Aug. 20, 1935. C. V. BATES 2,012,153

MEANS FOR OPENING AND CLOSING CIRCUITS

Filed Oct. 12, 1932

Fig. 1

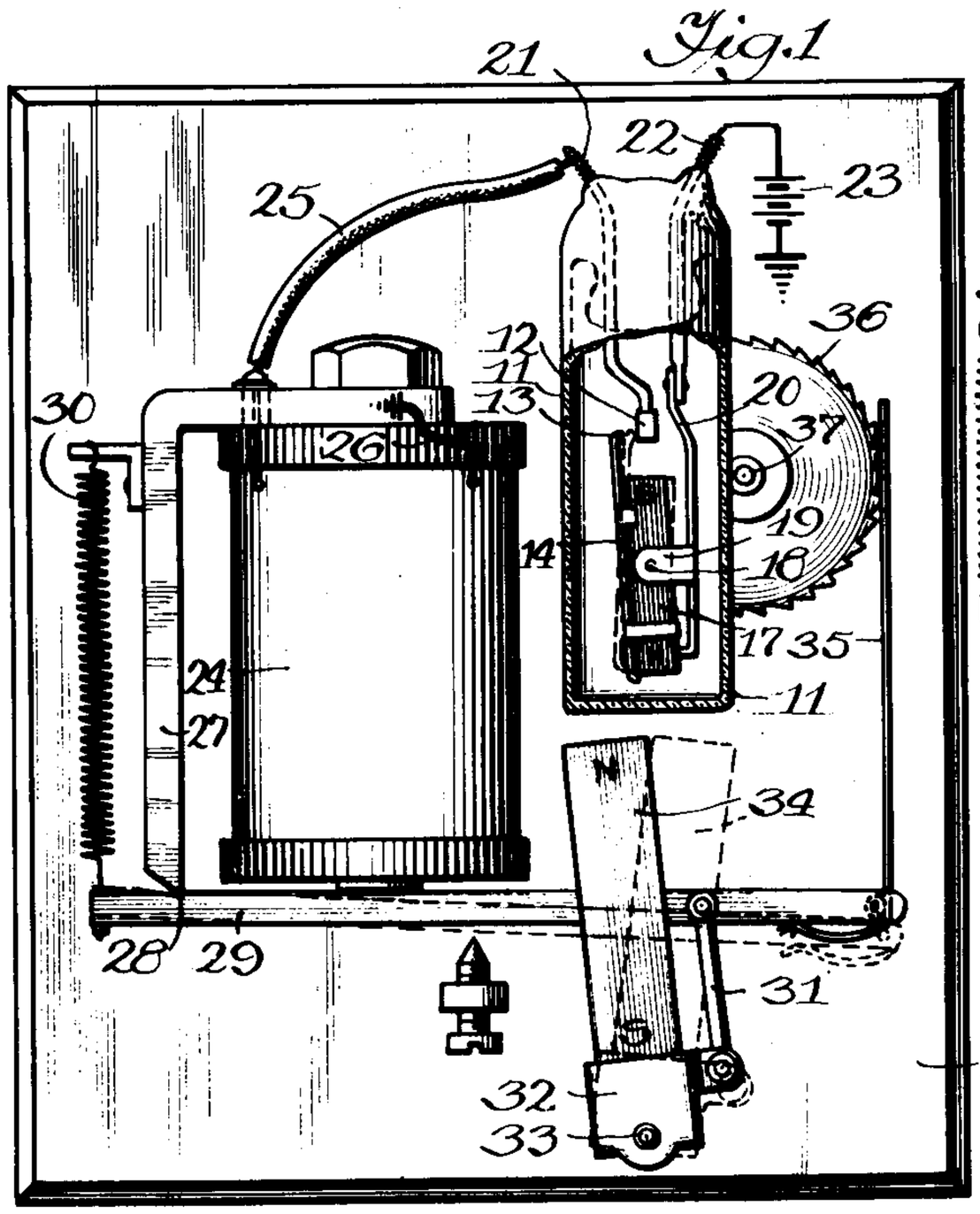
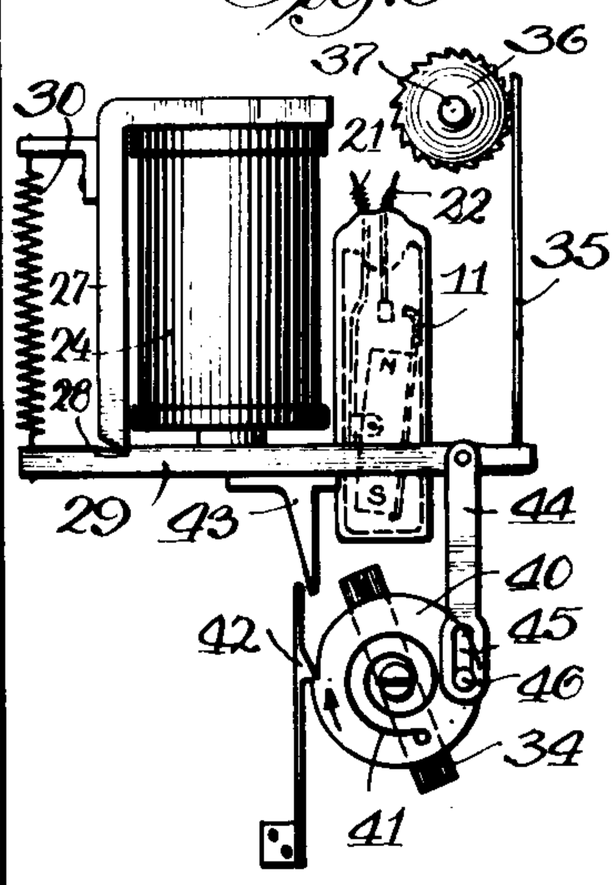


