No. 843,981. PATENTED FEB. 12, 1907.

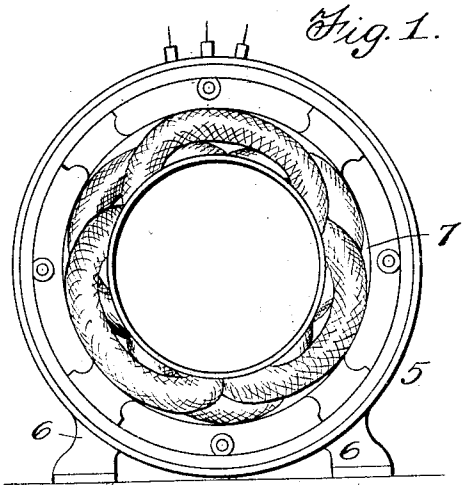
E. J. WILLIS.

INDUCTION MOTOR.

APPLICATION FILED NOV. 9, 1905.

3 SHEETS—SHEET 1.

Fig. 1.



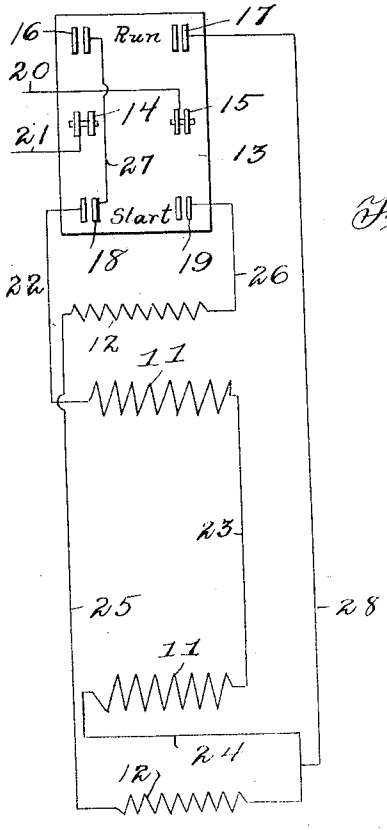


Fig. 3.

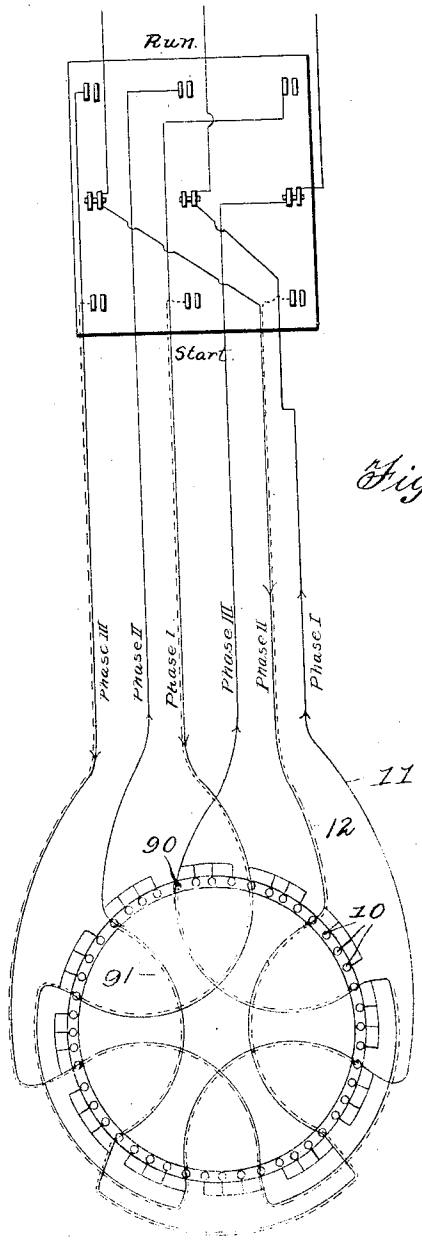


Fig. 7

Witnesses
Frank L. Campbell
E. C. Lewis

Inventor
Edward J. Willis
By Shipley and Parker,
Attorneys.

