May 24, 1966 A. W. GARDNER 3,252,389

DEEP-LIFT COMPACTION METHOD AND APPARATUS

Filed Dec. 3, 1962 2 Sheets-Sheet 1

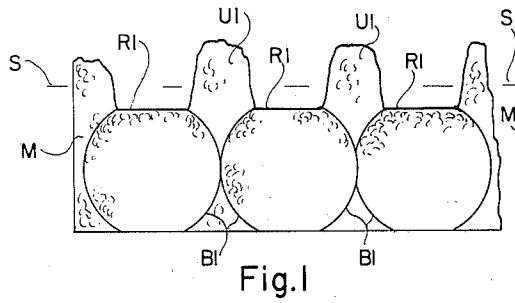


Fig. 1

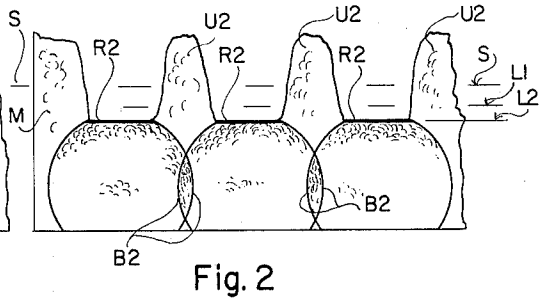


Fig. 2

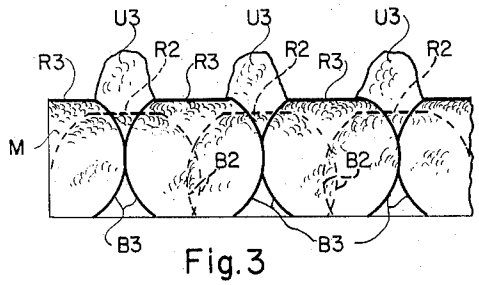


Fig. 3

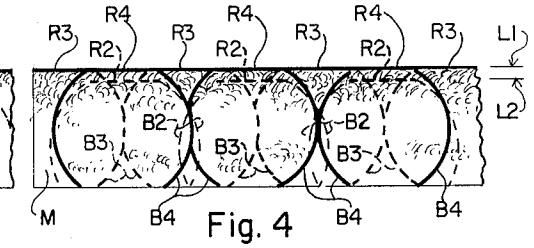


Fig. 4

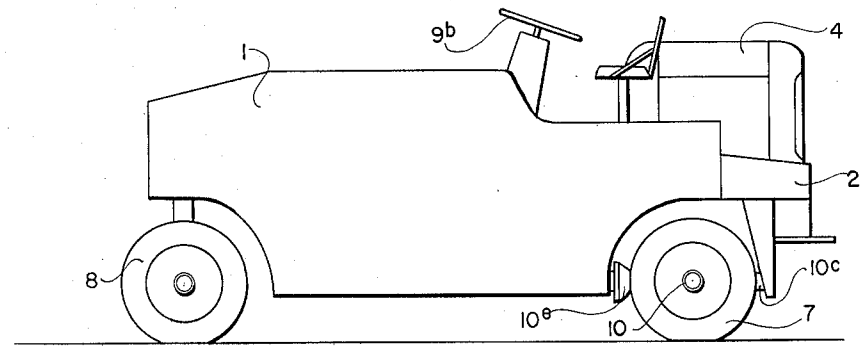


Fig. 6

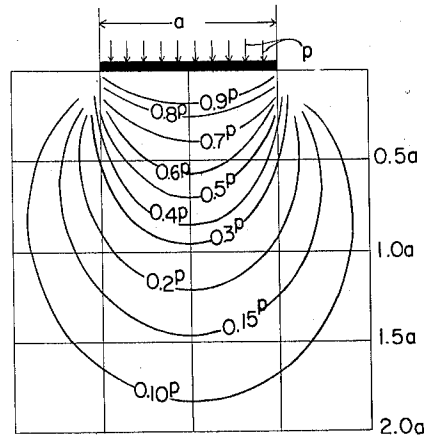


Fig. 5

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DEEP-LIFT COMPACTION METHOD AND APPARATUS

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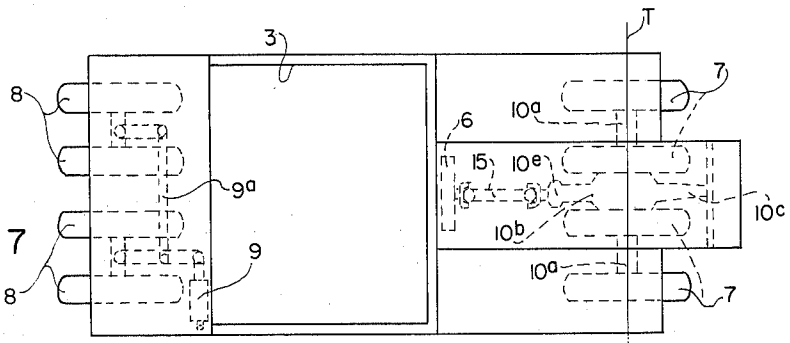


