No. 681,295. Patented Aug. 27, 1901.

J. B. BLOOD.

DYNAMO ELECTRIC MACHINE.

(Application filed Mar. 18, 1901.)

(No Model.)

FIG. 1

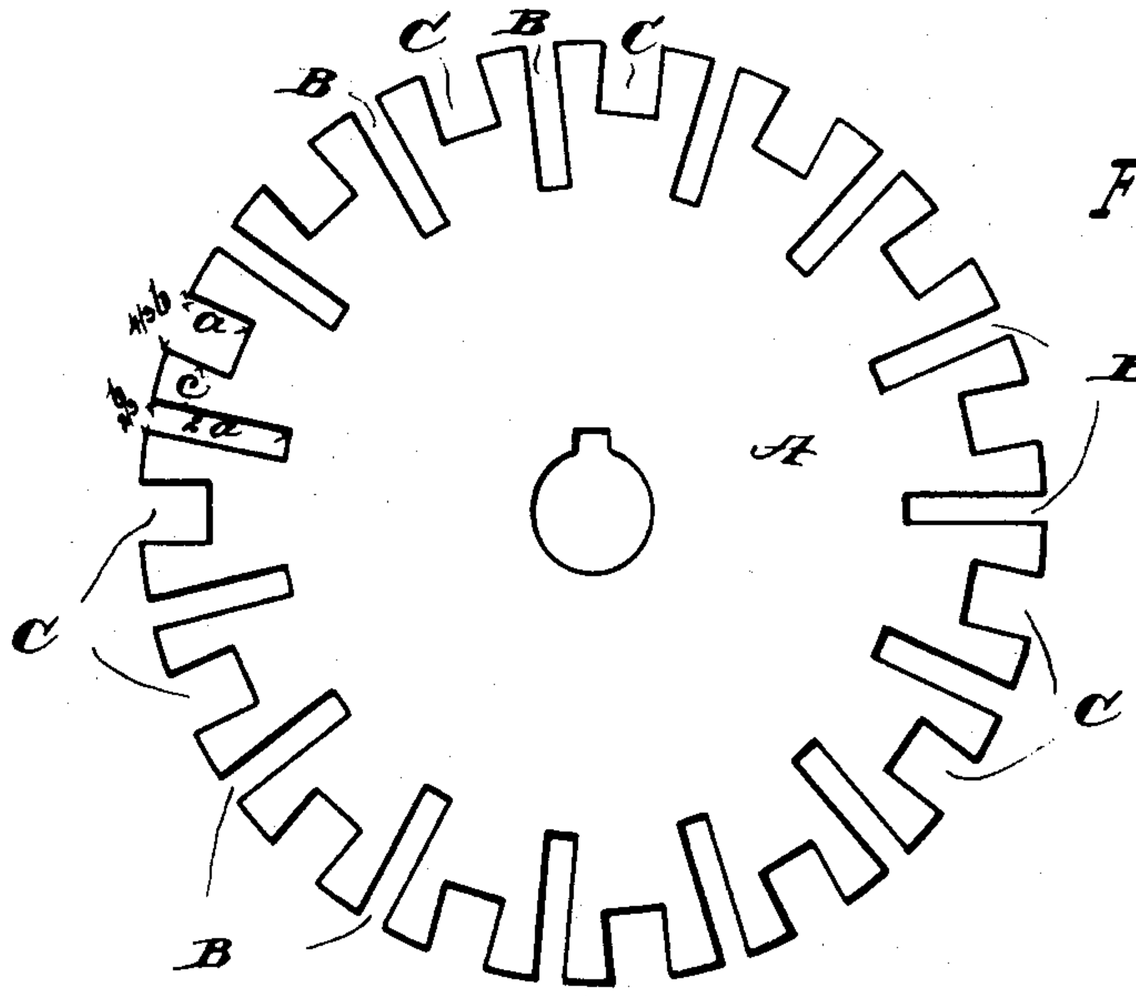


FIG. 2

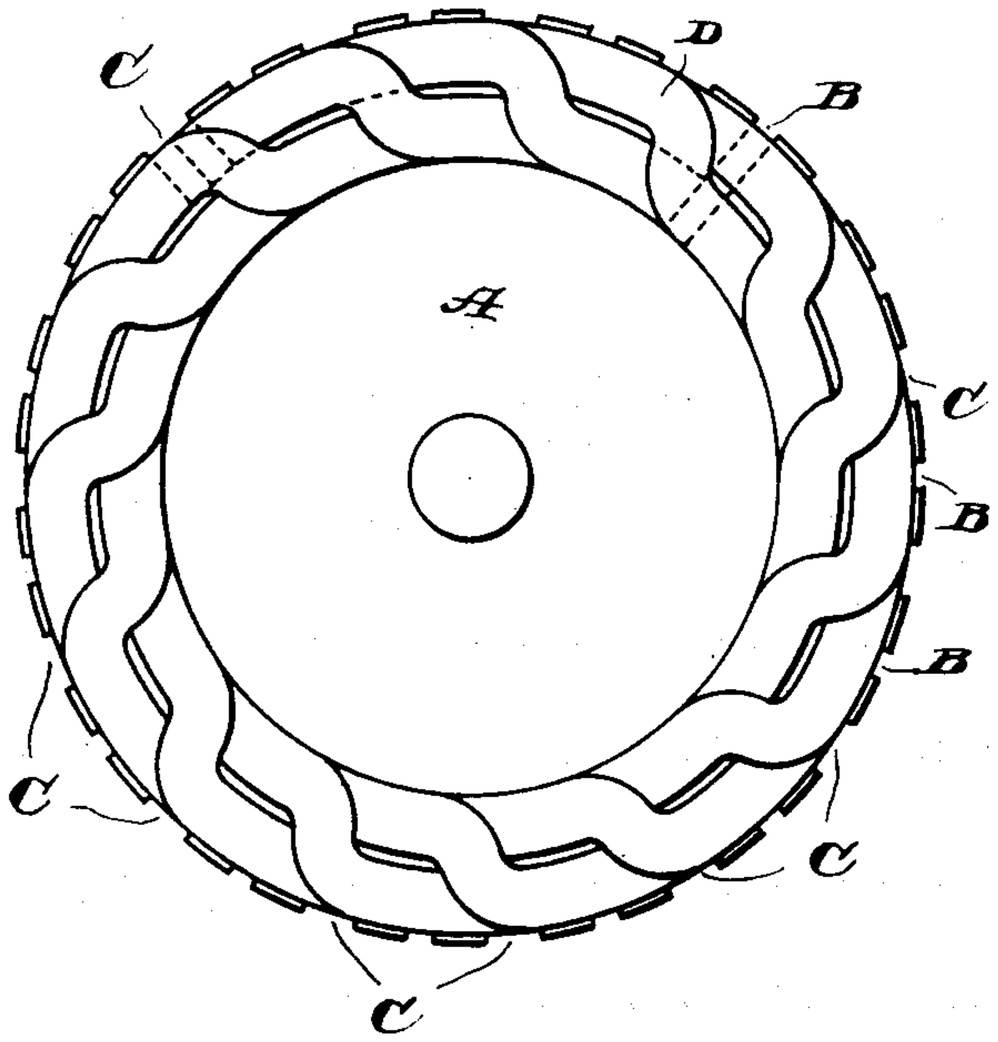
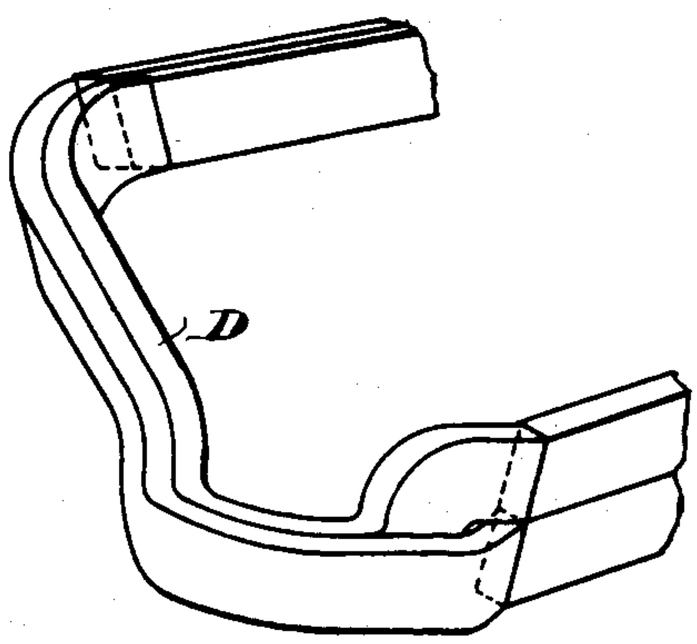


FIG. 3



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UNITED STATES PATENT OFFICE.

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DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 681,295, dated August 27, 1901.

Application filed March 18, 1901. Serial No. 51,577. (No model.)

To all whom it may concern:

Be it known that I, JOHN BALCH BLOOD, a citizen of the United States, residing at Newburyport, in the county of Essex and State of Massachusetts, have invented a new and useful Dynamo-Electric Machine, of which the following is a specification.

This invention relates to dynamo-electric machines.

The object of the invention is to simplify and improve the construction of dynamo-electric machines and to render the same more efficient.

A further object is to provide means whereby the heating effect of the current in the armature-coils is reduced to a minimum.

A further object is to provide means whereby the inductance is reduced to a minimum.