No. 843,981. PATENTED FEB. 12, 1907.

E. J. WILLIS.

INDUCTION MOTOR.

APPLICATION FILED NOV. 9, 1905.

3 SHEETS—SHEET 2.

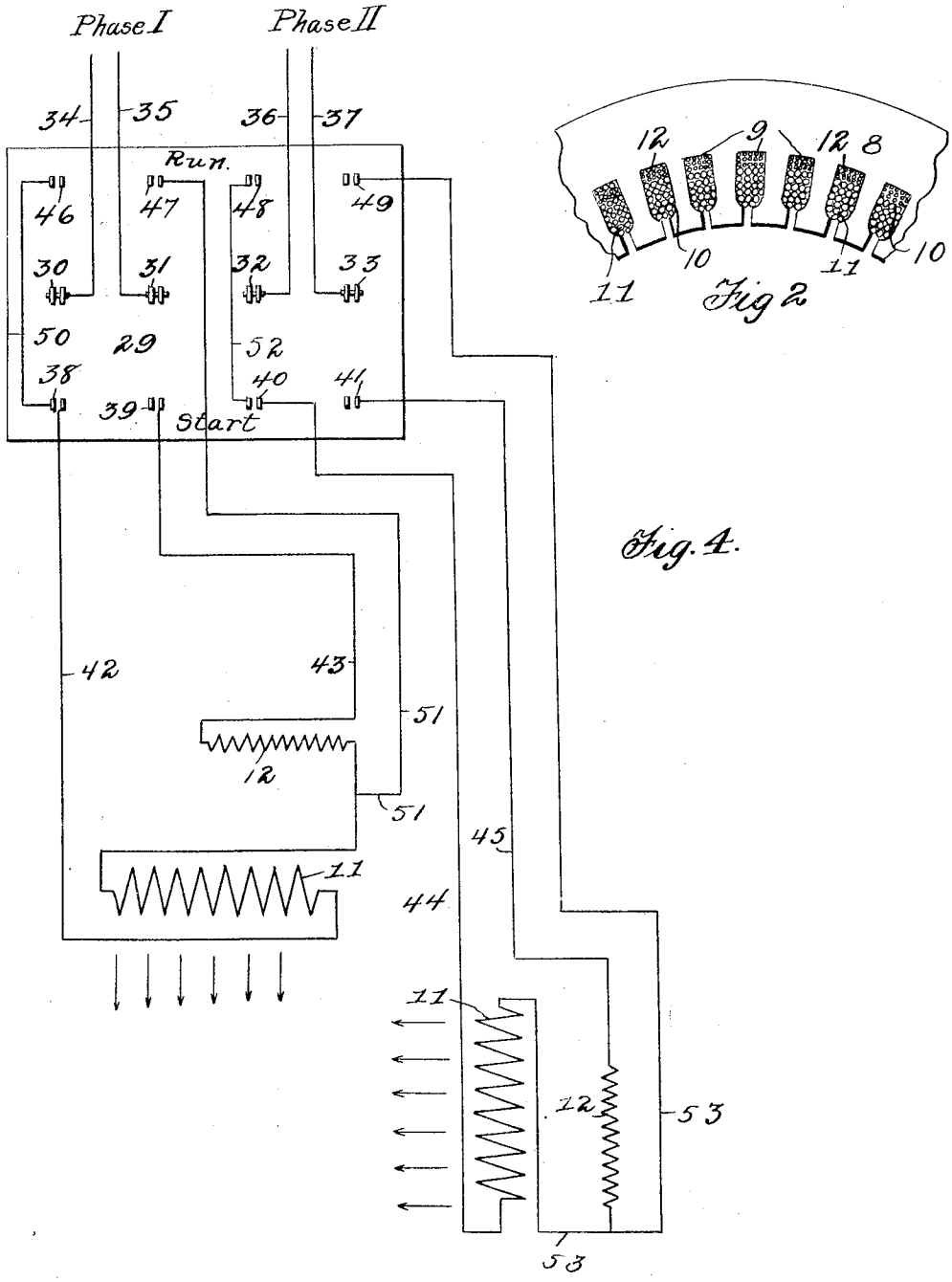


Fig. 4.

