The three-cylinder motor is gaining some adherents, for, besides the well-known machines with one-hand control, which have used a horizontal motor of this type for the past seven years, three other firms exhibited tonneaus with vertical three-cylinder engines in front. The three-cylinder engine was a feature of the Paris show, and is said to have very steady running qualities. Large stationary engines of this type are used direct connected to dynamos for electric lighting, and they give a very steady non-fluctuating light. Such triple-cylinder motors are balanced without the use of counter-weights, since the cranks are set 120 deg. apart; and, as the impulses occur regularly every two-thirds of a revolution, the motor has an extremely steady torque.

The two-cycle motor does not seem to offer many attractions to the average manufacturer, and there was but one firm exhibiting vehicles of that type. A novel detachable glass front with side curtains was shown on one of this company's stanhopes, and a similar arrangement was found on a runabout with coupé top employing a de Dion type of motor, so that the improvements for protection against the elements are not limited to the touring cars.

Among the exhibits in the basement were to be seen a novel two-cycle motor having a crank shaft on top of the cylinders and driving the flywheel located near their base by a Reynold silent chain. In place of a crank case, each cylinder was prolonged at the bottom and carried a second piston connected to the main piston above it and, on the outside, to the crank shaft. On the downward stroke of the pistons the lower one draws the mixture into the space between them, and on the upward stroke crowds a large part of it into the working part of the cylinder through a port high up in its wall. The arrangement is intended to do away with the crank case, which in time is apt to get leaky around the crank shaft bearings. A small three-cylinder steam engine with concentric poppet valves, intended for use with a flash boiler, was also on exhibition. This engine had 3¼ x 4-inch cylinders, and was said to be capable of developing 20 horse power at 1,500 revolutions per minute.

While dealing with novel motors, mention should be made of a three-cylinder compound gasoline motor which has been thoroughly tested on the road. This motor has two four-cycle working cylinders on the outside, with a large two-cycle cylinder between them. The two outer cylinders exhaust in turn into the inner one, so that the piston of the latter gets an impulse once every revolution and exhausts into the air at a pressure of but 25 pounds per square inch.

Among the gasoline engines exhibited was a double opposed-cylinder motor made in several sizes from 6 to 60 horse power and intended to be used on vehicles with a three-speed, sliding-gear transmission of the same make. This motor has been on the market for the past two or three years and is said to be a powerful, well-built engine.

Among novelties in motor arrangement should be noted two double opposed-cylinder engines arranged side by side longitudinally of the car, and coupled together, with a common flywheel and sprocket from which a chain was run to a countershaft. Another large touring car of this make had a vertical four-cylinder motor fitted with both make-and-break and jump spark ignition. This type of double ignition is in some favor abroad.

A novel transmission device was exhibited by a well-known maker of spark plugs and coils. It consisted of a casing on the center of the rear axle, containing two rotary water motors. Connected with this casing was another on the longitudinal driving shaft. This contained four or five plunger pumps arranged in a circle and in such a way that their strokes could all be varied from nothing to the maximum. The two casings were filled with oil and were oil-tight. By starting the pump's plungers, the wheels could be made to turn very slowly, and by increasing their stroke, the wheels could be speeded up. The device has been well tested and is said to be thoroughly practical. It is a very neat solution of the transmission problem.

At the show this year the disposition of the manufacturers to satisfy the public as to the smallest details of construction and operation was apparent. Several of them showed their motors in full operation, turned by electric motors. The exhibit of a popular runabout was the finest one of this sort. The body was fitted with glass sides, and within it was a motor cylinder with the upper half cut away, showing the piston moving back and forth and the valves as they opened and closed. Even electric automobile motors were shown in the course of construction, a half-wound armature being exhibited beside a cell of Edison battery. The exhibit of Exide battery plates and separators was spread out on a large board, and was most interesting as showing the appearance of the plates of the lead pasted type of cell. the competitor of the new Edison nickel-steel battery. Several machines were shown with Edison batteries, though the majority were fitted with batteries of the lead type. The only novel electric car was a light surrey, in which the electric motor is mounted in front under the hood, and a bevel gear drive is used to the rear axle.

