June 22 , 1926. 1,589,744

H. COHIC

SWITCH

Filed Feb. 24, 1922 3 Sheets-Sheet 1

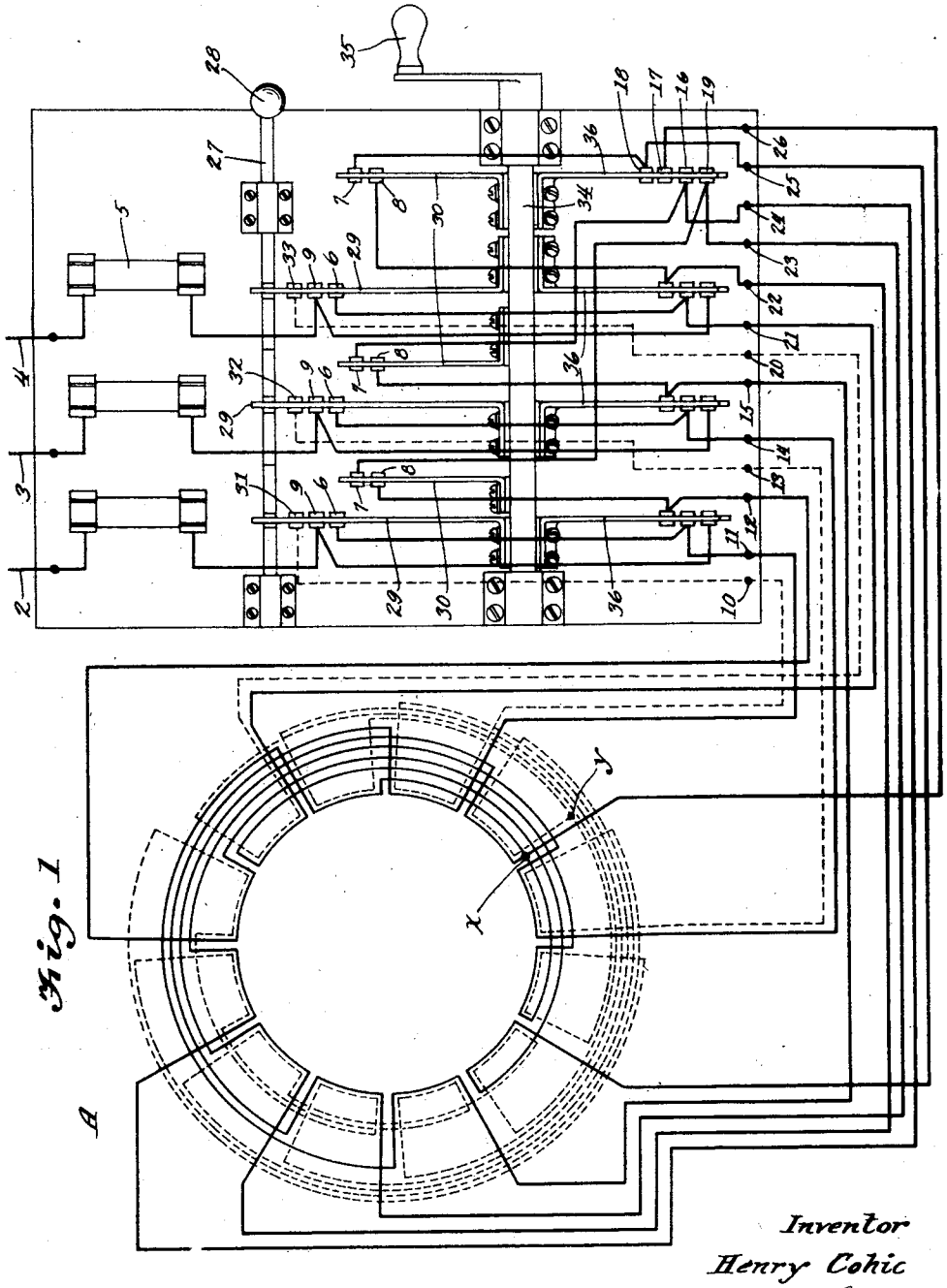


