

R. E. HELLMUND.
INDUCTION MOTOR.
APPLICATION FILED DEC. 4, 1907.

931,302.

Patented Aug. 17, 1909.

3 SHEETS—SHEET 1.

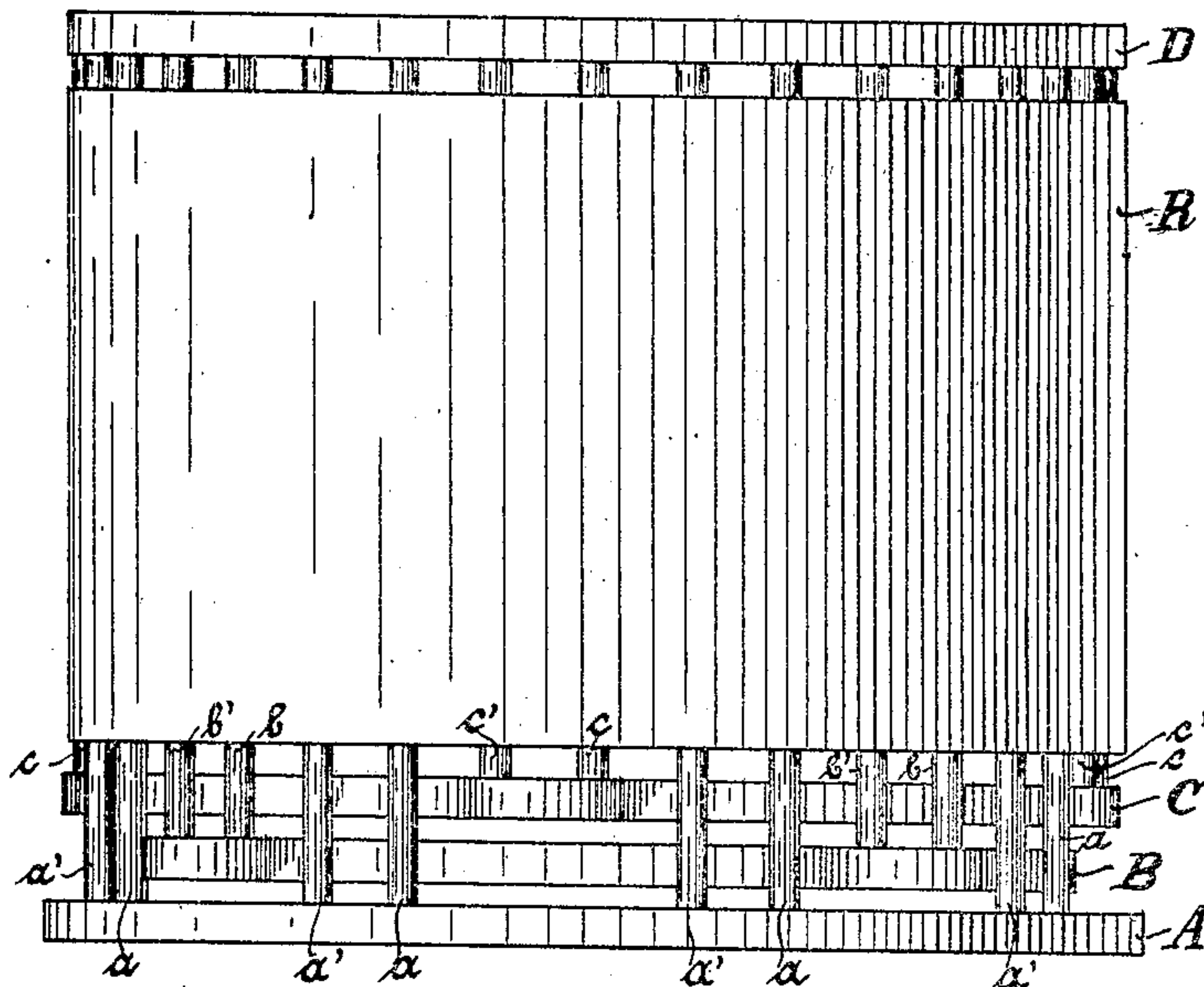


Fig. 1.

