Diameter—11⅛".
Lining—Moulded type. Width 1¾". Thickness ¼". Length per wheel 23".
Clearance—.010" toe, .005" heel on each shoe.
Hand Brake Adjustment:—See Service Brakes.
Hill-Holder:—Optional on all models. See article in Brake Section and also Clutch Section above.

ENGINE NUMBER:—First number—B-7901. Stamped on left center of engine block.

ENGINE SPECIFICATIONS:—**Type**—8 cyl., 'L' head.
Bore—3 1/16". **Stroke**—4¼".
Displacement—250.4 cubic inches.
Rated Horsepower—30 (NACC).
Developed Horsepower—115 at 3600 R.P.M.
Compression Ratio—6.5-1 Std. aluminum head.
Compression Pressure—105-115 lbs. at cranking speed of 150 R.P.M.
Vacuum Reading—Gauge should show steady reading of 18" with engine idling at 450 R.P.M. or 8 M.P.H.
NOTE—Tighten aluminum cylinder heads only when engine is cold.

PISTONS:—Lynite, aluminum alloy, 'T' slot, Cam Ground type with elliptical skirt .00825-.01075" greater in diameter at right angles to pin bosses. Recondition cylinders to take finished replacement pistons.
Weight—13.6 ozs. **Length**—3¾".
Removal—Pistons and rods removed from above.
Clearance—.0015" as measured ¼" upon skirt at right angles to pin bosses for new pistons. See Fitting New Pistons.
Replacement Pistons:—Finished pistons with fitted pins furnished .002", .004", .010", .015", .020", .030" oversize. Exact size of all new pistons as measured ¼" up on skirt at right angles to pin bosses is stamped on head.
NOTE—Bore size of individual cylinders on all production engines is stamped on top of block opposite cylinder as follows: Std. 3.0625" bore—'O'. 3.0620" or .0005" undersize bore—'20'. 3.0615" or .001" undersize bore—'15', etc.
Fitting New Pistons:—Check clearance by inserting .003" hardened feeler 1" wide between piston and cylinder wall on pressure or camshaft side at right angles to pin bosses. Piston should be inserted in inverted position with slot away from camshaft. Pressure requried to withdraw feeler must be between 7-13 lbs.
Installing Pistons:—Slot should be on minimum pressure side or away from camshaft.

PISTON RINGS:—Two compression, one oil control ring per piston, all above pin. Lower ring groove drilled radially with ten 5/32" oil drain holes. Do not increase size or number of holes.
NOTE—A narrow heat deflector groove is located above the top compression ring. No ring it fitted in this groove.

Piston Ring Specifications.

Ring	Width	End Gap	Side Clearance
Comp.	⅛"	.013-.018"	.135"
Oil Cont.	3/16"	.013-.018"	.145"

NOTE—Compression rings are undercut or stepped and must be installed with this step downward. Inner rings used behind oil ring on all engines.

PISTON PIN:—Diameter ⅞". **Length** 2⅞".
Pin is locked in connecting rod.
Clearance in Piston—.0002" or light push fit.
NOTE—New pins are fitted and furnished with all new replacement pistons.

CONNECTING ROD:—Weight 32 ozs. **Length** 8".
Crankpin Journal Diameter—1.87425-1.87525".
Lower Bearing—Removable steel-backed, lead-bronze lined type.
Clearance—.00075-.00275". Sideplay .005-.010".
Bearing Adjustment:—None. Replace bearings. Do not file caps. New bearings should be pressed in place in rod and cap (upper and lower halves interchangeable) so that tongues on bearings engage grooves in rod and cap and oil holes line up. Bearings cannot be reamed, and crankpins must be turned down to size giving correct clearance. Bearings furnished .005", .010", .020" undersize and standard.
Installing Rods:—Oil escape hole in upper half of rod lower bearing must be toward right or camshaft side of engine on all rods.

CRANKSHAFT:—Nine bearings with bolted-on counterweights.
Journal Diameters—2 11/32" all bearings.
Bearings—Interchangeable steel-backed, babbitt lined type. No shims.
Clearance—.001"-.003".
Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps. No fitting or line reaming necessary for new bearings.
End Thrust:—Taken by thrust plate assembled between front main bearing and crankshaft gear. Adjusted by adding or removing shims between thrust plate and bearing. Endplay should be .003-.006".

