June 5, 1951 E. O. SCHWEITZER, JR 2,555,513

MAGNETIC TIME-DELAY MECHANISM

Filed Feb. 16, 1948

Fig. 1.

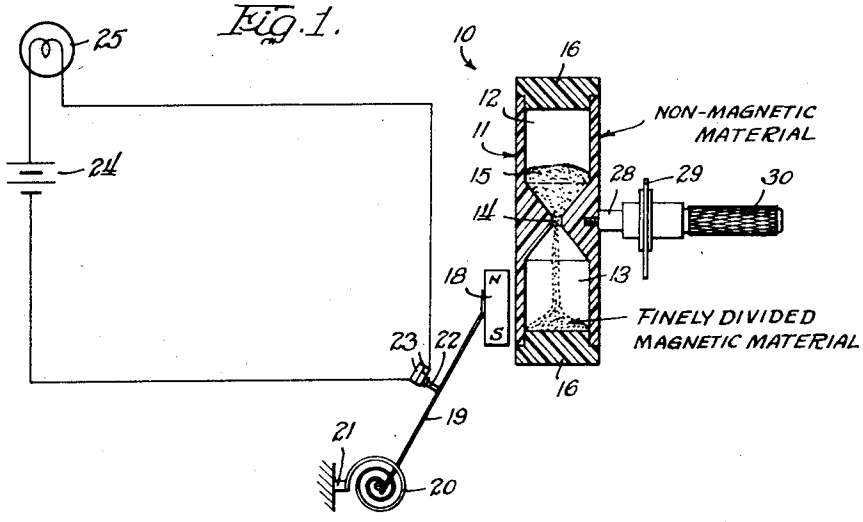


Fig. 2.

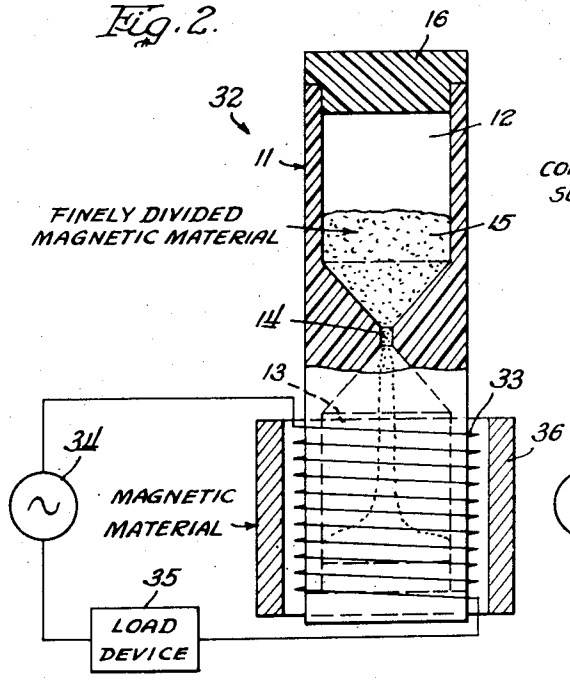
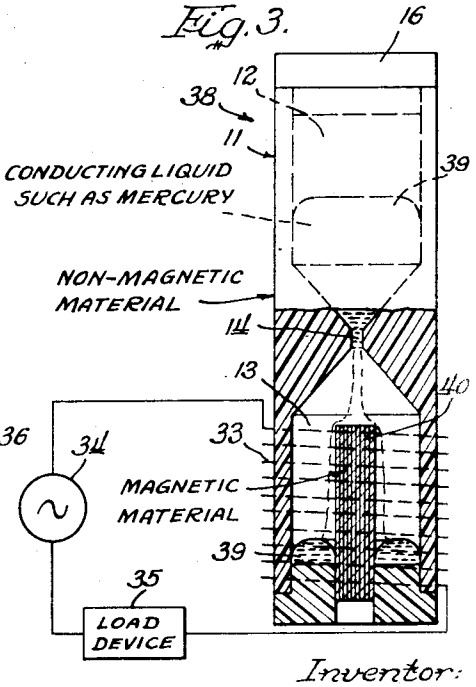


Fig. 3.



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MAGNETIC TIME-DELAY MECHANISM

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17 Claims. (Cl. 171—242)

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My invention relates, generally, to magnetic control mechanisms and it has particular relation to magnetic time delay mechanisms.

