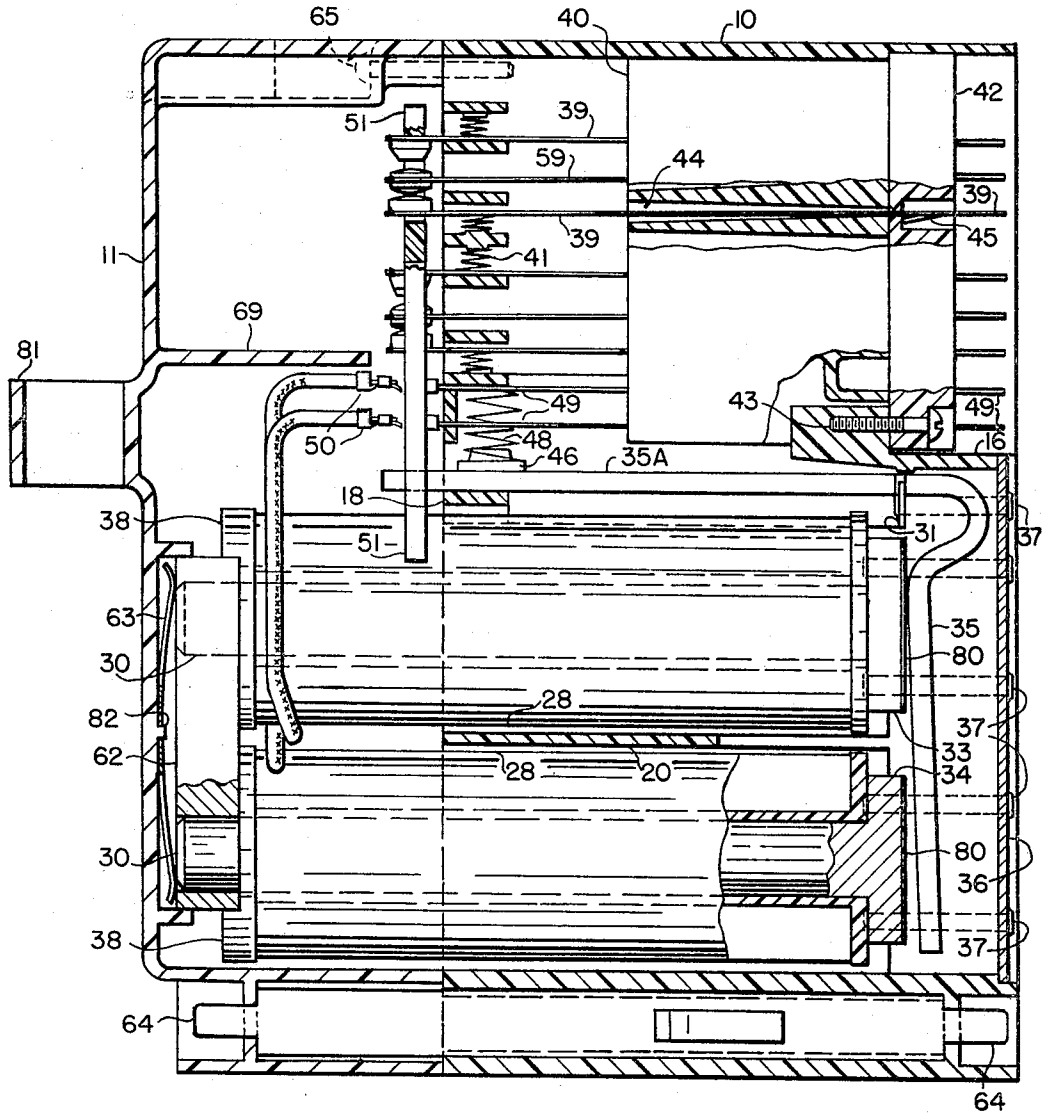
April 28, 1970 W. D. MAYNARD ET AL 3,509,502

ELECTROMAGNETIC RELAY STRUCTURE

Filed Nov. 7, 1967 4 Sheets-Sheet 1

FIG. 1



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ELECTROMAGNETIC RELAY STRUCTURE

