M. J. ILG.

WEDGE OR KEY FOR SLOTTED DYNAMO ELECTRIC MACHINE ELEMENTS.

APPLICATION FILED MAY 27, 1915. RENEWED SEPT. 15, 1920.

1,375,699. Patented Apr. 26, 1921.

Fig. 1

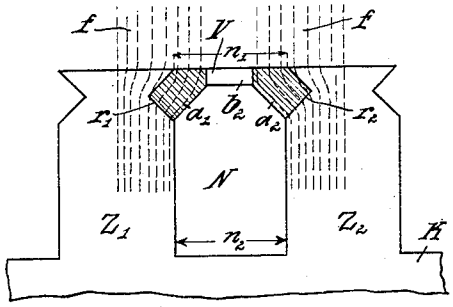
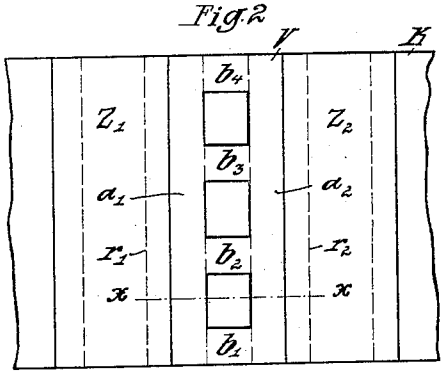


Fig. 2



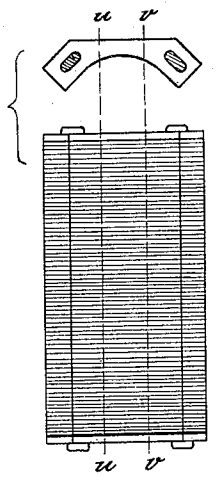


Fig. 3

Fig. 4

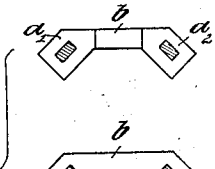


Fig. 5

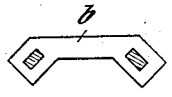


Fig. 6

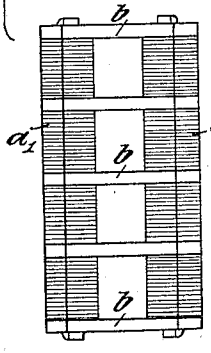


Fig. 7

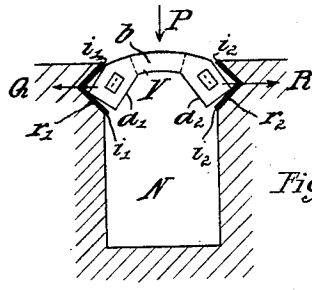


Fig. 8

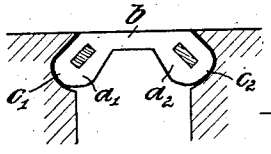


Fig. 9

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UNITED STATES PATENT OFFICE.

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WEDGE OR KEY FOR SLOTTED DYNAMO-ELECTRIC-MACHINE ELEMENTS.

1,375,699. Specification of Letters Patent. Patented Apr. 26, 1921.

Application filed May 27, 1915, Serial No. 30,844. Renewed September 15, 1920. Serial No. 410,483.

To all whom it may concern:

Be it known that I, MAX JOSEPH ILG, a German citizen, and resident of Nuremberg, Bavaria, Germany, have invented certain new and useful Improvements in Wedges or Keys for Slotted Dynamo-Electric-Machine Elements, of which the following is a specification.

In dynamo-electric machines having slotted iron cores it is often desired to close the slots in order to fully surround the current carrying windings which are placed therein. For inserting a winding into a slot and in order to be able to easily exchange parts of the winding which have become damaged, it is most convenient, to use so-called open slots, that is to say slots of a cross-section which is not smaller at the top of the slot than at the bottom, because the winding elements may be readily inserted into and taken out of a slot of this kind.

