Information

On the Operation
and Care of the

Studebaker

(*E-M-F*)

"30"

The Studebaker Corporation
Detroit, Michigan

INFORMATION

On the Operation
and Care of the

Studebaker

(*E-M-F*)

"30"

The Studebaker Corporation
Detroit, Michigan

Branches and Supply Depots
The Studebaker Corporation

Atlanta, Ga., 114-116 Auburn Ave.
Birmingham, Ala., 2029 Avenue C.
Boise, Ida.
Boston, Mass., Lawton Ave. and Cummington St.
Buffalo, N. Y., 1021 Main St.
Butte, Mont.
Charlotte, N. C., 224 N. Tyron St.
Chicago, Ill., 21st and Michigan Ave.
Cleveland, Ohio, 700 Canal Road.
Columbus, Ohio, 419 Fourth St.
Dallas, Texas, 1513 Commerce St.
Denver, Colo., 1515 Cheyenne Place.
Detroit, Mich.
Fargo, N. D., 224 Broadway.
Idaho Falls, Idaho.
Indianapolis, Ind., 311-313 N. Pennsylvania Ave.
Kansas City, Mo., 1620 Grand Ave.
Los Angeles, Cal., 1620 E. Seventh St.
Louisville, Ky., 4th and Yorks Sts.
Memphis, Tenn., 249 Monroe Ave.
Milwaukee, Wis.
Minneapolis, Minn., Second Ave. S. and Sixth St.
New York, N. Y., 59th St. and Broadway.
Oklahoma City, Okla., 7 West Main St.
Oakland, Cal., 12th and Jackson.
Omaha, Nebr., 2026 Farnum St.
Phoenix, Ariz.
Philadelphia, Pa., 18th and Spring Garden.
Portland, Oregon, Chapman and Alder Sts.
St. Louis, Mo., 4360 Duncan St.
Sacramento, Cal., 800 L St.
Salt Lake City, Utah, 157 State St.
San Antonio
San Francisco, Cal., Mission and Fremont Sts.
Seattle, Wash., 2201-2207 2nd Ave.
Sioux Falls, S. D., 230 E. 10th St.
South Bend, Indiana, Administration Bldg.
Spokane, Wash., 1032 Sprague Ave.
Stockton, Cal., 407 E. Weber Ave.
Tacoma, Wash.
Twin Falls, Idaho.
Toledo, Ohio, 627 Madison Ave.
Washington, D. C., 118 "Q" St., N. E.

To Owners of Studebaker (E-M-F) "30" Cars

To introduce to you—to make you thoroughly acquainted with—your Studebaker (E-M-F) "30" car, is the duty for which we have prepared this little Instruction Book.

It is to our interests, as well as yours, that you should know your car. Study out and verify the facts in this book. The effort will pay you big dividends in satisfaction alone. In addition, a thorough understanding of your car will greatly increase the amount of work it will do for you and its longevity in your service.

Knowing your car also, qualifies you for membership in that great army of satisfied owners of Studebaker cars who, as volunteer salesmen, are so important a part of our distributing system. That explains our interest in the affair.

In all probability, this Instruction Book will guide you in successfully solving every problem you face in your new capacity as a Studebaker (E-M-F) "30" owner-driver. If, however, you find that there arises some condition which the book does not explain, ask your local dealer or write us, addressing your letter to the Service Department.

Our Service Department is the outgrowth of years of experience in supplying the wants of Studebaker (E-M-F) "30" and Studebaker (Flanders) "20" owners. Its staff of skilled experts is your representative in our factory. To take care of your interests through the branch in whose territory you are located, through your own local dealer, and direct with you, whenever you ask its help, is the sole duty of this department. It also includes in its equipment a complete stock of repair parts for every model which this company has ever produced.

It is very possible that you may never find it necessary to consult our Service Department. Your car's sturdy characteristics will surely delight you. But, if the need comes, remember that the Studebaker Service Department is exactly what its name implies.

The Studebaker Corporation
Detroit, Michigan

First General Instructions Upon Receipt of Car

INSPECTION

Make a thorough inspection and see that your car has all its catalogue equipment as follows:

3 Oil Lamps	Horn
2 Gas Lamps	Generator or Prest-O-Lite Tank

TOOLS (Comprising)

Hammer	1314	Magneto Wrench	1301
Valve Cap Wrench	1308	Pliers	1316
Cylinder Nut Wrench	1307	Cold Chisel	1318
Monkey Wrench	1317	Cotter Pin Puller	1320
Screw Driver	1315	Punch	1319
Hub Cap Wrench	1309	Tire Pump	1363
Double End Wrench	1310	Oil Gun	1313
Double End Wrench	1311	Oil Can	1326
Double End Wrench	1312	Jack	1335
		Jack Handle	1394

This box containing tools is stamped and sealed and can be found under the rear seat. If you have purchased top (which includes complete set of side curtains and dust cover for top when it is down), windshield or speedometer, be sure each is in place and properly adjusted.

Also see that the car has not been damaged in transportation, as all cars upon leaving the factory are thoroughly inspected and shipped in perfect order. Should the car reach you in a damaged condition, claim for damages should be made immediately to the railroad, before unloading. Also notify Claims Department, The Studebaker Corporation, Detroit, Mich., and it will do all in its power to effect a prompt and satisfactory settlement. All cars are drained free from gasoline and water before leaving the factory.

FILLING ACETYLENE GAS GENERATOR

Replace bottom of generator and turn water valve to position marked "ON." After waiting about a minute to allow the gas to generate, open both doors on gas lamps, allowing any gas that may have accumulated to escape before lighting lamps. In the event that the light does not burn evenly, there may be a small particle of dirt in the burner, which can often be removed by tapping lightly on side of burner. Do not let any water accumulate in pipes leading to lamps. Blow these pipes out occasionally to keep them dry.

FILLING OIL LAMPS

Detach the oil reservoir from the side and tail lamps and fill with kerosene oil, which will supply sufficient for 20 or 30 hours of burning. Clean the oil burner and trim the wicks regularly.

TO FILL WATER SYSTEM

See that drain cock at bottom of radiator and drain cock at lowest point of pump are closed. Unscrew filler cap on top of radiator and fill with clean water. This should be free from sediment or you may have trouble. After filling for the first time, open pump drain cock and allow about one quart of water to drain off in order to release any air that may have been trapped or bound in the circulating system, close drain cock and refill radiator.

TO FILL GASOLINE TANK

See that drain cocks at bottom of gasoline tank and at bottom of carburetor are closed, also that cock in tube leading from gasoline tank to the carburetor is open. Remove gasoline tank filler cap, insert funnel, and fill by straining through a dry chamois. Gasoline should always be strained through chamois in order to keep out dirt and water. Replace filler cap. The filler cap has a small air vent in its center, and this vent must never be covered or closed in any way. Be careful not to put papers under the front seat and inadvertently close it tight. If you do, gasoline cannot run into carburetor, because air cannot enter top of tank to relieve the vacuum and allow the gasoline to run out through the tubing into the carburetor.

TO FILL OIL RESERVOIR AND TO OIL PARTS

The Oil Reservoir generally contains enough oil for 15 to 20 miles running, but before you drive the car the first time, be sure and fill it as follows:

Unscrew filler cap at top of Oil Reservoir which is built in the right side of the crank case. Fill with high grade cylinder oil. Never use poor oil, the best is none too good. (See "Lubrication System," page 26.) Replace filler cap and screw it down tightly with a wrench, and be sure to see that washer is under it. This must be screwed down absolutely air tight because the oiler works on the vacuum system. (See Principles of "Lubrication System," page 26.)

Oil the moving portions of the car in accordance with Oiling Diagram and General Directions on page 27.

PRINCIPLE ON WHICH A GASOLINE MOTOR WORKS

The principle on which the gasoline motor works is very simple, and it might not be amiss to briefly explain in detail the process under which the operation takes place.

The gasoline which is carried in the gasoline tank feeds through a copper tube to the carburetor by gravity—the carburetor being lower than the tank. The carburetor is an instrument for converting raw gasoline into explosive gas by mixing gasoline with air.

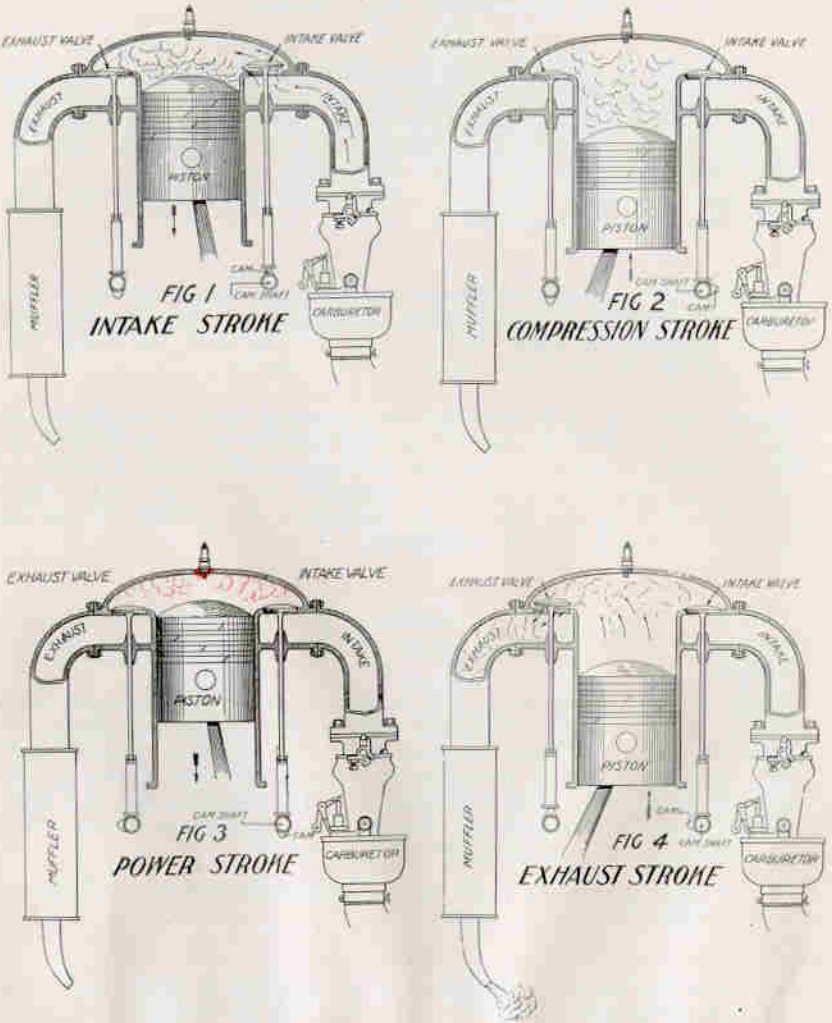


Diagram showing the four strokes of a standard four-cycle motor

PRINCIPLES ON WHICH A GASOLINE MOTOR WORKS—*Continued*

The motor of the Studebaker (E-M-F) "30" consists principally of four cylinders, four pistons, a crankshaft, connecting rods which connect the pistons to the crankshaft, and eight valves. The piston traveling down in the cylinders, which are air tight, causes a vacuum or suction which pulls the gasoline through a fine needle valve in the carburetor, separating the fluid into vapor. This is then mixed with the proper amount of air and is sucked through the inlet manifold or pipe into the cylinder through the intake valve, which has been opened by the action of the camshaft at the same instant the piston starts on its downward travel. (See Fig. 1.) This is known as the "Suction or Intake Stroke."

When the piston reaches the bottom of the cylinder, it starts back on its journey, and the large amount of gas which has been drawn into the cylinder is forced by the uprising piston into a smaller compact mass. This upward action of the piston is known as the "Compression Stroke." (See Fig. 2.)

During the action of this "Compression Stroke," both intake and exhaust valves are closed. When the piston reaches the top of its travel, this highly explosive gas, which it has compressed, is fired by an electric spark furnished by the magneto or battery and delivered to the cylinder through the medium of the spark plug. This spark is an electric current which jumps from one point to the other through the gap in the spark plug. The gas is instantly ignited, and the force of the charge drives the piston down, which is known as the "Power Stroke." (See Fig. 3.)

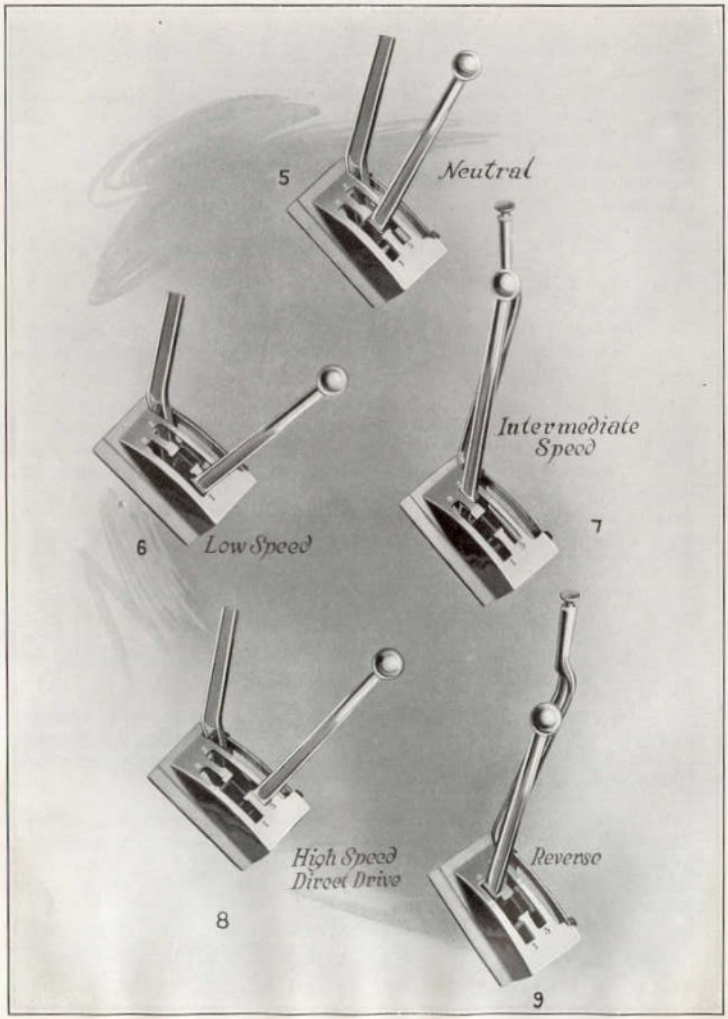
The instant the piston starts again on its upward stroke, the exhaust valve opens through the action of the camshaft, while the intake valve remains closed, and as a result, all of the exploded gas is forced through the exhaust valve into the exhaust pipe, hence to the muffler, which silences the noise of the exhaust. (See Fig. 4.)