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FIG. 2

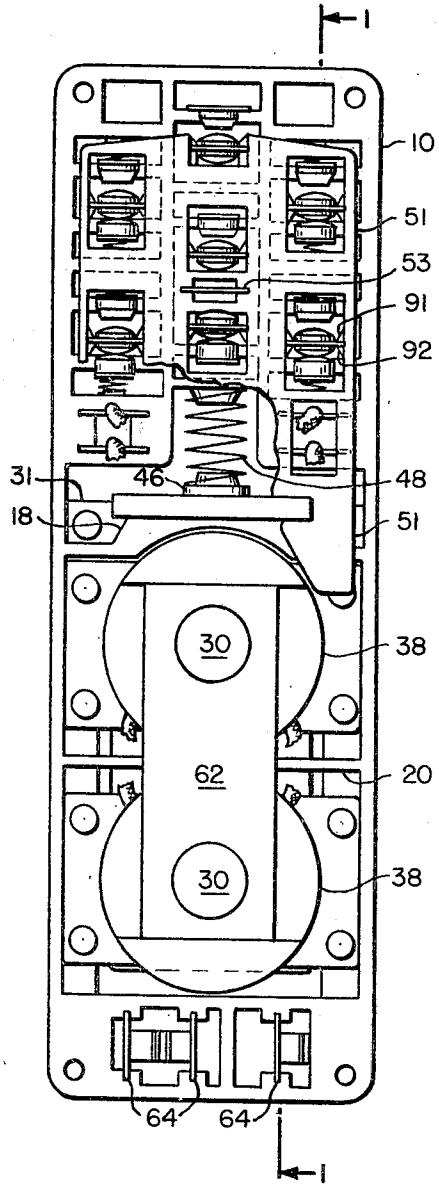
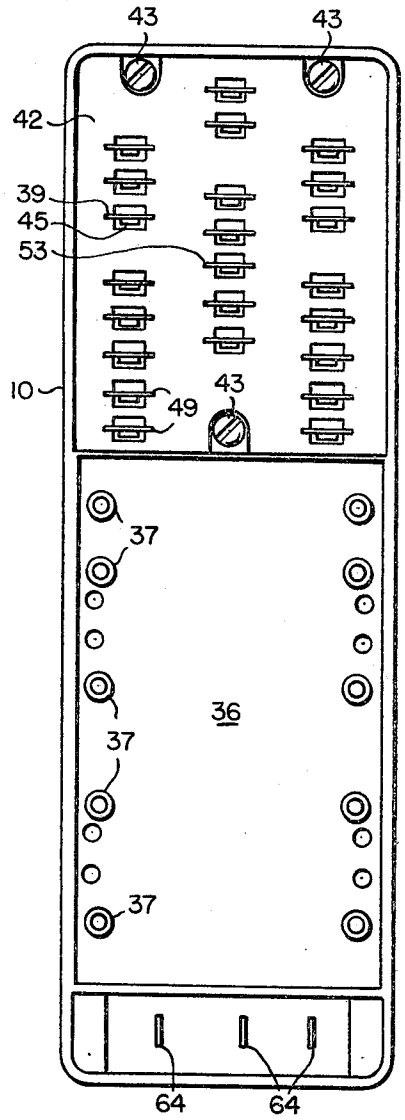


FIG. 3



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ELECTROMAGNETIC RELAY STRUCTURE

