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MULTI-CONTACT ELECTRICAL SWITCHES

Filed Oct. 21, 1958

5 Sheets-Sheet 1

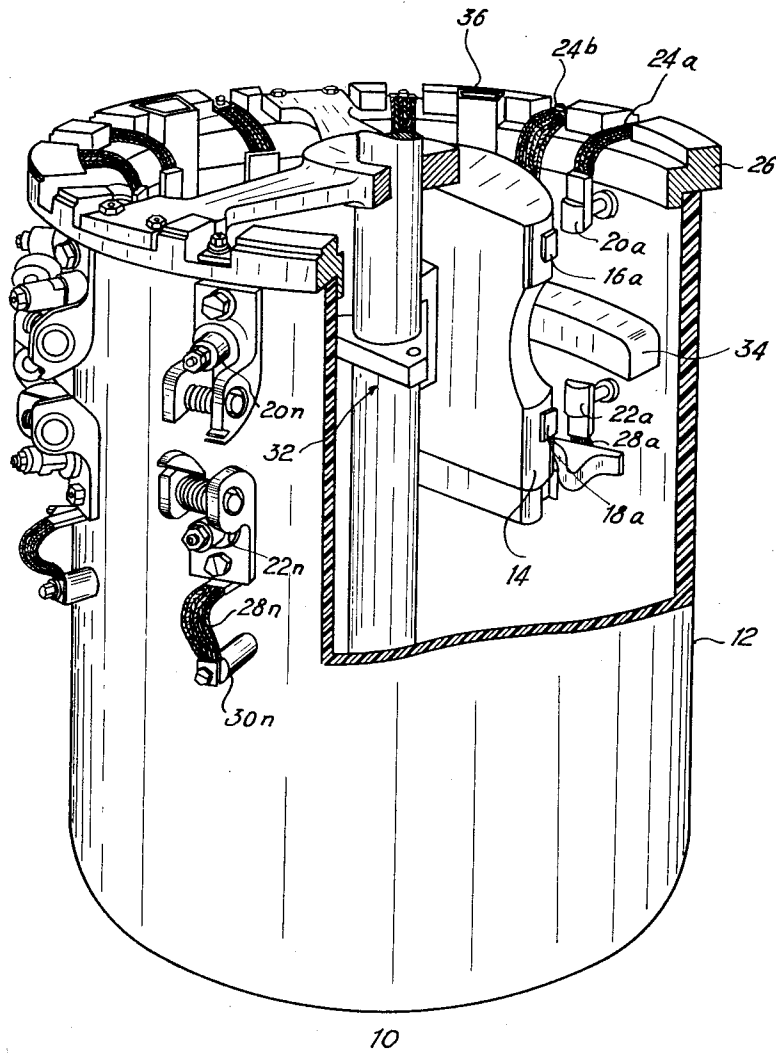


Fig. 1

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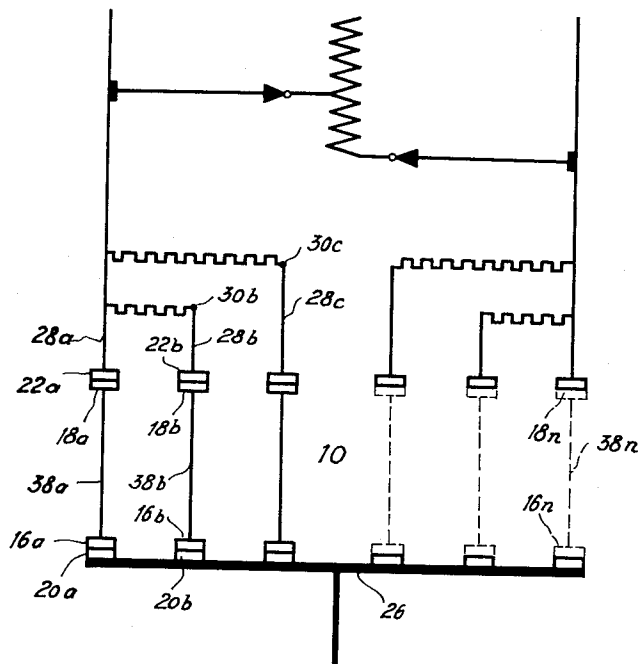


