Sept. 19, 1967 B. BEIERLEIN 3,342,118

TAMPING DEVICE

Original Filed May 21, 1962 2 Sheets-Sheet 1

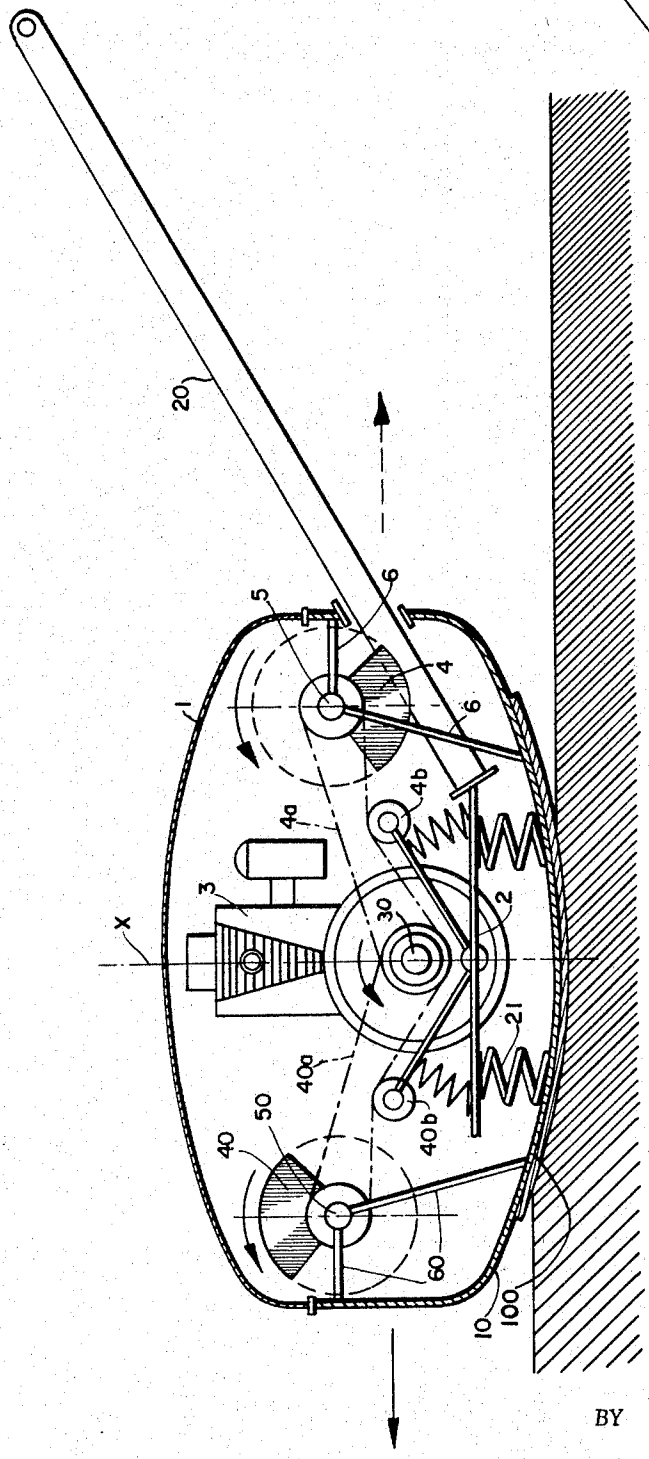


FIG. 1.

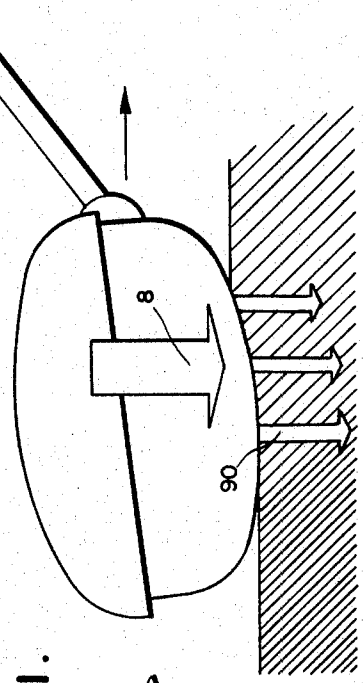


FIG. 3.