Fig. 7

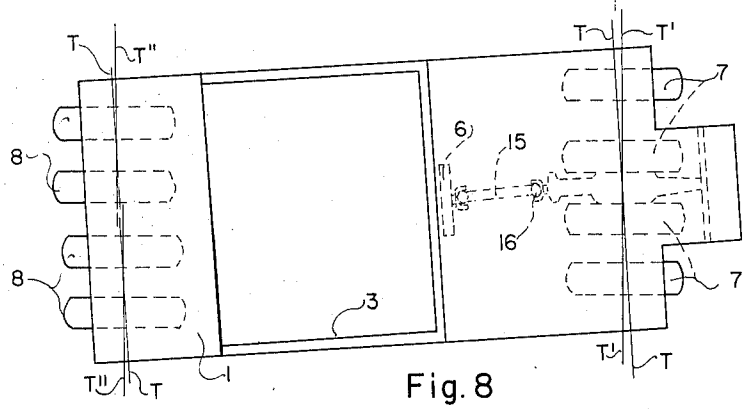


Fig. 8

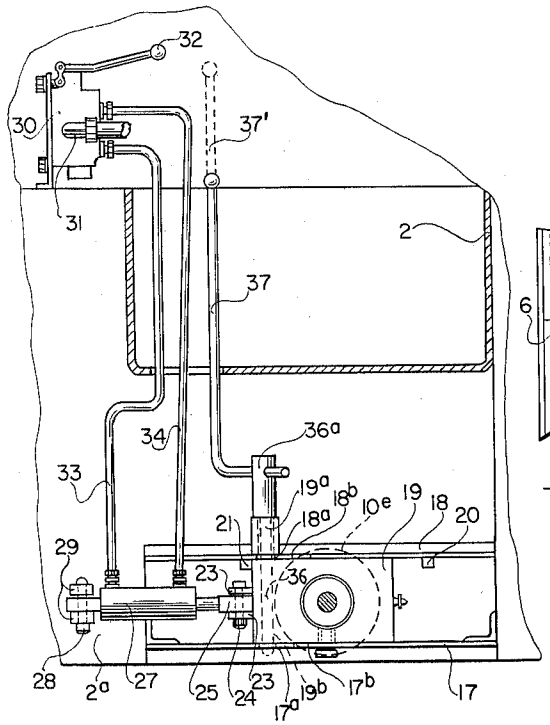


Fig. 10

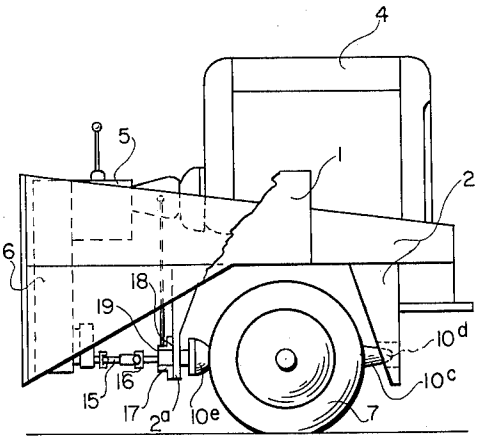


Fig. 9

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3,252,389

DEEP-LIFT COMPACTION METHOD AND APPARATUS

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Filed Dec. 3, 1962, Ser. No. 241,846
11 Claims. (Cl. 94—22)

This invention relates to improvements in compaction methods and apparatus, and particularly relates to the compaction of soil and other loose granular materials with special emphasis on techniques and equipment capable of efficiently compacing the underlying portion of a lift of material prior to the final compacting of the material in the upper portion of the lift nearer its surface.

In the art relating to compaction methods and apparatus, improvements leading toward greater sophistication have been greatly assisted by the pressure bulb theory of soil compaction, which is discussed in some detail in column 5 of the specification of Gardner Patent 2,754,743 and which theory describes compaction efforts on loose granular materials as producing bulb-shaped contour lines of substantially equal compactive stress emanating from the face of the bearing plate exerting the effort on the materials, and said lines extending into the material to a depth dependent upon the unit-area pressure applied by the bearing plate as well as by other factors, such as the granular nature of the material itself and its moisture content. These pressure bulbs are usually drawn as profiles taken in a plane through the narrowest dimension of the bearing plate. It is especially important to note that pressure bulbs extend outwardly beyond the periphery of the plate so that two pressure-bulb profiles created by spaced mutually adjacent bearing plates can include lines which overlap as well as lines which are mutually tangent. This pressure-bulb theory clearly establishes that two spaced bearing plates when applied side by side in a plot of loose material actually compact by overlapping pressure bulbs all of the soil located near the bottom of the lift, even though they leave uncompacted interstices near the top of the lift.

