INFORMATION

Packard Six

MOTOR CARS

526-533

Price Fifty Cents

Issued by

THE SERVICE DEPARTMENT

PACKARD MOTOR CAR COMPANY

DETROIT, MICHIGAN

VT-228-10000-2-28

OPERATION AND CARE

of

Packard Six

Motor Cars

526-533

General Operation

New Packard cars, when shipped from the factory, have been properly adjusted and lubricated but the gasoline tank and cooling system are drained.

These cars are reinspected and placed in standard running condition by Packard distributers before delivery to the owner.

To Prepare a New Car for Operation

1. Fill the radiator with clean water (capacity 5 gals.). In cold weather an anti-freeze mixture should be used. See page 56.
2. Fill gasoline tank (capacity 22 gals.).
3. See that oil in crankcase is up to petcock level (capacity 7 qts.).
4. Check oil in chassis lubricating tank on dash (capacity 1 qt.). Lubricate chassis by pulling handle under instrument board.
5. Check the air pressure of tires, which should be 40 lbs.
6. Test battery with hydrometer and see that plates are covered with ¼ in. of distilled water.
7. Test all lights to see that they are burning properly.

Preliminary to Starting Motor

See that the change speed lever is in neutral position and that the hand brake is set.

Pull the control on the instrument panel marked "spark" out about ¼-inch, which retards the spark.

NOTE: Spark is fully advanced when control is pushed all the way in.

Move throttle lever on steering wheel up about 1 to 1½ inches from the closed position.

Turn key in the ignition switch.

To Start the Motor

Pull the carburetor control on the instrument panel which is marked "choke" all the way out.

Disengage the clutch by depressing the clutch pedal with the left foot and with the right foot crank the motor by depressing the electric starter button on the toeboard; release the starter button immediately when the motor starts.

After the Motor Starts

Be sure to push the choke in immediately, keeping it pulled out just far enough to maintain smooth motor operation. It will be necessary to keep the throttle open slightly until the motor warms up, then close the throttle until the motor runs slowly. The choke and spark control should have been closed by this time.

To Stop the Motor

Turn off the ignition switch on instrument board. This is important, because if the motor is stopped with the switch on the battery will discharge itself through the ignition apparatus.

Running a New Motor

The most critical period in the life of the motor is the first 500 miles of operation. Permanent injury may be done through failure to observe the

simple but fundamental rules concerning the working in of all new machinery. During the period when the motor is new sustained high speed driving should not be done as this is detrimental in the extreme until after the motor has been worked in.

On the other hand it is not necessary or desirable to operate the motor during this period at low speeds only. Better results will be obtained by increasing the speed from time to time providing the higher speeds are not maintained for more than a few seconds.

At the end of the first 500 miles of operation the crankcase oil should be replaced and thereafter at the end of each 1000 miles in summer and every 500 miles during the winter.

Learning to Drive

All written instructions are subject to limitations and it is taken for granted that the typical Packard purchaser is no longer a novice in motor car operation.

It is recommended that those not familiar with the operation of a car secure individual instructions from the Packard distributer or dealer from whom the car was purchased. He will be very glad to assist.

There are, however, certain rules and suggestions that will be helpful to every driver, and these are set forth in "Hints on Good Driving" on the opposite page.

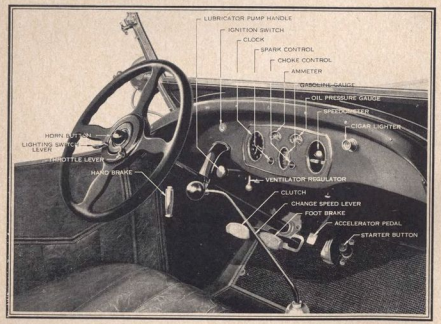


Plate No. 1—Instrument Board and Control

Hints on Good Driving

Low operating cost depends as much upon good driving as upon careful attention to the upkeep of the car. A driver may be judged according to whether or not he observes the following rules:

1. Respect the rights of others, particularly pedestrians.

2. Exercise extreme care when driving in streets where children are playing, when overtaking and passing street cars and other vehicles and when entering or crossing main thoroughfares.

3. Signal with hand when slowing down, turning or stopping, even though the car is equipped with an automatic or mechanical warning device.

4. Approach railroad crossings cautiously and shift into second speed to avoid stalling on tracks.

5. Drive so as to require the use of the brakes as little as possible. When approaching an obstacle which necessitates stopping the car, ease up on the accelerator pedal so that the car will slow down. Throw out the clutch and apply the brakes gradually a short distance from the final stop. Maximum mileage thus will be obtained from tires and gasoline, and the brakes will require adjusting less frequently.

6. Drive with the carburetor control all the way in at all times, except when starting with the motor cold. Even with a cold motor it will not be necessary to run with a rich mixture for more than a few hundred feet. Observation of this rule is very essential if you wish to obtain high gasoline mileage as well as reduce dilution of the crankcase oil and carbonization of the motor.

7. Drive with the spark fully advanced at most times, except when climbing steep grades at low speed, when it should be retarded as required; see page 41. When driving at maximum speed the spark should be fully advanced.

8. Disengage the clutch before attempting to shift gears and always stop the car before changing from a forward gear to reverse gear or from reverse gear to a forward gear.

9. All instruments are so located that the driver can see and read them easily. Form the habit of glancing at these instruments occasionally, for it is by them that the proper functioning of the motor lubrication and electrical systems as well as the speed of the car is indicated.

10. When using the motor as a brake in going down hill, do not turn off the ignition switch, for, contrary to past impressions, turning off the ignition when coasting against the motor does not improve the braking effect or assist in cooling the motor.

CAUTION—The exhaust fumes of all gasoline motors contain a deadly poisonous gas, known as carbon monoxide. If the motor is run for a time in a small closed garage this deadly gas in the air may increase to a proportion where it will prove fatal.

Periodic Inspection and Care

General Care

Periodic and systematic inspections and adjustments of wearing parts of the car, in addition to regular everyday attention, such as washing and cleaning, keeping tanks and reservoirs filled, tires properly inflated, etc., are necessary in order to obtain the highest degree of efficiency of which the car is capable.

Adjustments should not be made until necessary, although it is very important that thorough inspections be made at regular intervals to prevent excessive wear or loss of power due to causes which may not be detected readily in ordinary running. The principal points requiring attention are listed below. Any symptom which may arise and which generally would be indicated by an unusual noise should be corrected immediately, before it has had a chance to develop into any serious trouble.

A schedule for the lubrication of all parts of the chassis is perhaps the most important thing in connection with the care of the car. It will be found on page 20.

Every Day

Inspect gasoline and oil supply.

Check level of water in radiator. Do not fill higher than two inches from top of radiator cap, or considerable water will be lost through the overflow pipe when the motor is started.

Be sure that the oil pressure gauge on the instrument board shows pressure the moment the motor is started.

See that tires are properly inflated and examine for embedded glass, small cuts, etc. See instructions for proper care of tires on page 15.

Once a Month or Every 1000 Miles

Drain crankcase and refill with fresh oil.

Inspect and if necessary adjust brakes. See page 65.

Inspect tension of fan belt. See page 55.

Inspect the ignition contact breaker points. These points, if working properly, will have a silver gray appearance with a pebbled surface at point of contact. New points may show only a small spot, usually near the edge, and when in this condition should not be disturbed. If the points are blackened they should be cleaned and adjusted as outlined on page 40.

Inspect battery. See page 44.

Examine cooling system for leaks, tightening pump gland nut if necessary.

Clean gasoline filter under vacuum tank.

Examine body bolts and motor to frame bolts, spring clips, etc. Keep tight.

Check alignment of front wheels. See page 63.

Check adjustment of front end chain. See page 31.

Care of Body and Finish

Care of Lacquer Finish

All the precaution necessary in washing varnished cars is desirable but need not be taken with cars finished in lacquer. It is essential, however, to use clean sponges, loosening and softening dirt and mud with water before rubbing off. Lacquer, which is polished to give it a bright lustre, will scratch and precautions must be taken not to destroy the smooth surface.

The car after exposure may lose some of its lustre and become dull or leave a spotted appearance. This can be removed by polishing with a good grade of polish such as Packard 1-sis.

The polishing of a lacquer finished body at regular intervals is absolutely essential if the finish is to retain its full lustre and beauty. This is contrary to the practice on varnish finishes.

The washing and polishing operations may show traces of color remaining on the cloth. This should cause no alarm, as it is a perfectly natural condition with all lacquers and simply represents a slight weathering which does not noticeably affect the life of the finish.

The directions for the use of polish given on the bottle should be followed. Care should be taken not to rub too hard or too long over stripes as they are applied over the lacquer and may be cut off if care is not taken.

Lacquer finishes are much more resistant to acid and alkali materials than is varnish, but alcohol anti-freeze solutions will spot lacquers if spilled upon the finish and allowed to remain. If immediately wiped off no trouble will result. Glycerine anti-freeze solutions do not affect lacquers and are more satisfactory to use.

The wheels of the car should be treated with the same method and care as the body and bonnet, except that they are not chamoised.

When grease or oil is found on the lacquer surfaces it may be removed with a good furniture polish applied with a clean cloth. The polish should be applied only to the grease spots and then removed with another clean cloth.

Wash under parts of car with cold or lukewarm running water, soaking mud off as much as possible. Grease and oil on the under parts of chassis, exclusive of wheels, and on the motor, can be removed by washing with gasoline or kerosene and drying with a clean cloth.

If an enclosed body is exposed to low temperature shortly after having been washed, the water banked up at the lower edges of the windows may freeze and prevent their being lowered. This will not occur if the windows are lowered slightly for a short period to enable the water to drain away.

Running boards can best be cleaned with soap and water. Thoroughly rinse with running water after cleaning.

Care of Upholstery

The upholstery material in closed cars is exposed to conditions which will cause it to become soiled and deteriorate if it is not given the proper care.

It is desirable at least once a month or more often if necessary to clean the upholstery with a vacuum cleaner and a whisk broom.

If the material becomes spotted, Packard fabric cleaner should be used to remove the spots.

Leather upholstery may be washed with pure soap and water, rinsing off the soap and drying with a moist chamois. Never use gasoline on leather upholstery.

Care of Tops

Dust on the outside of tops should be removed with a damp sponge. The inside or cloth side should be dusted with a whisk broom or stiff brush. Never fold the top while it is damp.

Carriage dressings and gasoline are generally injurious to top, as they eventually cause the material to harden.

Instructions for Lowering Touring Car Top

Unfasten gypsy curtains from the rear bow sockets and body fasteners, folding them in against the back curtain. This is absolutely necessary to prevent tearing the top when folded. Attach bow support brackets. The brackets should be located so that the bows will fall in them properly. Open both bow support clamps.

Loosen flap across top of windshield and loosen the wing nuts at the top of the windshield stanchions. Lift top off of the windshield and tighten the wing nuts.

Break the top support in forward half of top by raising the front bow with one hand and taking hold of the bow directly above the back of the front seat, pulling straight down until broken joint is within about four inches of the body moulding. In this position tip bows back until rear bow rests in the bow support bracket.

The lining padding should be pulled down neatly between the bows and pushed in toward the center, so that when the top is down the pads will be between the rear seat and the top and not between the bows. Lower balance of bows.

Step to the rear of the car and pull the top material out from between the upper bows, letting it hang in a double fold. Then make a triangular fold at each corner and fold the material twice, laying it neatly in place on the lower bow. Engage the hook at the top of the bow support bracket and clamp bow support brackets, making sure that none of the top material is clamped between the bow sockets and bow support bracket.

NOTE: It is recommended that a top envelope be used whenever the top is carried in the lowered position.

In applying the top envelope, see that the loose folds of the top are snugly stowed in place. Slip on the top envelope, drawing tightly in place with the straps that will be found at the front end. In the case of the touring car, attach two supporting straps to two fasteners, which should be fitted to the back of the body in order to support the rear curtain light and prevent damage to the back of the body. Bring the two straps found at each lower corner of the envelope up between the body and the bows and around the bow support clamps. These straps will

pull the under side of the envelope together with the loose folds of the top material, up a sufficient distance to prevent scratching or marring the surface of the body. In the case of the roadster the rear curtain light is supported when the top is down by a tab attached to it and secured by means of a lift-the-dot fastener to the back of the seat compartment, and no fasteners are equipped for the top envelope, which in this case rests on the rubber mat on the rear deck of the body. No bow support brackets are required on the roadster, as the top bows rest on two rubber bumpers on the rear deck of the body, being held there by straps fastened through the envelope.

Nickel Polish

Packard nickel polish or a good silver polish is best for removing tarnish from nickel. Better still, however, is the practice of preventing the nickeled surfaces from tarnishing by rubbing them frequently with an oily cloth. This will keep them bright without polishing. Do not use brass polish on nickel, as the abrasive ingredients scratch the surface.

CAUTION: Enclosed body interior fittings, such as regulator handles, are lacquered over the silver plating, and should, consequently, never be polished with a metal polish.

Lubrication of Body Parts

It is a good plan occasionally to put a drop or two of oil on the working parts of the windshield, also door locks and hinges, foot rest, etc. Lubrication of these parts will keep them in a free working condition and will assist in eliminating squeaks.

Care of Tires

Keep tires inflated to 40 lbs.

Test the tire pressure with a reliable gauge at least once a week. When touring this should be done every morning. Air pressure is affected comparatively little by heat and should not be diminished because of hot weather.

When an under-inflated tire revolves, the excessive flexing of the carcass sets up heat which destroys the adhesion of the cord layers. They separate, weaken and finally show a break around the inside of the tire.

If the injury is discovered before more than the innermost plies are broken, a reliner may be cemented or vulcanized in and the tire placed in service again. If the injury is more serious it cannot be repaired and, therefore, it is better to prevent this trouble by close attention to air pressure.

In case of tire trouble on the road do not run the tire flat even for a hundred feet, for the carcass will be mashed between the steel rim and the road and will be broken so that repairing is impossible.

Tread Wear and Scraped Side Walls

To prevent scraping off tread rubber always apply the brakes gradually and let the clutch engage smoothly.

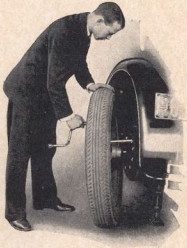
Repair small side wall cuts or any exposed fabrics while still new with cement and tire putty and have large ones vulcanized at once.

Cuts Caused by Chains

Always apply chains loosely because if applied tightly the cross chains strike the tire at the same spots continually and soon cut into the tread. Never put chains on one rear wheel only because the opposite wheel will spin and wear the tread of the tire and the differential is also liable to damage.

Do not reverse chains by placing the worn side against the tire as the edges of the links sharpened by use cut into the tread. If chains are necessary in an emergency remove them as soon as the emergency has passed.

