July 18, 1961 K. C. JOHNSON 2,993,150

RELAY CONSTRUCTION

Filed Sept. 15, 1958 2 Sheets-Sheet 1

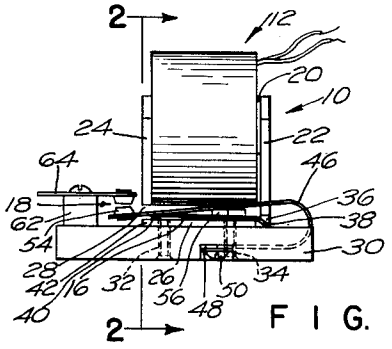



FIG. 1

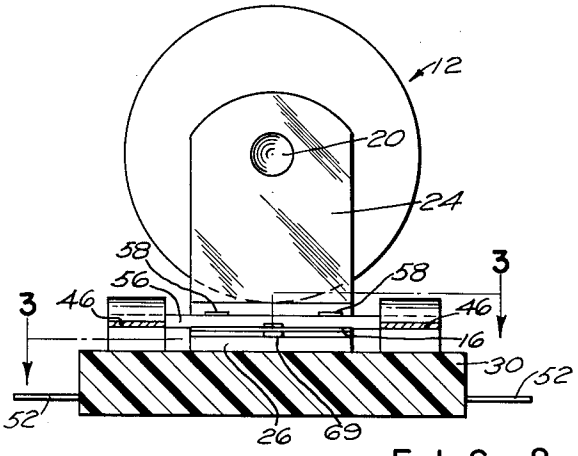



FIG. 2

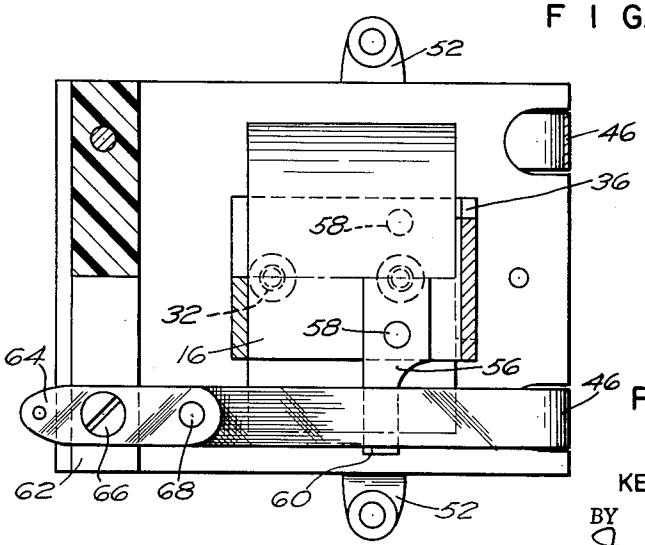



FIG. 3

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July 18, 1961 K. C. JOHNSON 2,993,150

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Filed Sept. 15, 1958 2 Sheets-Sheet 2

