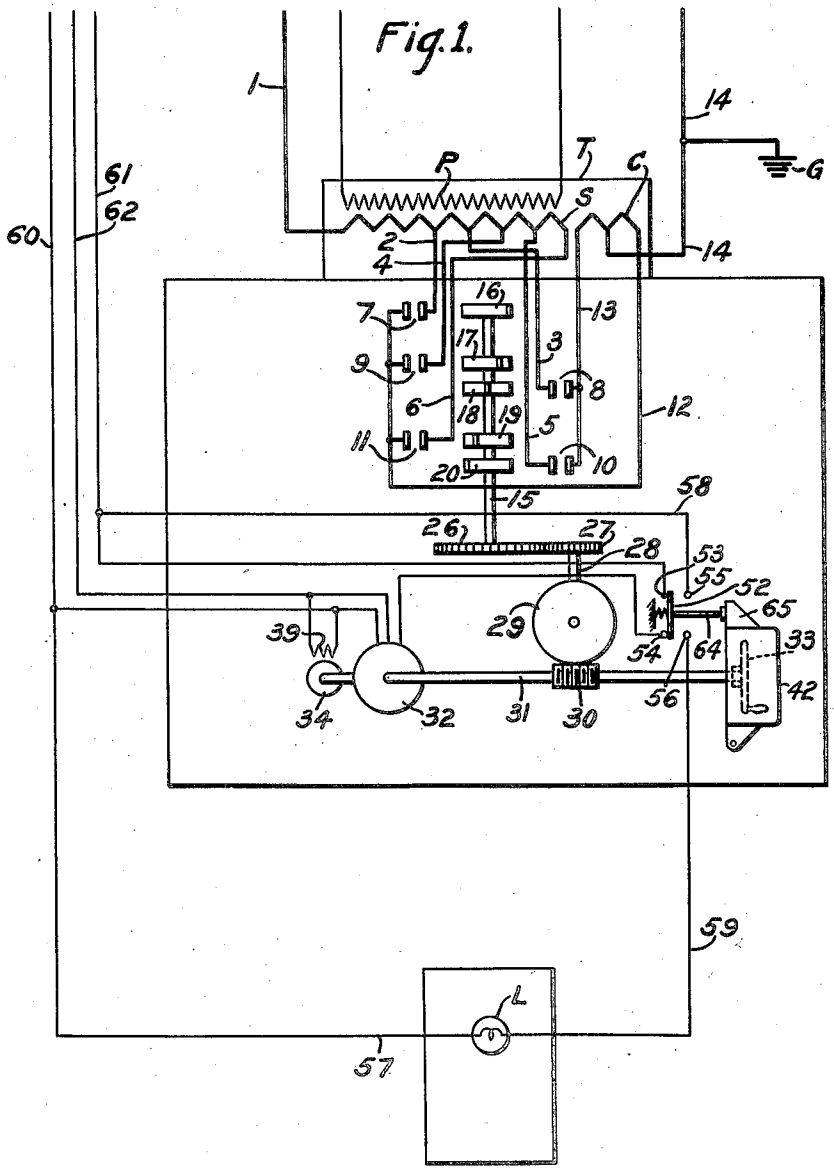
April 16, 1929. L. H. HILL 1,709,667

TAP CHANGING SYSTEM

Filed July 14, 1928 2 Sheets-Sheet 1

Fig. 1.