There were some steam vehicles on exhibition, the most prominent, of a well-known make, having a flash boiler, condenser, and a compound steam engine direct connected to the rear axle by a longitudinal shaft with bevel gear drive. Steam cars of the surrey and runabout types, which were fitted with the usual type of engine and boiler, were shown by other manufacturers, one of whom exhibited a machine fitted with a mechanical lubricator driven by the engine. A very commendable new steam vehicle was one in which the lack of reserve power characteristic of flash boilers was overcome by combining "flash" and tubular principles in one steam generator—the flash coil being located below the horizontal tubular portion, and the whole having a heating surface of 96 square feet. The engine consisted of two high-pressure cylinders opposed to two low-pressure—all horizontal, with a valve by which live steam might be turned into all cylinders—thus increasing the power, in emergencies, by simply throwing over a lever.

Wheel steering is well-nigh universal on the 1904 machines. In most instances, however, the wheel can be tilted or the steering post moved forward in order to allow the driver to enter and leave his seat with ease. The spark and throttle devices are generally placed on the wheel, and in one or two instances the change-gear lever is on the steering column also. The contact boxes of the jump spark ignition systems are generally placed so that they can be conveniently reached for inspection and adjustment. On one machine the contact box was fitted with a glass cover, while on another it was located on the front end of the car, beside the starting handle.

Dry batteries are still chiefly used as a source of current, only a few of the larger cars being fitted with magneto ignition. One interesting device that was shown separately was an electro-magnetic igniter arranged as a plug to screw into the cylinder and operated by current from a spring-actuated magneto.

Interest in automobiles, as evidenced by the attendance at the show, is much greater than in previous years. It is estimated that 30,000 people visited the Garden during the opening night and first two days of the following week. The dearth of commercial vehicles on exhibition is doubtless accounted for by the fact that the demand for pleasure vehicles is so great that manufacturers, in seeking to supply this more profitable trade, have no time to devote to the commercial automobile. Yet this is the machine that will eventually be developed, and that will relieve much of the traffic congestion in the crowded streets of all large cities. An increase in electric vehicles for business purposes was apparent.

IMPROVEMENTS AND CHANGES IN AUTOMOBILE CONSTRUCTION AS NOTED AT THE PARIS SHOW.

As the Parisian *modiste* sets the style in feminine dress, so the motor car manufacturers of that famous old-world city may be said to set the fashion in things pertaining to automobile locomotion; and it is at the annual show held in the spacious Grand Palais each December that their models for the coming year are first exhibited.

In the construction of multi-cylinder motors for the powerful gasoline cars, the cylinders are now generally cast separately instead of in pairs. This does away with the mass of metal between the cylinders, which was apt to cause unequal expansion, and makes each cylinder a unit that can be removed in case of breakage, and replaced at one's convenience. The mechanically operated inlet valve has gained not a few adherents during the past twelvemonth. Instead, however, of the inlet valve being in a chamber on one side of the cylinder and the exhaust valve being in a similar chamber on the other side, thus necessitating a cam shaft on each side of the motor for each set of valves, the practice now is to locate the two valves side by side in a single chamber, and operate them by a double cam on the single half-speed cam shaft. By this arrangement, the motor has been brought back almost to its former simplicity, while the advantages of the mechanically operated valve—quiet and steady running, with a wide range of speed—have all been retained. The use of steel cylinders has diminished considerably.

With regard to bearings, there is a decided tendency to go back to the old style ball bearings, for the engine crank shafts, as well as for the transmission gear bearings, and other important bearings throughout the car. The ease of adjustment of the ball bearing, together with its frictionless and smooth running qualities, has doubtless had much to do with influencing manufacturers toward its readoption; and if the balls are made of the best hardened steel and properly proportioned to the loads they have to carry, there seems to be no good reason why this form of bearing should not give entire satisfaction, besides having the great advantage of instant adjustment, which the ordinary plain bearing does not have.

