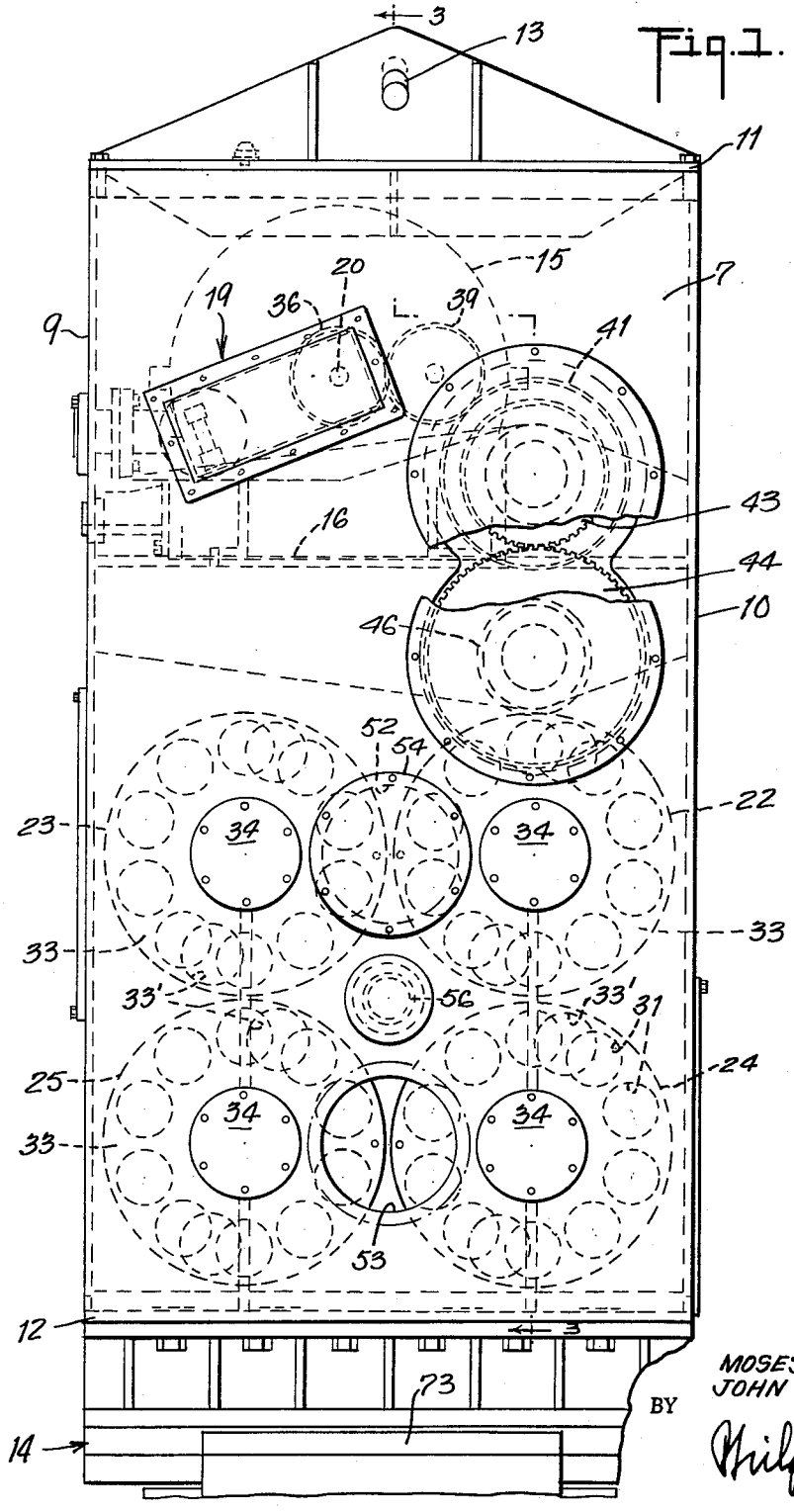
Dec. 21, 1965 M. HORNSTEIN ETAL 3,224,514

VIBRATORY PILE HAMMER

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Fig. 1.