CAMSHAFT:—Six bearing. Helical gear drive.
Bearings—Split, steel-backed, babbitt-lined type.
Clearance—.00075-.00225" (front), .002-.00375" (all others).
NOTE—When new bearing installed, see that oil holes in bearings and block line up.
End Thrust:—Taken by steel thrust washer and spacer assembled between gear hub and front bearing. Endplay .006" maximum.
Timing Gears:—Cast-iron (crankshaft), Celoron Fabric (camshaft). Camshaft gears furnished in three sizes marked 'S'—standard, 'H'—high limit, 'L'—low limit. Use next largest size to take up backlash when replacing gears.
NOTE—Screw thread for gear puller and pusher formed in camshaft gear hub recess. Gears must not be driven on or off of shaft.
Camshaft Setting:—Gears are marked. Mesh marked tooth of crankshaft gear between two marked teeth on camshaft gear.

VALVES:—

	Head Diameter	Stem Diameter	Length
Intake	1 13/32"	11/32"	5 7/32"
Exhaust	1 9/32"	11/32"	5 7/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.001-.003"
Exhaust	45°	11/32"	.001-.003"

Tappet Clearance—.016" all valves (cold).
Valve Guides:—Pressed in block from upper end.
Valve Springs:—Springs installed with closed coils at top. Damper (cup type valve cage) used on all springs at top. Replace springs if more than 10% weaker than specifications below.

	Spring Length	Spring Pressure
Valve Open	1¾"	125-135 lbs.

Valve Lifters:—Mushroom type with separate guides. Lifters removed from bottom only.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 15° BTDC. Close 49° ALDC.
Exhaust Valves—Open 54° BLDC. Close 10° ATDC.
To Check Valve Timing—With tappet clearance of .020", #1 intake valve should open with piston 15° or .0915" before top dead center when mark 'IN.OP/1-8' on flywheel lines up with pointer in inspection hole in right top surface of housing.
Motor Gauge—Weidenhoff #104 Adapter, #2 Rod.

LUBRICATION:—Force-feed by oil pump to main bearings, connecting rod bearings, camshaft bearings, and valve lifters. Splash from connecting rod bearing escape hole to cylinder walls and piston pins. Timing gears lubricated by oil by-passed by oil pressure regulator relief valve.
Normal Oil Pressure—40 lbs. minimum at 40 M.P.H.
Oil Pressure Relief Valve—Operates at 40 lbs. Located at right front cor. of engine. Not adjustable.
Crankcase Capacity—8 qts.
Oil Pump:—Gear type located in the oil pan. Driven by vertical shaft from camshaft (drive gear on oil pump shaft—distributor driven through tongue-and-slot coupling above gear).
NOTE—Whenever oil pump is taken off engine, drive gear must be properly meshed with camshaft so that distributor rotor position will be correct. To install pump, turn engine over until #1 piston is on top dead center entering power stroke with flywheel mark 'UDC/1-8' at indicator on clutch housing. Turn pump shaft so that distributor drive slot is two teeth clockwise (viewed from below) from correct installed position with slot parallel to camshaft and wide half of coupling toward camshaft. Shaft will be rotated to this position as gears are meshed. Check by sighting down distributor drive shaft hole (distributor off engine) or see that rotor is opposite #1 segment in distributor cap (see wiring diagram).

CULTCH:—Long Model 9AB-10CI. Single plate, dry disc type. See article in Clutch Section for relining and assembling instructions.
Adjustment—Free movement of clutch pedal must be 1" minimum. To adjust, loosen locknut and turn adjustment lever setscrew on left side of clutch housing. Check Hill-Holder setting.
Hill-Holder Adjustment:—On cars with Hill-Holder, check action after adjusting clutch. Brakes should be released just before cloutch engages. Adjust by loosening locknut and turning adjusting nut at end of hill-holder control rod. Shorten rod for earlier brake release or lengthen rod for later release.
Clutch Removal:—Disconnect clutch pedal linkage, disconnect drive shaft at front universal, remove transmission, take off clutch pan under clutch housing, take out clutch mounting screws turning all screws out evenly to release clutch spring tension, remove clutch from below.

