Jan. 2, 1968 G. K. FREEMAN, JR 3,361,997

MULTIPLE CONTACT SERIES/PARALLEL ELECTROMAGNETIC SWITCH

Filed May 22, 1967 2 Sheets-Sheet 1

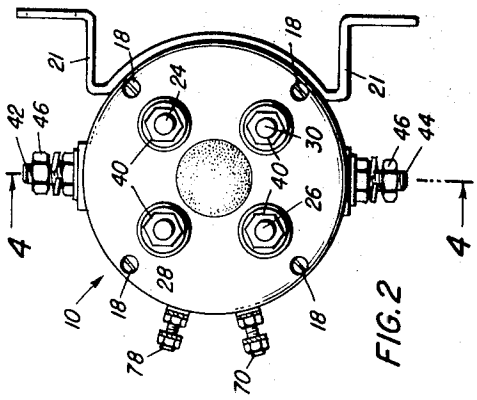


FIG. 2

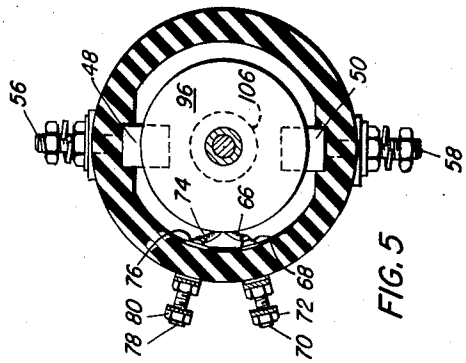


FIG. 5

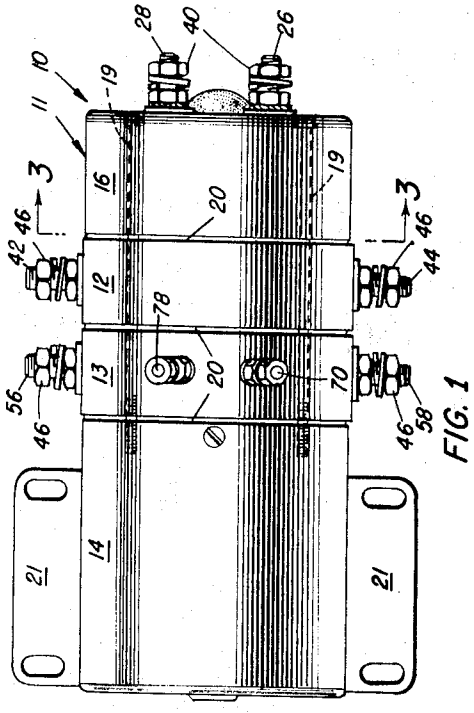


FIG. 1

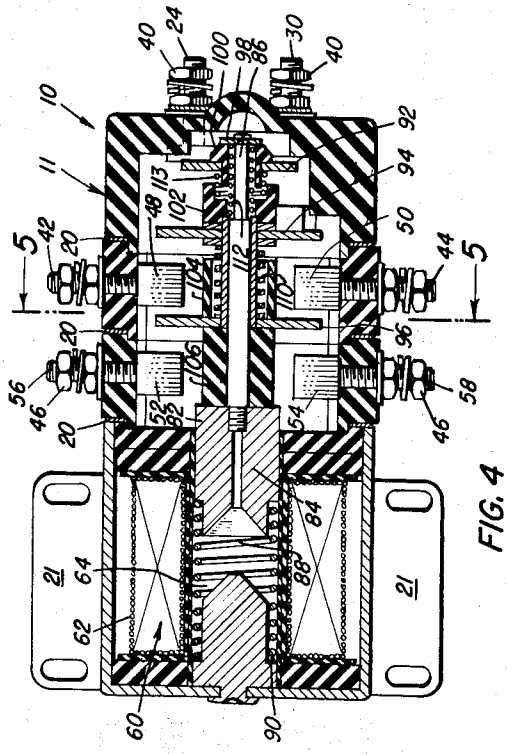


FIG. 4

