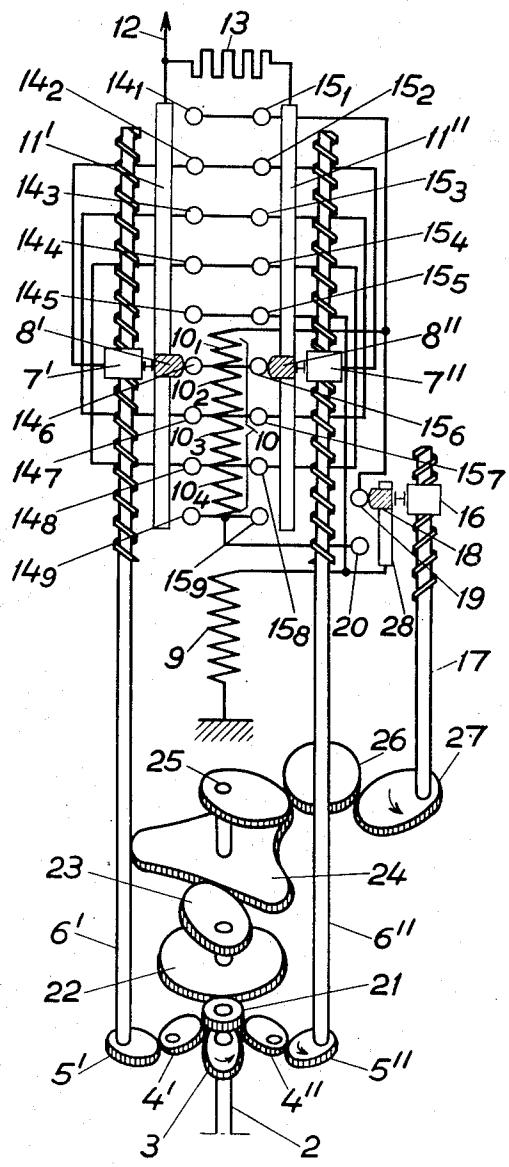
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ON-LOAD TAP CHANGER FOR TRANSFORMERS

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ON-LOAD TAP CHANGER FOR TRANSFORMERS

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On-load tap changers for transformers have for their object to perform a change-over of a terminal of a winding from one tap to another in the same winding or in a separate regulating winding in such a manner that the load current can flow through the transformer without interruption at any time during a tap change. In order to obtain such an interruption-free tap change without short-circuiting the parts of the winding which are between adjacent taps, the change-over from one tap to another is made in two steps by means of two alternately acting contacts, one of which first connects the terminal to a succeeding tap over an impedance, the direct connection then being made by means of the other contact.

In order to attain a larger regulating range by means of a given regulating winding, the tap changer may be provided with a switch by means of which the parts of the regulating winding are successively disconnected and then again successively connected in, but in the opposite direction.

The present invention concerns an arrangement in tap changers either for actuating the said alternately acting contacts of the said switch, or for actuating both the contacts and the switch, by means of a driving member running with a substantially constant speed, for instance a directly coupled motor or a flywheel with stored energy, and in such a manner that the contacts are moved practically momentarily from one contact position to another and remain in this position until the time comes for removal to the next contact position.

Hitherto it has only been possible to attain such a motion by means of a very complicated intermittently acting mechanism. By the present invention, however, the desired motion of the contacts of the tap changer is attained by means of simple and reliable elements and a driving member running with a practically constant speed. The invention is chiefly characterised in that between the driving member and the contacts of the tap changer there is inserted a toothed gear train which comprises at least three series-connected non-circular, for instance elliptical, toothed wheels. According to one form of the invention, the gear mechanism may comprise two parallel trains of wheels, which are driven from a common pinion driven by the driving member, which trains each drive one of the contacts of the tap changer, and according to another form of the invention, this gear mechanism may comprise a third wheel train, driving the said switch.

It has previously been proposed to use elliptical toothed wheels in order to attain a varying gear ratio. In hitherto known gears, however, only one pair of elliptical wheels has been used, and the change of the ratio obtainable in such a pair has therefore been rather limited. The present invention, however, concerns the use in each gear train of at least three non-circular toothed wheels in series, and therefore any desired variation of the gear ratio can be attained. For the present purpose this is of the greatest importance, because it is possible to attain, in combination with a continuously rotating driving shaft, a step-by-step motion of the contacts and also a practically momentary motion of the switch, which occurs first when another contact or switch has performed a plurality of motions.

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On the accompanying drawing the invention is shown applied to a tap changer of the type comprising a switch for connecting a regulating winding either in the same direction as the main winding or in the opposite direction, and with a resistor as current-limiting impedance.