It is the object of the present invention to apply this basic theory to the pneumatic-tire roller art in a novel way to provide improved compaction, meaning more uniform compaction down substantially to the bottom of the lift of loose material, and to provide more efficient compaction directed toward obtaining specified density with fewer passes over the lift.

It is another major object of this invention to provide a method of compacting a zone of loose materials wherein adjacent areas arranged for convenience in spaced rows are compacted by several passes therover until the material therebelow has been processed to a required or practical extent based on the "law of diminishing returns," and then subsequently the uncompacted material which extends above the rows of areas in the interstices therebetween is distributed and compacted over the entire zone. By this method, the lower portion of the lift of material is compacted first, and then only after it is so compacted is the upper portion of lift processed. The usual prior-art approach compacts the entire zone from the top surface down on all passes of the machine and therefore special compactive effort is never applied to the lower portion of the lift as a preliminary step. It is important to recognize that after a very limited number of passes, usually 2 or 3 passes applying the same unit-area of loading, the materials are compacted nearly to their ultimate density obtainable with that amount of loading on the machine. If, as is usually the practice, the entire plot of loose material has its material compacted by compacting the entire surface area

on the first pass of the machine, it is then too late to pay special attention to the compaction needs of the material near the bottom of the lift. Thus the novel sequence of events taught in the present method is important from the point of view of obtaining efficient compaction of the material near the bottom of a lift before processing the material near its surface.

It is another major object of the invention to provide multiple-axle pneumatic-tire roller apparatus which comprises a novel combination of elements, each one of which when considered by itself is at least broadly known in the art, but which in combination provide a machine well suited to perform in an efficient way the steps which make up the present novel method, which steps can also be performed by other equipment or even by the repeated use of hand implements. Specifically this apparatus comprises a multiple-axle pneumatic rolling machine including on at least two of its axles plural rubber-tired wheels mutually spaced apart substantially by the width of a wheel, at least one of the axles including steering means and at least two of the axles being mutually positionable to two positions such that, when the axles are positioned to cause the wheels thereon to run parallel courses, in the first position the wheels on the trailing axle will precisely track the wheels on the leading axle, but in the second position the wheels on the trailing axle will roll the interstices between the leading wheels and will therefore follow in staggered relation to the leading wheels. It is the novel combinaton of the strategic placement of wheels across the width of the machine on each axle, plus the ability to steer the wheels on at least one of the axles, plus the ability to relatively position the wheels on the various axles so that they either track or are staggered when running parallel courses, that provides a machine capable of more efficient compaction for reasons to be explained more fully hereinafter in terms of the pressure bulb theory.

Still a further object of this invention is to provide a novel mechanism for positioning the wheels of a pneumatic-tired roller in one or the other of the two positions set forth above.

Other objects and advantages of the invention will become apparent during the following discussion of the drawings, wherein:

FIGS. 1, 2, 3, and 4 show cross-sectional views taken through a lift of loose material and showing relative compaction thereof in four different degrees after the wheels carried on each axle of a two-axle machine have rolled the material during two successive passes of the machine;

FIG. 5 is a schematic representation in a vertical plane showing pressure-bulb contour lines of constant compactive stress caused by downward forces on a bearing plate, the widths of these contour bulbs being shown horizontally in the drawing and the depths thereof being shown vertically in the drawing;

FIG. 6 shows a side view of a pneumatic-tired rolling machine comprising an illustrative embodiment of a novel apparatus according to this invention;

FIG. 7 shows a plan view of the machine illustrating the leading and trailing wheels positioned to precisely track each other;

FIG. 8 shows the same machine but with the leading and trailing wheels offset in mutually staggered relation;

FIG. 9 is a side view partly in section and showing the power unit end of the roller illustrated in FIG. 6, and showing the drive axle of the machine shiftably mounted for adjustment to one of two positions to change the tracking characteristics of the wheels on the drive axle with respect to the wheels on the steering axle; and

FIG. 10 shows a detail view of a suitable mechanism for changing the position of the drive axle illustrated in FIG. 9.

