Aug. 4, 1970 TETSUO MORI ETAL 3,522,564

REED RELAY

Filed Feb. 25, 1969 4 Sheets-Sheet 1

Fig. 1A

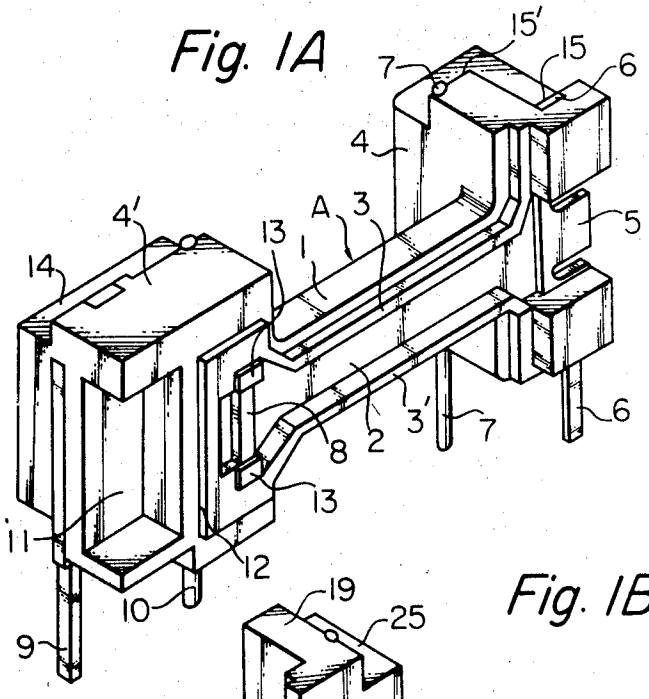


Fig. 1B

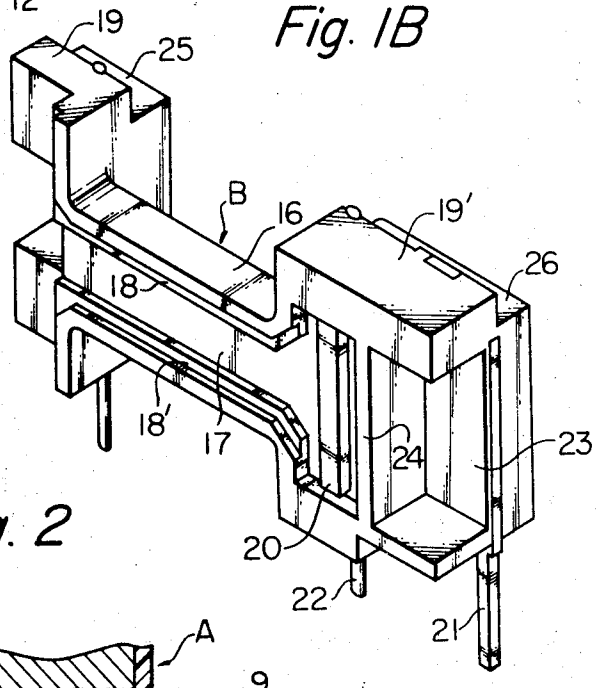
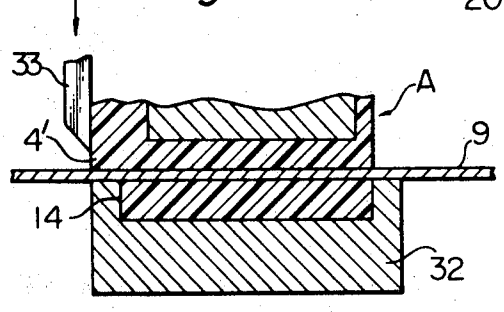


