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[54] COMBINED-ACTION VIBRO COMPACTING MACHINE FOR THE CONSTRUCTION OR ROADS

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[51] Int. Cl..... E01c 19/38

[58] Field of Search 404/122, 132, 82, 117

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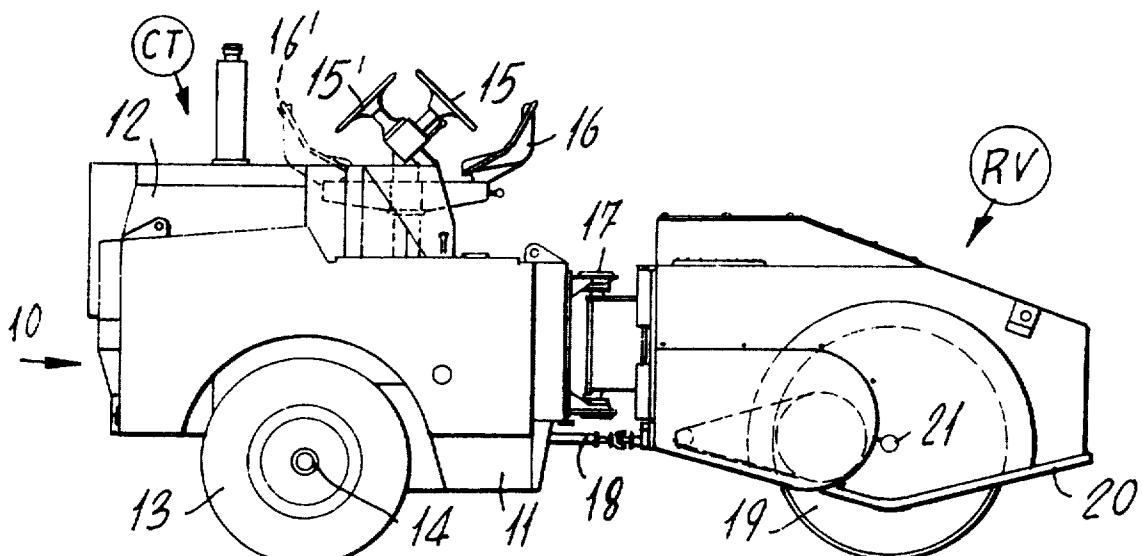
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[57] ABSTRACT

