PATENT SPECIFICATION

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Complete Specification Accepted: July 22, 1946.

COMPLETE SPECIFICATION

Improvements in or relating to the Cooling of Eddy-Current Apparatus

I, MARTIN PHILLIP WINTHER, of 335, Glendenning Place, Waukegan, State of Illinois, United States of America, a citizen of the United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in or relating to the cooling of eddy current apparatus of the type in which a coil or coils carried by an armature generate a flux interlinking the armature and an inductor drum thereby generating heat in the drum.

According to the invention the drum is formed with circumferential grooves separated by circumferential fins and with one or more stationary combs mounted adjacent to the periphery of the drum with the teeth thereof extending into the grooves of the drum the teeth and spacing of the comb or combs being complementary to the grooves and fins on the drum.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a vertical section showing one form of the invention;

Fig. 2 is a vertical section taken on line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail of a portion of Fig. 1;

Fig. 4 is a view similar to Fig. 3, but showing a modification;

Fig. 5 is a view similar to Fig. 1, showing still another modification;

Fig. 6 is a detailed view of a portion of Fig. 5; and,

Fig. 7 is an enlarged detail of certain circumferential grooves and teeth and a co-operating comb.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

In many smaller eddy current machines, air-cooling is feasible, and it is to these machines that the invention is directed.

Referring now more particularly to Fig. 1, there is shown at numeral 1 a driving motor having a shaft 3 to which is keyed a spider 5 which supports a hollow inductive rotor drum 7. At numeral 9 is the driven shaft which carries an armature 11 having radial teeth 13 and nested peripheral electric coils 15. The shaft 3 is piloted with respect to the armature 11 by means of a pilot bearing 17.

The coils 15 are electrically energised from suitable slip rings 19, to provide toric flux fields which are concentrated by the teeth 13 and interlink the armature 11 and the drum 7. Thereby eddy currents are engendered in the inductor drum 7 and the magnetic reaction provides a slip coupling between the drum 7 and armature 11. The rotary slippage is controlled by the degree of energisation of said coils 15.

The eddy currents in the inductor drum 7 produce heat which needs to be carried away. Heretofore various forms of fins on the outside of the drums 7 have been proposed. In general, I have found that axial fins are more costly to produce than circumferential fins, because of the milling operations required, but they have more capacity than circumferential fins. In addition the axial fins are noisy and special precautions need to be taken for introducing air into them if windage noises are to be satisfactorily reduced. Even then, they are not as quiet as the means of the present invention.

Circumferential fins are cheaper to produce than axial fins since they may be made simply by a turning operation on a lathe, or the like, but such fins ordinarily do not move enough air to cause efficient cooling. The air forms a stagnant film between such fins. By means of the present invention, such circumferential fins are caused to move the requisite amount of air.

The invention consists in producing on the outside surface of the inductor drum 7 a plurality of adjacently located deep **V**-shaped grooves which produce intermediate peripheral **V**-shaped fins 21. In the simplest form of the invention shown

in Figs. 1—3, these fins are all of the same depth. Preferably, the surfaces of the fins are rough, or wavy in section, as indicated in Fig. 7. This effect may be produced during the machining operation. Thus the surfaces of the teeth tend frictionally to drag air around with them in the grooves between the teeth.

Then, in order to force the air to leave the spaces between the annular fins or ribs or teeth, I provide radially located combs 25, mounted on a support 23. As indicated in Fig. 2, these combs are plate-like, being made for example of sheet iron, and are axially positioned at angular intervals. These combs have shapes complementary to the fins 21 and fit down into the grooves between fins fairly closely, as indicated in Fig. 7. I have found that a radical arrangement of the comb plates is best, because it permits of operating the machine in either direction and produces the best circulation of air, as indicated by the arrows in Fig. 2. The scooping action effected by non-radial combs is offset by dead-air pockets behind them. With radial combs, I have been able to project air radially out to a distance of 8 to 10 feet under normal operations of these machines. This prevents the hot air from being immediately drawn back into the grooves on the other sides of the combs and therefore effects very efficient cooling.

By the use of **V**-shaped annular fins and complementary combs, noise is substantially reduced, because the cool air flows in smoothly and uniformly behind each comb. It streamlines into the grooves between fins and hot air is swept out vigorously at the impact side of the combs. Here it is vigorously directed outwardly. There is no whipping or fanning action of the air by any multiplicity of axial blades, as in some former constructions.

