OPERATION AND CARE

National

MOTOR CARS

Highway Six, Series AC, and Highway Twelve, Series AD

NATIONAL MOTOR VEHICLE COMPANY
INDIANAPOLIS INDIANA U. S. A.

INDEX

OPERATION AND CARE

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MOTOR CARS

Series AC—Car No. 14001 to_____ 6-Cylinder 3½-inch x 5¼-inch Motor

Series AD—Car No. 16001 to_____ 12-Cylinder 2¾-inch x 4¾-inch Motor

NATIONAL MOTOR VEHICLE COMPANY

INDIANAPOLIS, INDIANA, U. S. A.

Main Office and Factory, East Twenty-Second Street and Monon Railroad

Cable Address: "AUTOMOBILE" Indianapolis, "A B C" Code, Fourth Edition, Western Union Code

Preparing A New Car For Running

WHEN preparing to run the car, fill the gasoline tank at the rear of the car by removing the gasoline tank cap (559). The gasoline should be poured through a screened funnel, but it is preferable to also strain through chamois skin. Care should be exercised to see that the bucket or utensil used in filling contains no water, as water in gasoline is very detrimental. The capacity of the tank is approximately 17 gallons.

The water system, which holds six and one-half gallons on the Highway Six and eight gallons on the Highway Twelve, should then be filled by opening the cap on the top of radiator. In cold weather about twenty-five per cent. of alcohol may be added to the water to prevent freezing.

Next, fill the oiling system by raising the cap on the oil filler (898C or 1378D) on the crank case of the motor and pour in about two and a half gallons of oil, or until the oil begins to flow out of the pet cock on left side of crank case pan.

The wires on dash, magneto and plugs should be inspected to see if they are connected securely to the terminal binding posts. To prevent the possibility of any accident, an examination of brakes, steering connections and all other parts should be made to see that they are properly connected and that no cotter pins are missing.

Starting the Engine—Using Electric Starter.

Insert key in ignition switch on dash and turn switch to position marked "magneto," then see that spark is slightly advanced, which is accomplished when the long lever on the steering post is placed part way up. Be sure that the controller lever is in "neutral" position. This insures disengagement of the gears so the car will not move when engine is started.

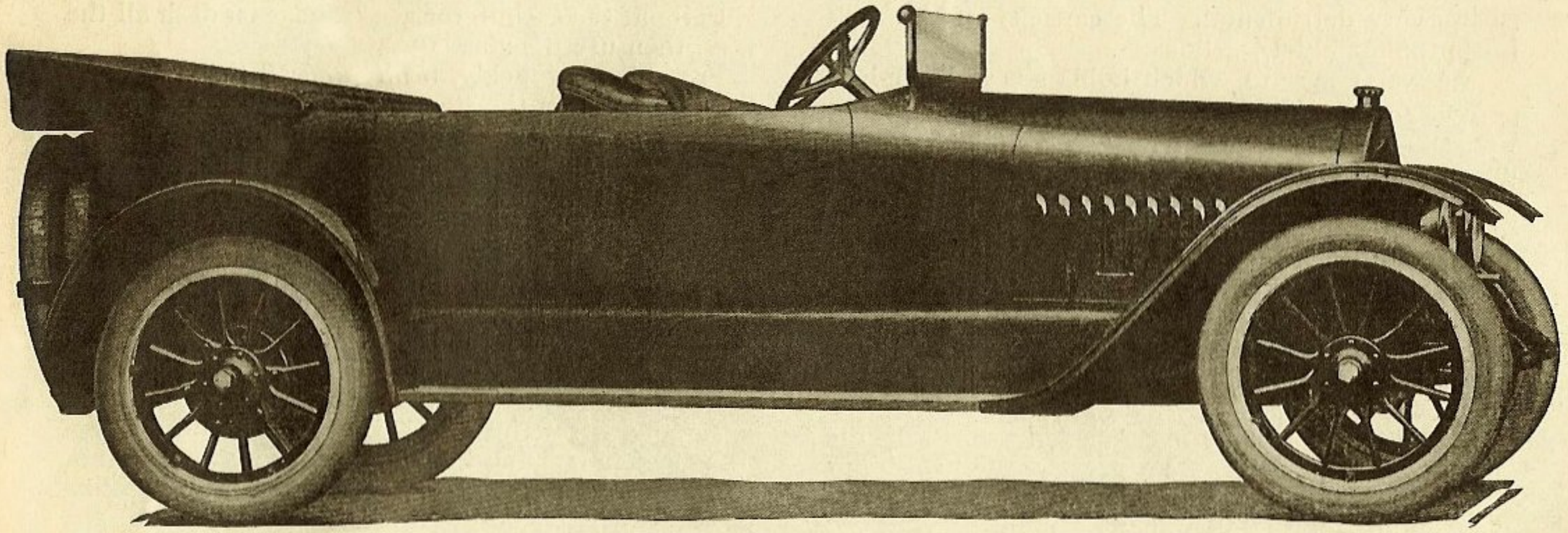
Pull out the carburetor adjustment on dash all the way, then use the starter.

Press down, quickly, firmly and all the way, with the right foot on the starter plunger in center of toe board. As soon as you hear the engine start, release the starter plunger quickly. Immediately push down throttle for a few seconds until engine gains momentum, and set the carburetor adjustment on dash to position for engine running.

If engine will not start and ignition system is working, then the trouble, in all probability, lies with the carburetor, and, no doubt the engine is not receiving enough gasoline. If not previously adjusted then adjust the carburetor as per detailed instructions given in this book. If difficulty is experienced in starting the engine, or if starter will not work, or in extremely cold weather, a little gasoline can be introduced into the cylinders through the priming cocks on top of them from the priming can. On account of the poor quality of fuel generally supplied, the gasoline used for priming should be high test gasoline.

BEFORE USING THE STARTER SEE—

THAT THERE IS PLENTY OF GASOLINE IN THE TANK.
THAT RADIATOR IS FULL OF WATER.
THAT CONTROLLING LEVER IS AT "NEUTRAL" POSITION.
THAT CARBURETOR CONTROL ON DASH IS SET AT "START" POSITION.



SIDE VIEW OF NATIONAL HIGHWAY SIX

Operating the Car

AFTER the engine has been started, advance the spark lever slightly. There are five positions for the gear shift lever. The center position is called neutral, no gears being engaged. When in neutral the lever may be moved to right or left, but will return to an upright position. By this means the driver can easily tell whether the gear is in neutral.

To start the car, the brakes are released by hand lever (539), the clutch held out by pressing down on left foot pedal (321), and first speed engaged by moving lever to the left and back, after which the clutch is engaged by releasing the foot pedal. The pedal should be released slowly and the throttle pedal (419C or 433D) pressed down slightly as the clutch engages. If this is not done the additional load on the engine will slow it down and perhaps stop it entirely. When the car is under way, change to second speed by throwing out clutch with left foot pedal, then moving lever to neutral and from neutral to the forward right-hand position. Third speed, or direct drive, is obtained by shifting to the right-hand rear position in the same way.

The speed of engine can be almost entirely regulated by throttle; for ordinary speeds keep spark lever near center of ratchet, when going faster advance spark lever slightly, and, when climbing hill, retard slightly, according to speed of engine. In turning corners and going over rough places, it is well to release the clutch with the foot pedal slightly, as this relieves the strain on the engine.

To stop quickly, release the throttle pedal, press the clutch pedal and throw on the hub brakes with the hand brake lever (539), or foot pedal (322), or both. The foot brake pedal is also used for slowing down, and will be found very convenient when going through crowded thoroughfares.

Care should be exercised in applying the brakes, especially on slippery streets, as too sudden application will often cause skidding. The locking of the wheels in this way is also very hard on the tires.

Always release the clutch before shifting the gears.

To reverse the car (WHICH SHOULD NEVER BE DONE UNLESS IT IS AT A STANDSTILL), hold the clutch out with left foot pedal and push the controller lever forward to L. H. notch, then gradually let the clutch in.

If it is necessary, when ascending an excessive grade, to use a lower speed throw out the clutch and pull the controller lever into the desired position. The knack of changing the speed quietly consists, when going from a lower to a higher speed, in pushing the foot pedal all the way down, so that the clutch comes clear out against the buffers (328), slowing it down slightly, then push the gear quickly into its proper notch.

To go from a higher to a lower speed, the opposite holds true in regard to the clutch, as it should not only be kept revolving, but the throttle opened so as to speed up the motor. This necessitates that the clutch pedal should be pushed down very slightly. When descending hills, the best method is to throw out the clutch and allow the vehicle to coast, being ready with the brake lever, however, so that the brakes may instantly be applied. If the hill is very steep, it is best to leave the engine in gear in one of the lower speeds, and it will be found that the machine will move down the hill slowly without the necessity of putting on the brakes.

When stopping, after the machine has come to a standstill, ALWAYS PLACE THE CONTROLLER LEVER IN "OFF" OR NEUTRAL POSITION.

To run the engine while the machine is standing, leave the throttle closed, and, by adjusting the spark lever on top of the wheel, get the slowest possible speed to keep the engine running.

To stop the engine, turn the switch to "Off" position, at the same time pressing down the throttle, so a charge of gasoline will be left in the cylinders. If the machine is to stand over night in very cold weather, drain the water from the cooling system, cylinders and water pump. Always see that the tires are well inflated and that you have the full equipment of tools. If any unusual noise develops in the engine, gearing or parts of the car, immediately stop and investigate the cause, as the remedy of such troubles at once may often save a great multiplication of them in the future.

Operation of Crank Case Oiling System and Oiling of Parts

Proper lubrication of all moving parts is an absolute necessity, and care should be taken to see that all parts are properly lubricated and a proper supply of oil is carried at all times. The oiling of the engine is accomplished by means of a self-contained crankcase oiling system. To fill the oiling system, remove cap (898C or 1378D) from the oil filling tube and pour in through a strainer sufficient oil to show at the pet-cock on the side of the oil pan. A float with ball indicator at top also indicates the quantity of oil in the case.

Oiling System, Highway Six.

The crankcase pan (844), or lower half of the crankcase of the engine, is divided horizontally into two compartments, the upper compartment being subdivided into buckets for each connecting rod to dip. The lower compartment carries the oil supply of two and one-half gallons and contains a gear oil pump, driven by a spiral gear on the camshaft. The upper compartment contains the oil which actually performs the duty of lubricating the engine and parts. The oil pump forces the oil from the lower compartment to the upper compartment of the crankcase pan. The amount of oil in the upper compartment is automatically carried at the same level at all times. This constant level of oil in the upper compartment is maintained by overflows of fixed height, which connect the upper and lower compartments. The oil pump handles more oil all the time than could be consumed in the proper lubrication of the parts. The excess returns from the upper compartment through the standpipes to the lower compartment. The oil is thus used over and over again until consumed. The oil pump also discharges oil at the camshaft gears in the front and at each of the main bearings.

The connecting rods are arranged with dippers, which pick up the oil and lubricate the connecting rods and camshaft bearings, by splash.

Twelve Cylinder Oiling System.

The oiling system on this engine is of the high pressure type, no splash lubrication being used, so that it is very necessary to watch the pressure gauge on dash when the engine is running, which indicates whether the engine is getting sufficient oil. Also it is very important to see that the tank at the bottom of crankcase, which holds two and one-

half gallons, is kept full. This oil system works as follows:

The large oil pump situated in the bottom of the crankcase (which is divided into two compartments, the lower being the tank which holds the oil) forces the oil up through the crankcase to all the main bearings, and from the main bearings through holes in the crankshaft to the connecting rods. Also oil is forced to the camshaft bearings. A small stream of oil is allowed to run out on the timing gears. There is sufficient oil thrown off from the rods to lubricate the cylinders and pistons and also the piston pin bearings. Sheet steel baffle plates, which are held by four cap screws, are used to prevent an excessive amount of oil being thrown up into the cylinders. The oil thrown off from the main bearings and rods, runs back into the tank where it goes through two screens on its way to the pump. There is a plug at the bottom of oil pan in front of the main screen which should be removed occasionally to let the old oil drain out and new oil should be put in. The filler cap on the side of motor is used for filling the crankcase. Also there is a pet-cock on the side of crankcase, which indicates the oil level when tank is full. A float is used with ball on top to indicate the amount of oil in the crankcase.

The oil pressure produced by the oil pump is indicated by pressure gauge on the instrument board. This pressure should always show 5 pounds or more when car is running over 15 miles an hour, but should never show over 25 pounds except when engine is first started up and the oil is cold. It may be advisable to keep the pressure a little higher than this when engine is new, and later it can be adjusted lower as the bearings get worn in. The pressure is regulated by a relief valve situated at back end of crankcase. There is a lock-nut on the adjusting screw which, when loosened and the adjusting screw turned to the right, increases the pressure; when turned to the left, decreases the pressure. The lock-nut must be securely fastened after the adjustment is made. Too high a pressure may cause the engine to smoke.

In case the oil gauge shows no pressure when engine is running at any reasonable speed, first see that there is plenty of oil in the crankcase. If there is, then the trouble may be due to the pressure valve sticking and staying open, or the gauge not working properly. In all probability, however, it will be due to the strainer screen in bottom of crankcase being obstructed with dirt. This should be cleaned by draining the oil out of bottom of case by removing the plug and cleaning off the screen with small brush. If engine uses an excessive amount of oil, first be sure that there are no leaks in the crankcase or oil pressure system. Then see that the oil pressure is not excessive. Badly worn crankshaft and connecting rod bearings also result in excessive oil consumption.

In case of accident, in which the main or connecting rod bearings are burned out, when these are renewed, be careful to see that all the oil holes in crankshaft are open and that no babbitt has gotten into them, obstructing the oil passages.

If center main bearing cap is removed for adjustment of bearing, use care in replacing, to see that hole in liner is in line with oil hole drilled in cap, so that oil passage is not shut off. The high pressure oiling system necessarily has a number of very small holes in different bearings and parts through which the oil must pass to provide proper lubrication. If dirt or too much carbon gets into the oil,

these holes are liable to become stopped up. It is well to remove the lower half of the crankcase once in a while and clean both screens thoroughly.

IMPORTANT

WATCH OIL PRESSURE GAUGE TO SEE THAT ENGINE IS GETTING PLENTY OF OIL.

GENERAL INSTRUCTIONS

It is advisable to draw all the oil out of the crankcase pan once every couple of thousand miles, by removing the cover or plug in the bottom; wash it out with gasoline and fill up with new, clean oil. See that oil strainer screens are clean.

Besides the engine parts reached by the crankcase oiling system, there are other parts which occasionally require oiling. The leather on the face of the clutch should be oiled, preferably with castor oil, whenever it becomes dry.

The clutch ball bearing and hub are lubricated from the transmission by holes drilled in the clutch shaft. It is well to inspect these occasionally. If they do not receive enough oil, apply a few drops and use a softer grade of grease in the transmission.

The universal joints at the ends of the driveshaft back of the transmission and at the rear axle should also be packed with non-fluid oil or graphite grease, through the filler caps provided.

The rear system is filled with rear axle lubricant. This should be cleaned out with kerosene every season and refilled. This same rule applies to the transmission.

There are several oil cups on magneto and starter motor, which lead to bearings and which should be kept oiled with a few drops of oil every five hundred miles.

The steering chuck should be kept oiled and occasionally packed with hard grease. All connections must be liberally supplied with oil. The bearings in wheels are packed with light cup grease, and should be washed out with gasoline and repacked twice a season.

The other points which should have a few drops of oil are the fan bearings, hand lever shafts, brakeshafts, clutchshaft, steering knuckles and torsion rod swivel bearing. Grease cups are provided for the king bolts, brake camshafts and spring supports on the rear axle, and spring bolts and links. These grease cups should be kept filled with a good grade of cup grease and screwed down occasionally.

The oil used in oiling system should be the best grade of gas engine oil. The oil used for oiling the remainder of the car can be any good grade of machine oil.

See that grease cups on cantilever springs are kept full of grease and screwed down.

See Lubrication Chart on Chassis Plan View

Key to Lubrication Chart

A—Engine lubrication. Supply oil as required. See explanation of oiling system.

B—Transmission and rear axle. Inspect once each month. Level of lubricant should only be high enough for gear teeth to dip continuously. Use good grade of transmission and rear axle lubricant.

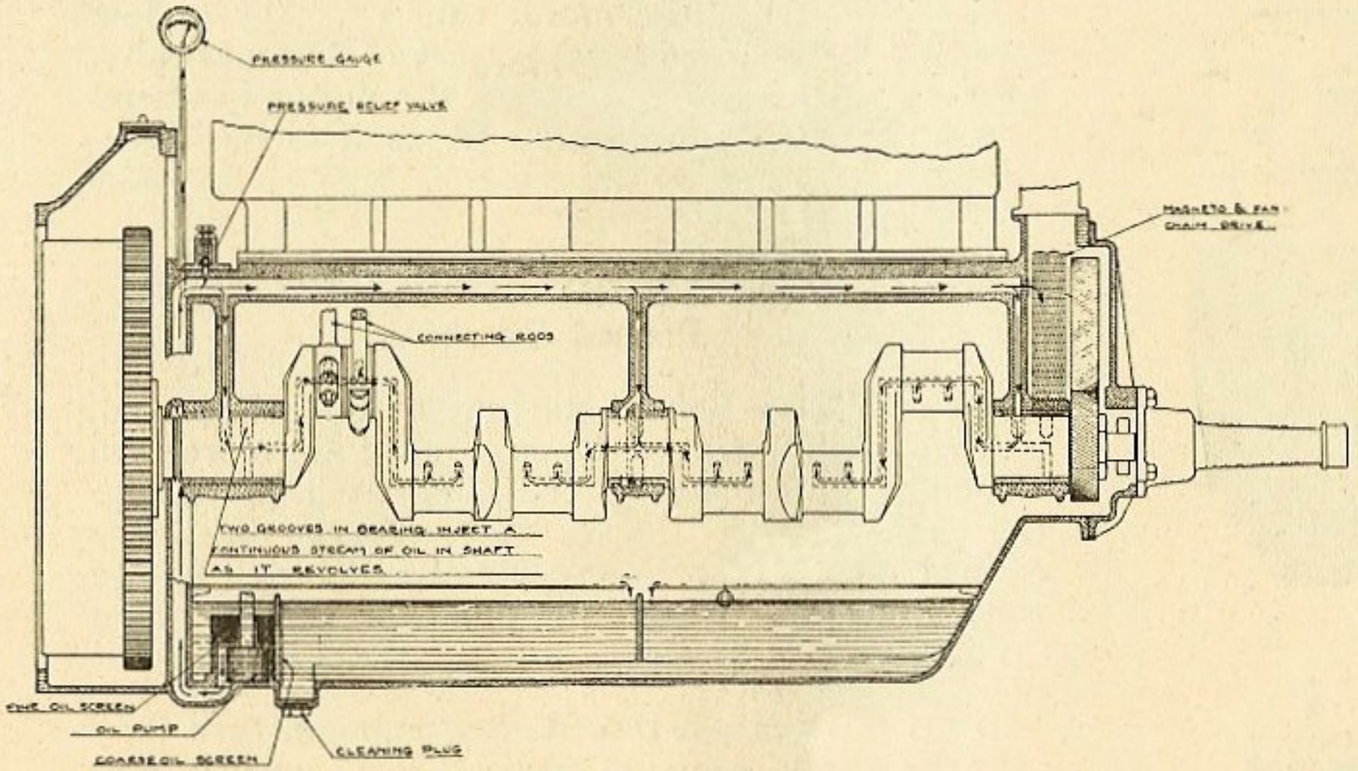
C—Grease cup. Screw down two turns every week.

