Our Legion Tires and Their Troubles.

By Orrel A. Parker.

Tires have long been made the scapegoat for a great many automobile ills. Not only is the tire blamed for any breaks or derangements of machinery, but during contests of both speed and endurance, the words "tire trouble" are supposed to be sufficient excuse for almost any delay. From their very nature and from the work they are called upon to perform, tires are subject to severe wear and are apt to be sources of trouble, but it is safe to say that ninety per cent of tire trouble arises from causes that can be removed.

A discussion of automobile tires is very much like a discussion of footwear, for the needs of self-propelled vehicles in the way of tires are as varied and diversified as the varieties of footwear needed by the different races and nations of mankind. In selecting tires for a car, the same judgment and discretion is necessary as in selecting shoes. Dancing pumps that wear satisfactorily in the ballroom would not last very long while tramping through the woods or mountain climbing. A track athlete would make a very poor showing if he were shod with a miner's hobnailed boots, and ordinary walking shoes would give a miner very poor service.

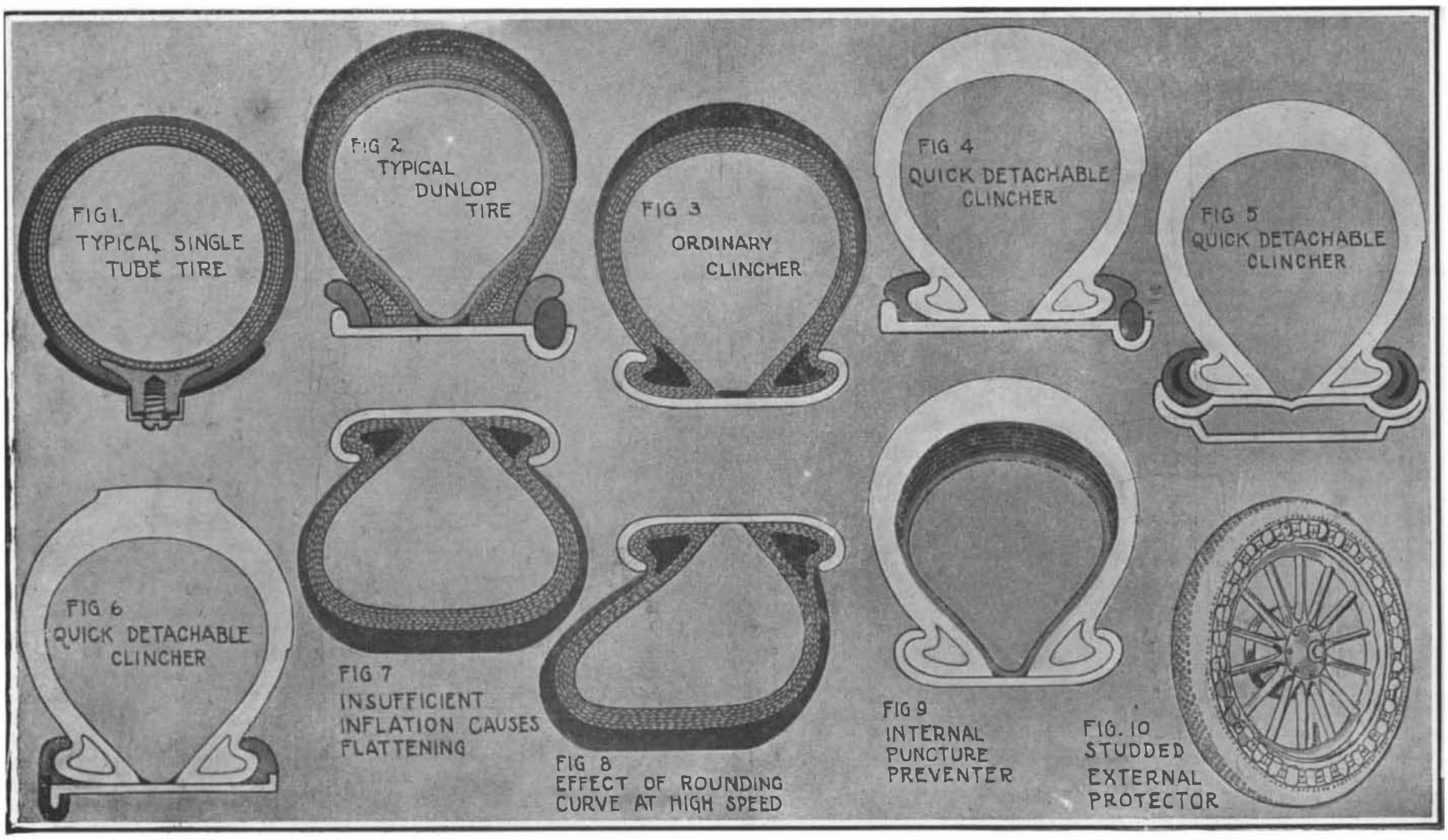
Tires may be roughly classified as pneumatic, solid, and special. The pneumatic tire is again subdivided into the "single-tube" or "hose-pipe" tire, which is now very little used, and the almost universal "double-tube" tire. A double-tube pneumatic tire consists of an outer shoe or casing, which is designed to be more or less readily removed, within which there is an inner tube or air chamber. The inflation of the inner tube usually serves the double purpose of holding the tire securely to the rim and at the same time inflating the tire sufficiently to sustain the weight of the vehicle.

