

## TYPES OF SHOCK ABSORBERS FOR AUTOMOBILES.

BY HOWARD GREENE.

Years of study and experimenting have been spent in the effort of evolving from the carriage spring a type of spring adapted for the suspension of automobile bodies on their chassis. At last a form of spring has been produced which possesses the maximum degree of strength and flexibility in proportion to weight and size.

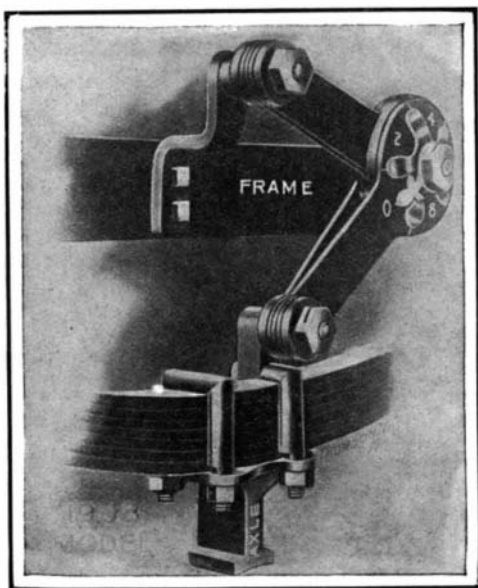


Fig. 1.—The 1908 Truffault-Hartford Shock Absorber.

The highest possible elasticity is necessary in order to afford comfort to the passengers, while tensile strength is needed to resist the severe shocks incident to driving rapidly over uneven and rough roads. The high elasticity which is so essential in the automobile spring has been found to possess one serious drawback, however; that is, an excessive rebound. All the useful work of the spring has been done when, in passing over an obstruction, the spring has been compressed and then returns to its normal position on the first rebound. In practice the action of the spring does not cease there, but is succeeded by a series of vibratory movements, as a rubber ball bounds and rebounds many times when thrown upon a stone pavement, unless the motion is checked by catching the ball in the hands. Breakages of springs often result from the excessive rebound after compression. When the spring is suddenly compressed or flexed downward as the wheel passes over an obstruction, the long top leaf is supported below by the shorter leaves; but unless clips are provided to hold the leaves together, the momentum of the body and its load on the upward rebound is liable to lift the free ends of the top leaf away from the lower leaves, and cause it to break where it is secured at the center.

The purpose of the shock absorber is to check the tendency to excessive rebounds, stopping the disagreeable vibration of the vehicle body, and preventing breakage of springs from this cause. Like many other automobile improvements, we are indebted for it very largely to the big international automobile road races. The excessive bounding of the light racing cars when traveling at terrific speeds over the roads proved exceedingly dangerous, and devices were designed to check this action and make the cars ride more evenly. The first and one of the most successful devices of this kind was applied to racing cars in France five years ago. Since then a number of changes and improvements have been made, and the device, which is known as the Truffault-Hartford, is now part of the regular equipment of several high-grade American and French cars.

Since its first introduction the shock absorber has grown rapidly in popularity with automobile owners, and nearly a score of American inventions of devices for a similar purpose have been brought out and are now on the market. These are of a variety of types, which may be divided into friction checks, hydrau-

lic checks, pneumatic shock absorbers, and supplementary spring devices. In addition to the mechanisms belonging to these main divisions or principal classifications, there are a number of devices that make use of a combination of two of the general principles, such as hydraulic and friction and spring and friction. All are constructed to be attached at one end to the spring or rear axle near the middle of the spring, and at the other end to the side of the frame above the axle, so

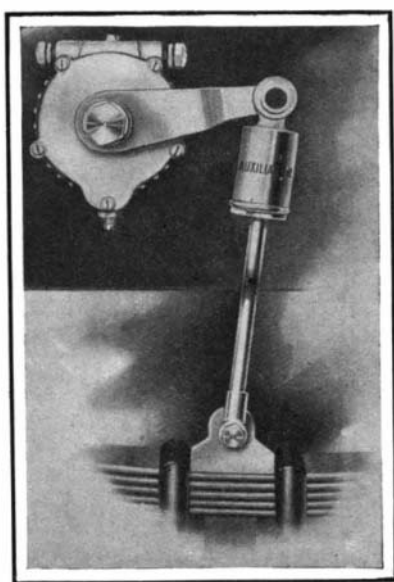


Fig. 2.—General View of the Paternoster Shock Absorber Attached to Car.

that the resistance which it offers will act directly between the spring and the frame.

