

V. A. FYNN.
 ALTERNATING CURRENT MOTOR.
 APPLICATION FILED JULY 9, 1909.

962,337.

Patented June 21, 1910.

5 SHEETS—SHEET 1.

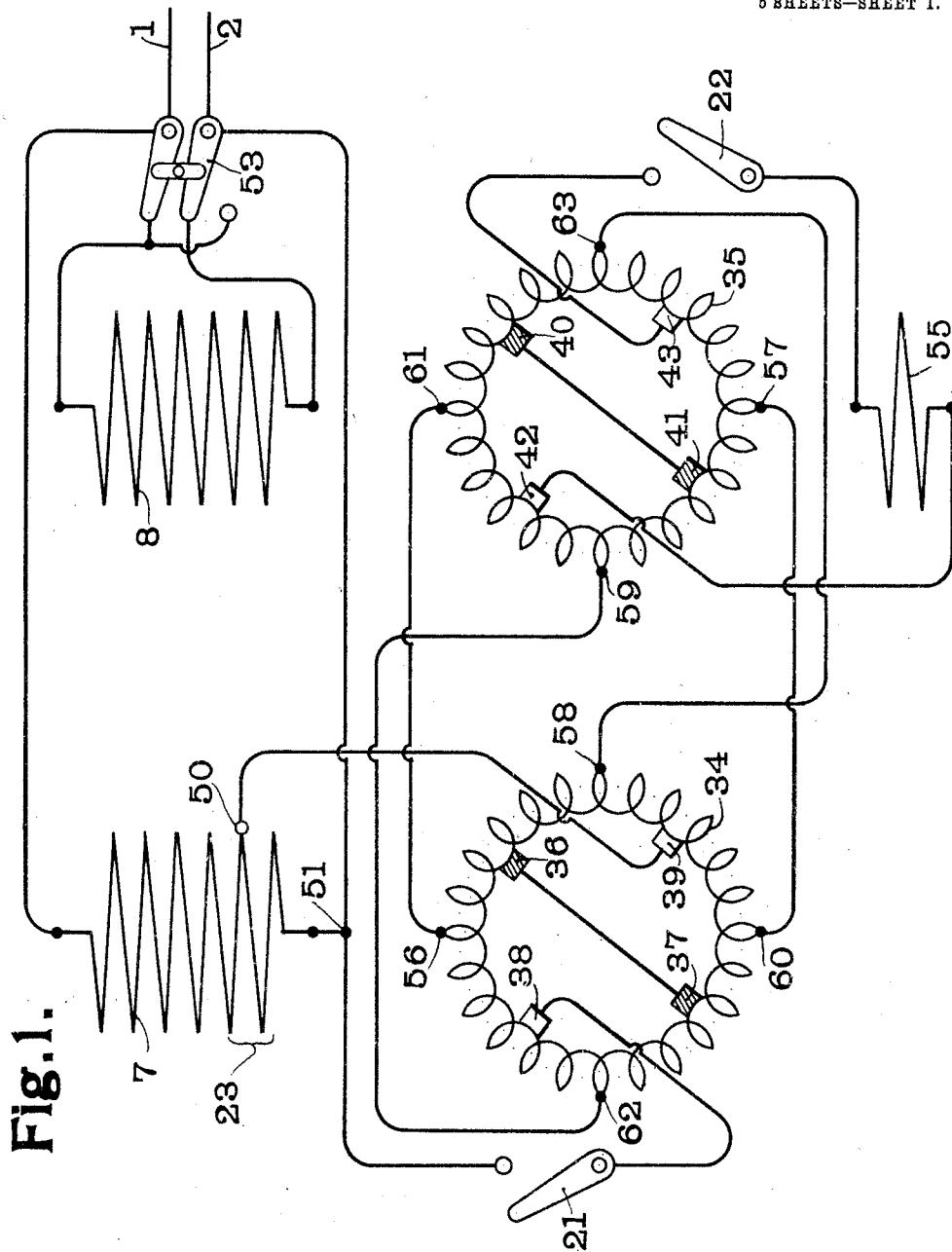


Fig. 1.