Fig. 2

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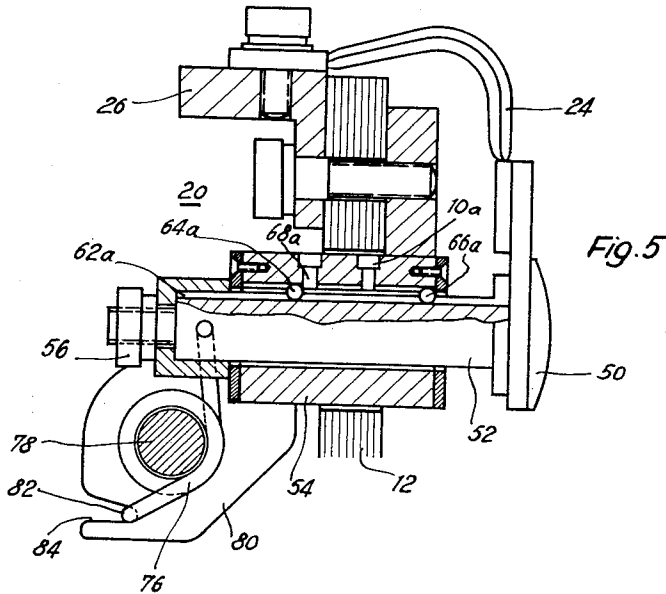


Fig. 5

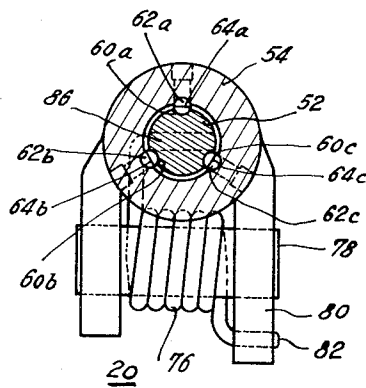


Fig. 6

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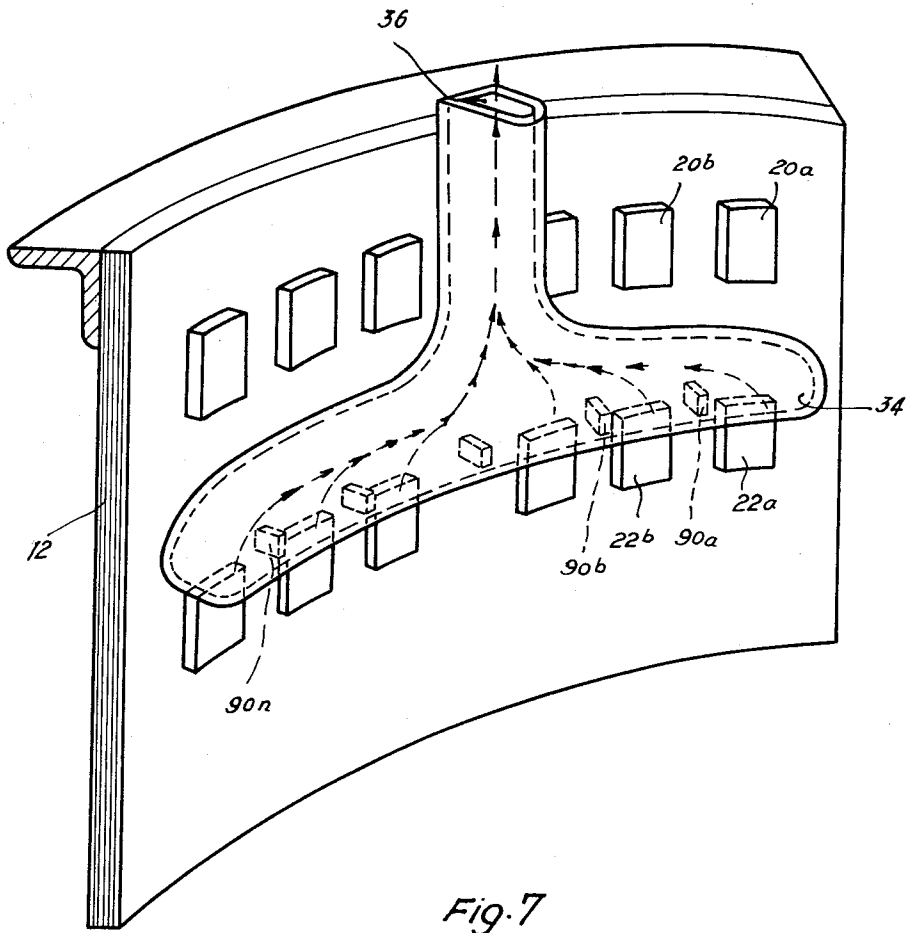
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MULTI-CONTACT ELECTRICAL SWITCHES

