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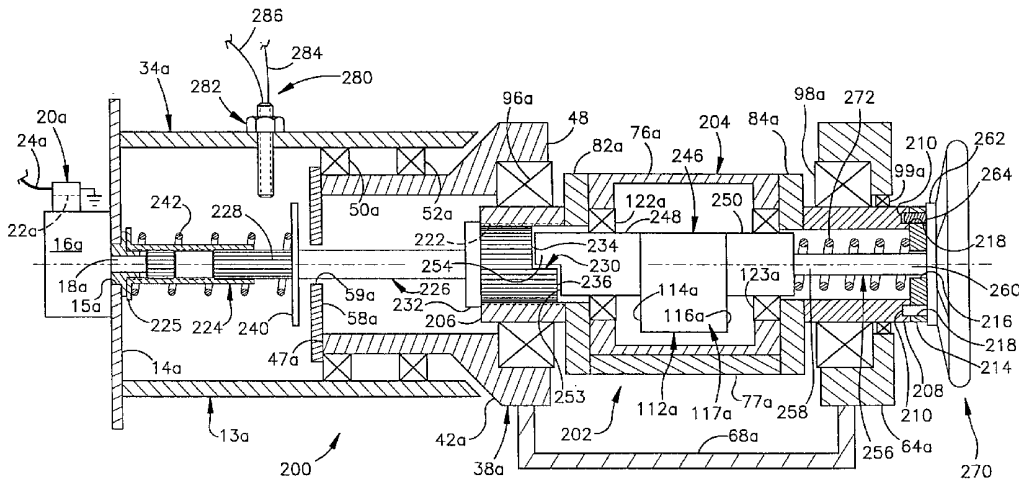
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(54) Title: APPARATUS FOR CONTROLLING VIBRATION MEANS OF A VIBRATORY COMPACTING MACHINE



(57) Abstract: According to the invention, a vibratory compacting machine includes a vibratory structure that includes an outer shaft having a first eccentrically weighted portion and an inner shaft having a second eccentrically weighted portion rotatable within the outer shaft. A hydraulic motor is controlled to rotate the shafts at a low speed when the vibratory structure is set for high amplitude vibrations and at a high speed when the vibratory structure is set for low amplitude vibrations. The motor is controlled by structure to prevent high speed rotation of the vibratory structure when the shafts are indexed for high amplitude vibration of the vibratory structure.



WO 02/14609 A1

**APPARATUS FOR CONTROLLING VIBRATION MEANS OF A  
VIBRATORY COMPACTING MACHINE**

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**TECHNICAL FIELD**

The present invention is generally concerned with apparatus for controlling vibration means of a vibratory compacting machine, and more particularly with providing switching means for controlling the speed of rotation of vibration means of a vibratory compacting machine.

**BACKGROUND OF THE INVENTION**

As shown in U.S. Patent No. 4,454,780 ('780 Patent), issued June 19, 1884 to Goehler et al., and assigned to the assignee of the present invention, it is known in art to provide apparatus for controlling vibratory apparatus for use in earth-compacting machines. The '780 Patent discloses vibratory apparatus that includes first and second elongate elements, and structure for mounting the respective elements for rotation, by a hydraulic motor, in unison with one another about a common axis. Each of the elements includes an eccentrically weighted, radially disposed portion thereof. For controlling the amplitude of vibration of the vibratory apparatus, the mounting structure is provided with apparatus for indexing one of the elements between first and second displaceably secured positions. In the first position, the weighted portions of the elements are disposed in radial alignment with one another, for high amplitude vibration of the vibratory apparatus. In the second position the weighted portions are disposed out of radial alignment with one another, for low amplitude vibration of the vibratory apparatus. For indexing purposes, the '780 Patent includes structure for axially displacing one of the elements in one direction from one of the displaceably secured positions, then rotatably moving the axially displaced element toward the other displaceably secured position, followed by axially displacing the moved element in the opposite axial direction and into the other

displaceably secured position. The indexing apparatus additionally includes a hand wheel connected to the aforesaid one of the elements to facilitate the displacement and rotation.

5 A vibratory compacting machine, in which vibratory apparatus of the type disclosed in the aforesaid '780 Patent may be mounted, is shown in U.S Patent No. 5,719,338 ('338 Patent), issued February 17, 1998 to Magaiski et al., and assigned to the assignee of the present invention. As discussed in the '338 Patent, it is know in the art to provide a vibratory compacting machine with an operator station including an instrument panel having a manually operable, two-position, on-off switch and a  
10 gauge available to the operator. The '338 Patent also discloses structure for sensing the speed of rotation of the hydraulic motor that is connected to the vibratory apparatus for rotating the eccentrically weighted elements thereof. The sensing structure is electrically connected, via the on-off switch at the instrument panel, to a micro-controller, and generates a signal proportional to the speed of rotation of the  
15 eccentrically weighted elements. The gauge is also electrically connected to the micro-controller. When the operator moves the switch to the "on" position thereof, the micro-controller processes the speed signal from the sensing structure and provides a signal related thereto to the gauge, for display thereby to the operator. Thus the operator has a readily available input related to the speed of rotation of the  
20 eccentrically weighted elements of the vibratory apparatus.

A long standing problem with prior art vibratory compacting machines has been the lack of apparatus for controlling the speed of rotation of the vibratory apparatus to prevent the selection of high speed rotation thereof when the vibratory apparatus has been indexed for high amplitude vibration. As a result, the bearings of  
25 the vibratory apparatus of the prior art have to be prematurely replaced, at great cost to their owners.

### SUMMARY OF THE INVENTION

30 According to the invention, there is provided apparatus for controlling vibratory structure of a vibratory compacting machine, wherein the vibratory structure includes an outer shaft having a first eccentrically weighted portion and an

inner shaft having a second eccentrically weighted portion rotatable within the outer shaft. In addition, the vibratory structure includes apparatus for mounting the respective shafts for rotation. Further, the compacting machine includes a hydraulic motor connected for rotating the vibratory structure. Preferably, the controlling apparatus comprises structure for selectively controlling the hydraulic motor for rotating the vibratory structure at a high speed and a low speed. In addition, the controlling apparatus preferably includes structure for selectively indexing the inner shaft for high and low amplitude vibration of the vibratory structure. And the controlling structure also preferably includes structure for preventing high speed rotation of the vibratory structure when the inner shaft is indexed for high amplitude vibration of the vibratory structure. Moreover, as an alternative to providing structure for preventing high speed rotation of the vibratory structure, when the inner shaft is indexed for high amplitude vibration of the vibratory structure, there is provided proximity switching structure for permitting high speed rotation of the vibratory structure when the inner shaft is indexed for low amplitude vibration of the vibratory structure.

### BRIEF DESCRIPTION OF THE DRAWINGS

As shown in the following Figures, wherein like reference numerals designate like or corresponding parts throughout the several views:

Figure 1 is a fragmentary transverse cross-sectional view of a portion of a prior art compacting machine, including vibratory structure having outer and inner eccentrically weighted shafts;

Figure 1A is a fragmentary transverse cross-sectional view of the remaining portion compacting machine of Figure 1;

Figure 1B is a view of Figure 1 taken substantially along the line 1B-1B thereof;

Figure 2 is a schematic view of vibratory structure according to the invention, showing the inner shaft thereof indexed for high amplitude vibration;

Figure 3 is a schematic view of the vibratory structure of Figure 2, showing the inner shaft thereof indexed for low amplitude vibration; and

Figure 4 is a schematic view of an electrical circuit according to the invention.