Referring now to the drawings and particularly to FIGS. 1 through 5 inclusive, it will be seen in FIG. 5 that according to the established pressure-bulb theory, a bearing plate of width *a* applied to a lift of granular material with a downward unit-pressure *p* will deliver compaction stresses into the soil ranging from 0.9*p* just under the surface of the bearing plate to 0.1*p* at a depth of about 1¾ times the dimension *a* and that these pressure lines, hereinafter referred to as pressure bulb contours, actually extend laterally considerably beyond the width *a*, and that the maximum extent in the lateral direction occurs at a distance below the bearing plate about equal to the width *a* thereof. There exists therefore a relationship between the width of the bearing plate and the depth of the loose material which will efficiently compact.

Applying this type of explanation to the present compaction process wherein rolling is first conducted by the roller of FIG. 6 with the wheels positioned in-line as shown in FIG. 7, a lift of loose material M after one pass of one axle of the machine will assume a condition as shown in FIG. 1 in which the compacted areas or ruts R1 extend below the original surface level S but in which the uncompacted material U1 is actually raised somewhat above the original surface S. It will be noted that the pressure bulbs which are schematically represented by the line B1 are shown as tangent at a depth approximating the width dimension *a* of the bearing surface which is the approximate elevation of the maximum width of a pressure bulb, as shown in FIG. 5.

FIG. 2 shows a moment later in the sequence of events when the wheels on the next trailing axle have also rolled these same ruts, and it will be noted that the level of these ruts R2 has now been depressed even further below the original surface S of the lift M. It should also be noted that the pressure bulb lines B2, corresponding with the lines B1 in FIG. 1, now overlap each other to a considerable extent. The amount of uncompacted material U2 is approximately the same and is located in the interstices betwen the ruts.

Assuming that these bulbs were made by a two-axle machine, at this point the machine has passed once over the material with the wheels on both axles in mutually-tracking alignment. The operator then readjusts the mechanism (to be discussed hereinafter) so as to stagger the trailing wheels with respect to the leading wheels and again drives the vehicle over substantially the same plot but this time steering the leading wheels onto the uncompacted interstices U2 so as to knock down these interstices and spread them transversely partially onto the rut areas R2 and partially therebetween under a series of new rut areas R3 located between the areas R2. It is to be noted that the pressure bulbs B3 are also tangent with each other and overlap the previously compacted area as well as the area between the pressure bulbs B2, thereby causing compaction of the latter and further stressing of the former. FIG. 3 shows at U3 the condition of the remaining uncompacted material after the leading axle rolls over the lift during the second pass of the machine.

Finally, FIG. 4 shows the condition of the lift after the trailing-axle wheels have traveled thereover in staggered relation during the second pass of the entire machine. In this position the pressure bulbs B2 and B3 (shown in broken line) are further supplemented by a new set of pressure bulbs B4 (shown in solid lines) which lie below compacted areas R4 which alternate with compacted areas R3 and are roughly the same distance below the original surface S. The level of the compacted areas R3 and R4 comprises the finished level of the rolled material. The above description sets forth the compactive process as carried out by the machine shown in FIGS. 6, 7, and 8, but this process could have been as well carried out by a man pushing a hand roller having a single set of wheels on it, resembling for instance the wheels on just one of the axles of the machine as shown in FIGS. 6, 7, and 8. The man would push the hand implement twice over the lift running the wheels on the second pass in the two ruts which were created by his first pass. Then on the third pass the man would roll the raised interstices to spread the loose material therein and compact it under the ruts R3 and R2. Then on the fourth pass the man would again roll the loose material located between the ruts R3 and above the ruts R2. There are still other ways of carrying out the present process although probably none of them is as effective as using multiple axle rollers loaded to deliver such unit-area stresses to the uncompacted material as will permit full consolidation thereof within a relatively few passes of the axles.

In order to explain the present process as distinguished from the usual prior art procedure performed, for instance, by an ordinary multiple axle roller having staggered leading and trailing wheel positions which process the entire surface of the material on the first complete pass of the machine, the following explanation in terms of the pressure bulbs shown in FIGS. 1–5 is presented. As was stated in the introductory portion of this specification, it is an important object of this invention to provide a method by which the material near the bottom of the lift being processed is compacted to a relatively high density approaching its final density before the material which occupies the top of the lift when finally compacted is processed. It can be readily observed that an ordinary smooth-faced cylindrical roller compacts loose material always by pressing downwardly on all of the material located in the path of the machine at the very top of the lift, and that on successive passes of such a roller the top surface progressively approaches the ultimate compacted level of the lift without punching through or ever going below this level. It is also apparent that when compaction is carried out in this manner the material nearest the top of the lift is compacted to the greatest density and that the density thereof decreases toward the bottom of the lift.

