United States Patent [19]

Wittenzellner et al.

[11] **3,739,111**

[45] **June 12, 1973**

[54] **TRANSFER SWITCH FOR TAP-CHANGING REGULATING TRANSFORMERS WITH IMPROVED CONTACT STRUCTURE**

[75] Inventors: **Georg Wittenzellner,** Oberhinkhofen; **Hans Stark,** Regensburg, both of Germany

[73] Assignee: **Maschinenfabrik Reinhausen Gebruder Scheubeck K.G.,** Regensburg, Germany

[22] Filed: **Jan. 25, 1972**

[21] Appl. No.: **220,668**

[30] **Foreign Application Priority Data**

Feb. 2, 1971 Germany ..... P 21 04 766.5

[52] **U.S. Cl.** ..... **200/11 TC,** 200/166 BE

[51] **Int. Cl.** **H01h 21/78,** H01h 1/22

[58] **Field of Search** ..... 200/8 R, 8 A, 10, 200/11 A, 11 R, 11 TC, 166 BE, 166 BF, 11 B

[56] **References Cited**

UNITED STATES PATENTS

3,238,320	3/1966	Bleibtreu	200/8 A X
2,577,225	12/1951	Barry	200/11 B
3,238,318	3/1966	Bleibtreu et al.	200/8 A X
3,458,670	7/1969	Wittenzellner	200/166 BE X

FOREIGN PATENTS OR APPLICATIONS

1,230,903	12/1966	Germany

Primary Examiner—J. R. Scott

Attorney—Erwin Salzer

[57] **ABSTRACT**

A transfer switch structure for tap-changing regulating transformers includes a cylindrical contact support for fixed contacts, cooperating movable contacts arranged inside the support and a liquid containing tank for housing said contact support. The tank is provided with terminals. A novel contact structure including spring-biased superimposed contact fingers forming an X-like pattern is provided for transferring current from the movable current-carrying contacts to the terminals of the transfer switch.