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## DESCRIPTION OF THE PREFERRED EMBODIMENTS

A prior art compacting machine 12 (Figures 1 and 1A), that may be modified in accordance with the present invention, includes framework 13 (Figure 1) having a shock mounting plate 14, and having a conventional hydraulic motor 16 that is  
10 conventionally fixedly secured to the shock mounting plate 14. The shock mounting plate 14 has an aperture 15 formed therein, and the hydraulic motor 16 has a conventionally externally-splined output shaft 18 extending axially therefrom and through the shock-mounting-plate aperture 15. In addition, the hydraulic motor 16  
15 includes conventional high speed control structure 20. The high speed control structure 20 includes a conventional high speed solenoid 22, having a power input lead 24 extending therefrom that is conventionally electrically energizable for causing the high speed control structure 22 to operate the hydraulic motor 16 to drive the output shaft 18 thereof at a high rotational speed. Moreover, the hydraulic motor  
20 14 includes conventional low speed control structure 26. The low speed control structure 26 includes a conventional low speed solenoid 28, having a power input lead 30 extending therefrom that is conventionally electrically energizable for causing the low speed control structure 26 to operate the hydraulic motor 16 to drive the output shaft 18 thereof at a low rotational speed.

25 The framework 13 (Figure 1) additionally includes a first, substantially cylindrically shaped, stationary, housing 34 that is conventionally fixedly attached to the shock mounting plate 14 as by means of a plurality of bolts 36, one of which is shown for illustrative purposes. Further, oppositely axially spaced from the first housing 34, the framework 13 includes a second stationary housing, which is not  
30 shown (NS). And, the compacting machine 12 includes rotatable drum structure 38, extending from the first housing structure 34.

The drum structure 38 (Figure 1) includes a first, generally cylindrically shaped, drum carrier 42 that is rotatably mounted within the first housing 34. The first drum carrier 42 has an inner end 47, and has an outer end, generally indicated by the numeral 48. And the compacting machine 12 includes a plurality of annularly-shaped bearings 50, 52, 54 and 56 interposed between first housing 34 and the first drum carrier 42. For preventing axial movement of the first drum carrier 42 out of the first housing 34, the compacting machine 12 includes an annularly-shaped plate 58, having a central aperture 59. The plate 58 is disposed in abutment with the bearing 50 and is conventionally fixedly attached to the inner end of the first drum carrier 42, as by means of a plurality of bolts 60, one of which is shown for illustrative purposes.

The drum structure 38 (Figure 1) additionally includes a second, annularly shaped, rotatable, drum carrier 64 (Figure 1A), that is axially spaced apart from the first drum carrier 42 (Figure 1). The second drum carrier 64 (Figure 1A) is conventionally mounted, by means of structure not shown, for rotation within the second housing (NS) of the framework 13 (Figure 1). Moreover, the drum structure 38 (Figs 1 and 1A) additionally includes a generally cylindrically-shaped, drum-supporting weldment 68, that extends between the first and second drum carriers, 42 and 64, and is conventionally fixedly attached thereto, as by means of a plurality of bolts 69 (Figure 1), one of which is shown for illustrative purposes.

The compacting machine 12 (Figures 1 and 1A) additionally includes vibratory structure 70 having an outer, elongate, eccentrically weighted, rotatable shaft 72. The outer shaft 72 includes a generally cylindrically shaped, central portion 76 thereof, having opposite ends 78 and 80. For eccentrically weighting the outer shaft 72, the outer shaft 72 includes a substantially semi-circularly-shaped weighted portion 77 (Figure 1B) that is conventionally fixedly attached to the central portion 76 by means well known in the art. In addition, the outer shaft 72 (Figures. 1 and 1A) includes a pair of oppositely-spaced, annularly-shaped, end portions, 82 and 84, that are conventionally fixedly attached to the opposite ends, 78 and 80 of the central portion 76 of the outer shaft 74. The end portion 82 has a central aperture 86, and the end portion 84 has a central aperture 88. The outer shaft 72 also includes oppositely spaced, generally cylindrically shaped stub shafts 90 and 92. The stub shafts, 90 and

92, are conventionally fixedly connected to opposite end portions, 82 and 84, of the outer shaft 72, so as to extend axially outwardly therefrom. The stub shaft 90 has an end 91 thereof extending toward the hydraulic motor 16. Further, the stub shaft 92 has an end 93 thereof facing outwardly of the drum structure 38. The outer shaft 72 also includes an annularly shaped end cap 94 that is disposed in abutment with, and conventionally fixedly attached to, the stub shaft end 93. And, the end cap 94 has centrally located aperture 95.

The eccentrically-weighted, outer shaft 72 (Figures 1 and 1A) is mounted for rotation within the oppositely spaced drum carriers, 42 and 64, by means of a plurality of annularly-shaped bearings 96, 97, 98 and 99, that are interposed between the drum carriers, 42 and 64, and the stub shafts, 90 and 92. For rotatably driving the outer shaft 72, the stub shaft 90 has an internally splined portion 100. Further, the compacting machine 12 includes an internally splined, cylindrically shaped, coupling 102 that is splined to the motor-output shaft 18 for rotation therewith. For holding the coupling 102 in place on the motor output shaft 18, the compacting machine 12 includes a conventional roll pin 104. Moreover, the compacting machine 14 includes an elongate, externally splined, drive shaft 106 that extends between, and is splined to, the coupling 102 and the stub shaft 90. And, for retaining the drive shaft 106 within the stub shaft 90, the outer shaft 72 includes a conventional pin 107 extending through the stub shaft 90.

The vibratory structure 70 (Figures 1 and 1A) also includes an inner, elongate, solid, cylindrically shaped, rotatable shaft 110. The inner shaft 110 includes a central portion 112 having opposite ends, 114 and 116, and, as shown in transverse cross-section in Figure 1B, an off-center axis of rotation 115. Accordingly, the inner shaft 110 has a weighted lobe portion, generally indicated by the numeral 117. The inner-shaft, lobe portion 117 (Figures. 1 and 1A) extends longitudinally of the length of the inner-shaft central portion 112 and eccentrically weights the inner shaft 110 relative to the axis of rotation thereof. In addition, the inner shaft 110 includes stub portions, 118 and 120, oppositely extending from the opposite ends, 114 and 116 of the central portion 112. The stub portion 120 has an outer end 121 facing outwardly of the drum structure 38. The inner shaft 110 is mounted for rotation within the outer shaft 72 by means of a plurality of annularly-shaped bearings, 122 and 123, that are interposed

between the inner-shaft stub portions, 118 and 120, and the outer-shaft end portions, 82 and 84.

For rotating the inner shaft 110 (Figures 1 and 1A) in unison with the outer shaft 42, the inner shaft 64 has a substantially circularly shaped cavity 130 formed inwardly of the stub portion 120 from the outer end 121 thereof. In addition, the vibratory structure 70 includes an elongate, solid, circularly shaped, extension shaft 132. The extension shaft 132 has opposite end portions, 134 and 136. The end portion 134 is disposed within the stub portion cavity 130 and is conventionally attached to the stub portion 120, as by means of a pin 137, and the other end portion 138 is slidably disposed within the aperture 95 of the outer-shaft end cap 94. Moreover, the extension shaft 132 has a substantially centrally located, externally splined portion 139. Further, the vibration structure 70 includes an internally splined, annularly shaped, collar 140, which is splined to the extension shaft 132, and has an external groove 142 formed therein. Still further, the vibration structure 70 includes a conventional key 144 disposed within the collar groove 140. And, the stub shaft 92 has a keyway 146 formed therein for receiving the key 144 and transmitting rotary motion of the stub shaft 92 to the collar 140 and thus to the attached extension shaft 132 and inner shaft 64 for rotation thereof.

