Feb. 28, 1939. R. W. BAILY 2,148,722

SUBMERSIBLE VIBRATOR

Filed Oct. 15, 1934 2 Sheets-Sheet 1

Fig. 2.

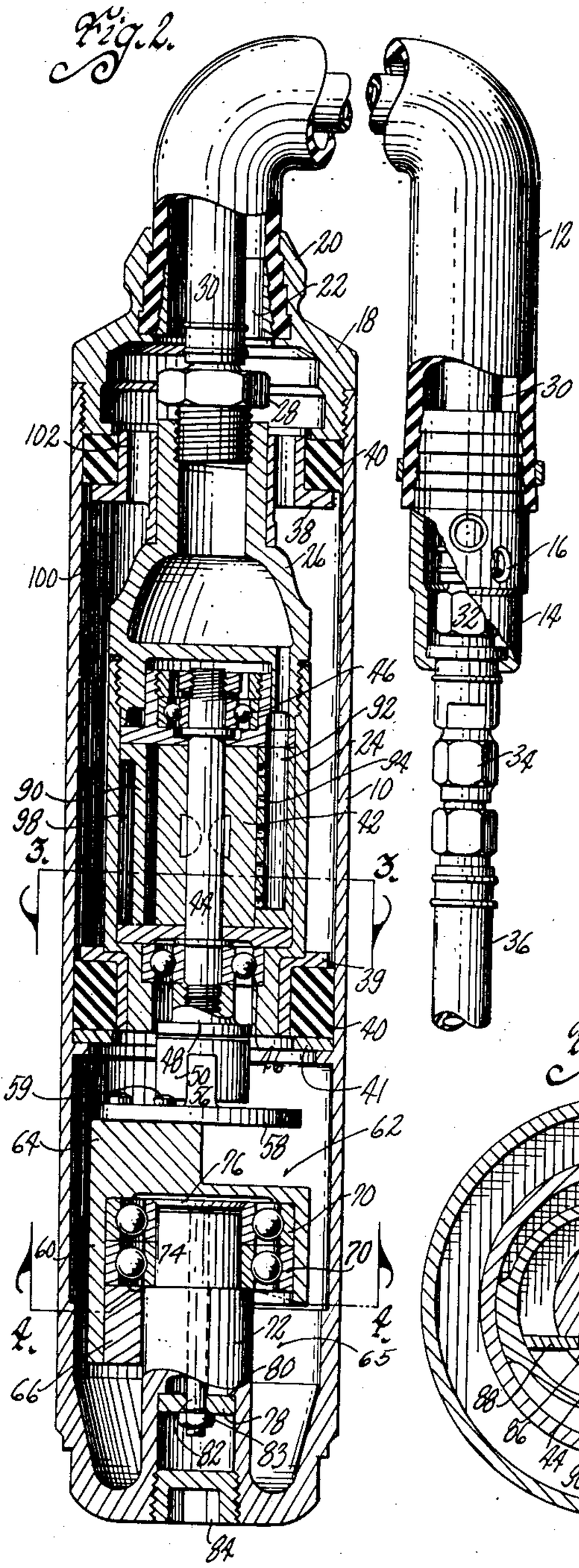


Fig. 4.

