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LOAD TAP SELECTOR FOR TAPPED TRANSFORMERS
 WITH SEVERAL CONTACT CIRCLES PER PHASE
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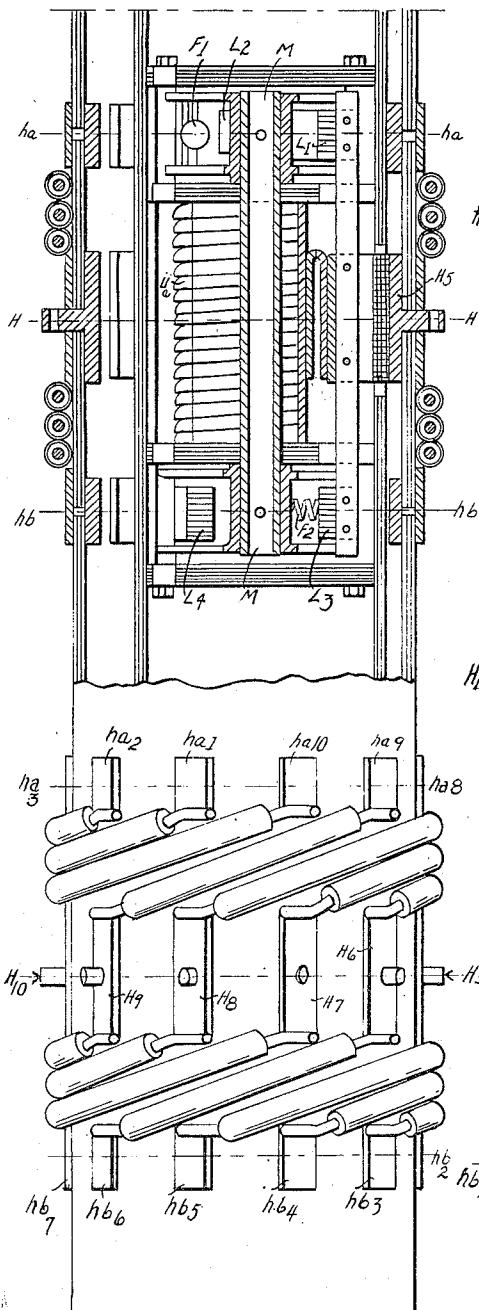


FIG. 1.

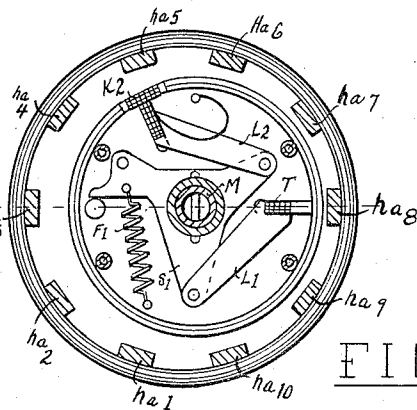


FIG. 2.

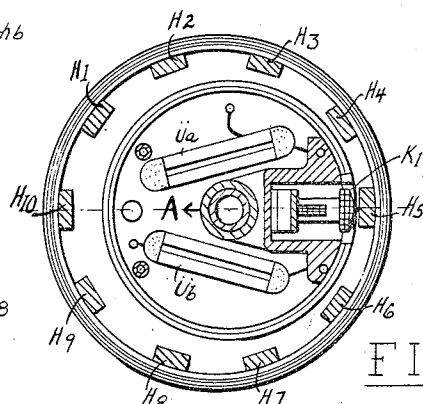


FIG. 3.

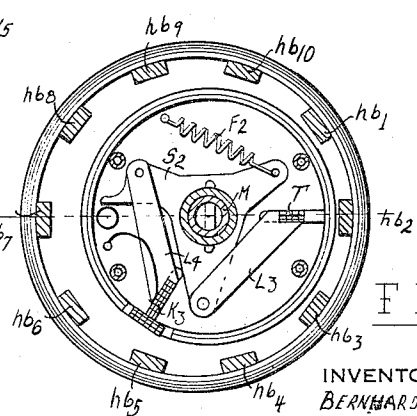


FIG. 4.

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LOAD TAP SELECTOR FOR TAPPED TRANSFORMERS WITH SEVERAL CONTACT CIRCLES PER PHASE

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6 Claims. (Cl. 200—6)

1

This invention relates to load switches for tapped transformers having several rows of contacts per phase.

