July 21, 1959 A. W. GARDNER 2,895,390

SEGMENTED ROLL

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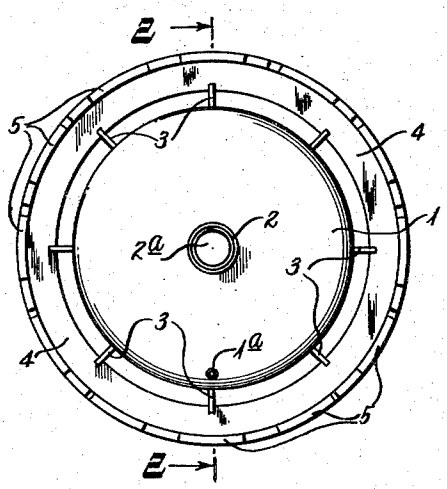


Fig. 1.

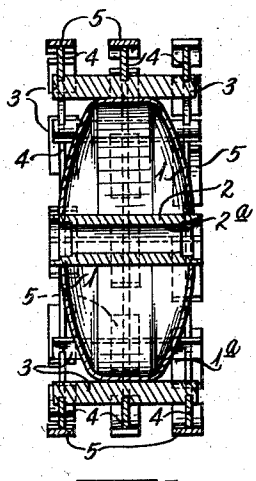


Fig. 2.

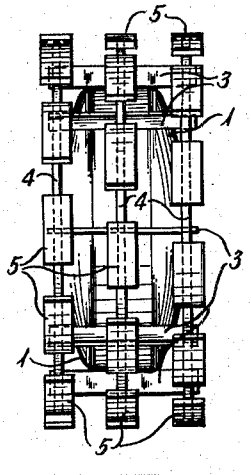


Fig. 3.

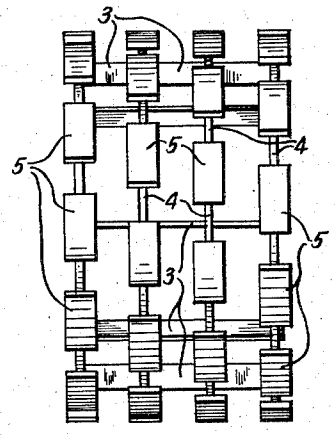


Fig. 4.

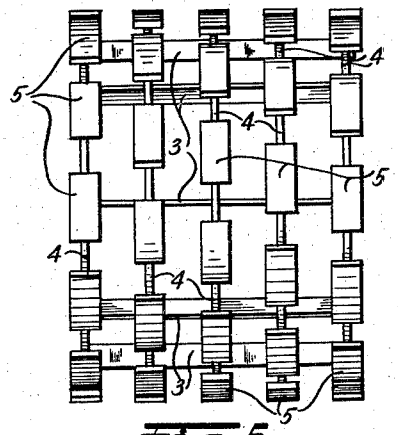


Fig. 5.

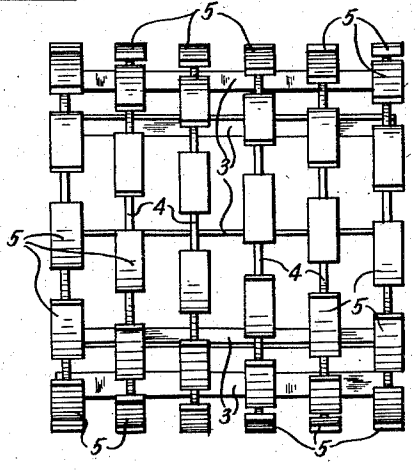


Fig. 6.

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Fig. 7.

