

Nov. 23, 1971

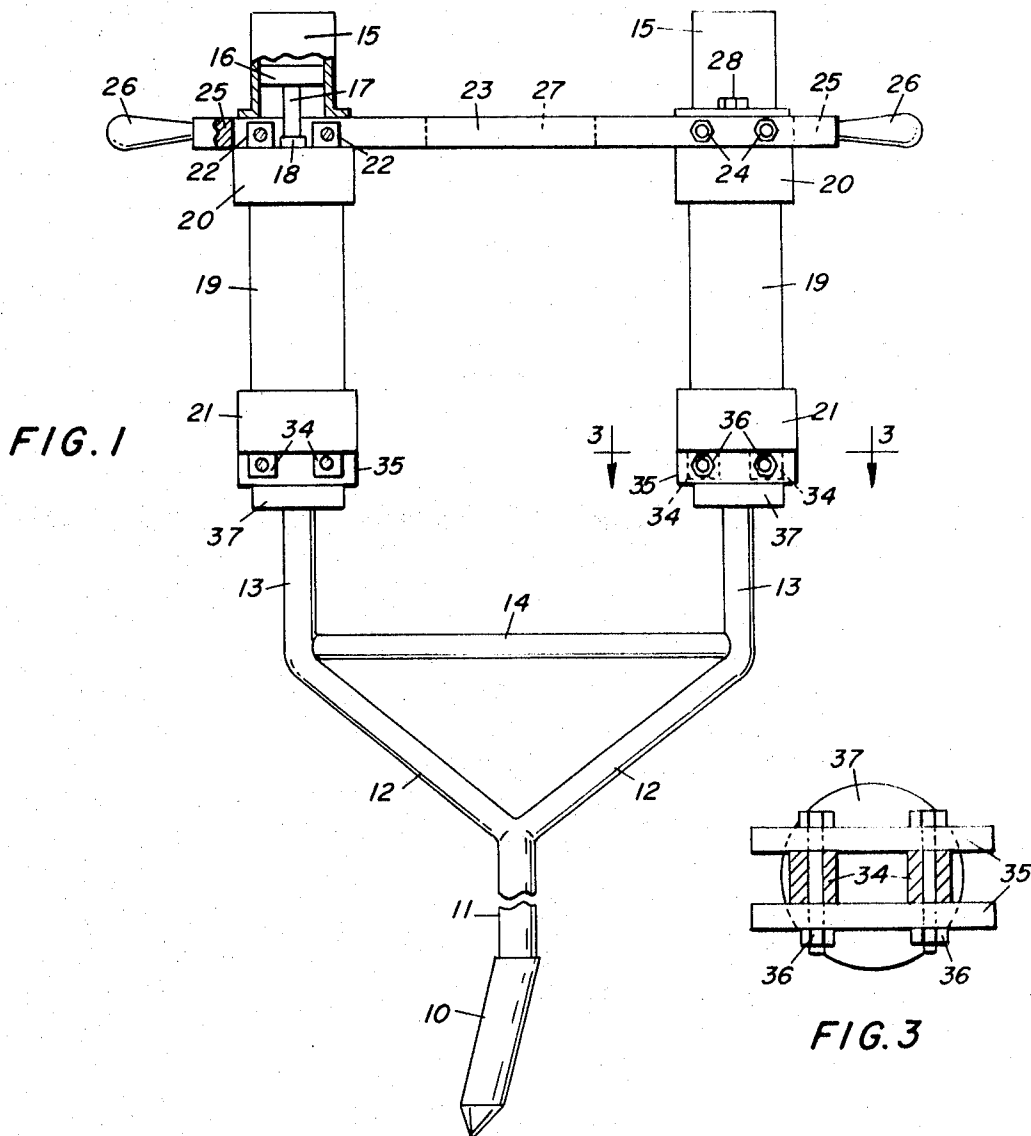
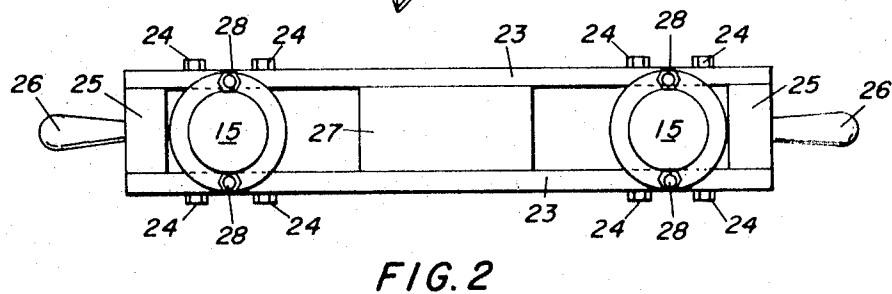
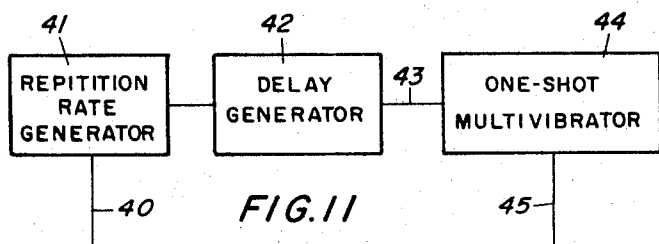
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3,621,786

