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MAY 18, 1943.
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O. CÜPPER
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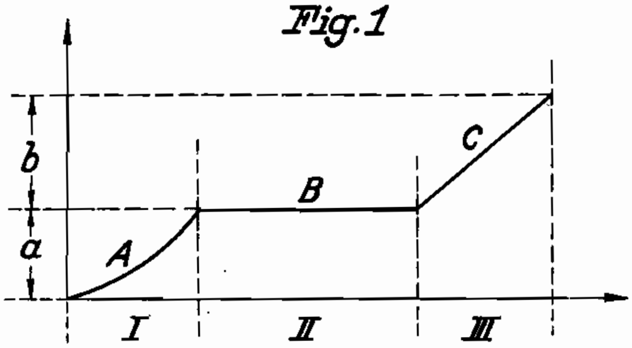
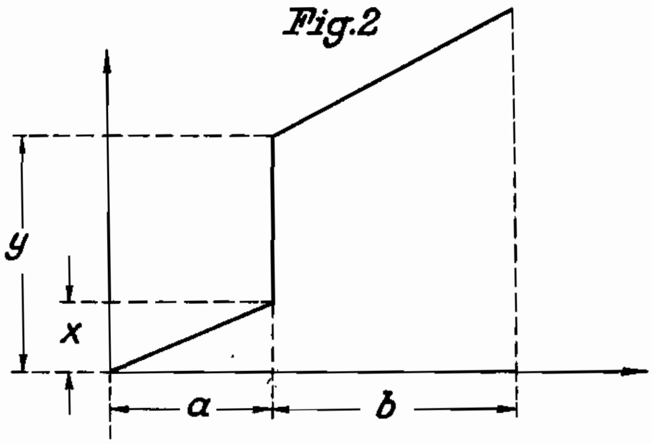
4 Sheets-Sheet 1