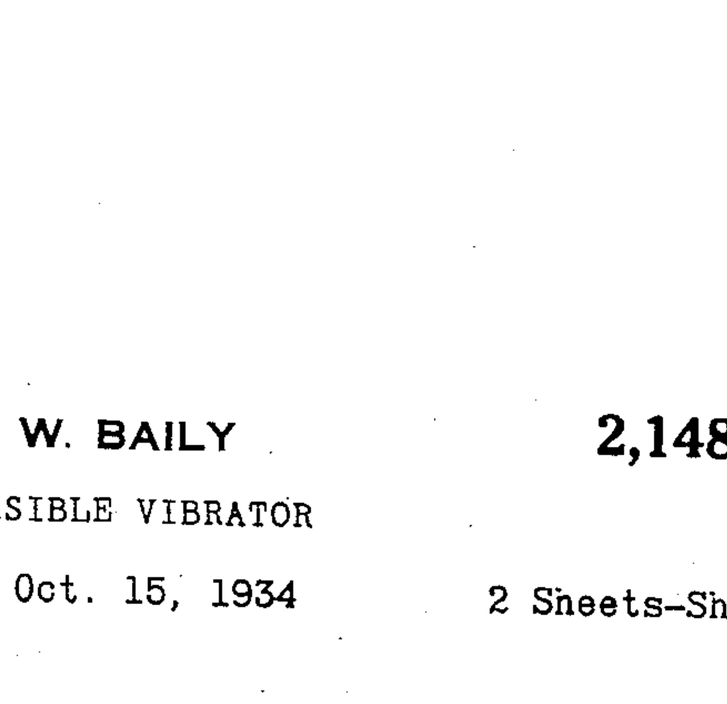


Fig. 1.

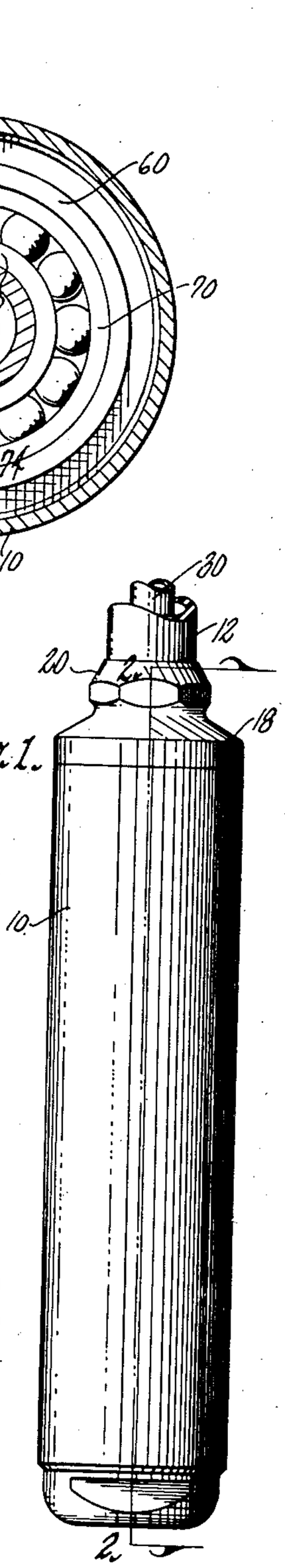
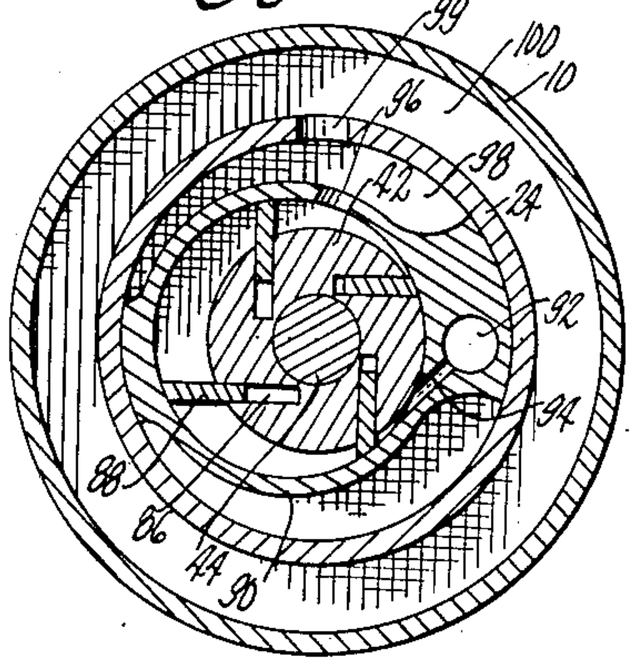


Fig. 3.



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Filed Oct. 15, 1934 2 Sheets-Sheet 2

Fig. 6.