RAILWAY BALLAST TAMPER

Filed April 22, 1970

3 Sheets-Sheet 1



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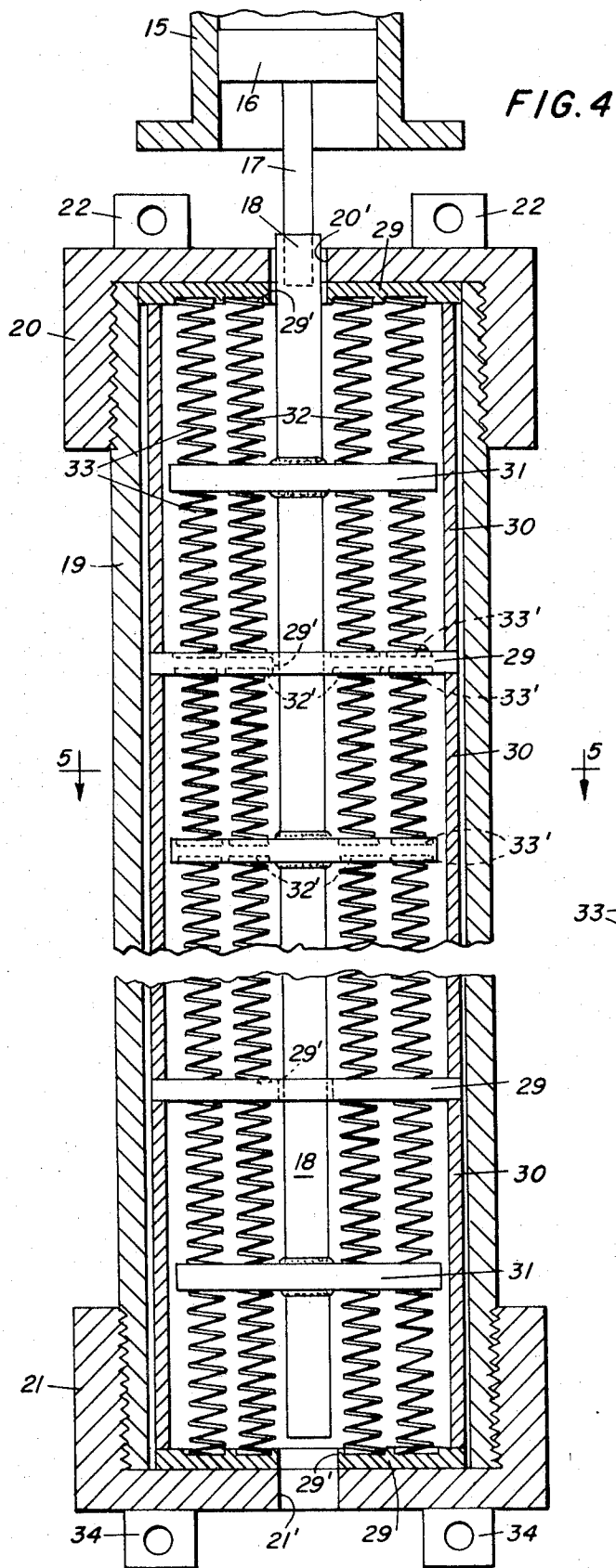
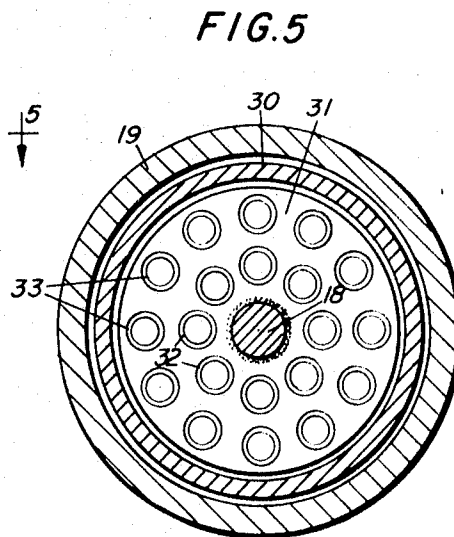
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RAILWAY BALLAST TAMPER