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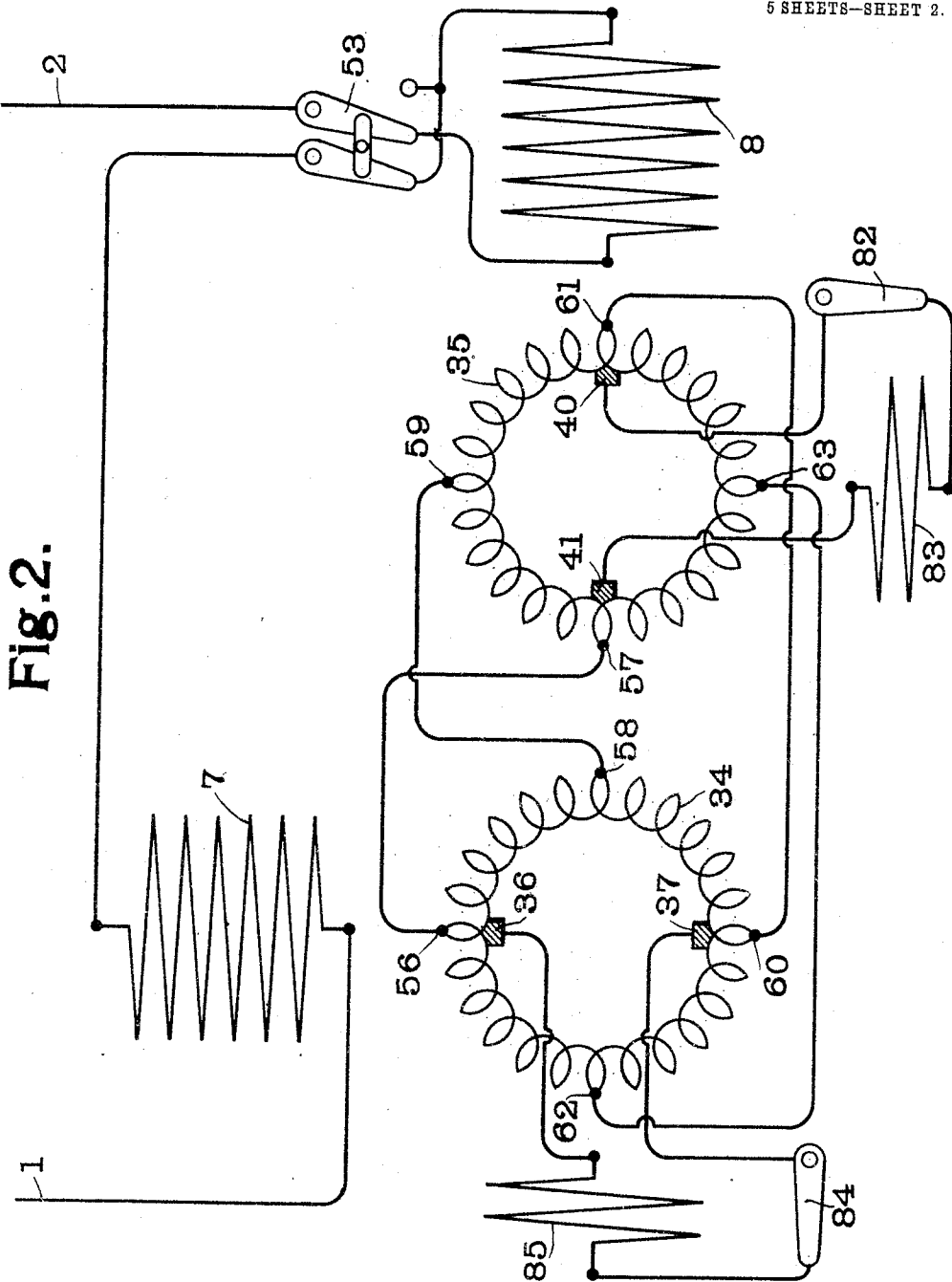
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5 SHEETS—SHEET 2.