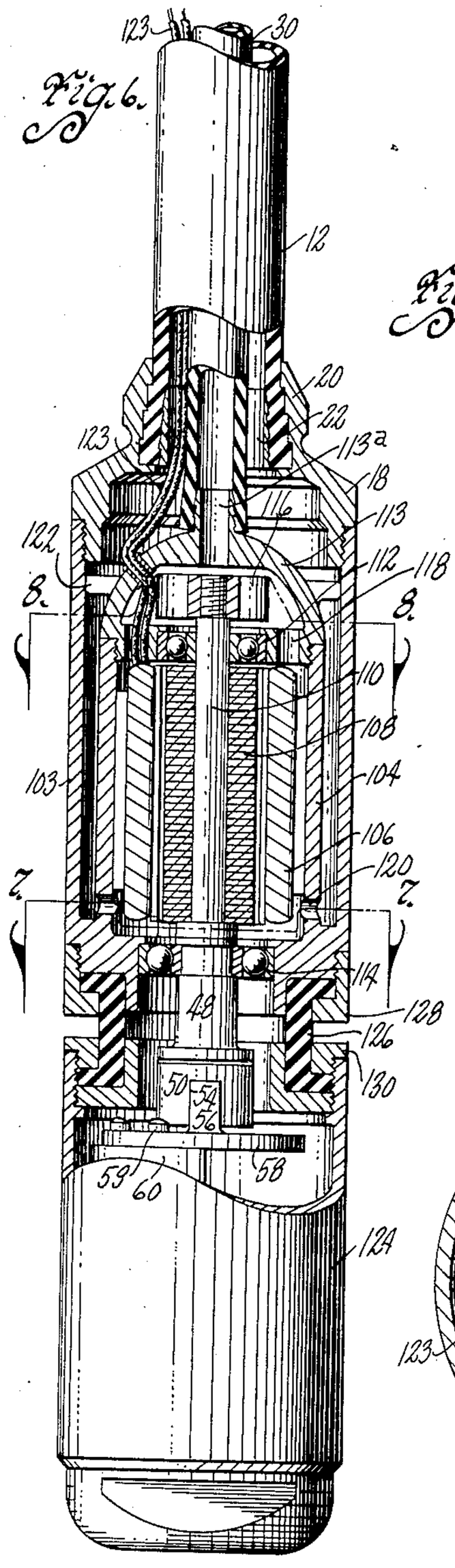

Fig. 5.

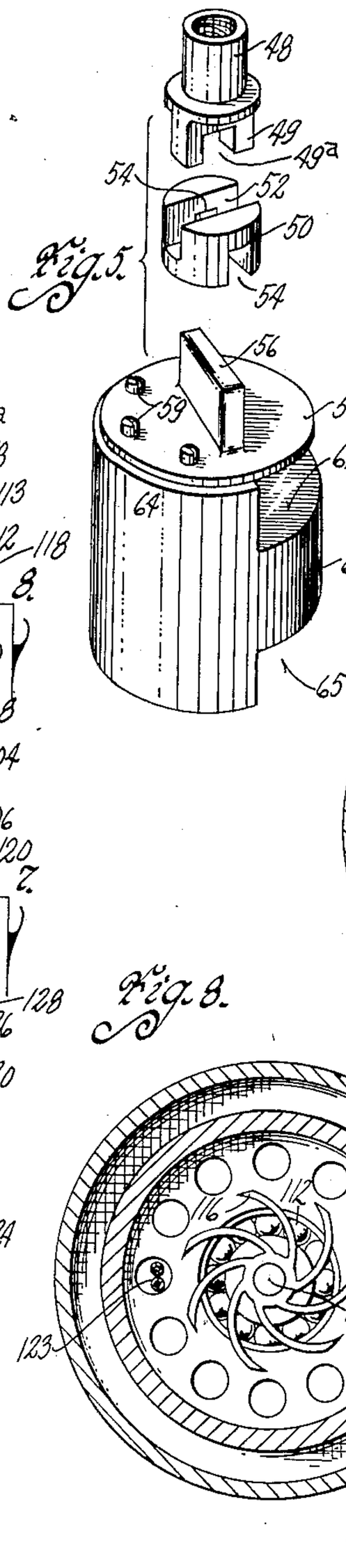

Fig. 9.