For controlling the vibratory structure 70 (Figure 1 and 1A), structure 150 is provided for selectively indexing the radial location of the weighted portion 117 of the inner shaft 64 relative to the radial location of the weighted portion 77 of the outer shaft 42 for changing the amplitude of vibration of the vibratory structure 70. The indexing structure 150 includes a hand wheel 152 that is conventionally fixedly attached to the extension-shaft end portion 138, as by means of a key (not shown). In addition, the indexing structure 150 includes a conventional compression spring 154, that is coaxially mounted on the extension shaft 132 between the inner-shaft stub portion 116 and the internally splined collar 140. As shown in Figure 1A, the spring 154 retains the inner shaft 64 in a removably secured position, wherein the weighted lobe portion 117 of the inner shaft 110 is longitudinally centrally aligned with the weighted portion 77 of the outer shaft 72. As thus located in radial alignment with one another, the weighted portions, 77 and 117, impart a maximum amplitude of vibration to the vibratory structure 70, as the inner and outer shafts, 110 and 117, are

rotated in unison with one another. For changing the radial location of the inner-shaft weighted portion 117 relative to the outer-shaft weighted portion 77, the indexing structure 150 is operable, by pulling the hand wheel 152 against the force of the spring 154. For axially moving the extension shaft 132 in a direction which slides the extension shaft 132 out of splined relationship with the collar 140, to permit rotation of the inner shaft 64 relative to the outer shaft 42. In the course of such operation of the indexing structure 150, the inner shaft 64 is thereby axially moved out of a removably secured position thereof. The indexing structure 150 is thereafter operable for rotating the axially moved inner shaft 64 a selected number of degrees of arc, of up to 180 degrees, toward another removably secured position thereof, followed by allowing the energy stored in the spring 154 to return the inner shaft 64 to another secured position thereof, wherein the weighted portion 117 of the inner shaft 64 is radially located out of alignment with the weighted portion 77 of the outer shaft 72. As thus relocated out of radial alignment with one another, the rotating weighted portions, 77 and 117, impart a selected lower amplitude of vibration to the vibratory structure 70, depending upon the number of degrees of arc of rotation of the hand wheel 152. Conventionally, the weighted portions, 77 and 117, of the inner and outer shafts, 42 and 64, are predetermined for balancing one another when the weighted portions 77 and 117 are radially located 180 degrees out of alignment with one another.

The compacting machine 200 (Figures 2 and 3) according to the invention includes numerous parts corresponding in all respects to those of the compacting machine 12 of Figures 1 and 1A. In the following discussion, such corresponding parts in Figures. 2 and 3 each bear the same numerical designation as they do in Figures. 1 and 1A, followed by the letter "a."

The compacting machine 200 (Figures 2 and 3) comprises framework 13a including a shock mounting plate 14a and a conventional hydraulic motor 16a that is fixedly secured thereto by means well known in the art. The shock mounting plate 14a has an aperture 15a formed therein, and the hydraulic motor 16a has a conventionally externally splined output shaft 18a extending axially therefrom and through the shock-mounting-plate aperture 15a. In addition, the hydraulic motor 16a includes conventional high speed control structure 20a. The high speed control structure 20a

includes a conventional high speed solenoid 22a, having a power input lead 24a extending therefrom that is conventionally electrically energizable for causing the high speed control structure 22a to operate the hydraulic motor 16a to drive the output shaft 18a thereof at a high rotational speed. The hydraulic motor 14a has a default low speed operating condition to drive the output shaft 18a thereof at a low rotational speed.

The framework 13a (Figures 2 and 3) additionally includes a first, substantially cylindrically shaped, stationary, housing 34a that is conventionally fixedly attached to the shock mounting plate 14a. Further, oppositely axially spaced from the first housing 34a, the framework 13a includes a second stationary housing, which is not shown (NS). And, the compacting machine 200 includes rotatable drum structure 38a extending from the first housing structure 34a.

The drum structure 38a (Figure 2 and 3)) includes a first, generally cylindrically shaped, drum carrier 42a that is rotatably mounted within the first housing 34a. The first drum carrier 42 has an inner end 47a, and has an outer end, generally indicated by the numeral 48a. The compacting machine 200 also includes a plurality of annularly-shaped bearings, 50a and 52a, interposed between first housing 34a and the first drum carrier 42a. For preventing axial movement of the first drum carrier 42a out of the first housing 34a, the compacting machine 200 includes an annularly-shaped plate 58a, having a central aperture 59a. The plate 58a is disposed in abutment with the bearing 50a and is conventionally fixedly attached to the inner end of the first drum carrier 42a.

The drum structure 38a (Figures 2 and 3)) additionally includes a second, annularly-shaped, rotatable, drum carrier 64a that is axially spaced apart from the first drum carrier 42a. The second drum carrier 64a is conventionally mounted for rotation relative the framework 13. Moreover, the drum structure 38a additionally includes a generally cylindrically shaped, drum-supporting weldment 68a that extends between the first and second drum carriers, 42a and 64a, and is conventionally fixedly attached thereto.

The compacting machine 200 (Figures 2 and 3) also includes vibratory structure 202 having an outer, elongate, eccentrically weighted, rotatable shaft 204. The outer shaft 204 includes a generally cylindrically shaped, central portion 76a.

For eccentrically weighting the outer shaft 204, the outer shaft 204 includes a substantially semi-circularly-shaped weighted portion 77a that is conventionally fixedly attached to the central portion 76a. The outer shaft 204 includes oppositely spaced, annularly shaped, end portions 82a and 84a. The end portion 84a is conventionally fixedly connected to one end of the central portion 76a, and the end portion 84a is conventionally fixedly connected to the opposite end of the central portion 76a. The outer shaft 204 also includes oppositely spaced, generally cylindrically shaped stub shafts, 206 and 208. The stub shafts 206 is conventionally fixedly connected to the outer-shaft end portion 82a so as to extend axially-outwardly therefrom, and the stub shaft 208 is conventionally fixedly connected to stub-shaft end portion 84a so as to extend axially-outwardly therefrom. The stub shaft 208 optionally includes two, longitudinally-extending, cavities 210 formed therein from the outer end 212 thereof. Assuming the provision of the cavities 210, the cavities are preferably spaced 180 degrees apart from one another. The outer shaft 204 also preferably includes an annularly shaped end cap 214 that is disposed in abutment with, and conventionally fixedly attached to, the stub shaft end 212. The end cap 214 has a centrally located aperture 216 and includes two apertures 218 formed therein that are spaced 180 degrees apart from one another. Assuming the provision of the cavities 210, the apertures 218 are respectively dimensioned for alignment with an opposite cavity 210.

