

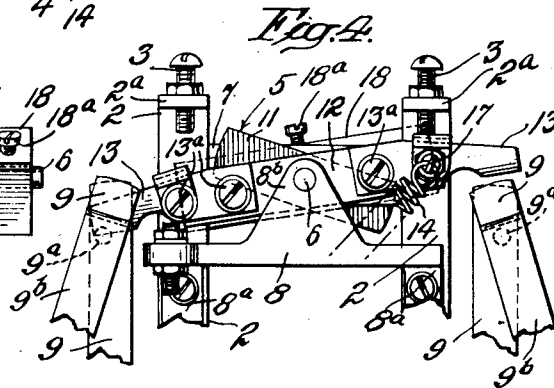
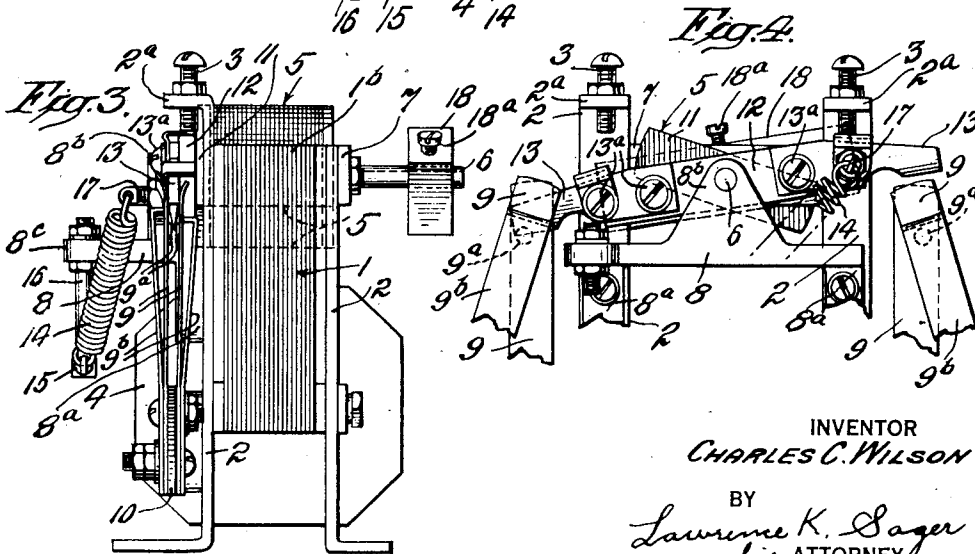
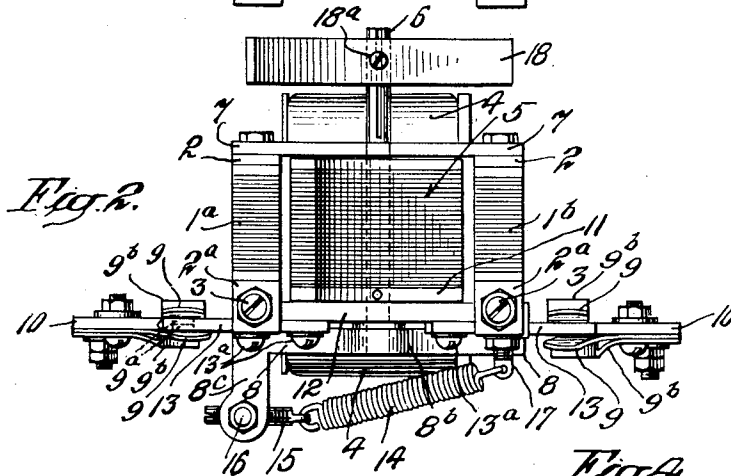
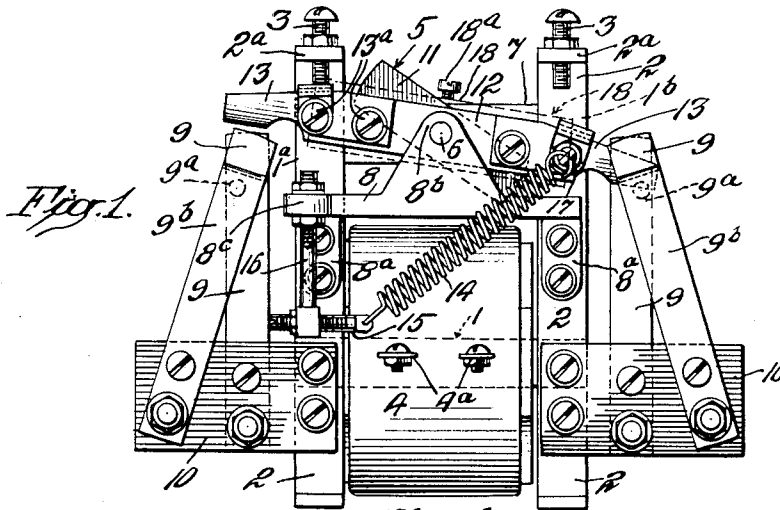
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C. C. WILSON