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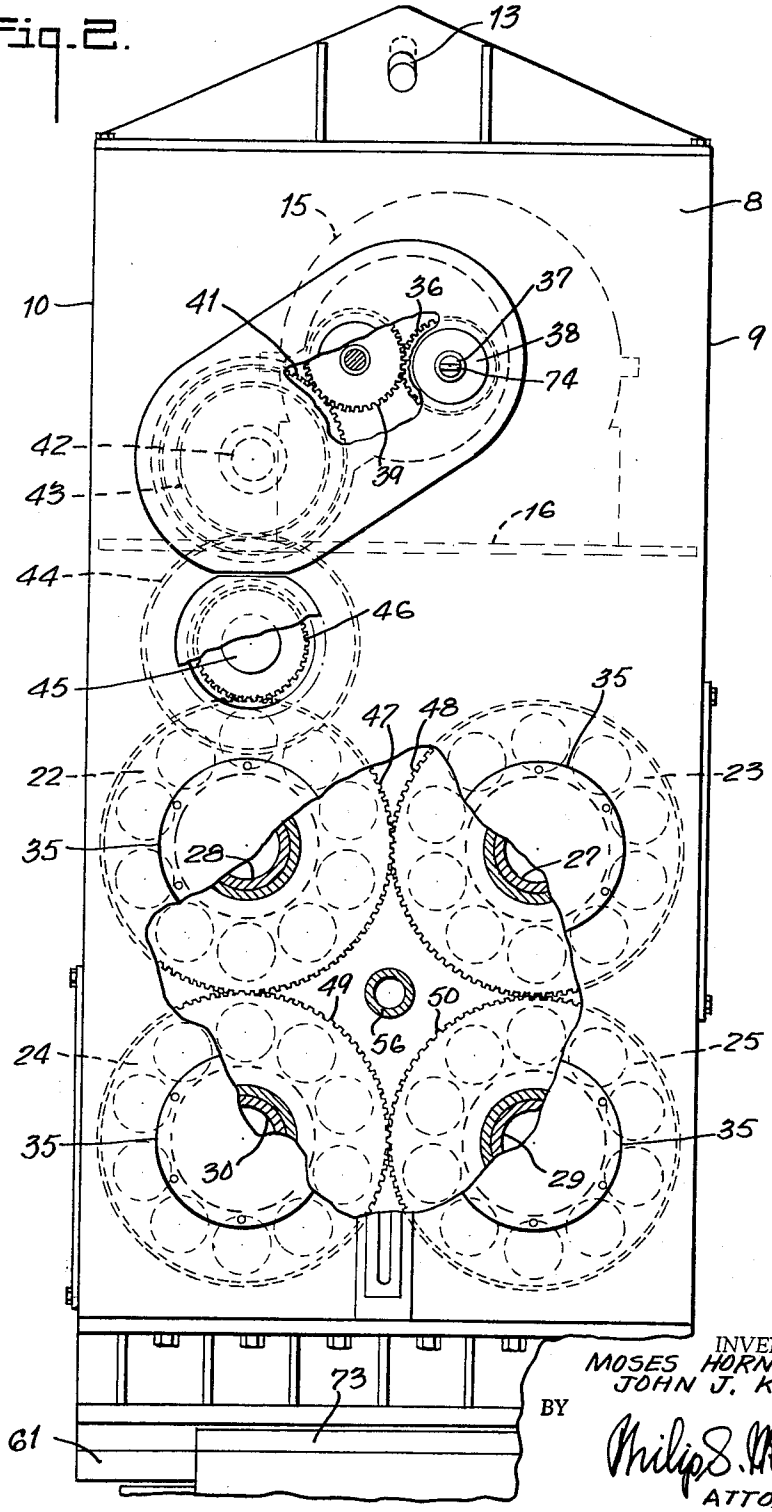
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Fig. 2.