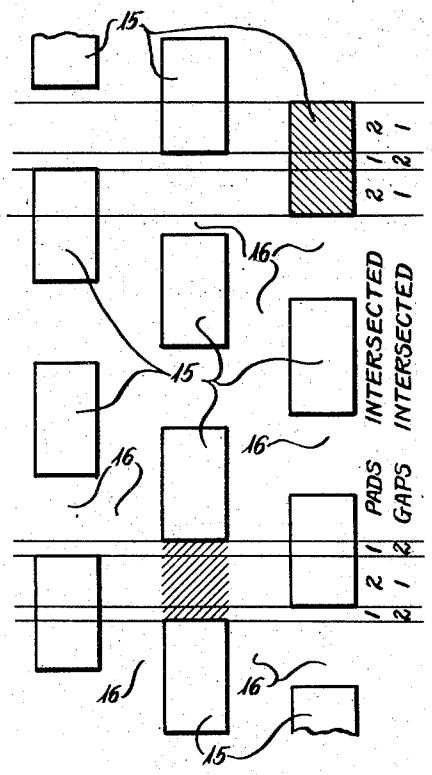
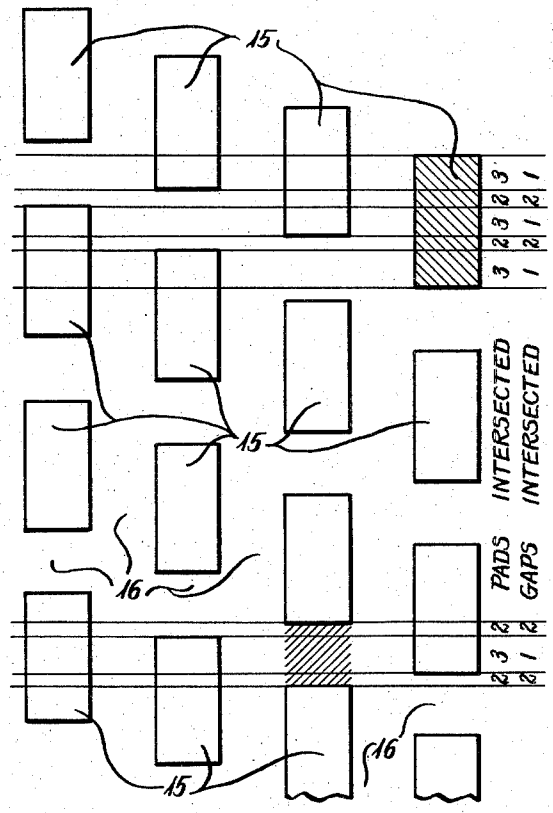


Fig. 8.



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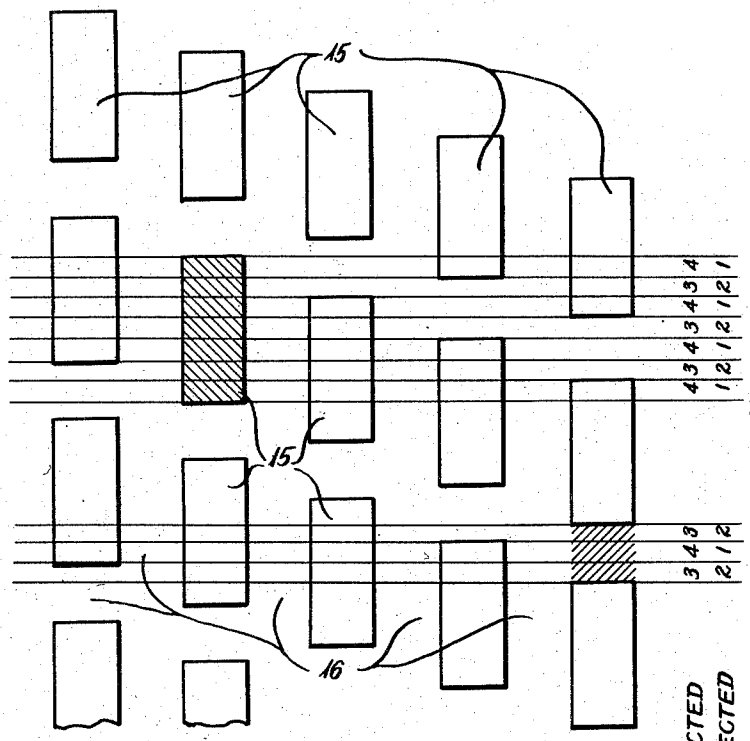


Fig. 9.