A single-tube tire, as shown in Fig. 1, is usually secured to the rim of the wheel by means of bolts or lugs. Tires of this type are generally credited with giving very good service, except that in the case of a puncture it is exceedingly difficult, if not impossible, to repair the tire properly. Tires of small size can sometimes be repaired by cementing an inserted plug, but larger size single-tube tires can be repaired only by cutting down through the various layers of fabric to the inside layer of rubber, which is designed to hold the air. After this has been vulcanized, the fabric is again built up layer by layer, and the outer covering and tread is put on last of all.

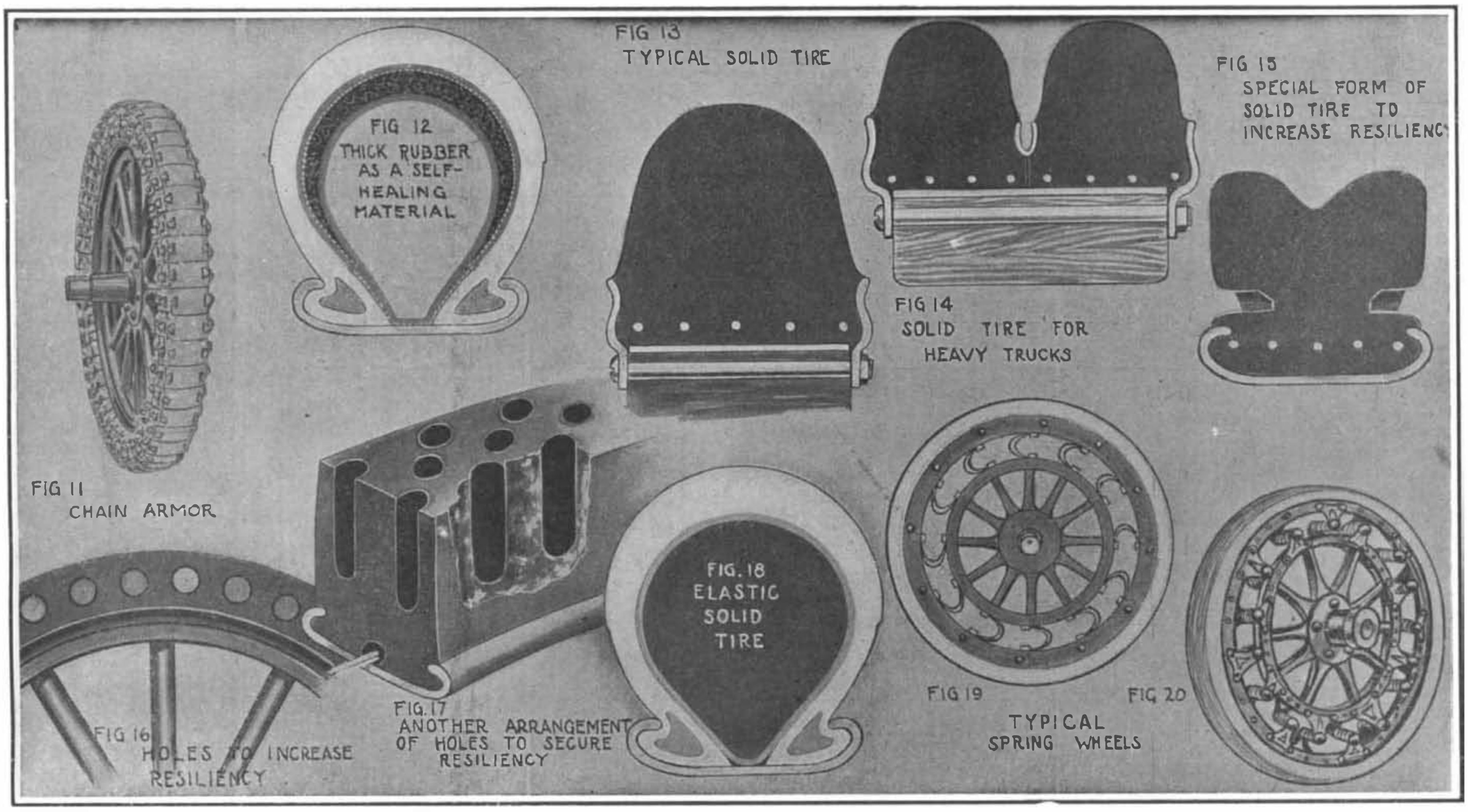
With the exception of one special type of pneumatic tire, which is bolted to the rim and not held on by the inflation of the inner tube, practically all double-tube tires can be classified as "clincher" or "Dunlop." Tires of the Dunlop type (Fig. 2) have wires in each side of the tire, as indicated by the letters A and A', which keep the tire from enlarging as it is inflated against the rim. The clincher type of tire is very widely used, and is again divided into two classes: the ordinary clincher (shown by Fig. 3) and the quick detachable (shown in Figs. 4, 5, and 6). The regular clincher tire is made usually with a bead which is more or less flexible, so that it can be stretched over the one-piece clincher rim on which it is used. On the other hand, the quick-detachable type of clincher tire is manufactured usually with a hard bead, which is designed not to stretch, for the reason that the lugs or stay bolts which are generally employed with the regular form of clincher tire are nearly always omitted in the quick-detachable type of clincher tires. Quick-detachable is a term now applied to clincher rims of any form which permits the removal of the outer flange, so that the casing containing the inner tube can be slipped on. After the outer flange or