Fig. 2



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Fig. 3

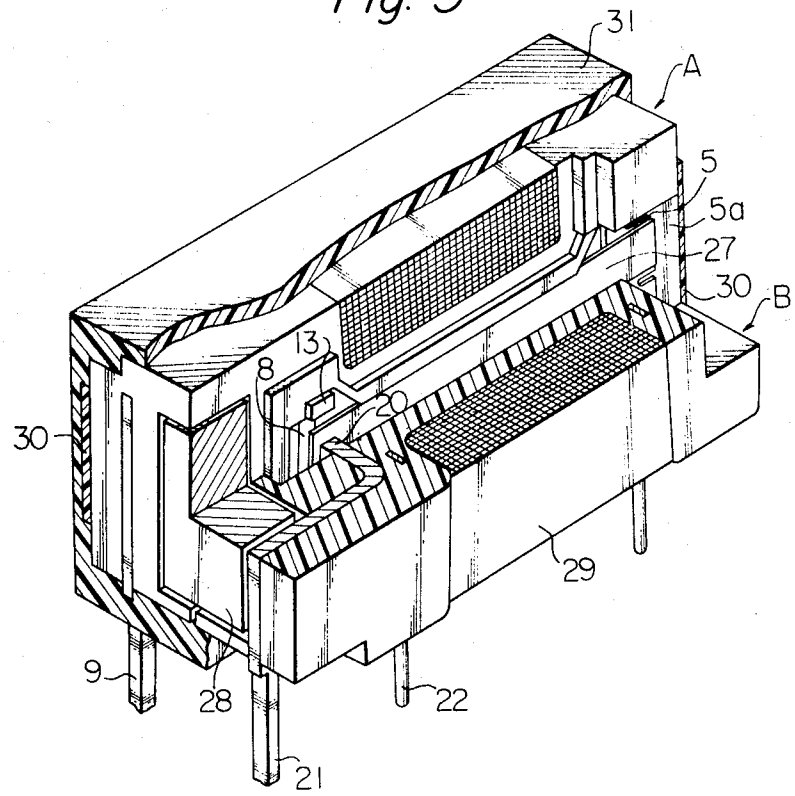
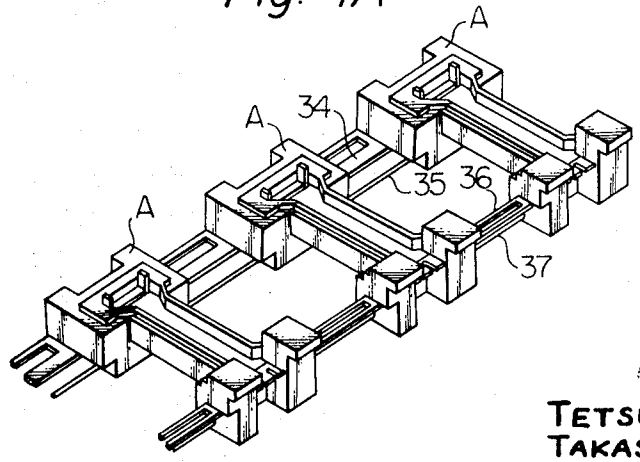


Fig. 4A



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Fig. 4B

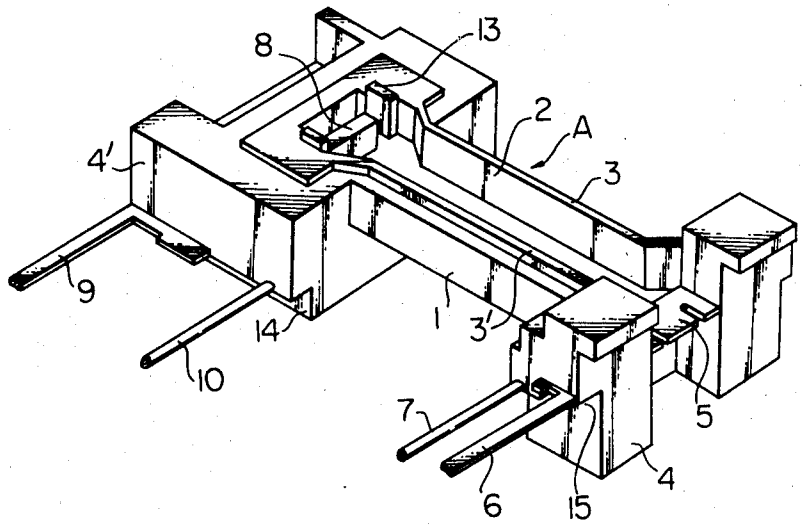
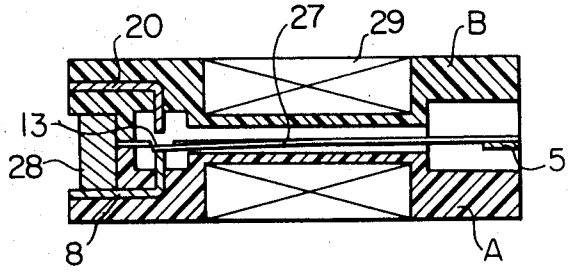


