Aug. 24, 1943. H. K. KOUYOUMJIAN 2,327,722

DASHPOT

Original Filed March 12, 1940

Fig. 1.

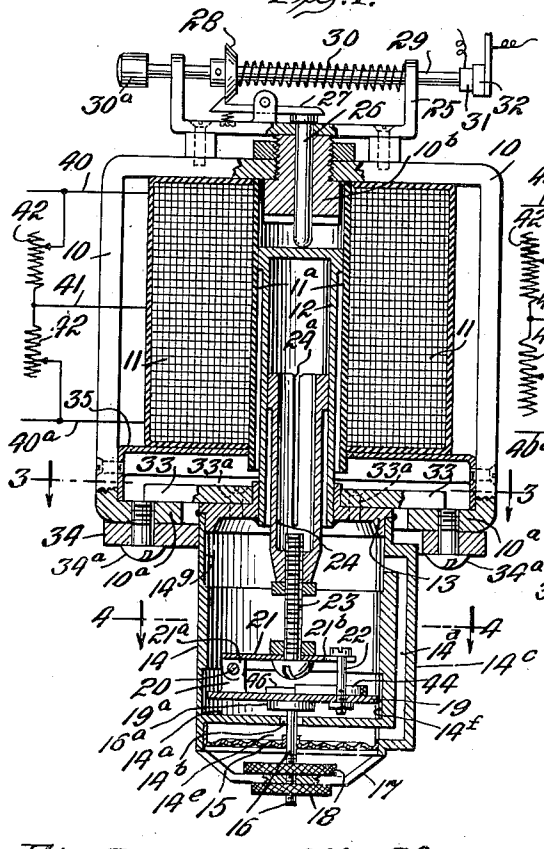


Fig. 2.

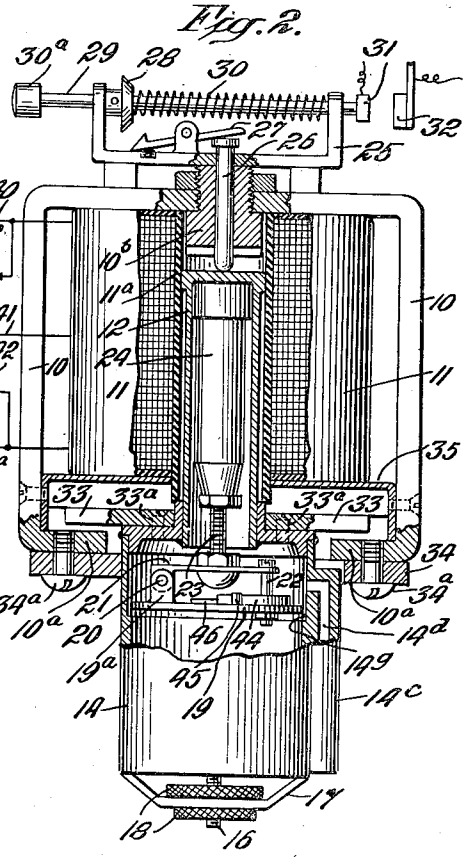


Fig. 3.

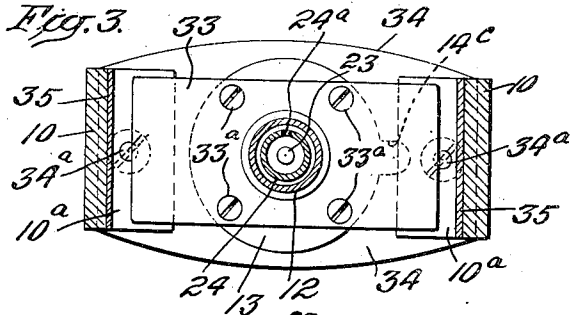


Fig. 4.

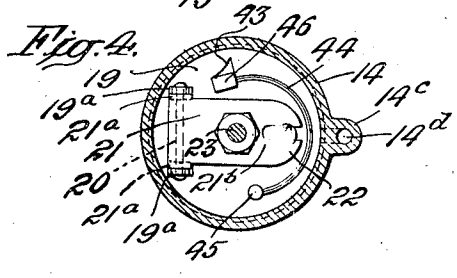
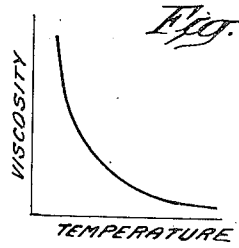


Fig. 5.



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DASHPOT

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Original application March 12, 1940, Serial No. 323,584. Divided and this application November 27, 1940, Serial No. 367,419

1 Claim. (Cl. 188—96)

This invention is particularly well adapted for use in connection with time delay relays but is applicable to various other uses. This application is a division of my pending application Serial No. 323,584, filed March 12, 1940; and various disclosures herein relating to the electromagnetic time delay relay are claimed in said pending application; and are described here for the purpose of showing how the improved dashpot functions in its cooperative action with the other parts in this particular application of the invention.