ring is put in place, the tire is inflated, as in the case of the regular clincher form of tire. A great many people confuse quick-detachable tires and demountable rims. All of the demountable rims manufactured in this country (with the exception of one of the bolted-on type) use the regular one-piece clincher rim, and the regular form of clincher tire. This one-piece clincher rim is fastened to the wheel in some manner which permits it to be more or less readily removed. We have no time or space in this article to go into a discussion of the various mechanical means by which this is accomplished. It is sufficient to say that on some forms of demountable rims, the ordinary long valve stem can be used, while on others it is necessary to use a short valve stem, which does not extend more than a small fraction of an inch within the interior circumference of the rim. The difficulty with this form of rim is that air can be pumped into the tire only when the rim is removed from the wheel. To overcome this difficulty, some demountable-rim manufacturers who cannot conveniently use a long stem, employ an L-shaped stem, which protrudes slightly from the side of the tire close to the rim. At least one form of demountable rim permits the use of regular long-stem lugs. Nearly all others require the use of what are called short lugs, which are held in place by a bolt or screw extending but a small fraction of an inch within the inner circumference of the rim. Most demountable rims require attention, on account of the loosening of the mechanical fastenings. The short lugs seem to work satisfactorily, but demountable rims which have inaccessible air valves are apt to give trouble. It may be said that, with this exception, most forms of clincher tires give satisfactory service upon demountable rims, and that the terrors of a deflated tire are very much lessened by having an extra tire already inflated upon a rim ready to take the place of the one which has gone out of commission.

