

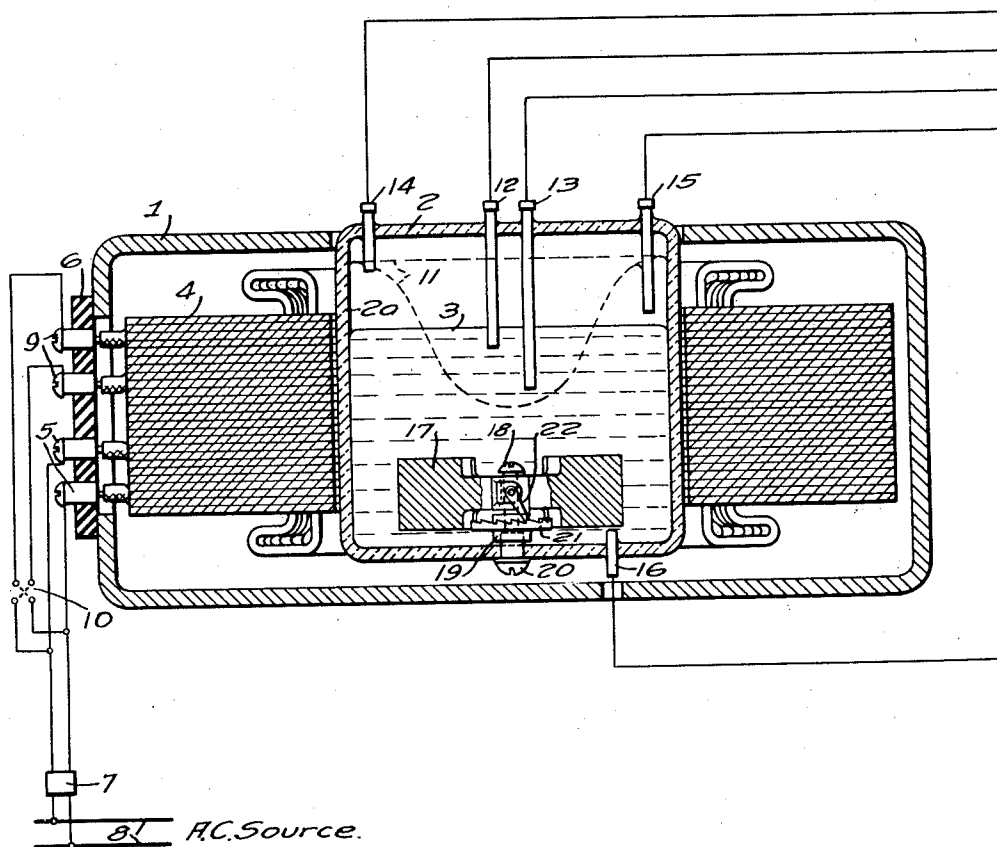
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R. C. BERGVALL

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RELAY

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WITNESSES:

E. A. McLoskey
Chas. C. Hoome

INVENTOR

Royal C. Bergvall.

BY

W. H. Saltzman
ATTORNEY

UNITED STATES PATENT OFFICE

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RELAY

Royal C. Bergvall, Wilkinsburg, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

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This invention relates to electrical contact devices and it has particular relation to time delay relays.

Most of the time delay relays heretofore available have required moving or rotating solid parts. Such parts introduce bearing problems which are objectionable as well known to the art. In some cases, a time delay is provided by means of a dashpot arrangement in which a fluid, such as air, is permitted to pass through a small opening, the rate of escape of the fluid determining the time delay. Variations in the orifice controlling the escape of fluid make the time duration in such instruments uncertain.

