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W. C. SEALEY

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CONTACT POSITIONING ARRANGEMENT FOR QUICK BREAK
MECHANISM OF LOAD TAP CHANGING TRANSFORMER

Filed Sept. 20, 1955

2 Sheets-Sheet 1

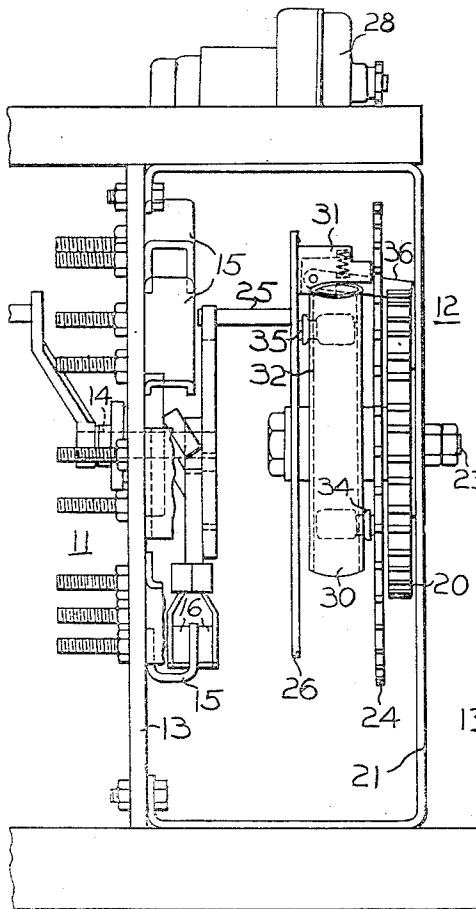


Fig. 2

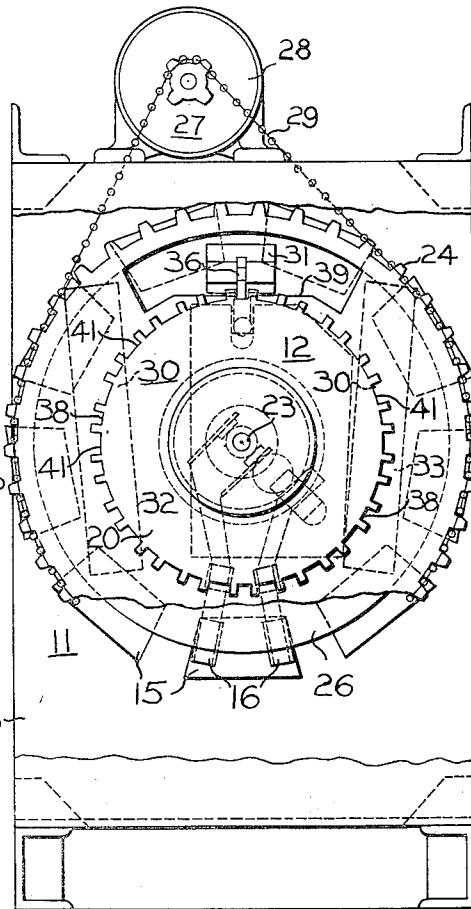


Fig. 1

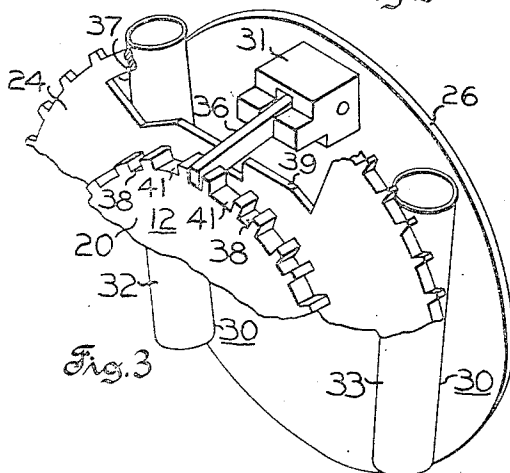


Fig. 3

Inventor
William C. Sealey
By Richard C. Cummins
Attorney

Dec. 18, 1956

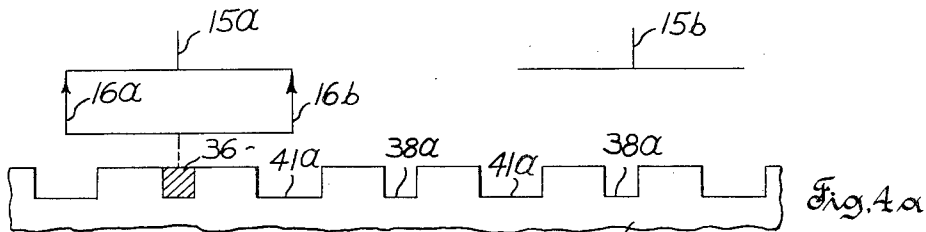
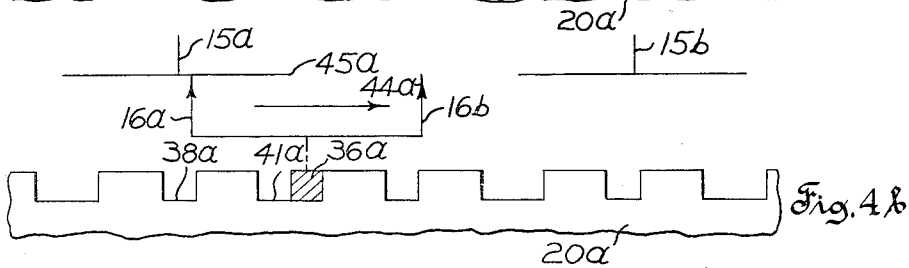
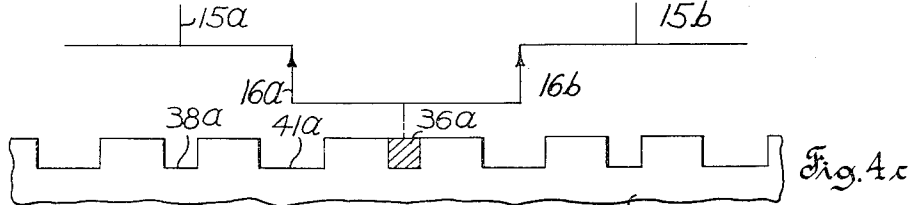
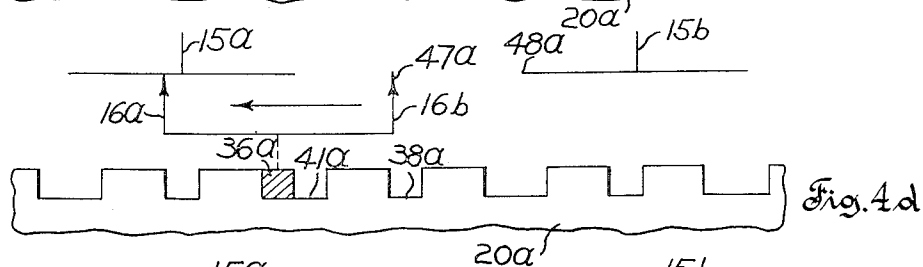
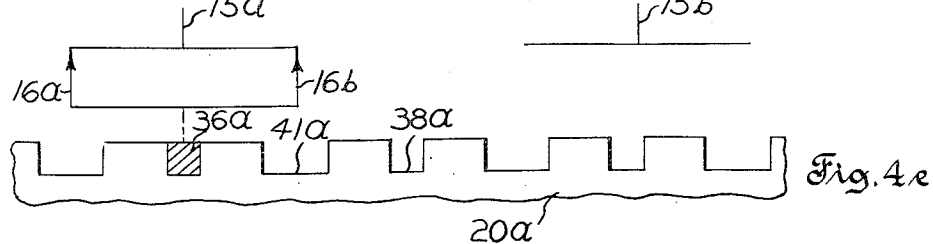
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2 Sheets-Sheet 2



Inventor
William C. Sealey
by *Richard C. Cummins*
Attorney

1

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CONTACT POSITIONING ARRANGEMENT FOR QUICK BREAK MECHANISM OF LOAD TAP CHANGING TRANSFORMER

William C. Sealey, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Application September 20, 1955, Serial No. 535,419

5 Claims. (Cl. 200—17)

This invention relates in general to load tap changing transformers and in particular to load tap changing transformers in which the movable contacts of the tap changing switch are moved with a snap action.

In prior art tap changing systems of the general type disclosed in U. S. patent to L. H. Hill, 2,177,109, October 24, 1939, Voltage Regulator, a motor controlled in accordance with a regulated voltage and operating at a relatively slow speed, applies a force to a detent mechanism to move the tap changing switch with an exceedingly fast snap action from one operating position to the next operating position.

In such systems, an extremely high potential gradient exists between the separating contacts of the switch at the moment of circuit interruption. Such a gradient breaks down the insulating medium, which is usually oil, and the ionized medium thus presents a low resistance to current flow. The heat generated in the arc maintains the ionization until such time as the separation of the contacts is great enough and the current flow small enough to discontinue ionization of the medium.

