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A. T. ERICKSON
ROTATING ROLLER MACHINE

3,221,619

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2 Sheets-Sheet 1

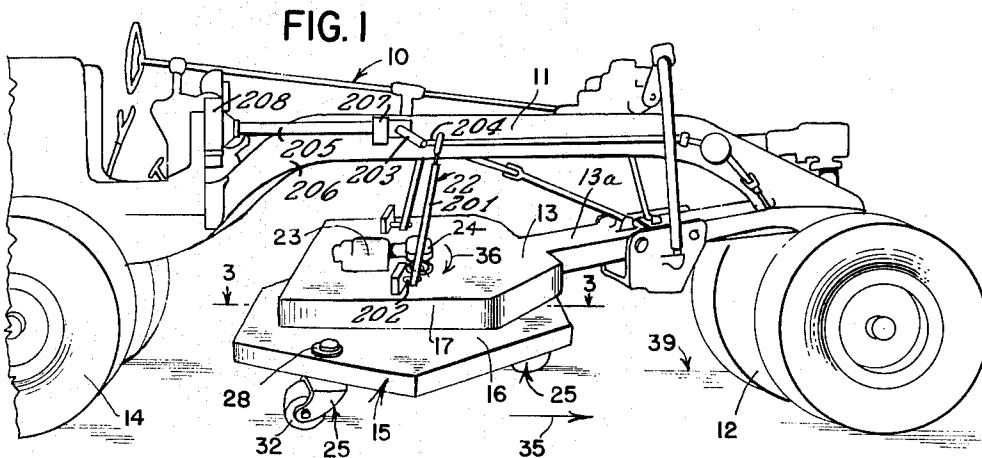


FIG. 8

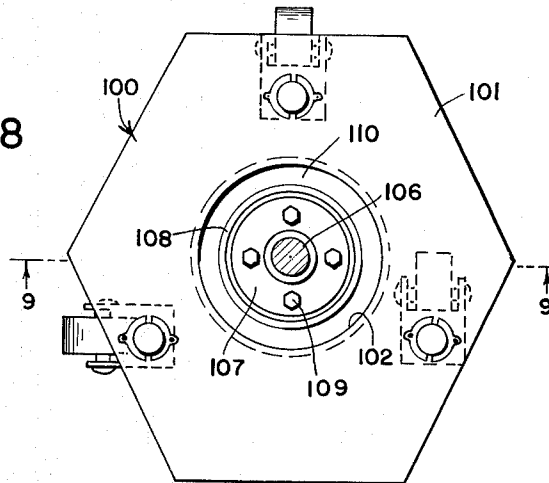
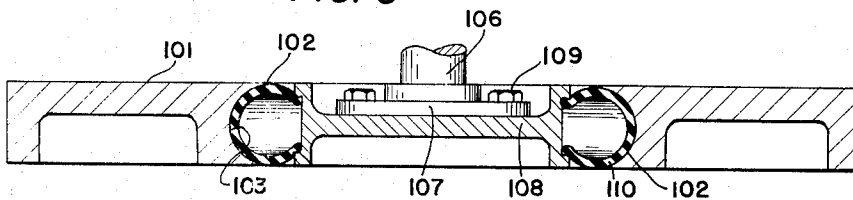