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3 Sheets-Sheet 2



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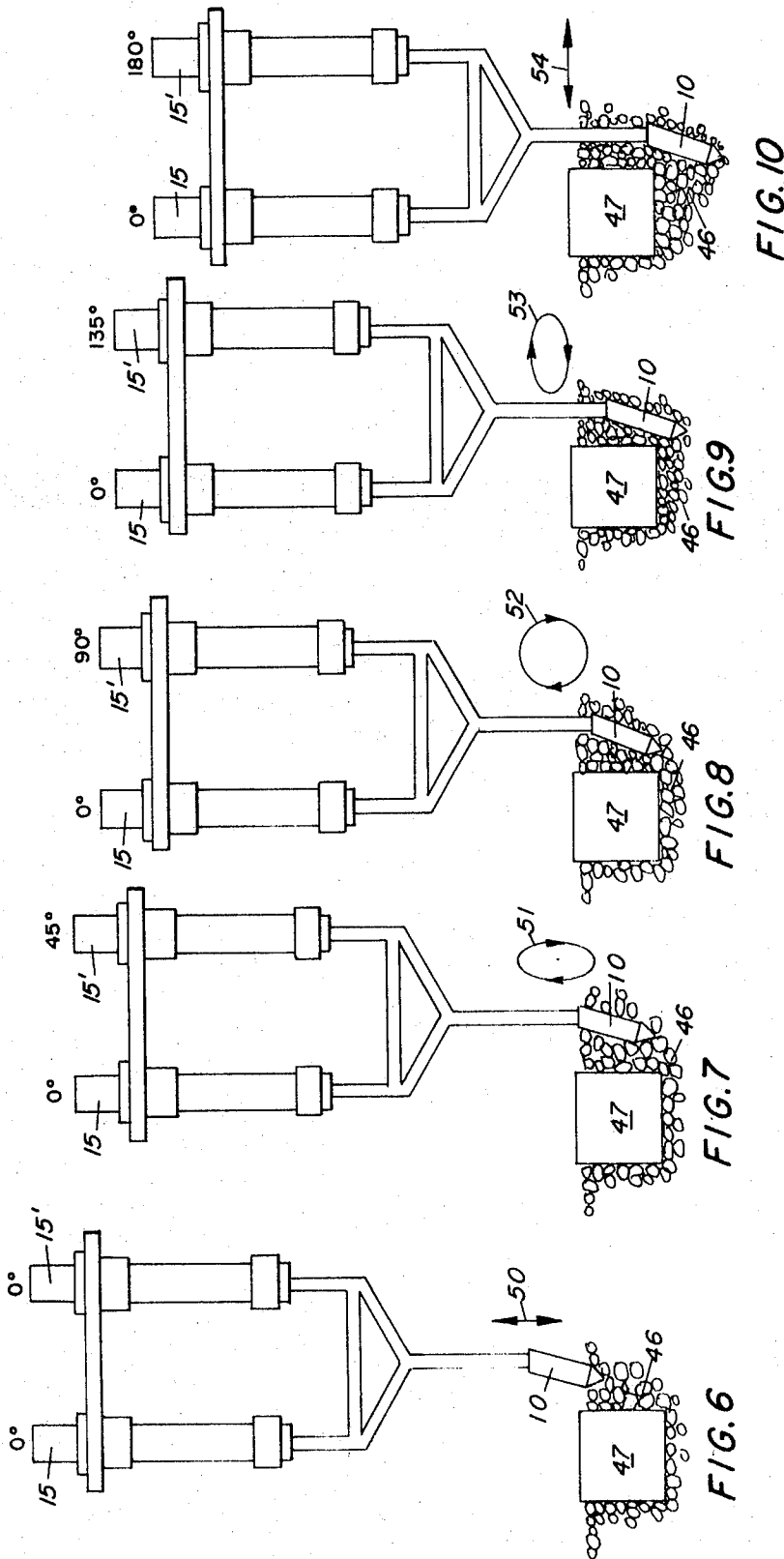
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RAILWAY BALLAST TAMPER

