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Fohrhaltz

[11] **3,761,650**

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[54] **DIRECT DRIVE AND STOP MECHANISM FOR LOAD TAP CHANGER**

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[73] Assignee: **General Electric Company,** Pittsfield, Mass.

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[52] **U.S. Cl.** ..... **200/17 R,** 200/18, 200/153 P

[51] **Int. Cl.** **H01h 3/40**

[58] **Field of Search** ..... 200/11 TC, 17, 18, 200/144 R, 144 B, 153 P, 153 PA

[56] **References Cited**

UNITED STATES PATENTS

3,247,333	4/1966	Bruckhoff	200/11 TC
3,396,248	8/1968	Wilson, Jr.	200/11 TC

Primary Examiner—J. R. Scott

Attorney—Francis X. Doyle

[57] **ABSTRACT**

A direct drive and mechanical stop mechanism for a load tap changer. The direct drive utilizes a partial or mutilated driving gear from which approximately one-half of the teeth have been removed. A pair of arms are provided on the driving gear adjacent the last teeth on each side of the gear which engage pins which are mounted on an intermediate gear. The engagement of the arms with the pins insure proper meshing of the teeth on the driving gear with the teeth on the intermediate gear. A driven gear is rotated 180° by each rotation of the intermediate gear to provide a single tap change through a Geneva gearing mechanism. At the end of each tap change, the drive gear disengages and the motor control stops. To prevent overrun, should the limit switches not operate, a mechanical stop is provided on the driven gear which mechanically stops the gears in either direction when the limits of the tap changer are reached. The stop mechanism provides a plurality of freely rotating washers which are mounted on a shaft which rotates with the driven gear. Each washer is provided with a tab which interferes with the next upper tab. When all of the tabs are lined up in engagement in a spiral fashion, the uppermost tab on the uppermost washer will engage a stop which is fixed to the frame of the tap changer thereby preventing further rotation of the driven gear in that direction.

5 Claims, 4 Drawing Figures

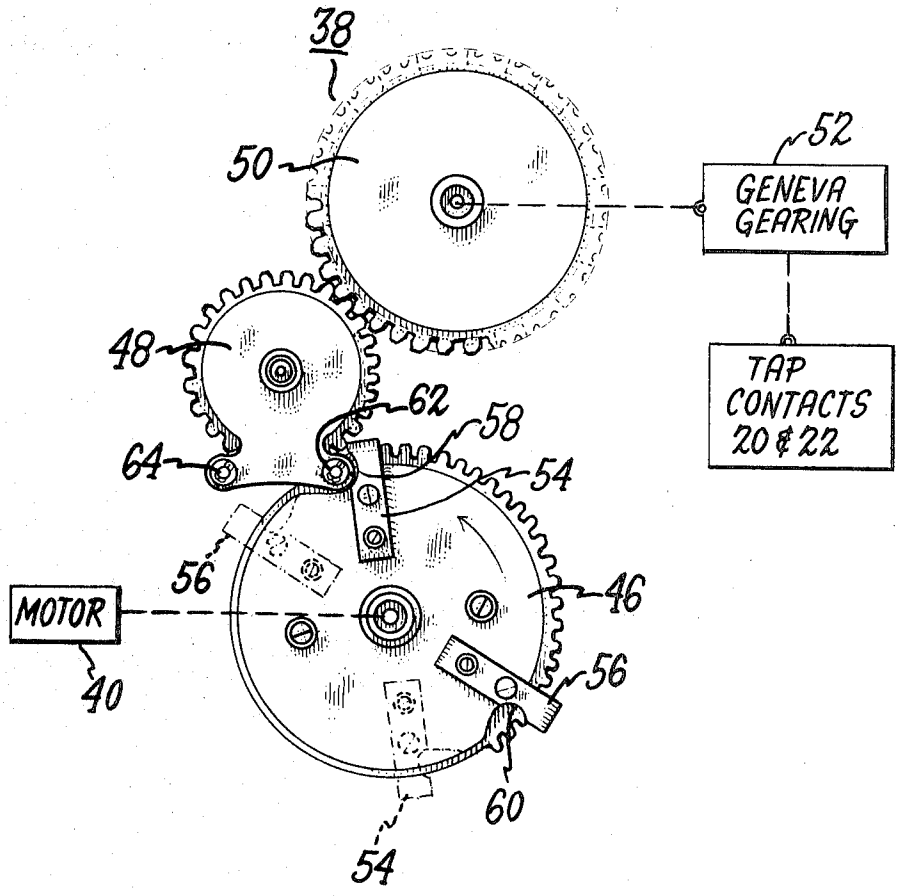


Fig. 1.