FIG. 9



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FIG. 2

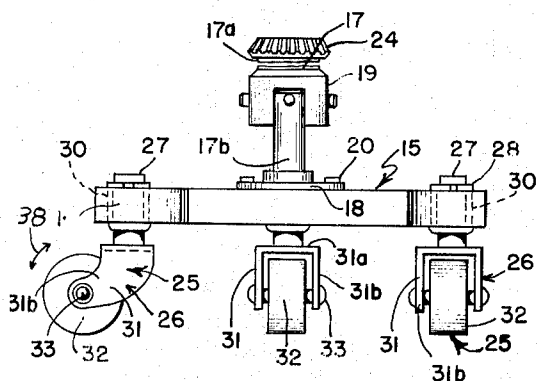


FIG. 10

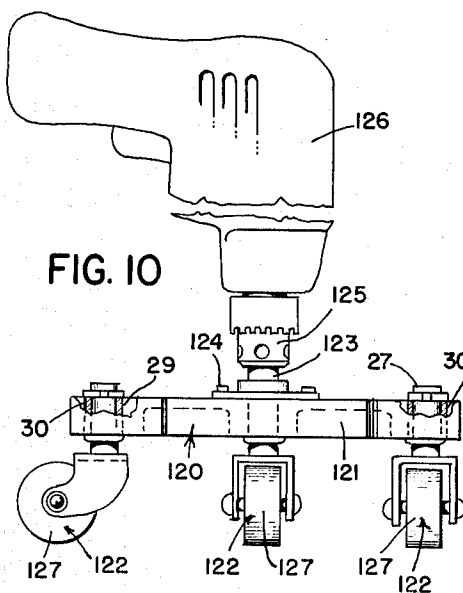


FIG. 3

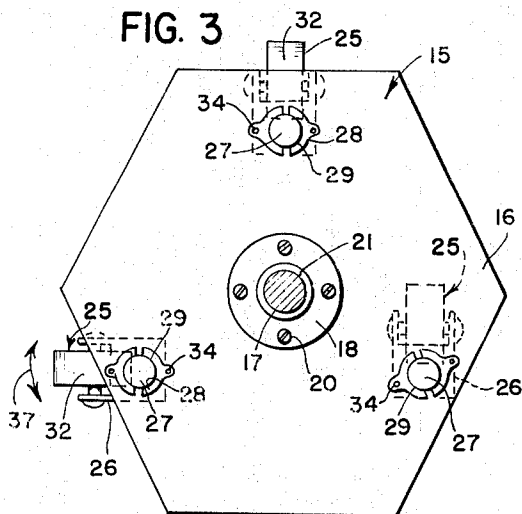


FIG. 5

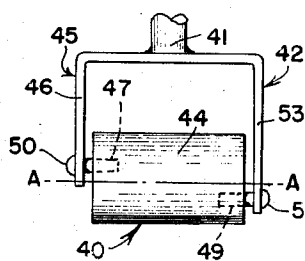


FIG. 7

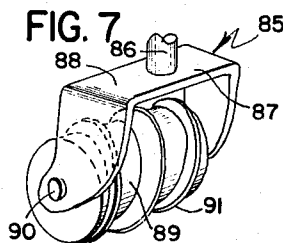


FIG. 6

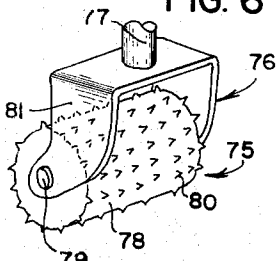
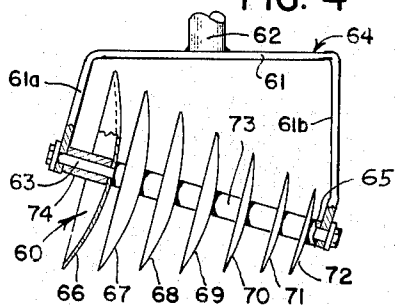


FIG. 4



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ROTATING ROLLER MACHINE

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3 Claims. (Cl. 94—50)

This invention relates to apparatus for applying compacting or severing pressure to a surface or a work area many times as the apparatus passes over said surface or work area only one time. More particularly, this invention relates to apparatus that is moved in a given direction generally parallel to a work area and drivingly rotates a plurality of tools about an axis parallel to the work area and freely permits rotation of said tools about an axis perpendicular to the work area to apply a compacting or a severing force to the work area.

In apparatus of the prior art for compacting or applying a pressure to a given surface, the surface is always worked over or approached from approximately the same direction as the apparatus makes a single pass over said surface. As a result, frequently the various portions of the surface are not compacted or worked over to the same degree. This leaves "soft spots" or areas that are not evenly worked. In order to overcome problems of the aforementioned nature this invention has been made.

An object of this invention is to provide a new and improved rotating roller machine for applying a compacting or severing pressure to the same area many times while working over the surface just once. It is still a further object of this invention to provide a new and improved rotating roller machine that may be used with different types of attachments in many different types of operations to apply to the surface a working action from many different directions (angles of approach) as the machine is passed over the surface only once.

It is still an additional object of this invention to provide a new and improved rotating roller machine that is readily usable in operations such as the construction of roads, dams, airports, and in the construction of buildings where pressure is needed for joining and fusing or otherwise packing the materials together, and in the upkeep of roads, for removing snow and ice, and in properly working the ground in various other types of activities.

It is still an additional object of this invention to provide a new and improved rotating roller machine that will cover a given area many times from varying directions and can be used for applying pressure anywhere from a few pounds to many hundred pounds per square inch to a given portion of the area.