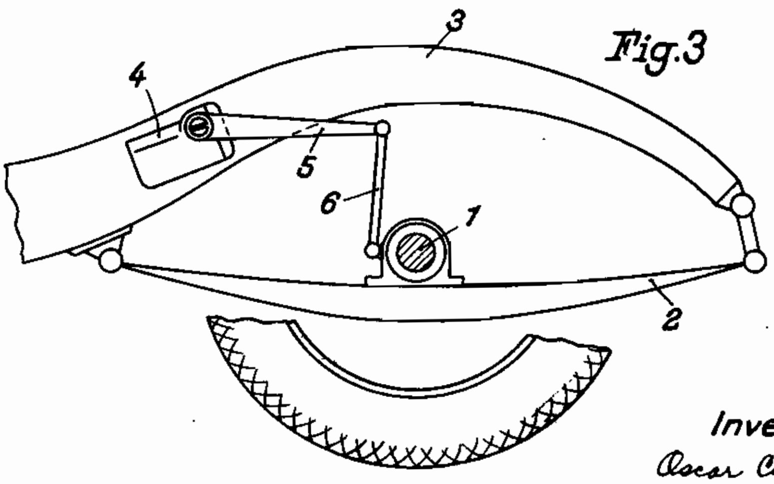


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Fig. 4

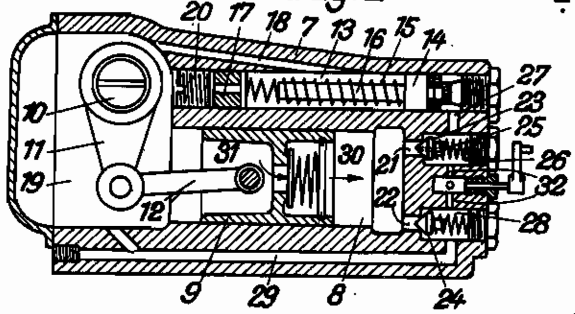


Fig. 6

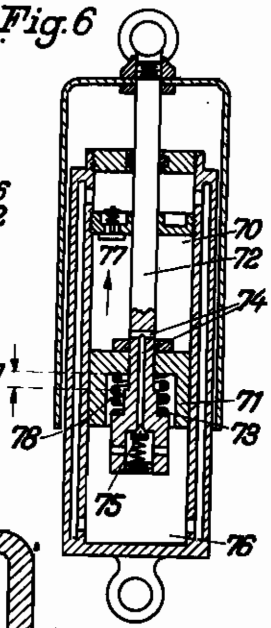


Fig. 5

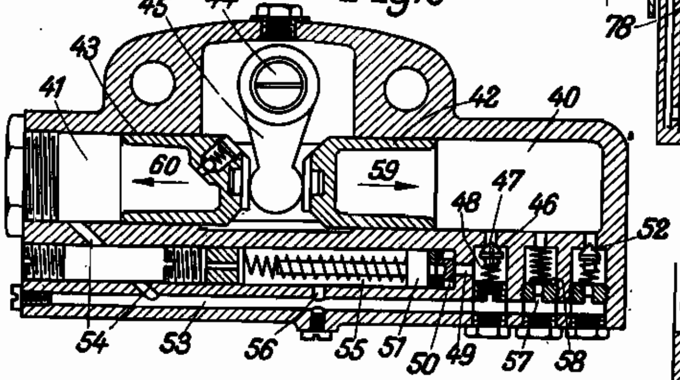


Fig. 7

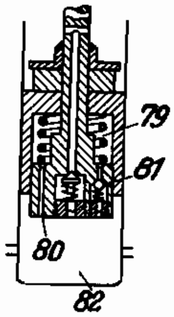
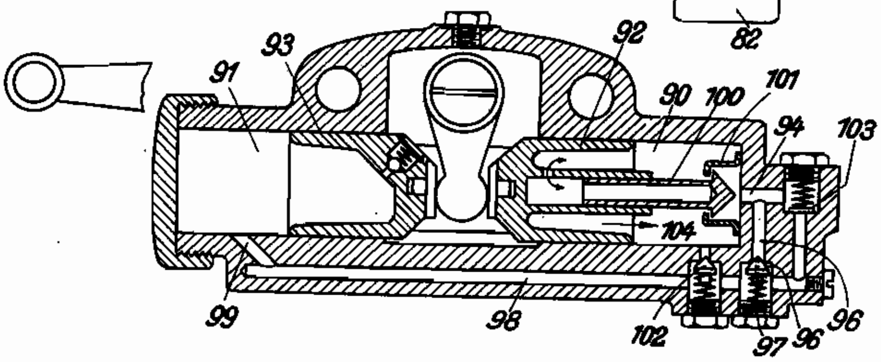


Fig. 8



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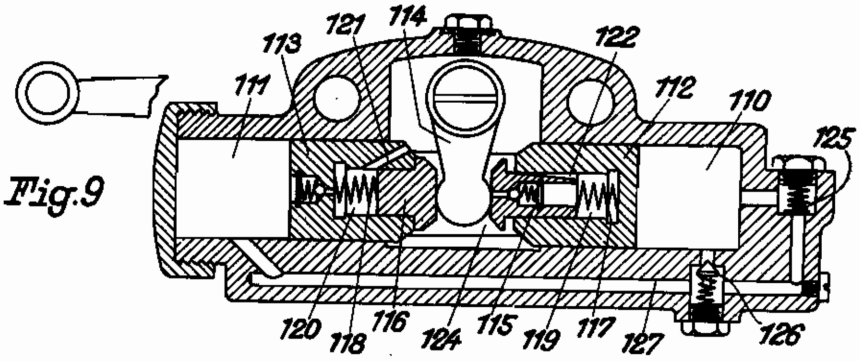

