C. A. PARSONS & A. H. LAW.

DYNAMO ELECTRIC MACHINERY.

APPLICATION FILED JULY 9, 1909.

1,022,255.

Patented Apr. 2, 1912.

4 SHEETS—SHEET 1.

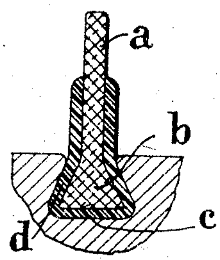

Fig.1.

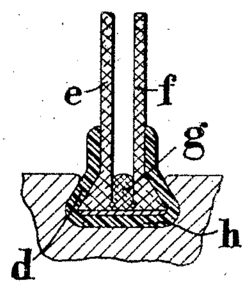

Fig 2.

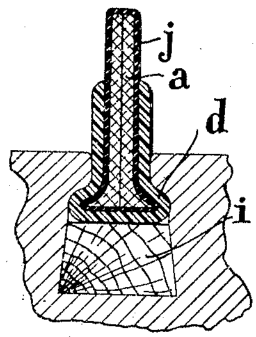

Fig.4.

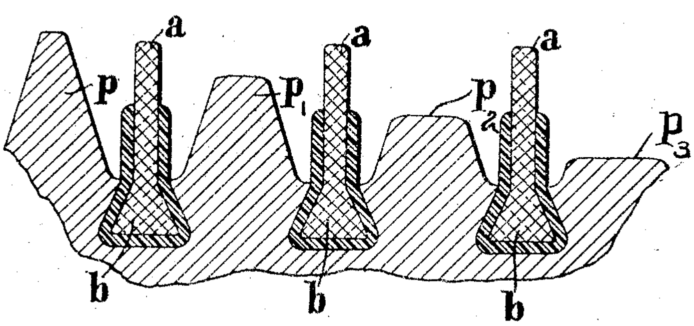

Fig.8

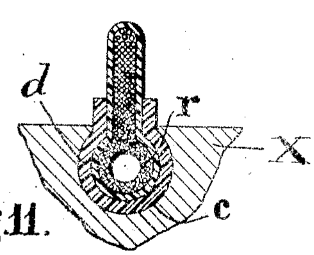

Fig.11.

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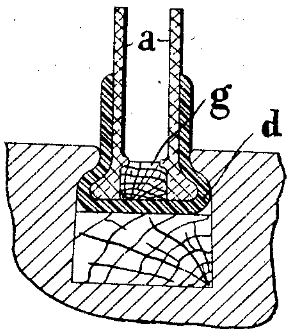