Among the objects of my invention are: To change the operating characteristics of a magnetic circuit by flow of a material from one position to another as a function of the time required for the flow to take place; to employ finely divided magnetic particles as the material which flows from one position to the other; to cause a permanent magnet to move from one position to an alternate position as a result of such flow of magnetic material; to change the reactance of a coil as a result of such flow of magnetic material; to employ an electrical conducting liquid as the material which flows from one position to the other; and to employ the electrical conducting liquid as a single turn secondary winding inductively coupled to said coil the current carrying capacity of which winding is increased as a function of the time required for the flow to take place.

Other objects of my invention will, in part, be obvious and in part appear hereinafter.

My invention is disclosed in the embodiments thereof shown in the accompanying drawing and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the constructions hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of my invention, reference can be had to the following detailed description, taken together with the accompanying drawing, in which:

Figure 1 illustrates, somewhat diagrammatically, a magnetic control mechanism embodying my invention;

Figure 2 is a view, partly in side elevation and partly in section and somewhat diagrammatic in character, illustrating another embodiment of my invention; and

Figure 3 is a view, similar to Figure 2, and showing still another embodiment of my invention.

Referring now particularly to Figure 1 of the drawing, it will be observed that the reference character 10 designates, generally, a time delay device constructed in accordance with one embodiment of my invention. The time delay device 10 includes an hourglass housing 11 that is formed of non-magnetic material such as a suitable plastic, either transparent or opaque, or brass. The housing 11 has an upper portion or upper container section 12 and a lower portion or lower container section 13 which are interconnected through a restricted aperture or constriction 14. In this embodiment of the invention a body 15 of finely divided magnetic material, such as a suitable number of small diameter steel balls, is located within the housing 11 and is arranged to flow from one portion or section 12 to the other portion or section 13 under the influence of gravity. The ends of the housing 11 may be closed by suitable plugs 16 also of non-magnetic material.

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It will be understood that opposite ends of the housing 11 may be symmetrical so that it may be turned upside down to provide the desired time delay by flow of the body 15 of finely divided magnetic material from one portion or section to the other as the case may be. However, the end portions of the housing 11 may be unsymmetrical, if desired, where the time delay function is to be performed with the housing 11 occupying one position only. For example, the upper portion 12 may be a long narrow cylinder or it may be a large diameter cylinder as compared to the size of the lower portion 13 where the time delay function is to be performed by the flow of the body 15 of finely divided magnetic material into the lower portion 13.

Movably mounted along the lower portion or lower container section 13 of the housing 11 is a permanent magnet 18 which may be carried at one end of an arm 19 that, in turn, is biased by a spiral spring 20 to move the permanent magnet 18 away from the housing 11. As shown, the spiral spring 20 may be anchored to a suitable support 21.

The movement of the arm 19 in response to movement of the magnet 18 on being attracted toward the housing 11 when the body 15 of finely divided magnetic material has flowed into the lower portion or lower container section 13 may be employed to perform any desired control function. For example, the arm 19 may carry a pin 22 which serves to maintain closed separable contacts 23 that are connected in a circuit including a battery 24 and a lamp 25.

It will be understood that the contacts 23 are held closed normally by the biasing force applied to the arm 19. Now when the lower portion or lower container section 13 of the housing 11 is filled by the body 15 of finely divided magnetic material, the permeability of the path of the flux from the magnet 18 within the housing 11 is increased. As a result the permanent magnet 18 is attracted to the body 15 of finely divided magnetic material within the lower portion or lower container section 13 of the housing 11 against the biasing force exerted by the spiral spring 20 and contacts 23 are separated. The energizing circuit for the lamp 25 is opened thereby and it is extinguished. The extinguishment of the lamp 25 takes place at the end of a time interval the length of which is determined by the time required for the body 15 of finely divided magnetic material to flow through the restricted aperture or constriction 14 into the lower portion or lower

container section 13 in an amount sufficient to cause the permanent magnet 18 to be attracted thereto as described. Obviously, the contacts 23 can be normally open contacts rather than normally closed contacts with a circuit being closed rather than opened at the expiration of a predetermined time interval. Instead of separable contacts 23, a suitable mechanical device can be operated or tripped by the movement of the arm 19 in response to change in position of the permanent magnet 18 as will be understood readily.