Each type of pneumatic tire is manufactured with treads of various kinds. Perhaps the plain smooth rubber tread is most generally used, but many manufacturers have a special form of raised, grooved, or corrugated rubber tread, each supposed to have special merit in preventing skidding and in wearing well. Various forms of steel studs and leather strips are also used to prevent skidding and slipping, not to mention combinations of wire and rubber for the same purpose. The recent offerings of tires made wholly or in part from leather are the result of the high state of perfection to which the mineral tanning processes have been brought, rendering the leather used so exceedingly tough yet soft and pliable as to be practically puncture proof. One recent make of tire, which combines in its composition leather, canvas, and rubber, with cold-drawn steel rivets for anti-skidding purposes, is distinguished from others of its kind by the fact that the leather tread is so designed in alternate layers that each section is renewable, and the life guaranteed by the maker is from 5,000 miles for the larger sizes to 10,000 miles for the 3-inch and 3½-inch sizes. Each of these forms of tread is perhaps well suited to certain conditions. Tires which give very good service when used in the city upon asphalt do not always prove satisfactory when used upon country roads. It seems that combinations of metal and rubber, or metal, leather, and rubber, do not last as well as treads that are made of rubber alone. Whatever form of non-skid tread is used, it is found of little value when an automobile encounters really deep mud or snow. Under these more severe conditions, all drivers of experience use some form of chain. Apparently smooth all-rubber tires are most economical and satisfactory for ordinary use, and chains used in connection with these tires form the best combinations for severe conditions of travel.

Every automobile owner is interested in what causes tire trouble, and is anxious to know by what means it can be avoided. In the first place, too much must



VARIOUS FORMS OF TIRES AND TIRE PROTECTORS.



PUNCTURE PREVENTERS, SOLID TIRES, AND SPRING WHEELS.

not be expected of a pneumatic tire. A new tire properly designed for the work it has to do should run about 2,000 miles without trouble, except in case of direct injury through a cut or a puncture. After the first two or three thousand miles, trouble is to be expected. I know of one very prominent automobilist of considerable experience who renews his tires after about 2,000 miles, and says that what he loses is more than made up by what he saves in the way of trouble when he tries to wear out the tires completely. *Overloading and under-inflating* are the two things which perhaps shorten the life of a tire more than anything else.

Too many manufacturers have been inclined in the past to equip their cars with pneumatic tires of too light weight. To lessen the cost of his product, the tire is the first thing upon which the manufacturer economizes. Sometimes tires of inferior quality are used, but generally the "economy" is attained by equipping the car with tires a size or two too small for the weight to be carried. Many times the manufacturer is not to blame for overloading the tires, for the reason that the owner of the car puts a tonneau on a runabout, or replaces a touring car body with a heavy limousine. This overloading of tires is sure to cause trouble; and very greatly shortens the life of a tire. Each size and weight of pneumatic tire is designed to carry a certain load, and to stand certain strains. If the load or the speed is very greatly increased, the strains upon the tire increase in even a greater proportion. There is no better investment than the slightly increased cost of larger tires. A tire with a comparatively light load upon it will run many times as far as the same tire with a slight overload.

Under-inflation is the cause of about as much trouble as overloading. A pneumatic tire is depressed or flattened slightly at the point where it rests upon the ground, and this point of flattening travels round and round the tire as the tire rolls along the road under the wheel. This flexing or bending of the tire gives the pneumatic tire its easy-riding qualities. If a tire is pumped up too hard, the weight of a car is not sufficient to flatten it, and the tire rides hard. On the other hand, if the tire is not sufficiently inflated, the tire flattens too much (Fig. 7). This flattening causes an excessive bending of the walls of the tire. A piece of wire may be broken by being bent back and forth a sufficient number of times. In the same way a tire will give way or blow out when its sides are flexed or bent too often. Pneumatic tires are designed and constructed to stand a certain amount of this bending, but under-inflation causes such severe bending that the life of a tire is very greatly shortened. A tire which will run 3,500 or 4,000 miles properly inflated, will have its life shortened to 1,500 or 2,000 miles or even less when run with poor inflation. The excessive flexing or bending of the sides of a tire also causes the tire to heat up. Rubber is vulcanized at a comparatively low temperature, and excessive heat is very injurious to the casing and inner tube. A tire which is properly designed will stand a pressure many times greater than that which is ever put on a tire in use. Few tires are ever injured through over-inflation. Every tire manufacturer continually urges his customers to keep tires properly inflated.

