Aug. 30, 1966 B. S. BENGTSSON 3,270,301

PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Filed June 13, 1963 6 Sheets-Sheet 1

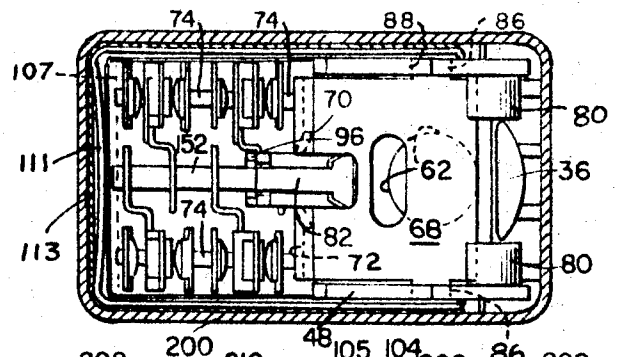


FIG. 1

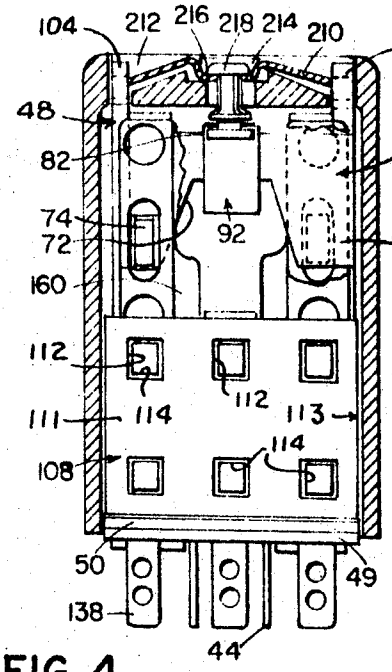


FIG. 4

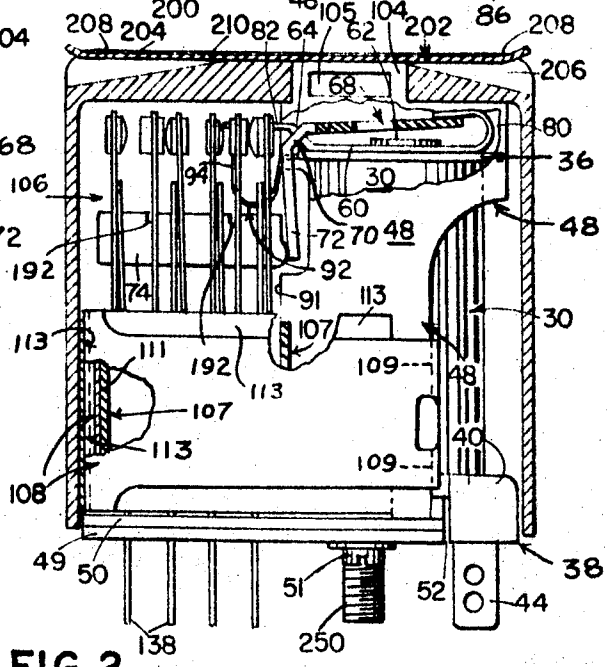


FIG. 2

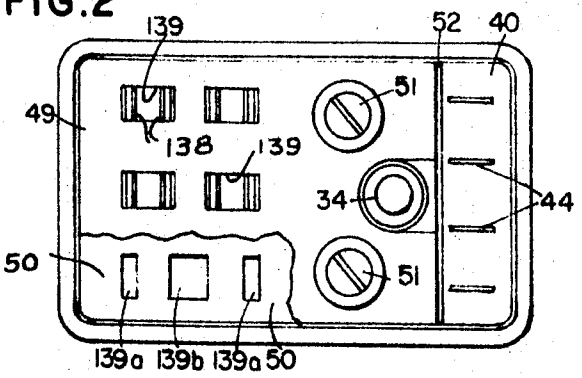


FIG. 3

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Aug. 30, 1966 B. S. BENGTSSON 3,270,301

PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Filed June 13, 1963 6 Sheets-Sheet 2

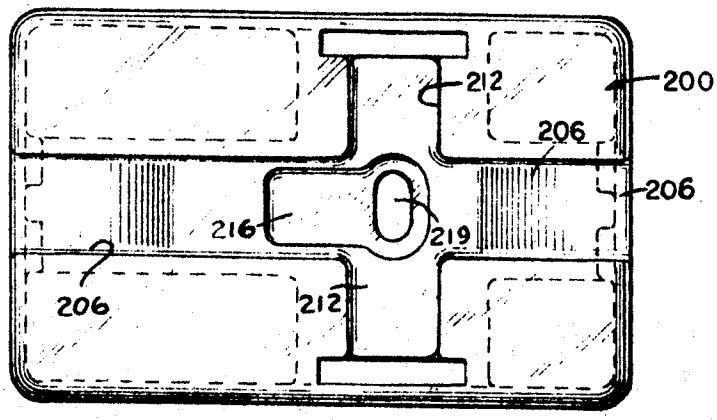


FIG.5

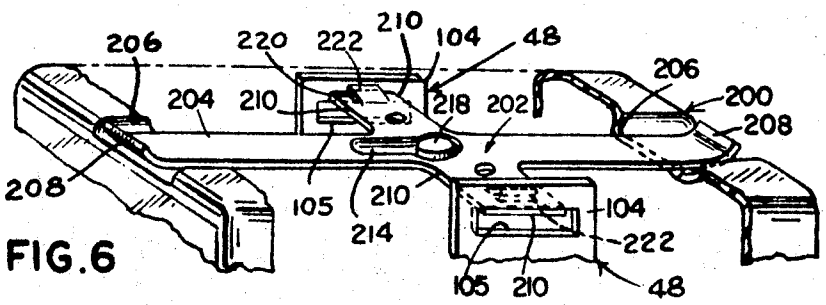


FIG.6

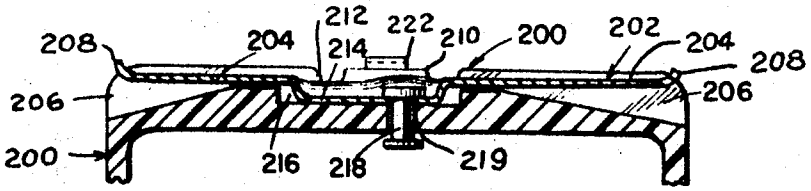


FIG.7

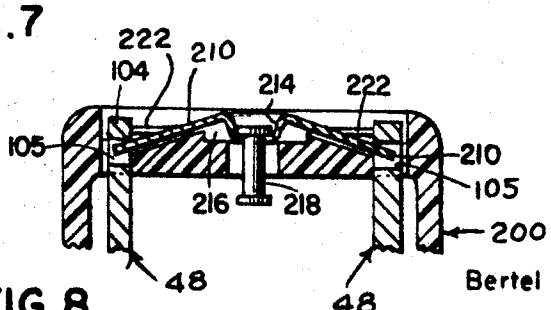


FIG.8

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Aug. 30, 1966 B. S. BENGTSSON 3,270,301

PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Filed June 13, 1963 6 Sheets-Sheet 3

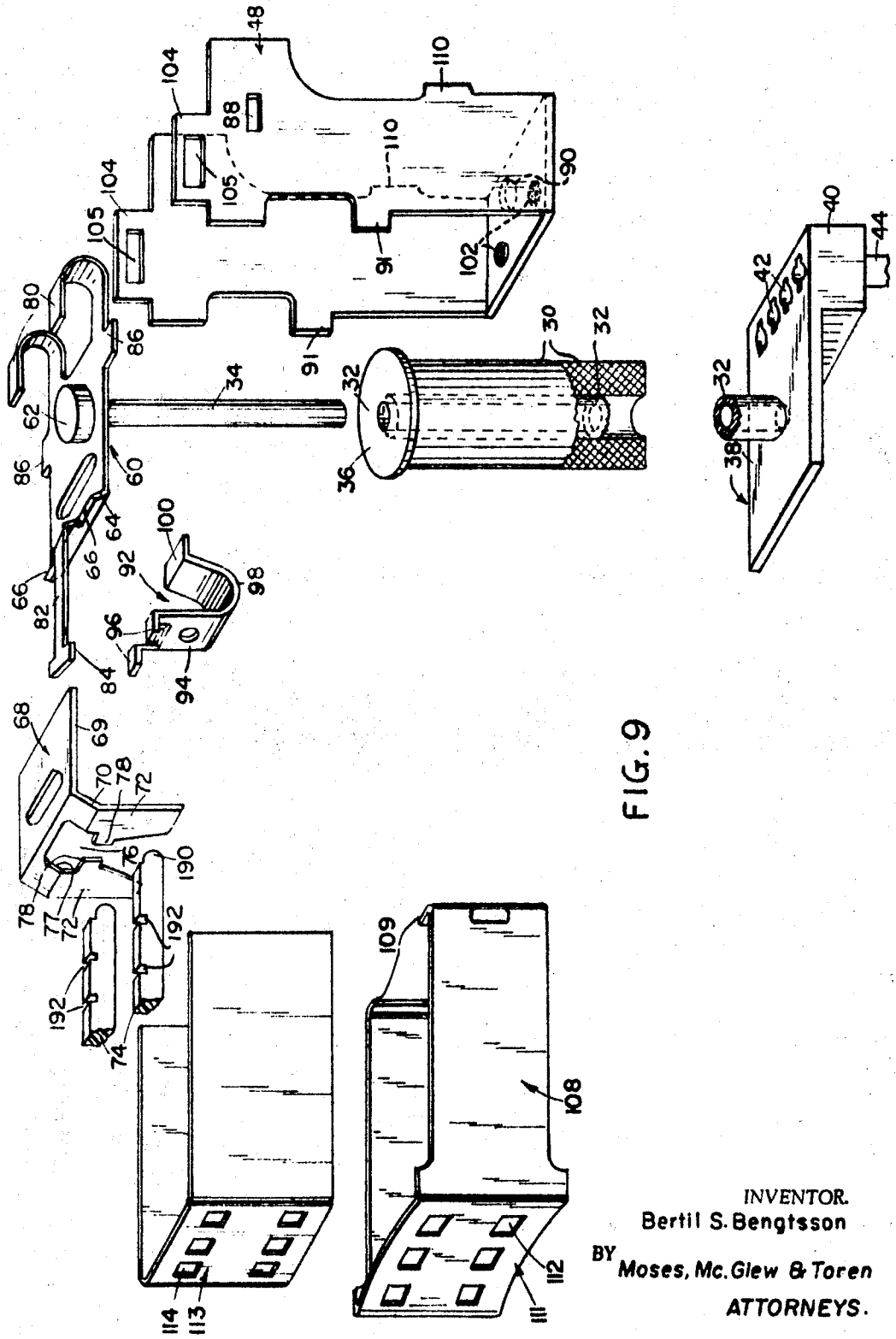


FIG. 9

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PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Filed June 13, 1963 6 Sheets-Sheet 4

