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Blum

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[54] **ALTERNATING-CURRENT PROTECTIVE DEVICE**

[75] Inventor: **Alex Blum**, Suhr, Switzerland

[73] Assignee: **Sprecher & Schuh AG**, Aarau, Switzerland

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[51] **Int. Cl.** **H01h 51/30**

[58] **Field of Search** ..... 335/99, 100, 103, 104, 335/105, 243, 244, 245, 247, 251, 132, 202, 193, 198; 200/166 BC, 166 H

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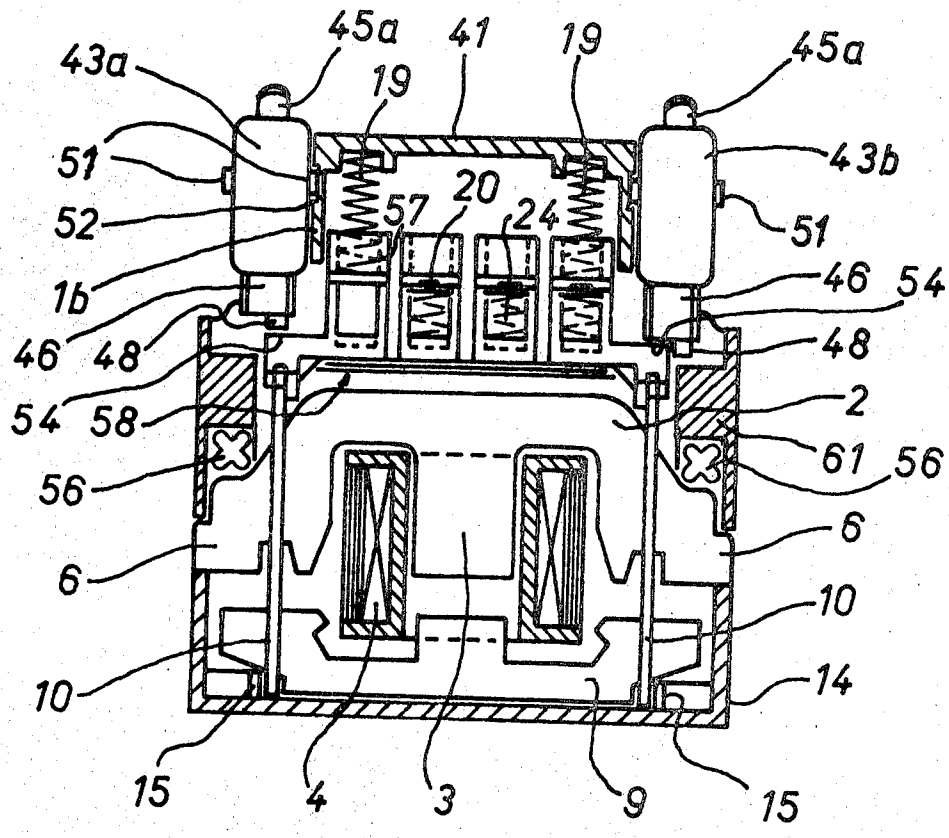
Primary Examiner—Harold Broome
Attorney, Agent, or Firm—Waters, Roditi, Schwartz & Nissen

[57] **ABSTRACT**

An alternating-current protective device comprising a housing, and a series of contact elements fixedly arranged in said housing, said fixedly arranged contact elements having movable contact bridges. A traverse serves for actuating said movable contact bridges. There is provided at least one separate contact element incorporating a contact element housing and a movable contact bridge. A plunger extends out of the contact element housing for actuating the movable contact bridge of said separate contact element. The separate contact element is positionable in the protective housing in a first position and in a second position turned through 180° with respect to the first position. The plunger of the separate contact element bears against an impact surface of the traverse. The plunger has two end surfaces arranged behind one another to define a front end surface and a rear end surface. These end surfaces are arranged at the plunger with respect to the impact surface such that in the one position of the separate contact element the front end surface bears against the impact surface of the traverse for the early actuation of the separate contact element and in the other position of said separate contact element the rear end surface bears against the impact surface of the traverse for the late actuation of such separate contact element.