In order that the crankshaft continue turning between the completion of one power stroke and the commencement of the next, it is necessary to have a flywheel. This is of sufficient weight and consequent inertia to insure the even running of the motor.

On a Studebaker (E-M-F) "30," as stated above, there are four cylinders, each going through this operation, and the "Power Strokes" are so arranged that they follow each other so that power is being exerted on the crankshaft every half revolution. The power which is thus developed by the rapid turning of the crankshaft is carried from the motor to the rear axle by the transmission mechanism, which consists of a clutch, universal joint, drive shaft and transmission gears. (See "Transmission System.")

TO START MOTOR

See that gear shifting lever is in neutral position. (See Fig. 5.) Open throttle lever (at the left) about three notches. Retard spark by placing spark lever (at the right) in extreme lower position. This is imperative, because in any other position the motor may kick back when



Showing the different positions of the gear shift lever

TO START MOTOR—*Continued*

cranking and starting crank handle strike and break your hand or wrist. (See "Ignition System.") Put switch key into coil and throw lever to side marked "Battery." Press in starting crank and pull it up quickly clockwise until motor starts. If it doesn't start immediately, refer to "Further General Suggestions," page 50. Always start by pulling up on starting lever and do it with a quick, snappy pull.

As soon as motor begins to run, turn switch on coil quickly to side marked "Magneto," advance spark to highest position and set throttle lever so that engine runs slowly.

If batteries become exhausted unexpectedly, the car can be started on the magneto, as follows: Advance spark lever to position two-thirds forward. Open throttle lever about three notches and turn coil switch to position marked "Magneto." Start the motor by cranking rapidly clockwise. As soon as the car starts, advance spark full forward and close throttle lever until motor runs slowly. The secret in starting on the magneto is to spin the starting crank rapidly. This is necessary in order to develop a powerful enough spark from the magneto to ignite the gas.

TO DRIVE CAR

With motor running, car is ready to drive. Release the hand brake, if it has been set, by pushing it to its furthest forward position. It is a good plan to set it whenever leaving car. Press forward clutch pedal as far as it will go, disengaging clutch. (See "Clutch Directions.")

Grasp the gear shift lever and pull it quickly back into first speed position on the H Plate. (See Fig. 6.) Gently press upon the accelerator (which is the foot control of the motor, corresponding to the hand throttle) to give somewhat more speed to the engine already running slowly. Gradually release clutch pedal, thus engaging clutch. The car will start easily. Increase the speed by gently pressing on the accelerator so as to give the car good rolling momentum. As it gathers momentum again release the clutch by pressing forward on the left pedal, and, with a quick, decided movement, shift the gear shift lever from first speed position into second or "Intermediate" speed. (See Fig. 7.) Again let the clutch in gently and accelerate to acquire further momentum.

Once more disengage clutch and slip the gear shift lever into third or "High" Speed. (See Fig. 8.) It is a good idea to always turn the palm of the hand outward when shifting from first to second and from second to high. This position is used in all ordinary driving. First and second speeds are used in starting, and when, on account of exceptional hills, very heavy roads, or in slowing down for traffic, it becomes desirable to give the motor additional leverage to enable it to pick up under load.

One rule the driver must always remember: The clutch must be disengaged whenever brakes are put on or gears shifted. By pressing the clutch pedal down, the clutch is disengaged in the flywheel and all

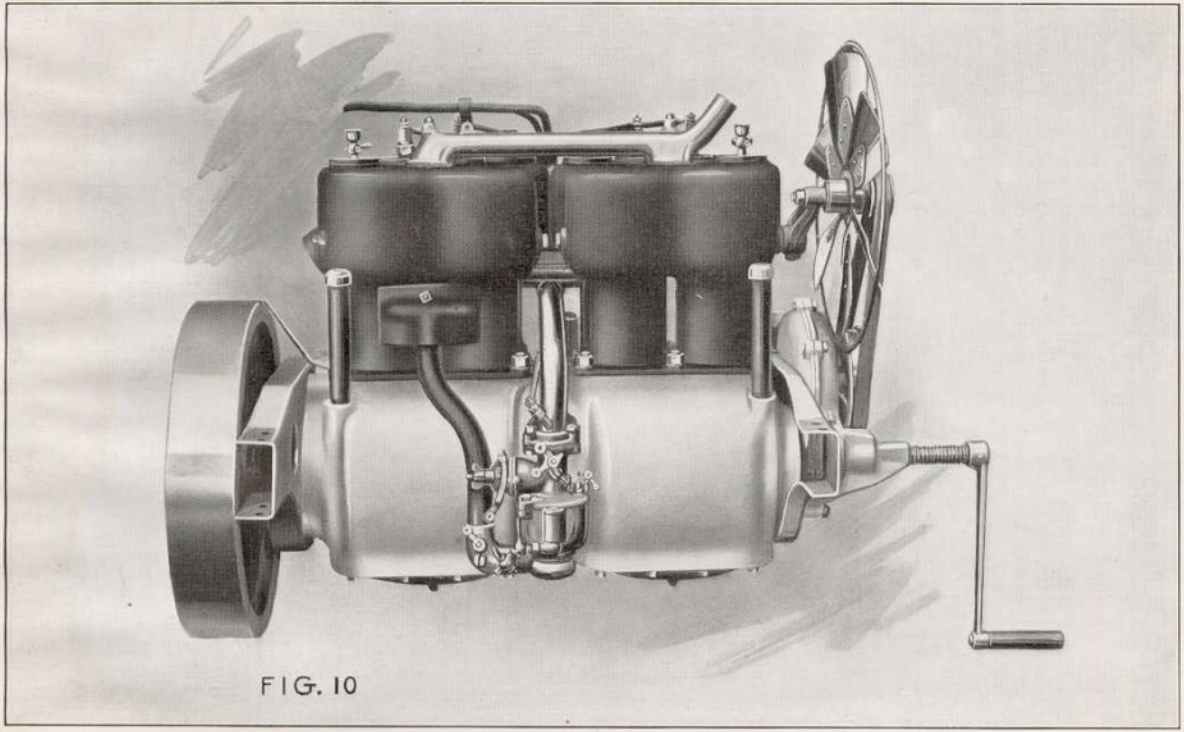


FIG. 10

Studebaker (E-M-F) "30" Motor—Right Side.

TO DRIVE CAR—*Continued*

the transmission mechanism remains inoperative as long as it is held in this position. If you try to shift gears without disengaging the clutch, you are trying to slip into mesh gears which are traveling at high speed, and are certain to injure the gear teeth.

Be careful to engage the clutch gently and without jerk. This is really very simply, and with a little practice you will soon do it correctly.

Also accelerate the motor *gently* so that you do not "race" it. Racing a motor loosens the bearings and other parts and will cause trouble and damage if continued for any length of time. (See "Care of New Motor," page 33.)

TO STOP CAR

Move hand throttle to lowest position. Remove foot from accelerator, disengage clutch by pressing forward the clutch pedal as far as it will go, and apply brakes by pressing the right pedal. If you desire to stop instantly, pull up hand brake lever. After car has come to a stop, while clutch is still disengaged, move the gear shift lever to neutral position and permit clutch to engage once more. The clutch is now turning with the motor, but the car is motionless because the gear shift lever is in neutral position. (See "Transmission System.")

TO REVERSE CAR

Never reverse until the car has stopped or you will damage the gears. Disengage clutch by pressing forward on the left pedal. Throw the gear shift lever into reverse position on the H Plate. (See Fig. 9.) Gently accelerate the motor and allow clutch to engage at the same time. (See "Transmission System.")

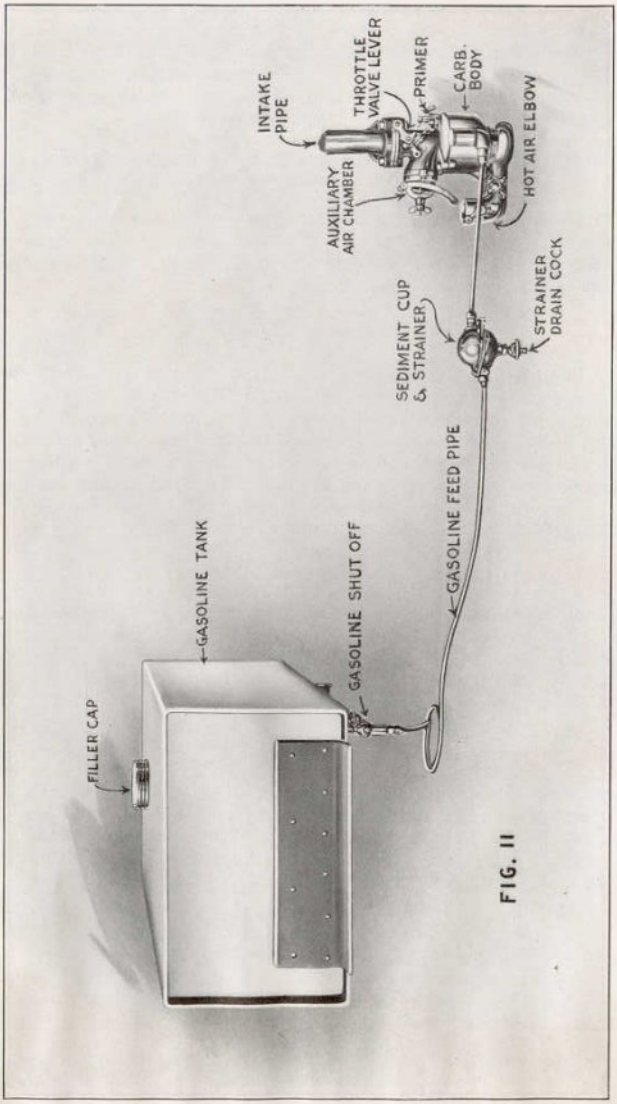
TO STOP MOTOR

Turn switch on coil to "OFF" position. This stops the electric current and prevents further ignition of the gas in the cylinders. Just as you turn the switch to "OFF," advance the throttle about three notches, and leave it advanced until motor has stopped. This fills the cylinders of the motor with gas and facilitates the starting next time.

Gasoline System

GASOLINE TANK

The gasoline tank is located under the front seat, or immediately to the rear of it, and has a capacity varying from 12 to 28 gallons, according to the model of car.



Gasoline System. Parts Numbers are shown—See Parts Price List

GASOLINE TANK—*Continued*

In filling, care should be taken that no dirt or foreign matter be allowed to drop into the tank. Gasoline should always be strained through a chamois. This not only frees it from dirt, but eliminates any water as well. A good point to remember is never to fill your gasoline tank while your lights are burning. The reason is obvious.

GASOLINE SHUT-OFF VALVE

The gasoline drain cock and sediment cup are located at the bottom of left side of tank. (See Fig. 11.) The sediment cup should occasionally be removed and cleaned. If you have any reason to believe that the gasoline contains any water, drain off some of the supply through the drain cock. The gasoline shut-off valve is in the copper gasoline line just as it leaves the gasoline tank.

GASOLINE FEED

The tank being higher than the motor, permits gasoline to be fed to the carburetor by gravitation. In case of an obstruction in the gasoline line, which, of course, can be detected by opening the drain cock in the carburetor, detach the copper pipe, both at the gasoline tank end and carburetor end, and thoroughly clean.

CARBURETOR

The carburetor is located on the right side of the motor, and is of the float feed type. (See Fig. 12.) It consists of a float chamber, mixing chamber, spray nozzle, float, auxiliary air valve and throttle valve. The gasoline flows by gravity from the gasoline tank into the float chamber through the needle valve.

The needle valve is controlled by a cork float, which rises as the float chamber fills with gasoline. The cork float closes the needle automatically when the gasoline is at the proper level in the float chamber. (See "Float.") The gasoline is drawn by the suction of the pistons through the spray nozzle into the mixing chamber or (technically known as) Venturi tube. Here it mixes with air which is drawn through the hot air intake pipe, the open end of which is placed close to the exhaust pipe.

The size of the hot air intake pipe and spray nozzle is so proportioned that the mixture of gasoline vapor and air is approximately correct. The finally corerct mixture is obtained through the auxiliary air valve, which is adjusted to admit just the correct amount of air. This consists of a vent and leather valve, which is controlled by a delicate spring so that the suction of the pistons automatically opens it wider. Adjustment of this auxiliary air valve is made by a threaded stem. (See "Auxiliary Air Valve.")