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2 Claims. (Cl. 200-8)

This invention pertains to electrical switchgear and more particularly to multi-contact electrical switches for on-load tap changing of transformers.

Generally, in such tap changers, a movable support member carries a plurality of contacts coupled to one terminal of the transformer while a fixed support member carries a corresponding plurality of contacts divided into two groups which are coupled via adequate impedances respectively to two successive taps of the transformer. The moving support member is moved with respect to the stationary support member and pairs of contacts are sequentially connected so that the tap may be changed without an interruption of current flow in the load, the fraction of the winding between the taps being shunted by the impedances during the passage from the one tap to another. The disconnected end of the switch is then displaced to the following tap and the same operation is continued until the required voltage is reached.

Although such switches work satisfactorily in many applications, they often cannot handle the required quantities of current unless they are excessively large. Further because of their complexity and size such switches may not operate in the time required by specific switching applications.

It is accordingly a general object of the invention to provide improved multi-contact switching apparatus.

It is another object of the invention to provide multi-contact switching apparatus which while handling very large currents occupies a minimum volume.

It is a further object of the invention to provide multi-contact switching apparatus of the class described which is fast acting.

The invention is embodied in apparatus which comprises a movable support for two rows of contacts which are electrically connected in pairs while all the contacts in the same row are insulated from each other. A fixed support member also carries insulatively two rows of contacts that are cooperatively disposed with the rows of contacts on the movable support member. The contacts of one row carried by the fixed support member are adapted to be coupled to one terminal of the transformer while the contacts of the other row carried by the fixed support member are divided into two groups which are adapted to be coupled respectively to two successive taps of the winding of the transformer via adequate impedances.

One feature of the invention is embodied in an electrical contact slidably mounted in a support means with spring means provided to ensure contact pressure against another electrical contact.

A further feature of the invention is incorporated in a hood which is disposed with respect to the electrical contacts for drawing off gases developed by electrical arcs created by the movement of electrical contacts.

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Other objects, features and advantages of the invention will be evident from the following detailed description of the invention when read in connection with the accompanying drawings wherein:

5 FIGURE 1 is a perspective view, partially broken away, of a multi-contact switching means in accordance with the invention;

FIGURE 2 is a schematic diagram of the electrical connections provided by the contacts of the multi-contact switching means of FIGURE 1;

10 FIGURE 3 shows one row of contacts disposed on a movable support means and the cooperating row of contacts on a fixed support means of the multi-contact switching means of FIGURE 1;

15 FIGURE 4 is a sectional view taken along the line 4-4 of FIGURE 3;

FIGURE 5 is a side view partially in section of one of the contacts on the fixed support means as shown in FIGURE 3;

20 FIGURE 6 is a cross-sectional view of the electrical contact of FIGURE 5; and

FIGURE 7 is a schematic representation of a hood incorporated in the multi-contact switching means of FIGURE 1.