Changing Wheels

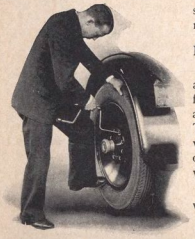


Place jack under axle as close to the wheel to be removed as is convenient and raise wheel clear of the ground.

Remove the cap screws at the wheel hub and lift the wheel from the hub.

To mount wheel, insert pilot end of wheel wrench through the upper hole in wheel and into upper screw hole in wheel hub flange, thus using the wheel wrench as a lever to lift wheel into place and properly locate the screw holes. At least two screws should be partially screwed in before withdrawing wrench.

Screws should be tightened down uniformly and, instead of working in rotation, it is best to tighten first one screw and then the one opposite.



The hub screws should be lubricated slightly when applying a wheel to prevent rust and damage to the threads.

Misalignment of Wheels

An unusual jolt or strain from bumping a curb, hitting a rise or hole in the road, or from scraping along gutters may cause misalignment or wobbling of wheels, or both. Then rapid tread wear results because the wheel no longer runs true with the one opposite but, instead, travels over the road with a diagonal grinding motion.

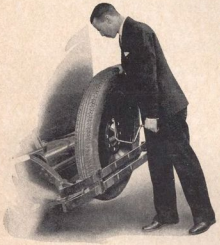
To check proper alignment of front wheels, see page 63.

Mounting Spare Wheel

The spare wheel can be mounted on its carrier with the minimum of effort and without soiling the clothing by observing the following directions:

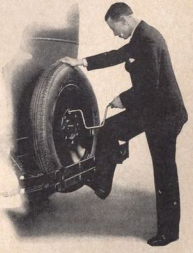
Lean wheel against rear bumper with the inside of the wheel facing out and tire valve at the bottom. Take hold of tire next to the ground and turn wheel up inside of bumper, which will bring inside of wheel next the carrier with tire valve at the top.

Now insert wrench through upper stud hole in wheel and into hole in top of wheel carrier and by using the wheel wrench as a lever the wheel can be lifted onto the carrier and guided into place on the two locating pins.



The locking plate should be screwed up snugly, the correct position of the plate being determined by the word "Top" which is stamped on its face.

There are four marks on the flange of the lock handle, one of which should be brought into register with the word "Top" on the plate. This aligns the lock plunger with its hole and insures an easy operation of the lock.



Tire Cover

The tire cover should be installed with the split in cover at the bottom of tire, which will provide drainage for any water that might collect in cover.

When applying cover, start at top of tire, stretching cover smooth as it is worked on toward the bottom, reversing this process when cover is removed.

Care of Car in Storage

Storage Space

Cars or bodies taken out of service for any length of time should be carefully prepared for storage and kept in a dry garage, preferably with some heat and with a subdued even light from all sides.

Avoid extreme heat or sudden changes in temperature and the immediate proximity of steam pipes.

Protection of Finish

Wash the car carefully before storing and be sure that all oil and grease spots are removed from the painted and enameled parts.

Draining the Water System

Drain the water system thoroughly before leaving car in storage.

Care of Motor

When laying up the car, drain the crankcase, refill with fresh oil and run the motor for a few minutes.

Remove the spark plugs and inject two or three tablespoonsful of oil into each cylinder. Clean the plugs, dip the ends in oil and replace them in cylinders.

Crank the motor for twenty to thirty seconds, using the electric starter with the ignition switch off and the throttle closed, thus insuring a distribution of the oil over cylinder walls and valve mechanism.

Before putting the motor back into service after car has been stored, again remove the spark plugs, inject a small quantity of oil in each cylinder and crank the motor by hand for a few seconds with the ignition switch off. Then turn the ignition switch to "On" and after the motor has been started it should be run slowly for a few minutes.

Battery

A battery that is not in service must be given attention at regular intervals.

See "Care of Battery," page 44.

Metal Parts

Exposed and unpainted metal parts of motor, body and chassis should be well greased to prevent corrosion and rusting. Lubricant should be removed with gasoline before putting car back into service.

Storage of Tires

Tires that are out of service for any length of time should be removed from the rims. The inner tubes should be put in the casings, partially inflated, and the tires stored in a moderately heated place away from the light. If tires are allowed to remain on the car, they should be deflated partially and the car jacked up so that no weight is allowed to rest on them or rapid deterioration will result.

General Lubrication

Keep Mechanism Clean

Keep all working surfaces, oilers and connections free from dirt and the motor and all other parts as clean as possible.

An oily motor collects dust and dirt very rapidly, which eventually work into the mechanism and cause premature wear.

Lubricants

Do not use cheap or little known lubricants. High-grade lubricants are the most economical in the long run. It is always safest to buy lubricants from a concern with an established reputation. Such concerns handle a large volume of business, and their experience and responsibility are the best insurance.

Cylinder Oil

A high-grade, well-refined medium cylinder oil such as supplied by any of the reputable oil companies should be used in the crankcase. Most of the companies grade their oil by the S. A. E. (Society of Automotive Engineers) specifications, and this designation should be used when ordering oil rather than the more common nomenclature light, heavy or medium. The oil used in the crankcase should be varied according to temperature conditions as shown on the chart below:

Winter		Summer
Extreme North	North	
S. A. E. No. 10	S. A. E. No. 20	S. A. E. No. 30

Cup Grease

Use a high-grade medium body cup grease at points where alemite connectors are indicated in lubrication schedule, also in front and rear wheel bearings.

Rear Axle Gears and Differential Lubricant

Use a good rear axle fluid mineral gear oil.

In cold weather the lubricant should be thinned with cylinder oil to approximate its summer consistency. With the return of warm weather, however, the oil should be drained and the case refilled with new oil of the summer consistency.

Transmission Gear Lubricant

Use a good transmission fluid mineral gear oil. In cold weather cylinder oil should be used to thin the lubricant as in the case of the rear axle.

Universal Joint Lubricant

Same as transmission.

Steering Gear

Use Whitmore's No. 52 Worm Gear Compound.

Chassis Lubricating Tank

Packard Chassis Lubricator Oil.

Note

Whenever rear wheels are removed from axle shafts for any reason, rear wheel bearings should be cleaned and repacked.

Schedule of Lubrication

EVERY DAY

Magazine hand pump, one stroke.

This pump distributes oil from a central reservoir to the following points:

4 Spring bolts—front and rear.

8 Spring shackle bolts—front and rear.

2 Steering cross tube ball joints.

1 Steering connecting rod ball joint front.

1 Steering lever ball joint.

10 Front axle brake shaft bearings.

4 Intermediate brake shaft bearings.

1 Clutch shifter bearing.

The motor crankcase should be kept filled to petcock level with a good grade medium oil and the oil level should be checked whenever gasoline or water is added. Crankcase should be drained and filled with new oil every 1000 miles during the summer and every 500 miles during the winter.

EVERY 2500 MILES

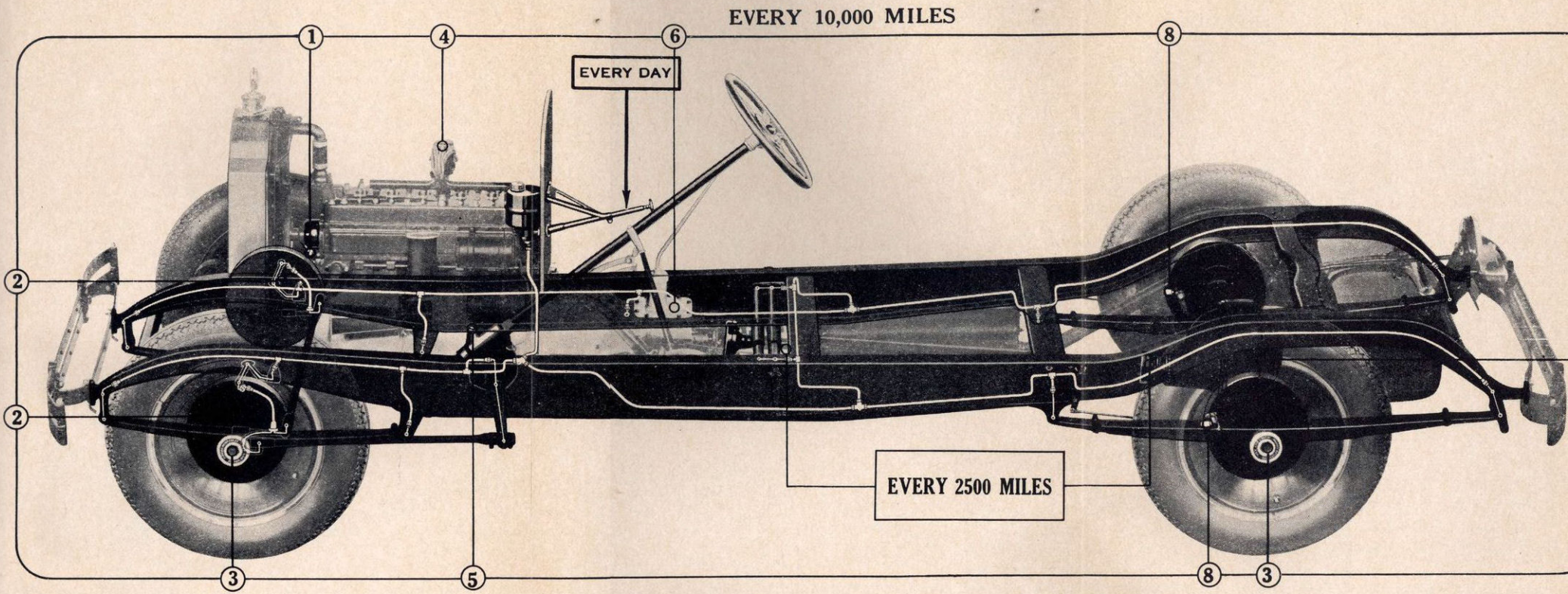
Universal joint—Refill—Turn shaft until one plug is directly on top. *Remove both oil plugs* in case, insert gun in lower hole and fill until the oil runs out at the top. Oil slip joint through oil hole in sleeve.

Distributor—Turn down grease cup and refill with vaseline.

One or two drops of very light oil should be used in the oilers of the generator and horn. Also apply a few drops of oil to the clevis pins and brake connections.

EVERY 10,000 MILES

1	1	Alemite connector water pump.
2	2	Alemite connectors steering knuckle pins.
3	4	Wheel hubs with bearings—pack with grease.
4	1	Distributor—Remove head, wipe clean inside, apply gun oil to the breaker mechanism and vaseline to the cam.
5	1	Steering gear—Fill case with Whitmore's No. 52 worm gear compound.
6	1	Transmission—Drain and flush case with kerosene—Refill to plug level in right hand side.
7	1	Rear axle—Drain and flush case with kerosene—Refill to plug level in rear. Remove rear axle cover plate for draining and flushing.
8	2	Rear brake operating cam bearings—Remove screw plug and pack with grease.


EVERY 10,000 MILES
1
4
6
8
EVERY DAY
2
2
EVERY 2500 MILES
3
5
8
3

Chassis Lubrication System

Under the instrument board and at left of the steering column is an oil gun with a round nickeled handle. To lubricate the chassis, pull this handle out until it stops (about 3 inches) and let go. This should be done daily, or at least once every hundred miles.

Although the chassis may be lubricated at any time while running, it is recommended to operate the lubricator when the engine is first started each day. If experience shows that this feeds more oil than is desired, pull the handle each time only half way out instead of all the way. While driving over wet or muddy roads, an extra operation of the lubricator is useful to flood the bearings with oil and thus exclude water and mud.

The oil gun is combined with the tank in a single unit mounted on the dash as shown in Plate No. 3.

The plunger draws its charge through the inlet valve "G" and forces the oil out through the felt filter "F." This felt can be removed for cleaning or replacement by unscrewing the retaining plug in the bottom of the tank.

Coiled around the pull-rod "I" in the upper part of the gun cylinder is a highly compressed spring which drives the piston downward, forcing oil into the chassis line. The piston is rendered oil-tight by double leather cups "J" and it is provided with a yielding metal expansion plunger that seats against a leather sealing washer "K" on the bottom of the cylinder.

Normal working of the system is indicated by a slow return of the handle.

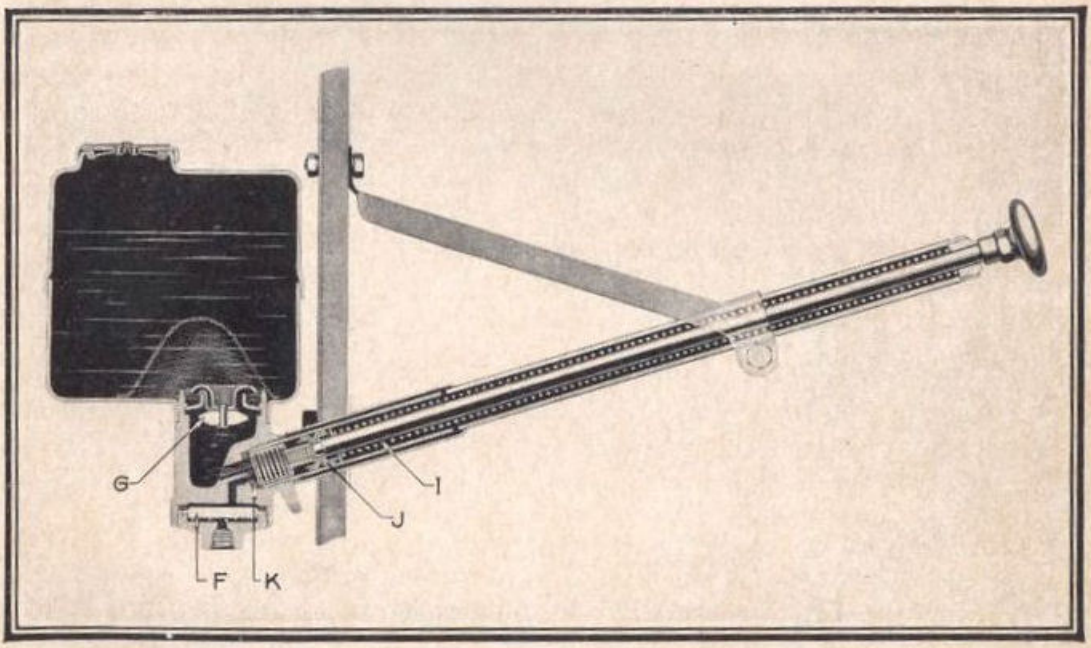
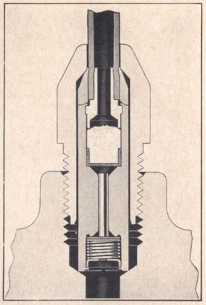


Plate No. 3—Chassis Lubrication Oil Gun and Tank

Drip Plugs



The drip plugs, as shown in the accompanying illustration, control the amount of oil that is delivered to each bearing of the chassis.