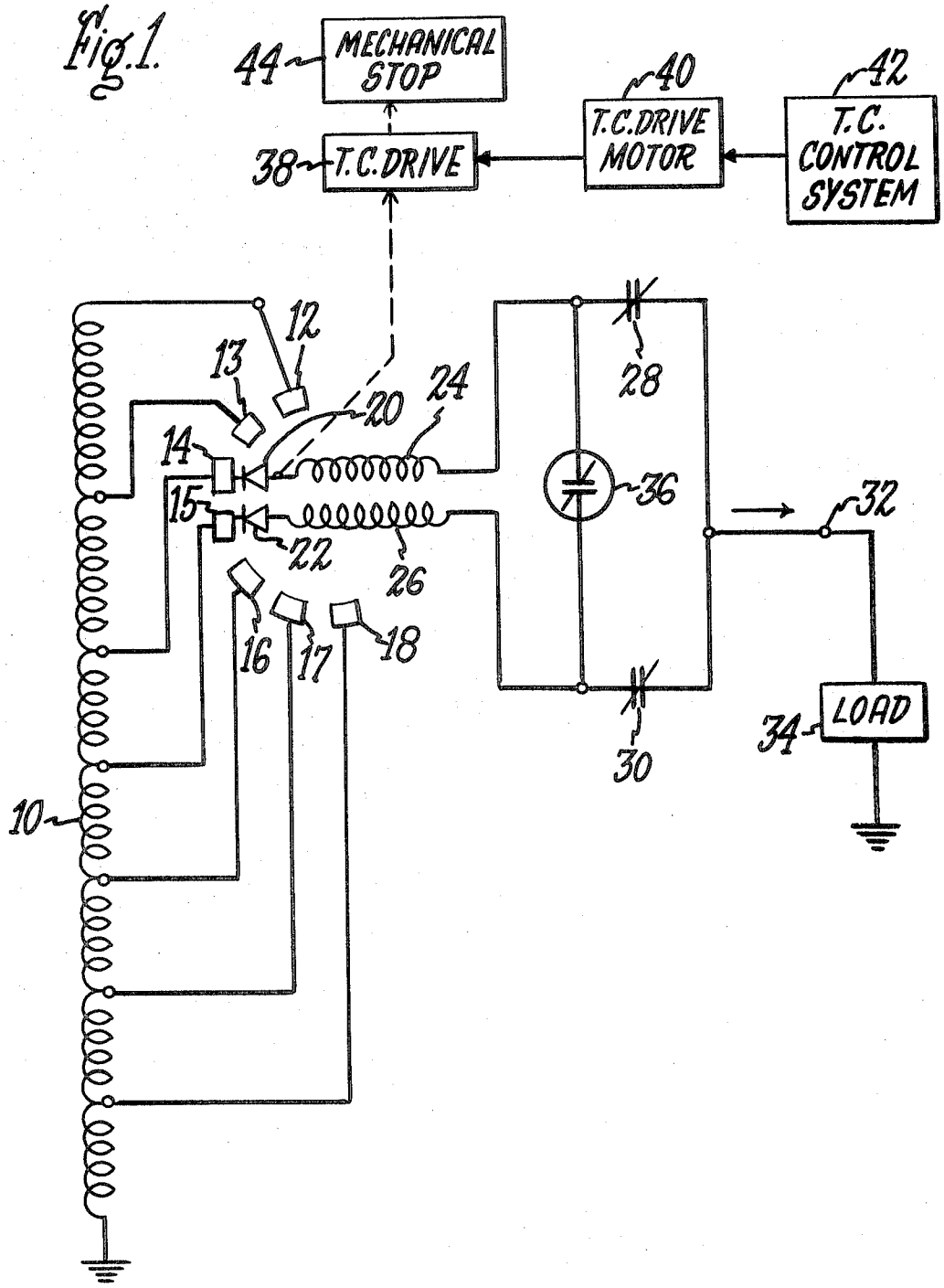

MECHANICAL STOP
44
T.C. DRIVE
38
T.C. DRIVE MOTOR
40
T.C. CONTROL SYSTEM
42
12
13
20
24
28
14
15
22
26
36
32
16
17
18
30
LOAD
34
10

Fig. 2.