Fig. 3



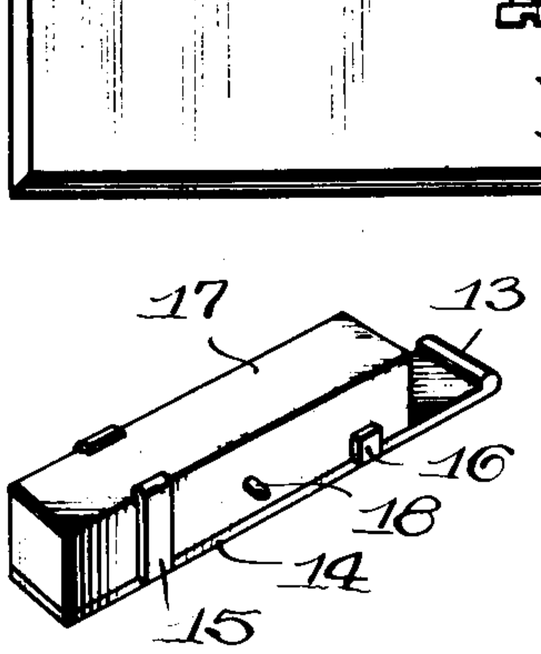


Fig. 2

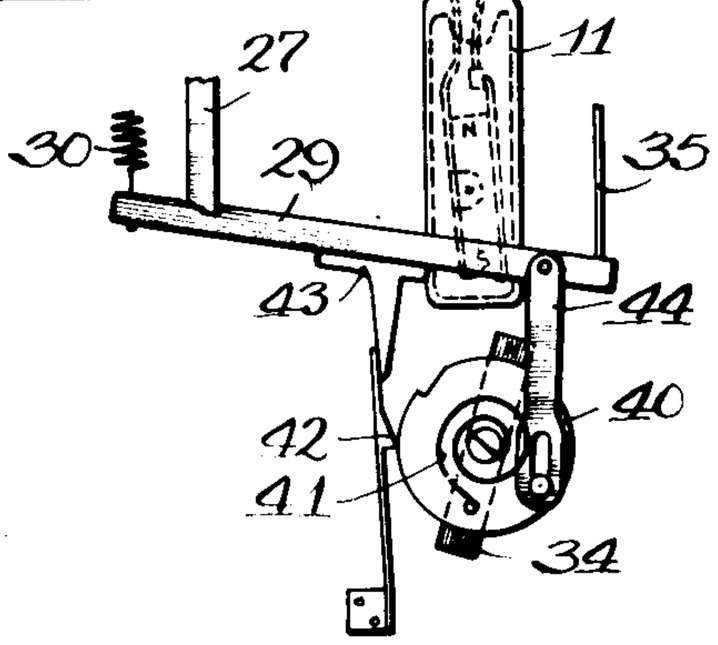


Fig. 4

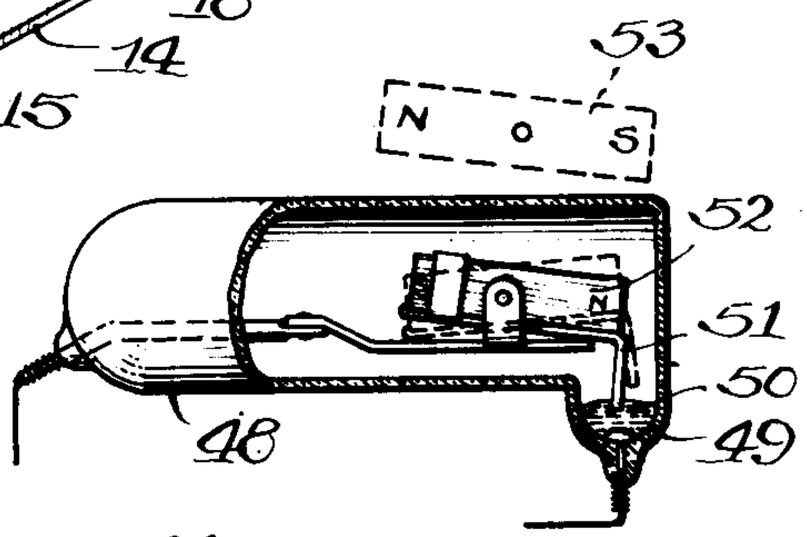


Fig. 5

Witness:
Chas. K. Kourse.

Inventor,
Clifford V. Bates
George Bayard Jones & Abby.

Patented Aug. 20, 1935 2,012,153

UNITED STATES PATENT OFFICE

2,012,153

MEANS FOR OPENING AND CLOSING CIRCUITS

Clifford V. Bates, Chicago, Ill.

Application October 12, 1932, Serial No. 637,407

19 Claims (Cl. 200—98)

My invention relates to improvements in means for opening and closing circuits of the type in which the movable contacts are sealed in a tube or receptacle from which most of the air has been exhausted to eliminate corrosion of said contacts and render the operation of the device dependable throughout long periods of use.

In devices of this character as proposed heretofore, one of the sealed-in contacts is usually a vibrating strip and is caused to vibrate or oscillate to open and close the circuit by means of an electro-magnet or electro-magnets mounted in fixed position outside of the tube. The use of electro-magnets requires contacts in the circuits of the same to permit the current to flow to energize the magnet, to interrupt the current, or to cause a reversal of flow, and thus the difficulty arising from the use of circuit opening contacts exposed to air is not avoided but there is merely a change in the location of said contacts.

My improvement contemplates the use of a movable, permanent magnet in the tube an another magnet, preferably permanent, outside the same, whereby when said outer magnet is moved mechanically or electrically, it moves the enclosed magnet and thus opens and closes the circuit without any auxiliary outside contacts.

The general object of the invention, therefore, is to provide means for operating a sealed-in contact maker and breaker by means of cooperating permanent magnets inside and outside the tube whereby auxiliary contacts exposed to the air are avoided.

Another object is to provide a device of this character for opening and closing a circuit at desired intervals, the operation of which shall be unaffected by vibration, such for example as that of an automobile or aeroplane.

