C. A. ADAMS.

MEANS FOR CONTROLLING ELECTRICALLY DRIVEN CENTRIFUGAL MACHINES.

APPLICATION FILED APR. 3, 1907.

981,601.

Patented Jan. 17, 1911.

2 SHEETS—SHEET 1.

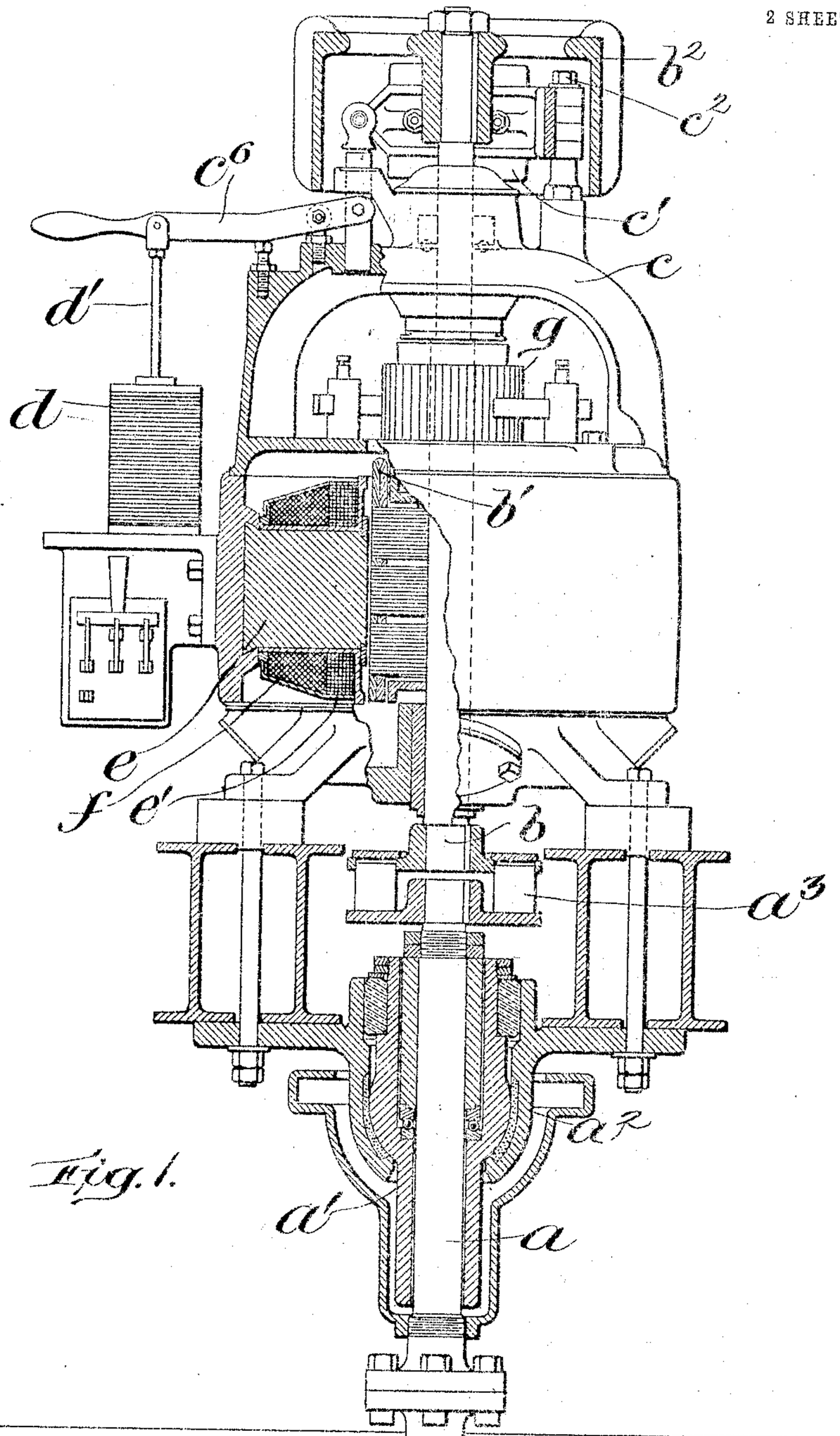

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

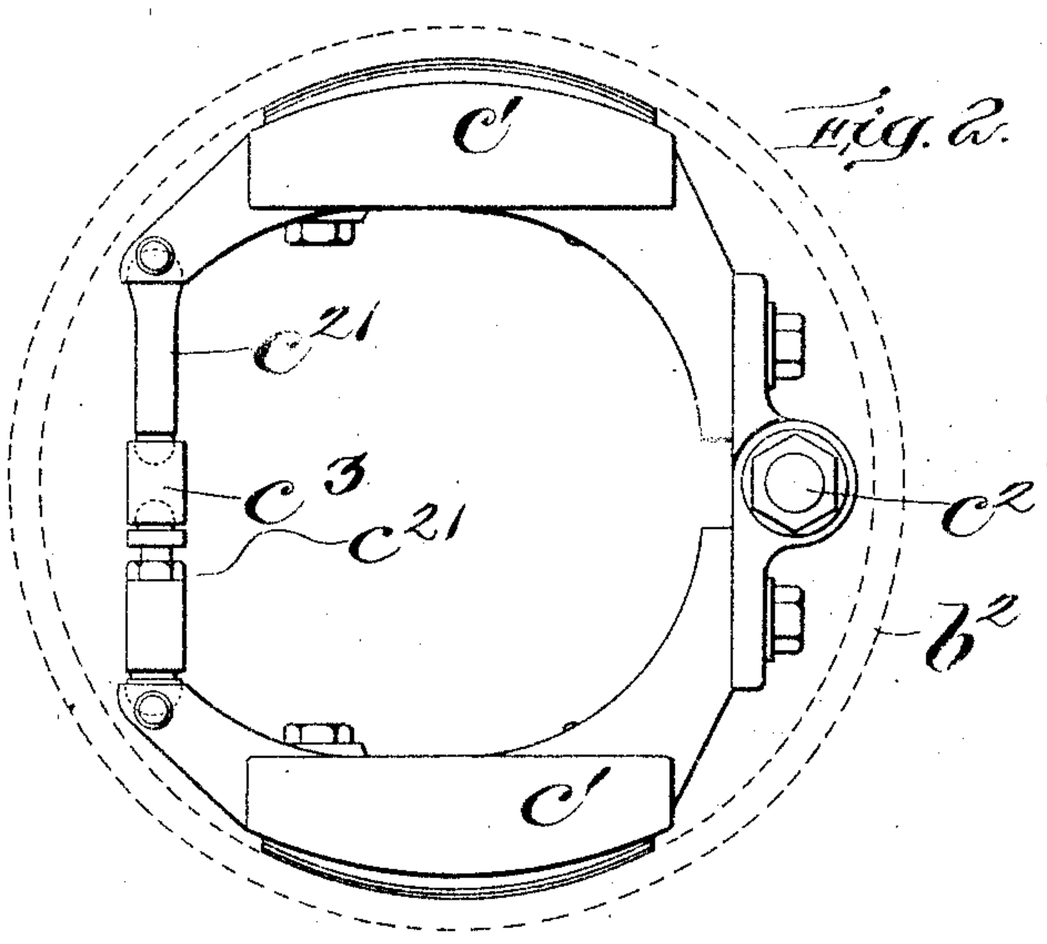


Fig. 3.