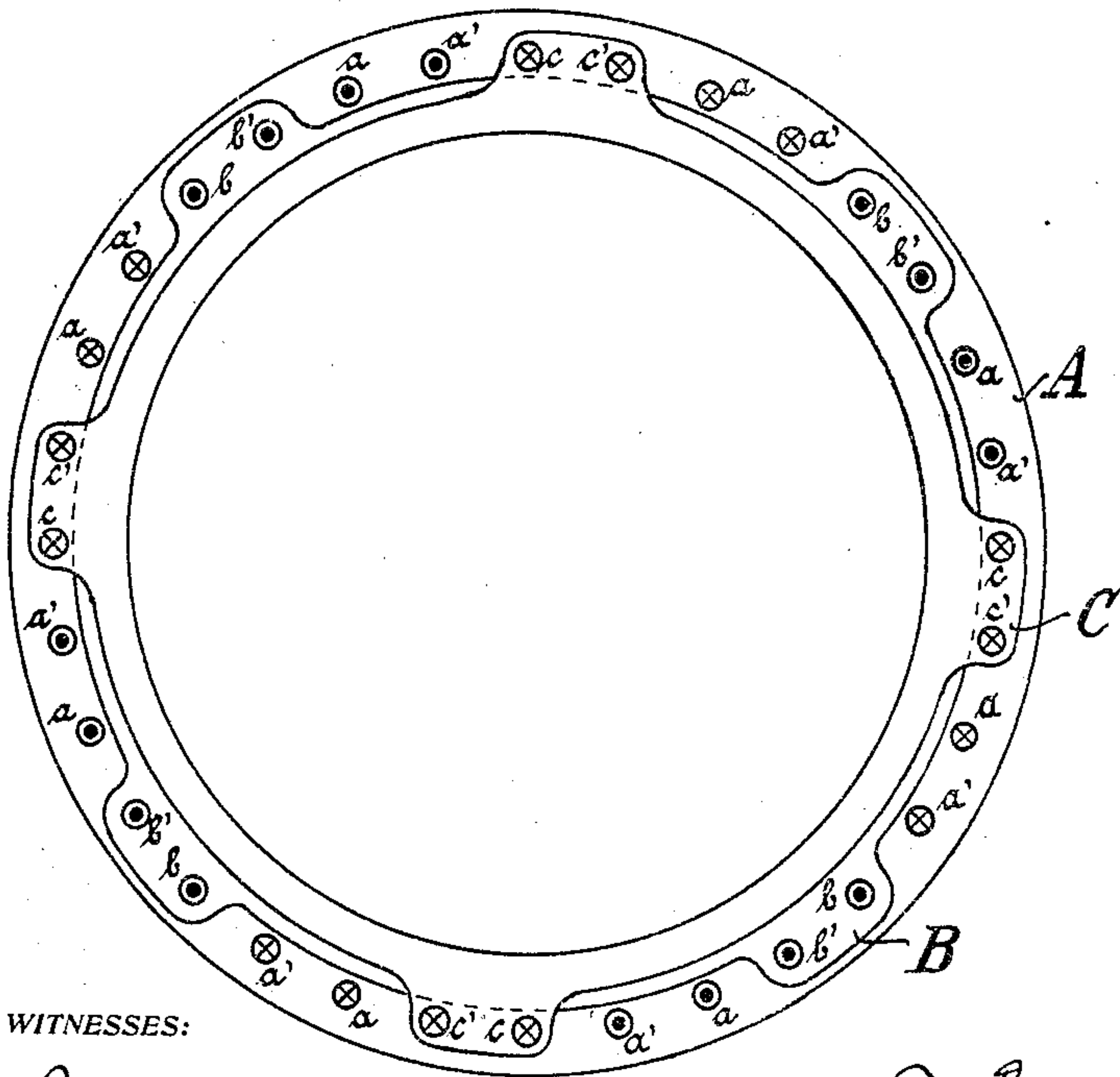


Fig. 2.