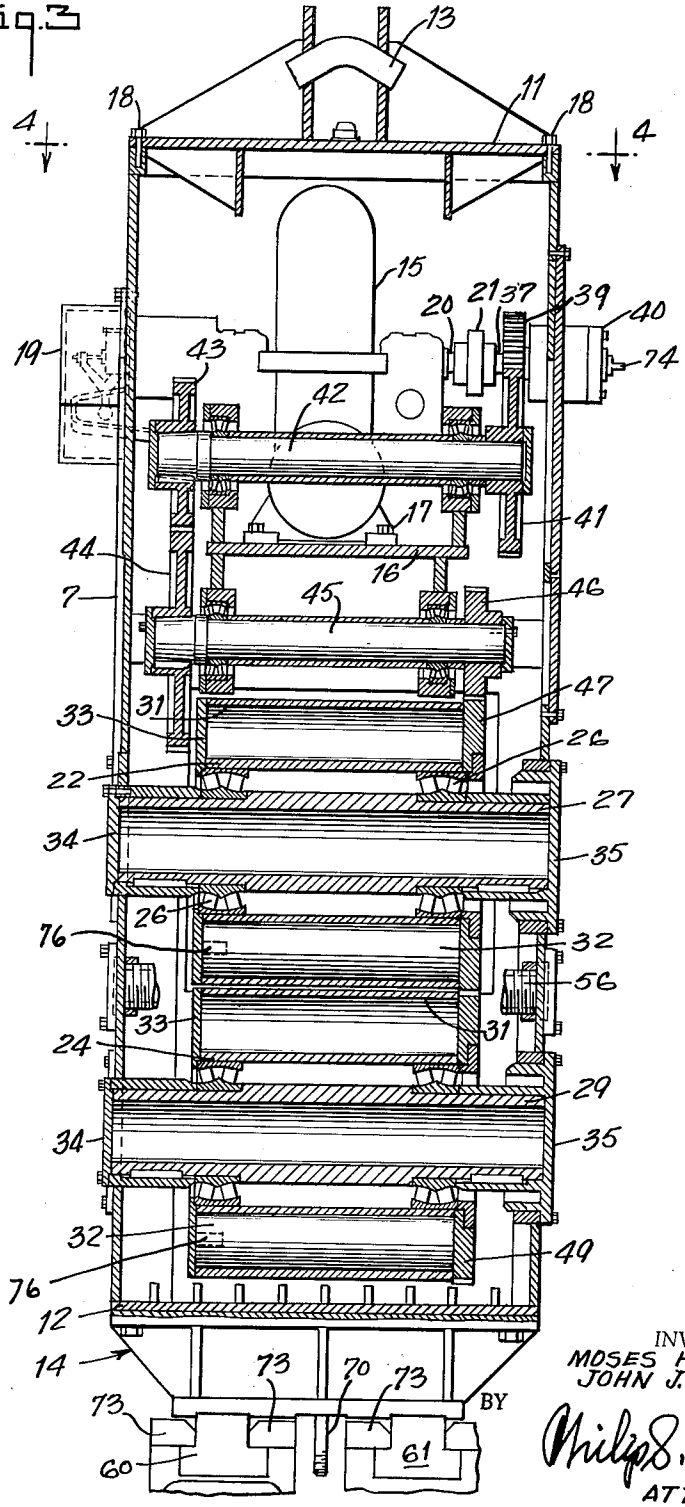
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Fig. 3



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Fig. 4.

