Oct. 1, 1957 C. H. SPITLER 2,808,238

CONCRETE VIBRATOR

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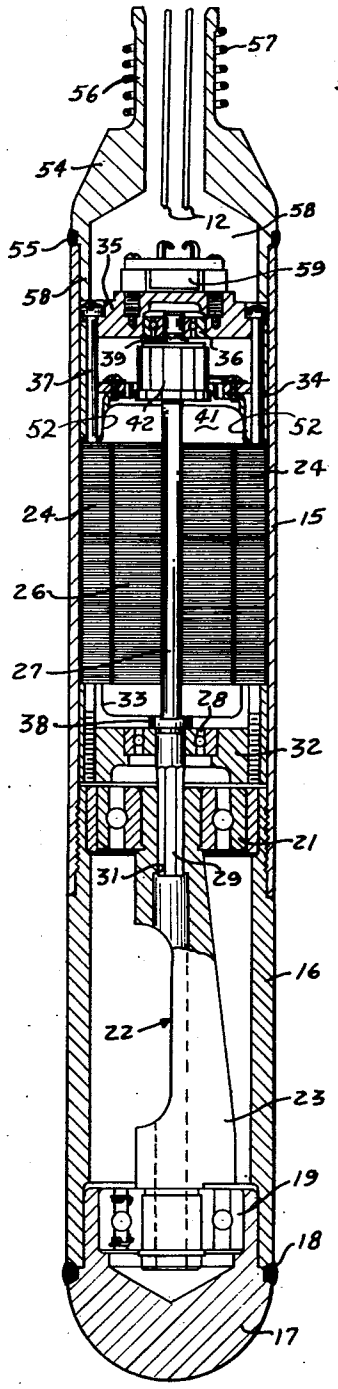


Fig- 2

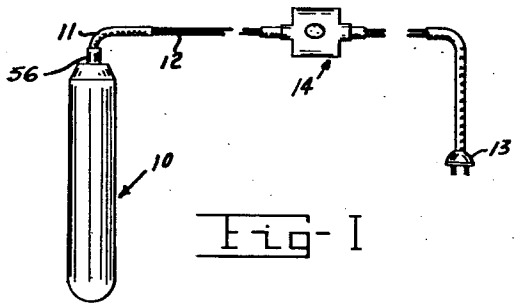


Fig- 1

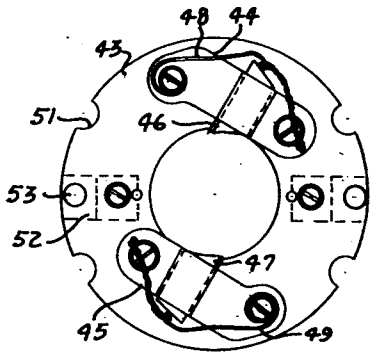


Fig- 3

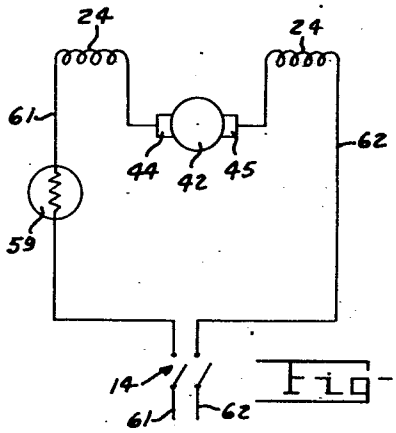


Fig- 4

INVENTOR.
CLEM H. SPITLER
BY Tom Walker

United States Patent Office

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CONCRETE VIBRATOR

Clem H. Spitler, Dayton, Ohio, assignor to Master Vibrator Company, Dayton, Ohio, a corporation of Ohio

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9 Claims. (Cl. 259—1)

This invention relates to submersible power tools, for example, concrete vibrators, and particularly to a tool of the kind described in which the motor is a part of the submersible tool and remotely controlled.

The object of the invention is to simplify the construction as well as the means and mode of operation of concrete vibrators, whereby such vibrators may not only be economically manufactured, but will be more efficient and satisfactory in use, adaptable to a wide variety of applications, and be unlikely to get out of repair.

An object of the invention is to incorporate in a tool of the kind described a universal commutator type of motor, and thereby to obtain in a concrete vibrator or like device the well known advantages of such a motor.

Another object of the invention is to provide in the tool a thermal overload control whereby operation of the motor automatically will be interrupted in the event of overheating.

Still another object of the invention is to construct the motor and associated parts in a unitary assembly in a manner substantially precluding damage thereto from the strenuous conditions of use associated with concrete vibrating tools.

A still further object of the invention is to provide a generally new mode of mounting and of actuating the commutator brushes.

