July 4, 1950 M. RIGERT 2,513,677

MULTIPLE STEP SWITCH

Filed March 5, 1949 3 Sheets-Sheet 1

Fig. 1

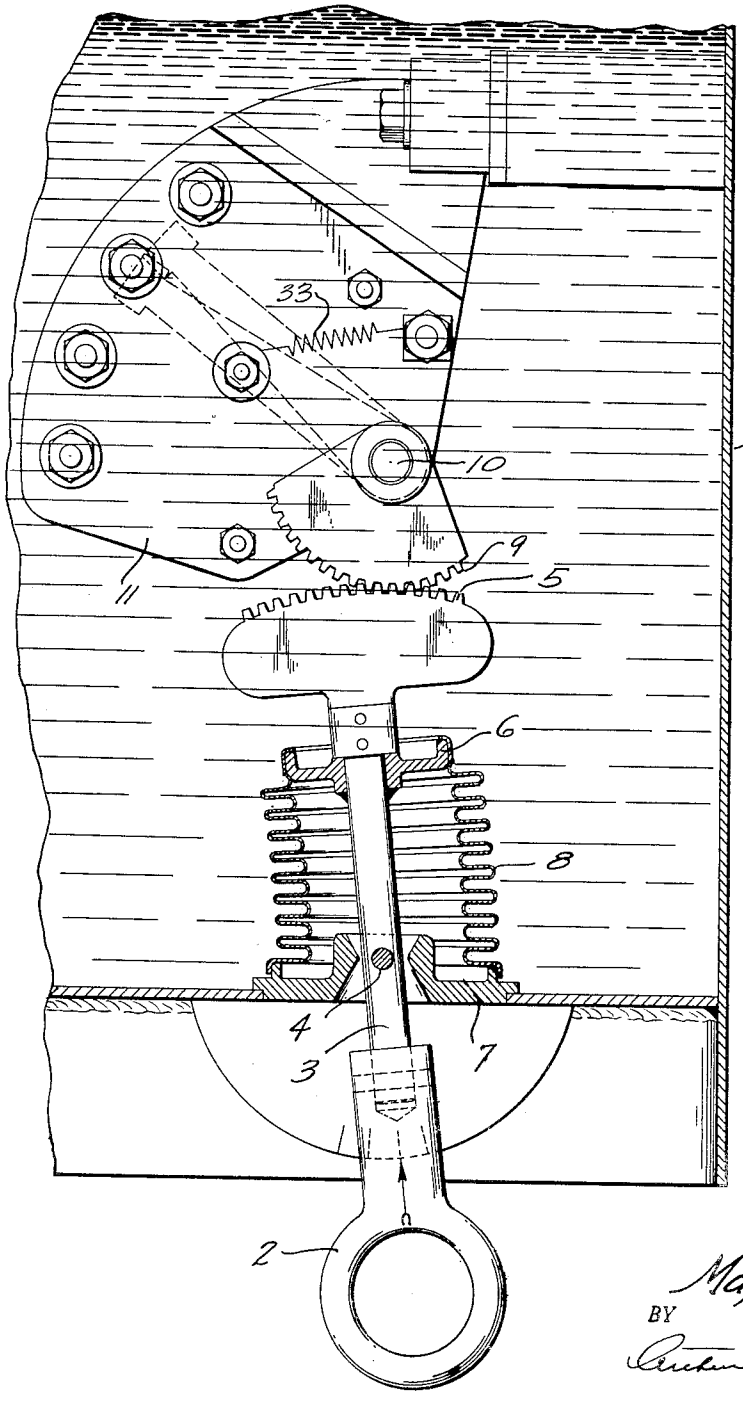



Fig. 8

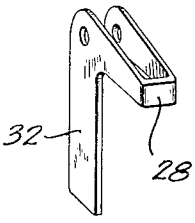
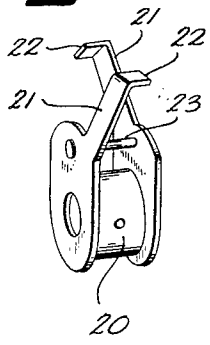