Fig.3

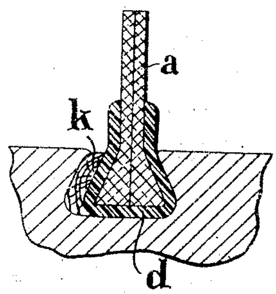

Fig.5

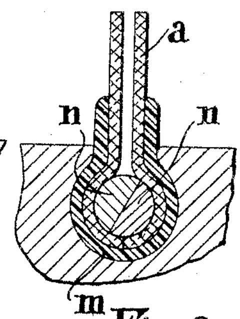

Fig.6

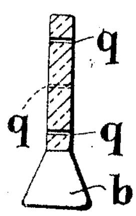

Fig.9

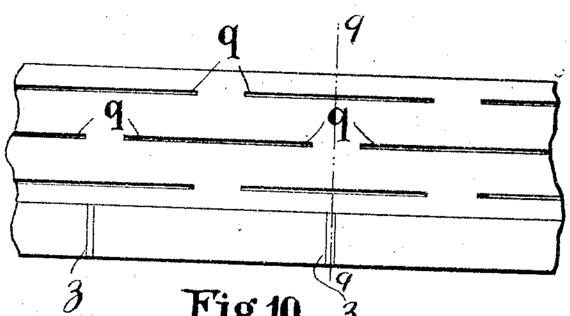

Fig.10

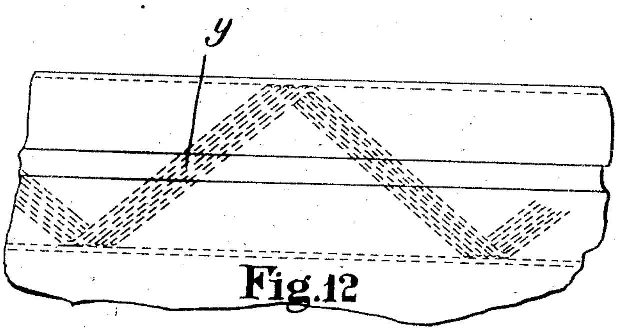

Fig.12

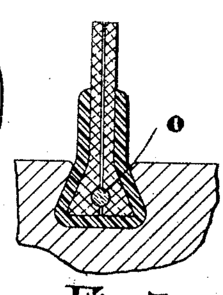

Fig.7

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DYNAMO ELECTRIC MACHINERY.

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4 SHEETS—SHEET 3.

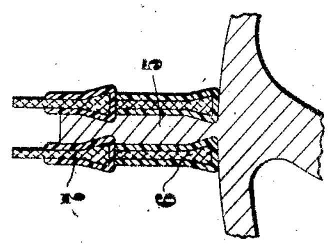

Fig. 15.

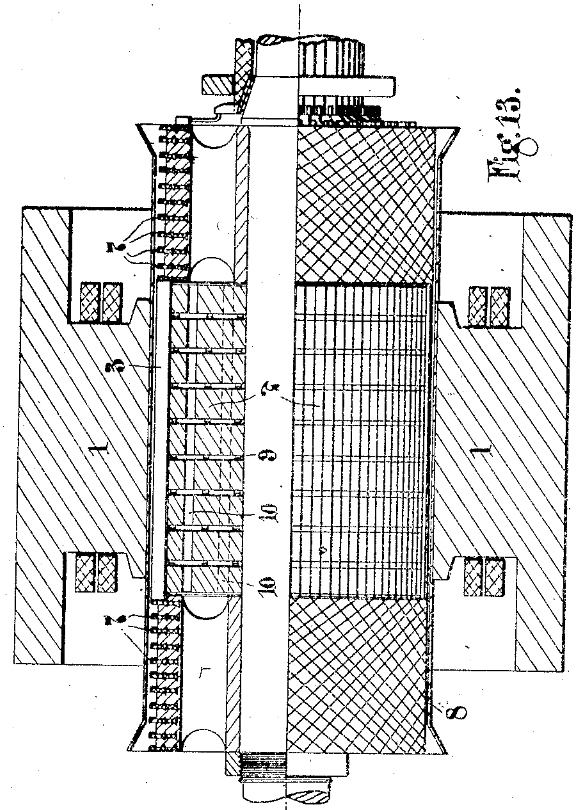

Fig. 13.

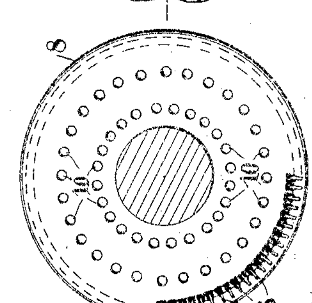

Fig. 14.

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4 SHEETS—SHEET 4.