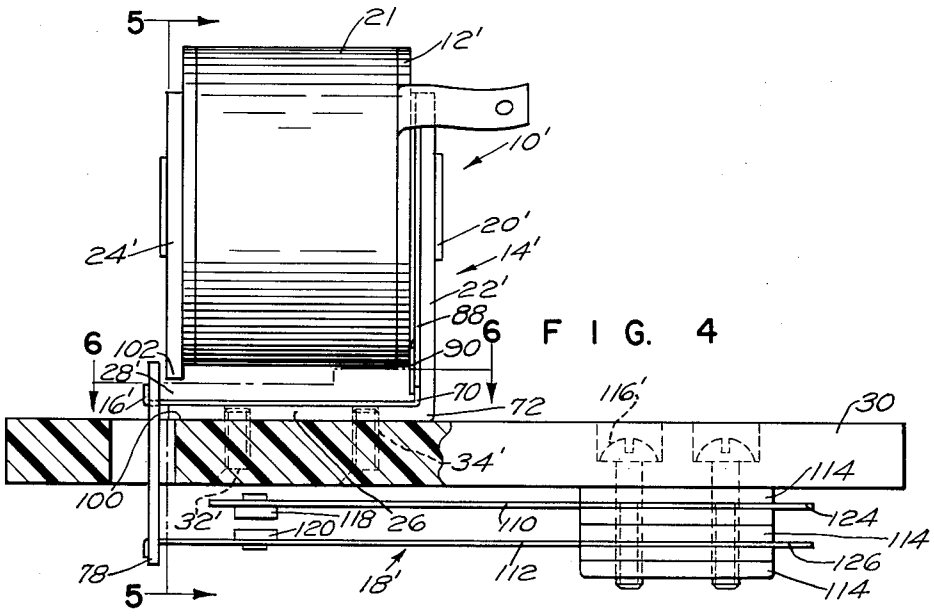



FIG. 4

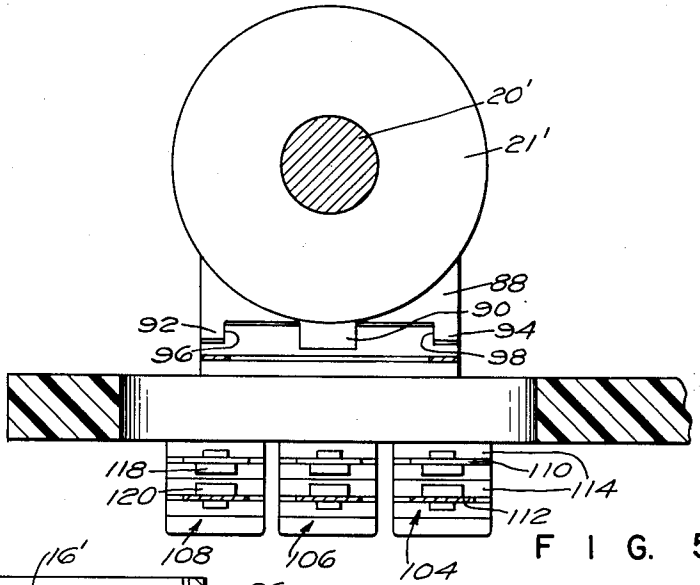



FIG. 5

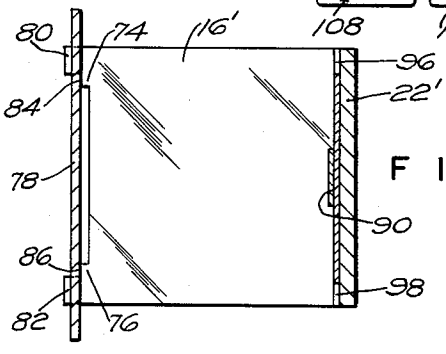



FIG. 6

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United States Patent Office 2,993,150 Patented July 18, 1961



2,993,150

# RELAY CONSTRUCTION

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Filed Sept. 15, 1958, Ser. No. 760,885
2 Claims. (Cl. 317—198)

The present invention relates to improvements in relay constructions and more particularly to an improved relay frame and armature arrangement so constructed as to provide improved operating characteristics over prior relay designs.

Electrical relays have heretofore been extensively employed and have generally comprised a movable armature that is magnetically attracted towards a pole piece of the opposite polarity whereby electrical contacts attached to or carried by the armature are thus brought to bear against or moved away from mating contacts to make or break electrical circuits, usually other than the relay operating circuit.

Limitations on prior relay constructions existed in the rapidity of actuation thereof, the sensitivity and minimization of bounch and/or chatter of the electrical contacts and various other mechanical and electrical operation characteristics. Also, prior relay constructions left much to be desired from the standpoint of miniaturization.

Accordingly, it is a primary object of the present invention to provide an improved relay construction which overcomes objections of prior relay constructions and overcomes limitations heretofore present.

A further object of the present invention is to provide an improved relay construction which is susceptible in use where miniaturization of the device in which the relay is employed is contemplated.

Another object of the present invention is to provide an improved relay construction which is comprised of parts having simplified design which are easily manufactured and easily assembled into relay constructions.

Still another object of the present invention is to provide an improved relay construction which has rapidity of actuation, high sensitivity, and wherein bounce and/or chatter is (or are) minimized and wherein mechanical shock and vibration resistance is increased.

A further object of the persent invention is to provide am improved relay construction wherein a substantially lighter weight armature can be utilized but wherein the increased reluctance due to such design of the armature is offset by the construction and arrangement of the relay frame structure.

A still further object of the present invenition is to provide an improved relay construction wherein both the attraction and repulsion magnetic forces are utilized to actuate the armature.

Another object of the present invention is to provide an improved relay construction wherein the frame structure which carries the armature employs means for holding the armature from movement in predetermined undesirable directions while at the same time permitting substatnially free movement of the armature in preselected directions.

Various other objects and advantages will become apparent from the detailed description to follow.

In the drawings:

FIGURE 1 is a side elevational view of one embodiment of my improved relay construction;

FIGURE 2 is an end elevational view of the relay construction of FIGURE 1;

FIGURE 3 is a horizontal sectional view taken substantially along the plane of line 3—3 in FIGURE 2;

FIGURE 4 is a side elevational view similar to FIGURE 1 but showing a modified form of relay construction;

FIGURE 5 is a vertical sectional view taken substantially along the plane of line 5—5 in FIGURE 4; and

FIGURE 6 is a horizontal view taken substantially along the plate of line 6—6 in FIGURE 4.