It is usually advantageous to use more than two combs, although even one comb would be sufficient for conditions of moderate heat dissipation. In the latter case, the cool air enters behind the comb and warm air is deflected off on the other side of the comb after a full circuit of the drum. In the case of a multiplicity of combs, cool air enters behind each comb and is deflected at the next comb, the action being repetitious within one revolution.

A number of combs is very desirable where larger amounts of energy are to be dissipated. The distance between the combs is adjusted so as to insure easy entrance of air, pick-up of the air, and deflection of it when it has obtained a temperature of the order of 100—180° F.

In Fig. 4, like numerals designate like parts. In this embodiment, the depth of the grooves, and consequently the height of the fins 21, is not uniform. As is known, the production of heat in an eddy-current drum takes place where the eddy currents occur which is where the flux is concentrated. Therefore, it is desirable that the heat-dissipating fins 21 be directed down to the region where the eddy currents occur; but no further, so as not to remove iron needed for flux passage. If this flux-containing region is not flat, but has some curvature, then the grooves and fins are brought about down to that curvature, as indicated in Fig. 4, for example, where the coil 15 produces the magnetic field indicated by the dotted lines.

Figs. 5 and 6 show a multi-coil machine in which the polarities of the coils are of the character to produce the magnetic fields indicated in the dotted lines. Such fields provide heating regions in the inductor which are of similar shape. Thus it is desirable that the depths of the grooves vary up and down along the length of the drum as indicated, to follow this shape more or less.

In the machine shown in figs. 5 and 6, like numerals designate like parts, but in this case, since the inductor drum 7 requires an additional head 29, an additional pilot bearing 31 is used.

As indicated, in this case the depths of the various grooves are grouped so as to provide for example, starting from the left in Fig. 6, first three deep fins 33, then three medium depth fins 35, and then four short fins 37; then again three medium depth fins 35; and finally two deep fins 33. The series is then repeated for each coil 15. The purpose of having several fins of the same depth is to provide for simplifying cutting of the grooves. This causes the successive groups of fins to reach down to the eddy-current region which is satisfactory enough for all practical purposes.

The combs which are renumbered as 39 in Figs. 5 and 6 have teeth of complementary shape. The functions are analogous to those already described.

From the above, it will be seen that, by means of the **V**-shaped fins which are rather simple to produce, there is obtained an air cooling means which is quiet, since the air streamlines down into the **V**-shaped grooves over the more or less pointed teeth, and then streamlines out again very quietly, but vigorously. The temperature may be controlled in accordance with the various capacities which may be expected of various machines by altering the spacing and number of combs.

It is desirable that the teeth of the combs fit the fins on the rotor as closely as is mechanically feasible without friction.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:—

1. Apparatus of the type referred to in which the drum is formed with circumferential grooves separated by circumferential fins and with one or more stationary combs mounted adjacent to the periphery of the drum with the teeth thereof extending into the grooves of the drum the teeth and spacing of the comb or combs being complementary to the grooves and fins on the drum.

2. Apparatus of the type referred to as in claim 1, wherein the grooves in the periphery of the drum are of **V**-shape with intermediate **V**-shaped fins between them.

3. Apparatus of the type referred to as in claim 1 or claim 2, wherein the circumferential grooves and fins on the drum are of different depth, the spaced teeth of the comb or combs being formed to correspond therewith.

4. Apparatus of the type referred to as in claim 1 or claim 2 wherein the circumferential grooves and fins on the rotary member are of different depth by groups, the depth of all grooves in a group being substantially equal, the spaced teeth of the comb or combs being formed to correspond therewith.

5. Apparatus of the type referred to as in any of claims 2, 3 and 4, wherein the widest portions of the circumferential **V**-shaped grooves on the drum are directed outwards.

6. Apparatus of the type referred to as in any of the preceding claims having a plurality of axially positioned combs angularly spaced about the periphery of the drum.

7. Eddy current apparatus as in claims 5 and 6, wherein the surfaces of the fins forming the grooves in the drum are rough or wavy in section.

8. Eddy current apparatus constructed substantially as described with reference to and as illustrated in Figs. 1, 2 and 3, Fig. 4 or Figs. 5 and 6 of the accompanying drawings.

Dated this 25th day of September, 1942.

