April 16, 1929. L. H. HILL 1,709,724

TRANSFORMER TAP CHANGING SYSTEM

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Fig. 1.

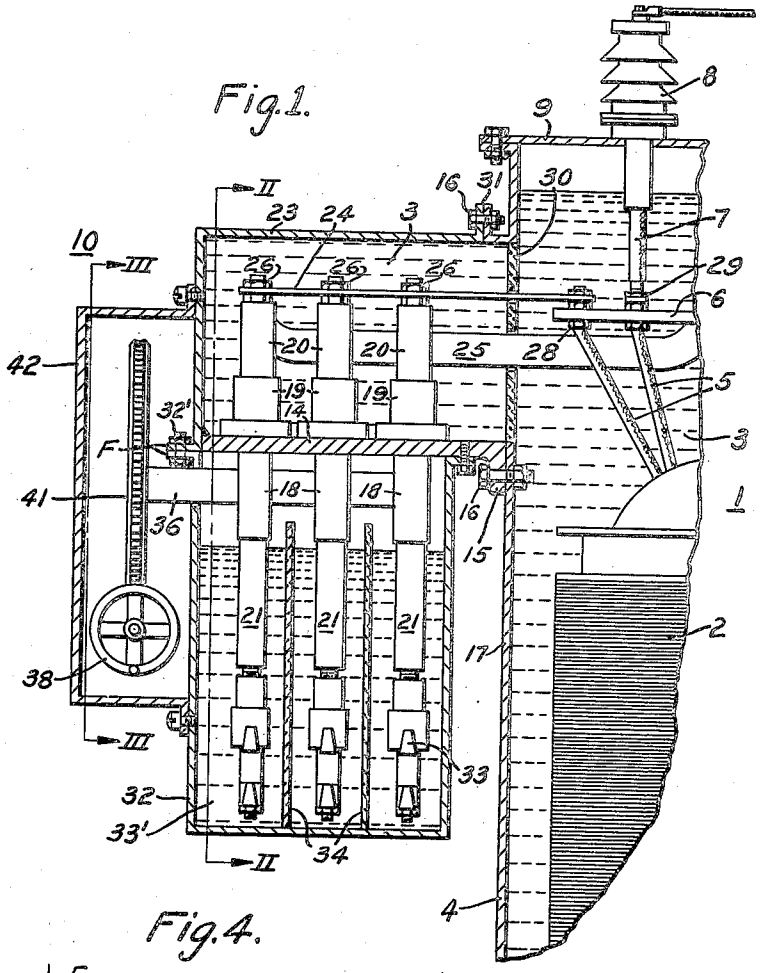
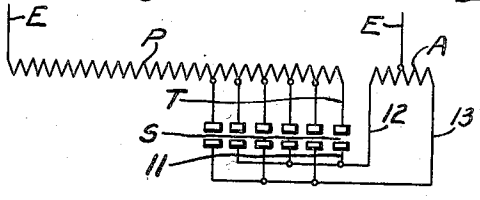


Fig. 4.



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Fig. 2.

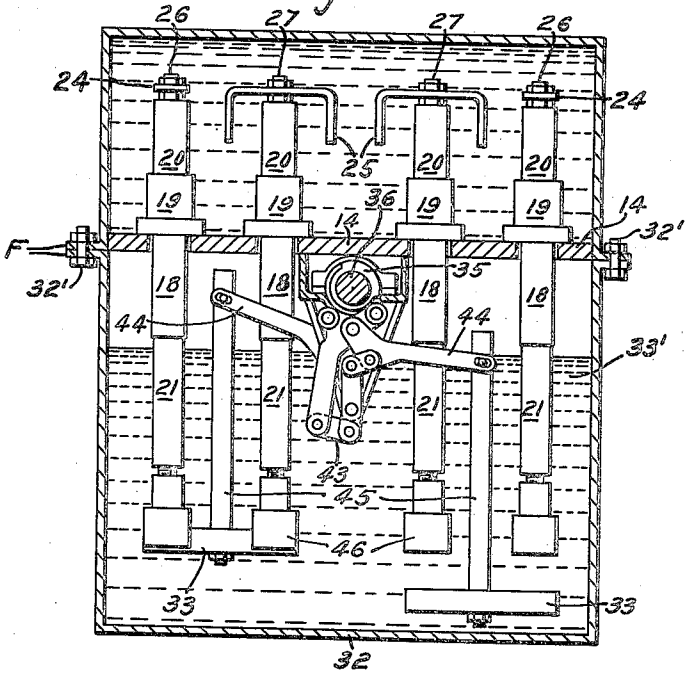
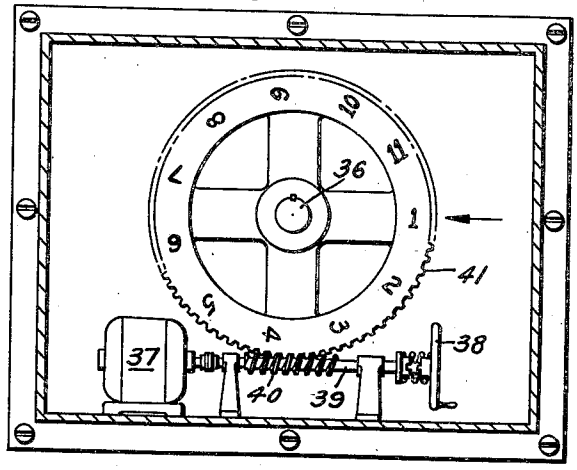