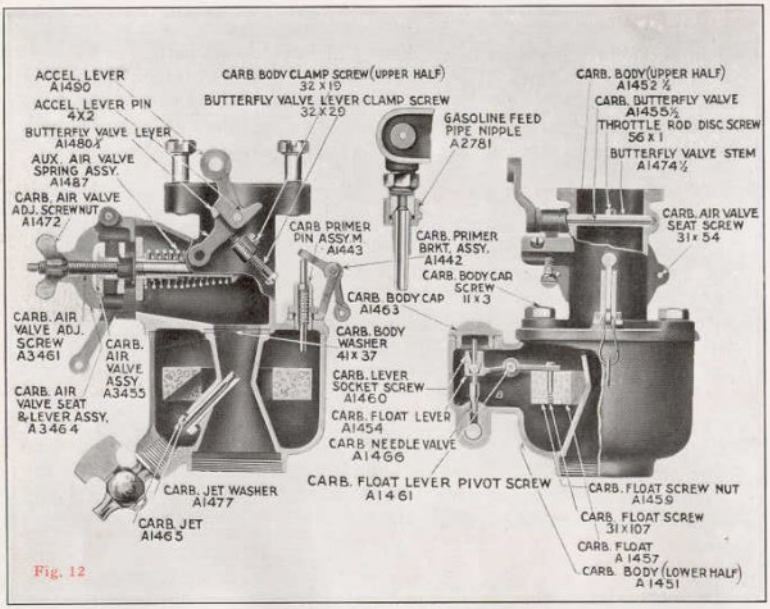


Fig. 12

Sectional View of Carburetor—Parts Numbers Are Shown. See Parts Price List.

CARBURETOR —*Continued*

The explosive mixture of gasoline vapor and air is admitted into the intake manifold through the butterfly throttle value, which is controlled by both the throttle lever on the steering post and by the foot accelerator pedal.

CARBURETOR—(1) Float

This is a U-shaped cork disc, covered with shellac to render it impervious to gasoline, which floats on top of the gasoline supply in the float chamber. Its function is to automatically open and close the needle valve which controls the inflow of gasoline. The float thus keeps the gasoline in the float chamber at a constant level, flush with the top of the spray nozzle. (See Fig. 12.)

The priming pin is devised to press down the float and permit the float chamber to fill with gasoline above the ordinary level, thus providing a "rich" mixture for starting the motor. If motor starts with difficulty, always press down priming pin until gasoline spurts out of the small hole in the top of the carburetor. Be sure that priming pin rises again after you release it. If it is caught in any way the carburetor will flood. (See Fig. 12.)

CARBURETOR—(1) Float—*Continued*

The needle valve is a cone-capped pin which is controlled by the float, and which opens and closes the gasoline feed pipe as the float falls or rises. (See Fig. 12.)

CARBURETOR—(2) Mixing Chamber

This is simply a tube in which air sucked from the hot air intake pipe, and the gasoline vapor sucked through the spray nozzle in a fine spray, come together and are mixed so as to form an explosive gas. (See Fig. 12.)

CARBURETOR—(3) Auxiliary Air Valve

This is adjustable, and makes it possible to regulate the amount of air in the mixture. The threaded stem merely changes the tension of the spring, and increases, or decreases, the amount of air admitted. (See Fig. 12.)

The adjustment of this auxiliary air valve, which is the only adjustment on the carburetor, is as follows:

Start the motor running and open the throttle about three notches on the sector. Loosen the locknut on the auxiliary air valve stem and screw the stem out several turns. This reduces the amount of air admitted and makes a "rich" mixture, because it increases the tension of the spring, thus holding the leather washer against the seat of the valve. Then commence unscrewing stem, and continue to turn it until you can open the throttle wide and hear a coughing sound in the carburetor. The throttle should suddenly be opened wide and closed again at different intervals of turning the stem in order to determine this result. This coughing sound means that the mixture is composed of too much air and not enough gas proportionately.

Now screw the stem in very slowly, testing with the throttle at every half turn, until you just reach a point where it is possible to open the throttle quickly and not hear the sound referred to above. This is the correct point of adjustment for driving. Tighten locknut on threaded stem.

The carburetor seldom needs attention, but if you have adjusted it and are in doubt as to the results obtained, consult a Studebaker dealer, or write direct to Service Department, of The Studebaker Corporation, Detroit, Mich., explaining your difficulty.

CARBURETOR—(4) Throttle Valve

This is controlled both by the hand throttle lever on the steering post and by the foot accelerator. It is of the butterfly type, and merely opens or closes the entrance from the carburetor to the intake manifold. The throttle valve should be adjusted so that when the hand or foot throttles are closed, the motor will just run evenly on all four cylinders. This can be ascertained by the regularity of the impulses in the exhaust when both the spark and throttle levers are set at their lowest positions. If the motor, however, should run too fast, or should stop when the

CARBURETOR—(4) Throttle Valve—*Continued*

throttle is at lowest position, adjustment is necessary, directions for which are as follows:

Loosen the locknut at set screw where throttle shaft enters carburetor. (See Fig. 12.) Place throttle in lowest position. If motor runs too fast, unscrew set screw so that butterfly valve in carburetor is closed a little tighter.

If motor runs too slow, screw in the set screw so that valve is held a little more open. Lock set screw with locknut after adjustment.

CARBURETOR—(5) Carburetor Drain Cock

This is located at the bottom of the float chamber, and is the lowest point in the gasoline system, consequently it is a place where water will locate should any be allowed to get into the gasoline tank. It is a good practice to drain off a little gasoline at intervals of about once a week. This will allow the water or sediment to escape.

CARBURETOR—(6) Flooding of Carburetor

If carburetor floods so that gasoline squirts out continually from vent, or runs out through the air holes placed in the hot air intake pipe, it is most likely that a particle of sediment is caught in the needle valve, preventing it from closing. This may be dislodged by tapping the outside of the carburetor around the needle valve. Open the drain cock at the same time. If this does not succeed, take off top of carburetor and remove the dirt. Dirt will not get there if you strain the gasoline through a chamois.

If there develops a slow leak, it is possible that the needle valve does not accurately seat and needs grinding or replacing. It also happens in rare cases that the cork float is set a trifle too high and it will be necessary to lower it in order to attain the correct level. (See "Float.")

CARBURETOR—(7) Hand Throttle and Foot Accelerator

The driver is given the choice of controlling the throttle valve by either the hand throttle lever or foot accelerator. Both have the same function and produce the same results. However the foot accelerator is best to use when driving through a crowded street, because the operator can then keep both hands on the steering wheel and regulate the speed of the car with his foot.

CARBURETOR—(8) Hot Air Intake Valve

This is a butterfly valve set in the hot air intake pipe, the function of which is to cut off the supply of air when starting the motor. There is a wire attached to this valve, one end of which passes through the front of the radiator, and which is to be pulled forward in starting the motor, especially when it is cold. To cut off this air, results in only raw gas being sucked up into the motor, which facilitates its starting, as this "rich" mixture will burn more readily than a "leaner" mixture.

CARBURETOR—(9) Auxiliary Dash Adjustment

Our later 1912 cars are equipped with an auxiliary dash adjustment to the carburetor, the function of which is to facilitate starting the motor. This adjustment consists of a yoke placed over the auxiliary air intake and operated through a lever at the lower part of the dash, just where the latter joins the foot board. When this lever is pulled up to the highest position, it holds the leather air valve against the air intake, thus closing the latter and preventing the entrance of cold air into the mixing chamber of the carburetor. This provides a good rich mixture in the cylinders which is ignited much more easily. After, however, the motor has become warm, the dash lever can be pushed down and the air valve will return to its normal position, which is proper for road service.

GRADE OF GASOLINE

There has been so much misunderstanding on the part of the average car owner in regard to the kind of grade of gasoline to use, that it is necessary to devote a little space to this subject.

The common standard, at least to the layman's mind, is gravity, such as 72 degrees or 64 degrees, etc., but this is not a true standard unless coupled with it is given the field from which the crude oil is produced. For instance, it is found that 62 gravity gasoline made from Ohio crude oil gives the best results. It is also found that 58 to 60 gravity gasoline is best if made from crude oil pumped in Kansas and Oklahoma. Gasoline showing 56 gravity made from Texas and California crude gives very excellent results, which all goes to show that a gravity test means nothing, and should not be used as a standard in speaking of the different grades of gasoline.

The real true test of gasoline is made by finding its initial and maximum boiling points. A grade of gasoline which has a low initial boiling point is quicker and more spontaneous, and if used, will greatly facilitate the starting of the motor. However, if this particular gasoline happens to have a low maximum boiling point, it will not develop as many heat units, or is not as satisfactory to use, as a gasoline which has a higher initial boiling point and also a higher maximum boiling point. This latter might cause difficult starting of the motor, but it contains more heat units and is cheaper and more satisfactory in the end.

Going into the matter a little more thoroughly, it is not difficult to understand what "boiling point" means, for it is nearly self-explanatory. It is the point on the Fahrenheit Thermometer at which a liquid will begin to boil. That is only the initial boiling point, and the refiner does not stop there. He distills a given quantity of gasoline, and while it is in process of distillation, ascertains at what point each 10% of the liquid will boil until the entire quantity has evaporated. In this manner, he determines not only the initial boiling point, but the maximum boiling point and all intervening boiling points as well.

GRADE OF GASOLINE —*Continued*

Consequently, the refiner knows and distinguishes gasoline not by *gravity*, but by *boiling points*. He knows it would be impossible to use the changing standard of gravity, but, knowing the boiling points, he can depend upon the quality of the goods.

In supplying yourself with gasoline, instead of attempting to buy it according to a gravity scale, and to pay an exorbitant price for some special kind or grade, purchase good gasoline sold by a reliable and responsible garage or supply store and manufactured by a distilling company of the same reputation.

General Principles of Ignition System

The purpose of the Ignition System is to supply an electric spark to each of the four cylinders. The spark is so timed as to ignite the compressed charge of gas at the correct instant. The current is supplied either by magneto or battery. The magneto produces a current which passes through a coil box on the dash which induces a secondary or high tension current that is carried to the spark plugs to make the spark. (See "Magneto.")

A series of four dry cells makes up the battery which provide a low tension current from which a high tension current is induced by the same coil on the dash. (See "Battery.")

BATTERY

This consists of four dry cells located under the rear seat or in the tool box compartment, according to model of car. They are used for starting the motor, and in case of emergency. The motor, however, can be started on the magneto. (See "To Start Motor.")

The dry cells require no attention except to see that the connections are tight and that they are not short-circuited by tools or anything of a metallic nature which might be placed near them. They should regularly be tested for strength. A set of dry cells should run from 500 to 1,000 miles, but their life will vary considerably. You will notice them growing weak by difficulty in starting, and, if possible, you should secure an ammeter to test them, which can be purchased at any Automobile Accessory Store. Any dry cell in the series which tests below six amperes should be discarded, as it makes the others practically valueless, and has the same effect on them as one bad apple placed in close proximity to three or four good ones.

In replacing the dry cells be careful to wire them as they come to you —one pole always connected to the opposite pole of another. (See "Wiring Diagram.")

MAGNETO

This is located on left side of motor and furnishes supply of electric current for the motor. It consists of two large iron magnets bent into a yoke which form a magnetic field. Between the poles of these magnets is an armature turned by the motor. In revolving, it repeatedly cuts at an angle the lines of force which pass between the poles of the magnets, and this induces an electric current in the copper wiring about the armature. This low tension current is short-circuited when the two platinum points of the low tension circuit breaker on the shaft are in contact. At the instant these two platinum points separate, the current is sent through the coil box or transformer on the dashboard, where it is stepped up to a high tension current.

It then returns to the distributor box of the magneto and passes in proper time to the spark plugs of each of the four cylinders. The cylinders of the Studebaker (E-M-F) "30" fire in the following rotation: Cylinders 1, 3, 4, 2—cylinder No. 1 being directly back of the radiator.

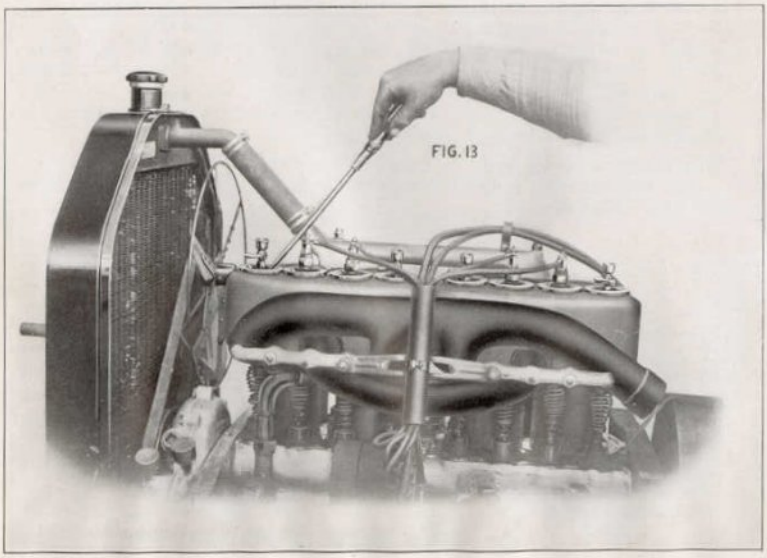
COIL

The coil is enclosed in a wooden box which is attached to the dash. There is no adjustment whatever and it should be left alone. Care should be taken that the coil is kept reasonably dry. If allowed to become very wet, the water is liable to get inside and injure it sufficiently to make it of absolutely no use. If, after careful investigation, you think you are having trouble with the coil, write to the nearest Branch, or to the Service Department, The Studebaker Corporation, Detroit, Mich.

When car is not in use, keep the switch on the "OFF" position.

SPARK PLUGS

Four spark plugs are used—one screwed into the motor over the inlet valve in each cylinder. Their function is to introduce the electric spark into the firing chamber of the cylinder. In order to do this, the plug is insulated and the end of it within the combustion chamber is provided with two points between which the spark jumps. These points should be separated by 1/32 of an inch, or about the thickness of a smooth



Short circuiting a cylinder to test its firing

SPARK PLUGS—*Continued*

dime. They should be kept clean and free from oil or carbon, as these will tend to short-circuit the plug and kill the spark, rendering the cylinder inoperative.

To clean the spark plug, it is usually best to use an old tooth brush and gasoline. If the insulation cracks, the plug becomes short-circuited and useless, and must be replaced.