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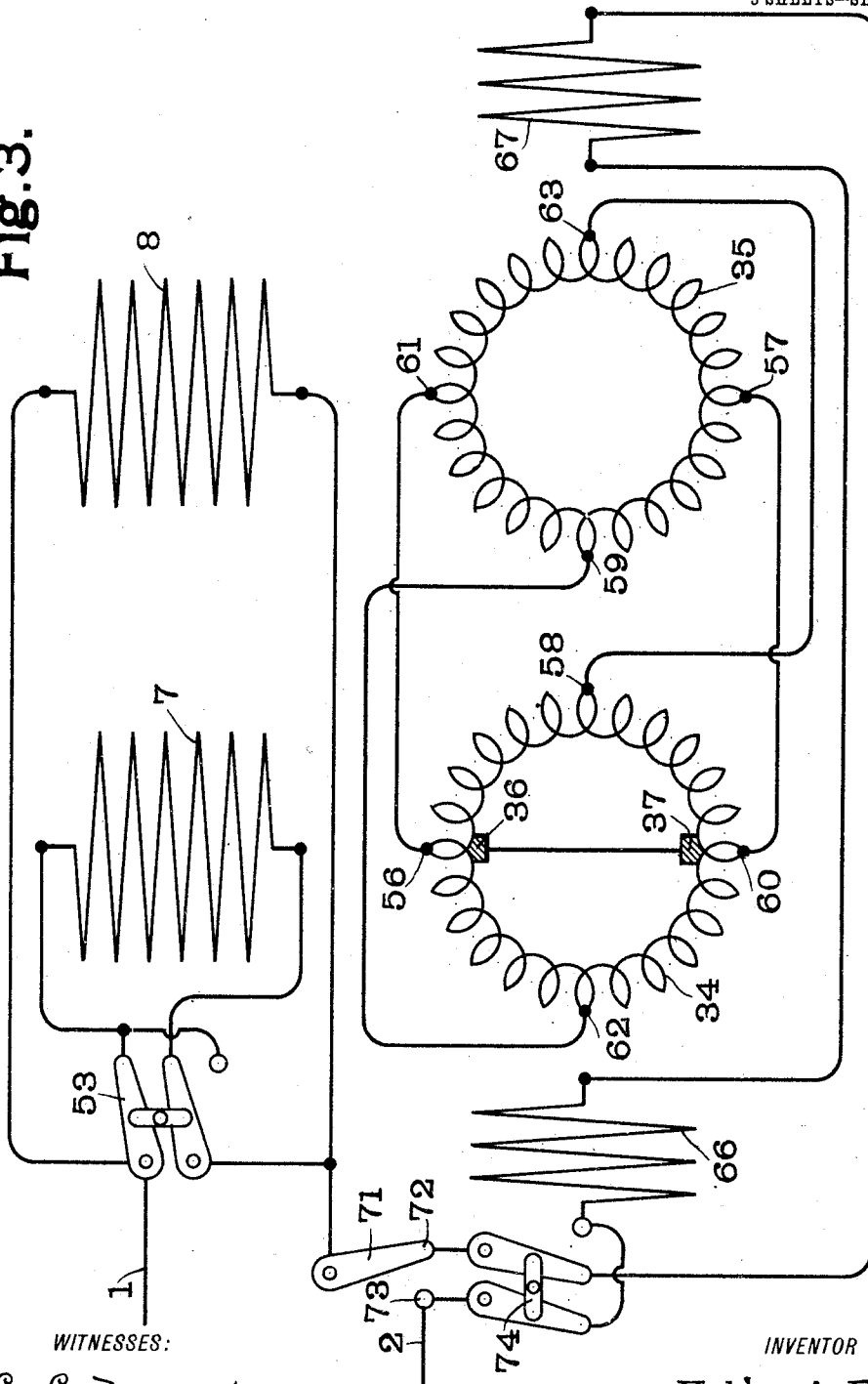
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Fig. 3.