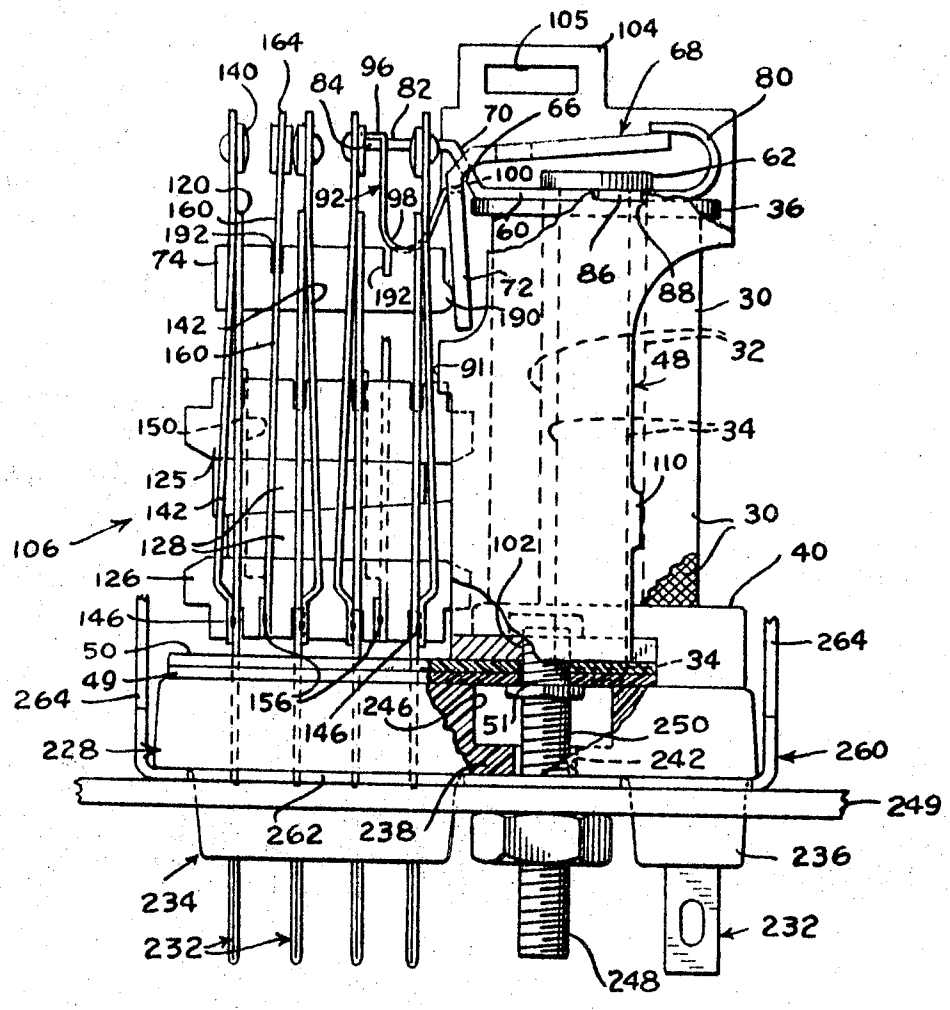


FIG. 10

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Aug. 30, 1966 B. S. BENGTSSON 3,270,301

PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Filed June 13, 1963 6 Sheets-Sheet 5

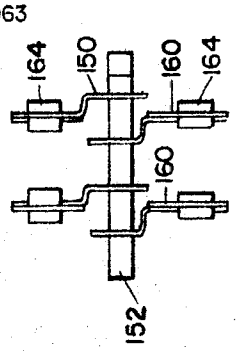


FIG. 17

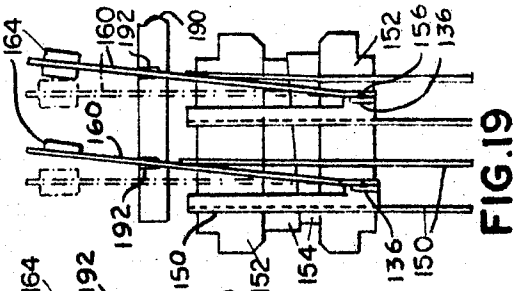


FIG. 19

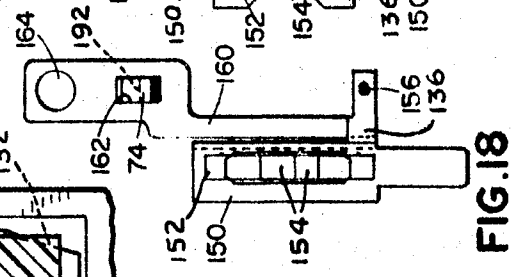


FIG. 18

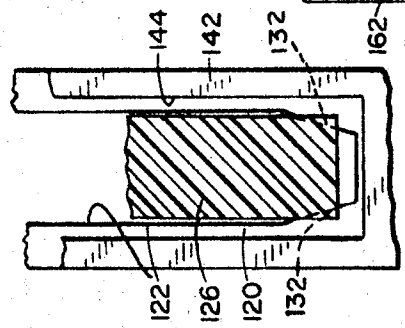


FIG. 15

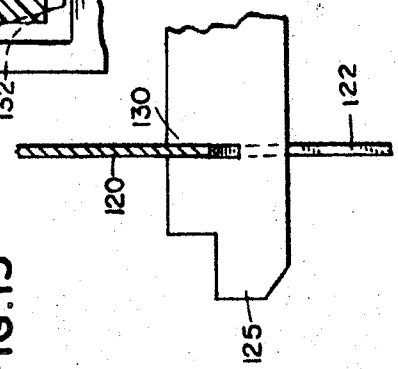


FIG. 16

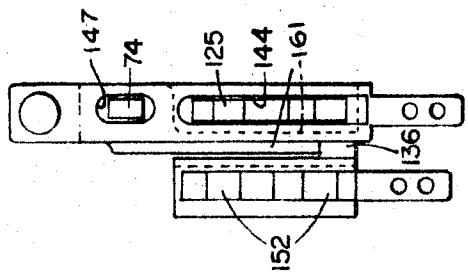


FIG. 13

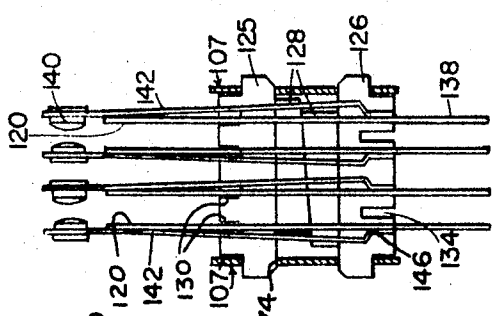


FIG. 12

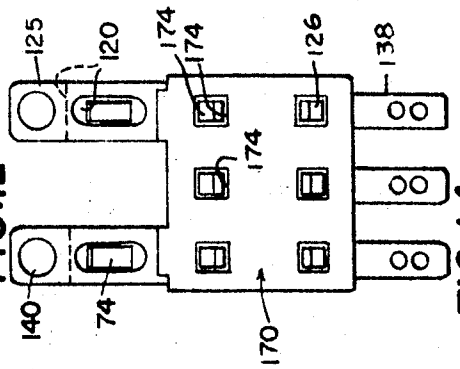


FIG. 14

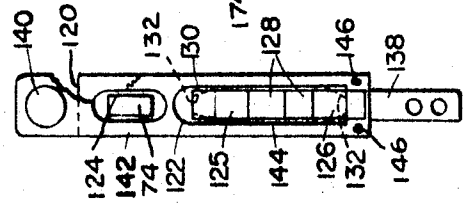


FIG. 11

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Aug. 30, 1966 B. S. BENGTSSON 3,270,301

PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Filed June 13, 1963 6 Sheets-Sheet 6