Other and further objects are those inherent in the invention herein illustrated, described and claimed, and will be apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated with reference to the drawings in which corresponding numerals refer to the same parts, and, in which:

FIGURE 1 is a partial perspective view of a motor vehicle having the first embodiment of the new and improved rotating roller machine of this invention attached thereto;

FIGURE 2 is a side view of the embodiment of the rotating roller machine illustrated in FIGURE 1 with the subframe omitted;

FIGURE 3 is a plan view of the first embodiment of

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the rotating roller machine of this invention which has a plurality of horizontal roller attachments secured thereto, said view being taken along the line and looking in the direction of the arrows 3—3 of FIGURE 1;

5 FIGURE 4 is a front view of a second attachment usable on the rotating roller machine of this invention, said attachment including a plurality of different size disks for breaking up the ground;

10 FIGURE 5 is a front view of a third type of an attachment usable on the rotating roller machine of this invention, said attachment including a roller mounted on shafts vertically offset from one another;

15 FIGURE 6 is a perspective view of a fourth type of an attachment usable on the rotating roller machine of this invention, said attachment including a barbed type roller;

20 FIGURE 7 is a perspective view of a fifth type of an attachment usable on the rotating roller machine of this invention, said attachment including a spiral knife roller usable for cutting various types of material;

FIGURE 8 is a plan view of a second embodiment of the rotating roller machine of this invention;

25 FIGURE 9 is a cross sectional view of the second embodiment of the rotating roller machine of this invention, said view being taken along the line and looking in the direction of the arrows 9—9 of FIGURE 8 with the wheels of FIGURE 8 omitted to illustrate the mounting of the main frame on the drive mechanism for absorbing the shock between said frame and drive mechanism;

30 FIGURE 10 is a side view of a third embodiment of this invention.

Referring now to the drawings and in particular to FIGURE 1 there is illustrated a side perspective view of a motor grader 10 having a grader frame 11 on which front and back wheels 12 and 14 are mounted. Mounted beneath the grader frame intermediate the front and back wheels for movement side to side and up and down by conventional mechanically operated linkage mechanism, generally designated 22, is a subframe 13, it being understood that other conventionally operated linkages could be used (for example electrical or hydraulic).

The linkage mechanism 22 affording the primary control of pressure exerted on subframe 13 relative to the grader frame 11 of the motor grader includes a pair of upwardly extending links 201 that at their lower ends are respectively pivotally connected to opposite transverse side portions of the subframe 13 by joints 202. The upper end of each link 201 is pivotally connected to the outer end of the adjacent crank arm 203 by a joint 204. Each crank arm in turn is keyed to one end of a driven shaft 205, there a shaft 205 on either side of the longitudinal frame member 206 of motor grader frame 11. Each shaft is journaled to frame member 206 at said one end by a transversely extending bracket 207 and has an opposite end extending into a housing 208 mounted on the motor grader frame. Suitable gears (not shown) are provided in each housing for rotating the respective shaft, the gears being driven by power from the main grader engine via the respective clutch for controlling the drive to the shafts for selectively rotating them in the desired direction and retaining them in the desired angular position. Since the means for driving the shafts 205 and controlling the drive thereto is conventional it is not shown and will not be further described. Through the provision of the aforementioned linkages and means for selectively moving said linkages and the fact that the subframe has a tongue portion 13a that at its forward end is pivotally connected to the adjacent portion of the vehicle frame, the downward pressure exerted on the subframe can be varied by operating the respective clutches so that shafts 205 are drivingly rotated.

A motor 23 is fixedly secured on the subframe 13 and drivingly connected to the upper end of the drive shaft 17 of the rotating roller machine, generally designated 15, of this invention by conventional gear means 24 (said gear means being schematically illustrated). The drive shaft 17 is journaled for rotation in the subframe and mounted to apply a downwardly directed, controlled pressure of from a few pounds to many hundred pounds from the subframe to the remaining portion of the machine. The drive shaft includes a universal joint 19 intermediate the upper end 17a and the lower end 17b.

The rotating roller machine 15 includes the aforementioned drive shaft 17 and a roller main frame 16. Although the main frame as illustrated is hexagonal in shape, it is to be understood that it may be of any appropriate configuration. The main frame has a central aperture 21, there being an appropriate retainer ring 18 located over said central aperture and bolted to the main frame by a plurality of bolts 20. The lower end of the drive shaft 17b is fixedly secured to the retainer structure for driving the main frame and also applying pressure to the main frame when pressure is exerted by the mechanical linkage mechanism 22 on the subframe.

Three vertical apertures 29 are formed in the main frame to extend therethrough, the apertures 29 being located equal distances from the drive shaft 17 and equal distances from one another. A bearing 30 is secured in each of the apertures for rotatably mounting the vertical shaft 27 of a ground working attachment. The attachment illustrated in FIGURE 1 is a horizontal roller attachment and is generally designated 25.