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TIME DELAY RELAY

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INVENTOR
CHARLES C. WILSON

BY
Lawrence K. Sager
his ATTORNEY

UNITED STATES PATENT OFFICE

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TIME DELAY RELAY

Charles C. Wilson, Mount Vernon, N. Y., assignor to Ward Leonard Electric Company, a corporation of New York

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4 Claims. (Cl. 175-372)

This application relates to time delay relays adapted for various uses and various applications according to particular requirements. The relay shown and described herein is adapted to delay the opening or closing of the contacts of the relay for controlling automatic transfer equipments for preventing transfer during any drop in line voltage of short duration, such as may be caused by starting motors; but when the drop in voltage persists beyond a predetermined time, the relay will cause the control of the contacts for operating the transfer equipment; and the more pronounced the drop in voltage, the shorter the time delay interval. The invention is applicable, however, to the control of other devices, such as circuit breakers, time limit direct current starters, alternating current auto-transformer starters and various other devices.

One object of the invention is to provide a simple form of time delay relay which avoids the use of dashpots, gear driven devices, escapement mechanisms and other forms of mechanical retarding auxiliaries, and likewise avoids the use of electrical devices such as condensers and resistors with various connections to controlling circuits. Another object is to unite the retarding means with the relay in a compact form which may be readily assembled. Another object is to provide an improved form of time delay relay wherein the retarding means will always function properly, be practically independent of temperature changes and require no attention or maintenance regardless of its length of service. Another object is to secure a maximum desired time delay when the condition to which the relay coil is subjected is slightly above or below a predetermined response value and to give less and less time delay the greater the departure from the response value; that is, the time of response varies inversely to the degree of departure from the response value. Another object is to provide a simple means of adjustment for varying the time delay and the character of the response curve. Another object is to provide a time delay relay which is conveniently adapted for variations in design to fulfill particular requirements. Other objects and advantages will be understood from the following description and accompanying drawing.

The invention is based upon the addition to the movable armature of the relay, of an auxiliary retarding movable element which is subjected to the stray field of the relay magnet or to a supplemental field thereof. During the movement of the armature the additional element

moves with it and, in general, the retarding effect is due to the induction of eddy currents in this element. In this manner the flux to which the retarding element is subjected is dependent upon the strength of field of the relay magnet which is quite different from utilizing an auxiliary rotating drag disk subjected to the field of one or more separate permanent magnets. Furthermore when the relay of this improvement is subjected to alternating currents, the retarding element is subjected to an alternating flux which serves to give an increased retarding effect and a wide range of control.

The accompanying drawing shows this improvement applied to a voltage sensitive relay for use in automatic transfer equipments. Fig. 1 is a front view; Fig. 2 is a plan view; Fig. 3 is an end view; and Fig. 4 is a view showing the movable parts in their attracted position.

Referring to Figs. 1, 2 and 3 which show the movable parts in their unattracted position, the magnet frame assembly 1 is of U shape with the legs extending upwardly to form the two poles 1a and 1b with their faces opposite each other. The magnet frame is laminated and over the clamping strips of the laminations are secured the strips 2 at the front and back of each leg, these strips being extended downwardly to form supports for the relay. The two front strips are bent outwardly at their upper ends to form supports 2a for the adjustable screws 3 which serve as stops for the movable element in its two extreme positions. The coil 4 of the relay envelops the lower portion of the magnet frame between the two legs and is provided with terminals 4a for connection of leads thereto.

The armature 5 is laminated and of rectangular form with rounded ends and is located between the opposing pole faces of the magnet. It is fixed to a shaft 6 which is rotatably mounted in bearing supports at opposite sides of the magnet. The rear bearing is in a cross plate 7 of non-magnetic metal secured to the back of the poles of the magnet; and the front bearing is in the upper portion of a bracket 8 of non-magnetic metal which is secured by depending lugs 8a to the front portion of the magnet frame at opposite ends. This bracket extends forwardly and then upwardly forming an extension 8b for the front shaft bearing.

