

July 14, 1942.

W. B. ELLWOOD
CIRCUIT CLOSING DEVICE
Filed March 29, 1938

2,289,830

3 Sheets-Sheet 1

FIG. 1

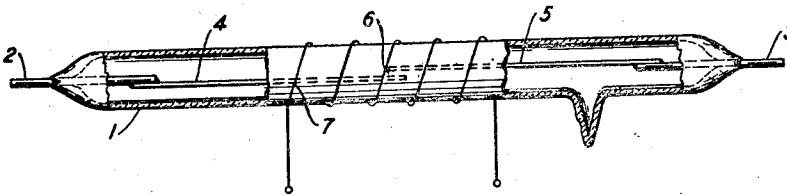


FIG. 2

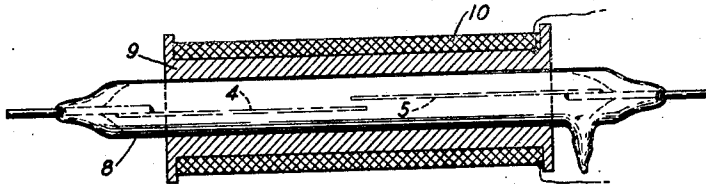


FIG. 3

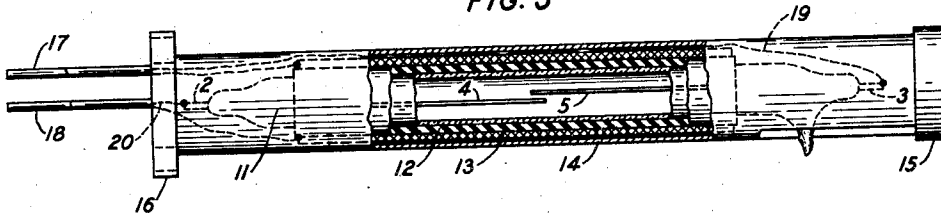


FIG. 4

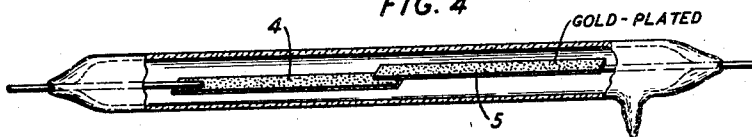
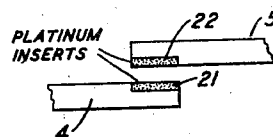


FIG. 5



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FIG. 6

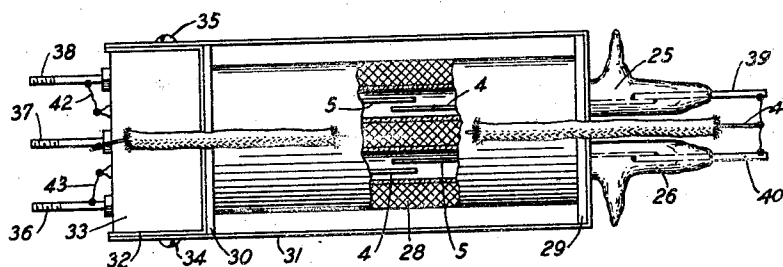


FIG. 7

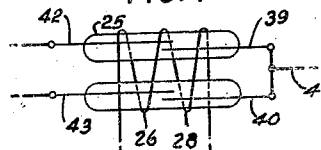
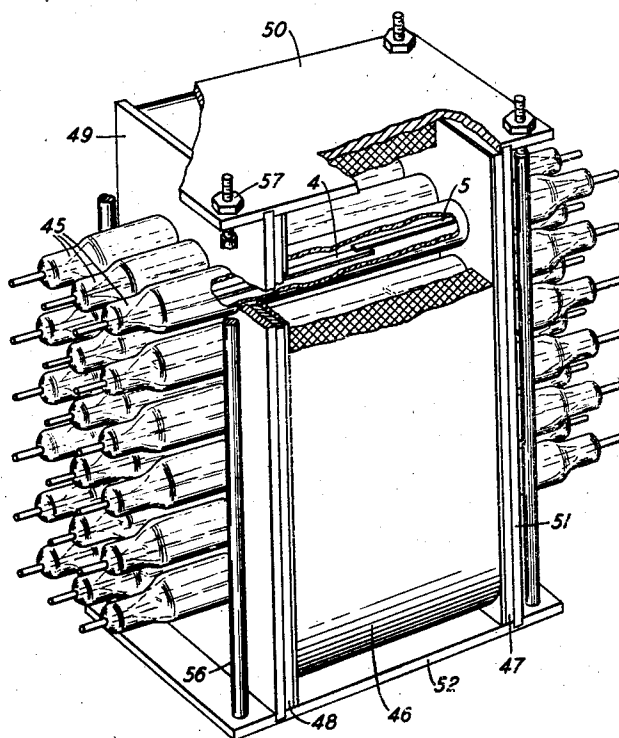