5 Claims, 3 Drawing Figures

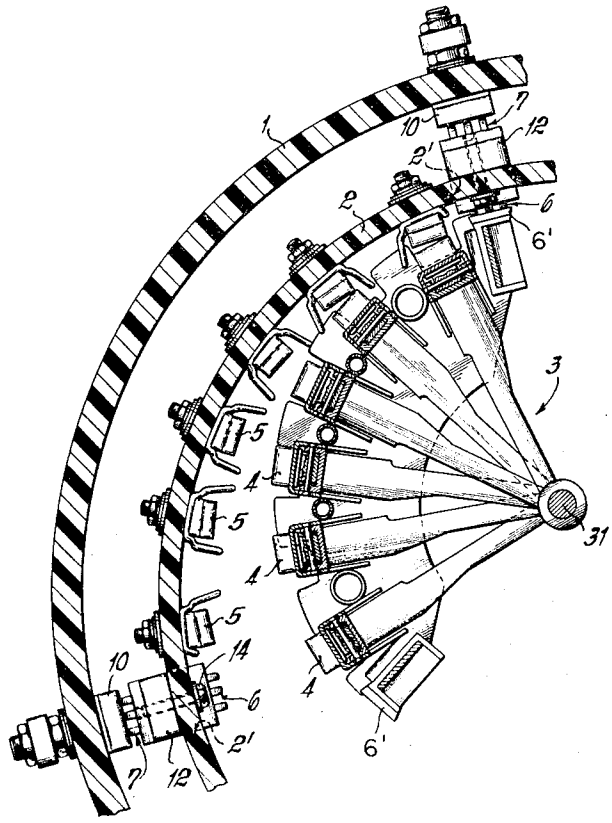


FIG. 1

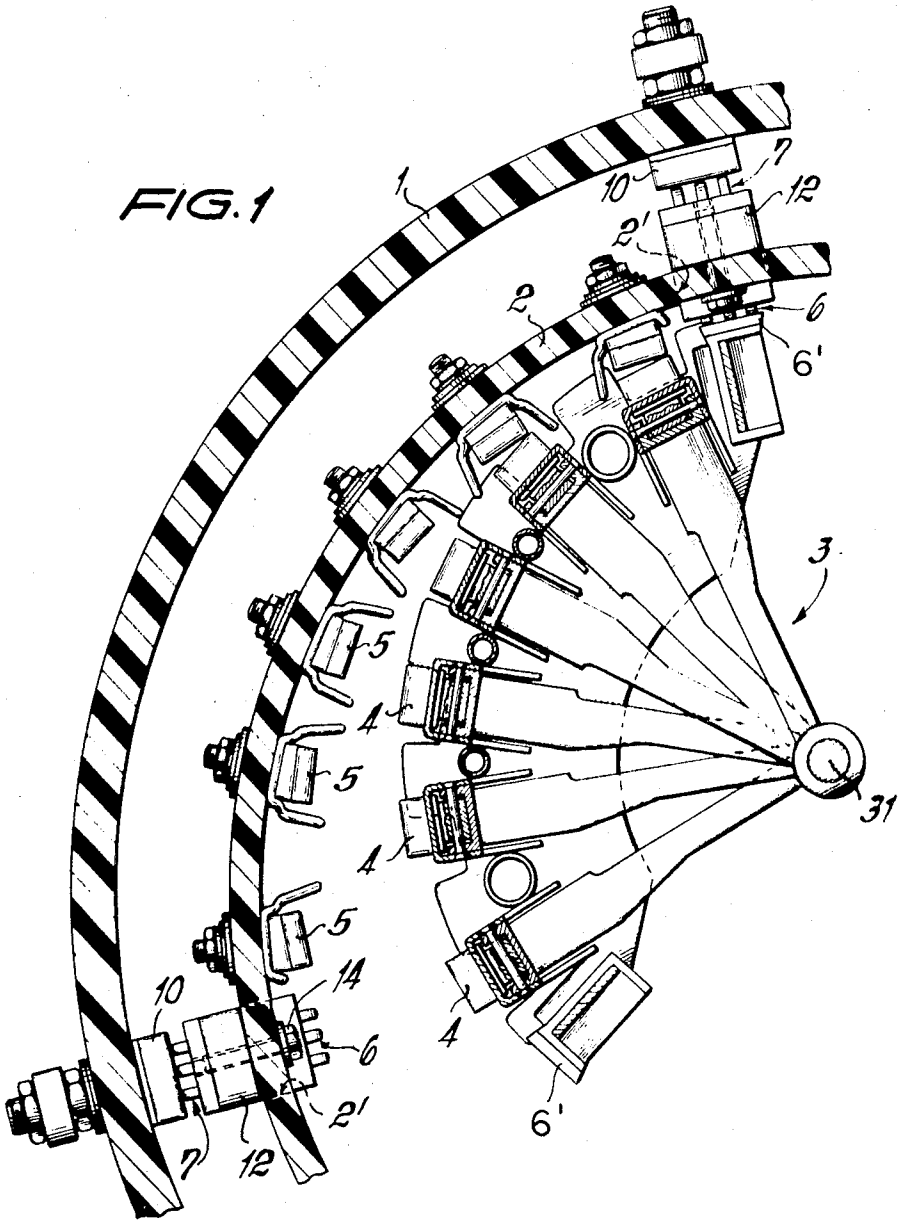


FIG. 2

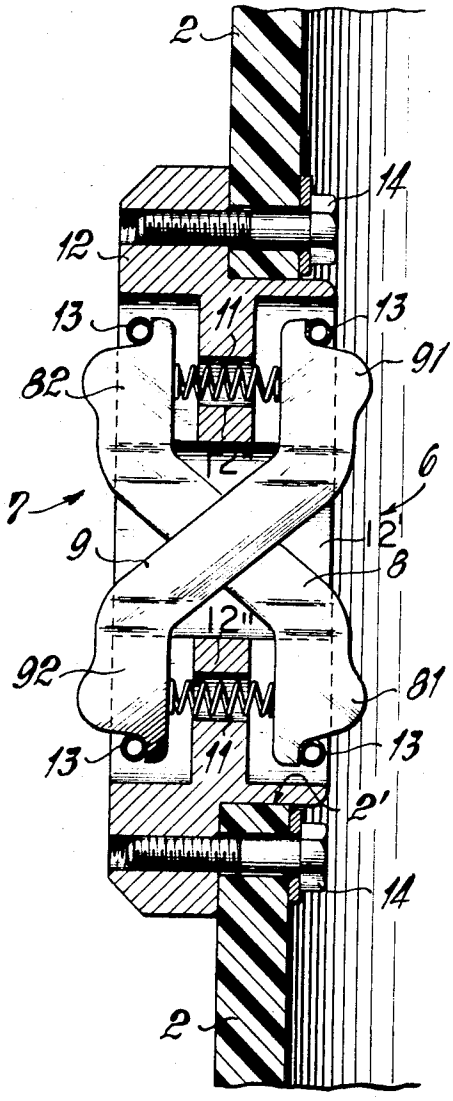
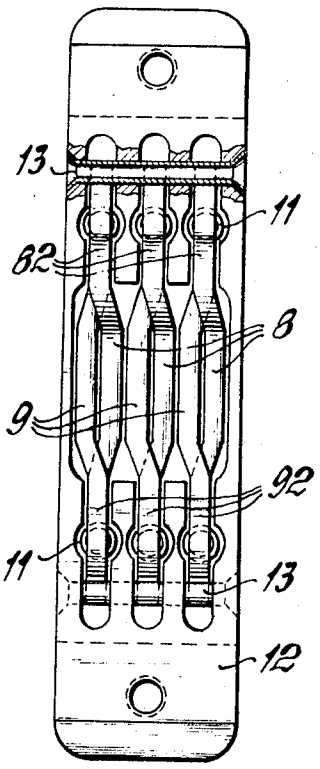

2
14
12
13
11
13
91
82
12
6
7
12'
9
8
12''
92
81
13
11
13
2'
14
2

FIG. 3


13
11
82
8
9
92
11
13
12

TRANSFER SWITCH FOR TAP-CHANGING REGULATING TRANSFORMERS WITH IMPROVED CONTACT STRUCTURE

BACKGROUND OF THE INVENTION

This invention refers to transfer switches for tap-changing regulating transformers and more particularly to transfer switches known as Jansen-type transfer switches.

The principal object of the invention is to provide transfer switches of the above description with current-carrying contact means which do not involve braids, or similar flexible conductors.

U.S. Pat. No. 3,238,318 to A.Bleibtreu et al., Mar. 1, 1966 for CONTACT BRIDGES FOR RADIAL CONTACTS WITH FULCRUM AND RESILIENT SPRING STRUCTURE discloses a Jansen-type transfer switch having current-carrying contacts of which the present invention is an outgrowth, and a considerable improvement.

The structure disclosed in the above patent includes a substantially cylindrical contact support supporting a plurality of fixed contacts arranged in a circular pattern. Said plurality of fixed contacts includes a pair of fixed current-carrying contacts. A plurality of movable contacts is arranged inside of the aforementioned contact support. Each of said plurality of movable contacts is provided with operating means to effect selective engagement and disengagement of one of said plurality of fixed contacts by one of said plurality of movable contacts in a predetermined sequence. The aforementioned plurality of movable contacts includes a pair of