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FIG. 4

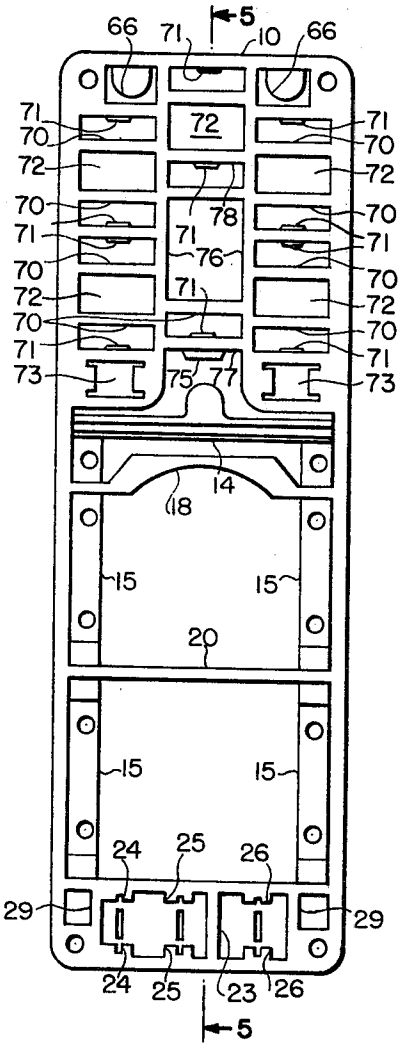


FIG. 5

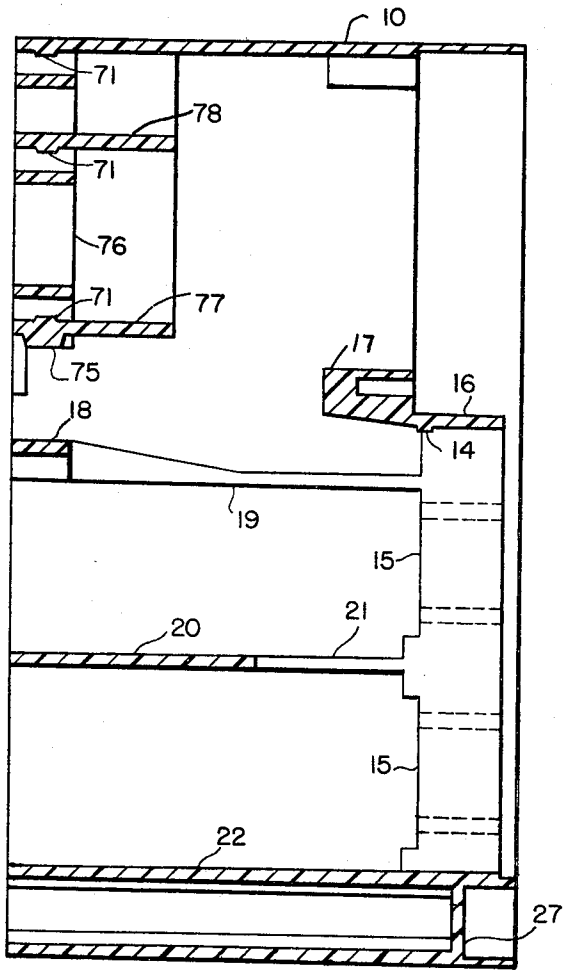
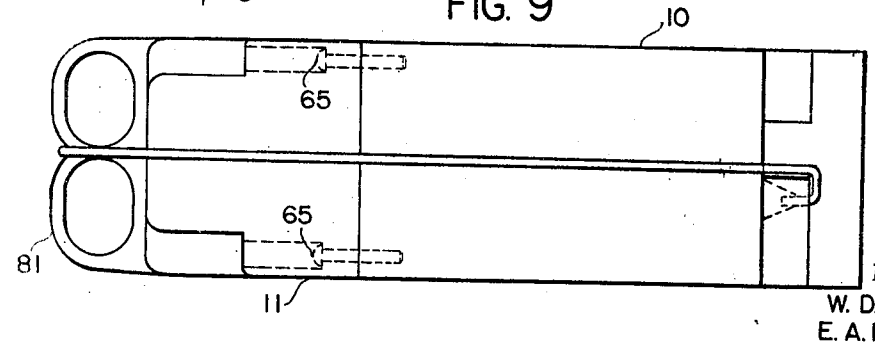


FIG. 9



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FIG. 7

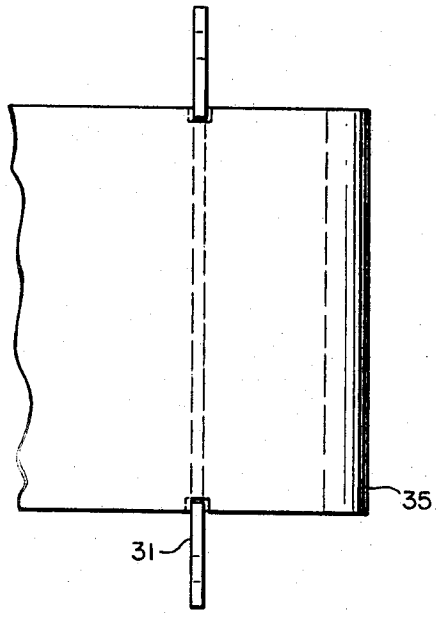


FIG. 8

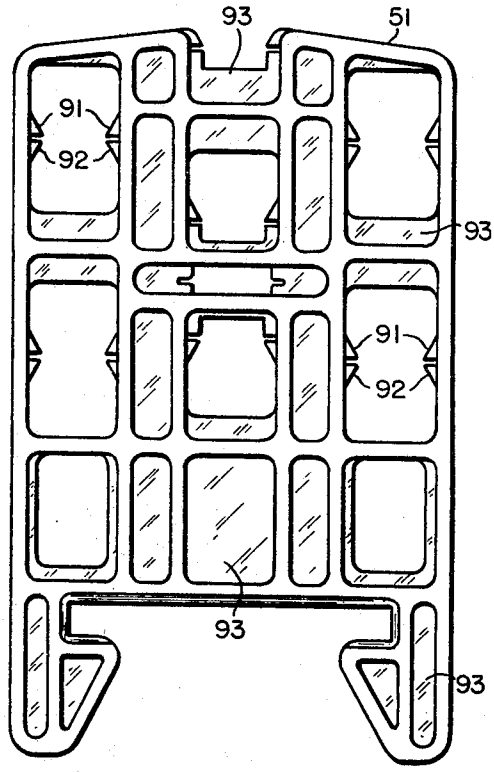
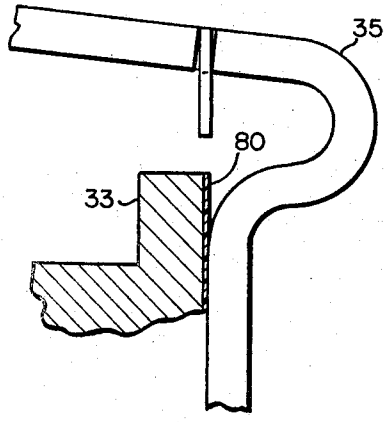