Fig. 5



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Aug. 4, 1970 TETSUO MORI ETAL 3,522,564

REED RELAY

Filed Feb. 25, 1969 4 Sheets-Sheet 4

Fig. 6A

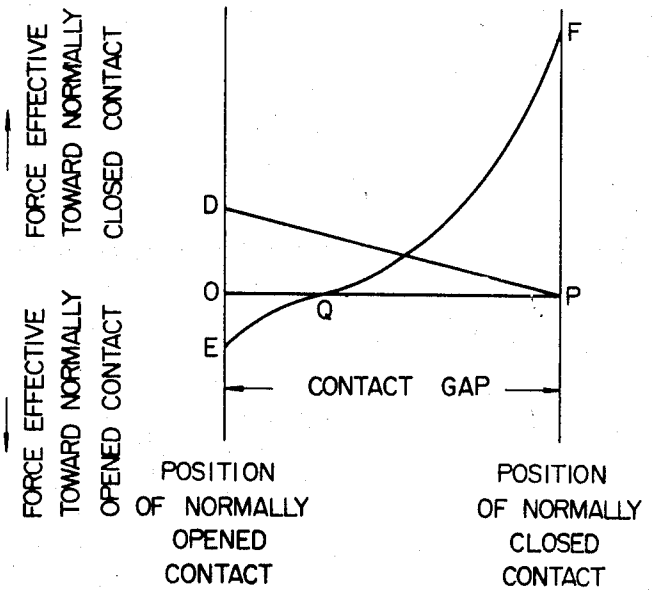
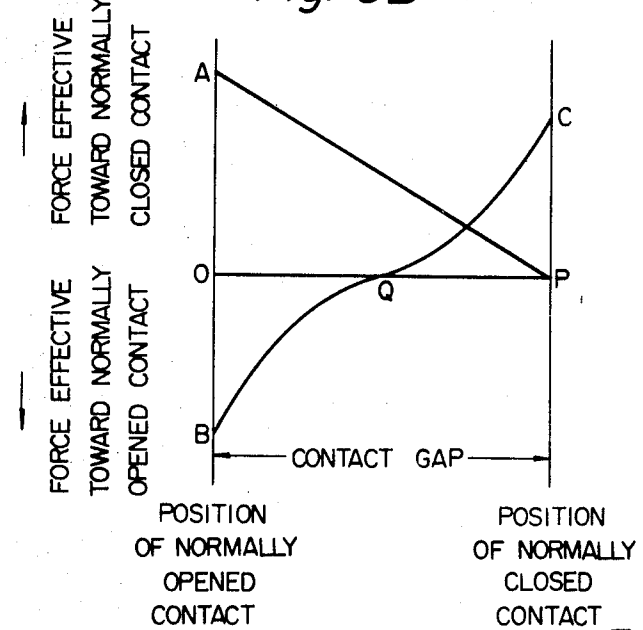


Fig. 6B



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3,522,564

REED RELAY

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Int. Cl. H01h 45/04
U.S. Cl. 335—153 7 Claims

ABSTRACT OF THE DISCLOSURE

A reed relay comprising two separated members in longitudinal direction of the relay body, respective which are molded from a synthetic resin. The molded members are provided therein with a reed acts as a movable contact, fixed contacts, terminals and a permanent magnet, and are jointed to each other so as to form a single relay body, around which an exciting coil is wound.