The present compaction method processes the material in the lift differently in view of the fact that on the very first pass the compaction device punches through and sinks down toward a level L2, FIG. 4, which is considerably below the ultimate level L1 to which the lift will be compacted. It is by virtue of this punching through to a lower level L2 that the material nearer the bottom of the lift will be compacted to a higher density than it would be if the material were rolled by an ordinary cylindrical roll which never punches through or descends below the level L1 but always remains above it until it arrives at it.

It is to be noted by comparing FIGS. 1 and 2 that on the first pass of the machine over the material M the leading and trailing wheels are positioned so that they track each other, and therefore the trailing wheels pass over the same ruts R1 as were initially compacted by the leading wheels. As shown in FIG. 2 the trailing wheels on the first pass of the machine lower the compacted areas R1 down to the level labeled R2. If more passes are necessary in order to reach the required or specified density a three axle machine can be used to provide three passes over the original rut areas R1, or alternatively, the same machine can be driven over these ruts again so as to stress the material therebelow to whatever degree is desired. As a practical matter, when compacting ordinary lift materials such as soils or aggregate, when a properly loaded machine has passed twice over the same relatively narrow areas, as represented in this case by the rut areas R1 and R2, the material in the pressure bulbs below these areas is quite well compacted, so that further passes thereover yield only marginal increases in density. Note in comparing FIGS. 1 and 2 that the pressure bulb contours which in FIG. 1 are tangent, as a result of further stressing in FIG. 2, overlapped each

other to a considerable degree. Moreover, the material in these pressure bulbs will receive the benefit of two more compactive passes thereover as shown in FIGS. 3 and 4, and since both of these passes are made by passing the wheels over uncompacted materials U2 and U3 of low density, a great deal of the compactive effort on each pass thereover will be transmitted therethrough and into the lower material of the lift below the level L2, FIG. 4. As stated above by the time the machine has made its first complete pass the material deep down in the lift under the pressure bulbs B1 and B2 has been stressed twice and is rather well consolidated.

On the third pass of a set of wheels over the material M, the vehicle is steered so as to roll the wheels over the uncompacted area U2 causing one part of it to be spread laterally to overlie the previously compacted areas R2 and causing the other part of it to be compacted into the space between the areas R2 and compressed below the rut areas R3. The pressure bulbs B3 will thus be located directly between the previously compacted pressure bulbs B2 of the material in the lower portion of the lift. The material which is located immediately between the rut areas R2 and which had not been previously compacted at all, is now subjected to compaction at rather high pressure since this material is located only a small distance below the rut areas R3 at which level the compactive stress is relatively high. Moreover, the application of this compactive effort to the areas R3 will stress for the second time the lowermost materials between the pressure bulbs B2, thereby tending to consolidate the material in these overlapping marginal areas to densities approaching the density immediately under the areas R2. Moreover, since the pressure bulbs B3 are substantially tangent with each other, almost the entire volume beneath the level L2 will be stressed again, for the third time.

On the fourth pass of the wheels over the material M, FIG. 4, the wheels roll over the uncompacted area U3, which as can be seen in FIG. 3 comprises only a relatively shallow lift located above the rut areas R2. Thus, one pass of a set of wheels over the areas R4 is sufficient to fully consolidate the relatively shallow materials U3 being compacted thereby. Again, this compactive effort does not stop at the level of the material U3 but continues to stress the materials located therebelow and below the level L2.