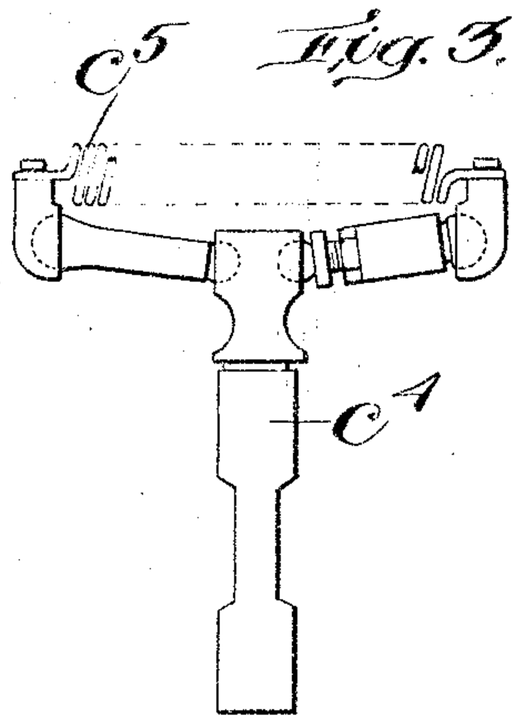


Fig. 1.

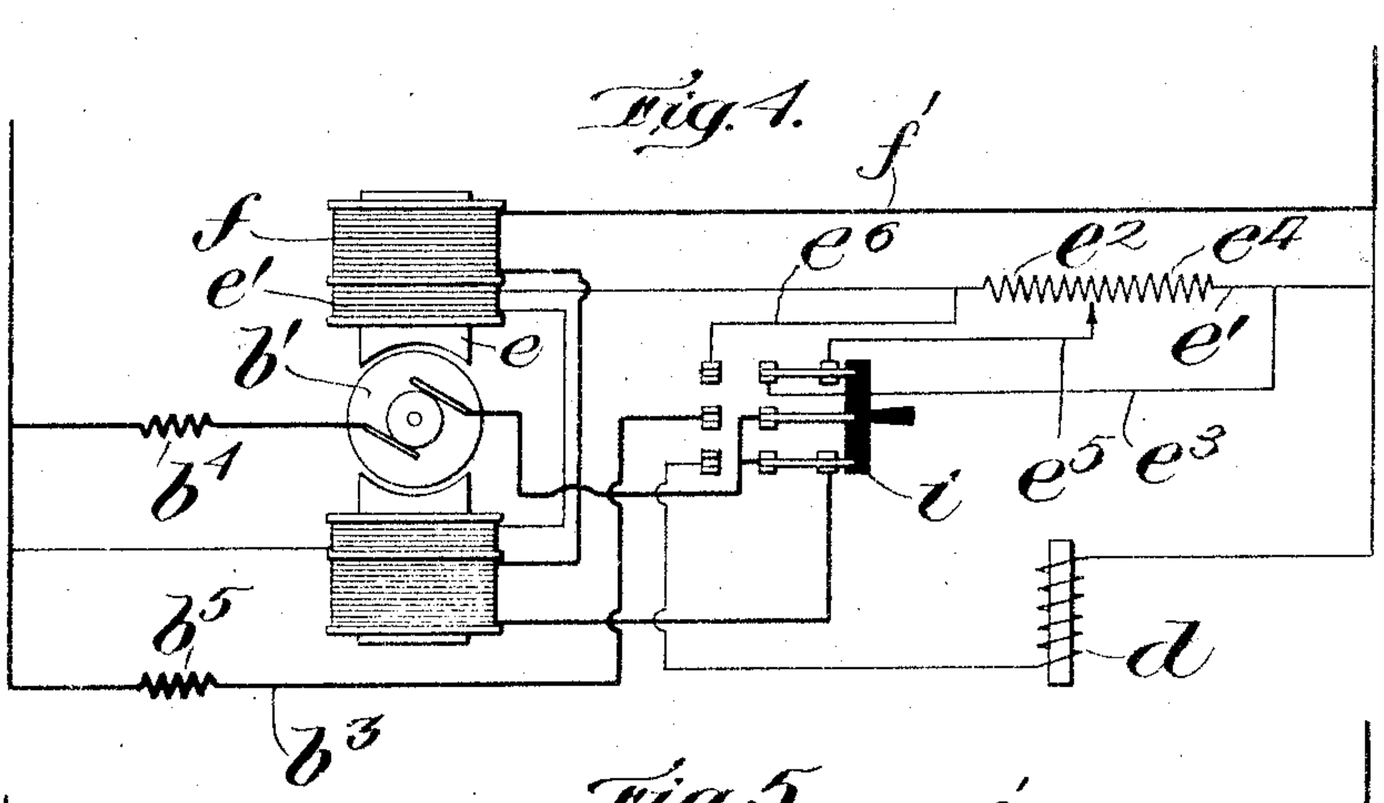
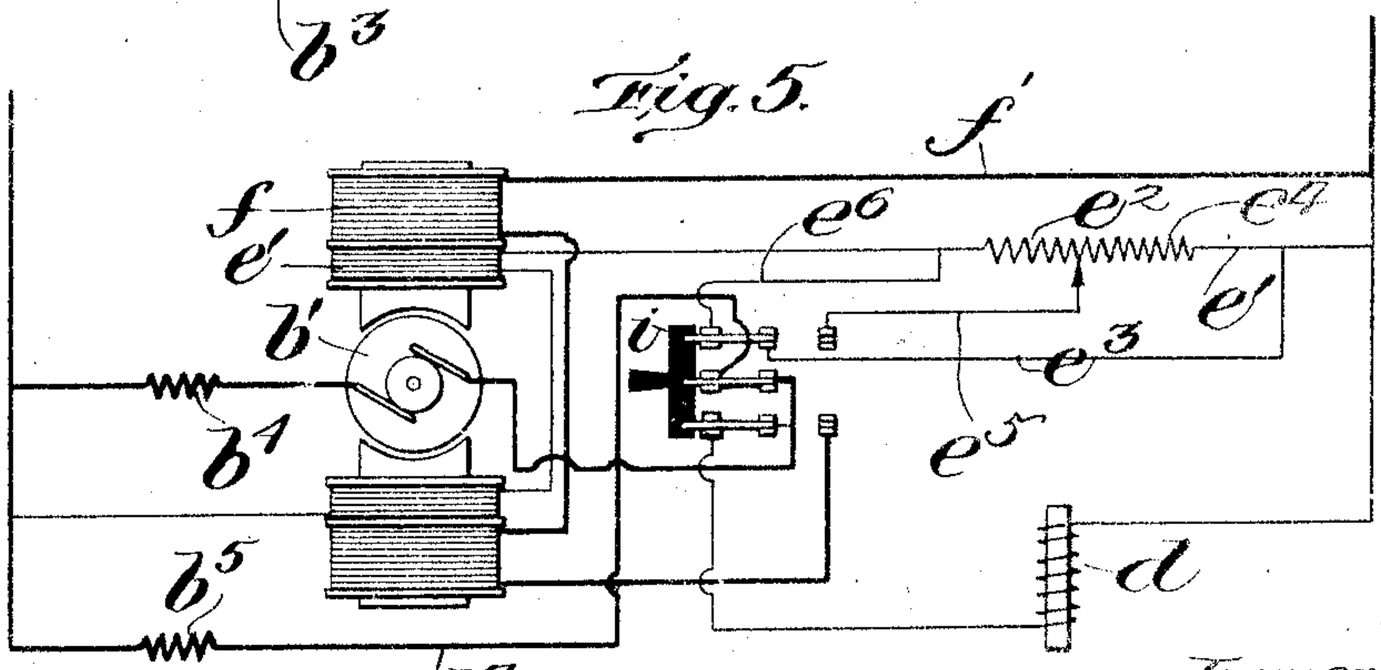


Fig. 5.



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UNITED STATES PATENT OFFICE.

COMFORT A. ADAMS, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO AMERICAN TOOL & MACHINE COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

MEANS FOR CONTROLLING ELECTRICALLY-DRIVEN CENTRIFUGAL MACHINES.

981,601. Specification of Letters Patent. Patented Jan. 17, 1911.

Application filed April 3, 1907. Serial No. 366,091.