In the form of relay shown, two pair of contacts are carried on fixed supports and the contacts of each pair face and engage each other except when separated by an insulating piece carried by the armature. The left-hand pair of

contacts 9 are in the form of thin yieldable strips of phosphor bronze, or other suitable material, and carry projecting contact surfaces 9a on their inner faces near the top of the strips. Unless forced apart the contact projections are pressed together by the spring pressure of the strips, or they may be provided with auxiliary spring pressure strips 9b, as well shown in Fig. 3. The contact strips are supported at their lower ends on an insulating plate 10 which in turn is secured at its inner end to the magnet frame. The upper ends of the contact strips are flared outwardly, as shown in Figs. 2 and 3, so as to permit the entrance of an insulating member to separate the contacts. The right-hand pair of contacts and contact strips are similar to the left-hand pair and the parts are similarly numbered.

The closed or open position of the contacts is controlled by the armature of the relay. There is fixed to the front side of the armature a clamping plate 11 of non-magnetic metal which carries a cross-bar or plate 12 of non-magnetic metal, the ends of which extend in front of the strips 2 of the magnet frame. The ends of the cross-bar engage respectively the adjustable stops 3 and thereby limit the movement of the armature in its two extreme positions. A strip 13 of insulating material is attached to the face of each end of the cross-bar by screws 13a and extends outwardly over the upper ends of the contact strips. The outer ends of the two strips are wedge shaped in their downward direction, as shown in Fig. 3, so as to permit them to pass within the flaring ends of the contact strips. When the armature is in the attracted position, as shown in Fig. 4, the left-hand insulating strip 13 has passed between the ends of the left-hand contact strips and separated the contacts and the right-hand insulating strip is then out of engagement with the right-hand contact strips permitting their contacts to be closed. In the unattracted position, as shown in Fig. 1, the reverse condition exists.

A spring 14 tends to hold the armature in its unattracted position. This spring is secured at one end to a screw 15 which is adjustable through the head of a screw 16 which in turn is adjustably secured to a lug 8c extending outwardly from the frame 8. This permits adjustment of the lower end of the spring in two directions at right-angles to each other. The upper end of the spring is connected to a screw 17 which projects outwardly from the end of the cross-bar 12. The location of the connection of the ends of the spring results in the latter extending diagonally from one end of the cross-bar towards the other side of the relay, as shown in Fig. 1. Thus when the armature moves from its unattracted position to its attracted position, the line of action of the spring approaches nearer to the axis of the armature and results in a decreasing pull on the armature as it moves to its attracted position and results in an increasing pull as the armature is moved to its unattracted position. The spring may be variously adjusted and located to suit particular requirements.

The shaft 6 of the relay is extended beyond the bearing support 7 for the purpose of carrying the retarding means. In the form shown in the drawing, this is a longitudinally extending block or strip of metal 18 of rectangular cross-section. It is of unlaminated magnetic material, such as iron or steel and its ends extend to and are located to one side and oppo-

site the rear of the magnet frame poles with an intervening air gap or gap of non-magnetic substance. It is adjustable axially on the shaft 6 being held in any desired position by a set screw 18a, the inner end of which enters a longitudinal groove in the shaft 6 for maintaining its proper angular position. It is preferably angularly positioned on the shaft by means of this groove so that in about the half-way position of the armature, the drag, or auxiliary armature 18, will occupy a horizontal position opposite the upper ends of the poles.

The drag element is subjected to a stray or auxiliary field from the sides of the poles and being made of magnetic material, will create a considerable stray field passing through it from one pole to the other through the intervening gaps. During the movement of the armature from one of its extreme positions to the other, in either direction, eddy currents will be induced in the drag element 18 which result in imposing an electro-magnetic retarding effect on the movement of the armature. This retarding effect varies according to the strength of the magnetic field of the relay, that is, the greater the strength of the magnet the greater the drag effect. Consequently, if the armature is assumed to be in its attracted position, and the voltage applied to the terminals of the relay coil is slightly below the drop-out value of the relay, the time delay interval in passing from the attracted to the unattracted position of the armature is a maximum. In the form shown, this may be made several seconds and in certain tests amounted to five or six seconds. On the other hand, when the voltage applied to the relay was dropped to a very low value suddenly, the time of movement to the unattracted position was a small part of a second, or about one-tenth of a second. In the latter case, the drag element produced no material time delay. Thus the time delay varies inversely with the amount of drop in voltage below the drop-out value and also depends upon the rate of change of voltage drop. Consequently when this relay is used for controlling transfer equipments, a severe drop or complete failure of voltage will cause little or no time delay in the transfer, while a voltage drop to values slightly less than the set drop-out voltage of the relay will cause a maximum delay and thereby avoid operation of the transfer equipments unless the drop in voltage is continued beyond the maximum time delay of the relay. The drag element likewise imposes a time delay when the armature is moved from its unattracted position to its attracted position.