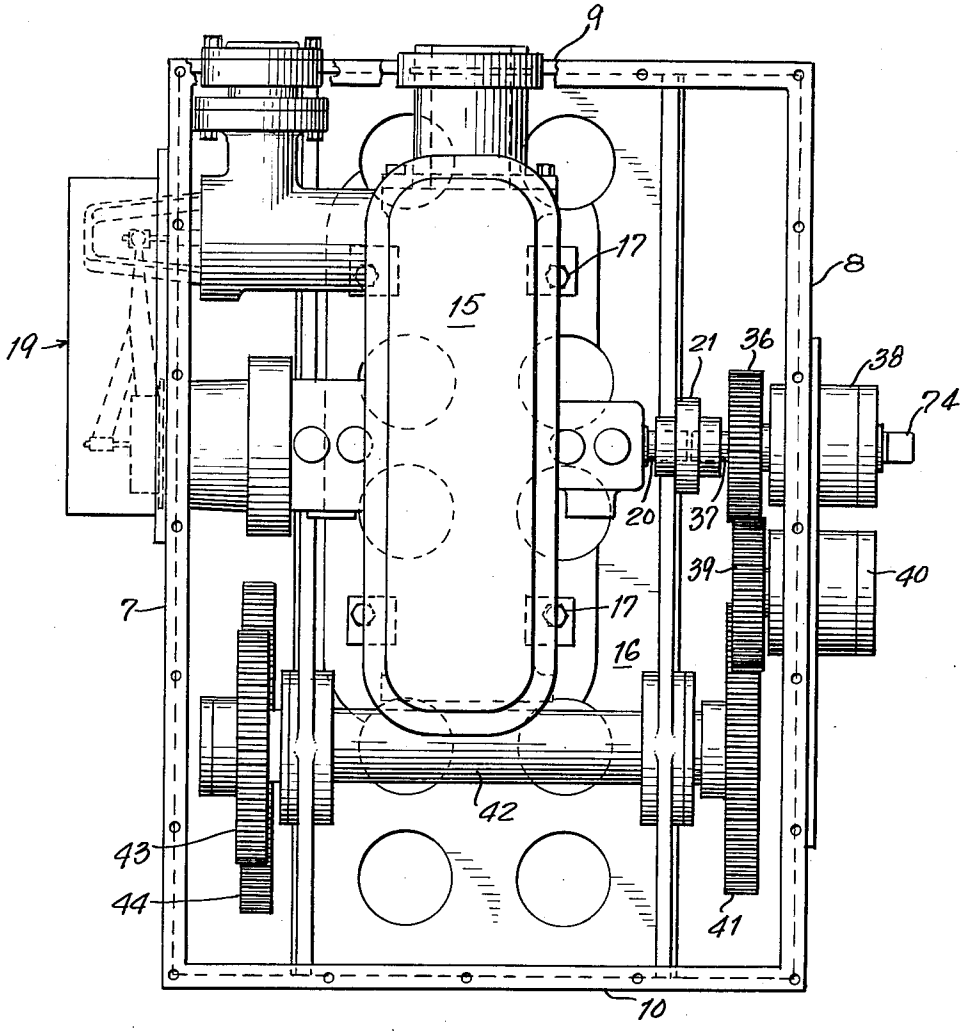


Fig. 5.

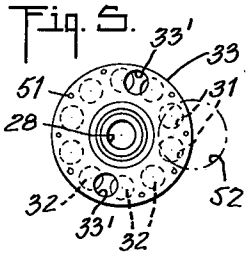
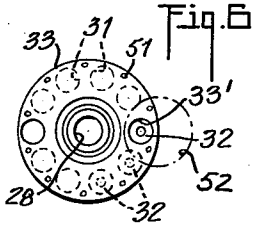


Fig. 6.



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Fig. 7.

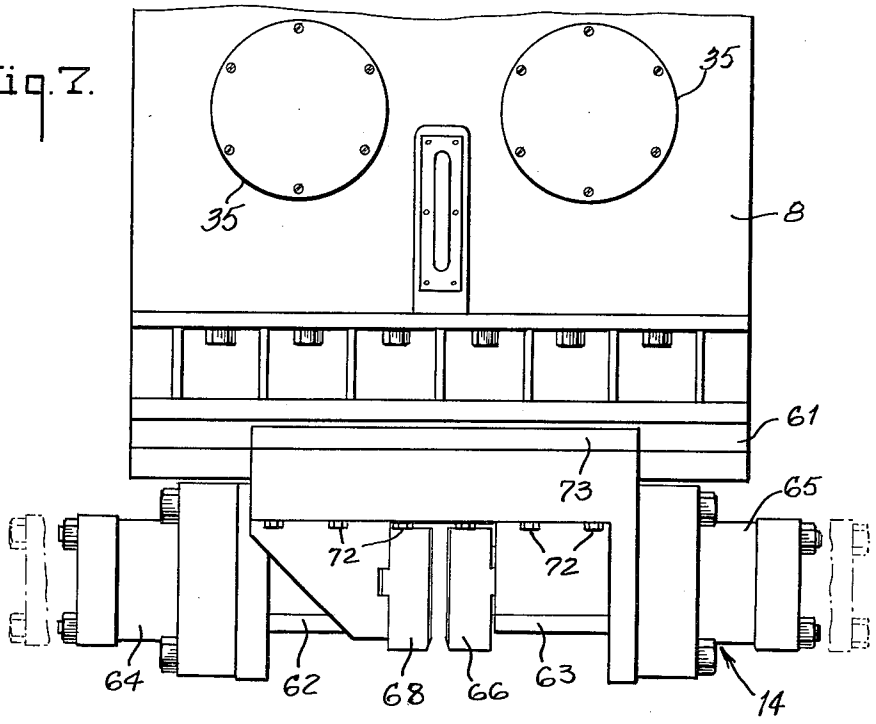
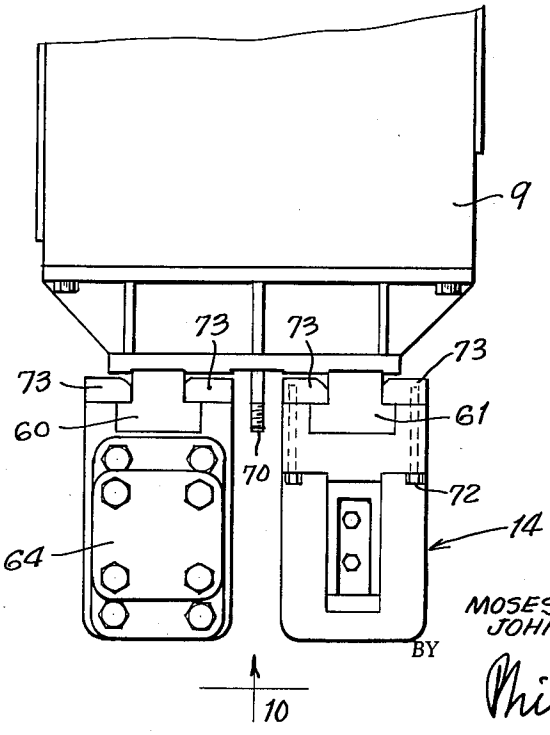