This invention relates generally to reed relays and, more particularly to such reed relays that can be easily manufactured in the size of mass-production and having less chattering at contacts.

The present invention has been suggested to make it possible to simultaneously mold a large number of frame body and to cut respective terminals of the bodies simultaneously in a desired length so that a large number of frame bodies may be manufactured simultaneously and, thus, various problems having been caused in mass-producing the reed relays are effectively solved, which solution has been established by way of forming the frame body of reed relay in two separate portions so that respective portions may be separately molded and a single frame body will be formed by simply engaging the two portions with each other, and also by arranging a plurality of terminals molded in the frame body on the same cutting surface of terminal cutting die.

Thus, the principal object of the present invention is to provide a reed relay which may be manufactured at a low cost and in a mass-production scale.

Another object of the present invention is to provide a reed relay having less chattering at its contacts.

Other objects and advantages will become apparent upon reading the following detailed description of the present invention, which shall be made with reference to the accompanying drawings, wherein:

FIG. 1A is a perspective view of one of the two synthetic resin molded members for the frame body according to the present invention.

FIG. 1B is a perspective view of the other synthetic resin molded member.

FIG. 2 is an explanatory view showing the cutting state of terminals.

FIG. 3 is a perspective view showing a completed reed relay according to the invention, of which a portion being cut out.

FIGS. 4A and 4B are explanatory views to show the method of manufacturing the synthetic resin molded members according to the present invention.

FIG. 5 is a longitudinally sectioned view of another embodiment of the reed relay according to the present invention.

FIG. 6A is an explanatory view to show characteristics of the reed relay according to the invention, and FIG. 6B is an explanatory view to show characteristics of conventional reed relays.

The present invention shall now be disclosed in detail

with reference to an embodiment as illustrated. It should be appreciated that the invention is not to be limited to the particular embodiment, but it is rather intended to include all alternatives, modifications and equivalent arrangements which will fall in the scope of the appended claims.

Referring now to the drawings, in FIG. 1, A and B are both molded members of a synthetic resin and the reed relay frame body will be formed in a single body by engaging respective molded members with each other.

First of all, structure of the first molded member A shall be explained with reference to FIG. 1A. In the drawing, **1** is a main body part of the member A, and is provided with a cavity **2** extending in longitudinal direction at a side wall of the main body part **1** and with projections **3** and **3'**, respectively, lying along each of upper and lower edges of said cavity. **4** and **4'** are flange parts provided at both ends of the main body part **1**. Further, **5** is a mounting plate, which is embedded in the flange part **4** so as to locate at an end of the cavity **2** and is formed of a metal plate having a terminal **6** as shown to be extending downwardly. **7** is a coil terminal, which is embedded in the flange part **4** similarly to said terminal **6** and extending at an end downwardly likewise. **8** is a fixed contact, which is embedded in the flange part **4'** so as to locate at the other end of the cavity **2** and is formed of a metal plate having a terminal **9** as shown to be extending downwardly. **10** is a coil terminal, which is embedded in the flange part **5** similarly to said terminal **9** so as to extend at an end downwardly. **11** is a further cavity opened at an end of the member A and the side to be engaged with the other molded member B. **12** is a separating wall provided between said cavities **2** and **11**. **13** and **13'** are projections provided on the flange part **4'** in proximity to said fixed contact **8** at an end of the cavity **2**, respectively. These projections **13** and **13'** are adapted to restrict, when the molded members A and B are engaged with each other, clearance between both fixed contacts embedded respectively in the molded members A and B so as to be of a fixed amount with their projected tips which will contact with opposing surface of fixed contact of the other molded member B or of engaging side surface of the latter forming the same plane with the fixed contact surface. **14** is a stepped part provided at a side surface of the flange part **4'**, and **15** is a stepped part provided at a side surface of the other flange part **4**.