Load selectors for tapped transformers are connected without the insertion of a step selector with the transformer taps and take care of the selecting and load switching on the same contact row. In the already known load switches, the stationary switch contacts connected with the transformer taps are uniformly distributed on the periphery of a circular or cylindrical contact carrier, generally an insulating plate or insulated cage consisting of bars or an insulated cylinder. Within this stationary contact circle, the system of movable load switch contacts with their contact resistances, serving for the switching of the load, move from contact to contact tangentially or on chords or on cycloidal paths or similar paths. This movable contact system is evenly directed towards the radial central axis of the main (in case of multi-phase load selectors towards the radial central axis of all main contacts to be switched at the same time) and regulates the correct time sequence of the connections and disconnections of the movable load switch contacts by arrangement of the corresponding contact guides on axes which lead or lag behind the radial central axis by a certain angle. In this connection, however, the angular displacement of the axes always remains in the range of one switching step as determined by the angular distance between two adjacent stationary tap contacts on the external contact carrier.

Improvements made recently in the field of load switches cannot be applied to the known load switches whose arrangement of switch contacts cannot be limited to the angular distance between two stationary tap contacts. They must be distributed over the entire periphery of the inner circular or cylindrical contact carrier and accordingly cannot be connected with the same tap contacts in the case of a changeover switching operation, which is, however, necessary in order to maintain the correct switching sequence.

In accordance with the present invention, this difficulty is overcome by providing an entire circle or group of spaced stationary switch contacts arranged circumferentially on the outer circular or cylindrical contact carrier and connected with the individual transformer taps for each movable load switch contact on the inner circular or cylindrical contact carrier. For instance, there are thus produced, along with the customary movable main contact directly connected with the current shunt and with the two movable auxiliary con-

2

tacts connected with the main contact by means of switch resistances, three such groups of contacts. These groups of contacts can, for instance, operate in three horizontal planes displaced axially with respect to each other in the longitudinal direction of the load selector. During this switching operation, the stationary switch contacts belonging to different circles or groups, but belonging to the same transformer tap, are electrically connected with each other on the outer contact carrier, while the movable switch contacts on the inner contact carrier are connected positively and mechanically with each other by a common contact lever. If the axially displaced contact circles or groups of contacts are arranged far enough apart from each other on the outer contact carrier, the conductors required for connection between the stationary, main and auxiliary contacts of the same transformer tap can be arranged in multi-screw thread formation in the intermediate spaces produced thereby. The insulation of these conductors against the voltage potential of the adjacent conductors and contacts is suitably effected by winding layers of cable paper thereon.

It is the main object of the present invention to provide a load selector for tapped transformers that is highly efficient in operation and compact and simple in construction.

Other objects and advantages of the invention will be apparent from the description thereof to follow taken in connection with the accompanying drawings in which—

In the drawings,

Fig. 1 is a part elevational and part sectional view of a load switch having an outer and an inner cylindrical or tubular contact carrier, embodying my invention.

Fig. 2 is a cross-sectional view taken on the plane of the line *ha—ha* of Fig. 1.

Fig. 3 is a cross-sectional view taken on the plane of the line *H—H* of Fig. 1.

Fig. 4 is a cross-sectional view taken on the plane of the line *hb—hb* of Fig. 1.

In Fig. 1, a load switch is shown including an outer tubular or cylindrical load switch contact carrier and an inner tubular or cylindrical load switch contact carrier. The upper halves of the contact carriers are in longitudinal section to show the arrangement of the spaced stationary and movable load switch contacts. The contacts are arranged in groups and the individual contacts of each group are circumferentially spaced from each other. The groups are axially spaced from each other, with the upper group disposed

3

on the plane of the line $ha-ha$, the intermediate group on the plane of the line $H-H$, and the lower group on the plane of the line $hb-hb$ of Fig. 1.

The lower halves of the contact carriers are in elevation showing the helical course of the insulated connecting lines between the three stationary contacts belonging to each transformer tap.

In Fig. 3 are shown the main stationary load contacts $H1$ to $H10$ disposed in the central or intermediate plane indicated by the line $H-H$ of Fig. 1. These contacts are suitably fastened to the inner surface of the outer contact carrier and spaced circumferentially therearound.

Fig. 2 shows the lagging auxiliary stationary contacts $ha1$ to $ha10$ on the upper plane indicated by the line $ha-ha$ of Fig. 1, and Fig. 4 shows the leading auxiliary stationary load contacts $hb1$ to $hb10$ on the lower plane indicated by the line $hb-hb$ of Fig. 1. These auxiliary contacts are mounted on the inner surface of the outer carrier and spaced circumferentially therearound.

A rotatable tubular shaft m is suitably supported centrally of the inner contact carrier and extends through the area occupied by the three groups of stationary contacts. A triangular or spider-shaped plate $S1$ is fastened to the top end of the tubular shaft and a similar shaped plate $S2$ is fastened to the bottom end of the shaft. Insulating levers or push rods $L1$ and $L2$ are pivotally connected to two of the pointed ends of plate $S1$ and similar levers or push rods $L3$ and $L4$ are pivotally connected to the bottom plate $S2$. The outer free ends of the levers or push rods are operatively connected to movable load switch contacts $K1$, $K2$ and $K3$. Interposed in any suitable operative manner between the upper movable auxiliary switch load contact $K2$ and the lower auxiliary movable switch contact $K3$ and connected to the movable switch contacts are ohmic resistance elements Ua and Ub .