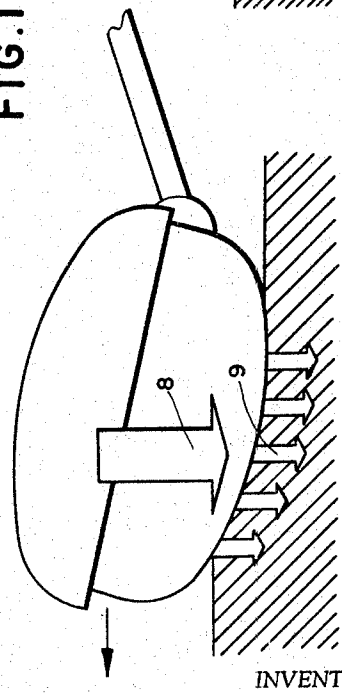


FIG. 2.

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Sept. 19, 1967 B. BEIERLEIN 3,342,118

TAMPING DEVICE

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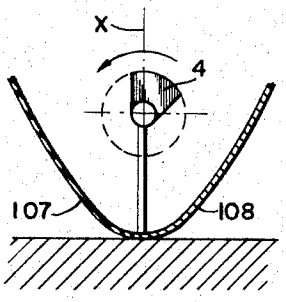


FIG. 5.

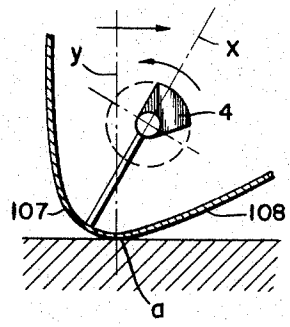


FIG. 6.

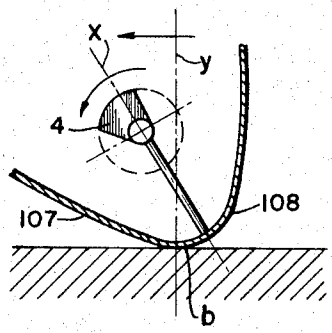


FIG. 7.

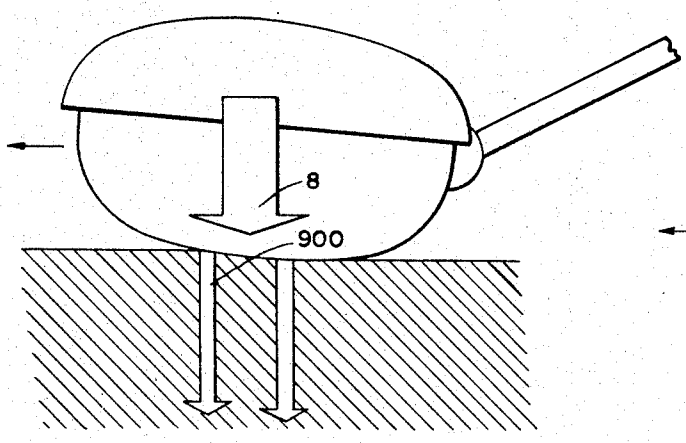


FIG. 4.

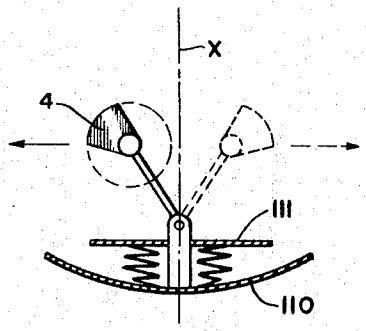


FIG. 8.

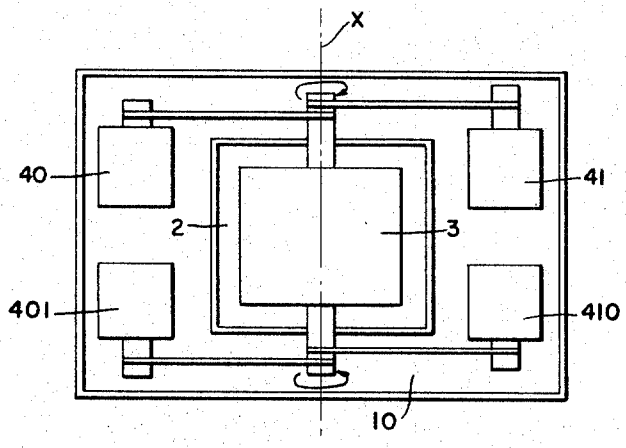


FIG. 9.

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3,342,118

TAMPING DEVICE

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Continuation of abandoned application Ser. No. 196,382, May 21, 1962. This application May 26, 1966, Ser. No. 553,260
Claims priority, application Germany, May 25, 1961, J 19,978; Feb. 14, 1962, B 65,938
7 Claims. (Cl. 94—48)

This application is a continuation of Serial No. 196,382, filed May 21, 1962, and now abandoned.