movable current-carrying contacts each arranged to cooperate with one of said pair of fixed current-carrying contacts. The transfer switch further includes a tank adapted to house said contact support and to be filled with a liquid medium, such as oil, for immersing said plurality of fixed contacts and said plurality of movable contacts therein. The tank for housing the contact support and the entire transfer switch mechanism is provided with and supports a pair of terminals each adapted to be conductively connected to one of said fixed current-carrying contacts. Each of said pair of terminals has a contact surface situated on the inside of the above referred-to tank.

The above structure has been clearly illustrated in FIG. 2 of the aforementioned U.S. Pat. No. 3,238,318 wherein reference numeral 2 has been applied to indicate the cylindrical contact support, numeral 23 to indicate the fixed contacts supported by support 2, numeral 22 to indicate the movable contacts cooperating with fixed contacts 23, and numeral 3 to indicate terminals on a tank of insulating material arranged in coaxial relation to contact support 2 and housing the latter.

The external terminals on the tank have contact surfaces situated inside of the tank which are normally engaged under pressure by the fixed current-carrying contacts. The aforementioned contact surfaces of the terminals and the portions of the fixed current-carrying contacts which are normally in engagement with them operate as disconnect switch means. These disconnect switch means make it possible to assemble the transfer switch by a mere insertion of the contact support into the tank, and to disassemble the transfer switch by a mere withdrawal of the contact support from the tank.