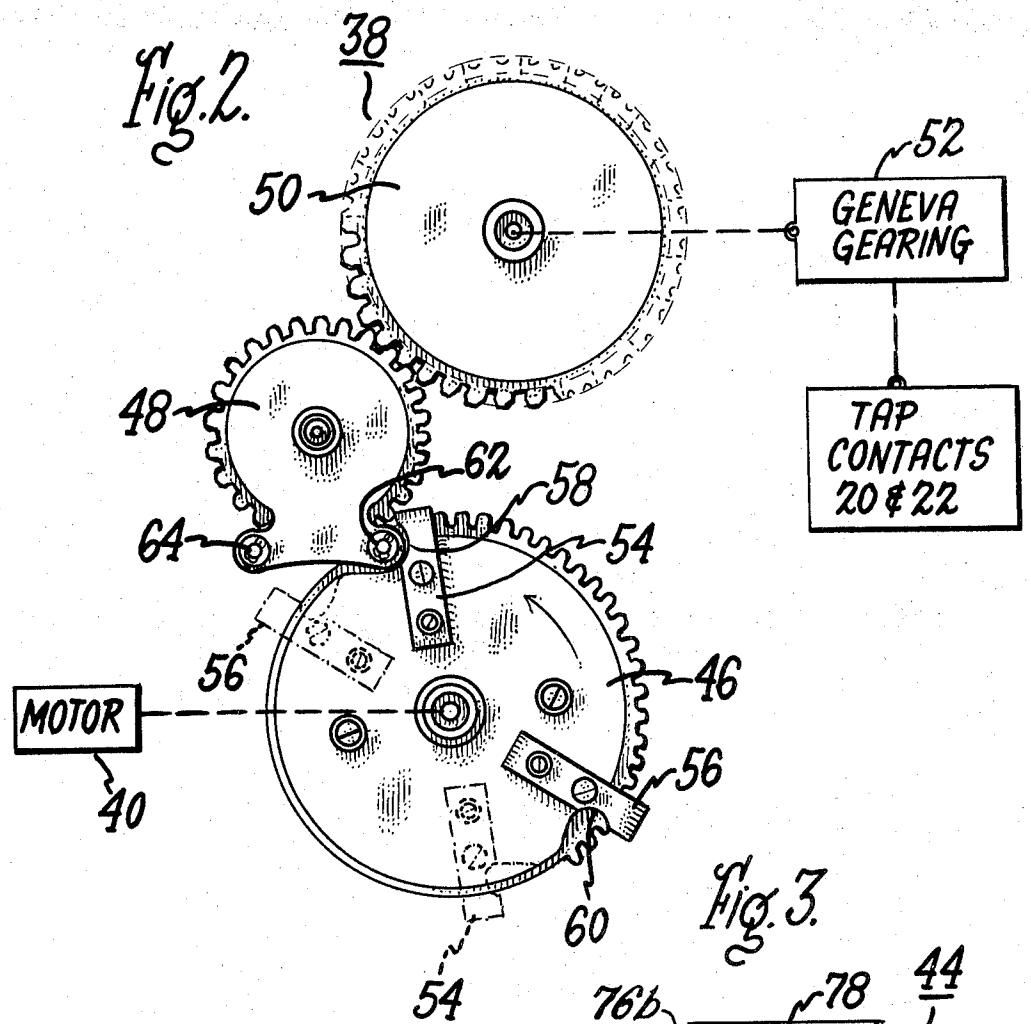


Fig. 3.

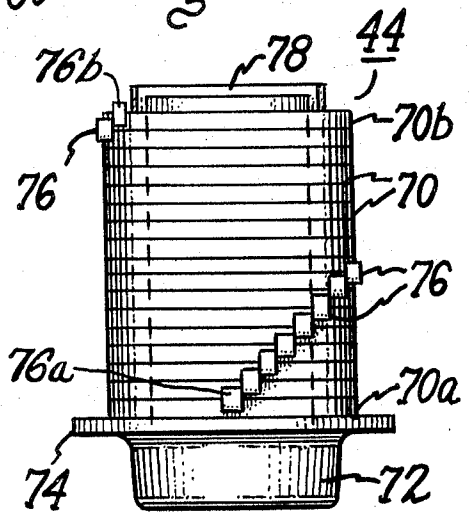
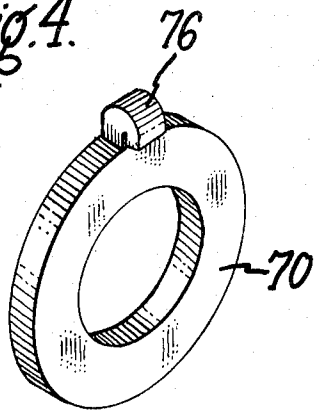


Fig. 4.



