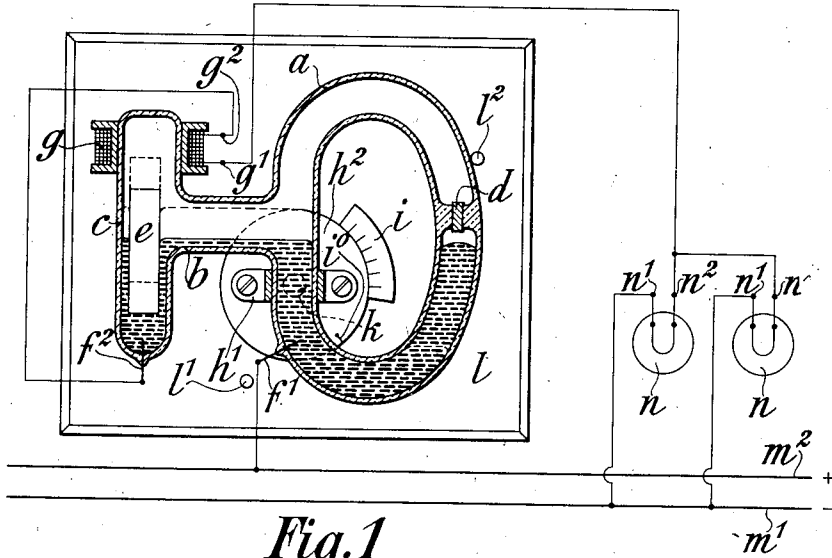
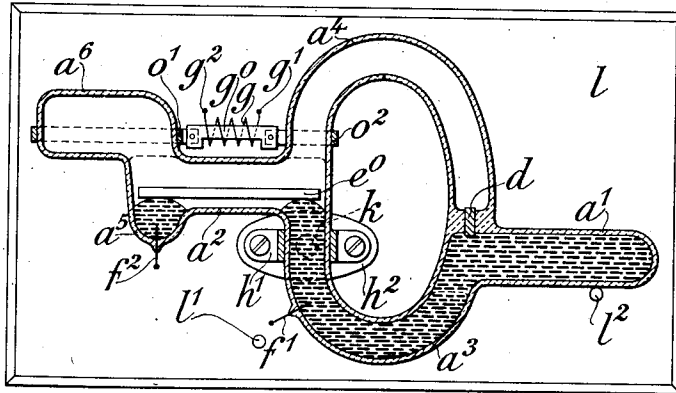
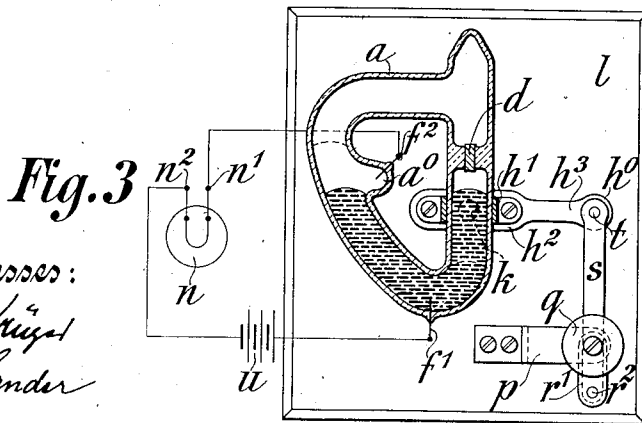


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TIMING DEVICE.
APPLICATION FILED MAR. 8, 1913.

1,094,440.

Patented Apr. 28, 1914.



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1,094,440.

Specification of Letters Patent. Patented Apr. 28, 1914.

Application filed March 8, 1913. Serial No. 753,113.

To all whom it may concern:

Be it known that I, HENRY STAFFORD HATFIELD, a citizen of Great Britain, residing at Brunswick, Germany, have invented a new and useful Timing Device, of which the following is a specification.