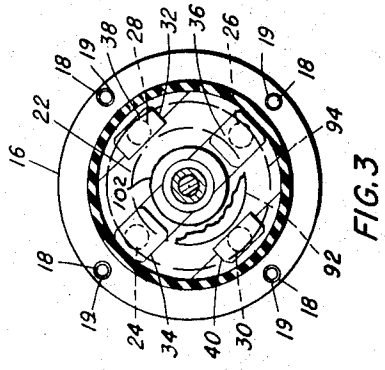


FIG. 3

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MULTIPLE CONTACT SERIES/PARALLEL ELECTROMAGNETIC SWITCH

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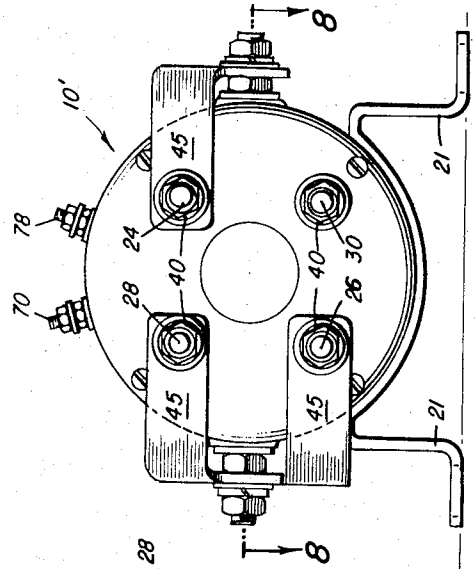


FIG. 7

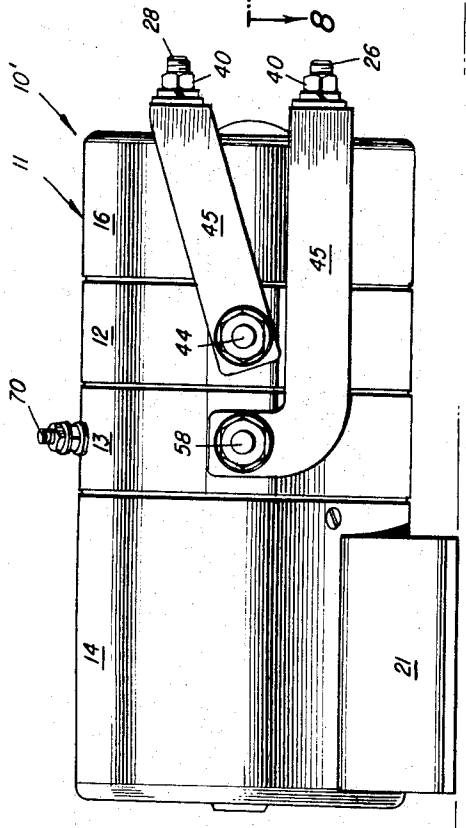
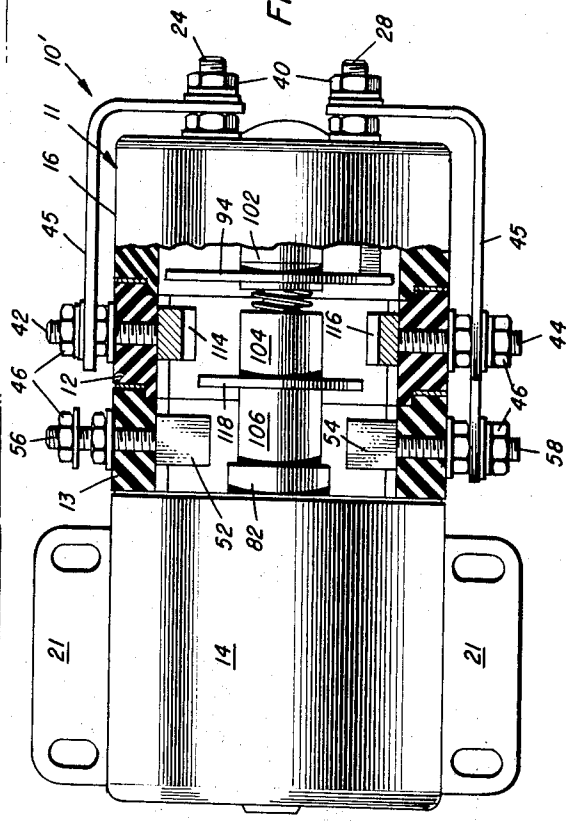