Fig. 9




INVENTOR.
Max Rigert
BY
Arthur R. Woodford
Attorney

July 4, 1950 M. RIGERT 2,513,677

MULTIPLE STEP SWITCH

Filed March 5, 1949 3 Sheets-Sheet 2

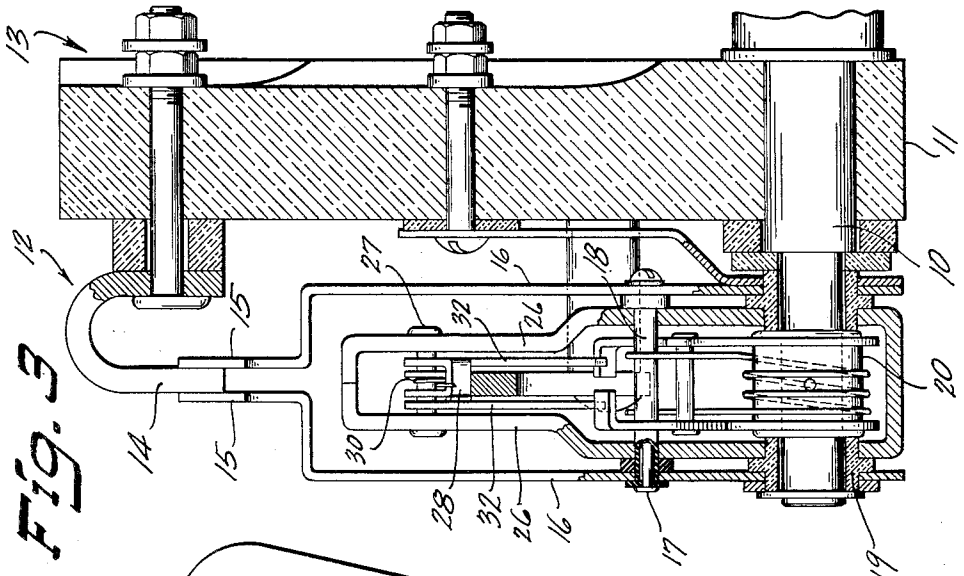



Fig. 3

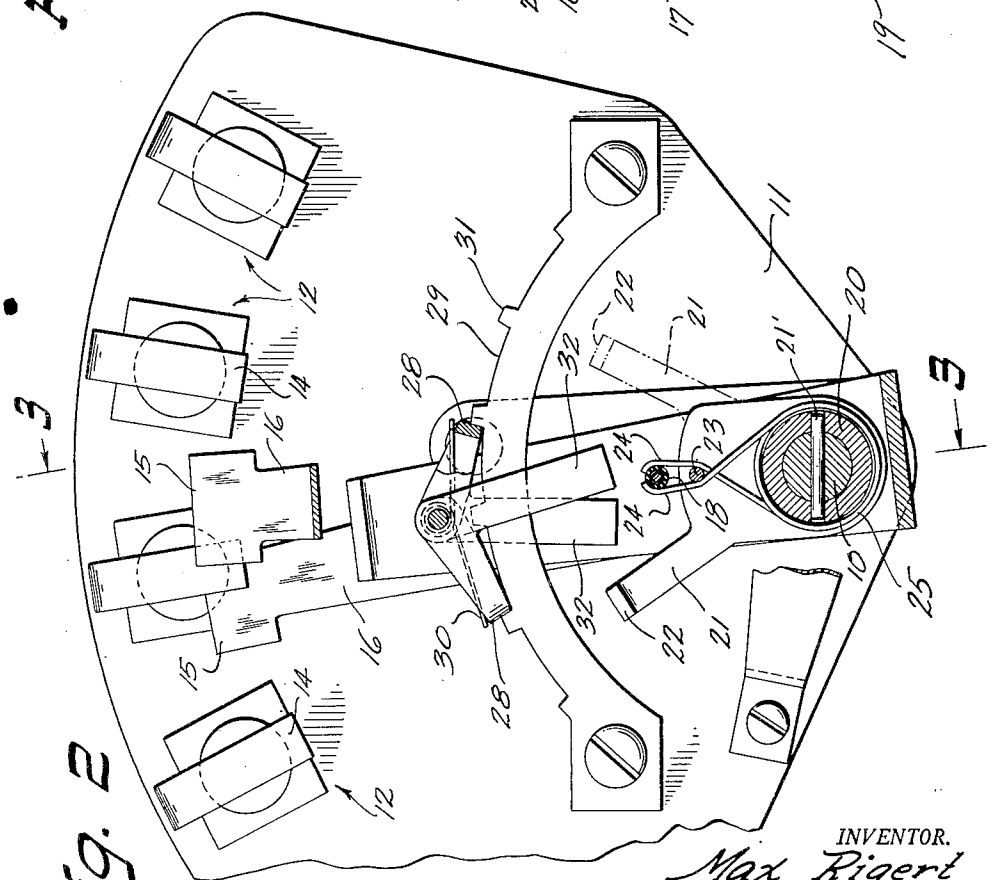



Fig. 2

INVENTOR.
Max Rigert
BY
Austin R. Woolford
Attorney

July 4, 1950 M. RIGERT 2,513,677

MULTIPLE STEP SWITCH

Filed March 5, 1949 3 Sheets-Sheet 3

Fig. 4

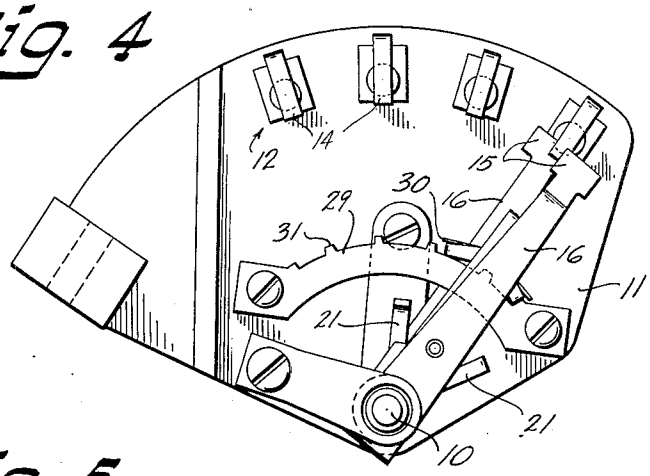
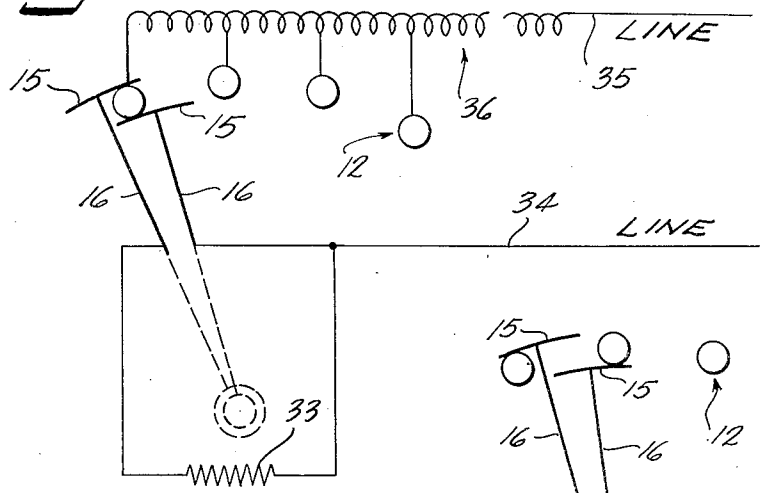



Fig. 5



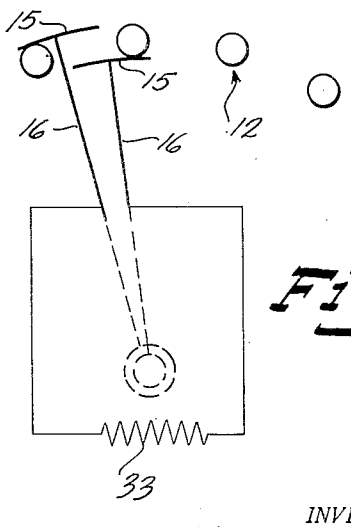




Fig. 6

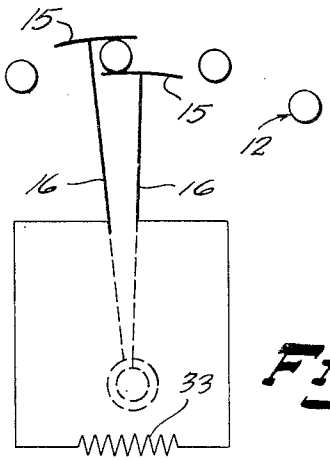



Fig. 7

INVENTOR.
Max Rigert
BY
Arthur R. Woodford
Attorney

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# UNITED STATES PATENT OFFICE

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## MULTIPLE STEP SWITCH

Max Rigert, Milwaukee, Wis., assignor to McGraw Electric Company, a corporation of Delaware

Application March 5, 1949, Serial No. 79,807

4 Claims. (Cl. 201—48)

1

This invention relates to a multiple step switch such, for instance, as a tap changer.