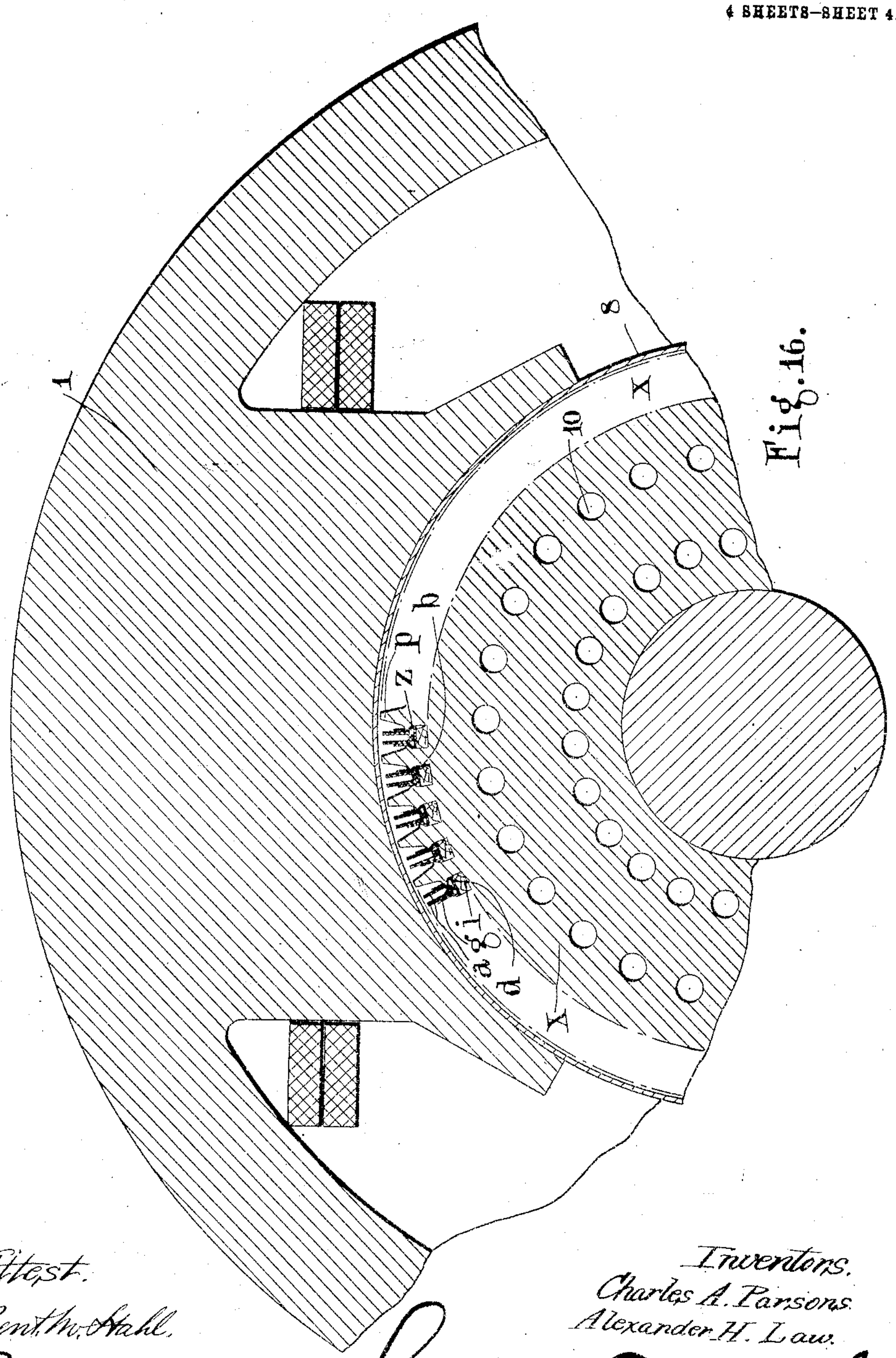

Fig. 16.

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UNITED STATES PATENT OFFICE.

CHARLES ALGERNON PARSONS AND ALEXANDER HENRY LAW, OF NEWCASTLE-UPON-TYNE, ENGLAND; SAID LAW ASSIGNOR TO SAID PARSONS.

DYNAMO-ELECTRIC MACHINERY.

1,022,255. Specification of Letters Patent. Patented Apr. 2, 1912.

Application filed July 9, 1909. Serial No. 506,755.

To all whom it may concern:

Be it known that we, CHARLES ALGERNON PARSONS and ALEXANDER HENRY LAW, subjects of the King of Great Britain and Ireland, residing at Heaton Works, Newcastle-upon-Tyne, in the county of Northumberland, England, have invented certain new and useful Improvements in and Relating to Dynamo-Electric Machinery, of which the following is a specification.