In accordance with my invention, a stator is provided for producing a rotating electrical field. In this field an electro-conductive fluid body, such as mercury, is positioned in a suitable container. Under the influence of the rotating field, the fluid also rotates and as it rotates its surface configuration changes under the influence of centrifugal forces. By positioning electrodes to engage and disengage the surface as it changes, a time delay for the engagement and disengagement of the electrodes is provided which is dependent upon the rate of change of the configuration of the fluid surface. A further control for the time delay may be provided by including a field reversing switch or control element for determining the direction of rotation of the electrical field. By so shaping the container for the fluid that the resistance to rotation of the fluid in one direction is different from the resistance to rotation of the fluid in the opposite direction, or by introducing an additional control element for this purpose, the time delay for one direction of rotation of the fluid will be different from the time delay for the opposite direction of rotation thereof.

Accordingly, it is an object of my invention to provide an electrical contact device which requires substantially no solid moving parts.

It is a further object of my invention to provide a time delay contact device controlled by the change in configuration of a fluid body.

It is a further object of my invention to provide a time delay device operable in either of two directions, wherein the time delays for the two directions are different.

Other objects of my invention will be apparent from the following description, taken in conjunction with the accompanying drawing, in which the single figure shows an elevational view in cross-section of a contact device embodying my invention.

Referring to the drawing, the contact device includes a housing 1 in which a container 2 is mounted in any suitable manner. The container holds a quantity 3 of any suitable electro-conductive fluid, such as mercury.

In order to control the movements of the fluid body 3, a rotating field is produced within the container 2 by any suitable means. Some of the devices suitable for this purpose include a poly-phase, split phase or shaded pole stator, such as commonly employed for induction motors. In the specific embodiment herein illustrated and described, a split phase stator 4 is employed for this purpose. The main phase winding of this stator is connected to a pair of terminals 5 which are mounted on an insulating panel 6 attached to the housing. These terminals 5 in turn are connected through a suitable control unit 7 to a source of alternating current 8. The split phase winding is connected to a second pair of terminals 9, which also are connected to the control unit 7 through a reversing switch 10.

When the control unit 7 is actuated to connect the stator 4 to the alternating-current source 8, a rotating field is set up within the container 2. Through an induction action, this rotating field causes the fluid 3 to rotate, and as the fluid rotates, its surface configuration changes under the influence of centrifugal forces to a shape 11 represented by the dotted lines on the drawing. This change in surface configuration is employed for controlling the engagement and disengagement of a plurality of break contacts 12, 13 and a plurality of make contacts 14, 15.

It will be noted that the break contacts 12, 13 are mounted adjacent the center of the fluid body and are of lengths such that they project for different distances beneath the surface of the fluid body when the fluid is at rest. As the fluid starts to rotate under the influence of the rotating electrical field, the central portion of the fluid falls until after a certain elapsed time it disengages the first break contact 12. As the fluid continues to rotate and accelerate, the central portion continues to fall until it disengages the second break contact 13.

For making desired contacts at predetermined intervals after the energization of the contact device, the make contacts 14 and 15 are positioned at different distances above the surface of the fluid when the fluid is at rest, and adjacent the periphery of the fluid. By reference to the drawing, it will be clear that as the fluid accelerates subsequent to energization of the device, the fluid first engages the contact 15 and subse-

quently engages the second make contact 14. A single contact 16 may be employed for completing a circuit for all of the make and break contacts.

The structure of the container 2 may vary considerably. Although any material may be employed which is not affected by the electro-conductive fluid, I prefer a non-conductive material, such as glass. Electrodes 12 to 16 may be mounted on this container in any suitable manner. The electrodes 12 to 15 may be passed through openings in the upper wall of the container 2 or they may be sealed to the container as well known in the art. If the container 2 is completely sealed it may be evacuated or gases may be introduced at any desired pressure for optimum circuit interruption performance. Instead of the common contact 16 being positioned at the base of the container, a contact positioned at any other position may be employed providing it maintains continuous contact with the fluid. In the position of the contact 16 illustrated, the contact would, of course, be sealed to the container 2 in order to prevent loss of fluid. The shape of the container may vary appreciably, but preferably a cylindrical container is employed having a cylindrical wall 2a. Although the container 2 may have an open upper wall for some uses, the container preferably will be substantially closed.