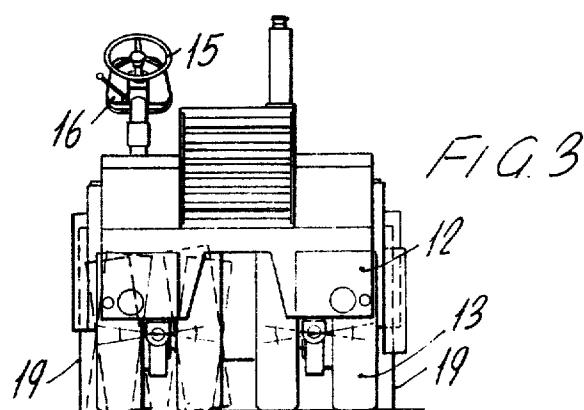
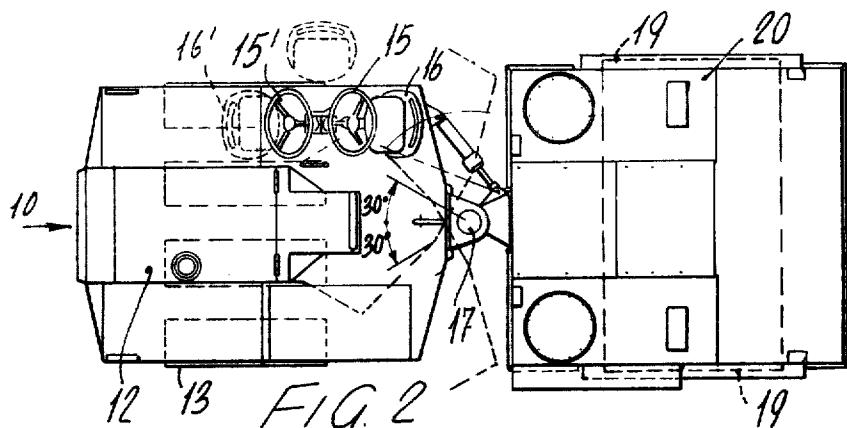
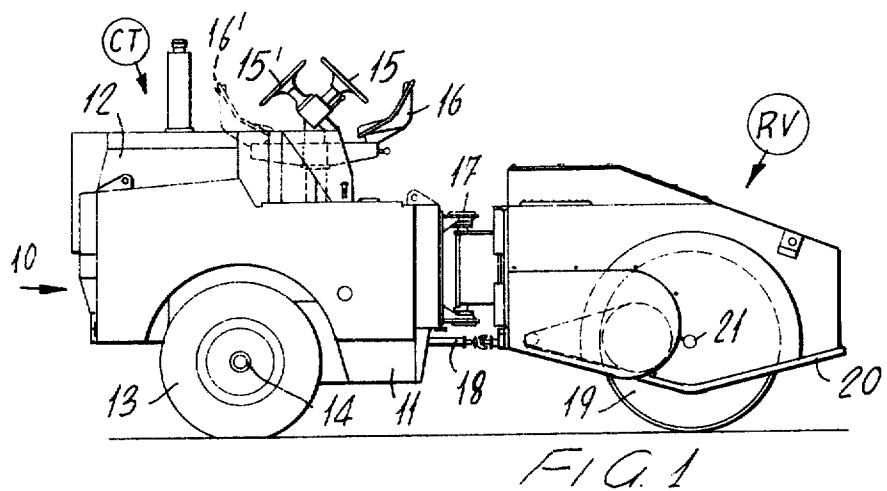
A vibro-compacting machine has two components pivotally interconnected for relative swinging movement about a vertical axis. One unit is a vibrating metallic drum and the other unit has pneumatically tired wheels. The distance between the two axes is not more than four meters and the pneumatic tires press on the ground with a force of about 9.2 metric tons while the vibrating drum presses on the ground with a force of about 5.8 metric tons. The width of the drum is about 1.5 meters, which is greater than the track of the wheels. The wheels are isostatically suspended so that they all press on the ground with equal force.

5 Claims, 3 Drawing Figures



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COMBINED-ACTION VIBRO COMPACTING MACHINE FOR THE CONSTRUCTION OR ROADS

It has already been tested and ascertained as well as patented by the same inventor and applicant, that the use of a combined-action machine to tamp the ground, a machine namely which comprises a compacting element formed by a series of pneumatic-tired wheels and a metallic vibrating drum element, both acting contemporaneously on the ground, attains better results than is possible to obtain by using two independent machines, a vibrating machine and one using tires of analogous characteristics. This, in itself, already surprising result is exceptionally enhanced when the combined-action compacting machine in question meets a series of structural and morphological conditions which have been determined on the basis of long and accurate experience and research.

These conditions are:

1. The vibrating drum element or component must operate at a distance not larger than 4 m. with respect to the element formed by the series of compacting pneumatic tired wheels.

2. The weight applied to the ground through the pneumatic tired wheels must exceed 50% of the total weight of the machine.

3. The centrifugal force of the metallic vibrating drum must be larger than 30% of the total weight of the machine.

4. The pneumatic wheels must be all isostatically suspended so that each of them acts on the ground with a force equal to the total weight of the tired component of the machine divided by the number of wheels.

5. The steering pivot link connecting the two elements or machine components, i.e., the vibrating one and the tired one must be located at the center namely, the vertical axis of rotation of the articulated joint must be equally spaced from the projections on the ground of the axes of said two elements or machine components.

6. The length of the vibrating metallic drum must exceed at least by some centimeters the width of the strip compacted by the series of pneumatic tired wheels; in other words the vibrating drum must extend on both sides beyond the cross dimension of the tired wheels.

7. The distance between each pneumatic wheel and the next one must be smaller than the width of each pneumatic tired wheel.

8. The vibration frequency must be made adjustable between 20 and 40 Hertz.

9. The pressure of the pneumatic tired wheels must be made adjustable between 2 and 6 atm. in order to adapt same to the different types of grounds to be compacted.

10. The diameter of the pneumatic tired wheels may be smaller than the diameter of the vibrating drum but must be larger than 60% of the diameter of said drum.

The above mentioned conditions constitute the real structural characteristics of the combined-action compacting machine of the invention which, besides the two first mentioned conditions, must meet at least three of the successive ones.