The eccentrically-weighted, outer shaft 204 (Figures 2 and 3) is mounted for rotation within the oppositely spaced drum carriers, 42a and 64a, by means of a plurality of annularly-shaped bearings 96a, 98a and 99a, that are interposed between the drum carriers, 42a and 64a, and the stub shafts, 206 and 208. The compacting machine 200 also includes structure 220 for rotatably driving the outer shaft 204. To that end, the stub shaft 206 preferably has an internally splined inner surface 222. Further, the driving structure 220 includes an elongate, internally-splined, cylindrically shaped, coupling 224, having a lip portion 225 thereof facing the motor 16a. The coupling 224, and thus the lip portion 225 thereof, is conventionally fixedly splined to the motor-output shaft 18a for rotation therewith. Moreover, the driving structure 220 generally includes an elongate, externally splined, drive shaft 226 that extends between, and is splined to the coupling 224 and the stub shaft 206. More

particularly, the drive shaft 226 includes an externally splined, end portion 228, facing towards the motor 16a, that is slideably splined to the coupling 224 for axial movement therein. And, the drive shaft 226 includes an externally-splined, end portion 230, facing away from the motor 16a, that is slidably splined to the stub shaft 206 for axial movement therein. The splined end portion 230 has a radius that is substantially twice that of the shaft-end portion 228. In addition, the drive shaft 226 includes a shoulder portion 232 adjacent to the splined end portion 230. Preferably the splined end portion 230 has a step 234 formed therein that defines a protrusion 236 thereof, having a substantially semi-circularly shaped transverse cross-section, that extends away from the motor 16a. Moreover, for retaining the drive shaft 226 in slidably-splined relationship with the stub shaft 206, the driving structure 220 includes an annularly-shaped member 240, that is conventionally fixedly attached to the shaft 226 for rotation therewith, and a spring 242, that is coaxially mounted around the coupling 224 and between the coupling-lip portion 225 and member 240. As thus constructed and arranged, the spring 242 urges the member 240 and thus the attached shaft 226 towards the stub shaft 206.

The vibratory structure 202 (Figures 2 and 3) also includes an inner, elongate, solid, cylindrically shaped, rotatable shaft 246. The inner shaft 246 includes a central portion 112a having opposite ends, 114a and 116a, and, as shown in transverse cross-section in Figure 1B, an off-center axis of rotation 115a. Accordingly, the inner shaft 110a has a weighted lobe portion, generally indicated by the numeral 117a. The inner-shaft, lobe portion 117a (Figures 2 and 3) extends longitudinally of the length of the inner-shaft central portion 112a and eccentrically weights the inner shaft 246 relative to the axis of rotation thereof. In addition, the inner shaft 246 includes stub portions, 248 and 250, oppositely extending from the opposite ends, 114a and 116a of the central portion 112a. The stub portion 248 has an outer end 252 facing toward the motor 16a. Preferably, the stub-shaft outer end 252 has a step 253 formed therein that defines a protrusion 254 thereof extending toward the motor 16a. The stub-shaft, outer-end protrusion 254 has a substantially semi-circularly-shaped transverse cross section. The inner shaft 246 is slideably and rotatably mounted within to the outer shaft 206 by means of a plurality of annularly-shaped bearings, 122a and 123a, that

are interposed between the inner-shaft stub portions, 248 and 250, and the outer-shaft end portions, 82a and 84a.

For rotating the inner shaft 246 (Figures 2 and 3) in unison with the outer shaft 204, the vibratory structure 202 includes an elongate, solid, circularly shaped, extension shaft 256, having opposite end portions 258 and 260. The extension-shaft end portion 258 is conventionally fixedly attached to the inner-shaft stub portion 250 and the extension-shaft end portion 260 is slideably disposed within the aperture 216 of the outer-shaft end cap 214. In addition, for inner-shaft rotation purposes, the vibratory structure 202 preferably, generally, includes a drive member 262 that is fixedly attached to extension shaft 256 and removably inserted into either of the end-cap apertures 218. More particularly, the drive member 262 is an annularly shaped member that is conventionally fixedly attached to the extension-shaft end portion 260. And, the drive member 262 includes a drive post 264 extending therefrom for removable insertion in either of the outer-shaft end-cap aperture 218. Moreover, assuming the provision of the optional, inner-shaft, stub-portion cavities 210 the drive post 264 may be removably inserted through either of the outer-shaft, end-cap apertures 218 and into the outer-shaft, stub-portion, cavity 210 aligned therewith. As thus constructed and arranged, the drive member 262 transmits rotary motion of the outer-shaft stub shaft 208 to the drive member 262 and thus to the attached extension shaft 256 for rotation thereof and of the inner shaft 246 attached thereto. Accordingly the outer and inner shafts, 204 and 246, are connected for rotation in unison with one another.

For controlling the vibratory structure 202 (Figures 2 and 3), structure 270 is provided for selectively indexing the radial location of the weighted portion 117a of the inner shaft 246 relative to the radial location of the weighted portion 77a of the outer shaft 204, for changing the amplitude of vibration of the vibratory structure 202. The indexing structure 270 includes a hand wheel 152a that is conventionally fixedly attached to the extension-shaft end portion 260, as by means of a key (not shown). Without departing from the spirit and scope of the invention, the hand wheel 152a may be conventionally fixedly attached to the drive member 262 and thus to the extension-shaft end portion 260. In addition, the indexing structure 270 includes a conventional compression spring 272 that is coaxially mounted around the extension

shaft 256 between the inner-shaft stub portion 250 and the outer-shaft end cap 214. As shown in Figure 3, the spring 272 retains the inner shaft 246 in a removably secured position, wherein the weighted lobe portion 117a of the inner shaft 246 is longitudinally centrally aligned with the weighted portion 77a of the outer shaft 204.

5 As thus located in radial alignment with one another, the inner shaft 204 is located in a first removably secured position wherein the weighted portions, 77a and 117a, impart a maximum amplitude of vibration to the vibratory structure 202, as the outer and inner shafts, 204 and 246 are rotated in unison with one another. Moreover, when the outer and inner shafts 202 and 246 are radially aligned with one another, the

10 drive-shaft, splined end protrusion 236, is disposed within the step 253 forming the inner-shaft, end-portion protrusion 254, and the inner shaft, outer end protrusion 254 is disposed within the step 234 forming the drive-shaft splined end protrusion 236. Thus, when the outer and inner shafts 202 and 246 are radially aligned with one another, the respective drive shaft and inner shaft protrusions, 236 and 254, are

15 spaced apart from one another and disposed in overlapping spatial relationship with one another within the outer shaft 202.

For low amplitude vibration of the vibratory structure 202 (Figures 2 and 3), the indexing structure 270 is operable for moving the inner shaft 246, from the above discussed first removably secured position, to a second removably secured position

20 wherein the inner shaft weighted portion 117a is radially disposed 180 degrees out of radial alignment with the weighted portion 77a of the outer shaft 204. To that end, the hand wheel 152a may be manually moved outwardly of the drum structure 38a against the force of the spring 272. For moving the drive member 262, and thus the post 264 thereof out of seated relationship with the end-cap aperture 218. The inner

25 shaft 245 is thus slidably moved within the bearings 123a a sufficient distance to move the inner shaft protrusion 254 out of the step 234 forming the drive-shaft protrusion 236, to permit rotation of the inner shaft 246 relative to the outer shaft 202. Thereafter, the indexing structure 270 is operable for rotating the axially moved inner

30 shaft 246, through an arc of 180 degrees toward the second removably secured position, followed by allowing the energy stored in the spring 272 to return the inner shaft 246 to the second removably secured position. In the second removably secured position, the weighted portions 77a and 117a of the outer and inner shafts, 204 and

246, are out of radial alignment with one another. Moreover, the drive member post 264 is disposed within the opposite end-plate aperture 218, and the inner-shaft protrusion 254 is disposed in abutment with the drive shaft protrusion 236.