FIG. 8



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FIG. 9

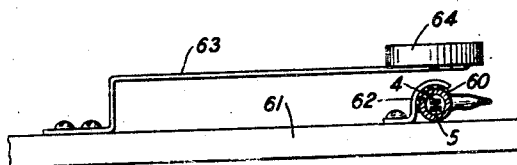


FIG. 10

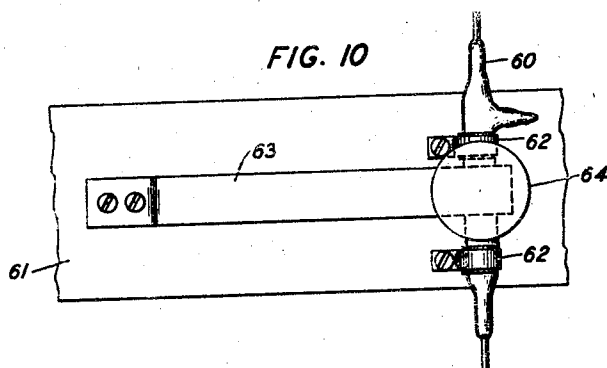


FIG. 11

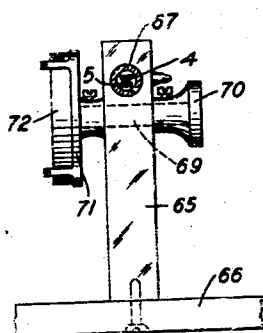


FIG. 12

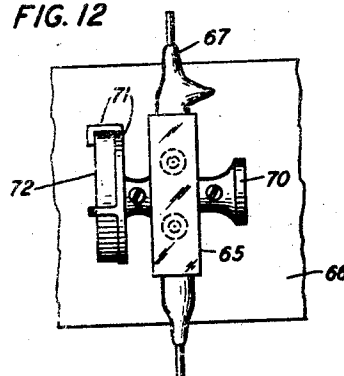
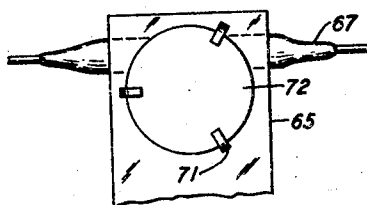


FIG. 13



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CIRCUIT CLOSING DEVICE

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Application March 29, 1938, Serial No. 198,629

21 Claims. (Cl. 200-104)

This invention relates to switching devices and particularly to devices for controlling electrical circuits.

An object is to reduce the cost and increase the utility and durability of such devices as well as reliability in operation.

Heretofore circuit controlling devices have been used comprising an evacuated or gas-filled vessel containing magnetic armatures operated upon by outside electromagnetic devices for controlling enclosed contacts, or in which contacts in a vessel are controlled by outside mechanical or electrical device operating on the vessel itself.

A feature of the present invention is a circuit controlling device in which the circuit making contacts themselves are of magnetic material and are enclosed in a gas-tight vessel having a coil outside said vessel for energizing said contacts to control electrical circuits.

Another feature is to provide such contacts of pure iron.

A further feature is an arrangement of a plurality of such vessels containing contacts with a single coil outside the vessels for simultaneously energizing said contacts to control electrical circuits.