Fig. 1

A

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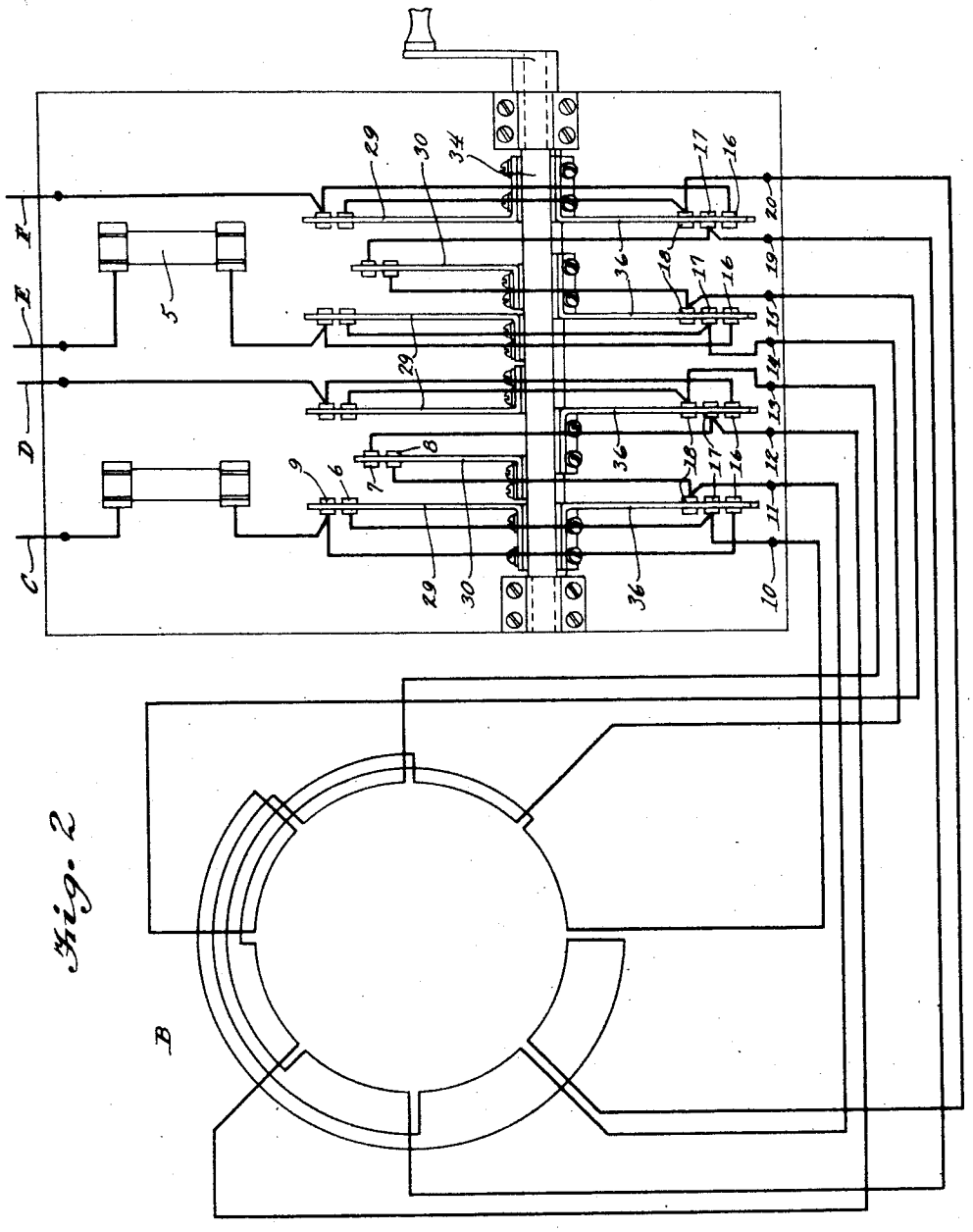