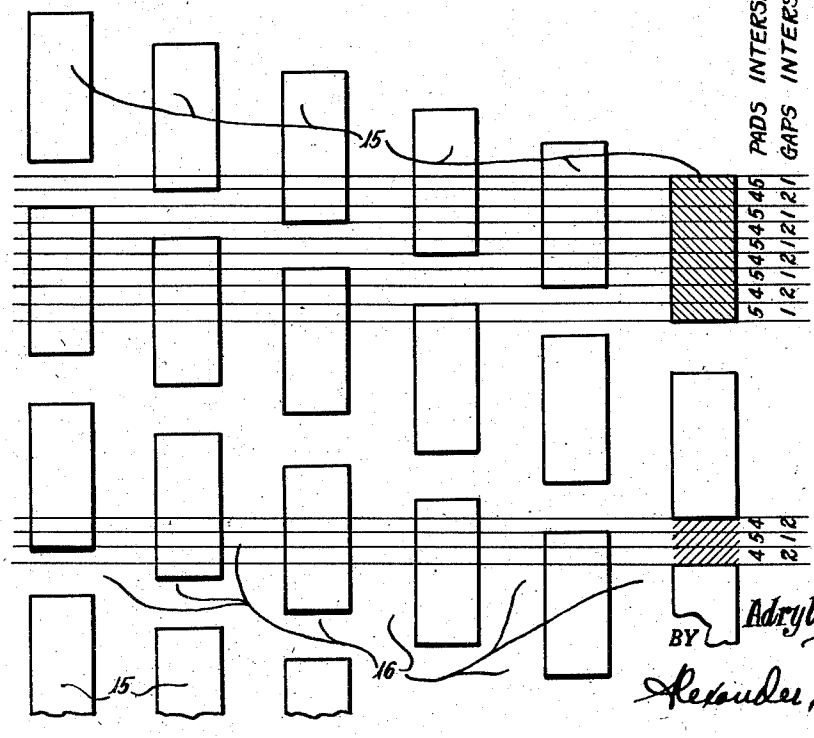


Fig. 10.

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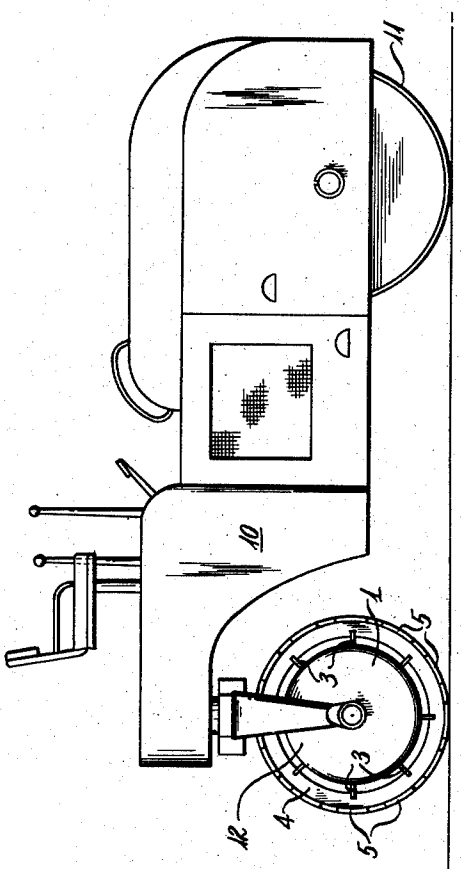


Fig. 11.

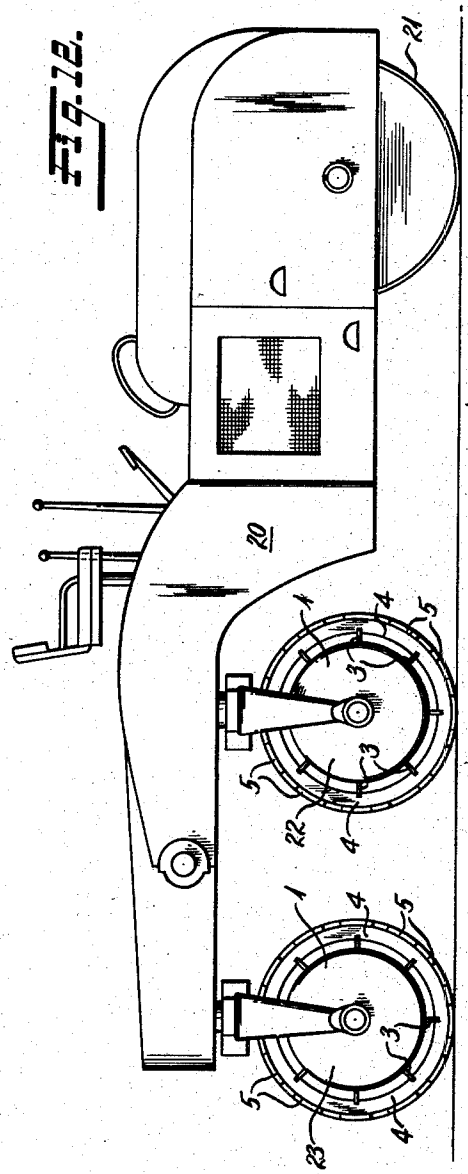


Fig. 12.