J. OWDEN O'BRIEN & SON,
Patent Agents, Manchester, 2.

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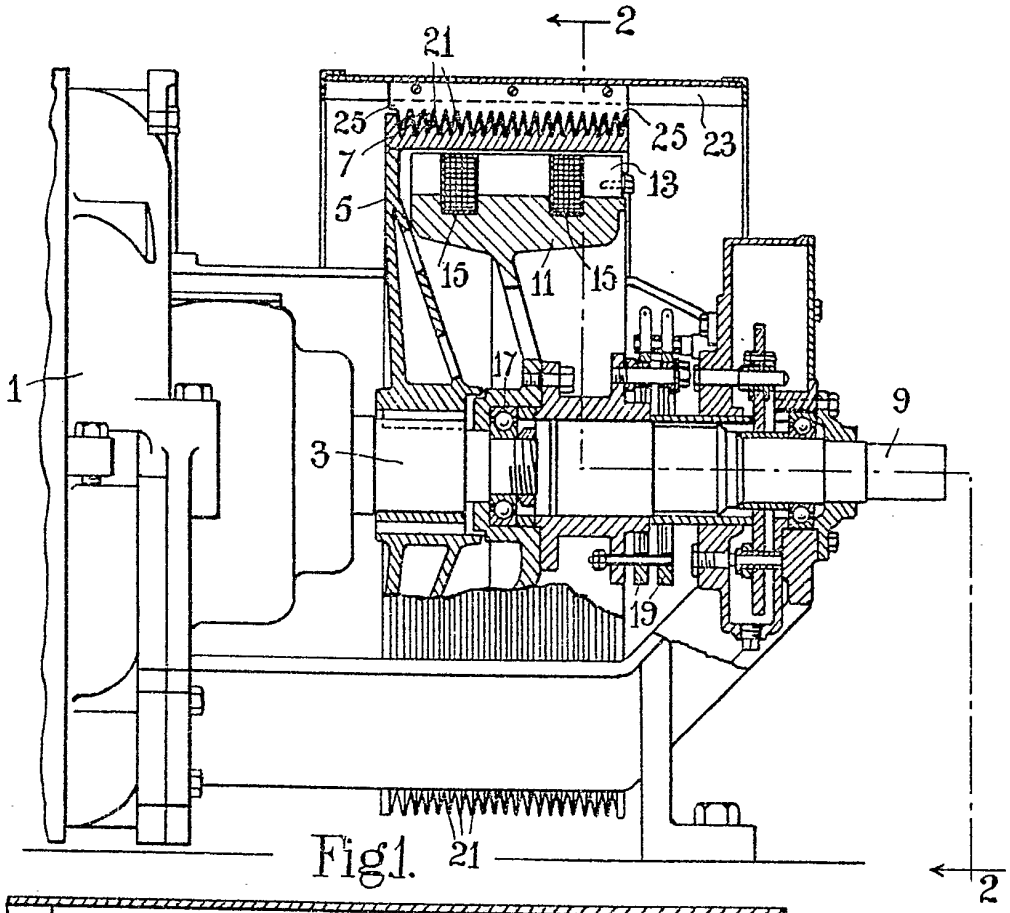

Fig.1.

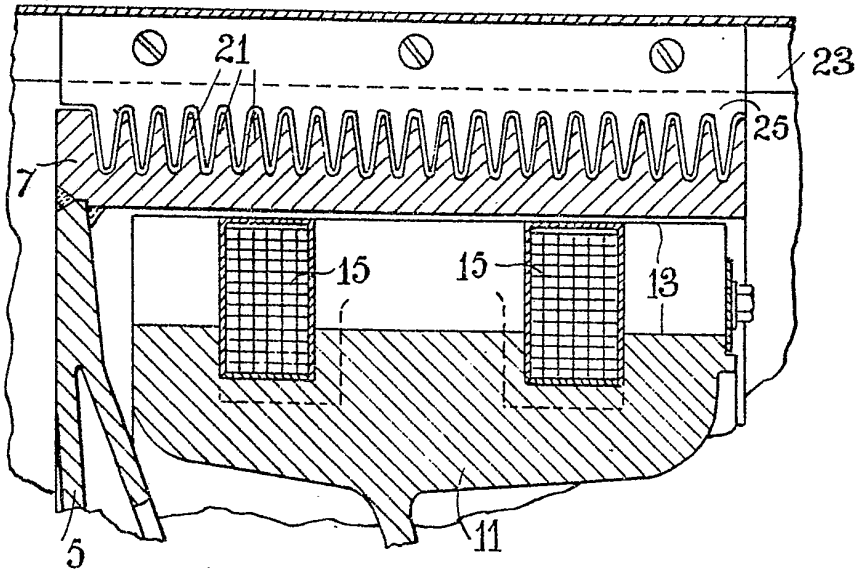

Fig.3.

