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INTERMITTENT CURRENT OPERATED MOTORS

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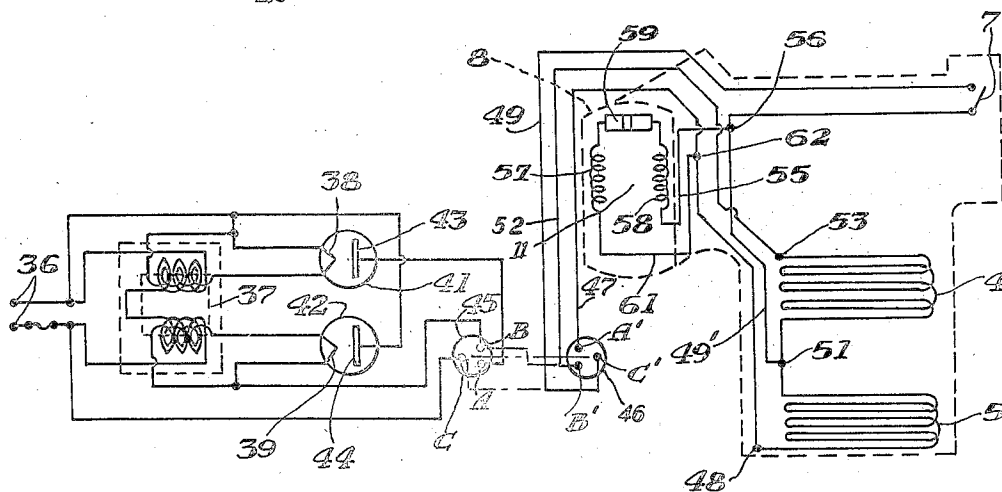
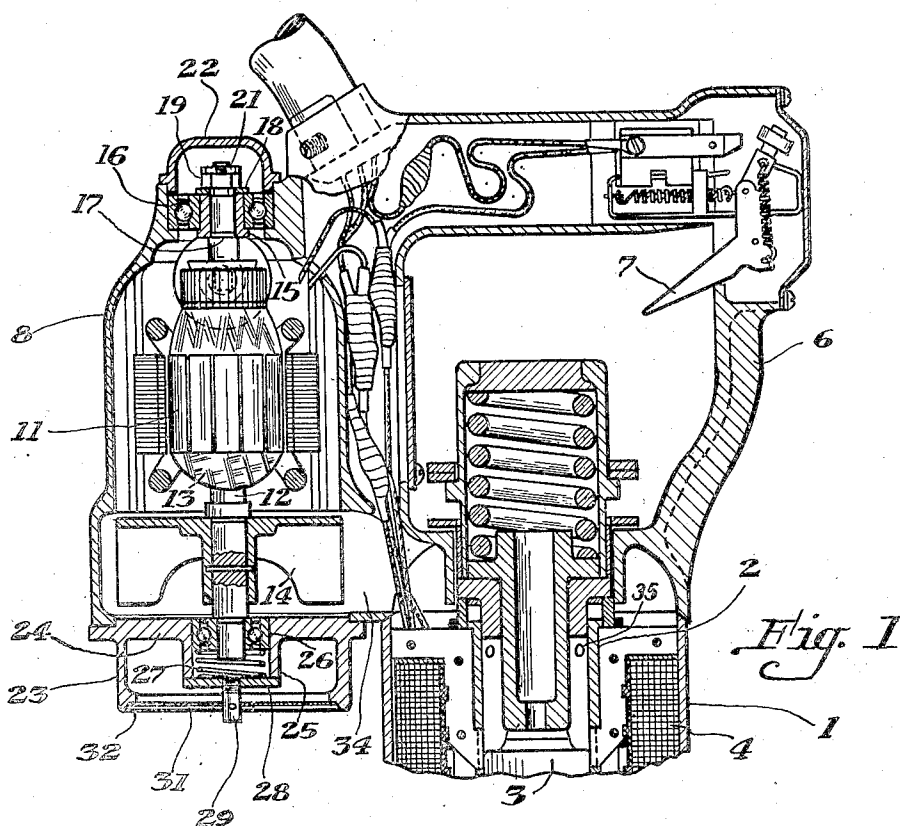


Fig. 2

31

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INTERMITTENT CURRENT OPERATED
MOTOR

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18 Claims. (Cl. 172-240)

1

The present invention relates to vibratory or reciprocatory motors operated by interrupted current impulses, and relates in particular to the operation of cooling means for such motors.