An additional object is to provide a device of this character for opening and closing a circuit at desired intervals, which is more positive in its movements than those proposed heretofore.

A further object is to provide a device of this character which is adapted for use as part of a clock movement, a thermostat control or in any other relation where very light delicate parts are desirable and where dependability of operation is essential.

Further objects and advantages will be apparent from a consideration of the following descriptive matter.

Several embodiments of the invention are shown in the accompanying drawing to illustrate some of its applications.

Fig. 1 is an elevation of the mechanism partly in section;

Fig. 2 is a perspective view of the pivoted circuit controlling member;

Fig. 3 is an elevation of a modified structure operating with a snap action;

Fig. 4 is a similar view with the parts in another position; and

Fig. 5 is an elevation, partly in section, of a modified form of tube and enclosed parts.

The mechanism selected for illustration may be assembled on any suitable support 10, the tube 11 being held thereon in any approved manner. Said tube contains relatively movable circuit controlling contacts 12 and 13, the former of which is preferably fixed and the latter is movable to engage and disengage the other fixed contact, and thereby open and close the circuit. Said movable contact may be mounted in various ways, as, for example, by being pivoted, as illustrated in Fig. 2. In this arrangement, it may constitute part of a sheet metal frame 14 having suitable lugs 15 and 16 thereon to hold it firmly against a permanent magnet, having trunnions 18 thereon received in openings in arms 19 on a stationary sheet metal support 20. Thus said bar is adapted to turn about a pivotal axis which is located between the ends of said bar, although it may be otherwise located. By virtue of the pivotal mounting, the magnet and the frame carried thereby may oscillate readily to cause the contacts 11 and 12 to engage and disengage each other. These contacts may be made of any suitable non-corroding metal or alloy.