Fig. 9

Fig. 10

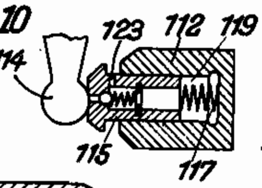

Fig. 11

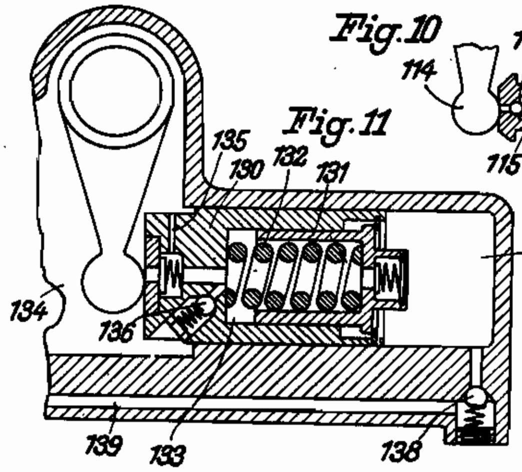

Fig. 15

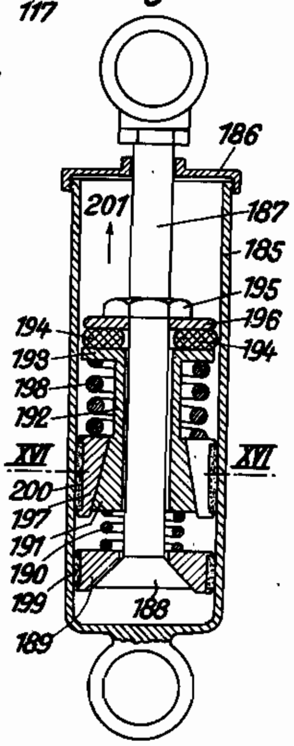

Fig. 12

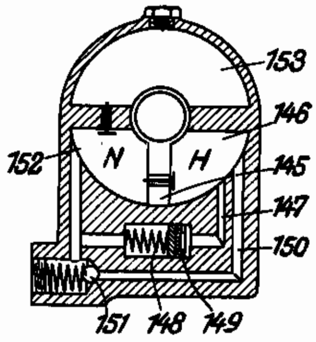

Fig. 16

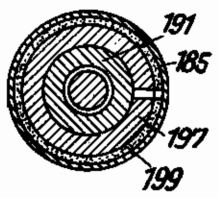

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Fig. 13

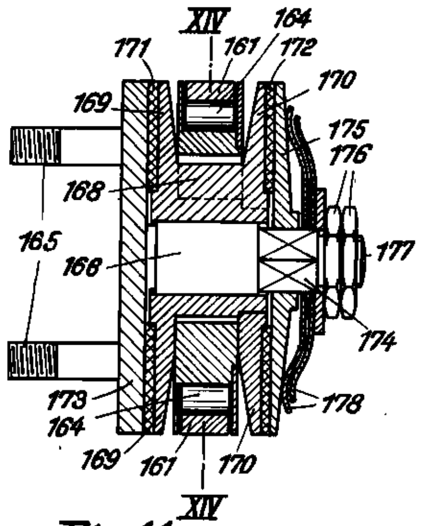
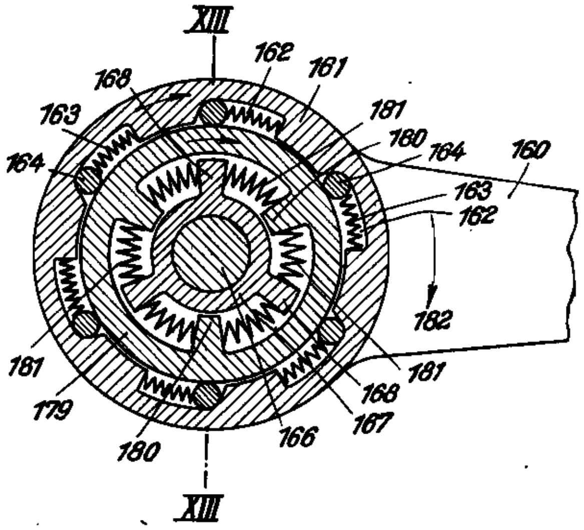


Fig. 14



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ALIEN PROPERTY CUSTODIAN

OSCILLATION ABSORBERS

Oscar Cüpper, Diessen/Ammersee, Germany; vested in the Alien Property Custodian

Application filed November 10, 1939

The present invention relates to a method of and means for absorption of oscillations more particularly for absorbing relative movements between the axis and the body of vehicles. The absorption may hydraulically as well as mechanically be effected.