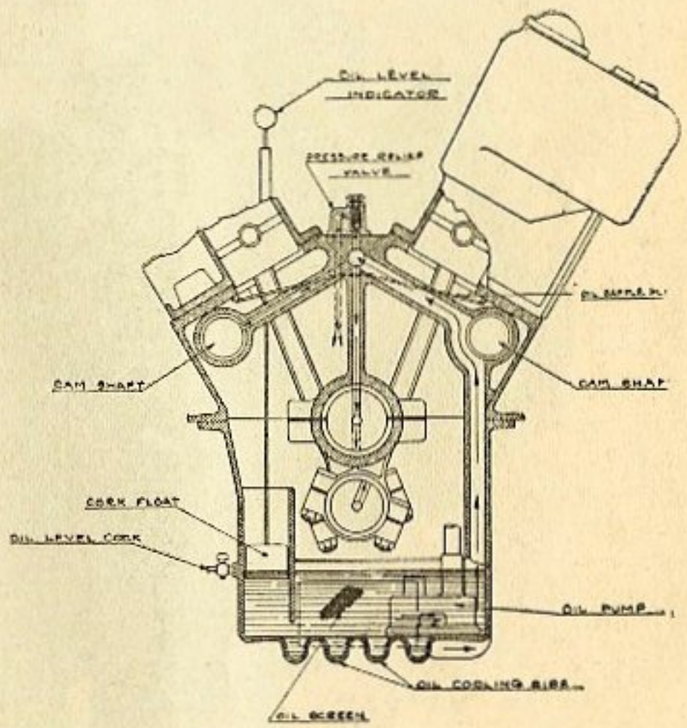
D—Pack with grease. Oil occasionally.

E—Oil cup. Oil every week.

F—Oil cup. Oil every two weeks.

G—Joint. Oil every two weeks.



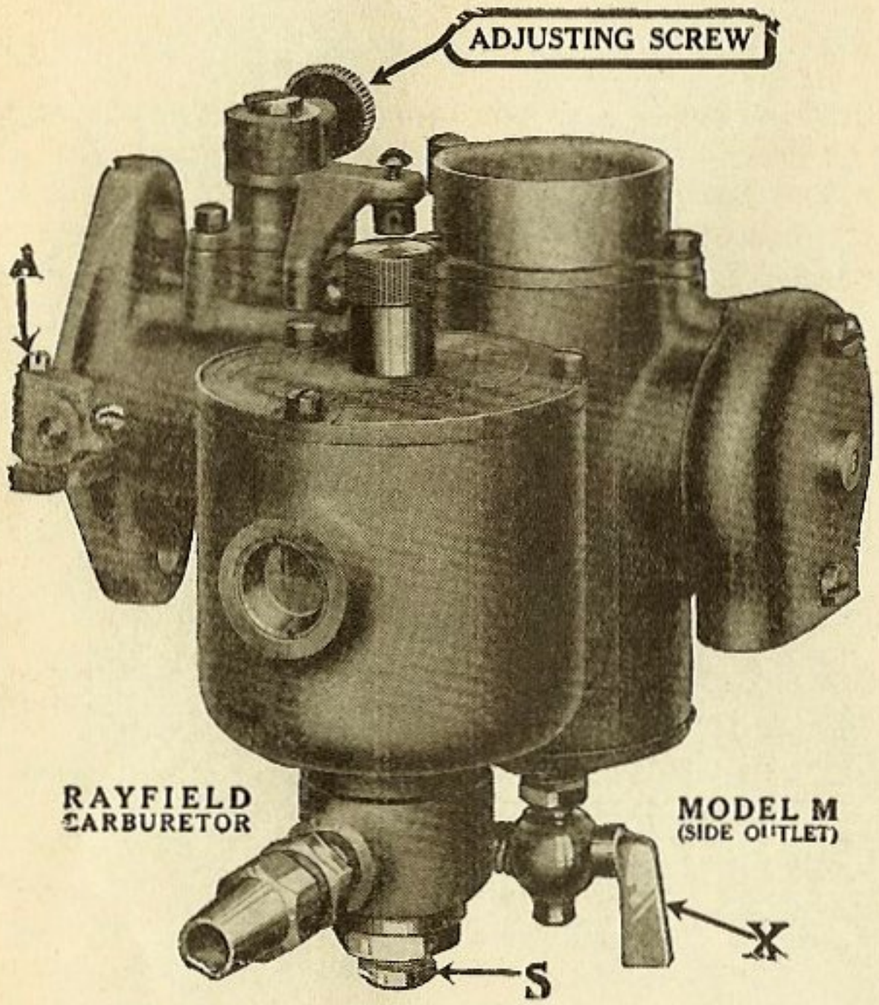


OILING SYSTEM
NATIONAL TWELVE CYLINDER MOTOR
SERIES AD

Highway Six Carburetor

THIS is a Rayfield Model M Carburetor and is attached to the lefthand side of engine.

Model M Rayfield has no air valve adjustment and only one gasoline adjustment.



CAUTION—Before adjusting the carburetor, be sure there are no obstructions in the gasoline line; that connections are absolutely tight and free from air leaks; that valves and ignition are properly timed, and that there is a hot spark and good compression in all cylinders.

ADJUSTING—The Model M Rayfield Carburetor has but one adjustment. Bear in mind that adjustment is turned TO THE RIGHT for richer mixture, as indicated on adjusting screw. This is a LOW SPEED ADJUSTMENT ONLY and should be set when the motor is thoroughly warm. When it is set so the motor runs properly at low speed, the high speed is taken care of automatically. Never adjust carburetor unless the motor is warm. The adjustment cannot change, as it is positively locked.

Always Adjust Carburetor with Dash Control Pushed Down.

STARTING—Before starting motor when cold, observe the following: Open throttle not more than one-eighth. If motor is cold, pull dash control up the full distance. When motor starts, push the control down immediately about a quarter of the way. As motor warms up, push the control down all the way.

If motor does not throttle low enough, turn Stop Arm Screw A (see cut) to the LEFT until it runs at the lowest number of revolutions desired.

DASH CONTROL—The Rayfield Dash Control, when properly used, will render easy starting, furnish a richer mixture when motor is cold, and maintain a correct mixture under the most extreme atmospheric changes. Pulling up the dash control lifts the spray needle and supplies a richer mixture. When it is pulled up the full distance, raw gasoline is drawn into the motor.

When carburetor adjustment is once made, it should not be changed, as the dash control will take care of both cold weather and cold motor conditions. Control button should be DOWN for running except when richer mixture is required.

General Information

Fuel conditions at the present time require the application of heat to the carburetor.

Do not under any circumstances attempt to operate the Model M Rayfield without the use of hot air.

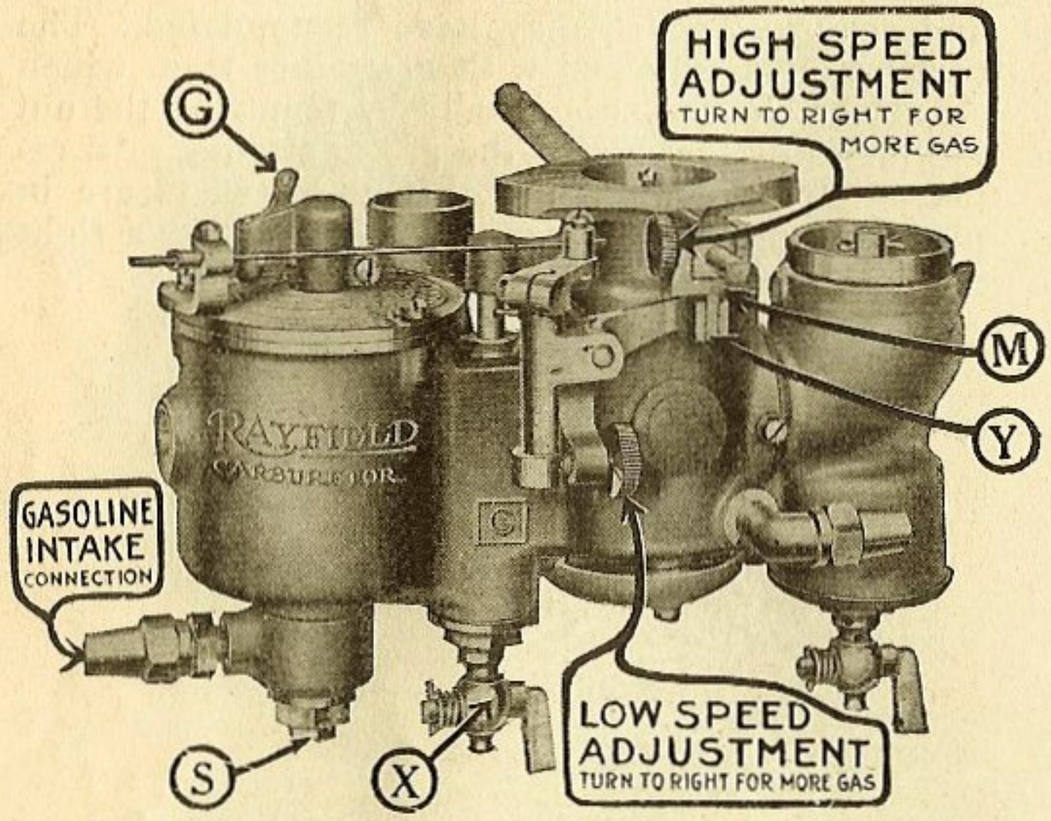
We recommend that all gasoline should be strained through chamois before using.

The float level is correctly set at the factory. **Do not change it.** If for any reason the carburetor does not give desired results, get in touch with a Rayfield service station, or write the factory as follows: Findeisen & Kropf Mfg. Co., Twenty-first and Rockwell streets, Chicago.

The float chamber and dash pot should be drained occasionally through drain cock X, to remove water and sediment which may have accumulated. The carburetor is equipped with a strainer trap, which should be cleaned occasionally by removing the nut S which gives access to the gauze strainer. In replacing the trap, be sure that the gaskets are in place and nut is drawn up firmly to insure a tight joint.

Highway Twelve Carburetor

A RAYFIELD 1¼-inch carburetor is used on the twelve cylinder. It is attached between the cylinders by an aluminum pipe and flange, and consists of a float chamber, in which the float works,



actuating an inlet valve by means of a float lever, which shuts off the supply of gasoline from tank as soon as the float chamber is full.

This carburetor has two jets, and the gasoline is drawn through them into the mixing chamber, quantity being controlled by adjustments on the outside of carburetor.

Important—When adjusting a Rayfield Carburetor, bear in mind that both adjustments are turned to the right for a richer mixture, as indicated on adjustment screw heads.

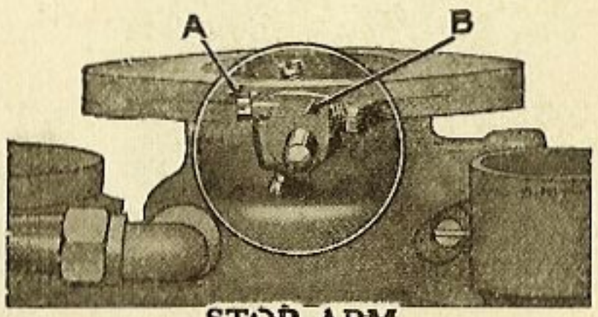
Caution—Before adjusting the carburetor, be sure there are no obstructions in the gasoline line; that manifold connections are absolutely tight and free from air leaks; that valves and ignition are properly timed, and that there is a hot spark and good compression in all cylinders.

Always adjust carburetor with dash control down. Low speed adjustment must be completed before adjusting "high."

Adjusting Low Speed.

With throttle closed, and dash control pushed in, close nozzle needle by turning low speed adjustment to left until block Y (see cut) slightly leaves contact with cam M. Then turn to right about three complete turns. Open throttle not more than one-eighth. Prime carburetor by pulling steadily a few seconds on priming lever G. Start motor and allow it to run until warmed up. Then with retarded spark, close throttle until motor runs slowly without stopping.

If motor does not throttle low enough, turn stop arm screw A (see cut of throttle shaft) to left until



STOP ARM

A.—Stop Arm Screw. B.—Stop Arm.
Turn screw A to left to throttle motor lower.

it runs at the lowest number of revolutions desired. Now, with motor thoroughly warm, make final low speed adjustment by turning low speed screw to left until motor slows down and then turn to the right a notch at a time until motor idles smoothly.

Adjusting High Speed.

Advance spark one-quarter. Open throttle rather quickly. Should motor back-fire, it indicates a lean mixture. Correct this by turning the high speed adjusting screw to the right about one notch at a time, until the throttle can be opened quickly without back-firing.

If "loading" (choking) is experienced when running under heavy load with throttle wide open, it indicates too rich a mixture. This can be overcome by turning high speed adjustment to the left.

Adjustments made for high speed will in no way affect low speed. Low speed adjustment must not be used to get a correct mixture at high speed. The adjustment of the Rayfield cannot change. Both adjustments are positively locked.

Starting—Before starting motor when cold, observe the following: Open throttle not more than one-eighth. Enrich the mixture by pulling up dash control. Prime carburetor by pulling on priming lever G for a few seconds.

When stopping motor, pull up dash control. Open throttle about one-quarter and switch off ignition. This leaves a rich mixture in the motor, which insures easy starting.

Dash Control.

An important feature of the carburetor is the dash control. Pulling out the dash control lifts the spray nozzle needle and supplies a richer mixture. When properly used, it will render easy starting, furnish a richer mixture when the motor is cold and maintain a correct mixture under the most extreme atmospheric changes.

When carburetor adjustments are once made, they should not be changed, as the dash control will take care of cold weather as well as cold motor conditions.

Control button should be down for running, except when a richer mixture is required.

Pull button up full distance for starting.

Adjustment of carburetor should always be made with dash control down and motor warm.

Important—Do not change the float level. It is correctly set at the factory. Always prime carburetor well before starting motor. Pull steadily on priming wire. Don't jerk.

Ignition System

A DIXIE high tension magneto is used with one set of spark plugs.

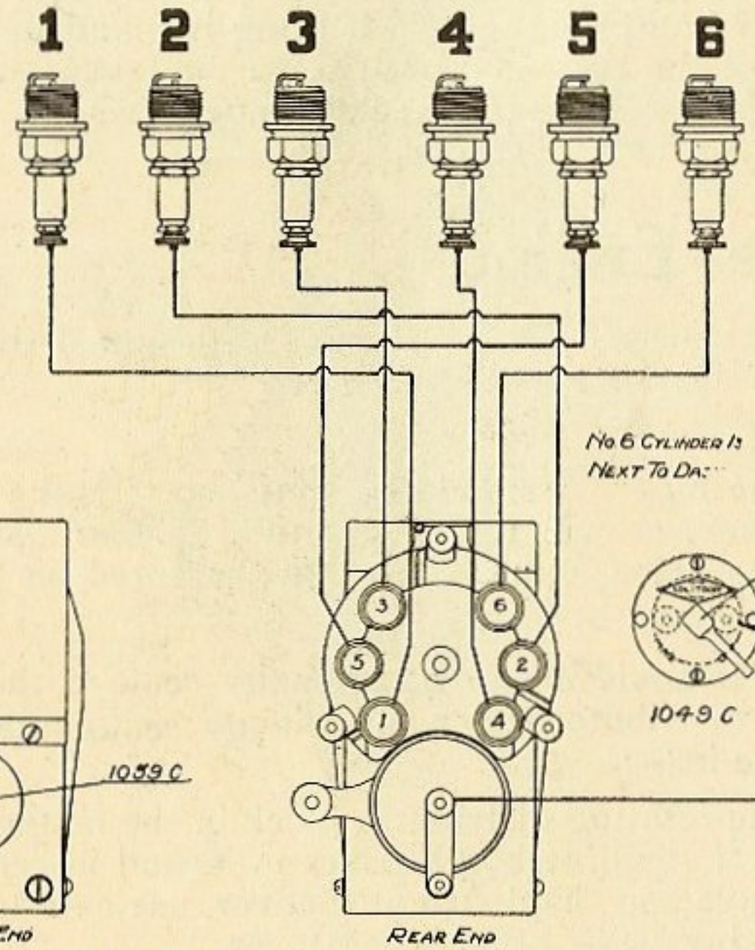
The high tension current is generated in the magneto itself, no outside sources of current being used, and is conducted from the distributor to the spark plugs through rubber-covered cables.

Whenever the distributor head is removed, use care in replacing it to see that the small carbon brushes which project from the side of the motor are not broken off.