FIG.20

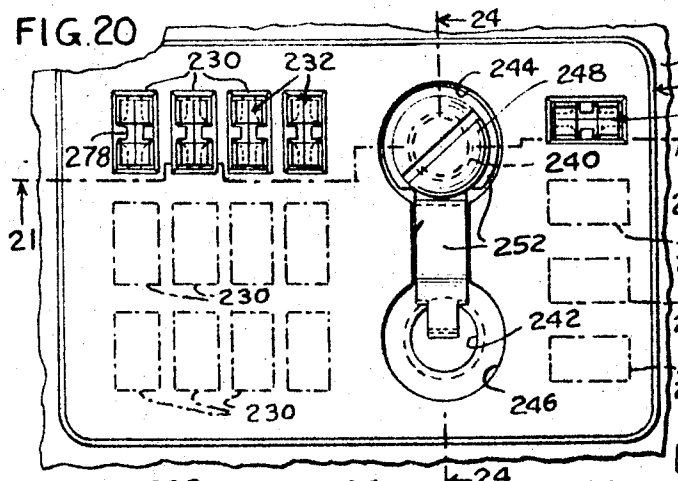


FIG.23

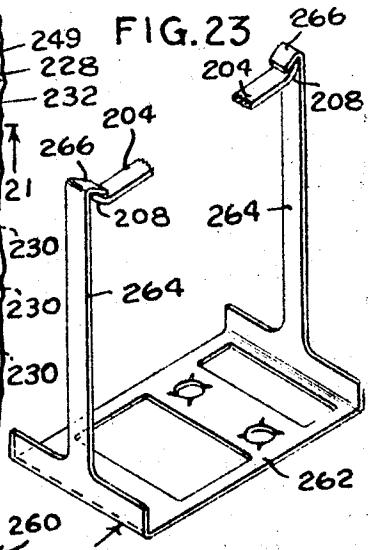


FIG.21

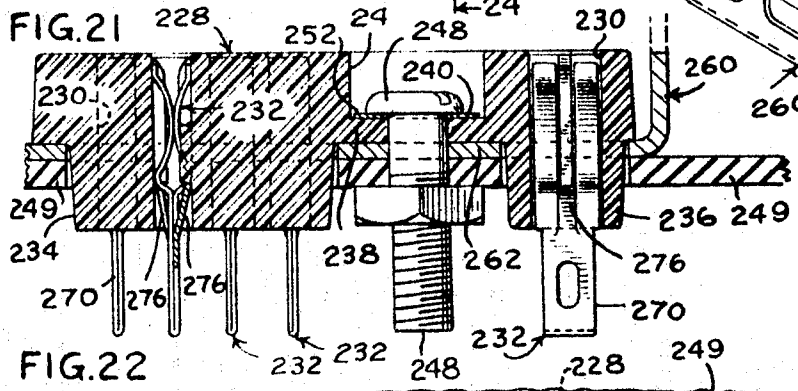


FIG.25

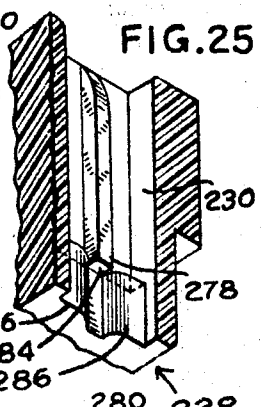
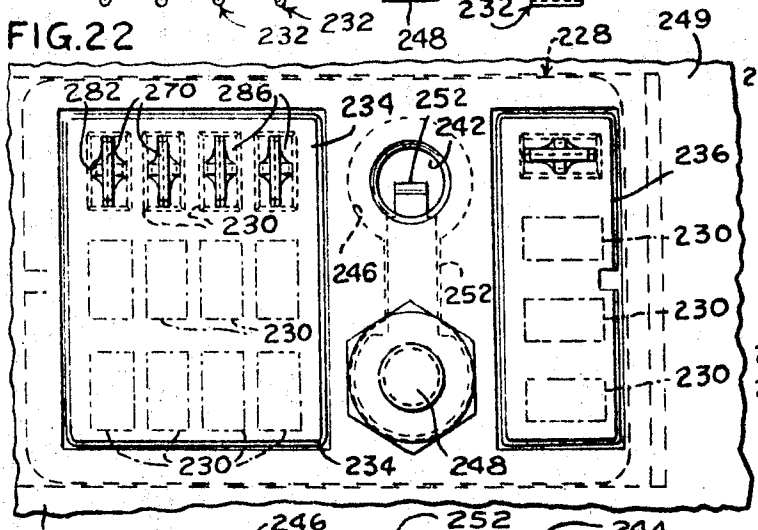


FIG.22



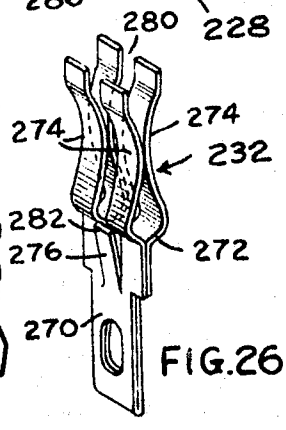


FIG.26

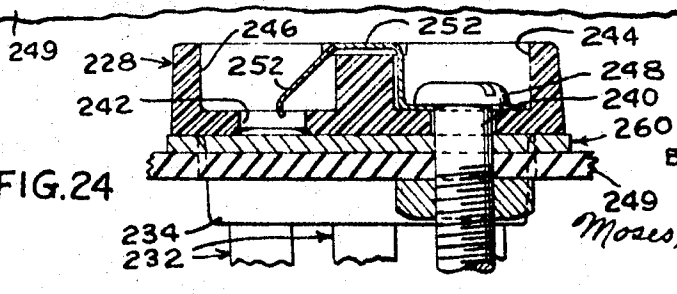


FIG.24

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United States Patent Office 3,270,301
Patented August 30, 1966

3,270,301

PLUG-IN TYPE MINIATURE RELAY WITH TRANSPARENT COVER

Bertil S. Bengtsson, Scituate, Mass., assignor to Sigma Instruments Inc., a corporation of Massachusetts

Filed June 13, 1963, Ser. No. 287,675
13 Claims. (Cl. 335—129)

This invention relates to electric relays and is directed to features of construction of relays having the principal object of providing a relay of the greatest possible reliability in action and long life.