The prior art found that if the quick moving parts of the above type tap changer were made lighter in weight, and therefore of less inertia, the detent mechanism would move the movable contacts of the switch from one position to the next with such rapidity that the arc drawn at the separating contacts would not have sufficient time to be extinguished. It was also found that if the speed of separation of the breaking contacts were reduced to provide more arcing time, failure to extinguish the arc and consequent burning of the contacts would ensue. It was further discovered that if the value of the current and voltage made and broken by the tap changing switch in regulators of the above type were increased, the same problems were presented of maintaining or increasing the speed of contact separation, while at the same time providing a greater time for extinguishing the arc.

In order to overcome these problems the prior art found it desirable to momentarily stop the movable contacts midway between the stationary contacts. This was desirable, since higher initial breaking speeds could be maintained without decreasing the time available for the arc to be extinguished. A system of this general type in which the movable contact is momentarily stopped midway between the stationary contacts is disclosed in U. S. patent to W. C. Sealey, 2,560,002, July 10, 1951.

With the application of this general tap changing principle to power transformers and step voltage regulators having relatively large current carrying capacities, it was found that the distance between the leading edge of the stationary contact and the trailing edge of the movable contact, when the movable contact was momentarily stopped, would have to be increased if the arc was to be extinguished within a reasonable time and without damage to the contacts. The present invention accomplishes this increased spacing between the separating contacts without any increase in the distance between stationary contacts or the size of the dial switch by extending the

2

auxiliary notch, intermediate the main notches in the index plate of the detent mechanism, in the direction of movement of the movable contacts. This arrangement of the notches in the index plate allows the movable contacts to be momentarily stopped at a point where the distance between the leading edge of the stationary contact and the trailing edge of the movable contact is greater than has heretofore been possible to obtain in prior art devices.

It is therefore an object of the present invention to provide an improved load tap changing transformer.

Another object of the present invention is to provide in a load tap changing transformer, an improved mechanism for changing taps with a snap action movement.

A further object of the present invention is to provide in a load tap changing transformer having a detent mechanism for changing taps with an interrupted snap action, an improved arrangement for momentarily stopping the movable contacts at a predetermined point to cause the arc established at contact separation to be more readily extinguished.

Objects and advantages other than those mentioned above will be apparent from the following description when read in connection with the drawings in which:

Fig. 1 is a view in elevation of a load tap changing transformer having a quick break mechanism embodying the present invention;

Fig. 2 is a side view of the transformer shown in Fig. 1;

Fig. 3 is an isometric view of a portion of the detent mechanism of the transformer shown in Figs. 1 and 2; and

Figs. 4a through 4e are diagrammatic views illustrating the improved operation of the load tap changing transformer shown in Figs. 1 and 2.

Referring to the drawing, the load tap changing transformer shown in Figs. 1 and 2 comprises generally a tap changing switch 11 and a detent mechanism 12. Tap changing switch 11 comprises an insulating panel 13, a shaft 14 rotatably mounted in the panel with its axis of rotation normal to the face of the panel, a plurality of stationary contact members 15 and a pair of movable contact members 16. The stationary contact members 15 are spaced circumferentially on an arc of a circle having its center on the axis of rotation of shaft 14. The movable contact members 16 are fixedly mounted with respect to the shaft 14 and are rotatable therewith in the plane of the stationary contact members 15.

Movable contact members 16 are spaced apart a distance corresponding to the circumferential spacing of the stationary contact members 15 so that both movable contacts 16 may be disposed on one stationary contact member 15 or disposed in a bridging relationship with respect to a pair of adjacent stationary contact members 15.

The detent mechanism 12 as shown comprises a stationary index plate 20 supported in a plane parallel to the tap changing switch 11 by suitable support members 21, a shaft 23 which is rotatably journaled in the center of the index plate 20 with its axis normal to the plane of the plate 20, a sprocket wheel 24 which is rotatably mounted on shaft 23 parallel to index plate 20, and an actuating disk 26 fixedly mounted on shaft 23 parallel to sprocket wheel 24 and spaced axially therefrom. Connecting means 25 are provided between the actuating disk 26 and the movable contacts 16 to cause contacts 16 to move in accordance with the movement of disk 26.

The detent mechanism 12 further includes means 27 for driving the sprocket wheel 24 at a relatively slow uniform speed. As shown, the driving means 27 comprises a motor 28 and a chain 29, but other known arrangements may be used if desired.