Fig. 2

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Fig. 3

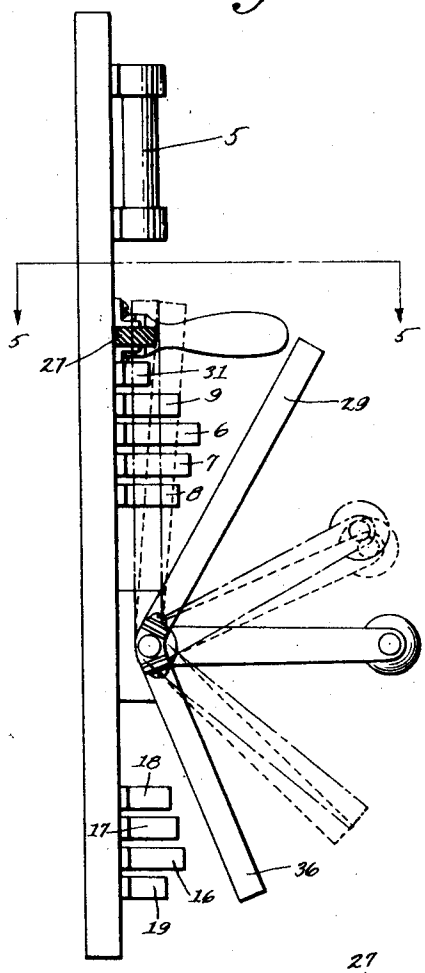


Fig. 4

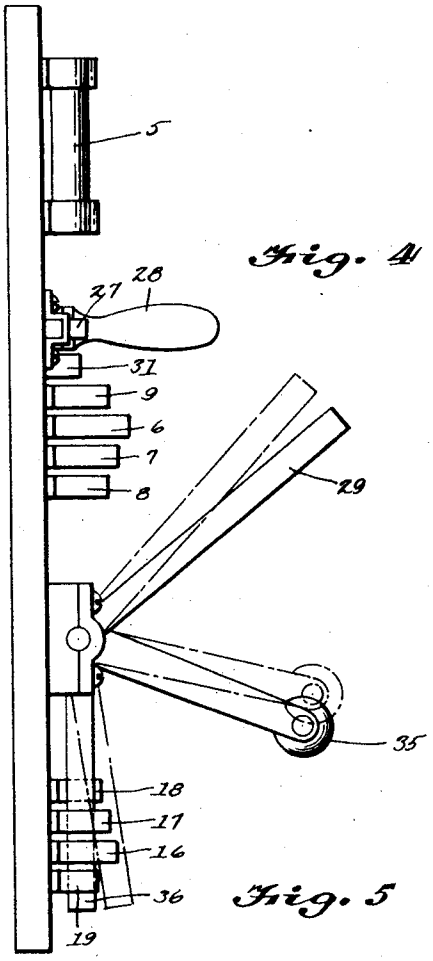
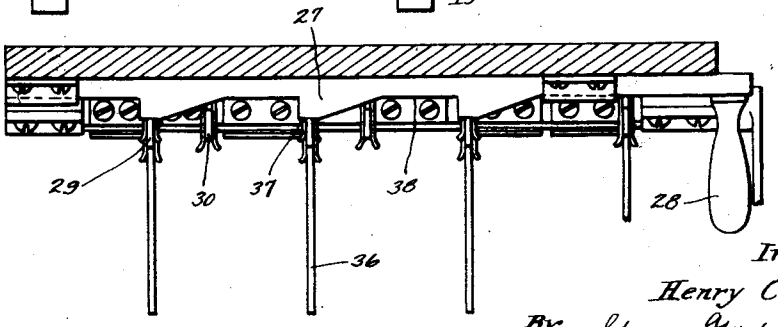


Fig. 5



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UNITED STATES PATENT OFFICE.

HENRY COHIC, OF CLEVELAND, OHIO.

SWITCH.

Application filed February 24, 1922. Serial No. 538,958.