To determine whether or not a cylinder is firing, start the motor and place a screw-driver, or some metal rod, between the terminal at the upper end of the spark plug and the cylinder wall. (See Fig. 13.) This short-circuits the cylinder. If it has been firing, the short-circuiting will make a perceptible slow up in the running of the motor, which indicates that the spark plug is O. K. If there is no change, test the spark plug as follows:

Unscrew the plug, and with wiring attached, lay it on its side on the cylinder. Start the motor and if the plug is good, you will see the spark jump between the points. If these are 1/32 of an inch apart and it refuses to give spark, your trouble is in the plug, or wiring to that plug, and should be cleaned or replaced. If plug proves good, the trouble is due to some other cause.

WIRING

The Ignition System is wired according to the Diagram. (See Fig. 14.) Care should be taken that the wires are kept clean and are not allowed to become covered with grease or dirt, also that the insulation is intact. It is advisable to go over the wiring occasionally and tighten up all of the terminals, as they sometimes have a tendency to become loose, due to the vibration of the car. If wiring is for any reason removed, be sure and replace it according to the Diagram.

SPARK LEVER

This is located on the inside or top of the sector and controls the time at which the spark occurs in the cylinder. When the lever is at lowest position, spark is retarded and occurs after piston has reached highest point of up-stroke and has started down. When the spark lever is advanced, spark occurs in the cylinders before the piston reaches the top of its up-stroke. When the motor is running fast, spark should always be fully advanced for the reason that the explosion of the gas by the spark is not instantaneous, and the advanced spark allows time for the fired gas to develop to maximum pressure at instant piston starts on its downward course. However, when the car is driven over rough roads, hills, sand, etc., or the motor is pulling hard, or at any time when the motor is running slowly, spark lever should be retarded about one-half way on the sector, as then the explosion occurs after piston reaches dead center and has started down. This position of the lever results in developing maximum power under the above conditions.

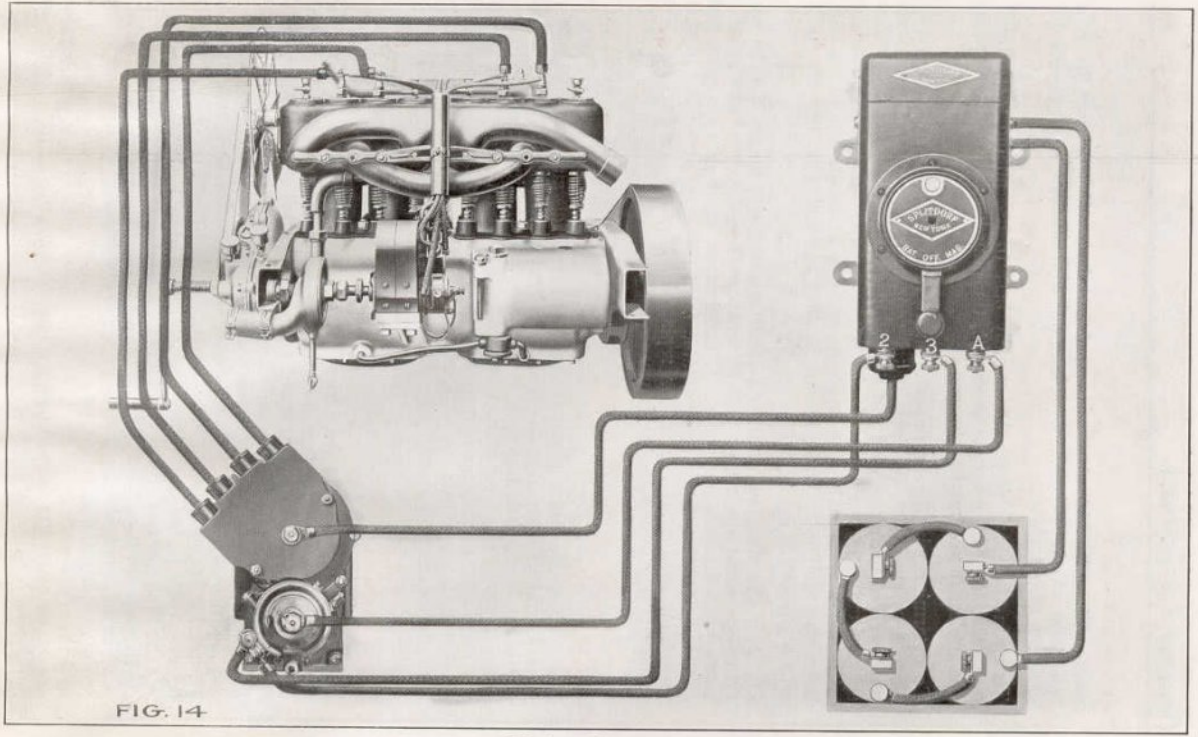


FIG. 14

Wiring Diagram

CARE OF MAGNETO

The magneto requires little or no attention other than keeping it clean from excessive oil and water. It should be oiled once a month with one or two drops of thin oil in oiler on armature shaft. (See Oiling Diagram.) Distributor box can easily be removed by taking off two small brass nuts on each side of the black rubber housing. When this is taken off, the inside should be carefully wiped out with clean waste moistened with gasoline.

The magneto requires only one adjustment, and should be left exactly as it leaves the Factory until motor has been run at least one season. Do not "fuss" with your magneto. Leave it alone. If you are in doubt about it take it to some competent repair man for any adjustment, or write to Service Department, The Studebaker Corporation, Detroit, Mich., for instruction.

ADJUSTMENT OF MAGNETO

After long use, the little platinum points in the breaker box may become pitted or dirty. In order to clean or reset them, follow the directions below:

Loosen small rods that connect the spark control, also set screw at bottom of the magneto. Remove cover of breaker box, which is held in place by a spring. Then the breaker box itself can be pulled out. Clean with gasoline and dry thoroughly before replacing. If the platinum points are dirty, clean with gasoline and dry. If the points are pitted, dress them smooth with a very fine file or piece of emery. Then have someone turn the motor over with the starting handle until the little cam on the end of the armature shaft has opened the two points at its widest, with breaker box fully retarded. There should be a clearance between them of just 1/32 of an inch, which is the thickness of a smooth dime. (See Fig. 15.) If this clearance is any more or less, it will be necessary to loosen the set screw, on one end of which is one of the platinum points, and set this screw either up or down, as it is necessary to make the correct adjustment and arrive at the clearance referred to above. Replace cover and spring and connect up the magneto according to directions of the Wiring Diagram.

TIMING OF THE SPARK

It sometimes is necessary to check up the timing of the spark relative to the marks on the flywheel. This is not necessary except in very rare cases, especially after the motor has been torn down and re-assembled incorrectly, so that the owner is in doubt as to whether or not the spark is being delivered to the different cylinders at the correct instant.

To ascertain the time of the spark, disconnect the terminal from No. 1 spark plug, and throw the switch over to the battery side, turn the motor over with the starting handle, and have someone carefully watch the markings on the flywheel. Note the exact point on the flywheel when the spark hops across from the wire to the plug. The spark should occur, with the spark lever fully retarded, about an inch after the dead center line on the flywheel is past the center of the rear cylinder.

TIMING OF THE SPARK—*Continued*

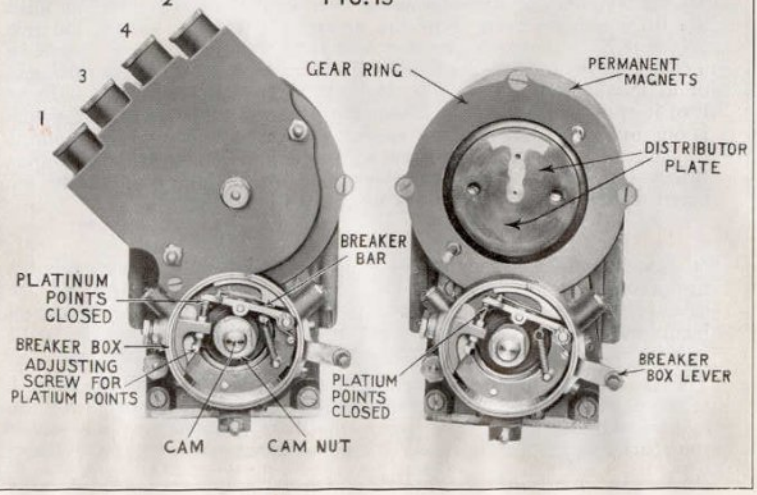
If you find that this is not the case, it is necessary, first, to examine the platinum points in the magneto and note as to whether or not they have the correct clearance. (See "Adjustment of Magneto.") If this does not remedy the trouble, it is necessary to remove the radiator, timing gear cover, and magneto and pump shaft gear. If the spark is timed too late, replace magneto gear, setting it one tooth to the right, and if the spark is timed too early, replace the gear one tooth to the left. (See Fig. 13.)

This paragraph is, primarily, meant for repair men, or owners, who are familiar with the dissembling and assembling of the motor, and we would not suggest that an owner who is not well posted or equipped to do this work attempt it, but take it up with the Studebaker Branch in his locality, or write for full instructions to Service Department, The Studebaker Corporation, Detroit, Mich.

TO REPLACE MAGNETO

In order to replace magneto, if removed, it is first necessary to turn the crankshaft over with the starting handle until you have the piston in No. 1 cylinder (first cylinder back of radiator) on dead center. This can be determined by opening up the exhaust cock on top of the cylinder and holding your finger over this cock until the motor comes up on the

FIG. 15



Magneto Diagram. Parts Numbers are shown—See Parts Price List

TO REPLACE MAGNETO—*Continued*

compression stroke, when, of course, there will be a rush of air out through the exhaust cock. Just at the instant when you can feel the air coming out, look at the flywheel and watch for the line marked "Dead Center." Continue to turn crankshaft over very slowly until this line is opposite the center of No. 4 cylinder. At this point piston is at dead center.

Put magneto on bracket, and connect up wiring in accordance with Wiring Diagram. Then place switch key in coil, and throw switch over to battery position. Disconnect terminal from No. 1 spark plug, hold it about 1/32 of an inch from top of plug, turn the magneto shaft with the fingers until spark jumps across the gap between the terminal of the wire and No. 1 spark plug. At the point where it jumps, magneto is set to fire in No. 1 Cylinder, and should be reconnected to pump shaft without turning the magneto shaft.

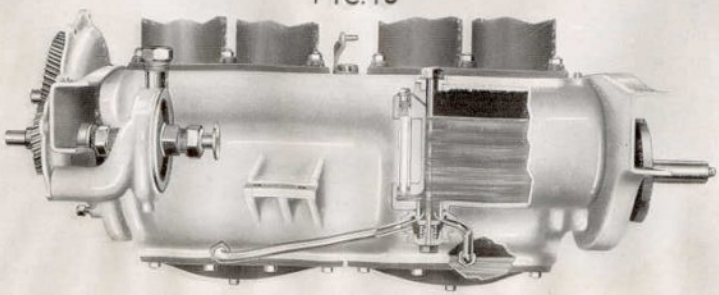
General Principles of the Lubrication System

The function of the Lubrication System is to automatically supply oil to the motor cylinders, connecting rods, crank shaft bearings, camshaft, and all parts within the crank-case and cylinders that require lubricating. It consists of a reservoir of ½ gallon capacity, and two pipes leading from this reservoir to the crank-case.

On the reservoir there is a gauge glass and on the top is a filler cap which is to be removed when it is necessary to fill the reservoir with oil. Under the filler cap is a long stem which extends down to the bottom of the reservoir and has on the lower end of it a leather washer or valve. (See Fig. 16.)

The motor oiler is absolutely automatic in its action, and requires no attention other than the making sure that it is kept supplied with oil and that the filler cap is screwed down tightly with a wrench. Two supply pipes run from the bottom of the oil reservoir and project through the side of the crank-case to a point about ⅝ of an inch from the bottom. As the motor uses oil from the crank-case compartments sufficient to uncover the supply pipes, air will bubble back into the oil reservoir, thus relieving the vacuum and permitting more oil to flow into the crank-case, maintaining automatically a constant level of the oil. The different parts of the motor are lubricated by the connecting rods dipping into the oil and splashing it all over the interior of the crank-case and cylinders.

FIG. 16



IMPORTANCE OF LUBRICATION

The importance of lubrication cannot be too strongly emphasized, and every owner ought to be absolutely sure that the oil reservoir is at least half full of lubricating oil. More troubles in an automobile have developed from lack of lubrication than from any other one item pertaining to its care. We wish to direct your careful attention to the Oiling Diagram at the back of this book, and, in our estimation, it is necessary that you follow it implicitly.

KIND OF OIL AND GREASE

There are many good oils on the market, and it pays, in the long run, to use only the very best quality of lubricants. We will not attempt to name all of the brands of oil which can be used satisfactorily in the Studebaker (E-M-F) "30" motor, but below is a list of the better known oils which we recommend:

"Polarine"
"Monogram V"
"Packard"
"Havoline"
"Harris"

For the transmission and rear axle, use heavy transmission oil, made by Cuyaga Co.; for the oil cups use cup grease; for timing gear case use heavy transmission oil; for the front and rear universal joints use cup grease.

WHEN AND WHERE TO OIL CAR

(See Oiling Diagram.) We recommend that you follow exactly the directions on this diagram for oiling the car.