25 FIGURE 1, in general, shows a multi-contact switching means 10 comprising a fixed support member 12 encompassing a movable support member 14 of insulative material. Disposed in movable support member 14 are a first row of contacts 16(a-n) and a second two of

30 contacts 18(a-n). As is hereinafter more fully disclosed, each of the contacts 16 is respectively connected electrically to an associated contact 18 to form a pair of contacts. Disposed in fixed support member 12 are a first row of contacts 20(a-n) cooperative with contacts

35 16(a-n) and a second row of contacts 22(a-n) cooperative with contacts 18(a-n). Associated with each of the contacts 20 is a flexible cable 24 having one end fixed to the contact 20 and the other end fixed to a common conductor 26 for connection to one terminal of the transformer (not shown). Similarly, associated with

40 each of the contacts 22 is a flexible cable 28. One end of each cable 28 is connected to its associated contact 22 and the other end is connected to a terminal 30 which is connected to a tap of the winding of the transformer via an appropriated impedance (not shown).

45 Movable support means 14 is coupled to a rotary drive means 32, hereinafter more fully described. As rotary drive means 32, rotates, sequential connections are made between contacts 16 and 20, and between contacts 18

50 and 22. As these connections are made and broken there is usually considerable electrical arcing which develops gases. To facilitate the removal of these gases a hood 34 and a chimney or conduit 36 is disposed above the contacts 22.

55 More particularly, FIGURE 2 shows schematically the electrical connections effected by the multi-contact switching means 10. The contacts 22a and 22n which may be considered fixed contacts are shown connected respectively to two successive taps of the winding of the transformer while the other contacts of the same row

60 22b . . . 22m are shown connected to the same taps via the corresponding impedances. The contacts 16(a-n) which may be considered moving contacts, are connected via jumpers 38(a-n) to respective contacts 18(a-n)

65 which may also be considered in pairs, that is contact

16a via jumper 38a to contact 18a, contact 16b via jumper 38b to contact 18b, etc. Thus, when movable support member 14 (FIG. 1) is rotated there are sequential connections between contacts 20 and 22, that is contact 20a to contact 22a, then contact 20b to contact 22b, etc. There will be two makes or breaks in series in each case to minimize the voltages developed across pairs of contacts.

FIGURE 3 shows in greater detail the cooperation between the row of contacts 20(a-n) mounted in fixed support member 12 and the corresponding row of contacts 16(a-n) carried by movable support member 14. Movable support member 14 is connected via an arm 40 to a shaft 42. Shaft 42 is disposed in a hub member 44. A central shaft 46 imparts rotary motion to hub member 44. Thus, movable support member 14 is eccentrically coupled to rotary drive means 32. During the rotation of shaft 46 of rotary drive means 32 the eccentric action transmitted by shaft 42 and arm 40 causes the contacts 16(a-n) to sequentially roll over the associated contacts 20(a-n). A similar action takes place between the contacts 18(a-n) and the contacts 22(a-n). It should be noted that this eccentric type of arrangement permits a shortening of the radius of rotation of the movable support member 14. Thus, the inertia of the system is minimized which is highly desirable in quick-action devices.

FIGURE 4, which is a sectional view of FIG. 3 shows primarily the electrical connection established between contacts 20 and 22 when contacts 16 and 18 are in position against contacts 20 and 22 respectively. Imbedded in the insulating material of movable support member 14 is a jumper 38 which forms a permanent electrical connection between the contacts 16 and 18.

A more detailed view of one of the contacts 20 is shown in FIGURES 5 and 6. In particular, a contact point 50 is fixed to one end of a plunger 52. Fixed to contact point 50 is a flexible cable 24 which couples the contact 20 to the common terminal 26. A sleeve 54 slidably accommodates plunger 52 to permit free axial movement thereof. The sleeve 54 has an axial length shorter than the axial length of the plunger 52. A collar 56 is fitted on the extending end of the plunger 52 remote from the contact point 50 to limit the travel of plunger 52.

In order to enhance the slidable movement, three grooves 60(a-c) are axially cut at equiangular displacements in plunger 52 and three corresponding grooves 62(a-c) are axially cut in sleeve 54 to provide races for ball bearings. Two ball bearings 64 and 66 are placed in each of the races on opposite sides of stop pins 68 and 70. Cover plates 72 and 74 fixed at the ends of the sleeve 54 prevent the escape of the ball bearings 64 and 66 from their races.