To all whom it may concern:

Be it known that I, COMFORT A. ADAMS, citizen of the United States, and resident of Cambridge, Middlesex county, Massachusetts, have invented certain new and useful Improvements in Means for Controlling Electrically-Driven Centrifugal Machines, of which the following is a specification.

This invention has relation to the control of electrically driven centrifugal machines and is intended to provide a construction and arrangement whereby the machine may be quickly brought to a state of rest from its full speed without undue heating of parts and also to provide an advantageous arrangement for employing the driving motor for the purpose of properly checking and arresting the revolution of the machine.

The conditions attending the operation of machines of this type are peculiarly severe and exacting since in certain of its applications to industrial purposes these machines when loaded weigh upward of a ton and are rotated at a high rate of speed approximating 1100 revolutions or more per minute.

When used in sugar houses the duration of actual run for each load is very short, say from two to five minutes, so that the machine has to be started and stopped at very short intervals. Under such conditions the quickness and effectiveness in obtaining a maximum speed as well as in bringing the machine to a full stop is a most important factor in the efficiency and value of the machine. To attain these results advantageously and effectively is the problem which this invention is intended to solve.

Stated briefly and in general terms the invention comprises the combination with a centrifugal machine of an electric motor whose shunt-wound field is connected with the two supply mains and whose armature arranged in an open loop circuit has a direct connection with the two mains, means being provided for breaking the direct connection between the armature and one of the mains and for closing the loop circuit to cause a reversal of the current through the armature. Means are also provided for cutting in a brake actuating coil for the purpose of assisting the reverse current in stopping the machine after said reverse current has decreased in strength owing to the slacking of the armature speed so that it exerts a relatively small force in stopping the machine.

In the accompanying drawings Figure 1 is an elevation partly in section illustrating a direct-connected electrically driven centrifugal machine and its electromagnetic brake and switch by which the proper control of the machine is secured. Fig. 2 is a plan view of the braking members. Fig. 3 is an elevation of a detail of the brake shoe toggle levers. Fig. 4 is a diagrammatic view showing the different electrical connections and the course of the electric currents when the machine is starting and running normally. Fig. 5 is a diagrammatic view showing the electrical connections as they are used to stop the machine.

The centrifugal machine itself may be of any suitable construction and in this case comprises a rotary basket supporting shaft a rotatably mounted in an oscillatory head a' resting in the fixed hanger a^2 and having connection with the motor shaft section b of the driving shaft by means of any suitable form of flexible coupling or joint a^3. The motor shaft b to which the armature b' is secured extends through the supporting bearing bracket c and has secured to its upper end the hollow brake band or wheel b^2 inside of which are mounted the brake shoes c' which are pivoted to a vertical pivoted post c^2 extending upward from the frame C. The exterior of these brake shoes is provided with convex friction faces or blocks adapted to engage the inner annular face of the rotary brake band b^2.

The free ends of the brake shoes c' are engaged by oppositely disposed expansion or toggle levers c^2 whose adjacent ends engage a connecting link c^3 to which is attached the depending pull or draft rod c^4. A retractile spring c^5 serves to normally draw the brake shoes toward each other out of engagement with the rotary brake wheel b^2. In this case I have shown the draft rod c^4 connected to the short end of an actuating lever c^6 which may be used as a hand lever and which has also an actuating rod d' provided with an iron cylinder or core within the solenoid d.

The motor here shown is of the multi-

polar compound-wound type, although the series wound field is not essential in the practice of the invention. The cores or poles e of the field magnets are surrounded by the shunt-wound coil e' which has direct connection with both the mains which supply the current to the machine so that the current flows continuously through this shunt coil. The series wound coil f when employed is connected through the medium of a switch with one of the poles of the armature at one end and with one of the electrical mains at the other end, the other pole of the armature being connected directly with the other main so that when the switch is closed the current will flow through both the series field and the armature but when the connection is broken through the switch no current will flow in this direction from the series field to the armature.