FIG. 6

FIG. 8



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MULTIPLE CONTACT SERIES/PARALLEL ELECTROMAGNETIC SWITCH

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2 Claims. (Cl. 335—126)

ABSTRACT OF THE DISCLOSURE

This invention relates to electric switches and more particularly to a multiple contact electromagnetic switch for selectively or sequentially controlling a plurality of electrical circuits having a solenoid displaceable armature bearing a number of movable contacts which engage and disengage stationary contacts positioned proximate the armature in the wall of the switch housing.

This application is a continuation-in-part of my now pending application Ser. No. 474,714, filed July 26, 1965.

Objects of the invention

Series/parallel switches, double row, double pole switches and separate circuit switches are old and well known. A principal object of the present invention is to provide a novel series/parallel switch device in which the functioning of the two separate electromagnetic switch devices previously required are combined in a single series/parallel switch device of a relatively simple and compact construction. Though a switch constructed in accordance with this invention may be used in any of the above-mentioned capacities and others, yet, the switch is comparatively simple in its construction and easily assembled during manufacture.

Another object of the present invention is to provide a novel series/parallel apparatus of the character referred to in which there are multiple pairs of current-carrying stationay contacts and which also has movable current-carrying contact members engageable with the stationary contacts in response to actuation by a common actuating means.

Still another object of this invention is to provide a series/parallel apparatus of the kind above-indicated in which the actuating means with the movable contact members includes spring means causing the movable contact to positively engage opposite stationary switch contact members and prevent the imperfect positioning of movable contact members against their associated fixed contacts.

Yet another object of the present invention is to provide a series/parallel apparatus of the kind above-indicated in which the movable contacts are so proportioned with reference to the spacing of the stationary contacts of the pairs that the armature may be assembled as a unit making high speed and mass production possible. For this season and also for compactness, the locations of the contacts with respect to each other in the switch, and the size of each movable contact assumes importance.

The switch has a segmented housing assembly which is preferably made of electrically insulating material. The segmented housing assembly contains a solenoid structure including a fixed coil and an armature. The armature carries a plurality of adjustable and reversible contacts for cooperatively engaging fixed contacts secured to the plural segments of the housing assembly of the switch. The switch is assembled by joining cooperating segments with securing contact screws to permit the rapid and straight forward assembly of an individual unit about the slidably disposed armature.

The three movable contacts assembled on the armature are held spaced from each other by means of non-conductive spacers, and the washers that form the movable contacts are free to rotate on the spindle so that different areas of the movable fixed contacts engage during successive operations of the switch. A significant improvement exists in the way that the movable contacts are related to each other, through the armature and the fixed contacts of the switch. Heavy duty fixed contacts are carried by the segments of the cover and these are bridged by the movable contacts when the solenoid is energized. There is a first spring which reacts on the armature in such a way that the spring is compressed when the solenoid is energized. In addition, there is a second spring which reacts on the armature and at least the movable contact which bridges the fixed contacts in one segmented portion of the cover. The first spring is considerably heavier than the second spring, and it becomes compressed when the armature is electromagnetically moved to one of its positions. When de-energized, the armature is released and the first spring moves the entire armature to the rest position. The second spring reacts on at least one of the movable contacts which causes the initial separation of the movable contact of the armature by a quick snap action from the fixed contacts in the switch cover segment. This rapid movement of the movable contact with respect to the armature, as opposed to movement with the entire armature caused by the heavier spring, minimizes the possibility of arcing thereby contributing to the longevity of the contacts.