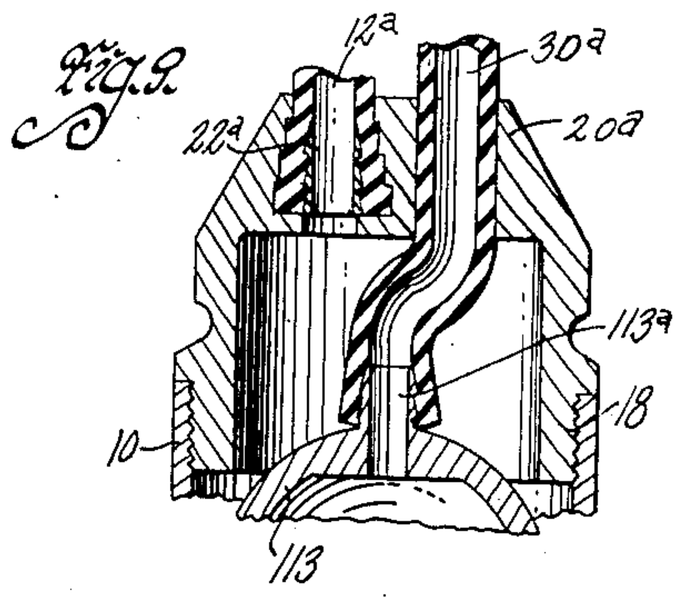

Fig. 7.

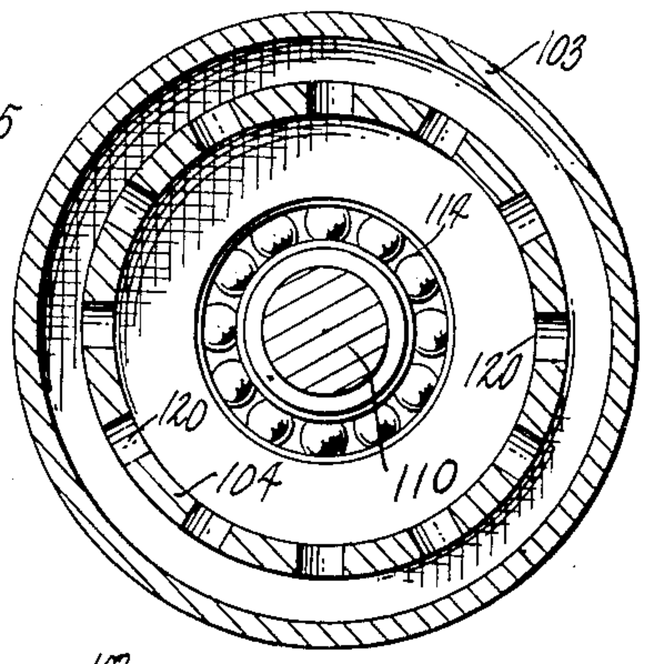

Fig. 8.

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UNITED STATES PATENT OFFICE

2,148,722

SUBMERSIBLE VIBRATOR

Robert William Baily, Philadelphia, Pa.

Application October 15, 1934, Serial No. 748,384

15 Claims. (Cl. 259—1)

One object of my present invention is to provide a vibrator mechanism which has particular though not exclusive use for the compacting of unset concrete, the mechanism being immersed or submerged in a mass of concrete during its deposit and being comparatively simple and durable to manufacture.

A further object is to provide means for resiliently supporting a motor within a housing or immediately adjacent thereto, the housing being submersible in a mass of vibratable material and having therein a vibrator means operatively connected with the motor, the means of connection being of flexible character to prevent the transmission of destructive vibrations from the vibrator means to the motor which operates it.

Still a further object is to provide means for conducting actuating fluid to the motor and conducting spent fluid away from the motor to prevent contamination of the material being vibrated.

Another object is to provide means for cooling the motor if it is, for instance, of the electric type, and to provide means for manipulating and guiding the vibrator housing, preferably in the form of a flexible elongated tube-like handle, the cooling fluid for the motor and the spent fluid therefrom being conductible through said handle if desired.

Still a further object is to provide means for so supporting the bearings carrying the vibrator means, which may consist of an out-of-balance weight, that the bearings will not be subject to injury due to distortion of the vibrator housing.

A further object is to provide vibration damping means between the motor and the vibrator housing.

Another object is to provide such a device having housing sections for the motor and vibrating rotor respectively and vibration damping means interposed between such sections.

With these and other objects in view my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is an outside elevation of a submersible vibrator embodying my invention.

Figure 2 is an enlarged sectional view on the line 2—2 of Figure 1 showing internal details of construction.

Figure 3 is an enlarged sectional view on the line 3—3 of Figure 2 showing a compressed air operated type of motor.