The known oscillation absorbers generally are so constructed that the absorption effect either remains equal over the entire range of absorption or steadily increases according to a linear or a curve in a definite ratio to the magnitude of the oscillations. Moreover, so-called balancers, heeling absorbers, are known in which the relative movement between the axis and the body of a vehicle on the one side of the vehicle effects an equal or nearly equal relative movement on the other side of the vehicle to thereby maintain the body of the vehicle in a position substantially parallel to the road or track.

Now, the invention starts from the fact that a vehicle taking a curve is considerably more lifted on the inner side of the curve than on the outer side. The reason for this is that in the first case the power of the spring during release acts in the sense of the centrifugal force, whereas on the other side the spring counter-acts the centrifugal force. Hitherto the inclination of a vehicle taking a curve could only be prevented by means of the above mentioned balancers. Now the inventor has recognized that with regard to the relative small inclination on the outside of the curve it is only necessary to prevent lifting of the vehicle on the inside to obtain, besides absorption of oscillations, an extended steadying action without mutual connection between the absorber means at both sides of the vehicle.

The method of absorbing oscillations according to the invention consists in this that in a first range of absorption an absorption of the oscillations is effected, on exceeding a definite magnitude of oscillations the oscillation movements are entirely or nearly entirely braked and thereafter, in a second range of absorption further absorption of oscillations is effected as soon as a definite strain is reached between the body and the axis of the vehicle.

These two ranges of absorption may have different absorption effects. For instance, in the first range of absorption the absorption effect may increase according to a curve with the magnitude of the oscillations, whereas in the second range this effect increases according to a linear. Also each range may be subdivided in a plurality of individual ranges of different absorption.

The devices for carrying out the method according to the invention may be constructed as hydraulical as well as mechanical oscillation absorbers.

In connection with hydraulical oscillation absorbers the desired effect may be obtained by the fact that the flow of liquid in the absorber is interrupted between the two ranges of absorption, whereby the relative movement between the axis and the body of the vehicle also is interrupted. To this purpose the liquid displaced during the first range of absorption may be received by an additional space and the second range of absorption then may begin only if after filling of the additional space the pressure of the liquid has exceeded a predetermined value.

According to the invention the two ranges of absorption may be formed by throttling devices of different throttling action arranged one after the other, an additional space being connected to the pipes provided between the throttling devices. The additional space preferably consists of a cylinder in which a spring-loaded piston is arranged. On a one-sided movement of the oscillation absorber the one side of the piston is connected to the pressure space of the absorber and the other side of the piston to the reserve or space chamber, whereas in connection with double-acting oscillation absorbers the two sides of the piston each are connected to a pressure chamber.

In a very simple manner the effect also may be obtained by arranging two valves having different throttling actions in parallel in the path of the liquid displaced from the absorber cylinder. One of these valves, i. e. the one having the smaller throttling effect is closed on exceeding a definite relative movement between the axis and the body of the vehicle, whereas the other valve is opened for a certain amount after a further increase of pressure. Between the point of time in which the valve having the smaller throttling effect is closed and the point of time in which the valve having the larger throttling effect is opened there is a period of time during which no relative movement occurs between the axis and the body of the vehicle.

A mechanical oscillation absorber may for this purpose consist of two or more friction absorbers arranged one behind the other, the maximum absorbing power of the one absorber being smaller for a definite amount, depending on the desired magnitude of the intermediate range, then the minimal friction power of the second friction absorber. To obtain a smooth change between the individual steps the two friction absorbers are connected together by a resilient intermediate member the elasticity of which is chosen in accordance with the absorption efficiency of the two friction absorbers. Moreover, the distance the spring may move preferably is limited by stops to thereby fix the maximum mutual movement.

Further details of the invention may be seen from the following description of the drawings which show various examples of devices for carrying out the method according to the invention.

In these drawings:

Figs. 1 and 2 show diagrams explaining the operation of the device according to the invention,

Fig. 3 is a view of an absorber fitted to a vehicle,

Fig. 4 is a longitudinal section through a single-acting hydraulic oscillation absorber.