When it is desired to shift the housing 11 so as to cause the body 15 of finely divided magnetic material to flow from the lower portion or lower container section 13 back to the upper portion or upper container section 12, the housing 11 may be mounted to rotate about a horizontal axis that is transverse to its longitudinal axis. For this purpose the housing 11 may be secured to one end of a shaft 28 that is mounted for rotation by a support 29. Suitable friction means may be provided for holding the housing 11 in any position to which it may be rotated. The shaft 28 has a knurled handle 30 to facilitate gripping the same for rotating the housing 11 from one position to the other.

In Figure 2 of the drawing another embodiment of my time delay device is illustrated, generally, at 32. In this embodiment of my invention the housing 11 may be identical with the housing 11 shown in Figure 1 and described hereinbefore. The time delay function likewise may be effected by the flow of the body 15 of finely divided magnetic material from the upper portion or upper container section 12 through the restricted aperture or constriction 14 to the lower portion or lower container section 13.

In lieu of the permanent magnet 18, shown in Figure 1, a coil 33 surrounds the lower portion or lower container section 13 of the housing 11. The coil 33 may be connected for energization to a source 34 of alternating current, such as a 60 cycle 110 volt source. The source 34 is arranged to energize a load device 35 of any suitable character which, as shown, is connected in series circuit relation with the coil 33.

Before the body 15 of finely divided magnetic material begins to flow through the aperture 14 into the lower portion or lower container section 13 of the housing 11 as shown in Figure 2, the reactance of the coil 33 is relatively low and the current flow to the load device 35 is correspondingly high. Now, as the body 15 of finely divided magnetic material fills the lower portion or lower container section 13, the reactance of the coil 33 is increased and there is a corresponding reduction in the flow of current therethrough and to the load device 35. It will be understood that the change in flow of current through the load device 35 takes place as a function of the time required for the body 15 of finely divided magnetic material to flow into the lower portion or container section 13.

It is desirable to provide a high permeability path for the return flux of the coil 33 in order to reduce the flux concentration adjacent the restricted aperture or constriction 14. For this purpose a sleeve 36 of magnetic material may be located around the coil 33.

In Figure 3 of the drawing there is illustrated, generally, at 38 still another embodiment of my time delay device. It employs the same housing 11 as shown in Figure 1 and described hereinbefore with certain slight modifications. Instead of employing the body 15 of finely divided magnetic material to provide the desired time delay function, an electrical conducting liquid 39, such as mercury, is employed. The liquid 39 is arranged, as will be understood readily, to flow through the restricted aperture or constriction 14 from the upper portion or upper container section 12 to the lower portion or lower container section 13. In so doing the liquid 39 forms a single turn secondary winding around a core 40 of magnetic material which, as shown, is located within the lower portion or lower container section 13 of the housing 11. The liquid 39 gradually fills the space between the outside of the core 40 of magnetic material and the inner walls of the lower portion or lower container section 13. The conductivity of this single turn short circuited secondary winding is increased as the quantity of the liquid 39 increases. There is a corresponding reduction of the current flowing through the coil 33 and the load device 35 since the reactance of the coil 33 is increased as a function of the increase in current flow through the liquid 39 surrounding the core 40. Thus, the current flowing through the load device 35 is decreased as a function of the flow of the liquid 39 into the space around the core 40.

Since other embodiments of my invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawing and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. A magnetic control mechanism comprising, in combination, a pair of containers, a permanent magnetic circuit associated with one of said containers, and magnetic means arranged and adapted to flow through a restricted orifice solely under the influence of gravity to said one container from the other to vary the operating characteristics of said magnetic circuit as a function of the time required for such flow to take place.

2. A magnetic control mechanism comprising, in combination, a pair of containers, an electromagnetic circuit associated with one of said containers, and magnetic means arranged and adapted to flow solely under the influence of gravity through a restricted orifice to said one container from the other to vary the operating characteristics of said magnetic circuit as a function of the time required for such flow to take place.

3. A magnetic control mechanism comprising, in combination, a pair of containers, an electromagnetic circuit associated with one of said containers, means providing a low reluctance path around said electromagnetic circuit to limit the magnetic flux generated thereby substantially within its confines, and magnetic means arranged and adapted to flow to said one container from the other to vary the operating characteristics of said magnetic circuit.

4. A magnetic control mechanism comprising, in combination, a pair of containers, an electromagnetic circuit associated with one of said containers, and non-magnetic electrical conducting means arranged and adapted to flow through a restricted orifice to said one container from the other to vary the operating characteristics of said magnetic circuit as a function of the time required for such flow to take place.