Referring more particularly to the drawings, wherein like numerals apply to like parts throughout, and having reference first to FIGURES 1 through 3, it will be seen that I have shown one form of improved relay construction **10** which includes a relay coil **12**, a frame structure **14**, armature **16** and switch arrangement **18**. The coil **12** can be of substatnially conventional construction including a core **20** on which is wound an electrically conductive wire adapted to be connected in circuit with a source of electrical power.

The frame structure **14** includes a pair of spaced poles **22** and **24** which are of generally the same size and configuration parallelly disposed at opposite ends of the core **12** and connected to opposite ends of the core **20** by low reluctance paths. One of the poles **22** is preferably formed of L-shape and has the extension portion **26** generally parallel to the axis of the coil **12** and terminating in slightly spaced relation to the lower end of the pole **24**, at **28**. The frame structure **14** has the extension portion **26** secured to the base **30** by means of the pair of screws **32** and **34**. The frame structure **14** is formed with a pair of oppositely disposed notches at **36** located at the bend of the L-shape frame element for a purpose presently to be described.

The armature **16** is made from a substantially thinner magnetic metallic stock than the poles **22** or **24** or the pole extension **26**, so as to be lightweight. The armature **16** has one end thereof offset or laterally bent at **38**, at each side thereof, so as to be engaged in the pair of notches **36** whereby lateral movement of the armature **16** is prevented. The armature **16** is substantially coextensive with and of substantially the same size and shape as the pole extension portion **26**. The end of the armature **16** remote from the offset portion **38** terminates at **40** intermediate the one pole extension end **42** and the other pole end **44** at the gap **28**.

The switch means **18**, of course, can assume various arrangements. A specific arrangement is shown in FIGURES 1 through 3 and will now be described although it is to be understood that various other switch means and arrangements can be employed as desired. Switch means **18** includes a leaf spring switch element **46** which is of substantially U-shape and has one leg thereof received in a recess **48** of the base **30** and held to the base by means of the screw at **50**. A similar U-shaped spring element **46** is disposed at the opposite side of the base **30** and held similarly. Each leaf spring element **46** has an electrical connection element **52** connected thereto and projecting out from the side of the base **30**, as seen best in FIGURE 3. The other leg of each of the leaf spring elements **46** passes over the base **30** to each side of the armature **16** and terminates in a contact button at **54**. A coupling bar **56** is secured to the armature **16** by means of the pins or rivets **58** and has its ends engaged beneath the leaf spring elements **46** as at **60**.

The base **30** has a support block **62** secured thereto and a pair of electrical connectors **64** are secured thereon by means of the screws **66**. One end of each of the electrical connectors **64** has a contact button **68** carried thereby in slightly spaced relation to the previously described electrical contacts **54**.

From the foregoing, it is believed that the operation of the relay construction **10** will be readily obvious. When electrical power is applied to the coil **12**, the poles **22** and **24** which are connected to the core **20** provide

high permeability paths for the magnetic flux produced by the energized coil 12. One pole will of course be north while the other pole will of course be south and the extension portion 26 which is connected to the one pole 22 will of course be of the same polarity. The armature 16, being received on the extension portion 26 and in substantially continuous contact therewith, has the same polarity as the extension portion 26 and will therefore be repelled by the extension portion 26 at the same time it is attracted to the pole 24 which is of opposite polarity. In order to facilitate action of the repelling force, the armature 16 can be provided with anti-freeze pins as shown at 69. Because of the lightweight of the armature 16, rapid action occurs and chatter is substantially eliminated. Moreover, inasmuch as the armature 16 is substantially freely carried by the pole 22, movement upon actuation of the coil 12 is substantially free of resistance.

Having reference now to FIGURES 4 through 6, it will be seen that a modified form of relay construction is shown at 10'. The relay construction 10' includes the coil 12', frame structure 14', armature 16' and switch means 18'. Once again, the coil 12' includes a core 20' on which is wound a multiplicity of turns of wire at 21.

The frame structure 14' includes a first pole 22' and a second pole 24' which are preferably of substantially the same thickness and located in spaced parallel relationship at the opposite ends of the coil 12', the poles 22' and 24' being connected by low reluctance paths with the core 20'. The pole 22' is provided with an extension portion 26' so as to constitute a substantially L-shaped element. The extension portion 26' extends from the one pole 22' and terminates in juxtaposition to the other pole 24' so as to provide a gap at 28'. The L-shaped pole element 22' is secured to the base 30' by means of a pair of screws 32' and 34'.