FIG. 6



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United States Patent Office 3,509,502
Patented Apr. 28, 1970

3,509,502

ELECTROMAGNETIC RELAY STRUCTURE

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Filed Nov. 7, 1967, Ser. No. 681,209
Int. Cl. H01h 50/58, 50/64
U.S. Cl. 335—129 11 Claims

ABSTRACT OF THE DISCLOSURE

This electromagnetic relay is of the safety type as used by railroads. It has parts molded of black fiber glass plastic material and has other parts formed of metal and constructed to be assembled in such a way as to provide a composite structure requiring no adjustment after initial assembly. The armature is mounted on a knife edge bearing with the working airgap at the rear of the relay and the contact operator at the front of the relay. The plastic cover holds a magnetic back yoke in place for connecting the two magnetic core members, which back yoke is directly removable when the cover is removed so as to be able to replace the coils without further disassembly. The coils have quick detachable connectors which connect to the coil lead fingers at the front of the relay. The contact fingers are pushed into position from the front of the relay with the cover removed and a guide block is permanently provided for assisting the entry of the contact fingers into the rear mounting block into which such fingers automatically lock when they are placed in position.

BACKGROUND OF THE INVENTION

The present invention relates to railroad safety relays, and more particularly to an electromagnetic relay assembled from a multiplicity of parts and constituting an operable relay when once assembled without further adjustment.

Heretofore, electromagnetic relays of the safety type have been built which are highly efficient, but most expensive to manufacture. One of the reasons for the expense in manufacture is that the relay requires a fine adjustment after initial assembly in order to be properly operative. Also, such fine adjustment of the relay tends to deteriorate and reduce the life of the relay.

The present invention relates to a safety type relay which has a gravity biased armature for operating the contacts, which armature is additionally biased by a suitable coil spring so as to minimize its response to vibration and bounce, and also to maintain its operability uniform over a long life. The armature operates the contact fingers of the relay through a contact pusher member connected to the contacts directly in line with their contact points to directly oppose any tendency to stick due to fusion effects that might develop through the relay operation; and also to avoid the variable deflection of the contact fingers.

Thus, the purpose of the present invention is to provide an improved safety relay which does not require adjustment after the initial assembly, and which is easily and rapidly assembled from parts that can be mass produced and yet meet the rigid requirements necessary for safety operations.

Another object of the present invention is to provide an improved relay assembly wherein the parts are readily assembled into precise positions due to the type of manufacture of the parts so as to provide the desired operating

characteristics which are insensitive to minor production variations.

A further object of the invention is to provide a relay having an efficient magnetic structure which can be quickly and readily disassembled in part for the replacement of the coils on the relay.

SUMMARY OF INVENTION

In general, the relay of this invention includes a housing structure having the shape of a parallelepiped with rectangular bases, a lattice structure located inside the front of the housing structure and integral therewith, the lattice structure having spaced openings, with a guide block located in the housing structure abutting the lattice structure, and a slotted contact mounting block located within the housing structure at the rear of the guide block, the slots in the contact mounting block being located to match the spaces in the lattice structure, and the guide block having internal chutes with openings at one end matching the spaces in the lattice structure and with openings at the other end matching the slots in the contact mounting block.

The relay of this invention is further characterized by having its housing in the form of a rectangular box substantially open on the inside thereof with openings at the front and back and with the other sides completely enclosed, an electromagnetic structure located in the lower portion of the housing and having an L-shaped armature cooperating therewith, one arm of the armature cooperating with the electromagnet at the rear of the relay to form a working airgap, and the other arm of the armature extending forwardly through the mid portion of the housing, whereby the armature is gravity biased to normally open the working airgap, with electrical contacts mounted in the upper portion of the housing, and a pusher member operated by the other arm of the armature for operating the contacts.

The relay of the present invention is further characterized by having an L-shaped armature mounted on a knife edge bearing in exact alignment with the pole faces of the two cores so as to have one arm of the armature in a working airgap with the pole faces and the other arm extending through the central section of the housing structure and operatively connected to the contacts located in the upper portion of the structure, windings on the two cores, and a slip-on type back yoke having holes for snugly receiving the two cores, and a cover for enclosing the front side of the relay housing with a spring means mounted on the inside thereof for holding the back yoke in position.

For a better understanding of the present invention together with other and further objects thereof, reference is made to the following description, taken in connection with the accompanying drawings, while its scope will be pointed out in the appended claims.