In the intermediate or central plane indicated by the line $H-H$ of Fig. 1, the main switch load stationary contacts $H1$ to $H10$ are supported on the inner surface of the outer contact carrier and arranged circumferentially in spaced relation therearound. The main movable switch contact $K1$ is arranged in this plane and is adapted to contact the stationary contacts in said plane.

In the upper plane indicated by the line $ha-ha$ of Fig. 1, the stationary auxiliary switch contacts $ha1$ to $ha10$ are supported on the inner surface of the outer contact carrier and arranged circumferentially in spaced relation therearound. The auxiliary movable switch contact Ka is also arranged in this plane and is adapted to contact the stationary contacts in said plane.

In the lower plane indicated by the line $hb-hb$ of Fig. 1, the auxiliary stationary switch contacts $hb1$ to $hb10$ are supported on the inner surface of the outer contact carrier and arranged circumferentially in spaced relation therearound. The auxiliary movable switch contact $K3$ is also arranged in this lower plane and is adapted to contact the stationary contacts in said plane.

The stationary load contacts provided with the same index number, for example, $H5$, $ha5$ and $hb5$, are positioned in staggered relation about 120° apart and are electrically connected to each other by the connections or conductors shown in helical formation at the bottom of Fig. 1, and connected to the transformer tap bearing the same index number.

The movable load switch contacts including the

4

main contact $K1$ and the auxiliary contacts $K2$ and $K3$ are electrically connected with the current shunt A directly or by means of the ohmic switch resistances Ua and Ub (Fig. 3). They are mechanically connected to the central tubular shaft m by means of the levers $L1$, $L2$, $L3$ and $L4$, the spider plates $S1$ and $S2$. The main movable contact $K1$ is connected to the levers $L1$ and $L3$ by means of a rod T extending between and connected to said levers. The auxiliary movable contacts $K2$ and $K3$ are connected to shaft m by the links or levers $L2$ and $L4$.

A torque is imparted to the rotatable shaft m by coil springs $F1$ and $F2$ acting upon the spider plates $S1$ and $S2$, respectively, which torque forces the movable contacts $K1$, $K2$ and $K3$ radially outward until one of them comes into contact with one of the stationary load stationary contacts, bringing the latter into circuit with the transformer winding and the current shunt A . Thus as shown in the drawing, at the top of Fig. 1 and in Fig. 3, the main movable contact $K1$ is moved into contact with the stationary top contact $H5$ and electrically connects the latter directly with the current shunt A .

The auxiliary movable contacts $K2$ and $K3$ are actuated only upon the switching of the load from one transformer stage to another, for example, from contact $H5$ to contact $H4$. During this switching operation, the inner cylindrical contact carrier rolls in the known manner in the outer cylindrical contact carrier, for instance, from contact $H5$ to $H6$, $H7$, $H8$, $H9$, $H10$, $H1$, $H2$, $H3$ to $H4$ as viewed in Fig. 3. During this switching movement, the movable main contact $K1$ moves in a cycloidal path from contact $H5$ to $H4$. Before contact $K1$ moves from contact $H5$, movable contact $K3$ (Fig. 4) is moved into contact with contact $hb5$ and in this way maintains the continuous electric connection from contact $H5$ via contact $hb5$, movable contact $K3$ and the switch resistance Ub to the current shunt A .

Continued further rolling of the inner cylindrical contact carrier brings movable contact $K2$ (Fig. 2) into contact with contact $ha4$. Before contact $K3$ is moved away from contact $hb5$, an electrical connection is established from contact $H4$ through contact $ha4$, movable contact $K2$ and the contact resistance Ua to the current shunt A . Continued further rolling beyond contact $ha4$ carries movable contact $K1$ into contact with the tap contact $H4$ and brings the latter into direct electric connection with the current shunt A . In this way, the load switching from contact $H5$ to contact $H4$ is completed.

A current interruption has not taken place during this switching movement inasmuch as springs $F1$ and $F2$ always impart a torque on the mechanical devices of the system consisting of the three-armed spider plates $S1$ and $S2$, the central tube m , the levers $L1$, $L2$, $L3$, $L4$, and the supporting rod T , which torque the movable contacts $K1$, $K2$ and $K3$ displace outwardly as far as possible in a radial direction so that each passing contact can only move from its stationary mating contact when the contact moving up already has touched its coacting stationary contact. This is only possible when the auxiliary movable contacts $K2$ and $K3$ have a sufficiently large angle, for example, about 120° , as compared with the main movable contact $K1$. The corresponding stationary engaging contacts must therefore be rotated over the main contacts (for example, $H5$ and $H4$, respectively) as to cover this same angle with smooth electrical action.