STEERING:—Steering Gear—Ross Model 620 Cam-and-lever type with cam lever follower mounted on roller bearings. See article in Steering Section for complete adjustment procedure.
Front Suspension:—Planar type independent suspension with transverse spring. See article in Steering Section for complete description and adjustment procedure.
Kingpin Inclination—9½° crosswise.
Caster—Minus ¼ to plus ¾°. Not adjustable.
Camber—1-1½°. Check with tires properly inflated, car on level floor, after bouncing car up and down several times so that wheels are in normal running position.
Toe In—3/16" (⅛-7/32"). Adjustable.

BRAKES:—Lockheed Hydraulic, four wheel type. Hand lever applies rear wheel brakes. See article in Brake Section for complete adjustment procedure.
Wheel Cylinders—Stepped or two-stage bore type:
Front Wheels—Front Shoe Cyl. 1⅜". Rear 1".
Rear Wheels—Front Shoe Cyl. 1¼". Rear 1".
NOTE—Wheel cylinder bore size marked on casting. Not interchangeable.
Drum Diameter—12⅛".
Lining—Moulded type. Width 1¾". Thickness ¼". Length per wheel 25".
Clearance—.010" toe, .005" heel on each shoe.
Hand Brake Adjustment:—See Service Brakes.
Hill-Holder:—Optional on all models. See article in Brake Section and Clutch Section above for adjustment.

ENGINE NUMBER:—First number—157,000. Stamped on left side of cylinder block opposite #6 cylinder.

ENGINE SPECIFICATIONS:—Type—6 cyl. 'L' head.
Bore—3". **Stroke**—5".
Displacement—212 cubic inches.
Rated Horsepower—21.6 (AMA).
Developed Horsepower—88 at 3800 R.P.M. (Std. 6.0-1 head), 100 at 3800 R.P.M. (Optl. 7.0-1 head).
Compression Ratio & Pressure—To check pressures, remove spark plugs, crank engine with throttle wide open.
Std. 6.0-1 Head .....111 lbs. at 215 R.P.M.
Optl. 7.0-1 Head .....127 lbs. at 207 R.P.M.
Vacuum Reading—Gauge should show steady reading of 18-19" of HG. with engine idling at 350 R.P.M. or 7 M.P.H.
NOTE—High Octane fuel must be used in engines with optional high compression 7.0-1 head.

PISTONS:—Own Lo-Ex aluminum alloy, 'T' slot, Cam ground type. Use finished replacement pistons when reconditioning engine. See Reconditioning parag'ph.
Weight—10.5 ozs. stripped. Stamped on piston head.
Length—3 3/16".
Removal—Pistons and rods removed from above.
Clearance—Top .016". Skirt .002". See Fitting New Pistons.
NOTE—These pistons are interchangeable with 1935 and may be installed in complete sets on 1934 model.
Reconditioning Cylinders:—Size of original bore indicated by letter stamped on lower edge of valve chamber opposite cylinder as follows: A-3.000", B-3.0005", C-3.001", D-3.0015", E-3.002", AO-3.010", BO-3.0105", CO-3.011", DO-3.0115", EO-3.012". Recondition cylinder to standard oversize for which replacement piston and rings are available (see piston and ring data below).
Replacement Pistons:—Standard and oversize pistons marked by leter on head available for **cylinder bores** of size indicated: 'B'-3.000&3.0005", 'D'-3.001&3.0015", 'F'-3.002 & 3.0025", 'J'-3.004", 'L'-3.005", 'BO'-3.010 & 3.0105", 'DO'-3.011 & 3.0115", 'FO'-3.012 & 3.0125", 'LO'-3.015", 'BB'-3.020", 'DD'-3.021", 'FF'-3.022". All pistons installed in engine must be of same weight as indicated by mark on head.
Fitting New Pistons:—Use .0015" feeler ½" wide on side opposite slot at right angles to pin bosses to check clearance. Tension to withdraw feeler must be 3-4 lbs.
Installing Pistons:—Slot toward left or away from camshaft.