In the drawings:

FIG. 1 is a side elevation partially in section taken on lines 1—1 of FIG. 2 which shows the parts of the electromagnetic relay constituting the structure of the present invention;

FIG. 2 is a front view with the cover of the relay removed and with parts shown in section to illustrate the assembly shown in FIG. 1;

FIG. 3 is a back view of the structure shown in FIG. 1 illustrating more particularly the slotted contact mounting block and the coded back cover for the electromagnetic portion of the relay;

FIG. 4 is a front view of the housing structure only of the relay to show the form of the structure to which all of the other parts are related;

FIG. 5 is a side sectional view of the housing structure shown in FIG. 4;

FIG. 6 is an enlarged side view of the armature and its knife edge bearing;

FIG. 7 is an enlarged top view of the armature and its knife edge bearing as shown in FIG. 6;

FIG. 8 shows a front view of the contact pusher member shown in side view in FIG. 1; and

FIG. 9 is a top view of the front cover as mounted on the housing structure and which is held in place on a terminal board by a wire bail fitted over the handle on the cover and extending to the two recesses in the terminal board.

Generally speaking, the electromagnetic relay of the present invention is comprised of a molded frame or housing structure **10** which encloses the various parts and to which a transparent cover **11** is attached. Inside the upper portion of the housing, the contact assembly is located, and in the lower portion of the housing, the electromagnetic structure is located.

The armature **35** is mounted on a knife edge bearing **31** riveted onto the housing between the upper and lower portions of the housing and near its back. The armature **35** is L-shaped and has a portion or arm which cooperates with the two pole faces **33** and **34** of the two cores **30** which are rigidly attached to the housing structure. There is also a contact operating portion or arm **35A** of the armature which extends towards the front of the housing between its upper and lower portions.

The knife edge bearing **31**, the armature **35**, the cores **30** and the coded back plate **36** are assembled and riveted in place in the housing at the same time on the two vertical bosses **15** located one on each side of the lower portion of the housing. The contact operating portion of the armature **35A** rests at its forward end against the upper side of a cross-bridge **18** arranged in the form of an arch connecting the two sides of the housing **10**. Also, a flat cross-bridge member **16** is located at the back of the housing connecting the tops of the two vertical bosses **15**. There are two horizontal ribs **19** connecting with the two vertical bosses and extending forward to the arched cross-bridge. In a similar fashion, two horizontal ribs **21** extend from the vertical bosses forward to a flat cross-bridge **20** at the front of the housing located between the space allotted to the cores and coil members of the electromagnetic structure.

The first-mentioned flat cross-bridge **16** at the back of the housing and connecting the tops of the two vertical bosses **15** has a downwardly extending abutment **14** running crosswise directly above the armature on its knife edge bearing and acting to hold the armature downwardly on such knife edge bearing.

At the front of the upper portion of the housing is a honeycomb or lattice structure for providing back stops for certain fixed contact fingers and providing supports for the coil springs located to supply the bias to such fixed contact fingers. This honeycomb or lattice also has a back stop for the coil spring which biases the armature to a normal position against the arched cross-bridge **18**. In addition, this lattice structure provides rigidity to the housing. The back upper portion of the housing is open so as to receive a contact guide block **40** which is also of a honeycomb form. In addition, a rear contact mounting block **42** is provided with suitable slots and is bolted into position following the insertion of the contact guide block **40**.

The contact fingers, such as finger **39**, are moved into position from the front of the housing. As they enter their respective spaces in the lattice structure at the front of the housing, they also enter the respective chutes, such as chute **44**, in the contact guide block which guides the end of the finger to enter the appropriate slot in the contact mounting block **42** at the rear of the relay. As a small portion of this contact **39** extends out of the slot at the rear of the mounting block **42**,

a tool is used to grasp the extending end and pull it rearwardly until the contact finger locking member **45** springs downwardly and engages the side of the slot in the block **42**. When all the contact fingers are in position, the coil springs **41** are inserted into the lattice structure in a way to bias the fixed contact fingers against their respective stops in the lattice structure. Also, the coil spring **48** for biasing the armature is placed in position in the lattice structure.

Assuming that all of the contact fingers are in appropriate positions, the contact pusher member **51** is mounted over the armature arm **35A** and each movable contact finger is inserted in the respective slots in the pusher member **51**. When the pusher member **51** is appropriately located, a lock finger **53** is then slipped into position through the slot in the pusher member **51** and through the contact guide block **40** and into the rear contact mounting block **42** until it is locked into position. This lock finger **53** has projections at the front which extend to the right and left as viewed from the front so as to hold the contact pusher member **51** in position against the rear projections on each of the movable contact fingers mounted in the pusher member.

The test fingers **64** are provided with narrow projections at each end. Each finger **64** may be slid into its appropriate position in the slide runways provided at the base of the relay.

The two coils **28** on suitable plastic spools **38** are inserted over the cores **30** and moved into their positions. Their lead wires come out at the front of the relay for attachment to the lead fingers **49** located at the sides of the lattice structure. The quick detachable connectors **50** actually insert through a suitable space in the pusher member **51**. When this has been done, a back yoke **62** is fitted onto the two extending cores **30** with such back yoke **62** having holes for receiving the cores which provide a smooth and accurate fit with the core members. The cover **11** is then positioned over the front of the relay to enclose the electromagnetic portion and the contact assembly. A spring **63** is located in the cover to hold the back yoke tightly in position on the cores. The placement of the cover **11** also receives the ends of the test fingers **64** through slots in the cover.