Figure 4 is an enlarged sectional view on the line 4—4 of Figure 2 showing details of the vibrator element.

Figure 5 is a perspective view of the vibrator element and a flexible connecting means for operatively connecting it with the shaft of the motor.

Figure 6 is a view similar to Figure 2 showing a modified construction in which a separate casing is provided for the motor instead of the motor being enclosed in the vibrator housing as in Figure 2.

Figure 7 is an enlarged sectional view on the line 7—7 of Figure 6 illustrating ventilation exhaust openings for the motor.

Figure 8 is a similar sectional view on the line 8—8 of Figure 6 showing ventilating intake openings and a ventilating blower; and

Figure 9 is a sectional view similar to portions of Figures 2 and 6 showing a modified conduit arrangement.

It is desirable in a submersible type of vibrator that the actuating motor be closely associated with the vibrator element in the vibrator housing, or at least arranged in a casing immediately connected with the housing, but as heretofore constructed, mechanism of this character has involved the energetic vibration of the motor casing and motor parts, which for obvious reasons is undesirable and frequently results in such injury to the motor as to put it out of commission. In other types of vibrators, long flexible drive shafts in flexible casings are employed to transmit the power from the motor to the vibrator. The vibration of the vibrator puts such long flexible shafts under jolting strains which soon cause them to break down. Flexible shafts of this character, especially in long sizes, are quite expensive.

Also, when the vibrator housing is of large diameter and comparatively thin in shell thickness, the vibrator means, especially if it is an out-of-balance weight, is sustained by bearings carried by the large diameter casing and the required large diameter of such bearings is out of proportion to their working duty, causing excessive losses of power by friction. In addition, such large diameter tubes or housings are liable to be distorted either by bending of the housing or by flattening thereof due to impact with external objects resulting in destruction of the bearings.

In addition, it is desirable in some instances to house the motor within the vibrator housing in order to avoid the use of the long flexible shafting mentioned, which shafting has a very short operating life, due especially to the vibrations imparted to it by the vibrator means.

Where it is more desirable to locate the motor outside the vibrator housing, it then becomes desirable to place the motor immediately adjacent the housing and approximately in line therewith, connecting the motor casing and the vibrator housing together in a manner to maintain their approximate alignment, but also to prevent the transmission of destructive vibrations from the vibrator to the motor, the preferred construction involving a short flexible connection between the motor shaft and the shaft of the vibrator element.

It is also necessary to provide means for manipulating and guiding the vibrator and when the motor is driven by means other than electricity, to convey the fluid used for power to the motor and convey the spent fluid away from the motor, in order that such spent fluid may not contaminate the material being vibrated.

I provide a vibrator having the desirable characteristics above outlined and which I will now describe.

On the accompanying drawings, the reference numeral 10 indicates a vibrator housing. It is preferably elongated and tubular in shape, having its lower end closed.

I provide a handle 12 for manipulating the housing 10 and it is preferably a flexible tube such as a rubber hose.

In the outer end of the handle 12, a sleeve-like fitting 14 is provided having exhaust openings 16. The opposite end of the handle 12 is received within a boss 20 of a removable head 18 for the upper end of the housing 10. A tapered retainer sleeve 22 may be provided for retaining the hose-like handle assembled relative to the boss.

Within the housing 10, I provide a motor casing 24 having a head 26 of tubular construction with which is connected a fluid reception fitting 28. A fluid supply hose 30 is connected with the fitting 28 and extends through the hose 12 and the sleeve 14 to a fitting 32 swivelly associated with the fitting 14. A fluid supply hose 36 is connected with a strainer 34 and the strainer is connected with the fitting 32 for supplying fluid pressure from the hose 36 to the hose 30. A suitable control valve for the actuating fluid can be provided in the hose 36 or anywhere in the line between this hose and the hose 30 as found desirable.

The motor casing 24 has its ends supported in collars 38 and 39 which in turn are supported by resilient rings 40 of rubber or the like. The upper ring 40 contacts with the head 18, while the lower one contacts with a washer 41 to prevent longitudinal movement of the rings relative to the housing 10.

