

Jan. 1, 1963

M. J. SHATTO
COMPACTION ROLLER

3,071,050

Filed Aug. 20, 1959

2 Sheets-Sheet 1

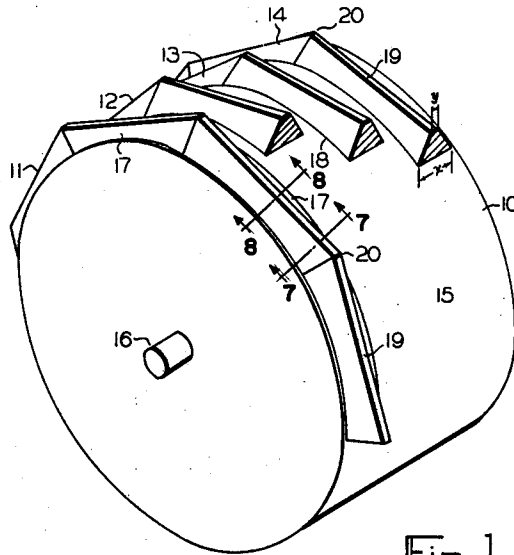


Fig. 1

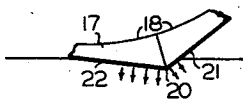
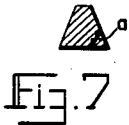


Fig. 3a

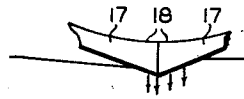


Fig. 3b

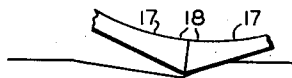


Fig. 3c

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2 Sheets-Sheet 2

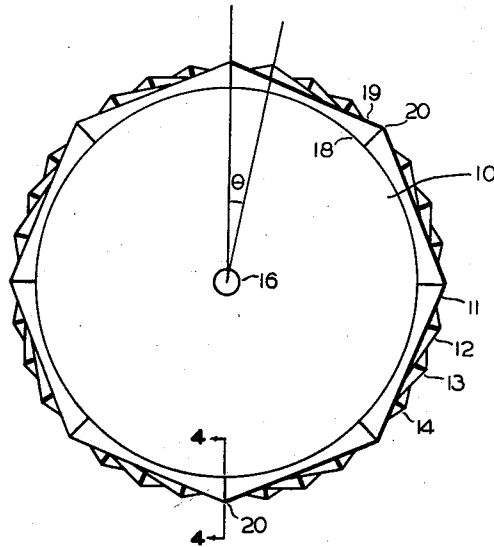


Fig. 2

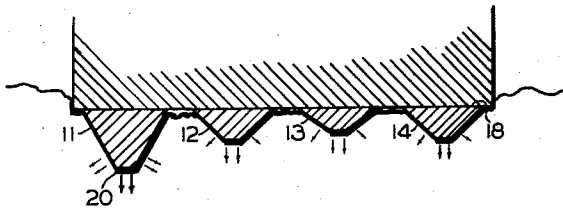


Fig. 4

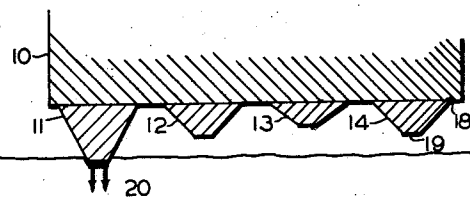


Fig. 5

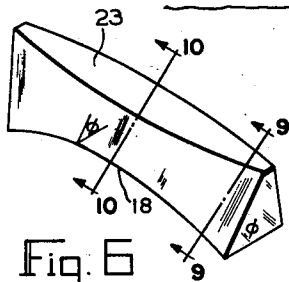


Fig. 6



Fig. 9



Fig. 10

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3,071,050

COMPACTION ROLLER

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4 Claims. (Cl. 94—50)

This invention relates to compaction rollers adapted for use with self-propelled or pulled units to compact soil or gravel and the like in earthwork.

More particularly this invention concerns a novel compaction roller comprising a cylindrical drum having on its periphery a plurality of continuous circumferential ribs in spaced relation. Each rib is tapered in the transverse plane of its height having a lesser breadth at its peripheral face than at its base. The peripheral face of each rib is formed of a number of plane surfaces which intersect to provide a series of load-bearing apexes about the circumference of the rib.