My invention relates to methods of and means for shifting the connections of electric motors; and is more especially related to alternating current motors of the polyphase type. It has for its object to shift the connections between the field coils of such type to either series or multiple at will; and to do this without endangering the life of the motor, even when the motor is run indefinitely in either arrangement, where the motor is so wound that it can run in parallel without overheating.

It is well understood that, with a given voltage, motors of the specified type will use less current and generate less horsepower when running in series than when running in parallel. The difficulty in the past has been that no arrangement was thought feasible to connect the field coils in series for permanent running when connected directly with the mains after starting in parallel and no means for shifting over by switch mechanism to the multiple connection, where the larger load was essential, had yet been devised. The common manner of starting an A. C. motor of the polyphase type was to use a starting box having a transformer by which a reduced voltage of that required for normal running was obtained, and which precluded running by such starter for longer than a very few minutes at a time, otherwise the safety of the starter and of the motor itself was endangered. For this reason employees were often directed to never run the motor by such starter longer than one minute at a time, after which a single cut-out switch must be thrown to cut out the starter.

For the above reasons, motors that generated 10 H. P. when running in parallel and but 5 H. P. when running by the starter connection were not used in the latter connection for any appreciable interval, even though but a 5 H. P. load was to be carried, but the current essential for said 10 H. P. had to be used, if such a motor was to be used at all. This resulted of course in great waste of current.

To remedy these disadvantages, it is my purpose to dispense with the starter boxes altogether and use a switch of my special design for making the desired connections of field coils as above explained.

It is a further object of my invention to make the shift above stated by a manual double throw switch from series arrangements to parallel or vice versa; and to use a plurality of blades for the purpose of making connection with one set of contacts immediately after disconnection with the other, thus avoiding a long interval between the two connections.

I further propose to wind my motor of the three-phase type with an additional conductor in parallel with certain of the lines usually found in motors of this type, and to make this line alternative by leading it from contacts which are not touched by the switch as ordinarily used, but which will be reached by a further thrust of the switch blade when a positively provided obstacle, ordinarily held in its path, is released.

A further object is to provide a switch of the blade type which though ordinarily engaging from 3–5 contacts will be so constructed that three, for example, will be contacted at first without closing the circuit, and a contact with the fourth or fifth clamp will be effected last of all. This is regarded as very important.

While the principle of my invention will be explained as embodied in a polyphase alternating current motor, it is to be expressly understood that I am by no means to be restricted to this type of electric motors, but that it may be used on motors of the single-phase type as well, and on direct current also, also for delta connection of the three-phase A. C. motor, though in such cases with certain modifications to adapt it to the particular conditions present in the mechanism to be fitted. In each case, the number and connection of the switch blades will require appropriate adjustment to meet the individual case.

In the drawings accompanying this specification,

Figure 1 shows a four-pole three-phase inducing winding of the Y type together with a blade switch for shifting to either series or parallel connection, or by further thrust to connect an additional wire in parallel when the main conductors are in series;

Figure 2 shows my invention applied to a four-pole two-phase motor;

Figure 3 shows a side view of the switch and the slidable bar for preventing the extreme position of the switch;

Figure 4 shows another side view of the switch when in the lower position, and

Figure 5 is a view of the slidable bar as shown in a transverse section on the line 5—5 of Fig. 3.

Referring now to Fig. 1, showing the Y-type of three-phase motor, the switch 34 is represented as having the blades 29 and 30 for engagement with the upper contacts, and blades 36 for engagement with the lower contacts, the conductors 10 to 15, and 20 to 26 are shown leading to the proper contacts for the switch blades, the contacts 10, 13 and 20 representing the additional lines for increasing the torque at starting, if such should be needed, and arranged in parallel but not effective, unless the upper blades of the switch are thrust in fully as shown in the broken and dotted line position in Fig. 3. The lines 2, 3 and 4 are shown as entering the switch through the usual fuses 5. It will be seen from inspection of Figs. 3 and 4 that when the switch blades 29 and 30 are in engagement with the contacts 6 to 9, the blades 36 are out of contact with conductors below, and vice versa. This construction will be remembered when tracing the various lines in the diagram.