For preventing high speed rotation of the vibratory structure 202 (Figures 2 and 3), when the inner shaft 246 is indexed for high amplitude vibration of the vibratory structure the 202, the compacting machine 202 includes proximity switching structure 280. The proximity switching structure 280 includes the member 240, and includes a conventional proximity switch 282, having leads 284 and 286. The member 240 is preferably a disk. As shown in Figure 3, the disk 240 is movable into proximity with the proximity switch 282, against the force exerted by the spring 242, in response to the indexing structure 270 being indexed for low amplitude vibration of the vibratory structure. Further, as shown in Figure 2, the disk 240 is preferably movable out proximity with the proximity switch 282, when the energy stored in the spring 242 is released, due the indexing structure 270 being indexed for high amplitude vibration of the vibratory structure. Thus, as shown in Figure 4, the proximity switch lead 284 preferably extends from a normally open terminal 290 of the proximity switch 282 and the proximity switch lead 286 preferably extends from the common terminal 292 of the normally open terminal 290 of the proximity switch 282, whereby the proximity switch 282 maintains an open circuit to the hydraulic motor 16a until the disk 240 is moved into proximity with the proximity switch 282 (as shown in Figure 3) in response to indexing the inner shaft 246 for low speed vibration of the vibratory structure. 202.

For selectively controlling the hydraulic motor 16a, the compacting machine 200 includes a conventionally manually operable power switch 300 that is conventionally connected to the framework 13a of the machine 200. The power switch 300 has a common terminal 302, a low motor-speed terminal 306 and a high motor-speed terminal 308. The compacting machine 200 also includes a conventional source of supply of Direct Current (D.C.) power 310 that is conventionally electrically connected to the common terminal 302. In addition, the power switch 300 includes a manually movable toggle 312 and a wiper arm 314. The toggle 312 is conventionally attached to the wiper arm 314 for selective movement thereof. And the wiper arm 314 is conventionally electrically connected to the

common terminal 302 for electrically switching D.C power therefrom to the low and high motor-speed terminals 306 and 308, in response movement of the toggle 312. When the toggle 312 and the wiper arm 314 is moved to the high motor-speed terminal 308, D.C. power from the common terminal 302 is applied to the proximity switch common terminal 292. However, the proximity switch 282 prevents high speed rotation of the hydraulic motor 16a, and thus of the vibratory structure 202, when the indexing structure 270 (Figure 2) has been indexed for high amplitude vibration the vibratory structure 270. On the other hand, the proximity switch 282 (Figure 4) operates to permit D.C. power to be applied to the high speed solenoid 22a, via the proximity switch 282, for high speed rotation of the hydraulic motor 16a, and thus of the vibratory structure 270, when the indexing structure 270 (Figure 3) indexes the inner shaft 246 for low amplitude vibration of the vibratory structure 270. As previously discussed, the motor 16a has a default low speed condition and the toggle is moved to the low position 306 simply as a means for the operator to be aware that the motor 16a is rotating the vibratory structure 204 (Figures. 2 and 3) at a low amplitude of vibration.

Although the preferred embodiments of the invention have hereinabove been shown and described in detail, such embodiments should be considered to illustrative and not restrictive in character. In this connection it is noted that numerous variations of the preferred embodiments of the invention may become apparent to persons skilled in the art as a result of having seen the foregoing drawings and read and understood the accompanying description appertaining to the invention, and it is intended that such variations as fall within the scope the invention shall be protected to the same extent as are the preferred embodiments of the invention.

What is Claimed is:

1. Apparatus for controlling vibratory structure of a vibratory compacting machine, wherein the vibratory structure includes an outer shaft with a first eccentrically weighted portion and an inner shaft rotatable having a second eccentrically weighted portion within the outer shaft, and the compacting machine includes a hydraulic motor for rotating the vibratory structure, the apparatus for controlling comprising:
  - (a) structure for selectively controlling the hydraulic motor for rotating the vibratory structure at a high speed and a low speed;
  - 10 (b) structure for selectively indexing the inner shaft for high and low amplitude vibration of the vibratory structure; and
  - (c) structure for preventing high speed rotation of the vibratory structure when the inner shaft is indexed for high amplitude vibration of the vibratory structure.
- 15 2. The apparatus for controlling according to Claim 1, wherein the indexing structure is operable for moving the inner shaft and thereby the second weighted portion thereof out of radial alignment with the first weighted portion of the outer shaft for low amplitude vibration of the vibratory structure.
- 20 3. The apparatus for controlling according to Claim 1, wherein the structure for preventing includes proximity switching structure for preventing high speed rotation of the vibratory structure in response to indexing the inner shaft for high amplitude vibration of the vibratory structure.
- 25 4. The apparatus for controlling according to Claim 1, wherein the structure for preventing includes proximity switching structure for permitting high speed rotation of the vibratory structure in response to indexing the inner shaft for low amplitude vibration of the vibratory structure.
- 30 5. The apparatus for controlling according to Claim 1, wherein the compacting machine includes a stationary housing, a drive shaft portion connected to the hydraulic motor extending into the housing, and the structure for preventing high

speed rotation includes a proximity switch fixedly attached to the housing and a member fixedly attached to the drive shaft portion, and the indexing structure operable for axially moving the drive shaft portion and thereby the member affixedly attached out of proximity with the proximity switch for actuation thereof to thereby  
5 prevent high speed rotation of the vibratory structure.

6. The controlling apparatus according to Claim 1, wherein the inner shaft has first and second removably secured positions thereof, the indexing structure operable for moving the inner shaft from the first removably secured position thereof  
10 to the second removably secured position thereof for high amplitude vibration of the vibratory structure, and the indexing structure operable for moving the inner shaft from the second removably secured position thereof to the first removably secured position thereof for low amplitude vibration of the vibratory structure.

15 7. The controlling apparatus according to Claim 5, wherein the hydraulic motor includes a first solenoid operable for high speed rotation thereof, the switching structure including a proximity switch having a normally open terminal electrically connected to the first solenoid, the proximity switch including a normally closed terminal and a first common terminal, the structure for controlling including a  
20 manually operable switch having a selectable high speed terminal thereof electrically connected to the first common terminal of the proximity switch, the manually operable switch including a second common terminal, the structure for controlling including a direct current (d.c.) source of supply of power electrically connected to the second common terminal, the proximity switch normally switched to the normally  
25 closed terminal thereof for preventing high speed rotation of the vibratory structure when the manually operated switch is selectively operated to apply power to the high speed terminal thereof, and the proximity switch operable to permit the application of power to the hydraulic motor for high speed rotation thereof to in response to indexing the inner shaft for low amplitude vibration of the vibratory structure.

30 8. Apparatus for controlling vibratory structure of a vibratory compacting machine, wherein the vibratory structure includes an outer shaft and an inner shaft

rotatable within the outer shaft, wherein the outer shaft has a first eccentrically weighted portion thereof, wherein the inner shaft has a second eccentrically weighted portion thereof, wherein the vibratory structure includes structure for mounting the respective shafts for rotation, wherein the compacting machine includes a hydraulic motor connected by a drive shaft portion for rotating the vibratory structure, and the apparatus for controlling comprising:

- (a) structure for selectively controlling the hydraulic motor for rotating the vibratory structure at a high speed and a low speed;
- (b) structure for selectively indexing the inner shaft for high and low amplitude vibration of the vibratory structure; and
- (c) proximity switching structure for permitting high speed rotation of the vibratory structure when the inner shaft is indexed for low amplitude vibration of the vibratory structure.

