No. 822,325. PATENTED JUNE 5, 1906.

K. TORNBERG.

CONTACT DEVICE.

APPLICATION FILED NOV. 3, 1904.

Fig. 1.

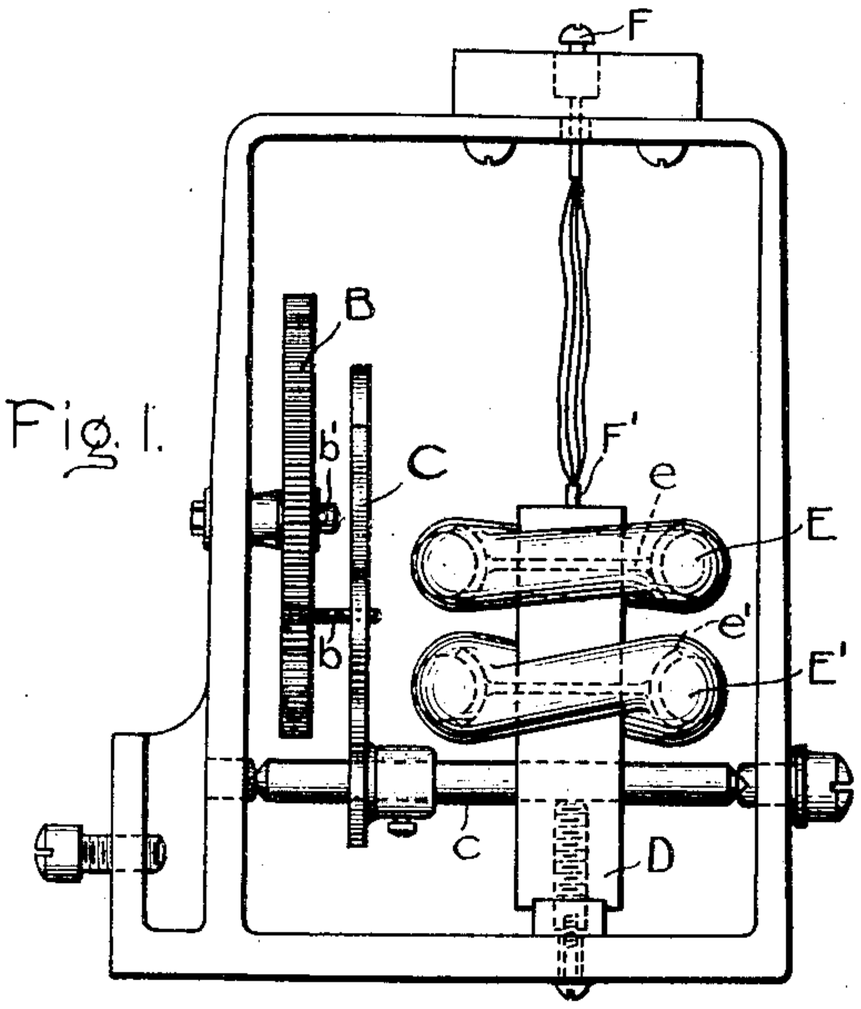


Fig. 2.