The armature 16' is formed of thin metal and terminates at one end in the offset upturned portion 70 at the bend 72 in the L-shaped pole element 22'. The armature 16' lies in contact with the extension portion 26' and is substantially coextensive therewith, being of substantially the same size and shape as the extension portion 26. If desired, anti-freeze pins as at 69' and 71' can be employed. The opposing end of the armature 16' is formed with a pair of fingers at 74 and 76 which extend through the insulating plate 78 of the switch means 18'. The fingers 74 and 76 terminate in slightly bent ends at 80 and 82 so as to retain the insulating plate 78 against the shoulders 84 and 86 of the fingers. The fingers 74 and 76, although extensions of the armature 16', are of minimum size so as to not adversely affect the operation of the relay construction. The means for holding the armature 16' in its proper relationship to the poles of the relay includes the coupling plate 88 which is carried inside the pole 22'. The lower end of the coupling plate 88 is formed with a centrally disposed lip 90 which is engaged over the offset end 70 of the armature 16'. At the sides of the lower coupling plate 88' are a pair of shoulders 92 and 94 which are cooperative with notches or recesses 96 and 98 formed in the offset ends 70 of the armature 16'. Thus, the armature 16 is held from movement at the bend of the pole 22' from movement vertically in either direction or horizontally in either direction while permitting free movement of the opposing end of the armature 16' with respect to the end 100 of the extension portion 26' and the end 102 of the other pole 24'.

The switch means 18', once again, can be comprised of any desirable arrangement but one arrangement will be described as an example. Three sets of leaf spring switch elements are shown in FIGURE 5, as at 104, 106 and 108. Each set includes an upper leaf spring element 110 and a lower leaf spring element 112 which at common ends are held in fixed insulated relationship by means of the blocks at 114 attached to the base 30 by means of the screws 116. Adjacent portions of the leaf spring elements 110 and 112 are provided with electrical contacts 118 and 120. The lower leaf spring switch elements 112 are all engaged through slots formed in the lower edge portion of the insulating plate 78 so that the lower leaf spring elements 112 are coupled for movement with the armature 16' through the insulating plate 78. Of course, the ends 124 and 126 of the leaf spring elements 110 and 112, respectively, are adapted to be connected to various electrical circuits so as to operate the same by the relay 10'.



In operation, when the coil 12' is actuated, the magnetic flux created by energization of the coil 12' follows the high permeability path of the north and south poles, which can be at either end of the coil 12'. The extension portion 26' is, of course, of the same polarity as the one pole 22'. Similarly, the armature 16' will be of the same polarity as the one pole 22' because of its being magnetically coupled thereto. Thus, the armature 16' will be repelled by the extension portion 26' and attracted by the pole 24' so as to pull the connector plate 78 upwardly so as to close the electrical contacts 118 and 120 in their respective circuits. Here again, the light weight of the armature 16' and its freedom of movement produce an overall relay construction which is extremely rapid in its action and avoids many of the objections heretofore present in relay constructions.

Accordingly, it is believed that I have provided a relay construction which fulfills the objects hereinbefore enumerated.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by these claims.

I claim:

1. A relay comprising a frame structure having a pair of spaced pole elements, a coil-wrapped core connecting said pole elements, one of said pole elements having an extension portion extending into juxtaposition to the other of said pole elements to provide a low reluctance flux path, and a relatively lightweight armature closely cooperative with said extension portion over substantially the entire area of the former to provide a low reluctance path to the armature, said one pole element being of generally L-shape with one leg thereof constituting said extension portion terminating adjacent the other pole element, at least one notch in said one pole element, and said armature being a thin metal plate having an offset portion cooperative with each said notch so as to provide free movement of the armature relative to said other pole element while substantially holding said armature from movement in other directions.

2. A relay comprising a frame structure having a pair of spaced pole elements, a coil-wrapped core connecting said pole elements, one of said pole elements having an extension portion extending into juxtaposition to the other of said pole elements to provide a low reluctance flux path, and a relatively lightweight armature closely cooperative with said extension portion over substantially the entire area of the former, said one pole element being of generally L-shape with one leg thereof constituting said extension portion terminating adjacent the other pole element, and said armature being a thin metal plate substantially coextensive with said extension portion and ter-

minating in an offset portion abutting said one pole element, a coupling plate connected to said one pole so as to overlie said offset portion and having shoulder means engaging said armature plate so as to provide free movement of the armature plate relative to said other pole element while substantially holding said armature plate from movement in other directions.



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