It is an object of the invention to provide a relay construction which can be easily assembled, adjusted and, if necessary, repaired. With these objects in view, a feature of the invention consists in a construction in which the various switch contacts as well as the means for mounting the armature for its pivotal movement are all located in the front part of the relay so that these elements which require adjustment and testing and may show wear with long use are all accessible without necessitating the dismounting of the relay from its support or disconnection of the relay from the conductors connected to the relay terminals.

Other objects of the invention are to provide an armature mounting which is strong and durable and to provide connections between the armature and the movable switch contacts which are easily assembled and which operate with a minimum of friction.

For simplicity of manufacture, it is another object of the invention to provide a motor assembly which may be mounted on the base of the relay and a switch assembly which may be mounted on the motor assembly and connected therewith by contact finger lifters which transmit motion directly from the armature to the contact fingers without actual attachment to either the armature or the contact fingers. The contact fingers are preferably mounted in a pile or piles parallel with the actuating coil of the relay and so arranged that all space within the relay casing is utilized most economically, thereby permitting the relays to be made of minimum overall dimensions.

A novel mode of assembly is preferably used for the contact fingers in which they are held in accurately spaced relationship, which is not dependent upon the interleaving of the contact members and insulation layers. Accuracy of spacing is secured and is maintained throughout the life of the relay. Where insulating spacers are used to separate the fingers, changes in dimensions of the pile-up may occur due to atmospheric conditions which cause swelling or shrinking of the insulating layers. Where spacing is dependent on interleaved layers, exact thickness of the layers must be secured and errors due to inaccuracy of thickness are cumulative.

Another feature of the contact fingers and means for mounting the same permits the flexible part of the fingers to be made much longer than in prior art constructions without increasing the overall size of the relay. The use of the long fingers enables them to be made of thicker stock than if short fingers were utilized and still permit the fingers to have the necessary flexibility. The life of the contact fingers is thereby prolonged. The use of thicker stock also provides fingers of greater conductivity which reduces the internal resistance of the relay. The thickness of the fingers also provides better contact alignment and enables the fingers to resist distortion due to shock.

The improvements in mounting and design of the contact fingers described form the subject matter of an application for United States Patent filed on June 11, 1963, Serial No. 287,039, now Patent No. 3,236,987 and therefore are not specifically covered herein. However, insofar as these features are specifically applicable to and embodied in the relay construction itself, claims to the relay including some of these details are made in the present application.

A further feature of the invention relates to an improved mounting of the armature.

A still further feature of the invention is a novel cover construction which may be mounted over the relay and taken off without dismounting the relay from its support. The cover construction is also of such nature that the cover may be made of a transparent plastic which can be very rigid.

Another novel feature of the present invention is an improved socket in which the relay is supported.

Many other objects and advantages will appear in the course of the detailed description of a preferred embodiment of the invention shown in the accompanying drawings, which form a part of this specification.

In the drawings:

FIG. 1 is a front view, FIG. 2 a side view, FIG. 3 a rear view and FIG. 4 a top view of the relay. In FIGS. 1, 2 and 4 the casing is shown in section;

FIG. 5 is a view on a larger scale showing the front of the relay casing with the casing retaining spring removed;

FIG. 6 is a perspective view of the front of the relay, parts of the casing being broken away;

FIG. 7 is a vertical sectional view of the front of the casing and means for securing it;

FIG. 8 is a horizontal section of the parts shown in FIG. 7;

FIG. 9 is an exploded perspective view showing various parts of the relay.

FIG. 10 is a side elevation of the coil, armature and certain of the contact fingers, parts being broken away;

FIG. 11 is an elevation of the stationary contact fingers of the pile-up;

FIG. 12 is a side elevation of the pile-up shown in FIG. 11;

FIG. 13 is a view similar to FIG. 11 showing a part of the movable contact pile-up assembled with the fixed contact pile-up;

FIG. 14 is a front elevation showing the complete assembly of the fixed and movable contact fingers;

FIG. 15 is a fragmentary elevation on an enlarged scale of a part of the pile-up assembly shown in FIG. 11, parts being shown in section;

FIG. 16 is a fragmentary section showing the engagement of one of the bracket plates with the comb;

FIG. 17 is a top view of the movable contact pile-up showing the movable contact fingers and one of their supporting combs;

FIG. 18 is an elevation of one of the movable contact pile-ups showing the right hand set of fingers only;

FIG. 19 is a side elevation of the movable contact pile up shown in FIG. 18;

FIGS. 20 to 26 show a socket construction which may be used in connection with the relay; FIG. 20 being a front view of the socket; FIG. 21 being a section on line 21—21 of FIG. 20; FIG. 22 a rear view; FIG. 23 a perspective of a relay holding frame carried by the socket; FIG. 24 a section on line 24—24 of FIG. 20; FIG. 25 an enlarged sectional perspective showing the inside of one of the recesses in the socket; and FIG. 26 is an enlarged perspective of one of the spring contact clips.

In the drawings, some of the figures are on a larger scale than other figures. It will be understood, of course, that the actual dimensions of the relay will depend upon the use for which the relay is designed. The construction, however, can be embodied in very small relays and, in the case of the particular construction chosen for illustration, an idea of the actual size of the relay may be

gained from the fact that the maximum linear dimension of the relay is about 1¼ inch.

Referring to the drawings in detail, the illustrated relay comprises a motor consisting of an electromagnet and a movable armature attracted thereby. In the example of the invention illustrated, an armature mounted for pivotal movement about a knife-edge is most satisfactory. The electromagnet comprises a coil **30** wound on a bobbin **32** and having a ferrous core **34**. The bobbin is of rigid material such as a phenolic plastic and has a conventional head **36** at its front end and a head **38** at its rear end which carries a terminal block **40** having holes **42** in which are mounted the terminals **44** to which the ends (not shown) of the coil windings are attached. The coil is mounted in a U-shaped frame **48** of magnetic material. Shield plates **49** and **50** of a hard plastic, secured to the frame **48** by screws **51**, serve the two-fold purpose of switch support and dust cover.