The parts within the tube are electrically connected with the external circuit by leading-in wires 21, 22, sealed in the glass in a well known manner. Most of the air is exhausted from the tube prior to the sealing operation or any inert gas or gases may be introduced therein as may be desired.

The external circuit may include a battery 23, or other suitable source of current, and a magnet 24, energized and deenergized by the closing and opening of the contacts within the tube. The magnet terminals are connected through conductor 25 to one of the tube terminals and through conductor 26 to ground or a metallic return circuit to the battery.

The magnet includes a frame 27, the lower end of which 28 constitutes a pivot on which the armature 29 may turn. In the position shown in Fig. 1, the armature engages one pole of the magnet, the spring 30 tending to draw said arma-

ture away from said magnet pole. The armature, or an extension of it, is provided with a link 31 which rocks a cup-shaped member 32 or seat about a pivot 33, said seat being adapted to hold a permanent magnet 34.

The up and down movement of the armature may be communicated to any suitable mechanism which it is desired to operate. For example, said armature may have a pawl 35 attached thereto, which, on its downward movement rotates a ratchet wheel 36 with a step by step movement, the latter being mounted on a shaft 37 which may be part of a clockwork mechanism or any other gear train or mechanical device.

The poles of the enclosed and the external magnet are marked in the drawing to indicate that like poles are adjacent each other whereby a rocking motion of the lower and outside magnet 34 back and forth about its pivot 33 will repel the lower end of the pivotally mounted magnet 17 inside the tube and will thus throw said enclosed magnet back and forth to cause the contacts 12 and 13 to open and close the circuit.

In the position shown, the circuit has just been opened within the tube, the outside magnet having swung to the left to the limit of its throw and repelled the lower end of the enclosed magnet to the right to the limit of its throw, the circuit having been opened by a quick movement of the pivoted contact member as soon as the outside magnet in its throw to the left passes what may be called the dead center with reference to the enclosed magnet. The spring 30 is now free to contract and swing the outer end of the armature downwardly, thus causing the ratchet wheel 30 to rotate and at the same time rocking the outside magnet from its left hand position to its right hand dotted line position. After it passes beyond the dead center, it repels the lower end of the enclosed magnet, thus rocking the latter and closing the circuit, whereupon the magnet 24 is energized instantaneously, attracts its armature, and the pawl is thrown open quickly to the position shown in Fig. 1, ready to make a repetition of the cycle of operations.

The magnet 34 may be turned end to end so as to bring unlike poles of the two magnets near each other, although for many purposes the repulsion effect is the better of the two as it causes the enclosed magnet to operate with a snap action.

The instrument as illustrated in Fig. 1 is capable of withstanding considerable vibration without affecting the dependability of its operation. However, with the circuit closed and the armature moving downwardly under the influence of the spring, there may be a certain inertia to be overcome in the ratchet wheel 36 and the mechanism driven thereby, with the result that the swinging movement of the magnet 34 from the left to the right may require an appreciable interval of time, and as it approaches the dead center, or after it reaches the same, excessive vibration of said magnet and of all the parts mounted on the panel 10 may result in vibration of the movable contact 13 against the fixed contact 12. To provide for a dependable operation in cases of excessive vibration, such, for example, as in cases of clocks used in aeroplanes, I provide for a quick snap action of the outside actuating magnet, to eliminate any possibility of the action just described.

Figs. 3 and 4 illustrate suitable mechanism for accomplishing the snap action. The same reference characters have been applied to the tube, the electro-magnet and associated parts, where they are substantially the same as those previously described. The operating magnet 34 is carried on a rotatable disc 40, the latter being biased, in the direction indicated by the arrow, by spring 41. In this position, rotation of said disc is prevented by engagement of a spring detent 42 with a notch in the disc. Said detent is drawn aside by the cam projection 43 on the armature 29 as the latter is drawn downwardly by the spring 30. Thus, when the circuit is opened and the electro-magnet 24 is deenergized, the disc is released and the spring 41 throws it through a partial rotation, thus throwing the magnet 34 quickly from one extreme position to the other, and likewise causing the enclosed magnet to move quickly from one extreme position to the other. The outer end of the armature carries a link 44 having a slot 45 at its lower end to receive a pin 46 on said disc whereby the return movement of said armature lifts said link and restores the disc 40 to initial position against the action of the spring 41 where it is held by the spring detent 42 until the cycle of operation is repeated. The upward movement of the armature is instantaneous and throws the outside magnet back to initial position very abruptly, thus operating the enclosed magnet also with a snap action.