8 Claims, 9 Drawing Figures



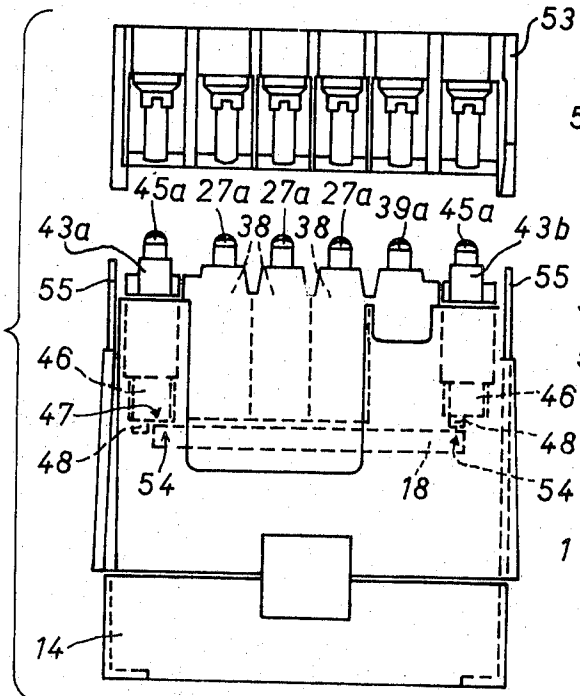


Fig.1

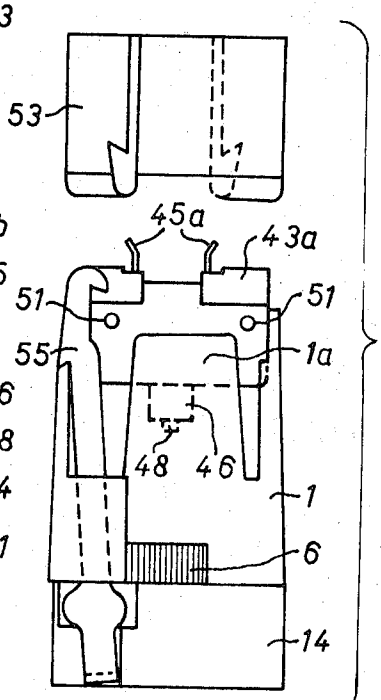


Fig.2

Fig 3

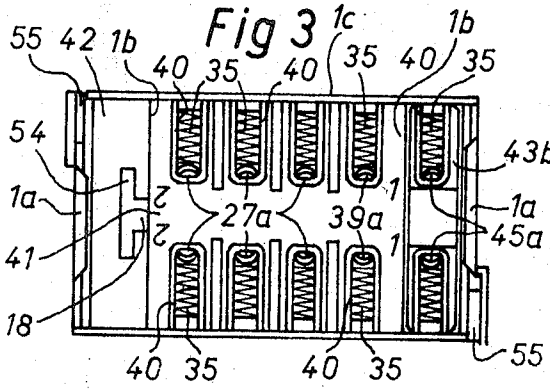


Fig.4

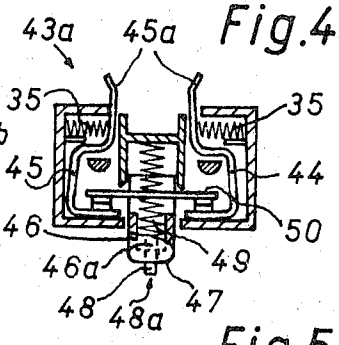


Fig.5

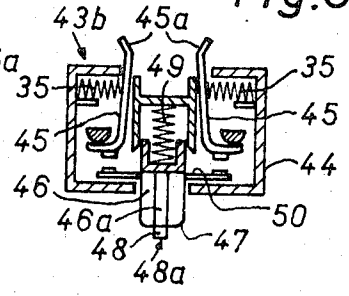
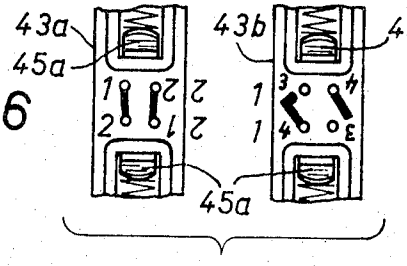