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3 Sheets-Sheet 3



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3,621,786

RAILWAY BALLAST TAMPER

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14 Claims

ABSTRACT OF THE DISCLOSURE

A ballast tamper having a tool support operable by a resonant frequency power drive. The direction of the tamping force on the tool is controlled by providing a pair of resonant frequency actuators, each operably connected to a separate force-transmitting branch member of a bifurcated tool mounting structure. The other ends of the branch members are connected together to a common point on the tool support. The relative vibration phase relationship of the power drives is controllably variable through one hundred and eighty degrees whereby the resultant direction of the force on the tool is variable from vibratory vertical movement to vibratory horizontal movement and in passing between these limits can assume an ellipsoidal orbital circumferential movement with the major axis vertical to ellipsoidal movement with the major axis horizontal providing in the intermediate relations forces both horizontal and vertical and variable in both direction and magnitude by variation of the relative power drive phase relationship of the two actuators.

The present invention relates to tampers and particularly pertains to railway track ballast tampers for placing and packing ballast around and under railroad ties and may be carried and driven pneumatically, hydraulically, or electrically.

Most ballast tampers use an eccentric type vibrator or a straight longitudinal type of vibration and it has been difficult and inefficient to provide a good solid packing and tamping of the ballast up under the ties and it is an object of this invention to provide an improve more efficient tamper by using a power drive operable at the resonant frequency of the tamper actuator.

Another object of this invention is to provide an improved tamper by utilizing a pair of actuators connected to a common point on the tool support and each having a separate power drive with relative vibration phase control thereof whereby the driving force on the tool is controllable in direction both vertically and laterally.

The present invention increases the efficiency of the tamper by causing it to vibrate at its resonant frequency so that a maximum vibrating force is developed for a given power drive. This includes an improved resilient nested compression spring force transmitting structure utilizing balanced compression springs between drive plates, vibrated by the power drive, and driven plates on the tool support actuator. The improved tool tamping force control is provided by a pair of power drives mounted on separate actuators connected to a common point on the tool support and being relatively power phase controllable from completely in-phase operation, which provides straight vertical vibration, to one hundred and eighty degrees out-of-phase operation, which gives straight lateral vibration. The relative phase of the two power drives are shiftable to any desired relation between these limits to provide a variable proportion of vertical to lateral force which varies with the relative position of the drives so that ellipsoidal orbital angular movements of any desired types can be provided according to the requirements of the ballast being tamped, and this shift in the direction of the tamping tool action can be accom-

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plished continuously without interrupting the tamping operation.