The front end of the core projects through the pivot plate **60** and has an enlarged head **62** resting on and supporting the plate. The pivot plate is preferably made of the form shown with an angular section **64** having knife-edges **66** upon which the armature **68** pivots. The pivot plate is made of non-magnetic material such as Phosphor bronze. The making of the pivot plate of non-magnetic material is important as it greatly increases the wear resistance because of lower pressure on the pivot edge, as the magnetic field will not traverse the pivot plate, and also due to the same cause magnetic particles which would increase wear will not be attracted to this area. There is no flux concentration at the knife-edge as would occur if the pivot plate were of magnetic material. The armature **68** comprises a major portion **69** which passes across the head **62** of the core, a rearwardly bent section **70** which pivots on the knife-edges **66**, and two spaced operating arm portions **72** which engage the contact spring lifters **74** which form the operative connection between the motor and the movable contact springs to be described. Between arms **72** is a slot **76** which has a widened portion **77** separated from the narrow portion by lugs **78**. At its lower edge, the pivot plate **60** has two bent-up tabs **80** which form back stops for engagement with the lower edge of the armature **68**. The extent of movement of the armature may be adjusted by bending the tabs more or less. The pivot plate **60** is extended beyond the knife-edges **66** to form a narrow neck **82** having a T-shaped head **84**. The neck **82** passes freely through the slot **76** in the armature. The pivot plate is provided with side lugs **86** which enter slots **88** in the sides of the frame **48** so as to locate the pivot plate properly and help in supporting the coil in position. The rear end of the core **34** projects through the bobbin **32** and fits tightly in a hole **90** in the rear end of the frame **48**. The rear end of the core preferably makes a driving fit with the hole **90** so that when driven through the hole, the bobbin and pivot plate **60** are locked firmly between the back of the frame and the head **62** of the core. The frame **48** is also provided with lugs **91** which form stops for locating the contact pile-ups, as will be described below.

The armature **68** is held in position by means of a return spring **92** which has a portion **94** terminating in two lugs **96** which engage the T-head **84** of the pivot plate. The spring also has a return bend portion **98** which terminates in a bent edge flange **100** which fits in the wide portion **77** of the slot **76** in the armature and bears on the lugs **78**. The spring **92** positions the armature by holding the rearwardly bent portions **70** in contact with the knife-edges **66** of the pivot plate. The spring also applies a biasing force to the armature which holds the lower edge of the armature portion **69** against the back stop tabs **80** of the plate **60**. When the coil is energized, the armature part **69** is drawn towards the head **62** of the core until it is parallel therewith. This causes the arms **72** of the armature to push up the spring lifters **74**. The spring **92** provides the necessary biasing force to hold the armature part **69** away from the end of the core when the coil is not energized.

When the relay is mounted against a perpendicular panel, as in the instance described, the coil is horizontal and the armature is on the front end of the coil so that if the casing or housing of the relay is removed, the armature is exposed to view and its pivotal mounting on the knife-edges may be inspected and any defects corrected. Furthermore, the return spring **92** is also at the front end of the coil where it may be inspected and adjusted. The force applied by the spring may be adjusted by bending the tongue **82** of the pivot plate to which the end of the spring is attached.

The frame member bottom is provided with threaded holes **102**. At the outer ends of the side arms of the frame, extensions **104** are provided which project through slots in the relay cover and which have slots **105** therein to receive the retaining tongues of the cover retaining plate to be described below.

The switch assembly

The switch assembly shown comprises three intermeshed pile-ups, two comprising the stationary contact fingers and the other comprising the armature-moved contact fingers. These fingers and the pile-ups may be of any known construction, but are preferably constructed in the manner described in copending application Serial No. 287,039 above referred to.

The pile-up, designated generally by the numeral **106**, comprises a group of bracket plates carrying contact fingers and held together by comb members in a manner which will be described in detail below. On the sides of the pile-up assembly **106** are mounted spacer plates **107**. This pile-up assembly is mounted adjacent to and carried by the frame **48**, one of the spacer plates **107** resting on the side members of the frame **48** and bearing against the lugs **91**. The pile-up assembly is directly secured in this position by means of a spring clip **108** having arms extending on each side of the pile-up assembly and having an inwardly curved end **111** which holds the pile-up assembly against the frame. The ends of the arms of the spring clip **108** are bent over at **109** and snap over the lugs **110** on the frame, the curved end **111** being partly straightened out during this process so as to hold the pile-up in position under constant spring tension. The curved end **111** is provided with holes **112** in which parts of the pile-up mounting means are received. Inside of the spring clip a U-shaped layer of insulation **113** is preferably mounted, this layer of insulation having the holes **114** matching the holes **112**.

In the construction here shown and as disclosed in said patent application Serial No. 287,039, the contact fingers are not piled one on top of the other separated by insulating separators. Instead, the contact fingers are held in spaced relationship by means of notched combs which are passed through holes in the brackets carrying the contact fingers and forced into engagement with the edges of the holes by means of expansion elements, such as wedges.

Referring to FIGS. 11 and 12, these show the stationary contact pile-ups, each member comprising a bracket or plate **120** having a long slot **122** therein and a shorter slot **124**. Two of these stationary pile-ups are used in the illustrated construction as shown in FIGS. 1, 4 and 14. A series of the plates or brackets **120** is set up in a nest or fixture (not shown) which holds the plates or brackets in position properly spaced apart. The combs **125** and **126** are then inserted in the slots **122** and the wedges **128** are driven between the backs of the combs so as to force the notches **130** in the combs into engagement with the ends of the slots **122**. The ends of the slots are wedge-shaped as indicated at **132** so that these wedge-shaped edges will bite into the combs at the bottom of the notches **130** and lock the bracket plates firmly in accurately spaced position. The combs **126**, in addition to the notches **130**, also have notches **134** between the

bracket-engaging notches, the notches **134** being for engagement with projections **136** formed on the bracket plates **150** on which are mounted the armature movable contact fingers to be described. The bracket plates **120** are provided with tabs **138** which, when the spring pile-ups are mounted in the relay, project through holes in the shield plates so that they may be plugged into suitable sockets or may be soldered to connecting wires or otherwise connected in circuit. The holes in the shield plates are preferably arranged in differing but registering series as shown in FIG. 3. In one of the plates, for instance plate **49**, are six holes **139** arranged in three rows of two each, two tabs **138** passing through each hole. In plate **50** there are three holes in each row, two narrow holes **139***a* each receiving one tab, and a wider central hole **139***b*, through which pass the two adjacent central tabs of each row. This arrangement of the holes and tabs provides a completely enclosed base, permits easy assembly and gives better support and alignment to the tabs.