5

I claim:

1. In a load selector for tapped transformers having a large number of taps of the type consisting of stationary and movable load switch contacts and ohmic contact resistances connected to same, said stationary load switch contacts being connected with the individual transformer taps and arranged in an insulated manner, a switching device including a contact carrier carrying said stationary contacts and having an externally cylindrical shape, said movable load switch contacts cooperating with the stationary load switch contacts and a current shunt connected therewith; a contact carrier carrying said ohmic contact resistances and being of substantially cylindrical shape, means allowing said last carrier to roll eccentrically in the outer contact carrier, including means whereby each movable load switch contact cooperates with a circle of stationary load switch contacts corresponding to it, and conductors rigidly and mechanically connecting the stationary load switch contacts belonging to different circles but to the same transformer tap.

2. A switching device according to claim 1 in which said movable load switch contacts are arranged approximately uniformly over the entire periphery of the inner movable contact carrier, in which the circles of the stationary load switch contacts, with each of which a separate movable load switch contact cooperates, are arranged axially displaced from each other on the cylindrical surface of the outer carrier, and in which the metallic connections between the stationary load switch contacts belonging to the same transformer tap are arranged in the intermediate spaces between the axially displaced contact circles in a multi-screw-thread formation.

3. A switching device for a tapped transformer having a plurality of taps including an outer tubular member having rows of axially spaced stationary contacts on its inner surface, the individual contacts of each row being spaced circumferentially, means of connection between said stationary contacts and the transformer taps, an inner tubular member rollable on the contacts on said outer tubular member, a rotatable shaft supported centrally of said inner tubular member and radially movable contacts carried by said shaft for contacting the stationary contacts, and means including coiled springs for moving said shaft, the stationary contacts of different rows connected to one transformer tap being connected to each other, and also including in cooperative relationship with the means for moving said shaft, plates fastened at the respective ends of said shaft, insulating levers pivotally connected, respectively, at the inner ends, to predetermined points of both said plates, the outer ends of said insulating levers being operatively connected to the respective movable contacts.

4. A switching device for a tapped transformer having a plurality of taps including an outer tubular member having rows of axially spaced stationary contacts on its inner surface, the individual contacts of each row being spaced circumferentially, means of connection between said stationary contacts and the transformer taps, an inner tubular member rollable on the contacts on said outer tubular member, a rotatable shaft supported centrally of said inner tubular mem-

6

ber, a movable contact carried by said shaft opposite each row of stationary contacts adapted to contact said stationary contacts, and means for moving said shaft, and also including in cooperative relationship with the means for moving said shaft, plates fastened at the respective ends of said shaft, insulating levers pivotally connected, respectively, at the inner ends, to predetermined points of both said plates, the outer ends of said insulating levers being operatively connected to the respective movable contacts.

5. A switching device for a tapped transformer having a plurality of taps including an outer tubular member having rows of axially spaced stationary contacts on its inner surface, the individual contacts of each row being spaced circumferentially, an inner tubular member rollable on the contacts on said outer tubular member, a rotatable shaft supported centrally of said inner tubular member, a movable contact carried by said shaft opposite each row of stationary contacts adapted to contact said stationary contacts, and coiled springs for moving said shaft, and means of connection between the stationary contacts and the transformer taps, the stationary contacts of different rows connected to one transformer tap being connected to each other, said connections being disposed in the spaces between the rows of stationary contacts, and also including in cooperative relationship with the means for moving said shaft, plates fastened at the respective ends of said shaft, insulating levers pivotally connected, respectively, at the inner ends, to predetermined points of both said plates, the outer ends of said insulating levers being operatively connected to the respective movable contacts.

6. A switching device for a tapped transformer having a plurality of taps including an outer tubular member having rows of axially spaced stationary contacts on its inner surface, the individual contacts of each row being spaced circumferentially, an inner tubular member rollable on the contacts on said outer tubular member, a rotatable shaft supported centrally of said inner tubular member, a movable contact carried by said shaft opposite each row of stationary contacts adapted to contact said stationary contacts, coiled springs for moving said shaft, and conductors connecting stationary contacts of different rows to one transformer tap and to each other, said conductors being disposed in the spaces between the rows of contacts and being arranged in helical formation, and also including in cooperative relationship with the means for moving said shaft, plates fastened at the respective ends of said shaft, insulating levers pivotally connected, respectively, at the inner ends, to predetermined points of both said plates, the outer ends of said insulating levers being operatively connected to the respective movable contacts.

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