In order to separate the movable contacts 16 from the stationary contacts 15 with a snap action, detent mechanism 12 further includes a spring arrangement 30

for converting the slow rotation of sprocket wheel 24 into a rapid snap action of the actuating disk 26, and a latching means 31 for preventing movement of the actuating disk 26 until the spring arrangement 30 is biased to a predetermined extent. Spring arrangement 30 comprises a pair of spring assemblies 32, 33 spaced symmetrically on opposite sides of shaft 23 and transverse to the axis thereof. Each of the spring assemblies has one end 34 connected to the sprocket wheel 24 and the other end 35 connected to the actuating disk 26. The spring assemblies 32 and 33 are arranged so that the actuating disk 26 is in a state of balance when the mechanism 12 is deenergized.

Latch means 31 comprises a latch member 36 which has one end pivotally mounted on an edge portion of the actuating disk 26 so that the other end extends through a suitable circumferentially elongated opening 37 in the sprocket wheel 24. The index plate 20 is provided with a plurality of circumferentially spaced main notches 38 which are engageable with the portion of the latch member 36 extending through the opening 37. The main notches 38 are disposed in index plate 20 in accordance with the operating positions of the switch 11 so as to properly position movable contacts 16 with respect to stationary contacts 15 at these operating positions.

When a tap change is desired, the snap action movement of the movable contacts 16 is obtained by energizing motor 23 either manually or by a condition responsive motor control circuit (not shown). Energizing motor 28 causes the sprocket member 24 to rotate slowly. Rotation of sprocket 24 biases the spring assemblies 32 and 33 since like ends of each of these assemblies are attached to the rotating sprocket while the other ends are attached to the actuating disk 26 which is prevented from turning by the engagement of the latch member 36 in a main notch 38. The actuating disk 26 remains fixed until the spring assemblies 32, 33 are biased to a predetermined extent at which time the latch member 16 is caused to be pivoted out of engagement with main notch 38. The pivoting action of latch member 36 is obtained by the camming action of the sides 39 of the opening 37 in the sprocket 24.

The energy stored in the spring assemblies 32, 33 at the time latch member 36 is released causes actuating disk 26 to move with a snap action. Since contacts 16 move in accordance with the movement of actuating disk 26, one of the movable contacts 16 moves off the stationary contacts 15 quite rapidly, reducing contact deterioration caused by the arc established when the contacts separate.

Because of the rapidity at which the contacts separate and the relatively small circumferential spacing of the stationary contacts, means are provided to momentarily stop the movable contacts 16 to provide sufficient time for the arc to clear itself. This means comprises an auxiliary notch 41 disposed between each pair of main notches 38.

In one respect, the auxiliary notch 41 is similar to that disclosed in the aforementioned patent to Sealey, in that the auxiliary notches serve to stop the movable contact momentarily between the stationary contacts.

However, the advantage of the present construction of the auxiliary notch 41 over that previously suggested in the aforementioned Sealey patent will be readily seen by referring to Figs. 4a through 4e which illustrate diagrammatically the structure and operation of the tap changing switch shown in Figs. 1 and 2. In these figures stationary contact members 15a and 15b correspond to a pair of electrically adjacent contact members 15, movable contacts 16a and 16b correspond to movable contacts 16, latch member 36a corresponds to latch member 36, and index plate 20a corresponds to index plate 20.

Figs. 4a, 4c and 4e illustrate the position of the movable contact members 16 with respect to the stationary contact members 15 when the load tap changing transformer is in adjacent operating positions. Figs. 4b and

4d illustrate the position of the movable contact at times that contacts 16 are momentarily stopped between operating positions to provide sufficient time for the arc to be extinguished. The operation of the mechanism when moved in one direction is shown from Fig. 4a through Fig. 4c, and the operation in the other direction by Figs. 4c through 4e.

As shown in Figs. 1 and 4a the auxiliary notches 41 are similar to the main notches 38 except that they are extended in the direction of movement of the movable contacts 16 in order to increase the distance between the trailing edge 44a of contact 16b and the leading edge 45a of contact 15a. A similar increase in distance is obtained when contacts 16 are moved in the opposite direction as shown in Fig. 4d where trailing edge 47a of contact 16b is spaced from leading edge 48a of contact 15b. By extending the latch engaging portion of auxiliary notch 41 it is possible to increase the distance separating contacts 15a and 16b to a greater distance than has been obtained in the prior art without increasing the size of the dial switch 11. This permits higher operating currents to be handled by the switch 11 without increasing contact deterioration due to arcing and also results in the arc being extinguished more rapidly.

It will be seen from Figs. 4a through 4e that by merely making auxiliary notch 41a wider than the main notches 38a many advantages in operation are obtained that are not obtainable by heretofore suggested load tap changing transformers. Besides permitting the interrupting of higher currents, the mechanical wear on the latch 36 and index plate 20 is considerably reduced since the spring assemblies have a greater snubbing action when the latch is allowed to move past the midpoint between stationary contacts. This greater snubbing action also results in a quieter operating mechanism since the impact speed of the latch against the side of the notch is decreased.