Each plug is fitted with a check valve to prevent the escape of oil except when under operating pressure. A restricting pin which nearly fills an accurately sized hole acts as a controlling resistance to the flow of oil and the number of drops to each bearing is regulated by the size of the pin used.

In addition to the felt strainer in the tank, the system provides each drip plug with a felt strainer to intercept any dirt that might be in the system.

Drip plugs do not require cleaning at any time, nor is their operation impaired through use. Throughout the life of the motor car, each drip plug, under all conditions of operation, delivers its definite portion of the gun charge. Attempts to adjust drip plugs or to replace their parts are liable to impair the operation of the system. If a drip plug has been damaged, a new one of the same marking should be substituted.

Oil Supply

The supply tank, which is mounted on the dash under left side of the bonnet, has a capacity of one quart, which provides seventy-five charges.

Tank should be refilled when oil is down to bottom of the wire gauze strainer, although enough remains for a few more charges.

A filtered oil of high viscosity but with a low cold test is recommended and it is very important that no oil be used that contains lead, soap, graphite or any other element in suspension which would clog the felt filter in bottom of the tank.

Packard Chassis Lubricator Oil has all of the desired characteristics, finding its way through the filter readily, even at low temperatures. It is, therefore, suggested that this oil be used exclusively in the chassis lubricator tank.

The operator will be reminded of any neglect to refill the tank by the action of the handle which, when let go, descends rapidly (instead of slowly) when the tank is nearly empty. Upon refilling a few minutes may elapse, owing to the time required for the oil to pass through the tank filter, before the usual full gun charge can be drawn; whereupon the handle when let go again settles slowly, which indicates normal working.

In very cold weather the viscosity of the oil is increased many times and the descent of the handle will consume a much longer time. It is advisable when operating the handle in cold weather to pull it out slowly and hold it out against the stop for a few seconds to allow a full charge of oil to flow into the gun before the handle is released.

Motor Lubrication System

Circulation of Oil

The oil is drawn from the crankcase reservoir through the strainer located at the pump housing and is pumped to the main oil distributing manifold which is supported from the crankshaft bearing caps. From this manifold the oil is supplied to the seven main crankshaft bearings through holes drilled in the bearing caps. Independent oil passages in the crankshaft, leading from the main bearings, carry the oil to the connecting rod lower end bearings and through a hole drilled lengthwise of the connecting rod to the piston pins.

All camshaft bearings are lubricated by oil which is forced to the hollow camshaft from the oil lead running from the crankshaft rear bearing to the camshaft rear bearing.

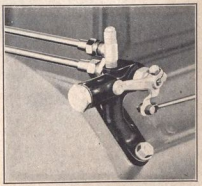
After passing through the hollow camshaft and lubricating the four camshaft bearings, the oil passes out through holes in the camshaft sprocket onto the chain. The chain carries oil to the generator sprocket, which also has holes leading the oil down to the generator shaft bearing. After these bearings are supplied with oil, the surplus drains back into the crankcase oil reservoir.

The cylinder walls are lubricated by oil spray thrown from the connecting rod lower end bearings. Holes drilled in the crankcase allow the oil mist to rise into the valve compartments and lubricate the valve mechanism. Baffle partitions located crosswise in the bottom of the crankcase retard surging of the oil.

In cold weather the crankcase oil becomes very thick and a short time elapses before it becomes thin enough to be thrown off from the connecting rods in sufficient quantities to thoroughly lubricate the cylinder walls.

Unvaporized gasoline is also drawn into the combustion chambers by excessive use of the choke in starting, which tends to wash the oil from the cylinder walls.

This condition will often cause a scuffing of the aluminum pistons. In order to prevent this occurrence and insure adequate lubrication of the pistons and cylinders when starting, an oil by-pass valve, as shown in the illustration, is located at the rear of the crankcase and connected to the carburetor choke.



An oil manifold on the side of the cylinder block is connected to this valve and, whenever the choke is pulled out, oil is pumped onto the skirt of each piston. This auxiliary lubricator functions only when it is

needed, which is during the starting and warming up period, and, being operated in conjunction with the choke, is shut off when the choke is pushed in.

An oil filter is mounted on the left side of the motor through which the oil is passed to remove any dirt or foreign substance, thus protecting the engine against wear from this source.

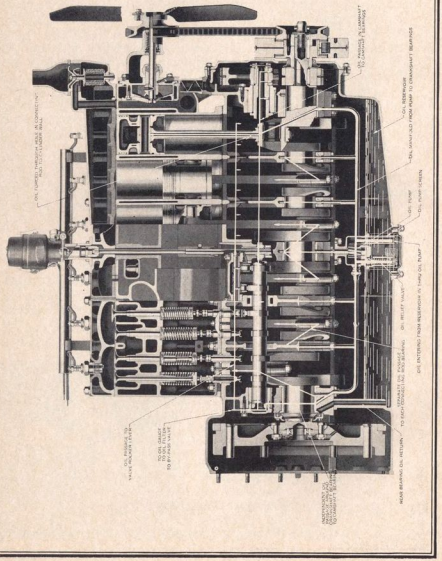


Plate No. 4—Motor Lubrication Diagram

Oil Pressure

The gauge on the instrument board should show from 20 to 35 pounds oil pressure while running at twenty-five miles per hour, and not less than 2 pounds pressure at five miles per hour with the standard rear axle ratio and the motor warm.

Failure of the gauge to show pressure after the motor has been running for a few minutes is an indication of lack of oil or clogging of the strainer or oil pipes. The motor should be stopped immediately and the cause determined.

Insufficient or excessive pressure on the gauge may indicate improper adjustment of the oil relief valve.

The fact that the gauge may register only 10 or 15 pounds with a hot motor is no cause for alarm. Under hard driving the heat tends to lower the viscosity of the oil which automatically increases the amount thrown off at the bearings and the consequent lowering of pressure at the gauge.

When the motor is cold, the pressure will be higher until the oil thins down. During extremely cold weather the oil may show excessive pressure, due to congealing of oil in the pipes, which prevents free circulation. Running the motor slowly for a few moments will give the oil a chance to warm up and become thinner.

Oil Supply

The oil supply is maintained by pouring oil directly into the crankcase through the filler on the left side of the motor. Keep the crankcase filled to the petcock level. The petcock is operated by a rod through the crankcase splasher on the left side of the motor.

CAUTION: About 7 quarts are required to fill the crankcase to the petcock level. Do not carry an excess of more than one gallon of oil above this point as the connecting rods would be apt to dip, especially in hilly or rolling country. When touring, this excess gallon may be added so that fewer stops for oil will be required. Always refill when level falls below the petcock.

Changing Oil in Crankcase

Due to the natural results of combustion under greatly varying temperatures and conditions, the engine oil, while in use, is being diluted constantly with unburned fuel and condensed water vapor, which depreciate the value of the oil as a lubricant.

The rapidity with which these damaging elements accumulate can be governed to a great extent by the driver of the car through the judicious use of the choke and by the installation of adequate cold weather protection for the motor. Gasoline accumulates in the engine oil because only a mixture of the proper ratio of air and gas will form perfect combustion in the cylinder.

Water vapor is a product of combustion and is most prevalent in cold weather when a certain amount of this vapor condenses on the cylinder and crankcase walls and becomes mixed with the oil. Under certain con-

ditions this will produce two very undesirable elements in the oil, namely: sulphurous acid and oil sludge.

The accumulation of these non-lubricating elements in the oil is detrimental to the wearing surfaces of the motor. Gasoline thins the oil, reducing its lubricating ability. Water is a non-lubricant and is liable to freeze, stopping the oil circulation.

The sulphurous acid attacks all polished steel surfaces and causes excessive wear. These harmful elements can be removed only by draining the crankcase at regular intervals and, as they accumulate more rapidly as the temperature decreases, the crankcase should be drained every five hundred miles during the cold weather and every thousand miles in the summer.

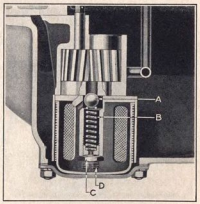
The oil may be drained by removing the drain plug at the bottom of the left side of the crankcase. After draining thoroughly, clean the strainer. Do not run the motor with kerosene in the system. Do not run the motor until the crankcase has been refilled with fresh oil to the petcock level. This will require about 7 quarts.

Insufficient Lubrication

If through an oversight the motor does not receive proper lubrication and begins to heat or knock, it should be stopped immediately. Allow the motor to cool. Fill the crankcase reservoir with oil to the petcock level. Fill the radiator with water after the motor has cooled thoroughly.

Run the motor slowly, and note whether the proper oil pressure is indicated by the gauge. Should there be apparent damage, the motor should be inspected thoroughly without further driving.

Motor Oil Pump



A gear pump, as illustrated, is located at the lowest point of the crankcase and forces oil from the reservoir through the motor lubricating system as shown in Plate No. 4.

The pump is operated by a shaft driven through a spiral gear on the camshaft and, as it is submerged in the oil supply, never requires priming.

The oil is strained before entering the pump through a cylindrical screen which surrounds the pump inlet. This strainer may be withdrawn and cleaned whenever necessary by removing the small plate on bottom of crankcase. No adjustment of the pump gears is required, the oil pressure being regulated by the relief valve "A," which is controlled by the tension of the coiled spring "B."

The inlet to the relief valve is connected with the pump discharge passage and any excess pressure causes the valve to open and allows the surplus oil to return to the inlet of the pump.

Adjustment of the relief valve to raise or lower the oil pressure is accomplished by removing the cover plate on bottom of crankcase, loosening the lock nut "C" and turning the slotted adjusting screw "D" to the right for increased pressure or to the left for decreased pressure. Be sure lock nut is tightened before cover is replaced. Motor and crankcase oil should be warm when making oil pressure adjustment.

Crankcase Breathers

Two breathers are provided to keep the interior of the crankcase at atmospheric pressure and provide ventilation to facilitate the escape of oil and water vapors.

One is combined with the oil filler on the left side of the motor and the other is mounted on the top of the timing chain compartment at the forward end.

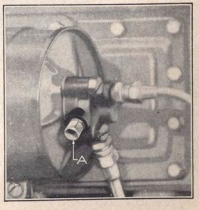
Oil Filter

An oil filter which is attached to the left side of the motor removes from the oil carbon and dirt that is too small to be caught by the pump strainer, thus preventing wear that would result from dirty oil.

It is not, however, intended to remove from the oil unburned fuel and acids which form in the crankcase due to natural service and improper use of the carburetor choke; therefore, instructions regarding the draining of the crankcase oil and the proper use of the choke should be followed carefully.

The rate of oil flow through the filter will gradually decrease, as the foreign matter in the oil is collected, until it ceases to function due to clogging. There is a by-pass valve provided which, in this event, allows the oil to return directly to the crankcase.

An occasional inspection should be made to see that the filter is operating. This can be determined by removing the small plug "A." If oil flows from the opening the filter is functioning; if not, it has become clogged and the filter cartridge should be replaced.



When making this test the engine must be running and should be warm enough to allow a free flow of oil. Make sure the plug is replaced when test is completed.

The filter cartridge should be replaced when it becomes inoperative, otherwise the whole purpose of the filter is defeated. New units will be installed by any Packard Service Station at a nominal cost.

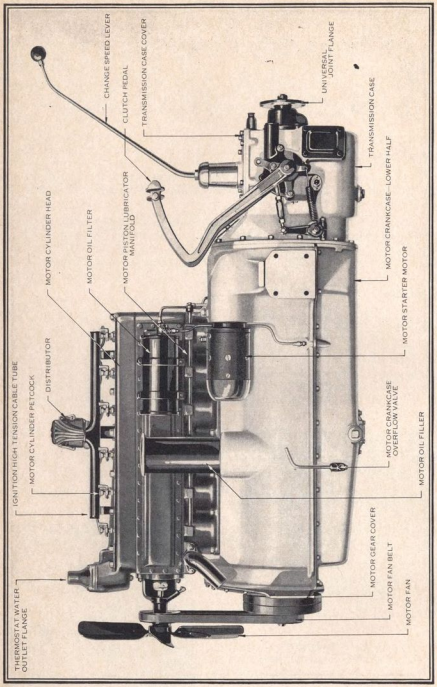


Plate No. 5—Motor Left Side

Lubrication of Motor Electrical Units

Generator

The oiler at the end of the generator armature shaft, which is plainly marked with an arrow, should receive a few drops of light oil every 2500 miles. Oil should never be used on the commutator.

Distributor

The grease cup on the distributor housing should be kept full of vaseline and given one turn about once each month.

Every 10,000 miles a few drops of light machine oil should be applied to the breaker mechanism and the cam coated lightly with vaseline. Remove the distributor rotor and saturate felt with engine oil.

Motor Features

General Principle

The Packard Six motor is of the four-cycle type and of L-head construction. The cylinders are cast in block with a detachable head and are removable from the crankcase.

The valves are operated through rocker arms from the camshaft, which, together with the generator, is driven by an adjustable silent chain. Lubrication of the motor is by full force feed system. (See page 23.)

The front motor supports are mounted in rubber insulators which eliminate the transmission of metallic resonance to the car.

Pistons and Rings

The pistons are aluminum alloy of a special steel bridge and slotted skirt design with three compression and one oil ring above the piston pin. The piston pin floats free in the connecting rod and piston and is held in place by expanding lock rings. Pistons are fitted with a .0015 inch clearance in the cylinder bore and the pins are a palm push fit cold. This exact fit is necessary for lubrication and to prevent unnecessary thrust of the piston against the cylinder wall.

Piston rings have a gap measure of .010 to .016 inch and are assembled to move freely in the grooves when the piston is shaken. Piston and connecting rod assemblies should be removed from the top of the motor.

Maintaining Compression

Compression in all cylinders should be equal and up to standard. Weakness or loss of compression is most probably due to imperfectly seated valves, which may be caused by insufficient clearance between the valve stems and tappets, or by sticky valve stems and guides.

The use of a poor or improper grade of lubricating oil or running with too rich a mixture may cause carbon deposits to collect in the cylinders and on the valve seats, preventing valves from seating properly.

Compression should be tested for uniformity in all cylinders at regular intervals. This can best be done by rocking the motor against the compression of each cylinder by means of the hand crank.

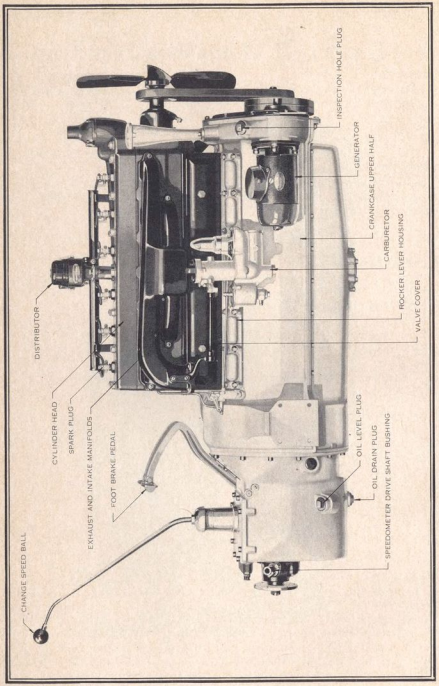


Plate No. 6—Motor Right Side

If the compression varies greatly between the various cylinders, the cause should be determined and remedied. The nearest Packard Service Station should be consulted when low compression is experienced.