The present invention relates to timing devices, which are intended either to keep an electric circuit, which is normally open, closed for a certain period or to keep a circuit, which is normally closed, open for a certain period, the commencement of this period being determined, by a joint rotatory motion of two tubes, which communicate with each other and contain a conducting fluid, bringing about a difference of height between the two levels of this fluid, and the duration of the said period being determined in such a manner that, on the raised level sinking, the other level goes on forcing a non-conducting fluid through a system of narrow openings, until the said difference of height is equalized. Such a device is *e. g.* applicable to an arrangement, in which electric lamps are to be kept in circuit for only a certain period, or where a current limiter, which, on a certain current strength in a circuit being exceeded, breaks the said circuit, is to be rendered ineffective for a certain period by being short-circuited. The system of narrow openings, through which the non-conducting fluid is forced, can, *e. g.*, be formed by a porous plug (say a plug of retort-carbon or clay); the whole system can also consist of a single opening, *e. g.* of a capillary tube. The non-conducting fluid can be either liquid or gaseous. In such well-known devices of this type as are described *e. g.* in the German patent specification 202634, that quantity of non-conducting fluid, the flowing of which through the narrow openings secures the observation of the required period, already lies, before the said rotatory motion is effected, between that level of the conducting fluid, which is adjacent to the narrow openings, and these openings themselves. The device is therefore operated by means of a simple rotatory motion of the communicating tubes. Hence, on the device being put into operation, no displacement of the conducting fluid with regard to the tubes takes place in opposition to the direction, in which this fluid afterward moves, when forcing out the non-conducting fluid. Therefore by means of the

conducting fluid the circuit can be made or broken only once, just because for this purpose only that motion of the fluid is available, which results from the forcing out of the non-conducting fluid. When, therefore, with the aid of such a device a normally open circuit is to be kept closed for a certain period, only the circuit-breaking required at the end of this period can be brought about by means of the sinking of the fluid-level, consequently by employing contacts within the tubes, the cutting in of the current, on the other hand, must be effected, when operating the device, by means of contacts lying outside the tubes. Inversely, on keeping a normally closed circuit open for a certain period, only the requisite making of the circuit can be effected by means of contacts lying within the tubes, while for the initial breaking of the circuit external contacts are necessary.

In the new device the conducting fluid is, before the device is put into operation, in the same position with regard to the tubes as after the termination of the period controlled by the device. The device is operated by a rotatory motion, which consists of two oppositely directed, equally great partial rotatory motions, the quantity of fluid, which is to be forced out, only reaching its place on the first partial rotatory motion being made, by flowing across from the level of the conducting fluid to be raised, to the other one. Consequently for the making and breaking of the particular circuit two motions of the conducting fluid relatively to the tubes are available, the first one of which (which may take place rapidly) serves for doing away with the normal state of connection, while this state is restored at the end of the second one (which takes place slowly). Both alterations in the state of connection can be carried out by the means just described without contacts lying outside the tubes.

When the conducting fluid of the new timing device is intended to form, at the commencement of the flowing of the non-conducting fluid through the narrow openings, a conducting connection between two contacts, which connection is opened after the passage of the said fluid by the sinking of the raised level, it will be found convenient to so dispose the contacts that the connection between them is only effected after the com-

pletion of the two partial rotatory motions. This will prevent the possibility of the circuit, which is to be closed only for a certain period, being switched in for an unlimited time, which might occur, if only the first partial rotatory motion were carried out.

The new device further permits of a graduation of the period controlled by the device, without the tubes themselves having to be altered in any way. For since the quantity of the non-conducting fluid flowing from one level to the other is the greater, the greater the two partial rotatory motions, the duration of the said period can be influenced by a variation in the amount of the partial rotatory motions.

In the annexed drawing: Figure 1 shows a form of the timing device according to the present invention, which is suitable for making a current limiter inoperative for a certain period, the current limiter and the timing device forming a single piece of apparatus. Fig. 2 shows a second form of such an arrangement. Fig. 3 shows a third form of the new timing device, suitable for closing a circuit for a certain period.