As mentioned earlier, the switch may be used in a number of ways, one of which is as an ordinary double pole switch of the electromagnetically operated type. An important specific use of the switch is in connection with storage batters for motor vehicles, more particularly for large vehicles used in the trucking industry. The switch may have its contacts connected with the cells of a battery to connect them alternately in series and parallel. For example, a 24 volt vehicle storage battery containing twelve cells, may have the cells connected alternately in series and in parallel so that the motor vehicle may have available for consumption current impressed at 12 or 24 volts respectively. Alternatively two conventional 12 volt batteries may be used in a series/parallel connection. Such systems are known in the art, and the benefit obtained is to have the high voltage available for starting while the motor vehicle may operate on the designed twelve volt series system during all other phases of motor vehicle operation.

Although the series/parallel arrangement for the cells of a storage battery is a possible use of the invention, the switch is so constructed that it may be used wherever plural circuits must be sequentially or selectively controlled. A preferred form of the invention has four pairs of contacts at the inner ends of four pairs of binding posts, terminals or the like. The armature has three movable contacts, preferably washers, adapted to move in a way that the rest position for the switch has two of the movable contacts bridging two pairs of fixed contacts. When the switch is in the energized position, that is, when the electromagnetic coil is energized, the normally closed pairs of contacts are opened by movement of the armature and the movable contacts carried by the armature. Two movable contacts normally maintained in a non-contacting position with respect to the two remaining pairs of fixed contacts bridge those fixed contacts to complete two additional energized circuits.

These together with other objects and advantages which will become subsequently apparent, reside in the details of construction and operation shown and described, as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part

hereof, wherein like numerals refer to like parts throughout.

Figure description

FIG. 1 is an external plan view of the preferred embodiment of a series/parallel electric switch device embodying the present inventive concept.

FIG. 2 is an external end view of the preferred embodiment of a series/parallel switch device.

FIG. 3 is a transverse sectional view of the preferred embodiment of a series/parallel switch device taken along line 3—3 of FIG. 1.

FIG. 4 is a longitudinal plan sectional view of the preferred embodiment of a series/parallel switch device taken along line 4—4 of FIG. 2.

FIG. 5 is a transverse sectional view of the preferred embodiment of a series/parallel switch device taken along line 5—5 of FIG. 4.

FIG. 6 is an external side elevational view of an alternative embodiment of the series/parallel switch device embodying the present invention.

FIG. 7 is an external end elevational view of an alternative embodiment of the series/parallel switch device taken along line 8—8 of FIG. 7.

Detailed description

Referring now to the drawings and particularly FIG. 1, there is generally designated a switch **10** having a housing assembly **11** composed of a first segmented housing member **12**, a second segmented housing member **13**, a solenoid housing member **14** and an end housing member **16**. These particular housing members are joined, for example, by bolts **18** passed through aligned openings **19** in each of the components to form housing assembly **11**. Gaskets **20** are located between the confronting surfaces of each of the housing members to provide a sealed moisture-proof junction therebetween. Brackets or flanges **21** are secured to solenoid housing member **14** to provide convenient means for mounting the switch **10** on a supporting surface.