Fig. 5 illustrates a section through a double-acting hydraulic oscillation absorber,

Fig. 6 is a section through a hydraulic telescope-oscillation absorber,

Fig. 7 is a sectional view of a detail of the device shown in Fig. 6,

Figs. 8 and 9 show sectional views of two further modifications of double-acting hydraulic oscillation absorbers,

Fig. 10 shows a section through another construction of a detail of the device illustrated in Fig. 9,

Fig. 11 is a section of a further hydraulic oscillation absorber,

Figs. 13 and 14 show a longitudinal section and cross section respectively through a single-acting mechanical oscillation absorber, and

Figs. 15 and 16 show a longitudinal section and a section on line XVI—XVI of Fig. 15 respectively of a double-acting mechanical telescope-oscillation absorber.

In the diagram shown in Fig. 1 the relative movements between the axis and the body of a vehicle are plotted on the ordinate, whereas the distance of the road traversed by the vehicle is plotted on the abscissa. If the vehicle traverses the distance I absorption according to the curve A occurs, the relative movement obtaining a magnitude a. Then suddenly (in praxis of course with a certain change) interruption of the relative movement occurs during which time the distance II corresponding to the straight line B is traversed. Then again during traversing the distance III relative movement of the magnitude b is effected according to a linear C.

In Fig. 2 the centrifugal force acting upon the absorber is plotted on the ordinate and the relative movement is plotted on the abscissa. The centrifugal force of the magnitude x produces a relative movement of the magnitude a. During further increase as far as to the magnitude y the relative movement is positively interrupted and further relative movement is effected only after exceeding of this magnitude of power.

From Figs. 1 and 2 it may be seen that the distance II is the shorter the sooner the magnitude of power y is reached. The magnitudes x and y may exactly be determined by correspondingly constructing and dimensioning the devices.

Fig. 3 shows the arrangement of the oscillation absorber on the vehicle. The rear axis 1 is rigidly connected to the spring 2 of the vehicle. Fixed to the frame 3 of the vehicle is the oscillation absorber 4 which is connected to the axis 1 of the vehicle by means of a linkage 5, 6.

Fig. 4 shows a single-acting oscillation absorber in the casing 7 of which a cylinder 8 containing a piston 9 is provided. The absorber shaft 10, driven by the lever 5 (see Fig. 3), effects the drive of the piston 9 by way of a pair of levers 11, 12. In the casing 7 a second cylinder 13 of considerably smaller dimensions is provided in which operates a piston 14 loaded by a spring 15. Fixed to the piston 14 is an extension 16 which cooperates with a preferably elastic stop 17. The space of the cylinder 13 between the piston 14 and the stop 17 is connected to the spare chamber 19 by way of a passage 18 so that on movement of the piston 13 the corresponding change of spaee between the piston and the stop is possible. The tension of the spring 15 may be adjusted by a screw 20. The end of the cylinder 8 is provided with two bores 21 and 22 which are closed by spring-loaded valve cones 23 and 24 respectively. In the valve cone 23 a passage 25 is provided. By way of a bore 27 the space 26 in front of the valve cone 23 is connected to the space of the cylinder 13 in front of the piston 14, whereas the space 28 in front of the valve cone 24 is connected to the spare chamber 19 by way of a passage 29.

The operation of the oscillation absorber shown in Fig. 4 is as follows:

If due to relative movement between the spring 2 and the frame 3 of the vehicle (see Fig. 3), for instance on mutual separation, the piston 9 is moved in the direction of the arrow 30, the liquid displaced from the cylinder 8 flows through the passage 25 or at a larger pressure by opening the valve 23 into the space 26 and from there by way of bores 27 into the cylinder 13 the piston 14 of which is shifted against the action of the spring 15 until the rod 16 abuts against the stop 17. Now, no further reception of liquid by the cylindei 13 is possible and the movement of the piston 9 is completely braked. A further relative movement of the members 2 and 3 (see Fig. 3) and therefore of the piston 9 now cannot occur as long as the spring power of the valve 24 is larger than the liquid pressure in the cylinder 9. If then this pressure is increased so far as to open the valve 24 the liquid may escape into the spare chamber 19 by way of the chamber 28 and the passage 29.

If now the piston 9 returns again against the direction of the arrow 30 liquid is sucked in from the spare chamber 19 by way of the snifting valve 31.