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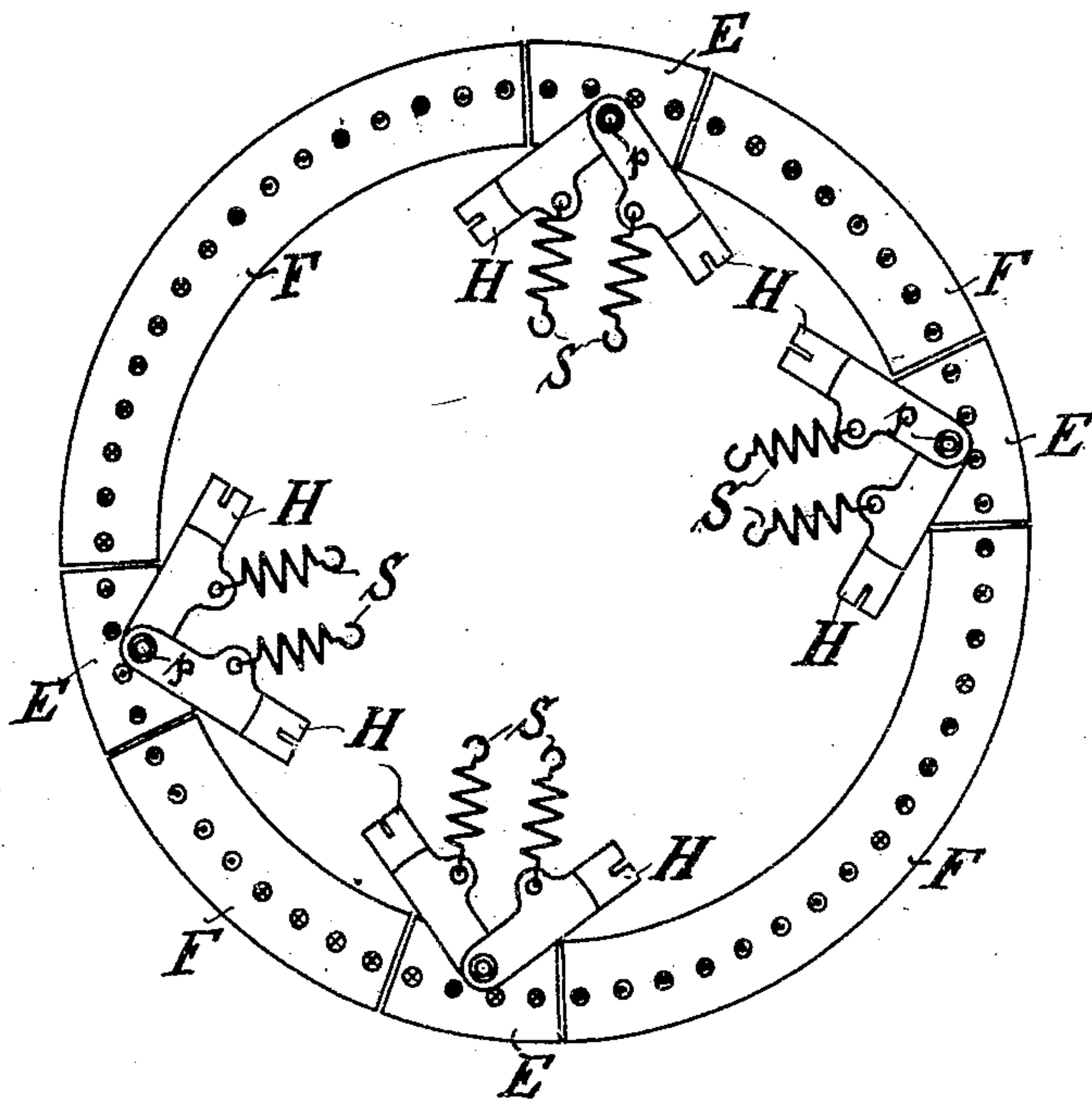


Fig. 3.