Further objects and advantages of the invention will be appreciated and become apparent from a consideration of the following description referring to the accompanying drawings, and the features of novelty which characterize this invention are pointed out in the appended claims.

In the drawings:

FIG. 1 is an elevational view of a manually manipulatable tamper embodying the invention with portions broken away to show certain structural features.

FIG. 2 is a top plan view of the structure illustrated in FIG. 1.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 1, showing the operative connection of the actuator to the force-transmitting member of the bifurcated tool mounting structure.

FIG. 4 is an enlarged vertical sectional view through an actuator shown in FIG. 1, illustrating features of the resilient force-transmitting structure.

FIG. 5 is a sectional view taken along line 5—5 of FIG. 4.

FIGS. 6, 7, 8, 9, and 10 schematically illustrate the relative force on the tool under different relative phase relations of the two power drives of the pair of actuators.

FIG. 11 is a schematic diagram of an electric circuit for providing the desired relative phase control of a pair of electromagnetic power drives for the tool.

Referring to the drawings, a tamper embodying the present invention is illustrated wherein maximum efficiency is attained by driving the tool at resonant frequency of the actuator thereof. A suitable tamper tool 10 is mounted on a tool support 11 to which a bifurcated power drive mounting is secured. This mounting member comprises two actuating force-transmitting arms 12 connected at the lower ends thereof to a common point on the tool support 11 and at the other end respectively each to a connecting rod 13. A brace 14 rigidly secures together the upper ends of the arms 12 and provides a strong rigid triangle shaped tool mount.

The improved power drive also comprises an actuator arrangement which can be continuously controlled to tamp ballast downwardly, laterally, and even upwardly under a tie, with a controllable variable combination of these movements. Such an actuator includes a pair of suitable power drive sources 15, which may be vibrators of the conventional air, hydraulic, or electromagnetic, or an eccentric motor type. Each of these power drives 15 and its associated actuating and force-transmitting mechanism is the same and drive is provided with a driving piston or armature 16, which is vibrated at the desired repetition rate corresponding to the resonant vibration of its driven actuator mechanism. A suitable piston rod 17 operably connects the piston 16 to a drive rod 18 which is mounted for sliding movement within a force-transmitting actuator. The actuator comprises a cylindrical housing 19 having end driven plates 20 and 21 suitably secured thereto. The upper end plate 20 is rigidly secured to a mounting member which may be varied according to the size and type of the tamper. In one embodiment the upper end plate 20 is provided with a pair of bosses 22 fitted in a mounting frame member between transverse members 23 and secured thereto by bolts 24. The transverse members are rigidly secured together at the ends by suitable elements 25 to which handles 26 are secured for manually moving and directing the tamper. A central spacer element 27 is rigidly secured between the transverse members 23 to reinforce the structure. The drives 15 are provided with feet 28 rigidly secured to the mounting frame.

The vibratory force is transmitted from the drives 15

to the tool 10 through a driving connection formed by the actuators. As shown in FIGS. 4 and 5, the driving connection comprises a plurality of driven plates 29 substantially equally spaced by members 30 which support the driven plates within the housing 19. This structural arrangement is arranged to transmit forces between the driven plates and through the driven plate at each end of the assembly to the housing end plates 20 and 21. These end plates secure the driven plates and spacing members rigidly within the housing. The driven plates 29 and the end plates 20 and 21 are formed with central axially aligned passageways 29', 20', 21' therethrough and through which the drive rod 18 extends. A plate 31 is arranged substantially midway between each pair of adjacent driven plates. These drive plates 31 are secured to the drive rod 18 in any suitable manner, and are supported in their substantially centered positions between the driven plates by a plurality of substantially equally circumferentially spaced springs 32 and 33 arranged on each side of each drive plate in concentric inner and outer sets and seated in recesses 32' and 33' in the drive plates and 32'' and 33'' in the driven plates. The compressed engagement of the springs 32 and 33 with the drive and driven plates provides for an efficient even transmittal of forces between these plates whereby the vibratory driving force of the power drives 15 are efficiently and resiliently transmitted to the associated actuator and plate.