A flat cross-bridge **69** in the cover **11** fits appropriately just above the winding lead connectors **50** to separate them from the movable contact fingers extending through the contact pusher member. Such cover is held in position by suitable screws inserted into appropriate recessed holes in the corners of the cover and extending into the housing member at its four corners. The relay is then ready to be fitted into a suitable terminal board.

More specifically and with reference to FIG. 1, the electromagnetic relay structure is shown in a side elevational view with certain parts in section as taken in general on lines **1—1** of FIG. 2. This relay comprises a housing structure **10** and a cover member **11**. The housing structure **10** is shown with a front view in FIG. 4 with all parts removed and in a side sectional view taken on lines **5—5** in FIG. 5 also with all parts removed.

Referring to FIG. 4, the housing structure **10** is molded of a fiber glass filled resin in a single piece in the form of a rectangular box-like shape sometimes termed a parallelepiped with rectangular bases. Such molding includes different compartmental separations and structure to give added strength and rigidity to the structure, as well as providing certain functions broadly explained above.

In FIGS. 4 and 5, it can be seen that the housing structure **10** has inwardly extending vertical bosses **15** along the rear inside edge on both sides. At the top of these bosses **15** is a cross-bridge **16** which is flat and extends between the two sides of the housing **10**. An upstanding central boss **17** is provided for receiving a screw. Around the inside of the wall of the housing **10** adjacent the rear edge is a depressed strip making the wall of the housing slightly thinner. This makes a recess for receiving the

slotted contact mounting block **42**. This block **42** has screws inserted in the boss **17** at the bottom of the upper space or portion and also inserted in the two bosses **66** at the top (see FIG. 4). Therefore, the top floor of the cross-bridge **16** is raised slightly on each side of the boss **17**; and similarly the underside of the same portion is slightly raised. The abutment **14** joins these two levels underneath and extends downwardly an appropriate amount to meet the top of the armature. In FIG. 4, it can be seen that the lower edge of the abutment **14** is very slightly curved downwardly (see thick line) in the center just a sufficient amount to just barely clear the armature. This allows the armature to ride flat on its knife edge bearing **31** without binding as seen in FIG. 1, and yet be properly held in position.

At the front of the housing **10** is an arched cross-bridge **18** which extends from side to side. Running along each side of the housing **10** on the inside are ribs **19**. Each of these ribs **19** connects the arched cross-bridge **18** with the corresponding vertical boss **15** on its side of the housing. To give added strength, the ribs **19** have raised edges near the front and leading into the sides of the upper floor of the arched cross bridge **18** as best seen in FIG. 5.

Another flat cross-bridge **20** connects the sides of the housing **10** at the front thereof, and this cross-bridge **20** also has ribs **21** extending backwardly along the sides to the corresponding vertical bosses **15**.

At the bottom of the housing **10** is a compartment for receiving the test fingers **64** which compartment is provided with the enclosing flat bridge **22** located at the bottom of the vertical boss **15**. A vertical rib **23** near the center of the compartment runs the length of it to give stability. Similar ribs **29** are located at each side of the compartment for the same reason. Within the two smaller compartments are pairs of grooved ribs **24, 25** and **26**. At the back of this lower compartment, located a short distance inwardly is a horizontal enclosing rib **27** having these vertical slots seen in FIG. 4.

The upper portion of the housing structure **10** is a honeycomb or lattice structure which forms the back stops **70** for the fixed contacts and also the seats **71** for the coil springs biasing such contacts. Spaces **72** are also provided for the movement of the movable contacts. At the bottom of this honeycomb there are two grooved spaces **73** for receiving pairs of coil connector fingers. A seat **75** is also provided for the armature biasing coil spring **48**. In the four corners of the housing **10** are bosses for receiving self-tapping screws adapted to secure the cover **11** in place.

The inside of the honeycomb or lattice structure has two further inwardly projecting ribs **76** for giving added strength to the lattice structure and also for limiting the inward position of the contact guide block **40**. These two ribs **76** extend downwardly from the top of the housing **10** to the slot **77**. An intermediate slot **78** also connects the two vertical ribs **76** which are in line from the front of the lattice structure to the near mid portion of the contact compartment.