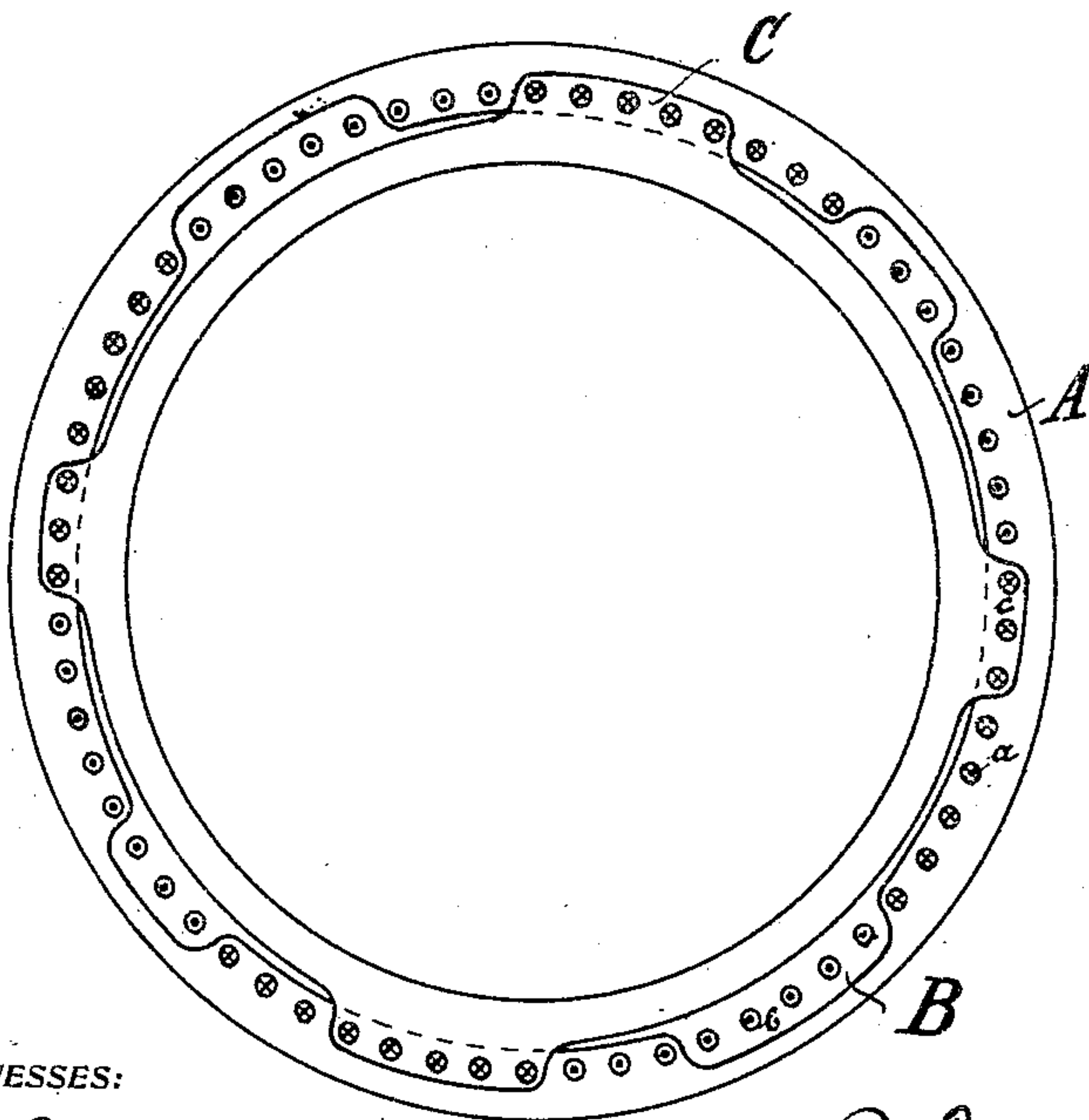


Fig. 4.

