Jan. 26, 1960 R. L. PEEK, JR 2,922,857

CONTACT MAKING DEVICE

Filed Sept. 24, 1957

FIG. 1

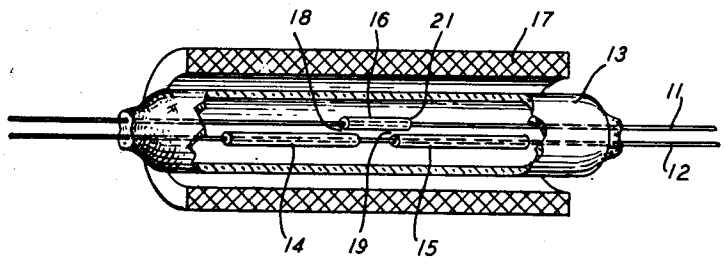


FIG. 2

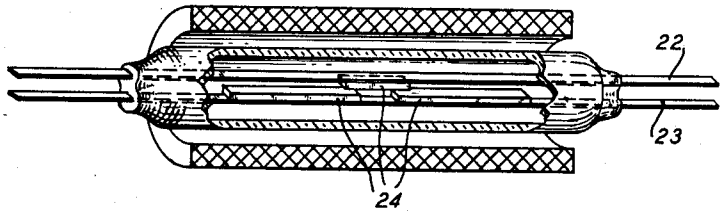


FIG. 3

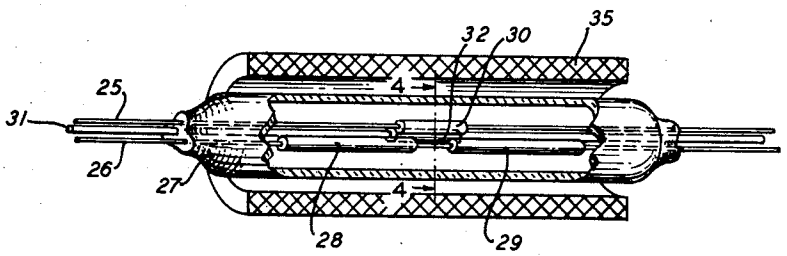
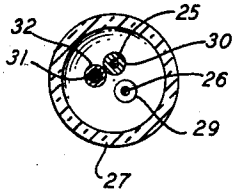


FIG. 4



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CONTACT MAKING DEVICE

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5 Claims. (Cl. 200—87)

This invention relates to contact making devices, and more particularly to such devices of the sealed reed type having fast operating speed.

As new switching systems are developed having a large number of electronic components enabling them to operate at faster speeds than priorly attainable, the slowness of operation of the electromechanical switches or relays with which these systems must cooperate becomes a major problem. Many present switching systems utilize all metallic paths for the transmission of voice currents because of the reliability of the all metallic path, as opposed to a path including electron discharge tubes. However, the present slow operating relays which comprise the switches of that metallic path render nugatory the possible high speeds of operation attainable by the electronic control circuits for the relays.

While it is generally realized that faster operating speeds can be obtained by reducing the spacing between the contact making members, there has been difficulty in the past in manufacturing sealed reed type relays with a high degree of gap spacing accuracy. And because of this inability to insure a highly accurate spacing of the contact making members, the latter necessarily cannot be brought as close together as would be desirable.

It is an object of this invention to achieve a more accurate, as well as closer, spacing of the contact making members of a sealed reed type relay.

It is another object of this invention to increase the operating speed of contact making devices.

These and other objects are attained in accordance with this invention wherein a pair of spaced, parallel, supporting wires under tension are each provided with contact making members comprised of magnetic material. A longitudinally spaced pair of said contact members are mounted on one of said supporting wires, and a single contact member is mounted on the other so that when said contact members are brought together under a magnetic force the single contact member bridges, and contacts, said pair of contact members. The contact members are disposed within a tubular, non-magnetic envelope with the pair of supporting wires securely mounted at each of the ends thereof. Because the pair of wires are mounted in position under tension, the distance between the midpoints thereof, along with the distance between the opposed contact members, can be accurately set to any given amount.

A further feature of the invention lies in the parallel contact arrangement employed. The single contact member mounted on one of the wires contacts both the contact members mounted on the other, thus providing parallel, electrical connections between the wires. This provides contact on two separate areas, thus increasing contact reliability as dirt or film cannot prevent electrical closure unless present on both areas of contact at once. It also reduces contact chatter resulting from small transient separations due to vibration, particularly that resulting from impact in operation, as there must be simultaneous separation at both contact areas to produce such openings. Finally, this parallel contact arrangement minimizes contact sticking. If one contact should stick, a force is exerted, at the opposite end of the single contact member, which sets up a prying action at the point of contact causing said contact to break.

These and other features of this invention may be more fully understood by reference to the following detailed description and accompanying drawing, in which:

Fig. 1 is a side view of a sealed reed type relay illustrative of one specific embodiment of this invention, a portion of the enclosing envelope being broken away to reveal the internal members more clearly and the encompassing magnetic coil being shown in section;

Fig. 2 is a similar view showing a second embodiment of this invention;

Fig. 3 is a similar view of another embodiment of the invention in which a permanent magnet, back contact member is added; and

Fig. 4 is a slightly enlarged view taken on the line 4—4 of Fig. 3.