In both forms of the device thus far described, it will be seen that the circuit of the electro-magnet 24 has no exposed contacts whatever, the only contacts being those enclosed in the sealed-in container which may be made of glass or any other suitable material.

In Fig 5 I have shown a modification wherein a liquid contact is used, as for example mercury. The tube 48 is preferably held in fixed position and has a downward extension 49 which receives a small amount of mercury 50 into which dips the pivoted contact 51 which is actuated by the enclosed magnet 52. The operating magnet 53 outside of the tube may be pivoted or otherwise movable, to rock the enclosed magnet back and forth about its pivot. In this figure the magnets are shown as having unlike poles adjacent each other to attract each other rather than to repel, to illustrate that either arrangement may be employed. The dotted line positions show the two magnets in circuit opening position. As shown, the rocking movement of the enclosed magnet 52 is ample to open the circuit abruptly when the contact 51 is suddenly lifted from the mercury and there is no danger of vibration maintaining an intermittent contact. With the mechanical arrangement shown in Fig. 1, the pivotal movement of the enclosed magnet is quite limited and the arrangement of the two magnets, more or less in alignment, is such that the repelling action is preferable to the reverse arrangement wherein the adjacent poles attract each other. In the form shown in Figs. 3 and 4 where the actuating magnet moves with a quick snap action the presentation of unlike poles is preferable although either arrangement may be employed.

I claim:

1. The combination with an evacuated tube having terminals passing through the walls thereof, of relatively movable contacts supported within said tube by said terminals, a permanent magnet secured to one of said relatively movable contacts and a permanent magnet outside said tube to magnetically influence said first mentioned mag-

net and move the same upon relative movement between said tube and said outside magnet.

2. The combination with an elongated evacuated tube having terminals passing through the walls thereof, of a conducting member carried by one of said terminals, a polarized bar of magnetic material pivotally supported by said member in a position substantially parallel with the longitudinal axis of said tube whereby a limited rocking movement is permitted, a contact carried by said bar and a fixed contact carried by the other of said terminals in position to be engaged by said first contact.

3. The combination with an evacuated tube having terminals passing through the walls thereof, of a conducting member carried by one of said terminals, a pair of ears on said member a polarized bar of magnetic material received between said ears and pivotally supported thereby, a contact element carried by said bar in electrical contact with said ears, a fixed contact element carried by the other of said terminals in position to be engaged by said first contact element, a polarized bar of magnetic material mounted outside said tube and means for moving the latter to rock the enclosed bar about its pivot to open and close a circuit.

4. The combination with an evacuated tube having a permanent magnet in bar form pivotally mounted therein, of a permanent bar magnet pivotally mounted outside said tube nearly in alignment with said enclosed bar magnet and means for rocking said outside magnet whereby said inside magnet is also rocked by the attraction or repulsion of the adjacent magnetic poles, and circuit contacts also enclosed in said tube and moved into and out of engagement with each other by said inside magnet.

5. In a device of the class described, a support, a seat pivotally mounted thereon, a polarized bar magnet adapted to be fitted reversibly in said seat, means for rocking said magnet back and forth, and an evacuated tube adjacent the movable end of said magnet and containing contacts magnetically actuated by said magnet.

6. In a device of the class described, an elongated evacuated tube, a bar magnet pivotally and longitudinally mounted therein, means for limiting the pivotal movement of said magnet, a bar magnet pivotally mounted outside said tube in substantial alignment with said enclosed bar magnet, a free end of said outside bar magnet being arranged to swing back and forth near one end of the pivoted magnet within said tube through a longer arc than that of said enclosed magnet, the adjacent poles of said magnets being similar whereby the rocking of said outside magnets will move said inside magnet back and forth with a quick snap movement.

7. The combination with an evacuated tube having a pivoted polarized bar magnet therein, contacts engaged and disengaged by the movement of said magnet, a polarized bar magnet pivotally mounted outside of said tube and means for moving said outside magnet back and forth with a quick snap action, the adjacent poles of said inside and outside magnets being dissimilar whereby they tend to attract each other.

8. The combination having an elongated, evacuated tube with a polarized bar magnet pivoted therein lengthwise with respect to said tube whereby a limited rocking movement of said bar magnet is permitted, said tube having mercury therein forming a circuit contact, of a contact movable with said magnet to dip into said mercury and to withdraw therefrom upon relatively slight movement of said magnet and a movable permanent bar magnet outside of said tube for rocking said enclosed magnet to thereby open and close a circuit.

