Nov. 12, 1968 L. D. CLARK ET AL 3,410,528

CONCRETE VIBRATOR

Filed Oct. 17, 1966

FIG-1

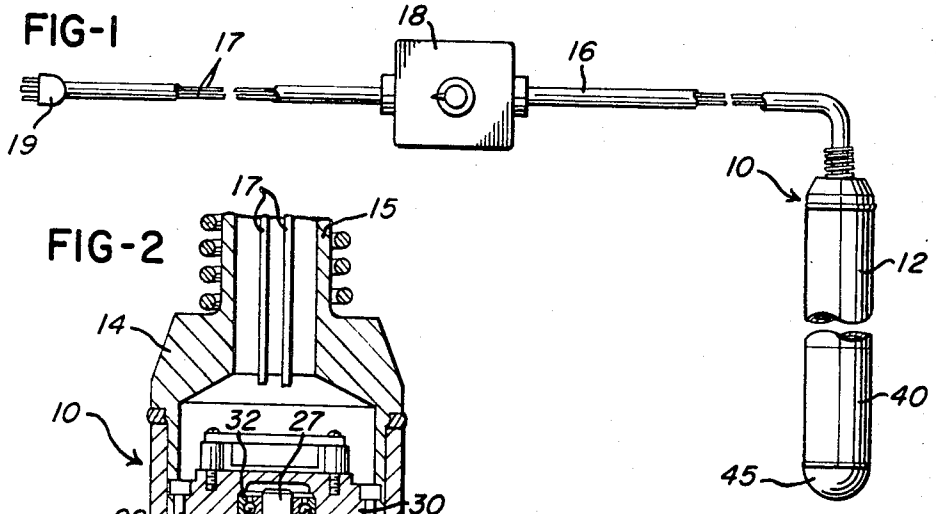


FIG-2

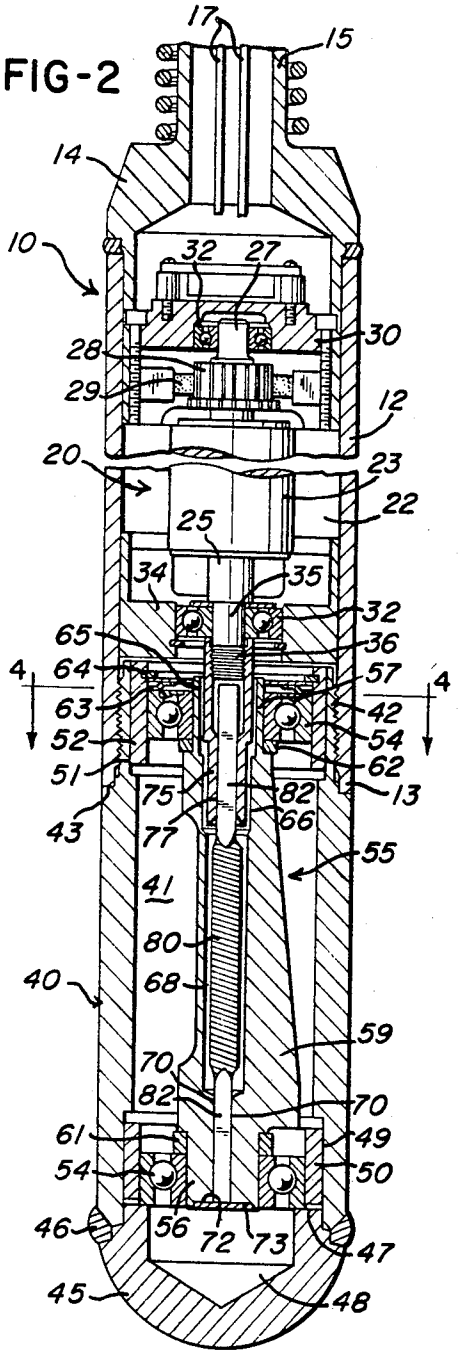


FIG-3

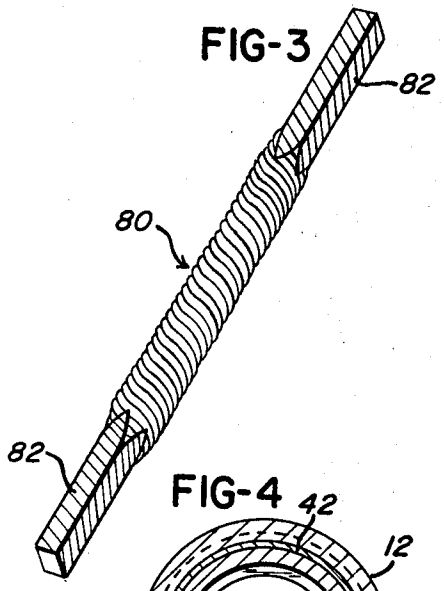
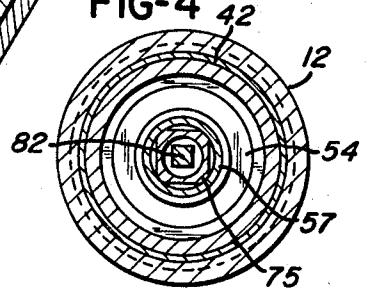