The primary object of this invention is to provide a compaction roller that is capable of effecting a greater compaction per unit mass than compaction apparatus commonly in use at the present time, through the provision of tapered continuous circumferential ribs on the periphery of the roller and apexes on the load-bearing face of such ribs by which the weight of the roller is applied through a decreasing area as the density of the material under treatment increases on repeated passes of the roller. Thus a deep compaction is first obtained when the ribs and their apexes penetrate into the material and as the density of the material increases the roller rides higher on its tapered ribs, placing greater weight on a lesser area of contact.

The manner in which this and other objects are attained will be perceived by the following description of a preferred embodiment of the invention illustrated in the accompanying drawings in which:

FIGURE 1 is a perspective view of a compaction roller according to the present invention showing a portion of the circumferential ribs cut away;

FIGURE 2 is a side elevation of the compaction roller illustrated in FIGURE 1;

FIGURES 3a, 3b and 3c illustrate the action of an apex of a rib of the compaction roller passing over the surface of loose soil under treatment;

FIGURE 4 is a sectional view of the ribs of the compaction roller taken along the line 4—4 of FIGURE 2 when the roller is operating in loose soil;

FIGURE 5 is a similar sectional view of the ribs of the compaction roller when the material being compacted has reached a high density;

FIGURE 6 is a perspective view of one section of rib of an alternative embodiment adapted to be attached to the drum of the roller.

FIGURE 7 is a cross sectional view through an end portion of a rib segment, taken along the line 7—7 of FIGURE 1.

FIGURE 8 is a cross sectional view through a mid-portion of a rib segment, taken along the line 8—8 of FIGURE 1.

FIGURE 9 is a cross sectional view through an end portion of a modified rib segment, taken along the line 9—9 of FIGURE 6.

FIGURE 10 is a cross sectional view through a mid-portion of a modified rib segment, taken along the line 10—10 of FIGURE 6.

Referring to these figures it will be seen that in its preferred embodiment the compaction roller of this invention comprises a drum 10 and a plurality of continuous circumferential ribs 11, 12, 13 and 14 fixed to the periph-

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ery 15 of the drum. The roller is provided with an axle 16 and may be mounted to the frame of a self propelled or pulled vehicle (not shown) for convenient use.

Each of the ribs 11, 12, 13 and 14 is formed from similarly shaped steel segments 17 welded to the periphery 15 of the drum. The segment 17 is formed with an undersurface 18 curved to the radius of the drum to which it will be fixed. The breadth of segment 17 at its base (x) is substantially greater than the breadth of the segment at its peripheral face (y), and thus the rib is tapered in the transverse plane of its height, possessing a cross-section in the shape of a truncated wedge. The peripheral face 19 of the segment is planar, i.e. flat, and parallel to a plane tangential to the curved base 18 of the segment halfway along the length of the segment. Thus the height of the segment measured from under surface to peripheral surface varies from a minimum at the mid point along the length of the segment to a maximum at the ends of the segment. When two segments are butted end to end on the drum, an apex 20 is formed where their peripheral faces intersect. As shown in FIGURES 1 and 2, the abutting segments define a series of apexes 20, interspersed at opposite ends of flat peripheral face portions 19, about the periphery of each rib.

In the preferred embodiment of the invention, the segments of each rib are so positioned on the drum that the apexes of any rib are staggered with respect to the apexes of any adjacent rib. Ideally in the positioning of the segments on the circumference of the drum no two apexes across the drum should be in line, so that in the course of a single revolution of the roller on a hard surface, the full weight of the roller is transferred from an apex of one rib to an apex of another and successively to the apexes of the other ribs across the surface of the drum. The advantage of this arrangement of the ribs will be seen from the description of the operation of the roller that follows.

As illustrated in FIGURE 2 each rib is formed of eight segments, in outline the rib being an octagon with eight angles and thus eight apexes. Adjacent ribs are staggered at an interval measured by the angle formed by planes passing through the centre axis of the drum and successive apexes of adjacent ribs. This angle designated as θ in FIGURE 2 of the drawings, equals

$$\frac{\pi}{16}$$

or $11^{\circ}15'$ in the embodiment illustrated. Thirty-two load-bearing apexes are thus provided, evenly spaced about the circumference of the roller.