Carbonized Cylinders

If the motor knocks easily under load, and does not seem to develop its normal amount of power, it usually is an indication that there is carbon in the cylinders.

To clean the carbon remove cylinder head according to the following directions:

Drain the water from the cooling system. Remove the top hose connection, the distributor, its shaft and connections. It will then be possible to raise the cylinder head, which is secured to the cylinder block by studs. The carbon can then be easily removed with a scraper.

If it is desired to grind the valves at the time the head is off, full instructions may be obtained from the nearest Packard Service Station.

CAUTION: Before replacing the cylinder head be sure that the cylinders are clean and entirely free from loose carbon or any other foreign substance. Also see that the cylinder head gasket is not broken or defective.

After the cylinder head has been reassembled by reversing the above instructions, retime the spark as explained on page 41.

Valve Adjustment

Starting from the front of the motor the valves for the six cylinders are placed in the following order:

1 EX, 1 IN
2 IN, 2 EX
3 IN, 3 EX
4 EX, 4 IN
5 IN, 5 EX
6 IN, 6 EX

The valve push rods should be so adjusted that the clearance between the tappet and the valve stem is .004 inch for the inlet and exhaust valves when the motor is warm.

CAUTION: Insufficient clearance will result in a riding valve when it becomes hot and loss of power and rapid depreciation of the valve and valve seat follow.

The inlet valves are larger than the exhaust valves in order to increase high-speed "breathing capacity."

Front End Chain

The camshaft and generator shaft are driven from the crankshaft by a triangular drive adjustable silent chain.

Adjustment will ordinarily be necessary after about 1000 miles, after which adjustments should be made only when it becomes noisy. To inspect the chain, remove the inspection hole plug, which is above the chain at the right forward end of the crankcase.

If the combined inward and outward deflection of the chain at the inspection hole equals or exceeds one-half inch, the chain should be re-adjusted.

To adjust the chain, loosen the three nuts on the generator flange studs. The lower stud pivots the generator, making it merely necessary to move the top of the generator away from the motor until the chain is tight.

The proper tension can be determined by adjusting until a slight humming noise develops, and then slacking or backing up the adjustment until this noise disappears.

Tighten the three nuts. Recheck the deflection of the chain, which should be ¼ inch.

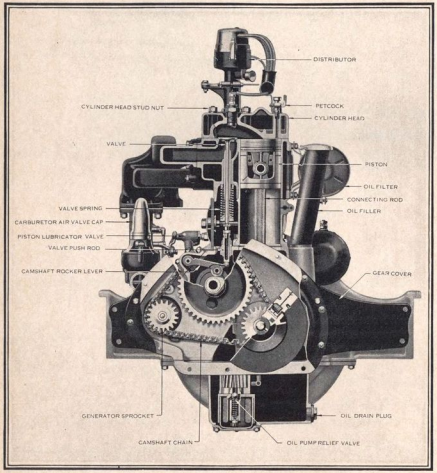


Plate No. 7—Motor Front View

To Set Valve Timing

Adjustments of the timing chain do not affect the valve timing; therefore, no change in the setting of camshaft is possible unless the chain has been removed or has been allowed to get so loose that it has jumped a tooth on the sprocket.

If, for any reason, it becomes necessary to reset the valve timing, turn the engine until No. 1 piston is on top dead center, then align the two teeth marked "O" on the camshaft sprocket with the two teeth marked "O" on the crankshaft sprocket (see Plate No. 7), making sure that their position does not change when the chain is assembled, as a variation of only one tooth will make a very marked difference in the operation of the motor.

The chain adjustment should be loosened before chain is applied and then adjusted according to previous instructions after the installation has been completed.

NOTE: The ignition timing should be checked after the valves have been retimed. See page 41.

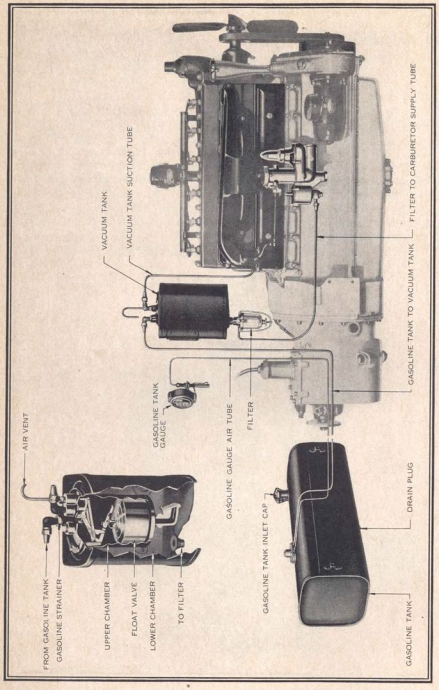


Plate No. 8—Gasoline Vacuum System

Gasoline System

General Principle

The gasoline supply of 22 gallons is carried in the main tank at the rear of the frame. From there it is drawn to a vacuum tank on the dash by suction from the engine. From the vacuum tank it flows to the carburetor by gravity.

Gasoline Gauge

A gauge is mounted on the instrument board to indicate the amount of gasoline in the tank at the rear of car. The gauge is accurate to within ½ gallon and is automatically adjusted by the surging of the gasoline in the tank.

The construction of the gauge is very simple and rugged, there being no moving parts except the small amount of liquid in the gauge head which is mounted on the dash. If the connections are kept tight, the gauge should read accurately throughout the life of the car.

Should the car be left standing for a week or so, the gauge may show empty when there are still several gallons in the tank. Driving the car a few blocks so as to surge the gasoline in the tank will quickly cause the gauge to register the correct amount.

The connections on the air line—both front and rear—must be kept tight and should never be disconnected, except when necessary to make repairs.

A loose connection will cause erratic movement of the gauge, caused by the admission of gasoline to the air line. Before tightening a loose connection the front air line connection should be disconnected at the dash and the line blown out with a hand air pump. After the line has been thoroughly dried it can be reconnected. The gauge on the dash will read zero and it will be necessary to drive the car a few blocks before it will again register correctly.

Gasoline Filter

To prevent water and sediment from accumulating in the carburetor, a gasoline filter is connected to the lower outlet of the vacuum tank. Any water or dirt removed from the gasoline can be seen in the glass bowl of the filter. It should never be allowed to become more than half full of water. Strainers also are provided in the inlet to the vacuum tank and in the inlet to the carburetor.

Vacuum Tank

The vacuum tank has four connections, three at the top and one at the bottom. The lower connection leads to the carburetor and the upper ones to the main gasoline supply tank, to the intake-manifold of the engine, and to the open air.

The tank consists of two chambers. The upper chamber contains a float which operates, through levers, two valves, one in the suction line from the intake-manifold and the other to the atmospheric vent which leads into the upper chamber of the tank. When there is no gasoline in the upper chamber, the float is down, the valve communicating with the atmosphere closed and the valve in the suction line open. With the

engine running, suction will draw gasoline from the supply tank and fill the upper chamber of the vacuum tank. This causes the float to rise, which in turn opens the atmospheric vent and closes the suction line. The gasoline now passes into the lower chamber where it feeds to the carburetor by gravity, allowing the float in the upper chamber to drop. This causes the suction valve to open again and the operation is repeated. The lower chamber is open to the atmosphere at all times, so that a steady flow of gasoline to the carburetor is assured.

Care of the Vacuum Tank

The vacuum tank requires very little attention. The small screen at the top of the vacuum tank directly under the connection leading to the gasoline tank in the rear should be removed and cleaned periodically. No other attention is required.

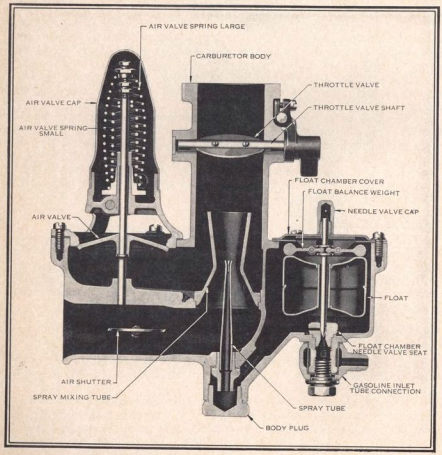


Plate No. 9—Carburetor

Carburetor

The carburetor is of the automatic float feed type with a single stage spray nozzle and a cylindrical mixing chamber.

The gasoline enters the float chamber of the carburetor through the inlet strainer, which should be cleaned occasionally. A constant level of supply of gasoline is maintained by the float, thereby regulating the height of the gasoline in the spray nozzle which is directly connected with the float chamber.

The gasoline flows into the float chamber through a needle valve, automatically operated by the action of the float. Pivoted balance levers resting on the top of the float open and close the needle valve according to the movement and position of the float.

To ascertain whether or not the carburetor is receiving gasoline, remove the screw cap on the float chamber cover and raise the needle valve stem thus exposed. Gasoline should issue here almost immediately. This floods the carburetor and should therefore not be continued after gasoline once appears.

The mixing chamber is a cylindrical passage, in which the gasoline atomizes and mixes with the air before being drawn into the manifold.

The gasoline after leaving the float chamber enters the spray nozzle, which is located in the center of the mixing chamber.

The suction created by the pistons causes air to enter the mixing chamber through both primary and auxiliary air inlets. In passing round the spray nozzle the air draws the gasoline from it, atomizing and mixing it with the air in the proper ratio for combustion.

Carburetor Control

The throttle of the carburetor may be operated either by means of the throttle lever on the steering wheel or the accelerator pedal.

The accelerator pedal is the usual means of controlling the speed of the car. Its action is instantaneous and when released the motor resumes the speed determined by the position of the hand throttle lever setting.

The accelerator pedal is set to have a clearance of $\frac{3}{16}$ inch between pedal and top of toeboard when throttle is wide open.

A clearance is necessary in order to insure the full range of throttle opening.

Primary Air Intake

The primary air intake contains a shutter which is normally open and not in use when running. This shutter is operated by the carburetor control on the instrument panel, which also operates the auxiliary air valve and is used to choke the motor for starting when cold. By pulling the carburetor control all the way out, the auxiliary air intake is completely closed and the primary intake practically closed, allowing a very rich mixture to be drawn into the cylinders. The control should be pushed in, at least part way, as soon as the motor has started firing.

Throttle Valve

The throttle valve is of the butterfly type and is located in the carburetor body above the spray nozzle. It is controlled by a hand lever on the steering wheel and by the accelerator pedal.

An adjustable stop screw holds the throttle valve slightly open and allows a small amount of mixture to reach the motor cylinders with the throttle lever above the steering wheel in the closed position. The minimum amount of mixture for idling the motor is thus supplied.

To increase the minimum speed, loosen the check nut and turn the set screw to the right. To decrease the speed, back off the set screw.

Auxiliary Air Valve

The auxiliary air valve is in a housing forward of the mixing chamber and is controlled by the tension of two springs, one within the other.

At low motor speed most of the air is admitted through the primary air intake around the spray nozzle.

To prevent too rich a mixture at greater throttle openings, the auxiliary air valve is opened by the increased suction of the motor.

The carburetor thus automatically produces a more nearly correct mixture for all motor speeds than could be obtained by manual control.

The normal running position for the carburetor auxiliary air valve is attained when the carburetor control is against the instrument board. The motor while cold, however, will require a richer mixture initially than after it has become warm by running. This rich mixture may be obtained by keeping the control out about $\frac{1}{4}$ inch. Due to the thermostatic water control, the motor warms up very rapidly and the control should not be allowed to remain out of normal running position any longer than is necessary.

If convenient, idle a cold motor after it has been started, before running the car. By allowing the motor to heat up in this way, it will pull with greater efficiency when put under load.

Too rich a mixture supplied to a motor will waste gasoline, cause an accumulation of carbon, may seriously interfere with the proper lubrication of the cylinder walls, and foul spark plugs.

CAUTION: When supplied with too rich a mixture, either through choking the carburetor too much in starting or through operating the motor with the carburetor control too far out, the motor is liable to refuse to run. To overcome the "loading," open throttle and crank the motor by the starter and with the carburetor control pushed against the dash and the ignition switch in the "off" position. After the cylinders are blown out, partially close throttle, turn on the switch, and start the motor in usual way.

Auxiliary Air Valve Adjustment

Permanent adjustment of the auxiliary air valve is made by changing the tension of the air valve springs. These springs which control the action of the valve are, in addition, adjusted for temporarily varying operating conditions by means of a cam operated by the carburetor control on the instrument board.

The proper adjustment for normal running conditions is obtained when the carburetor control is against the instrument board. To enrich the mixture, pull the control out as required.

The auxiliary air valve itself should be adjusted to the leanest possible mixture at which the motor will idle properly when hot. The dash adjustment should be pushed all the way in and the valve, when depressed to the point where it touches the inside spring, should have a drop of $\frac{5}{32}$ inch from its seat.

To check proceed as follows:

Push the carburetor control all the way in. Measure height of top of air valve stem from some fixed point on the motor. Depress air valve until it strikes inside spring. Measure height of top of stem as before. The difference in these two measurements is the air valve drop.

The outer spring should be adjusted so that the valve just touches its seat when the carburetor control is against the dash. Then with the motor warm reduce the compression of this spring as much as possible, retaining smooth motor operation.

Make sure that air regulating connecting rod clevis is so adjusted that the air shutter completely closes when the carburetor control on the instrument panel is pulled all the way out.

CAUTION: In warm weather, or if the motor is warm, the mixture may be so rich if the carburetor control is pulled out too far that the charge will not ignite and the surplus of unburned gasoline may interfere with the proper lubrication of the cylinder walls. See Caution, page 38.

Suction Tube

A suction tube leads from the base of the spray mixing tube into the upper part of the mixing chamber above the throttle valve. The function of this tube is to prevent loading of the motor when it is idled or driven by the car in coasting with the clutch engaged. This is accomplished by the tube removing the gasoline which collects in the carburetor body due to condensation. It also prevents loading under continued low throttle driving and aids in giving immediate response in acceleration. Failure of the suction tube to function properly is evidenced usually by gasoline dripping from the carburetor and by loading of the motor as described. The cause of failure would be air leakage into the tube or connections, or, more frequently, clogging of the passage way either in the tube elbow or carburetor body. The best way to clean this passage way is to remove the tube and lower elbow connection. Blow these and the drilled leads in the carburetor body out with compressed air.