Experience has established that the compacting effect obtained by a combined-action vibro-compacting machine according to the present invention exceeds in quality not only the effect of two equivalent separate machines even if used contemporaneously but also the

effect of compound or combined-action machines which do not satisfy at least a preponderant part of the above mentioned conditions.

The reason for this surprising result is due to the fact that the vibration, provided it is sufficiently powerful and has a frequency suitably chosen in function of the granulometric composition of the material to be compacted, reduces the inner friction of the material itself, causing the "granules" to easily glide one between the other, as if they would be immersed in a lubricating liquid. Generally speaking under these conditions, the weight of each granule tends to draw same downwards to fill the voids thereby increasing the density of the layer. It is obvious that if to the weight of each granule it is possible to add, at the right moment the compressive action of a pneumatic wheel inflated at the right pressure, the densification and the definitive stabilization of said densification is accelerated and improved since said pneumatic wheel acts on a material which is in a state of "paralubrication," i.e., a state in which the internal frictions are almost totally absent.

It should however be kept in mind that the pneumatic tired wheels must not cause the material to glide excessively, neither they must sink or plunge into said material causing same to flow-back laterally.

To avoid these inconveniences, experience has shown that it is necessary to respect the conditions relative to load, weight and dimensions enumerated above.

I Comparative Test

Material to be compacted: a layer of gravel cement having a finished thickness of 20 cm.

There have been used first two separate units:

35 a. a self-moving pneumatic tired unit having a total weight of 15-16 tons, comprising seven tired wheels of 11.00.20 standard section with a weight per wheel of ca. Kg.2,200.

40 b. a vibrating self-moving compacting unit of 10 tons in weight, made of two vibrating drums, each having a width of m.1.50 and a vibration frequency which may be adjusted from 30 to 40 Hertz.

The two above mentioned units have been used contemporaneously, endeavoring to keep them as close as possible.

45 To attain the required density larger or equal to 95% of the "modified Proctor," it has been possible to obtain a maximum production of 130 m³/h.

Using, for the same work and on the same material, the combined action machine of the invention having the following characteristics:

total weight: 15 tons

four 11.00.20 pneumatic tired wheels

load per wheel: Kg. 2,300.

width of the vibrating drum: m.1.50

vibration frequency adjustable from 20 to 40 Hertz
it has been possible to obtain a production of 150 m³/h. The compound machine of the invention used for this test respects and satisfies all the ten above unemphasized conditions.

II. Comparative test

Material to be compacted: bituminous conglomerate with a finished thickness of 15 cm. The first compaction has been carried out with a vibrating roller of 6 tons; width of the vibrating drum: m.1.25; vibration frequency: 35 Hertz and with a tired compacting unit with

seven pneumatic wheels of 11.00.20 standard section and a total weight of 15 tons.

The required density at the end of the rolling was less than to 5% of voids. With these two machines it has been impossible to attain the predetermined and required density in the deeper zones of the layer.

The disposition of the machines has thereafter been changed. The tired compacting unit has been placed immediately behind the finisher so as to operate on the still warm and plastic material which may be more easily compacted. It has been thus possible to attain a better densification in depth but said tired unit caused deformations and undulations on the ground which the vibrating roller following behind was not capable to "cancel out" satisfactorily. It proved necessary to add a third static compacting roller of the type having three metallic wheels in order to attain an acceptable result from the point of view of densification and "planarity."

On the same material to be compacted and under the same working conditions there has been used a combined-action machine according to the present invention formed by a front-vibrating drum element and by a back compacting element comprising a series of pneumatic tires, said two elements being connected to each other by a central steering pivot and having characteristics which are identical to the one mentioned in the first comparative tests. Use of this combined-action machine alone has satisfied all the density and planarity requirements as well as proved that said combined-action machine is capable of performing, if necessary, a greater amount of work than the three compressors together used in the first part of this second test.

The accompanying drawing diagrammatically shows a combined-action machine according to the present invention formed by a vibrating roller RV and by a self-propelled static compactor CT comprising a series of four tired wheels; said vibrating roller RV and said compactor CT are connected to each other by a central steering pivot link, the distance between the axis of the drum and the axis of the isostatically suspended tired wheels amounting to about 3 m. More precisely:

FIG. 1 is a side elevation view of the combined-action vibro-compacting machine of the invention;

FIG. 2 is a plan view of the same; and

FIG. 3 is a rear view of said machine in the direction of the arrow 10 in FIG. 1.