Assuming then, that the switch blades 29 and 30 are in the dotted line position of Fig. 3, the blades 29 will be in engagement with contacts 6 and 9, while blades 30 will contact 7 and 8. Current from line 2 will then pass from contact 9 to 6 and thence to 16, and through line 11 to the motor field returning through line 23, thence through 7 and 8, line 12 and to the stop x where the Y connection is made. Current from line 3 leads through line 14 to the motor field returning through line 24, thence out through lines 15 to x. From line 4, current leads out through line 21, returning through line 25, thence out through 22 and to x. For this reason, the 12 leads, otherwise required, will be reduced to 10, the three lines being joined at x as in this type of motor winding. This connection will be seen to afford direct connection with the mains and will connect the coils of induction in series, as will be readily understood, as well as dispense with the starter which involves additional expense and requires insulation to prevent excessive heating of the elements.

When the blades 36 are in engagement with the various contacts, referred to generally as 16 to 19, the series contacts then being separated, the course of the current flow will be as follows: Line 2 divides at 16 and 17 and passes out through lines 11 and 12, the former leading to line 23 and the latter to x. Line 3 divides at 16 and 17 passing out through lines 14 and 15, the former returning to the switch by 24 and the latter leading to x. Line 4 leads through lines 21 and 22, the former to 25 and the latter to x. Line 26 serves as a connector, when the switch is connected in parallel between the three lines uniting at x and the three lines (23, 24 and 25) meeting at the blade 36 of the switch, as will be understood.

Thus it will be seen that all the coils are used, no change has been made in the winding of this type of motor in very general use, and the parallel connection has been made whereby approximately twice the horse power can be realized that was possible from the series connection. The mere throw of this switch has made possible this selection of windings whereby when a lower load is to be carried, the coils of this standard wound motor are connected in series, but when the normal or larger load is to be carried, involving the larger use of current, the connection may be readily shifted to parallel, and this too by a double throw switch. The motor being constructed to endure running in parallel, neither position of this switch is injurious to the motor, and therefore the motor may be run in either position of the switch indefinitely.

It is usual to solder together the ends of the various coils of the motor so as to bring out the minimum number of leads. If coils that are to be run in series have their intermediate ends soldered together, and coils run in parallel have their like ends soldered to common leads, normally I bring out both ends of each coil, and my switch makes the equivalent of these usually soldered connections. When the coils are to be in series, as in the upper position of the switch, the intermediate ends are connected, as by contacts 7 and 8 and bar 30, and it is to be seen from Figs. 3 and 4, that this connection will be made before bar 29 reaches contact 9, so as to throw on the current. This is evidently equivalent to soldering the ends of the coils before turning on the current. In the lower position of the connecting switch, like ends of coils to be run in parallel are connected by the switch. It is to be noted that in either case, when the switch is opened, each coil of the motor is segregated, instead of being left connected as they must be when soldered together, and I deem this feature one of great importance in lessening sparking when the switch is opened.

It will be found that sufficient torque results from the series winding to start even with a load, but if it is desired for any reason to increase the torque at starting, an additional winding may be put on the motor field in parallel with certain of the lines for this particular purpose, and this additional winding will now be traced in this particular motor. Of course, it may be installed on the other polyphase motors of the alternating current variety if it is desired.

When used in this motor, the lines for this purpose, shown in Fig. 1, in section lines, will lead as follows: from 9 to 31,

then to 10 and finally to the junction at Y. Line 3 leads from 9 to 32 to 13 and thence to Y. #4 leads from 9 to 33 and thence through 20 to Y, so that the additional line in parallel can be used at starting when the switch arms 29 and 30 are thrust in to the extreme position. This latter is made possible by the longitudinal shifting of the bar 27 which, as shown in Fig. 5, is provided with high parts 37 and low parts 38, so that when the said bar is in the position shown at Fig. 5, the lines 10, 13 and 20 are not available. When however, the bar is shifted to bring the parts 38 in proper register, the said lines for extra torque will be connected, as explained.