Ignition System

Low Tension Circuits

The ignition system is of the single wire or grounded return type. The source of current is the generator which charges a storage battery. The positive battery terminal is grounded. The negative terminal is connected to the motor starter switch. From the battery junction box negative terminal the low tension current is carried to the negative side of the ammeter. From the positive ammeter terminal the circuit leads to terminal marked "Batt" on the circuit breaker relay which is located on the back of instrument board panel cover, and a second lead connects the ammeter positive terminal with the motor generator.

The low tension current leaves "Batt" terminal on circuit breaker running to the ignition coil, which it enters at post "Neg" and leaves at post "Pos," carrying current to a terminal on the distributor housing, connected to the contact breaker points.

Ignition Switch

A combination ignition switch and coil on the instrument board controls the ignition. It is operated by means of a key which, when turned to the right, causes a plunger containing the lock to snap out and complete the low tension circuit. The key should always be removed from the switch after ignition is turned on so that merely pushing in the plunger will lock the ignition.

Ignition is turned off by pushing plunger in to the "off" position and this should always be done when leaving car. Otherwise, if the breaker points should happen to be closed when motor is stopped, a low tension circuit is completed through these points and the battery circuit would flow continuously, thus running down the battery.

Ignition Breaker

The breaker in the distributor unit completes the low tension circuit when the breaker points are in contact. When the points separate, the instantaneous clearing of the low tension current from the primary winding of the coil induces a high tension current in the secondary winding which surrounds the primary winding.

The high tension current is conducted to the cylinder spark plugs through the distributor head.

The breaker mechanism consists of two sets of contact breaker points, operated by a three lobed cam mounted on the top of a vertical shaft which is driven at camshaft speed. This causes the low tension circuit to be broken three times to each revolution of the crankshaft.

Arcing across the contact breaker points when they are separating is minimized by the use of a condenser, located underneath the distributor housing. Indirectly the condenser also serves to intensify the high tension current wave.

The contact breaker points of the distributor unit should be kept smooth and parallel, with a clearance of from .020 inch between them when fully separated. A feeler gauge for adjusting these points is attached to the ignition breaker and distributor wrench.

Firing Order

The firing order is 1-5-3-6-2-4, numbering the cylinders in succession, beginning with number one at the front of the motor.

High Tension Circuits

The high tension motor ignition passes from the center terminal on the end of the coil to the center terminal of the distributor head, thence through the distributor to the proper spark plug. The high tension current after jumping the spark plug gap completes the circuit through the grounded low tension circuit, the secondary winding for the motor ignition circuit being connected to the primary winding.

High Tension Distributor

The distributor is mounted on top of the distributor unit located on the cylinder head. Its function is to direct the high tension current produced by the action of the breaker points, coil primary current, etc., to the proper cylinder. This is accomplished by means of a rotor through leads to the spark plugs according to the firing order of the motor.

Spark Advance

The point at which ignition occurs in the cylinders relative to piston travel is automatically controlled within the driving range by a centrifugal governor in the distributor unit. This is accomplished by varying the angular relation between the timer shaft and crankshaft. This relation may be further affected by operating the spark control located on the instrument panel, which has the effect of bodily shifting the entire range of action of the automatic spark advance.

For starting and for extremely low speeds the spark control should be kept pulled out about ¼ inch. For ordinary or high speeds the control should be pushed all the way in, which is full advance.

For maximum economy above fifteen miles per hour the spark should be fully advanced but on heavy pulls this may cause an objectionable detonating condition in the motor, in which event it may be temporarily retarded.

To Check Spark Setting

The spark setting is measured on the circumference of the flywheel. In the fully advanced position the ignition point should be 21/32 of an inch before top dead center.

A pointer is located in the starter motor hole, as shown in the illustration, and the flywheel is marked to indicate the point at which the spark should occur.

Remove the starter motor, the distributor cap and rotor—set the spark control in the fully advanced position. Open all priming cups with the exception of the one in No. 1 cylinder. Crank the motor by hand until compression begins in this cylinder, then open this priming cup and continue to crank the motor slowly to the point where the circuit breaker just begins to separate. Visual determination of the separation of the breaker points is not accurate enough and it is advisable to use the following procedure:

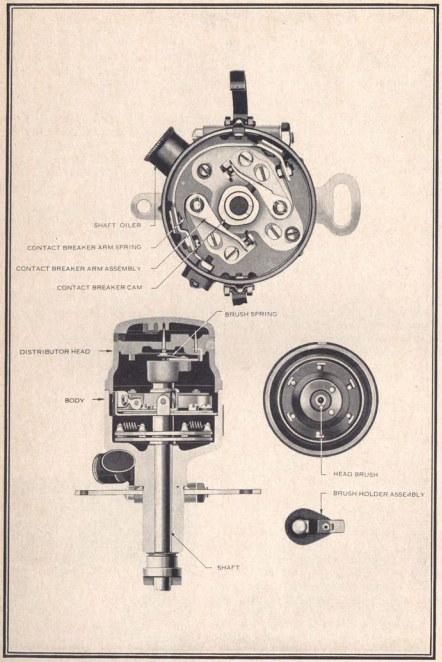


Plate No. 10—Distributor Unit

Turn the ignition switch on and watch the ammeter as the motor is slowly hand-cranked with petcocks open. At the instant of breaker point separation the ammeter reading will fall to zero current flow. All other circuits in the electrical system should of course be open when this check is being made.

In this position, the marking "Upper D. C. Cylinder No. 1" on the flywheel should have $\frac{3}{32}$ inch to travel before reaching the pointer. This point is marked by a letter "S" stamped on the flywheel.

Retiming the Spark

Retiming the spark should not be necessary unless previous disassembling has caused disarrangement of related parts.

In order to retime the spark, set the flywheel, as explained under "To Check Spark Setting." With the spark control in the fully advanced position, remove the distributor cap and loosen the clamp screw in the plate underneath distributor.

The distributor can then be turned so that the contact breaker is just opening when the position of the rotor coincides with the position of the terminal marked No. 1 on the distributor cap. Tighten the clamp screw in the plate without moving the distributor and recheck the setting as explained under the paragraph "To Check the Spark Setting" on page 41.

Spark Plugs

The ignition spark jumps across a gap between the center point or electrode and the point connected to the body of the plug. These points should be adjusted with a gap of .025 of an inch between them. Improper adjustment of the spark plugs will impair the efficiency of the motor and may cause it to miss fire.

.025 of an inch gap gives a good spark for slow running and for hard pulling, and is the best all-around adjustment obtainable.

The spark plugs should be kept free from carbon which otherwise will cause short-circuiting. The plug points may be cleaned with fine sandpaper. It is also a good plan to wash the plugs occasionally in gasoline. The carbon which collects in the recess surrounding the porcelain should be thoroughly cleaned out to avoid short-circuiting.

The center electrode is insulated from the body of the plug with porcelain. If this becomes cracked, the plug should be replaced, as otherwise it will ignite the mixture in the cylinder irregularly if at all.

It is advisable to replace spark plugs every 10,000 miles.

Replacing the Complete Distributor Unit

If the distributor unit has been removed for any reason, it may be replaced, providing the motor has not been disturbed or rotated, nor the distributor unit itself changed from the position it held when removed. Generally, however, it will be advisable to proceed upon the basis that something may have altered its position slightly.

In this event hand-crank the motor to No. 1 cylinder compression—see above—and stop with "Upper D. C. Cylinder 1 and 6" $\frac{3}{32}$ inch to go before reaching the dead center mark on the flywheel housing.

Remove the distributor cap from the ignition apparatus and rotate the distributor rotor until its position corresponds with the position of No. 1 terminal on the distributor cap.

Keep the lever, which is at the bottom of the distributor unit, in its rear position and make any necessary adjustments for connections on the adjustable clevis at one end of the inclined spark control rod.

The distributor unit may now be set in place and all connections made.

Any slight misadjustment may be corrected as described under "Retiming the Spark" on page 43.

NOTE: If the distributor driveshaft has been removed it should be applied to the distributor after the rotor has been set to No. 1 terminal, and both put in place on the engine as a unit, otherwise the rotor may not coincide with No. 1 terminal with the distributor in place.

Starting and Lighting System

The starting and lighting system is of the single wire type, the units being grounded. In other words, the return connection is made through the various metal parts of the chassis. The current is furnished by a storage battery which is charged by a generator operated by the motor. A heavy cable leads from the starter motor and is connected to the negative battery terminal through the starter switch. The positive battery terminal is grounded. The current for lighting and ignition is consequently taken directly or indirectly from the negative battery terminal.

The Battery

The battery is located in a battery case in the right front fender outside of the frame. It is kept in place by hold-down bolts at each end, the nuts of which should be tightened just enough to hold the battery firmly. To disconnect the battery, loosen the binding posts on the frame so that the leads may be disconnected and pulled off.

The battery is common to the ignition, starting and lighting systems. It is composed of three cells, and is 6-volt with a capacity of 100 ampere hours. The negative terminal is connected to the starter switch and the positive is grounded.

Care of Battery

In ordinary service the battery should require no other attention than to keep the liquid ¼ inch over the tops of the plates, adding only distilled water as required. Never add acid.

The simplest and most reliable method for gauging the condition of the storage battery is to test each cell with a hydrometer. When the battery is fully charged a reading of about 1.280 specific gravity will be obtained in each cell. If the driving conditions have been such as to insure an adequate amount of charging from the generator and one or more cells constantly register below 1.200, the nearest service station of the battery manufacturer should be consulted.

Outside of isolated cases of overcharging, undercharging, excessive discharging, etc., the common cause of battery failure is neglect on the part of the operator to add or have added the required distilled water. This should be done every two weeks in the winter and every week in summer. On touring or other heavy mileage work attention is required more frequently.

This further guards against unforeseen breakdowns of the battery, as unusual or irregular water consumption is a warning to have the battery inspected at the maker's service station.

If the battery should become discharged from allowing the car to stand with lights burning, ignition switch left on, or from any other cause, it should be given a recharge immediately.

A fully discharged battery will freeze at about twenty degrees above zero.

A battery that is three-fourths discharged will freeze at about zero.

When placing car in storage it is best to remove the battery and have it stored at a charging station where it will receive proper attention.

CAUTION: The battery should always be disconnected when removing the generator or when connecting or disconnecting any of the wires on switch or ammeter so as to prevent possible damage to these units through a short circuit.

The Generator

The generator is carried at the front end of the motor on the right side. On top of the generator is mounted a small box which contains the relay to which the negative generator lead is connected. The positive side of the generator is grounded. In removing the generator do not remove the bronze housing into which the generator shaft extends. The sprocket which drives the generator is mounted on this bronze housing and its removal would necessitate replacing the front chain on the generator sprocket and the sprocket on the bronze housing, and resetting the camshaft.

Do not run the motor with the generator or the battery wire disconnected. An attempt to do this may cause serious trouble by either burning out the lamp bulbs, damaging the generator or running down the battery.

Relay

The relay is located on the top of the generator. It is an automatic switch which closes the circuit between the generator and the battery when the generator speed is sufficient to begin furnishing current, and automatically opens when the speed of the generator is too low to furnish current, or the motor is stopped.

Regulation of Generator

The generator is automatically regulated to furnish a constant current output at all except very low speeds. There is also a slight decrease at high speed. This is obtained by exciting the field with current received from one main brush and a third brush. For ordinary service an output of 9 to 11 amperes registered on the ammeter is satisfactory. When the car is driven slowly a large percentage of the time, or if the lights are used extensively, it is desirable to increase this output to not more than 13 amperes. These ampere readings apply only when all lamps are turned off, that is, when all circuits on the car except the charging and ignition circuits are open. On the other hand, if the lights are seldom used or if a rather high average speed is maintained, it may be desirable to lower the output to 4 or 6 amperes.

The winter charging rate should be higher than the summer rate. The changing of the rate can be performed quickly at the nearest Packard Service Station. High battery water consumption is usually an indication

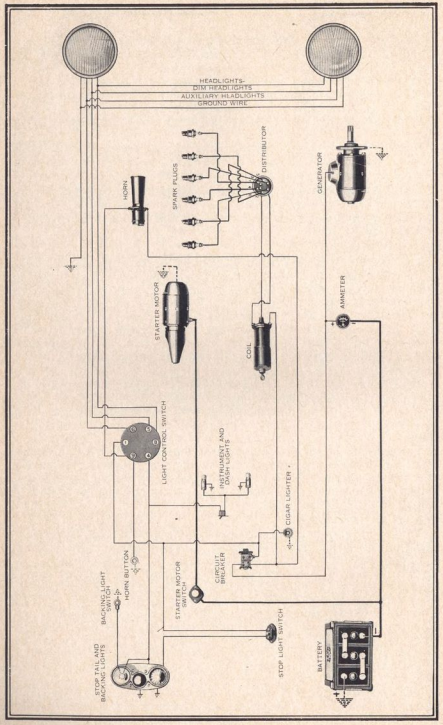


Plate No. 11—Wiring Diagram

of high charging rate. Low battery charge usually indicates a low charging rate. See page 44 for testing battery gravity.

To adjust the output, loosen the screw in the center of the knurled adjusting nut on the commutator end of the generator, turn this nut slightly counterclockwise to increase the charging rate, and turn it slightly clockwise to decrease the charging rate.

When the engine is running the ammeter registers the amount of charging current passing from the generator to the storage battery. If the ammeter fails to register when the lights are off and the car traveling over 12 miles per hour, look for loose connections or broken wires between the generator and battery. Be sure also to inspect the battery ground lead. See that the generator commutator is clean and that the brushes are making good contact.

CAUTION: The car should not be driven with the storage battery removed and using dry cells for ignition current unless the third brush and one main brush are removed from contact with the commutator, otherwise serious injury to the electrical system will result.

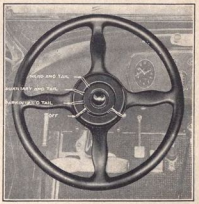
Ammeter

The ammeter is located in the instrument board panel. It is connected between the generator, lighting and ignition circuits and the battery and indicates the amount of current flowing into or out of the battery, except that used by the starter motor.

When the engine is not running or is idling, the ammeter will register amount of current flowing to lamps or ignition should these switches be on.

CAUTION: Do not continue to operate the motor with the ammeter showing zero or less with lamps off, as serious damage may be done to the generator or other parts of the system.

Light Switch



The light switch is located on the bottom of the steering gear housing and is operated by a lever on the steering wheel.

There are three positions of the lighting switch: First, tail and parking lights; second, tail and deflected beam driving lights; and third, tail and raised beam driving lights.

The lights in the instrument board panel are lighted in all three positions of the light switch but can be turned off at any time by an auxiliary switch located on the bottom of the panel.

A slide in the bottom of the instrument board panel also permits the floor of the front compartment to be illuminated when so desired.

Circuit Breaker

The circuit breaker is located on the back of the instrument board panel. This protective device takes the place of the usual fuses. The normal lighting current does not affect the circuit breaker but if a short circuit should occur, causing a heavy current to flow, it would operate

the circuit breaker, causing it to make a buzzing noise, which will continue until the short circuit has been eliminated, which should be done as soon as it can be located. An additional effect of the circuit breaker in action is a flickering of the lights.