Fig.6



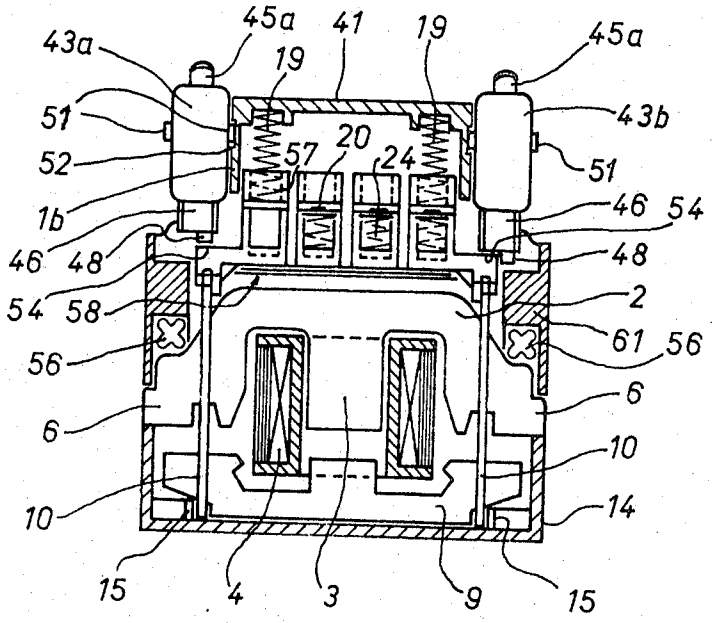


Fig.7

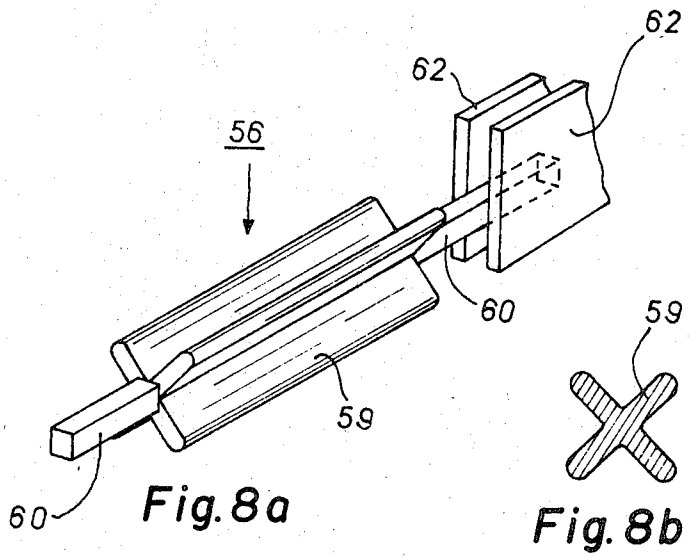


Fig.8a

Fig.8b

ALTERNATING-CURRENT PROTECTIVE DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved construction of alternating-current protective device of the type wherein the movable contact arrangement is force-lockingly connected with a movable magnetic core portion, and wherein for at least one pole of its magnetic core there is provided a short-circuit ring, wherein a ring portion thereof is located in a groove disposed in the pole surface, the short-circuit ring being movably arranged by means of the movable magnetic core portion and the ring portion as well as the groove are dimensioned in their cross-section such that in each switching position of the movable magnetic core portion the ring portion extends without contact into the groove, and wherein the force-locking connection of the movable contact arrangement with the movable magnetic core portion is formed by the short-circuit ring arrangement and for such purpose there is arranged at each outer leg of a movable E-shaped magnetic core portion a short-circuit ring which slides in guides at the protective housing and both of the short-circuit rings are connected at their ends confronting the movable contact arrangement by a transversely extending member formed of electrically insulating material. Such type alternating-current protective device has been disclosed for instance in Swiss Pat. No. 512,819.

For protective devices generally, apart from their satisfactory operational reliability, there is also of importance their adaptability to the system with which they are employed and the economies in manufacturing the same. In circuit technology there is of advantage a type of protective device which, while possessing relatively favorable price and good switching characteristics, also possesses increased longevity, is simple to use and can be employed to perform the most different switching- and control operations. A prior art multi-pole protective device with a certain adaptation capability as concerns the number and type of contact elements consists of, for instance, three main components, a protective housing in which there can be mounted, as desired, a number of separate contact elements with opening- or closing contacts, a housing cover at which there is accommodated the drive component for the contact elements, and a connection block for the terminals which can be plug connected or mounted upon the group of contact elements. These three main components can be held together by a standard two-stage pawl or ratchet closure, wherein for instance there are arranged two closure plungers under spring pressure at the housing cover so as to be upright tiltable and two respective hooks which bear against one another, one of which fixedly retains in its one tiltable position the protective housing and the other of which fixedly retains in the other tiltable position the connection block, so that merely by tilting the closure plunger the mounted connection block can be released and the contact element can be exchanged.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide an improved construction of alternating-current protective device which is not associated with the aforementioned drawbacks and limitations of the prior art proposals.