The Truffault-Hartford, which is made by the Hartford Suspension Company, of New York, and is illustrated in Fig. 1, belongs to the friction type and is of the simplest construction. In general form it is like the stop of a trunk lid. The end of one arm is held by a stud on a plate that is bolted to the side of the car frame, and the small ends of a pair of other arms are attached by a bolt to a plate that is held by the spring clamps. The other ends of the arms are enlarged into circular friction plates, the end of the pair of the upper arm being placed between the disks of the pair

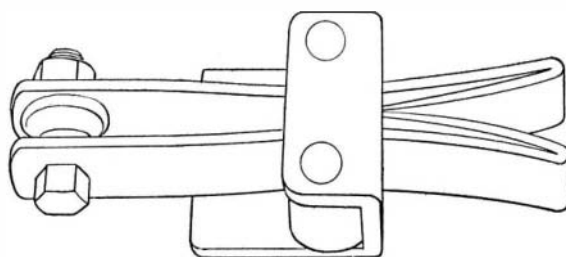


Fig. 5.—Shippey Shock Absorber—Non-Friction Spring Action.

of lower arms. The arms are joined together firmly by a center stud fitted with a hardened steel bushing. Under the nut of the stud on one side is a star-shaped spring steel washer, that maintains constant compression on the friction plates and compensates for wear. An absorbent friction material is interposed between the faces of the disks, increasing the friction and at the same time providing a receptacle for retaining lubricant, enough of which is held in the material to last indefinitely. The device is both dustproof and waterproof, and each set is tested to a uniform tension. All arms are of equal length, making the suspension uniform and the shock absorbers interchangeable.

This form of shock absorber is simple, strong, unobtrusive, and durable. It acts in both directions, that is, against the compression and against the rebound of the car springs, acting as a brake to vibration. It does not have the same effect as the use of a stiffer spring, but, while leaving the springs as flexible and responsive as before, stops excessive play and absorbs the shocks by converting motion into frictional heat.

Many virtues are claimed for this shock absorber. Besides preventing breakage of springs in the way mentioned and increasing the comfort of riding, its use prevents racking of the car by reducing the rolling and pitching motions, saves wear on the tires by reducing skidding and making the use of brakes less often necessary, obviates the need of slowing down for ordinary crosswalks and holes in the road surface, and, by checking the rebound and keeping the wheels constantly in contact with the road, utilizes more of the power de-

veloped by the engine, thereby also increasing in some degree the speed of the machine.

The principle and general form of the Hartford shock absorber have been extensively copied, and a number of devices have been patented and offered for sale during the last two or three years that differ from it only in detail, such as the mechanical means for developing the friction.

It is held by many students of the subject that only

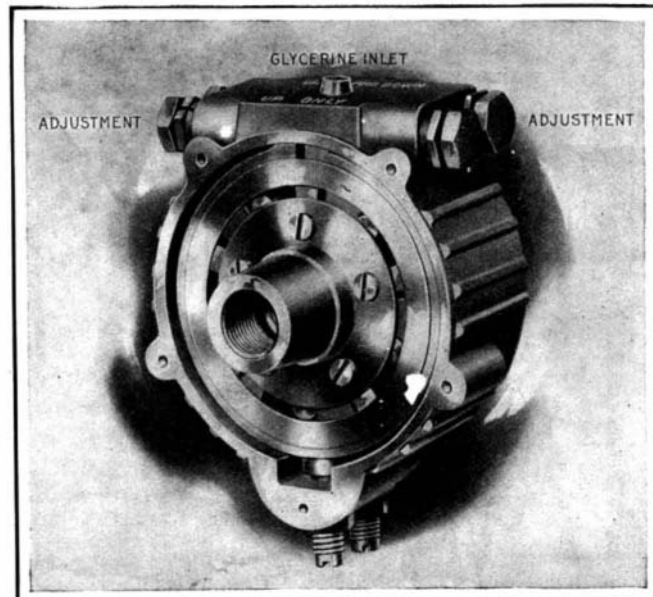


Fig. 3.—Roller Clutch, Brake Bands, and Adjustments of the Paternoster Shock Absorber.

the recoil of the spring should be checked, or that it should be checked more than the compression. Acting under this belief, a European inventor in 1905 patented the Paternoster shock absorber, which is now manufactured and on the market in this country. A general view of this attached to a car, is given in Fig. 2. The frictional elements are contained in a circular case attached to the frame, while the link from the arm to the spring is provided with a small cylindrical case that incloses two soft-rubber buffer springs, between which plays a plunger on the end of the rod. This device is called an "auxiliator," and is intended to permit a certain amount of play of the springs to go unchecked, when running over smooth roads.