The main object is to provide an improved dashpot which may be depended upon in long continued use to function in the same manner according to the strength and duration of the controlling force. A further object is to avoid the use of check valves in the dashpot. Such valves are commonly used for permitting a quick return of the piston to its initial position but their failure to seat properly and uniformly at all times affects the controlling action to give varying and unpredictable results. The present invention permits a rapid return of the piston while avoiding variations in the response curve that are due to the use of check valves. Other objects and advantages will be understood from the following description and accompanying drawing.

Fig. 1 is a vertical central section showing one embodiment of the improved dashpot applied to an electromagnetic time delay relay and showing the parts in their initial lower position; Fig. 2 is a similar view showing the parts in their uppermost position, the element controlled by the relay having then been actuated; Fig. 3 is a horizontal section on the line 3—3 of Fig. 1; Fig. 4 is a horizontal section on the line 4—4 of Fig. 1; and Fig. 5 is a chart indicating change of viscosity of a liquid with change of temperature.

Referring to Figs. 1, 2 and 3, an inverted U-shaped frame 10, having inwardly projecting lower ends 10a, is of magnetic material, such as iron or steel. It has a central core 10b of magnetic material at its top portion which projects downwardly to some extent within the frame. A winding 11 having a central insulating sleeve 11a is positioned between the sides of the frame 10 and surrounds the core 10b at the upper part of the winding. A sheet metal strip 35 of non-magnetic material is secured at its ends to the lower portions of the sides of the frame 10 and serves to retain the winding 11 in position.

A cylinder 12, closed at its upper end and of non-magnetic material, is movable freely within the winding 11 and its upper end is normally below the lower end of the core 10b. The lower end of this cylinder is open and is secured by a sealed joint to the upper plate 13 of the dashpot. The cylindrical body 14 of the dashpot is joined to its upper plate 13 by a sealed joint, the lower end 14a of the dashpot having a small central opening 14b. The dashpot is provided with a vertically extending projecting portion 14c at one side having a passage 14d which connects the interior top portion of the dashpot with the space 14e below the bottom plate 14a. This space is closed by a flexible metal sheet 15 below the plate 14a, the sheet 15 being united at its outer rim by a sealed joint with an extended lower portion of the dashpot cylinder. A stem 16 carrying a head 16a above the plate 14a passes through the opening 14b with considerable clearance space and passes through the metal sheet 15, being secured thereto by a sealed joint. The lower end of the stem is threaded and passes freely through a cross-piece 17, the outer ends of which are fixed to the lower end of the dashpot. Above and below the cross-piece are nuts 18 threaded on the stem 17. It is evident that by adjusting these nuts the stem may be adjusted vertically to any desired position and the flexible sheet 15 will yield sufficiently to permit such adjustment without affecting any joint or interfere with the sealing of the unit. In forming the sealed joints above referred to, they may be soldered, brazed or otherwise formed to insure a perfectly sealed unit. Threaded connections or joints depending upon friction are not dependable for a permanent sealing and in the above described unit, all such connections are eliminated, even for the purpose of adjustment. Thus there can be no change in the unit due to the presence of any unsealed joint.

The piston 19 of the unit, instead of being of the usual form, is a flat circular plate of comparatively small thickness. This has at one side an upwardly extending pair of spaced projections 19a which are pivotally connected by a pin 20 to a pair of spaced projections 21a extending downwardly at one side of a plate or strip 21. This plate extends partially across the interior of the dashpot. Fixed to the piston plate 19 at the side opposite the hinged portion is an upwardly projecting screw bolt 22 which passes freely through a slot 21b in the cross-plate 21. The head of the bolt normally rests on the top of the plate 21 and then holds the hinged piston plate in a plane perpendicular to the axis of the dashpot cylinder. The lower end

of the bolt and its nut are soldered to the plate 19 to avoid any change of adjustment. A screw bolt 23 is fixed to the center of the plate 21 and extends upwardly into the lower end of a cylinder 24 of magnetic material. The connections of the bolt to plate 21 and to the cylinder 24 are soldered to prevent change of adjustment after the desired condition is attained. The cylinder 24 is movable freely vertically within the cylinder 12 and in its lowest normal position the top of cylinder 24 is some distance below the top of the cylinder 12, as shown in Fig. 1. The cylinder 24 is provided with a vertical slot 24a at one side to reduce the effect of induced eddy currents when an alternating controlling current is applied to the winding 11.