The bracket plates **120** preferably do not form the actual contact fingers or carry the contact buttons as in most spring pile-ups. Instead, the contact buttons **140** are carried on the ends of spring contact fingers **142** which have slots **144** therein wide enough to pass freely over the combs **125** and **126** and wedges **128**, without contact therewith, the lower ends of the contact fingers being welded or otherwise secured to the bracket plates **120** below the slots **122** as indicated at points **146**. In this way, a very substantial increase in length of the contact fingers is secured without any increase in the overall length of the spring pile-up. This is because the contact fingers bend from points **146** which are at the further end of the means by which the contacts are mounted, as represented in this case by the rear combs **126**. On the contrary, in the ordinary spring pile-up, the only flexible part of the spring is that from the forward ends of the spacers between the contact fingers (which in this instance would be represented by the forward combs **125**) to the buttons of the contact springs. With the present construction, the length of the flexible contact fingers is practically at least double the fllexible length which could be secured by the old construction. This decreases the sharpness of the bend, reduces metal fatigue and enhances durability. It also has the important advantage of permitting a heavier stock to be used in the contact fingers, thereby securing a greater rigidity in a lateral direction and better alignment of the contacts. The greater weight of stock also provides a greater current capacity thereby reducing the resistance of the contact fingers of the relay. By properly shaping the contour of the contact fingers, the desired spring pressure of the fingers may be secured. In other words, the spring contact fingers are so shaped initially that they will press with a given force against the outer ends of the bracket plates and will present the proper resistance when engaged by the movable contacts.

A somewhat similar pile-up is used for the armature moved contacts. These contacts, as shown particularly in FIGS. 17, 18 and 19, comprise flanged bracket plates **150** which are held together by means of combs **152** separated by wedges **154** similar to the combs and wedges shown in connection with the stationary spring pile-ups. Brackets **150** have flanges **136** to which are welded at **156** the spring contact fingers **160**. The brackets and fingers are formed as rights and lefts arranged alternately and intermeshing respectively with the two series or stationary contact pile-ups described. The contact fingers **160** have slots **162** therein through which pass the lifters **74** aforementioned. At the outer ends of the contact fingers **160** are the movable contact buttons **164**. The assembled spring pile-ups are completed by having spacer plates **170** and **172** placed on the sides thereof, these plates having holes **174** formed therein which snap over the ends of the combs.

The movable contacts **164** mounted on the contact fingers **160** are moved by the lifters **74** which have rounded bearing ends **190** which rest on the armature portions **72**. The lifters are provided with notches **192** which engage the movable contact fingers **160**. The lifters pass through the slots **124** in the plates **120** and through the slots **147** in the contact fingers **142**. This means of connecting the motor to the switch elements is of the simplest character and embodies no connecting means other than the mere pressure of the curved portions **190** against the armature. There is an absolute minimum of friction. The lifters are preferably made of a very light material such as a hard plastic and the inertia of the movable system is reduced to a minimum. The armature itself has no switch parts permanently affixed thereto.

The relay housing

In many if not most instances, it is desirable to enclose the relay in a tight housing. It is also desirable to make the housing of a transparent material as this permits the operation of the relay to be inspected without removal of the housing. In many prior relays, plastic housings have been used which were secured to the relay by having parts of the plastic snapping into engagement with the relay base. However, where it was desired to use a transparent housing, difficutly was experienced because the transparent material most available for housings is not resilient enough to form a part of the housing mounting means by snapping with projections or otherwise so as to hold it in place. In accordance with the present invention, a housing is utilized which is held in place by means of a metal retainer so that the resiliency of the housing is not iself relied upon for this purpose.

In the construction shown, the plastic housing or cover is indicated at **200** and has fixed to its outer surface a retainer **202** which comprises a spring metal plate preferably of cruciform shape having long arms **204** fitting in grooves **206** in the top of the cover and having outwardly bent ears **208**. The retainer has cross arms **210** which lie in grooves **212** in the outer face of the cover. The central part of the cruciform retainer plate is depressed at **214** to fit into a recess **216** in the cover in which it is held by a rivet **218**. The recess **216** is wider than the depression **214** and the hole **219** in the cover is also wider than the rivet **218**, so that the retainer **202** may be moved slightly sideways to facilitate engagement and disengagement of the cross arms with the ears **104** of the frame **48**. In the arms **210** there are cut-outs **220** near their ends and the portions inside of the cut-outs are bent out of the plane of the arms so as to form stops **222**. When the cover is to be attached to the relay, it is pressed thereover and the ends of arms **210** are caused to snap between the perforated ears **104** of the frame **48**. When it is desired to remove the cover, the ends of the arms are disengaged from the ears **104** and the cover is free to be lifted off.

Socket construction

The relay may be mounted upon the supporting panel in any suitable manner and the terminals may be connected to the conductors by soldering or in any other suitable way. However, it is often preferable to provide a supporting panel with a socket having socket contact members into which the terminal tabs on the relay may be pressed, thus supporting the relay mechanically as well as establishing electrical connections. FIGS. 20–26 show a suitable construction of socket. This is a hard plastic molding **228** having recesses **230** therein in which are mounted spring terminals **232**. The socket member **228** has two bosses **234** and **236** on its bottom which are separated by a portion of reduced thickness **238**. In the latter are holes **240** and **242** which open into sunken depressions **244** and **246**. In the hole **240** is a screw **248** which holds the socket member to the panel board or

wall 249, the screw being grounded in any suitable manner. The hole 242 receives a stud 250 on the relay base. A grounding spring 252 is mounted on the screw 248 and is engaged by the stud 250 so as to ground the magnetic circuit of the relay. The socket member is shown as provided with a relay retaining clip 260 having a base frame 262 and two spring uprights 264 which extend up at each end of the relay and have hooked ends 266 which are engaged by the ends 208 of long arms 204 of the cover retaining plates 202, thus holding the relay to the panel board.