Thus, it has been illustrated that by using the compactive sequence comprising the present method, the material at the bottom of the lift is more heavily stressed because it is initially stressed from a level L2 which is actually below the ultimate level L1 of the rolled final surface, and because it is processed before the surface material is compacted, thereby providing preliminary and superior ultimate compaction of the lower materials in the lift. The usual method of compaction using a staggered wheel arrangement which compacts the whole surface of the material makes it impossible on subsequent passes to compact the material in the lower portion of the lift to as high a density with the same loading of the machine. By this latter means, the rolling effort is always applied from a level located above or at the final surface level of the compacted material, rather than from a level located below or at the final surface thereof. In the Gardner Patent 2,857,828, which teaches the combination of a smooth-faced cylindrical roll following a buoyant segmented roll, only one pass is made by the segmented roll over the lift material in the waffle pattern before rolling this pattern smooth with a smooth-faced roll. This method therefore is basically of the same type as the usual method practiced by a two-axle pneumatic roller having staggered wheels on the leading and trailing axles. The present method is not taught by either of the above practices because full compaction is not obtained in the lower portion of the lift by only one application of the waffle pattern since it is followed immediately by a smooth-faced roll. In order to accomplish the degree of compaction of the lower level materials obtainable by the present process, it would be necessary to reapply the same waffle pattern at least once in exactly the same location and then once again in staggered relation before the smooth-faced rolling is commenced. Even then, the same effect would not be accomplished because the segmented roll compacts considerably more than 50% of the area of the lift on each pass of the roll since less than half of the area of the roll is cut away. There are several factors attributable to this fact. In the first place, the amount of loose material remaining in the uncompacted interstices of the waffle pattern is relatively small as compared with the amount of loose material remaining in the uncompacted areas U1 or U2 of the present disclosure, which quantity of uncompacted material is sufficient that when it is spread out on the third pass of the wheels it actually provides a whole new layer located above and covering the level L2 of the ridges R2. In the second place, the compactive force applied on the third pass of the wheels as shown in FIG. 3 is concentrated on and applied solely to the areas R3 which are located symmetrically between the areas R2 and thus the compactive effort is applied in concentrated degree to the areas R3 rather than being shared partially by the area R2 as would be the case if the Gardner segmented roll were followed by a smooth roll. Thus, the present disclosure operates on the soil differently from the Gardner disclosure set forth above, and this is true principally because it was the purpose of that Gardner disclosure to provide a device in which the compaction pads never punch through or go below the ultimate level to which the surface of the material is processed.

On the one hand, the present disclosure is designed to compact to as great an extent as possible the lower material in a relatively thick lift without primary concern for precisely uniform density of the material nearer the surface of the lift when compacted. On the other hand, this segmented Gardner roll disclosure is intended to provide means for producing a finished surface so uniformly rolled that the roller can be used on soft black-top to roll the final surface thereon. The present method is intended for application to loose materials to compact them in preparation for receiving some other finish on top thereof. Because the objects of the two methods are very different, the two methods are different, each one being especially designed to produce satisfactory practical results in the minimum number of passes.

Referring now to FIGS. 6–8, these figures show a preferred embodiment of a machine for carrying out the present process in a particularly efficient manner. The machine includes a body 1 supported on a chassis 2 and including a hopper 3 designed to hold a quantity of ballast so that the loading on the machine can be controlled. The machine further includes an engine 4 connected by a transmission 5 and a gear train 6 with a driven rear axle 10 supporting and driving a plurality of rear wheels 7. The front end of the vehicle is supported on wheels 8 which are provided with steering means including a hydraulic cylinder 9 and a connecting linkage 9*a* which are controlled by the steering wheel 9*b*, in a manner well known per se.

The rear axle 10 actually comprises axle members 10*a* extending in both directions from a center casting 10*b* and supporting 4 wheels 7. This axle includes differential means (not shown) inside the center housing 10*b* which center housing extends rearwardly as at 10*c* and is supported in a ball joint 10*d* about which the axle is free to pivot in a vertical plane disposed transversely of the chassis 2 of the machine so that the rear wheels can rock within this plane to follow the ground contours. A suitable axle is described in detail in my copending patent application Serial Number 117,470, filed June 15, 1961. Since the ball joint 10*d* is a universal type of joint, the axle can also pivot thereabout in a horizontal plane in order to shift from a position in which the axle 10

lies in a common vertical plane with the transverse line T shown in FIG. 7, to a somewhat skewed position represented by the line T' as shown in FIG. 8. This skewing of the axle **10** when observed in plan view as shown in FIG. 8, permits the rear wheels to change from a position in which they track the front wheels **8** when all of the wheels of the vehicle are rolling in parallel directions, to a staggered position as shown in FIG. 8 in which the rear wheels are symmetrically offset with respect to the front wheels when all of the wheels are rolling in parallel directions. This skewing effect is accomplished by suspension means shifting the front end **10***e* of the axle casting **10***b* toward the right side of the vehicle using a sliding block mechanism which is shown in greater detail in FIGS. 9 and 10.

This is, of course, not the only mechanism by which the rear wheels can be positioned with respect to the front wheels, the prior art including many showings of vehicles having articulated frames, for instances of the type shown in the patent to Wright, 2,494,324. Another possibility is to slide the wheels, or one whole axle, transversely of the vehicle frame to change the tracking characteristics of the leading and trailing wheels. However, the structure shown in FIGS. 6, 7, and 8 is preferred for use in the present application.

Referring now to FIGS. 9 and 10 the gear train **6** delivers power from the transmission **5** to a telescoping drive shaft **15** having a universal joint **16**, this drive shaft being connected through the front end of the axle **10***e* to the differential means (not shown) within the casting **10***b*. The chassis **2** includes a downwardly extending plate **2***a* to which a pair of angle-iron guides **17** and **18** are affixed. These guides slidably support a block **19** which in turn supports the front of the casting **10***e* in one of two selectable positions.