Next, the structure of the second molded member B shall now be explained. **16** is a main body part, which is provided with a cavity **17** extending in longitudinal direction at a side wall of the main body part **16** and with grooves or stepped sections **18** and **18'** at upper and lower edges of the cavity **17**, respectively. These stepped sections **18** and **18'** are adapted to engage with the projections **3** and **3'** of the first molded member A so as to receive them. **19** and **19'** are flange parts respectively provided at each end of said main body part **16**. **20** is a fixed contact embedded in the flange part **19'** so as to locate at an end of the cavity **17**. Said fixed contact **20** is formed of a bent metal plate having a terminal **21** as shown to be extending downwardly. **22** is a coil terminal, which is embedded in the flange part **19'** similarly to the terminal **21**. **23** is a further cavity, which is opened at an end of the molded member B and the side to be engaged with the first member A. Between the cavities **17** and **23**, a separating wall **24** is provided. **25** and **26** are stepped parts provided at side surfaces of the flange parts **19** and **19'**, respectively.

As will be seen in FIG. 3, a movable reed **27** will be provided between the fixed contacts **8** and **20** so as to freely contact with either one of the contacts with its one

end, the other end of which is welded to the mounting plate **5** for the reed **27**.

In assembling the frame body of reed relay according to the present invention by engaging both the molded members A and B with each other, the flange parts **4** and **19** and the other flange parts **4'** and **19'** are faced to and engaged with each other, respectively, and respective cavities **2** and **17** are closely faced to each other, so that the projections **3** and **3'** provided on the first molded member A will be fitted into the stepped sections **18** and **18'** provided on the second molded member B, respectively, thereby the both members A and B will be combined into a single body. It will be noted here that, at this occasion, the projections **13** and **13'** provided on the member A will serve to restrict the clearance between the respective fixed contacts **8** and **20**. Further, the cavities **11** and **23** of the both members A and B will form a small room as the both members are combined, thus a permanent magnet **28** will be inserted into this room formed.

29 is a coil wound on the main body parts **1** and **16**, **30** is an adhesive tape wound for tightly holding the both members A and B as combined, and **31** is a synthetic resin layer for covering the whole reed relay body. The layer **31** may be formed by means of dipping or any other suitable way.

While the particular embodiment has been disclosed in the above so as to be provided with a permanent magnet **28**, it should be appreciated that such magnet may be omitted without disturbing the function of the embodiment to serve as a relay.

It should be also noted that one of the further features of the reed relay according to the present invention resides in the particular mounting positioning of the terminals. Referring to the first molded member A, it will be noted that the terminals **6** and **7** are positioned in proximity to the stepped parts **15** and **15'** provided at a side wall of the flange part **4**, respectively, and that the terminals **9** and **10** are likely positioned in proximity to the stepped part **14** provided at a side wall of the flange part **4'**. This feature is for the sake of enabling to cut all excessive and unnecessary portions of the terminals with a cutting blade in a single step, after molding the synthetic resin molded member A with a plurality of materials for such terminals simultaneously embedded therein. As shown in FIG. 2 of an embodiment of the above cutting step, the molded member A will be placed on a die **32** having stepped or protruded parts to be complementary shape for the stepped parts **14**, **15** and **15'** of the member A, so that the all excessive and unnecessary portions of the terminal materials will be cut off along the side surfaces of flange parts **4** and **4'** with a cutting blade **33** slided along said surfaces. It will be apparent that the same cutting operation will be carried out with respect to the second molded member B and that the above mentioned terms "unnecessary or excessive portions" of the terminals are to mean the other portions of the terminal materials than the portions to be as the terminals and remained projected out of opposite side of the flange parts to the side from which the terminals extend.