Referring now to Fig. 1, in the specific illustrative embodiment there depicted a pair of parallel, supporting members **11** and **12** formed of wire are positioned in a tubular, hermetically sealed, glass envelope **13**. The wires are spaced a predetermined distance apart and are sealed under tension in each of the ends of the glass envelope **13**. A longitudinally spaced pair of tubular contact members **14** and **15** are mounted on wire **12**, and a single, tubular, contact member **16** is mounted on wire **11**. The contact member **16** is symmetrically disposed with respect to the opposed contact members **14** and **15** so that when said contact members are moved toward each other, under the influence of a magnetic force, the member **16** makes contact with both members **14** and **15**. The tubular contact members have an inside diameter slightly larger than the diameter of wires **11** and **12** so that they may be readily threaded thereon, and when properly positioned along the lengths of wire, the contact members are secured in place by a simple crimping or squeezing operation. The wires **11** and **12** are preferably formed of non-magnetic material, while the contact members can be of any soft magnetic material. Choice of material for wires **11** and **12** varies with the method of supporting and sealing the switch. For a switch hermetically sealed in glass the material must retain its tension during the heating involved in sealing the glass—tungsten and molybdenum are materials that have been found satisfactory for such use.

The tubular magnetic contact members **14**, **15** and **16** are plated with a thin layer of a non-magnetic material (e.g., silver) to provide a small non-magnetic gap between the members in contact to reduce any magnetic attraction due to residual magnetism when the energizing coil **17** is deenergized, thus facilitating release of the switch. This non-magnetic layer may itself be a suitable material for electrical contact, or be plated with a second layer of such material. Thus, if an inert gas is used to fill the hermetically sealed tube, a silver plating may alone be used, or if the tube is sealed in air the silver coating may be covered with a thin plating of gold to assure satisfactory electrical contact.

An energizing coil **17** encompasses the envelope **13**. On energization of this coil a magnetic field is provided which causes the contact members to move toward each other to close the gaps **18** and **19**, and thus provide parallel electrical connections between the wires **11** and **12**. Upon removal of this field the tension stress in the wires restores the contact members to their original positions. Inasmuch as the tubular contact members **14** and **15** are relatively inflexible and they extend along a major portion of the enclosed length of wire **12**, it will be obvious

that the lateral movement of these contact members will be less than that of contact member **16**.

As has been noted, the wire supporting members **11** and **12** are sealed within the glass envelope **13** under tension. Briefly, fabrication is carried out by first centrally positioning the wires and attached contact members within a length of glass tubing. The wires are then tensioned and while so tensioned the gap spacing is set the selected amount by laterally displacing the wire ends. By way of example, for tungsten wires of 10 mils diameter the tension used is of the order of 1,500 grams weight. Because the pair of wires are under tension the distance between the midpoints thereof, as well as the distance between the opposed contact members, can be set with the same degree of accuracy that the wire ends are displaced. Thus, by knowing the wire and contact member diameters, the setting of the gap and the measurement thereof can be effectively carried out at the free ends of the wires. It has been found that this arrangement affords a greater degree of control over gap setting than existing arrangements wherein reed wires enter respective ends of a tubular envelope and the gap setting is carried out by angularly offsetting the wires in opposite directions. Fabrication of the instant device has shown that the gap spacing can be set with an accuracy of greater than $\pm.2$ mil. It follows, that with increased accuracy in gap setting, it is possible to set the opposed contact members much closer together.

With the gap spacing set the selected amount, the ends of the glass tube are sealed by the application of heat. Although this may cause some tendency toward relaxation of the tension, the wires will remain subject to sufficient tension to insure satisfactory operation.

In addition to faster operating speed, less chatter is experienced as the gap distance is shortened. Chatter is the result of the relay contacts coming together at sufficiently high velocities to cause a rebound upon impact. By decreasing the distance between the contact making members the velocity reached by the members just prior to impact is accordingly lowered with the result that rebounds and accompanying chatter are less likely to occur. In addition, as previously explained, chatter openings can only occur in this parallel contact arrangement when member **16** rebounds simultaneously from both members **14** and **15** and small differences in the times at which these rebounds occur reduce the time in which the contact is open.

When the switch gaps **18** and **19** are closed the wires **11** and **12** are interconnected through parallel contact paths. Besides providing dual contact areas, which give added insurance against dirt, films, and the like, and which decrease contact chatter, this arrangement tends to minimize the problem of contact sticking. Assuming for the moment that the contacts of switch gap **18** should stick, the tubular contact member **16** would tend to assume an angular position with respect to contact member **14**, and thus a prying action would be set up at the point of contact causing said contact to break. More specifically, if the contacts of switch gap **18** should stick, the tensioned wire **11** would set up a force at the point **21** which, acting through the lever arm (contact member **16**), would force or pry apart the members **16** and **14**. This same type action would of of course take place should the contacts of gap **19** be the ones to stick.