If magneto fails to give sparks, first see if the inside of the distributor head has a streak of carbon from one contact point to another, worn from the carbon brushes. Wipe this off with a rag wet in gasoline, as it will short-circuit the instrument and prevent sparking. Then remove the cover over the circuit breaker and see if the platinum points are opening and closing properly as the engine turns over. The points should make a good contact when closed and should open about 1/64 of an inch. See that the contact points are not loose and that the circuit breaker arm moves freely on its pivot pin.

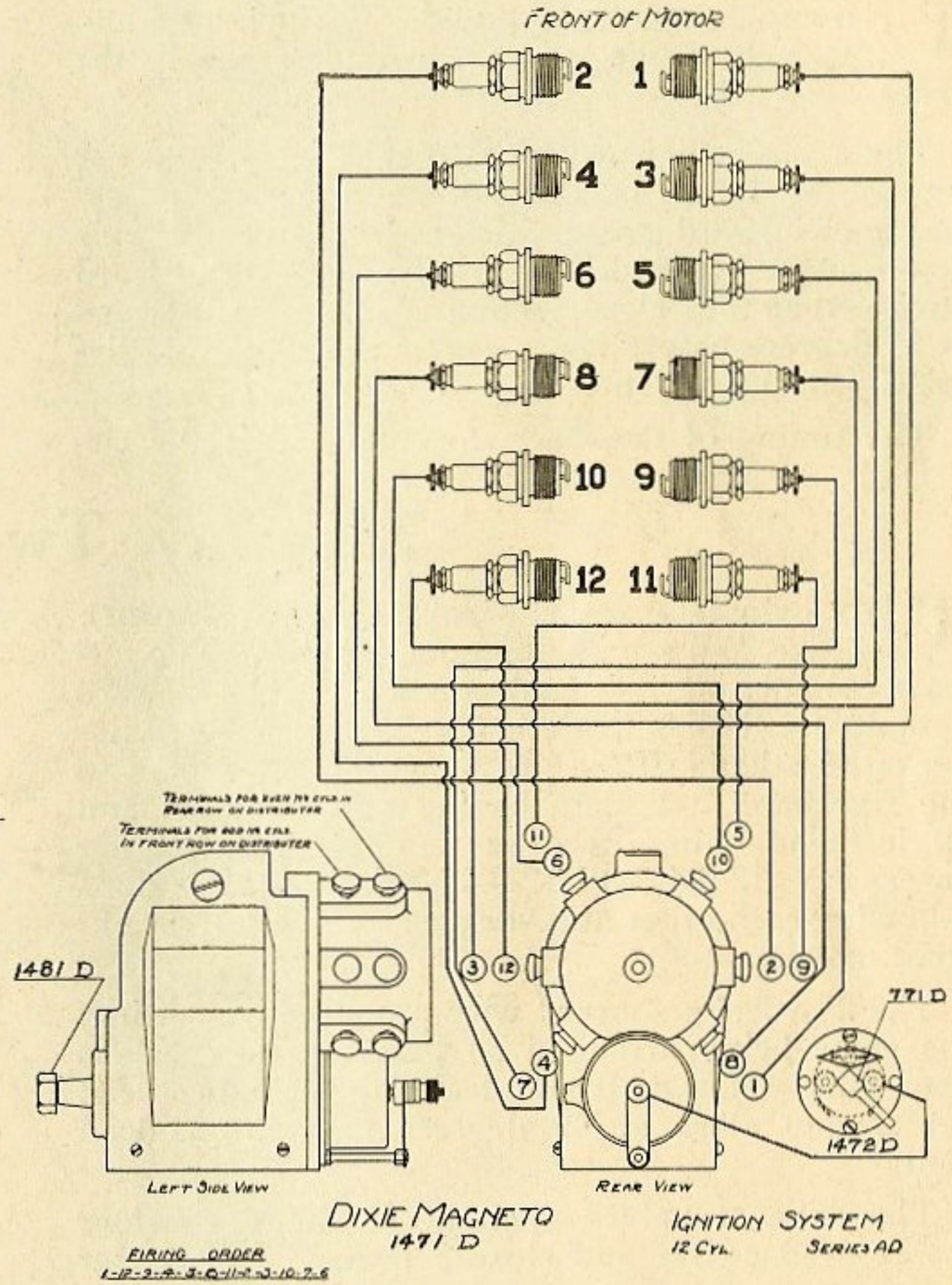
The sparking action of the magneto is stopped by connecting the single wire from the breaker box to the body and frame of the car through the switch 1049C or 1472D.

The gap in the spark plugs should be set between .025 inch and .030 inch.



Dixie Magneto
1048 C
Firing Order
1-5-3-6-2-4

Ignition System
6 Cyl. Series AC



Dixie Magneto
1471 D
Firing Order
1-12-2-4-3-8-11-6-5-10-7-9

Ignition System
12 Cyl. Series AD

Highway Six Engine

THE engine has six cylinders, 3½-inch bore and 5¼-inch stroke, and the cylinders fire in the order 1-5-3-6-2-4.

The cams, which work the admission valves, are set so the crank is about 5 degrees past center on the downward stroke when they open, and stands at an angle of 45 degrees past center on upward stroke when they close, while the exhaust cams open at 55 degrees before lower center and close at 5 degrees past upper center.

The timing of the magneto is such that the circuit breaker, at full retard, should open at about 1¼ inches before top center, as measured on the flywheel. The flywheel is marked with proper valve setting.

To tighten the connecting rod bearings requires the removal of the bottom half of the aluminum crankcase. This is easily accomplished by removing cap screws around its edge where attached to upper half of case. If a bearing is found too loose, one of the thin metal liners can be taken out, or if this proves to be too much, a paper liner can be substituted for a metal one.

Highway Twelve Engine

THE cylinders are 2¾-inch bore and 4¾-inch stroke, and are numbered as follows: The forward cylinder on righthand side is No. 1, the forward cylinder on lefthand side is No. 2, the second cylinder on righthand side is No. 3, etc. This results in all the righthand cylinders having odd numbers and all lefthand cylinders even numbers. The firing order is 1-12-9-4-5-8-11-2-3-10-7-6, the explosions following each other at 60-degree intervals of crankshaft movement.

The flywheel is marked with proper valve setting, the cams being arranged so that the inlet valves open when crankshaft is 5 degrees past upper dead center and close at 49 degrees past lower dead center.

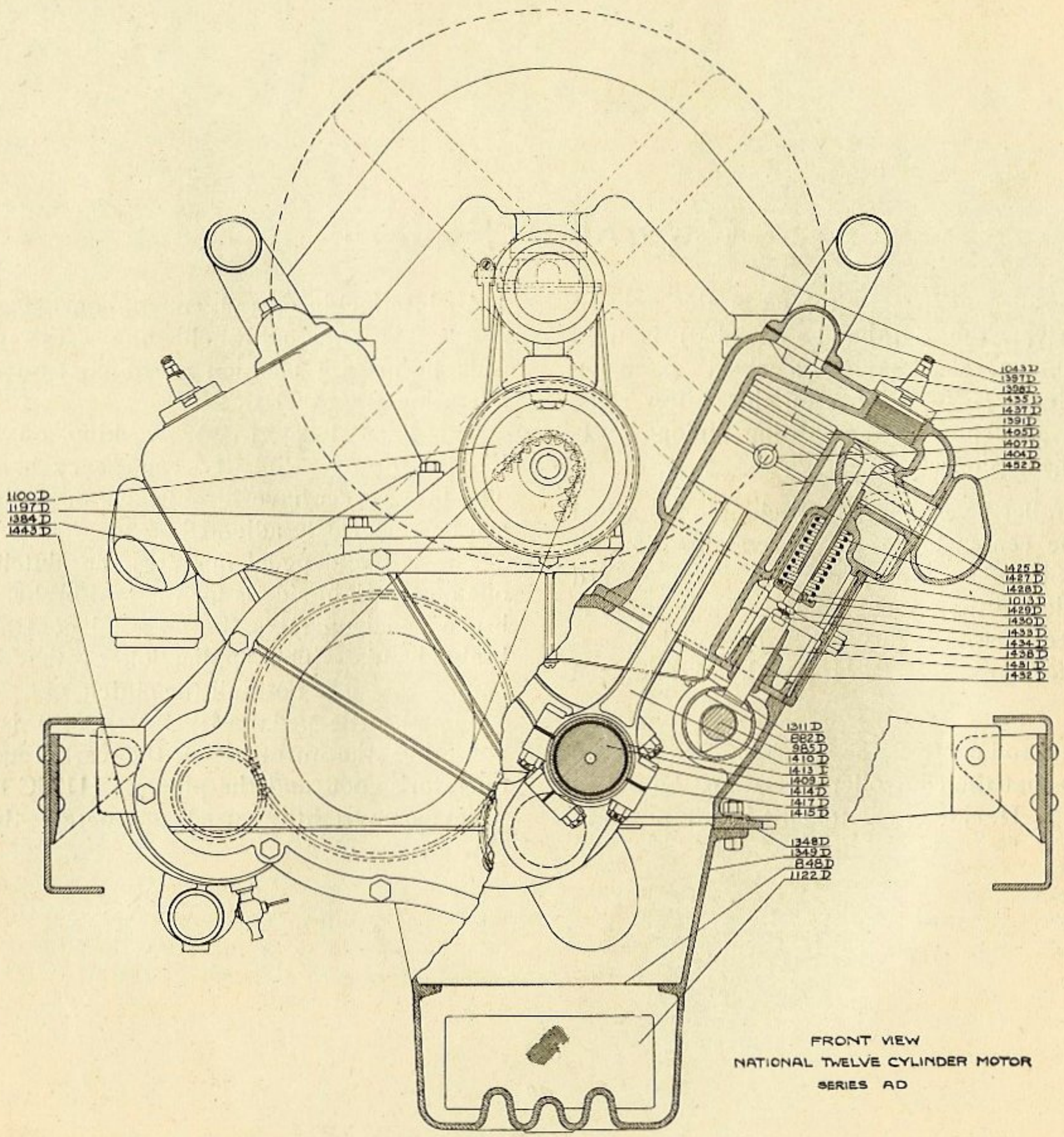
The exhaust valves open at 55 degrees before lower dead center and close 5 degrees past upper dead center. The cams are so designed that .004 inch clearance between valve stem and tappet will give the above timing.

The magneto should be timed so that the circuit breaker, at full retard position, should open 1½ inches before upper center, as measured on the flywheel.

It is advisable to occasionally remove the magneto distributor cover and wipe the carbon dust out of the inside.

The rotating distributor block in the magneto has several small carbon brushes in it, and in removing or replacing the distributor cover, use care to avoid breaking these brushes.

The bearings are adjusted in the same manner as those of the Highway Six engine.



FRONT VIEW
NATIONAL TWELVE CYLINDER MOTOR
SERIES AD

Controller System

OF the two hand levers situated at the right of the driver, the righthand one (490) is used for changing speeds, having a short extension lever, which works in notches on the shifter rods, these being connected to the shifting pinions (521-522) in transmission case.

The controller lever works by rocking on a swivel support, the center being the neutral position, in which all of the gears are out of mesh. The forward L. H. position is the reverse; rear L. H. position is the first speed forward; forward R. H. position, second speed forward; rear R. H. position, high speed forward.

One shifter rod controls the reverse and first speed forward, so that the controller lever must be pulled toward the L. H. side of car to shift it into notch in this shaft.

An interlocking arrangement, consisting of a ball and socket, effectually holds one of the two sliding rods in neutral position when controller lever is operating the other one.

The hand lever (538), working on a ratchet is used for operating the emergency hand brakes. The brake rods have turnbuckles on them, so they can be very easily adjusted.

The lefthand pedal operates the clutch, and the one on the right side is for the foot brake. The foot brake pedal operates the external contracting hub brake bands. The application of the emergency hand brake does not pull the clutch.

The throttle pedal (419C or 433D) is used for operating the throttle on the carburetor by the operator's foot, and the plunger (1175C or 1540D) to extreme right is used to operate the electric starter.

Steering

THE steering wheel (395) operates an adjustable steering chuck (385), consisting of a worm gear and sector; the shaft of sector has a steering arm (374) attached to its outside end. The latter connects by a ball and socket jointed fore and aft rod (110) to the arm on the left steering knuckle (81).

A cross-connecting rod (183) ties the steering knuckles together. Care should be used to see that the connections on these rods are kept adjusted and the nuts and bolts are tight. The housing of the steering chuck should be kept packed with grease and a few drops of oil added occasionally.

The bolts holding springs and other parts are secured with nuts and cotter pins and should be gone over occasionally to see that they are tight, there being much less wear on a tight than a loose bolt.

Rear System

THE rear system should require but little attention. It is well to jack up occasionally, ~~able steering chuck (358), consisting of a worm~~ after unbolting the flange (171) and pulling out the inner splined axles (159), examine the adjustment of the wheels and their roller bearings (14), which run on the outer ends of the axle casing (120). The bearings of each wheel are held on by two nuts (22) on the ends of the tubing and have a lock washer (23). These nuts should be kept tight. Every few months the wheels should be taken off entirely, the bearings examined and repacked with light cup grease. The bearings should be adjusted with a slight amount of play.

To remove the bevel gear and differential it is necessary to take off the rear cover (134) and the two caps (125), holding the differential bearings in the gear case and withdraw the two inner axles (170).

To adjust the pinion which meshes with the bevel gear in rear axle, it is necessary to remove the long, narrow cover (148) held by two cap screws on the upper side of front portion of rear axle. Inside of this you will find a large slotted adjusting nut (141), which can be turned after loosening clamp bolt (151) until the pinion has the correct adjustment in the gear. The gear can be adjusted slightly sidewise by the adjusting nuts (128) at each end of the hub of the differential. There are adjusting nuts at the front end of pinion shaft (144), which are only to be used in adjusting the tapered roller bearing. A very slight amount of end play should be allowed on these tapered bearings. If they are adjusted too tight, they are liable to cause trouble.

The Clutch and the Transmission

BOTH the main and the countershafts of transmission should be examined occasionally, to see that the ball bearings are in good condition. The case should be cleaned occasionally by removing the drain plug in the bottom and flushing with gasoline, then refilling with a mixture of good, heavy grease.

The speed reductions within the transmission are as follows:

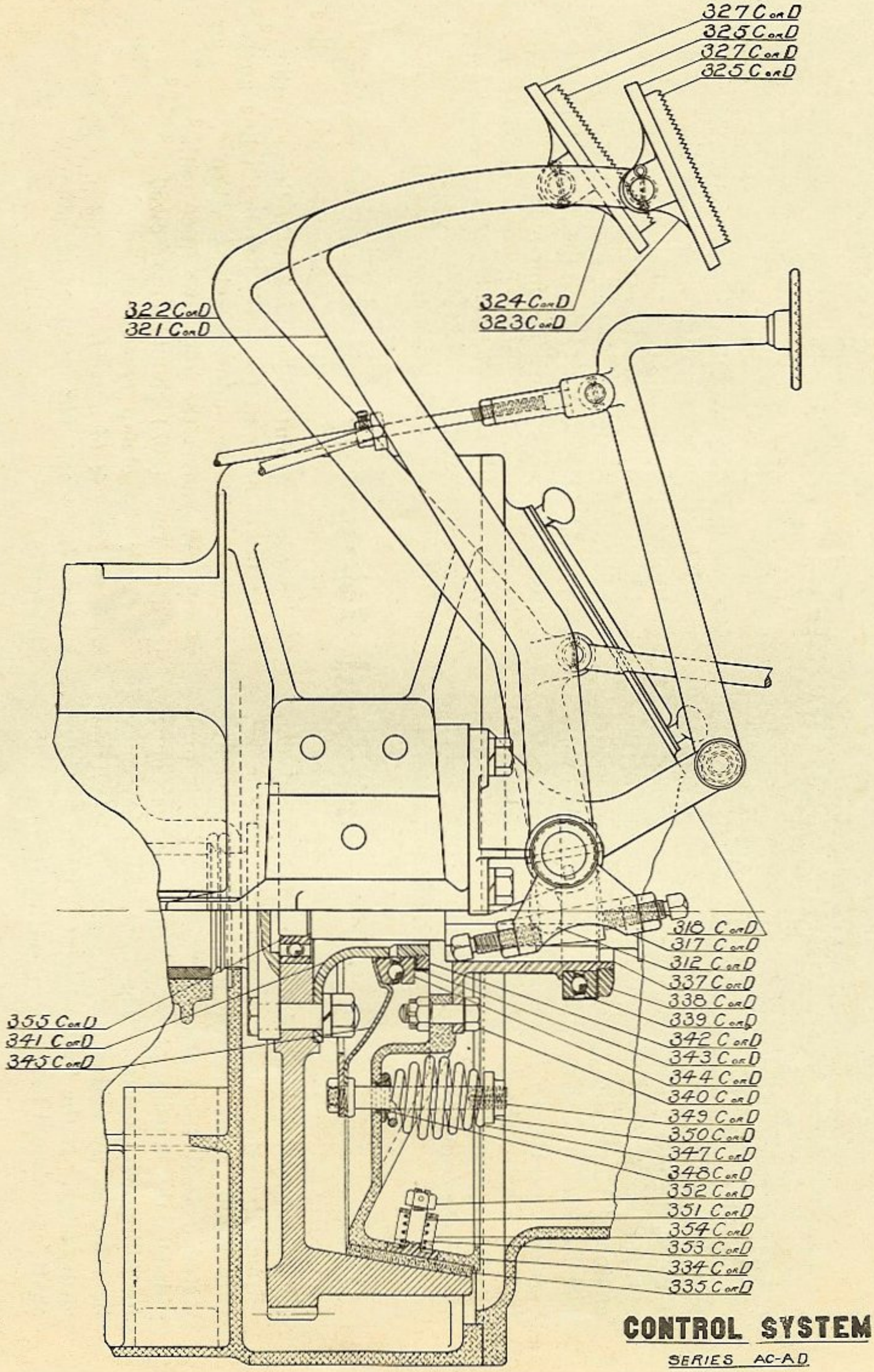
First speed forward, 1 to 3.65.
Second speed forward, 1 to 2.0.
Third speed forward, 1 to 1 (direct drive).
Reverse, 1 to 4.77.

The standard ratio of the driving gears in the rear system is 12-53 on the Highway Six; 12-55 on the Highway Twelve.