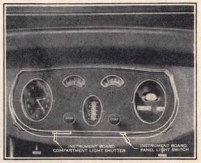
Stop Light Switch

A switch built into the pedal anchorage closes the circuit to the stop light when the brake pedal is depressed. The connection to the switch is in the form of a bayonet lock type of plug, so that it may be removed readily when work is to be done on the unit.

The stop light should light when the pedal is depressed one to one and one-quarter inches. Do not screw the adjusting set screw in farther than sufficient to give this result, as otherwise the mechanism may bottom through the switch and destroy it. If the set screw is screwed out too much the stop light will be lighted continuously.

Backing Light Switch

A switch built into the gear shifter rail cover on the rear of the transmission operates the backing light when the gear shift lever is moved into the reverse position. The connection to the switch is in the form of a bayonet lock type of plug so that it may be removed readily when work is to be done on the transmission unit.



Lighting

All electrical appliances receive their current through the large cable leading from the battery "Neg" post. The other ends of both lighting system and battery wires are grounded to complete the circuit.

Wiring for tail light is carried in a flexible conduit attached to the left frame member.

Headlight and auxiliary wires are carried in a rubber casing leading to the headlights. The circuits lead from the negative terminal of the battery, through the various terminals, switch, circuit breaker, etc., to the headlight bulbs which are grounded through a return cable to the frame.

Lamp Bulb Sizes

	Volt	C. P.
Headlight, Auxiliary } One bulb of the two filament type	7	21
Parking	7	3
Instrument Board	7	3
Dome Light (Closed Bodies)	7	6
Tonneau (Open Bodies)	7	3
Tail Lamp	7	3
Stop Light	7	21
Backing Light	7	21

All lamp bulbs have the Ediswan base and are of the single contact type with the exception of the headlight which is a double filament bulb with two contacts, one for each filament.

Headlamps

The headlamp is a complete lighting unit of the type which uses a double filament bulb of 21 C. P. for each filament. The two filaments are spaced 1/8 inch apart above and below the central axis of the bulb and reflector. Lighting the lower filament gives what is termed the upper or "driving" beam for long distance illumination. The upper filament produces the lower or "passing" beam which is for city driving or wherever the upper beam might cause annoyance to others. The lower beam is tilted downward about 2½ degrees from the upper position or about one foot on a wall 25 feet from the lamp and provides as much illumination as the upper beam except that it is deflected to the road surface closer to the car.

A special variable axis parabolic reflector tilts and spreads the light through a ribbed or fluted lens designed solely for use with this reflector. In addition to the screw at the rear for focusing the bulb an adjustment is provided for raising or lowering the bulb in the reflector to secure best results from different bulbs. This is done by the lower screw at back of lamp which turns a small eccentric, tilting the socket and bulb up or down in the slotted guide tube attached to the reflector.

Cleaning Headlamp Reflectors

The headlamp reflectors are plated with pure silver and very seldom require attention. If they should require polishing, extreme care must be exercised to select materials that will not scratch the reflector.

Powdered dry rouge and a chamois skin are recommended. If the reflectors are tarnished, the rouge may be moistened with alcohol; afterward polish with dry chamois and rouge. The chamois used on the reflectors must not have been used for any other purpose and must be soft and free from dust.

To Focus Lamps

Place car on level ground or floor and squarely facing a smooth wall 25 feet from the front of lamps. Mark a horizontal line ("A," Fig. 1) on the wall at the height of headlamp bulbs from the ground.

Next mark two vertical lines from line "A" to the ground exactly in front of each lamp center. The distance between these vertical lines should be the same as the distance between the headlight bulbs.

With one lamp covered to hide its light, set the lighting control switch at the upper or driving beam position. Turn the lower of the two screws in the back of the headlamp (vertical adjustment screw) to the right until it stops, then turn it to the left one-quarter turn or slightly less; the total movement is covered by a half turn of the screw.

Turning this screw to the right raises the bulb in reflector and tends to lower the top of the driving beam, producing a flatter cut-off and less drop to the lower beam. Therefore, set the bulb so that the beam shown in Fig. 2 is obtained by proceeding as follows:

Turn the large focus screw in center of lamp slowly to left or right until a light spot approximately the shape of Fig. 2 is obtained.

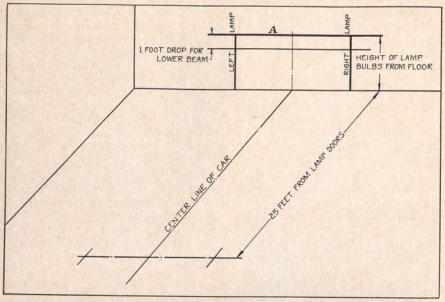


Fig. 1

Aim or point the lamp by loosening the nut on lower side of lamp mounting. The center of the beam should strike the vertical line on wall in front of this lamp, and the top of beam should touch line "A" when car is fully loaded. If car is empty, allow at least 4 inches between line "A" and top of light beam. Under no circumstances should any part of the bright beam rise above line "A."

Make sure that the lamp is firmly fastened in position when it is aimed correctly. Then repeat the foregoing operations with the other lamp. The two upper beams should be similar in shape and should

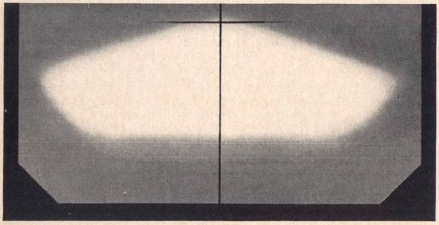


Fig. 2

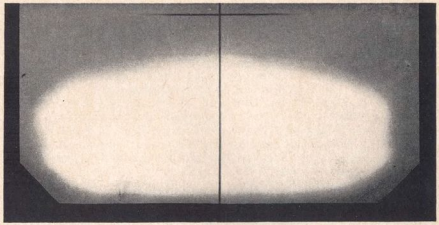


Fig. 3

strike the wall at the same height from the ground. Now turn the control switch to the lower or "passing" beam position and note whether the cut-off or top of the bright area on wall has dropped as in Fig. 3, about one foot. If the amount of drop is considerably less than one foot, turn lower screw (vertical adjustment) to left very slightly and try both upper and lower beams on the wall. When the upper beam from one lamp looks like Fig. 2, it is correctly adjusted and the lower beam will have the proper amount of drop or tilt.

The lower beams project a powerful light close to the car and are of great comfort when meeting another car with glaring lights, since the roadside and ditch are brightly illuminated.

Follow your local and state regulations regarding headlights when they differ in any way from these instructions.

Electric Starter

Starter Motor

The starter motor is located on the left side of the engine at the rear. The motor shaft carries a sleeve provided with a helical thread, on which is carried a threaded pinion.

When motion is imparted to the shaft of the starter motor, it causes the pinion to advance and mesh with the flywheel. When the engine starts and the flywheel speed exceeds that of the starter motor, the pinion is disengaged from the flywheel automatically.

Operating the Starter

Adjust the "spark" control and "choke" on the instrument panel according to instructions on page 9. Turn the ignition switch on. Disengage clutch. Press down the starter button as far as it will go. Hold the button down until the engine starts firing, when it should be instantly released.

CAUTION: Never press starter button down while engine is running.

A heavy drain is thrown upon the battery whenever it is used for starting purposes. If the motor does not start readily, do not attempt to start it by continued cranking. Release the button and locate the trouble. It may be due to an improper setting of the carburetor control on the instrument board, no gasoline, switch turned off, loose or broken wire connections or other causes. Continued cranking may cause battery trouble. "Loading" of the motor due to excessive choking will also frequently cause failure to start. See page 38.

In the event of any electrical trouble consult the nearest Packard Distributer. Do not attempt any repairs or allow local electricians to tamper with the electrical equipment, as the maker's responsibility ceases where such repairs have been attempted.

NOTE: When the starter motor does not turn the motor, and after an initial click makes no indication of receiving current, the trouble may be due to the starter driving pinion jamming on the flywheel teeth. If this is so it would be practically impossible to hand-crank the motor. To disengage, TURN OFF IGNITION SWITCH, engage high gear and clutch and rock the car back and forth. On the reverse rock the pinion will back free from the flywheel teeth and the car should be rolled forward about two feet, after which the motor may be started in the regular way.

Starter Switch

The starter switch is attached to the inclined toeboard at the center. The button protrudes through the inclined toeboard. The heavy cable on one side of the switch is fastened to a terminal on the top of the starter motor; the other side is connected to the battery. Pressure on this button closes the circuit, allowing current to flow to the starter motor.

Removing Starter

To remove the starter motor disconnect the heavy cable at the terminal on top of the starter motor. Remove the cap screw in the flywheel housing just above the starter motor. The unit can then be pulled forward.

NOTE: Before removing either the starter motor or generator it is well, in the interest of safety, to disconnect the battery ground wire.

Cooling System

Water Circulation

The heat generated in the motor must be dissipated in order to permit the motor to function properly. This is accomplished by providing water jackets cast integral with the cylinder block, through which water is circulated by means of a centrifugal pump.

Water is drawn from the bottom of the radiator by the pump and then forced through the water inlet manifold, which is in the form of a cover plate on the left of the cylinder block, to the cylinder water jacket. The outlet from the jacket is through the thermostat, then through the upper hose connection to the top of the radiator. The thermostat by-pass is a concealed pipe in the cylinder head.

Radiator

The water is cooled by the radiator, through which a current of air is drawn by the fan.

The radiator is of the ribbon type, and the radiator core through which the water passes is independent of the outer shell, and is easily removable should repairs be necessary.

Keep the cooling system filled with water as free from lime and other impurities as is possible.

Any steam or surplus water will escape through a vent pipe, extending from beneath the filler cap to the lower right corner of the radiator. The emission of steam is generally an indication of a low water supply or an overheated motor, but may also be caused by a frozen radiator or clogging of the water system. See anti-freeze solutions on page 56.

CAUTION: Avoid pouring water into an empty or nearly empty water system when the motor is hot. On a cold day the emission of steam from the radiator overflow does not indicate necessarily the presence of insufficient water to continue operating the motor. On the contrary it may indicate only that the cooling system is clogged by ice. Stop the motor and thaw out the entire system, fill with anti-freeze solution to give proper protection against freezing, and then proceed.

Draining the Water System

To drain the water from the entire system, open the drain cock at the bottom of the radiator on the left side.

If the car is not to be used during freezing weather, the water system should be drained thoroughly. After the water has ceased flowing run the motor for a minute or two to be sure that the system is entirely cleared of water.

Cleaning the Water System

The radiator and cylinder water jackets should be flushed occasionally to remove any sediment which may accumulate.

To clean the radiator, remove the hose connections and flush by forcing water under city pressure through it from the bottom to the top. Avoid excessive pressure. The cylinder water jackets should be thoroughly cleaned and flushed at times of overhaul.

CAUTION: Do not use chemicals in the process of cleaning the cooling system. If strong enough to aid the process materially they will also attack certain parts of the system and it is very difficult to remove them entirely when the cleaning is completed.

Water Pump

A centrifugal water pump is mounted at the forward end of the cylinder block of the motor. The pump impeller is driven by the fan belt. An adjustable gland nut on the front of the pump shaft keeps the packing tight to prevent leakage. The forward end of the water pump shaft is carried on a roller bearing, which is lubricated by means of an alemite connector, located on the side of the pump housing.

Thermostat

The thermostat, located at the forward end of the cylinder head, bypasses the water around the radiator until the water has reached the

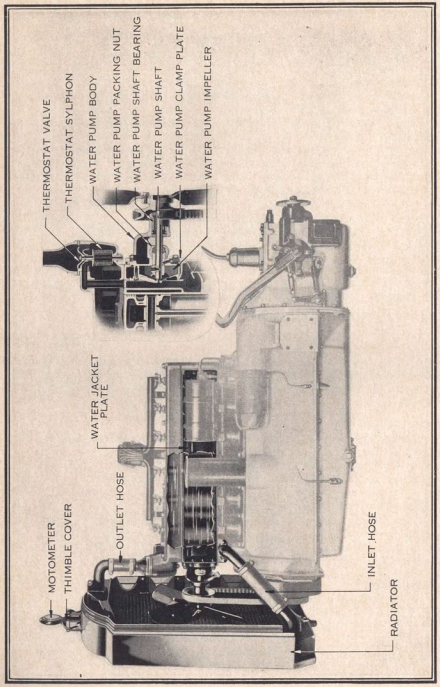


Plate No. 12—Cooling System

proper temperature to permit efficient running of the motor. A by-pass in the cylinder head connects the thermostat housing with the intake side of the pump. Valves controlling the ports to the radiator and the by-pass tube are carried on a shaft actuated by the thermostat sylphon.

When the motor is cold the radiator valve is closed and the by-pass valve is open, allowing the water to circulate through the cylinder water jacket and back to the pump without entering the radiator. As the water becomes heated the expansion of the thermostat sylphon causes the radiator inlet valve to open, and at the same time closes the by-pass valve, making it necessary finally for all water to circulate through the radiator when the motor has become thoroughly warm.

No adjustment of the thermostat is necessary.

Moto-Meter

A moto-meter attached to the radiator filler cap indicates the temperature of the cooling system.

Overheating is generally due to running with an improper mixture, insufficient spark advance, carbonized cylinders, fan belt slipping, radiator not filled, anti-freeze solution in radiator in warm weather, radiator or cylinder water jackets clogged with scale or rust, or insufficient lubrication.

Fan Belt

A belt-driven fan placed directly behind the radiator draws a current of air through the radiator to increase the cooling capacity.

It is very important that the fan belt be kept reasonably tight, but care should be taken not to place excessive tension on it, a deflection of one and one-half inch between the pulleys being recommended. A new belt should be adjusted after the first five hundred miles, but after the initial stretch has been taken up it will require little attention thereafter.

To adjust the fan belt, loosen the four nuts on the front end of the water pump and rotate the water pump body which is mounted eccentrically, thereby increasing or decreasing the tension of the belt. If the four nuts are slacked off too much, the water leakage will be excessive when adjusting the fan belt. This can be prevented by partially draining the cooling system before making the adjustment.

Cold Weather Starting

Cold gasoline will not vaporize readily in frigid air to form a mixture that can be easily ignited in the cylinders. For this reason the instructions for starting the motor (page 9) should be followed carefully so as to avoid continued cranking of the motor, which will result in exhausting the battery and adding an undue quantity of unburned fuel to the crankcase oil.

Cold Weather Care

The operator of a motor car cannot be impressed too strongly with the importance of maintaining "summer heat," so to speak, under the bonnet of his car. The two factors chiefly controlling the length of life of a motor are lubrication and temperature of operation. The operator himself has complete control over both of these factors, and, therefore, the results he obtains from a motor are a measure of the reasonable care he gives it.