Within the circular case attached to the frame of the car are two brake drums, each encircled by a stationary brake band. The bands are adjustable, so far as their pressure on the drums is concerned, by means of screw adjustments which can be manipulated from the outside of the case. One of the drums is connected with the arm rigidly and permanently, while the other is loose on a central arbor cast integral with the case, but is adapted to engage with the arm by means of a roller clutch (Fig. 3) only during the upward movement of the car spring, when there is danger of breakage of the spring and a certainty of a "toss" of the occupants of the car if a full rebound is permitted. Thus there is only one brake acting on the downward movement or compression of the spring, when the stresses are of a legitimate character, but two brakes act, producing twice as much friction, on the upward movement or rebound. The brake bands are of steel, hardened and ground on the wearing surfaces; wear can be taken up and accurate adjustments made by means of the screws already referred to, so that the checking action can be suited to the individual car. The bronze case containing the drums, brake bands, and clutch is closed by a tight cover with a ground joint and is filled with glycerine, which affords excellent lubrication and at the same time acts as a medium for conveying heat away from the brakes and drums.

(Continued on page 349.)

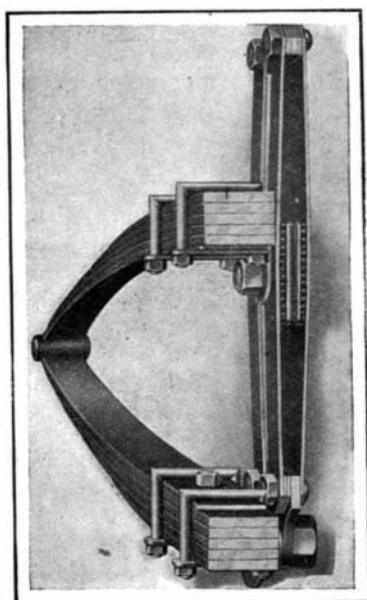


Fig. 4.—Gabriel Shock Absorber Attached.

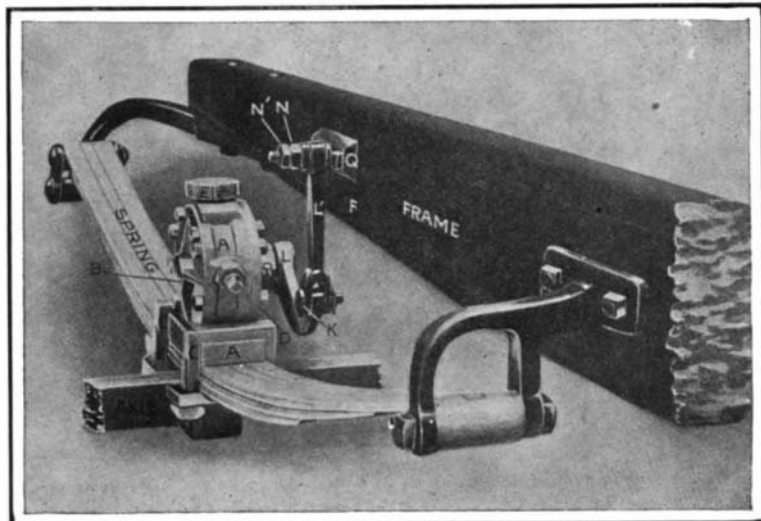


Fig. 6.—Hotchkiss Hydraulic Anti-Jolt Device Attached.

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## TYPES OF SHOCK ABSORBERS FOR AUTOMOBILES.

(Continued from page 326.)