9. The controlling apparatus according to Claim 8 including the proximity switching structure operable for preventing high speed rotation of the vibratory structure in response to indexing the inner shaft for high amplitude vibration of the vibratory structure.

10. The controlling apparatus according to Claim 8, wherein the compacting machine includes framework, the proximity switching structure includes a proximity switch fixedly attached to the framework, the proximity switching structure includes a member fixedly attached to the drive shaft portion, and the indexing structure is operable for axially moving the drive shaft portion and thereby the attached member into proximity with the proximity switch for actuation thereof to permit high speed rotation of the vibratory structure.

11. The controlling apparatus according to Claim 8, wherein the compacting machine includes framework, the proximity switching structure includes a proximity switch fixedly attached to the framework, the proximity switching structure includes a member fixedly attached to the drive shaft portion, and the indexing means is operable for axially moving the drive shaft portion and thereby the attached member

out of proximity with the proximity switch for actuation thereof to thereby permit high speed rotation of the vibratory structure.

12. The controlling apparatus according to Claim 8, wherein the inner shaft  
5 has first and second removably secured positions thereof, the indexing structure is operable for moving the inner shaft from the first removably secured position thereof to the second removably secured position thereof for low amplitude vibration of the vibratory structure, and the indexing structure is operable for moving the inner shaft  
10 from the second removably secured position thereof to the first removably secured position thereof for high amplitude vibration of the vibratory structure.

13. The controlling apparatus according to Claim 12, wherein the proximity  
switching structure is operable in response to one of the axial movements of the inner shaft to permit high speed rotation of the vibratory structure, and the proximity  
15 switching structure is operable in response to the other of the axial movements of the inner shaft to prevent high speed rotation of the vibratory structure.

14. The controlling apparatus according to Claim 13, wherein the indexing  
structure is operable for axially moving the drive shaft portion and thereby the  
20 attached member into proximity with the proximity switch for actuation thereof to thereby permit high speed rotation of the vibratory structure.

15. A vibratory compacting machine comprising:

(a) vibratory apparatus including an outer shaft having a first eccentrically  
25 weighted portion and a inner shaft having a second eccentrically weighted portion rotatable within the outer shaft, the vibratory apparatus including structure for mounting the inner and outer shafts for rotation, the inner shaft having a protrusion thereof defined by a step formed therein;

(b) a hydraulic motor;

30 (c) first apparatus for connecting the hydraulic motor to the outer shaft for rotation thereof by the motor, the first apparatus including a drive shaft having a protrusion defined by a step formed therein;

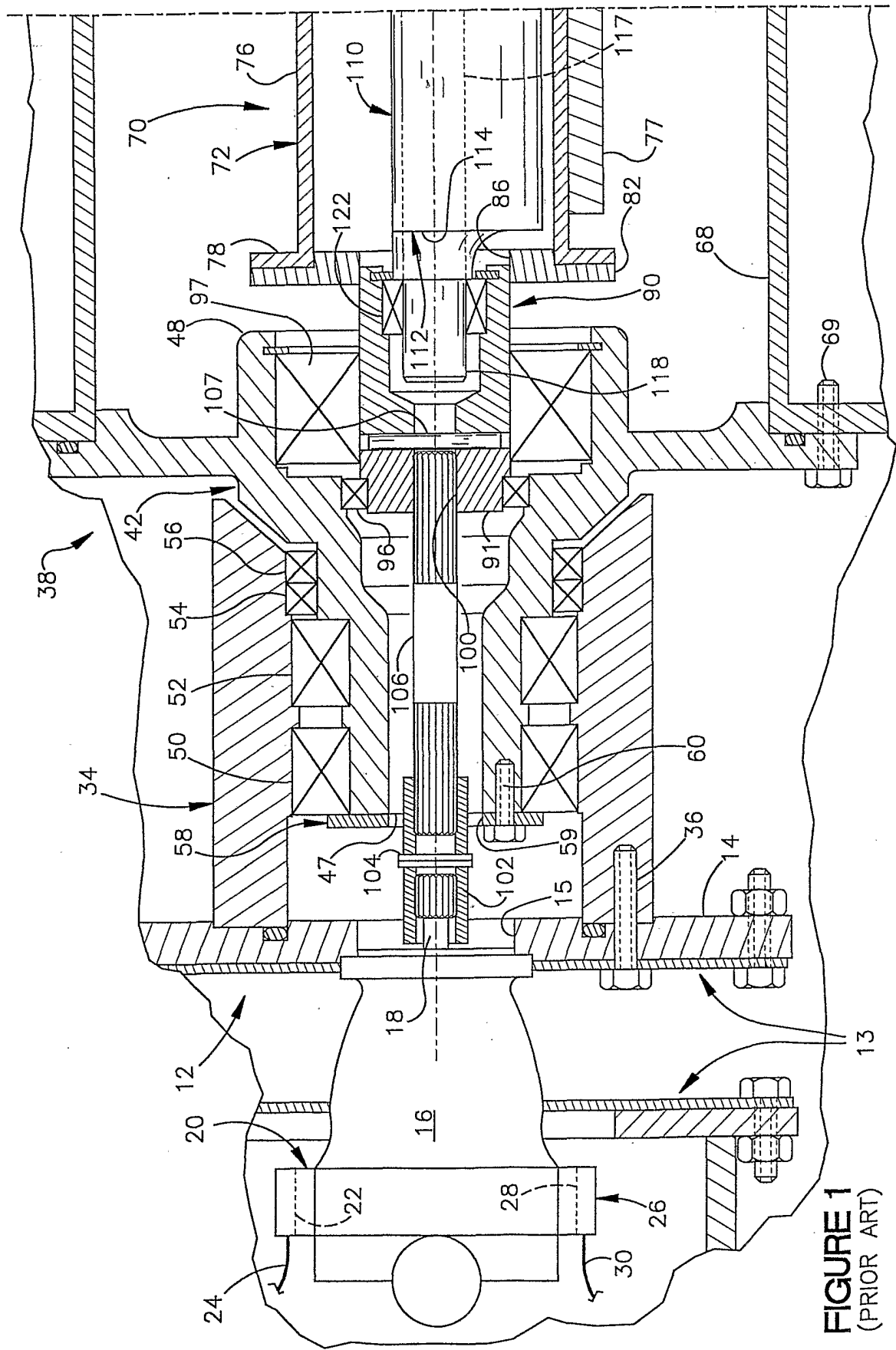
(d) structure operable for indexing the weighted portion of the inner shaft into radial alignment with the weighted portion of the outer shaft for high amplitude vibration of the vibratory apparatus, the protrusions of the drive shaft and inner shaft disposed in an overlapping spatial relationship with one another when the inner shaft is indexed for high amplitude vibration of the vibratory apparatus, the indexing structure operable for indexing the weighted portion of the inner shaft out of radial alignment with the weighted portion of the outer shaft for low amplitude vibration of the vibratory means, and the respective protrusions disposed in abutment with one another when the inner shaft is indexed for low amplitude vibration of the vibratory apparatus.