The time delay interval may be adjusted by moving the magnetic element 18 axially along the armature shaft to thereby change the intervening gap and it has been found by tests that within limits the greater the distance of the drag element from the poles of the relay, the greater will be the time delay transfer. This result is due to the combined effect of the induction of eddy currents in the drag element and the amount of flux which this element may pull from the poles of the relay. When the armature is adjusted on the shaft to a position near the poles of the relay, it shunts a greater amount of flux from the relay magnet and the resultant effect of all the factors involved, including magnetic and electromagnetic, shortens the time delay interval. In fact with the drag element adjusted close to the poles, the delay was not more than four-tenths of a second even when the volt-

age was dropped from the normal voltage to the drop-out voltage of the relay. In addition to adjusting the drag element axially on the armature shaft, the time delay may be changed by adjusting the drag element angularly on the armature shaft. Likewise a change in the time delay may be obtained by varying the thickness of the drag element; and within limits the thicker the element the greater the time delay. Likewise the shape of the drag element will affect the time delay interval and if made in the form of a circular plate, the time delay will be increased over that obtained by a bar or strip. Although it is preferable to use an unlaminated drag element, the time delay interval may be decreased by forming it of laminations; and the thickness of the laminations will alter the time delay interval. Instead of making the drag element of magnetic material, it may be made of non-magnetic material, such as copper. In the latter case, the drag effect is due to the induction of eddy currents arising from the stray field of the magnet and in such a case the time delay interval will, in general, be increased the nearer the element is adjusted to the poles of the relay.

Although the relay is particularly well adapted for use with alternating current excitation, the invention is applicable to the use of direct current relays; and in the design of the relay, the form and shape of the poles and of the cooperating drag element in relation thereto, may be variously made for producing the required character of time delay to suit particular requirements. It is evident that the contacts controlled by the relay may be variously arranged for securing the desired control of the apparatus to which it is applied and in some cases, instead of controlling the opening or closing of contacts, the relay may actuate any mechanical device, such as a latch for securing desired effects. This invention thus may be utilized for a number of different purposes and has many applications and may be embodied in various forms without departing from the scope of the invention.

I claim:

1. A relay comprising a magnet having a main controlling winding and having the pole faces of the magnet facing each other, a movable armature in the path of the main field of said magnet and between the pole faces of the magnet and controlled in its movement by said main field, a shaft for rotatably supporting said armature,

and a retarding metal element driven by said shaft and located at the side of said poles with an intervening gap and subjected to the stray field between said poles through said gap and rotated in said stray field upon movement of said armature for retarding the movement of said armature.

2. A relay comprising a magnet having a main controlling winding and having the pole faces of the magnet facing each other, a movable armature in the path of the main field of said magnet and between the pole faces of the magnet and controlled in its movement by said main field, a shaft for rotatably supporting said armature, a retarding metal element driven by said shaft and located at the side of said poles with an intervening gap and subjected to the stray field between said poles through said gap and rotated in said stray field upon movement of said armature for retarding the movement of said armature, and means for adjusting said element on said shaft for changing the retarding action of said element.

3. A relay comprising a magnet having a main controlling winding and having the pole faces of the magnet facing each other, a movable armature in the path of the main field of said magnet and between the pole faces of the magnet and controlled in its movement by said main field, a shaft for rotatably supporting said armature, and a retarding element of magnetic material driven by said shaft and located at the side of said poles with an intervening gap and subjected to the stray field between said poles through said gap and rotated in said stray field upon movement of said armature for retarding the movement of said armature.

4. A relay comprising a magnet having a main controlling winding and having the pole faces of the magnet facing each other, a movable armature in the path of the main field of said magnet and between the pole faces of the magnet and controlled in its movement by said main field, a shaft for rotatably supporting said armature, and a retarding non-magnetic element driven by said shaft and located at the side of said poles with an intervening gap and subjected to the stray field between said poles through said gap and rotated in said stray field upon movement of said armature for retarding the movement of said armature.

CHARLES C. WILSON.