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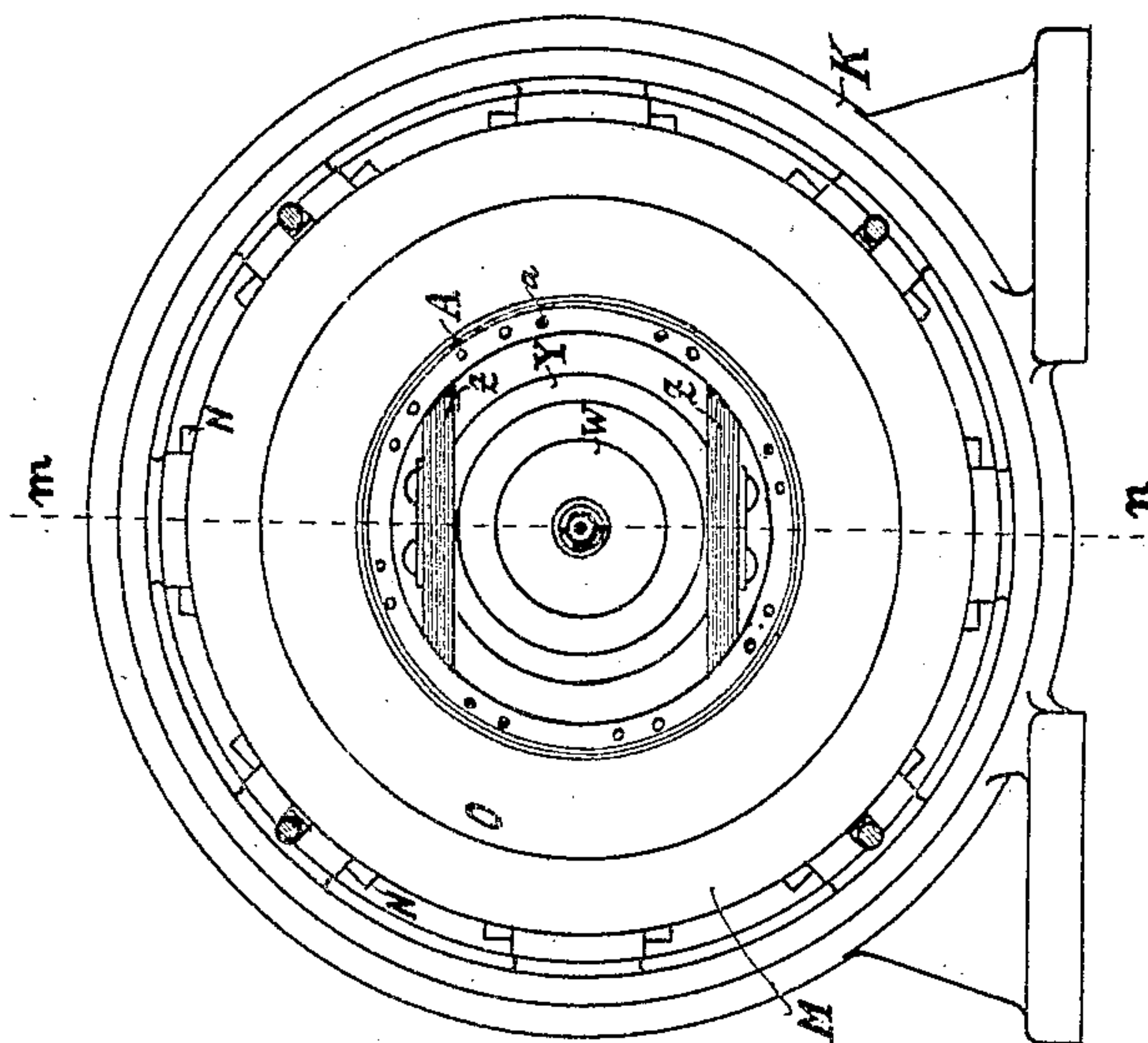


Fig. 5.