The fuel in use today demands precautionary measures which differ from those with which we were familiar several years ago.

We recommend that some sort of cover, preferably of the automatic shutter type, be fitted to the radiator. Louvre covers, fitted to the inside of the bonnet, are also recommended.

With these two items the operation of the car will be much more satisfactory as the usual warming up period in cold weather will be shortened greatly and the proper operating temperature will be more uniformly maintained. They also aid in preventing spark plug fouling, lowered gasoline mileage, rapid deterioration and inefficient motor performance.

Anti-Freezing Mixture

The capacity of the cooling system is about 4¼ gallons and the proportions of the anti-freeze mixture should be arranged for this amount.

We recommend a solution of glycerine and water, as its resistance to freezing is not weakened by evaporation. The original expense is somewhat greater but so long as none is lost by leakage the addition of water is all that is necessary as the glycerine itself will not evaporate even under high motor temperatures.

Glycerine of 1.26 specific gravity or 30 degrees Baume should be used mixed with water in the following proportions by volume for the temperatures expected:

Glycerine	Water	Freezing Point
30%	70%	12°F Above zero
40%	60%	2°F Below "
45%	55%	8°F " "

It is advisable to shellac the inside of the hose connections as otherwise there may be a tendency to seep at the joints. Another point to bear in mind is that regardless of what anti-freeze mixture is used the radiator should never be filled to the top, for more than a quart will be lost through the overflow when the motor warms up.

A simple solution of alcohol, in no way injurious, has a lower boiling point than water. Consequently, on warm days with the car standing and the motor running, the solution will boil easily and evaporate. Alcohol is also injurious to a lacquer finish. The boiling point of denatured alcohol is about ten degrees higher than that of wood alcohol.

Do not use a solution of calcium-chloride or any alkaline solution, as these are injurious to the metal parts, and are also liable to clog the cooling system if the water of the solution is inadvertently allowed to be reduced through evaporation.

CAUTION: If the water in the radiator should become frozen on account of not containing a sufficiently strong solution, run the motor only enough to get it warm and cover the radiator over entirely until it thaws out. A better procedure still is to get the car into a warm place and allow it to thaw out.

Transmission and Clutch

General Principle

The motor unit includes the clutch and transmission assemblies, enclosed in a housing attached to the rear end of the crankcase casting. The transmission case contains a selective gear set giving three speeds forward and one reverse. The driving torque is transmitted to the spiral bevel driving gears in the rear axle through a shaft with a universal joint at each end. The final drive is through the differential and live axle shafts to which the rear wheels are keyed.

Action of Speed Changing Gears

A splined driving shaft carries two sliding gears, moved by two gear shifter forks. These gears engage with countershaft gears for first and second speeds, and a constant mesh idler for reverse. Third speed or direct drive is obtained by coupling the second speed gear to the end of the clutch shaft. The sectional view of the transmission shows the gears in the neutral position.

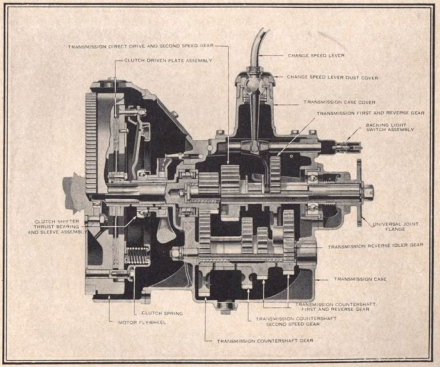


Plate No. 13—Transmission and Clutch Section

In this position with the motor running and the clutch engaged all gears are in motion with the exception of the direct drive first and second speed gears which are fitted by means of splines to the main transmission driving shaft. The forward end of the main shaft is mounted in a roller bearing located on the inside of the clutch shaft gear.

First speed is obtained by sliding the larger or first speed and reverse gear forward into mesh with the first speed countershaft gear. This permits the car to be driven forward at the greatest transmission gear ratio, through the constant mesh gears, at the front of case, and the countershaft and first speed gears.

Second speed is obtained by sliding the smaller or second speed and direct drive gear back into mesh with the second speed countershaft gear. Third speed or direct drive is obtained by sliding the smaller driving shaft gear forward until the internal teeth in this gear engage with the ends of the teeth on clutch shaft gear, thereby locking both shafts together for direct drive.

For reversing the drive the larger transmission driving shaft gear is brought back into mesh with the reverse idler pinion, which is in constant mesh with the small gear at the rear end of the countershaft. The drive is then through the constant mesh gears at the forward end of the transmission case, the countershaft and the reverse idler pinion which is in mesh with both the countershaft gear and the driving shaft gear. This arrangement causes the main driving shaft to be revolved in the reverse direction.

While it is possible to shift from any one gear to another without going through an intermediate gear, it is necessary in each case to move the shifter lever through the neutral position. This brings the sliding gears out of engagement and in making the next shift the sliding gear that is not to be used is automatically locked in the neutral position.

Cleaning Transmission

It is a good plan to drain the oil from the transmission after every 10,000 miles of running and to flush out the case with kerosene. The case should then be refilled to the filling plug level with good transmission fluid oil.

Cold weather has the effect of thickening the lubricant, and it should be diluted with enough cylinder oil to bring it to its summer consistency. If the oil is too thick, increased difficulty will be found in shifting gears.

With the return of warm weather the transmission should be drained and refilled with oil of the original consistency.

The drain plug is located in the bottom of the transmission case and the level plug on the right side.

Clutch

Attached to the flywheel and enclosed in a housing which forms an extension of the transmission case is a single plate clutch.

The clutch consists of one dry driving plate and one driven disc which are connected alternately with the flywheel and the clutch shaft. The driven disc is faced with a special molded friction material which contacts with the driving face of the flywheel and the driving plate.

The clutch driving plate and driven disc are held in engagement by the tension of twelve coil springs. Pressure upon left foot pedal compresses the springs and allows the clutch plates to separate slightly and disengage the clutch.

Care of Clutch

The clutch plate is run dry. It is unaffected by atmospheric conditions and requires no lubrication.

The pressure springs compensate automatically for all wear of the friction facings; therefore, no clutch adjustment is needed. The only adjustment that is necessary is on the clutch pedal.

The release sleeve is of the anchor type and is fitted with a lubricator connection from the chassis lubricator tank for supplying lubricant to the clutch shifter bearing.

If, for any reason, the clutch is removed it will be necessary to use the splined clutch shaft to align the splined hub of the driven disc with the pilot bearing in flywheel when clutch is reassembled.

Clutch Pedal

Do not "ride" the clutch pedal, that is, do not hold the foot against it when driving steadily, as there is a possibility of keeping it partially out of engagement and causing slippage which will result in undue wear of the frictional surfaces. In addition this practice throws a continuous load on the clutch shifter bearing and causes it to wear more rapidly.

See that clutch pedal is properly adjusted in the engaged position.

When the clutch is in the fully engaged position, the pedal should depress $\frac{5}{8}$ inch under light pressure before the heavier resistance of the clutch springs is encountered.

If the pedal is brought up against the floor board before the clutch is entirely engaged, full action of the clutch springs is not obtained, which will allow the clutch to slip and wear rapidly.

The turnbuckle in the rod connecting the clutch pedal with the clutch release lever on the left of the clutch housing furnishes the necessary means of obtaining the correct adjustment for the clutch pedal. Lengthening the rod by means of the adjusting nut will increase the amount of travel before the clutch disengages.

No other change from the original position will be required, as the clutch springs are automatic in the compensation for wear of the friction surfaces.

Chassis Features

Frame

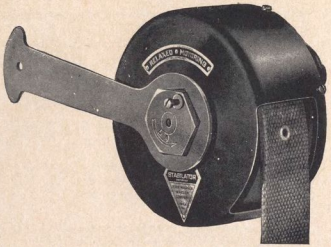
The frame consists of pressed steel channel section side members $\frac{3}{16}$ inch thick and 8 inches deep, tapered from front to rear in such a manner that no offsets are required.

In addition to the usual channel cross members, cross tubes are welded to rigid forgings and riveted to each end of the frame sides to prevent undue frame weave.

Running board and fender brackets are riveted securely to the side members and the frame ends provide a neat mounting for the bumpers without the use of brackets.

Springs

The springs are all of the semi-elliptic type and are carried directly under the frame.



The front springs are 38 inches long and 2 inches wide. They are mounted on the under side of the front axle and are shackled at their front end by a compression shackle. This construction affords an ideal design for the use of low pressure tires with a good steering result and at the same time greatly reduces the bending stresses in the front springs due to braking torque.

The rear springs are 56 inches long and 2¼ inches wide, and are underslung from the semi-floating type rear axle. They are shackled at the rear end. All spring eyes of both front and rear springs are fitted with bronze bushings.

Spring Clips (Important)

It is advisable to inspect the spring clips on the axles periodically and tighten them firmly.

Spring breakage is frequently due to the spring clips being loose and not holding the spring firmly to its seat. The spring clips will require taking up more frequently when new than after the vehicle has been in service for a few hundred miles.

Stabilators

Stabilators are used to retard spring rebound. They operate on the principle of braking the upward travel of the chassis which results from the reaction of the springs when they have been compressed by the wheels rising in passing an obstacle in the road surface. When the spring has been compressed to a maximum, the Stabilator braking effect is at a maximum and vice versa.

Maintaining Stabilators

Full directions as to overhauling procedure may be obtained at the nearest Packard Service Station. This operation should rarely, if ever, be required. It is, however, a good idea to have the Stabilators inspected at a service station about every 10,000 miles.

CAUTION: Stabilators should never be lubricated—they do not require lubrication. To lubricate Stabilators would be just as fatal as to lubricate the wheel brakes—they would cease to hold. There are no bearings or moving parts in a Stabilator except the brake shoe. Therefore there is nothing to lubricate and nothing that can squeak.

To Adjust Stabilators

When shipped on cars from the Packard factory Stabilators are properly adjusted and should not require readjustment unless for the purpose of combating unusual operating conditions or in the event the Stabilator has been removed.

In checking the adjustment inspect the position of the eyelet in the strap—this should be ½ inch below the top of opening in case as shown in cut, page 60.

The position of the eyelet is governed entirely by the way the strap is attached to axle bracket and is not changed in any way by adjustment of the Stabilator itself. It is necessary, however, to unwind the Stabilator spring before attempting to unclamp the strap to change the eyelet position.

Always use the special Stabilator wrench as shown, which is made to fit the slots in the adjusting nut so it cannot slip off. Remove the screw in the adjusting nut cover and screw it into end of locking pin in the adjusting nut, which will form a means of operating the locking pin while unwinding or winding the Stabilator spring. Turn the adjusting nut very slightly in the direction indicated by the arrow stamped on the adjusting nut. This slight movement will enable you to pull out the locking pin far enough to allow the nut to turn back to the next notch into which the pin will fit. There are six of these notches in one revolution of the nut. With the pin holding the nut in this new and weaker position, take a new hold with the wrench and in the same manner allow the nut to go back one more notch, and so on until the adjustment is all off or "dead." In fitting the wrench on the adjusting nut make certain, each time, that the wrench fits into the grooves provided for it around the edge of the nut.

The adjusting nut should then be tightened nine notches for the front Stabilators and seven notches for the rear which gives a setting of 29 lbs. and 24 lbs. respectively when checked by means of a spring scales hooked into the end of the adjusting wrench.

In general, for hard driving over rough roads more tension can be used, but this results in a choppy, stiff ride on ordinary roads at ordinary speeds. If the tension is lowered, rebound becomes objectionable so that a range of two notches is ordinarily the maximum advisable.

Front Axle

The front axle is of I-beam construction and, unlike conventional design, is made to attach to the upper plate of the front springs, which reduces the stresses set up in the springs by brake torque.

Easy steering is obtained by mounting the steering knuckles both at top and bottom on ball bearings. The upper bearing has two rows of balls and takes only radial loads, while the lower bearing is designed to take both radial load and downward thrust, due to weight imposed on the front axle.

Friction is further reduced by employing ball and socket joints for the front axle cross tube. This tube is made adjustable so that the proper alignment of front wheels can be maintained.

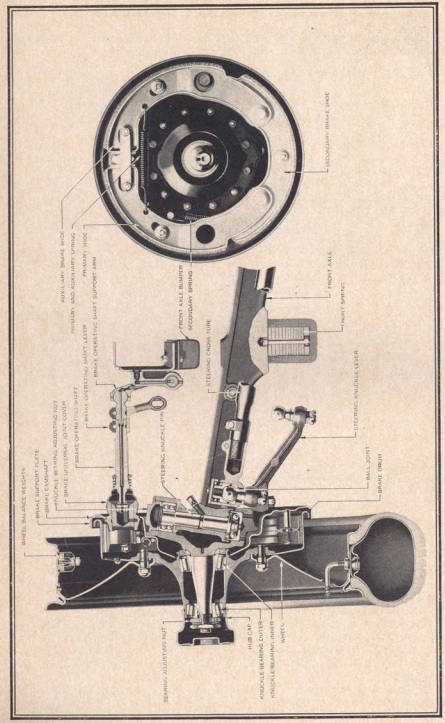


Plate No. 14—Front Axle

Wheels

To Adjust Front Wheel Bearings

The front wheels are mounted on roller bearings. These are carefully adjusted at the factory and should need little attention other than an occasional cleaning and repacking with cup grease once every 10,000 miles under normal running conditions.

To take up on the bearing, remove the hub cap, and the cotter pin in the end of the spindle. Loosen the lock nut, Plate 14, enough so the lock washer will disengage from the pin in the adjusting nut. Then tighten the adjusting nut up snugly with one hand, using a wrench with not to exceed a 12-inch handle, then back off one-half turn, locking it in this position with the locking washer and tighten the lock nut, insert and spread the cotter pin. The wheel should turn freely under light pressure of one finger with scarcely perceptible looseness in the bearing when tested by shaking the wheel at rim.

Front Wheel Alignment

The proper alignment of front wheels is an important factor in tire economy and easy steering. The front wheels should have a toe-in of $\frac{1}{8}$ inch, that is, difference in measurements taken between the felloe bands at the front and rear of the wheels at a height equal to the distance from the center of the spindle to the ground.

The distance between the felloe bands at the rear measurement should never be more than $\frac{1}{8}$ greater than the front measurement taken at the same height.

To adjust the wheels, proceed as follows: Plate No. 14. Remove the castellated nut from ball joint on adjustable end of the cross tube and knock the ball joint out of the spindle lever. Loosen the locking bolts in the ball socket and lengthen or shorten the cross tube as desired by turning the socket; lengthening the cross tube increases the toe-in.

Reinstall the assembly, being sure to clamp all the nuts securely. Revolve wheels one-half revolution and check the adjustment.

NOTE: As the checking of front wheel alignment should be performed very accurately and requires a gauge of a certain type to get such a result, we recommend that this operation be performed by an authorized Packard Service Station.