As shown in FIGS. 1 and 3, each lower actuator end plate 21 is formed with a pair of bosses 34 rigidly secured to the lower portion thereof. These bosses fit between transverse bars 35 and rigidly secured thereto in any suitable manner as by means of bolts 36. The transverse bars 35 are rigidly secured to end plates 37 in any suitable manner and these end plates 37 are rigidly secured to the upper ends of the connecting rods 13. Thus the vibratory forces transmitted from the power drives 15 to the actuator end plates 21 are transmitted through the connections of the bosses 34 to the end plates 37 and therethrough to the respective connecting rod 13 and arm 12.

The resonant frequency is obtained by proper choice of the pressure of the springs 32 and 33 relative to the associated mass of the drive plates 31 and the drive rod 12. The control of the direction of the force on the tool 10 is determined by the relative phase of the two power drive forces on the drive rods 12. The relative vibratory phases of the two power drives can be controlled in any suitable manner as by the control valves in pneumatic or hydraulic drives or by suitable phase shifting of the two energizing sources with an electrical drive. An electrical drive is shown in FIG. 11 and one electrical power drive is energized by an output 40 of a repetition rate generator 41 and this same generator output is connected to any conventional delay generator 42 and the output 43 thereof is connected to a one-shot multi-vibrator 44, the output 45 of which is connected to energize the other electrical power drive. By simply controlling the delay of the output 43 of the delay generator, the relative phase of the two energizing source outputs 40 and 45 of the two power drives can be controlled as desired.

FIGS. 6 through 10 schematically illustrate varying phase differences in the vibratory forces of the two power drives and their effects on the resultant operating force on the tamper tool. The relative phase relations and consequent tool operating vibratory force can be varied to any intermediate relationships from those illustrated and this variation can be attained without interrupting operation of the tamper.

FIG. 6 illustrates an operation wherein there is no phase difference in the two power drives and they are both in phase. Under this condition the two drives work in unison and apply a combined vibrational force on the tool bit 10 directly up and down when the tamper is in a vertical position and resultant tool force is indicated by the arrow 50. The tool bit 10 would be forced down into

ballast 46 around a tie 47 at the start of the tamping operation using this type of vibratory drive phase relationship.

In order to tamp the ballast down and laterally against the tie, the relative power drive phases may be shifted as shown in FIGS. 7 and 8. In FIG. 7, the phase in the power drive 15' has been shifted to lag that of drive 15 by forty-five degrees. This produces a resultant force on bit 10 which has an elliptical orbital motion as indicated at 51 with the major elliptical axis disposed in a vertical position. By further shifting the phase lag of the drive force of the power drive 15' to ninety degrees the lag behind power drive 15, as shown in FIG. 8, the vibratory force on bit 10 is given a true circular orbital motion 52. The opposite type of orbital motion can be obtained by making power drive 15 lag correspondingly behind power drive 15'.

In properly tamping ballast, it is essential that it be compacted well under a tie. This is accomplished by shifting the phase lag of power drive 15' still further, as shown in FIG. 9, wherein power drive 15' lags in phase by approximately one hundred and thirty-five degrees behind power drive 15. This gives the bit 10 an elliptical orbital motion with its major axis in a horizontal position as shown at 53 which produces a force tending to drive the ballast under the tie 47 and also to lift it up slightly.

FIG. 10 illustrates a phase difference wherein power drive 15' lags at one hundred and eighty degrees behind power drive 15. This produces a horizontal vibratory force on bit 10 as indicated by the arrow 54. This movement is useful in forcing ballast 46 under tie 47.

These phase shifting drives may be controlled in a gradual function. The phase shift may be locked in any one phase relationship, or shifted directly from one phase relationship to another. This flexible force directional control combined with the mechanical resonant vibration mechanism produces a highly efficient and practical tamper wherein the resultant tool force may be controllably varied through one hundred and eighty degrees.