As can be seen in FIG. 10, the block **19** is limited in its transverse sliding motion by two stops **20** and **21** which are welded to the track member **18**. The block is provided on its left side with a pair of spaced lugs **23** through which a pin **24** is passed to connect the end **25** of the connecting rod of a hydraulic cylinder **27**. The other end of this cylinder **27** is captivated by the bolt **28** to a pair of lugs **29** which are rigidly supported on the frame member **2***a*. The cylinder is actuated by a hydraulic fluid from a source (not shown) introduced into the housing of a valve **30** through pipe **31**. The valve is controlled by a knob **32** which has two operative positions furnishing hydraulic fluid under pressure to the pipe **33** to push the connecting rod and block **19** to the right against the stop **20**, or to furnish fluid under pressure through the pipe **34** to the other end of the cylinder **27** to retract the block **19** into the position shown in FIG. 10 where the block **19** abuts the stop **21**. A locking pin **36** serves to lock the block **19** in one of these two positions, and pass downwardly through an opening **19***a* on top of the block **19**, the pin passing through aligned bores **19***b* in the block, **18***a* in the guide **18**, and **17***a* in the guide **17**. The upper end of the pin **36** is provided with an enlargement **36***a* which is connected with a control arm **37** which is shown in solid lines with the pin in the down position locking the block with respect to the guides **17** and **18**. In the up position **37'** of the lever arm **37** (shown in broken lines) the pin **36** is withdrawn upwardly so that it no longer transfixes the bores **18***a*, **19***b* and **17***a*, thereby permitting the hydraulic cylinder **27** to move the block **19** against the stop **20** when the valve **30** is actuated. When the block **19** reaches the other position in which it abuts the stop **20** the pin can then be lowered again through the bore **19***b* and through two different holes in the guides **18***b* and **17***b* so as to lock the block **19** in this other position.

Referring again to FIGS. 7 and 8 it will be noted that, when the wheels **7** are positioned as shown in FIG. 7 to precisely track the front wheels **8**, the steering will be in straight forward position unless the vehicle is turning. On the other hand, when the rear wheels **7** are in offset

position as shown in FIG. 8 so that they are normal to the line T', the position of the steering gear **9** must be corrected to move the wheels **8** to a new position in which the steered wheels **8** lie normal to the line T'' instead of the transverse line T, so that when the vehicle is running straight its chassis is actually "crabbing" to a small degree. The angle between the lines T and T' is the same as the angle between the lines T and T'', and in this position the wheels **7** do not track with the wheels **8** but are staggered with respect thereto, the staggering being preferably symmetrical although not necessarily precisely symmetrical.

The present invention is not limited to the illustrative examples and embodiments set forth in the present specification and drawings, but only by the scope of the following claims.

I claim:

1. The method of compacting loose material within a plot to a required density, including the steps of compacting the material in the plot in spaced longitudinal rows of areas of about the same width as the interstices therebetween; recompacting the same areas prior to compacting said interstices and until the material therebelow reaches the required density; then subsequently compacting part of the material located in the interstices into the areas between said rows, and distributing the remaining part thereof onto the rows and compacting it.

2. The method of compacting a lift of predetermined depth of loose material within a plot to a required density, including the steps of compacting the material in the plot by compacting it in a pattern of spaced areas of about the same width as the interstices therebetween and the centers of the areas being mutually spaced apart by distances approximating said depth; recompacting the same areas until the material therebelow reaches the required density substantially to the bottom of the lift; then subsequently compacting part of the material located in the interstices, and distributing the remaining part thereof onto said areas and compacting it.

3. The method of compacting loose material within a plot to a required density, including the steps of simultaneously compacting the material in plural spaced adjacent longitudinal rows of areas separated by interstices; then recompacting the same areas until the material therebelow reaches the required density at least as far down as a depth equal to the distance between centers of adjacent rows; then subsequently compacting part of the material located in the interstices into the areas between said rows, and distributing the remaining part thereof onto the rows and compacting it.

4. The method of compacting loose material within a plot to a required density including the steps of repeatedly compacting the material in the same longitudinal rows of mutually spaced areas of about the same width as the interstices therebetween until the material therebelow reaches the required density to a depth at least equal to the width of an area; then subsequently redistributing the loose material located in the interstices across the plot and compacting the remaining loose material across the whole plot to form a substantially smooth surface located at a level above said areas.