With the above general understanding of the housing structure, it can be readily seen that the cores **30** can have their pole pieces **33** and **34** fitted into recesses in the vertical bosses **15**. Also, a knife edge bearing plate **31** can be placed in the recess between the cross-bridge **16** and the ribs **19**, so as to receive the armature **35**. The coded back plate **36** is placed over the compartment and rivets **37** are slipped through the pole pieces **33** and **34**, the bosses **15** and the coding plate **36**. The flattening of the heads of these rivets **37** thus secure the core pieces **30**, the armature **35** and its bearing **31**, the coded back plate **36** in position. The core pieces **30** thus extend outwardly toward the front of the housing **10**. The armature **35** has two vertical slots, one on each side, which are slightly wider than the bearing strip **31** (see FIG. 6). The position shown in FIG. 6 is with the armature in its attracted position at which time the armature lays flat against the flat plastic residual strips **80** on the pole faces. Such strips are placed on the pole faces just before they are fitted into the vertical bosses **15**. With the armature in this position, the entire slot of the armature is required for the sides of the bearing which merely enter the slots which is best seen in FIG. 7. The right-hand side of the bearing plate is in exact alignment with the left side of the armature. The coil button **46** is also slipped into its receiving hole in the armature **35A**.

The contact guide block **40** is slipped into the upper portion of the housing structure **10** and is held in position against the back of the lattice structure by placing the contact mounting block **42** in position where it is held by inserting three self-tapping screws **43**.

The fixed contact fingers **39** are slid into appropriate spaces in the lattice structure and enter the contact guide chute **44** in the contact guide block **40**. Upon the further insertion of the contact, it is guided to enter its slot in the mounting block **42**. When a sufficient portion of the finger exits through the slot in the block **42**, a tool is inserted into the recess at the rear of block **42** adjacent the slot and is used to pull it through until the lock finger **45** springs downwardly and holds the contact in place. This fit of the contact **39** in the block **42** is snug and tight on both the upper and lower surfaces of the contact and particularly so with regard to the side edges. It is the snug slot in this block plus the continuing longitudinal sliding portions into the block which determine the relatively exact perpendicular projection of the forward end of the contact finger **39**. When the fixed contacts are positioned, then the movable contacts **59** are similarly slid into their positions where they lock in place. When all of these contacts are in position, suitable coil springs **41** are placed on their seats in the lattice structure for biasing the fixed contacts to their appropriate normal positions. In addition, insulated seat **46** is inserted into a hole **47** in the armature and a biasing spring **48** slipped into position onto the two opposing seats **46** and **75**.

The winding connector fingers **49** are slipped into position the same as the other contact fingers, but these contact fingers merely extend forwardly for receiving quick detachable connectors **50**.

When all of the fingers have been placed in position, the contact pusher member **51** shown in front view of FIG. 8 is positioned over the armature arm **35A** and gently laid against the movable contacts which may need slight adjustment in order to enter the slots in the extending fingers **91** and **92** of the contact pusher member. These fingers **91** and **92** grasp each of the movable contacts exactly opposite their contact making points so that such contacts are forceably moved by operation of the armature removing any tendency of the contacts to burn closed as the pusher member **51** is moved by the armature.

When the pusher member **51** is moved inwardly so that it abuts against the contact side extensions, then a lock finger **53** is inserted which has projections at its outer end for holding the pusher member **51** in position. This lock finger **53** has the same kind of locking fingers **45** for the contact block **42** as previously described.

The coils are wound on plastic spools **38** which readily slide over the core members **30** with the coil ends suitably positioned and having the quick detachable contact members **50** attached at their ends. Thus, the two coils can be slipped over their respective cores **30** and their four terminals suitably connected to their respective fingers **49** rather quickly through appropriate spaces left in the contact pusher member **51**. The outer ends of the spools **38** have a raised portion at one side. These raised portions are placed at the top and the bottom of their respective spools so that a back yoke **62** can be slipped over the ends of the cores. This fit of the back yoke **62** is snug so as to make ready magnetic contact with the cores **30**. This back yoke **62** is molded from powdered magnetic material which is amalgamated into a unitary structure which has high magnetic permeability.

A spring **63** is located in a suitable space on the cover for contacting the back yoke **62** and holds it firmly in position, when the cover is placed in position. The test fingers **64** may have to be slightly adjusted to enter their respective slots in the cover.

When the cover is in position, the screws **65** are inserted to hold the cover **11** onto the housing **10**. When the relay is thus constructed, it is complete and ready for operation.

To place it in operation, it is merely mounted on a plug board adapted to receive its projecting contact fingers and having coded projections to enter the coded holes in the coded back cover **36**. A wire bail **60** is connected in the slot on the terminal board and is sprung over the outer handles **81** of the relay as shown in FIG. 9. In this way the relay is held on the terminal board and is removable when desired.

It is noted that FIG. 8 shows an enlarged front view of pusher member **51** which can also be found in FIGS. 1 and 2. This front view shows the extending lips **91** and **92** which take hold of the contact fingers directly adjacent the contact points as can also be seen in FIGS. 1 and 2. Also, mild shading is shown in areas of FIG. 8 to illustrate the thin webs **93** of molded material between major portions or bars of the material. These thin web portions **93** act to give strength and stability to the pusher member **51**. The larger fingers **94** act to grasp the armature arm **35A** as can be seen in FIG. 2. (It is noted that one of these fingers **94** is omitted from FIG. 2.)