FIG-4



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United States Patent Office 3,410,528 Patented Nov. 12, 1968

3,410,528

CONCRETE VIBRATOR

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Filed Oct. 17, 1966, Ser. No. 587,163
5 Claims. (Cl. 259—1)

ABSTRACT OF THE DISCLOSURE

A concrete vibrator has a self-contained motor including a rigid shaft member with one end positioned adjacent an end of a rotatable weight member. An axially extending cavity is formed within one of the members and receives a shaft which is adapted to flex within the cavity and has one end connected to the weight member and its other end connected to the shaft member of the motor.

This invention relates to portable power tools, and more particularly, to a motor driven vibrator adapted to be submerged in fresh concrete.

The present invention has special relation to a concrete vibrator having a self-contained motor such as shown in Patent No. 2,808,238 issued to C. H. Spitler and assigned to the same assignee as the present invention. To provide substantial vibration energy in such a vibrator, it has been found desirable to employ an eccentric weight having substantial mass. On the other hand, it is desirable to confine the weight within a housing of minimum diameter so that the vibrator can be inserted into a narrow chamber, as for example, between the forms for a thin vertical concrete wall. Thus it is common to employ an eccentric weight having substantial length as compared to its diameter.

It is also desirable to minimize the overall length of the vibrator and thus generally the motor and eccentric weight are arranged in close coupled relationship with a splined connection between the motor shaft and the adjacent end portion of the eccentric weight. Usually, the housing enclosing the eccentric weight is threadably connected to the casing enclosing the motor so that the eccentric weight can be assembled into the housing and the motor assembled into the casing independently, after which the housing and casing are assembled. This construction not only provides for convenient subassemblies but also enables the vibrator to be conveniently serviced after an extended period of use.

It has been found difficult to maintain precise alignment between the rotatable axis of the eccentric weight and the axis of the motor shaft in order to avoid excessive wear of the bearings supporting the eccentric weight and also excessive wear in the spline connection between the weight and motor shaft. Precise alignment can be held by maintaining extremely close machining and grinding tolerances of the assembled components, however, such tolerances significantly increase the manufacturing cost of the vibrator.

Accordingly, it is a primary object of the present invention to provide a concrete vibrator having a self-contained motor and including an improved drive connection between the motor shaft and the eccentric weight so that the need for extremely precise machining and accurate alignment between the motor bearing and the eccentric weight bearings is eliminated.

A more specific object of the invention is to provide a concrete vibrator incorporating a drive motor in closely spaced relationship with an eccentric weight and including a flexible shaft connecting the motor shaft to the eccentric weight.

Another object of the invention is to provide a concrete vibrator as outlined above wherein the flexible shaft has sufficient length to provide a cushioning effect for preventing excessive stresses from being developed within the motor or transmitted between the rotating parts.

Still another object of the invention is to provide a concrete vibrator as outlined above wherein the eccentric weight includes means for receiving the flexible shaft in generally coextensive relationship, with one end of the flexible shaft connected to the motor shaft and the opposite end of the flexible shaft connected to the end of the eccentric weight which is more remotely spaced from the motor shaft.

It is also an object of the invention to provide a concrete vibrator including a drive motor and eccentric weight in closely spaced relationship and incorporating a flexible connecting shaft which is economical in construction and can withstand substantial heat without significantly affecting its strength.

These and other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing—

FIG. 1 is a partially broken away view of a concrete vibrator constructed in accordance with the invention and showing a power supply cable extending therefrom;

FIG. 2 is a partially broken away axial section of the vibrator constructed in accordance with the invention;

FIG. 3 is an enlarged perspective view of the flexible drive shaft shown in FIG. 2; and

FIG. 4 is a transverse section through the vibrator taken generally along the line 4—4 of FIG. 2.

Referring to the drawing which illustrates a preferred embodiment of the invention, FIGS. 1 and 2 show a concrete vibrator **10** which includes a cylindrical casing **12** having a forward portion **13** with internal threads. A plug member **14** is rigidly connected to the rear portion of the casing **12** by a circumferential weld and includes a tubular neck **15**. An electrical supply cable **16** having leads **17** extends from the neck **15** through a control switch **18** to a plug **19**.