5. A magnetic control mechanism comprising, in combination, a pair of containers, an electromagnetic circuit associated with one of said containers, a magnetic core in said one container, and liquid electrical conducting means arranged and

adapted to flow through a restricted orifice to said one container from the other and around said core to increase the reactance of said electromagnetic circuit as a function of the time required for such flow to take place.

6. A time delay mechanism comprising, in combination, upper and lower containers, a magnetic circuit associated with said lower container, and means arranged and adapted to flow through a restricted orifice from said upper container to said lower container solely under the influence of gravity to vary the operating characteristics of said magnetic circuit as a function of the time required for the flow to take place.

7. A time delay mechanism comprising, in combination, upper and lower containers, a permanent magnetic circuit associated with said lower container, and magnetic means arranged and adapted to flow solely under the influence of gravity through a restricted orifice from said upper container to said lower container to vary the operating characteristics of said magnetic circuit as a function of the time required for the flow to take place.

8. A time delay mechanism comprising, in combination, upper and lower containers, an electromagnetic circuit associated with said lower container, and magnetic means arranged and adapted to flow from said upper container to said lower container to vary the operating characteristics of said magnetic circuit as a function of the time required for the flow to take place.

9. A time delay mechanism comprising, in combination, upper and lower containers, an electromagnetic circuit associated wtih said lower container, means providing a low reluctance path around said electromagnetic circuit to limit the magnetic flux generated thereby substantially within its confines, and magnetic means arranged and adapted to flow to said lower container from said upper container to vary the operating characteristics of said magnetic circuit as a function of the time required for the flow to take place.

10. A time delay mechanism comprising, in combination, upper and lower containers, an electromagnetic circuit associated with said lower container, and non-magnetic electrical conducting means arranged and adapted to flow from said upper container to said lower container to vary the operating characteristics of said magnetic circuit as a function of the time required for the flow to take place.

11. A time delay mechanism comprising, in combination, upper and lower containers, an electromagnetic circuit associated with said lower container, a magnetic core in said lower container, and liquid electrical conducting means arranged and adapted to flow to said lower container from said upper container and around said core to increase the reactance of said electromagnetic circuit as a function of the time required for the flow to take place.

12. A time delay mechanism comprising, in combination, an hourglass housing of non-magnetic material located in an upright position, a magnetic circuit associated with the lower portion of said housing, and means arranged and adapted to flow from the upper portion of said housing to its lower portion under the influence of gravity to vary the operating characteristics of said magnetic circuit as a function of the time required for it to flow through the restricted orifice between said upper and lower portions of said housing.

13. A time delay mechanism comprising, in combination, an hourglass housing of non-magnetic material, means mounting said housing for rotation about a horizontal axis that is transverse to the longitudinal axis of said housing, a permanent magnet movably mounted adjacent the portion of said housing that occupies the lowermost position, means biasing said permanent magnet away from said housing, and magnetic means within said housing arranged and adapted to flow from its upper portion to its lower portion to provide a low permeability path for the flux of said permanent magnet whereupon the same is attracted thereto against the force of said biasing means a predetermined time after said magnetic means starts to flow, and means responsive to the movement of said permanent magnet from one position to the other.

14. The invention, as set forth in claim 13, wherein the means responsive to the movement of the permanent magnet is separable contact means.

15. A magnetic control system comprising, in combination, an hourglass housing of non-magnetic material located in an upright position, a coil surrounding the lower portion of said housing and adapted to be energized from an alternating current source through a load device, and magnetic means within said housing arranged and adapted to flow from its upper portion to said lower portion to increase the permeability of the flux path within said coil and thereby its reactance as a function of the time required for the flow to take place whereby the current flow through said load device is reduced correspondingly.

16. The invention, as set forth in claim 15, wherein a tubular member of magnetic material surrounds the coil to provide a high permeability path for its return flux and reduce the magnetic flux at the constriction between the upper and lower portions of the housing.

17. A magnetic control system comprising, in combination, an hourglass housing of non-magnetic material located in an upright position, a coil surrounding the lower portion of said housing and adapted to be energized from an alternating current source through a load device, a core of magnetic material within said lower portion of said housing and spaced from its inner wall, and a body of electrically conducting liquid within said housing arranged and adapted to flow from its upper portion to the space around said core in said lower portion to provide a single turn short circuited secondary winding inductively coupled to said coil whose current carrying capacity is increased as a function of the time required for the flow to take place whereby the current flow through said load device is reduced correspondingly.

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