A further object of the invention is to provide a concrete vibrator possessing the advantageous structural features, the inherent meritorious characteristics and the mode of operation herein mentioned.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompany drawings, or their equivalents.

Referring to the accompanying drawing wherein is shown one but obviously not necessarily the only form of embodiment of the invention,

Fig. 1 is a view of a concrete vibrator constructed in accordance with the illustrative embodiment of the invention and including the cable and switch mechanism associated therewith;

Fig. 2 is a view at an enlarged scale and in longitudinal section of the vibrator tool of Fig. 1;

Fig. 3 is a top plan view in detail of the commutator brush holder; and

Fig. 4 is a diagram of the electrical circuit by which the motor is activated and controlled.

Like parts are indicated by similar characters of reference throughout the several views.

Referring to the drawings, a power actuating unit in accordance with the instant invention, may in accordance with the illustrated embodiment of the invention take a form as shown in Fig. 1 wherein a concrete vibrating tool **10** is suspended from cable means **11**, the latter in-

cluding electrical conductors **12** extending from a plug **13**. The latter is adapted to be connected to a source of electrical power, which may be a portable power generating unit. There is interposed in the cable **11** and electrical conductors **12** a manually operated switch mechanism **14** by which the supply of electrical power to the concrete vibrator **10** may be controlled. Powered by the electrical current so supplied, a motor in the device **10** rotates an eccentrically mounted weight, as will hereinafter more clearly appear, for a gyrating motion of the device **10**, which motion is under control of a relatively remotely located operator who holds the control switch **14**.

Considering the vibrating unit or device **10** in greater detail, it may be seen to include a cylindrical housing **15**, one end of which is internally threaded to receive a reduced diameter externally threaded end of a housing **16** which is thus aligned with and forms a continuation or extension of the housing **15**. The connection afforded is a rigid yet releasable one. Installed in the other end of the housing extension **16** is a rounded closure member **17** which may be integrally united with the housing extension as by means of a weld **18**. Within the closure member **17** is a bearing **19** and there is received in the first mentioned or inner end of the housing extension **16** a bearing **21**. An eccentrically weighted member **22** has its ends rotatably mounted in the bearings **19** and **21**. Thus, the part **22** has aligned ends coaxially disposed in the housings **15** and **16** and a laterally offset portion **23** which in response to rotary motion of the part in the bearings **19** and **21** produces an unbalanced condition resulting in a swinging, gyrating motion of the housings **15** and **16**.

The housing **15** provides a mounting for the motor, which includes a field assembly **24** concentrically arranged in the housing **15** and an armature **26** coaxially disposed therein. Forming in effect an integral part of the armature **26** is a central shaft **27** which at its lower or one end extends through and beyond a bearing **28** and is formed with an irregularly shaped extension **29** received in a similarly shaped socket **31** in the part **22**. Rotation of the armature **26**, and of the shaft **27** which is a part thereof, is effective rotatively to drive the weighted part **22**.

The connection between the housings **15** and **16** is a releasable one in order that the housing extension **16** may be readily removed and replaced with the same or a like driven tool. It may be noted, in this connection, that the connection between the shaft **27** and the part **22** is disabled by the act of separating the housings **15** and **16** and is enabled by relative motion of the housings in an opposite or approaching or assembling sense.

The bearing **28** is mounted in a plate **32** having upstanding finger portions **33** in contacting supporting relation to one end of the field assembly **24**. At the opposite end, the field assembly **24** is engaged by one end of a spacer sleeve **34** which at its other end is in contacting supporting relation to an upper bearing plate **35**. Recessed in the under surface of the plate **35** is a bearing **36** receiving the other or opposite end of the shaft **27**.

The bearing plates **32** and **35**, spacer sleeve **34** and field assembly **24** occupy an interconnected relatively stationary relation to one another by virtue of longitudinal bolts **37** which extend from the bearing plate **25** downward through the sleeve **34** and field assembly **24** to the bearing plate **32**. The armature shaft **27** is, as has been seen, mounted for relative rotary motion in the bearings **28** and **36**, and is held against longitudinal motion by shoulders **38** and **39** thereon respectively abutting the bearings as described.

The bearing plate **35**, together with the adjacent end

of the motor assembly, defines a chamber **41** in the peripheral area of which are the bolts **37** and in the center of which is the shaft **27**. A commutator ring **42** is fast on the shaft **27** in the space **41** and it in turn is surrounded by a non-conductive disc **43** on which are oppositely disposed brush holders **44** and **45**. Brushes **46** and **47** are in respective holders **44** and **45** and are urged by respective springs **48** and **49** toward the center area of the disc where they engage and ride on the surface of the commutator **42**. The springs **48** and **49** insure a continuous contact of the brushes with the commutator ring despite vibration and other causes which may tend momentarily to break such contact.