According to the present invention I connect a rotary motor preferably of the series wound type in shunt with a vibratory or reciprocatory motor operated by interrupted current impulses. By connecting the motors in this way I am able to increase the speed of the rotary motor considerably above the speed it would have if operated alone by interrupted current impulses of the same frequency, and in addition, the vibratory or reciprocatory motor operates at a lower temperature range. I believe that the counter electromotive force set up by the collapsing field of the vibratory motor is dissipated into the rotary motor thus removing a source of heating of the vibratory motor and providing an additional electric current for operating the rotary motor that increases its speed. If desired, a series motor may be employed in conjunction with the reciprocatory or vibratory motor for its cooling effect alone, but I prefer to operate a fan or blower or pump by the series motor to supply cooling fluid to the vibratory or reciprocatory motor and thus utilize the energy thereof. The term vibratory as herein employed is intended to generically include reciprocatory motors as well.

In applying the invention to a reciprocatory hammer, I mount the series motor and fan upon the hammer handle to cool the hammer motor, and thus am able to double the impact power of the hammer per unit of weight. The axis of the series motor preferably is arranged parallel to the axis of the reciprocatory hammer and the bearings thereof are constructed to resist shock.

The invention will be described in greater detail in connection with the accompanying drawing wherein there is shown a preferred form of the invention by way of example, and wherein:

Figure 1 shows a series wound motor operated fan mounted on a reciprocatory hammer handle, part of the hammer structure being broken away, and

Figure 2 is a wiring diagram showing how the series motor and reciprocatory motor are connected electrically.

Referring to the drawing, there is shown at 1 an electrically operated vibratory motor of the type known as a reciprocatory hammer of any suitable construction, preferably comprising a barrel 2, a free piston 3 therein and plurality of coils 4, 5 (Fig. 2) surrounding the barrel and adapted to be actuated by interrupted unidirectional

2

current obtained from an alternating current source through a rectifier in known manner. The hammer is of known construction, and has a handle structure 6 within which is a trigger type operating switch 7. Mounted on the hammer casing in any suitable manner is the casing 8 housing a combination fan and series motor 11. The motor 11 has an armature shaft 12 carrying an armature 13 and fan 14 suitably pinned thereto. At one end shaft 12 carries a flanged sleeve 15 which rotates in a ball bearing assembly 16 and is held on the shaft against a shoulder 17 by a resilient retaining washer 18, overlapping the inner ring or race of the ball bearing assembly, and a castellated nut 19 and cotter pin 21. The upper bearing is covered by a dust proof cap 22.

The bottom portion 23 of the casing is attached thereto in any suitable manner and has spokes 24, with openings therebetween and which hold a central hub 25 containing the lower ball bearing assembly 26 mounted with its inner race on the lower end of shaft 12. The ball bearing assembly is slidably mounted in a bore in the hub 25 so that it may have a longitudinal movement limited by resilient washer 18 and a spring 27 engages the outer ring of the ball bearing at its one end and a plate or cover 28 at the other end to cushion the longitudinal movement of shock of the shaft. Plate 28 is secured to the hub in any suitable manner and carries a stub 29 threaded therein to receive a foraminous plate or screen 31 resting at its periphery on an internal shoulder 32. The fan 14, which preferably is of the centrifugal type, draws air through the screen 31 and discharges it through opening 34 in the hammer housing into the interior of the hammer casing 1 where it serves to cool the hammer coils and discharges through suitable openings 35 provided at each end of hammer band 2 into the interior of the barrel.

The operation of the invention will be explained with reference to the wiring diagram of Figure 2. Single phase alternating current is supplied across the terminals 36 to a transformer 37 which supplies heating current for the filaments or cathodes 38 and 39 of the vacuum tube rectifiers 41 and 42 having anodes or plates 43 and 44. Anode 43 and cathode 39 are connected to a suitable receptacle 45 having terminals A, B and C adapted to receive a plug 46 having prongs A', B' and C'. Prong A' is connected by wire 47 to the terminal 48 of coil 5; prong C' is connected by wire 49' to a terminal of switch 7, the other switch terminal being connected by wire 49 to the mid terminal 51 between coils 5 and

3

4; and prong B' is connected by wire 52 to the terminal 53 of coil 4. A wire 55 connected at terminal 56 on wire 49' leads to the field and armature coils 57 and 58 of the fan motor 11 connected in series by brushes 59 in known manner, and a wire 61 connects at terminal 62 on wire 47.