Open slots on the other hand have the disadvantage that they do not give a sufficiently large surface of the slotted iron body in order to have a magnetic path as large as possible for the entrance of the magnetic lines of force into said body, thereby necessitating a larger size of the iron body and a surplus of ampere turns for generating the field. Also other inconveniences are sometimes found in addition to this when open slots are used in dynamo-electric machine elements.

Attempts have been made to avoid these disadvantages connected with open slots by closing the slots by means of magnetizable wedges or keys after having the winding inserted into the slots. Many forms of such magnetizable keys or wedges and many modes for keeping the same safely in position have been devised and employed in practice. Of all these constructions, however, none has so far been able to fully meet the practical requirements.

The object of my present invention is to devise a key or wedge for the slots of dynamo-electric machine elements such as armatures, which more fully meets the practical requirements and which especially results in a number of mechanical and magnetic properties that are not found in the ordinary constructions.

My invention is an improvement of the ordinary slot-key generally of the shape of a flat wedge, which consists in the first place of magnetizable parts serving as a proper path for the lines of force coming out of the teeth of the slotted iron body or core, or in other words to increase the surface of said body for the passage of lines of force; these parts may therefore be called the flanks of the wedge or key. Secondly, this wedge or key consists of one or more parts which serve for uniting said flanks and therewith for retaining the shape of the wedge as a whole, which latter parts may therefore be called bridges. This distinction between the several parts of the slot-key is more fully explained by referring to Figures 1–7 of the accompanying drawing.

In Fig. 1 a cross section of the slot key is shown and in particular it is indicated in this figure how the lateral magnetizable ribs or flanks of the key affect the lines of force;

Fig. 2 shows a plan view of the arrangement in Fig. 1;

Figs. 3 and 4 and 5 to 7 show modifications of the forms of the key adapted to be inserted into the slots of dynamo-electrical machine elements according to the invention;

Fig. 8 shows the manner of placing the key in its seat, and

Fig. 9 shows a particularly advantageous form of the key.

In Figs. 1 and 2 a part of the slotted iron body or core K is indicated as having a slot N between the two teeth Z_1 and Z_2. Fig. 2 is a view of the surface of said slotted body K and Fig. 1 a section in the plane of Fig. 2. The slot N is what is called an open slot, for the width n_1 of its cross-section (Fig. 1) at the surface of K is not smaller than the width n_2 at the bottom of the slot. The slot is closed by a wedge or key V which is inserted into the slot after the winding has been mounted therein. In the teeth Z_1 and Z_2 there are provided two grooves r_1 and r_2 preferably of wedge-shaped cross-section which serve for receiving the wedge or key V, thus forming a seat for firmly retaining the same in position. The wedge V proper consists of the flanks a_1 and a_2 and the bridges b_1, b_2, b_3, b_4 keeping said flanks in position, four such bridges being shown in the drawing. The number of these bridges of course may be chosen as desired, also only one bridge may be employed. In Fig. 1 I have shown how

the lines of force f, f pass from the teeth Z_1, Z_2 through the flanks a_1, a_3 of the wedge or key V and how the surface of the teeth is increased thereby for the passage of the magnetic lines of force.

The flanks of the wedge or key must be of magnetizable material in order to serve their purpose, while the bridges are used only for mechanical purposes and therefore do not need to be of such material. These bridges may however be of magnetizable material and may be connected with the flanks in any manner. In case of a wedge or key which is made from laminated iron sheets, such as represented in Figs. 3 and 4, the middle parts of the laminæ, for instance that portion within the range of the lines u and v shown in the drawing, may be regarded as individual bridges or all these parts together may be considered as a single bridge. With the wedge or key of the kind shown in Figs. 5 and 7, whereby the laminated flanks a_1 and a_2 are kept together by means of connection pieces of a shape according to Fig. 6, the middle part b of these connecting pieces will then have the function of said bridges.