The cone clutch which drives the car, with the exception of being oiled occasionally, should require very little attention. Should it show a tendency to slip at any time, see that the clutch is properly engaging, and that the clutch pedal is not holding it out by touching the floor. If the pedal touches the floor, it may be lowered by the adjuster (317). If the clutch continues to slip after it is found that it is properly engaging, tighten the spiral springs (347), which is accomplished by turning the adjusting nut (350). If the clutch still slips, it is possible that the leather has worn so that the clutch goes into the flywheel too far and rests against the clutch spring spider (345). In this case, it is necessary to replace the leather or to increase the diameter by placing a heavy paper lining between the leather and the aluminum cone.

Inspect the clutch ball thrust bearing and clutch hub occasionally and if they appear dry add a few drops of oil. These points are ordinarily supplied with oil from the transmission through holes drilled in the shaft and if they show a tendency to run dry a softer grade of grease should be used in the transmission.

The face of the clutch cone is covered with leather, under which are six spring plungers (351) which prevent the clutch taking hold too suddenly. These plungers have an adjusting nut (352) which should be so set that the plungers move only 1/64 inch when the clutch is released. The leather facing of the clutch should last at least a year, and may be replaced when necessary by removing the clutch.



CONTROL SYSTEM

SERIES AC-AD

Cooling System and Air Pump

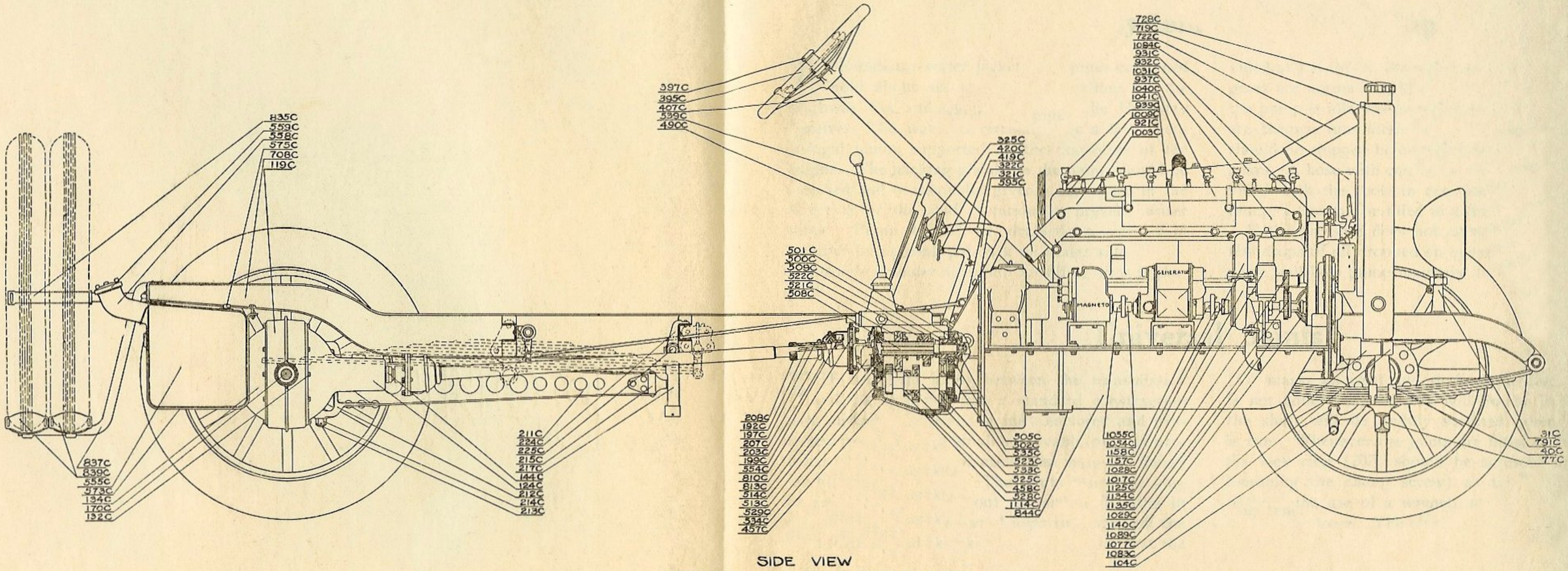
THE radiator water jackets and pipes combined hold about six and one-half gallons on the Highway Six and eight gallons on the Highway Twelve. The water is circulated by a large centrifugal pump, supported on the crankcase of the engine. The packing glands on the pump should be watched and occasionally given a few turns in the direction of the shaft rotation to prevent water leaks. Pump should be drained in very cold weather by opening pet-cock on under side.

A single cylinder air pump for filling tires is provided and is driven through a pair of gears. These gears are normally held out of engagement, so that the pump is idle, except when used to fill tires, and are thrown into mesh by a small lever. Engine should be stopped before attempting to mesh these gears. A hose with connection for tire valve is provided with the tools in car, and, by attaching to pump, a tire can be filled in a few moments.

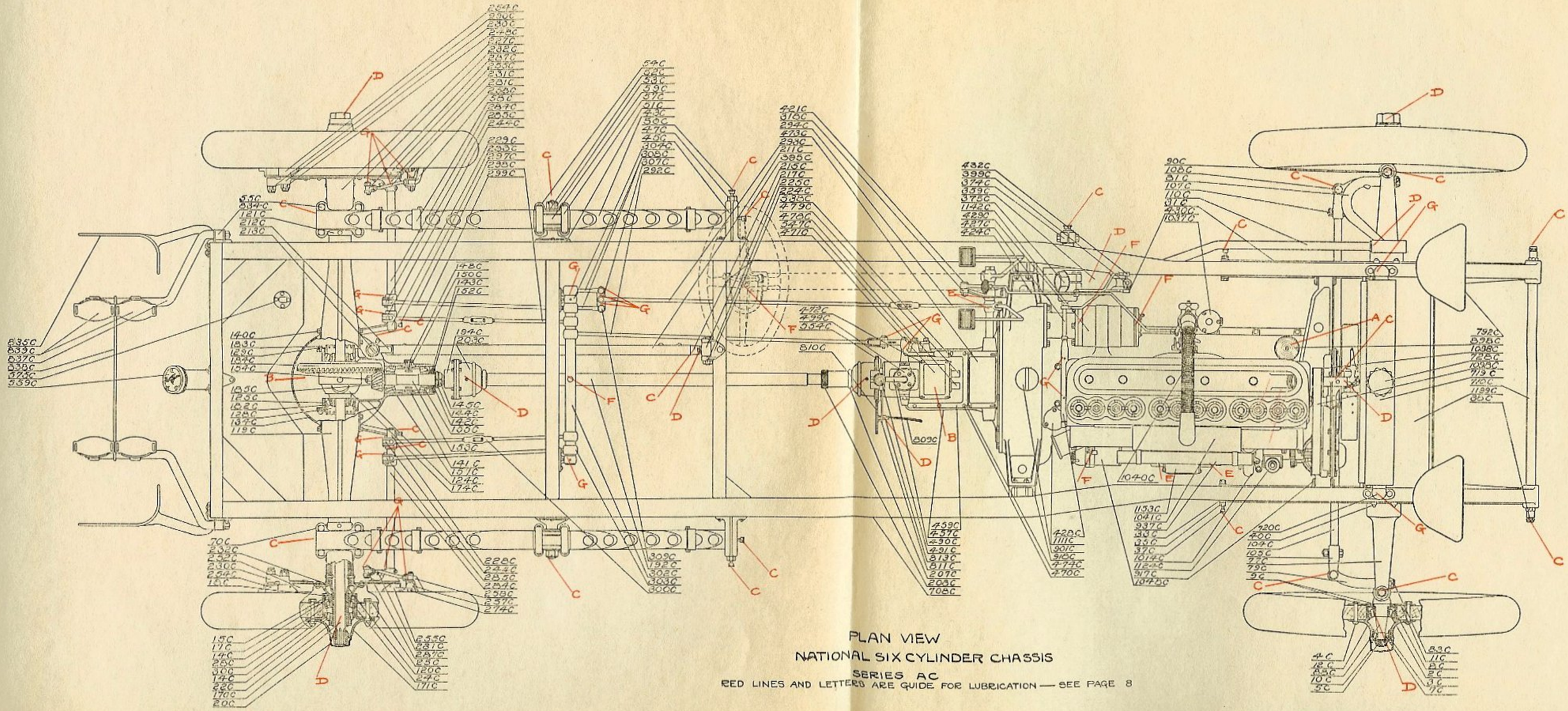
If the pressure does not come up sufficiently, a few drops of oil dropped on openings of pump inlet valve will help pump maintain its compression.

Universal Joints

THE universal joints between the transmission and the rear axle are a standard construction with sliding joint and are fully enclosed and protected from dirt. A small removable plug is provided in the housing of each joint near the flange for filling with grease. The joints and shaft may be removed by taking out the six small bolts in each flange. If the forward joint is slipped off the shaft, care should be taken in putting it on that the "O" marks on joint and shaft are in line. If this is not done the joint pins will not be in line and the shaft will be unduly strained when the car is run. Whenever the joints are filled with grease, the lock ring (207) should be screwed up (after loosening the clamp screw) as tight as possible without the use of a wrench, so that the packing will not be loose. The clamp screw should then be tightened.



SIDE VIEW
NATIONAL SIX CYLINDER CHASSIS
SERIES AC

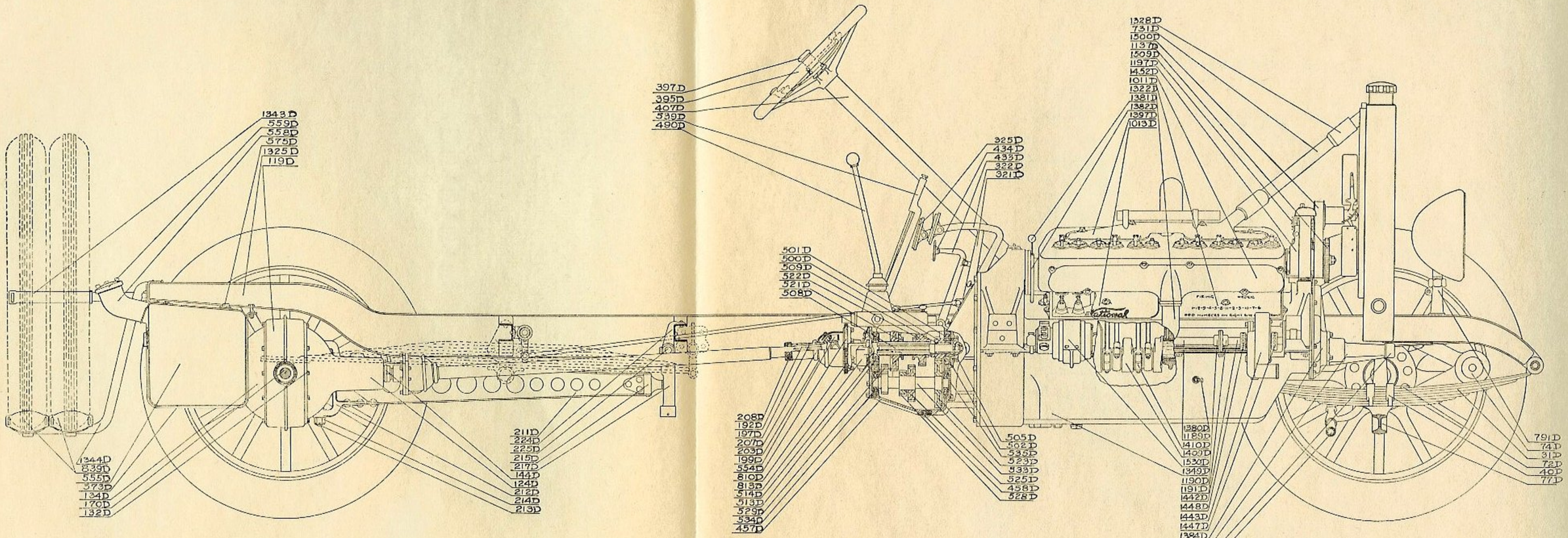


PLAN VIEW

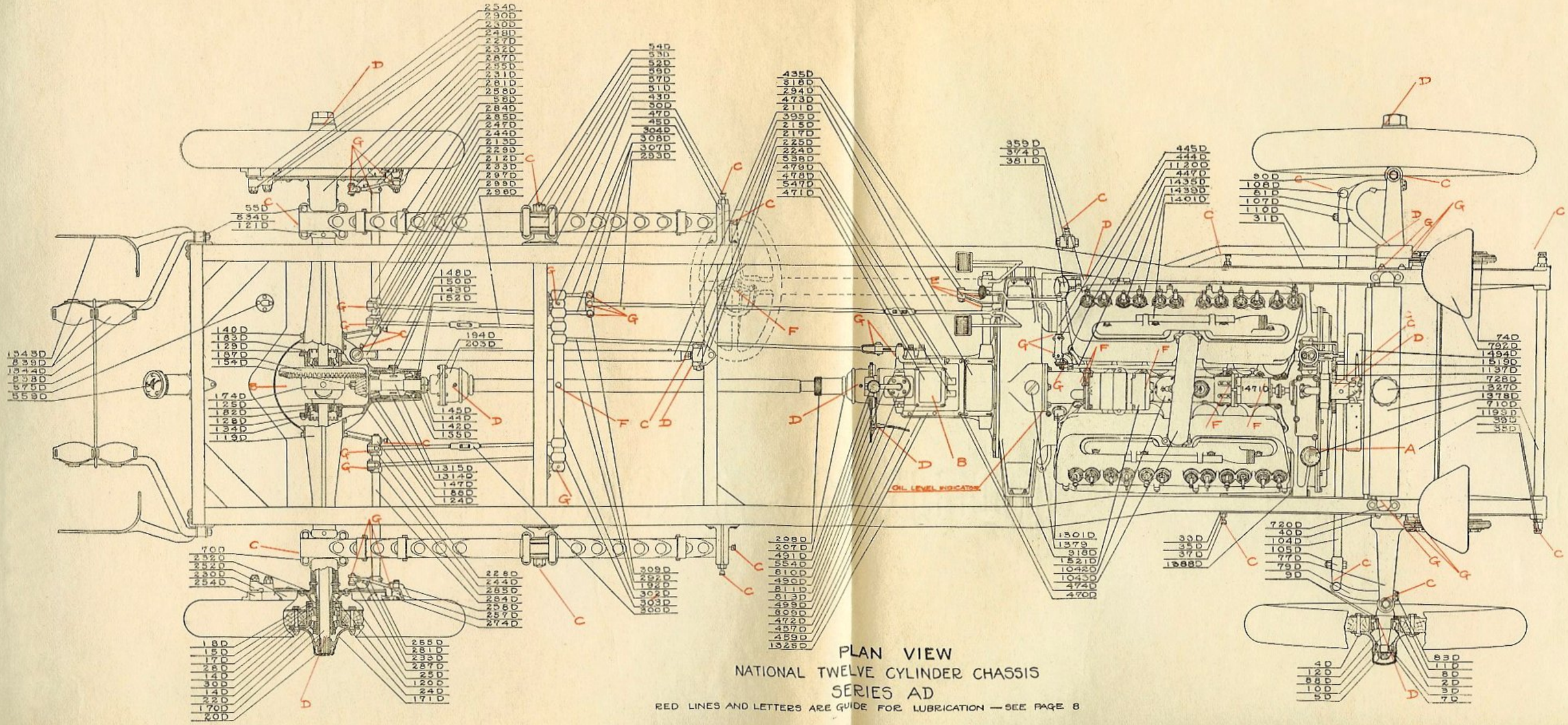
NATIONAL SIX CYLINDER CHASSIS

SERIES AC

RED LINES AND LETTERS ARE GUIDE FOR LUBRICATION — SEE PAGE 8



SIDE VIEW
NATIONAL TWELVE CYLINDER CHASSIS
SERIES AD



PLAN VIEW

NATIONAL TWELVE CYLINDER CHASSIS

SERIES AD

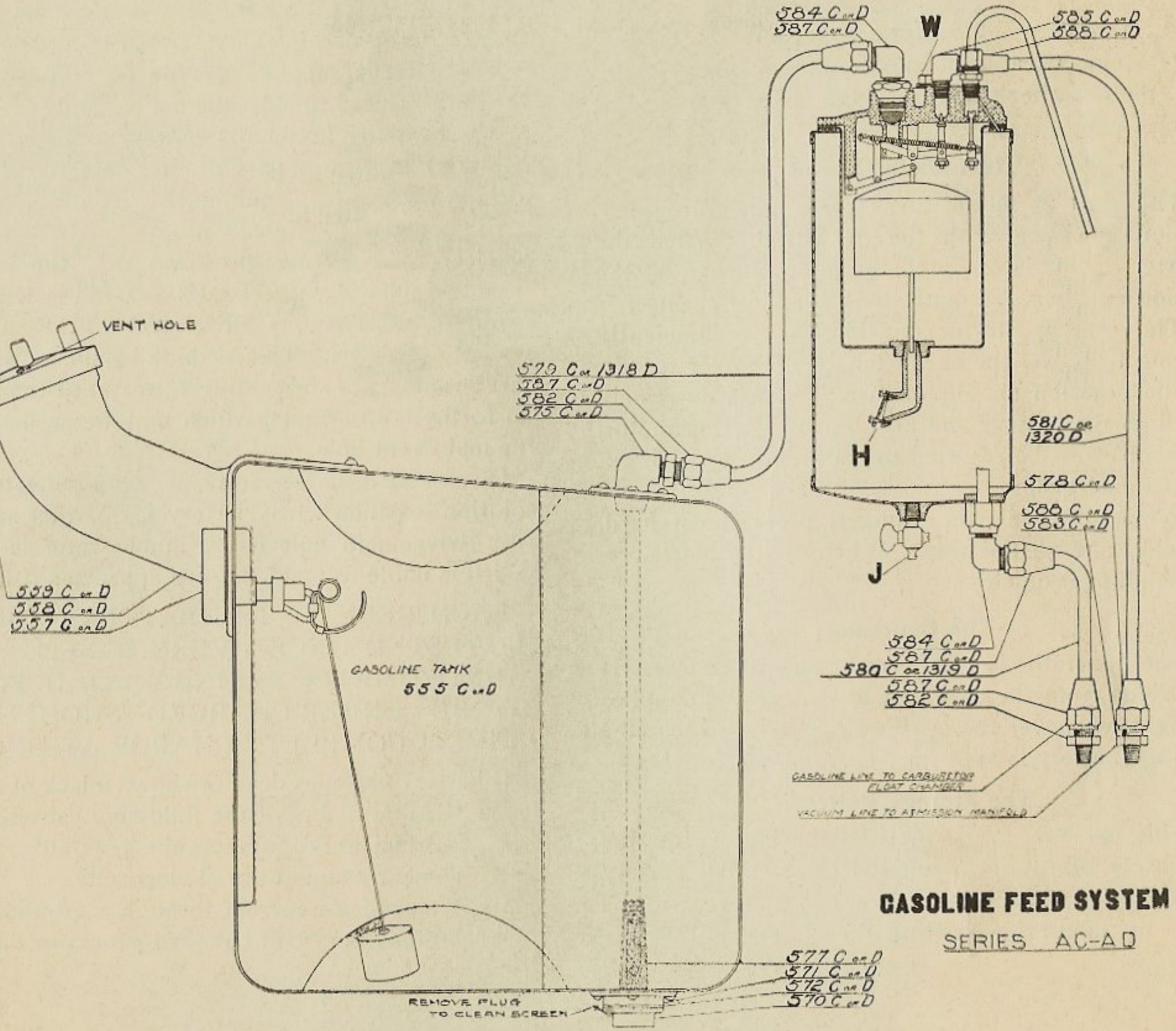
RED LINES AND LETTERS ARE GUIDE FOR LUBRICATION — SEE PAGE 8

Gasoline System

GASOLINE is supplied to the carburetor from the vacuum tank on the dash. When fuel is used down to a certain level in the vacuum tank, a float opens a valve which leads to the inlet passage. The inlet passage is always under a vacuum when the motor is running, due to the suction of the pistons, and this vacuum draws fuel from the tank in the rear of the car until the inner vacuum tank is filled to a certain high level, when the float closes the vacuum valve and opens the inner tank to the atmosphere, which allows the gasoline to run into the outer tank. The carburetor is fed from the outer tank by gravity.