One of the chief advantages of this invention is that it eliminates the complicated mechanical and magnetic structures of the usual electromagnetic relays and enables these to be replaced with a simple pair of magnetic contacts which perform both the magnetic and electrical functions essential to an electromagnetic circuit closing device. By enclosing the contacts in a tube with a suitable gas or in a vacuum, it is possible to use magnetic metals, such as iron, which is a good conductor and consequently a good electrical contact material, provided it is safeguarded from corrosion. And this freedom from corrosion is achieved by enclosing the contacts in sealed tubes, as noted, with suitable gases. Furthermore, the use of magnetic material for the contacts themselves is what makes it possible to dispose of the usual magnetic armatures and operate the contacts directly by the magnetic field.

The invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows the applicant's invention in the form of an air-tight vessel partly in section and containing circuit making contacts and a coil surrounding it;

Fig. 2 shows a similar arrangement with a spool surrounding the vessel and on which a coil has been wound;

Fig. 3 shows a vessel with a modified coil structure surrounding the vessel;

Fig. 4 shows a vessel containing plated pure iron contacts;

Fig. 5 shows two contacts with precious metal inserts at points where the contacts may engage each other;

Fig. 6 shows two vessels containing contacts and surrounded by a single coil;

Fig. 7 shows a circuit diagram of the arrangement disclosed in Fig. 6;

Fig. 8 shows a plurality of vessels arranged in a frame structure and surrounded by a single coil;

Figs. 9 and 10 show the application of the applicant's invention to a key structure in which the coil is replaced by a permanent magnet, Fig. 9 is a side view and Fig. 10 is a top view; and

Figs. 11, 12 and 13 show the application of the applicant's invention to an interrupting device, Fig. 11 is a side view, Fig. 12 a top view and Fig. 13 is a fragmentary side view looking from the left side of Fig. 11.

Referring now to the drawings and particularly to Fig. 1, 1 is a glass vessel in which the terminals 2 and 3 have been sealed in at opposite ends. To the terminal 2 is secured by welding or soldering a flexible contact strip 4 of pure iron. This contact strip may have a rectangular cross-section. A similar contact strip 5 is secured in the same manner to terminal 3. The vessel 1 may contain any suitable inert gas such as helium, argon, neon, or any other non-corrosive gas.

The pressure of the enclosed gas may be adjusted to the best operating conditions of the device. The contacts 4 and 5 are so arranged in relation to each other that they may close an electrical circuit at their tips at point 6. Surrounding the tube 1 is a wire coil 7. This coil may be energized by connecting it to a source of current and when suitably energized electromagnetic lines of force act on the contacts 4 and 5 to cause them to be attracted to each other at point 6 and close an electrical circuit between the terminals 2 and 3.

Fig. 2 shows a vessel 8 with contacts and terminals similar to those disclosed in Fig. 1. Surrounding this tube is an insulation spool 9 on which the energizing coil 10 has been wound.

Fig. 3 shows a tube 11 similar to that disclosed in Fig. 1. Surrounding this tube is an insulation sleeve 12 and on this sleeve is wound an energizing coil 13. Covering the coil 13 is a metal sleeving 14 having secured thereto a cap

15 at one end and a terminal block 16 at the opposite end to which terminals 17 and 18 are attached. The terminal 17 is connected by means of a wire 19 to the terminal 3 and terminal 18 is connected by wire 20 to the terminal 2 of the tube 11. The metal sleeve 14 may act as a shield and return path for the electromagnetic lines of force produced in the coil 13.

Fig. 4 shows a tube identical in construction to that shown in Fig. 1 except that the contacts 4 and 5 may be coated or plated with a precious metal such as gold.

Fig. 5 shows the tips of the contacts 4 and 5 with inserts 21 and 22, respectively, at the points where they engage each other. These contacts may consist of platinum inserts welded to the contacts, the purpose being to provide modified contacting effects for the electrical currents between these contacts when engaging each other.