16. The compacting machine according to Claim 15, wherein the indexing structure includes an extension shaft and a drive member, the extension shaft having one end thereof fixedly connected to the inner shaft and the other end thereof fixedly connected to the drive member, and the drive member removably secured to the outer shaft.

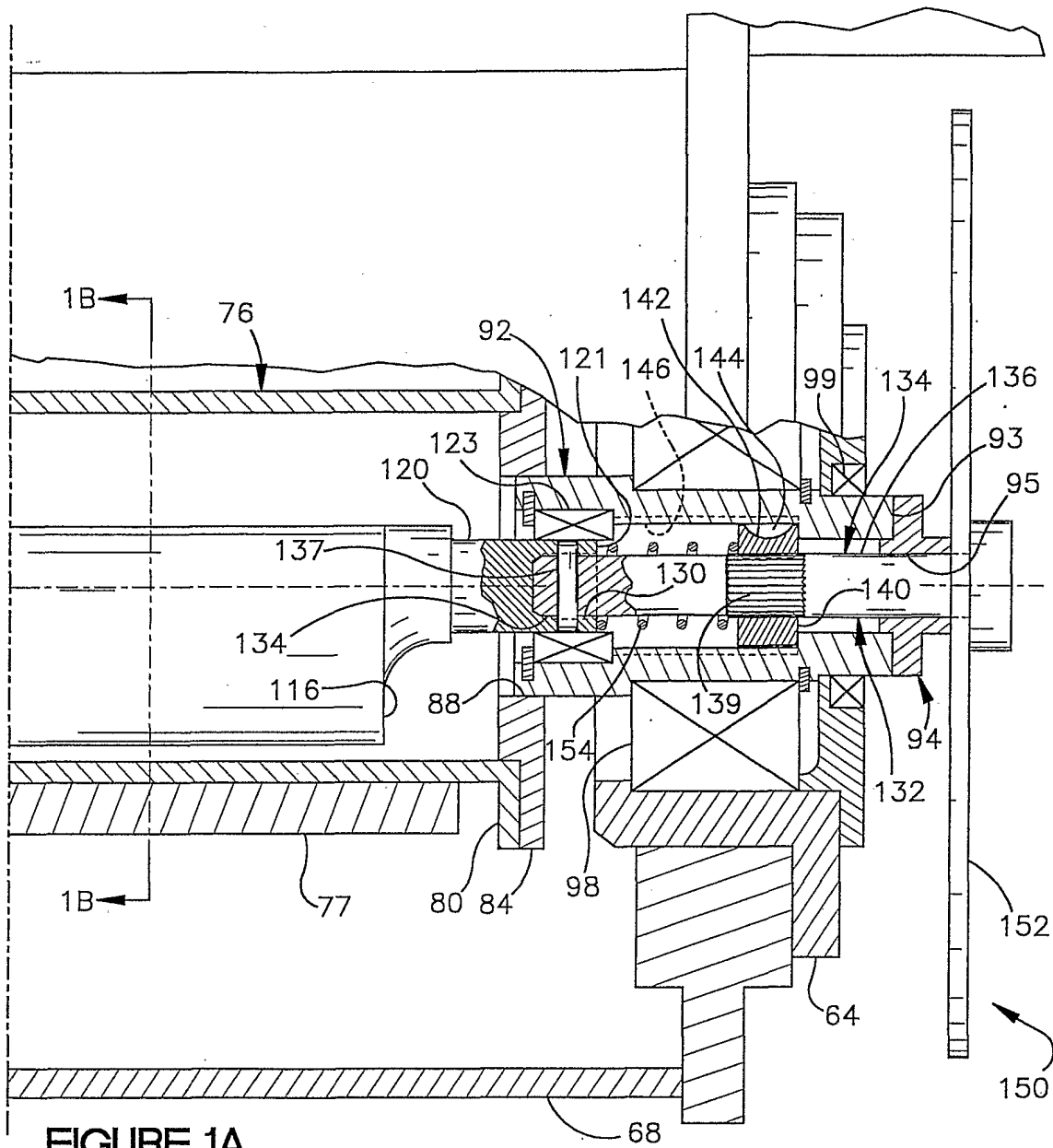
17. The compacting machine according to Claim 16 including framework and a proximity switch fixedly attached to the framework, wherein the drive shaft has a member fixedly connected thereto for movement therewith, the indexing structure is operable for moving the drive shaft toward the hydraulic motor when the indexing structure is indexed for low amplitude vibration of the vibratory apparatus, and the drive shaft moving the attached member into proximity with the proximity switch for operation thereof when the indexing structure is indexed for high amplitude vibration of the vibratory apparatus.

18. The compacting machine according to Claim 17 wherein the indexing structure includes an extension shaft and a drive member, the extension shaft having one end thereof fixedly connected to the inner shaft and the other end thereof fixedly connected to the drive member, and the drive member including a post extending therefrom, the post having a first removably secured position thereof wherein the post is located when the indexing structure is indexed for high amplitude vibration of the

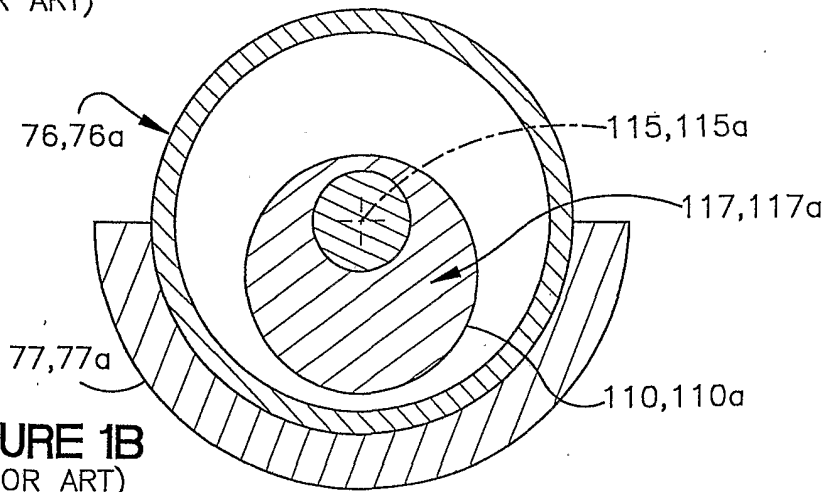
vibratory apparatus, and the post having a second removably secured position thereof wherein the post is located when the indexing structure is indexed for low amplitude vibration of the vibratory apparatus.