Another and more specific object of the present invention aims at the provision of an improved construction of alternating-current protective device of the general character described which can be employed in a much more versatile manner than for instance state-of-the-art multi-pole protective devices and which is particularly simple in handling and in the mounting of the individual components.

Another and more specific object of the present invention relates to a new and improved construction of protective device of the character described which is relatively simple in construction and design, extremely economical to manufacture, easy to use, not readily subject to breakdown or malfunction, and requires a minimum of servicing and maintenance.

Now in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the alternating-current protective device of this development is manifested by the features that a row of contact elements fixedly arranged in the housing of the protective device can be supplemented by at least one separate contact element having contact bridge means movable by the traverse, said at least one separate contact element having a plunger depending from the contact element housing for actuating its movable contact bridge in a first position and in a second position turned through 180°. The plunger of the associated contact element is thus pushed against an impact surface of the transverse or transversely extending member. The plunger of the separate contact element possesses two end surfaces located behind one another in their lengthwise extension, these end surfaces being arranged at the plunger with respect to the impact surface of the transversely extending member such that in the one position of the supplemented contact element for its early actuation the front end surface bears at the impact surface of the transversely extending member and in the other position, for the late actuation, the rear end surface bears against the impact surface of the transversely extending member.

As concerns the fixed contact elements the fixed contact pins can be resiliently retained in a cover plate of the protective housing and the contact bridges in the transversely extending member formed of electrically insulating material. At both ends of the row of fixed contact elements there can be provided in the protective housing a respective insertion compartment for the reception of a separate contact element, the ends of the traverse or transversely extending member extending into the insertion compartments and such ends possess the impact surfaces for the plunger of the inserted separate contact elements. Advantageously the separate contact elements are identical to one another in appearance, the contact element housing having an external shape which is axially symmetrical with respect to the plunger axis. The front end surface at the plunger is located at one side of the central plane containing the plunger axis and taken through the contact arrangement and the rear end surface is located at the other side of such central plane. The separate contact elements can be break and make contact elements. For ease in handling and orientation concerning the nature of the inserted contact elements the separate contact elements can be designated at the upper side of the housing with symbols characterizing break and late break and make and early make and contact-characterizing numerals or the like, wherein the char-

acterizing numerals for the contacts for the break- and make symbols are rotated through 180° with respect to the characterizing numerals or the like for the contacts for the late break- and early make symbols.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. **1** is a front view of a multi-pole alternating-current protective device designed according to the invention with a connectible or mountable connection or terminal block;

FIG. **2** is a side view of the protective device of FIG. **1**;

FIG. **3** is a plan view of the protective device of FIG. **1** with removed connection block and with inserted separate contact element;

FIG. **4** schematically shows in sectional view a separate contact element constructed as an opening or break element;

FIG. **5** schematically shows in sectional view a separate contact element with closing or make contacts;

FIG. **6** illustrates the designation or marking of a separate contact element with break contacts and one such with closing or make contacts, which when inserted in one position in the protective housing constitute a late break element and late make element respectively and when inserted turned through 180° constitute an early break element and early make element respectively;

FIG. **7** schematically illustrates the drive component of the protective device of FIG. **1**;

FIG. **8***a* is a perspective view illustrating details of a dampening element of the protective device;

FIG. **8***b* is a section taken through a central portion **59** of the dampening element of FIG. **8***a*.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, the protective device depicted in FIGS. **1** to **3** embodies a protective device housing **1**, also referred to herein as the protective housing, which contains three fixed or stationary contact elements **38** arranged in a row adjacent one another equipped with closing or make contacts, the contact bridges or crossbars of which are actuated by a traverse or transversely extending member **18**, as will be explained more fully hereinafter. The fixed contacts of such contact elements **38** and a pair of further fixed contacts, at which there is connected the magnetic coil of the protective device, are resiliently mounted in recess **40** of a housing cover plate **41** (FIG. **3**) and possess extensions or protuberances **27***a* and **39***a* respectively which protrude past the housing cover plate **41**, these extensions being constructed as plug contacts. Springs **35** which bear against the housing walls **1***c* fixedly retain the fixed contacts in the cover plate **41**. At each end of the double row of stationary or fixed contacts there is located within the housing an insert compartment or chamber **42** for the insertion of a separate contact element **43***a* and **43***b* respectively.