Another method of retarding excessive spring action by frictional resistance is employed in the Gabriel shock absorber (Fig. 4). Two long strips of finely-tempered spring steel are bolted together at their ends, with steel blocks and thin steel washers between, so as to leave a long, narrow space between the two strips. A steel plate, recessed on each side to hold pads of camel's hair belting, is placed between the long steel strips, the pads of camel's hair belting being next to the inner surfaces of the strips, and causing them to spring apart considerably. A stud in the steel plate projects through a long slot running the full length of one of the steel strips, and this stud is screwed into the frame of the car, just above the middle of the spring. One end of the pair of steel strips is secured to the middle of the car spring by a special angle plate adapted to be held down by the clamps that secure the spring to the axle. As the car rises and falls on its springs, the padded plate slides up and down between the spring steel strips. While the car runs on fairly smooth roads, where spring movement is slight, the movement of the padded plate is confined to the central portion of the device, where there is but little friction, and the free play of the springs is not checked. When rougher roads cause a wider range of spring action, however, the padded plate is moved further up or down toward the ends of the strips, where the space is more contracted and friction is, consequently, much greater. Thus the friction increases gradually as the spring movement increases, whether the movement is upward or downward. The thin steel washers, already mentioned, inserted with the steel blocks between the ends of the strips, can be removed to increase the spring pressure on the padded block, or more can be put in to reduce friction, thus providing a simple means of adjustment. Lateral motion of the car body, or swaying, is provided against by elongating the bolt holes in the top of the device, and by not setting up the bolt at that point very tightly, allowing a little play. Camel's hair belting, it may be said, is remarkably well adapted to resist wear under the conditions imposed here. This material is also frequently used for the facing of brake bands, especially on the contracting and expanding brake bands generally used on the rear-wheel drums of almost all high-powered automobiles.

Springs of special form are utilized in the Shippey shock breaker (Fig. 5). Two flat steel springs, bolted together at their lower ends, curve away from each other toward the top. Extensions of the main springs are carried inward and downward, coming together at the center and acting as auxiliary springs to add to the force holding the main springs apart. This forms the part of the device which is attached to the axle or spring of the

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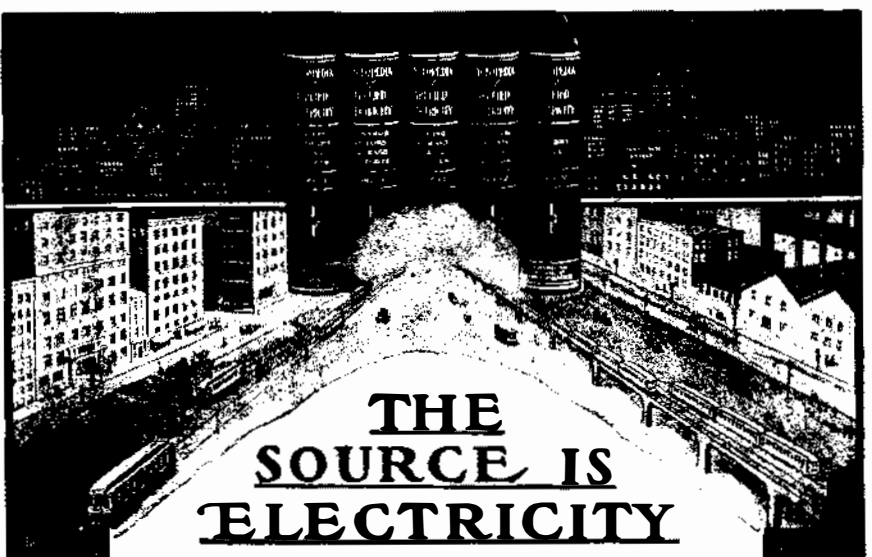
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car. Secured to the frame is a steel bracket carrying two hardened steel rollers, between which the springs of the shock absorber move up and down as the car springs play. There is but little resistance to the downward movement of the car springs or to the first part of the upward movement; but as the spring begins to exceed normal limits of motion on the rebound, the shock absorber springs are drawn down between the rollers, and the force required to compress them checks the upward movement. The higher the car body rises the greater is the resistance offered, as the springs are furthest apart at the top, and more force is required to compress them.

In the Hotchkiss anti-jolt device (Fig. 6), the resistance offered by a small aperture to the passage of a liquid is made to check the rebound of the car springs. A circular chamber (Fig. 7) accurately finished interiorly, is filled with glycerine and fitted with a radial piston on a steel shaft, the piston being packed with leather to make it tight in the chamber. The shaft passes out through a stuffing-box in the cover, which is fitted on with a ground joint to prevent leakage. In the chamber there is also a metal partition extending from the inner circumference to the shaft, where another packing of leather makes a tight joint. In the partition is a small opening controlled by a needle valve, adjustable from the outside. Another passage, much larger, runs through the chamber casting from one side of the partition to the other at the top, forming a bypass, and in it is a check valve which permits the flow of liquid in one direction only.