The relay may be applied to the actuation of any desired controlled element and is here shown as serving to open a controlling circuit but could obviously be applied to the closing of a circuit or to perform any other desired function. A U-shaped frame 25 is shown fixed to the top of the frame 10. Passing down freely through the frame 25 and the center of the core 10b is a pin 26 which projects beyond the core and approaches close to, or may engage, the top of the cylinder 12, as shown in Fig. 1. The top of the pin is headed so as to be retained by the frame 25 when the pin is in its lowest position. Pivotally mounted on the frame 25 is a latch 27, the inner end of which engages the top of the pin 26 while its outer end is spring pressed upwardly to normally engage and restrain a circular beveled plate 28. This plate is fixed to a shaft 29 which is supported by and longitudinally movable in the upwardly extending ends of the frame 25. A spring 30 encircles the shaft between the plate 28 and one end of the frame and tends to move the shaft to the left against the latch 27. The left-hand end of the shaft is provided with a handle or knob 30a. The right-hand end carries an insulated contact 31 which is connected to any desired control circuit. This contact normally engages a fixed contact 32 through which the circuit is completed.

Returning now to the magnetic circuit of the relay, a cross-plate 33 of magnetic material is fixed to the top plate 13 of the dashpot by the screws 33a and normally engages the top of the inwardly projecting ends 10a of the magnet frame, as shown in Fig. 1. This completes a magnetic circuit from the sides of the frame 10 in a main path through the cross-plate 33 and cylinder 24 to the core 10b and then to the sides of the frame 10. This magnetic circuit tends to hold the movable unit comprising the dashpot, plate 33 and cylinder 12 in its lowest position with the plate 33 attracted downwardly towards the ends 10a of the magnet frame. In order to keep the movable unit from turning on its axis and to maintain the plate 33 in alinement with the extensions 10a under all conditions of operation, a brass plate 34 is fitted slidably over the dashpot and has a recess for receiving the side projection 14c of the dashpot, as shown in dotted lines in Fig. 3. This plate is fixed by screws 34a to the under side of the extensions 10a of the magnet.

The operation may be understood by first considering the parts in the positions shown in Fig. 1. When current is applied to the winding 11, a magnetic flux will be created which will pass mainly through the circuit, as already described, to the cross-plate 33, and the movable unit will be retained in the position shown in Fig. 1. If the current is sufficiently small, no action of the parts takes place. If, however, the current be increased to or above a predetermined amount, the magnetic cylinder 24 starts to move upwardly at a rate of movement depending upon the strength of the current in the winding 11. This action is due to the magnetic attraction imposed upon the cylinder 24 by the winding tending to draw it within the winding. The dashpot retards the upward movement of the cylinder 24, the rate of movement being dependent upon the relation between the magnetic force exerted upon the cylinder 24 and the retarding action of the dashpot. The magnetic force exerted depends, of course, upon the strength of current in the winding 11.

The dashpot is filled or nearly filled with a suitable liquid, such as oil, and is preferably of a character whose viscosity does not change materially with change of temperature. When the plate of the dashpot moves upwardly, the retarding force is dependent upon the rate of flow of the liquid through the passage 14b from the upper side of the plate 19 to its lower side. The rate of this flow is adjusted, in the manner already described, by the position of the stem 16 and its head 16a. Raising or lowering the position of the head 16a with reference to the bottom plate 14a of the dashpot will, of course, increase or decrease the space between the plate 14a and the underside of the head 16a and thereby control the rate of flow of the liquid in the dashpot. The lower portion of the dashpot cylinder is shown as having a slightly larger interior diameter 14f than the central portion and likewise the upper portion of the dashpot cylinder is shown as having a slightly larger diameter at 14g. The piston or plate 19 of the dashpot is fitted quite closely to pass along the central portion of the dashpot without much clearance so as to reduce the passage of oil around the rim of the plate 19 to a comparatively small amount. The enlarged lower portion 14f of the dashpot cylinder is for the purpose of permitting the dashpot plate 19 to be moved easily and quickly from its lowest position to the portion of the cylinder having a smaller diameter. This reduces friction of repose of the parts and likewise avoids any tendency of the parts to stick in their lowest position and requires a comparatively light force of short duration to raise the plate 19 to engage the central portion of the dashpot which has the smaller diameter. The plate 19 and cylinder 24 then move upwardly at a rate dependent upon the factors already described.

The magnetic attraction of the cylinder 24 is affected by two branch magnetic circuits. One, as already described, is through the plate 33. The other is from the sides of the frame 10 below the winding to the cylinder 24 and then to the core 10b. In the initial position of the parts, the flux passing through the plate 33 is so strong that the movable unit is held down. But as the cylinder 24 passes upwardly, it finally reaches a position where the flux through the plate 33 is greatly decreased whereas the flux from below the winding to the cylinder 24 is greatly increased. This relative change of flux in the two paths finally results in the weight of the parts and attractive force between the plate 33 and the extensions 10a being overcome by the upward pull exerted on the cylinder 24. The movable unit, comprising the plate 33, cylinder 12 and dashpot with their contents, then moves bodily and quickly to their raised position as

shown in Fig. 2. This action raises the pin 26, trips the latch and permits the spring 30 to open the controlling circuit at the contacts 31 and 32. At the time this action takes place, the plate 19 of the dashpot passes into the region of the larger diameter 14g which suddenly reduces the retarding dashpot action and thereby cooperates in permitting a quick movement of the unit in its final responsive action.