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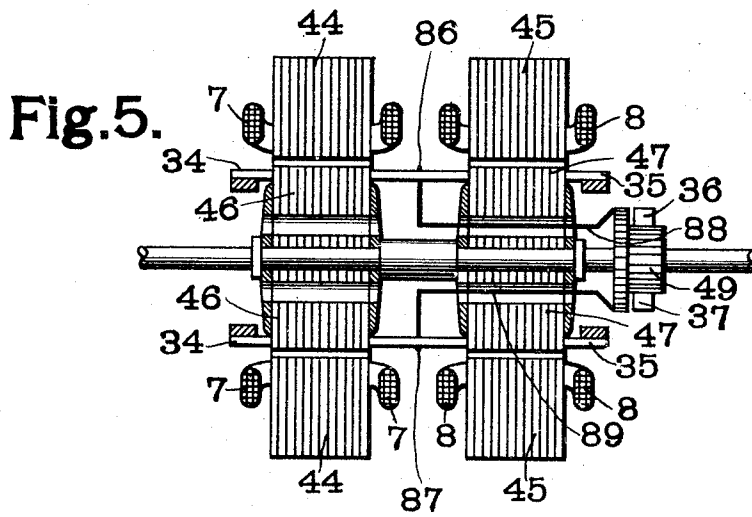
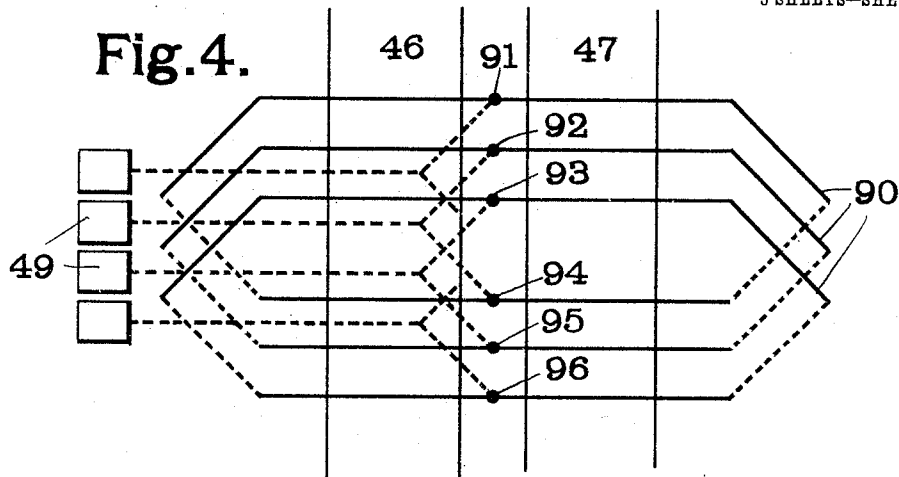