CARE AND REPAIR OF OILING SYSTEM

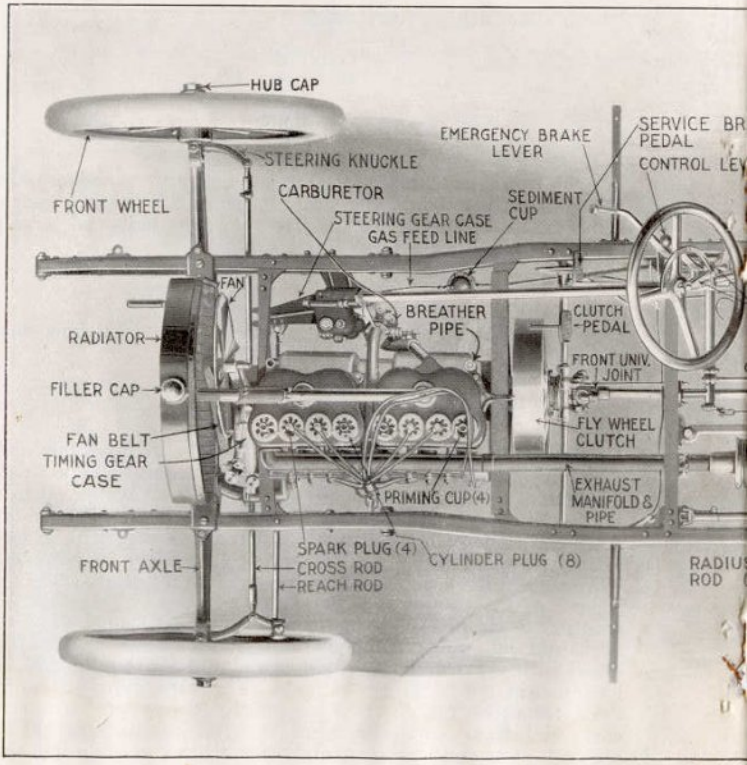
(A) Cleaning Reservoir and Crank-Case

Every month it is advisable to clean out the oil reservoir and crank-case. In order to clean the former, simply unscrew the pet cocks from the bottom of the hand-hole plates and allow all of the oil to run out. While the oil is running out, be sure to take off the filler cap and press down the stem with the finger. Fill the reservoir with kerosene and allow it to stand over night. Do not replace filler cap, however, as this will result in the kerosene running down into the crank-case.

In order to clean crank-case, remove the pet cocks and allow all of the oil to run out. Replace the pet cocks and pour two quarts of kerosene oil in each breather pipe. Start motor and allow it to run slowly no longer than ten to fifteen seconds. The connecting rods will splash the kerosene on the different parts inside the motor. Remove the pet cocks and drain out the kerosene, then, of course, refill the reservoir with oil, press down on stem, and after it has run down into the crank-case, refill it again so that you will have a good supply.

OILING SYSTEM—(B) Cause and Effect of Air Leaks

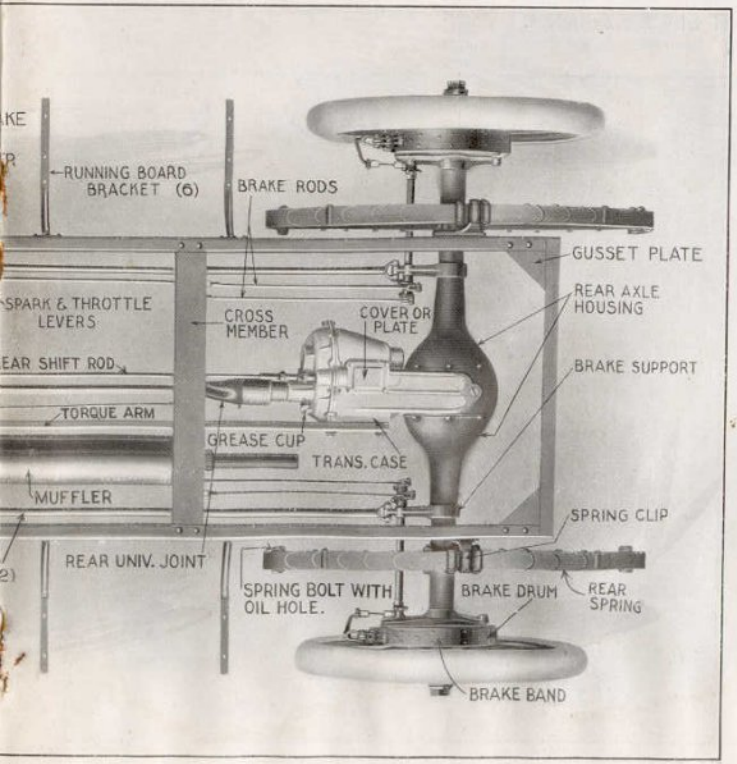
The proper operation of the vacuum feed oiling system depends entirely upon one thing, that there shall not be the slightest air leak in the oil reservoir or its connections. Such a leak will relieve the vacuum in the reservoir and allow too much oil to run into the crank-case. The result will be that the oil will be raised above its proper level, too much of it will be thrown around by the connecting rods, it will work up into the compression chamber of the cylinders, where it will burn and be ejected through the muffler in the form of smoke. This is not only disagreeable, but results in too large a consumption of oil per mileage of the car. More important, however, it causes a large amount of carbon to be deposited on the pistons, piston rings, valves, etc. (See "Carbonization of Motor," page 35.)



OILING SYSTEM—(C) Location and Repair of Leaks

If you find that the consumption of oil is out of the ordinary, and also that the car is smoking, the trouble without doubt is due to an air leak. This, however, only happens in rare cases. The most likely place for such a leak is around the washer under the filler cap, the cork washers at the top and bottom of the sight gauge glass, or in the connections between the reservoir and crank-case.

We would recommend that you examine these points very carefully, and if necessary install new washers and also tighten up all of the connections. If you do not find any evidences of a leak in the points mentioned, a positive way to locate same is to remove the dust pan, draw off the oil from the crank-case, remove the hand-hole plates and plug up the ends of the oiler pipes in the crank-case. Fill the reservoir with



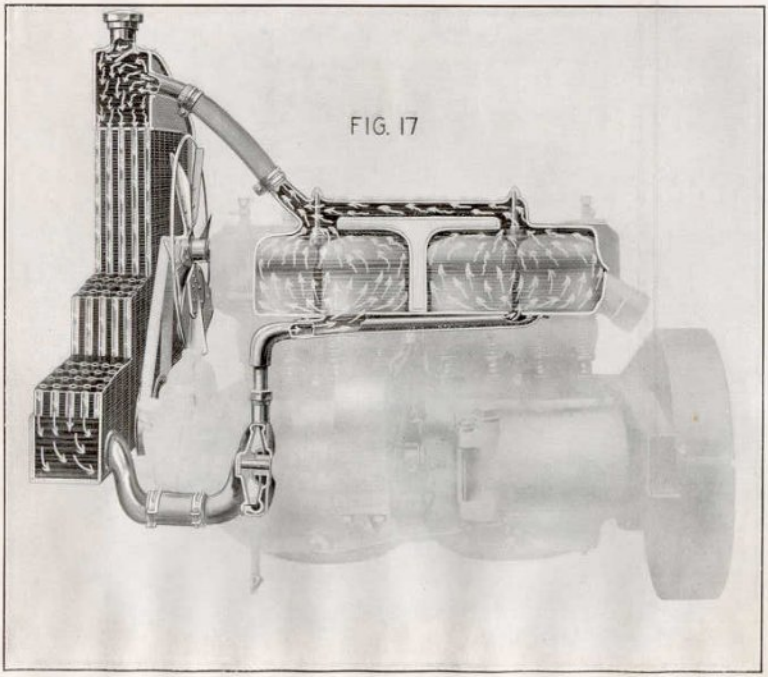
Diagram

gasoline, allow it to run down into the pipes by pushing down on the stem, and the leak can be readily located by the gasoline oozing out. If trouble cannot be located, write to nearest Studebaker Branch, or to Service Department of The Studebaker Corporation, Detroit, Mich.

Motor Cooling System

WATER SYSTEM—(A) General Principles

There is a great amount of heat generated by the explosions in the cylinders and by the friction of the moving parts, which necessitates some method for cooling the cylinders, as otherwise the motor will overheat and lose power rapidly. (See "Overheating of Motor," page 51.) Water is used for this purpose in the Studebaker (E-M-F) "30." The water system, which contains 14 quarts, consists of a radiator, hose connections, water line pipes, pumps, and water jackets which are incorporated with the cylinders.



Water System

WATER SYSTEM—(A) General Principles—*Continued*

The radiator being filled with water and the motor running, the centrifugal pump forces the water to circulate as follows: From the pump it is driven through the lower water line into the cylinder water jackets. Here it absorbs the heat and goes on to the upper water line and thence to the radiator. In the radiator it percolates slowly down through many fine tubes and is cooled by the air rushing through the fins surrounding the tubes, and thence returns to the pump.

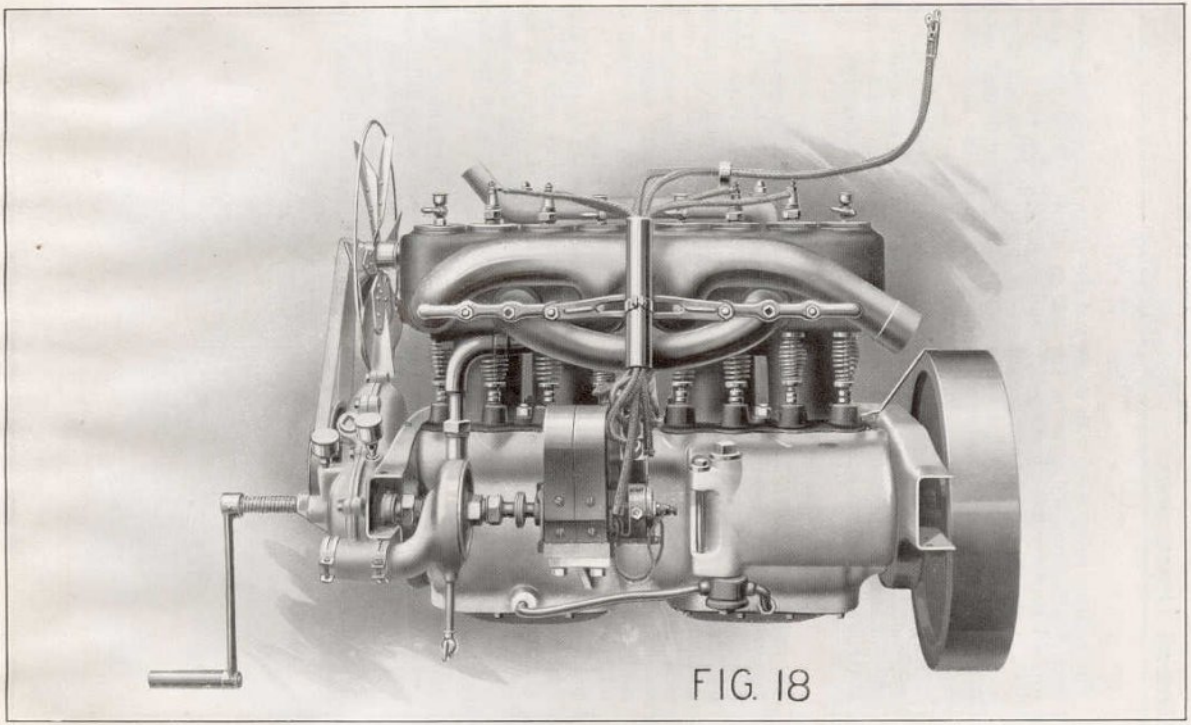
The action of the air through the radiator is facilitated by a fan on the front of the motor which is rapidly turned by a belt, connected to a pulley attached to the front of the camshaft. This fan tends to pull in the air through the radiator and assists in the cooling operation.

WATER SYSTEM—(B) Radiator, Pump and Fan

The radiator of the (E-M-F) "30" is of the tubular type. It needs to be kept full of clean, "soft" water. There is a pet cock at its lowest point, and through it the system should be drained occasionally. If the radiator fills with sediment from the use of dirty or "hard" water, it should be cleaned with a strong solution of soda. Pour this in and let stand over night, after which, allowing motor to run for a few minutes in the morning, drain radiator and fill with clean, "soft" water. Be careful not allow any oil to be mixed with the water, as it tends to interfere with radiation.

The pump is of the centrifugal type and requires no attention other than to be careful it is not allowed to become choked through the use of dirty water. On the pump shaft on each side of the pump are two stuffing boxes which prevent leakage of water. These should occasionally be tightened, and if any serious leakage does occur, renew the oiled packing.

The fan requires no particular attention, except that it be oiled. (See Oiling Diagram.) It sometimes happens that the belt gets a little loose and causes the fan to slip and not be turned as rapidly as it should. If this is the case, loosen the nut which holds the eccentric arm of the fan, raise the arm slightly and retighten the nut. This will tighten up the belt.



Studebaker (E-M-F) "30" Motor—Valve Side

Important Features of Motor and Suggestions

CARE OF NEW MOTOR

It is necessary to handle a car with a new motor more carefully than one which has been run for some time. This is due to the fact that the bearings are fitted rather tightly, and if the motor is run continuously at a high rate of speed, overheating and possibly a burned bearing will result. Do not under any conditions "race" a new motor unnecessarily. Therefore, to forestall any trouble of this nature, pour a little extra oil into the crank-case through the breather pipes when starting to drive a new motor, which will provide it with sufficient lubrication.

LOSS OF COMPRESSION

Compression is made by the ascending piston compressing or forcing the gas into a small space between the top of the cylinder and the piston at the highest point of upward travel. It is quite important that this compression should be equal in all the cylinders and up to the proper standard. It should be tested occasionally by opening the pet cocks and turning the motor over, noting the resistance in each cylinder, and with this in mind, closing them and ascertaining whether or not one cylinder is a little weaker than the others. If such is the case, have the valves ground, as they have probably become coated with deposits of carbon and are not seating properly. (See "Grinding Valves.")

There is also a bare possibility of the trouble being due to the fact that there is no clearance between the push rod and valve stem of the intake and exhaust valves of that particular cylinder, which would not allow the valve to close tightly, thus allowing the compression to escape. (See "Adjusting Valves.")