The present invention relates to a tamping device, i.e., an apparatus for compacting soil or other loose material, which is suitable for use in construction work such as road building and the like.

More particularly, the present invention relates to a tamping device which incorporates a bottom plate that physically engages the surface material to be compacted, and vibratory means for vibrating this plate.

Tamping devices may be either self-propelled or be pulled by a suitable tractor. In existing devices, the bottom plate, and, more particularly, that portion of the plate which actually engages the surface of the material being compacted, is generally flat and has leading and trailing edges fashioned as inclined run-up ramps which are quite wide and are intended to prevent the tamping device from becoming embedded in the material. These ramps cannot, however, be considered as constituting part of the actual working or contact surface of the tamper because they will generally not engage the material, or at best, contact only the top-most material or obstacles embedded within the material over which the tamper is supposed to pass.

It will be appreciated that with such tampers the size of the contact area in actual engagement with the material will, irrespective of the density of the material, always be the same; consequently the specific pressure (kg./cm.^{2}) exerted by the tamper upon the material will always be the same. This is undesirable because less pressure per unit area is needed for loose material than for more tightly compacted material.

It is, therefore, one of the objects of the present invention to provide a tamper which overcomes the above disadvantage, namely, a tamper which, without changing the energy input to the driving means, will deliver an increased specific pressure with increased density of the material, i.e., a tamper which will automatically and inherently exert a higher pressure per unit area on more tightly packed material than on loose material. This is accomplished by making at least the actual engaging portion which contacts the surface of the material to be tamped convex with respect to the surface of the material, with the curvature of the engaging portion being such that the area of this portion which actually touches the surface of the material is dependent on the density of the material. Explained in simplest terms, the tamper will, thanks to its curved engaging portion, ride more deeply in loose material than in compact material, so that, in loose material, the area of the engaging plate actually contacting the surface will be greater than if the engaging portion rides in compact material. Since the weight of the tamper remains constant, the pressure per unit area will be higher when the tamper rides high in compact material, than when it rides low in relatively loosely packed material.

Another feature of the present invention concerns itself with the self-propulsion of a tamper. Existing tampers use, as the vibratory means, a rotary vibrator, i.e., an unbalance which is mounted for rotation about an axis transverse to the direction of travel of the tamper

and is rotated by a suitable driving unit. It was heretofore thought that the direction of rotation of the unbalance was determinative of the direction of travel. Therefore, it was deemed necessary to equip the tamper with suitable coupling, transmission and shifting means which would allow the unbalance to be rotated in either direction.

Accordingly, it is another object of the present invention to provide a tamper which overcomes this last-mentioned drawback, and this has been made possible by the realization that there are factors other than the direction of rotation of the unbalance which determine the direction of travel of the tamper. More particularly, it has been found that if the transverse axis of the rotary vibrator is located sufficiently high above the engaging portion touching the surface of the material being tamped, and if this axis is so located that the angle which is formed between the engaging portion and a line passing through the axis and the center of the length of the engaging portion, considered in the direction of travel of the tamping device, is of appropriate size, the direction of rotation of the vibrator has substantially no influence on the direction of travel. Such an arrangement may incorporate either a convex engaging portion, as described above, or a substantially flat engaging portion which latter will of course not produce the advantages of the former.

Such an arrangement offers advantages unknown to the prior art. For one thing, it is possible to provide two rotary vibrators located front and back, i.e., on opposite sides of a transverse vertical plane passing through the center of gravity of the plate, both of which vibrators are connectible to a single unidirectional drive unit without the intermediate of reversing gears. All that is required is that the respective vibrators be coupled to the drive unit, which can easily be done by conventional clutch mechanisms. As a result, the tamper can be self-propelled either forward or backward without it being necessary to change the direction of rotation of the drive unit. Secondly, the feature in question makes it possible to provide but a single vibrator whose position on the bottom plate is adjustable so as to lie in the particular position necessary to produce either forward or backward travel, as desired. This is not possible in existing tampers in which the change of position from one side of the vertical transverse median plane, by itself, has no effect on the direction of travel, so that it is necessary also to change the direction of rotation of the vibrator.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a sectional elevation of one embodiment of a tamper according to the present invention.

FIGURES 2, 3, and 4 show the operation of the tamper of FIGURE 1.

FIGURES 5, 6, and 7 are sectional elevations of another modified embodiment of a tamper according to the present invention the same being shown in three different operative positions.