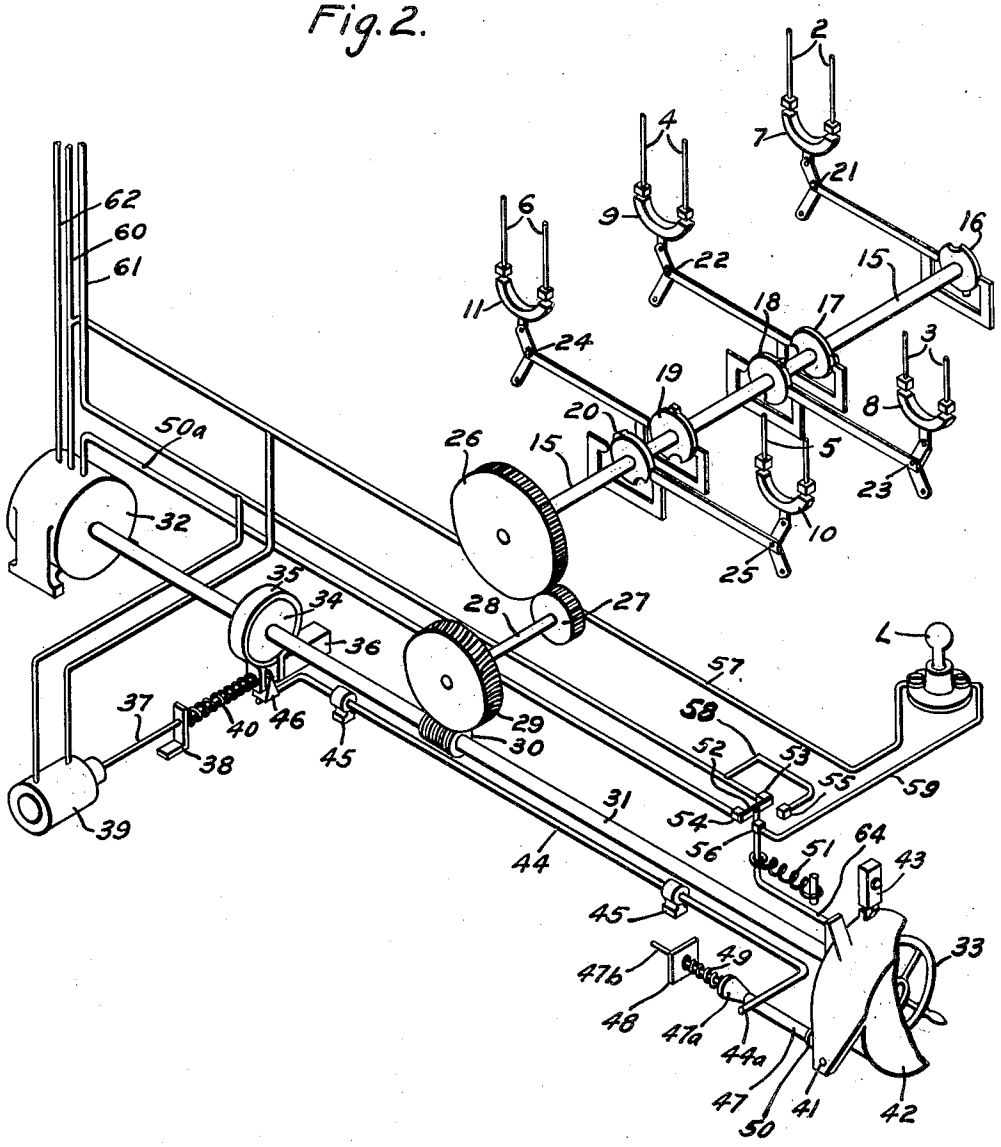
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Fig. 2.



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UNITED STATES PATENT OFFICE.

LELAND H. HILL, OF COLLINGSWOOD, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TAP-CHANGING SYSTEM.

Application filed July 14, 1928. Serial No. 292,769.

My invention relates to tap changing mechanism for electric transformers and more particularly to means for manually operating remotely controlled tap changing mechanism.

An object of my invention is to provide means for protecting an operator from injury by the operation of a normally remotely controlled tap changing mechanism.

Another object of my invention is to simplify tap changing equipment when the latter is designed for both automatic and manual operation.

A further object of my invention is to provide means for remotely disconnecting the energizing circuit to a control motor, mechanically releasing and maintaining released a brake for said motor, and operating a signal, when normally remotely controlled tap changing mechanism is placed in condition for manual operation by the lowering of a cover normally protecting a handwheel on the shaft of said motor.

These and other useful and desirable objects will be set forth in the following description of my invention when taken in connection with the accompanying drawings.

In the drawings:

Figure 1 is a diagrammatic view of tap changing equipment constructed in accordance with my invention, and

Fig. 2 is a semi-diagrammatic perspective view of the equipment illustrated in Fig. 1.

Referring to Fig. 1 there is illustrated a transformer T comprising a high tension or primary winding P and a low tension or secondary winding S. Coactively related with the transformer T and particularly its low tension winding S is a compensating winding or auto-transformer C.