According to my invention now at least the magnetizable flanks of the wedge or key shall be of laminated construction and at the same time the shape and material of the bridges shall be such that said bridges can be stretched by a proper tool, so that they will remain in stretched condition and that the flanks will firmly fit the grooves of the teeth. These bridges therefore must be of malleable material and must not be resilient, so that they will be readily deformable without again assuming their original shape. The malleability of the bridges according to my invention is utilized for fastening the wedge or key within the grooves provided on the upper part of the teeth and more particularly this is accomplished in the following manner:

The wedge or key is made of a width which is slightly smaller than the contour of said grooves, *i. e.*, of its seat, so that the key may easily be inserted. Thereupon the width of the key is increased by stretching the bridges, which causes it to become firmly jammed into its seat.

Since the material of the bridges as above stated must be malleable, a wedge or key which is made of soft iron according to Figs. 3 and 4 will immediately satisfy this condition. In case of a wedge or key having non-magnetic bridges, such as for instance shown in Figs. 5, 6 and 7, brass, German silver or the like is used for the bridges. Regarding the shape to be chosen for the bridges according to my invention it is most advantageous to make the bridges somewhat arched, so that by exerting a proper pressure on them they will be stretched and will force the flanks to firmly fit into the grooves provided at the upper end of the teeth. It is also preferable, if bridges are used similar to those illustrated in Figs. 5, 6 and 7 to arch both their upper and lower faces in the same outward direction, because in this case the stretching of the bridges for fastening the same between the teeth can be accomplished in a very simple manner by hammer blows.

Fig. 8 represents my invention in the just mentioned modification applied to a wedge or key of the kind shown in Figs. 5, 6 and 7. The bridges b of the wedge or key V, as seen from the front, are outwardly arched in the same direction on both their upper and lower faces. As shown in this figure the wedge or key will still be lying loosely within its seat after having been inserted in a direction perpendicular to the drawing. The grooves r_1, r_2 are usually lined with insulating sheets i_1 and i_2, such as for instance paper. For fastening the wedge or key the arched bridges b are stretched by a pressure or a hammer blow which is exerted thereon in the direction indicated by the arrow P. This will cause the flanks a_1, a_2 to be spread out in the direction of the arrows Q, R, so that they will be pressed firmly into the grooves r_1, r_2. I am aware that it is known to employ laminated slot keys or wedges, and also to spread such keys or wedges into their seats. According to my invention the key for closing the slot is so constructed that at least the flanks are made from laminated material and that the key as a whole is spread into the slot which results in the advantage that the insulating sheets between the key and its seat (i_1, i_2, Fig. 8) may be chosen extremely thin. This insulation must be present in order to prevent eddy-currents from being generated during operation in the ordinarily laminated teeth of the slotted dynamo body or element, if between the several laminæ of the teeth and the laminæ of a wedge or key the conductive connection is accomplished. The insulation should be as thin as possible, in order that the magnetic lines of force in passing from the flanks of the wedge or key into the teeth of the slotted body shall meet as little resistance as possible. If the key is driven into its seat from the side the insulation will be very heavily strained especially in case the key is made from laminated material, because the edges of the several laminæ will act not unlike the teeth of a file. The insulation would therefore have to be comparatively thick. If a key having solid flanks is spread into the seats the pressure of the flanks will as a rule be received by the several laminæ of the teeth, which always project from the others by reason of inevitable inaccuracies of manufacture. On account of the heavy pressure exerted upon the insulation at