9. A circuit closing device comprising a glass tube, a metal frame therein holding a bar magnet, a contact at one end of said frame, a pivotal support for said magnet, a second contact to be engaged by said first contact and terminals sealed in said glass tube one of which supports said second contact, the other of which supports all of said remaining parts.

10. The combination with an evacuated tube having terminals passing through the walls thereof, of a conducting member carried by one of said terminals, a polarized bar of magnetic material, means on said conducting member providing a pivotal support for said bar near the middle thereof, a fixed contact carried by the other of said terminals and a contact carried by said bar and movable into and out of engagement with said first contact when said bar moves back and forth about its pivotal support.

11. The combination with a sealed evacuated tube having circuit terminals sealed in the end wall thereof, of a conducting member extending from one of said terminals toward the other end of said tube, a yoke on said member, a polarized bar magnet pivotally mounted on said yoke intermediate its ends, a contact carried by said bar and a second contact secured to the other of said terminals in position to be engaged by said first contact when said bar is oscillated about its pivotal support.

12. In a circuit controlling device, a container, a polarized magnet therein, a pivotal support for said polarized magnet, circuit controlling contacts in said container one of which is actuated by the movement of said polarized magnet about its pivotal support to open and close a circuit, and a polarized magnet outside said container having one of its poles near a pole of the polarized magnet within said container, and of the same polarity, whereby relative movement between said two magnets will cause one of them to repel the other.

13. The combination with an evacuated tube having terminals passing through the walls thereof, of relatively movable contacts supported within said tube by said terminals, a permanent bar magnet arranged longitudinally within said tube, and means for movably mounting said bar magnet, whereby it may be moved under the influence of a magnet outside said tube, said contacts being actuated by the movement of said inside magnet.

14. The combination with an evacuated tube having terminals passing through the walls thereof, of relatively movable contacts supported by said terminals within said tube and out of contact therewith, a permanent bar magnet arranged longitudinally within said tube, means for movably mounting said bar magnet, a permanent bar magnet movably mounted outside said tube substantially in alignment with said inside magnet, whereby movement of the end of said outside bar magnet transversely back and forth will move said inside magnet, said contacts being actuated by movement of said inside magnet.

15. The combination as in claim 14 in which the adjacent ends of said magnets are of like polarity.

16. The combination with a sealed glass tube having conductors passing through the end

thereof of a permanent bar magnet mounted longitudinally within said tube and pivotally supported whereby it may rock slightly, electrical connections from said pivotal support to one of said conductors, a contact carried by said bar magnet and a second contact connected to the other of said conductors.

17. In a circuit controlling device, a small, pivotally mounted, permanent bar magnet, a contact member secured thereto and movable therewith, a second contact mounted to be engaged and disengaged by the movable contact, an elongated, sealed container of non-magnetic material surrounding said bar magnet and providing only a small clearance between the two thereby limiting the pivotal movement of said bar magnet to a few degrees, a permanent magnet movably mounted outside of but adjacent to said container, and means for moving said outside magnet back and forth a distance greater than the path of movement of the adjacent end of said bar magnet to cause the latter to engage and disengage said contact members, the air being exhausted from said container to prevent substantial deterioration of said contacts.

18. The combination with an evacuated tube having terminals passing through the walls thereof, of relatively movable contacts within said tube, an extension of conducting material on one of said terminals, one of said contacts being supported by said extension, said other contact engaging said other terminal adjacent said first contact, a permanent magnet mounted on said extension whereby movement of said magnet will cause the engagement and disengagement of said contacts, and a permanent magnet outside said tube to magnetically influence said first mentioned magnet and move the same upon relative movement between said tube and said outside magnet.

19. The combination with an evacuated tube having terminals sealed in the wall near one end thereof, of a pair of substantially parallel members of conducting material arranged longitudinally within said tube, one end of one member having a contact thereon, a second contact on the inner end of one of said sealed-in terminals and adjacent said first contact, a permanent bar magnet secured longitudinally to the contact bearing member, the other of said pair of members being secured at one end to the inner end of the other of said sealed-in terminals, and being connected near its other end to said contact bearing member to permit slight relative movement between said members, and a permanent magnet outside said tube to magnetically influence said first mentioned magnet and move the same upon relative movement between said tube and said outside magnet, whereby said contacts are caused to engage and disengage each other.

CLIFFORD V. BATES.