While the invention has been described as applied to three-phase motors thus far, it can be applied to all polyphase motors by proper arranging of the connections with the switch arms. It will now be described as applied to a two-phase motor of the alternating current type as shown in Fig. 2 of these drawings. Line C leads from 9 to 6, when the switch arms are in the upper or series position, thence through 17 and 10, then back through 12, 17, 7 and 8, out through 11, then back through 13, 6, 9 and out at D. Line E leads through 9, 6, 17, 14, back through 19 then 7, 8, 18, 15, 20, 18, 6, 9, and out at F. This results in a series connection. When the switch is thrown to the lower position, the line C leads through 16, dividing at 17 and 18, the former leading through 10, 12, 17, 16 and out at D. The line from 11 leads through 13 and then out at D. Line E divides at 16 through 17 and 18 so that current passes through 14 and 15 and back through 19 and 20 and this out at F, whereby the connections are made in parallel which is the normal running position as it delivers the most power and therefore uses the most current from the mains.

It will thus be seen that an alternating current motor need not be run in the parallel connection requiring the larger current for its use, unless so strong a current as may be furnished by such parallel connection is desired, but that by my mechanism, the connection may be made in series by an easily-thrown switch so that a great economy in the current consumed may be gained without any loss in the life of the motor mechanism, and also saving the great expense of the starter unit, for which there will be no need when my device is used.

It is further to be noted that by the provision of my unitary switch having a plurality of blades, all manually operable together and arranged in at least two sets at an angle from each other, I am able to make various connections the character of which is determined by the extent of thrust; that by thrusting the blades in one direction toward a corresponding set of contacts, certain of said contacts will first be connected by the blades which will unite the normally segregated coils, and that further thrust of the blades will then make a positive and accurate connection between the connected coils and the contacts which are directly connected with the mains. To more definitely and concretely illustrate this arrangement, in Fig. 1 of the drawings, the upper blades 29 and 30 of the switch mechanism first connect together contacts 6, 7 and 8 (See also Fig. 3), effecting a connection of the induced coils in series, and yet not making any connection whatever with the mains until a further thrust is given the switch blades to reach the contacts 9, when the mains will then be connected with the coils in series. In the thrust of the blades in the opposite direction, 16, 17 and 18 are first connected, at the same time connecting the coils in parallel before connecting with the mains, after which a further thrust of the switch blades in that direction will connect the coils, so connected together, with the mains through the intermediacy of the contact 19, as see Fig. 4 of the drawings. With this arrangement, too, the above-described use is unavoidable, for inward thrust of the blades must necessarily connect the various coils in either parallel or series, depending upon the direction of operation of the switch before making any connection with the mains, and opening the switch necessarily disconnects from the mains before changing the relative connections of the coils with each other. This is a feature which I regard of great importance. As further explained in our description, if it should be necessary to increase the torque at starting in series, the movement of the sliding bar may permit a further thrust of the switch blades which will result in connection with lower contacts that will throw in an additional line in parallel for this purpose. By locking the said bar in its normal position, however, such additional line will never be used, although the usual coils will be connected together before connecting with the mains, as above explained.

While my mechanism is illustrated and described as applied to an alternating current motor, it is by no means my intention to restrict its use to such motors, as the arrangement of the plural blade switches for use with direct current motors may be effected, and I do not desire to limit myself other than as expressly stated in the following claims, interpreted in the spirit of my disclosure, and falling within the general scope of my invention.

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

A switch comprising a base, two sets of

contacts mounted on said base, the contacts in each set being of three different lengths, a common hinge axis mounted on the base between the two sets of contacts, a plurality of arms mounted on said axis in one plane, a plurality of arms mounted on said axis in another plane, the angle between said planes being more than 90° and less than 180°, and a bar having high and low levels thereon slidable transversely of one set of contacts, the lower of said levels permitting engagement of the arms in one plane with contacts of two different lengths and the high levels permitting engagement with only contacts of the same length, and the throw of the switch permitting engagement of the arms with other contacts of the same length.

In testimony whereof I hereunto affix my signature.

HENRY COHIC.