The commutator g is of the continuous current type and should have its brushes adjusted to permit the current to flow in either direction without sparking.

The circuit or conductor e' of the shunt-wound coils is provided with a variable resistance and also with a by-pass, connection being made through the medium of the switch in such a way that during the normal running of the machine the current may be made to pass through any desired portion of the variable resistance, while during the braking operation of the machine this resistance may be entirely cut out by allowing the current to flow around the resistance through the by-pass. This will be more clearly understood by reference to Fig. 4 which represents diagrammatically the arrangement of the connections during the normal operation of the machine. In this case the switch i is thrown to the right and the current from the supply main is flowing through the conductors e', e^3 and e^5 through the resistance e^2 to the shunt-wound coils of the field.

With the switch turned to the right as in Fig. 4 there will be a direct flow of current from the positive to the negative main through the series fields, the armature and the resistance b^4 which is permanently connected into the armature circuit. On the shifting of the switch to the left however, as indicated in Fig. 5, this circuit is broken and as the armature itself is included in the loop circuit b^3 which is closed by the shifting of the switch to the left, the armature then running under the momentum of the machine will now act as a generator producing a flow of current in the reverse direction through the loop circuit b^3. In this loop circuit is interposed a small resistance b^5 as shown.

With the switch thrown to the left the current through the conductor e' will flow to the shunt-wound coils of the field through the by-pass circuit e^3, e^6 passing around the entire variable resistance and thus the current flowing through the circuit of the shunt-wound field coils will be materially strengthened during the braking action so as to more than compensate for the cutting out of the series field during the braking period.

The solenoid d which is in open circuit while the armature is in direct connection with the two mains of the machine, is brought into action and energized by the shifting of the switch to the left so that it begins to exert a pull upon the brake lever to expand and set the brake. In this case one terminal of the solenoid is connected with the positive supply main, while the other terminal is connected with the loop armature circuit b^3. The effect of this arrangement is as follows: Upon throwing the switch from the position shown in Fig. 4 to the position of Fig. 5, the direct flow of the current from the mains through the armature is cut off and a reverse current through the loop circuit which is closed thereby is produced, the momentum E.M.F. which produces this current being at first nearly equal to that of the supply mains and of course, opposite in direction. The work now done by the armature as a generator rotating under the momentum of the machine, serves to rapidly check the speed of rotation and consequently to lower the E.M.F. of the armature. With this decreasing E.M.F. in the loop circuit the intensity of the current passing through the solenoid d is increased owing to the increase in the difference of potential between the two terminals of said solenoid, so that the solenoid acts with increasing strength upon the brake mechanism. By this principle of arrangement the initial braking action is principally that exerted through the employment of the armature as a generator but as the braking effect exerted in this way is diminished rapidly by the slowing up of the armature, a correspondingly increased force is exerted by the electromagnetic brake to arrest the rotation of the machine.

The use of the resistance coil e^2 in the shunt field circuit e' serves to prevent too great a rush of current through the shunt circuit during the starting of the machine, while the cutting out of this resistance in shifting the switch to stop the machine serves to strengthen the shunt current and thus compensate for the loss of the series winding which is then cut out of circuit. The shunt field is much more serviceable during braking as it does not decrease with decreasing speed.

While the use of the series coil is advantageous in that it strengthens the field during the period of greatest load, namely the starting period of the machine, it will be understood that the use of the series winding is not essential in the practice of this invention.

When switch is in central position the extra resistance in shunt-field serves to avoid heating of the field when machine is at rest.

What I claim is:—

1. The combination with a centrifugal machine of a direct-connected motor having shunt-wound field coils in whose circuit is included a resistance coil, an armature, means whereby the supply current to the armature is cut off and a counter-current established through the armature to arrest the revolution of the machine, and means for simultaneously strengthening the shunt field current by decreasing the resistance in its circuit, the means for cutting off the armature current and the means for decreasing the resistance in said shunt circuit being operated by a common lever, substantially as described.