Fig 2.

Inventor

Edward J. Willis

Witnesses

Frank G. Campbell

C. C. Lewis.

By Shepherd and Parker,

Attorneys.

No. 843,981. PATENTED FEB. 12, 1907.

E. J. WILLIS.

INDUCTION MOTOR.

APPLICATION FILED NOV. 9, 1905.

3 SHEETS—SHEET 3.

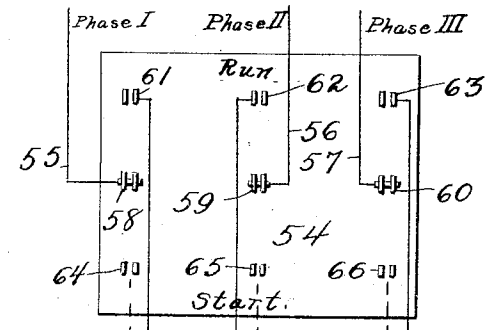


Fig. 5.

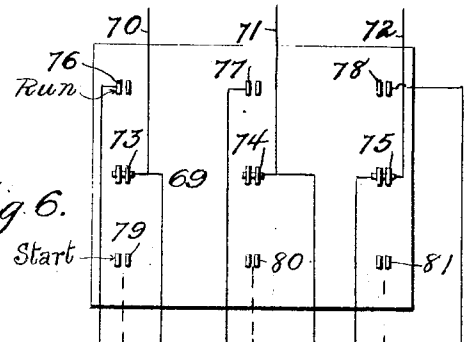
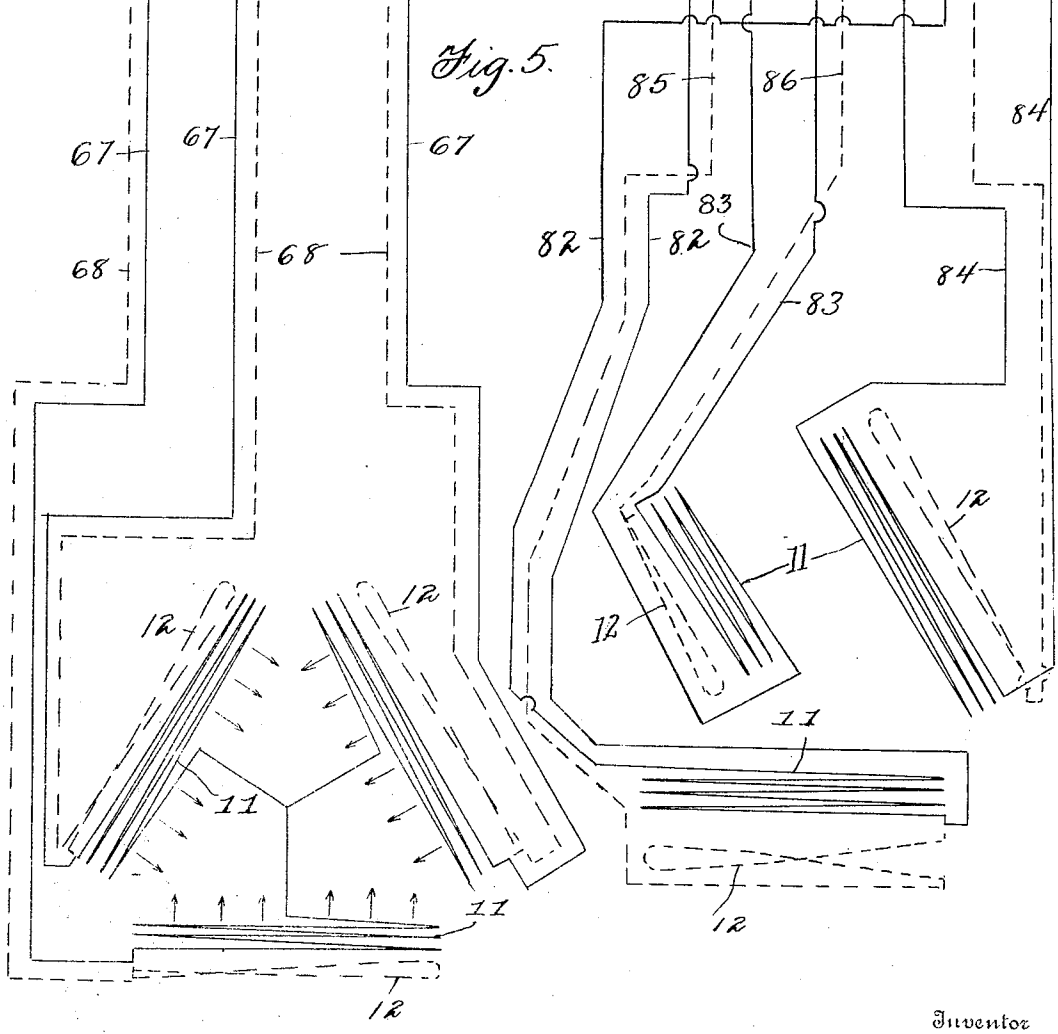