A cavity **22** is formed within housing assembly **11** by fitting the housing member components as previously described to form the switch structure **10**. Four binding posts **24**, **26**, **28** and **30** are secured to end housing member **16** to provide external circuit connections which are to be sequentially controlled. The inner ends of each of the binding posts are formed into fixed contacts which are locked against the inner surface of end housing member **16** by notches or grooves **32**. The binding posts are in pairs with the first pair consisting of posts **24** and **26**, and a second pair consisting of binding posts **28** and **30**. A first pair of fixed contacts **34** and **36** are integral with the inner ends of binding posts **24** and **26**, and a second pair of fixed contacts **38** and **40** are integral with the inner extremities of binding posts **28** and **30**. All of these fixed contacts may be made as heads on the binding posts and ground where necessary so that flat contact surfaces are obtained. The first pair of contacts **34** and **36** are coplanar, and the second pair of contacts **38** and **40** are coplanar but located in the plane spaced from and parallel to the plane containing the first fixed contacts **34** and **36**. The four described contacts **34**, **36**, **38** and **40** are at least partially disposed in cavity **22** of end housing member **16**. The binding posts may be made in any known fashion, for example, as screw threaded shanks with holding nuts **40** thereon backed by washers and adapted to accommodate additional nuts for holding eyelets at the ends of wires for the completion of electrical circuits.

A third pair of binding posts **42** and **44** are attached to the first segmented housing member **12**. Nuts **46** backed by lock washers and pliable washers are threadably received on binding posts **42** and **44**, and additionally nuts may be placed on these posts in order to hold eyelets at the ends of conductors or to hold any other type of connecting part of a conductor, for instance a part of a bus

bar **45** having a hole therein as shown in FIGS. 6, 7 and 8. The inner ends of the binding posts **42** and **44** have a third pair of fixed contacts **48** and **50** respectively thereon. These may be formed as heads of binding posts **42** and **44** as previously described in conjunction with posts **24**, **26**, **28** and **30**. The posts are anchored within the structural wall of first segmented housing member **12** to prevent rotation during assembly.

Contacts **48** and **50** are coplanar and in a plane parallel and spaced from the planes containing the first and second pairs of fixed contacts **34** and **36** and **38** and **40**. These contacts are adjustable and reversible to expose a new surface for making electrical connections in the event that becomes necessary or desirable. The contacts **48** and **50** need only be reversed or rotated 180 degrees to expose the opposite surface for cooperation with the movable contacts subsequently to be described. A fourth pair of fixed contacts **52** and **54** is located in still another plane but one that is parallel to the planes containing contacts **48** and **50** and the planes containing the first and second pairs of fixed contacts **34** and **36** and **38** and **40**. The fourth pair of fixed contacts **52** and **54** is secured to binding posts **56** and **58** passing through holes in the second segmented housing member **13** and held in place by nuts **46** backed by washers and adapted to receive conductors. These contacts are also adjustable and reversible to provide differing contacting areas and give longer switch performance without parts replacement.

There is an electromagnetic switching mechanism for bridging the various pairs of contacts previously described. This electromagnetic mechanism consists preferably of a solenoid generally designated **60** having a coil **62** which in turn contains an armature-receiving chamber **64**. One end **66** of the wound coil **62** extends to head **68** at the inner extremity of binding post **70**. The binding post **70** is passed through an opening in the wall of second segmented housing member **13** and has a nut **72** thereon. The other end **74** of coil **62** extends to head **76** at the inner extremity of binding post **78**. The binding post **78** is passed through an opening in the wall of second segmented housing member **13** and has a nut **80** thereon. By impressing a voltage across binding posts **70** and **78** and thus passing a current through the solenoid wound coil **62**, that coil becomes energized. The armature **82** of the solenoid is constructed of a plunger **84** having a lower reduced shank **86**. The armature **82** is reciprocably disposed in cavity **22** so as to be movable within armature-receiving chamber **64** since the armature is attracted inwardly of the coil when the coil is energized. Accordingly, the rest position of the armature is established by a first spring **88** which reacts on a part of the solenoid structure **90** and the plunger **82** in a manner which will be described in more detail subsequently. When in the rest position, the first and second pairs of fixed contacts **34**, **36**, **38** and **40** respectively are bridged and thus closed by armature-carried movable contacts subsequently to be described. These same contacts are open when the solenoid is energized.