PISTON RINGS:—Two compression, one oil ring above pin, one oil ring below pin per piston. Upper oil ring groove drilled with twelve 5/16" oil drain holes and two 5/16" holes to pins. Lower oil ring groove drilled with four 5/16" holes and two oil drain slots. Rings are straight cut and are positioned by pin in piston ring groove.

Ring	Width	End Gap	Wall Thickness
Comp.	3/32"	.005" Min.	.123"
Oil (both)	3/16"	.005" Min.	.128"

NOTE—Use standard or oversize rings of size indicated for replacement pistons (see Replacement Piston section above): 3.000"—B, D, F; 3.003"—J; 3.005"—L; 3.010"—BO, DO, FO; 3.015"—LO; 3.020"—BB, DD, FF. If rings are filed, clearance at pin must be kept uniform with end gap.

PISTON PIN:—Diameter ¾". Length 2 7/16".
Pin floats in piston and rod. Held by locking ring at each end. Pin hole in rod is bronze-bushed. Pins furnished standard, .002", .005", .010" oversize.
Pin Fit in Piston—Hand push fit with piston heated to 200° F.
Pin Fit in Rod Bushing—.0003" clearance. With this clearance rod will just turn of own weight.

CONNECTING ROD:—Weight 29.4 ozs. **Length** 8 3/16".
Crankpin Journal Diameter—1 15/16".
Lower Bearing—Spun-babbitt lined type. Rods serviced on 'exchange' basis.
Clearance—.001". **Sideplay**—.006-.010".
Bearing Adjustment:—Laminated shims. Do not file rods or caps.
Installing Rods:—Lower bearings are offset. Install rods with right hand offset (widest half of bearing toward rear) in cylinders #1, 2, 4, and rods with left hand offset (widest half of bearing toward front) in cylinders #3, 5, 6. Oil scoop on bearing cap must be toward camshaft on all rods.

CRANKSHAFT:—3 bearing. Integral counterweights.
Journal Diameters—#1, 2 11/32"; #2, 2⅜"; #3, 2 13/32".
Bearing Type—Removable bronze-backed, babbitt-lined. Bearings furnished for service reamed to standard size or unfinished with 1/32" stock to permit reaming to desired size.
Clearance—.001".
Bearing Adjustment:—Laminated shims. Do not file bearing caps.
End Thrust:—Taken by flanges on #2 (center) main bearing. Endplay .006-.012". Adjusted by replacing bearing.

CAMSHAFT:—Three bearing. Gear driven.
Journal Diameters—#1, 2"; #2, 1 31/32"; #3, 1½".
Bearing Clearance—.0015".
End Thrust:—Taken by spring-loaded plunger in end of camshaft and thrust plate on gear case cover.
NOTE—If gear case cover removed, see that spring and plunger are in place when cover is replaced.
Timing Gears:—Crankshaft gear cast-iron. Camshaft gear GE. or Cont. Diamond Fibre Bakelite.
Camshaft Setting:—Gears are marked. Mesh marked tooth of crankshaft gear between two marked teeth on camshaft gear.

VALVES:—

	Head Diameter	Stem Diameter	Length
All valves	1⅜"	⅜"	5 11/32"

	Seat Angle	Lift	Stem Clearance
Intake	45°	11/32"	.0015-.003"
Exhaust	45°	11/32"	.003-.005"

Tappet Clearance—.006" intake, .008" exhaust with engine hot.
Valve Guides:—Removable type. Pressed in block. Finish ream guides after installation to size giving correct clearance.
Valve Springs:—Cages installed on bottom of all springs. Springs should be installed with open side of cage toward cylinder.