Fig. 6.



Witnesses

Frank G. Campbell

C. A. Lewis

Inventor

Edward J. Willis.

By Shepherd and Parker,

Attorneys

UNITED STATES PATENT OFFICE.

EDWARD J. WILLIS, OF RICHMOND, VIRGINIA.

INDUCTION-MOTOR.

No. 843,981. Specification of Letters Patent. Patented Feb. 12, 1907.

Application filed November 9, 1905. Serial No. 286,536.

To all whom it may concern:

Be it known that I, EDWARD J. WILLIS, a citizen of the United States, residing at Richmond, in the county of Henrico and State of Virginia, have invented certain new and useful Improvements in Induction-Motors, of which the following is a specification.

This invention relates to a new method of starting and operating induction-motors and to a motor of improved construction which is particularly well adapted for operating in accordance with the principles of said method.

The objects of my invention are to provide for easily and economically starting induction-motors and for maintaining them in an efficient running condition after being started. These objects are accomplished in the practice of my invention by the use in the manner hereinafter described of starting-coils which may be of relatively high resistance in addition to running-coils wound to correspond to usual formulæ, whereby any selected voltage can be thrown upon the motor at the time of starting and the motor run after starting with the maximum economy and efficiency. Means are provided for connecting the starting-coils in series with the running-coils when it is desired to start the motor and for cutting the starting-coils out of circuit after the motor has been fairly started, thus enabling the full voltage to pass directly to the running-coils, and thereby maintain the motor in a powerful and efficient running condition.

With these and other objects in view the present invention consists in the combination and arrangement of parts, as will be hereinafter more fully described, shown in the accompanying drawings, and particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is an end elevation of a portion of an induction-motor constructed in accordance with the invention. Fig. 2 is an elevation of a portion of the stator of an induction-motor, illustrating the arrangement of the starting and running coils. Fig. 3 is a diagrammatic view illustrating the winding of a single-phase motor when constructed in accordance with the invention. Fig. 4 is a diagrammatic view illustrating the winding of a two-phase motor when constructed in accordance with the invention. Fig. 5 is a diagrammatic view illustrating the method of winding a three-phase motor, said winding being arranged in accordance with what is known as a "three-phase Y system." Fig. 6 is a diagrammatic view illustrating a method of winding a three-phase motor, said winding being arranged in accordance with what is known as a "three-phase delta system;" and Fig. 7 is a diagrammatic view further illustrating the winding of the stator of a three-phase delta connected motor when constructed in accordance with the invention.

Referring to the drawings, the numeral 5 designates the frame of an induction-motor, which is supported on legs 6. Mounted within the frame 5 is a stator 7, composed of the usual punched laminæ 8, said laminæ being punched in such manner as to form radial recesses 9 therein. It will be readily understood that these recesses 9 form transverse channels 10 in the stator when the laminæ forming said stator have been assembled. This construction is well known and forms no part of the present invention beyond the fact that recesses 9 are made deep enough to receive not only the usual running-coils 11, formed of comparatively large wire of relatively low resistance, but also to receive starting-coils 12, which may be formed, as shown, of small wire of relatively high resistance. Starting-coils 12 are arranged in the bottoms of the channels 10 beneath the running-coils 11, whereby the magnetic leakage from said last-named coils may be reduced to a minimum.