FIGURE 8 is a sectional elevation of yet another modified embodiment of a tamper according to the present invention.

FIGURE 9 is a plan view of yet another modified embodiment of a tamper according to the present invention.

Referring now to the drawings and FIGURE 1 thereof in particular, the same shows a tamper comprising plate means constituted by a hollow shell-like casing 10 which has a removable cover member 1 mounted thereon so as to form a closed housing. The casing

contains a central carrier plate **2** which is resiliently supported within the casing **10** by suitable compression springss **21**. As is clearly shown in FIGURE 1, the bottom of the housing **10** is convex with respect to the surface of the material being tamped. While the bottom of the casing **10** itself may contact the material and thus constitute the engaging portion, it is expedient to provide a separate element **100** which is removably mounted on the casing **10**, preferably under stress, i.e., the element **100** may be a curved plate which is initially bent slightly out of its natural shape so that its natural resilience will help hold the plate on the casing. The reason that it is desirable to provide a separate, exchangeable element is that the engaging portion is subject to wear so that the usefulness of the tamper as a whole can be prolonged simply by replacing a worn engaging portion by a new one.

The carrier plate **2** carries a drive unit **3** whose weight constitutes a load on the entire plate means of the tamper. This drive unit **3** may be in the form of an internal combustion engine, or an electric motor, or a motor-generator set. The drive unit has two power take-offs each of which is connectible to the drive shaft of the unit by means of a respective clutch mechanism which is of conventional construction. FIGURE 1 shows one such take-off and clutch assembly at **30**. Each take-off is connected with respective vibrators **4**, **40**, constituted by rotary unbalance weights arranged on opposite sides of a transverse vertical plane *x* passing through the center of gravity of the plate means as a whole and mounted for rotation about a transverse axis in suitable bearings **5**, **50**, carried by mounting members **6**, **60**. The actual connection between each take-off and its respective vibrator may be a conventional chain or belt drive **4***a*, **40***a*, tensioned by spring-biased tension rollers **4***b*, **40***b*. As shown by the arrows, each of the vibrators, when coupled to the drive unit **3**, will be rotated in the same direction, namely, counter-clockwise as viewed in FIGURE 1.

If the tamper is to move leftwardly, then the now-front vibrator **40** is coupled to the drive unit **3**. The tamper will then move leftwardly, and, in the course of this movement, carry out pendular or rocking movements of small amplitude, i.e., the tamper will make small leftward jumps.

If the tamper is next to pass back over the same stretch, the vibrator **40** is disconnected from the unit **3** and the vibrator **4** is connected thereto. To do this, it is not necessary to stop the drive unit, because there exist many types of couplings which allow this change-over to be carried out while the drive unit is running. Once this change-over has been effected, the unbalance vibrator **4** will rotate in the same direction as that in which the unbalance vibrator **40** previously rotated; the tamper will, however, now move rightwardly.

As stated above, this is a surprising result which could heretofore not be obtained, because it was thought that the direction of rotation of the unbalance was determinative of the direction of travel of the tamper.

FIGURE 1 also shows a handle **20** passing through the closed housing formed by the casing **10** and cover **1** and attached to the carrier plate **2**. The handle **20** can be used to steer the tamper for sideways or curvilinear movements, and the free end of the handle **20** can carry the controls for the drive unit **3** and the clutches by which the vibrators are coupled to the unit.

If the tamper moves over soft and newly strewn, i.e., loosely packed, material, then substantially the entire engaging portion at the underside of the casing or plate means will contact the surface of the material to be tamped. This is shown in FIGURE 2, wherein the arrow **8** symbolizes the entire weight and vibratory force of the tamper, while the five small arrows **9** show that, due to the fact that the tamper sinks relatively deeply into the material, the force **8** is distributed over a large contact

area. Consequently, the specific pressure, i.e., the force per unit area represented for example by kg./cm.^{2}, is relatively low. In practice, the pressure at this stage corresponds to that exerted by existing tampers.

Assuming that the tamper has finished the initial tamping of the material and then moves in the opposite direction as shown in FIGURE 3—which, as explained above, can be accomplished simply by disconnecting the vibrator **40** and connecting the vibrator **4**—the tamper will move over already partly tamped and therefore more compact material. Consequently, the curved engaging portion **100** will no longer ride as deeply within the material as before. Therefore, a lesser portion of the total area of the engaging portion will now touch the surface, and the force **8**—which, of course, remains constant—will now be distributed over a smaller area, as symbolized by the three arrows **90** which are depicted larger to represent the higher pressures. Finally, FIGURE 4 shows a third pass over the material; the tamper will now ride quite high so that only a small area of the portion **100** will contact the surface. This is symbolized by the two still larger arrows **900**.