Fig. 8.



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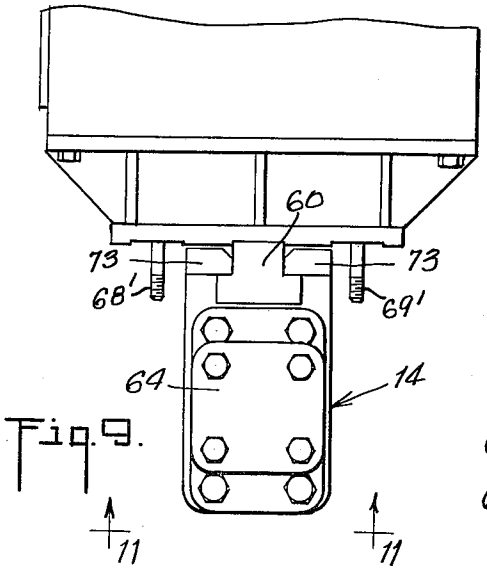


Fig. 9.

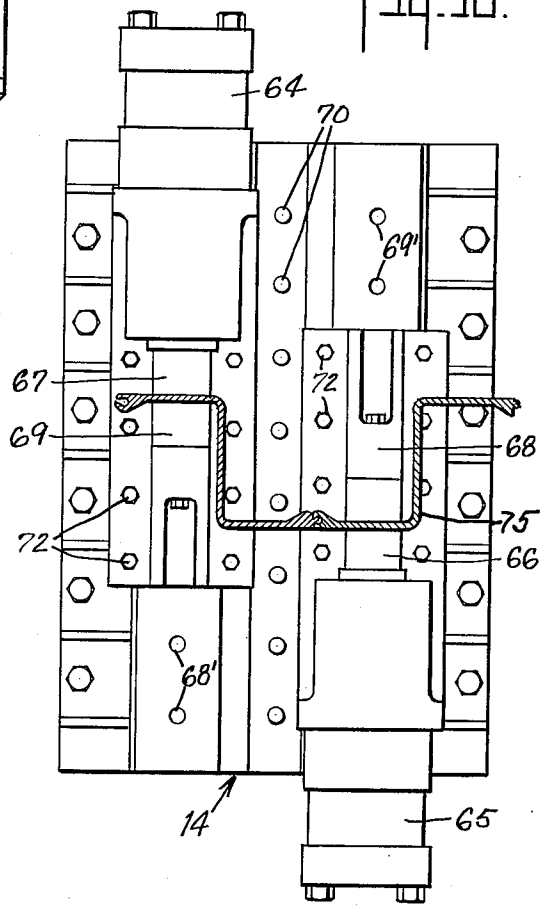


Fig. 10.