In Fig. 1 a glass tube *a* closed upon itself and forming approximately an ellipse has fused to one of its sides a glass tube *b*, which communicates with a glass tube *c* perpendicular to *b*. Opposite the junction of the tubes *a* and *b* the tube *a* is closed with the exception of an opening, into which a plug *d* of retort-carbon fits tightly. The lower part of each of the tubes *a*, *b* and *c* is filled, when the device is in the state shown in the drawing, with mercury, the remaining part of the hermetically sealed glass body containing hydrogen gas. In the mercury contained in the tube *c* there floats an iron core *e*. A contact *f*¹ is fused into the bottom part of the tube *a* and a contact *f*² into the bottom of the tube *c*. A coil *g*, the terminals of which are marked *g*¹ and *g*², surrounds the upper part of the tube *c*. The glass body is fixed by means of a holder *h*¹ on a plate *h*², which is fitted with an index *i*⁰. The plate *h*² is journaled rotatably on a pivot *k*, which is fitted to a base-plate *l* to be disposed vertically. This base-plate further bears a scale *i* and two stops *l*¹ and *l*².

In order to illustrate the mode of operation of the device there are indicated in the drawing the two mains *m*¹ and *m*² of a continuous current supply and two incandescent lamps *n*, each with its terminals *n*¹ and *n*². The lamps are connected each by its terminal *n*¹ with the main *m*¹ and by its terminal *n*² with the terminal *g*¹ of the coil *g*. The contact *f*² is connected with the terminal *g*² and the contact *f*¹ with the main *m*². When, with the device in the condition shown in the drawing, the strength of the current flowing through the lamps exceeds a certain amount, the coil *g* draws the iron core *e* into

itself, so that the mercury leaves the tube *b* and by this means the connection between the contacts *f*¹ and *f*² is broken. On a reduction in the strength of the current, *e. g.* the cutting out of a lamp, makes it possible to render the current limiter inoperative and thereby to restore the connection between the contacts *f*¹ and *f*². When for a certain period the current limiter is to be inoperative at any strength of current, first of all the glass body must be given a counter clockwise rotatory motion. During such rotation a certain quantity of hydrogen gets past the mercury into the part of the tube *a* lying below the carbon plug *d*. On the glass body being rotated back again this quantity of hydrogen is imprisoned between the level of the mercury contained in the right-hand part of the tube *a* and the carbon plug. The level of the mercury in the tube *b* and that of the mercury in the right-hand part of the tube *a* thereupon assume the positions shown in dotted lines. When the coil *g* now draws in the core *e*, on the current reaching a certain strength, the mercury-level in the tube *b* will nevertheless not sink low enough for the connection between the contacts *f*¹ and *f*² to be interrupted. Through the over-pressure acting in consequence of the difference in height of the two mercury-levels on the hydrogen imprisoned between the right-hand mercury-level and the carbon plug, the hydrogen is gradually forced through the pores of the carbon plug, so that the mercury-level in the right-hand part of the tube *a* rises more and more, while that in the tube *b* sinks by degrees. When the mercury-level in the tube *b* has sunk again nearly to its former position, the current limiter is again capable of cutting out the lamps at a certain current-strength. The duration of the period, for which the current limiter is made inoperative, depends on the angle, through which the glass body is tilted, as with the size of this angle the quantity of hydrogen passing from one mercury-level to the other increases. When the scale *i* is correspondingly graduated, the duration of the said period may be directly read off on the said scale. The stop *l*¹ prevents a too great rotatory motion of the glass body and the stop *l*² facilitates the finding again of the normal position.