There are three movable contacts, consisting of a first contact **92**, a second contact **94** and a third contact **96**. Each of the movable contacts is preferably made of a conductive washer mounted on shank **84** in such a way that the washers are capable of freely rotating. The free or reduced end **86** of shank **84** has a fastener, for instance, washer **98** held in place by peening a reduced extension **86** of shank **84** thereover. There are four insulating spacers **100**, **102**, **104** and **106** assembled on the shank **84** and held in place by washer **98**. Spacer **104** has a central opening recess **108** in which a second spring **110** is seated. A comparatively light third spring **112** is disposed against washer **98** and second contact **94**. The positioning of the second and third spring provide firm and uniform contact between the bridged fixed pairs of contacts and the particular movable contact that may be urged thereagainst when the coil is energized or de-energized. Additionally, a fourth spring

113 may be provided to ensure firm contact bridging. Since all of the movable contacts are displaceable against the biasing force of a compressed spring disposed therebetween, it is a certainty that the displacement of the contact-carrying armature **82** will always make and bridge to fixed contact circuits since the actual displacement will be greater than necessary to move those movable contacts against the fixed contacts to be bridged.

In operation of the switch, control current is applied through coil **62** by applying a voltage across posts **70** and **78** in order to energize the coil of the solenoid. This in turn displaces armature **82** causing the three movable contacts on the armature to move from the rest position to the second or energized position (not shown). When the control current is discontinued, the armature returns to the rest position by virtue of the force exerted by compressed spring **88**.

When in the rest position, movable contact **92**, which is considered the first movable contact, bridges the first fixed contacts **34** and **36**. Spring **113** yields and compresses under the pressure exerted by the force of spring **88** against the armature plunger and the immobility of contact **92** as the latter is pressed against the first pair of fixed contacts **34** and **36**. Therefore, the tolerance between the movable contacts on the armature may be quite large. Further, the second movable contact **94** bridges the second pair of fixed contacts **38** and **40** so that two individual circuits may be controlled, that is, opened or closed automatically selectively. One or more individual circuits that are connected with the third and fourth pairs of fixed contacts **48**, **50** and **52**, **54** are opened at this time.

When coil **62** is energized, the armature **82** is withdrawn into the bore or chamber **64** compressing spring **88**. Movable contact **94** engages and bridges the third pair of fixed contacts **48** and **50** causing spacer **104** to move toward washer or contact **96** thereby compressing the spring **110**. Accordingly, spring **110** is placed under a compressive load when the armature is withdrawn into the solenoid coil chamber. Additionally, the third movable contact **96** bridges the fourth pair of fixed contacts **52** and **54**. This means that contacts **38** and **40** are no longer bridged by movable contact **94**, and that the first pair of contacts **34** and **36** are no longer bridged by the first movable contact **92**.

At the instant that the solenoid coil **62** is de-energized, the immediate reaction is for the heavily loaded spring **88** to very quickly expend its stored potential energy in a direction to forceably push the armature plunger **86** outwardly from coil chamber **64** so that the movable contact **94** is snapped away from the third pair of fixed contacts **48** and **50** and movable contact **96** is snapped away from the fourth pair of fixed contacts **52** and **54**. The fixed contacts **48** and **50** and **52** and **54** are heavy-duty, high capacity contacts, and the action of the spring **110** is helpful in opening or unbridging those contacts very quickly. Spring **88** additionally aids in this disengaging or unbridging operation, but an equally important function of spring **88** is to return the entire armature assembly with its movable contacts, to the rest position where the first and second pairs of fixed contacts are again bridged by movable contacts **92** and **94**. Switch **10** is now prepared for another cycle of operation identical to that previously described.