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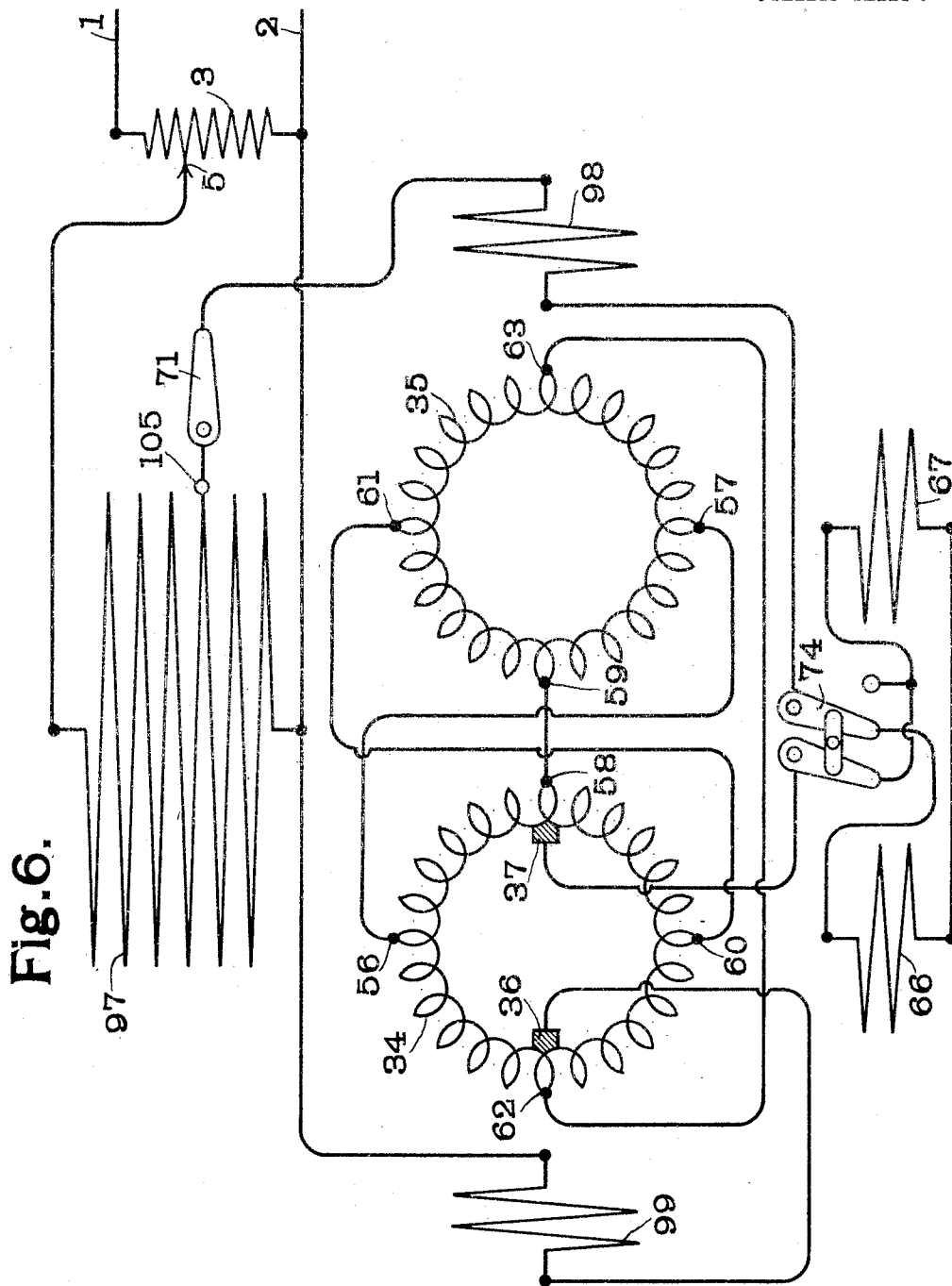
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UNITED STATES PATENT OFFICE.