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2,895,390

SEGMENTED ROLL

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Application December 17, 1956, Serial No. 628,880

7 Claims. (Cl. 94—50)

This invention is a novel and useful roll for crushing and compacting loose materials, the roll in effect comprising a cylinder whose surface is partially cut away in a certain pattern so as to provide a plurality of separate segments of the original cylindrical surface, these segments being in the form of individual compaction pads. This roll is an improvement in certain respects over the conventional cylindrical roll, and in addition has certain advantages over the so-called "sheepsfoot" roll and other rolls having discontinuous surfaces.

It is an important object of the present invention to provide a segmented roll which has sufficient surface area, and which surface area is so placed, that the roll will contact the loose materials by pressing them down until they approach the final rolled level of the material, as distinguished from a roll which punches through this final rolled level.

It is another important object of the present invention to provide a roll in which peripheral gaps are provided permitting the roll to periodically bypass the wedge of loose material which it would ordinarily push ahead of it if it were a solid cylindrical roll. In the case of a solid cylindrical roll it frequently happens that a wedge of loose material being pushed ahead of the roll becomes so large that it stalls the forward progress of the machine carrying the roll. If stalling does not occur, the roll may climb over and partially compact this wedge of loose material, and thus leave behind it a large poorly-compacted defect. A roll which does not build up such a moving wedge of loose material does not require as great horsepower to insure that the machine carrying the roll will not be stalled, and in addition the roll does not build up large defects spaced at periodic intervals along the surface being rolled. Actually, the present roll does build up very small quantities of material before a transverse gap in the face of the roll permits this material to be bypassed, but the wedge of material built up is so small that it does not create an appreciable defect.

Another object of this invention is to provide a roll having regularly spaced transversely disposed gaps permitting the bypassing of loose material pushed ahead of the roll, and these gaps being circumferentially staggered around the periphery of the roll so as to minimize changes in the buoyancy of the roll as it progresses over the material being processed. In order to provide the desired structure, this invention discloses a roll which is divided into annular rows of compaction pads wherein the transverse gaps between the pads in the rows are staggered out of alignment, but in which there is at all times at least one pad in tangential contact with the surface being rolled. This feature serves to distinguish the present invention over the "sheepsfoot" roll wherein there are many transverse areas across the face of the roll in which there is located no sheepsfoot lug. The "sheepsfoot" roll is therefore not a buoyant roll. It is accordingly an object of the present invention to provide a roll wherein the unit area pressure is increased over that of the solid cylindrical roll, while at the same time the

present roll retains a considerable portion of the buoyancy of the solid cylindrical roll, as distinguished from the "sheepsfoot" roll which is definitely non-buoyant.

During a pass of the present roll, its buoyancy does vary, since as the roll rotates there is an instant during the transition between contact with the ground of one pad and the next succeeding pad when a line drawn transversely across the face of the roll passes through, for example, two gaps between pads. Then in the next instant of this example, a line drawn transversely across the face of the roll and in contact with the ground intersects only one gap. Thus it will be seen that as a given roll progresses along the ground, the number of gaps coming in contact with the ground varies alternately between one and two when measured in a very narrow area taken across the face of the roll parallel with its axis. Thus the unit pressures applied by the pads will fluctuate somewhat as the roll progresses. During the instant of rotation when the fewest number of pads are in contact with the material being rolled, the roll will be inclined to crush said material, and the materials so crushed will then be more responsive to compaction effort during subsequent passes of the machine over the material. This action serves as an advantage when compacting scarified materials or materials containing aggregates such as decomposed granite or coral rock. This variation of buoyancy serves to distinguish the present roll over the roll disclosed and claimed in the issued Gardner Patent #2,754,734. The present roll is not adapted so well to providing a smooth-finished surface but it will produce in certain types of materials a greater density. The above-mentioned patented Gardner roll is a compaction and finishing roll, whereas the present roll is a crushing and compaction roll.