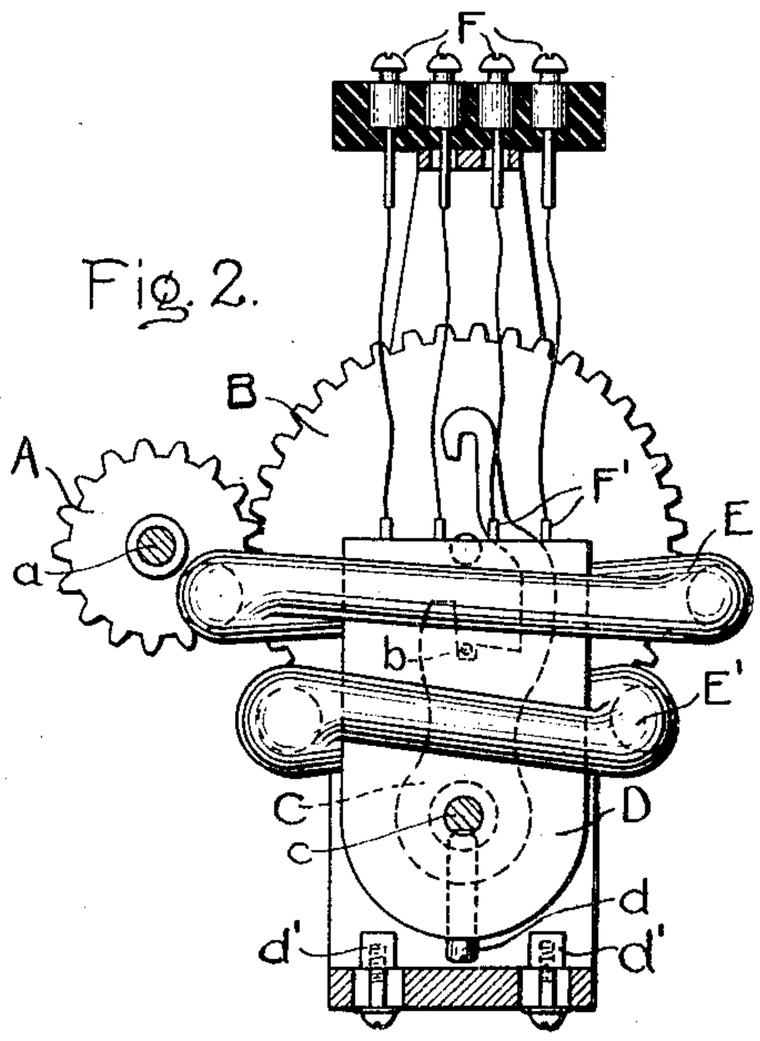


Fig. 3.