This invention relates to dynamo electric machinery and more especially to the armatures or rotating parts carrying conductors. It is also applicable to stationary parts of alternators or any electrical winding in which it is desirable to reduce the self induction as much as possible and which at the same time has to be secured strongly against mechanical forces.

In the direct current dynamo electric machines whether generators or motors, it is well known that better commutation is obtained with less sparking at the brushes by laying the armature windings on the surface of the core rather than by embedding them in slots. This is especially true in the case of high speed machines adapted to be driven by steam turbines and it has hitherto been the practice in surface wound armatures of this type to hold the windings in position by steel binding wires.

The object of this invention is to obtain an arrangement for holding conductors whereby the constructional advantages of the slot type of winding are combined with the advantages as regards commutation of the surface type.

A further object is to provide means whereby the self induction of embedded or partially embedded conductors may be reduced thus reducing the tendency to spark at the brushes in direct current armatures.

According to this invention the conductors are only partly embedded in the iron so that the self induction of the windings is not appreciably increased while in many of the modifications proposed the conductors are made flat and thin so that the path for the lines of force causing self induction is kept a maximum and eddy currents are kept a minimum.

The invention consists in an arrangement for holding conductors in dynamo electric machinery wherein each conductor is held to the core by locking a portion of the conductor into a suitable groove or slot in the core either with or without additional expanding or holding means for keeping it in the slot.

The invention also consists in the various improved arrangements hereinafter described.

Referring now to the accompanying drawings, Figure 1 shows a plain solid conductor locked without any special means for tightening according to one form of the invention. Figs. 2 to 7 inclusive show modified arrangements and forms of conductor according to this invention. Fig. 8 shows an arrangement of holding conductors applied to an armature in which the iron is carried to a height approximately equal to that of the conductor. Figs. 9 and 10 show in section and side elevation respectively a modified conductor with slots for the purpose of increasing its resistance to eddy currents. Figs. 11 and 12 are similar views of a form of a stranded conductor. Figs. 13, 14 and 15 show a construction according to one form of the present invention. Fig. 16 shows in part sectional side elevation an armature and field magnets and a modified form of conductor.

In carrying the invention into effect in the form shown in Fig. 1, the conductors a are formed of a strip of copper, aluminum or other conducting material drawn or otherwise shaped with an enlarged part b to fit into a suitably shaped slot c in a part x—which in the case of armature conductors would be a core, but in the case of armature end windings might be an end ring—with a dovetail connection, the slot and the part of the conductor therein, having suitable insulation d. With this formation the strip can be slipped into position from one end of the core, and does not need any special tightening or fixing means.

According to a modified form shown in Fig. 2 the conductor may be made in two parts e and f with enlarged sides, each part being capable of radially entering into the core slot, a separating piece or calking strip g, being inserted between them for the purpose of keeping them fast in the slot. The calking strip may be of copper or other metal and may be forced in radially or it may be of insulating material, in which case one can obtain two conductors per slot. In the form shown a metal plate h is used but this is not essential. The calking piece may be soldered, brazed or calked between or to the conductors. The conductors also may have projections formed thereon at their facing sides in order that the calking strip may be driven in longitudinally and held in place by these projections. Further if desired all parts may be tinned before assembly and afterward sweated into a solid mass.

According to a further modification for example as indicated in Figs. 3 and 4 the conductors a may be held in place by means of tapered pieces of wood i or other material driven under them. If desired, these pieces may be of metal and help to carry current, or may themselves be one or more of the conductors. Further if desired insulation j may be wrapped entirely around the conductors of any of the forms as indicated in Fig. 4 in order to prevent short circuiting by dirt or dust.

The wedge indicated in Figs. 3 and 4 may be in two tapered parts driven in from either end. In these forms also the slot is shown slightly tapered so that the conductors can easily be pushed in from the end of the armature, but are tight when driven up to the top of the slot.