Within the motor casing 24, I provide a rotor 42 secured to a motor shaft 44. The shaft is supported in bearings 46 which in turn are supported by the casing 24. A flange 48 is connected with the lower end of the rotor or motor shaft 44 and has a blade 49 extending downwardly therefrom. This blade is notched as indicated at 49*a*. The blade 49 fits slidably in an intermediate member 50 having a notch 52 to receive the blade. The member 50 also has a notch 54 arranged crosswise of the notch 52.

The notch 54 is adapted to receive a blade 56 of a plate 58. The plate 58 has a vibrator rotor 60 secured thereto as by screws 59. The rotor 60 has a notch cut in one side thereof and indicated at 62, leaving the other side indicated at 64 solid. The central portion of the rotor 60 is tubular, while the lower portion is an extension of the tubular center portion with a notch 65 cut therein. A weight 66 is secured in the rotor 60 by any suitable means such as screws 68.

Within the tubular center portion of the rotor 60, bearings 70 are mounted, these being retained by the weight 66. The bearings 70 are supported on a stub shaft or spindle 72 extending upwardly from the lower end of the housing 10. The spindle 72 terminates in an extension 74.

A washer 78 is mounted against a shoulder 80 within the stub shaft 72 (the stub shaft being tubular in cross section) and a clamp bolt 82 extends through the washer 78 and terminates in an enlarged head 76 which engages the upper bearing 70. A retainer nut 83 is mounted on the clamp bolt against the washer 78 and is enclosed by a plug 84 screwed into the lower end of the housing 10.

The rotor 42 has vane slots 86 therein in which are slidably mounted vanes 88. The outer ends of the vanes 88 are adapted to contact with a stator 90 mounted eccentrically relative to the rotor 42. An intake passageway 92 extends from the head 26 which receives actuating fluid from the hose 30 and discharges through intake ports 92 into the stator 90. The actuating fluid, preferably air under pressure, causes clockwise rotation of the rotor 42 and the spent fluid is exhausted through ports 92 into a space 98 of the motor casing 24. Exhaust openings 99 discharge the spent fluid from the motor casing into the space 100 of the housing 10, from which space it is exhausted through ports 102 to within the head 18.

The exhaust fluid then flows outwardly between the exterior and interior walls of the hoses 30 and 12 and finally exhausts to atmosphere through the exhaust openings 16 of the fitting 14. Thus this air is disposed of without being discharged into the material being vibrated.

In Figure 6, I have illustrated an electric motor rather than a pneumatic motor and have shown the motor in a casing 103 which is separate from the vibrator housing indicated at 124. The vibrating means within the housing 124 is similar to the means already described, although in both forms of the invention, a bearing for each end of the vibrator element instead of a single spindle-like bearing can be provided. Such a double bearing arrangement is illustrated in my Patent No. 1,876,271, issued September 6, 1932.

Within the casing 103, I provide a motor housing 104 which can be integrally formed relative to the casing or made separate and suitably inserted therein as found desirable. Within the housing 104, stator windings 106 are illustrated, while the reference numeral 108 indicates an electric motor rotor. The rotor 108 is secured to a shaft 110 mounted in bearings 112 and 114. The bearing 112 is carried by a separable head member 113 for the housing 104, while the bearing 114 is carried by the housing itself. The lower end of the shaft 110 is connected with the rotor 60 as already described in connection with Figure 2.

On the upper end of the motor shaft, I preferably provide a ventilating fan or blower 116. It is adapted to receive air from the hose 30 which is connected with a boss 113*a* of the head 113 and discharge it through openings 118 into the motor proper to cool it.

The air is discharged from the motor proper through openings 120 and returns through the space between the hoses 30 and 12 to outside atmosphere. Instead of compressed air being

admitted to the hose **30**, this hose merely draws in air from atmosphere.

The upper end of the housing **104** may be steadied relative to the casing **103** by spoke-like projections **122**. Electric supply wires **123** for the motor may conveniently extend through the hose or handle **12** to the motor.

The housing **124** is supported relative to the casing **103** by a flexible connection such as a resilient sleeve **126**. Retainer nuts **128** and **130** are associated with the casing **103** and the housing **124** respectively and with flanges on the ends of the connecting element **126** to assemble the parts relative to each other.