In case the oscillation absorber need be used without steadying action a connection 32 capable of being shut is provided between the chambers 26 and 26.

Fig. 5 shows a double-acting oscillation absorber operating in the one direction with and in the other direction without balancers. The absorber is provided with two cylinders 40 and 41 in which operate pistons 42 and 43 respectively. These pistons are driven by means of a cam lever 45 fixed upon the absorber shaft 44. Th cylinder 40 is conneoted to a cylinder 50 containing the spring-loaded piston 51 by way a valve 46 having a passage 47, a chamber 48 and a bore 49. Moreover, the high pressure cylinder 40 may be connected to the low pressure cylinder 41 by means of a high pressure valve 52 and passages 53, 54. The low pressure cylinder 41 in this case, therefore, corresponds to the spare chamber 19 of the construction shown in Fig. 4. The space 55 behind the piston 51 may also be connected to the passage 53 by way of a bore 56. The passage 53, moreover, has a further bore 57 discharging into the cylinder 40 and closed by a low pressure valve 58.

The operation of this device is as follows:

If the pistons are moved in the direction of the arrow 59 the operation exactly corresponds to that of the device shown in Fig. 4, the valve 58, however, remaining closed. If the pistons are moved in the direction of the arrow 50 the liquid from the low pressure cylinder 41 flows by way of the passages 54, 53, 57 and the valve 56 into the high pressure cylinder 40.

The telescope-oscillation absorber shown in Fig. 6 has a cylinder 70 with a piston 71 which against the action of a spring 73 may be shifted upon its rod 72. The cylinder space 70 may be connected to the space 76 below the piston 71 by way of a bore 74 provided in the piston rod 72 and a high pressure valve 75.

The operation of this absorber is as follows:

If the piston rod 72 is moved in the direction of the arrow 77 the piston 71 first of all is not shifted, but the spring 73 is compressed about the distance *d*. Only if the pressure in the space 77 is so high that the valve 75 may be opened further movement of the piston rod 72 together with the piston 71 may occur.

Whereas according to the construction shown in Fig. 6 the space 78 containing the spring 73 is in open connection with the space 76, the corresponding space 79 of the construction according to Fig. 7 is closed and provided with a passage 80 as well as with a valve 81 which together correspond to the members 46, 47 shown in Fig. 5 and discharge into the space 82.

In Fig. 8 another double-acting oscillation absorber having a high pressure cylinder 90 and a low pressure cylinder 91 is shown which are provided with pistons 92 and 93 respectively. By way of bores 94, 95, valves 96, having a passage 97, and passages 98, 99 the space 90 is connnected to the space 91. The bore 94 may be closed by a valve 100 controlled by the piston 92. The stroke of the valve 100 is limited by a stop 101. Moreover, a high pressure valve 102 and a low pressure valve 103 are provided between the passage 98 and the cylinder 90. This arrangement operates in such a manner that if the piston 92 is moved in the direction of the arrow 104 the valve body 100 also is moved until it comes to bear against the walls of the bore 94 and thereby interrupts the flow of liquid through the valves 98, 97. On a corresponding increase of pressure flow of the liquid occurs by way of the high pressure valve 102. As the valve body 100 slides in the piston 92 the way of the piston 92 is independent on the stroke of the valve body 100.

The double-acting oscillation absorber shown in Fig. 9 also is provided with two cylinders 110 and 111 in which operate pistons 112 and 113 respectively. In the direction towards the driving cam 114 a smaller piston 115 and 116 respectively is provided in the pistons 112 and 113 respectively. The smaller pistons 115 and 116 are loaded by springs 117 and 118 respectively. The space 119, 120 between the large and the small pistons respectively is connected to the spare chamber 124 either by way of a bore 121 in the large piston 113 or by a slot 122 in the small piston 115 or according to Fig. 10 by way of a bore 123 in the small piston 115. The cylinder 110 is provided with a low pressure valve 125 and a high pressure valve 126 which are connected to the cylinder 111 by way of a passage 127.