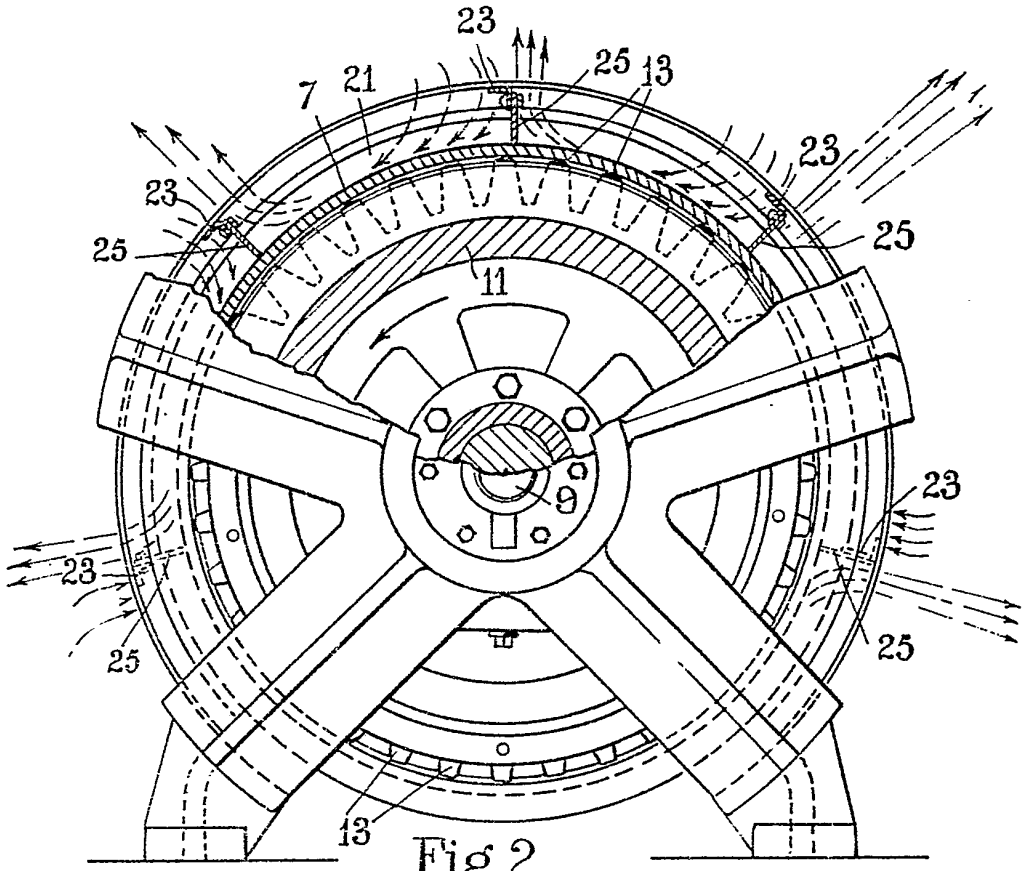

Fig.2.

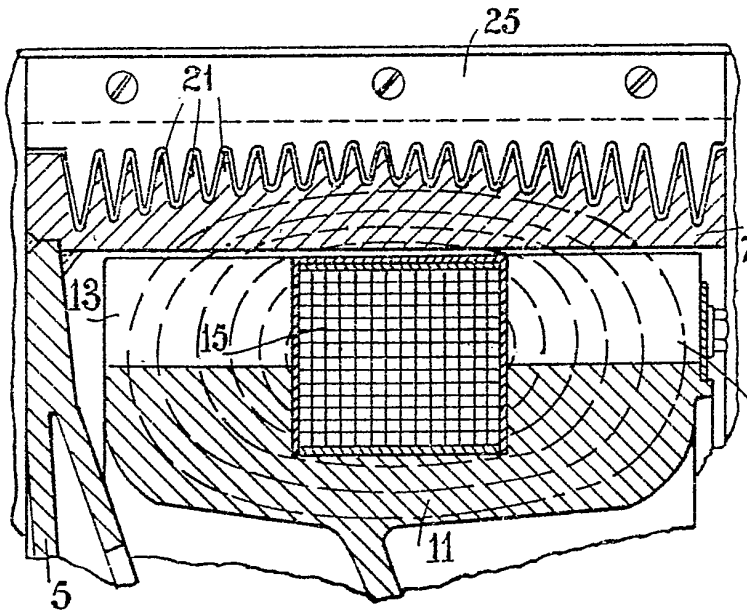

Fig.4.