The spring clips 232 as shown particularly in FIGS. 21 and 26, are formed of two thicknesses of spring material of good conductivity such as Phosphor bronze, the lower parts of which form flat stems 270 which are offset at 272 so as to form pairs of inwardly curved contact spring portions 274 which press against the tabs 138 projecting from the relay. The two thicknesses of material may, if desired, be formed from a single blank doubled upon itself. The clips 232 are retained in the recesses 230 by lances or short tongues 276 cut out of the stems 270 and bent so as to normally spring apart when the clips are forced into their recesses. The recesses are formed with projecting ribs 278 (FIG. 25), located in the cutouts 280 between the pairs of contact spring portions 274. The lances 276 are pressed in as they slide over the ribs 278 and then spring out so that their tops 282 snap under the shoulders 284 at the bottoms of the ribs 278, thereby positively locking the clips 232 in their recesses. In the lower parts of the recesses 230 are stop ribs 286 which engage the offsets 272 of the clips 232 and properly locate the clips in the recesses.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. In an electric relay, a coil having a magnetic core extending therethrough, a non-magnetic pivot plate, having at one end a transverse edge which constitutes a knife-edge bearing, carried by an end of the core, a magnetic armature pivotally mounted on said knife-edge bearing and having a free end extending inwardly from said bearing and placed so as to be magnetically influenced by said end of the core, a contact pile-up having contact fingers extending parallel to the axis of the coil, the ends of the fingers being adjacent to the end of the coil where the armature is pivoted, said armature having an end extending outwardly from said bearing and operative on said contact fingers to actuate the latter upon pivoting of said armature, and means for supporting the contact pile-up near the opposite end of the coil, said pivot plate having fingers spaced from its said one end and bent therefrom and extending over the free end of said armature, and said fingers being bendable to pre-set one limit of pivotal movement of said armature.

2. A relay having a motor assembly including a frame, a coil mounted in the frame having a core, the rear end of which is fixed to the frame, the outer end of the core having a head thereon, a pivot plate of non-magnetic material having a hole therein through which the coil core passes, the head of the core engaging the pivot plate and holding it to the coil, and an armature pivotally mounted on the pivot plate, the pivot plate having a transverse edge thereon, the armature bearing against said edge, the pivot plate having a neck projecting beyond said edge and an armature return spring, one end of which engages the armature and the other end of which engages said pivot plate neck.

3. A relay having a motor assembly including a frame, a coil mounted in the frame having a core, the rear end of which is fixed to the frame, the outer end of the core having a head thereon, a pivot plate of non-magnetic material having a hole therein through which the coil core passes, the head of the core engaging the pivot plate and holding it to the coil, and an armature pivotally mounted on the pivot plate, the pivot plate carrying a bendable tab forming an adjustable back stop for the armature.

4. In an electric relay, a frame having parallel spaced legs, a coil mounted between said legs, and an armature carried by the frame, a contact pile-up comprising a plurality of spaced bracket plates having registering slots therein, means for securing said bracket plates together comprising toothed combs passed through the slots in said plates and means for holding said combs spread apart so that the teeth of the combs engage said bracket plates and hold them in proper spaced relationship, flexible contact fingers carried by said bracket plates extending parallel with the axis of said coil, a spacer plate mounted on a side of said contact pile-up, said spacer plate being mounted on the sides of the frame legs and bearing against locating stops formed on said legs, a spring clip passing over the contact pile-up and spacer plate and holding said pile-up in fixed position on said frame and operating means connected to said contact fingers and engaged with said armature for operation of said contact pile-up by said armature.

5. A construction as claimed in claim 4, in which the contact fingers are secured at their rear ends to the rear ends of said bracket plates and are thereby free to bend practically throughout the entire length of the fingers.

6. An electric relay comprising a motor assembly having a U-shaped frame, the transverse portion of said frame having a hole therethrough, a magnetic core mounted in said frame having an end passing through said hole and forming a driving fit therewith, a plastic bobbin mounted on the core, a coil on the bobbin, a non-magnetic armature pivot plate having a hole therein through which the magnetic core passes, the outer end of the core having a head bearing against the pivot plate and holding the pivot plate and bobbin in position when the inner end of the core is driven through the hole in the frame.

7. An electric relay comprising a motor assembly having a U-shaped frame, said frame having a hole through the end of the U, a magnetic core mounted in said frame having an end passing through said hole and forming a driving fit therewith, a plastic bobbin mounted on the core, a coil on the bobbin, an armature pivot plate of non-magnetic material having a hole therein through which the core passes, the outer end of the core having a head bearing against the pivot plate and holding the pivot plate and bobbin in position when the inner end of the core is driven through the hole in the frame, said pivot plate having a transverse edge thereon, a magnetic armature pivoted on said edge, said pivot plate also having a neck projecting beyond said edge, a spring engaging said armature and said neck and biased to hold the armature in position and to apply a biasing force thereto, and a contact pile-up secured to the frame.

8. An electric relay comprising a motor assembly and a contact finger assembly and a plastic casing enclosing said assemblies, and having fixed to its outer wall a spring plate for holding said casing in position, the motor assembly including a frame having a bottom and legs extending outwardly from said bottom, said legs terminating in projecting formations, the plastic casing having holes therein through which said leg end formations pass, the casing holding plate engaging said end formations.

9. A construction as claimed in claim 8, in which the spring casing holding plate is shiftably mounted on the front of the casing so as to facilitate the engagement and disengagement of the plate with said end formations.

10. A construction as claimed in claim 9, in which the spring plate is of cruciform shape and has transverse arms which engage said end formations, the plate and casing having interengaging formations preventing substantial angular displacement of the plate on the casing but per-

mitting lateral displacement of the plate in the direction of said transverse arms.

11. A construction as claimed in claim 10, in which a socket member is provided for attachment to a support, said socket member having sockets therein for receiving and holding the contact pins of the relay, and a frame carried by the socket member having spring arms projecting therefrom, said arms having end formations engaging the ends of the longitudinal arms of the cruciform casing holding plate.

12. In a relay having a frame, a motor assembly and a contact pile-up assembly mounted thereon, said contact pile-up assembly including a plurality of contact elements having extensions projecting rearwardly therefrom, the frame carrying two superimposed plates of insulating material each of which has an opening large enough to permit two adjacent contact extensions to project therethrough, the opening in one plate permitting the passage of one pair of contact extensions, and the opening in the other plate permitting the passage of one of said contact extensions and of a third contact extension, said plates each having a solid portion overlying and closing the part of the opening in the other plate between the adjacent contact extensions extending through said plate.

13. A construction as claimed in claim 12, in which the relay is provided with a cover, the openings in the plates being staggered so that each plate covers all open portions in the other plate except those through which the contact extensions actually pass.

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