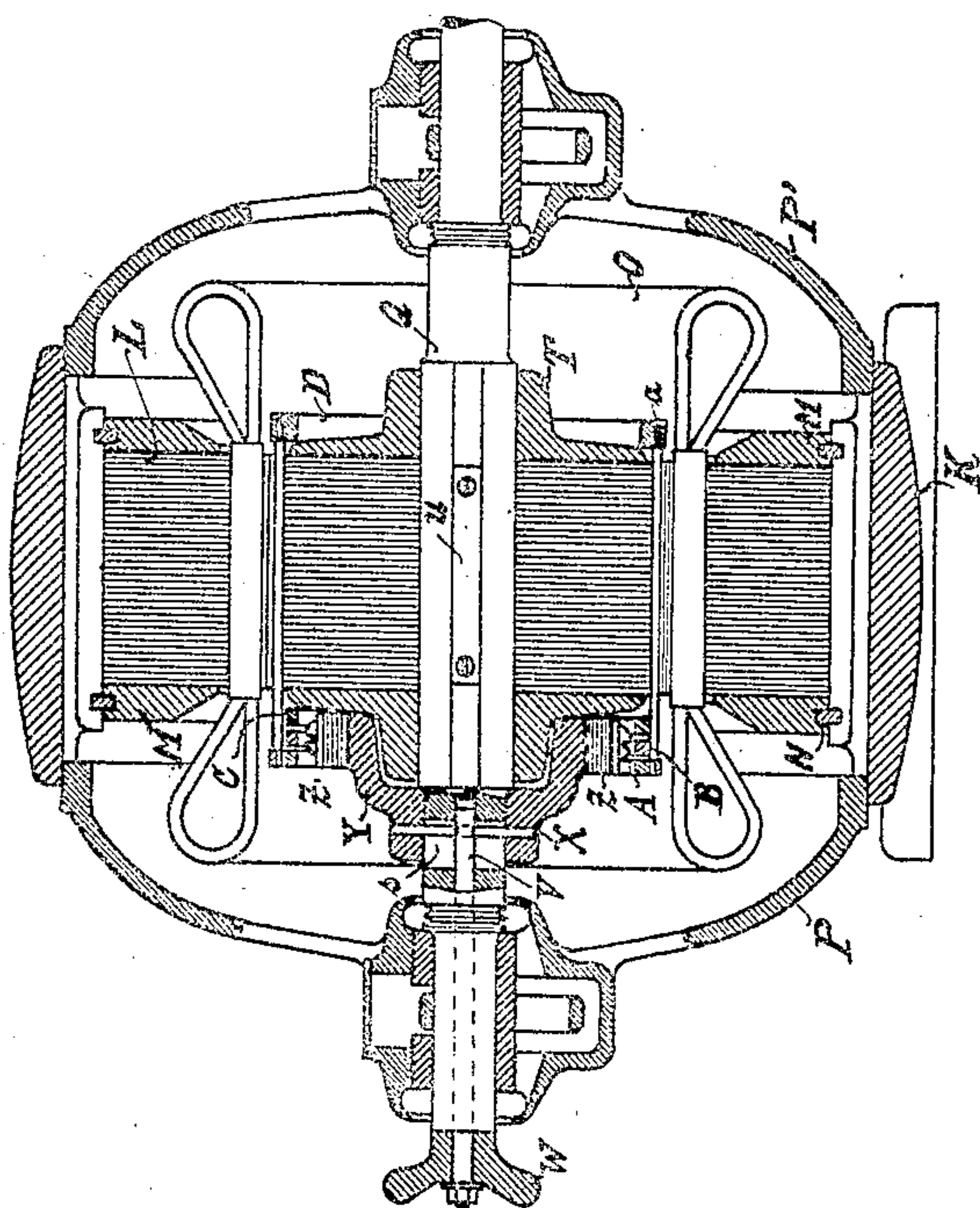


Fig. 6.