It will be appreciated that the ribs of the roller may be formed integrally with the drum without changing the essential character of the invention. Also the ribs may be formed from a greater or lesser number of segments, the number illustrated in the drawings being a convenient choice having regard to the size of the roller illustrated. The segments may be attached to the drum in some suitable manner other than welding without departing from the spirit of the invention.

The operation of the roller is illustrated in FIGURES 3a, 3b and 3c of the drawings which show a portion of one rib of the roller passing over the surface of loose soil under treatment. As the roller moves forward the rib penetrates into the loose soil. Pressure is initially exerted both angularly on the leading load-bearing surface 21 and downwardly on the trailing load-bearing surface 22 (FIG. 4a). As the roller rotates, the full weight of the roller is applied downwardly when the apex reaches its point of deepest penetration (FIG. 4b). On further rotation this portion of the roller is withdrawn from the soil without disturbing what has been compacted (FIG. 4c).

Where, as described and illustrated in FIGURE 2, the segments of adjacent rings are staggered around the circumference of the roller, only one apex of any rib is in full compaction position at any point of time. The result is an increased and more even compaction over the whole surface covered by the roller than would be the case if the apexes were in line across the breadth of the roller. A cross section of a portion of the roller when the apex 20 of rib 11 is at the point of full compaction is shown in FIGURE 4. The apex 20 has penetrated deeply into the loose material to effect a deep compacting. The ribs 12, 13 and 14, being, at the point of this section, of lesser depth than rib 11, apply a lesser pressure to the soil over which the roller is passing.

The vertical taper on each rib greatly increases the efficiency of the roller. First, by reason of this taper, a compacting force is created sideways and downward between each rib as well as directly downward through the peripheral face of the rib. Thus not only the material directly beneath the ribs is compacted but also the material between the ribs, to leave the entire surface covered by the roller in an improved state of compaction.

Secondly, the tapered rib provides a means of achieving a greater compaction pressure per unit area as the material being compacted becomes more dense. Upon repeated passes of the roller, the density of the material increases and the roller rides higher on its ribs. By reason of the taper on the ribs, the weight of the roller is applied through a decreasing area as the roller rides higher, until, when the material reaches its greatest density, the roller is riding on its apexes alone and a very great weight is applied to a small unit area. The weight of the roller is at such time applied from apex to apex in successive ribs, any one apex only being momentarily in contact with the ground as the roller is moved. This feature of the invention is illustrated in the cross section designated as FIGURE 5. It will be seen that the full weight of the roller is applied through the apex 20 of rib 11 to a very small area. Thus the maximum compressive force is employed to firmly pack the soil after it has been subjected to initial compaction.

The tapering of the ribs is also an important factor in the capability of the roller of this invention to be self-cleaning. A roller with ribs having perpendicular sides will tend to accumulate soft, wet or sticky material between the ribs. After a short period of use the spaces between ribs will become completely filled with material, the surface of the roller will lose its irregular surface and the roller will lose its advantage over a simple cylindrical roller in the ability to effect a deep compacting. The tapered ribs minimize this tendency to pick up material as the roller moves.

From the aspect of self-cleaning ability, there is also a substantial advantage to the angular rib over the type rib that presents an undulating surface to the ground, having alternate troughs and crests about the circumference of the roller. With the present invention the load-bearing surface of the segment is planar without any hollows between two apexes of a ring. There is no depression on the peripheral surface of the rib in which the material over which the roller passes can accumulate.

Moreover the fact that the load-bearing surface of the rib is planar with periodic apexes allows the roller to reach further into the material being rolled for deep compaction, yet leaves an undisturbed compacted surface when the portion of the rib is withdrawn from the soil as the roller moves forward.

Where heavy gravel is being compacted, the extreme pressures exerted through the apexes of the ribs will tend to crack and crush the larger stones and so promote compaction.

The angular character of the surface of the roller also assures good traction in difficult conditions when the roller is employed on a self-propelled vehicle that must

be capable of climbing grades and maneuvering in wet material.