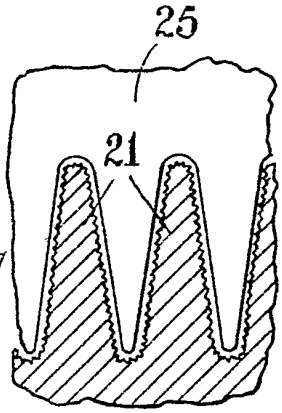

Fig.7.

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3 SHEETS

SHEET 1

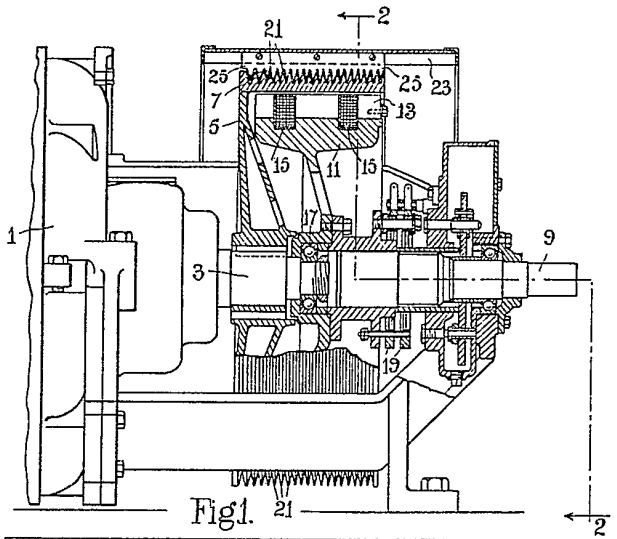

Fig.1.

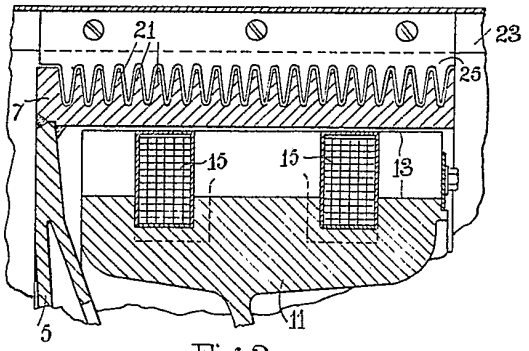

Fig.3.

SHEET 2

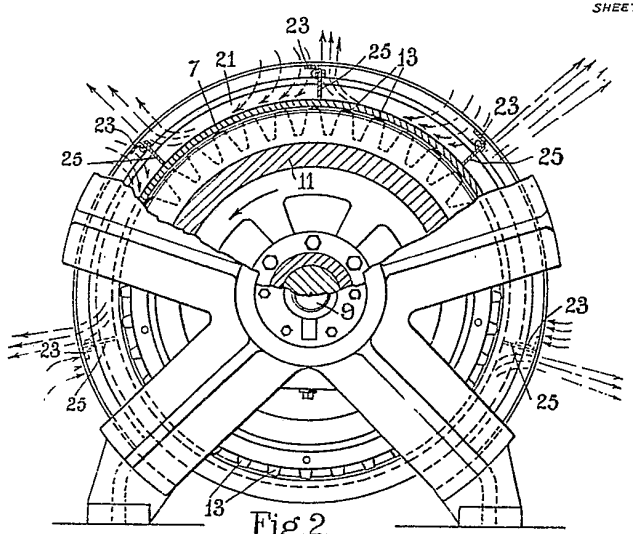

Fig.2.

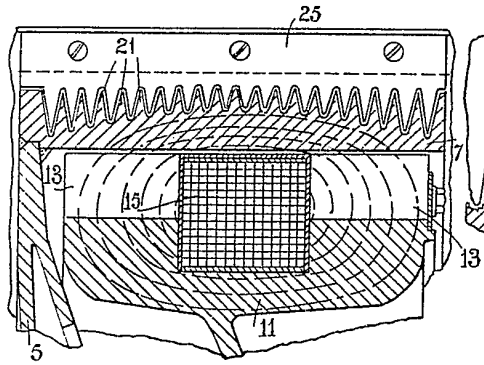

Fig.4.