The separate contact elements **43***a* and **43***b* are identical as viewed from the outside and constructed such that each such contact element can be introduced into an insert compartment **42** in a first position and in a second position rotated through 180°. The fixed contacts of the separate contact elements **43***a* and **43***b* likewise possess extensions or protuberances **45***a* serving as plug contacts, which, when the separate contact elements are inserted are aligned with the contacts located in the housing **1**. For the purpose of connecting conductors with the fixed contacts of the fixed and separate contact elements **38** and **43***a*, **43***b* and with the coil terminal contacts there is provided a plug connectible connection block or terminal block **53**. When the connection block **53** has been removed the separate contact elements **43***a*, **43***b* can be inserted into the housing **1** or reversed in position therein.

FIG. **4** schematically shows in cross-sectional view a separate contact element **43***a* with opening or break contacts and FIG. **5** illustrates a separate contact element **43***b* with closing or make contacts. For both types of contact elements a plunger **46** is displaceably arranged in a substantially bowl-shaped housing **44** within guides **46***a* together with the contact bridge or crossbar **50** which is resiliently mounted in the plunger **46**. A restoring or return spring **49** acts upon the plunger **46**. The fixed contacts **45** which are fixedly retained in the housing **44** by means of the springs **35** are differently constructed when serving as opening or break contacts and closing or make contacts, yet their extensions **45***a* which protrude out of the housing **44** are however the same and, as mentioned, can be constructed as plug contacts. Such type or similar contact elements are known in the art. The plunger **46** of the illustrated separate contact elements **43***a* and **43***b* possesses a flat end surface **47** with a cam or dog **48** forming a raised portion. Each of the separate contact elements **43***a*, **43***b* inserted into the protective housing **1** is retained at the required elevational position by means of bulbous or protruding portions **51** provided at its side walls and which engage with recesses **52** appropriately arranged at an associated partition wall **1***b* of the protective housing (FIG. **7**). At the side walls of the protective housing **1** there are formed resilient tongues or flaps **1***a* (FIG. **2** and FIG. **3**), by means of which the contact elements **43***a* and **43***b* are pressed against the partition walls **1***b* of the protective housing **1**, so that apart from the exact elevational position of the contact elements in the protective housing there is also ensured for their effortless insertion and repositioning or reversal.

As has been indicated in FIG. **1** by phantom lines the plungers **46** of the inserted separate contact elements **43***a* and **43***b* impact against the traverse or transversely extending member **18**, by means of which the contact elements are actuated. The traverse **18** is provided at both of its ends with a respective impact surface **54** for the plunger **46** of the therewith associated contact element **43***a* and **43***b* and owing to the provision of the cam **48** the plunger **46** of each contact element possesses the end surfaces **47** and **48***a* located at different elevational positions. These surfaces **47** and **48***a* are formed at the associated plunger **46** with respect to the impact surface **54** of the traverse **18** such that in one inserted position of each such separate contact element the front end surface, i.e., the end surface **48***a* of the cam **48** bears against the impact surface **54** of the traverse **18** and in the other inserted position, rotated or turned through 180°, of the contact element the rear end surface **47** bears against the impact surface **54** of

the traverse **18**. With the cam **48** bearing against the impact surface **54** of the traverse **18** the rest position of the plunger **46** is displaced by an amount corresponding to the height of the cam and the contacts of the contact element are appropriately sooner opened or closed than for the inserted position of the contact element where the rear end surface **48** bears against the impact surface **54** of the traverse **18**.