A further object is to provide means whereby the capacity and efficiency of armature-cores are increased.

Other objects will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location, and arrangement, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

In the designing of dynamo-electric machines and in the practical operation thereof it is exceedingly advantageous to reduce to the minimum the effects of heating in the armature-coils, as the energy consumed in the heating of such coils is energy wasted. The general rule is that the heating is inversely proportional to the cross-sectional area of the copper in the inductor wires or limbs, and consequently the greater the cross-sectional area of the inductor sections or wires the less will be the resistance and the less will be the loss or waste of energy consumed in heating up the inductor wires or sections. Therefore it is a matter of material importance in the construction of dynamo-electric machines to provide means whereby the largest possible cross-sectional area of inductor-section may be employed with given conditions of size of armature, magnetic flux, current, &c. Again, it is also exceedingly desirable and advantageous to reduce to a minimum the inductance. The general rule is that, other things being equal, the inductance is inversely proportional to the circumferential distance around or the perimeter of the inductor wires or limbs, and consequently the greater this circumferential distance—that is, the longer the perimeter of the active limb of the inductor-section—the less will be the inductance. Therefore it is important and advantageous that this perimeter or circumferential distance be as great as possible. My invention therefore contemplates increasing the cross-sectional area of the inductor-copper with a given cross-section of field and at the same time increasing the circumferential distance around the active coil-limbs. These results may be accomplished in many different ways. In the accompanying drawings I have shown one construction and the best form in which I contemplate carrying my invention into practical operation.

Figure 1 is an end view of an armature-core constructed in accordance with the principles of my invention. Fig. 2 is a similar view showing the inductor sections or coils applied to the core. Fig. 3 is a detached broken view in perspective of an armature coil or section.

Reference sign A designates the armature-core, and in carrying out my invention I form in the peripheral surface of such core and in the usual or any convenient manner slots or seats B C to receive the inductor sections or coils. Instead, however, of forming these slots or grooves of uniform dimensions throughout each slot or groove B is one-half the width and twice the depth of the slots or grooves C, or, to state it in a different way, each slot or groove C is twice the width and one-half the depth of a groove or slot B. The grooves or slots B C alternate with each other, and the inductor sections or coils are received therein, one leg or limb of each coil or section being received in a slot or groove B and the other leg or limb being received in a slot or groove C, as clearly indicated in Figs. 2 and 3.

In the manner above described I am enabled to increase to a maximum the transverse or cross-sectional area of the inductor sections or coils, thereby reducing the resistance thereof, and consequently the heating effect, to a minimum. I am also enabled to increase to a maximum the circumferential distance around the active limbs of the inductor-sec-

tions, and hence reduce the inductance thereof to a minimum. To more clearly illustrate, suppose the armature-core to be provided with slots or seats of uniform dimensions—that is, with a width b, a depth a, and the distance between adjacent slots at the foot or base of the tooth c. Then the cross-sectional area of two slots will be $a \times b + a \times b$ or 2^{ab} and the iron section of the core at the root of the tooth equal to c. It will also be seen that the perimeter or circumferential distance around a leg or limb of the inductor will be $a + a + b + b$ or $2^a + 2^b$. However, with the improved construction of my invention as above set forth with the same depth a of the wide slot C as before and a width of $4 \diagup 3^b$ the deep slot B will be of a depth equal to 2^a and a width $2 \diagup 3^b$ and the same distance c being maintained through the iron core between adjacent slots at the foot of the tooth and in the line of the bottom of the wide slot. Now with these relative dimensions it will be seen that the cross-sectional area of each slot, which of course determines the cross-sectional area of the limb or leg of the inductor-coil which is received therein, is equal to $4 \diagup 3^{ab}$ and for any two slots will be $8 \diagup 3^{ab}$ or 2.66^{ab}, which is thirty-three per cent. greater than where the slots are of equal dimensions, as above shown, thus gaining in the same percentage in the cross-sectional area of the inductor-sections, and consequently reducing the resistance and the heating of the coils. Moreover, the periphery of the wide slot is $a + a + 4 \diagup 3^b + 4 \diagup 3^b$ or $2^a + 8 \diagup 3^b$, and the periphery of the deep slot is $4^a + 4 \diagup 3^b$, both of which measurements are greater than the corresponding measurements of the ordinary constructions. Consequently by my invention I not only secure a greater cross-sectional area of inductor-section, but I also secure the advantage of greater circumferential distance around the inductor-limbs, and consequently a less inductance.

The coils employed for the windings may be of the detachable counterpart type, as indicated at D in Fig. 3, and I employ one-half as many coils as there are slots, each coil entering a wide shallow slot at one end and a narrow and deep slot at the other end, as clearly indicated in dotted lines in Fig. 2, and in order to accomplish this one limb or leg of the coil is one-half the thickness and double the width of the other limb or leg. It will be understood that each coil or winding is a single unit, although for the sake of illustration of the principle involved the coil is shown in Fig. 3 as though it were made double or of separate parts.