The self-propelled static compacting element CT comprises a frame 11 carrying an engine 12 with all the equipment necessary for control and traction as well as a series of pneumatic tires 13, each isostatically mounted on the axis 14. The steering location is directionally reversible and includes two opposed steering wheels 15, 15' and two opposed seats 16, 16' to be used by the driver according to need.

The other element RV of the machine is connected to the first mentioned static element CT by means of a steering pivot means 17 and the cardanic control means 18 for the transmission of torque to the vibrating metallic drum 19. This last one is mounted on frame 20 by means of antivibrational suspension and the axis 21.

The structural characteristics of this combined-action machine, the combination of which ensures an extraordinary efficiency, consist in that the distance between the axis 14 of the tired wheels and the axis 21 of the vibrating drum does not exceed 4 m. In this particular instance, said distance amounts to 3m. The weight discharged on the ground through the series of pneu-

matic tires 13 is larger than 50% of the total weight of the combined-action machine, said pneumatic tires 13 being all isostatically suspended to weigh on the ground with a force equal to the total weight of the tired section or unit of the machine divided by the number of wheels. Furthermore the centrifugal force of the metallic vibrating drum is larger than 30% of the total weight of the combined action machine and the width of the metallic drum is larger than the strip compacted by the series of parallel pneumatic tires 13, i.e., the drum extends laterally some centimeters beyond each side.

To all these structural characteristics there may be added some other non essential ones which, however, have been found to be favourable to increase the efficiency of the machine. For instance the position of the steering pivot 17 connecting the two elements together may have its vertical rotational axis equally spaced from the axes 14 and 21 of the two elements or components RV and CT.

Furthermore the vibration frequency of the drum 19 may be adjustable between 20 and 40 Hertz and the distance between each pneumatic wheel and its adjacent one is smaller than the width of each pneumatic wheel, the diameter of said pneumatic tires being preferably larger than 60% of the diameter of the vibrating drum.

What is claimed is:

1. A combined-action vibro-compacting machine comprising a vibrating element including a metallic drum, and a compacting element or component formed by a series of pneumatic tired wheels, said two components being connected by a steering pivot link, characterized by the combination of the following features; the distance between the axis (14) of the tired wheels (13) and the axis (21) of the vibrating drum (19) does not exceed 4 m; the weight discharged on the ground through the series of pneumatic tires (13) being about 9.2 metric tons and the weight discharged on the ground through the vibrating drum being about 5.8 metric tons; a frame (11) and means mounting the pneumatic wheels (13) on the frame for vertical movement relative to the frame and relative to each other so that each wheel follows the contour of the ground, the pneumatic wheels (13) being thus each isostatically suspended to weigh on the ground with a force equal to the total weight of the tired section of the machine divided by the number of wheels; the centrifugal force of the metallic vibration drum is larger than 30% of the total weight of the combined-action machine; the width of the metallic drum is about 1.5 meters and is larger than the width of the strip compacted by the series of parallel pneumatic wheels (13) namely so that the drum extends beyond each of the sides.

2. The combined-action vibro-compacting machine as claimed in claim 1, characterized in that the vertical axis of the steering pivot link is equally spaced from the two horizontal rotation axes (14) of the pneumatic tired wheels (12) and (21) of the vibrating drum (19).

3. The combined-action vibro-compacting machine as claimed in claim 1, characterized in that the vibration frequency of the metallic drum (19) is adjustable between 20 and 40 Hertz.

4. The combined-action vibro-compacting machine as claimed in claim 1, characterized in that the distance of each pneumatic tired wheel from the next one is smaller than the width of each of said wheels.

5. The combined-action vibro-compacting machine as claimed in claim 1, characterized in that the diameter of the pneumatic tired wheels (13) is larger than 60% of the diameter of the vibrating drum (19).

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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,890,056

DATED : June 17, 1975

INVENTOR(S) : DOMENICO DOMENIGHETTI

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In item 54, the title of the invention, and also at the top of column 1, change "CONSTRUCTION OR ROADS" to --CONSTRUCTION OF ROADS--.

Signed and Sealed this
twenty-seventh Day of April 1976

[SEAL]

Attest:

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Attesting Officer

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