Objects of this invention are to provide a multiple step switch which is so constructed that the movable contact assembly is locked in place at any given stationary contact and is moved with a snap action from one stationary contact to an adjacent stationary contact and again locked in place when in engagement with the above mentioned adjacent stationary contact, and which also is so arranged that it does not interrupt the electrical circuit as it passes from one stationary contact to another, but temporarily and substantially only instantaneously places an impedance, such as a resistance for instance, between the stationary contacts while the movable contact assembly is in motion and immediately electrically removes such impedance after the movable contact assembly has arrived at the adjacent stationary contact.

In greater detail, objects of this invention are to provide a multiple step switch in which a plurality of stationary contacts are provided and are connected, for example, to taps on a transformer, and in which a movable contact assembly is operated in a step-by-step manner and is locked in place, and in which this movable contact assembly is provided with staggered contacts so arranged that normally they are both in engagement with a single selected stationary contact but which are so positioned relatively to each other that they respectively engage adjacent stationary contacts while the movable contact assembly is in motion, the staggered contacts being rigidly connected and being movable as a single unit by the manually operable means.

An embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a fragmentary, sectional view through a portion of the tank of a transformer showing the multiple step switch or tap changer in position.

Figure 2 is an enlarged face view of the multiple step switch taken from the opposite side of that shown in Figure 1 with parts broken away.

Figure 3 is a sectional view on the line 3—3 of Figure 2 with parts broken away.

Figure 4 is a view of a part of the multiple step switch, such view being taken from the opposite side of Figure 1.

Figures 5, 6, and 7 are diagrammatic views showing the movable contact assembly in successive positions.

Figure 8 is a view of one of the latching pawls removed from the remainder of the apparatus.

2

Figure 9 is a view of a portion of the driving and tripping means removed from the remainder of the apparatus.

Referring to the drawings, it will be seen that the multiple step switch has been shown as a tap changer and will be so described hereinafter. It is preferably mounted below the oil level in a transformer tank 1 and is operated by a manually movable member 2 accessible from the outside of the tank. This manually movable member includes a rod 3 pivoted as indicated at 4 and provided with a segment gear 5 at its upper end and with an intermediate head 6. The intermediate head 6 is joined to the bottom portion 7 of the manually movable assembly by means of a metal bellows 8 so as to provide an oil-tight seal between the head 6 and the bottom of the tank 1, it being understood, of course, that the bottom portion 7 of the assembly hereinabove described is welded or otherwise secured to the bottom of the tank.

The segment gear 5 meshes with a segment gear 9 rigidly carried by the shaft 10 of the tap changer. The shaft 10 is revolubly supported in an insulating disk or body portion 11 which is supported either from the transformer or from the tank which latter arrangement is shown in Figure 1. The insulating body portion 11 carries a plurality of stationary contacts indicated generally by the reference character 12. These stationary contacts are provided with terminal portions 13, see Figure 3, and with arched overhanging contact portions 14 which are engaged by the staggered contacts 15 of the movable contact assembly. This movable contact assembly consists, as stated, of the movable staggered contacts 15. These staggered contacts are carried by arms 16 which are rigidly secured together by means of a pin 17 provided with an insulating sleeve 18. The lower ends of the arms 16 are rigidly mounted on insulating collars 19 mounted on a reduced extension of the shaft 10. The shaft 10 also carries a metal collar 20 which is secured thereto by means of a pin 21' and the collar 20 is so arranged that it spaces the insulating collars 19 apart. The collar 20 is provided with rigid arms 21 terminating in feet 22 which is shown most clearly in Figures 3 and 9. The arms 21 are also joined or braced by means of a pin 23. The pin 23, as is evident from Figures 2 and 3, is positioned between the spaced arms 24 of a spring 25 coiled about the hub or collar 20. The outer ends of the arms 24 of the spring 25 are positioned on opposite sides of the insulating

sleeve 18 which surrounds the pin 17, see Figures 2 and 3.

It is to be noted further, particularly from Figure 3, that the insulating collars 19 also carry an arched yoke-like member 26 through which the pin 17 and sleeve 18 extend. This arched-like member or yoke member 26 is provided with a pivot pin 27 on which two oppositely turned or positioned locking pawls 28 are pivoted. These pawls 28 are urged into locking engagement with an indexing rack or plate 29 by means of a spring 30. The indexing plate 29 is provided with spaced teeth 31 against which the locking pawls 28 normally seat, as shown for instance in Figure 2. The locking pawls 28 are provided with releasing tongues or extensions 32, see Figures 2 and 3, which releasing tongues are positioned in the path of movement of the feet 22 of the arms 21 of the collar 20.