VALVES—(A) Inlet and Exhaust

There are eight valves—two for each cylinder. These valves are operated by a camshaft which turns in the crank-case, and, by reason of the accurate grinding of each cam, raises or lowers the valves at precisely the correct interval. (See Fig. 21.) The head of the valve is a round disc, the under rim of which is beveled. This fits closely into a concave in the cylinder wall. As the camshaft raises the inlet valve 9-32 of an inch, the gasoline mixture from the carburetor enters. The camshaft turning permits the valve to lower again, which is accomplished by the pressure of a spring attached to the valve stem in plain sight on the left-hand side of the motor. The bevel rim of the valve top fits in the concave seat perfectly, so that no gas can escape, and the compression in the firing chamber is at all times maintained.

The exhaust valves are identical in appearance and operation, merely rising at different intervals and permitting the exploded gases to be driven out by the uprising piston into the exhaust manifold and then into the muffler.

VALVES—(B) Grinding Valves

It is necessary sometimes to grind the seat of the valves so that the head will accurately fit. When the motor is new, this is very rarely necessary, but after it has been run for some time, carbon is deposited on the valves and after long use they may become pitted.

Remove spark plugs and exhaust cocks and turn out the valve cap or plug into which they fit. A wrench is provided for this purpose. Fill up the opening leading from the valve chamber into the cylinder with waste to prevent dirt falling into cylinder. This is very important, but be very careful not to allow any waste to fall into the cylinders.

REMOVE VALVES

Then raise the spring retainer No. 135 with valve lifter No. 1322, and pull out retainer pin A-4x10. The springs can then be withdrawn and the valves lifted out. Smear the valve seat and the valve with a valve grinding paste, which usually consists of flour of emery and oil, or powdered glass and oil. Replace the valve in the cylinder and rotate it back and forth with a valve grinding brace, which you can secure from your dealer, or the nearest Studebaker Branch, by ordering Part No. S1083. Remove the valve at brief intervals and examine it to note whether or not you are getting a perfect seat. When finished, remove valve and all traces of the valve grinding paste with gasoline. Do not forget to remove waste. Replace valve, spring, retainer and adjusting nut.

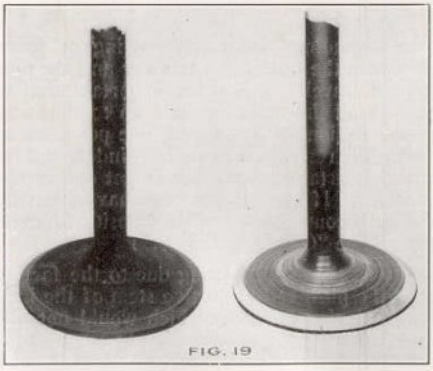


FIG. 19

Dirty Valve before Grinding—Valve after Grinding

E-M-F VALVE ADJUSTMENT

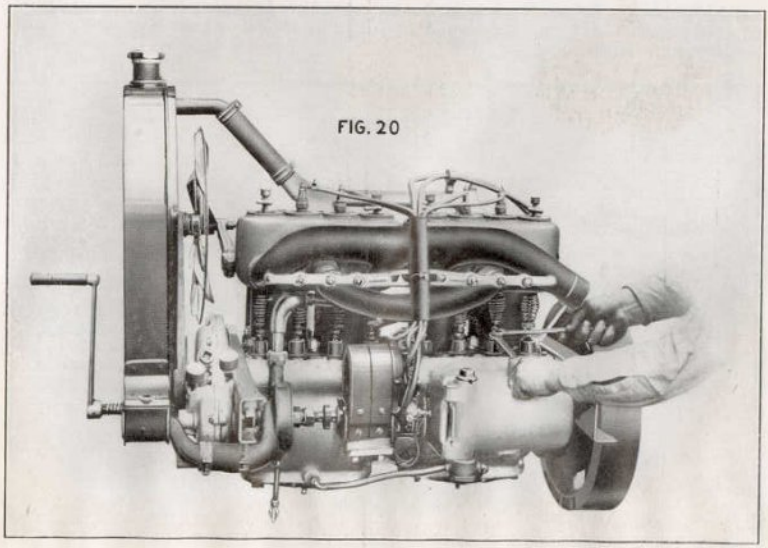
The clearance space between the push rod and valve stems should be about .003 on the inlets and .004 on the exhaust valve. To ascertain if this is correct detach the wire from No. 1 Spark Plug, open all exhaust cocks, and with the switch thrown on battery side, turn the motor over slowly until the spark is obtained on No. 1 cylinder. Both valves will then be seating or at their lowest position. A piece of ordinary letter paper is .003 of an inch thick and if the space above referred to is more or less than this, loosen the jam nut on the push rod No. 26 X2 with a wrench, No. 2892, holding the push rod during this operation with special wrench 5 Z114, then turn the adjusting screw

E-M-F VALVE ADJUSTMENT—*Continued*

out until the space between this screw and the valve stem is just sufficient to allow the passage of a piece of letter paper, and secure the lock nut again in position; go over all eight valves in this manner and after spinning the motor a number of times, check these over thoroughly to see that no mistake has been made before starting the motor. It would be advisable to have the motor warm, as it will be in actual road service when this adjustment is made.

CARBONIZATION OF MOTOR—(A) General Indications

If you note that the motor is overheating easily, has weak compression and develops a "knock" or "clank" when on a hard pull or going up a grade, there is probably a large deposit of carbon on the cylinders, piston, and in the compression chamber. This may be due to the use of poor lubricating oil or incorrect adjustment of the auxiliary air valve of the carburetor. (See "Carburetor.") Even though it is not affected by these two conditions, a small residue of carbon will adhere to the interior of the compression chamber and head of the piston, and if left for a great length of time, will develop the trouble mentioned above.



Adjusting Valves

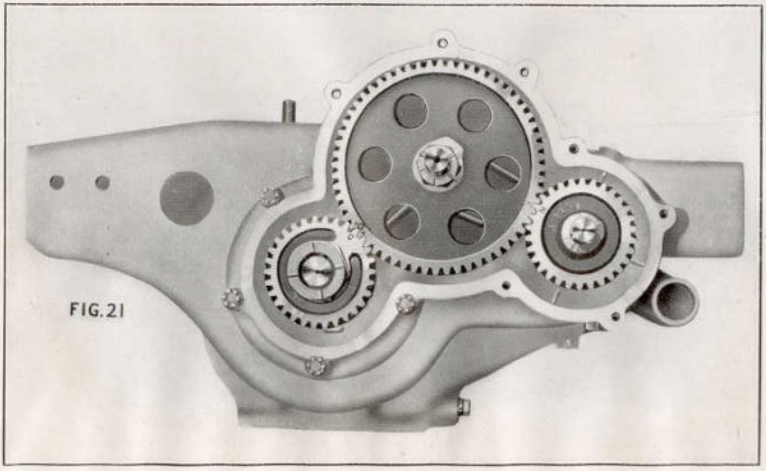
CARBONIZATION OF MOTOR—(B) Remedies

In the first place, it is an excellent plan about once a week to inject two or three oil-guns full of kerosene into the auxiliary air valve of the carburetor when the motor is running at a medium rate of speed. The kerosene will be sucked up into the cylinders along with the gas from the carburetor and will clean out the compression chamber and be exhausted out through the muffler along with the fired gas.

It is a good plan to occasionally introduce about five tablespoonfuls of kerosene into each of the cups above the valves when the motor is warm. Permit this to remain in the compression chamber for about five or ten minutes and then start the motor. The kerosene will have softened the carbon, and by the action of the motor it will be thrown out to a considerable extent and the compression chamber and pistons cleaned. If there is a great deal of carbon deposit, it will be necessary to lift the cylinders and scrape the pistons and cylinders. There are also several carbon removers advertised and sold by accessory stores which have proven satisfactory.

TIMING GEARS

These consist of three spiral gears running in an aluminum housing on the front of the crank-case of the motor, which are sometimes called half-time gears. (See Fig. 21.) One gear is fastened on the end of the crankshaft and turns a gear which operates the camshaft. The camshaft gear in turn operates a third gear which drives the pump and magneto shaft.



Timing Gears—Showing Marks for Proper Setting

TIMING GEARS—*Continued*

The pump and crankshaft gears are of the same size and turn at the same rate of speed. The camshaft gear is twice the size of the crankshaft gear, because each valve opens only once every two revolutions of the crankshaft (see "Principle on which Gasoline Automobile Works") making it necessary that the camshaft turn only half as fast as the crankshaft.

These gears require no attention except proper lubrication. (E-M-F timing gears require non-fluid oil.) If at any time it is necessary to remove them, consult a Studebaker Dealer, or write to the Service Department of The Studebaker Corporation, Detroit, Mich., for proper instructions.

Transmission System

CLUTCH

The clutch is directly in the rear of the crank-case and fits in the fly-wheel. It is an aluminum spider with a rim which is shaped like the rim of a cone and reminds one of a narrow section of a large flower pot. This cone is attached to the drive shaft leading to the rear axle and connects the motor and transmission mechanism.

A heavy spring is used to press it hard into the fitting section on the inside rim of the flywheel. The cone is faced with leather, which grips this inside rim, holding both tightly, and as the flywheel revolves with the crankshaft, the clutch and drive shaft also revolve. Under the leather face of the clutch is a series of flat springs which allows it to engage gently.

In order to disengage the clutch, it is necessary to press down upon the foot pedal at the driver's seat. This presses back the spring, the leather faced cone slips back from the flywheel and the flywheel

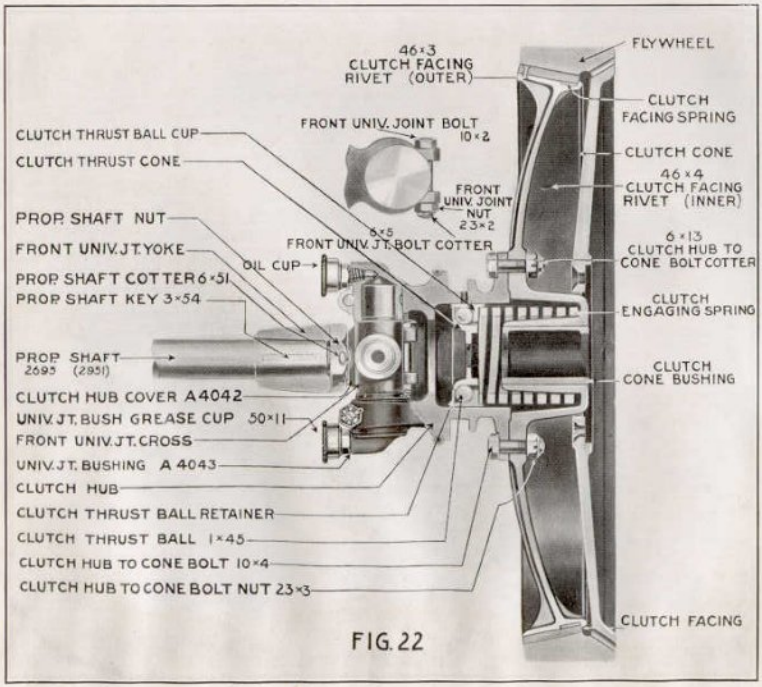


FIG. 22

Showing Parts Numbers—See Parts Price List

CLUTCH—*Continued*

revolves without the cone and drive shaft turning. It remains in this position—disengaged—as long as the driver presses down upon the foot pedal.

CLUTCH—(A) Care

The clutch leather should be treated occasionally with a little Neatsfoot or Castor Oil. Never use lubricating oils on the leather as they will cause it to slip. The clutch bushing is oiled by an oil lead from the rear main crankshaft bearing, which in turn is lubricated by the splash in the motor. (See "Lubrication System.")

CLUTCH—(B) Remedies for Clutch Troubles

If the clutch slips, clean the facing thoroughly with kerosene and apply Neatsfoot Oil. This same remedy can be applied if the clutch becomes dry and "grabs."

TRANSMISSION GEARS—(A) General Construction

From the clutch the drive is taken by a propeller shaft equipped with a universal joint at either end to the gear case just forward of the rear axle. Within this aluminum case are housed the transmission gears. The function of the transmission is to increase the pulling power of the motor by giving it, through the changing of gears, a greater leverage on the rear wheels. This is necessary, as the same power for starting the car and for going over heavy roads and up hills need not be used when driving over a smooth road or pavement.

The Studebaker (E-M-F) "30" transmission is of the sliding gear type and has three speeds forward and one reverse, as follows:

"First," or "low," speed is geared at the ratio of 12½ to 1. In other words, when the hand lever is thrown into the first speed slot, gears in the transmission are meshed so that it is necessary for the crankshaft in the motor to turn twelve and one-half times in order that the rear wheels turn once.

"Intermediate," or "second," speed is geared 7 to 1; "high," or "third," speed is geared 3½ to 1, and "reverse," is geared 17 to 1.

The transmission which provides this gear reduction consists of a countershaft, on which are four gears of different sizes—the main drive shaft upon which are two sliding gears of equal size, and a small gear attached to the side of the transmission case, by itself, which is called an "idler" gear and is brought into action when making the proper gear reduction for reverse.

TRANSMISSION GEARS—(B) Action of Gears

You will note from the picture that the large gear on the front end of the countershaft is always in mesh with the small pinion gear on the end of the drive shaft. The power from the motor is carried through the clutch and propeller shaft to this pinion which delivers it to the

TRANSMISSION GEARS—(B) Action of Gears—*Continued*

large gear on the countershaft, consequently, with the clutch engaged, the motor running, and the hand lever in neutral, the propeller shaft is turning, but the main drive shaft on which are the sliding gears is idle. (See Fig. 25.)