5. An improvement in a rolling machine of the type having a chassis carrying axle means supporting at least two rows of ground-engaging wheels and having means for steering the wheels in at least one row, and the wheels in each row extending substantially all the way across the chassis and being in each row mutually spaced apart by approximately the width of a wheel, the improvement comprising suspension means fixed to the chassis and having a member shiftable transversely of the chassis and connected with at least one non-steering axle means and supporting the latter with respect to the chassis for selectively adjusting the position of that axle means with respect to the chassis to select one position in which the wheels on the last-mentioned axle means track in line

with the steered wheels, and to select another position in which the wheels on the last-mentioned axle means are offset to travel in staggered relation to the steered wheels.

6. An improvement in a rolling machine of the type having a chassis carrying longitudinally spaced axle means supporting at least two rows of ground-engaging wheels and the wheels in each row being mutually spaced apart by approximately the width of a wheel, the improvement comprising transversely disposed suspension and guide means fixed to the chassis and supporting a block transversely positionable with respect to the chassis and connected with at least one axle means and supporting the latter with respect to the chassis and including means for positioning the latter to select one position in which the wheels on said one axle means track in line with the wheels on at least one other axle means, and to select another position in which the wheels on said axle means are offset to travel in staggered relation to the wheels on the other axle means; and means for selectively locking the block in one of said positions.

7. An improvement in a rolling machine of the type having a chassis carrying two longitudinally spaced axle means supporting two rows of ground-engaging wheels and having means for steering the wheels in the first row and having means for driving at least some of the wheels in the second row, and the wheels in each row being mutually spaced apart by approximately the width of a wheel, the improvement comprising horizontally disposed longitudinally spaced pivot means fixed to the chassis and supporting the center of the axle means carrying said second row of wheels; block means supporting at least one of said pivot means; guide means transversely disposed and attached to said chassis and supporting the block means with respect to the chassis in one of two selectable positions wherein the wheels in the second row are disposed to track in line with the wheels in the first row, and in the other position the wheels in the second row are offset to travel in staggered relation to the wheels in the first row.

8. A compaction roller comprising a chassis; a first row of steerable wheels supported transversely of the chassis; axle means disposed across the chassis and spaced longitudinally thereof from said first row of wheels; a second row of wheels on said axle means, the wheels in each row extending all the way across the chassis and being mutually separated by distances substantially equalling the width of a wheel; suspension and shifting means carried by the chassis and connected with said axle means for supporting the latter with respect thereto and including means for adjusting the position thereof transversely with respect to the chassis; and stop means operative on said shifting means for stopping the latter in a first position in which, when the wheels are all rolling in parallel planes, the steerable wheels and the wheels in the second row are mutually in line with each other, and in a second position in which the steerable wheels and the wheels in the second row are offset into symmetrically staggered mutual relationship.

9. A compaction roller comprising a chassis; a first row of steerable wheels supported transversely of the chassis; an axle disposed across the chassis and spaced longitudinally thereof from said first row of wheels and having horizontally disposed mounting extensions at right angles to the center of the axle and extending therefrom in both directions; a second row of wheels on said axle, the wheels in each row being mutually separated by distances substantially equalling the width of a wheel; pivot means carried by the chassis and supporting one of said extensions; a block transversely slidably connected with the chassis and having a second pivot means supporting the other of said extensions, the axle being supported for pivoting in a vertically disposed plane by said pivot means; and means for sliding the block transversely of the chassis back and forth with respect to the chassis for adjusting the position of the axle with respect thereto to a first position in which, when the wheels are all rolling in parallel planes, the steerable wheels and the wheels in the second row are mutually in line with each other, and to a second position in which the steerable wheels and the wheels in the second row are offset into staggered mutual relationship.

10. A compaction roller comprising a chassis; a first row of steerable wheels supported transversely of the chassis; an axle disposed across the chassis and spaced longitudinally thereof from said first row of wheels; a second row of wheels on said axle, the wheels in each row being mutually separated by distances substantially equalling the width of a wheel; guide means disposed transversely of and fixed to the chassis; block means slidable on said guide means and pivotally connected with the axle at a point located along a line extending longitudinally of the chassis and passing through its transverse center; axle supporting means fixed to the chassis and pivotally connected with the axle on said line but on the other side of the axle from said point; and power-actuated means carried by the chassis and connected with said block means for adjusting the position thereof with respect to the guide means to one position in which, when the wheels are all rolling in parallel planes, the wheels in the two rows are mutually in line with each other, and to another position in which the wheels in the two rows are offset into staggered mutual relationship.

11. In a roller as set forth in claim 10, said power-actuated means comprising hydraulic cylinder means connected between said chassis and said block means, and said guide means and said block means having holes therethrough which come into mutual alignment in said positions; and pin means for locking the block means in a selected one of said positions by transfixing the block and guide means at said holes.

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