It is to be noted from the description thus far given that the shaft 10, the pin 23, and the feet 22 constitute driving and releasing means which respectively coact with the spring 25 and with the releasing fingers 32 of the locking pawls 28. When the shaft 10 is turned, it will be seen that energy is stored in the spring 25 and tends to move the staggered contacts 15 in the same direction as that in which the shaft is rotated. However, motion of the staggered contacts 15 is prevented by means of the locking pawls 28 until the appropriate foot 22 engages the corresponding tripping finger 32 and releases the corresponding locking pawl. The spring causes an instantaneous snap action of the staggered contacts 15 from one stationary contact portion 14 to an adjacent stationary contact portion. However, it is to be noted from an examination of the diagrammatic showing in Figures 5, 6, and 7 that during the time that the movable contact assembly is passing from one stationary contact to another that the staggered contacts 15 engage, respectively, adjacent stationary contacts. This is shown in Figure 6. The engagement is only substantially instantaneous or momentary, but nevertheless the electrical circuit is not interrupted as an impedance 33 is electrically connected between the staggered contacts 15 and thus temporarily connects adjacent stationary contacts. It is to be noted that one of the line wires 34 is connected to one of the staggered contacts and the other line wire 35 is connected to one side of the transformer winding indicated at 36. This transformer winding may be either the primary or secondary of the transformer as desired, no attempt having been made to show both windings or the magnetic core.

It is to be noted particularly that when the movable contact assembly is at rest, both of the staggered contacts 15 are simultaneously in engagement with the same stationary contact. It is also obvious that the impedance 33 is only in circuit for an extremely brief interval of time during the time of transition of the staggered contacts 15 from the position shown in Figure 5 to that shown in Figure 7, for instance.

It will be seen that a very simple multiple step switch such as a tap changer has been provided which does not interrupt the electrical circuit even when it is passing from one tap to another tap, which is locked in place and which has a substantially instantaneous or snap action in passing from one stationary contact to the other.

It is understood that the tap changer is preferably positioned below the oil level as described and that due to this fact and due also to the peculiar construction of the tap changer and to its substantially instantaneous snap action, that there is very little arcing produced and consequently the wear on the tap changer is very little.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A multiple step switch comprising a plurality of spaced stationary contacts, a movable contact assembly comprising a pair of rigidly mechanically connected staggered contacts, an impedance electrically connecting said staggered contacts, said staggered contacts being arranged to normally simultaneously engage a single stationary contact and being movable successively from one stationary contact to another stationary contact with one staggered contact engaging one stationary contact and with the other staggered contact engaging the succeeding stationary contact during movement, means for moving said staggered contacts with a snap action from one stationary contact to another, and means for temporarily locking said movable contact assembly against motion with said staggered contacts simultaneously in engagement with any selected stationary contact.

2. A multiple step switch comprising a plurality of spaced stationary contacts, a movable contact assembly comprising a pair of rigidly mechanically connected staggered contacts, an impedance electrically connecting said staggered contacts, said staggered contacts being arranged to normally simultaneously engage a single stationary contact and being movable successively from one stationary contact to another stationary contact with one staggered contact engaging one stationary contact and with the other staggered contact engaging the succeeding stationary contact during movement, spring means for moving said movable contact assembly, manually movable means for storing energy in said spring means, and trip means actuated from said manually movable means for releasing said movable contact assembly for quick limited motion from one stationary contact to an adjacent stationary contact.

3. A multiple step switch comprising a series of spaced stationary contacts, a stationary indexing plate, a movable contact assembly having a pair of staggered contacts rigidly mechanically connected and normally simultaneously engaging a single stationary contact and arranged to respectively engage adjacent stationary contacts, an impedance electrically connecting said staggered contacts, locking means normally coacting with said indexing plate to lock said staggered contacts in simultaneous engagement with a single stationary contact, spring means for moving said movable contact assembly, and manually movable means for storing energy in said spring means and for tripping said locking means.

4. A multiple step switch comprising a series of spaced stationary contacts, a stationary indexing plate, a movable contact assemby having a pair of staggered contacts rigidly mechanically connected and normally simultaneously engaging a single stationary contact and arranged to respectively engage adjacent stationary contacts, an impedance electrically connect-

ing said staggered contacts, locking means normally coacting with said indexing plate to lock said staggered contacts in simultaneous engagement with a single stationary contact, spring means for moving said movable contact assembly, and manually movable means for storing energy in said spring means and for tripping said locking means, said locking means being arranged to re-lock said movable contact assembly following a tripping operation with the staggered contacts in simultaneous engagement with the next adjacent stationary contact.

MAX RIGERT.




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