If a tire is constructed with many layers of fabric, so that the walls of the tire are very thick, two difficulties are at once experienced. The bending of the sides of the tire as the car runs causes excessive heating. This bending also causes the different layers of fabric to separate. Besides, a tire frequently "rim-cuts," and is injured by having the steel rim pressed down against it. Tires that have heavy thick walls frequently give good service if they are kept well inflated, while, on the other hand, under-inflation causes them to "rim-cut" and blow out very quickly. Some tires, especially those of foreign manufacture, are very thin and flexible. They are made of strong fabric and high-grade rubber, and are less liable to injury through under-inflation. The bending of the sides of the tires also generates less heat, because the sides of the tire are thinner. Such tires are serviceable on good roads and at high speeds, but frequently they do not stand the cuts of a rough country or mountain road as well as a heavier form of tire.

A defective rim will also frequently shorten the life of a tire. A dent in the rim may cause undue strain upon the fabric at that point. Sometimes a rim which has been run without a tire is slightly flattened down and sharpened, so that a tire will not fit exactly, and is cut and injured by the rim. Persistent trouble with one wheel usually results from this cause or from the wheels being out of line. Any mechanical derangement of the car or its running gear which causes a wheel to be out of line, or the bending of a wheel which causes it to "wobble" as it goes round, will soon cause trouble with the tire. In the same way unequal action of brakes on the rear wheels, by which all the braking strain comes upon one wheel, or an improper design of the differential, which causes more driving strain upon one wheel than the other, will cause that particular tire to show excessive wear.

Other things being equal, the wear on tires is proportional to the skill and care used in driving. A driver who starts his car suddenly, jumps into high gear within a few feet, comes up at full speed to within a few feet of the place where he wishes to stop, and then puts on the brakes hard, subjects his tires to unnecessary wear and to excessive strains which greatly shorten their lives. In the same way a driver who applies excessive power, and unnecessarily spins his wheels upon a wet pavement or muddy or sandy road, grinds down his tires. The sides of tires are very frequently injured by being needlessly run in narrow ruts, or by being rubbed up against the curb when stopping or by turning a corner too sharply. Perhaps the greatest strain is placed upon tires in taking curves and turns at too high a speed. Everyone knows that it takes a great deal of power and force to change the direction of a moving body. Friction between the roadway and the tires causes this change of direction, thus producing very great side strains upon the tires (Fig. 8). The frequency with which tires explode at turns should be a sufficient warning even to the most reckless driver. The slower the speed with which corners and curves are taken, the longer tires will last. The life of the tire can also be increased by throwing out the clutch in going around corners and over severe bumps. The differential or equalizing gear works when a car turns a corner. It does not turn as readily when transmitting power as when running idly. One racing driver of worldwide reputation goes so far as to assert that a differential gear does not work at all when a car is rounding a curve under power. If the differential does not work, the rear tires must slip and undergo the strains and wear that go with slipping. Many automobiles are so designed that when the body of the vehicle is jounced up and down, as when crossing raised car tracks or similar obstructions, motion is transmitted by the body of the vehicle to the tires through the driving chains or driving shaft. This slight jerking back and forth of the tire, which an owner could hardly discover, is given by engineers as the reason why some cars are especially hard on tires.

The lightness and resiliency of air are responsible for the worldwide adoption of pneumatic tires in spite of their many shortcomings. That the expense and uncertainty of pneumatic tires have caused thousands of inventors to try to solve the problem of providing a trustworthy resilient tire, is shown by the three thousand patents on improvements in tires which have been issued by the United States Patent Office. Of course, a vast majority of these patents are worthless, because they were taken out by men with no experience in the manufacture or use of tires.

Various forms of internal puncture protectors have been devised. Some consist of layers of felt, and others of disks of metal between layers of fabric. These are usually crescent shape in design, and are placed between the inner tube and the casing (Fig. 9). Under favorable conditions some of these protectors have been known to stay in a tire for a considerable period of time without causing trouble. No doubt they prevented many possible punctures. As a general rule, however, the introduction of any material between the casing and the inner tube soon causes trouble. The continuous flexing or bending of the tire, especially when run with under-inflation, soon causes a breaking or derangement of the internal protector. The added thickness also causes excessive heating. For these reasons the use of internal protectors of these types has not become very general.