It is very unlikely that it will ever be necessary to open the tank; but, if it is opened, use care to prevent damaging the shellaced gasket under the head, as this joint must be airtight. If the tank has become empty, close the carburetor throttle and use the starter for a few revolutions, which will create sufficient vacuum to fill the tank. If the tank does not fill easily, the trouble may be caused by dirt or sediment under the flapper valve H. Remove the plug W and pour a little gasoline into the tank, which will wash the dirt away and allow the tank to work. This flapper valve sometimes gets a black carbon pitting on it, which holds it from the seat. In this case, the valve should be scraped with a knife. It is a good plan to flush the tank, as above, every three months, whether it seems to need it or not. At the same time, open pet-cock J in bottom of tank to let out any sediment or water which may have collected there.

If the vacuum tank fills up with gasoline so high as to run through the vacuum line into the manifold, the trouble is probably due to a leaky float which will not operate the valves. In this case remove the plug W, which relieves the vacuum, and run until the gasoline in the vacuum tank is exhausted. Then replace the plug W for a few moments, to fill the tank again. You can thus reach a place where the leaky float may be repaired.



GASOLINE FEED SYSTEM

SERIES AC-AD

Electrical Equipment

THE electrical system consists of the starting motor, the generator, the battery and the lamps.

The Starting Motor.

The starting motor turns the engine through a pinion engaging with the fly wheel. When the starter switch is operated the motor turns and the pinion engages automatically with the fly wheel.

The electric starter on this car is sufficiently strong to propel the car in one of the lower speeds, if the occasion should require. This is extremely hard on the battery and also on the starting motor, so should not be resorted to except in a case of extreme emergency.

When using starter plunger, press down hard, quickly and all the way. When engine starts, release plunger quickly.

The Generator.

The generator is on the right side of engine. It is driven from the camshaft by a gear and supplies current whenever the engine is running, so that the storage battery is kept fully charged.

The Storage Battery.

This is a 6-volt 95-ampere hour battery on the Highway Six, and a 6-volt 100-ampere hour battery on the Highway Twelve. It supplies current to the starting motor for starting the engine and to the lamps when the engine is not running.

The current supplied by the generator replaces the current used to start the engine and to keep the lamps burning, keeps the battery charged and in addition evaporates part of the water in the electrolyte, which is the liquid in the battery cells. This action cannot be avoided and will result in the level of electrolyte getting too low unless the evaporation is replaced by ADDING DISTILLED OR CLEAR RAIN WATER TO THE CELLS EVERY WEEK. This is done by unscrewing the three vent plugs and adding water until the level is up to the bottom hole, which may be seen through the main vent hole.

Do not fill cells above inside or bottom hole, as solution expands when battery is charged and will rise above main hole if too much water is added, which is liable to make battery appear as if leaking.

EACH CELL OF THE BATTERY SHOULD BE TESTED ONCE EVERY MONTH WITH A HYDROMETER SYRINGE AND IF FOUND TO BE UNDER-CHARGED SHOULD RECEIVE A COMPLETE CHARGE AT ONCE.

If battery becomes dead or shows a lack of energy it may be due to any of the following causes:

1. Insufficient output from the generator.
2. Too extravagant use of electricity.
3. A leakage of current through a ground.
4. A break in circuit between generator and battery.

First, ascertain if generator is giving its proper output, which for this car should be 11 amperes or more when car is running 15 miles per hour, no lamps burning.

If the generator is shown to have its rated output, then stop your engine to ascertain if there is any leakage of current. When engine is still, if the ammeter shows current flowing from the battery, no matter how little, examine the wiring, lamp connections or other circuits for a ground.

One cause of generator not giving its rated output may be due to the commutator becoming blackened. This is not liable to happen often, but when it does the generator should be removed from car, the brush caps taken off the back end and the commutator sandpapered and polished bright.

Complete instructions will be found in the separate instruction book for starter.

The lamps are of the following sizes and may be bought from this description:

Headlight, 15 candlepower, 2-inch bulb.
Dimmer, 6 candlepower, 1-inch bulb.
Dash lamp, 2 candlepower, ¾-inch bulb.
Tail lamp, 4 candlepower, ¾-inch bulb.

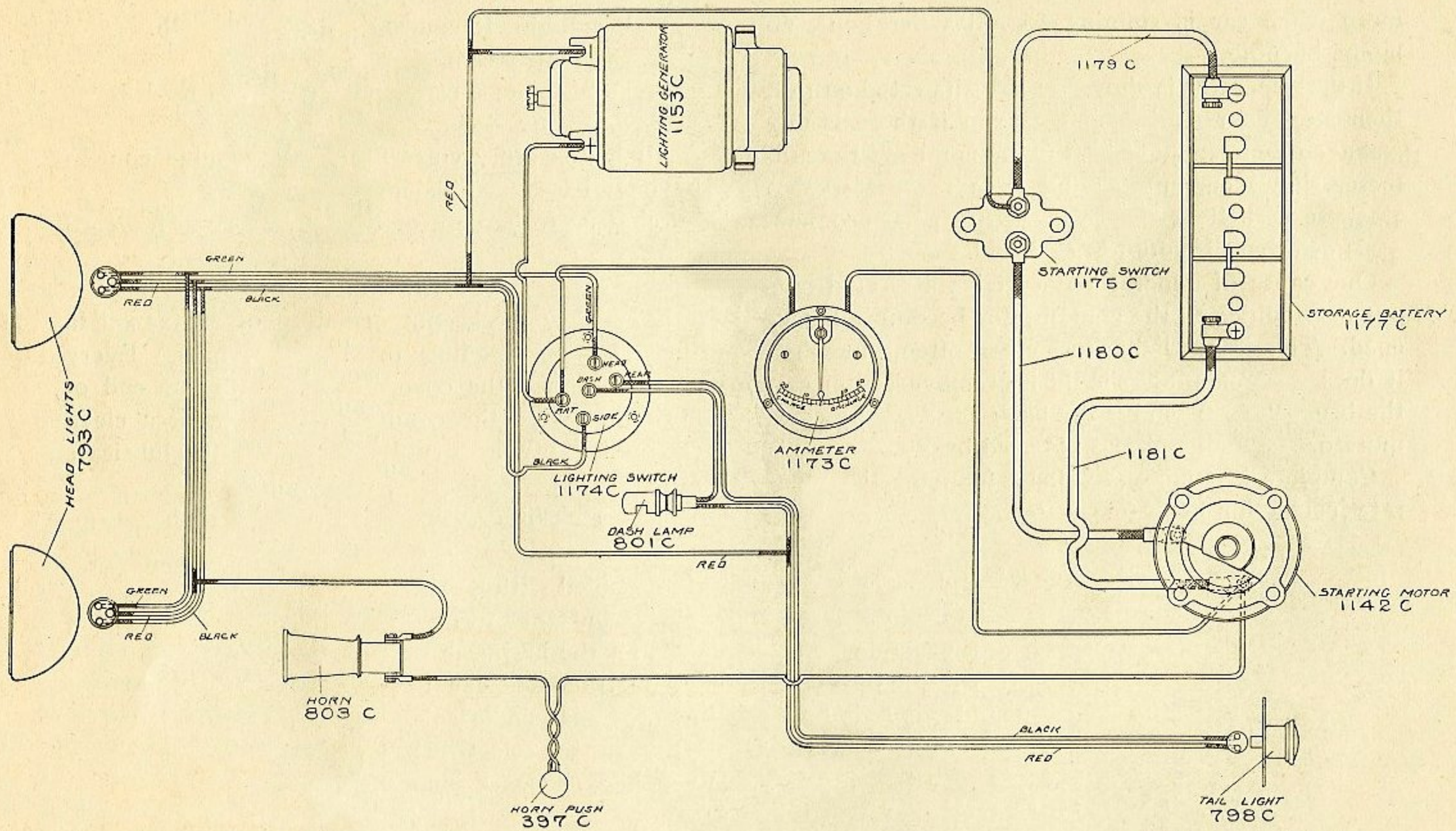
All lamps are 7-volt lamps with double contact bayonet bases. This information is necessary in purchasing to be sure of the correct lamp for each place.

The Electric Horn.

Every few weeks put one drop of engine oil in the oil tubes leading to shaft bearings. Every month remove the cover plate at the rear end of horn and wipe the commutator dry with a clean rag and apply a very little vaseline to lubricate same.

Too much oil or vaseline will cause trouble.

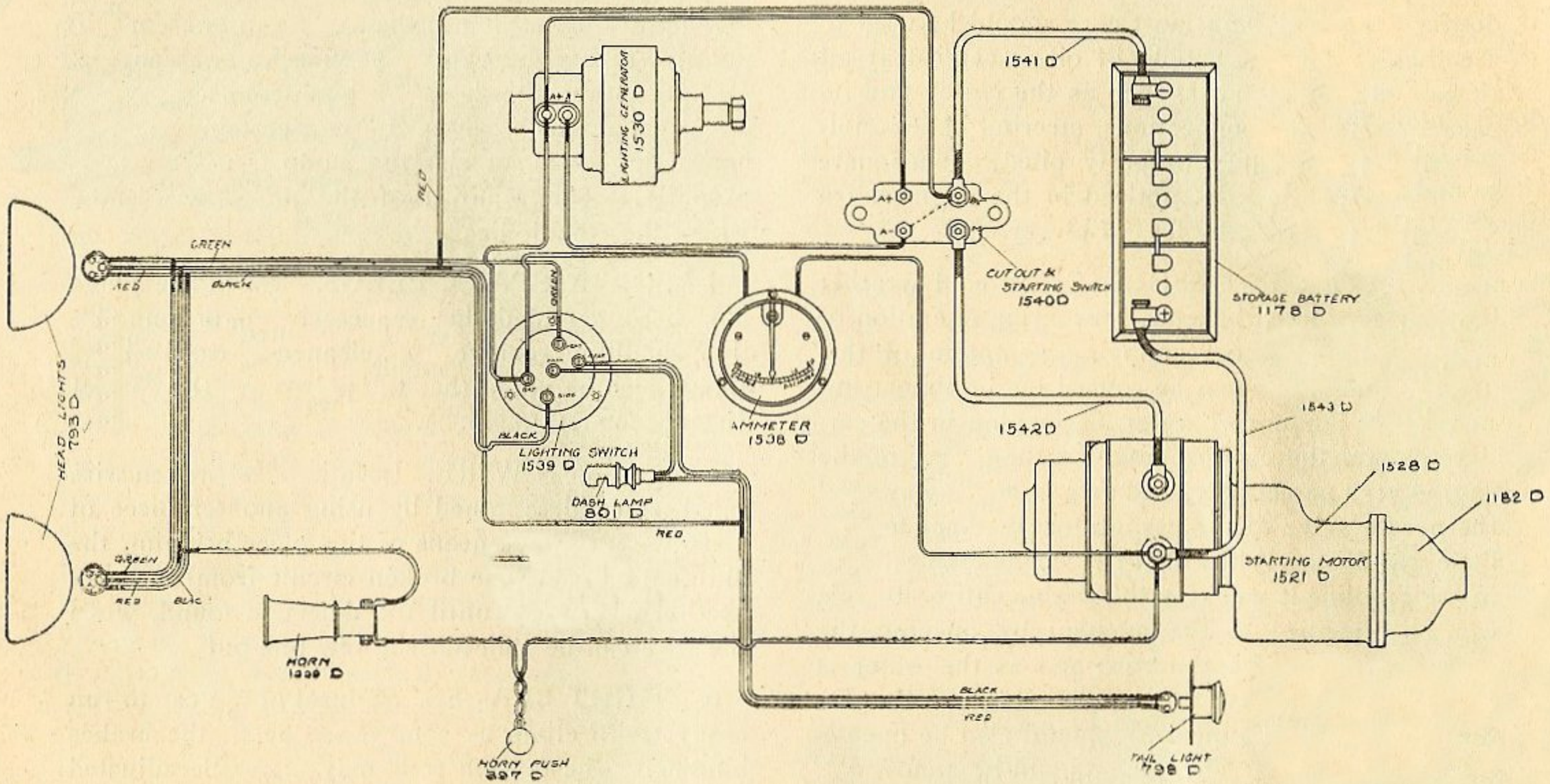
The twelve cylinder motor is provided with a drip pan and drain passage under the carburetor to carry off any gasoline that may fall from the carburetor. If this drain passage becomes obstructed, clean it out and wipe up any gasoline that may have collected, as otherwise a spark from the electrical equipment might set fire to it and cause serious damage



WESTINGHOUSE

STARTING & LIGHTING SYSTEM

SERIES AC



WESTINGHOUSE
STARTING & LIGHTING SYSTEM
SERIES AD

Troubles and Their Remedies

1. INADEQUATE LUBRICATION is most detrimental, and the utmost care should be used to see that the proper supply of oil is carried at all times and that all parts, such as the clutch and its bearings, steering connections, steering chuck, universal joint, etc., are properly oiled. Inadequate lubrication can be first noticed in the engine by a knocking sound and by loss of power.

2. WATER IN GASOLINE. In cold weather it will freeze in carburetor, preventing operation of the same. The most annoying symptom of this trouble, and which can be caused by an almost imperceptible amount of water, is popping in the carburetor and the cutting down of the power of the engine very perceptibly, and acts in every way as if the needle valve of the carburetor were set for too little gasoline. When there is considerable water in the gasoline it will stop the engine entirely. This can be remedied at the moment by opening the cock at bottom of carburetor, and as the water is heavier it will drain out first. The plug (570C or D) directly under gasoline tank should also be opened for a few seconds. This plug should be removed at least once every 30 days and the strainer taken out and cleaned. The only complete remedy, however, is a new supply of gasoline, which should be poured through a chamois skin.

3. LACK OF WATER CIRCULATION. This will cause the engine to heat very materially, lose its power and begin to knock. It can be seen by looking in the opening in the top of the radiator and noting whether the water is flowing from the engine. If not, either the hose or pipe connections are stopped up, which can easily be ascertained by disconnecting them, or else the pump is not working properly. The removal of the pump will show where the trouble lies.

4. SOOTY SPARK PLUGS. When the plugs have become fouled, due to excessive oil or long use, they should be removed and cleaned in gasoline. It should also be noted that the points are the correct distance apart(1/32 inch)

5. BROKEN WIRE. Location of a broken wire can best be determined by using another piece of loose wire, and by means of this piece bridging the different parts of the broken circuit from one connection to another until the defect is found, when the wire can be spliced or a new one put in.

6. TIGHT BRAKES. Refusal of the car to run easily or to climb hills may be due to the brakes binding. The tension rods may easily be adjusted to prevent this.

7. LOSS OF COMPRESSION, which very materially reduces the power of the engine, can readily be ascertained by turning the engine over by means of the crank, and trying each cylinder separately, with the relief cocks on the others opened. This

loss will, in all probability, be due to the valves not seating properly, due to their being covered with soot. This can be remedied by removing the valve caps and washing the valve seats and stems with kerosene; or, if they still refuse to seat, they should be ground with emery, turning the valve with a large screwdriver or brace placed in slot in its top. The ports of the engine during this operation must be closed with waste to prevent the emery getting into the cylinders. A loose valve cap or spark plug will often cause loss of compression.

8. BACK-FIRING. When an engine back-fires into the carburetor, either it is not getting sufficient gasoline, due to the needle valve not being properly set or obstructed or else to an admission valve sticking. The sticking of admission valve will be found due either to its having become sticky with soot(which is readily cleaned with kerosene), to a bent stem, or else to a weak spring. The spring can easily be removed by taking out the cross-pin which holds it and withdrawing the valve. Back firing may be due to water in gasoline.

9. KNOCK IN ENGINE. This will generally be caused by carbon in cylinders, the remedy for which is to remove the cylinders and scrape out the carbon, both from cylinders and top of pistons. A loose bearing on connecting rod may also cause a knock. A slight knock may be heard if one of the valve lifters is not adjusted properly.