It will be understood that my invention is capable of being carried into practice with any desired construction of armature-core, whether solid or laminated or otherwise and whether the armature is fixed or rotatable.

From the foregoing description it will be readily seen that with a given magnetic flux and a given inductance the heating effect would be greatly decreased, or with a given inductance and heating a much larger magnetic flux is gained, or with a given flux and heating effect a much less inductance is secured, and hence a much larger current can be used, thereby increasing the capacity or output of the machine. Thus advantage may be secured in employing a machine of less weight for a given work to be accomplished or a greater output or capacity is secured with the same size or weight and less heating or less speed and greater power is developed.

My invention may be carried out in machines designed for any particular use. Thus in the case of motors for automobiles using storage batteries for source of current difficulty has heretofore been experienced on account of the high resistance of the motor, which prevents the flow of sufficient current at the start to give the requisite torque or turning movement. Moreover, energy is consumed to no useful purpose in merely heating the wires, which loss of energy results in diminishing the store of the batteries without performing useful work. By my invention these objections are very greatly avoided and a greater mileage is secured by the same battery capacity. In the case of motors employed for elevated, suburban, or street railways, where a large acceleration at the start is desired and where there are frequent stopping and starting, the desired acceleration is greatly retarded by reason of the initial current being used up in heating the coils, and also because of the burning or destruction of the armature when current sufficient to give the desired acceleration is initially turned on. By my invention the resistance is lessened, and hence with a given degree of heat development greater acceleration is secured and the danger of burning or destroying the armature is avoided. Again, in the case of very small motors the space for the insulation on the inductor-coils is limited. By my invention greater room for the same size of motor is secured, thereby permitting of the use of proper size of wires, and hence increasing the capacity of the motor.

Other instances of the utility of my invention might be cited, but it is believed that the foregoing is sufficient to emphasize its practical value and importance, and I do not desire to be limited or restricted in respect of the use to which my invention may be put nor to the exact details of construction and arrangement shown and described, as variations therefrom and changes in the details thereof would occur to persons skilled in the art and still fall within the spirit and scope of my invention; but,

Having now set forth the object and nature of my invention and a construction embodying the principles thereof and having explained the same, its purpose, function, and mode of operation, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. An armature-core having slots to receive the inductor-sections, the slots which receive the same inductor-section varying in dimensions from each other, as and for the purpose set forth.

2. An armature-core having slots to receive the inductor-sections, adjacent slots varying in dimensions from each other, a slot of one dimension adapted to receive one limb of an inductor-section and a slot of another dimension adapted to receive the limb of the same inductor-section, as and for the purpose set forth.

3. An armature-core having slots to receive the inductor-sections, the slots which receive the same inductor-section being of the same transverse area but of differing linear dimensions, as and for the purpose set forth.

4. An armature-core having slots to receive the inductor-sections, adjacent slots being of the same area but of differing linear dimensions, as and for the purpose set forth.

5. The combination with an armature-core having slots to receive the inductor-sections, alternate slots being of the same linear dimensions and the dimensions of the intermediate slots differing therefrom, of inductor-sections, one limb of each section being arranged in a slot of one dimension and the other limb thereof arranged to be received in a slot of a differing dimension, as and for the purpose set forth.

6. An armature-core having slots arranged in pairs, each pair of slots receiving respectively the two limbs of the same inductor-section, the slots of each pair differing from each other in linear dimensions but of the same transverse area, as and for the purpose set forth.

7. An armature-core having slots to receive the inductor-sections, each alternate slot being half the depth and double the width of the next adjacent slots, as and for the purpose set forth.

8. The combination with an armature-core having slots, each alternate slot being half the depth and double the width of the next adjacent slot, of a coil or inductor section having one of the limbs thereof received in a slot of one dimension and the other received in a slot of a different dimension, as and for the purpose set forth.

9. An armature-core having slots, each alternate slot being half the depth and double the width of the next adjacent slot, in combination with a coil or inductor section having the active limbs thereof of dimensions corresponding to adjacent slots of the core, as and for the purpose set forth.

10. An armature-coil or inductor-section having one of the limbs thereof one-half the thickness and double the width of the other limb, as and for the purpose set forth.

11. An armature coil or winding having its active limbs of the same cross-sectional area but of different linear dimensions, as and for the purpose set forth.

12. An armature coil or winding having its active limbs of differing dimensions, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 4th day of March, 1901, in the presence of the subscribing witnesses.

JOHN BALCH BLOOD.

Witnesses:
JOSHUA HALE,
LOUIS L. DODGE.