While a particular embodiment of this invention has been described and illustrated, modifications thereof will occur to those skilled in the art. It is to be understood that this invention is not to be limited to the exact details disclosed.

What I claim and desire to secure by Letters Patent is:

1. A tamper comprising, a ballast tamping tool, means for operating said tool including a bifurcated tool mounting member having a tool support and two actuating force-transmitting members connected to a common point on said tool support, a pair of actuators, means operatively connecting a separate one of said actuators to each of said force-transmitting members, a separate vibratory power drive means for vibrating each actuator, and means for controlling the vibration phase relationship of the power drive means of said actuators relative to each other whereby the resultant direction of the force on said tool is controllably variable through one hundred and eighty degrees from vibratory vertically downwardly, to ellipsoidal orbital circumferential movement with the major axis vertical, to ellipsoidal movement with the major axis horizontal, to vibratory horizontal movement.

2. A tamper as defined in claim 1 wherein each of said actuators comprises, a resilient spring force transmitting means between said power drive means and said force-transmitting member operably connected thereto.

3. A tamper as defined in claim 2 wherein each of said power drive means comprises a power drive for vibrating its respective actuator at resonant frequency thereof.

4. A tamper as defined in claim 2 wherein each resilient force transmitting means comprises a housing having an end driven plate at each end thereof, said driven plates having central axially aligned passageways therethrough, a drive rod extending through said driven plate passageways, a drive plate in said housing between said driven plates and secured to said drive rod, spring means on each

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side of said drive plate in compressed engagement therewith and with the driven plate adjacent thereto whereby forces are adapted to be transmitted through said spring means between said drive and driven plates, means operably drivingly connecting said drive rod to said power drive means, and said operative connection of said actuator to said force-transmitting member comprising a connection of said housing to said latter member.

5. A tamper as defined in claim 4 wherein each power drive means comprises a power drive for vibrating its respective tool actuator at resonant frequency thereof.

6. A tamper comprising, a ballast tamping tool, means for operating said tool including a tool mounting member having a tool support, a resonant frequency actuator comprising a housing having an end driven plate at each end thereof, said driven plates having central axially aligned passageways therethrough, a drive rod extending through said driven plate passageways, a drive plate in said housing between said driven plates and secured to said drive rod, spring means on each side of said drive plate in compressed engagement therewith and with the driven plate adjacent thereto whereby forces are adapted to be transmitted through said spring means between said drive and driven plates, vibratory power drive means operably drivingly connected to said drive rod for vibrating the tool actuator at resonant frequency thereof, and means operatively connecting said actuator housing to said tool support.

7. A tamper as defined in claim 6 wherein said nested spring means comprises a plurality of substantially equally circumferentially spaced compression springs.

8. A tamper comprising a ballast tamping tool, means for operating said tool including a tool mounting member having a tool support and two actuating force-transmitting members connected to a common point on said tool support, a pair of resonant frequency actuators each comprising a housing having an end driven plate at each end thereof, said driven plates having central axially aligned passageways therethrough, a drive rod extending through said driven plate passageways, a drive plate in said housing between said driven plates and secured to said drive rod, spring means on each side of said drive plate in compressed engagement therewith and with the driven plate adjacent thereto whereby forces are adapted to be transmitted through said spring means between said drive and driven plates, vibratory power drive means operably drivingly connected to said drive rod for vibrating the respective tool actuator at resonant frequency thereof, and means operatively connecting a separate one of said actuator housings to each of said force-transmitting members.

9. A tamper as defined in claim 8 having means for controlling the vibration phase relationship of the power drive means of said actuators relative to each other whereby the resultant direction of the force on said tool is controllably variable through one hundred and eighty degrees from vibratory vertically downwardly, to ellipsoidal orbital circumferential movement with the major axis vertical, to ellipsoidal movement with the major axis horizontal, to vibratory horizontal movement.