In carrying the invention into effect according to the modification shown in Fig. 5, the split conductors a may be inserted radially into a suitable slot d and a wedge piece k or wedge pieces forced in and held in place either by calking or burring the core plates. According to the further modification shown in Fig. 6 circular slots m may be made in the core and suitable wedge pieces n inserted between a shaped conductor a acting to force it toward the sides of the slot. Fig. 7 shows a somewhat similar arrangement in which the wedging action is obtained by forming the conductors with a small semicircular groove through which a wire o which may be of steel or other material, is tightly drawn, thus forcing the conductors apart.

Fig. 8 shows an arrangement of holding the conductors applied to an armature in which the iron p is carried up to a height approximately equal to the conductor a but in which it is kept well away from the conductor so as not appreciably to increase the self induction of the windings. This construction has the advantage that the air gap reluctance in the magnetic circuit is reduced, and therefore, less magnetizing current is required, while at the same time the self induction is not appreciably increased. It will be seen that the arrangement in Fig. 8 differs materially from the ordinary arrangement with a completely sunk conductor, since it is possible to keep the iron well away from the conductors. This has the effect as pointed out of reducing self induction, and at the same time allows of increased ventilation and more efficient cooling of the conductor than can be obtained with a completely embedded conductor. If preferred, the iron core may only be carried a short distance up as shown alternatively by the teeth p_1, p_2 and p_3 in the figure. Of course, teeth of only one height are used in any ordinary case.

By dividing the strips into two or more pieces eddy currents are reduced to a minimum and this loss may be still further reduced by means of longitudinal slits q cut in the projecting portion of the conductor as shown by way of example in Figs. 9 and 10. These slits do not appreciably increase the resistance in a longitudinal direction.

In the modifications described above a small portion of each conductor is embedded in the core. The conductor will therefore have a slightly larger amount of self induction than if placed entirely on the surface. If desired, this extra self induction may be obviated by putting through transversely the embedded parts of the conductors at short intervals along the core as indicated by z in Fig. 10. This will prevent any current flowing in the portion of the conductor which is embedded in the core and the self induction will therefore be due solely to the part of the conductor which is external to the core and which must be made of sufficient cross sectional area to carry the whole of the current. It is found, however, that without these transverse cuts the self induction of the conductor as a whole is increased to only a very small extent provided there is an external portion whose self induction is small and which is either a part of or in electrical connection with the embedded part. Further if it be desired to reduce the eddy currents in the conductors, instead of making the conductors of strips they may be made of a suitably constructed stranded cable, (as shown for example in Figs. 11 and 12) having an enlarged portion r, with an insulating piece d fitting into suitably shaped slots or grooves c, in the core x and tightly locked in any of the methods described above.

Fig. 12 diagrammatically shows for clearness only one stranded cable y passing at regular intervals external to the core. Fig. 11 shows a section through the same except that all the conductors are assumed to be in place. The lay of the cable should be so proportioned that each strand passes into the slot in the core at sufficiently frequent intervals to carry the part external to the core and generally to preserve the stiffness of the cable.

The end windings of armatures may be constructed according to any of these modifications in which case the conductors designated by a, e, or f on the drawings would be the end conductors and the grooves such as c might be formed in end rings; but it is not essential that the end windings should be held in this manner as any other suitable means may be employed.

A general construction according to one form of the present invention is illustrated in Figs. 13 to 15, the latter being of a larger scale than the other two figures. This construction shows magnet poles 1 and an armature 2 into which conductors 3 of the kind referred to above are locked. The drawing also shows a manner in which conductors of this kind can be placed in end rings; the end rings have projections 5 thereon into which the lower row of conductors 6 is locked and above which is placed the upper row of conductors 7. The projections 5 extend upward to embrace the expanded parts at the lower side of the conductors on the top layer. A modified general arrangement is shown in Fig. 16 including the magnets 1 as in Fig. 13 together with a core x with projections as shown in Fig. 8, and conductors a with internal wedges g, as shown in Fig. 3.