In seeking to protect a tire from puncture, a great many forms of external protectors have been devised. They are usually made from leather or from fabric and rubber, and are frequently covered with rivet heads or metal studs (Fig. 10). Sometimes these protectors are placed over the casing when the tire is deflated, and are held on by inflation. In other cases there are metal hooks, which catch under the edge of the clincher rim. Other types of protectors are held on by rings and by buckles. Such protectors are usually rather expensive, and cost perhaps about half

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while the gap may be as wide as 1/32 inch, better results will be attained if it does not exceed 1/64 inch. The widening of the gap from burning will introduce resistance that is too high to be overcome, and an interruption of the circuit from this cause will be indicated by sparking at the safety spark gap.

The most important point in the care of a magneto is its lubrication. It is usual to provide the oil cups with overflows to prevent an accumulation of oil that might work its way into the armature, and the lubricant is conducted to the bearings by wick feeds. These oil cups should never be permitted to run dry, for the clearance is so small that a worn bearing will permit the armature to strike the pole pieces.

The interrupter and distributer covers should be tight to prevent the entrance of dust, but should these parts become fouled they must be wiped off with a rag and a little gasoline. Where carbon brushes are used, as in the distributer, the carbon dust that will collect must be removed, or it will tend to cause a short circuit.

The most reliable and satisfactory ignition for automobile engines is obtained through the use of magnetos, but their full benefits are realized only when they are kept clean and properly lubricated. Attempts to improve them by altering adjustments or making changes will only result in dissatisfaction, and the maker may be relied upon to have worked out the details and made the settings with a knowledge based on deeper study and wider experience than is possessed by the average automobilist.

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as much as a new tire would cost. Such protectors add to the thickness and consequently to the heating of a tire. There is also bound to be more or less friction between the outer covering and the tire. If the outer covering is of the right size and is properly adjusted, this friction is not excessive. Such a protector, however, frequently stretches if it is not put on sufficiently tight, and very great wear takes place between it and the tire. Another form of tire cover consists of what is really a chain armor (Fig. 11). These covers are held on in a variety of ways, very much the same as leather and fabric and rubber tire protectors. They are very heavy, and to be durable they must be made of hardened steel. They rust badly, and most forms of them wear between the links, so that they soon become loose, for which reason it is necessary to take out a row of links in order to tighten them up.

Another method of seeking to avoid trouble is to provide self-heating materials designed to close a puncture. Gummy, sticky substances of various kinds placed in a leaky tire frequently cause it to hold air temporarily, but the usual experience is that the tire holds air only when it is comparatively cool, and that as soon as the tire heats up in running, the material becomes more soft, and air escapes. In addition, these compounds usually have a bad effect on rubber and fabric, and a tire which has been thus "doped" is soon completely worthless, for the reason that the materials usually make it impossible to vulcanize and repair the tire. Various forms of self-healing inner tubes have been devised. Sometimes the thickness and softness of the rubber is employed (Fig. 12), sometimes a plastic material and fibers, and sometimes by the introduction of fabric in the construction of the inner tube. Other inventors have constructed two, three, and sometimes four inner tubes inside of one another with valves, so that when one tube is punctured another can be immediately inflated without removing the tire or inner tube.

None of these devices solves the problem satisfactorily, and many are failures. Automobilists of the widest experience usually agree that the best and cheapest form of pneumatic tire is the ordinary plain round-tread clincher tire and inner tube on the regular one-piece clincher rim.

Solid tires are used almost exclusively on comparatively slow-moving business vehicles. Many people think solid tires never cause any trouble; but in this they are mistaken, for solid tires also are subject to many ills. They are, on the whole, much more dependable than a pneumatic tire, but a cut in a solid tire is apt very soon to pound itself into a great flat place that destroys the tire. Perhaps the greatest difficulty with solid tires is found in attaching them to the wheel. Fabric bases with cross wires, diagonal wires, and wires running lengthwise are employed. Solid tires are sometimes put on by hydraulic pressure, and other forms are held on by flanges bolted up on either side. Solid tires may be classified as plain, cushion, sectional, and special. Plain solid tires (Fig. 13) do not afford very much in the way of resiliency. They serve chiefly the purposes of being a silencing band, and of giving traction upon the roadway. Their width and thickness vary according to the loads they are designed to carry, and when used on heavy trucks or omnibuses, it is found more satisfactory to use two and sometimes three narrow tires side by side than one very wide single tire (Fig. 14). The plain solid tire is rolled continually between the wheel and the pavement, which rolling has a tendency to make the tire stretch and become longer, just as a piece of metal expands in a rolling mill. This lengthening or stretching of the tire causes particular difficulty in securing the tire firmly to the rim of the wheel.