The leads **17** supply electricity to a universal motor **20** including a stator **22** retained within the casing **12** and a rotor **23** having a shaft **25**. The rear end portion **27** of the shaft **25** supports a commutator **28** which rotates between a pair of brush contacts **29**, and is supported by a bearing retaining bracket or housing **30**. An anti-friction bearing **32** is mounted within the housing **30** and rotatably supports the rear end portion **27** of the motor shaft **25**. Another anti-friction bearing **32** is retained within a forward bearing housing **34** and rotatably supports the forward end portion **35** of the motor shaft **25**. External threads **36** are formed on the forward end portion **35** of the motor shaft. While FIG. 2 illustrates a universal motor enclosed within the casing **12**, it is to be understood that for purposes for the present invention, the universal motor could be replaced by an induction motor for use on high frequency AC, or by a pneumatic motor, without departing from the scope of the invention.

A cylindrical eccentric-weight-receiving housing **40** defining a chamber **41** and including a threaded tubular neck portion **42** defining an annular shoulder **43**, is connected to the forward end portion **13** of the casing **12** in coaxially aligned relation with the shoulder **43** engaging the end surface of the casing to form a water tight connection therewith. A semi-spherical cap member **45** is secured to the forward end portion of the housing **40** by a circumferential weld **46** and forms an annular shoulder **47** surrounding a grease retaining chamber **48**.

The forward end portion of the housing **40** includes a counterbore **49** in which is press fitted a cylindrical bushing **50**. Similarly, the rear neck portion **42** of the housing **40** is formed with a counterbore **51** in which is press

fitted a bushing **52**. The inner cylindrical surfaces of the bushings **50** and **52** are each ground to reecive the outer races of one of a pair of anti-friction bearings **54** which rotatably support an elongated weight member **55** having end portions or journals **56** and **57** mounted within the inner races of the bearings **54**.

The weight member **55** includes an eccentrically-located tapering portion **59** which has its greatest mass located adjacent the forward journal **56**. The eccentricity of the portion **59** of the weight member produces the gyrating effect of the vibrator when the weight member **55** is rotated within the bearings **54**.

The inner race of the forward bearing **54** is located on the journal **56** of the weight member by a cylindrical spacing ring **61**, and a corresponding ring **62** locates the inner race of the bearing **54** on the journal **57**. A spring member **63** is mounted within the rear bushing **52** and is retained by a snap ring **64** seated within an internal groove formed within the bushing **52**. The spring member **63** biases the weight member **55** forwardly so that the outer race of the forward bearing **54** seats against the shoulder **47** of the cap member **45**.

In accordance with the present invention, a cylindrical bore **65** is formed within the rear journal **57** of the weight member **55** and a cylindrical counterbore **66** of reduced diameter extends from the bore **65** to an elongated cylindrical cavity **68** formed within the central portion of the weight member **55**. A socket opening **70**, preferably square in cross-section, is formed within the forward journal **56** of the weight member **55** and extends from the cavity **68** to a counterbore **72** formed within the end surface of the journal **56**. A plug **73** is press fitted into the counterbore **72** to prevent grease or oil within the chamber **48** from entering the socket opening **70**.

A generally tubular adaptor **75** is threaded onto the forward end portion **35** of the motor shaft **25** and seats against the inner race of the adjacent bearing **32**. A reduced forward portion of the adaptor **75** extends into the counterbore **66** of the weight member **55** and is similarly formed with a square cross-section socket **77** of the same size as the socket **70** formed within the forward journal **56** of the weight member **55**.

An elongated flexible shaft **80** (FIG. 3) formed by overlapping layers of helically wound wire and including swaged square end portions **82**, is positioned within the cavity **68** with the rear end portion **82** of the shaft received within the square socket **77** formed within the adaptor **75** and the forward square end portion **82** of the shaft received within the socket **70** formed within the journal **56** of the weight member **55**. The plug **73** also forms a stop for the shaft **80**. Thus the connection between the motor shaft **25** and the weight member **55** is produced by the adaptor **75** and flexible shaft **80** which directly drives the forward end portion of the weight member where the major portion of the mass is located.

From the drawing and the above description, it can be seen that a concrete vibrator constructed in accordance with the present invention provides several desirable features and advantages. For example, by locating the longated flexible shaft **80** coextensive with the weight member **55** within the cavity **68**, the weight member is driven substantially at its forward end through a flexible drive shaft without affecting the closely spaced relationship between the rear end portion or journal **57** of the weight member **55** and the forward end portion **35** of the motor shaft **25**. Thus by locating the flexible drive shaft **80** within the cavity **68**, there is no increase in the overall combined length of the weight member **55** and motor **20**.