In armatures such as those described above it will be seen that the conductors may be worked at very high current densities owing to the great facilities for ventilation and this enables great economies in size to be effected and much larger outputs obtained at any given speed.

Ventilating ducts may be provided at short intervals in the core so that the air entering at one or both ends of the armature can pass radially outward between the conductors and thence out between the magnet poles. It is however preferred to line the face of the magnets with a suitable thin cylinder which will present a smooth surface to the outflowing air and allow this air after leaving the ventilating ducts to pass axially along the armature between the conductors thus minimizing noise and at the same time most effectively cooling the conductors and the core. This cylinder may be perforated at intervals to allow a portion of the air to escape, or the air may be supplied by fans on or external to the armature and may pass from the center outward or from the ends inward. A construction of this kind is also shown in Fig. 13 in which a thin cylinder 8 is provided lining the bore of the magnets 1 and presenting a smooth surface to the outflowing air. Ventilating ducts 9 are formed in the core 2 and these are in communication with passages 10 extending throughout the length of the armature.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

1. In dynamo electrical machinery, a core with a slot therein, the width of the slot at the periphery of the core being less than its width nearer the center a conductor with an enlarged side adapted at least in part to enter the slot; as set forth.

2. In dynamo electric machinery a core with a slot therein the width of the slot at the periphery of the core being less than its width nearer the center a conductor having an enlarged side adapted loosely to enter said slot and insulating means situate between the conductor and the slot wall; as set forth.

3. In dynamo electric machinery a core with a slot therein the width of the slot at the periphery of the core being less than its width nearer the center, a conductor having an enlarged side adapted loosely to enter said slot, and wedging means for the purpose of tightening the conductor in the slot; as set forth.

4. In dynamo electric machinery a core with a slot therein the width of the slot at the periphery of the core being less than its width nearer the center, a conductor having an enlarged side adapted loosely to enter said slot, insulating means between the conductor and the slot wall and wedging means for the purpose of tightening the conductor in the slot; as set forth.

5. In dynamo electric machinery a core, a conductor radially in part embedded in the core with transverse cuts in the embedded part; as set forth.

6. In dynamo electric machinery a core with slots therein together with conductors in said slots said conductors having a part which projects radially beyond the mouth of the slot and a part which is embedded and locked in said core; as set forth.

7. An armature for dynamo electric machinery comprising in combination a slotted magnetic core and conductors in said slots of which conductors a part of each projects radially beyond the mouth of the slot and a part is embedded and locked in said core; as set forth.

8. In dynamo electric machinery a core with slots therein a conductor arranged with respect to the core to have two paths of different self-induction electrically connected in parallel one path formed of a part of the conductor projecting radially beyond the mouth of a slot and the other path formed of the other part of the conductor embedded and locked in the core; as set forth.

9. In dynamo electric machinery a core body having a slot therein conductors arranged radially in part in said slot and in part radially projecting therefrom together with means for separating them and wedging them in the slot; as set forth.

10. In dynamo electric machinery a core a conductor radially in part embedded in the core and in part extending beyond the

same and projections on said core extending to the same height as the conductors so that the external diameter of the core is substantially equal to that of the circle circumscribed about the conductors; as set forth.

11. In dynamo electric machinery a machine element a conductor and a locking part on said conductor said conductor in part projecting radially from said machine element and in part embedded in said element and locked therein by said locking part; as set forth.

12. In dynamo electric machinery a core a conductor in part projecting radially therefrom and in part embedded with means directly locking one side of said conductor and said core; as set forth.

13. In dynamo electric machinery a conductor a solid element adjacent thereto said conductor having a part projecting radially beyond said solid element and a part embedded in said element together with means interlocking said conductor and said element; as set forth.

In testimony whereof, we affix our signatures in presence of two witnesses.

CHARLES ALGERNON PARSONS.
ALEXANDER HENRY LAW.

Witnesses:
FREDERICK GORDON HAY BEDFORD,
ALBERT WILLIAM PARR.