The water circulating pump and ignition dynamo or magneto is gear driven in almost every instance, and all gears and small parts are inclosed or otherwise completely protected. A new pressed steel frame brought out by the Darracq Company has sheet steel extending inward from its side bars to a rectangular opening in which is placed the motor and transmission. The cases of these organs are bolted to the sheet steel "apron" thus formed, with the result that the chassis has a complete flooring on its front end, which protects all the parts from dust, mud, or water.

The majority of the manufacturers are using the pressed steel frames for their chassis, i. e., a frame like that just described, which is stamped out of a single piece of steel by hydraulic presses. There are, however, quite a few firms like that of Panhard & Levassor, for example. who are using the armored wood frame as heretofore, while still other makers—Renault, de Dion, etc.—stick to the tubular frame. Some cars are fitted with a honeycomb radiator without a pump, thermo-siphon circulation alone being relied on, as on the Renault cars. A novelty that will be appreciated by many is an arrangement whereby pushing in on the starting crank in order to make it engage, automatically retards the spark, and makes it impossible for the motor to kick back.

The honeycomb, or cellular radiator, although considerably in evidence, is being replaced by a modification of the old-style coiled tubes with corrugated heat-radiating disks or flanges. The new type of radiator consists of an outer rectangular frame of square cross-section (which acts also as a tank) with small horizontal or vertical flanged tubes connecting the sides or the top and bottom. Although this type of radiator is not so efficient as the honeycomb type, in which the water is held in numerous thin films, it does not spring a leak so easily, and can be repaired with greater facility. Besides the danger of leaking, the honeycomb radiator is said to give trouble from dirt or precipitated calcium carbonate choking up its passages. Furthermore, recent experiments have shown that from 46 to 60 per cent of the heat in the fuel is carried away by the cooling water when a honeycomb radiator is used; and so it is advantageous to run a motor as hot as it can be run without causing trouble, even if the water does boil away sooner and require replenishing several times a week instead of but once a month.

Improvements in carbureters form another interesting feature of the recent Paris show. Great efforts have been made to design carbureters that will accomplish the same results as the Krebs carbureter, the novelty of the previous Salon, by furnishing as nearly perfect a mixture as possible at all speeds of the motor. M. Bollée has designed a carbureter with two spraying nozzles—one in a small pipe and the other in a large one. When running at slow speeds, the air is inspired by the motor very rapidly through the smaller pipe, thus drawing a good supply of fuel from the spraying nozzle; while when the motor runs at full speed, the suction is through the larger pipe, the spraying nozzle of which delivers practically the same quantity of gasoline because the air drawn in at an increased speed passes through a larger pipe, thus making the rate of flow past the nozzle about the same. The changing from one pipe to the other is accomplished automatically according to the speed of the motor.

In ignition devices, what is known as the Eisemann magneto is coming into quite general use. This magneto, a description of which was given in SUPPLEMENT Number 1452, generates both a high-tension or jump spark current, and a low-tension current. The high-tension spark first jumps the gap between the spark plug points, thus making a passage for the low-tension primary spark, which follows instantly, and gives a hot, red spark having the best igniting properties. By the use of this specially wound magneto, a regular spark plug can be used and yet as sure and hot a spark be obtained as with the ordinary make-and-break igniter. As a number of the best machines have heretofore been fitted with both jump and contact igniters, the development of this magneto has made possible a simplification of the ignition apparatus.

The live rear axle, with bevel gear drive through a universally jointed longitudinal driving shaft, is coming more and more into vogue for all but the heaviest cars, and in a few instances it is used even on these, as on the new Hotchkiss cars, for example. The machines built by this well-known firm, the makers of the Hotchkiss rapid-fire gun, contain a great deal of fine engineering work. Among the novelties noted on them are an arrangement whereby the pitch of the blades of the fan for cooling the water can be varied, thus increasing the air draft when desired, as in climbing a long hill; a positive locking device similar to the breech-locking mechanism of a gun, whereby the main driving shaft is positively locked to the engine crank shaft after the clutch is thrown in; and steering pivots in the center of the front wheel hubs.