In the periphery of the disc **43** are semi-circular cutouts **51** through which pass power supply leads to the motor assembly. Also, bracket-line feet **52** are fastened to the underside of the disc and rest on the field assembly **24**. The disc **43** and feet **52** are formed with aligned openings **53** for passage of the bolts **37** therethrough. According to the construction and arrangement of parts, it will be understood, the disc **43** is held against rotation with the commutator ring **42** and in effect becomes a part of the interconnected assembly of relatively stationary motor elements.

The upper end of the device **10**, or that end receiving the cable **11**, is closed by a member **54** welded to the top of housing **15**, as at **55**. Projecting upwardly from the body of part **54** is a tubular projection **56**, to which is connected one end of the cable **11** and over which a strain relief spring **57** is fitted. At the opposite or inner end of the part **54** is a reduced diameter cylindrical portion **58** received in the upper end of the housing **15** and substantially abutting the upper surface of the bearing plate **35**. The part **54** is open throughout its length for entrance of the conductors **12** into a space **58** above the plate **35**. The conductors **12** are suitably connected to the electric motor, within the housing **15**, and interposed in such connection is a thermal overload switch **59** mounted on the bearing plate **35** in position to be subjected to the heat generated in bearing **36** and in the chambers or spaces **41** and **58**. In the event of overheating, or of a rise in temperature above a predetermined value the switch **59** operates to open the circuit through the motor and thus to discontinue its operation until the temperature has decreased, whereupon the circuit is automatically reclosed.

The thermal overload switch **59** is, or may be, of a conventional kind as are the electrical connections to and from the motor, of which the switch **59** is a part. Thus, and as shown in Fig. 4, the conductors **12** may be considered to comprise electrical leads **61** and **62** extending from a source of electrical power. The switch **14** is represented therein as of the double pole single throw kind which when it is closed tends normally to establish a circuit through line **61** to field assembly **24**, brush **44**, commutator ring **42**, brush **45** and thence to field assembly **24** and back by way of lead **62**. The thermal switch **59** is interposed in lead **61** and when open interrupts the flow of current as described irrespective of the position of switch **14**.

Concentricity of the housing members **15** and **16** is insured by accurately machining the contacting threaded surfaces thereof. Such surfaces are machined in concentric relation with the bores of the housing. The threaded connection between the housing member **15** and **16** maintains mechanical connection of the two units and provides a seal against entrance of water or other foreign materials to the inside of the vibrating unit.

The present vibrator construction utilizes a universal type A. C.-D. C. motor. Being of the commutator type, the motor may be connected to either single phase A. C. current or to a source of direct current. The motor is of high speed characteristics operating at approximately 28,000 R. P. M. under no load conditions. With the weight **22** applied thereto, and the entire unit comprising

the housings **15** and **16** assembled, the rotation of the motor is in the neighborhood of 15,000 R. P. M. or slightly over. When the assembled vibrator is placed within a mass of fresh concrete the unit has a speed of approximately 8,000 to more than 12,000 R. P. M. depending on the consistency of "slump" of the concrete being vibrated. With such high speed operation the vibratory impulses delivered to the mass of freshly poured plastic concrete are of high frequency which provides for better compaction and working of the concrete than vibrators heretofore known. While there have been vibrators heretofore used which produce high frequency vibration of the concrete, such vibrators required special power supply units which produced high frequency A. C. current. By this is meant the frequency of the A. C. current was in excess of the standard or conventional 60 cycle current normally employed. The ability to use the present vibrator unit connected to either a standard 60 cycle single phase A. C. power supply or a source of D. C. current while still producing high frequency vibration of the plastic cement is of considerable advantage since it eliminates the need for the contractor to provide a special power supply and permits use of conventional power supplies normally obtainable on any construction job. Prior to development of the present unit, use of conventional power supply (60 cycle single phase A. C.) produced speeds of less than 3600 R. P. M., the maximum synchronous speed at "no-load" of the induction or "squirrel-cage" motors which have heretofore been used as the driving means for prior art vibrators.