VALÈRE ALFRED FYNN, OF LONDON, ENGLAND.

ALTERNATING-CURRENT MOTOR.

962,337.

Specification of Letters Patent. Patented June 21, 1910.

Application filed July 9, 1909. Serial No. 506,730.

To all whom it may concern:

Be it known that I, VALÈRE ALFRED FYNN, a subject of the King of England, residing at London, England, have invented a certain new and useful Alternating-Current Motor, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to means for starting and operating single phase induction motors in which the induced winding responsible for the operation of the motor is permanently closed on itself independently of any commutator. It is known that motors of this type have distinct mechanical advantages and good operating characteristics but are difficult to start with a powerful torque and with a small current, or in other words with a large torque per ampere.

One object of my invention is to provide such means for starting said motors with a large torque per ampere as will not make it necessary to dimension or dispose the secondary working winding permanently closed on itself with any other objects in view but those of highest effectiveness and efficiency under normal running conditions.

Other objects of my invention are to avoid the use of all automatic short-circuiting devices inside the rotor, to provide means for compensating such machines and to generally improve their characteristic properties both at starting and under normal working conditions.

I achieve my objects by providing my motor with a rotor having two commuted windings interconnected at a plurality of points, one commuted winding extending over one part of the rotor laminations and the other commuted winding extending over another part of the rotor laminations; by controlling and directing the flow of current in said windings in such a manner that said currents will only close by way of a commutator or commutators at starting; by producing a motor flux threading each commuted winding and adapted to yield the starting torques in conjunction with the ampere turns in the commuted windings and by producing a main flux threading each commuted winding in such a direction as to cause currents to flow in both commuted windings independently of any commutator. I may improve

the power factor of my machine by impressing an E. M. F. of suitable phase and magnitude on one or both of the commuted windings. When the machine is up to speed and the main fluxes are so directed as to cause currents to flow in both commuted windings independently of any commutator then the machine operates like an ordinary self-excited shunt induction motor.

In describing some ways of carrying my invention into practice I will refer to the accompanying diagrammatic drawings of two pole motors where—

Figure 1 shows a motor having two interconnected commuted windings each connected to its own commutator, capable of starting as a self-excited series induction motor and provided with compensating means. Fig. 2 is similar to Fig. 1 but the motor is arranged to start as a self-excited series induction motor with the motor field winding disposed on the stator instead of the rotor. No means for compensating are shown. Fig. 3 is a machine arranged to start as a separately excited series induction motor and both commuted windings are connected to the same commutator. Fig. 4 is a diagram of a rotor winding suitable for a motor such as shown in Fig. 3. In Fig. 5 is shown another rotor winding suitable for such a motor as shown in Fig. 3. Fig. 5 also illustrates a possible mechanical disposition of the motor parts of a machine made according to this invention. Fig. 6 shows a motor arranged to start as a neutralized series conduction motor, the two rotor windings being connected to a common commutator.

Referring to Fig. 1, the stator carries two longitudinally displaced main stator windings 7, 8 connected in parallel to the mains 1, 2 the switch 53 providing means for reversing the current through one of them, in this case through winding 8. The rotor carries two longitudinally displaced commuted windings 34, 35 each connected to a commutator and each short-circuited by the brushes 36, 37 and 40, 41 respectively along an axis displaced from that of the corresponding main winding. The displacement should preferably be such that both commuted windings produce a torque in the same direction. The two commuted windings are so interconnected at four points that when the main windings produce fluxes of same direction and in parallel axes then no current will flow through the interconnections

56 to 61, 58 to 63, 60 to 57 and 62 to 59. In the starting position of the switches shown in Fig. 1, windings 7, 8 magnetize in the same direction and the currents induced in the windings 34 and 35 respectively only close by way of their respective commutators and short-circuited brushes, the motor starting as a self-excited series induction motor. When the machine has reached a sufficient speed the current through 8 is reversed and currents now flow in both commuted windings closing through the interconnections. These windings may be interconnected at any desired number of points. If it is desired to compensate the machine then an E. M. F. of approximately the same phase as that of the supply is impressed on the auxiliary brushes 38, 39 and 42, 43 respectively. The commuted windings being interconnected it is preferred to derive this compensating E. M. F. from windings not conductively interconnected. In Fig. 1, one E. M. F. is derived from part 23 of 7 and the other from winding 55. These E. M. F.'s are controlled by switches 21, 22. The auxiliary brushes are shown displaced by $180/n$ degrees with respect to the corresponding short-circuited brushes, but they can however be placed at right angles to the axis of the corresponding main flux. The letter n stands throughout for the number of poles of the motor. After the motor is up to speed the short-circuited brushes can be moved so as to coincide with the axis of the corresponding main flux. By moving these brushes beyond that axis the motor may be started in the opposite direction. Under normal working conditions the short-circuited brushes will carry part of the working current.

In Fig. 2 the main stator windings 7, 8 are connected in series instead of in parallel and are not only longitudinally but also axially displaced. The switches are shown in their starting position. The rotor carries two commuted windings 34, 35 each provided with its own commutator and so interconnected at four points that no current will flow through these interconnections at starting. Brushes 36, 37 and 40, 41 are coaxially disposed with the corresponding main stator windings and are connected by way of the switches 82, 84 to auxiliary stator windings 83, 85 displaced by about $180/n$ degrees with respect to the corresponding main stator windings. The machine starts as a self-excited series induction motor the windings 85, 83 doing duty as motor field windings. When the motor has reached a sufficient speed the current through 8 is reversed at 53 and the switches 84, 82 may be opened. In order to reverse the direction of rotation the current should be reversed through 85 and 83 at starting.