To enhance the connection between the contacts 20 and the associated contacts 16 spring biasing means is included in the contact 20. More particularly, a torsion spring 76 is developed about a bar 78 which is connected via support member 80 to sleeve 54. One end 82 of torsion spring 76 is hooked into a slot 84 of support member 80 while the other end 86 is engaged in a hole 88 of plunger 52. Thus, plunger 52 is urged forward in the direction of the contact point 50.

Since there are often gases formed due to the electrical arcing when electrical contacts are made and broken, and since these gases are ionized, it is highly desirable to exhaust the gases developed about the lower contacts to prevent them to reach the upper contacts where they should cause arcing between them. Accordingly, FIGURE 7 shows schematically a hood 34 for exhausting the gases. The hood 34 is disposed above the contacts 22(a-n). A conduit 36 is coupled to a hole or exit port in the top of the hood 34 to prevent the gases developed about the contacts 22 from fouling the atmosphere about the contacts 20. In addition, partition 90(a-n) inter-

posed between pairs of adjacent contacts 22 prevents the gases from spreading between the contacts. It should be noted that the hood 34 and the partitions 90 are of a material that is resistant to the high temperatures associated with electrical arcs. It should be further noted that the exact dimensions of the hood 34 are dependent on the clearance between the movable support member 14 and the fixed support member 12 (see FIG. 1).

There has thus been shown improved multi-contact switching means which permits the switching of greater quantities of electrical energy without increasing the size of the switch gear. The multi-contact switching means because it employs eccentric action for driving the movable support member minimizes the inertia of the system thus permitting more rapid switching.

Further improved contacts have been shown which by using spring biasing increase the reliability of the electrical connection formed during the switching action. There has also been shown means for preventing the danger of ionization by providing means for exhausting gases developed as a result of electrical arcing.

It will now be obvious to those skilled in the art that many modifications and variations which satisfy the objects and accrue many or all of the advantages while not departing from the spirit of the invention as defined by the appended claims.

What I claim and desire to secure by Letters Patent is:

1. Apparatus for on-load tap changing of an electrical transformer, comprising, means defining a rupturing chamber, a plurality of contact assemblies each having a first and second fixed contact resiliently mounted in said rupturing chamber, means for coupling said first fixed contacts to one terminal of said transformer, means for coupling said second fixed contacts to successive taps of said transformer, a rotatable member made of insulating material rotatably mounted in said chamber, a plurality of third and fourth contacts fixed on said rotatable member, means providing an electrical connection internally of said member made of insulating material permanently connecting said third and fourth contacts each contact assembly comprising a plunger having at least one axial groove, an electrical contact disposed at one end of said plunger, a sleeve for slidably accommodating said plunger, said sleeve having at least one axial groove, a ball bearing mutually accommodated by said groove, and spring biasing means for urging said plunger in a direction toward said electrical contact.

2. Apparatus for on-load tap changing of an electrical transformer, comprising, means defining a rupturing chamber, a plurality of contact assemblies each having a first and second fixed contact resiliently mounted in said rupturing chamber, means for coupling said first fixed contacts to one terminal of said transformer, means for coupling said second fixed contacts to successive taps of said transformer, a rotatable member made of insulating material rotatably mounted in said chamber, a plurality of third and fourth contacts fixed on said rotatable member, means providing an electrical connection internally of said member made of insulating material permanently connecting said third and fourth contacts each of said contact assemblies comprising a plunger having a plurality of axial grooves, an electrical contact disposed at one end of said plunger, a flexible cable fixed to said electrical contact for connecting an electrical circuit thereto, a sleeve for slidably accommodating said plunger, said sleeve having an axial length less than the axial length of said plunger, a collar disposed at the other end of said plunger for limiting the axial travel thereof, a plurality of axial grooves in said sleeve, a plurality of pairs of ball bearings, each of said pairs being mutually accommodated by one of the axial grooves of said sleeve and one of the axial grooves of said plunger, a support means for said sleeve, and a torsion spring, one end of said torsion spring being fixed to said support member and the other end of said torsion spring

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being fixed to said plunger for urging said plunger axially in a direction toward said electrical contact.

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