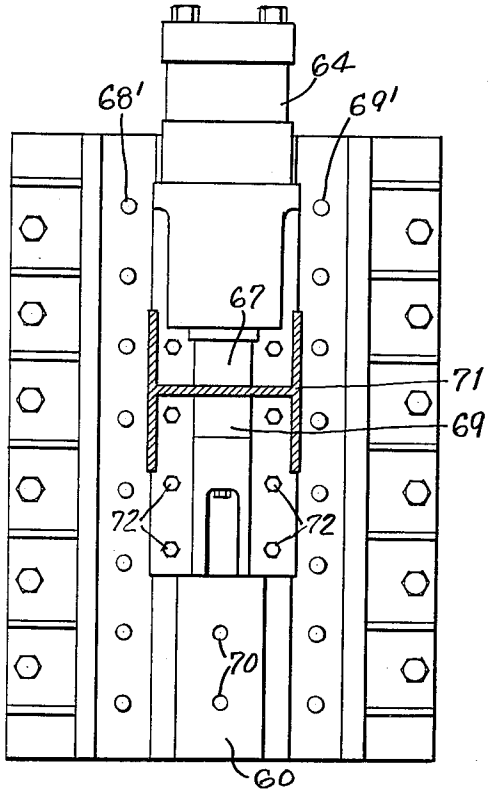


Fig. 11.

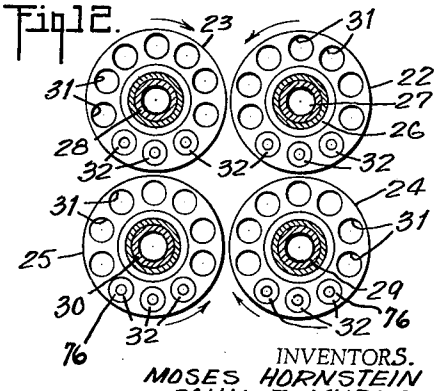


Fig. 12.

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United States Patent Office 3,224,514 Patented Dec. 21, 1965

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VIBRATORY PILE HAMMER

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Filed Aug. 18, 1964, Ser. No. 390,345
8 Claims. (Cl. 175—55)

The invention herein disclosed relates to pile hammers of the vibratory type in which piling is sunk or pulled by vibratory action instead of by impact.

Special objects of the invention have been to avoid vibrating frequencies liable to endanger adjacent or surrounding property and to accomplish this without sacrificing driving power.

In a practical embodiment of the invention, this has been accomplished by combining a number of vibratory members geared together and arranged to be driven at a rate less than a frequency known to be critical, such as 800 cycles per minute and providing in the aggregate a total of vibratory force required without impractical or undue concentration of energy at one point.

By combining a plurality of vibrating elements the maximum actuating force desired is attained while keeping bearing loads at the individual units within practical limits.

Further special objects of the invention have been to provide a practical operating construction adapted to utilize available power sources.

For this purpose the vibrator has been designed so that different forms of prime movers can be readily substituted and the machine thus be operated by electric motor, steam, compressed air, internal combustion, turbine or other forms of motive power.

Further important objects of the invention have been to accomplish these results in a practical and efficient structure suitable to present day operating conditions and requirements.

The foregoing and other desirable objects have been accomplished by the above and further novel features of construction, combinations and relations of parts as hereinafter described in detail and illustrated in the accompanying drawings.

The drawings accompanying and forming part of this specification illustrate a present practical embodiment of the invention but structure may be modified and changed as regards the immediate illustration, all within the true intent and scope of the invention as hereinafter defined and claimed.

FIG. 1 in the drawings is a side elevation of one of the hammers, partly broken away to show a portion of the gearing.

FIG. 2 is an elevation of the back or opposite side of the machine, partly broken away to illustrate other portions of the gearing.

FIG. 3 is a vertical sectional view on substantially the plane of line 3—3 of FIG. 1.

FIG. 4 is a plan view on substantially the plane of line 4—4 of FIG. 3.

FIGS. 5 and 6 are diagrammatic views on a smaller scale showing how the end plates on the rotors may be turned to line up the openings therein with the cells in the rotors for changing the weights in the rotors.

FIGS. 7 and 8 are broken front and end elevations of the double form of clamp for sheet piling, on the bottom of the hammer.

FIG. 9 is a broken end elevation of the single form of clamp for H beam piling.

FIG. 10 is a cross sectional view on substantially the plane of line 10—10 of FIG. 8 showing the double clamp in engagement with sheet piling.

FIG. 11 is a similar view showing the single clamp in engagement with an H beam, this view taken on substantially the plane of line 11—11 of FIG. 9.

FIG. 12 is a diagrammatic view on a smaller scale illustrating the cooperative relation of the four rotors.