In Fig. 3 both commuted rotor windings

34, 35 are connected to the same commutator although these windings are longitudinally displaced as before. The connections to the common commutator do duty as interconnections between the two windings. Only four of these interconnections are shown in the figure so as not to detract from its clearness. In practice more points should be thus interconnected and it is best to interconnect all the coils of the two windings in this manner. The main stator windings 7, 8 magnetize in the same direction at starting and the interconnections between 34 and 35 are therefore such that no current will flow from one winding to the other through these interconnections at starting. Short-circuited brushes 36, 37 are however coaxially disposed with 7 and both commuted windings will send a current through this short-circuit at starting. In order to produce a torque with the ampere turns thus set up in 34 and 35 two auxiliary windings 66, 67 displaced by $180/n$ degrees with respect to the corresponding main windings are so disposed as to generate a motor flux which will link in a suitable direction with 34 and 35 respectively. The direction of rotation can be reversed by reversing the current through 66 and 67 by means of 74 at starting. When up to speed the current through 7 is reversed and the auxiliary windings can be disconnected by moving switch 71 to point 73.

Fig. 4 shows the diagram of a rotor winding well adapted for use with such motors. It consists of coils 90 closed on themselves and so wound as to embrace all the rotor laminations. The middle points 91, 92 . . . 96 of the conductors forming the said coils are interconnected for instance in the manner shown, the interconnections being connected to the segments of a commutator 49. This arrangement is equivalent to a multiple winding embracing the group of laminations 46 and a multiple winding embracing the group of laminations 47, both multiple windings being connected to a common commutator.

Fig. 5 shows a possible mechanical disposition of the parts of a motor similar to that shown in Fig. 3. Both rotor and stator laminations are divided into two groups of laminations 46, 47 and 44, 45 for the easy accommodation of the various windings. The rotor winding is shown as being of the squirrel-cage type and is here designated by the numerals 34, 35; the middle point of each bar of the squirrel-cage is connected by means of a wire such as 88 to the commutator 49. Brushes 36, 37 resting on this commutator may be interconnected or not as desired and are preferably made wide enough to each cover a plurality of segments. According to the position of these brushes relatively to the axis of the main stator wind-

ings the motor will exert a torque or not and will start in the one or other direction. It would even be sufficient to use only one brush on this commutator. At starting 7 and 8 magnetize in opposite directions with reference to the squirrel-cage and whatever current flows closes by way of the commutator, the squirrel-cage acting as two commuted windings in parallel. When a sufficient speed has been reached the current in one of the main stator windings is reversed and the commutator becomes practically inoperative.

In Fig. 6 the stator is provided with a main stator winding 97 embracing both groups of laminations. The rotor carries two longitudinally displaced commuted windings 34, 35 so connected to a common commutator that 97 will induce currents in these windings which will close independently of the commutator. In other words, these two windings are so interconnected that the E. M. F. induced in the commuted winding 34 by the stator winding 97 is of the same direction with reference to the interconnections between 34 and 35 as the E. M. F. which 97 induces in 35, thus when the E. M. F. induced in 34 by 97 is directed from 60 to 56 then the E. M. F. induced in 35 by 97 is directed from 57 to 61. These two E. M. F.'s are of the same direction with reference to the interconnections because point 56, for example, is connected to point 57. Brushes are disposed on the commutator along an axis displaced by about $180/n$ degrees with respect to 97. Each stator group carries an auxiliary winding 99, 98 doing duty as neutralizing winding and an auxiliary winding 66, 67 doing duty as motor field winding and displaced by $180/n$ degrees with respect to the corresponding neutralizing winding. The brushes are connected in series with both neutralizing windings and both motor field windings thus forming the starting circuit controlled by switch 71. The E. M. F. impressed on this starting circuit is derived from 97 itself, which is therefore connected to the mains 1, 2 from the very first by way of the adjustable transformer 3. The motor starts as a neutralized series conduction motor, the position of switch 74 determining the direction of rotation. The windings 66 and 67 are so connected that the E. M. F. induced in 34 by 66 is, with reference to the interconnections between 34 and 35, of opposite direction to the E. M. F. induced in 35 by 67. The current induced in 34, 35 and which closes in these windings independently of the commutator does not contribute to the torque at the moment of starting. It is therefore best not to impress the full line voltage on 97 in the early stages but to raise this voltage as the speed increases. A machine connected in this manner will not race for as soon as a