In Fig. 3 the method of arranging the winding of a single-phase motor is diagrammatically illustrated. Referring particularly to said figure, the numeral 13 designates the base-plate of an ordinary double-throw knife-switch. The blades of said switch are pivoted to the terminals 14 and 15, and the running terminals 16 and 17 and the starting terminals 18 and 19 are so arranged that terminals 14 and 15 may be connected to terminals 16 and 17 or to terminals 18 and 19 at will. It will therefore be seen that if when the motor is to be started the switch is thrown into such position as to connect the terminals 14 and 15 to the terminals 18 and 19 the circuit between the motor-coils and the line-wires 20 and 21, which are connected to terminals 14 and 15, will be completed as follows: The current from terminal 14 will pass through wire 22 to one of the running-coils 11, thence through wire 23 to a second running-coil, thence through wire 24 to one of the starting-coils 12, thence through wire 25 to a second starting-coil,

thence through wire 26 to terminal 19, and through the switch-blades to terminal 15. After the motor has been fairly started the switch may be moved to bring the terminals 14 and 15 into connection with the terminals 16 and 17, which will result in cutting out the starting-coils and permitting the current to pass unrestrictedly to the running-coils through the following circuit: from contact 14 to contact 16, thence through wire 27 to contact 18, thence through the connections hereinbefore described to both of the running-coils. A wire 28 completes the circuit from the second running-coil to terminal 17, it being of course understood that at this time the switch-blade makes connection between terminals 15 and 17

Referring now to Fig. 4 of the drawings, the numeral 29 designates the base-plate of a four-blade knife-switch. Mounted upon the base are the contact-points 30, 31, 32, and 33, upon which the blades of the switch are pivoted. Line-wires 34, 35, 36, and 37 are connected to said terminals. The wiring about to be set forth is for a two-phase motor. Starting contact-points 38, 39, 40, and 41 are also mounted upon base 29. When it is desired to start the motor, the switch is thrown into position to connect the points 30,31, 32, and 33 with the starting-points 38, 39, 40, and 41, at which time the circuit will be completed through line-wire 34, through one of the blades of the switch to contact-point 38, thence through wire 42 to a running-coil 11, thence through a starting-coil 12 and wire 43 to contact-points 39 and 31. At the same time a circuit is formed through line-wire 36, contact-points 32 and 40, and wire 44 to a running-coil 11 of the second phase. Said circuit is completed through the starting-coil of the second phase, wire 45, and contact-points 41 and 33 to line-wire 37. After the motor has been fairly started the switch is moved to connect the contact-points 30, 31, 32, and 33 with running contact-points 46, 47, 48, and 49, at which time the circuit of the first phase is as follows: through line-wire 34, contact-points 30 and 46, wire 50, contact-point 38, wire 42, running-coil 11, wire 51, and contact-points 47 and 31 to line-wire 35. The circuit of the second phase is as follows: through line-wire 36, contact-points 32 and 48, wire 52, contact-point 40, wire 44, running coil 11, and wire 53 and contact-points 49 and 33 to line-wire 37. It will be seen that at this time the starting-coils will not be in series with the running-coils, and said running-coils alone will be in circuit with the line-wires.

As has been hereinbefore stated, the diagrammatic view, Fig. 5, illustrates a three-phase Y-winding for an induction-motor provided with the starting and running coils hereinbefore mentioned. In this figure the reference-numeral 54 designates the base-plate of a three-blade knife-switch. Line-wires 55, 56, and 57 are connected to contact-points 58, 59, and 60. Running contact-points 61, 62, and 63 are mounted upon said base-plate, as are also mounted the contact-points 64, 65, and 66. As will be readily understood from the drawings, when the contacts 61, 62, and 63 are connected by the switch-blades to contacts 58, 59, and 60 the current may pass through wires 67 directly to the running-coils 11; but when the switch is shifted to bring points 64, 65, and 66 into connection with points 58, 59, and 60 the current must pass through wires 68 and starting-coils 12, as well as the running-coils.