10. BROKEN SPRINGS. Experience has shown that the breaking of springs is due almost entirely to loose spring clips (40 and 57). Spring clip nuts should be drawn up tightly once every couple of months.

11. MAGNETO TROUBLES. Faulty ignition may be caused by a streak of carbon dust from one contact point to another on the inside of the distributor head, which is generally caused by oil. Wipe off the inside of the distributor with a cloth dampened in gasoline and allow the gasoline to dry off before replacing the distributor head.

In removing and replacing the distributor head, be careful not to break the small carbon brushes in the rotating piece. Remove the cover of the breaker box and see that the breaker arm moves freely on its pivot pin and that the platinum points make good contact and separate the correct distance (1/64 inch). This distance may be corrected by adjusting the contact screw. See that the screws holding the stationary anvil supporting the contact point are not loose.

12. TWELVE CYLINDER OILING SYSTEM. In case proper oil pressure is not indicated on gauge when you have a full supply of oil in the tank, clean the oil screen by removing the drain plug in bottom of oil pass and using a small brush. The oil pan should be removed occasionally and both screens cleaned thoroughly.

List of Parts for Series AC Highway Six and Series AD Highway Twelve

To avoid confusion, follow instructions carefully. Please give both number and name of part when ordering, also number of car found on name plate on frame. When ordering parts of engine, give number of engine found on name plate on crankcase of engine, also car number. Part numbers for Highway Six cars are followed by the letter C, while part numbers for the Highway Twelve are followed by the letter D. A great many of the part numbers in this list are given with both letters and, in ordering, that letter should be used which applies to the car in question.

FRONT WHEELS.

1C or D Front wheels with Firestone Felloe Bands, without tires and bearings. (Specify rims and size of tires.)
2C or D Inside front wheel bearing (Bock No. 418).
3C or D Outside front wheel bearing (Bock No. 235).
4C or D Bolts for holding spokes to hubs.
5C or D Nut for spindle of knuckle.
7C or D Washer for spindle of knuckle.
8C or D Felt dust washer.
9C or D Felt dust washer retainers, thick and thin.
10C or D Front hub dust cap.
11C or D Flange for front wheel hubs.
12C or D Hubs for front wheels.

REAR WHEELS.

13C or D Rear wheels with Firestone Felloe Bands, without tires and bearings. (Specify rims and size of tires.)
14C or D Rear wheel bearings (Bock No. 375).
15C or D Felt dust washer.
17C or D Felt dust washer outer retainer.
18C or D Felt dust washer inner retainer.
19C or D Felt dust washer retainer lock wire.
20C or D Rear hub caps.
21C or D Rear hub gaskets.
22C or D Lock nuts for rear wheels.
23C or D Rear wheel lock nut washer.
24C or D Rear wheel hubs.
25C or D Brake drums.
27C or D Brake drum bolts.
28C or D Rear hub bolts with nuts.
29C or D Rear hub bolt locks (steel stamping).
30C or D Rear hub bolt cap nuts.

SPRINGS AND CONNECTIONS.

31C or D Front springs, 38″x2″.
32C or D Bracket for rear end front spring.
33C or D Links for front springs.
34C or D Rebound clips complete (front springs).
35C or D Spring bolts, rear end front springs.
37C or D Front spring rear bolt grease cup.
38C or D Front spring front bolt grease cup.
39C or D Front spring grease cup lock washer.
40C or D Front spring clips.
41C or D Front spring seat pad.
42C or D Sheet steel clip holder for front spring.
43C or D Rear cantilever spring, complete with attaching pad for Six Passenger, 50″x2¼″.
44C or D Rear cantilever spring, complete with attaching pad for Roadster, 50″x2¼″.
45C or D Cantilever spring bracket (front end spring).
47C or D Cantilever spring bracket bolt.
48C or D Cantilever spring bracket shackle.
49C or D Cantilever spring bracket shackle bushing.
50C or D Cantilever spring bracket shackle bolt (with grease cup).
51C or D Cantilever spring hanger (center of spring).
52C or D Cantilever spring hanger washer.
53C or D Cantilever spring hanger nut.
54C or D Cantilever spring hanger spring seat.
55C or D Rear axle spring pad bolt.
57C or D Cantilever spring clips with nuts for hanger.
58C or D Rebound clips complete, cantilever springs.
59C or D Cantilever spring center plate.
70C or D Rear spring seat pad.
71C or D Grease cup for cantilever spring hanger spring seat.
72D only Lower front shock absorber bracket, R. H. or L. H.
73D only Upper front shock absorber bracket, R. H. or L. H.
74D only Shock absorber, R. H. or L. H.

FRONT SYSTEM.

75C or D Front axle complete, with steering knuckles and cross connecting rod.
77C or D Front axle center I beam, forging only (machined).
78C or D Right steering knuckle, complete with arm.
79C or D Right steering knuckle arm with nut.
80C or D Left steering knuckle, complete with arm.
81C or D Left steering knuckle arm with nut.
82C or D Steering arm bushings.
83C or D Steering arm nut.
84C or D Steering arm Woodruff Key (No. 13).
85C or D Steering arm ball.
87C or D Steering arm ball castle nut.
88C or D R. H. steering knuckle only.

89C or D L. H. steering knuckle only.
90C or D King bolt through steering knuckle.
91C or D King bolt upper bushing.
92C or D King bolt lower bushing.
93C or D King bolt taper pin.
94C or D King bolt steel dust washer.
95C or D Steering knuckle thrust ball bearing complete.
97C or D Steering knuckle thrust ball bearing upper race.
98C or D Steering knuckle thrust ball bearing lower race.
99C or D 5/16" balls for steering knuckle thrust bearing.
100C or D Steering knuckle felt washer.
101C or D Steering knuckle felt washer retainer.
102C or D Grease cup for king bolt.
103C or D Cross connecting tube, complete with yoke ends.
104C or D Cross connecting tube.
105C or D Cross connecting tube yoke.
107C or D Cross connecting tube yoke bolt with nut.
108C or D Cross connecting tube bolt with nut (through steering arm).
109C or D Cross connecting tube bolt grease cup.
110C or D Ball rod from steering chuck to axle complete.
111C or D Slotted adjusting screws, in ball rod ends.
112C or D Ball sockets in ball rod ends.
113C or D Spring in ball rod ends.

REAR SYSTEM.

Give car number and number of axle stamped on differential carrier lock cover.

114C Highway Six rear axle complete, including housing, cover, differential support, spring supports, brake supports, internal and external brakes, inner axles, wheel nuts, differential driving gears 12-53 ratio, driving shaft with bearings and adjusting sleeve, universal joint companion flange.
1312D Highway Twelve rear axle complete, including housing, cover, differential support, spring supports, brake supports, internal and external brakes, inner axles, wheel nuts, differential driving gears 12-55 ratio, driving shaft with bearings and adjusting sleeve, universal joint companion flange.
115C or D Rear axle outside only, including housing, cover, differential support, spring supports, brake supports.
117C or D Rear spring supports on axle, with bolts.
118C or D Spring support bolts, with nuts.
119C or D Pressed steel housing only.
120C or D Wheel bearing sleeve tubing.
121C or D Spring support stop rings.
122C Differential carrier complete with gears, 12-53 ratio for Highway Six, bearings and universal joint companion flange assembled.
1313D Differential carrier complete with gears, 12-55 ratio for Highway Twelve, bearings and universal joint companion flange assembled.
123C or D Differential carrier with bearing caps and studs.
124C or D Differential carrier only.
125C or D Differential bearing caps.
127C or D Differential bearing cap studs with nuts.
128C or D Differential bearing adjuster.
129C or D Differential bearing adjuster lock.
183C or D Differential bearing adjuster lock screws.
130C or D Differential carrier inspection plug.
131C or D Differential carrier short cap screws and lock washers.
132C or D Differential carrier long cap screws and lock washers.
133C or D Differential carrier thin head cap screws and lock washers.
134C or D Cover for axle housing.
135C or D Differential carrier grease filler plug.
137C or D Housing cover oil level plug.
138C or D Housing cover gasket.
139C or D Differential carrier gasket.
140C or D Cap screws and lock washers for housing cover.
141C Pinion shaft bearing adjuster.
1314D Pinion shaft bearing adjuster.
142C or D Pinion shaft felt retainer.
143C or D Pinion shaft dust washer (felt).
144C or D Pinion shaft outer bearing adjusting nut.
145C or D Pinion shaft outer bearing lock nut.
147C or D Pinion shaft outer bearing lock nut lock washer.
148C or D Pinion shaft bearing adjuster lock cover.
149C or D Pinion shaft bearing adjuster cover cap screw.
150C or D Pinion shaft bearing adjuster cover gasket.
151C or D Pinion shaft bearing adjuster clamp bolt and nut.
152C or D Pinion shaft outer bearing spacer.
153C Pinion drive shaft.
1315D Pinion drive shaft.
154C or D Pinion drive shaft end nut.
155C or D Pinion drive shaft outer bearing (Bock No. 335).
157C or D Pinion drive shaft inner bearing (Bock No. 417).
158C or D Universal joint hex. nut.
159C or D Inner axle with driving flange.
170C or D Inner axle only. (Give diameter.)
171C or D Driving flange for inner axle.
172C or D Bushings for torsion rod bolt.

DIFFERENTIAL DRIVING GEARS.

173C or D Differential complete without driving gears.
174C or D Differential case without internal gears and pinions.
175C or D L. H. differential case for driving gear.
177C or D R. H. differential case (opposite driving gear).
178C or D Bolt and nut for differential case.
179C or D Bevel gear inside of differential.
180C or D Bevel pinion inside of differential.
181C or D Spider for bevel pinions inside of differential.
182C or D Bearings on differential (Bock No. 375).
184C only Large bevel gear. Give car number, also number of teeth on both gear and pinion. 12-53 gear.
185C only Bevel drive pinion. Give car number, also number of teeth on both gear and pinion. 12-53 pinion.
187D only Large bevel gear. Give car number, also number of teeth on both gear and pinion. 12-55 gear.
188D only Bevel drive pinion. Give car number, also number of teeth on both gear and pinion. 12-55 pinion.
189C or D Driving gear rivets.
190C or D Bevel drive pinion key.

DRIVE SHAFT AND TORSION ROD.

191C or D Drive shaft with both universal joints and companion flanges.
192C or D Drive shaft.
193C or D Universal joint flanged hub (trans. end).
194C or D Universal joint flanged hub (axle end).
195C or D Universal joint body.
197C or D Universal joint yoke (trans. end).
198C or D Universal joint yoke (axle end).
199C or D Universal joint cross.
200C or D Universal joint cross bushing.
201C or D Universal joint cross bushing lock wire.
202C or D Universal joint casing (inside).
203C or D Universal joint casing (outside).
204C or D Universal joint casing oil plug.
205C or D Universal joint casing packing.
207C or D Universal joint lock ring.
208C or D Universal joint dust cap.
209C or D Universal joint dust cap steel washer.
210C or D Universal joint dust cap felt washer.
211C or D Torsion rod with front and rear ends riveted in.
212C or D Torsion rod rear yoke.
213C or D Torsion rod rear yoke bolt.
214C or D Torsion rod rear yoke bolt nut.
215C or D Torsion rod front end forging.
217C or D Torsion rod hanger completely assembled.
218C or D Torsion rod hanger tube.
219C or D Torsion rod hanger tube swivel bearing bushing.
220C or D Torsion rod hanger upper ball socket.
221C or D Torsion rod hanger lower ball socket.
222C or D Torsion rod hanger spring.
223C or D Torsion rod hanger slotted spring adjusting nut.
224C or D Torsion rod hanger bracket.
225C or D Torsion rod hanger bracket bolt with nut.

BRAKES.

227C or D Brake carrier on axle tubing.
228C or D R. H. brake lever bracket on axle housing.
229C or D L. H. brake lever bracket on axle housing.
230C or D Brake band supporting pin bracket.
231C or D Brake shaft support.
232C or D Brake dust shield.
233C or D Brake shaft support grease cup.
234C or D Brake lever keys.
235C or D Internal brake bands complete with lining, end clips and anchor clip.
237C or D Lining for internal brake bands.
238C or D Internal brake spring.
239C or D Internal brake supporting bracket or anchor clip.
240C or D Internal brake end clips.
241C or D Internal brake cam.
242C or D Internal brake cam washers.
243C or D Internal brake shaft Woodruff Key.
244C or D Internal brake lever.
245C or D Internal brake lever bolt and nut.
247C or D Internal brake shaft.
248C or D Internal brake band supporting pin with nut.
249C or D Internal and external brake anchor clip.
250C or D Internal and external brake anchor clip pin.
251C or D Internal and external brake anchor clip spacer.
252C or D External brake band complete, with lining, anchor and end clips.
253C or D Lining for external brake band.
254C or D External brake supporting bracket or anchor clip.
255C or D External brake upper clip.
257C or D External brake lower clip.
258C or D External brake contracting lever.
259C or D External brake contracting lever spring.
270C or D External brake tension rod.
271C or D External brake tension rod clevis pin.
272C or D External brake tension rod clip washer.
273C or D External brake tension rod adjusting nut.
274C or D External brake tension rod spring.
275C or D External brake tension rod stop with nut.
277C or D External brake tension rod stop nut.
278C or D External brake tension rod stop half nut.
279C or D External brake tension rod stop washer.
280C or D External brake clip clevis pin.
281C or D External brake contracting link.
282C or D External brake contracting link clevis pin.
283C or D External brake lever connecting tube with two levers assembled.
284C or D External brake connecting tube.
285C or D External brake lever inside.
287C or D External brake lever outside (next to brake support).
288C or D External brake lever stop pin.
289C or D External brake connecting tube bushing.
290C or D External brake supporting pin with nut.

BRAKE RODS.

291C or D Intermediate foot brake rod with turnbuckle, length 48¼.
292C or D Intermediate hand brake rod, length 39⅝.
293C or D Intermediate foot brake rod long end, length 36 5/16, L. H. thread.
294C or D Intermediate foot brake rod short end, length 10 11/16, R. H. thread.
295C or D Side rods for internal hand brake with turnbuckle, length 22⅝.
297C or D Side rods for external foot brake, length 22⅝.
298C or D Side rods for internal hand brake, length 10 11/16", L. H. thread.
299C or D Side rods for internal hand brake, length 10 11/16", R. H. thread.
300C or D Turnbuckle for brake rods.
301C or D Brake shaft complete with brackets.
302C or D Outside brake shaft tubing with levers.
303C or D Inside brake shaft tubing with levers.
304C or D Brake shaft bracket.

305C or D Equalizing link complete, rods, cross bar and clevis pins.
307C or D Cross bar for equalizing link.
308C or D Equalizing link rods.
309C or D Clevis pins, diameter ⅜".
310C or D Spiral springs for equalizing levers.
311C or D Chain for equalizing levers.

CLUTCH AND CONTROL.

312C or D Clutch yoke.
313C or D Clutch yoke bolt.
314C or D Clutch yoke shaft long end.
315C or D Clutch yoke shaft short end.
317C or D Clutch lever adjuster.
318C or D Clutch yoke shaft bracket.
319C or D Clutch yoke shaft collar, long.
320C or D Clutch yoke shaft collar, short.
321C or D Clutch lever.
322C or D Foot brake lever.
323C or D Clutch foot pedal with flat spring.
324C or D Brake foot pedal with flat spring.
325C or D Rubber pedal pad.
327C or D Rubber pedal pad retainer.
328C or D Clutch bumper plunger.
329C or D Clutch bumper spring.
330C or D Clutch bumper plunger nut.
331C or D Clutch bumper retainer.
332C or D Clutch bumper retainer lock nut.
333C or D Cone clutch complete with clutch hub and large thrust bearing.
334C or D Clutch cone with leather and springs under leather.
335C or D Clutch leather.
337C or D Clutch hub.
338C or D Clutch hub nut.
339C or D Clutch hub ball thrust bearing complete.
340C or D Clutch hub bolt with nuts.
341C or D Clutch flywheel extension.
342C or D Clutch flywheel extension nut.
343C or D Clutch flywheel extension nut lock.
344C or D Clutch flywheel extension ball thrust bearing complete.
345C or D Clutch spring spider.
347C or D Clutch spring.
348C or D Washer for clutch spring.
349C or D Clutch spring stud with nut.
350C or D Clutch spring adjusting nut.
351C or D Clutch leather plunger.
352C or D Clutch leather plunger nut.
353C or D Clutch leather plunger spring.
354C or D Clutch leather plunger retainer.
355C or D Clutch shaft ball bearing in flywheel (No. 205).

STEERING AND STEERING CHUCK.

Give car number and number on steering chuck.

357C or D Steering post complete with chuck, anchor bracket, wheel and spark and throttle levers. (State whether for Touring, Toy or Roadster.)
358C or D Steering chuck complete.
359C or D Steering housing.
370C or D Steering housing head.
371C or D Anchor bracket.
372C or D Worm.
373C or D Worm wheel.
374C or D Steering ball arm with bolt and nut.
375C or D Adjusting screw.
377C or D Ball races (plain).
378C or D Ball races (saucer).
379C or D Ball retainers (loaded).
380C or D Column jacket bushing.
381C or D Adjusting screw bushing.
382C or D Worm house bushing.
383C or D Housing bushing (short).
384C or D Housing bushing (long).
385C or D Worm wheel grease cup No. 0, ⅛", Winkley.
387C or D Column spark gear.
388C or D Column throttle gear.
389C or D Secondary spark gear.
390C or D Secondary throttle gear.
391C or D Secondary bracket.
392C or D Spark lever, on steering wheel.
393C or D Throttle lever, on steering wheel.
394C or D Spark and throttle control bracket.
395C or D Steering wheel.
397C or D Horn push button.
398C or D Secondary spark lever.
399C or D Secondary throttle lever.
400C or D Worm wheel thrust washer.
401C or D Stationary tube buffer.
402C or D Throttle tube buffer.
403C or D Secondary spark tube with bushing.
404C or D Secondary throttle rod.
405C or D Steering tube with bushing.
407C or D Column jacket.
408C or D Stationary tube, ¾" diameter, with bushing.
409C or D Column spark tube.
410C or D Column throttle tube.
411C or D Adjustment clamp bolts.
412C or D Housing bolt.
413C or D Worm key.
414C or D Clamp bolt.
415C or D Anchor bracket clamp screw.
417C or D Steering post support to instrument board. (Specify model.)
Ball rod. (See front axle.)