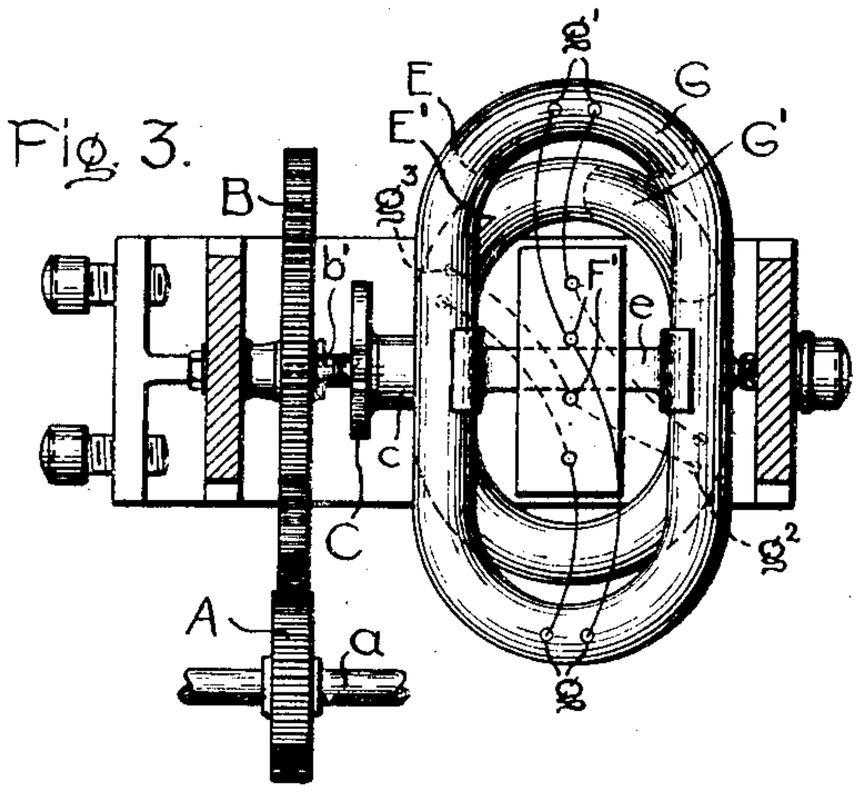


Fig. 4

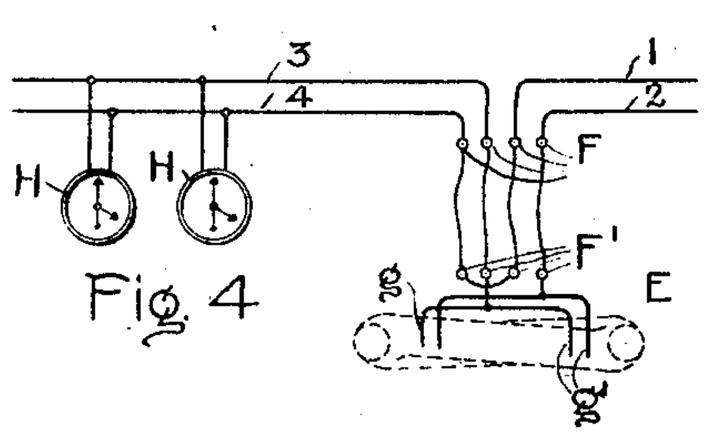
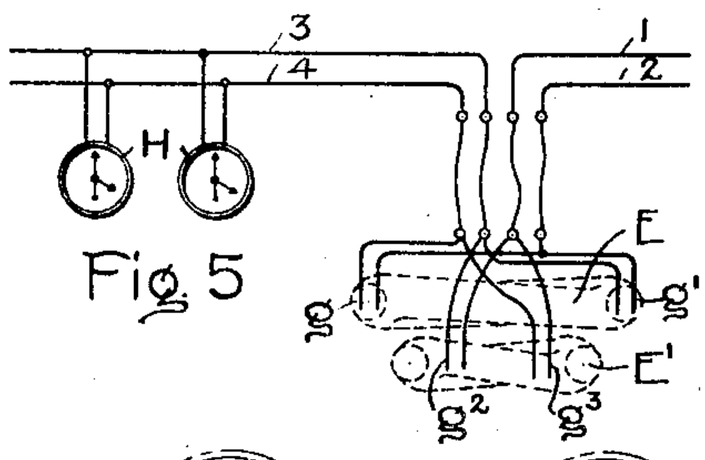
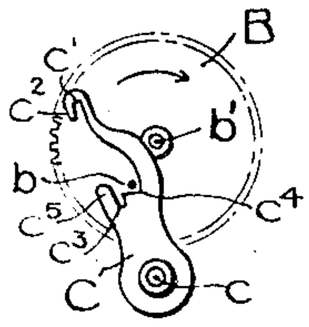
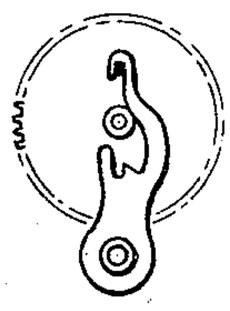
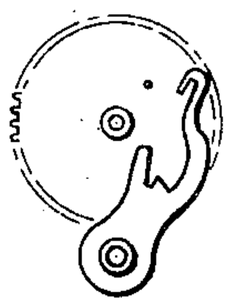


Fig. 5









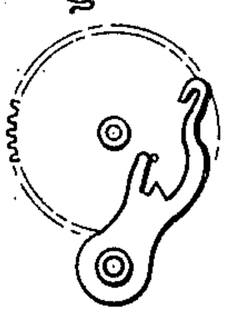


Fig. 6. Fig. 7. Fig. 8. Fig. 9. Fig. 10.

Witnesses.
Jonathan E. Briggs.
Helen Oxford

Inventor:
Knut Tornberg.
by Albert G. Davis
Att'y.

UNITED STATES PATENT OFFICE.

KNUT TORNBERG, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CONTACT DEVICE.

No. 822,325. Specification of Letters Patent. Patented June 5, 1906.