Instead of a handle consisting of a hose within a hose, two separate hoses may extend to the mechanism as illustrated in Figure 9. In this figure, the head **18** is illustrated as having a boss **20***a* provided with a pair of openings into one of which an exhaust hose **12***a* extends and is retained by a retainer **22***a* and through the other one of which the intake hose **30***a* extends. The hose **30***a* is then bent within the head **18** to engage the boss **113***a* of the head **113** if the electric motor of Figure 6 is utilized, or the fitting **28** if the pneumatic motor of Figure 2 is utilized.

Practical operation

In the operation of my vibrator, the housing **110** is partially or completely submerged in a vibratable material, using the handle **30** for manipulating it. With the type of mechanism shown in Figure 6, the housing **124** and the casing **103** can be submerged or only the housing **124** can be submerged if desired. The material with which my device is usually used consists of fresh unset concrete or other plastic material and when the motor shafts **44** or **110** are rotated, they rapidly rotate the out-of-balance vibrator element **60** which causes the vibrator housing **10** or **124** to oscillate, thereby imparting pulsations to the concrete, causing it to become additionally plastic and to thereby flow into the desired position, while at the same time the entrapped air and surplus water is expelled from the mass.

By means of the flexible connection between the motor and the vibrator element and between the motor and the vibrator housing, destructive vibrations are not transmitted from the vibrator housing to the motor. At the same time, the axes of the motor and vibrator element are maintained in operating alignment, variations from true alignment being limited only by the capabilities of the flexible shaft, casing and housing couplings.

Where the motor is supported within the vibrator housing as in Figure 2, the rings **40** prevent the housing vibrations from being transmitted in any marked degree to the motor, while with the construction of Figure 6, the flexible connection **126** prevents vibrations of the housing **124** from being transmitted to the casing **103** and thence to the motor.

With either form of the invention, the flexible handle **12** may be utilized by the workman for holding the vibrator suspended at any desired depth in the concrete and for moving the vibrator laterally through the concrete to desired positions. This handle can be quite long and provided in sections if desired so that the vibrator may be lowered a considerable distance below the position of the operator as in deep wall forms and the like. The handle also forms a convenient means for conveying actuating fluid to or from the motor or as a suitable enclosure for a supply hose, while at the same time acting as a conduit for exhaust fluid.

By providing the bearing for the vibrator element in the form of a single stud, distortions of the housing **10** cannot throw the bearing out of alignment as when separate bearings are provided for opposite ends of the vibrator element and each is supported by the housing.

From the foregoing description, it will be obvious that I have provided a unitary vibrating mechanism easily manipulatable with the aid of the handle **12** and to which actuating fluid is conveniently supplied through the medium of the handle. All destructive vibrations as ordinarily transmitted from the vibrator element to the motor are reduced to a minimum by the specific constructions illustrated.

Some changes may be made in the construction and arrangement of the parts of my vibrator without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims, any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. Vibratory mechanism comprising a housing adapted to be at least partially immersed in a mass to be vibrated, a rotor having its centre of mass disposed eccentrically to its axis of rotation and located within said housing, a motor therefor also located within said housing, a flexible driving connection between said motor and said rotor and a flexible connection adapted to deaden vibratory motion interposed between a vibratory portion of said housing and said motor.

2. Vibratory mechanism comprising in combination, a housing adaped to be immersed at least partially in a mass to be vibrated, means for vibrating said housing, a motor flexibly associated with said housing, a flexible coupling between said motor and the means for vibrating said housing and a flexible handle for manipulating said motor and said vibrating means.

3. In a vibrator of the class described, a vibrator housing adapted to be submerged at least partially in a mass of vibratable material, vibratory means therein, power operated means therefor, flexible connections between said power operated means and said vibrator housing and between said power operated means and said vibratory means and a flexible handle for manipulating the foregoing elements in said mass of vibratable material.

4. In a vibrator of the class described, a vibrator housing adapted to be submerged at least partially in a mass of vibratable material, vibratory means therein, power operated means therefor, flexible connections between said power operated means and said vibrator housing and between said power operated means and said vibratory means, a flexible handle for manipulating the foregoing elements in said mass of vibratable material and means extending through said handle for supplying power to said power operated means.