Balancing Wheels

When Packard cars leave the factory all wheels, complete with tires, are in static balance. Balancing weights are provided so that the balance of the wheels can be maintained when tires are changed or repaired.

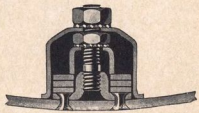
Because of the high speed that can be attained with this car it is very important that the wheels be in as nearly perfect balance as possible. Uniform tire pressures should be maintained in order to avoid the so-called tramping and shimmy of the front wheels at high speed.

The rapid revolutions of the wheels develop gyroscopic forces which, if combined with unbalanced forces, will cause a severe wobble and tramp of the front wheels. These forces change their direction very

rapidly and impose severe strains on the steering mechanism. The same condition is true with the rear wheels, but the stresses are transmitted to the axle shafts and their bearings and are not so apparent.

The tires used on Packard cars are balanced by the tire manufacturer and the light side of the tire is designated by a red dot near the tire bead. The heavy section of the inner tube is at the joint, which also contains the valve stem. The inner tube should, therefore, be assembled to the tire with the valve stem registering with the red dot, which will cancel out considerable of the unbalance in both the tire and tube.

A further correction of any unbalanced condition that might exist in the wheel and tire assembled is provided by five studs in the wheel rim, to which lead and steel washers may be added, as shown in the illustration.



The valve stem furnishes the sixth point at which weight may be added if required. A perfect balance of the wheel can only be obtained on a front spindle free from grease and with no interfering drag from felt retainers or brake shoes. We, therefore, recommend that a balancing check of the wheels be made at a Packard Service Station whenever tires are changed or repaired if high-speed driving is to be indulged in.

Steering Knuckle Stops

Adjust the steering knuckle stop screws in the front axle outer ends so that in hard-over positions the tires do not touch any part of the chassis or running gear and so that they stop the movement of the steering knuckle before the steering gear bottoms in its case.

Brakes

Brakes are provided on all four wheels and are of the self-energizing, internal expanding type. Each brake consists of three shoes with wire woven asbestos facings which contact with the wheel drum. All four brakes are operated by the brake pedal. The two brakes on the rear wheels can be operated by the hand lever independently of the brake pedal so as to provide a standing or parking brake.

Use of Brakes

Apply the brakes gradually. When stopping the car, or slowing it for rounding corners, reduce the speed as much as possible by closing the throttle; then apply the brakes, disengaging the clutch before actually coming to a stop. If the brakes are in good condition, and properly adjusted, either the foot or the hand brake is sufficient to slide the rear wheels. When about to descend a very steep hill, shift the gears into second speed, engage the clutch, and allow the motor to run with the spark advanced and throttle closed. When using the motor in second as a brake, keep the speed below 30 miles an hour and do not shut off the motor. *See Caution, page 11, paragraph 10.*

Brake Adjustment

Adjustments for wear can be made by taking up on the ball socket nuts "A" at the ends of front brake cables and rear brake pull rods. Best results will be obtained when making this adjustment by raising all four wheels off the ground so that the brakes can be equalized properly.

When making the following adjustment, an equal braking effect should be secured between each right and left front wheel and then between each right and left rear wheel, but no attempt should be made to equalize the braking effect between the front and rear wheels, as this is automatically accomplished by equalizing linkage.

1. Make sure that linkage and cross shafts are perfectly free and yoke pins lubricated.

2. Loosen check nut on ball socket nut "A" and take up on this nut until brake starts to drag, then back off until wheel just turns free, following this procedure on each wheel.

3. Then, with brake pedal slightly depressed, check the equalizing effect on the two front wheels by turning the wheels forward against the brake action. If the effort required to turn each wheel is not approximately equal, loosen the ball socket nut on the tight wheel and take up slightly on the opposite one. When a satisfactory result has been obtained, tighten the check nuts.

4. Repeat this operation on the rear wheels, bearing in mind that rear wheels will not turn as freely as front wheels on account of the differential action.

When brakes have become worn to an extent where the foregoing adjustments have caused the brake operating levers "B" to assume a nearly vertical position when brakes are released, it will then be necessary to make an adjustment of the shoes as follows: (It is recommended that this operation be performed by a Packard Service Station.)

1. Loosen the two shoe support bolt nuts "C" on each brake shield.

2. Apply the brake pedal hard several times to seat shoes in the drums, then, with a medium pressure on the brake pedal so as to keep shoes in contact with the drums, pull all nuts "C" down very tightly.

3. With the brakes released, loosen jamb nut "D" on the brake shield and turn brake shoe adjusting cam "E" clockwise until the brake binds in the drum, then back off just enough so the wheel can be turned without brake dragging. Hold the adjusting cam in this position while tightening the jamb nut. Again check to see that wheel turns without dragging. Repeat this operation on each wheel.

4. Remove the ball socket nuts "A" and clamp screws in the front brake operating levers "B."

5. Carefully mark each lever with reference to a certain shaft serration, remove the lever from the shaft and replace so that lever is moved forward just three serrations from its original position.

6. Replace the clamp screws and the ball socket nuts.

7. Adjust and equalize the brakes as explained in paragraphs above.

8. Repeat this operation on the rear brake operating levers, moving these levers three serrations toward rear of car, after which adjust and equalize the rear brakes.

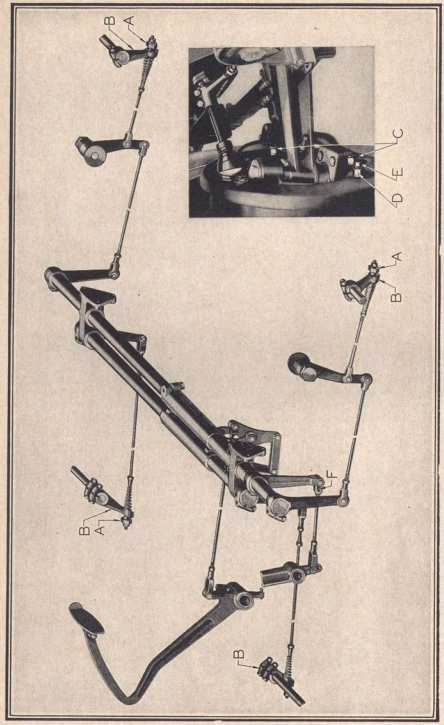


Plate No. 15—Four Wheel Brake Features

NOTE: After the adjustments have been made, the center line of the brake operating levers should form an angle of sixty to seventy degrees with the center line of the brake pull rod with the brakes released.

It is also advisable to check the clearance between the end of slot "F" in hand brake pull rod and the yoke pin.

There should be approximately $\frac{1}{32}$" clearance between the pin and the end of the slot with all brakes released.

Steering Gear

The steering gear is of the worm and sector type and has three adjustments to compensate for wear.

The steering gear usually requires little attention; the housing is filled with lubricant at the factory and with ordinary usage an occasional inspection will be sufficient. If lost motion or backlash becomes too great, an adjustment should be made.

It is advisable to make adjustments to eliminate end thrust in the worm and sector shaft before adjusting the worm and sector to a closer mesh, as removal of end thrust is very often all that is necessary.

To take up end play in the worm which is mounted between two ball thrust bearings, loosen the clamp bolt at top of steering case and turn the large hex nut, Plate 16, attached to the pillar tube to the right until there is no perceptible end thrust in the steering post.

To take up end play in the sector shaft remove the screw from the lock plate at back of steering case and without removing the locking plate move it toward the front of car to the next lock screw hole and replace screw.

The sector shaft has its bearing in an eccentric bronze bushing and wear between the worm and sector can be taken up by turning this bushing so that it throws the sector into closer mesh with the worm.

This is accomplished by removing the screw from the lock plate which is located on the frame side member and, without removing the lock plate, move it toward the front of car to next lock screw hole.

In the event a position between holes is required for the correct adjustment, this can be obtained by removing the lock plate from the serrations on the bushing and engaging it one tooth over.

CAUTION: The thin side of the eccentric bushing should always be toward the front of car and all adjustments should be made with front wheels in the straight ahead position.

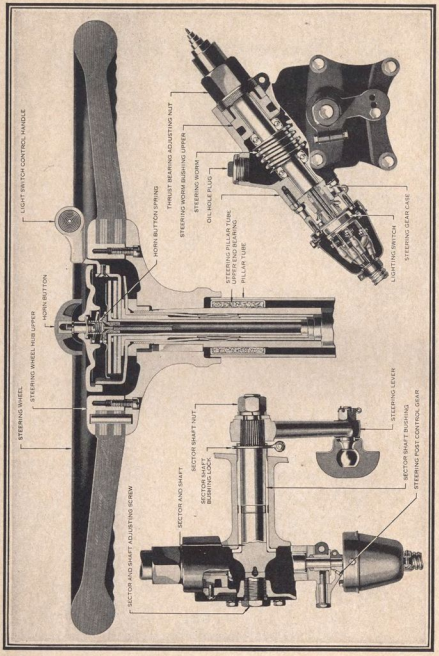


Plate No. 16—Steering Gear

Rear Axle

The differential is mounted on tapered roller bearings supported in the differential carrier which is bolted to the front face of the rear axle case. The axle shafts are mounted on ball bearings at the outer ends of the case and are fitted to the differential gears at the inner ends by means of splines. The rear wheels are keyed directly to the axle shafts.

The differential driving pinion is straddle-mounted on ball bearings and meshes with the differential driving gear which is bolted directly to the differential. These gears are adjusted at the factory and should require no further attention other than to receive proper lubrication.

Any adjustment of the gears should be made by a competent mechanic and if, for any reason, this should be necessary it is best to have the work performed at a Packard Service Station.

Cold weather has the effect of thickening the rear axle lubricant, and it should be diluted with enough cylinder oil to bring it back to its summer consistency. A very thick oil in cold weather may become entirely non-fluid, so that it lines the walls of the case without lubricating the gears and bearings.

With the return of warm weather, however, the axle should be drained and refilled with oil of the original consistency.

Cleaning Rear Axle

It is a good plan to drain the oil from the rear axle after about every 10,000 miles and to flush out the case with kerosene. This can be done by removing the rear cover plate. After replacing the cover plate, refill to the level indicated by the filler plug in the cover.

Rear Axle Shaft Outer Bearings

Whenever the wheels are removed, the axle shafts should also be removed and the ball bearings on the shaft outer ends repacked with grease. It will be noted that the construction traps the grease around these bearings so that it is not required to pull the axle shafts specifically for the purpose of lubricating the bearings more often than every 10,000 miles.

Oil Leakage

Too high an oil level in the rear axle case is the most common cause of leakage, so the level should always be checked and the consistency of the oil inspected before other steps are taken to cure a leaking axle.

Oil leakage at the driving pinion, aside from being due to high level, indicates improper functioning of the oil throw off and return mechanism which takes the oil working along the pinion shaft and returns it to the axle case. An inspection of this mechanism should deal principally with the fits of the parts in the axle case forward extension and on the pinion shaft. Light drive fits are required. Oil return holes should be cleaned if clogged by thick oil, etc.

Oil leakage at the axle shaft outer end, with the proper oil level in the case, indicates improper stuffing box action and the shaft should be removed and the stuffing box, which comes out with it, repacked or tightened as required.

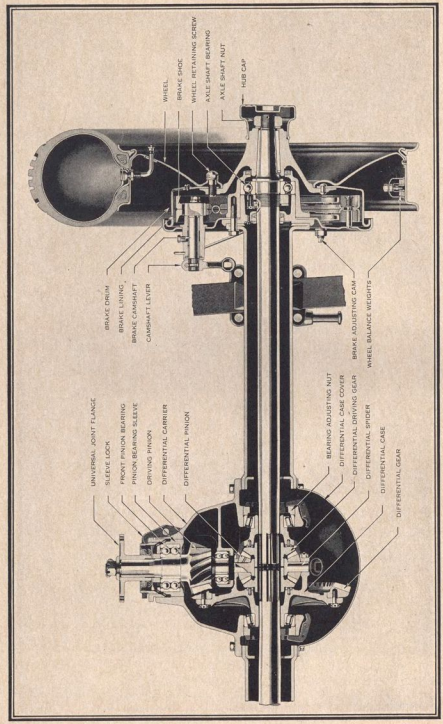


Plate No. 17—Rear Axle and Brake Section

Rear Axle Noise

If an unusual noise is noticed in the rear axle it is advisable to consult a Packard Service Station at once. It can then be ascertained whether or not damage has occurred or is apt to occur. The object of an early consultation is to prevent damage to expensive parts due, possibly, to improper adjustment.

Universal Joints

There are two universal joints on the driving shaft between the transmission and rear axle. These are surrounded by metal casings and run in oil. Every 2500 miles oil should be added by removing **both oil plugs** and turning shaft until one hole is on top, then insert oil gun in lower hole and fill until oil runs out at the top hole. The slip joint may be oiled through hole in sleeve.

Equalizing Wheel Traction

Tires of the same diameter should always be used on the rear wheels. Tire chains and special treads should always be used in pairs.

Any variation in the diameter of the rear tires or in the traction of the wheels causes the differential to work whenever the car is in motion. The result is considerable waste of power and unnecessary wear of the differential parts. In addition the smaller diameter or smoother tire-to-road contact will suffer from braking friction, as it will slide more easily than the other.

Location of Serial Numbers

Front axle—Right hand spring pad.
Rear axle—Left side of differential carrier.
Steering—Upper face of steering gear case.
Carburetor—Right hand flange.
Frame—Left hand side member just forward of dash.
Transmission—Top center just forward of transmission cover.
Body on sill of right rear door—in rear compartment of Coupe and Roadster.

Most accessories such as starter, ignition unit, generator, etc., have their respective serial numbers, and, while these are not necessary for registration, they should be noted by the owner for identification purposes.

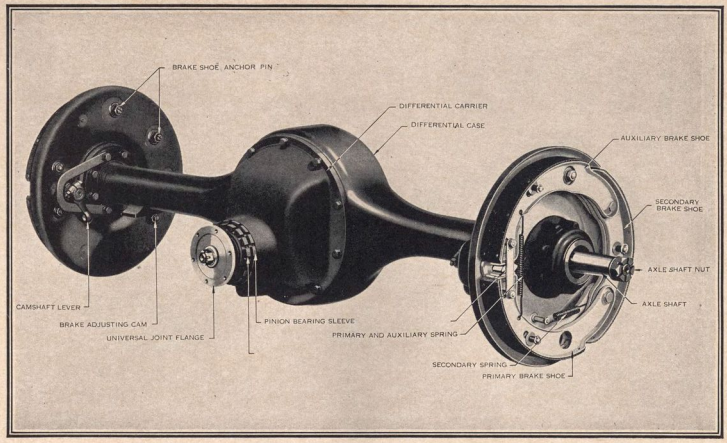


Plate No. 18—Rear Axle and Brake Construction