With the particularly simple constructional embodiment depicted in FIGS. **2** and **7** the traverse **18** extends at each end up to the region of the center or center line of the associated plunger **46** of the inserted separate contact elements **43***a* and **43***b* and the plunger cams **48** are always arranged at one-half of the end surface **47** of the associated plunger **46**, so that in the one inserted position of the relevant contact element the cam **48** comes to lie adjacent the traverse **18** and in the other inserted position comes to lie upon the traverse. For rapid and reliable orientation the separate contact elements **43***a* and **43***b* are marked, for instance at the housing surface between the stationary contacts **45**, for a contact element with opening or break contacts with the symbol for a break and a late break and for a contact element with closing contacts with the symbol for a make and early make, as such has been shown for instance in FIG. **6**. At the symbols the contacts are additionally designated with characters or numerals, for instance "**1**" and "**2**" for break contacts and "**3**" and "**4**" for make contacts, wherein at each contact element the numeral of one symbol is rotated through 180° with respect to the numeral of the other symbol, so that also the inserted position can be read-off. The symbol which is situated closer to the housing wall **16** designates the function in the selected inserted position (FIG. **6**). The numeral at the contact element together with the numeral arranged adjacent thereto at the housing provides a reading for the terminal number of the inserted contact element. For the separate contact element which has been depicted in FIG. **1**, of which the left contact **43***a* is a break and plug connected for late actuation and the right contact element **43***b* is a make and plug connected for early actuation there are provided the designations shown in FIG. **6**.

The drive portion of the protective device, by means of which the traverse **18** is actuated, is mounted in the housing cover **14**. The three main components of the protective device, namely the housing cover **14**, protective housing **1** and connection block **53** are retained together by a conventional two-stage pawl or ratchet closure, the closure plungers **55** of which are arranged at the side walls of the protective device.

The movable magnetic core or armature portion **9**, as best seen by referring to FIG. **7**, is displaceably mounted together with the short-circuit rings **10** in guides **15** in the housing cover **14**. The E-shaped magnetic core **2**, upon the middle or center leg **3** of which there is pushed the magnetic coil **4**, bears at its pole ends **6** against the side walls of the housing cover **14** and with the protective housing **1** placed upon the cover **14** is pressed by means of dampening elements **56** (see also FIG. **8**), arranged at the side walls of the protective housing **1**, against the housing cover **14**. Both of the short circuit rings **10** are connected with one another by the traverse **18** guided in the protective housing **1** and which traverse is formed of electrically insulating material. The traverse **18** possesses four extensions or projections **57** formed thereat and having pot-shaped head ends, as best seen by viewing FIG. **7**. In three of these projections **57** there are mounted the contact bridges or crossbars **20** with the contact springs **24** for the fixed contacts of the contact elements fixed in the housing and which fixed contacts are arranged at the housing cover plate **41** (FIG. **3**). Restoring or return springs **19** are mounted in the pot-shaped head ends of both outer projections **57**, these restoring springs bearing against the housing cover plate **41** and pressing the traverse **18** against the short circuit rings **10**. The movable system consisting of the traverse **18**, short-circuit rings **10** and magnetic armature **9** are force-lockingly or positively held together by the restoring springs **19** and pressed against the surfaces **14***a* at the cover. The separation or partition plate **58** is engaged with the protective housing and serves as the closure of the contact space or compartment. For a faultless mode of operation of the protective device, that is to say, for an exact and recoil-free actuation of the movable contacts, and the longevity of the protective device, the dampening elements are of significance. In any case the dampening element should be accommodated to the relevant force-path relationship of the protective device. FIG. **8** illustrates a simple and effective dampening element **56**. This dampening element **56** is in the form of a rod-shaped body formed of flexible plastic having a central portion **59** possessing a star-shaped cross-sectional configuration, the radial arms of which are loaded for bending shear and compression, and at both ends of which there are mounted square holding arms **60**. For mounting purposes the holding arms **60** are clamped at their ends in clamping jaws **62** located in housing projections **61**. The central portion of the body forming the actual dampening element constitutes a four-arm star arrangement, at which bear the pole ends **6** of the magnetic core **3**, and which can be easily appropriately dimensioned to the force-path relationship of the relevant protective device.