In FIGS. 6, 7 and 8 there is shown an alternative embodiment of the present invention having identical housing components to those previously described and shown in FIGS. 1 through 5. There have been made some minor changes, specifically in the third pair of fixed contacts **114** and **116** mounted to first segmented housing member **12**, and to third movable contact **118** carried by armature **82**. Contacts **114** and **116** have been reduced in size and arcuately fashioned or ground along their inner surfaces to permit passage of third movable contact or washer **118** which has also been reduced in size, without the need of completely disassembling the housing member components of the switch structure. This enables switch **10** to be rapidly and economically assembled or disassembled by simply withdrawing the entire contact-carrying armature once end housing member **16** has been removed. As is seen from FIGS. 1 through 5, the preferred embodiment of this invention would require complete removal of end housing member **16**, first segmented housing member **12**, and second segmented housing member **13** before the armature structure could be removed since contact **96** could not pass between fixed contacts **48** and **50** unless first segmented housing member **12** was withdrawn. Other than the specified changes in shape and size of those particular components designated, there are no other structural differences between the preferred and alternative embodiment of the present invention.

Obviously, many modifications and variations may be made in the construction and arrangements of the housing members as well as the fixed contacts and the movable contacts as well as other phases of the present inventive concept in the light of the above teachings without departing from the real spirit and purpose of this invention. Such modifications of parts and alternatives as well as the use of mechanical equivalents to those herein illustrated and described are reasonably included and modifications are contemplated.

I claim:

1. An electromagnetic heavy duty segmented switch for selectively energizing and de-energizing a plurality of circuits comprising: a housing assembly including an end housing member, a first segmented housing member, a second segmented housing member and a solenoid housing member; a first pair of binding posts extending through said end housing member and having first fixed coplanar contacts at their inner ends, said first pair of binding posts extending from one side of said end housing member and said first fixed contacts being locked on the opposite side of said end housing; a second pair of binding posts extending through said end housing member having second fixed coplanar contacts at their inner ends, said second pair of binding posts extending from one side of said end housing member and said second fixed contacts being locked on the opposite side of said end housing member in a plane different from the plane carrying said first fixed contact; a third pair of binding posts extending from said first segmented housing member having a pair of third fixed coplanar contacts at the inner ends of said posts within said housing assembly; a fourth pair of binding posts extending from said second segmented housing member having fourth fixed coplanar contacts at the inner ends of said posts, said contacts extending within said housing assembly to a greater extent than said pair of third fixed coplanar contacts; means for releasably securing said end housing member, said first segmented housing member, said second segmented housing member and said solenoid housing member to form a chamber within said housing assembly; a solenoid in said chamber having a coil structure and an armature, said armature carrying a first, second and third movable contact, and said coil structure having energizing binding posts carried by said second segmented housing member, said third movable contact adapted to engage said fourth fixed coplanar contacts and avoid said third fixed coplanar contacts when said armature is removed from said chamber; a first spring reacting on said armature and urging said armature to a rest position whereby said first movable contact bridges said first pair of fixed contacts and said second movable contact bridges said second pair of fixed contacts; a second spring reacting on said armature and said third movable contact, said third movable contact being movable with said armature and additionally movable with respect to said armature against the oppositon of said second spring; a third spring reacting on said armature in said armature in said first movable contact, said first movable contact being movable with said armature and additionally movable

with respect to said armature against the opposition of said third spring; and a fourth spring responsive to the movement of said armature and adapted to position said first movable contact against said first fixed contacts whereby upon energization of the coil structure the armature and movable contacts move to a position in which the second and third movable contacts bridge the third and fourth pair of fixed contacts and the first and second pairs of fixed contacts are separated from the first and second movable contacts as the first spring is compressed, and upon de-energization of the coil structure, the armature and movable contacts return to the rest position in which the first and second movable contacts bridge the first and second pairs of fixed contacts and the third and fourth pairs of fixed contacts are separated from the second and third movable contacts as the first spring forcibly expands, said coil structure having energizing

terminals extending through said second segmented housing member, said third and fourth pairs of fixed contacts being adjustable to provide different contacting areas.

2. An electromagnetic switch as claimed in claim 1, said third and fourth pairs of fixed contacts being reversible by rotation through 180 degrees to provide different contacting areas.

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