The body of the machine is shown in the form of a rectangular casing made up of parallel side walls 7, 8, connected by parallel front and back walls 9, 10, with top and bottom 11, 12, the top carrying the crane connection 13, and the bottom carrying the pile clamp 14.

The driving force is provided in the illustration, by steam, compressed air or gas turbine 15, mounted in readily removable relation on a supporting platform 16, built into the upper portion of the casing.

This motor is shown bolted in place at 17, and the head of the casing is shown removably bolted in place at 18, enabling quick changeover of power units.

Operation of the turbine is shown controlled by a governor 19, of conventional design and the shaft 20, of the turbine is shown as connected with the load by a coupling 21.

The load consists in this disclosure of four drums or rotors geared together and arranged in pairs 22, 23, and 24, 25, disposed one pair directly above the other.

These rotors are in the form of annular cylinders supported by roller bearings 26, on the four stationary tubular shafts 27, 28, 29, 30, each rotor having ten longitudinal cylindrical cavities or cells 31, to receive weights 32, of the same, close-fitting formation.

These weights may be of lead, or other heavy metal, such as tungsten or uranium alloys, or other heavy material and they are held in place by circular covers 33, at the ends of the rotors.

In the illustration, there are three similarly placed weights 32, in place, in each of the four rotors, all shown disposed at the bottom of the stroke.

A greater or less number of the weights may be used, depending on the degree of eccentric force desired or required.

The particular location of the weights also is a determining factor in application of the vibratory effort.

With the cells which are opposite the loaded cells, empty as shown, all the weight is at one side, but if some counterbalance effect is desired, one or more of the weight plugs may be placed in the cells opposite the loaded side of the rotors.

The stationary supporting shafts 27, 28, 29, 30, are shown supported by end caps 34, 35, seated in the side walls 7, 8, of the casing.

The drive gearing from the motor to the rotors is shown made up of pinion 36, on shaft 37, journalled in box 38, in line with the motor shaft 20, and connected thereto by coupling 21, meshing pinion 39, journalled in box 40, gear 41, on countershaft 42, pinion 43, on the latter shaft in mesh with gear 44, on a second countershaft 45, and pinion 46, on the latter in mesh with gear 47, on the end of the first rotor 22, in mesh with companion gears 48, 49 on rotors 23, 24 and the latter two in mesh with gear 50 on rotor 25, as shown in FIG. 2.

The rotors thus are all tied together, rotating in unison with weighted and light sides in the same constant running relation.

The weights are in the nature of plugs closely fitting in their seats and held against longitudinal displacement by the cover plates 33.

These end plates are rotatably adjustable on the ends of the rotors so that they may be shifted to bring openings 33′ therein into register with the cells, for removal or replacement of the weights.

When these changes have been made, the plates may be turned back into covering position and be secured by cap screws 51.

Handholes 52, 53 in the side wall 7 of the casing provide necessary access for weight changing, these openings being large enough and placed intermediate the rotors of each pair to enable servicing of companion rotors through the same opening.

Removable cover plates 54, 55 are provided for these service openings.

One or more cross stays may be provided connecting the side walls, such as the one indicated at 56, FIGS. 1, 2 and 3.

The pile clamp 14, is shown as made up of parallel T-head rails 60, 61, secured in inverted relation on the bottom of the casing and supporting companion slides 62, 63, carrying cylinders 64, 65, operating movable clamping jaws 66, 67, in opposition to companion fixed jaws 68, 69.

These clamp cylinders are disposed at opposite sides of the hammer so as to act in opposition to each other, thus to grip the mating sections of sheet piling 75 in balanced, opposite directions as shown in FIG. 10.

This clamp is made so that it may be quickly converted to driving H beam piling by removing the two clamp slides and replacing one clamp slide in centered position on the bottom of the casing.

FIGS. 9 and 11 illustrate this changeover in which the two supporting rails 60, 61, FIG. 8, have been released from the supporting bolts 68', 69' and one of these rails has been secured by the bolts 70, FIG. 8 in centered position supporting one of the slides carrying the companion clamp jaws for gripping an H beam 71.

The slides while adjustable and removable in respect to the supporting rails may be fixedly secured thereon through use of the bolts 72, FIG. 8, which secure the overstanding bars 73 in clamping engagement with the rail heads.

The diagrammatic views, FIGS. 5 and 6, show how the weight confining plates on the ends of the rotors may be turned to bring the openings therein into and out of alignment with the cells in the rotors and how then changes in loading may be effected through the service openings in the side wall of the housing.