An arm is attached to the outer end of

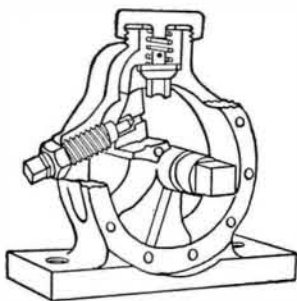


Fig. 7.—Hotchkiss Shock Absorber With Cover Removed and Section Broken Away to Show Check-valve and By-Pass.

the shaft carrying the radial piston, and to this arm is pivoted a link; the chamber with its piston is bolted to the car spring, while the upper end of the link is attached to the frame above. Any movement of the spring is of course communicated to the link and thence to the arm, the shaft, and the piston. In order to move the piston, however, the glycerine in the case must be displaced, as it is confined in the two spaces formed by the piston and the partition, the only communication being through the small valve-controlled hole and the larger bypass. On the downward movement of the car body the glycerine is permitted to pass freely through the check valve in the bypass, and the opening is of such size that there is little or no retarding effect. On the upward movement, however, the check valve closes, and there is left only the small hole in the partition. Through this the glycerine is forced comparatively slowly, and the speed of the spring rebound is retarded to conform to the rate at which the glycerine can pass the orifice. Obviously, the smaller the hole the slower the movement; and as the opening can be regulated by the needle valve referred to, the speed of action permitted can be adjusted to a nicety.

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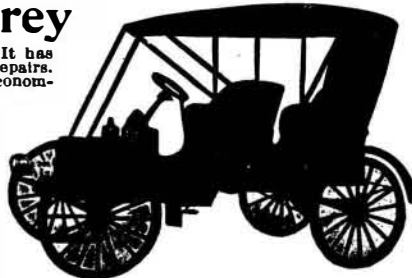
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bined in the Baldwin spring recoil check, made by the Baldwin Chain and Manufacturing Company, of Worcester, Mass. This is shown in Figs. 8 and 9. From the body or frame of the car is suspended a cylinder, A, open end down, by two rods depending from a pivoted yoke, H, and carrying compound springs, F, G. In the middle cylinder is a plunger

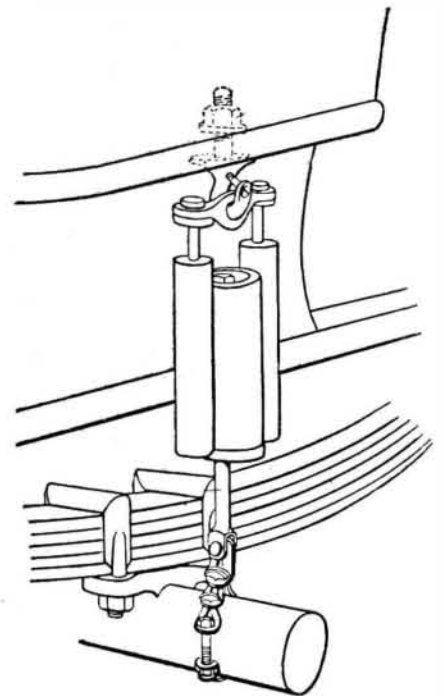


Fig. 8.—The Baldwin Combined Spring and Friction Recoil Check.

B, divided vertically into halves and faced with cork on its bearing surfaces. Rod E has a slotted head engaging the inner ends of two small toggle arms whose outer ends bear on the two halves of the plunger, so that a downward pull on the rod tends to force apart the two halves and bring them into more or less forcible contact with the cylinder walls, while the upward movement of the rod withdraws the plunger from contact with the cylinder walls. The action of the toggles is modified by small helical springs, so that a rapid, sudden pull of the rod will cause the plunger to exert a greater pressure against the cylinder walls and a consequent slower movement. Within each of the smaller cylin-

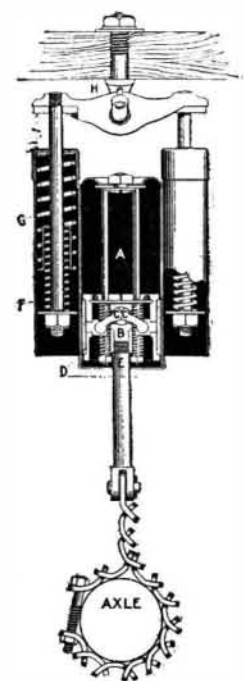


Fig. 9.—View Showing the Combined Spring Recoil and Friction Check Partly in Section.

ders are a pair of coiled springs, F and G, one of these springs being lighter than the other. With an up-and-down movement of about 4 inches, the rebound is checked by these springs. Should, however, a much greater movement of the frame with respect to the axle occur, the piston, B, will travel upward in the cylinder, A, while the frame is approaching the axle, but will immediately lock, and then travel slowly downward as soon as the rebound begins.