SPARK THROTTLE CONTROL DETAIL—HIGHWAY SIX.

419C Throttle foot pedal.
420C Throttle foot pedal button.
421C Throttle foot pedal shouldered screw.
422C Throttle foot pedal clevis.
423C Throttle foot pedal clevis pin.
424C Rods complete from steering gear and foot pedal to carburetor bell crank.
425C Spiral spring for carburetor rod.

427C Spark control shaft complete.
428C Spark control shaft bracket.
429C Spark control shaft levers. (State how long.)
430C Rod complete steering gear to spark shaft.
431C Rod complete magneto to spark shaft.
432C Ball connectors.

SPARK THROTTLE CONTROL DETAIL—HIGHWAY TWELVE.

433D Throttle foot pedal.
434D Throttle foot pedal button.
435D Throttle foot pedal shouldered screw.
437D Throttle foot pedal clevis.
438D Throttle foot pedal clevis pin.
439D Rod from foot pedal to throttle shaft lever.
440D Rod from steering gear to throttle shaft lever.
441D Rod from steering gear to spark shaft lever.
442D Yoke slide for throttle rod.
443D Spark and throttle shaft assembly with bracket and levers.
444D Throttle shaft bracket with cap.
445D Throttle shaft tube, short, with miter gear and lever.
447D Throttle shaft tube, long, with miter gear and lever.
448D Spark shaft rod, short, with miter gear.
449D Spark shaft rod, long, with miter gear.
450D Throttle shaft levers. (State how long.)
451D Spark shaft levers. (State how long.)
452D Rod from throttle shaft to carburetor.
1317D Spiral spring for carburetor rod.
453D Rod from spark shaft to magneto.
454D Ball connectors.

TRANSMISSION.

Give number on transmission, also number of car.

455C or D Transmission complete with levers.
457C or D Transmission case only.
458C or D Transmission case plug.
459C or D Transmission case cover.
470C or D Transmission case cover cap screw.
471C or D Transmission case cover hand hole plate.
472C or D Transmission case cover hand hole plate thumb screws.
473C or D Clutch hand hole cover.
474C or D Clutch hand hole cover thumb screws.
475C or D Shifting rod end bearing plate.
477C or D Shifting rod end bearing plate cap screw.
478C or D Shifting rod, low speed.
479C or D Shifting rod, high speed.
480C or D Shifting rod interlock ball.
481C or D Shifting rod fork.
482C or D Shifting rod fork cap screw.
483C or D Shifting rod fork taper pin.
484C or D Shifting rod plunger.
485C or D Shifting rod plunger pin.
487C or D Shifting rod plunger spring.
488C or D Shifting rod plunger retainer.
489C or D Shifting rod plunger retainer nut.
490C or D Hand gear shift lever.
491C or D Hand gear shift lever ball grip.
492C or D Gear shift lever pin.
493C or D Gear shift lever plunger.
494C or D Gear shift lever plunger spring.
495C or D Gear shift lever plunger retainer.
497C or D Gear shift dust cap.
498C or D Gear shift dust cap ring.
499C or D Gear shift bell.
500C or D Clutch shaft and main drive gear (integral).
501C or D Main drive gear ball bearing (No. 210).
502C or D Main drive gear retainer.
503C or D Main drive gear retainer cap screws.
504C or D Main drive gear packing.
505C or D Main drive gear packing gland.
507C or D Main drive gear packing gland lock.
508C or D Main drive shaft.
509C or D Main drive shaft roller bearing.
510C or D Main drive shaft thrust pin.
511C or D Main drive shaft thrust ball.
512C or D Main drive shaft thrust ball seat.
513C or D Main drive shaft ball bearing (No. 307).
514C or D Main drive shaft ball bearing retainer.
515C or D Main drive shaft ball bearing retainer cap screws.
517C or D Main drive shaft packing.
518C or D Main drive shaft packing gland.
519C or D Main drive shaft packing gland lock.
520C or D Main drive shaft nut.
521C or D Sliding gear—first and reverse speeds.
522C or D Sliding gear—second and third speeds.
523C or D Countershaft driven gear—meshes with main drive gear.
524C or D Countershaft driven gear rivet.
525C or D Countershaft gear—second speed.
527C or D Countershaft second speed gear rivet.
528C or D Countershaft gear—first speed.
529C or D Reverse idler gear.
530C or D Reverse idler gear shaft.
531C or D Reverse idler gear shaft cap screw.
532C or D Countershaft assembled with gears.
533C or D Countershaft and reverse gear (integral).
534C or D Countershaft ball bearing (front and rear) No. 305.
535C or D Countershaft ball bearing retainer (front and rear).
537C or D Countershaft ball bearing retainer screws.
538C or D Hand brake lever assembled, with latch.
539C or D Hand brake lever only.
540C or D Hand brake lever plunger.
541C or D Hand brake lever plunger spring.
542C or D Hand brake latch cap screw (short).
543C or D Hand brake latch cap screw (long).
544C or D Hand brake latch cap screw nut.
545C or D Hand brake latch rod.
547C or D Hand brake ratchet.
548C or D Hand brake ratchet cap screws.
549C or D Hand brake shaft.
550C or D Hand brake shaft lock nut.
551C or D Hand brake shaft nut.
552C or D Transmission rear flange to universal joint.
553C or D Key to rear flange.
554C or D Speedometer drive gear.

GASOLINE SYSTEM.

555C or D Gasoline tank complete with filler, cap, gauge, outlet flange and strainer.
557C or D Gasoline tank gauge complete.
558C or D Gasoline tank filler.
559C or D Gasoline tank filler cap.
570C or D Gasoline tank drain plug.
571C or D Gasoline tank drain plug flange.
572C or D Gasoline tank drain plug gasket (sheet lead).
573C or D Gasoline tank bands.
574C or D Gasoline tank band bolts.
575C or D Gasoline tank feed flange.
577C or D Gasoline tank feed pipe strainer.
578C or D Gasoline vacuum tank (on dash).
579C Gasoline pipe to vacuum tank complete.
1318D Gasoline pipe to vacuum tank complete.
580C Gasoline pipe vacuum tank to carburetor.
1319D Gasoline pipe vacuum tank to carburetor.
581C Air pipe vacuum tank to carburetor.
1320D Air pipe vacuum tank to inlet manifold.
582C or D Straight connection for gasoline pipes.
583C or D Straight connection for air pipes.
584C or D Elbow connection for gasoline pipes.
585C or D Elbow connection for air pipes.
587C or D Union nuts for gasoline pipe.
588C or D Union nuts for air pipe.

MUFFLER AND CONNECTIONS.

589C Muffler complete.
1321D Muffler complete.
590C or D Cut out bell crank on muffler.
591C or D Cut out bell crank bracket on muffler.
592C or D Cut out valve.
593C or D Cut out valve spring.
594C or D Muffler brackets on frame.
595C Exhaust pipe (steel tube).
1322D Exhaust pipe (steel tube).
597C only Exhaust pipe clamp bolt and nut.
598C or D Muffler cut out pedal complete on floor.
599C or D Muffler cut out pedal plunger.
700C or D Muffler cut out pedal body.
701C or D Muffler cut out pedal bell crank.
702C or D Muffler cut out pedal latch.
703C or D Muffler cable.
704C Muffler tail pipe.
1323D Muffler tail pipe.
705D Muffler tail pipe support, R. H. or L. H.

FRAME.

707C Pressed steel frame, with parts riveted on, including fender sockets, front engine arm bracket, spring brackets, step irons and torque bar hanger bracket.
1324D Pressed steel frame, with parts riveted on, including fender sockets, front engine arm bracket, spring brackets, step irons and torque bar hanger bracket.
708C Pressed steel frame (bare).
1325D Pressed steel frame (bare).
709C or D Cross member rod between front arms.
710C or D Cross bar tubing between front arms.
711C or D Bumper brackets and bolts.
712C or D Rubber bumpers.

HOOD AND RADIATOR.

713C or D Hood.
714C or D Hood fasteners.
715C or D Hood handles.
717C or D R. H. hood strip along frame.
718C or D L. H. hood strip along frame.
719C Radiator.
1327D Radiator.
720C or D Radiator trunnion brackets.
721C or D Rod from radiator to dash.
722C Top hose from radiator to engine.
1328D Top hose from radiator to engine.
723C Hose from bottom of radiator to pump.
1329D Hose from bottom of radiator to pump.
724C or D Hose clamps. (State where used.)
725C Radiator outlet elbow.
1330D Radiator outlet elbow.
727C or D Strainer in radiator filler.
728C or D Radiator filler cap.
729C or D Nut on radiator supporting rod.
730C or D Drain cock in bottom of radiator.
731D only Top connecting pipe engine to radiator.

FENDERS AND DUST SHIELDS.

733C or D R. H. front fender for all models, with irons.
734C or D L. H. front fender for all models, with irons.
735C or D R. H. rear fender for 4-passenger Toy, with irons.
737C or D L. H. rear fender for 4-passenger Toy, with irons.
738C or D R. H. rear fender for 6-passenger Toy, with irons.
739C or D L. H. rear fender for 6-passenger Toy, with irons.
740C or D R. H. rear fender for Coupe, with irons.
741C or D L. H. rear fender for Coupe, with irons.
742C or D R. H. rear fender for Roadster, with irons.
743C or D L. H. rear fender for Roadster, with irons.
744C or D R. H. rear fender for Sedan, with irons.
745C or D L. H. rear fender for Sedan, with irons.
747C or D R. H. running board splashers.
748C or D L. H. running board splashers.
749C or D Door for grease cup opening in splasher.
1199C or D Radiator splasher.

ENGINE DUST PANS.

750C Complete set dust pans.
1331D Complete set dust pans.
751C Dust pan on right side of engine.
1332D Dust pan on right side of engine.
752C Dust pan on left side of engine.
1333D Dust pan on left side of engine.
753D only Dust pan right front.
754C only Cover for pump connection hole.

RUNNING BOARDS AND STEPS.

Specify model of car.

755C or D	R. H. running board complete with linoleum covering and edge strip.
757C or D	L. H. running board complete with linoleum covering and edge strip.
758C or D	Pressed steel step brackets.
759C or D	Aluminum edge strip around running boards.

BATTERY BOX AND TOOLS.

770C	Battery box.
1338D	Battery box.
771C or D	Ignition switch key.
1334C or D	Tool pocket key.
772C or D	Adjustable S wrench
773C or D	Adjustable straight wrench.
774C or D	Large screw driver.
775C or D	Small screw driver.
777C or D	Adjustable pliers.
1335C or D	Large open end wrench.
1337C or D	Small open end wrench.
778C or D	Oil can.
779C or D	Auto hammer.
780C or D	Cold chisel.
781C or D	Punch.
782C or D	Spark plug wrench and handle.
783C or D	Valve cap wrench.
784C or D	Dust cap and wheel nut wrench.
785C or D	½x8" steel bar for socket wrench.
787C or D	Rubber hose and gauge for tire air pump.
788C or D	Auto jack and handle.
789C or D	Tire repair kit.
790D only	Valve removing tool.

LAMPS, HORN, SPEEDOMETER, ETC.

791C or D	Front lamp bracket.
792C or D	Front lamp complete.
793C or D	Front lamp without electric globes.
794C or D	7-volt 15 C. P. globe for front lamps.
795C or D	7-volt 6 C. P. globe for front lamps.
797C or D	Tail lamp complete.
798C or D	Tail lamp without electric globe.
799C or D	7-volt 4 C. P. globe for tail lamp.
800C or D	Dash lamp complete.
801C or D	Dash lamp without electric globe.
802C or D	7-volt 2 C. P. globe for dash lamp.
803C	Horn complete with bracket.
1339D	Horn complete with bracket.
804C	Horn bracket on motor.
1340D	Horn bracket on frame.
805C or D	Robe rail. (Specify model.)
807C or D	Foot rail. (Specify model.)
808C or D	Speedometer.
809C or D	Flexible shaft for speedometer.
810C or D	Pinion on flexible shaft for speedometer. (Specify car gear ratio and size of tires.)
811C or D	Speedometer bracket on transmission.
812C or D	Speedometer shaft elbow at instrument board.
813C or D	Speedometer swivel joint.

BODY PARTS.

Specify car number and model.

814C or D	Body complete, painted, upholstered, with cushions, coat and foot rails.
815C or D	Body door hinges.
817C or D	Body door locks, right and left.
818C or D	Door lock handles.
819C or D	Cushions for front seat.
820C or D	Tonneau cushions.
821C or D	Tonneau carpet.
822C or D	Top bank board, bound and covered with linoleum. (Give width and length.)
823C or D	Lower bank board, bound and covered with linoleum. (Give width and length.)
824C or D	Floor board, bound and covered with linoleum, with heel plate. (Give width and length.)
825C or D	Heel plate.
827C or D	Brake and control lever escutcheon plate.
828C or D	Door sill scuff plate. Specify whether for front or rear doors.
829C or D	Steering post plates.
830C	Instrument plate. Complete with all instruments.
1341D	Instrument plate. Complete with all instruments.
831C	Instrument plate only.
1342D	Instrument plate only.

TOP IRONS.

Specify model.

832C or D	Top irons on side Tonneau seat, right and left.
833C or D	Top irons on rear of Tonneau seat, right or left.

TIRE IRONS.

834C or D	Tire iron bracket.
835C	Upper tire irons.
1343D	Upper tire irons.
837C	Lower tire irons.
1344D	Lower tire irons.
838C or D	Tire iron cross rod.
839C or D	Tire holders.
840C or D	Tire straps.

HIGHWAY SIX ENGINE.

Give number of engine shown on plate on crankcase.

841C	Engine complete with fan and starting crank bracket. Does not include starter, generator, carburetor, magneto, tire pump, clutch, or supporting brackets.

CRANKCASE.

842C Crankcase complete, including caps for crank bearings, gear cover and oil pan.
843C Upper half of crankcase, studded, without gear cover.
844C Oil pan complete with oil pump.
845C Oil pan dipper trough.
847C Oil pan dipper trough gasket.
849C Crankshaft front bearing cap.
850C Crankshaft front bearing, upper.
851C Crankshaft front bearing, lower.
852C Crankshaft front bearing laminated shims.
853C Crankshaft center bearing cap.
854C Crankshaft front center bearing, upper.
855C Crankshaft front center bearing, lower.
857C Crankshaft rear center bearing, upper. (Bronze backed babbitt.)
858C Crankshaft rear center bearing, lower. (Bronze backed babbitt.)
871C Crankshaft center bearing laminated shims.
872C Crankshaft rear bearing cap.
873C Crankshaft rear bearing, upper.
874C Crankshaft rear bearing, lower.
875C Crankshaft rear bearing laminated shims.
877C Camshaft front bearing.
880C Camshaft front center bearing.
881C Camshaft rear center bearing.
883C Camshaft rear bearing.
887C Crankcase gasket, R. H.
888C Crankcase gasket, L. H.
889C Crankshaft front bearing stud and nut.
891C Crankshaft center bearing stud and nut.
892C Crankshaft rear bearing stud.
894C Nut for crankshaft rear bearing stud.
895C Water pump gear shaft bushing.
897C Oil filler tube.
898C Oil filler cap.
899C Oil filler strainer.
900C Oil filler stud.
901C Flywheel housing screw cap.
902C Starting motor inspection cap.
903C Pet cock in side of oil pan.
904C Oil level indicator assembled.
905C Oil level indicator float and rod.
907C Oil level indicator pipe and ring.
908C Oil level indicator float guide.
909C Oil level indicator pipe cap.
910C Oil level indicator glass.
911C Oil level indicator glass gasket.
912C Oil distributing pipe plug.
913C Crankcase gear cover.
914C Crankcase gear cover cap screws.
915C Crankcase gear cover gasket.
917C Front engine arm, hanger on frame.
1389C Front engine arm bolt and nut.
918C Rear engine arm bracket.
919C Rear engine arm bracket bolts and nuts.

CYLINDER.

920C Cylinder complete with valves, valve caps, water jacket cover and priming cups. (No manifolds included.)
921C Cylinder, bare, with valve stem guides.
922C Studs for holding cylinder to crankcase, short.
923C Studs for holding cylinder to crankcase, medium.
924C Studs for holding cylinder to crankcase, long.
925C Nuts for cylinder studs.
927C Cylinder head plug.
928C Cylinder head plug gasket.
929C Cylinder base gasket.
931C Fan bracket stud.
932C Cylinder water jacket cover on top of cylinder.
933C Cylinder water jacket cover gasket.
934C Cylinder water jacket cover cap screw. (Give length.)
935C Cylinder water jacket cover cap screw gasket.
937C Secondary wire distributing tube.
938C Secondary wire distributing tube bracket.
939C Priming cups.

PISTONS.

940C Piston complete with rings and pin.
941C Piston plain.
942C Piston rings.
943C Piston pin.
944C Piston pin set screw.

CRANKSHAFT—CONNECTING RODS AND FLYWHEEL.

945C Crankshaft plain.
947C Connecting rod complete with bearing and bolts.
948C Connecting rod forging, machined.
949C Connecting rod piston pin bushing. (Upper.)
950C Connecting rod bearing bushing (lower) two pieces.
951C Connecting rod bolt.
952C Connecting rod bolt nut.
953C Connecting rod shims.
954C Flywheel.
955C Flywheel bolt.
957C Flywheel bolt nut.
958C Steel timing gear on crankshaft—36 teeth.
959C Crankshaft starting pin.

CAMSHAFT AND GEARS.

973C Camshaft.
974C Camshaft gear—72 teeth.
975C Camshaft gear capscrews.
Camshaft bearings. (See crankcase parts.)
977C Camshaft thrust screw.
978C Camshaft thrust screw washers.
979C Water pump gear—24 teeth.
980C Water pump gear shaft.
981C Water pump gear shaft nut.
982C Oil pump spiral driving gear.
983C Camshaft end nut.

VALVE DETAIL.