Alternating current is derived at the terminals 36 from any suitable alternating current source such as, for example, an ordinary electric lighting circuit carrying sixty cycle alternating current, or any other frequency, and rectifiers 41 and 42 pass divided complementary current impulses of opposite polarity separated by zero current intervals to the coils 4 and 5 of the hammer. The current impulses of one polarity passing through rectifier 42 pass through terminals B, B', and common return terminals C, C' and are led to coil 4 through wires 42, 49' and 49, and the current impulses of opposite polarity passing through rectifier 41 pass through terminals AA' and common return terminals CC', and are led to coil 5 through wires 47, 49' and 49. Current also is supplied by the rectifiers to the motor 11 which receives impulses from both rectifiers 41 and 42, the motor being connected in shunt or parallel with coil 5, and both the hammer motor and the series motor are connected through the common trigger switch so that neither operates without the other.

In one embodiment of the invention the fan motor operates at about six thousand to sixty five hundred revolutions per minute when operated in this circuit without the hammer connected. When the hammer is connected and is operating, the fan motor will operate at about ten thousand to eleven thousand revolutions per minute. This difference in speed I believe is due to the generated counter electromotive force due to the collapsing field of the hammer windings at the end of each current impulse which supplies an induced voltage across the terminals of the series motor.

It is preferred to connect the series motor in parallel across the ends of coil 5 which pulls the piston downward for thereby we obtain about eight per cent. more impact power than when the series motor is connected in parallel across coil 4 which pulls the piston upward. The hammer motor operates at a higher efficiency and at a lower temperature which is believed to be due to the fact that this counter electromotive force circulates a current through the fan motor, and the increased cooling stream of the fan, thus enabling the hammer to be designed with an overall lower weight and greater power per unit of weight than if an independent fan motor were employed.

In a portable manually supported tool of this type the maximum weight and size is limited by the requirement of easy manipulation, and it is desirable to obtain the maximum power per unit of weight. To obtain substantially the same impact power without the cooling fan, it would be necessary to make the hammer twice as large as one preferred embodiment of the invention with a corresponding increase in weight.

In the preferred embodiment employing a two coil hammer, the hammer piston is moved in one direction by one coil and is moved in the opposite direction by the other coil, as shown and described in Patent 1,797,253 issued March 24, 1931, to Carl S. Weyandt, the invention of course not being limited to this specific type of hammer motor.

4

What we claim as our invention and desire to secure by United States Letters Patent is:

1. In combination, a vibratory armature motor having a plurality of actuating coils, a series wound rotary motor connected in shunt with one of said coils of the vibratory motor, a source of alternating current, and a rectifier interposed between said source and each of the actuating coils to supply alternate spaced unidirectional current impulses thereto, whereby the operating efficiency of both motors is increased over that when operated independently by the rectifier.

2. In combination, a series wound rotary motor, a second motor having two coils with one connected in shunt with the first motor, and a source of unidirectional intermittent pulsating current supplied alternately to said coils for operating said motors, whereby the operating efficiency of both motors is increased over that when operated independently from the intermittent pulsating current.

3. In combination, an electric hammer motor of the reciprocating armature type comprising a casing and a pair of actuating coils in said casing, a series wound rotary motor mounted on said casing and connected in shunt with one of said actuating coils, a fan driven by said rotary motor for supplying cooling air to said hammer, a source of alternating current, and a rectifier interposed between said source and each of said coils to supply alternate spaced unidirectional current impulses thereto, whereby the operating efficiency of both motors is increased over that when operated independently by the rectifier.

4. In combination, an electric hammer of the reciprocating armature type, a handle for manipulating said hammer, a rotary motor casing mounted on said hammer and carrying a motor field, a rotary armature in said field having its axis of rotation parallel to the axis of reciprocation of the hammer, a fan in said casing driven by said motor to supply cooling air to said hammer, a fixed bearing at one end of the rotary motor casing for carrying one end of the armature, a floating bearing at the other end of the rotary motor casing for carrying the other end of the armature, and resilient means for urging the armature against the fixed bearing and for absorbing destructive shock due to the impact of the electric hammer.