Fig. 6 shows two devices 25 and 26 each identical with the structure disclosed in Fig. 1. These are spaced apart and surrounded by a coil 28. At the right-hand end of this coil is placed a spoolhead 29 and at the opposite end a similar spoolhead 30. These spoolheads are held together by means of a metal strap 31 bent in the shape of a U with the bottom portion engaging spoolhead 29 and the sides engaging another U-shaped metal strap 32, the bottom portion of which is pressed against the spoolhead 30. Between the two sides of the strap 32 is placed an insulation block 33 and these three parts 31, 32 and 33 are held together by screws 34 and 35. In the block 33 are inserted terminals 36, 37 and 38 in any suitable manner and to these terminals are wired connections from the terminals of the two tubes. The wiring connections may be such as disclosed in Fig. 7 in which the terminals 39 and 40 at one end of the vessels 25 and 26, respectively, are connected together to a conductor 41 which in turn may be connected to the terminal 37, while the terminals 42 and 43 at the opposite ends of the vessels 25 and 26 may be connected respectively to the terminals 36 and 38, as shown in Fig. 6.

Fig. 8 shows a plurality of vessels 45 similar to that disclosed in Fig. 1 bunched together in a single structure comprising a coil 46 surrounding all the vessels. This coil may be provided with insulated spoolheads 47 and 48 at opposite ends and surrounding this coil and spoolheads is a metal frame comprising plates 49, 50, 51 and 52, the plates 49 and 51 being held in place in slots in the plates 50 and 52 which latter plates are clamped together by means of bolts 56 and nuts 57. The plates 49 and 51 are provided with apertures through which the vessels 45 are passed and held in proper relation to each other. With this construction any tube may be removed and replaced at will. By energizing the coil 46 the contacts in all of the vessels 45 are operated simultaneously to make electrical connections. For instance, it has been found from practical experience that to establish connections between the contacts in the various vessels, the energization of coil 46 needs only to be increased slightly above the energization required for operating the contacts in a single vessel. This multiple device may perform the circuit controlling functions commonly performed by the well-known multi-contact relays.

In Figs. 9 and 10 the applicant's invention is applied to a key arrangement in which a tube 60 such as that disclosed in Fig. 1 is clamped to a base plate 61 by means of a clamp 62. To this

base plate 61 is fixed a flexible spring 63 at the free end of which is secured a magnetized metal block 64. By pressing down on the block 64 the magnetic lines of force produced thereby will operate the contacts 4 and 5 to make an electrical connection. This block may be made of any material that may be magnetized to produce a permanent magnet.

Figs. 11, 12 and 13 show the invention applied to an interrupting device. In these figures an upright 65 has been secured to a base plate 66. The vessel 67 such as disclosed in Fig. 1 has been inserted in an aperture in the upright 65. Below the vessel 67 and at right angle to it has been inserted in an aperture in upright 65 a shaft 69 having a knob 70 at one end and a clamp member 71 at the opposite end. This clamp is provided with three prongs holding a permanent magnet 72. This permanent magnet may be of the same type as magnet 64 shown in Figs. 9 and 10. By rotating the knob 70 the magnet 72 is rotated and as the north or south pole of this magnet 72 approaches the vessel 67 the magnetic lines of force cause the contacts 3 and 4 to be attracted toward each other. Consequently, by spinning this shaft 69, the connection between the contacts 4 and 5 may be alternately closed and opened to control electrical circuit connections.

What is claimed is:

1. In a multi-contact circuit controlling device, a plurality of sealed tubes arranged in a bundle, supporting and clamping means for holding said tubes in position so that any one may be removed and replaced, a pair of normally separated resilient contacts of magnetic metal sealed in each of said tubes respectively, and a single electromagnetic coil placed around said bundle of tubes to produce a field that magnetizes all of said contacts when said coil is energized to cause the contacts of each pair to move magnetically into engagement with each other to establish circuit making connections between each pair of contacts.

2. In a circuit controlling device, a gas-tight vessel, two resilient circuit making springs of magnetic material in said vessel, each of said springs serving as an armature and as a contact and a coil outside said vessel for flexing said springs towards each other to close electrical circuit connections between them when said coil is energized.

3. In a circuit controlling device, a gas-tight vessel, two flexible circuit making springs of magnetic material in said vessel, each of said springs serving as an armature and as a contact and magnetic means outside of said vessel for magnetizing said springs to flex them towards each other to establish electrical circuit making connections between them.

4. In a circuit controlling device, a gas-tight vessel, two resilient circuit making springs of pure iron in said vessel, each of said springs serving as an armature and as a contact and magnetic means outside of said vessel for magnetizing said springs to flex them towards and into engagement with each other to establish electrical circuit making connections between them.