Application filed November 3, 1904. Serial No. 231,201.

To all whom it may concern:

Be it known that I, KNUT TORNBERG, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Contact Devices, of which the following is a specification.

My invention relates to contact-making devices for electric circuits, and is particularly adapted for use with electrically-controlled clocks or other synchronous devices or in apparatus the circuit of which is to be made and broken at predetermined times.

The object of my invention is to provide a device which is simple in construction, positive and reliable, and with a minimum friction in operation. An exceedingly simple and practically frictionless contact-making device consists of a closed tube with a globule of mercury contained therein. I have found experimentally, however, that with the ordinary construction, in which a globule of mercury is caused to move back and forth in a closed tube, the mercury eventually becomes sluggish and adheres to the sides of the tube. I have also discovered that if the mercury instead of being caused to reciprocate in a tube is caused to travel continuously around an endless tube there is not the same tendency to become sluggish and to adhere.

One feature of my invention consists in providing an endless closed tube which when reciprocated causes a globule of mercury contained therein to circulate around the tube. I accomplish this by providing a novel form of bent or twisted tube, as will be hereinafter described. In order to obtain a positive and reliable action of the contact-maker at the instant when its operation is required, it is essential that a quick movement should be given to the tube at that instant.

Another feature of my invention consists in so arranging the connection between the driving means and the tube that with a steady or intermittent movement of the driving means a quick and certain movement is imparted to the tube at predetermined intervals. More specifically considered, this feature of my invention consists in the combination, with a rotating member, of a cam-shaped member adapted to be engaged and moved by the rotating member and to be released at predetermined intervals, so as to permit its sudden movement under the influence of gravity or other suitable force.

Other features of my invention will appear from the following specification and will be more specifically pointed out in the appended claims.

My invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows a side elevation of a contact device arranged in accordance with my invention. Fig. 2 shows an end elevation of the same. Fig. 3 shows a plan view. Figs. 4 and 5 are diagrams showing the circuit connections; and Figs. 6 to 10, inclusive, are diagrams showing the connection between the driving means and the tube-carrying member.

In the drawings, A represents a pinion mounted on the shaft *a*, which is driven from the master-clock or other prime mover with which the controlled devices are to be synchronized.

B represents a gear mounted on the shaft *b'* and engaging the pinion A. I have shown the gear B of twice the diameter of the pinion A, so that one revolution of the pinion produces half a revolution of the gear. The gear B carries a pin *b*, (shown in Figs. 1 and 2,) which is adapted to engage a forked cam C, which is mounted on the shaft *c*. By the engagement between the pin *b* and the cam C the rotation of gear B produces a reciprocating movement of the cam, as will be hereinafter explained. Thus it will be seen that each revolution of the pinion A tips the cam C in one direction, and the following revolution tips it back to its original position. Also mounted rigidly on the shaft *c* is the member D, which is provided with a projection *d*, as shown in Fig. 2, adapted to engage either of the stops *d'*, so as to limit the movement of shaft *c*. The member D carries the contact-tubes E E', which are secured to the member D by the arms or clamps *e e'*, respectively. The member D also carries at its upper end the contacts F', which are connected by flexible leads with the stationary contacts F, mounted at the top of the casing. The contacts F' are connected to terminals *g g'* in tube E and g^2 g^3 in tube E'. These connections are clearly shown in Fig. 3. As will be seen from the drawings, the tubes E and E' are oblong-shaped continuous closed tubes.

The ends of these tubes are bent, as shown in Fig. 1, so that the sides of the tube cross each other at an angle. Each tube contains a globule of mercury, as is indicated by G G′ in Fig. 3.