In order to allow the terminals and the fixed current-carrying contacts to cooperate in the above disconnect-switch-like fashion the fixed contacts must be subject to a strong spring bias and given a small freedom of substantially radial motion relative to the cylindrical support for the fixed contacts. This requirement of a small freedom of motion calls for the provision of braids or similar flexible contact means. The design of braids, or like flexible current-carrying means, is difficult, particularly if large current intensities are involved, because the presence of the flexible current-carrying means must not impair the freedom of motion of the spring-biased contact surfaces. Besides, the performance of braids and like flexible current-carrying means is often rather unsatisfactory.

It is one object of this invention to substitute for braids, and like flexible current-carrying means, contact structures not subject to the drawbacks and limitations of braids and like conductors of electricity.

SUMMARY OF THE INVENTION

The present invention consists of a novel finger contact structure for carrying current from the movable current-carrying contacts of a transfer switch to the terminals thereof. The finger contacts include a pair of spring-biased superimposed contact fingers arranged cross-wise to form an X-like pattern. Each of said pair of contact fingers has a radially inner contact surface arranged to be engaged by one of a pair of movable current-carrying contacts and each of said pair of contact fingers further has a radially outer contact surface arranged to engage a radially inner contact surface of one of a pair of terminals supported by the tank of the transfer switch.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a somewhat diagrammatic transverse section of a three-phase transfer switch embodying the invention and shows the constituent parts of one of the three phases only, the constituent parts of the other two phases of the transfer switch being broken away;

FIG. 2 is a side elevation of the current-carrying finger contact structure which forms the essential element of the present invention and FIG. 2 further shows in cross-section the way in which the aforementioned finger contact structure is supported and positioned; and

FIG.3 is a front view of the structure of FIG.2 seen from the left to the right of FIG.2, or in radially inward direction of FIG.1

DESCRIPTION OF PREFERRED EMBODIMENT

In the drawings reference character 2 has been applied to indicate a substantially cylindrical contact-supporting structure of electric insulating material. Structure 2 supports a plurality of fixed contacts 5,6 arranged in a circular pattern. Contacts 5 are arcing contacts and contacts 6 are current-carrying contacts within the meaning normally attributed to these terms. A plurality of movable contacts is arranged inside contact support 2. Each of these movable contacts is provided with operating means 3 to effect selective engagement and disengagement of one of said plurality of fixed contacts by one of said plurality of movable contacts. The movable contacts include the movable arcing contacts 4 cooperating with the fixed arcing contacts 5 and the movable current-carrying contacts 6' cooperating with the fixed current-carrying contacts 6. The contact-operating means are formed by linkages

driven by shaft 31 arranged in coaxial relation to contact support 2.

The structure shown in FIG. 1 may be designed and operate along the lines disclosed in considerable detail in U.S. Pat. No. 3,218,400 to A. Bleibtreu,Nov. 16,1965 for TRANSFER SWITCH FOR TAP-CHANGING REGULATING TRANSFORMERS HAVING SQUIRREL-CAGE-SHAPED SUPPORT FOR THE FIXED CONTACTS THEREOF; the aforementioned U.S. Pat. No. 3,238,318 to A.Bleibtreu et al., March 1,1966 for CONTACT BRIDGES FOR RADIAL CONTACTS WITH FULCRUM AND RESILIENT SPRING STRUCTURE; or U.S. Pat. No. 3,458,670 to G.Wittenzellner, July 29,1969 for TAP CHANGER CONTACT BRIDGE WITH SPRING-BIASED LOST MOTION CONNECTION. Reference may be had to these patents in regard to the details of the structure shown in FIG.1. It should be understood that movable contacts 4 may be formed by movable contact bridges each adapted to conductively interconnect, or to separate, a pair of fixed contacts taking the place of the fixed contacts 5 of FIG.1. This modification of the structure of FIG.1 has been shown and described in detail in the above referred-to prior art patents.