5. In a circuit controlling device, a plurality of gas-tight vessels, resilient circuit making contacts of magnetic material in each vessel, a coil surrounding all of said vessels for magnetizing all of said contacts to flex them to establish elec-

trical circuit making connections between the contacts in each vessel.

6. In a circuit controlling device, a plurality of gas-tight vessels, resilient circuit making contacts of magnetic material in each vessel, a single magnetic flux producing means outside of said vessels for magnetizing said contacts simultaneously by said flux to flex them to establish individual circuit controlling connections between the contacts in each vessel.

7. A multi-contact circuit controlling device comprising a frame having four flat side members of magnetic material and bolts for clamping said members together, two opposing sides of said frame having apertures therein, a plurality of glass vessels, a pair of normally separated resilient contacts of magnetic material sealed in each of said vessels, each of said vessels being suspended in two opposing apertures in said two last-mentioned side members, and a single electromagnetic coil winding placed around all of said vessels between said two last-mentioned side members to produce a field through the side members of said frame and through all of said contacts to magnetize said contacts when said coil winding is energized to cause the contacts of each pair to move magnetically into engagement with each other to establish a circuit making connection between them.

8. A multi-contact circuit controlling device comprising a frame having two parallel side plates of magnetic material in which apertures are cut in horizontal and vertical rows, the apertures in one plate registering with corresponding apertures in the other plate, a top plate and a bottom plate parallel with each other and bolts inserted in the top and bottom plates for clamping the side plates between said top and bottom plates, a plurality of glass vessels, a pair of normally separated resilient contacts of magnetic material sealed in each of said vessels, each of said vessels being inserted at one end in an aperture of one side plate and at the other end in the corresponding opposing aperture in the other side plate, and a single electromagnetic coil winding placed around said vessels inside said frame to produce a field that magnetizes all of said contacts when said coil winding is energized to cause the contacts of each pair to move magnetically into engagement with each other to establish circuit making connections between them.

9. In a circuit controlling device, a gas-tight vessel, a single pair of pure iron springs in said vessel each serving as a retractile spring and as a circuit making contact, a non-corrosive gas in said vessel to preserve contact making surfaces of said springs and a coil surrounding said vessel for flexing said elements to close an electrical circuit between them when said coil is energized.

10. In a circuit controlling device, a gas-tight vessel, containing a non-corrosive gas, single resilient magnetic elements in said vessel each serving as an armature and as a circuit closing contact and a coil outside of said vessel for magnetizing said elements to close electrical circuit making connections between said elements when said coil is energized.

11. In a circuit controlling device, a gas-tight vessel, single independent resilient magnetic elements in said vessel, magnetic means outside of said vessel, each of said elements operative in response to flux from said magnetic means to serve as an armature to be flexed by said flux and to serve as a circuit making contact to

establish electrical circuit connections between said elements.

12. In a circuit controlling device, an enclosed vessel, two resilient circuit making springs of magnetic material in said vessel, serving as armatures and circuit closing elements without the use of precious metal or other material at the contact surfaces, and a coil outside said vessel for flexing said springs towards each other to close electrical circuit connections between them when said coil is energized.

13. In a circuit controlling device, an enclosed vessel, two resilient circuit making springs of magnetic material in said vessel, serving as armatures and circuit closing elements with precious metal plating on said springs to prevent deterioration, and a coil outside said vessel for flexing said springs toward each other to close electrical circuit connections between them when said coil is energized.

14. In a circuit controlling device, a vessel, two resilient circuit making contact springs of magnetic material arranged in said vessel so that one of said springs extends into the vessel from one end thereof and the other extends into said vessel from the opposite end thereof, said springs being so located in relation to each other that the free ends thereof are in close proximity to each other to serve as contacting points when the springs are flexed towards each other, and a coil surrounding said vessel so located and of such shape that when the coil is energized the magnetic flux density will be concentrated near the free ends of the springs to concentrate and produce a maximum magnetization of the springs at these points for attracting the free ends of said springs into engagement with each other.