It is another important object of the present invention to provide a roll having rows of annularly spaced pads, the pads being of such length and so staggered with respect to the pads in adjacent rows that at no place on the surface of the roll are the leading or trailing edges of any of the pads in transverse alignment.

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

Figure 1 is an end elevation of the new segmented roll showing the arrangement of pads and supporting hub.

Fig. 2 is a sectional view along line 2—2 of Fig. 1.

Fig. 3 is a front elevation of the roll shown in Fig. 1, this roll having three rows of pads.

Fig. 4 is a front elevation of a roll similar to that shown in Fig. 1, but this roll having four rows of pads.

Fig. 5 is a front elevation of a roll similar to that shown in Fig. 1, but this roll having five rows of pads.

Fig. 6 is a front elevation of a roll similar to that shown in Fig. 1, but this roll having six rows of pads.

Figs. 7, 8, 9 and 10 show the compaction pattern left in the material being rolled by one pass of a roll thereover, these compaction patterns representing the patterns left by the rolls shown in Figs 3, 4, 5 and 6, respectively.

Fig. 11 is a side elevation of a 2-axle tandem rolling machine wherein a segmented roll is mounted as a guide roll in combination with a conventional cylindrical drive roll.

Fig. 12 is a side elevation of a 3-axle tandem rolling machine wherein two segmented rolls are mounted as guide rolls in combination with a conventional cylindrical drive roll.

In the practical embodiment shown in the drawings, the segmented roll comprises a composite cylindrical broken surface supported on a hub of a design selected to prevent fouling of the individual pads which comprise the rolling surface. With particular reference to

Figs. 1, 2 and 3, the roll illustrated therein comprises two disc-like members 1 facing each other and secured together so as to provide a hollow roll structure. Passing through the center of each of the discs 1 is a bearing sleeve 2 which is welded to each of the discs at its circle of contact therewith, and is provided with a bore 2*a* adapted to receive an axle and bearings or other supporting structure. The hollow disc roll may also be provided with a valve 1*a* through which water may be inserted or withdrawn for the purpose of loading the roll. Around the outer periphery of this hollow disc structure are fixed a plurality of bars 3, each being secured to the disc structure and extending in a direction axial thereof, and all of the bars 3 being equally spaced around the outer periphery thereof.

The bars together form the supporting means for a plurality of rings 4 which surround the discs and are secured by any suitable means, such as welding, to the bars 3. The rings 4 are mutually spaced by equal distances and are concentric with the axis of the bearing sleeve 2 and of the discs 1. The rings 4 serve as supports for the individual compaction pads 5 which are in turn secured to the outer peripheries of the rings 4 and mutually spaced in the manner hereinafter described.

Any number of rings 4 may be employed, depending on the number of rows of compaction pads desired to form a particular roll. Since the parts required to form any one of the rolls shown in Figs. 3, 4, 5 or 6 will be analogous, the same reference character will be used to denote all pads, rings, discs and bars, respectively.

Referring to Figs. 11 and 12, Fig. 11 shows a 2-axle tandem roller 10 having a drive roll 11 and having a steering roll 12. This steering roll 12 is shown as being of the segmented type, and may comprise one or more rolls, as illustrated in Figs. 3, 4, 5 and 6, journaled side by side on the same axle. A 3-axle machine 20 is shown in Fig. 12, the machine 20 having a drive roll 21 and two steered rolls 22 and 23.

In both of the tandem combinations shown in Figs. 11 and 12 respectively, the particular combination of solid cylindrical roll and segmented roll is not necessarily to be adhered to. Actually, either machine may be equipped entirely with segmented rolls or, in the case of the 3-axle tandem machine shown in Fig. 20, this machine may be equipped with either one, two, or three segmented rolls as may be desired for a particular purpose. For example, where it is necessary to roll very loosely packed material, or to roll harder packed material to extremely high density, a tandem roller employing segmented rolls on each axle would prove to be highly effective, and all of these segmented rolls need not be identical. Because of the fact that the segmented roll does not build up a traveling wedge of loose material ahead of it, a machine equipped with a leading roll of the segmented type may be used to process material which is so loosely packed that it would stall the machine if its leading roll were a conventional cylinder.