these places, the insulation again must be comparatively thick. If however according to my invention a laminated key is spread into its seat the flanks will be able to fit the unevenness of the surfaces of the seats, because the flanks are to a certain extent pliable. This pliability is caused by the fact that the several laminæ can be displaced relatively to each other and is due to a certain extent to the flexibility of the rivet holding the several laminæ together and to the fact that the several bridges may be stretched or deformed to a different extent. The pliability of the wedge or key effects a more uniform distribution of the pressure upon the insulation and thereby does away with the necessity of using a heavier insulation between the key and its seat, such as in the case of solid flanks. The flexibility of the laminated wedge or key has further the advantage that when the key is spread into its seat it is very well secured against falling out of the slot, for a sort of toothed connection between the key and its seat is made by the alternate recesses and projections which mesh with each other and thus serve to safely hold the key in position. The fact that the insulating sheets are very thin has a further advantage in that the thin sheets do not even up the slight projections and recesses of the key and its seat, so that the aforementioned effect of the toothed connection will come more fully into action. When stretching the outwardly arched bridges b, such as has been described on the hand of Fig. 8, the flanks a_1 and a_2 make a small rotary motion in the grooves r_1 and r_2. During this motion the insulating sheets i_1 and i_2 may be injured by sharp edges occurring at the flanks of the key. In order to prevent this the profiles of the flanks and seats are rounded off and more particularly at least at those points which will possibly slide upon one another during the operation of spreading the key into its seat. An example of the rounded edges is shown in Fig. 9, the rounded off points being shown at c_1 and c_2.

The rivets for keeping the laminæ of the flanks together are made from a tough material, such as tombac, bronze, German silver or the like. The cross-section of these rivets is preferably of oblong shape, as shown in Figs. 3, 5 and 9. The heads of the rivets are most conveniently formed by simply bending down the projecting ends of the rivet, shown in Fig. 8. The oblong cross-section of the rivet in the first place prevents a rotation of the several laminæ relatively to each other and of the flanks relatively to the bridges in case a form is given to the key according to Figs. 5, 6, 7 and 8. Besides, this oblong cross-section of the rivets offers the advantage that it deducts from the effective cross-section for the passage of the lines of force in the flanks, as compared with rivets of round cross-section having the same mechanical strength. In addition to this the further advantage is secured that the bending strength of the rivet is increased in that direction in which it is strained when the key is spread into its seat.

Having thus described my invention I claim as new and desire to secure by Letters Patent of the United States:—

1. A wedge or key for the slots of dynamo-electric machine elements, consisting of laminated magnetizable flanks, and bridges connecting said flanks, said bridges being of malleable material, whereby said wedge or key may be spread into its seat by deforming said bridges, substantially as described and for the purposes set forth.

2. A wedge or key for the slots of dynamo-electric machine elements, consisting of laminated magnetizable flanks, and bridges of a malleable material interposed between said flanks, said bridges being originally arched in outward direction on the ends of said wedge or key, whereby said bridges may be deformed after insertion of the key to keep the same firmly in the slot.

3. A wedge or key for the slots of dynamo-electric machine elements, consisting of laminated magnetizable flanks, and bridges of malleable material interposed between said flanks, said bridges being originally arched in outward direction relatively to said slots, whereby said key may be spread into its seat by deforming said bridges, and rivets passing through the length of said flanks.

4. A wedge or key for the slots of dynamo-electric machine elements, consisting of laminated magnetizable flanks, and bridges of a malleable material interposed between said flanks, said bridges being originally arched in outward direction relatively to said slots, whereby said key may be spread into its seat by deforming said bridges, and rivets of oblong cross-section passing through the length of said flanks.

5. A slot key, comprising in combination, laminated magnetizable flanks and comparatively narrow deformable bridges connecting said flanks.

6. A slot key, comprising in combination, laminated magnetizable flanks and comparatively narrow deformable curved bridges connecting said flanks.

7. A slot key, comprising in combination, laminated magnetizable flanks and deformable bridges connecting said flanks, said key being originally arched.

8. A slot key, comprising in combination, laminated magnetizable flanks and deformable bridges connecting said flanks, said bridges being shaped so as to spread said flanks apart upon being deformed.

9. A slot key, comprising in combination,

laminated magnetizable flanks, rivets passing through and holding said flanks together, and comparatively narrow curved bridges connecting said flanks, said bridges being shaped so as to spread said flanks apart upon being deformed.

10. A slot key, comprising in combination, laminated magnetizable flanks, rivets of oblong cross-section passing through and holding said flanks together, and comparatively narrow curved portions connecting said flanks, said curved portions being shaped so as to spread said flanks apart upon being deformed.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

MAX JOSEPH ILG.

Witnesses:
GEORG WURZNER,
J. C. MCNALLY.