Fig. 3.



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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.

TRANSFORMER-TAP-CHANGING SYSTEM.

Application filed July 21, 1928. Serial No. 294,406.

My invention relates to equipment for changing transformer taps under load, and more particularly to the housing arrangement of such equipment, in combination with the tank of a transformer.

My invention has for an object to provide means for simplifying transformer-tap-changing equipment.

A further object of my invention is to provide means for improving the housing arrangement of tap-changing equipment used in conjunction with the transforming apparatus.

I obtain these and other desirable and useful objects by mounting all of the circuit breakers or tap-changing switches to be used with the tap-changing equipment on an oil-tight base that is secured to the wall of the transformer tank. Such base is preferably disposed in a horizontal plane, and the insulating bushings of the breakers or switches extend through it. A housing encloses the upper portions of the bushings and such housing is filled with oil of the same quantity as that in the main transformer tank. The leads are thereby completely immersed in oil.

The portions of the bushings extending below the base are preferably immersed in circuit-breaker oil that is contained in a removable tank mounted beneath the base. Such arrangement greatly simplifies the conductor-insulating problem and provides an improved structure with respect to prior apparatus.

My invention, however, may be more readily understood if the following description is read with reference to the accompanying drawings.

In the drawings:

Figure 1 is a view, partially in elevation and partially in section, of tap-changing apparatus mounted on the wall of a transformer tank in accordance with my invention.

Fig. 2 is a view, in front elevation, of the tap-changing equipment, the casing being in section on line II—II of Fig. 1.

Fig. 3 is a view, in front elevation, of the tap-changing equipment, the casing being in section on line III—III of Fig. 1, and

Fig. 4 is a schematic diagram of the tap-changing connections for the main-transformer and preventive-auto-transformer windings.

Referring to Fig. 1, the transformer 1, comprises the usual laminated core 2 on which are wound primary and secondary windings (not shown). The whole structure is immersed in a fluid insulating and cooling medium, such as oil 3, that is contained within a tank 4.

One of the windings (P, Fig. 4) of the transformer 1 is provided with a plurality of taps that are connected, by insulated conductors 5, to a terminal board 6. The conductors 5 from the primary winding P of the main transformer 1, as well as conductors 11 that are alternately connected to conductors 12 and 13 leading to the preventive auto-transformer A, are connected to the terminal board 6.

The primary and secondary windings are provided with conductors 7 that are insulated from the tank cover 9 by bushings 8.

Transformer tap-changing equipment 10 for altering the voltage ratio of transformation, while the transformer is loaded, comprises a plurality of circuit breakers or switches S mounted on a common oil-tight base 14. The base 14 is preferably secured, by means of a flange 15 and bolts 16, to the wall 17 of the transformer tank 4. The circuit breakers or switches severally comprise insulating bushings 18 and 19 that extend through the plate 14 and have upper portions 20 and lower portions 21.

The upper portions 20 of the circuit-breaker bushings are enclosed in a casing 23 that communicates with the transformer tank 4 and provides means for completely immersing the upper ends of the bushings in the oil 3.

Conducting leads, such as 24 and 25 are provided for electrically connecting the terminals 26 and 27, respectively, of each of the circuit breakers or switches S, to terminals, such as 28 and 29 of the terminal board 6 of the transformer 1.

The upper casing 23, housing the upper portions 20 of the bushings, is oil tight, as heretofore mentioned, and the oil 3 is freely communicable between the casing 23 and the transformer tank 4. The casing 23 may be joined to the wall 17 of the main transformer casing in any suitable manner, as, for example; by means of coacting flanges 31 secured together by bolts 16.

A panel 30, preferably of insulating material, such as micarta, is inserted in the

opening between the casing 23 and the tank 4 for supporting the conductors, such as 24 and 25, extending therethrough.