The direction of rotation of the fluid body 3 is dependent upon the position of the reversing switch 10. By so shaping the container 2 or by employing some additional device, the resistance offered to the rotation of the fluid may be made asymmetric relative to the two directions of rotation thereof. In the specific embodiment illustrated, a plurality of spaced vanes 17 are positioned within the fluid in the container and are mounted for rotation about a shaft 18, here represented as a machine screw. The shaft 18 may be carried on a boss 19 which is attached to the container in any suitable way, as by a machine screw 20, a suitable liquid-tight seal being maintained between the boss 19 and the container. Movement of the vanes 17 is controlled by a ratchet 21 attached to the boss 19 and a pawl 22, which is carried by the vane structure and which may be spring biased against the ratchet 21. The vanes 17 may be constructed of magnetic, conductive or non-conductive material which is not affected by the fluid 3 in accordance with the particular effects desired.

It is believed that the operation of the contact device herein described is apparent from the foregoing description. The control unit 1 may be operated by hand or it may be made responsive to any variable quantity, such as temperature, voltage, current or power, for connecting the contact device to the alternating-current source 8. When a connection has been established through the control unit 1, a rotating field is set up within the container 2 which accelerates the fluid 3. As the fluid accelerates, the surface configuration thereof gradually changes from a plane to the configuration 11 shown in dotted lines. During this gradual change in the surface configuration, the circuits between the break contacts 12 and 13 and the common contact 16 are successively broken, and the circuits between the make contacts 15 and 14 and the common contact 16 are successively established.

When the energization of the contact device is interrupted, as by opening of the contact unit 1, the make and break contacts are restored in reverse order to their initial conditions.

If the energization of the contact device is such that the fluid 3 tends to rotate in a clockwise direction, as viewed from the top, the vanes 17 offer substantially little resistance to the rotation of the fluid, and the make and break contacts are engaged or disengaged at predetermined intervals after such energization. If the position of the reversing switch 10, however, is such that the fluid 3 tends to rotate in a counter-clockwise direction, the pawl 22 tends to hold the vanes 17 stationary, and these stationary vanes resist the movement of the fluid 3. Consequently the fluid will now require a different time interval for engaging and disengaging the various make and break contacts. The position of the reversing switch 10 may be determined by hand or automatically in response to any variable quantity, such as temperature, voltage, current or power, as well known in the art.

The various contacts 12 to 16 may be connected for controlling any circuit known to the art. Various contact arrangements and different numbers of contacts may be employed as desired. Since the level of the fluid 3 depends on the degree of energization of the stator 4, by positioning a number of contacts, such as 14 and 15, at different levels in the container, the number of contacts engaged by the fluid will be a measure of the energization of the stator 4, or a measure of the magnitude of the voltage applied to the stator.

Although I have described my invention with certain specific embodiments thereof, it is obvious that numerous modifications are possible. Therefore, I do not wish my invention to be modified except as requested by the appended claims when interpreted in view of the prior art.

I claim as my invention:

1. In an electrical contact device, a container, mercury in said container, a plurality of contact elements extending into said container and insulated from each other, said contact elements being positioned to engage and disengage said mercury in accordance with the level of said mercury, and means for producing a rotating electrical field in said container for rotating the mercury contained therein, whereby said mercury under the influence of centrifugal action changes its position relative to said contact elements.

2. In an electrical contact device, a container, mercury in said container, a plurality of contact elements extending into said container and insulated from each other, said contact elements being positioned to engage and disengage said mercury in accordance with the level of said mercury, means for producing a rotating electrical field in said container for rotating the mercury contained therein in either of two directions whereby said mercury under the influence of centrifugal action changes its position relative to said contact elements, and asymmetric means for varying the rate of change in the flow of said mercury in accordance with the direction of rotation of said mercury.

ROYAL C. BERGVALL.