Fig. 6 illustrates the arrangement of coils in a three-phase delta system of winding induction-motors. In said figure the numeral 69 designates the base-plate of a three-blade electric switch. Line-wires 70, 71, and 72 are connected to contact-points 73, 74, and 75, secured to said base-plate. Running contact-points 76, 77, and 78 and starting contact-points 79, 80, and 81 are also mounted upon said plate 69. As will be seen from the drawings, when contact-points 73, 74, and 75 are connected to points 76, 77, and 78 the current may pass from the line-wires 70, 71, and 72 directly to the running-coils 11 through the wires 82, 83, and 84; but when the switch is shifted to bring the points 73, 74, and 75 into connection with starting-points 79, 80, and 81 the current must pass through wires 85, 86, and 87, and the starting-coils 12, as well as the running-coils 11.

In Fig. 7 the winding of a three-phase motor has been carried out throughout the diagrammatically-illustrated stator. The switchboard and leads are substantially the same as illustrated in Fig. 5, the starting-coils being, however, represented by dotted lines and the running-coils by full lines. From the description of Fig. 6 the diagram shown in Fig. 7 will be readily understood. The starting-coils are arranged in series with the running-coils. Take the winding of phase three, for instance. One end, but not the incoming lead of the starting-coils, is connected to the incoming lead of the running-coils at 90, so that the current from the starting lead will pass through the starting-coils and running-coils before passing out of the motor at terminal 90, while current from the incoming lead of the running-coils passes directly to running-coils without passing through the starting-coils.

While it is a preferred embodiment of my invention to have the starting-coils wound in a similar manner to the running-coils, differing therefrom only in the number of turns, as illustrated in Fig. 7, it is to be understood that my invention is of a generic character, as particularly pointed out in the appended claims. The result of arranging the starting-coils in series with the running-coils, as here-

in set forth, is to reduce the magnetic flux per pole while the motor is being started and also to reduce the magnetizing-current. As the starting-current is a direct function of magnetizing-current, the starting-current, and consequently the starting torque, will also be reduced. By virtue of this construction the drop in potential along the line, which is the usual result of cutting in a motor at rest, is prevented, and improved means for starting said motor are provided.

While the method of arranging the wiring shown and described is well adapted to serve the purposes set forth, it is to be understood that the invention is not limited thereto, but that such changes as may be made within the scope of the appended claims may be resorted to without departing from said invention.

Having thus described my invention, what I claim as novel, and desire to secure by Letters Patent, is—

1. An induction-motor having a slotted stator running-coils of relatively large wire disposed within the slots of said stator, starting-coils of relatively small wire also disposed within the slots of said stator, and means for throwing said starting-coils into or out of series with the running-coils.

2. An induction-motor having a slotted stator, starting-coils disposed within the slots of said stator and at one end of said slots, running-coils similarly wound and disposed in the same manner within another portion of the said slots and at the opposite end thereof, and means for throwing the starting-coils into and out of circuit with the running-coils.

3. A polyphase induction-motor having a slotted stator, starting-coils disposed within a portion of the slots thereof, running-coils similarly wound and disposed in the same manner within another portion of the said slots and means for throwing the starting-coils into and out of circuit with the running-coils.

4. A polyphase induction-motor having a stator provided with slots therein extending outward from the central portion thereof, starting-coils disposed within the outer portion of said slots and running-coils similarly wound and disposed in the same manner within the inner portion of said slot.

5. A polyphase induction-motor having a stator provided with slots extending outward from the central portion thereof, starting-coils of relatively small wire disposed within the outer portion of said slots and running-coils of relatively large wire similarly wound and disposed in the same manner within the inner portion of said slots.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD J. WILLIS.

Witnesses:

W. BRYDON TENNANT,

M. J. TRAYLOR.