Cushion tires are not manufactured for as heavy work as the plain solid tire, and are designed to give a greater degree of resiliency, an end which is attained by making the tire of a softer composition of rubber, and also by making the tire thicker in proportion to its width. Many special forms have been designed to increase the resiliency (Fig. 15). Sometimes there are holes through the tire parallel to the axle of the wheel (Fig. 16). Sometimes the tires are manufactured with holes in them in the direction of the spokes of the wheel (Fig. 17). All of these cushion tires depend for their resiliency upon the bending of the rubber. The resiliency is therefore limited considerably. If the tire is overloaded or is improperly designed, so that it bends too much, the tire not only consumes a great deal of power and is "slow," but there will soon be a destructive breaking down of the rubber, which will destroy the tire. At speeds of from twelve to eighteen miles per hour, cushion tires give satisfactory service if they are properly designed for the work they have to do, provided the vehicle is designed to stand a sufficient amount of vibration.

Sectional solid tires have been used with considerable success, particularly abroad, on the heaviest forms of trucks. Each tire is made up of small sectional segments shaped very much like bricks, one of the main advantages of this form of tire being that an injured segment can be readily renewed.

In the class of special solid tires may be included many forms of tire which are at the present time largely experimental. We may mention tires made up of wooden blocks, fiber blocks, and tires made up of sectional steel plates with a cushion of rubber beneath, as well as many other combinations. None of these have come into very general use.

In classifying tires as pneumatic, solid, and special, we place in the last classification filled tires, spring wheels, and wheels which have pneumatic hubs or pneumatic cushions within the circumference of the wheel. A tire filler is an elastic solid substance which takes the place of air in any form of penumatic tire (Fig. 19). The filling must be introduced into the tire under pressure in just the same manner as the tire is filled with air. After the tire is filled to the proper degree of hardness, the material is allowed to set, in which process it must undergo a chemical change, so that it cannot again be melted by heat. At the present time the greatest difficulty with a tire filling is that the wheels, tires, and tubes must be sent to the factory for filling. A properly filled tire rides about as easily as an air-filled tire at the same pressure, while the advantages in favor of the filled tire are many. Punctures obviously cannot have any effect upon it.

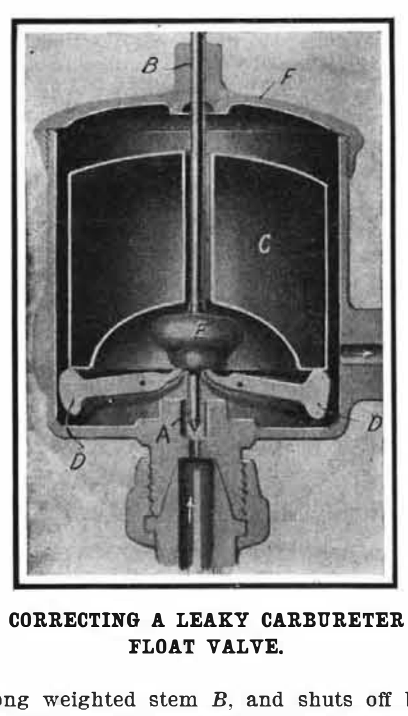
Spring wheels nearly always have an ordinary felloe and rim equipped with a solid rubber tire. Within the wheel arrangements of springs are designed to take up the shock and vibration (Figs. 20 and 21). The most common defect of spring wheels is that while they may be resilient, they do not hold the rim and tire strictly at right angles to the axle. Then again, any mechanism depending upon springs for its action is only as reliable as the spring.

Attempts have been made to introduce special wheels (usually shod with a solid tire) which depend for their resiliency upon a pneumatic tube or tire about the hub or within the felloe of the wheel. Combinations of this kind are expensive, and none of them have become very well known commercially.

The tire problem is the most serious one which the manufacturer and the automobilist have to face to-day. There is no question but hundreds of people would become users of the automobile if they were not afraid of the great expense and uncertainty of pneumatic tires.