10. A tamper comprising a ballast tamping tool, means for operating said tool including a tool mounting member having a tool support and two actuating force-transmitting members connected to a common point on said tool support, a pair of resonant frequency actuators, means operatively connecting one of said actuators to each of said force-transmitting members, said actuators each comprising a housing having an end plate at each end thereof and a plurality of axially substantially equally spaced driven plates therein with spacing members supporting said driven plates in said spaced relation and arranged to transmit forces between said driven plates and said end plates, said driven plates and said spacing members being mounted in said housing, said driven plates and said end plates having central axially aligned passageways therethrough, a drive rod extending through

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said driven plate and end plate passageways, a plurality of drive plates in said housing between said driven plates axially substantially equally spaced and fixedly secured to said drive rod, spring means on each side of each of said drive plates in compressed engagement therewith and with the driven plate adjacent thereto whereby forces are adapted to be transmitted through said spring means between said drive and driven plates, and vibratory power drive means operably drivingly connected to said drive rod for vibrating the respective tool actuator at resonant frequency thereof.

11. A tamper comprising a ballast tamping tool, means for operating said tool including a tool mounting member having a tool support and two actuating force-transmitting members connected to a common point on said tool support, a pair of actuators, means operatively connecting one of said actuators to each of said force-transmitting members, said actuators each comprising a housing having an end plate at each end thereof and a plurality of axially substantially equally spaced driven plates therein with spacing members supporting said driven plates in said spaced relation and arranged to transmit forces between said driven plates and said end plates, said driven plates and said spacing members being mounted on said housing, said driven plates and said end plates having central axially aligned passageways therethrough, a drive rod extending through said driven plate and end plate passageways, a plurality of drive plates in said housing between said driven plates axially substantially equally spaced and fixedly secured to said drive rod, spring means on each side of each of said drive plates in compressed engagement therewith and with the driven plate adjacent thereto whereby forces are adapted to be transmitted through said spring means between said drive and driven plates, vibratory power drive means operably drivingly connected to said drive rod for vibrating the respective tool actuator, and means for controlling the vibration phase relationship of the power drive means of said actuators relative to each other whereby the resultant direction of the force on said tool is controllably variable through one hundred and eighty degrees from vibratory vertically downwardly, to ellipsoidal orbital angular movement with the major axis vertical, to ellipsoidal movement with the major axis horizontal, to vibratory horizontal movement.

12. A tamper as defined in claim 11 wherein each of said spring means comprises a plurality of substantially equally circumferentially spaced compression springs.

13. A tamper comprising a ballast tamping tool, means for operating said tool including a tool mounting member having a tool support and two actuating force-transmitting members connected to a common point on said tool support, a pair of resonant frequency actuators each comprising a cylindrical housing having an end plate at each end thereof and a plurality of axially spaced driven plates therein with spacing members supporting said driven plates in said spaced relation and arranged to transmit forces between said driven plates and said end plates, said driven plates and said spacing members being axially slidably mounted in said housing, said driven plates and said end plates having central axially aligned passageways therethrough, a drive rod extending through said driven plate and end plate passageways, a plurality of drive plates in said housing substantially midway between said driven plates axially substantially equally spaced and secured to said drive rod, spring means comprising a plurality of substantially equally circumferentially spaced compression springs on each side of each of said drive plates in compressed engagement therewith and with the driven plate adjacent thereto whereby forces are adapted to be transmitted through said springs between said drive and driven plates, vibratory power drive means operably drivingly connected to said drive rod for vibrating the respective

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tool actuator at resonant frequency thereof, means operatively connecting one of said actuator housings to each of said tool mounting, force-transmitting members, and means for controlling the vibration phase relationship of the power drive means of said actuators relative to each other whereby the resultant direction of the force on said tool is controllably variable through one hundred and eighty degrees from vibratory vertically downwardly, to ellipsoidal orbital angular movement with the major axis vertical, to ellipsoidal movement with the major axis horizontal, to vibratory horizontal movement.

14. A tamper as defined in claim 13 wherein each of

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said spring means comprises two spaced concentric sets of said substantially equally circumferentially spaced compression springs.

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