Upon discontinuance of the current in the winding 11, or its reduction to a sufficient amount, the weight of the parts will restore then to their initial position shown in Fig. 1. The controlling switch may be reclosed by the handle 30a and the device is then in a condition to repeat its action.

The cylinder or movable core 24 when released is permitted to fall rapidly within the cylinder 12. This is due to the fact that when the plunger starts to move down, the liquid in the dashpot will turn the plate 19 about its pivot pin 20 and cause its opposite portion to move up against the plate 21. This permits the free flow of the liquid around the edges of the plate 19 in its tilted position, and thereby permits the plate 19 and parts connected therewith to fall to their lowest position shown in Fig. 1. It is evident that when the attractive force again raises the cylinder 24, the plate 19 will always have the same definite position in relation to the other parts and always give uniformity of action in its upward movement. It is thus apparent that the variables introduced by the use of check valves are avoided and that the device permits a quick return of the parts to their initial positions.

It is evident that the relay cannot function to give immediate response to an excessively high current in the winding 11 because the core or cylinder 24 must always travel upwardly a certain distance within the cylinder 12 before there is sufficient change of flux in the respective magnetic paths to permit the upward movement of the movable unit. Moreover, the relay is dependable for securing the same response curve with reference to time intervals and the strength and duration of current in the winding 11 because there are no variables which affect the operation, even after long continued use.

The parts may be variously designed and modified for adaptability to particular requirements and in accordance with the preferences of the designer. In some cases the strip 35 may be made of magnetic material and reduced in size or extent provided the magnetic circuit is designed to insure a proper flux at the bottom of the winding 11 to overcome, at the proper time, the magnetic attraction of the magnetic circuit which initially retains the movable unit in its lower position. The core 10b may sometimes be eliminated or may be extended further within the winding 11 for adaptation to the proportions of other parts.

Where the temperature changes of the dashpot are such as to materially affect the viscosity of the liquid used in the dashpot and thereby materially affect the timing of action of the relay, special means is provided for compensating for the change in viscosity. Fig. 5 indicates in a general way the change in viscosity of a liquid, such as some oils, with changes of temperature. The viscosity rapidly decreases with initial increases in temperature; and decreases much less with continued increase in temperature. The compensation for such changes should correspond with the viscosity curve of the particular liquid used.

In the drawing, as more particularly shown in Fig. 4, an opening 43 of general right-angle triangle form is made in the plate or piston 19 having the hypotenuse corresponding in general with the shape of the viscosity curve of the particular liquid used, after first determining the viscosity curve of the liquid used. Means is then provided for making this opening more or less effective in accordance with the temperature of the liquid. At low temperatures the opening is fully uncovered and as the temperature increases the opening is more extensively closed with the initial increases in temperature than with the higher increases in temperature, in accordance with the viscosity curve of the liquid used. For accomplishing this change of the opening, a curved bi-metallic strip 44 is mounted edgewise on the plate 19, being attached at one end to a post 45 fixed to the plate. The other end of the strip carries a plate 46 resting on the piston plate 19, one side of the plate being parallel to one of the right-angle sides of the opening 43. This side is adapted to slide over the opening 43 in a direction at right-angles to the said right-angle side of the opening and close it more or less. Upon increase of temperature, the strip 44 will move the plate 46 outwardly to an amount corresponding with the increase in temperature and upon decrease of temperature will withdraw the plate 46. Thus the position of the plate will correspond with the temperature of the dashpot. But owing to the fact that the shape of the opening 43 is of general triangular form and that the side thereof nearest the plate 46 is at right-angles to the direction of movement of the plate 46, the opening will be closed to a greater extent upon temperature increases starting at low temperatures than upon the same temperature increases starting at higher temperatures. Thus the extent of the opening is made to conform in general with the change of viscosity of the liquid and automatic compensation therefor is obtained.

Although a preferred embodiment of the invention has been described, it will be understood that various modifications may be made without departing from the scope of the invention and that the dashpot may be used for various purposes.

I claim:

A dashpot comprising an enclosing cylindrical body portion, a piston within said body portion, a movable element for raising the piston from its normal lowest position to an upper position, said piston being in the form of a plate and having a pivotal connection with said element, and means connecting said piston and said element for restraining and holding the piston in a plane at right-angles to the axis of the body portion in the normal lowest position of the piston and during any upward movement of the piston and for permitting free movement of the piston on its pivot to a position inclined to the axis of the body portion during downward movement of the piston.

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