In the second example, Fig. 2, two glass tubes *a*¹ and *a*² are disposed with a slight relative difference in height and are connected above and below by two U-shaped glass tubes *a*³ and *a*⁴. The tube *a*⁴ is closed, where it communicates with the tube *a*¹, with the exception of an opening, into which a plug *d* made of retort-carbon is tightly fitted. At its left-hand end the tube *a*² is provided at the bottom with a small cup *a*⁵ and at the top with a pocket *a*⁶. Into the tube *a*² there is fused a contact *f*¹ and into

the cup a^5 a contact f^2 . An electromagnetic body g^0 surrounded by a coil g is fixed to the glass body by means of two clamps o^1 and o^2 . The terminals of the coil are marked g^1 and g^2 . The glass body is fixed by means of a holder h^1 on a plate h^2 ; this plate is rotatably journaled on a pivot k fitted to a base-plate l , which is to be disposed vertically and is provided with two stops l^1 and l^2 . The tubes a^1 and a^3 as well as the cup a^5 are filled, when the device is in the state shown in the drawing, with mercury, the remainder of the hermetically sealed glass body contains hydrogen gas. A small iron bar e^0 lies on the mercury menisci projecting above the tube a^3 and the cup a^5 . The left-hand part of the apparatus again represents a current limiter, the small iron bar e^0 being lifted (the apparatus being suitably connected up, *e. g.* corresponding to the arrangement in Fig. 1), on the electro-magnet g^0 being excited to a certain extent, from off the mercury menisci and the connection between the two mercury menisci being thus interrupted. When the current limiter is to be made inoperative for a certain period, the glass body must be brought from the position shown in the drawing, where it touches the stop l^2 , by a rotatory motion in the counterclockwise direction to lie against the stop l^1 . During this rotation mercury flows out of the tubes a^1 and a^3 through the tube a^2 into the pocket a^4 , while hydrogen enters the tube a^1 . On the glass body being rotated back into the position shown in the drawing, the mercury, which had entered the pocket a^4 , returns into the tube a^2 only after the completion of the two partial rotatory motions necessary for operating the device, a certain amount of hydrogen is imprisoned in the tube a^1 and a mercury connection is established between the contacts f^1 and f^2 , the two mercury levels taking up the positions shown in dotted lines. The current limiter is by this means again inoperative, until the hydrogen inclosed in the tube a^1 has been forced out and the mercury has left the tube a^2 .

For operating the device shown in Fig. 3 special gear is made use of, which arrangement is generally speaking of advantage, when the timing device is to be fitted with a device, which counts, how often the timing device has been operated, or with a device, which permits of the timing device being used only after a coin has been placed in the apparatus. A glass tube a closed upon itself, approximately straight as to its right-hand part and curved as to its left-hand part, is closed in its right-hand part, about half way up this part, with the exception of an opening, into which a plug d of retort-carbon is tightly fitted. Into the bottom of the tube a a contact f^1 is fused and into a pocket a^0 of its left-hand part a contact f^2 .

The hermetically sealed glass body is filled, when the device is in the state shown in the drawing, as to its lower part with mercury and for the rest with hydrogen gas and is fixed by means of a holder h^1 on a plate h^2 . This plate, which has an extension h^3 with an eye h^0 at its outer end, is rotatably journaled on a pivot k , which is fitted to a base-plate l , which latter is to be vertically disposed. In a bearing body p , likewise fitted to the base-plate l , a button q is rotatably journaled, on the shaft of which a crank r^1 is fixed. The crank-pin r^2 is connected by means of a link s with a pivot t fitted to the eye h^0 . For the purpose of illustrating the mode of operation of the device there are indicated in the drawing a battery u and an incandescent lamp n , the terminals of which are marked n^1 and n^2 . The terminal n^1 is connected with the contact f^2 , and the terminal n^2 is connected with one pole of the battery, the other pole of which is connected with the contact f^1 . With the device in the state shown in the drawing the lamp is not switched in. When this lamp is to be put in circuit for a certain period, the button q must be turned around once. During this turning of the button the glass body will be caused to first of all perform a rotatory motion in the counterclockwise direction, a certain amount of hydrogen gas passing into the part of the glass tube a lying below the carbon plug; the glass body thereupon reverses the sense of rotation and returns on the completion of the turning of the button into the position shown in the drawing, the amount of hydrogen gas, which has passed below the carbon plug becoming imprisoned between the right-hand mercury-level and the carbon plug and the two mercury-levels assuming the positions indicated by dotted lines. Between the contacts f^1 and f^2 a conducting connection is thus established, so that the lamp is in circuit. Through the difference in height, existing between the two mercury-levels, the imprisoned amount of hydrogen will be gradually forced through the pores of the carbon plug, so that the mercury-levels will slowly return into the positions shown, the lamp being again cut out, when the left-hand mercury-level has left the contact f^2 .