While only one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A load tap changing transformer comprising a tap changing switch having a plurality of spaced stationary contacts and a pair of correspondingly spaced movable contacts cooperating with said stationary contact members to define operating positions for said transformer, detent means for switching one of said movable contacts from one of said stationary contacts to the next with a snap action to cause said one movable contact to be rapidly separated from said one stationary contact, said means including a stationary index plate provided with a plurality of main notches, and a latch device movable in accordance with the movement of said movable contacts and engageable with said main notches to accurately position said movable contacts with respect to said stationary contacts at said operating positions, and an auxiliary notch adapted to receive said latch device to momentarily stop said movable contacts at a point between said operating positions which disposes said one movable contact further from said one stationary contact than said next stationary contact, said auxiliary notch disposed between said main notches with the latch engaging portion of said auxiliary notch extended in the direction of movement of said latch device.

2. A load tap changing transformer comprising a dial type changing switch having a plurality of circumferentially spaced stationary contacts and a pair of correspondingly spaced movable contacts cooperating with said stationary contacts to define operating positions for said transformer, detent means for switching said movable contacts from one of said operating positions to the next with a snap action to cause one of said movable contacts to be rapidly separated from one of said stationary contacts, said detent means including a stationary circular

5

index plate provided with a plurality of circumferentially spaced main notches, and a latch device movable in accordance with the movement of said movable contacts and engageable with said main notches to accurately position said movable contacts with respect to said stationary contacts at said operating positions, and an auxiliary notch adapted to receive said latch device to momentarily stop said movable contacts at a point between said operating positions which disposes said one movable contact further from said one stationary contact than the next said stationary contact, said auxiliary notch disposed between said main notches and extended circumferentially in the direction of movement of said latch device.

3. A tap changing under load transformer comprising a tap changing switch having first and second spaced stationary contacts and first and second correspondingly spaced movable contacts cooperating with said stationary contacts to define operating positions for said transformer, and a detent mechanism for moving said first movable contact from said first stationary contact to said second stationary contact with a snap action movement, said mechanism including a stationary index plate provided with alternately arranged main and auxiliary notches, and a latch device movable in accordance with the movement of said movable contacts and engageable with said notches to prevent movement of said movable contacts until said detent mechanism is biased to a predetermined extent, said main notches being disposed in said index plate to cause said latch device to accurately position said movable contacts with respect to said stationary contacts at said operating positions, said auxiliary notches disposed between said main notches to momentarily stop said first movable contact between said first and second stationary contacts, the latch engaging portion of said auxiliary notch being extended in the direction of movement of said movable contacts to cause said first contact when momentarily stopped to be spaced further from said first stationary contact than said second stationary contact.

4. A tap changing under load transformer comprising a tap changing switch having first and second spaced stationary contacts and first and second correspondingly spaced movable contacts cooperating with said stationary

6

contacts to define operating positions for said transformer, a detent mechanism including a stationary index plate provided with a plurality of spaced notches, a latch device movable in accordance with the movement of said movable contacts and engageable with said notches to prevent movement of said movable contacts until said detent mechanism is biased to a predetermined extent, alternate said notches being disposed in said index plate to accurately position said movable contacts with respect to said stationary contacts at said operating position, means for biasing said detent mechanism to said predetermined extent, means for disengaging said latch device from one of said notches when said mechanism is biased to said predetermined extent to cause a snap action movement of said movable contacts, and auxiliary notches disposed between said alternate notches cooperating with said latch device to momentarily stop said first movable contact between said first and second stationary contacts, the latch engaging portion of said auxiliary notch being extended in the direction of movement of said movable contacts to cause said first movable contact when momentarily stopped to be spaced further from said first stationary contact than said second stationary contact.

5. A switch actuating mechanism for moving a movable contact from a first stationary contact to a second stationary contact with a snap action movement, said mechanism including a stationary index plate provided with alternately arranged main and auxiliary notches, and a latch device movable in accordance with the movement of said movable contacts and engageable with said notches, said main notches being disposed in said index plate to cause said latch device to accurately position said movable contact with respect to said stationary contacts, said auxiliary notches disposed between said main notches to momentarily stop said movable contact between said stationary contacts, the latch engaging portion of each said auxiliary notch being extended in the direction of movement of said movable contact to cause said movable contact when momentarily stopped to be spaced further from said first stationary contact than said second stationary contact.

No references cited.