In the drawing, 2 designates a driving shaft which is connected with a continuously moving driving member, for example a motor, not shown in the drawing. An elliptical pinion 3 mounted on shaft 2 engages two elliptical toothed wheels 4' and 4'', which in turn engage elliptical toothed wheels 5' and 5'', which are secured to the partially screw-threaded shafts 6', 6'', respectively. On the threaded parts of these shafts, nuts 7' and 7'' are mounted, which are mechanically, but not electrically, connected with contacts 8' and 8'' respectively. These contacts slide on contact bars 11' and 11'', and during their motion along these bars are brought into contact with tap contacts 14_1—14_9 and 15_1—15_9, respectively. These tap contacts, other than contacts 14_5 and 15_5, are connected with taps on parts 10_1—10_4 of the regulating winding 10. Tap contacts 14_5 and 15_5 are connected to one end of the main winding 9. The contact bar 11' is directly connected with the line terminal 12 to the transformer, whereas the contact bar 11'' is connected with line terminal 12 through a resistance 13.

A pinion 21 is also mounted on the shaft 2 and engages an intermediary wheel 22. On the shaft of this latter wheel there is an elliptical pinion 23 which engages a non-circular toothed wheel 24. On the shaft of the latter wheel, there is an elliptical pinion 25, which acts over an intermediary elliptical toothed wheel 26 on an elliptical toothed wheel 27 on a partially screw-threaded shaft 17. On the threaded part of this shaft a nut 16 is mounted which is mechanically, but not

electrically, connected with a contact 18 sliding on a contact bar 28, and is alternately brought into contact with the contacts 19 and 20. The contact bar 28 is directly connected with the main winding 9 of the transformer, the contact 19 is connected with one end of the regulating winding 10, and the contact 20 is connected with the other end of said winding.

The arrangement acts in the following way: In the position of the contacts 8' and 8'', shown on the drawing, the line terminal 12 of the transformer is connected to the main winding 9 of the transformer over the part 10_1 of the regulating winding 10. When the driving shaft 2 is in motion in such a direction that the contacts 8' and 8'' are moved downwards, the nut 7'' is first moved downwards one step, so that the line terminal 12 is connected with tap contact 15_7 through the resistance 13, and so that the two parts 10_1 and 10_2 of the regulating winding are connected in series with the main winding through the resistance 13. The contact 8' then performs a rapid movement down to tap contact 14_7, and during this motion the contact 8'' remains at rest on tap contact 15_7. In this manner the contacts 8' and 8'' alternately step downwards until at last all four parts of the regulating winding have been connected in series with the main winding. The tap changer has now reached one of its end positions. When driven in the opposite direction, the different parts of the regulating winding are successively disconnected until the contacts 8' and 8'' reach tap contacts 14_5 and 15_5, respectively, in which position the whole regulating winding is out of circuit. When the contact 8'' reaches tap contact 15_4, the line terminal 12 is connected to the winding 9 through the resistance 13 over tap contact 15_4, tap contact 15_8, part 10_4 of the regulating winding, contact 20, contact 18, and bar 28. As will be seen, a fourth part of the regulating winding is connected to the main winding, but now in opposite direction, and upon continued motion upwards of the contacts 8' and 8'' the different parts of the regulating winding again are connected into circuit in series with the main winding 9, but now, as said before, in opposite direction. The movement of the contact 18 from contact 19 to contact 20 is performed during the period between contact 8' leaving tap contact 14_6 and contact 8'' arriving at tap contact 15_4, for the reason that during this period the contact 18 is entirely out of action, as contacts 14_5 and 15_5 are directly connected to the main winding 9.

The movement of the contact 18 from one position to the other takes place only once during the time necessary for moving the contacts 8' and 8'' from the lowermost to the uppermost position or vice versa, and this is made possible by the large gear ratio, and the large variation of the gear ratio, which are attained by the use of non-circular toothed wheels connected in series between the pinion 21 and the toothed wheel 27.

The invention is not limited to the form shown on the drawing but comprises all arrangements where the movement of a contact in a tap changer is performed by means of a toothed wheel train comprising at least three non-circular toothed wheels. It is not, of course, necessary that the motion of the contacts takes place along a straight line, because a circular motion of the contacts can also be used.

I claim as my invention:

1. Gear mechanism for the tap changers of a transformer with two moving contacts, comprising a driving member rotating at uniform speed, a non-circular tooth gear wheel driven by said member, two non-circular idler tooth wheels both meshing with and driven by the first-mentioned wheel, a non-circular tooth wheel meshing with and driven by each of said idler wheels, and means whereby intermittent motion of the wheels driven by said idler wheels is transmitted to said contacts to move them with a step-by-step motion.

2. Gear mechanism for the tap changers of a transformer with two moving contacts, comprising a switch for reversing a regulating winding in relation to a main transformer winding, a driving member rotating at uniform speed, a gear train having at least two non-circular tooth wheels for imparting intermittent motion to said switch from said member, two trains each having at least three non-circular tooth wheels for imparting intermittent motion to said moving contacts over the tap contacts of the winding, the first-mentioned gear train providing a large gear ratio in relation to the other gear trains so that the tap changer and the switch will effect only one switch-over during the time the contacts of the tap changer move over all the tap contacts.

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