With this absorber the absorption of small oscillations is effected by displacement of the small pistons and a movement of the large pistons is only possible if after the relative movement of the small pistons a corresponding pressure is produced in the cylinders 110 and 111.

The oscillation absorber illustrated in Fig. 11 also is provided with two pistons 130 and 131 slideably arranged one in the other between which a spring 132 is inserted. The space 133 between the pistons 130 and 131 is connected to the spare chamber 134 by way of a passage 135 and a valve 136, whereas the high pressure cylinder space 137 is connected to the spare chamber 134 by way of a valve 136 and a passage 139 or in connection with double-acting oscillation absorbers with the cylinder at the other side.

The oscillation absorber shown in Fig. 11 is provided with a vane piston 145 and the high pressure space 146 of this absorber is connected to an additional receiving space 146 having a spring-loaded piston 149 by way of a passage 147. Moreover by way of a passage 150 and the high pressure valve 151 the high pressure space 146 is connected to the low pressure chamber 152. Above the two chambers 146 and 152 a spare chamber 153 is provided.

A first mechanical oscillation absorber having a step-like action is shown in Figs. 13 and 14. An annular casing 161 with recesses 162 containing balls or rollers 164 loaded by springs 163 is arranged at a lever 160 connected to the axis of the vehicle. The lever 160 corresponds to the lever 5 shown in Fig. 3. As explained later on the spring-loaded balls or rollers 164 act as free wheel mechanisms. Upon an axis 166 fixed to the frame of the vehicle by screws 165 a bushing 167 having radially directed flanges 168 is pivotally mounted. The bushing 167, moreover, carries two circular discs 169 and 170 against the outer faces of which bear friction discs 171 and 172 respectively. These friction discs are covered by the base plate 173 and a plate 175 mounted upon a square-head 174 of the axis 166. The members 173, 171, 169, 167, 170, 172 and 175 may resiliently be pressed together by nuts 176 screwed upon the threaded portion 177 of the shaft 166 and leaf springs 178 arranged between the nuts 176 and the cover plate 175. Loosely mounted in the casing 161 is a ring 179 having flanges 180 which are radially directed inwardly and bear against the flanges 168 of the bushing 167 by means of springs 181.

The operation of the device just described is as follows:

If the lever 160 is moved in the direction of the arrow 182 the casing 163 and, by way of the free wheel mechanisms 163, 164 which are effective in this direction only as the recesses 162 are broader at one end, the ring 179 are moved in the same sense. The springs 181 are compressed between the flanges 168 and 180 until either their convolutions bear against each other or their tension becomes larger than the friction power of the absorber to be overcome. From this moment the bushing 167 and the discs 169, 170 are moved by means of the flanges 168 and after overcoming the friction produced by the friction discs 171, 172 are rotated with regard to the fixed plates 173, 175.

The double-acting telescope-friction absorber shown in Figs. 15 and 16 consists of a sleeve 185 with guide cover 186 fixed for instance to the frame of the vehicle. Upon the rod 187 fixed to the axis of the vehicle and formed at its end as a solid cone 168 the following members are arranged one behind the other. A slotted or multi-part cone 189, a spring 190, a solid cone 191 provided with a sleeve-like extension 192 and a flange 193, an elastic disc 194 and a nut 195 with washer 196. The cone 191 is surrounded by a multi-part or slotted cone 197 pressed against or upon the cone 191 by means of a spring 198 bearing against the flange 193. The outer surfaces of the cones 189 and 197 carry a brake lining 199, 200.

The operation of this device is as follows:

If when the sleeve 185 is fixed the rod 187 is moved in the direction of the arrow 201 first of all by the tension or power of the spring 190 the cone 189 is pressed against the cone 188 and thereby against the wall of the sleeve 185. Due to the high friction with regard to the sleeve 185 and the free play or large clearance with regard to the rod 167 the cone 197 and the cone 191 with the extension 192, 193 are not moved by the rod 167 but remain in rest as long as the spring 190 for instance is completely compressed. Only then the two cones 190 and 197 are moved by the rod 187.

Therefore, with the friction absorbers according to Figs. 13 and 14 as well as with the friction absorbers shown in Figs. 15 and 16 an absorption in two stages is obtained.

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