**FIGURE 1**  
(PRIOR ART)



**FIGURE 1A**  
(PRIOR ART)



**FIGURE 1B**  
(PRIOR ART)

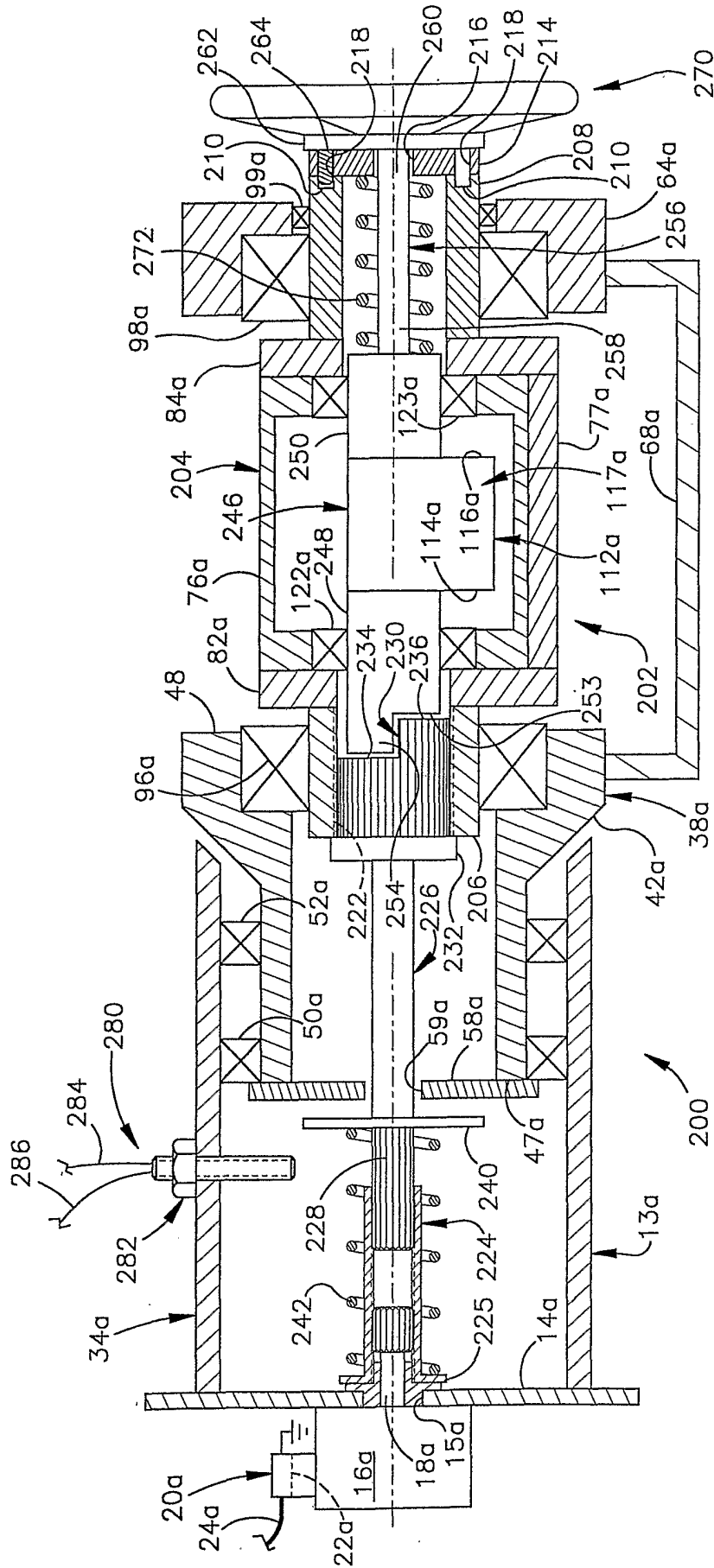


FIGURE 2



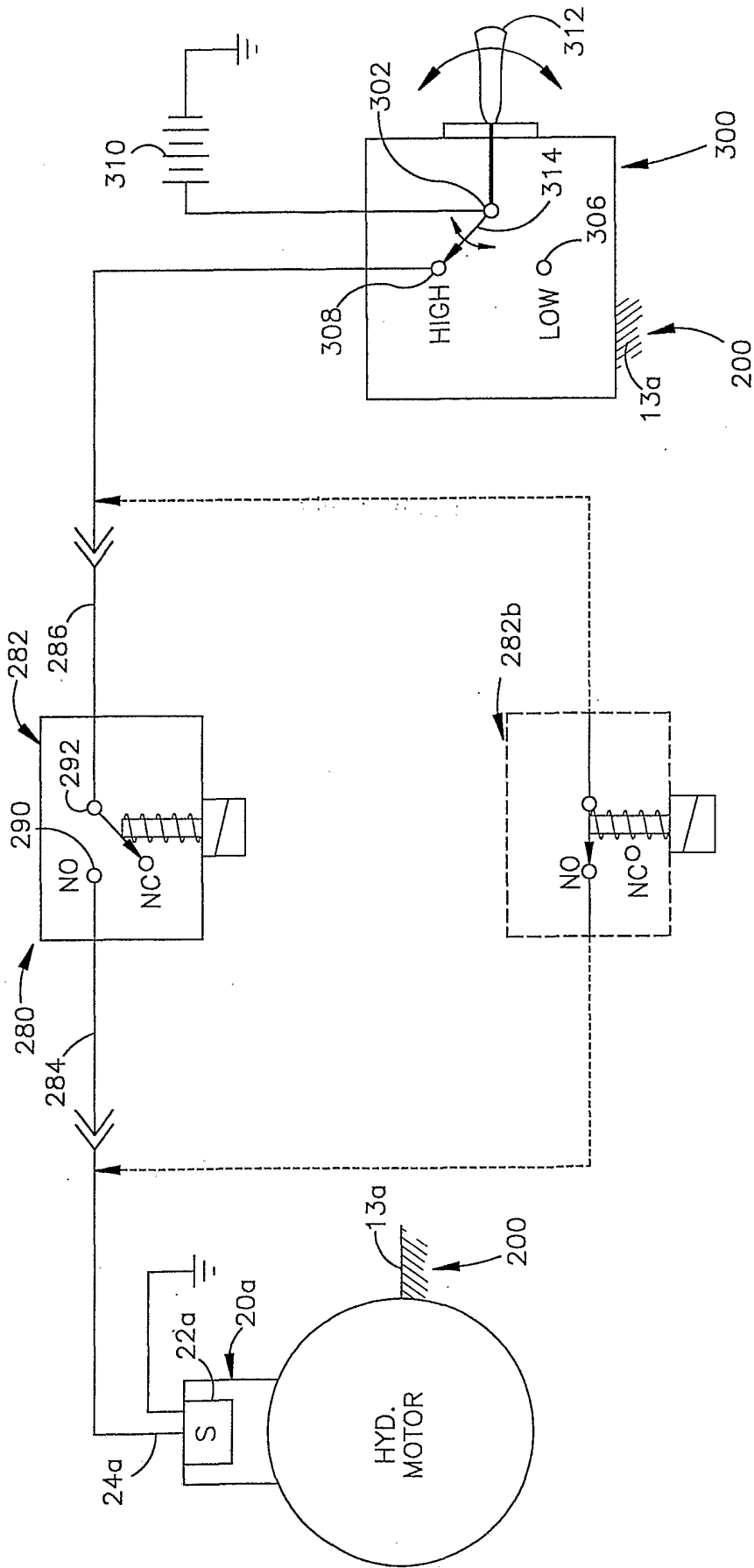


FIGURE 4

**INTERNATIONAL SEARCH REPORT**

International Application No

PCT/IB 01/01502

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 E01C19/28

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 454 780 A (GOEHLER ROBERT F ET AL) 19 June 1984 (1984-06-19) cited in the application	1, 2, 6
A	the whole document	8, 15
Y	US 3 867 073 A (BARRETT JOHN C ET AL) 18 February 1975 (1975-02-18) the whole document	1, 2, 6
A	EP 0 987 371 A (SAKAI JUKOGYO KK) 22 March 2000 (2000-03-22) column 21, line 14 -column 26, line 24; figures	1, 8, 15
A	US 4 645 014 A (ANDERSSON UNO ET AL) 24 February 1987 (1987-02-24) the whole document	1, 8, 15

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- \*G\* document member of the same patent family

Date of the actual completion of the international search

16 January 2002

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Information on patent family members

International Application No

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