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UNITED STATES PATENT OFFICE.

RUDOLF E. HELLMUND, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO HELLMUND
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INDUCTION-MOTOR.

No. 931,302.

Specification of Letters Patent.

Patented Aug. 17, 1909.

Application filed December 4, 1907. Serial No. 405,080.

To all whom it may concern:

Be it known that I, RUDOLF E. HELLMUND, residing at Pittsburg, in the county of Allegheny, and in the State of Pennsylvania, have invented certain new and useful Improvements in Induction Motors, of which the following is a full, clear, and exact description.

My invention relates to induction motors, and more particularly to that kind of induction motors, which are known under the name of squirrel cage induction motors.

The object of my invention is to insure a good starting torque with such motors without drawing an excessive current from the line; and another object of my invention is, to obtain this result with a few and simple parts.

The squirrel cage induction motor being an ideal motor in almost every respect, has the disadvantage of drawing an exceedingly large starting current from the line. Various kinds of special constructions have been heretofore devised to improve the starting condition, all of which have however the disadvantage, that they require a very large number of contact making and breaking parts in the rotor, therefore they are expensive and unreliable in service.

It is a well known fact, that the current in the bars of an induction motor secondary increases approximately in inverse proportion to any decrease of the number of bars in the secondary. From this fact it may be easily concluded that the secondary losses will increase, if the active number of secondary bars is decreased, while the resistance of each bar is kept the same. It is also well known, that increased secondary losses will give increased starting torque and decreased starting current. It will follow therefore, that any reduction of the number of active secondary bars will tend to increase the starting torque and to decrease the starting current. It is also known that, if with the number of active bars the number of active slots will be reduced, the leakage of the motor will be increased; this will also tend to decrease the starting current.

In order to reduce the number of active bars while starting, I arrange the conductors in groups so as to have in some of the groups only conductors, which are shifted about twice the pole pitch against each other. The current flowing in such a group will be

practically zero, while the group is disconnected from the other groups, because the potential induced in all the conductors of the group will be of the same phase and amplitude; that means, that all conductors of such a group are made inactive, while the group is disconnected from the other groups. By disconnecting several of such groups from the remaining conductors the starting condition of the motor may be considerably improved; while the number of contact devices required for accomplishing this result is very small. In order to obtain good results in practice it is not necessary, that all conductors, which belong to one of the disconnected groups are such that the potentials induced therein are exactly of the same phase. The action of the bar will always be reduced, if the potential induced in the conductors in one group are shifted against each other in phase by any angle being smaller or larger than 180 electrical degrees; but the reduction of the action of the bars will be the larger the closer the phase difference of the potentials induced in bars of the same group is to zero or to 360 or a multiple of 360 electrical degrees. The previous considerations will be more readily understood upon inspection of the drawings.

Figure 1 shows a side view of a squirrel cage rotor of my improved type to be used in connection with an eight pole motor. Fig. 2 shows the three rings A, B and C and the bars of the same rotor. Figs. 3 and 4 are modifications of my improved squirrel cage rotor. Fig. 5 is a front view of an induction motor, to which my improved rotor construction is applied, the front bearing of the motor being removed; and Fig. 6 is a section through the same motor along the line *m n*.