It will be seen from the above that, thanks to the convexly-shaped bottom plate, the tamping or compacting action is progressively more intense, so that relatively few passes over the material suffice to bring about a rapid and better result than could be achieved with heretofore known devices.

All of the embodiments described so far incorporate two vibrators which are selectively connectible to the drive unit to enable the tamper to self-propel itself in either of two directions. FIGURES 5, 6, and 7, however, show a tamper having but a single vibrator **4** in which the bottom plate means are so shaped and in which this single vibrator is so positioned that the tamper may still be caused to move in either of the two directions. This is accomplished by providing a substantially symmetrically curved plate means so shaped that during leftward movement it will be the section **107** on which the tamper rides whereas during rightward movement the tamper rides on section **108**. In practice, the sections **107**, **108** may be parabolic. Assuming the tamper to be upright, as shown in FIGURE 5, the vibrator **4** straddles the transverse vertical plane *x* passing through the center of gravity of the plate means **107**, **108**. From this position, the plate means, and with it the vibrator **4**, may be tilted into two different positions in one of which, shown in FIGURE 6, the vibrator lies on one side of a transverse vertical plane *y* passing through the point *a* at which the section **108** contacts the surface of the material, and in the other of which positions, shown in FIGURE 7, the vibrator lies on the other side of the plane *y* that now passes through the point *b*.

In order to make sure that an effective and stable over-center shift occurs, the vibrator should be located at a relatively large distance from the apex of the plate means **107**, **108**. In this way, the tamper will maintain itself in the position which it occupies. If the curvature of the plate means is relatively small, however, the tamper may be kept in its position by means of the above-described handle **20**.

When the tamper is in the position shown in FIGURE 5, wherein the vibrator straddles the vertical transverse plane *x* that passes through the apex now touching the surface of the material being tamped, there will be no tendency for the tamper to move in either direction; instead, the tamper will carry out up-and-down movement in one place. In the position of FIGURE 6, however, the tamper will move rightwardly, and in the position of FIGURE 7, the tamper will move leftwardly, as indicated by the arrows. It will be noted that the direction of rotation of the vibrator has no influence on the direction of travel, since in either case the vibrator is shown as rotating in counter-clockwise direction.

FIGURE 8 shows an embodiment in which the arcuate plate means **110** supports the carrier plate **111** and carries a vibrator **4** which itself is mounted for pivotal movement between the two positions shown in solid and dashed lines, respectively, wherein the vibrator is located on opposite sides of the plane *x*. Thus, the direction of travel of the tamper may be fixed by appropriately positioning the vibrator **4**, it being again pointed out that the direction in which the vibrator rotates will not influence the direction of travel.

FIGURE 9 shows a larger tamper whose vibratory means comprise two pairs of vibrators **41, 410; 40, 401**. Each pair is arranged, respectively, on opposite sides of the transverse vertical plane *x* passing through the center of gravity of the plate means, and the two vibrators of each pair are arranged, respectively, at the two lateral sides of the plate means. In the illustrated embodiment, all of the vibrators are adapted to be driven by a single drive unit **3** mounted on the carrier plate **2**, it being possible, however, to provide a separate drive unit for each vibrator or a drive unit for the two coaxial vibrators on the same side of the plane *x*. In the illustrated embodiment, the coupling means which connect the individual vibrators to the drive unit **3** are so arranged as selectively to couple to the drive unit any two vibrators of the same pair, or any two vibrators located on the same lateral side of the plate means. Thus, if the vibrators **41, 410** are coupled to the drive unit, the tamper will move rightwardly, whereas if the vibrators **40, 401** are driven, the tamper will move leftwardly. If, however, it is desired to let the tamper move along a curvilinear path, then the two vibrators **40, 41** or the two vibrators **401, 410** will be coupled to the drive unit. If, during forward movement in a given direction, the tamper is to be turned, then one of the two leading vibrators can be uncoupled from the drive unit.

In a similar manner, it is possible to obtain a self-steering arrangement by taking two independent tampers according, for example, to the embodiment of FIGURE 1, i.e., tampers which are inherently not self-steering as is the case in the embodiment of FIGURE 9, and connecting such tampers together one beside the other, preferably by means of elastic connecting means. If each tamper itself is controllable independently of the other, the composite two-tamper apparatus will then be steerable in the manner of the embodiment of FIGURE 8.