5. In a vibrator of the class described, a vibrator housing adapted to be submerged at least partially in a mass of vibratable material, vibratory means therein, power means therefor, flexible connections between said power means and said vibrator housing and between said power means and said vibratory means, a flexible handle for manipulating the foregoing elements in said mass of vibratable material and means extending through said handle for supplying actuating fluid

to said power means and conducting exhaust fluid therefrom.

6. In a vibrator of the class described, a vibrator housing adapted to be submerged at least partially in a mass of vibratable material, vibratory means therein, power means therefor, flexible connections between said power means and said vibrator housing and between said power means and said vibratory means and conduits for supplying actuating fluid to said power means and conducting exhaust fluid therefrom.

7. In a vibrator of the class described, a vibrator housing, vibratory means therein, power operated means therefor, flexible connections between said power operated means and said vibrator housing and between said power operated means and said vibratory means, means for circulating air through said power operated means to cool it and a pair of conduits for such air.

8. In a vibrator of the class described, a housing adapted to be submerged at least partially in a mass of vibratable material, vibratory means therein, power operated means also therein and resiliently mounted relative thereto and a flexible connection between said power operated means and said vibratory means.

9. In a vibrator of the class described, a vibrator housing, vibratory means therein, power operated means therefor, flexible connections between said power operated means and said vibrator housing and between said power operated means and said vibratory means and a flexible handle for manipulating the foregoing elements in a mass of vibratable material and for conducting an actuating fluid to said power operated means.

10. Vibratory mechanism comprising in combination a housing adapted to be inserted at least partially in a mass to be vibrated, an out-of-balance weight rotatably mounted in said housing, a prime mover, a hollow flexible connection supporting means for said housing extending from said prime mover to said housing and so arranged that the housing may be manipulated by means of said flexible connection, a flexible driving means connecting said prime mover to said rotor and carried within said hollow flexible connection, said hollow flexible connection and said flexible driving means being so arranged as to permit angular or lateral displacement or both of the axis of said rotor with relation to the axis of said prime mover.

11. In a submersible housing, means adapted to be submerged at least partially in a mass to be vibrated, a vibratory rotor in one part of the housing, a pneumatic motor in another part of the housing adapted to discharge into the housing, the device having means to carry the exhaust fluid away, a flexible driving means between the motor and the rotor, and a resilient connection, between the motor and the rotor forming a tight joint between that part of the housing means which contains the rotor and that part which contains the motor, said connection forming a means through which the driving means between the motor and rotor extends.

12. In a vibrator of the class described, a vibrator housing adapted to be submerged at least partially in a mass of vibratable material, vibratory means in the housing, a casing connected with the housing, power operated means in the casing, a flexible connection between the power operated means and the vibratory means, and a flexible connection between the power operated means and its casing.

13. Vibratory mechanism comprising a housing adapted to be immersed at least partially in a mass to be vibrated, a rotor in the housing having its center of mass disposed eccentrically to its axis of rotation, a fluid operated motor in the housing operatively connected with the rotor, a flexible hose-like handle secured to said housing and opening thereinto, a flexible fluid conduit connected to the motor and extending through said hose-like handle, the interior diameter of the handle being greater than the exterior diameter of the conduit to afford passage from the interior of the housing to the outer end of the handle for exhaust from the motor, the conduit and the handle being provided at the outer end of the handle with a swivel connection whereby they are relatively rotatable.

14. Vibratory mechanism comprising a housing adapted to be immersed at least partially in a mass to be vibrated, a vibration creating device in said housing, a motor in the housing to actuate said device, a hollow handle attached to said housing and opening thereinto, a fluid conveying conduit extending through said handle, and connected to said motor, said conduit having such outer dimension that a measurable space exists between the outer circumference of said conduit and the inner circumference of said handle, providing a passage for exhaust fluid from said motor, and fitting means connecting the outer end of the handle with the conduit, said fitting means having an opening for the egress of fluid from the handle and having swivel elements, whereby the conduit may rotate in the handle.

15. In a vibrator of the class described, a vibrator housing adapted to be at least partially immersed in a mass of vibratable material, vibratory means in said housing, a casing with a connection to said housing, said connection formed to maintain the axis of said housing in substantial alignment with the axis of said casing, power operated means in said casing, power transmission means connecting said power operated means and said vibratory means within said connection, said connection damping the transmission of destructive vibrations from said housing to said casing.

ROBERT WILLIAM BAILY.