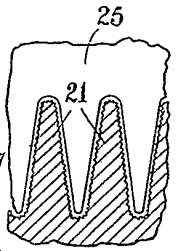

Fig.7.

[This Drawing is a reproduction of the Original on a reduced scale.]

H.M.S.O.(Ty.P.)

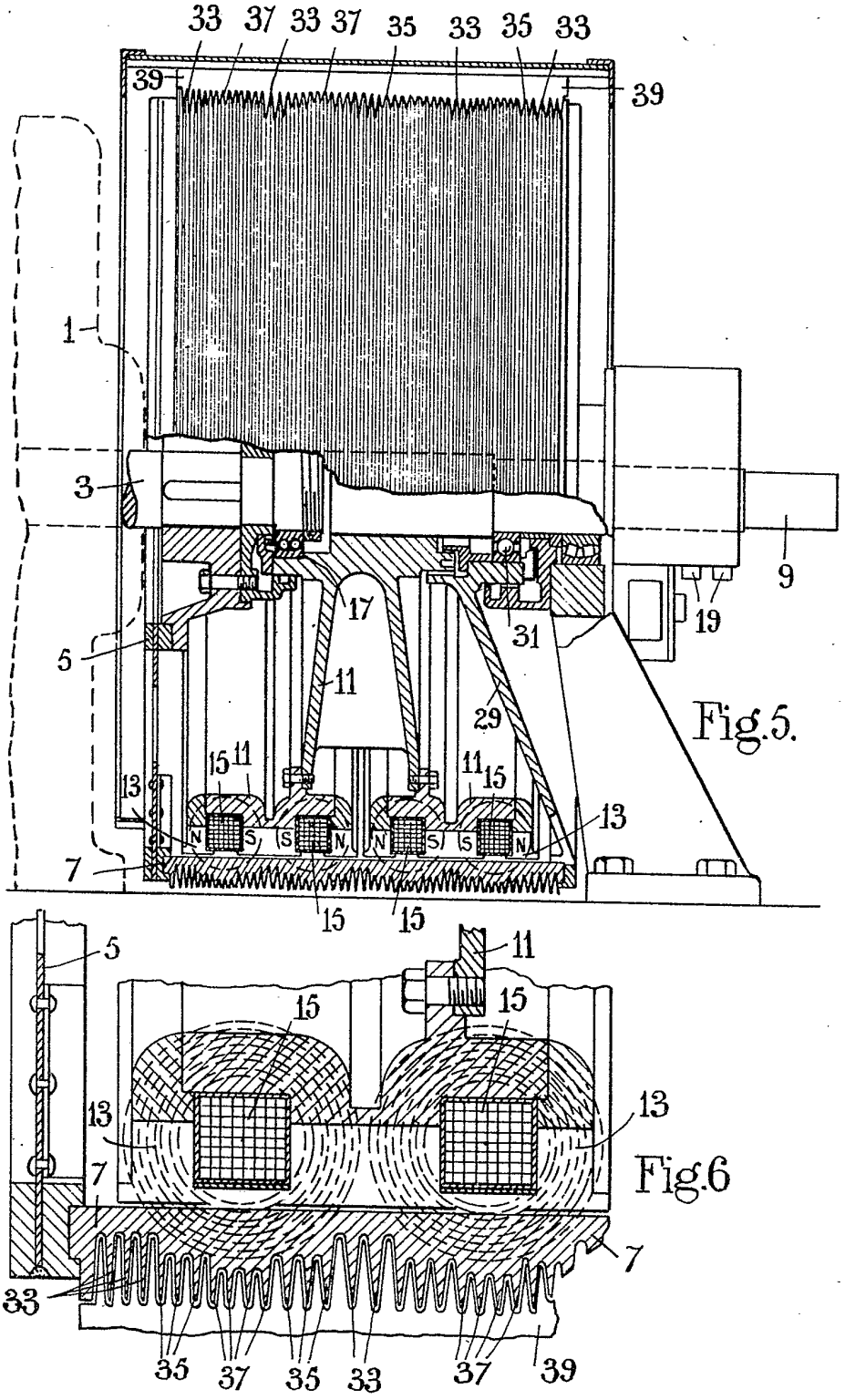

Fig.5.

Fig.6

[This Drawing is a reproduction of the Original on a reduced scale.]