In FIG.1 reference character 1 has been applied to indicate a tank of electric insulating material adapted to house, and housing, contact support 2, the fixed contacts 5,6 on support 2, their cooperating movable contacts 4,6' and the operating means 3,31 of the latter. Insulating tank 1 is arranged in coaxial relation to the cylindrical contact support 2, and the former is adapted to be filled with a fluid medium, e.g. oil, for immersing the fixed contacts 5,6 and the movable contacts 4,6' in the fluid medium. The latter has not been shown in the drawings. The tank 1 supports a pair of angularly displaced terminals 10 of which each is adapted by means in the nature of a disconnect switch to be conductively connected to one of the movable and the fixed current-carrying contacts 6',6. To this end each of the terminals 10 has a contact surface situated inside of tank 1 the function of which contact surface will be explained below more in detail.

The aforementioned fixed pairs of current-carrying contacts 6 are shown in FIG.2 less diagrammatically, more in detail and on a larger scale than in FIG.1. Each pair of fixed current-carrying contacts includes a pair of spring-biased superimposed contact fingers 8,9 arranged crosswise to form an X-like pattern. Each of contact fingers 8,9 has a radially inner contact surface 81 and 91, respectively, formed by a bulge-like projection. Each of contact fingers 8,9 further has a radially outer contact surface 82, and 92, respectively, each formed by a bulge-like projection. The radially inner contact surfaces 81,91 of contact fingers 8,9 are arranged to be engaged selectively by one of the movable current-carrying contacts 6'. This results in a radially outward movement of contact fingers 8,9 against the bias of helical compression springs 11,11. As a result of this movement of contact fingers 8,9 radially outer contact surfaces 82,92 engage under pressure the contact surfaces of terminals 10. Thus the contact fingers 8,9 which are formed by planar stampings arranged in parallel planes establish current paths of high conductivity from one of movable current-carrying contacts 6' to one of the terminals 10.

As mentioned above, FIG.1 shows a section of a portion of a tripolar transfer switch intended for three-phase circuits. The same, or a similar arrangement as shown in FIG.1 may be used for single-phase circuits. In the case of three-phase circuits one sector of about 120° of cylindrical contact support 2 supports the fixed contacts pertaining to one of three phases as shown more in detail in the prior art patents which have been identified above.

It will be apparent from FIG.2 that each of the helical compression springs 11 is interposed between the radially inner contact surface 81,91 of one of the pair of contact fingers 8,9 and the radially outer contact surface 92,82 of the other of the pair of contact fingers 9,8.

The cylindrical contact support 2 is provided with a pair of cutouts 2'. Each of said pair of cut-outs is arranged at one of the two points where the contact fingers 7,8 are arranged to be engaged by the movable current-carrying contacts 6'. A contact finger support 12 of electric insulating material is inserted into each of the cut-outs 2' and affixed to the cylindrical contact support 2. This is preferably achieved by means of bolts or studs to which reference numeral 14 has been applied. Each of the contact fingers 8,9 is provided adjacent the axially outer end thereof with an abutment-forming surface cooperating with one of four abutment studs 13 in order to limit the displacement of contact fingers 8,9 relative to support 12 under the action of biasing springs 11. Springs 11 tend to cause engagement under pressure of abutment means or abutment pins 13 and finger contacts 8,9.

Contact finger support 12 is provided with a relatively large central aperture or passageway 12' and with a pair of additional relatively small apertures or passageways 12''. Passageways 12' and 12'' extend from one side to the other side of the contact finger support 12 in each of the cut-outs 2' in the cylindrical contact support 2. Each of contact finger 8,9 projects substantially transversely through the central passageway 12'. Each of the compression springs 11 is arranged in one of the additional passageways 12'' of contact finger support 12 in each of cut-outs 2'. The abutment pins 13 are arranged at substantially right angles to the two parallel planes defined by contact fingers 8,9.

A single pair of contact fingers 8,9 is capable of carrying but relatively small currents from movable main contacts 6' to the terminals 10 on tank 1. Where large currents are involved, the arrangement of fingers 8,9 shown in FIG.2 may be multiplied as shown in FIG.3 In FIG.3 reference numeral 12 has been applied to a contact finger support having substantially the same geometrical configuration as the contact finger support of FIG.2, except for the fact that the depth of the central passageway 12' is increased to allow passage of a stack composed of substantially flat contact fingers 8,9 arranged in parallel planes. The aforementioned stack of contact fingers 8,9 includes a plurality of pairs of finger contacts 8,9. Each of said pair of contact fingers 8,9 includes a pair of spring biased superimposed contact fingers arranged crosswise to form an X-like pattern as shown in FIG.2 and described in detail in connection with that figure. In other words, the structure of FIGS. 2 and 3 differ only inasmuch as the former shows but one single pair of contact fingers 8,9 which are ar-

ranged crosswise, and the latter shows three such pairs of crosswise arranged contact fingers.