It will thus be seen that I have provided a compaction roller with marked advantages over the types of rollers now in use. The roller of this invention, like the "sheeps-foot" type of roller, possesses the advantage over a solid faced roller of being able to penetrate to compact the deeper layers of the material being rolled. It does not however possess the marked disadvantages of the "sheeps-foot" type of roller, which maintains the same compaction pressure regardless of the density of material under treatment and further kicks up a portion of the compacted earth as the foot is removed from the soil when the unit moves forward. The provision of angular apexes on the ribs, the staggering in the positioning of the apexes and the tapering of the ribs afford a means whereby a great compaction force can be applied over a very small area as the density of the material under treatment increases. The ribs leave the soil without picking the same up or "kicking" the soil.

While the invention has been described with reference to a preferred embodiment, numerous design variations will readily suggest themselves to those skilled in the art. For example, as illustrated in FIGURE 1, the segments are of constant width throughout their length both at their base and peripheral surface. By reason of the curvature of their base to conform to the radius of the drum, the height of any segment varies along its length, as does the slope of the sides of the segment. Thus, as shown in the cross sectional views provided by FIGURES 7 and 8, the slope angle a at the end of a segment side face is greater than the slope angle b at the middle of the segment side face. In an alternative form of segment illustrated in FIGURE 6, the slope of the sides of the segment $\angle \theta$ and the width of the base 18 is held constant resulting in a variation in the width of the peripheral face 23. This face is at its narrowest at the ends of the segment and has its widest point halfway along the length of the segment. By this means a small area at the apex is maintained, while a broader packing surface is provided between apexes. The constant segment side slope angle and the widening of the mid-portion of the outer segment face are illustrated in FIGURES 9 and 10, respectively, representing segment end and segment mid-portion cross sectional views.

The segments need not be formed with a curved undersurface to fit the curvature of the drum but may be made with a flat undersurface parallel to the peripheral face and attached to the drum at the point of tangential contact. While the ribs have been described as being formed from steel, any material having superior durability and hardness will be useful.

Accordingly it is to be understood that the invention is not to be limited to the precise form shown, but that it includes within its purview whatever changes fairly come within the appended claims.

I claim:

1. A compaction roller comprising:

a cylindrical drum,
a plurality of continuous circumferential ribs in spaced relation on the periphery of said drum, each of said ribs having an outer peripheral face,
each of the said ribs being tapered in the transverse place of its height and having a lesser breadth at its peripheral face than at its base,
the said peripheral face of each rib being formed of a plurality of plane surfaces which intersect to provide a series of apexes interspersed at opposite ends of flat peripheral face portions about the periphery of the said rib,

said ribs being so positioned on said drum that the apexes of any rib are staggered with respect to the apexes of adjacent ribs,

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said compaction roller being adapted to be repeatedly drawn over material to be compacted to progressively increase the density of said material, and said ribs, because of said transverse taper, being effective to penetrate said material to a progressively diminishing degree as said material increases in density so as to apply a progressively intensified compacting force.

2. A compaction roller comprising:

a cylindrical drum,

a plurality of continuous circumferential ribs fixed to the periphery of said drum in spaced relation, each of said ribs being formed from a plurality of segments, each having a base curved to the radius of the drum, each having a planar outer peripheral face, and being of lesser breadth at such peripheral face than at the base,

the planar peripheral faces of adjacent abutting segments intersecting to provide apexes interspersed at opposite ends of flat peripheral segment faces on the periphery of said rib,

said ribs being so positioned on said drum that the apexes of any rib are staggered with respect to the apexes of adjacent ribs,

said compaction roller being adapted to be repeatedly drawn over material to be compacted to progres-

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sively increase the density of said material, and said ribs being effective to penetrate said material to a progressively diminishing degree as said material increases in density so as to apply a progressively intensified compacting force.

3. The compaction roller defined in claim 2 in which the breadth of the base and the slope of the sides of each segment are constant values throughout the length of the segment, whereby the outer peripheral face of each segment widens in its mid-portion.

4. The compaction roller defined in claim 2 in which the segments making up the ribs are so fixed on the drum that the apexes of any rib are staggered with respect to the apexes of every other rib.

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