When the operator throws the lever into "first" speed, he pulls back the sliding gear in mesh with the third gear on the countershaft. This results in the sliding gear turning, which, of course, turns the main drive shaft and the rear wheels. (See Fig. 25.) In the same way, when the operator throws the lever into the slot marked "Intermediate," the front sliding gear is thrown in mesh with the second gear on the countershaft. (See Fig. 25.) When he throws the lever into "high" speed, the front sliding gear does not mesh with any gear on the countershaft, but is connected directly to the pinion on the end of the propeller shaft by jaws and turns the drive shaft without the power going through the countershaft. (See Fig. 25.)

When the lever is thrown into "reverse" speed, the rear sliding gear, instead of meshing with one of the gears on the countershaft, is thrown in mesh with the "idler," which is in mesh with the small, or fourth, gear on the countershaft, and, there being an odd number of gears in mesh, the drive shaft turns in the opposite direction and the rear wheels turn backward, instead of forward. (See Fig. 25.)

You probably will never find it necessary to use "first" speed except in starting from a standstill or on the most severe road conditions. The car should be run as much as possible on "third" speed, but whenever on heavy roads, steep hills, or when driving in congested traffic, do not be afraid to use your "second" speed, as it is there for that purpose. In fact, it is much better to change into "second" speed when the engine is laboring under and unnatural load than to cause undue wear and tear on the transmission and universal joints by remaining in "first" speed.

TRANSMISSION GEARS—(C) Care Necessary in Changing Speeds

In shifting gears, it is always necessary to disengage your clutch by pressing left pedal to the extreme point. You will find yourself only half releasing clutch if you do not use care and acquire correct practice. Shift the gear lever without timidity and with a quick, rapid movement. In passing from "first" to "second" speed and from "second" to "third" speed, do not accelerate motor while clutch is released. It should slow down a trifle between each shift. In stepping down, however, from "third" to "second" or from "second" to "first," accelerate your motor very gently while clutch is released in order that the gears which must engage together may be traveling at approximately the same speed. It is good practice to shift from "first" to "second" and from "second" to "third" with the palm of the hand out so that the natural push of the arm will swing the gear lever where it should go.

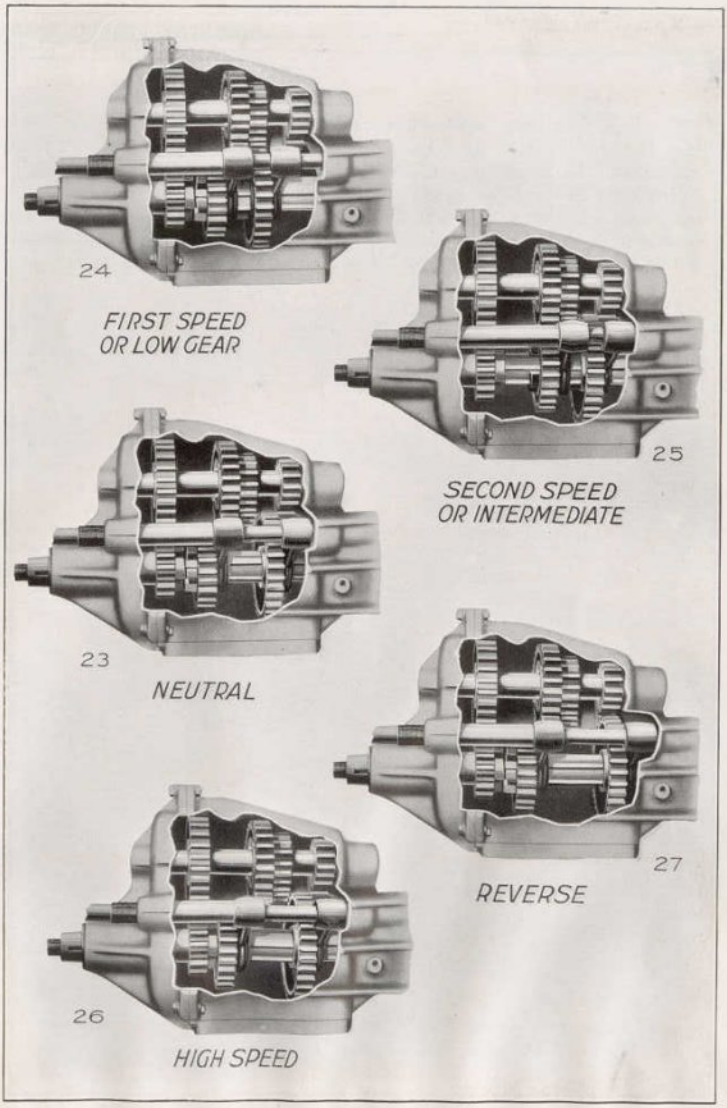
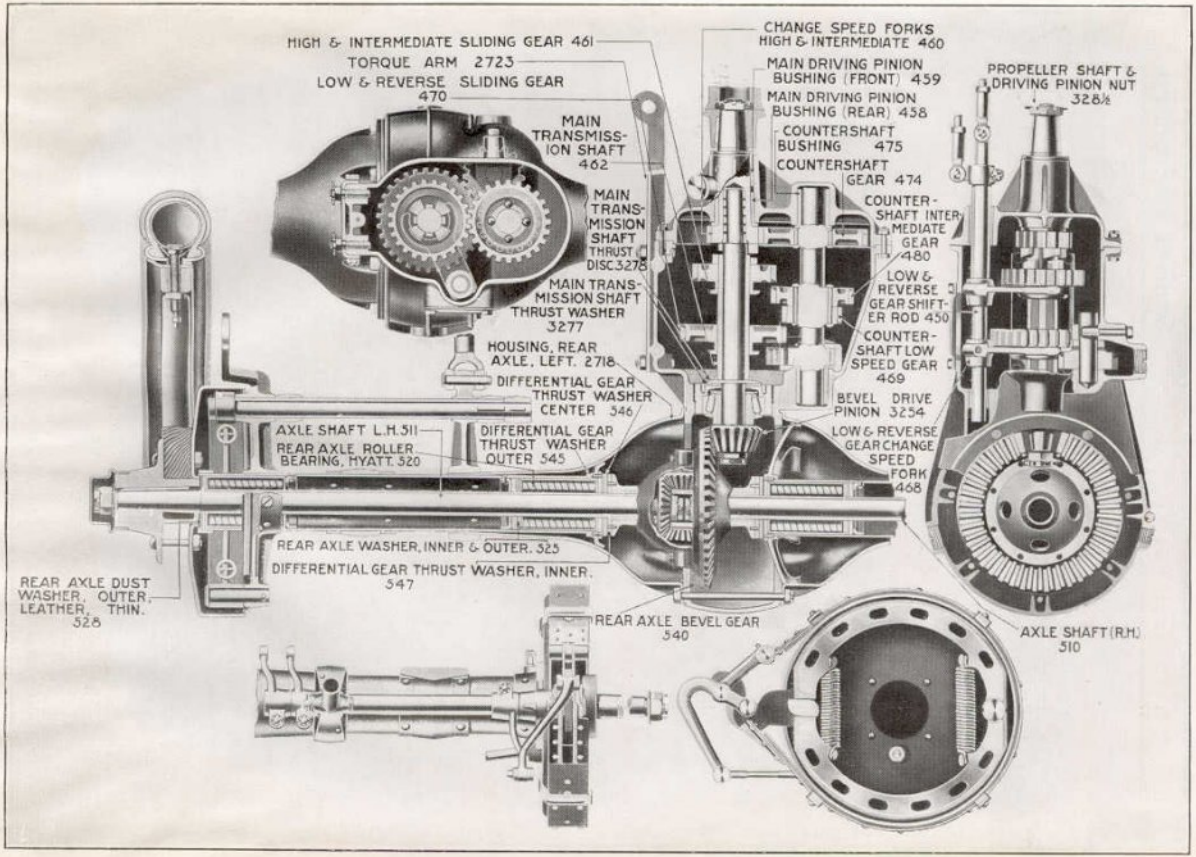


Illustration showing actual position of transmission gears in the different gear shifts

UNIVERSAL JOINT

The universal joint, sometimes called the "Toggle" joint, is a device for the transmission of a rotary motion between the clutch and transmission. The Studebaker (E-M-F) "30" is equipped with two universal joints, one at the forward end of the propellor shaft where it is attached to the clutch, and a second at the rear end where the propellor shaft connects with the primary drive shaft. These need no attention except to be kept well covered and lubricated. (Note oiling diagram.)



Showing Parts Numbers—See Parts Price List

Rear Axle and Running Gear

The rear axle, not including the transmission, consists of a drive pinion and ring gear, differential gears, rear axle shafts, all of which are enclosed in two housings, and rear wheels, brakes and tires. The rear axle is geared 3½ to 1 on direct drive and is of the semi-floating type. The axle shaft run on Hyatt Roller bearings.

PINION AND DRIVE GEAR

The pinion is on the rear end of the main drive shaft and is in mesh with a large ring gear which is bolted to the housing containing the differential. The power delivered to the main drive shaft through the medium of the sliding gears is transmitted to the ring gear which turns the rear axle and rear wheels.

The drive shaft, on which the pinion gear is keyed, turns in a Timken Roller bearing which is held in a large, hollow, retaining nut. This nut is threaded, allowing it to be screwed or turned in the rear axle housing. (See "Adjustment of Drive Pinion.")

DIFFERENTIAL

Since an automobile is not pulled but is driven by power transmitted to the rear wheels, it is essential there be some device whereby one wheel is allowed to turn faster than the other, which action takes place in turning corners, etc. This device is known as the differential and consists of six small gears enclosed in a housing within the large ring gear. The six gears which make up the differential are of two different sizes—four small bevel gears placed on a cross piece in such a position that they are not in mesh with each other and two larger gears which are keyed to the ends of the drive shafts.

The two larger gears are placed in mesh with the four smaller gears, and the whole is enclosed in a housing. The two drive shafts project out of each side of this housing, and the ring gear is bolted to it. By such an arrangement of gears, it is possible for one wheel to turn slower than the other, and even for one to turn in one direction while the other is turning in the opposite direction.

The differential assembly being bolted to the inside of the ring gear consequently must move with it, but just as soon as it is necessary for one shaft to turn slower than the other, it is enabled to do so through the action of these gears, even though the ring gear is turning at a greater speed.

This is rather difficult to explain clearly to the average man, but with the assistance of the picture on the opposite page you can better understand the operation.

The differential requires no adjustment, and it is only necessary to keep it properly lubricated. (See "Oiling Diagram.")

ADJUSTMENT OF DRIVE PINION

It is necessary that the drive pinion and ring gear be in correct position relative to each other in order to eliminate any noise which might result if not correctly meshed. This adjustment is made at the factory, and, except in rare cases, is not necessary to change.

The drive pinion can be moved forward or backward slightly by screwing in or out the retaining nut mentioned above. In order to do this, it is necessary to remove the cover from the transmission case, together with the countershaft and sliding gears and after loosening the retainer screw 4494, turn the adjusting nut 478 back or forward until the most silent position is obtained. A special wrench No. H8Z1885 is used in making this adjustment.

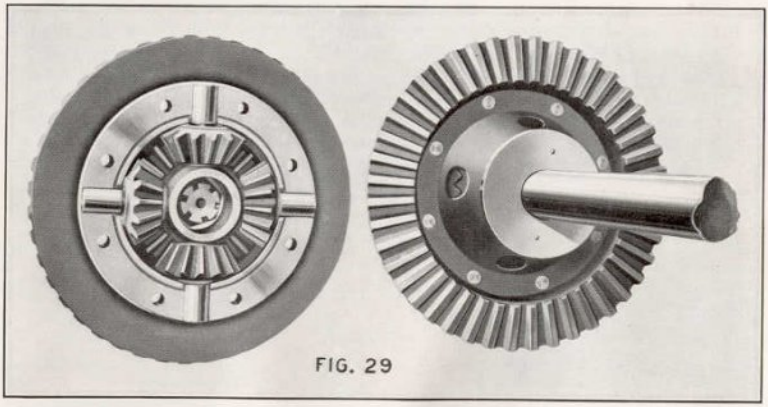


FIG. 29

Differential and Ring Gear shown with differential housing removed and assembled

BRAKES

These are two in number, operating on each wheel. The service brake is controlled by the foot pedal and consists of a band lined with asbestos contracting on the hub drum.

The emergency brake is controlled by the hand emergency brake lever and consists of two cast iron shoes which expand against the inner rim of the hub drum. (See cut on page 43.)

BRAKES—(A) Care

The service brake should be kept clean and free from grit, dirt or oil. Both brakes should be so adjusted that when pushing down on the foot lever, or pulling back on the emergency lever, equal braking power will be delivered to each wheel. If not, the brake will not only tend to wear quite rapidly, but will also shorten the life of the tire on the wheel.

BRAKES—(B) Adjustment

The service brake is operated by a foot pedal from which a long rod passes back to a transverse bar on the chassis directly beneath the tonneau. This brake bar is equipped with individual levers at either side, to which are attached additional rods, which connect with the service brake tubes on the rear axle.

The adjustment of these brakes is through the clevis at the forward end of these individual brake rods where they are attached to the transverse bar beneath the tonneau. This is accomplished by removing the pin which secures the clevis to the operating lever and tightening it up the required amount to make the brakes engage equally and positively.

TIRES

The tires on the Studebaker (E-M-F) "30" are 30 x 3" on the front wheels and 30 x 3½" on the rear wheels. They should be kept inflated to sixty-five pounds pressure. You can obtain a pressure gauge from any accessory or tire store. The cause of 75% of tire troubles is underinflation, and to keep your tire expense at a minimum, see that they are inflated regularly to the above pressure. Tires should also be kept free from oil and heat as much as possible.

Front Axle

The front axle is an "I" beam drop forging and requires no attention except lubrication. (See "Oiling Diagram.")