The operation of the tubes will be explained by reference to Fig. 4. In this figure 1 2 represent leads from a source of current, and 3 4 represent leads to the electrically-controlled clocks or other devices H. Assume that the globule of mercury is at the right-hand end of the front side of the tube. It is then in contact with neither of the contacts g or g', since the latter contacts are placed in the back side of the tube, while the former are at the left-hand end of the front side, as is shown in Fig. 3. As long as the tube remains in the position shown the mercury has no tendency to move and the circuit of the devices H will remain open. If the right-hand end of the tube is gradually raised until the front side of the tube passes the horizontal position, the mercury will move toward the left through the front side of the tube, momentarily engaging the contacts g and closing the circuit of the devices H and then passing down the steeper incline at the left-hand end of the tube and breaking the circuit. When the tube is tipped in the other direction, the mercury will pass back along the back side of the tube, making a momentary engagement with the contact g' and returning to its original position. Thus when the tube is reciprocated in either direction the circuit of the devices H is momentarily closed.

In the drawings I have shown two tubes, one arranged with a greater bend than the other, so that its sides have a greater inclination to the horizontal. The purpose of this is to obtain a reversal of current in the controlled devices, since some electrically-controlled clocks and similar mechanisms are so arranged that such reversal is required. The connection of circuits is shown diagrammatically in Fig. 5. Assuming the mercury in both tubes to be at the right-hand front end of both tubes, the mercury in tube E will connect the contacts g', which are placed at the end of the tube, while the mercury in tube E′ will not connect the contacts g^3, which are placed in the back side of the tube. The position of the mercury in the two tubes is clearly shown in Fig. 3. Now if the right-hand ends of both tubes are slowly raised the front side of the tube E will pass the horizontal position before the front side of the tube E′, since the sides of the former tube have a smaller slope. The mercury in tube E will consequently move to the left-hand end of the tube connecting the contacts g. The circuit of the devices H is still open, however, since the mercury still remains at the right-hand end of the front side of tube E′. When the tubes have been tipped a little farther, however, the front side of tube E′ will pass the horizontal, and the mercury contained therein will move toward the left, momentarily connecting the contacts g^2. The circuit will then be momentarily closed, as follows: from lead 1 through contacts g^2, lead 3, devices H, lead 4, contacts g, lead 2. The circuit is instantly broken, however, by the mercury in tube E′ passing down the steep incline at the end of the tube and leaving contacts g^2. When the tubes are tipped in the opposite direction, the mercury in tube E will first move toward the right along the back side of the tube, reaching the right-hand end of the tube and connecting contacts g'. Later the mercury in tube E′ will follow, momentarily connecting contacts g^3. A circuit will then be momentarily closed from lead 1 through the contact g^3, lead 4, devices H, lead 3, contact g', lead 2. Thus it is seen that this time the current will pass through the devices H in the opposite direction from that in which it passed when the circuit was closed the first time.

In order to obtain a positive and reliable action of the contacts, I so arrange the connection between the driving means and the tubes that the tubes are given a sudden quick movement at the instant when the mercury should move in the tube E′. This connection consists of the pin b, mounted on the gear B, and the forked cam C. The operation of this connection will be clear from an inspection of Figs. 6 to 10. The cam C is provided with two opposite notches c' and c^3, which are formed by the extensions c^2 and c^5, respectively. The right-hand side of notch c^3 is formed by the shoulder c^4, as shown. In Fig. 6 the cam is shown in one extreme limit of its movement, in which stop d of Fig. 2 is in engagement with one of the stops d'. The gear B is supposed to be moving clockwise, as indicated by the arrow. With the gear B in the position shown no movement of cam C is produced while the gear is turning through a certain arc. When the pin b engages the cam C, as indicated in Fig. 7, the cam is slowly moved toward the right, the pin b finally entering the notch c' at the upper end of the cam. This is shown in Fig. 8, which shows the position of the cam when the tubes are substantially horizontal. As the gear B moves onward, pushing cam C to the right, the center of gravity of the tubes and their support is shifted to the right-hand side of the supporting-shaft c, so that the cam C tends to move to the right independently of the gear B. It is prevented from so moving, however, by the extension c^2 at the upper end of cam C until a sufficient inclination of the tubes has been produced to cause the mercury to move in the tube having the lesser slope, as has been heretofore explained. After this movement has occured in the first tube, as the instant is reached at which con-