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein, without departing from the invention; and, it is, therefore, intended that the appended claims shall cover all such changes and modifications as fall within the true spread and scope of the invention.

What we claim is:

1. An electromagnetic relay having a plurality of contacts wherein the improvement comprises a rectangular box shaped housing substantially open on the inside thereof with openings at the front and back and with the other sides completely enclosed, an electromagnetic structure located in the lower portion of said housing and having an L-shaped armature cooperating therewith, one arm of said armature cooperating with said electromagnet at the rear of the relay to form a working airgap, and the other arm of said armature extending forwardly through the mid portion of said housing, whereby said armature is gravity biased to normally open said working airgap, electrical contacts mounted in the upper portion of said housing, and a pusher member operated by said other arm of said armature for operating said contacts, the housing having formed integral therewith at the front of the relay a lattice structure for supporting one end of the contacts that are fixed in that they are not subject to actuation by the armature.

2. A relay according to claim **1** in which a lattice structure is located in the upper portion of said housing with said electrical contacts mounted therein, and a coil spring mounted between said lattice structure and said armature for additionally biasing said armature.

3. A relay according to claim **1** in which said armature is mounted on a knife-edge bearing near its center, which is secured to the housing and in which the housing has a cross-bridge with an underhanging abutment directly over said armature above said knife-edge bearing.

4. A relay according to claim **1** in which said armature is mounted on a knife-edge bearing near its center, which is secured to the housing and in which the housing has a cross-bridge between the sides of said housing above said bearing and having an underhanging abutment, said abutment having a very slight arcuate portion across said armature and barely failing to touch said armature at its center.

5. A relay according to claim **1** in which said forward end of said armature is supported by an arched bridge portion of the housing connecting the two sides of said housing.

6. A relay according to claim **1** in which said forward end of said armature in its released position is supported by an arched cross-bridge member connected between the sides of said housing, and a coil spring between said armature and another cross-bridge member for biasing said armature toward said arched crossbridge.

7. In a relay, a housing structure of rectangular box shape and generally open on the inside thereof, the front and back portions of said structure being substantially open and the other sides thereof being completely enclosed, electrical contacts mounted in the upper portion of said structure and an electromagnet in the lower portion of said structure and having two cores with parallel pole faces at the back thereof, an L-shaped armature mounted on a knife-edge bearing in alignment with said pole faces so as to have one arm of said armature in a working airgap with said pole faces and the other arm extending through the central portion of said structure and operatively connected to said contacts, windings on said two cores, and a slip-on type back yoke having holes for snugly receiving said two cores, and a cover for enclosing the front side of said relay with a spring means mounted thereon for holding said back yoke in position.

8. In a relay as specified in the claim **7** wherein said windings have extending coil connections with quick detachable connectors mounted thereon, said quick detachable connectors being connected to coil connector fingers running from front to the back of said relay.

9. In a relay structure as specified in claim **7** wherein there are bosses running vertically along the back edge of the lower portion of said housing structure, and wherein said core members are mounted on the front of said bosses and a coded back plate is mounted at the rear of said relay on said bosses and said core and back plate being riveted to said bosses by the same rivets, said coded back plate having holes arranged in a coded configuration.

10. In a relay structure as specified in claim **7** wherein a spaced compartment is located at the bottom of the relay having grooved ridges running through an enclosed space for receiving test fingers each having constricted projections at each end, the projections at one end for passing through slots at the rear end of said compartment and the projections at the other end for passing through slots in said cover.

11. In a relay, a rectangular box shaped housing substantially open on the inside thereof with openings at the front and back and with the other sides completely enclosed, said housing being molded of a fire resistant plastic resin, and having a lattice framework in the upper front of the structure with cross members and with spaces, a slotted contact mounting block located within said housing at the rear thereof, said slots being located to match the spaces in said lattice framework, fixed and movable contact fingers mounted in said slots of said contact mounting block and extending through said lattice framework, an electromagnetic structure located in the lower portion of said housing and having an L-shaped armature cooperating therewith, said armature having one arm cooperating with said electromagnet at the rear of the relay to form a working airgap, and the other arm of said armature extending forwardly through the mid portion of said housing, a pusher member operated by said other arm of said armature and connected to said movable contacts, coil springs mounted in said lattice work for holding said fixed contacts against their respective cross members, and a coil spring between said lattice work and said armature for biasing said armature to open said working airgap, said core structure extending forward in the relay and having mounted thereon energizable coils, a sintered back yoke snugly fitted over said core members but removable therefrom, and a cover for enclosing the front

side of said relay with a spring means mounted thereon for holding said back yoke in position.

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