sufficient speed is reached the well-known action of a self-excited shunt induction motor sets in automatically and limits the speed. When a sufficient speed has been reached switch 71 can be opened.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In an alternating current motor, a stator, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points, and means for producing a flux through each commuted winding at starting, said fluxes being so directed that the E. M. F. induced in one commuted winding opposes the E. M. F. induced in the other commuted winding.

2. In an alternating current motor, a stator, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations the said commuted windings being connected in parallel to the same commutator, and means for producing a flux through each commuted winding at starting, said fluxes being so directed that the E. M. F. induced in one commuted winding opposes the E. M. F. induced in the other commuted winding.

3. In an alternating current motor, a stator, a plurality of windings on the stator, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points, and means for reversing the current through one of the stator windings.

4. In an alternating current motor, a stator, a rotor having two groups of laminations, a commuted winding on each group of said rotor laminations, said commuted windings being interconnected at a plurality of points, means for producing a transformer flux through each group of rotor laminations, and means for producing a motor flux through each group of laminations at starting.

5. In an alternating current motor, a stator having two groups of laminations, means for producing a main flux through each group of laminations, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points, and means for producing a flux through each commuted winding at starting, said fluxes being so directed that the E. M. F. induced in one commuted winding opposes the E. M. F. induced in the other commuted winding.

6. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, means for producing

a main flux through each group of laminations, an auxiliary winding on each group, a rotor having two groups of laminations, and a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points.

7. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, means for producing a main flux through each group of laminations, an auxiliary winding on each group displaced by $180/n$ degrees with reference to the main flux through each group, a rotor having two groups of laminations, and a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points.

8. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, means for producing a main flux through each group of laminations, two auxiliary windings on each group, one of which is coaxially disposed with reference to the main flux through each group, a rotor having two groups of laminations, and a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points.

9. In an alternate current motor, a stator containing two longitudinally displaced groups of laminations, means for producing a main flux through each group of laminations, an auxiliary winding on each group, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points, and means for directing the flow of the current in said commuted windings.

10. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, means for producing a main flux through each group of laminations, an auxiliary winding on each group displaced by $180/n$ degrees with reference to the main flux through each group, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at

a plurality of points and means for directing the flow of the current in the said commuted windings.

11. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, means for producing a main flux through each group of laminations, two auxiliary windings on each group, one of which is coaxially disposed with reference to the main flux through each group, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points, and means for directing the flow of the current in the said commuted windings.

12. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, means for producing a main flux through each group of laminations, two auxiliary windings on each group, one of which is coaxially disposed with reference to the main flux through each group, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted winding being connected to the same commutator, and means for directing the flow of the current in the said commuted windings.

13. In an alternating current motor, a stator containing two longitudinally displaced groups of laminations, a main winding on the stator embracing both groups of laminations, two auxiliary windings on each group, one of which is coaxially disposed with reference to the main winding on each group, a rotor having two groups of laminations, a commuted winding disposed on each group of rotor laminations, the said commuted windings being interconnected at a plurality of points, and means for directing the flow of the current in the said commuted windings.

In testimony whereof I have hereunto set my hand and affixed my seal in the presence of the two subscribing witnesses.

VALÈRE ALFRED FENN. [L. S.]

Witnesses:

ELIZABETH BAILEY,
E. E. HUFFMAN.