As a result of the flexible drive provided by the flexible shaft **80**, it has been found that it is no longer necessary to maintain extremely close machining and grinding tolerances of the forward end surface of the casing **12** and the annular shoulder **42** in relation to the bearing retaining surfaces formed within the bushings **50** and **52** and within the motor bearing brackets or members **30** and **34**.

Thus the cost of manufacturing the vibrator is significantly reduced.

Other advantages provided by the flexible shaft **80** are that the shaft can be economically produced and, in addition, provides a cushioning effect which substantially relieves the stresses transferred from the weight member **55** to the motor **20**. This cushion effect also prevents excessive wear between the square end portion **82** of the flexible shaft **80** and the mating sockets **70** and **77**. Furthermore, the flexible shaft **80** eliminates excessive stresses from being imposed on the bearings **54** supporting the weight member **55**.

While the drawing shows a preferred construction of the invention wherein the flexible shaft **80** is mounted within a cavity **68** formed within the weight member **55**, it is within the scope of the invention to form a cavity within the motor shaft **25** so that a flexible shaft therein connects the rear end portion **27** of the motor shaft **25** and the rear journal **57** of the weight member **55**, the basic concept of the invention being that the flexible shaft **80** is coextensive with either the motor shaft **25** or the weight member **55** or is located in a position where it is partially coextensive with both the weight member **55** and motor shaft **25**, that is, intermediate the end portion **27** of the motor and the end portion or journal **56** of the weight **55**.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a concrete vibrator including a casing containing a motor (**20**) having a rigid shaft member (**25**) with a first end portion (**27**) and a second end portion (**35**), bearing means (**32**) rotatably supporting said end portions of said shaft member, a housing (**40**) having one end portion (**42**) connected to said casing and an enclosed opposite end portion (**45**), an eccentric weight member (**55**) within said housing and having a first end portion (**56**) and a second end portion (**57**), bearing means (**54**) rotatably supporting said end portions of said weight member on an axis substantially coaxial with the axis of said shaft member, and said second end portion (**57**) of said weight member being disposed in close adjacent relationship with said second end portion (**35**) of said shaft member, the improvement comprising means defining an axially extending cavity (**68**) within one of said members intermediate the corresponding said first and second end portions, an elongated flexible shaft (**80**) extending within said cavity and having first and second end portions (**82**), a substantial portion of said cavity having a cross-sectional area greater than the cross-sectional area of said flexible shaft to permit flexing of said shaft within said cavity, means (**70** and **82**) disposed on one end of said cavity for connecting said first end portion of said flexible shaft to said first end portion of said member having said cavity, and means (**77** and **82**) disposed on the other end of said cavity for connecting said second end portion of said flexible shaft to the other said member for preventing wear of said bearing means due to misalignment between said motor shaft member and said weight member while minimizing the overall combined axial length of said motor and said weight member.

2. A vibrator as defined in claim **1** wherein said second end portion of said weight member forms a tubular journal, said bearing means including an anti-friction bearing rotatably supporting said journal, said means connecting said second end portion of said flexible shaft to said motor shaft member including an adaptor mounted on said motor shaft member and projecting into said tubular journal of said weight member with annular clearance space between said adaptor and said journal, and socket means connecting said second end portion of said flexible shaft to said adaptor.

3. A vibrator as defined in claim 1 wherein said first end portion of said weight member has substantially greater mass than said second end portion of said weight member, said cavity extends axially within said weight member between said first and second end portions, said first end portion of said flexible shaft being connected to said first end portion of said weight member, and said second end portion of said flexible shaft being connected to said second end portion of said shaft member adjacent said second end portion of said weight member.

4. A vibrator as defined in claim 3 wherein said flexible shaft includes overlapping layers of helically wound wire, said first and second end portions of said flexible shaft each having a square cross-sectional configuration, means forming a square socket within said first end portion of said weight member for receiving said first end portion of said flexible shaft, and said means connecting said second end portion of said flexible shaft to said motor shaft member including means forming a square socket for receiving said second end portion of said flexible shaft.

5. The vibrator as defined in claim 4 wherein said bearing means for said weight member include anti-friction bearing means rotatably supporting said end portions of said weight member, said first end portion of said

weight member being disposed adjacent said enclosed end portion of said housing, plug means within said first end portion of said weight member for closing said socket and forming a stop for said first end portion of said flexible shaft, means forming a bore within said second end portion of said weight member and extending to said cavity, and said connecting means for said flexible shaft including an adaptor positioned within said bore and threadably connected to said second end portion of said motor shaft member.

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