The lower portions 21 of the circuit-breaker bushings are enclosed within a casing 32 that is removably secured to the upper casing 23 by means of bolts 32′ and cooperating flanges F.

The casing 32 is preferably only partially filled with oil so that circuit-opening-and-closing portions 33 of the circuit breakers are completely immersed in oil 33′. The oil 33′ is provided for quenching arcs caused by the opening of the circuit breakers or switches and for insulating purposes. The oil 33′ is contained in a different compartment 32 from the oil 3 because of the fact that the opening and closing of the circuit breakers or switches, under load, causes the oil 33′ to deteriorate in quality, as an insulating medium.

The lower portions 21 of the circuit breakers are separated by insulating panels 34 that are preferably micarta sheets. Such panels increase the insulation between the lower portions of the circuit breakers or switches.

The circuit breakers or switches are operated, in accordance with a predetermined sequence, by cams 35, mounted on a shaft 36. The shaft 36 is driven, either directly by a motor 37 or manually by means of a hand-wheel 38, through a shaft 39 having a worm 40 coacting with a gear wheel 41 that is secured to the shaft 36. The gear wheel 41 is provided with numbers each of which corresponds to a definite arrangement of the tap-changing circuit breakers or switches. The gear wheel 41 is preferably provided with a cover (not shown) having a single opening through which the number indicating the position of the tap-changing apparatus may be read.

A larger cover 42 is secured to the casings 23 and 32 for protecting the motor control apparatus (not shown) and the motor 37.

Returning to the apparatus for opening and closing the circuit breakers, the cams 35 positively actuate the movable contact members 33 upwardly or downwardly by means of toggle mechanisms 43, arms 44 and vertical supporting members 45, by which the contact members 33 are carried.

In their extreme upper positions, the vertical members 45 hold the contact members 33 between, and in engagement with, fingers 46 that are mounted on the lower portions 21 of the circuit-breaker bushings, while, in their extreme lower position, the members 45 separate the contact members 33 from engagement with the fingers 46 by action of the cam operating mechanism.

By mounting the circuit breaker on a common oil-tight base, in the manner and for the purpose indicated, I have greatly simplified the arrangement of such apparatus when used in conjunction with transformers for tap changing under load.

It is to be noted that the tank 32 for containing oil for immersing the switches is made removable, so that the switches may be readily inspected and repaired without the necessity of disturbing any other portion of the apparatus housing.

A diagram of the wiring arrangement of the tap-changing mechanism is illustrated in Fig. 4. An auto-transformer A is connected, as shown in the diagram, to one of the terminals E of the transformer 1 and to the taps T of the winding P through the tap-changing switches S. The tap switches S are closed in a predetermined sequence to vary the voltage between the terminals E of the transformer 1. The winding P may, of course, be either the primary or the secondary winding of the transformer, although I have mentioned it as the primary, for convenience.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus that I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown and described is only illustrative and that the invention may be embodied in modifications of the structure disclosed.

I claim as my invention:

1. The combination with a transformer having an oil-filled tank, of tap-changing-under-load apparatus therefor, said apparatus comprising a plurality of circuit breakers, or switches, vertically mounted on a horizontally disposed oil-tight base secured to said tank, an oil-tight housing above said base for immersing the upper portions of said breakers, or switches, in the oil of said tank, and means, including a removable container attached below said base, for immersing the lower switch portions of said breakers in other oil than that in said tank.

2. In combination, a transformer having an oil-tight tank, a plurality of switches for changing taps of said transformer, and means for mounting said switches, including an oil-tight base secured to the wall of said tank, an oil-tight housing enclosing the terminal portions of said switches extending above said base, said tank and said housing containing oil that is communicable therebetween, and an oil-tight container mounted below said base for immersing the contact-making portions of said switches in oil.

3. In combination, a transformer having an oil-tight tank, a plurality of circuit breakers having conductors associated with a winding of said transformer, said circuit breaker comprising switches mounted on insulating bushings, means for supporting said breakers, including an oil-tight base se-

cured to the wall of said tank, said bushings extending through said base, an oil-tight housing for maintaining the portions of said bushings extending above said base and said conductors immersed in oil, and means for immersing said switches in oil comprising a container mounted on said base.

4. An improved housing arrangement for tap changing mechanism for an oil filled transformer having a walled base, comprising a horizontal oil-tight base secured to the wall of said tank, tap changing switches mounted on said base, an upper tank for enclosing the leads to the switches in the same oil as in the main tank, and a removable container for immersing the contactors of the switches in switch oil mounted on below said base.

In testimony whereof, I have hereunto subscribed my name this 13th day of July, 1928.

LELAND H. HILL.