Referring first to Fig. 1 in particular, R represents the laminated iron core of the rotor. Embedded in the same in the customary way are conductors *a a' b b' c c'*, which are at one end of the rotor connected to a ring D of conducting material. In Fig. 2 the bars are represented by the small circles *a a' b b' c c'*. The crosses and points inside of the small circles indicate in the conventional manner the direction of the potentials being induced in the rotor bars at a certain point of time based on the assumption of an eight pole primary. It is obvious, that in all the conductors *c* a potential of equal di-

rection and the same phase and amplitude will be induced, since they are 360 electrical degrees shifted against each other. The potentials induced in the conductors c' have also the same direction and amplitude and differ in phase only slightly from those induced in the conductors c . If therefore the conductors c and c' are connected to a common ring C, the current flowing in these bars will be very small and the bars will be practically inactive. The same is true in regard to the conductors b and b' , which are connected to the ring B, because all the conductors b are again shifted 360 electrical degrees against each other, because all the conductors b' are also shifted 360 electrical degrees against each other and because the shift between any of the adjacent conductors c and c' is very small. Conditions are essentially different however for the conductors connected to the ring A. This group of conductors contains conductors, which are approximately 180 electrical degrees apart from other conductors forming part of the same group. Therefore the potentials induced in the conductors a and a' are different in direction and the currents flowing in these bars will be similar to those flowing in any squirrel cage rotor. The ohmic losses in these bars and therefore the starting torque of the motor will be larger however than it would be, if all the bars c c' b and b' would be active; moreover the starting current in the primary will be reduced.

Fig. 4 shows the bars and rings of another eight pole rotor being different from the rotor in Figs. 1 and 2 only in so far as more bars are applied and some irregularity in the grouping of the bars is devised in order to avoid dead points for starting.

Fig. 3 shows a modification of my invention. The rotor has only one end ring on each side; one of the end rings is divided into sections in such a manner, that there are sections E E, designed to connect only conductors, in which potentials of a small phase difference are induced and which consequently are only little active. Contact brushes H H are mounted to pivots p p and kept in a position as shown in Fig. 3 by springs S S, while the motor is in stationary condition. After the motor has come up to speed the centrifugal force of the contact brushes will overcome the tension of the springs and the brushes will move outwardly thereby establishing electrical connections between the ring segments E E and F F, whereafter the rotor will operate like any regular rotor.

Referring now to Figs. 5 and 6, the latter

represent a motor provided with a rotor similar to the one shown in Figs. 1 and 2. K is a cast iron frame, in which the stator laminations are held in a well known manner by end plates M M and keys N N. Coils O O are placed into the slots of the stator core L. Two bearing brackets P P support a shaft Q. Mounted to the shaft Q is the rotor iron core R; the same is held by two end plates T T and a key U. Embedded in the rotor body are the conductors a' a' etc. and at the ends of the bars the rings A, B, C and D are arranged as described before. Contact brushes Z Z are mounted to a casting Y, which is arranged to be shifted along the portion of the shaft between the rotor R and the bearings P P. The shifting is accomplished by a pin X, which is fastened to a rod V. The latter extends through a hole in the shaft to the outside of the motor, where a circular handle W is fastened to the rod V. A small slot s is provided in the shaft to allow the movement of the pin X. In Fig. 6 the contact brushes Z Z are shown in a position, in which they connect the three rings A, B and C, that is the figure shows the motor in the running condition. By pulling at the handle W the brushes Z Z and their support Y may be moved toward the bearing and may be thereby brought into a position, in which they do not establish a connection between the rings. The contact will be moved to this position, while the motor is started or desired to run at a reduced speed. An intermediate speed may be obtained by placing the contact so as to connect two of three rings only.

It is evident to any one skilled in the art, that my invention may be reduced to practice by a great number of modifications different from those described above and I do not want to limit myself to the latter.

I claim as my invention:

In the squirrel cage winding of an alternating current motor conductor and members, each of which connects a number of said conductors in multiple, and at least one of said members being arranged so as to connect only conductors, which are apart from each other by a distance, which is different from the pole pitch, and means designed to establish and interrupt electrical connections between said members.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

RUDOLF E. HELLMUND.

Witnesses:

A. W. BURNS.

W. F. SANVILLE.