DIRECT DRIVE AND STOP MECHANISM FOR LOAD TAP CHANGER

BACKGROUND OF THE INVENTION

This invention relates to tap changers and more particularly to a direct drive and mechanical stop mechanism for a tap changer.

As is well understood in any tap changer, the tap changer must move precisely from one tap position to the next. In many types of electrically operated tap changers, an electrical motor winds up a spring which delivers the necessary force to make the desired tap change. In these instances, the starting and stopping of the motor is not critical since the precision of the tap changer depends upon the spring. In many instances, a direct drive system is utilized. The direct drive system is difficult due to overtravel of the motor at the end of the tap change. In instances where direct gear drive is used, it is necessary to provide either a complex cam and switch system or else an accurate braking of the motor to prevent undesired overtravel of the tap changer. Of course, in many instances, both the complex cam and switch system as well as the motor brake is utilized. A direct drive is considered desirable because it provides a direct relation between the gear and the position of the tap changer. Because of the cost and complexity of cams, switches and braking, it has been considered desirable to provide a direct drive system in which the motor could coast or overtravel without causing overtravel of the tap changer. Further, it has been considered desirable to provide a mechanical stop means for the tap changer drive which will automatically stop the tap changer at the end of the tap changer position if the electrical limit switches should not function properly.

It is, therefore, a principal object of this invention to provide a direct gear drive tap changing mechanism in which the driving gear becomes disengaged from the driven gearing after each tap change thereby preventing overtravel of the motor from causing overtravel of the tap changer.

A further object of this invention is to provide a direct drive tap changer mechanism with an automatic mechanical stop connected thereto to prevent overrunning of the limits of the tap changer in either direction in the event of failure of the normal limit switches of the tap changer.

A still further object of this invention is to provide a combined direct gear drive tap changer mechanism and an automatic mechanical stop that is simple in construction and operation and which is inexpensive in comparison to presently available direct drive systems.

SUMMARY OF THE INVENTION

In carrying out this invention in a preferred form, a tap changer is provided having a direct gear drive. The drive gear has a portion of its teeth removed such that it is disengaged from an intermediate gear for approximately one-half of each revolution. Means are provided on the drive gear cooperating with the intermediate gear to provide the accurate desired meshing of these gears in either direction of rotation. After each tap change, the drive gear is disengaged from the tap changer and coasts with the motor to an intermediate position. A mechanical stop means is provided connected to a gear means and mechanically stops the tap changer in either direction when a tap change is attempted beyond the limits of the tap changer.

The invention which is sought to be protected will be particularly pointed out and distinctly claimed in the claims which are appended hereto. However, it is believed that the invention and the manner in which its various objects and advantages are obtained, as well as other objects and advantages thereof will be better understood by reference to the following detailed description of a preferred embodiment thereof, particularly when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of one form of a tap changing circuit showing the mechanisms of this invention in block form applied thereto;

FIG. 2 is a partial top view of the direct drive mechanism of this invention;

FIG. 3 is a plan view of a preferred form of automatic mechanical stop mechanism of this invention; and

FIG. 4 is a perspective view of one of the washers which are utilized in the stop mechanism of FIG. 3.

DESCRIPTION OF PREFERRED EMBODIMENT

The preferred embodiment of this invention will be described with reference to a specific tap changing circuit which is shown in FIG. 1. However, it should be understood that the invention can be applied to any desired tap changing circuit. Referring now to the drawings in which like numerals are used to indicate like parts throughout the various views, FIG. 1 shows the schematic diagram of one form of tap changer circuit which includes a tapped winding 10 having a plurality of tap contacts 12, 13, 14, 15, 16, 17 and 18 arranged in a semicircular form as shown. The tap selector contacts 20 and 22 are connected through reactor coils 24 and 26 and bypass switches 28 and 30, respectively, to a contact 32 which in turn is connected to a load 34. An interrupter switch 36, for example, a vacuum interrupter is shunted across the parallel circuit which includes the bypass switches 28 and 30. As is well understood by those in the tap changer art, when it is desired to change from taps in the tap changer, for example, from tap 14 to tap 15, the bypass 28 will be opened thus shunting the current from contacts 14 and 20 through the vacuum interrupter 36 to the load 34. The vacuum interrupter 36 must then be opened prior to the movement of movable contact 20 to prevent current flow through contacts 14 and 20 and thus preventing arcing therebetween. When the contact 20 reaches fixed contact 15, then the vacuum interrupter 36 will close to divide the current through movable contacts 20 and 22. Bypass switch 28 will then be closed relieving the vacuum interrupter 36 of the current carrying duty. The above description of one operation of a tap changer is well known and is found, for example in U.S. Pat. No. 3,524,033 which is assigned to the same assignee as this application.