The rotors may be turned to align them with the service openings by means of a hand crank or the like.

In the example illustrated, the shaft 37 which is coupled to the motor shaft, is shown provided with a squared end 74 for engagement by a suitable hand crank or lever. The gear reduction enables this hand crank operation to bring the cells into registration with the servicing openings.

The invention provides a readily variable vibratory force compacted into a small powerful unit which may be combined with present day pile driving equipment, which can be quickly coupled to different forms of piling and which may be powered by different kinds of motors which may be available.

The vibrator may be used for extracting as well as for driving purposes and, being fully enclosed, may be used for underwater as well as dry land operations, supply and exhaust hose or other suitable power connections being provided for the turbine or other motive power employed.

For ease in handling, the weights 32 are shown as having screw seats 76, FIGS. 3 and 12, in the ends thereof for engagement by a screw form of extraction key or the like.

The cross bracing afforded by struts 56 and the stationary tubular shafts for the rotors provides a solid, rigid structure fully capable of transmitting effective vibration to piles, particularly at the relatively low, safe vibrating frequencies, for example in the range up to 800 cycles per minute.

The effective vibrating force may be governed by the number of cooperatively acting vibrating units and by the variable weighting of such individual units.

What is claimed is:

1. A vibratory pile hammer, comprising in combination
a base having means for coupling it in vibrating engagement with piling,
a pair of rotors journalled on said base on parallel horizontal axes in the same horizontal plane,
a motor on said base connected to drive said rotors in unison in opposite directions,
said rotors having open-ended cells in the peripheral portions of the same, parallel with the axes of rotation, and
correspondingly shaped weights seated and removably held in certain of said cells, travelling in approaching relation in the rotation of said rotors, with said base being in the form of a substantially rectangular casing containing the connected rotors and motor and in which said rotors are in the form of annular cylinders journalled on stationary tubular shafting.

2. A vibratory pile hammer, comprising in combination
a base having means for coupling it in vibrating engagement with piling,
a pair of rotors journalled on said base on parallel horizontal axes in the same horizontal plane,
a motor on said base connected to drive said rotors in unison in opposite directions,
said rotors having open-ended cells in the peripheral portions of the same, parallel with the axes of rotation, and
correspondingly shaped weights seated and removably held in certain of said cells, travelling in approaching relation in the rotation of said rotors in which the open ended cells in the rotors are closed by end plates having openings to register with said cells and in which said end plates may be turned to carry said openings into and out of register with the cells.

3. The invention according to claim 2 in which said base is in the form of a casing enclosing the parts described and in which said casing has service openings between adjoining rotors and with which said openings in the end plates may register for enabling changing of the weights in the rotors.

4. A vibrator for driving or extracting piles comprising the combination of
a base,
a motor on said base,
vibrating rotors on said base,
drive gearing connecting said motor with said rotors,
said rotors having cells in the peripheral portions of the same open at one end of the rotors,
plates at said ends of the rotors shiftable to cover or to uncover the open ends of said cells and
weights removably seated in said cells and kept in place by said end plates.

5. The invention according to claim 4 in which said drive gearing for the rotors is located at the ends of the rotors opposite those ends on which said cover plates are mounted.

6. The invention according to claim 1 in which said stationary shafting for the rotors consists of a tubular shaft for each rotor having its opposite ends secured in stationary relation on opposite side walls of the rectangular casing.

7. A vibratory pile hammer comprising the combination of
a casing,
stationary tubular shafts rigidly secured at their ends to opposite walls of said casing,
rotors journalled on said stationary shafts,
weights mounted in readily removable relation in said rotors,
a motor mounted in said casing,
drive gearing from said motor to the respective rotors,

a pile clamp at the bottom of the casing in rigid connection with said opposite walls of the casing to receive the full force of vibrations imparted to the casing,

said rotors being of annular formation in surrounding relation about the shafts and having cells in the peripheral portions of the same open at one end,

said casing having servicing openings providing access to said open ends of the cells,

said weights being insertable through said servicing openings into seated engagement in said cells and

releasable means on the ends of said rotors for closing the open end of said cells over the weights inserted therein.

8. The invention according to claim 7 with means externally of the casing for turning said rotors independently of said motor to carry the cells therein within reach of said servicing openings in the casing.

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