Referring now to the manufacturing method of the synthetic resin molded members of the reed relay according to the present invention, as shown in FIG. 4A, all of continuous metal materials **34** through **37** for the terminals **6**, **7**, **9** and **10** are arranged in parallel to each other, then a number of the molded members A are simultaneously molded along the materials **34** through **37** so as to be formed integrally with the latters by effecting a suitable molding operation. Then, these molded members formed in a series integrally with the continuous metal materials **34** through **37** will be placed on the cutting device, respectively, so that the materials **34** through **37** will be simultaneously cut along one side wall of the respective flange parts of each molded member as shown in FIG. 2, thereby the synthetic resin molded members A having the structure as shown in FIG. 4B can be obtained. In this case, it is desirable to make the interval between each of the molded members A formed integrally with the materials **34** through **37** to be a sufficient length for that of the terminals, and also, it will be apparent from the foregoing that the respective stepped parts **14**, **15** and **15'** of the flange parts **4** and **4'** are placed on corresponding stepped or raised parts of the cutting die **32** and the continuous materials **34** through **37** will be cut along a wall surface of the each flange parts at the opposite side to that where the terminals are to be projected.

It should be also appreciated that, while the manufacturing method of the first molded members A has been disclosed with reference to FIGS. 4B and 5B, the method of manufacturing the second molded members B is substantially the same with the above method, only except that different shaped molding die and cutting die adapted to the former will be used, and further that the stepped parts are provided on the flange parts having stepped side surface in proximity to these terminals, which fact being the second feature of the structure of molded members according to the invention, thereby the cutting operation of the continuous metal materials for the terminals will be extremely simplified and made easier.

FIG. 5 shows another embodiment of the present invention, wherein a reed relay formed with both molded members A and B engaged with each other and containing a permanent magnet **28** in a receptacle room formed with the cavities **11** and **23** is shown in a longitudinal sectioned view. **8** and **20** are fixed contacts made of a pure iron. An end surface of said permanent magnet **28** is, in the case of this embodiment as shown, brought into close contact with one of the fixed contacts, i.e., the fixed contact **8**, and the other end of the magnet **28** is arranged so as to be spaced from the other fixed contact **20**.

In the conventional reed relays, respective strengths of magnetic force at each of polarized fixed contact normally closed and polarized fixed contact normally opened are made to be equal. The relation between attracting force of the polarized fixed contacts and recovery force of the reed (movable contact piece) in such case will be as diagrammatically shown in FIG. 6B, in which straight line OP represents the value when the attracting force is zero, and a curved line BQC represents a relation of positioning of free end of the reed between each of the contacts to the attracting force of polarized fixed contacts. At the point Q, that is, at the intermediate point between each of the normally closed and opened contacts, the attracting forces caused by the both polarized contacts are cancelled with each other so as to be zero. The other straight line AP represents a relation of free end positionings of the reed between both contacts to the recovery force of the free end so as to contact with the normally closed contact. The attracting force of the normally closed contact at the time when the free end of reed is completely attracted by said contact is represented by PC. At a state where the reed is once excited and the excitation is terminated after the reed's free end is attracted to the normally opened contact, the reed's free end will be attracted towards the normally opened contact by a force OB. However, at this time, the recovery force OA of the reed which is larger than the attracting force OB will become effective and, thus, the reed's free end will be again attracted to the normally closed contact.

In order that the free end of reed will automatically recover to the normally closed contact, it is necessary to make the recovery force OA of the reed larger than the attracting force OB of the normally opened contact when the same is completely attracting the reed's free end. However, if the reed's recovery force is made to be excessively large, the reed's stiffness will become larger and consequently the chattering of reed's free at the time when the same reaches any of the fixed contacts will be caused to occur.

According to the present invention, the permanent magnet **28** is arranged in such manner that the distance between the magnet **28** and rear end of the polarized fixed contact **8** normally closed will be smaller than the distance between the magnet and rear end of the polarized fixed contact **20** normally opened (in the case of the embodiment as illustrated, the magnet is arranged to be in close contact with the normally closed contact), so that the normally closed contact **8** will be provided with a larger magnetic force than the force given to the normally opened contact **20**. With this arrangement, as diagrammatically shown in FIG. 6A, the attracting force PF of the fixed contact **8** normally closed at the time when the same is completely attracting the reed's free end will be made larger than the attracting force OE of the fixed contact **20** normally opened at the time when the same is completely attracting the reed's free end, thereby contacting pressure of the free end of reed **27** while the latter is attracted to the normally closed fixed contact **8** can be made larger. Further, due to the fact that the attracting force OE of the normally opened contact **20** while the reed's free end is attracted to the same is made to be smaller, the recovery force OD of the reed **27** which is effective in retracting the reed's free end from the normally opened contact **20** at the time the coil excitation is terminated will be able to be made smaller. Consequently, the stiffness of the reed can be made smaller and, thus, the chattering of reed apt to be caused at the time when the reed is engaged with any of the fixed contact **8** or **20** will be effectively prevented from occurring.