15. In a circuit controlling device, a tubular vessel, a terminal inserted in each end of said vessel, a comparatively long spring contact attached to each terminal, said springs being of magnetic material and extending toward each other to present their free ends in close proximity to each other to serve as contacting points without use of precious metal and a coil wound around said vessel to cover the springs so that the electromagnetic flux produced inside said coil when energized will pass through said springs and concentrate at the contacting points of the springs to magnetize them with the greatest possible efficiency and cause said springs to attract each other to establish a current carrying circuit connection at the contact points.

16. In a circuit controlling device, a tubular vessel, a terminal of non-magnetic material sealed at each end of said vessel and extending inside the vessel, two pure iron flat springs connected respectively to said terminals inside said vessel, said springs being arranged with their flat sides in parallel relation and with the free ends in close proximity to each other to form contact surfaces at said ends, and a coil wound around said vessel for the entire length of the vessel between said terminals to cover the entire length of said springs and so arranged that the flux produced inside of said coil when energized will concentrate with its greatest density at the contact surfaces of said springs to magnetize said springs and thereby cause them to be magnetically attracted toward each other and engage each other to establish a current carrying circuit across said contacting surfaces.

17. In a circuit controlling device, a long narrow tubular vessel, a terminal of non-magnetic material sealed in at each end of said vessel, a

pair of pure iron springs of equal length, plated with precious metal to prevent oxidation, each spring being welded to a corresponding terminal inside of said vessel, and extending toward each other with the free ends in close proximity to each other to provide contacting surfaces, a coil of insulated wire wound around the outside surface of said vessel to cover said springs with an equal number of turns so that flux produced by said coil when energized may be conducted through the entire length of said springs and magnetize them to an equal extent to cause said springs to attract each other and to engage each other to establish a current carrying connection between the free ends thereof.

18. In a multicontact circuit controlling device, a plurality of tubes of comparatively small diameter and of dielectric material arranged in a bundle, each tube having a terminal of non-magnetic material sealed to each end thereof and having two long narrow springs of magnetic material therein, each spring attached to a terminal and arranged so that the free ends of the two springs are in close proximity to each other at their free ends for the establishing of current carrying connections between said ends, and a coil of wire wound around all of said tubes so that equal numbers of turns of wires will extend around the oppositely arranged springs of said tubes, whereby when said coil is energized magnetic flux produced by said coil will equally magnetize all of said springs to cause them to be attracted by each other and engage each other for the establishing of independent current carrying connections across said springs in each tube.

19. In a circuit controlling device, an enclosed vessel, two resilient circuit-making spring elements of magnetic material arranged in a tandem formation with the outer ends of said springs sealed in the vessel and with the two inner free ends in close proximity to each other to form an air-gap and contact-making points, and a coil surrounding said vessel and said two spring elements so that when said coil is energized magnetic flux will flow through said spring elements

in a longitudinal direction and across said air-gap to cause the two elements to flex toward each other to establish a resilient electrical connection between said springs at the contact-making points.

20. In a circuit controlling device, a long narrow vessel sealed at its outer ends, two comparatively long and narrow resilient circuit-making spring elements of magnetic material arranged in said vessel with their outer ends sealed in the opposite closed ends of the vessel and with their free inner tips in close proximity to each other to form a comparatively narrow air-gap and contact-making surfaces at said air-gap for establishing an electrical connection between said springs, and an electrical coil wound around said vessel to extend along the length of said spring elements so that electromagnetic lines formed inside said coil when energized will pass through said spring elements along the axes thereof and across said air-gap to cause said spring elements to deflect toward each other to establish an electrical connection between said elements at said contact-making surfaces.

21. In a multicontact circuit controlling device, a plurality of long narrow vessels arranged in a bundle, a terminal sealed into each end of each vessel to form electrical connections from the inside of said vessel to the outside thereof, a pair of comparatively long and narrow reeds of magnetic material arranged in tandem formation in each of said vessels, each of said reeds in a vessel being connected at its outer end to the inner end of a corresponding terminal, the inner free ends of said reeds forming an air-gap between the tips thereof to establish an electrical connection between said tips, and a coil surrounding said bundle of vessels with its turns covering the entire length of said reeds in said vessel so that magnetic lines of force formed inside said coil when energized will pass through the axes of said reeds and across said air-gaps to cause the reeds in each of said vessels to be attracted toward each other to make electrical connection between the free ends thereof.

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