The construction of the vibrator shown herein is such that a minimum amount of vibration is produced in the region of the commutator **42**. The minimum amount of vibration at this particular point is achieved through use of the tapered weight **22**. The design of this weight is such that a cross-over of vibration is provided in the region of the commutator and its associated brushes. In other words, the vibrator shown herein becomes in a sense a pendulum swinging about a center approximately at the area occupied by the commutator and the brush ring. The vibration effect at this point is substantially neutralized, thereby improving the operation of the commutator inasmuch as the brushes **46** and **47** are not subjected to excessive vibration. The brushes therefore do not bounce or vibrate on the commutator and excessive wear and arcing is consequently eliminated.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. A concrete vibrator having a contained electric motor, including a housing section open at its opposite ends, bearing plates received in the respective opposite ends of said housing section, a field assembly disposed between said plates, bolts extending longitudinally between said bearing plates and defining a unitary assembly of said plates and said field assembly armature means coaxially disposed in said assembly including a shaft rotatably mounted in said bearing plates, a commutator ring on said shaft, a brush mounting ring having its periphery interengaged with said bolts, brushes on said disc engaged with said ring, a cable passing closure for one end of

said housing section, a housing extension on the other end of said housing section, and a weight mounted in said extension and rotatably driven by said shaft, said weight being so formed and connected to said shaft that vibration effects in the area of said commutator and brush ring are substantially neutralized in operation of said motor.

2. A concrete vibrator according to claim 1, characterized in that said cable passing closure has a cylindrical portion received in said one end of said housing and substantially abutting the adjacent one of said bearing plates.

3. A concrete vibrator having a contained electric motor, including a cylindrical housing section open at its opposite ends, a motor field assembly concentrically mounted in said housing between the ends thereof, armature means coaxially disposed relatively to said field assembly and including a shaft projecting through and beyond the opposite ends of said assembly, bearing plates receiving the opposite ends of said shaft, one of said shaft ends extending through and beyond its respective bearing plate, a housing extension detachably mounted on one end of said housing section receiving said one end of said shaft, an unbalanced rotary weight in said extension fixed to and driven by said one end of said shaft, tie bolts extending longitudinally between and through said bearing plates, a commutator ring on said shaft, a brush mounting disc surrounding said shaft and peripherally interengaged with said bolts, brushes on said disc engaged with said bolts, brushes on said disc engaged with said ring, and a cable passing closure on the other end of said housing.

4. A concrete vibrator according to claim 3, wherein electrical connections admitted through said closure are arranged to close a circuit through said brushes, characterized by thermal sensitive means in said housing and connected to said motor for opening said circuit.

5. A concrete vibrator, including aligned tubular housing elements containing respectively an electric motor and an unbalanced rotary weight driven thereby, the adjacent ends of said housing elements being in rigid telescoping engagement with one another, a tubular cable passing member installed in the other end of the housing containing said motor and defining with the motor a space in the said last mentioned housing between said cable passing member and said motor, electric current conductors entering said last mentioned housing by way of said member and passing through said space to electrical connection with said motor to close a circuit therethrough, and commutating means respectively connected to one of said housing elements and to said motor and spaced from said weight to lie in an area of substantially neutralized vibration.

6. A concrete vibrator according to claim 5 wherein said motor includes a shaft having one end projecting into said space, characterized by a bearing plate for said one end of said shaft, and a thermal overload switch mounted on said bearing plate and interposed in said conductors.

7. A concrete vibrator having therein a rotary eccentric weight, including aligned tubular housing members, the adjacent ends of which are in rigid telescoping engagement with one another, a closure member in the opposite end of one of said housing members, the rotary eccentric weight being supported within said one housing member, a cable passing closure member in the opposite end of said other housing member, a universal A. C.–D. C. motor concentrically supported in said other housing, electric current conductors entering said last mentioned housing by way of said cable passing closure member and connected to said motor, and a thermal overload interposed in said conductors between said cable passing closure member and said motor, the construction and arrangement being such that said thermal overload is responsive to excessive temperature within said housing to de-energize the motor until said temperature falls below a predetermined maximum and means mounting said eccentric weight in predetermined spaced relation to said motor to substantially neutralize vibration adjacent to said motor.

8. A concrete vibrator including a rotary eccentric weight at one end thereof, a high speed universal A. C.–D. C. motor at the other end thereof, the output shaft of said motor being connected to said rotary eccentric weight, said weight being spaced from said motor to provide vibration cross-over in the region of said motor, a source of single phase 60 cycle A. C. current or D. C. current to which the motor is connected, the construction and arrangement being such that under load the weight is rotated at a speed in excess 3700 R. P. M. when said motor is energized by single phase A. C. power or D. C. power.

9. A concrete vibrator having a pair of aligned concentric housings, including a universal A. C.–D. C. motor in one of said housings, an eccentric rotary weight in the other of said housings directly connected to the output shaft of said motor for unison rotation therewith, a commutator assembly adjacent one end of said motor including a brush mounting ring, the construction and arrangement being such that the commutator and brush mounting ring are located at a point of minimum vibration of said unit, said point being at the crossover of vibration developed by said rotary weight.

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