CORRECTING A LEAKY CARBURETER FLOAT VALVE.

A carbureter float valve may leak for various reasons. There may be dirt in it, in which case a good flushing out with gasoline will stop the trouble. The connection between the float and the valve may be of such a character that the vertical movement of the float causes the valve to rock slightly on its seat. Such a valve is practically impossible to keep tight. The connection between the float and the valve may be bent or badly adjusted, so that the float is unable to close the valve. As shown, the float *A* has a



CORRECTING A LEAKY CARBURETER FLOAT VALVE.

long weighted stem *B*, and shuts off by its own weight the gasoline entering from below. This valve is held open by the float *C*, which rests on two small levers *D D*, the inner ends of which lift upward against the weight *E* of the float valve. The float is supposed to rise sufficiently to let the valve close when the gasoline level is just below the top of the spray nozzle (not shown in the figure). Something may happen, however, to disturb this relation. For example, the weight *E*, which is usually threaded on the stem *B*, may become loose, so that while the weight is held up by the levers, the stem gradually screws itself down through *E* and closes the valve. On the other hand, the top of the float may, in some manner, strike the cover *F* of the float chamber, or the small ends of the levers *D D* may strike the bottom of the float chamber before the valve is closed.

Sometimes the valve simply leaks, and has to be ground in with pumice stone. This is a somewhat delicate process, and requires keeping the stem *B* as near the center as possible while the grinding is being done. By unscrewing the cover *F*, one can generally tell where the trouble lies. For example, if pressing down the stem *B* stops the dripping, it is evident that the trouble is in the float or its connections.

A metal carbureter float such as shown in the cut may have a minute leak, through which gasoline gradually enters and weights the float, so that it does not rise sufficiently to close the needle valve *A* at the proper gasoline level. Shaking the float will disclose the trouble. The remedy is to warm the float in a moderate oven until all the gasoline has evaporated out. While the drying out is in process, dip the float in warm water; the escape of bubbles will show where the leak is. After the float is dried out, allow it to cool and carefully solder the leak.

GETTING HOME WITH A BROKEN UNIVERSAL JOINT.

All cars in which the rear axle is driven through bevel gears have a propeller shaft transmitting power from the engine or transmission gears to the bevel pinions and gear. This propeller shaft has a universal joint at one or both ends, and sometimes the pin or bolt through this joint breaks. The obvious expedient is to hunt up a temporary bolt of any sort which will go through, and usually this is the best that can be done. Sometimes, however, not even an ordinary iron bolt is to be found, and in that case one may get along by making up a bundle of fairly thick iron wire, such as telegraph wire. This bundle, as large as will collectively enter the hole, is bound securely at its ends, and the ends of the wires are then splayed out and turned over. Evidently cautious driving is required with such a makeshift, but it has been done successfully.

SUPPRESSING RATTLE IN BRAKES, MUD GUARDS, ETC.

Most noises due to loose brake shoes and miscellaneous control members about the car are easily traced, and their correction demands only a little time and common sense. Sometimes leather may be used to quiet a part that rattles. Sometimes a tension spring will do the work. Sometimes bearing pins wear loose in their holes, and the latter must be reamed and larger pins inserted. Sometimes the mud guards work loose. A somewhat troublesome problem is presented by an aluminium mud guard which has cracked from vibration. It must be braced and held by small bolts with large heads, rather than by too large bolts with small heads, as it is dangerous to put much strain on material so soft and brittle as aluminium. It is an excellent plan to use leather washers next to aluminium mud guards, dash boards, etc., wherever bolts go through.

A NOVEL GASOLINE STRAINER.

Most carbureter troubles are caused by dirt or water, which has found its way into the carbureter. When trouble of this kind occurs, the motor usually stops. The crank is turned a few times, and then the carbureter is taken apart, with the result that in reassembling, the parts fail to readjust themselves properly.

In order to overcome this difficulty the Austro-American Separator Company of Cleveland, Ohio, have introduced a funnel which separates all water and dirt from gasoline. The separating is accomplished by the use of two pockets, in which water and dirt accumulate on account of their greater specific gravity, and by the use of two very fine, specially woven water-separating gauzes. Gasoline runs through this funnel much faster