We claim as our invention:

1. A transfer switch structure for tap-changing regulating transformers including

a. a substantially cylindrical contact support supporting a plurality of fixed contacts arranged in a circular pattern, said plurality of fixed contacts including a pair of fixed current-carrying contacts;

b. a plurality of movable contacts arranged inside said contact support, each of said plurality of movable contacts being provided with operating means to effect selective engagement and disengagement of one of said plurality of fixed contacts by one of said plurality of movable contacts in a predetermined sequence, said plurality of movable contacts including a pair of movable current-carrying contacts each arranged to cooperate with one of said pair of fixed current-carrying contacts;

c. a tank adapted to house said contact support and to be filled with a fluid medium for immersing said plurality of fixed contacts and said plurality of movable contacts in said fluid medium;

d. a pair of terminals supported by said tank each adapted to be conductively connected to one of said pair of fixed current-carrying contacts, each of said pair of terminals having a contact surface situated on the inside of said tank; and

e. each of said pair of fixed current-carrying contacts including a pair of spring-biased superimposed contact fingers arranged crosswise to form an X-like pattern, each of said pair of contact fingers having a radially inner contact surface arranged to be engaged by one of said pair of movable current-carrying contacts and each of said pair of contact fingers further having a radially outer contact surface arranged to engage said contact surface of one of said pair of terminals upon engagement of said radially inner contact surface thereof by one of said pair of movable contact-carrying contacts.

2. A transfer switch structure as specified in claim 1 including a pair of helical compression springs for biasing said pair of contact fingers, each of said pair of compression springs being interposed between said radially inner contact surface of one of said pair of contact fingers and said radially outer surface of the other of said pair of contact fingers.

3. A transfer switch structure as specified in claim 2 wherein

a. said cylindrical contact support is provided with a pair of cutouts;

b. a contact finger support is inserted into each of said pair of cut-outs and affixed to said cylindrical contact support;

c. each of said pair of contact fingers is provided with a pair of abutment surfaces each cooperating with abutment means on said contact finger support to limit the displacement of said pair of contact fingers under the action of said pair of helical compression springs; and wherein

d. said pair of helical compression springs is supported by said contact finger support and tends to cause engagement under pressure of said pair of abutment surfaces of each of said pair of contact fingers with said abutment means on said contact finger support.

4. A transfer switch structure as specified in claim 3 wherein

a. said contact finger support in each of said pair of cut-outs of said cylindrical contact support is bolted to said cylindrical contact support and provided with a relatively large central passageway and with a pair of additional relatively small passageways each arranged to opposite sides of said central passageway, said central passageway and said pair of additional passageways extending from one side to the other side of said contact finger support in each of said pair of cut-outs of said cylindrical contact support;

b. each of said pair of contact fingers projects substantially transversely through said central passageway of said contact finger support in each of said pair of cut-outs of said cylindrical contact support;

c. each of said pair of helical compression springs is arranged in one of said pair of additional passageways of said contact finger support in each of said cut-outs of said cylindrical contact support; and wherein

d. said abutment means on said contact finger support in each of said cut-outs of said cylindrical contact support is formed by four pins arranged substantially at right angles to the planes defined by said pair of contact fingers.

5. A transfer switch structure as specified in claim 1 wherein

a. said cylindrical contact support is provided with a pair of cut-outs;

b. a contact finger support is inserted into each of said pair of cut-outs and affixed to said cylindrical contact support; and wherein

c. said contact finger support in each of said pair cut-outs of said cylindrical contact support supports a stack composed of substantially flat finger contacts arranged in parallel planes and including a plurality of pairs of finger contacts, each of said pairs of finger contacts comprising a pair of spring-biased superimposed contact fingers arranged crosswise to form an X-like pattern.

* * * * *