2. The combination with a centrifugal machine of a direct-connected motor having shunt-wound field coils in whose circuit is included a variable resistance, an armature arranged in an open loop circuit and having direct connection with the supply mains, means for cutting off the supply current to the armature and causing a reverse current to flow through the loop circuit to counteract the rotation of the machine, and means for simultaneously increasing the strength of current in the shunt-wound field coils by cutting out the variable resistance included in their circuit, the means for cutting off the current of the armature and for strengthening the shunt field current, being controlled by a common lever, substantially as described.

3. The combination with a centrifugal machine of a direct-connected motor whose armature is arranged in an open loop circuit and has direct connection with the supply mains, said motor having also compound-wound field coils, means for cutting off the supply of current from the mains to the armature and to permit a counter-current in the armature to flow through the loop circuit, and means for simultaneously cutting out the series-wound coils of the field and strengthening the current flowing through the shunt-wound coils of the field, substantially as described.

4. The combination of the rotary driving shaft of a centrifugal machine, said shaft embracing a basket-carrying shaft, and a rigidly mounted electric motor shaft with which said basket shaft is flexibly connected, a brake mechanism connected with the motor shaft, a solenoid for actuating said brake mechanism when energized, a motor whose poles are energized by a continuous current, electrical connections by which the solenoid is energized and the flow of current to the armature is interrupted and the armature itself is caused to act as a generator to produce a reverse or counter current which shall retard the rotation of the machine, substantially as described.

5. The combination of the driving shaft, a compound-wound motor whose armature is directly connected therewith, a loop circuit including said armature, a brake actuating solenoid circuit electrically connected with one of the mains and with said loop circuit, and means for cutting off the flow of current through the series field to the armature for closing said loop circuit and said solenoid circuit in order to produce a counter current of diminishing strength through the loop circuit and a solenoid energizing current of increasing strength, substantially as described.

6. The combination of the rotary driving shaft, a compound-wound electric motor whose shunt circuit includes an extra rheostat, a loop circuit including said armature, a brake actuating solenoid circuit connected with said loop circuit, and means whereby the extra resistance in the shunt-wound coil and the series-wound coil may be cut out at the same time the loop circuit and the solenoid circuit are closed to produce a reverse current in the loop circuit of the armature and to energize the solenoid, substantially as described.

7. The combination of the driving shaft, a direct-connected motor whose field coils are included in a shunt circuit and whose armature is included in a loop circuit, a brake-actuating electric circuit connected with one of the mains and with said loop circuit, and means for cutting off the flow of current from the mains to the armature and closing said loop circuit and said brake circuit to produce a countercurrent of diminishing strength through the loop circuit and a current of increasing strength through the brake circuit.

8. The combination of the driving shaft, a direct-connected motor whose armature and field are arranged in parallel circuits, an electrically-actuated brake, means for short-circuiting the armature to produce a reverse current from the armature, and means for connecting the brake circuit with the supply mains and in series with the short-circuited armature to permit a direct current to flow through the brake circuit in opposition to the electromotive force generated by the armature whereby the decrease in speed of rotation of the armature results in progressively strengthening the action of the brake as the braking action of the reverse current in the armature decreases.

9. The combination of the drive shaft, a direct-connected motor whose armature is included in a loop circuit, an electrically actuated brake, a switch control, connections between the supply mains, the armature, the brake circuit, and the loop circuit, whereby through the shifting of the switch a direct

current is supplied to the brake circuit in opposition to the electromotive force generated by the armature running under the influence of its momentum.

10. The combination of the driving shaft, a direct-connected motor, means whereby the motor armature may be short-circuited to produce a reverse current and thereby retard the rotation of the shaft, a brake-actuating circuit, and connections whereby a direct current through said brake circuit may be opposed to the reverse current generated by the armature in order to cause the brake to act with increasing effect as the speed of rotation diminishes.

In witness whereof, I have hereunto set my hand, this first day of April, 1907.

COMFORT A. ADAMS.

In the presence of—
GEO. N. GODDARD,
KATHARINE A. DUGAN.