	Spring Pressure	Spring Length
Valve Closed	44 lbs.	2"
Valve Open	102 lbs.	1 21/32"

Valve Lifters:—Slipper type operating in individual removable guides. Lifter is prevented from turning by pin in guide.
Valve Timing:—See Camshaft Setting above.
Intake Valves—Open 10°40' BTDC. Close 60° ALDC.
Exhaust Valves—Open 50° BLDC. Close 18°44' ATDC.
These figures correct with .010" tappet clearance.
To Check Timing—Set tappet clearance #1 intake valve at .010". This valve should open with piston 10°40' or .0562" before top dead center when point on flywheel approximately 3.94 teeth before 'UDC.1-6/' mark lines up with indicator in hole in left front face of flywheel housing. Reset tappet clearance at .006". hot.
Motor Gauge—Weidenhoff #114 Adapter, #44 Rod.

LUBRICATION:—Duo-flow (splash) system. Force feed by oil pump to conecting rod troughs and timing gears. Splash to all other bearing points from troughs.
Normal Oil Pressure—3 lbs.
Oil Presure Regulator—Operates at 3 lbs. Located on right side of crankcase. Not adjustable.
Crankcase Capacity—6 qts. refill.
Oil Pump:—Oscillating plunger type pump mounted on right side of crankcase and driven by gears from the camshaft.
Oil Pressure Indicator:—Consists of signal light on instrument panel and switch built in oil pressure regulator. See article in Equipment Section for complete data.

CLUTCH:—Own Make. Single plate, cork insert type operating in oil. Driven plate can be recorked but is customarily replaced.
Clutch Plate—Thickness .203". Inside diameter 5.375" Outside diameter 8.625". Facing consists of 90 cork inserts.
Adjustment:—Free movement of clutch pedal must be 1½" at all times. To adjust, remove clevis pin in clutch pedal link rod (between frame and leg of 'X' member below clutch pedal shaft), loosen locknut at top of clevis, turn clevis to shorten or lengthen rod as required, tighten locknut, replace clevis pin. On cars with automatic clutch control, check linkage whenever clutch is adjusted.
Automatic Clutch Linkage Adjustment—Hold accelerator pedal in depressed position, pull backward on clutch control power unit rod at left of engine. With rod in extreme rear position check clearance between back of slot in rod yoke and clevis pin which attaches it to operating lever. Clearance at this point must be ⅞".
Servicing:—Oil in clutch should be renewed at 5000 mile intervals. See 1936 Hudson Eight page.

STEERING:—Steering Gear—Gemmer Worm-and-Sector type. See article in Steering Section for adjustments.
NOTE—An adjustable drag link with ¾" adjustment (made by shifting shims from front to rear of pitman arm ball seat) is used on Model 61 after #6110394 (except 6110601 to 6110650), Model 62 after #623419 (except 623506 to 623661 incl.).
Front Suspension:—Conventional 'I' beam section front axle with Elliott type ends and semi-elliptic springs. Torque arm at each end of axle connected to frame at rear by rubber-bushed bolt maintains axle alignment.
Specifications & Adjustment—Kingpin inclination, Caster, Camber, Toe In, Steering Geometry, and Kingpin thrust bearing specifications and adjustment same as for Hudson Eight (see 1936 Hudson Eight page).

BRAKES:—Service—Bendix Hydraulic. Due-Servo, Single Anchor type. Brake pedal connected to rear wheel brakes through cable linkage for additional reserve mechanical aplication of brakes. Hand lever aplies rear wheel brakes through this same linkage. See article in Brake Section for complete adjustment procedure.
Brake Drum Diameters—10 1/16".
Brake Lining—Moulded & Woven type. Width 1¾". Thickness 7/32". Length 22⅛" per wheel.
Brake Clearance—.010" heel and toe of each shoe.
Brake Pedal Adjustment:—For correct mechanical follow-up feature, adjust position of nut on connecting rod so that clearance between face of nut and end of push rod is 1 29/32" with equalizer against stop.
Hand Brake Adjustment:—See Service Brakes.

ENGINE NUMBER:—First number—42,000. Stamped on right front upper corner of cylinder block.

ENGINE SPECIFICATIONS:—Type—4 cylinder, 'L' head.

Bore—3⅛". **Stroke**—4⅜".

Displacement—134.2 cubic inches.

Rated Horsepower—15.63 (AMA).

Developed Horsepower—48 at 3200 R.P.M.

Compression Ratio & Pressure—5.7-1 cast-iron head, no optl. Pressure 87 lbs. at 216 R.P.M.