The contacts 20 and 22 are driven through a direct gear, tap changer drive 38 and a tap changer drive motor 40 as required, for example, by the tap changer control system 42. A mechanical stop 44 is provided which is connected to the tap changer drive 38 which will prevent overrunning of the limits of the tap changer should the limit switches fail.

The preferred form of direct drive mechanism according to this invention is shown in FIG. 2. As is there shown, a drive gear 46 is connected to be driven by the motor 40. Gear 46 drives an intermediate gear 48 which in turn drives gear 50. Gear 50 is connected to standard Geneva gearing 52 which in turn drives contacts 20,22 in the usual manner. Obviously, Geneva gearing 52 can be one or more Geneva gears, as desired. Drive gear 46 and driven gear 50 are the same size, while the intermediate gear 48 is one-half their size, providing a one to two ratio. In one preferred form, driven gear 50 is provided with 114 teeth, while intermediate gear 48 is provided with 57 teeth. As is shown in the drawing, approximately on-half of the teeth of drive gear 46 have been removed. In the preferred form previously mentioned, 63 teeth have been removed from gear 46 providing 51 driving teeth to mesh with intermediate gear 48. This construction of the driving gear 46 provides approximately 180° of free rotation before the drive gear 46 meshes with the intermediate gear 48. In order to provide accurate meshing of gears 46 and 48 and to provide substantial full rotation of gear 48, arms 54 and 56 are provided having notches 58 and 60, respectively, which engage pins 62 and 64 mounted on gear 48 in the manner shown. As is well understood, one rotation of gear 48 will drive gear 50 to 180° making one tap change. As shown in phantom lines in FIG. 2, when drive gear 46 has rotated gear 48 through a full revolution, arms 54 and 56 will be in the phantom position shown. In this position of gear 46, there are no teeth to mesh with gear 48 so that coasting of motor 40 and further driving of gear 46 will not affect the position of the tap contacts 20,22. Of course, should gear 46 now be driven in a reverse direction, arm 56 will contact pin 64 meshing the gears and driving the tap changer in the reverse direction.

As will be apparent from the above description, a tap change sequence may start with the drive gear 46 at any point on the toothless portion of the gear. As one of the arms 54 or 56 contacts the appropriate pin 62 or 64 on gear 48, the gears 46 and 48 mesh. Gear 46 then drives gear 48 through one revolution to thereby drive gear 50 through 180° to provide a desired tap change. Obviously, motor 40 does not have to start or stop at a precise point and no braking of motor 40 is required to provide precision tap changing.

When the tap changer reaches either contact 12 or contact 18, limit switches are actuated to prevent further operation of the tap changer to exceed the upper limit 12 or the lower limit 18. In the event of a malfunction of such limit switches, a mechanical stop 44 is provided according to this invention. The preferred form of mechanical stop 44 is shown in FIGS. 3 and 4 to which reference will now be made.

As shown in FIG. 3, the mechanical stop 44 comprises a plurality of metal washers 70 mounted on a shaft 72. Shaft 72 is provided with a flange 74 and the bottom washer 70*a* is fixed to such flange. Washer 70*a* may be secured to flange 74 by any desired means such as, for example, by bolts or welding. Shaft 72 is connected to driven gear 50 so as to rotate therewith. Each of washers 70 is freely mounted on shaft 72 and each is provided with a tab 76 (see FIG. 4). The tab 76 on each washer will engage the tab 76 on the next upper washer 70 in either direction of rotation. The washer 70*a* is also provided with a tab 76*a* which will engage the tab 76 on the washer 70 directly above washer 70*a*, also in either direction of rotation. A fixed stop 78 is provided which is fixed to the frame of the electrical device (not shown), such that tab 76*b* on top washer 70*b* will engage the edge of stop 78 in either direction of rotation.