The previously described dampening element considerably contributes to the operational reliability of the alternating-current protective device. With a protective device and with only four separate contact elements, of which two are equipped with opening or break contacts and two with closing or make contacts, it is possible to combine different contact element sets, so that the protective device can be used in an extremely versatile manner. Mounting is very simple, with the exception of the screws in the connecting block all of the components are only plug connected together. With the connecting block removed the separate contact elements can be easily inserted and positionally reversed, and owing to the clear and visible contact markings erroneous connections are practically eliminated.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims. ACCORDINGLY,

What is claimed is:

1. An alternating-current protective device comprising a housing, a series of contact elements fixedly arranged in said housing, said fixedly arranged contact elements having movable contact bridges, a traverse for actuating said movable contact bridges, at least one separate contact element incorporating a contact ele-

ment housing and a movable contact bridge, a plunger extending out of the contact element housing for actuating said movable contact bridge of said separate contact element, said at least one separate contact element being positionable in said protective housing in a first position and in a second position turned through 180° with respect to said first position, said traverse having at least one impact surface, the plunger of said separate contact element bearing against said impact surface, said plunger having two end surfaces arranged behind one another to define a front end surface and a rear end surface, said end surfaces being arranged at the plunger with respect to the impact surface such that in the one position of the separate contact element the front end surface bears against the impact surface of the traverse for the early actuation of said separate contact element and in the other position of said separate contact element the rear end surface bears against the impact surface of the traverse for the late actuation of said separate contact element.

2. The alternating-current protective device as defined in claim **1,** wherein the fixedly arranged contact elements and separate contact elements contain fixed contact pins with extensions serving as plug contacts, a connection block which can be plug connected with the contact elements, said protective housing being provided with insert compartments bounded by walls of said housing for receiving a respective separate contact element, said insert compartments being open at the side of the plug contacts of the protective housing and with said connection block removed render possible insertion of the separate contact elements in said first position and in said second position rotated through 180°, cooperating holding means provided at the walls of the insert compartments and at the separate contact elements by means of which the separate contact element inserted in the first or second position can be fixedly held in the insert compartments.

3. The alternating-current protective device as defined in claim **2,** wherein the fixed contact pins of the fixed contact elements are resiliently retained in a cover plate of the protective housing and the contact bridges of the fixed contact elements are resiliently retained at the traverse, said traverse being formed of electrically insulating material, at both ends of the series of fixed contact elements there is provided in the protective housing a respective one of said insert compartments for receiving a respective separate contact element, the ends of the traverse extending into the insert compartments and possessing impact surfaces for the plungers of the inserted separate contact elements.

4. The alternating-current protective device as defined in claim **3,** wherein the separate contact elements are identical as concerns their external appearance, the contact element housing of each separate contact element having an axially symmetrical external form with respect to the axis of the associated plunger, and at the plunger said front end surface is located at one side of the central plane which contains the plunger axis and said rear end surface is located at the other side of such central plane.

5. The alternating-current protective device as defined in claim **4,** wherein both insert compartments are bounded at the side of the fixed contact elements by a respectively fixed housing partition wall, and resilient tongues formed from the side walls of the protective housing by means of which the separate contact elements which have been inserted into the insert compartments can be pressed against the partition walls.

6. The alternating-current protective device as defined in claim **4,** wherein one such separate contact element is a break contact and the other separate contact element is a make contact and both such contact elements are designated at the top region of the housing by symbols for break and late break and make and early make respectively as well as by contact-designating numerals, wherein the symbols for break and early make are located at the side of the front end surface of the plunger and the symbols for later break and make are located at the side of the rear end surface of the plunger and the designating numerals for the contacts at the break- and make symbol are turned through 180° with respect to the designating numerals for the contacts at the late break and early make symbol, so that such designating numerals together with place numerals applied to the housing cover plate situated there adjacent form the terminal number.

7. The alternating-current protective device as defined in claim **5,** wherein the traverse is displaceably mounted in the protective housing, restoring springs supported at the cover plate of the housing, said housing having a support wall, the traverse being pressed against the support wall by means of the restoring springs, a movable magnetic core portion with short-circuit rings and a magnetic core with the magnetic coil being mounted in a housing cover means, said magnetic core having laterally protruding pole ends bearing at the side walls of the cover means, and dampening element means provided at the side walls of the protective housing, the arrangement of the aforementioned components being such that with the housing cover means mounted the magnetic core is pressed by means of the dampening element means against the cover means and the traverse is pressed by means of the restoring springs against the short-circuit rings.

8. The alternating-current protective device as defined in claim **7,** wherein said dampening element means comprises a respective dampening element arranged at the side walls of the protective housing, each said dampening element being a rod-shaped body of flexible plastic having a central portion possessing a substantially star-shaped cross-section and equipped with holding arms, said protective housing having clamping jaws, each dampening element bearing against a projection of the protective housing and in this position being retained by the ends of the holding arms clamped between said clamping jaws of the protective housing.

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