Vacuum Reading—Gauge should show steady reading of 18½" with engine idling at 7 M.P.H.
NOTE—Cylinder bore offset ⅛" from center line of crankshaft toward valve side of engine.

PISTONS:—Hard Grey Iron (cast-iron). Light weight type relieved at pin bosses.

Length—3¾".

Weight—23-25 ozs. (without rings or pins).

Removal—Pistons and rods removed from above.

Clearance—Top, .007-.008". Bottom .0025-.003".

Replacement Pistons:—Finished pistons furnished .003", .005", .010", .015", .020", .025", .030", .035", .040" oversize.

Fitting New Pistons:—Use .0025" feeler stock to check clearance. Pull required to withdraw feeler from between piston and cylinder wall must be 4 lbs. plus or minus 2 lbs.

PISTON RINGS:—Three compression, one oil control ring per piston, all above pin. Oil ring groove drilled radially with oil drain holes.

Ring	Width	End Gap	Wall Thickness
Comp (Top)	3/32"	.010-.012"	.140"
Comp (2, 3)	3/32"	.007-.012"	.140"
Oil Cont.	3/16"	.007-.015"	.140"

PISTON PIN:—Diameter—⅞". **Length**—2.713".
Pin floats in piston and rod. Retained by locking rings. Pins furnished .001", .003" oversize.

Pin Fit in Piston—Hand press fit. Clearance .0002-.0004".

Pin Fit in Rod Bushing—Thumb press fit. .0004-.0006".

CONNECTING ROD:—Length—9 3/16" (center-to-center).

Weight—36 ounces.

Upper Bearing (Piston Pin Bushing)—Bronze.

Crankpin Journal Diameter—1 15/16".

Lower Bearing—Spun babbitt-lined type.

Clearance—.001-.0025". Sideplay .005-.009".

Bearing Adjustment:—None (no shims). Replace rods.

Installing Rods:—Connecting rod lower bearings are offset. Install rods with short side of bearing toward nearest main bearing (short side forward on #1 and 3, toward rear on #2 and 4). Oil hole in lower bearing upper half must be toward right (away from camshaft) on all rods.

CRANKSHAFT:—Three main bearing type.

Journal Diameters—2 3/16" all bearings.

Bearing Type—Removable (slip-in) steel-backed, babbitt-lined. Bearings furnished .010" undersize.

Clearance—.001-.0025".

Bearing Adjustment:—None (no shims). Replace bearings. Do not file bearing caps.

End Thrust:—Taken by front (#1) main bearing. Endplay .004-.006". Adjustable by shims between crankshaft thrust washer and shaft.

CAMSHAFT:—4 bearing. Non-adjustable chain drive.

Bearing Type—Removable bushing (front), machined in crankcase (all others).

Bearing Clearance—.002".

End Thrust:—Taken by thrust plate behind camshaft sprocket and spring loaded plunger in forward end of camshaft bearing against thrust stud on chain case cover.
NOTE—When replacing chain case cover see that plunger and spring are in place in camshaft.

Timing Chain:—Link-Belt #33403-2. Width 1¼". Pitch ½". Length 23½" or 47 links.

Camshaft Setting:—Sprockets are marked. With pistons #1 and 4 at TDC. marks should be adjacent and in line with a straightedge across the shaft centers. Remove camshaft sprocket to install chain.

VALVES:—Head Diam. Stem Diam. Length

Intake	1 17/32"	.372"	5 13/64" (5¾" overall)
Exhaust	1 15/32"	.371"	5 13/64" (5¾" overall)

	Seat Angle	Lift	Stem Clearance
Intake	45°	21/64"	.002-.004"
Exhaust	45°	21/64"	.003-.005"

NOTE—Hard alloy steel inserts are used for exhaust valve seats.

Tappet Clearance—.004" Int., .006" Exh., engine hot.

Valve Guides:—Removable type installed with taper end up. Remove old guides from above and press in new guides until lower end extends ¾" below valve spring recess machined in block. Exhaust guide longer than intake guide.