5. In combination, a vibratory armature motor having a plurality of actuating coils, a series wound rotary motor connected in shunt with one of said coils of the vibratory motor, a source of unidirectional intermittent pulsating current supplied alternately to said coils, and a single pole switch connected between said source to control the operation of the two coils and the series motor for controlling the operation of both said motors, whereby the operating efficiency of both motors is increased over that when operated independently from the intermittent pulsating current.

6. In combination, an electric hammer comprising a casing, a plurality of actuating coils in said casing, a free armature adapted to be reciprocated therein by said actuating coils, a series wound rotary motor mounted on said casing and connected in shunt with one of said actuating coils, a fan driven by said rotary motor for supplying cooling air to said hammer casing, and a source of unidirectional intermittent current impulses supplied alternately to said coils for

5

actuating said motor and hammer, whereby the operating efficiency of both the motor and the hammer is increased over that when operated independently from the intermittent pulsating current.

7. In combination, an electric hammer comprising a free piston, a plurality of actuating coils surrounding said piston, a source of unidirectional intermittent current impulses for actuating said coils whereby one coil pulls the piston downward and the other coil pulls the piston upward, a series wound rotary motor mounted on said hammer and connected in shunt with the downward pulling coil, and a fan driven by said rotary motor for supplying cooling air to said hammer.

8. In combination, a vibratory armature motor comprising a free piston, a plurality of actuating coils surrounding the piston and arranged to actuate the same, a series wound rotary motor in shunt with one of said coils, and a plurality of rectifiers connected to a source of alternating current for supplying separated current impulses to said coils, whereby the operating efficiency of both motors is increased over that when operated independently by the rectifiers.

9. In combination, a vibratory armature motor comprising a free piston, a plurality of actuating coils surrounding the piston and arranged to actuate the same, a series wound rotary motor in shunt with one of said coils, a plurality of rectifiers connected to a source of alternating current for supplying separated current impulses to said coils and motor, and a single pole switch for controlling the flow of current to both of said motors, whereby the operating efficiency of both motors is increased over that when operated independently by the rectifiers.

10. In combination, a vibratory armature motor having a plurality of coils, a rotary motor connected in shunt with one of said coils of the vibratory motor, and a source of unidirectional intermittent pulsating current supplied alternately to said coils for operating said motors, whereby the operating efficiency of both motors is increased over that when operated independently from the intermittent pulsating current.

11. In combination, a rotary motor, a second motor having a plurality of coils one of which is connected in shunt with the first motor, and a source of unidirectional intermittent pulsating current supplied alternately to said coils for operating said motors, whereby the operating efficiency of both motors is increased over that when operated independently from the intermittent pulsating current.

12. The structure of claim 4 characterized in that the floating bearing is adjacent the working end of the electric hammer.

6

13. The structure of claim 7 characterized in that the current generated by the self-induced voltage of the downward pulling coil during the intervals between the spaced current impulses circulates through the series motor and increases the impact force of the hammer.

14. The structure of claim 7 characterized in that the current generated by the self-induced voltage of the downward pulling coil during the intervals between the spaced current impulses increases the speed of the series motor over that which it would operate alone at the same potential and produce a greater stream of air for the same size motor and also increases the impact force of the hammer.

15. In combination, an electric hammer motor having two operating coils, a source of alternating current, rectifiers interposed between the alternating current source and the coils of the hammer motor to supply alternate spaced unidirectional current impulses to the coils, a rotary motor connected on the load side at one of said rectifiers, a blower driven by the rotary motor to produce a stream of air for cooling the hammer motor, and the current generated by the self-induced voltage of the hammer motor coils during the intervals between the spaced current impulses causing an increase of the speed of the rotary motor over that which it would operate alone at the same potential, producing a greater stream of air for the same size motor.

16. In combination, a source of alternating current, a vibratory armature motor having a plurality of actuating coils arranged to operate the armature in opposite directions, a connection from one side of the alternating current source to one end of said coils, a connection from the other side of the alternating current source to each of the other ends of said coils, a rectifier interposed in each of the last named connections for supplying alternate current impulses to said coils, a series wound rotary motor in circuit between the first connection and the second connection on the load side of one rectifier whereby the power stroke of the armature of the vibratory armature motor is increased in the direction of the shunt connected coil and the speed of the series motor is increased over that which it would operate alone at the same potential.

17. The structure of claim 16 which also includes a switch in the first connection to interrupt the flow of current in the coils.

18. The structure of claim 16 which also includes a switch in the first connection to interrupt the flow of current in the coils and the series wound motor.

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