993C Valve.
994C Valve guide.
995C Valve spring.
997C Valve spring cup.
998C Valve spring cup retainer.
999C Valve push rod.
1000C Valve push rod guide.
1001C Valve push rod adjusting screw.
1002C Valve push rod adjusting screw nut.
1003C Valve cap for spark plug.
1004C Valve cap gasket.
1005C Valve cover plate front.
1007C Valve cover plate rear.
1008C Valve cover stud and nut.
1009C Valve cap for priming cup.
1010C Valve cover plate gasket.

WATER PUMP.

1014C Centrifugal water pump, complete.
1015C Centrifugal water pump shaft.
1017C Centrifugal water pump case.
1018C Centrifugal water pump case bushing.
1019C Centrifugal water pump case cover.
1020C Centrifugal water pump case cover bushing.
1021C Centrifugal water pump rotor.
1022C Centrifugal water pump front packing nut R. H. thread.
1023C Centrifugal water pump rear packing nut L. H. thread.
1024C Centrifugal water pump front packing gland.
1025C Centrifugal water pump rear packing gland.
1027C Drain cock for water pump.
1028C Inlet connection to cylinder.
1029C Water pump inlet elbow.

EXHAUST MANIFOLD.

1031C Exhaust manifold.
1032C Exhaust manifold gasket to cylinder, end ports.
1033C Exhaust manifold gasket to cylinder, middle ports.
1034C Exhaust manifold capscrews, long.
1035C Exhaust manifold capscrews, short.

CARBURETOR.

1037C Rayfield carburetor, model M.
1038C Carburetor choke with tube on dash.
1039C Carburetor flange gasket.
1040C Carburetor hot air pipe.
1041C Carburetor hot air stove.

MAGNETO AND PARTS.

1048C Dixie high tension magneto.
Wiring tube. (See cylinder.)
1049C Magneto switch.
Switch key. (See tools.)
1050C Spark plugs.
1051C Spark plug cables. (Give length.)
1052C Spark plug cable terminals.
1053C Switch wire terminals, magneto end.
1054C Magneto coupling, generator end.
1055C Magneto coupling, magneto end.
1057C Magneto coupling, leather disc.
1058C Magneto coupling, screw and nut.
1059C Magneto shaft nut.
1070C Magneto holding cap screws.

STARTING CRANK PARTS.

1074C Starting crank.
1075C Starting crank clutch sleeve.
1077C Starting crank bracket.
1078C Starting crankshaft and jaw.
1079C Starting crankshaft plunger.
1080C Starting crankshaft plunger spring.
1081C Starting crankshaft plunger spring cap.
1082C Starting crank bracket sleeve.
1083C Starting crank cover.

FAN PARTS.

1084C Fan complete with hub, shaft bearings, bracket and grease cup.
1085C Fan only.
1087C Fan shaft.
1088C Small fan pulley.
1089C Large (driving) fan pulley on water pump gear shaft.
1090C Fan supporting bracket.
1091C Fan supporting bracket bolt.
1092C Fan shaft bearing cup.
1093C Fan bearing cone.
1094C Fan shaft ball bearing retainer. (Loaded.)
1095C Fan shaft nut and retaining washer for fan.
1097C Fan shaft pulley retaining nut and washer.
1098C Fan belt.

OIL PUMP PARTS.

1101C Oil pump complete.
1102C Oil pump body.
1103C Oil pump gear, driver, on shaft.
1104C Oil pump gear, driven.
1105C Oil pump shaft bushing.
1107C Oil pump drive shaft.
1108C Oil pump shaft coupling.
1109C Oil pump shaft coupling pin.
1110C Oil pump spiral gear, driven.
1111C Oil pump shaft thrust plate.
1112C Oil pump shaft thrust plate gasket.
1113C Oil pump screen.
1114C Oil pump screen cover.
1115C Oil pump screen cover gasket.
1117C Oil pump spiral gear case cover plate.
1118C Oil pump spiral gear thrust washer.

TIRE AIR PUMP.

1124C Tire air pump complete, with gear and shifter.
1125C Tire air pump crank case.
1127C Tire air pump crank case cover.
1128C Tire air pump crankshaft.
1129C Tire air pump cylinder.
1130C Tire air pump intake valve and cap.
1131C Tire air pump outlet valve and connection.
1132C Tire air pump piston.
1133C Tire air pump connecting rod.
1134C Tire air pump gear driven.
1135C Tire air pump drive gear on water pump shaft.
1138C Tire air pump shifter.
1139C Tire air pump base bolt and nut.
1140C Tire air pump support bracket.

ELECTRIC SELF-STARTER AND LIGHTING GENERATOR.

1142C Starting motor complete with gears and housing.
1143C Starting motor bracket.
1144C Starting motor bracket strap.
1145C Starting motor bracket cap screws.
1147C Starting motor brush.
1148C Starting motor commutator cover.
1149C Starting motor gear housing.
1150C Starting motor automatic pinion.
1151C Starting motor pinion screw shaft.
1152C Starting motor pinion screw shaft spring.
1153C Lighting generator complete, without coupling.
1154C Generator brushes.
1155C Generator brush screw cap.
1157C Generator coupling, shaft end.
1158C Generator coupling, generator end.
1159C Generator coupling, leather disc.
1170C Generator coupling screws and nuts.
1171C Generator shaft end nut.
1172C Generator cap screws.
1173C Ammeter.
1174C Lighting switch.
1175C Starter foot switch.
1177C Storage battery, 6-volt, 95 ampere hours.
1179C Starter cable battery to switch.
1180C Starter cable switch to starter.
1181C Starter cable battery to starter. (When lighting cables are wanted, specify position and length.)

HIGHWAY TWELVE ENGINE.

Give number of engine shown on plate on crankcase.

1345D Engine complete with fan and starting crank bracket. Does not include starter, generator, carburetor, magneto, tire pump, clutch, or supporting brackets.

CRANKCASE.

1347D Crankcase complete, including caps for crank bearings, gear cover and oil pan.
1348D Upper half of crankcase, studded, without gear cover.
1311D Crankcase oil baffle plate.
1349D Oil pan complete with oil pump.
848D Oil pan splash plates.
1351D Crankshaft front bearing cap.
1352D Crankshaft front bearing, upper.
1353D Crankshaft front bearing, lower.
1354D Crankshaft front bearing, laminated shims.
1355D Crankshaft center bearing cap.
859D Crankshaft center bearing, upper.
870D Crankshaft center bearing, lower.
1350D Crankshaft center bearing, laminated shims.
1357D Crankshaft rear bearing cap.
1358D Crankshaft rear bearing, upper.
1359D Crankshaft rear bearing, lower.
1370D Crankshaft rear bearing, laminated shims.
878D Camshaft front bearing, R. H.
879D Camshaft front bearing, L. H.
882D Camshaft center bearing.
884D Camshaft rear bearing, L. H.
885D Camshaft rear bearing, R. H.
1371D Crankcase gasket, R. H.
1372D Crankcase gasket, L. H.
1373D Crankshaft front bearing stud and nut.
890D Crankshaft front bearing bolt and nut.
1374D Crankshaft center bearing stud and nut.
893D Crankshaft rear bearing bolt and nut.
1375D Water pump gear shaft bushing.
1377D Oil filler tube.
1378D Oil filler cap.
1379D Starting motor inspection cap.
1380D Pet cock in side of oil pan.
1381D Oil level indicator float and rod.
1382D Oil level indicator pipe.
1383D Oil level indicator pipe cap.
1384D Crankcase gear cover.
1385D Crankcase gear cover cap screws.
1387D Crankcase gear cover gasket.
1197D Magneto sprocket shaft housing.
1300D Magneto sprocket shaft bearing retainer.
1388D Front engine arm hanger on frame.
1390D Front engine arm bolt and nut.
918D Rear engine arm bracket.
919D Rear engine arm bracket bolts and nuts.

CYLINDER.

1391D Cylinder complete with valves, valve caps, water jacket cover and priming cups. (No manifolds included.)
1392D Cylinder, bare, with valve stem guides.
1393D Studs for holding cylinder to crankcase.
1394D Nuts for cylinder studs.
1395D Cylinder base gasket.
930D Cylinder base gasket for water connection.
1397D Cylinder water jacket cover, on top of cylinder.
1398D Cylinder water jacket cover gasket.
1399D Cylinder water jacket cover cap screw. (Give length.)
1400D Cylinder water jacket cover cap screw gasket.
1401D Secondary wire distributing tube.
1402D Priming cups.

PISTONS.

1403D	Piston complete with rings and pin.	1407D	Piston pin.
1404D	Piston plain.	1408D	Piston pin set screw.
1405D	Piston rings.		

CRANKSHAFT—CONNECTING RODS AND FLYWHEEL.

1409D	Crankshaft plain.	1418D	Flywheel.
1410D	Connecting rod complete with bearing and bolts.	1419D	Flywheel bolt.
1411D	Connecting rod forging, machined.	1420D	Flywheel bolt nut.
1412D	Connecting rod piston pin bushing, upper.	1421D	Crankshaft starting pin.
1413D	Connecting rod bearing bushing (lower) two pieces.	970D	Flywheel ring gear.
1414D	Connecting rod bolt.	971D	Steel timing gear on crankshaft—33 teeth.
1415D	Connecting rod bolt nut.	972D	Crankshaft timing gear nut.
1417D	Connecting rod shims.		

CAMSHAFT AND GEARS.

1422D	Water pump gear shaft.	988D	Camshaft gear bolts, short and nuts.
1423D	Water pump gear shaft nut.	989D	Camshaft gear bolts, long and nuts.
1424D	Oil pump spiral driving gear.	990D	Camshaft thrust collar with screws.
984D	Camshaft, R. H.	991D	Water pump gear—22 teeth.
985D	Camshaft, L. H.	992D	Chain sprocket. (Driver.)
987D	Camshaft gear—66 teeth.		

VALVE DETAIL.

1425D	Valve.	1434D	Valve push rod adjusting screw nut.
1427D	Valve guide.	1435D	Valve cap for spark plug.
1428D	Valve spring.	1437D	Valve cap gasket.
1429D	Valve spring cup.	1438D	Valve cover stud and nut.
1430D	Valve spring cup retainer.	1439D	Valve cap for priming cup.
1431D	Valve push rod.	1440D	Valve cover plate gasket.
1432D	Valve push rod guide.	1011D	Valve cover plate, right front and left rear.
1433D	Valve push rod adjusting screw.	1013D	Valve cover plate, right rear and left front.

WATER PUMP.

1441D	Centrifugal water pump, complete.	1448D	Centrifugal water pump rear packing nut L. H. thread.
1442D	Centrifugal water pump shaft.		
1443D	Centrifugal water pump case.	1449D	Centrifugal water pump front packing gland.
1444D	Centrifugal water pump case cover.	1450D	Centrifugal water pump rear packing gland.
1445D	Centrifugal water pump rotor.	1451D	Drain cock for water pump.
1447D	Centrifugal water pump front packing nut R. H. thread.	1030D	Water pump outlet pipe.

EXHAUST MANIFOLD.

1452D	Exhaust manifold.	1455D	Exhaust manifold capscrews, long.
1453D	Exhaust manifold gasket to cylinder, end ports.	1457D	Exhaust manifold capscrews, short.
1454D	Exhaust manifold gasket to cylinder, middle ports.		

CARBURETOR.

1458D	Carburetor choke with tube on dash.	1044D	Inlet manifold gasket.
1459D	Carburetor flange gasket.	1045D	Carburetor water pipe to pump.
1042D	Rayfield carburetor, model G3.	1047D	Inlet manifold water pipe to carburetor.
1043D	Inlet manifold.	1470D	Inlet manifold water pipe to cylinder.

MAGNETO AND PARTS.

1471D	Dixie high tension magneto.	1478D	Magneto coupling, magneto end.
	Wiring tube. (See cylinder.)	1071D	Magneto coupling, shaft end.
1472D	Magneto switch.	1479D	Magneto coupling leather disc.
	Switch key. (See tools.)	1480D	Magneto coupling screw and nut.
1473D	Spark plugs.	1481D	Magneto shaft nut.
1474D	Spark plug cables. (Give length.)	1482D	Magneto holding cap screws.
1475D	Spark plug cable terminals.	1072D	Magneto base plate.
1477D	Switch wire terminals, magneto end.	1073D	Magneto base plate shims.

STARTING CRANK PARTS.

1483D	Starting crank.	1489D	Starting crankshaft plunger spring.
1484D	Starting crank clutch sleeve.	1490D	Starting crankshaft plunger spring cap.
1485D	Starting crank bracket.	1491D	Starting crank bracket sleeve.
1487D	Starting crankshaft and jaw.	1492D	Starting crank cover.
1488D	Starting crankshaft plunger.		

FAN PARTS.

1493D	Fan complete with hub, shaft bearings, bracket and grease cup.	1515D	Fan bearing, adjustable cone.
		1499D	Fan shaft ball bearing retainer. (Loaded.)
1494D	Fan only.	1500D	Fan belt.
1495D	Fan shaft.	1099D	Fan hub and small pulley.
1497D	Fan shaft bearing cup.	1100D	Large (driving) pulley on magneto drive shaft.
1498D	Fan bearing, plain cone.	1547D	Fanshaft dust cap.

OIL PUMP PARTS.

1501D	Oil pump complete.	1198D	Oil pump driven gear shaft.
1502D	Oil pump body.	1119D	Oil pump drive shaft end nut.
1503D	Oil pump gear, driver, on shaft.	1120D	Oil pump thrust cap.
1504D	Oil pump gear, driven.	1121D	Oil pump circular screen.
1505D	Oil pump shaft bushing.	1122D	Oil pan screen.
1507D	Oil pump drive shaft.	1123D	Oil pump body cover plate.
1508D	Oil pump spiral gear, driven.		

OIL PRESSURE CONTROL.

1301D	Oil pressure relief valve assembled.	1307D	Oil pressure relief valve ball.
1302D	Oil pressure relief valve body.	1308D	Oil pressure gauge (on instrument board.)
1303D	Oil pressure relief valve adjusting screw.	1309D	Oil pressure gauge connecting tube.
1304D	Oil pressure relief valve adjusting screw nut.	1310D	Oil pressure gauge tube connection (on crankcase.)
1305D	Oil pressure relief valve spring.		

TIRE AIR PUMP.

1509D	Tire air pump complete, with gear and shifter.	1517D	Tire air pump piston.
1510D	Tire air pump crankcase.	1518D	Tire air pump connecting rod.
1511D	Tire air pump crankcase cover.	1519D	Tire air pump gear driven.
1512D	Tire air pump crankshaft.	1137D	Tire air pump drive gear on magneto drive shaft
1513D	Tire air pump cylinder.	1520D	Tire air pump shifter.
1514D	Tire air pump intake valve and cap.	1141D	Tire air pump base capscrews.
1515D	Tire air pump outlet valve and connection.		

ELECTRIC SELF-STARTER AND LIGHTING GENERATOR.

1521D	Starting motor complete with gears and housing.	1533D	Generator coupling, shaft end.
1522D	Starting motor bracket.	1534D	Generator coupling, generator end.
1523D	Starting motor bracket strap.	1535D	Generator coupling leather disc.
1524D	Starting motor bracket cap screws.	1537D	Generator coupling screws and nuts.
1525D	Starting motor brush.	1189D	Generator drive shaft.
1527D	Starting motor commutator cover.	1190D	Generator drive shaft coupling, shaft end.
1528D	Starting motor gear housing.	1191D	Generator drive shaft coupling, pump end.
1182D	Starting motor gear housing end cap.	1192D	Generator drive shaft coupling leather disc.
1183D	Starting motor pinion.	1193D	Generator drive shaft coupling screw and nuts.
1184D	Starting motor countershaft assembled, with gear and spring.	1194D	Generator support bracket.
		1195D	Generator support bracket strap.
1185D	Starting motor gear housing bushing for countershaft bearing.	1538D	Ammeter.
		1539D	Lighting switch.
1187D	Starting motor countershaft disc.	1540D	Starter foot switch.
1188D	Starting motor countershaft bearing nut.	1178D	Storage battery, 6-volt, 100 ampere hours.
1529D	Starting motor automatic pinion.	1541D	Starter cable battery to switch.
1530D	Lighting generator complete, without coupling.	1542D	Starter cable switch to starter.
1531D	Generator brushes.	1543D	Starter cable battery to starter.
1532D	Generator brush screw cap.	(When lighting cables are wanted, specify position and length.)	

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IMPORTANT ADDITIONAL INSTRUCTIONS

In cold weather we recommend that an adjustable cover be used for radiator, as we find it advisable, on account of the poor grade of gasoline which is generally used, to run the engine at a higher temperature than would be otherwise necessary. In cold weather by keeping the engine and carburetor warm much better results can be obtained.

On both Highway Six and Highway Twelve, contact points on circuit breaker of magneto should be adjusted with an opening of twenty thousandths (.020) inch. If more opening is allowed, the platinum points are liable to pit; if less opening, engine will not hit at very low speeds.

In regard to the 12-cylinder, after the car has been run about 5,000 miles, the silent chain in front of engine, which drives the magneto, should be adjusted if loose. This is accomplished by placing a liner on the aluminum cap or "castle" as it is called, and also placing a liner under the magneto so as to keep it in line. One or two heavy shellaced paper liners will answer the purpose. It must be borne in mind that the chain must never be adjusted tight, and a slight amount of slack must always be allowed in it.

The oiling system on the 12-cylinder is of the high pressure type, so it is necessary to watch the oil pressure gauge to see that you have plenty of oil in circulation. As soon as this gauge shows no pressure, then it means that there is no oil in the crankcase. Do not run engine unless oil pressure gauge shows pressure. The float with the red ball also shows amount of oil in crankcase.

In very cold weather when car has stood out some time, the oil in the crankcase becomes very thick, so that when engine is started the oil will not run through screen for a few minutes and consequently no pressure will show on gauge. Do not speed up car too fast until pressure begins to show.

On account of connecting rods on 12-cylinder being small, there is a tendency when adjusting them to get them too tight—watch this. If rod burns out, it is due to lack of oil in crankcase or the oil holes becoming stopped up with dirt. So see that dirty oil is let out of bottom of crankcase once in a while.

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