The present invention is further featured in that the portion where the reed **27** is disposed between the respective opposing fixed contacts **8** and **20** is shielded from the permanent magnet **28** contained in the relay body, by means of the separating walls **12** and **24** formed in respective molded members A and B. By closing thus the space between the permanent magnet and the contacting clearance of these opposing fixed contacts, it is effectively secured that any dusts that will be attracted from outside and magnetized by the permanent magnet will not enter into the clearance and, thus, any possible trouble caused by such magnetized dusts can be minimized.

A further advantageous feature of the present invention resides in that the mounting plate **5** for the fixed side of reed **27** is exposed outside the relay body at its outernal end edge through an opening **5***a* formed at outward ends of the cavities **2** and **17** of molded members A and B. With this arrangement, it is made possible to transform the reed mounting plate **5** from outside even after the members A and B are assembled, so that the free end of reed **27** contained far into the assembled members can be controllably positioned at an appropriate position between the respective fixed contacts **8** and **20**, by adequately transforming shape of the exposed part of the mounting plate **5** at which the other end of the reed **27** is secured to the plate **5**.

What is claimed is:

1. A reed relay comprising a first synthetic resin molded member (A), a second synthetic resin molded member (B) to be engaged with said first molded member (A) so as to be a single (frame) body, and an exciting coil wound on the combined single body of said first and second molded bodies;

said first molded member having a main body part (**1**) and flange parts (**4**, **4'**) at both ends thereof,

said flange parts being provided with terminals, respectively, engaging side of said first molded member with the second molded member being provided with a cavity (**2**) extending in longitudinal direction of the main body part,

said cavity being provided at one end with a fixed contact (**8**) embedded and at the other end with a reed mounting plate (**5**) embedded, respective which is formed integrally with one of said terminals at respective flange parts,

said reed mounting plate (**5**) being provided with a reed (**27**) extending through said cavity and secured at its one end to the reed mounting plate, the other end of which reed being arranged so as to freely contact with said fixed contact;

said second molded member (B) having a main body part (**16**) and flange parts (**19**, **19'**) at both ends thereof,

said flange parts being provided with terminals, respectively, engaging side of said second molded member with the first molded member being provided with a cavity (**17**) extending in longitudinal direction of the main body part,

said cavity being provided at one end with a fixed contact (**20**) embedded and formed integrally with one of said terminals at one of the flange parts, and

said first molded member (A) and second molded member (B) being so combined that the fixed contact (**8**) of first molded member and the fixed contact (**20**) of second molded member will oppose to each other through the free end of reed (**27**).

2. A reed relay according to claim **1**, which being provided with a permanent magnet received in a cavity provided at one end of the combined body of said first and second molded members (A, B).

3. A reed relay according to claim **1**, wherein said terminals provided at respective flange parts of the first and second molded members are positioned along side walls of said flange parts.

4. A reed relay according to claim **1**, wherein at least one of said first and second molded members being provided with at least one projection for determining clearance between said two fixed contacts, at the engaging side of the member with the other member opposing thereto.

5. A reed relay according to claim **1**, wherein said molded members respectively having at the side engaging with the other a complementary fitting part to fit in each other.

6. A reed relay according to claim **1**, wherein said cavity for receiving the permanent magnet at an end of the molded members being shielded from the fixed contacts embedded in said members by means of a separating wall.

7. A reed relay according to claim **1**, wherein said permanent magnet being separated from said fixed contacts with a smaller clearance at the side of normally closed contact than the side of normally opened contact.

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U.S. Cl. X.R.

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