Returning to the particular structure of a roll, as illustrated in Figs. 1 and 2, one important feature of the pad mounting assembly is that it should provide an open work structure which will not collect and retain quantities of the material being processed. Otherwise such material might pack solidly into the pad interstices and cause the segmented roll to take on the characteristics of a cylindrical roll, which result would be highly undesirable. In the present assembly the open spaces between the pads are not blocked from inside and therefore any material passing between the pads, around the rings 4, and between the bars 3 will continue on over the wheel until it comes into contact with a disc member 1. The disc member 1 will cause the materil to be deflected away from eithter side of the roll and drop back onto the surface of the material being processed. Scrapers may also be provided to scrape the roll surfaces and to clean the interstices between the pads.

It will be noted that four different illustrative examples are given in Figs. 3, 4, 5 and 6, inclusive. These examples each illustrate a roll having a different number of rows and pads,

Figure 3 having 3 rows,
Figure 4 having 4 rows,
Figure 5 having 5 rows,
Figure 6 having 6 rows, respectively.

It is to be understood, however, that the present invention is not limited to any particular number of rows.

When any one of these rolls is passed over a material to be processed there results a waffle-like series of depressions, each created by the contact of a pad with the surface of the material. In Figs. 7, 8, 9 and 10 four different waffle-like ground patterns are illustrated, wherein:

Figure 7 represents the pattern left by a roll of the type shown in Fig. 3; Fig. 8 represents the pattern left by a roll of the type shown in Fig. 4; Fig. 9 represents the pattern left by a roll of the type shown in Fig. 5; Fig. 10 represents the pattern left by a roll of the type shown in Fig. 6. The characteristics of these ground patterns will be more thoroughly discussed hereinafter.

Referring again to the tandem rollers shown in Figs. 11 and 12, and with particular reference to the combination in a tandem roller of segmented guide rolls and smooth faced drive rolls, it is important to note that these rolls form what may be called a compatible combination. By reference to the ground pattern of the segmented roll as shown in Figs. 7 through 10 inclusive, it may be seen that on the first pass of the segmented roll a series of waffle-like depressions 15 are made by the pads 5. The creation of such a pattern leaves the depressed material 15 surrounded by raised interstices 16 projecting thereabove. Thus, when during the same pass of the machine, the smooth faced drive roll passes over this pattern, the smooth faced roll will first depress the raised material 16 and then compact it down to the level of the material 15, or perhaps may even stress both materials 15 and 16 as it passes thereover, the smooth roll generally being more heavily loaded.

It is important to note that when compacting with a tandem combination of the type shown in Fig. 11 or Fig. 12, until the raised material 16 has been compacted to the level of the material 15 by the smooth faced roll, the smooth faced roll will act like a segmented roll whose surface is cut away in a pattern complementary to the leading segmented roll on the machine, since the raised material 16 initially supports the smooth faced roll as it passes thereover. Then, once the raised material 16 has been depressed to the level of the previously compacted material 15, the smooth faced roll will assume again the compaction characteristics of a cylindrical roll, and will accordingly leave behind it a smoothed surface.

Referring now to Figs. 7, 8, 9 and 10, it will be noted that on each of these figures two separate and different sets of parallel lines have been drawn across the illustrated ground pattern in a direction transverse to the direction of travel of the roll which created the ground pattern. These lines are disposed in a horizontal direction on the upright drawings. In each of these figures the lowermost set of parallel lines are all drawn through one selected gap appearing between successive pads of one row. It is further to be noted that the lowermost set of lines in each figure is divided into three groups in which the outermost groups each pass through two gaps and are separated by a central group which passes through only one gap. Even though the number of rows of pads changes progressively from three rows in Fig. 7 to six rows in Fig. 10, the characteristic of the lowermost set of lines remains the same in each figure, namely, three groups of parallel lines including two outer groups which pass through two gaps and these outer groups being separated by one central group which passes

through only the selected gap. It will also be seen that the intervals of the gaps can be varied considerably without altering the number of gaps intersected by each of the lines in the three groups in the lowermost set.

