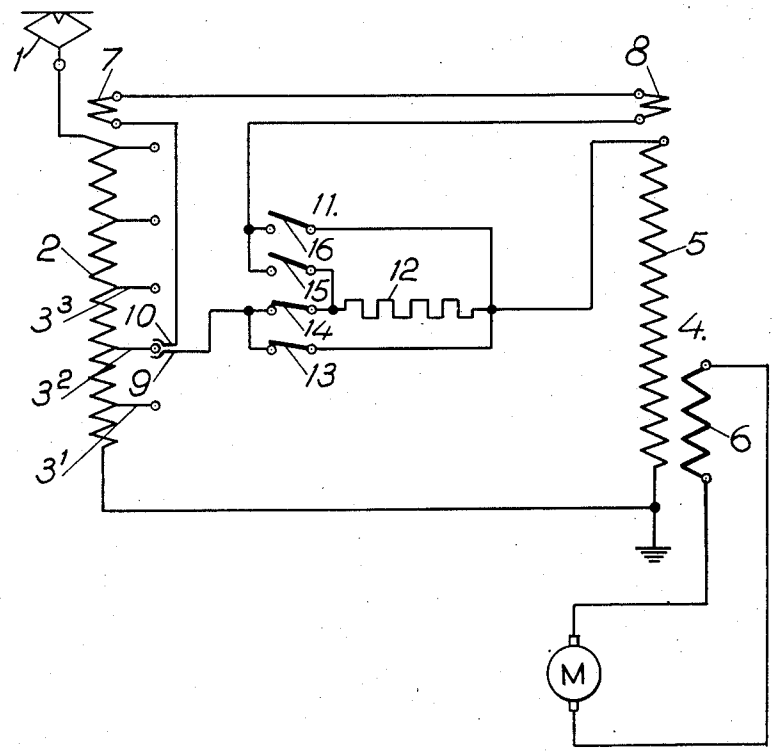
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TAP CHANGING TRANSFORMER SYSTEM

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TAP CHANGING TRANSFORMER SYSTEM

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In electrical railway drive the speed of the train generally is regulated by a variation of the voltage impressed upon the motors, and this variation is best attained by a regulation on the primary side of the locomotive transformer by its connection according to the desired speed to different tappings on a potentiometer or an autotransformer, which is connected between the trolley-wire and earth.

In order to attain a sufficiently fine regulation of the speed it is necessary to provide the said potentiometer with a large number of tappings and in order to decrease the number of tappings maintaining the number of voltage-steps the potentiometer has been provided with an additional winding coil, which coil during increasing the voltage by changing from one tapping to the next on the potentiometer, has been connected in series with the primary winding of the transformer. This additional winding has then been so dimensioned that the additional voltage generated by it has been parctically the half of the voltage between two adjacent tappings on the potentiometer.

In order to fully utilize the current load ability of the driving motors for the acceleration of the train it is, however, of interest to perform the regulation with voltage steps, which increase with increasing voltage in order to achieve the same increase in current in the motors for each regulating step. The above described arrangement can, however, not be used in the cases when the tappings on the potentiometer are so arranged that the voltage steps between adjacent tappings increase with increasing voltage because the voltage generated by the additional winding is constant and thus only can serve for dividing a single voltage interval into equal parts. If, however, the above described arrangement advantageously shall be used for the regulation of a locomotive it is, however, desirable that the additional winding will give a division of all the different voltage intervals in two practically equal parts. The present invention has for its object an arrangement, by which this becomes possible, and according to the invention this is achieved thereby that the said additional winding is connected to the transformer fed by the potentiometer instead of to the potentiometer itself so that the voltage over this additional winding will vary in accordance with the voltage impressed upon the transformer. It is also possible to imagine a combination of the two arrangements in that on the potentiometer as well as on the transformer an additional winding is arranged, which windings are connected in series and connected in series with the primary winding of the transformer.

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On the accompanying drawing an arrangement of the last mentioned kind is shown, where 1 designates the trolley-wire and 2 the winding of the potentiometer with the tappings 3^1, 3^2 and 3^3. 4 designates the locomotive transformer with its primary winding 5 and secondary winding 6 connected to a motor M. On the potentiometer an additional winding 7 is arranged and on the transformer an additional winding 8, which two windings mutually are series-connected and connected to one contact 10 on the step switch of the potentiometer, whereas the other contact 9 is connected with a switch 11, which contains a resistance 12 and four contacts 13, 14, 15 and 16.

The arrangement acts in the following way: It is at first supposed that the contacts 9 and 10 are connected with the same tapping on the potentiometer and the contacts 13 and 14 are closed. Then the contact 14 is opened and the contact 15 is closed and 13 is opened so that the voltage from the coils 7 and 8 over the resistance 12 is added to the voltage before impressed upon the winding 5. Then the circuit breaker 16 is closed so that said voltage without interconnection of the resistance 12 is introduced in the circuit of the winding 5. The voltage, which then is impressed upon the winding 5, is thus practically equal to the mean value of the voltage of the tappings 3^2 and 3^3. Now the contact 9 is moved to the tapping 3^3 and the contact 15 opened, 14 closed and 16 opened. By this the tapping 3^3 over the resistance 12 is connected with the winding 5 and then the resistance 12 is short-circuited so that the tapping 3^3 is directly connected with the winding 5 by closing the switch 13, and then the switch 14 is opened and also the contact 10 moved up to the tapping 3^3. In this way the winding 5 successively is connected with the different tappings of the potentiometer 2, but each time with interconnection of the windings 7 and 8. When the voltage impressed upon the winding 5 shall be lowered the procedure is the opposite.

Instead of designing the coils 7 and 8 as above mentioned so that they will deliver half of the voltage difference between the tappings on the potentiometer, they may of course also be so dimensioned that they only deliver a third of this voltage difference but are then in the same or the opposite direction as the main voltage inserted in series with the transformer winding 5. The switch 11 will then of course be otherwise de-

signed, because it must then serve for a reversing of the coils 7 and 8.

In spite of the fact that the invention in the first place is intended to be used for electric locomotives and described for such it may of course also be used in other cases, where a variation of a voltage shall be performed by a step regulation.

I claim as my invention:

1. In a voltage regulation system controlled by a transformer having its secondary winding connected with a load and its primary winding through a tap-changing device connectable with a plurality of taps on an auto-transformer coupled to a source of alternating voltage, an additional winding wound on the primary side of the transformer, said additional winding having such a size as to deliver an additional voltage with a fraction of the voltage difference between the succeeding taps and also being connectable by said tap-changing device with said taps for successive interconnection of said additional winding to the individual proceeding taps prior to the connection of the primary winding of the transformer therewith.

2. A system according to claim 1, wherein the additional winding comprises two parts connected in series, one of which is wound on the auto-transformer and the other is wound on the primary side of the transformer.

3. A system according to claim 1, wherein the additional winding has such a size as to deliver an additional voltage of substantially one-half the voltage difference between successive taps.

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