I claim:

1. A timing device comprising a tube closed on itself, a conducting fluid filling a part of the tube, a non-conducting fluid of a lesser specific gravity than the conducting fluid filling the remainder of the tube, the said conducting fluid forming two separate upper surfaces, means adapted to rotate the said tube through a certain angle and back again for each setting of the said device, which angle is sufficiently great to allow a portion of the non-conducting fluid to flow past the conducting fluid from one of the

upper surfaces of the latter to the other, two contacts within the said tube, which contacts are adapted to be connected by the said conducting fluid, and a restricted place in the bore of the said tube, which is formed by a system of fine openings adapted to form a passage for the non-conducting fluid.

2. A timing device comprising a tube closed on itself, a conducting fluid filling a part of the tube, a non-conducting fluid of a lesser specific gravity than the conducting fluid filling the remainder of the tube, the said conducting fluid forming two separate upper surfaces, means adapted to rotate the said tube through a certain angle and back again for each setting of the said device, which angle is sufficiently great to allow a portion of the non-conducting fluid to flow past the conducting fluid from one of the upper surfaces of the latter to the other, two contacts within the said tube, which contacts are adapted to be connected by the said conducting fluid, a restricted place in the bore of the said tube, which is formed by a system of fine openings adapted to form a passage for the non-conducting fluid, and part of the said tube being formed as a pocket adapted to receive a portion of the conducting fluid on the tube being rotated and to retain the same until the completion of the said rotation.

3. A timing device comprising a tube closed on itself, a conducting fluid filling a part of the tube, a non-conducting fluid of a lesser specific gravity than the conducting fluid filling the remainder of the tube, the said conducting fluid forming two separate upper surfaces, means adapted to rotate the said tube through an adjustable angle and back again for each setting of the said device, which angle is sufficiently great to allow a portion of the non-conducting fluid to flow past the conducting fluid from one of the upper surfaces of the latter to the other, two contacts within the said tube, which contacts are adapted to be connected by the said conducting fluid, and a restricted place in the bore of the said tube, which is formed

by a system of fine openings adapted to form a passage for the non-conducting fluid.

4. A timing device comprising a tube closed on itself, a conducting fluid filling a part of the tube, a non-conducting fluid of a lesser specific gravity than the conducting fluid filling the remainder of the tube, the said conducting fluid forming two separate upper surfaces, means adapted to rotate the said tube through a certain angle and back again for each setting of the said device, which angle is sufficiently great to allow a portion of the non-conducting fluid to flow past the conducting fluid from one of the upper surfaces of the latter to the other, two contacts within the said tube, which contacts are those of a current limiter and are adapted to be connected by the said conducting fluid, and a restricted place in the bore of the said tube, which is formed by a system of fine openings adapted to form a passage for the non-conducting fluid.

5. A timing device comprising a tube closed on itself and rotatable about a fixed pivot, a conducting fluid filling a part of the tube, a non-conducting fluid of a lesser specific gravity than the conducting fluid filling the remainder of the tube, the said conducting fluid forming two separate upper surfaces, crank-gearing adapted to rotate the said tube through a certain angle and back again for each setting of the said device, which angle is sufficiently great to allow a portion of the non-conducting fluid to flow past the conducting fluid from one of the upper surfaces of the latter to the other, two contacts within the said tube, which contacts are adapted to be connected by the said conducting fluid, and a restricted place in the bore of the said tube, which is formed by a system of fine openings adapted to form a passage for the non-conducting fluid.

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