STEERING GEAR

The steering gear is the worm and sector type. It is irreversible, which means that the front wheels are locked by the steering wheel and no shock or blow from the road can move them. The only way in which the direction of the wheels can be altered is by the intent of the driver, so it is not necessary for him to rigidly hold the steering wheel. This eliminates any chance of accident due to the wheels being turned one way or the other by rough places in the road.

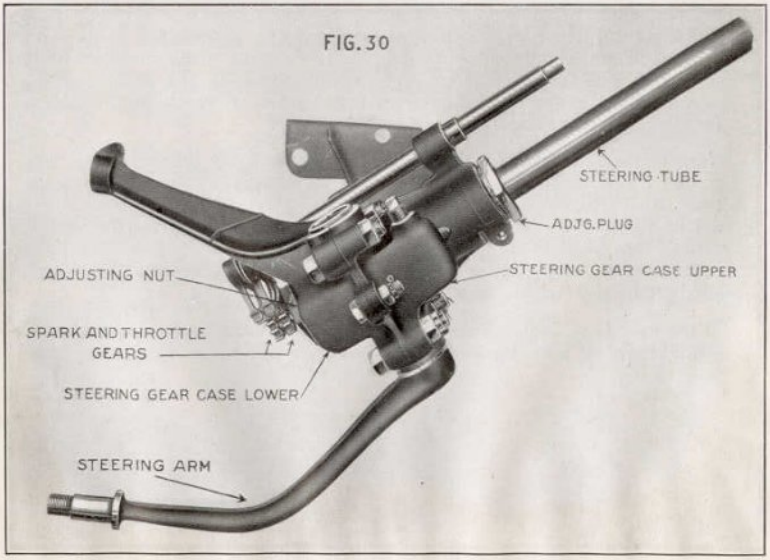
STEERING GEAR—(A) Care

The steering gear requires no care except to see that it is lubricated. (See "Oiling Diagram.")

STEERING GEAR—(B) Adjustment

After having driven the car for some time, it is possible that a little back lash or play will develop in the steering gear, which should be corrected as follows:

FIG. 30



Steering Gear. Showing Parts Numbers—See Parts Price List

STEERING GEAR—(B) Adjustment—*Continued*

First block the front end of the car clear of the floor so that the weight is removed from the front wheels and they can be moved readily with the steering wheel. Then remove your under tray and disconnect the steering arm from the reach rod back of the front axle. Then tighten up the large hexagon nut at the top of the steering gear housing. This will take up the end play at this point and remove the lost motion from the steering wheel. It is possible in cars that have been driven for a long period, the steering gears of which have been subjected to undue strain, that the sector which is riveted to the steering arm may have become loose at this point, in which case it would be advisable to insert new rivets. It is also advisable when making this adjustment to note the condition of the bolts and bushings in the steering knuckles and reach rod connections, as any lost motion at any of these points tends to greatly exaggerate any back lash that may be in the steering gear proper.

If you are still unable to remedy the trouble, write for further instructions to the Service Department of The Studebaker Corporation, Detroit, Mich.

STEERING GEAR—(C) Lining Up Front Wheels

It is also necessary that the front wheels be correctly lined up. It occasionally happens that they are thrown out of line through one of the wheels having been bumped in running against a curve or a rough place in the road. If the wheels are out of alignment, extra wear of the tires will result and should be remedied. A fairly exact way of determining this is to use a straight edge and measure between the felloes of the wheel or the edges of the rims on the wheels at the point directly in front of the front axle.

Carefully make note of this distance and measure in the same way across the wheels directly back of the front axle. The difference between these two measurements will be the amount that the wheels are out of alignment. If the wheels are only slightly out of true, the trouble can be remedied by holding one wheel, and with a long, heavy lever covered with cloth and projected between the spokes of the wheel, straightening it with a quick, decided pull.

If the case is radical, install a new steering knuckle, or have the old one straightened at a repair shop.

Body

CARE OF BODY

Studebaker cars are finished with exactly the same care and same number of coats of paint and varnish as the most expensive cars on the market. Since varnish seasons over a considerable period of time, the body consequently requires some care.

In the first place, never let grease or mud remain on the car longer than is absolutely necessary or it will damage the varnish. Do not attempt to scrape the mud off, but rinse the body thoroughly with clear water until the mud and foreign matter is removed. In washing the car, avoid the use of gasoline or strong alkali soap. In fact, there is no reason why soap should be used at all in washing the body. Water should not be allowed to dry, as this will cause the varnish to become cloudy and streaked, but it should be wiped dry with chamois skin.

The chassis and wheels should be washed with warm water and Castile or Ivory Soap, applying the same with a soft sponge until all grease is removed. Rinse it with clear water and dry thoroughly with chamois skin. Never use a sponge or chamois on the body that has been used on the chassis. Give the car good care, and its handsome appearance will last for a long time.

CARE OF TOP

The top should also have careful attention, and we offer some suggestions as to its care:

Dust should be removed from the mohair with a dry brush. Do not use gasoline or naphtha, as these will disintegrate the rubber in the fabric and cause it to separate and leak. To remove grease spots, use Castile Soap and warm water and carefully rinse with clean, warm water. The inside of the top should be cleaned with a stiff brush. Follow the same method as above in removing spots from the inside of the top.

Never put the top down or fold while wet or moist, as moisture might cause mildew in the fabric when closely folded together. When the top is down, it should be fastened securely with the straps that are provided, thus avoiding all chafing of the top fabric.

By adhering closely to these instructions, there is no reason why a top should not wear and last as long as the car.

Further General Suggestions

Do not touch any adjustments or tamper with any parts until you are sure as to what is the cause of the trouble. When in doubt do not attempt to overcome it until you have sat down and analyzed it thoroughly. There is always a sure cause for any trouble in an automobile.

IF MOTOR FAILS TO START

(1) Be sure gear shift lever is in neutral position.

(2) Look in the gasoline tank.

(3) Be sure that the gasoline is turned on in the gasoline line.

(4) Be sure that the gasoline is running into the carburetor, which can be ascertained by pressing on the priming pin and holding the pin down until gasoline squirts out of the small vent.

(5) Be sure switch key is in coil box and that switch is thrown to battery side.

(6) Be absolutely sure that all the terminals are tight on the batteries.

(7) Be absolutely sure that the batteries are not below the limit of strength—that is, each dry cell should test more than six on an ammeter gauge. One weak dry cell will make it very difficult to start the car and should be immediately discarded.

(8) Examine the terminals on every part of the Ignition System, and be sure that none of the wires are short-circuited or connections loose.

(9) Examine spark plugs to see that they are clean and points properly set. To test them, see "Spark Plugs," page 20.

(10) To be sure that spark is being delivered to plug, throw switch to battery side of coil box, disconnect terminal from one of the spark plugs and hold it about 1/32 of an inch from top of plug. Have someone turn motor over with a starting handle slowly. If spark hops from terminal to plug, the Ignition System is not at fault.

(11) If motor still refuses to start, it may be possible that you have primed it a little too much, or, in other words, have held the priming pin down until too much gasoline has spurted out of the small vent. It will be necessary to clean out this rich gas from the cylinder. To do this, have throttle lever retarded to about three notches on the sector, open up the pet cocks and turn motor over very rapidly with starting handle. This will clean out the cylinders. Then close pet cocks and crank in the regular way.

(12) If car still does not start and the conditions, as decsribed above, are correct, it is possible that you have an incorrect adjustment of the carburetor, a leak in the intake pipe, or water in your gasoline. See "Adjustment of Carburetor," page 15, and "Leaky Intake Pipe," page 16.

IF MOTOR STOPS

It is due to:

Lack of gasoline
Lack of oil
Overheating of motor due to lack of water
Disconnected wire or wires
Short-circuiting of wire or terminal.

IF MOTOR OVERHEATS

It is due to:

(1) Lack of proper lubrication. (See "Lubrication System.")

(2) Defective water circulation. It is necessary to ascertain that the system is free from any foreign matter or is not leaking.

(3) Carbon in the cylinders. (See page 35.)

(4) Incorrect adjustment of carburetor. A too "rich" gas mixture from the carburetor will cause overheating. Adjust carburetor. (See Fig. 12.)

(5) A broken fan or a slipping fan belt will cause a motor to heat rapidly. Same should be repaired.

(6) Driving with a retarded spark and an open throttle will also cause this same trouble.

AIR LEAK IN INTAKE MANIFOLD

It occasionally happens that on account of the vibration transmitted to the motor, the connections of the intake manifold to the carburetor and the cylinders become loose and allow air to be sucked in on the intake stroke of the piston. This extra air being drawn in causes the mixture to be too "lean" and results in the motor running unevenly and skipping. This condition can be remedied by tightening up these connections, and also, if necessary, by installing new gaskets.

DRIVING IN HEAVY TRAFFIC

In going through crowded streets, it is always best to drive on "second" speed, as this obviates the necessity of continually changing from one speed to the other. The "second" speed of the (E-M-F) "30" is geared 7 to 1 and should be used for that purpose.

SKIDDING

In driving over wet pavements or slippery roads, do not make sudden turns or changes of direction, also avoid sudden application of brakes. If, however, you feel the car is starting to skid, turn the front wheels quickly in the same direction that the rear of the car is turning, which will tend to straighten it out. This is similar to the turn of the front wheel in riding a bicycle. In skidding, throw out the clutch and close the throttle, but do not put on the brakes hard.

DRIVING UP A HILL OR OVER A HEAVY ROAD

In driving a car where it is necessary for heavy pulling, use the "second" speed and drive with the spark lever retarded. This causes the motor to develop a little more power, but the spark lever should be advanced as soon as a smooth road or a level is reached, as motor will overheat if continually driven with a retarded spark.

CHANGING SPEEDS

Every time the gears clash noisily, there is some harm done. A driver should learn how to change speeds quietly and without any wear and tear on the transmission gears. This is not difficult and can be attained by practice and close attention.

INSTALLING OF ACCESSORIES OR PRIVATE PARTS

Do not let any inventor or accessory company try out any new ideas, such as spring wheels, shock absorbers, self-starters, etc., on your car until you are absolutely sure, in your own mind, that they are not harmful. In fact, it is best to write to one of the Studebaker Branches, or to the Service Department of The Studebaker Corporation, Detroit, Mich., and find out what we have to say before installing anything of the above nature.

TOURING

When driving your car away from home and through strange towns, it is always best to inquire for a Studebaker Dealer. Studebaker-E-M-F and Flanders cars are sold in every section of the country, and as we have many hundreds of dealers, we feel confident you can obtain much better satisfaction and receive better treatment from them than you would from dealers handling other lines of cars.

On page 2 of this book, you will find a list of our Branches. Each one is fully equipped to take care of orders for repair parts and to make repairs. You can obtain any parts from them without delay, and no matter where you are, it is only necessary to write, or call on, the nearest Branch to procure what you want.

Cold Weather Suggestions

STARTING CAR IN COLD WEATHER

When the motor is cold, it is more difficult to start than when warm, and in order to facilitate this operation in the winter, it is sometimes necessary to vary the regular procedure.

(1) Examine the batteries and note that all of the terminals are tight and that dry cells are fresh. (See "Batteries.")

(2) Be sure that the gasoline used has been strained through a chamois to eliminate any water which might possibly be in it. There is a ring which you will find on the front of the radiator which is attached to a wire leading to the butterfly valve in the hot air intake pipe. Pull out on this ring, which closes the valve and cuts off the air from the bottom of the carburetor. This causes the mixture drawn up into the cylinders to be "richer" than otherwise and more susceptible to firing by the spark introduced through the plug.

(3) Prime the carburetor by pushing down on the primer pin and holding it until the gasoline squirts out of the small vent. If motor does not start, inject some gasoline into each one of the pet cocks in the top of the cylinders. This raw gas is quickly ignited and will start the motor. If the motor is very cold, it greatly assists the starting to pour some hot water on the gasoline intake pipe and to fill the radiator with hot water.

It is always best when stopping the car to open the throttle wide and throw off the switch, and as motor dies down gas will be drawn into the cylinders and will facilitate starting next time.

USE OF ANTI-FREEZING MIXTURE

In freezing weather, the water circulation system should be filled with some sort of anti-freezing solution. Below are the formulas for two which will give satisfactory results:

For temperature not lower than 5 degrees below zero—

Wood Alcohol	15%
Glycerine	15%
Water	70%

For temperature not lower than 15 degrees below zero—

Wood Alcohol	17%
Glycerine	17%
Water	66%

The cooling system of the Studebaker (E-M-F) "30" has a capacity of 16 quarts. Alcohol should be added occasionally to make up for the evaporation. This is due to the fact that a solution of alcohol lowers the boiling point of the water, consequently on warm days, with the motor running idle, the solution will tend to boil easily and evaporate. Do not use a solution of calcium chloride, or any alkaline solution, as these are injurious to the metal parts.

USE OF ANTI-FREEZING MIXTURE—*Continued*

In purchasing lubricating oil, ask for the light oil instead of medium or heavy oil. Most of the motor oil manufacturers make three grades, and light is the best to use in cold weather. In the transmission and rear axle use light transmission, instead of the heavy as recommended for warmer weather.

It is a good plan to cover the hood with a blanket or cover made for that purpose when driving in freezing weather. This keeps the motor warm and eliminates, to some extent, difficulty in starting and causes the motor to run more evenly.

STORING CAR

If you do not wish to run your car in freezing weather, obtain four jacks and lift it up off the floor of your garage. Drain off all of the water by opening both pet cocks, start the motor and allow it to run for about a minute. In fact, if you do run your car in cold weather and do not use the anti-freezing solution, it is necessary to drain the radiator when you leave the car for any length of time.

Tire manufacturers advise that the four tires should be removed, wrapped up and put in a dark, dry place. Clean the body and top, and with the top up, cover the whole car with some heavy sheeting. Remove batteries, as these are affected by the cold and will run out much faster than in warm weather. This is a good point to remember even when the car is driven in cold weather.

INDEX OF ILLUSTRATIONS

INDEX