In each of the figures there is also an uppermost set of lines, all of which lines are drawn parallel to each other and transversely across the face of the ground pattern, and all of which lines pass through a single selected pad. It is to be noted that these groups of lines in the uppermost set in each figure alternate far more often than the groups of lines in the lowermost set in each figure. In terms of the number of rows of pads, which is to be designated as N rows, the number of alternations of groups in each of the uppermost sets can be represented as equalling the quantity $2(N-2)$. It will be noted that the uppermost set of lines in each figure is divided into groups of lines, each group of lines including adjacent lines which pass through the same number of gaps and the same number of pads as they progress transversely across the ground pattern. It will be noted that in each case the outermost groups of lines each intersect only one gap and $(N-1)$ pads. These outermost groups are repeated, but in each case are separated by other groups of lines which intersect two gaps and also intersect $(N-2)$ pads.

The above relationships, stated in terms of the sets and groups of lines, and in terms of the number of rows of pads, serve to distinguish the present roll over prior art rolls, and further serve to define the present roll as set forth in the appended claims.

For practical considerations, when designing a roll of the type set forth in the present disclosure, the arcuate length dimension of pads must be chosen short enough so that the latter does not build up appreciable wedges of moving material, but on the other hand since the pads must have sufficient area to prevent their sinking too deeply into the material being processed during the early stages of compaction, the pads must be long enough and wide enough to provide the buoyancy needed. Proper choosing of the pad dimensions and spacings will depend on the type and weight of the machine on which the roll is to be mouned, and upon the character and density of the material to be processed.

It is to be understood, that this invention is not limited to the exact forms shown in the drawings, for obviously changes may be made therein within the scope of the appended claims.

I claim:

1. A roll for compacting loose material comprising a composite cylindrical broken surface supported on a hub, said surface comprising spaced annular rows of substantially identical compaction pads, the pads in each row being separated circumferentially by uniform gaps therebetween, said roll including a system of no less than three rows of pads progressively staggered in the same circumferential direction, wherein each gap defines a circumferential spacing from the trailing edge of one pad to the leading edge of the next pad in the same row, and this gap lies opposite a transverse edge of a pad in each immediately adjacent row, and said spacing being in each case greater than the circumferential distance from the said trailing edge to each transverse edge located adjacent said gap.

2. A roll for compacting loose material comprising a composite cylindrical broken surface supported on a hub, said surface comprising spaced annular rows of substantially identical compaction pads, the pads in each row being separated circumferentially by uniform gaps therebetween and the pads of the rows being mutually staggered, said roll including a system of N, equals not less than three, rows of pads progressively offset in the same circumferential direction by distances such that when an infinite number of parallel lines are drawn across the face of the roll parallel to its axis and all passing through a selected pad in one of said rows, there will be $(N-1)$ distinct groups of lines which intersect only one gap in said system, these groups being alternately separated by $(N-2)$ other groups of lines which intersect two gaps in said system.

3. In a roll as set forth in claim 2, the respective lines included in each of said $(N-1)$ groups all intersecting $(N-1)$ pads in the system, and the respective lines included in each of said $(N-2)$ groups all intersecting $(N-2)$ pads in the system.

4. A multiple-axle rolling machine having a plurality of axle-mounted tandem compaction rolls, at least one of said rolls comprising a composite cylindrical broken surface supported on a hub, said surface comprising spaced annular rows of substantially identical compaction pads, the pads in each row being separated circumferentially by uniform gaps therebetween, said roll including a system of no less than three rows of pads progressively staggered in the same circumferential direction, wherein each gap defines a circumferential spacing from the trailing edge of one pad to the leading edge of the next pad in the same row, and this gap lies opposite a transverse edge of a pad in each immediately adjacent row, and said spacing being in each case greater than the circumferential distance from the said trailing edge to each transverse edge located adjacent said gap.

5. In a machine as set forth in claim 4, at least one other of said rolls being a conventional cylindrical roll.

6. A multiple-axle rolling machine having a plurality of axle mounted tandem compaction rolls, at least one of said rolls comprising a composite cylindrical broken surface supported on a hub, said surface comprising spaced annular rows of substantially identical compaction pads, the pads in each row being separated circumferentially by uniform gaps therebetween, said roll including a system of N, equals not less than three, rows of pads progressively offset in the same circumferential direction by distances such that when an infinite number of parallel lines are drawn across the face of the roll parallel to its axis and all passing through a selected pad in one of said rows, there will be $(N-1)$ distinct groups of lines which intersect only one gap in said system, these groups being separated by $(N-2)$ other group of lines which intersect two gaps in said system.

7. In a machine as set forth in claim 6, at least one other of said rolls being a conventional cylindrical roll.

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