It will be seen from the above that the rotary unbalance vibrator acts as a pendulum whose direction of rotation has no effect on the direction of propagation of the tamper. The oscillations which are not effective directionally do, however, become directional by the fact that the line connecting the axis of the vibrator and the point at which the plate means engages the surface of the material itself forms a pendulum whose pivot point periodically moves over the surface.

It has been found that the tamper according to the present invention operates very quietly and uniformly, and avoids abrupt and other undesirable oscillations. Furthermore, the tamper is easily controlled and manipulated, and, due to its housing-like construction, the various component parts are well protected against dirt and moisture.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. A self-propelled tamping device comprising, in combination:

(a) plate means having a working surface which contacts the surface of the material to be tamped, said working surface being arched covexly and having a substantially uniform, generally cylindrical configuration, the axis of curvature of said working surface being transverse to the direction in which the tamping device is movable;

(b) a weightly mass resiliently carried by said plate means; and

(c) at least one rotary vibrator rigidly mounted on said plate means and incorporating but a single rotary unbalance mass for producing non-directional vibrations, said vibrator being located in the forward part of the tamping device for causing the tamping device, when said single rotary unbalance mass is driven, to move in a pendular manner over the surface to be tamped, whereby the non-directional vibrations are utilized to impart directional movement to the tamping device.

2. A tamping device comprising, in combination:

(a) plate means having an engaging portion for contacting the surface of the material to be tamped, said engaging portion being of arcuate configuration and curved convexly with respect to the surface of the material such that the area of said engaging portion which actually touches the surface of the material is dependent on the density of the material being tamped; and

(b) vibratory means mounted on said plate means for vibrating the same, said vibratory means comprising a single vibrator and means for changing the physical position thereof relative to a transverse vertical plane passing through the center of gravity of said plate means.

3. A tamping device comprising, in combination:

(a) plate means having an engaging portion for contacting the surface of the material to be tamped, said engaging portion being of arcuate configuration and curved convexly with respect to the surface of the material such that the area of said engaging portion which actually touches the surface of the material is dependent on the density of the material being tamped;

(b) vibratory means mounted on said plate means for vibrating the same, said vibratory means comprising a single vibrator movable with said plate means; and

(c) said engaging portion being so shaped that, by tilting said plate means, said vibrator may be positioned to lie on either side of a vertical transverse plane passing through the point at which said engaging portion contacts the surface of the material.

4. A tamping device as defined in claim **3** wherein said engaging portion is symmetrical with respect to a transverse vertical plane passing through the center of gravity of said plate means and wherein said vibrator straddles said plane.

5. A tamping device comprising, in combination:

(a) plate means having an engaging portion for contacting the surface of the material to be tamped, said engaging portion being of arcuate configuration and curved convexly with respect to the surface of the material such that the area of said engaging portion which actually touches the surface of the material is dependent on the density of the material being tamped; and

(b) vibratory means mounted on said plate means for vibrating the same, said vibratory means comprising two pairs of vibrators each pair being arranged, respectively, on opposite sides of a transverse vertical plane passing through the center of gravity of said plate means, and the two vibrators of each pair being arranged, respectively, at the two lateral sides of said plate means.

6. A tamping device as defined in claim **5** wherein said vibratory means further comprise a single drive unit for driving each of said vibrators in the same direction, and coupling means selectively coupling to said drive unit any two vibrators of the same pair or any two vibrators located on the same lateral side of said plate means.

7. A self-propelled tamping device comprising, in combination:

(a) plate means having a working surface which contacts the surface of the material to be tamped, the entire working surface being, with respect to the surface to be tamped, arched convexly and having a substantially uniform, generally cylindrical configuration, the axis of curvature of said working surface being transverse to the direction in which the tamping device is movable;

(b) a weighty mass resiliently carried by said plate means; and

(c) at least two vibrators each of which is rigidly mounted on said plate means, said two vibrators being arranged, respectively, on opposite sides of a transverse vertical plane passing through the middle of said plate means, each respective vibrator incorporating but a single rotary unbalance mass for producing non-directional vibrations, whereby when

the rotary unbalance mass of the particular vibrator which, with respect to the desired direction of travel of the tamping device, is located in the forward part of the tamping device, is driven, the tamping device will, under the influence of the non-directional vibrations produced by the rotary unbalance mass being driven, be caused to move in a pendular manner over the surface to be tamped and will also be propelled in the desired direction of travel.

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