As will be apparent during rotation of driven gear 50 to change taps, washer 70*a* will rotate. As washer 70*a* rotates, tab 76*a* will engage tab 76 on the washer 70 directly above washer 70*a*. Further rotation will cause the tab 76 of that washer 70 to engage the tab 76 of washer 70 immediately thereabove. In this manner, as the tap changer moves from one limit to the other, the washers 70 are driven until all of the tabs 76*a*, 76 and 76*b* are spiraled upwardly as shown in FIG. 3. Should the control 42 signal for a further movement in such direction, tab 76*b* will engage fixed stop 78 preventing further rotation of gear 50. In one form of this invention, one washer 70*a*, one washer 70*b* and sixteen washers 70 were provided. The tap changer was provided with 33 contacts. By use of this invention, all 33 positions could be used on the tap changer before the mechanical stop would prevent further rotation. As will be understood, shaft 72 and washer 70*a* would make 16 full revolutions before the upper washer 70*b* was positioned such that tab 76*b* would engage stop 78 in moving from one limit to the other of the tap changer. Obviously, the number of washers 70 and the dimensions of the tab 76 will depend on the number of positions of the tap changer.

While there has been shown and described the present preferred embodiment of the invention, it will, of course, be understood by those skilled in the tap changer art that various changes may be made without departing from the spirit and scope of the invention. Such changes are considered as being within the scope of the invention as it is described in the appended claims.

What is claimed as new and which it is desired to secure by Letters Patent of the United States is:

1. A direct drive and mechanical stop for a tap changer comprising a winding having a plurality of fixed contacts, a tap changer with a pair of movable taps movable into contact with one or with the adjacent fixed contacts, means driving said movable contacts, said means including a drive gear driven by a motor in a predetermined direction in accordance with the desired tap change, said drive gear having teeth removed from substantially half the circumference of said gear, a pair of arms on said gear one at each side thereof overlying the last teeth on said side of said gear, an intermediate gear mounted in meshing relation with said drive gear, said intermediate gear being one-half the size of said drive gear, pins mounted on said intermediate gear adjacent each other and in position to be engaged by one of said arms on said drive gear, engagement of one of said arms with one of said pins meshing said drive gear teeth with said intermediate gear, a driven gear mounted in meshing relation with said intermediate gear, Geneva gearing cooperating with said driven gear to move said movable tap contacts one position for each rotation of said intermediate gear, a mechanical stop, said mechanical stop including a shaft fixed to said driven gear, a plurality of washers mounted on said shaft, each of said plurality of washers having a tab portion adapted to engage the tab portion of the adjacent upper washer, the lowermost of said washers fixed to said shaft for rotation therewith while

the remainder of said washers are rotatable on said shaft, a fixed stop member at the top of said shaft having edges adapted to engage the tab portion of the uppermost washer to prevent rotation of said driven gear when all of said tabs are engaged with the next upper tab.

2. A direct drive and mechanical stop for a tap changer as set forth in claim 1 wherein said driven gear is twice as large as said intermediate gear and where said remainder of said washers is one more than half the number of fixed contacts on said winding.

3. A direct drive for a tap changer comprising a winding having a plurality of fixed contacts, a tap changer with a pair of movable taps movable into contact with one or adjacent fixed contacts, means driving said movable taps, said means including a drive gear driven by a motor in a predetermined direction in accordance with a desired tap change, said drive gear having teeth removed from substantially half the circumference thereof, a pair of arms on said gear, one on each side thereof and overlying the last teeth on the edge of said drive gear, an intermediate gear mounted in meshing relation with said drive gear, said intermediate gear being one-half the size of said drive gear, pins mounted on said intermediate gear adjacent each other and in position to be engaged by said arms on said drive gear, engagement of one of said arms with one of said pins meshing said drive gear teeth with said intermediate gear, a driven gear mounted in meshing relation with said intermediate gear, Geneva gearing cooperating with said driven gear to move said movable tap contacts one position for each rotation of said intermediate gear, whereby rotation of said drive gear rotates said intermediate gear one revolution and disengages such that overrunning of said motor will not cause overrunning of said tap changer.

4. A direct drive for a tap changer as set forth in claim 3 in which said driven gear is twice as large as said intermediate gear and causes one change of said tap changer for each half revolution of said driven gear.

5. A mechanical stop mechanism for a tap changer having a pair of movable tap contacts, means driving said pair of movable contacts over a plurality of fixed contacts, said mechanical stop including a shaft driven by said driving means, a plurality of washers mounted on said shaft, each of said plurality of washers having a tab portion adapted to engage the tab portion of the adjacent upper washer, the lowermost of said washers fixed to said shaft for rotation therewith while the remainder of said washers are rotatable on said shaft, a fixed stop member at the top of said shaft having edges adapted to engage the tab portion of the uppermost washer to prevent rotation of said shaft when all of said tabs are engaged with the next upper tab.

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