Valve Springs:—	Pressure	Length
Valve Closed	46½ lbs.	2¼"
Valve Open	85½ lbs.	1 15/16"

Valve Lifters:—One piece mushroom type. Operate in guide holes reamed in block. Clearance in guides .0008". Serviced by reaming guide hole and installing lifters furnished .005" oversize.

Valve Timing:—See Camshaft Settig above.

Intake Valves—Open at TDC. Close 45° ALDC.

Exhaust Valves—Open 40° BLDC. Close 5° ATDC.

To Check Valve Timing—Set tappet clearance #1 intake and exhaust valves at .010". Intake valve opens with piston on top dead center when flywheel mark 'T.C.I.O.1-4' lines up with pointed end of inspection plate cover screw (top of flywheel housing on left hand side). Exhaust valve closes with piston 5° or .0103" down on intake stroke when flywheel mark 'E.C.' lines up with indicator. Reset tappet clearance at .004" Int., .006" Exh. with engine hot.

Motor Gauge—Weidenhoff Adapter #104, #2 Rod.

LUBRICATION:—Pressure system. Gear type oil pump mounted on left hand outer crankcase wall.
NOTE—When installing oil pump, turn engine over until 'IGN' mark on flywheel lines up with pointed end of inspection cover screw on left top side of flywheel housing with #1 piston on compression stroke. Rotate distributor shaft so that rotor is in #1 firing position, then mesh oil pump gear so that tongue-and-slot connection to distributor shaft is engaged without changing position of distributor shaft.

Normal Oil Pressure:—30 lbs. at 30 M.P.H.

Oil Pressure Regulator:—Located under plug on oil pump cover. Operates at 30 lbs. Adjustable by adding or removing shims in plug above spring.

Crankcase Capacity—4 qts. (refill).

CLUTCH:—Borg & Beck. Single plate, dry disc type. See article in Clutch Section for relining and assembling directions.

Adjustment—Clutch pedal free movement should be ¾-1" (providing clearance of 1/16" between clutch release levers and clutch release bearing within housing). To adjust, loosen lock nut, turn turnbuckle on end of clutch lever link cable.

Removal—Remove front seat, cowl trim pads and accelerating pedal (removing rubber socket connection also). With fan turned so that top blades form a 'V' place a cloth over it to prevent injury to radiator core. Attach lifting hook in #4 spark plug hole. Remove propeller shaft. Remove bottom nuts from mounting bolts at rear of transmission. Raise engine until bell housing clear brake cross shaft. Remove rubber mounting rings and mounting bracket capscrews. Do not disturb upper nuts on mounting bolts. With transmission supported from below, remove engine bolts without withdrawing bolts entirely so that rear motor plate will not be disturbed (bolts should be driven in from front or engine side). Finally lift transmission out from top. Take out clutch mounting screws, lift clutch out.

STEERING:—Steering Gear—Lavine Worm-and-Block type. See article in Steering Section for adjustm'ts.

Front Suspension—Conventional 'I' beam section axle with Reverse-Elliot ends and semi-elliptic springs.

Kingpin Inclination—7½° crosswise.

Camber—2° or 21/32". No adjustment.

Caster—1-2°. Adjust by shims between spring and axle pad.

Toe In—3/32". Adjust by loosening tie rod clamp bolts and rotating tie rod.

Tread—50" (front), 51" (rear).
NOTE—Kingpin bushing diameter, .625". End thrust is taken by a taper roller bearing assembled between axle end and steering knuckle lower yoke. Tie rod ends are rubber bushed.

BRAKES:—Service—Bendix Mechanical, Duo-Servo., Single anchor type. Hand lever applies the service brakes. See article in Brake Section for complete adjustment procedure.

Drum Diameter—9".

Lining—Moulded type. Width 1¾". Thickness 3/16". Length 19 3/16" per wheel.

Clearance—.010" at heel and toe of each shoe.

Hand Brake Adjustment—No separate adjustment necessary. Hand brake linkage serves as stop for Service Brake linkage and Service Brakes are adjusted to this point (clevis pin in slotted connector link at lower end of Hand Brake lever rests in extreme rear position with Hand Brake fully released). Hand Brake linkage sets Service brakes through regular linkage.