Winding S comprises a main section and a plurality of sub-sections formed by properly connecting conductors 1, 2, 3, 4, 5 and 6 thereto. Interposed in the respective conductors 2, 3, 4, 5 and 6 are the switches or circuit breakers 7, 8, 9, 10 and 11. Conductors 2, 4 and 6 lead to a common conductor 12 connected to one terminal of the winding C while conductors 3 and 5 lead to a common conductor 13 connected to the other terminal of winding C. Connected preferably to the mid-point of winding C is a conductor 14 which, with conductor 1, forms the line conductors of the secondary circuit. In actual practice, the conductor 14 is either solidly grounded at G or connected to a portion of the winding S. As a general rule, the tap changing equipment must be connected to the grounded end of a star-connected winding or the middle of a winding connected in delta relation with similar transformer windings.

Referring to Figs. 1 and 2, a shaft 15 suitably supported in bearings, not shown, has keyed or otherwise suitably secured thereto a plurality of spaced members or cams 16, 17, 18, 19 and 20 adapted, upon a turning of shaft 15 to actuate the link and toggle mechanisms 21, 22, 23, 24 and 25, respectively, and thereby to positively close and open the respective switches 7, 9, 8, 11 and 10 in a predetermined sequence. Preferably, the shaft 15 makes less than one complete revolution for the whole range of tap changing.

In the example illustrated, shaft 15 may be moved into nine different positions to thereby operate the various switches and bring the windings S and C into a like number of different coacting relations. For purposes of ready reference, the different positions of shaft 15 and the resulting condition of the switches are here tabulated as follows:

Position No.	Closes switch No.
1	11
2	11 and 10
3	10
4	10 and 9
5	9
6	9 and 8
7	8
8	8 and 7
9	7

With the shaft 15 in position No. 1, the voltage across the secondary circuit is at its maximum value. When said shaft is in position No. 2, the winding C coacts with winding S in such manner that the voltage across the secondary circuit is the aforesaid maximum value less the voltage which would be induced in one-half of the sub-section of winding S between the conductors 6 and 5. With the shaft 15 in position No. 3, the entire sub-section of winding S between conductors 6 and 5, is eliminated and, therefore, the effective part of winding S is that between the conductors 1 and 5. Thus, as shaft 15 is moved successively to position Nos. 4, 5, 6, 7, 8 and 9, the voltage across the sec-

ondary circuit successively is decreased by an amount which would be induced in one-half of a sub-section of the winding S.

In accordance with my invention, movement of the aforesaid shaft 15 with consequent control of the tap changing switches may be effected as desired, either in response to operation of a suitable motive device or by a manual act. To this end, there is secured to the shaft 15 a gear 26 which meshes with a gear 27 secured to one end of a shaft 28 to the other end of which a gear 29 is secured.

Meshing with the gear 29 is a worm 30 rotatable with a shaft 31 mounted in suitable bearings, not shown. The rotatable element of a motor 32 is secured preferably to one end of the aforesaid shaft 31 while to the other end thereof a hand wheel 33 is secured.

Secured to the shaft 31 is a drum 34 with which coacts a brake or friction band 35, one end of which is secured to a fixed support 36. Extending from the other, or movable end of the band 35 is a rod 37 slidable in a bracket 38 and connected to the armature of an electromagnet 39. A helical spring 40, disposed between the bracket 38 and the aforesaid movable end of band 35, biases the latter to a braking position on the drum 34.

Pivoted at 41 to a suitable support, not shown, is a member or cover 42 which, when in the position illustrated in Fig. 2 prevents access to, and manual operation of the hand wheel 33. By preference, cover 42 is positively retained in the position illustrated in Fig. 2 by a lock 43.

A rod 44 rotatable in bearings 45 has secured to one end thereof an actuating member or cam 46 adapted for coaction with the movable end of band 35. The other end 44*a* of rod 44 is disposed upon a member 47, comprising an inclined portion 47*a*, and an extension 47*b*, of the member 47 is slidably mounted in a supporting member 48, between which and the portion 47*a*, a helical spring 49 is confined for biasing the member 47 into engagement with an extension or lug 50 carried by or movable with the cover 42.

When lock 43 is released, the cover 42 may be swung downwardly (Fig. 2) with resultant movement of lug 50 of the member 47. As a result, the member 47, under the influence of the spring 49, moves toward the right, Fig. 2, and the inclined position 47*a* of member 47 rotates rod 44 in such a direction that the cam 46 releases the brake band 35 from the drum 34. The hand wheel 33 may now be operated to rotate the shaft 31, and thereby, to move the shaft 15 into any one of its several positions, whereby the desired voltage may be maintained across the secondary circuit. When the cover 42 is returned to the position illustrated in Fig. 2, the inclined face 47*a* of member 47 is removed from the end 44*a* of rod 44, and the band 35 is tightened upon the drum 34, by the spring 40. Thus, the various parts are positively retained or locked in the selected position.