In the embodiment of Fig. 2, the parallel supporting members **22** and **23** are formed of non-magnetic flat tapes and the contact members **24**, comprised of flat strips of magnetic material, are mounted thereon by spot welding or the like. In all other respects this modification is equivalent to that shown in Fig. 1. The Fig. 2 embodiment does tend to lend itself more readily to mass production techniques, and thus from this standpoint alone it may be somewhat more desirable than the embodiment of Fig. 1.

Turning to the modification shown in Figs. 3 and 4, the parallel supporting members **25** and **26**, formed of wire, are mounted in glass envelope **27** under tension. As in Fig. 1, the tubular contact members **28** and **29** are mounted on wire **26**, and a single, tubular contact member **30** is mounted on wire **25** so as to make contact with both the members **28** and **29** when said contact members are moved toward each other under the influence of a magnetic force. In addition, supporting member **31** is mounted within envelope **27** under tension and is spaced from and parallel to the supporting members **25** and **26**. Supporting member **31** is formed of a wire of sufficient thickness as to reduce any lateral movement thereof to a negligible amount.

A tubular back contact member **32** is mounted on wire **31**, in the predescribed manner, and is coextensive with contact member **30**. The contact member **32** is permanently magnetized so as to normally hold member **30** in contact therewith and out of contact with members **28** and **29**. When the encompassing coil **35** is energized in the sense that creates a magnetic field in the same direction as that within the permanent magnet **32**, this field opposes the previously existing return field of the permanent magnet in member **30**, diverting the permanent magnet field to an air return path, and reducing or tending to nullify the field between **30** and **32**. This new coil field will follow a path through members **28**, **30**, and **29**, and will move member **30** into contact with members **28** and **29**. Upon deenergization, the contact member **30** is returned to its normal position under the influence of the field of the permanent magnet. If desired the relay of Figs. 3 and 4 can provide a transfer operation. That is, the wire **31** may also be connected to an external circuit, and upon energization of the coil **35**, electrical contact with wire **25** is transferred from wire **31** to wire **26**.

This invention has been described in terms of certain specific embodiments, and since modifications and equivalents thereof may be apparent to those skilled in the art, this description is intended to be illustrative of and not necessarily to constitute a limitation upon the scope of the invention.

What is claimed is:

1. A contact making device comprising a non-magnetic envelope, a pair of parallel spaced flexible supporting members of non-magnetic material mounted within said envelope under tension, a pair of longitudinally spaced contact members of magnetic material mounted on one of said supporting members, a single contact member of magnetic material mounted on the other of said supporting members, said single contact member being symmetrically disposed with respect to the opposed pair of contact members so as to make contact with both of said opposed pair when said contact members are moved toward each other.

2. A contact making device comprising a hermetically sealed non-magnetic tubular envelope, a pair of parallel spaced supporting wires of non-magnetic material mounted within said envelope under tension, said wires being sealed in the ends of said tubular envelope, a pair of longitudinally spaced tubular contact members of magnetic material mounted on one of said supporting wires, and a single tubular contact member of magnetic material mounted on the other of said supporting wires, said single contact member being symmetrically disposed with respect to the opposed pair of contact members so as to make contact with both of said opposed pair when said contact members are moved toward each other.

3. A contact making device comprising a hermetically sealed non-magnetic tubular envelope, a pair of parallel spaced supporting tapes of non-magnetic material mounted within said envelope under tension, said tapes being sealed in the ends of said tubular envelope, a pair of longitudinally spaced contact members of magnetic material mounted on one of said supporting tapes, a single contact member of magnetic material mounted on the

other of said supporting tapes, said contact members having flat contact making surfaces, and said single contact member being symmetrically disposed with respect to the opposed pair of contact members so as to make contact with both of said opposed pair when said contact members are moved toward each other.

4. A contact making device comprising a hermetically sealed non-magnetic envelope, a pair of parallel spaced flexible supporting members of non-magnetic material mounted within said envelope under tension, a pair of longitudinally spaced contact members of magnetic material mounted on one of said supporting members, a single contact member of magnetic material mounted on the other of said supporting members, said single contact member being symmetrically disposed with respect to the opposed pair of contact members so as to make contact with both of said opposed pair when said contact members are moved toward each other, a third parallel spaced supporting member of non-magnetic material mounted within said envelope under tension, and a permanent magnet mounted on said third supporting member for holding said single contact member in contact therewith and out of contact with said pair of contact members in the absence of any external magnetic influences.

5. A contact making device comprising a non-magnetizable envelope, a pair of spaced-apart elongated flexible members of non-magnetizable material, each of the flexible members being arranged within the envelope and longitudinally tensioned, magnetizable first contact means mounted on one of the flexible members, magnetizable second contact means mounted on the other flexible member, the first and second contact means being normally separated from each other, and magnetic means, outside of the envelope, operable for causing the first and second contact means to move into mutual contact.

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