tact is required, the pin *b* passes from under the extension c^2 and releases the cam C, so as to allow it to move suddenly to its extreme position, as shown in Fig. 9. By this sudden movement of the cam a positive and reliable movement of the mercury in the second tube is obtained. The cam remains in the position shown in Fig 9 until the pin *b* engages the extension c^5, as shown in Fig 10. The cam is then moved toward the left, the pin *b* passing down into the notch c^3. The pin remains in this notch until the center of gravity of the tubes has been moved to the opposite side of the shaft and the mercury has moved in the first tube. The pin remains in the notch in engagement with the shoulder c^4 until the proper instant is reached for the movement of the mercury in the second tube. At this instant the upward movement of the pin *b* releases the shoulder c^4 and allows the cam to move to the position shown in Fig. 6.

It will be seen that by properly arranging the contacts in the tube the length of time during which the circuit is closed may be adjusted as desired. Furthermore, if the driving member has an intermittent motion, as when driven by the escapement mechanism of a clock, instead of a continuous motion, the contact may be so arranged that the intervals of rest occur when the circuit is closed or opened, as desired.

Many changes may be made in the construction and relative arrangement of the parts of the device, and consequently I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a contact device, an endless closed tube having opposite portions bent so that its sides cross at an angle to each other, contacts mounted within said tube, mercury contained within said tube, and means for rocking said tube.

2. In a contact device, an endless closed tube, contacts mounted within said tube, mercury contained within said tube, and mechanism for rocking said tube with a reciprocating motion, said tube being shaped to cause the mercury to circulate through the tube always in the same direction when the tube is rocked.

3. In a contact device, two endless closed tubes, mercury contained in each tube, contacts arranged in one tube to be engaged by the mercury when the tube has been rocked, contacts arranged in the other tube to be engaged momentarily by the mercury while the tube is being rocked, and means for simultaneously rocking both tubes.

4. In a contact device, two endless closed tubes each having opposite portions bent so that the sides of each tube cross at an angle to each other, the sides of one tube crossing at greater angle than those of the other, contacts mounted in each tube, mercury contained within each tube, and means for simultaneously rocking said tubes.

5. In a contact device, a closed tube, contacts mounted therein, mercury contained within said tube, driving means, connections between said means and said tube whereby said tube is gradually rocked by said driving means and then released, and means for producing a quick movement of said tube when released.

6. In a contact device, a closed tube, contacts mounted therein, mercury contained within said tube, means for rocking said tube, and connections between said rocking means and said tube whereby a gradual and then a sudden movement of said tube is produced.

7. In a contact device, a pivotally-mounted closed tube, contacts mounted therein, mercury contained within said tube, means for rocking the center of gravity of said tube to either side of its support, and means for releasing said tube to permit its continued movement by gravity.

8. In a contact device, an endless closed tube having opposite portions bent so that its sides cross at an angle to each other, contacts mounted within said tube, mercury contained within said tube, means for rocking said tube, and connections between said rocking means and said tube whereby each side alternately is gradually brought to a substantially horizontal position and then is moved quickly through said position.

9. In a contact device, an endless closed tube, contacts mounted therein, mercury contained in said tube, a rotating member, a pin carried thereby, a member rigidly secured to said tube and adapted to be engaged and rocked by said pin, said member being arranged to be released by said pin on reaching a predetermined position, and means for producing a quick movement of said member when released.

10. In a contact device, a pivotally-mounted closed tube arranged with its center of gravity above its point of support, contacts in said tube, mercury contained in said tube, a rotating member, a pin carried thereby, and a notched cam secured to said tube and adapted to be engaged, rocked and released by said pin.

In witness whereof I have hereunto set my hand this 29th day of October, 1904.

KNUT TORNBERG.

Witnesses:

JOHN A. MCMANUS, JR.,

DUGALD MCK. MCKILLOP