A lowering of the cover 42 also breaks a circuit through the conductors 61 and 50*a* to the motor 32, by permitting a spring 51 to move a switching member 52 away from contacts 53 and 54 in the circuit 50*a*. The motor 32 is thereby deenergized and may be freely turned by the handwheel 33. The switching member 52 when moved by the spring 51, as the cover 42 is lowered, closes a circuit between contacts 55 and 56, and connects them in series circuit relation with a lamp L through conductors 57, 58 and 59. The conductors 57 and 58 are connected to conductors 60 and 61, respectively, of the supply conductors 60, 61 and 62. When the cover 42 is lowered, the lamp L, mounted on a panelboard, lights, indicating that the tap changer is in the proper position for hand operation and remote control is impossible.

The spring 51 may, of course, be associated with the switching member 52 and the cover 42 in any suitable manner, but by preference a bent rod 64 has the switching member 52 secured thereto at one end and coacts with an extension 65 on the cover 42 to open and close circuits through the contacts 55 and 56, and 53 and 54, respectively, against the force of the spring 51 when the cover 42 is moved to its closed position.

When the cover 42 is closed the handwheel 33 is free to turn with the operation of the shaft 31 by the motor 32, which is preferably automatically controlled from a source of electrical energy (not shown) through a circuit represented by conductors 60, 61 and 62. Operators working near the handwheel 33 are thereby protected from injury due to a turning of the same.

However, when it is desired to move the tap changing mechanism by hand a simple lowering of the cover 42 disconnects the motor 32, releases the brake drum 34, lights the lamp L and permits the handwheel 33 to be turned by the operator. After turning the handwheel 33 any desired amount, the apparatus is restored to normal condition for automatic operation by simply closing the cover 42.

As heretofore mentioned the cover 42 may be provided with a lock 43 to prevent an unauthorized lowering of the cover 42.

It will be apparent to those skilled in the art that various minor changes may be made in my invention without departing from the spirit thereof. I wish my invention, therefore, to be limited only by the scope of the appended claims.

I claim as my invention:—

1. In combination, a winding provided with taps and switching means for changing

the circuit connections to said taps, means including a motor for operating said switching means and having a control circuit, and a hand lever for operating said switching means, means for housing said hand lever, and means associated with said housing means for opening said motor control circuit whereby said tap changing means may be manually controlled by said hand lever.

2. In combination, electrical apparatus comprising a winding provided with taps, tap changing means for changing circuit connections to said taps, means including a motor and a hand lever for operating said tap changing means, means for braking said operating means, a cover for said hand lever, and means for electrically disconnecting said motor and mechanically disconnecting said braking means upon movement of said cover to such a position as to render said hand lever accessible for operation.

3. In combination, a cam-operated tap changing device, means including a motor and a handwheel on the same shaft for operating said device, an electromagnetically controlled brake for said shaft, a cover for said handwheel, and means including a mechanical interconnection between said brake and said cover for rendering said brake inoperative when said cover is opened.

4. In combination, means for tap changing, means including a motor having a control circuit for automatically operating said tap changer, and means for manually operating said tap changer comprising a lever mechanically connected to the armature of said motor, a cover for said lever, and means associated with said cover for opening and closing one point of said motor control circuit, when said cover is opened and closed, respectively.

5. In combination, means for tap changing, means including a motor having a control circuit and a hand lever for turning said tap changing means, a brake for said motor, means for housing said hand lever, means associated with said housing, means for opening and closing said motor control circuit when said housing means is opened and closed, respectively, and means for maintaining said brake released when said housing means is open.

6. In combination with a tap changing mechanism for a transformer, a motor for driving said mechanism, a brake for said motor, a signal, a handwheel for turning said motor, and a cover for said handwheel, of means for deenergizing said motor, releasing said brake, and operating said signal when said cover is opened, and means for restoring said mechanism for normal operation when said cover is closed.

In testimony whereof, I have hereunto subscribed my name this 10th day of July, 1928.

LELAND H. HILL.