The ground working attachment 25 includes a castor frame generally designated 26. The castor frame includes a vertical castor shaft 27 welded at its lower end to the web portion of the somewhat U-shaped castor bracket 31. The bracket 31 includes a leg 31b formed integral with either end of the web to extend in a downwardly and outwardly direction relative to the castor shaft. A roller 32 is rotatably mounted on the horizontal shaft 33, the ends of the horizontal shaft being retained in the lower ends of the legs 31b. It is to be noted that a vertical plane passed through the axis of rotation of the roller 32 is horizontally spaced from a vertical plane passed through the axis of rotation of the castor shaft and parallel to said horizontal shaft. The castor shaft is rotatably secured in depending relation to the main frame by the bearing 30 and retainer members 28, which are secured to the frame by appropriate means such as nuts and bolts 34.

The structure of the first embodiment of this invention and an earth working attachment usable therewith having been described, the operation thereof will now be set forth. The conventional moldboard mounting frame and moldboard are disattached from the motor grader and then roller machine 15 is mounted on the motor grader, the machine 15 being attached to the motor grader at 202 and 13a. Then after appropriate attachments such as attachments 25 have been secured to the main frame 16, the motor grader is driven over the surface to be worked, in, for example, the direction of the arrow 35. At the same time the linkage mechanism 22 are operated to apply pressure to the subframe which in turn exerts a downward pressure through the drive shaft 17 to the main frame 16. The amount of pressure applied to the main frame depends on the ground to be compacted and may be in the order of a few pounds to many hundred pounds. At the same time as the motor grader is being driven in the direction of the arrow 35, the motor 23 drives the gears, which in turn cause the drive shaft to rotate in the direction of the arrow 36, it being understood that in place of the motor 23, the drive shaft may be drivingly connected to the drive means of the motor grader by an appropriate type power take-off. The drive shaft in turn drives the main frame to rotate in the same direction as the arrow 36.

As the main frame rotates, the ground working attach-

ment 25 is free to rotate about a vertical axis in either direction of the double arrow 37 while at the same time the roller 32 is free to rotate about a horizontal axis in either direction of the double arrow 38. Since both the motor grader and the drive shaft are being driven, each roller 32 will have a complex path of motion that includes being rotated about the horizontal axis of the horizontal shaft 33, the vertical axis of the vertical shaft 27, the vertical axis of the drive shaft 17, and moved in forward direction as indicated by the arrow 35. The direction of rotation of the roller about the horizontal axis 33 and the vertical axis 27 will in large part depend upon the condition of the ground being compacted.

Even though the vehicle on which the rotating roller machine of this invention is mounted travels over a given area 39 only once, due to the provision of a plurality of ground working attachments and the complex path of motion of the attachments, the area is covered many times. Further, all three rollers will apply substantially the same amount of compacting pressure to the ground 39 over which the rollers travel since the universal joint 19 permits the main frame to tilt in any direction. Additionally, since the rollers are free to rotate about both the axis of the shafts 27 and the axis of the shafts 33, the area being compacted will be approached by the rollers from many different directions. The aforementioned factors result in the surface which is being worked being evenly compacted. As a result of the surface being "covered" a number of different times by the plurality of rollers secured to the rotary frame, a more uniform packing and a smoother surface will be obtained than by using, for example, conventional rollers that roll back and forth across the surface. That is, for example, if a conventional roller were of a given width and the center portion of the "width" of the surface being rolled included a softer center portion, the center portion would not be compacted to the same extent as the outer portions. However, with the structure of this invention the rollers contact a given surface at different times and approaching the same portion from different angles and thus compact the center portion to the same extent as the outer portion is compacted. Since the rollers can approach an area from substantially any direction and the same downward force is applied to each of the rollers, there will not be any soft spots left intermediate adjacent hard spots.

The structure and operation of the first embodiment of the rotating roller machine of this invention with the first type of work attachment 25 mounted thereon having been described, a second type of work attachment, generally designated 40, which may be used in place of the work attachment 25 will now be set forth (see FIGURE 5). The roller attachment 40 includes a castor type frame 45 made up of a somewhat U-shaped castor bracket 42, a vertical shaft 41 welded at its lower end to the web portion of said bracket and rotatably securable at its upper end in the main frame by retainers 28 and bearings 30, and a roller 44. The short horizontal shaft 47 is mounted at one axial end in the roller 44 offset from the central axis A—A of said roller and at the other end is rotatably retained in the lower end of the short leg 46 of the bracket 42 by an appropriate bearing member 50. A short horizontal shaft 49 at one end is mounted in the opposite axial end of the roller 44 parallel to, but on the opposite side of the axis A—A from the shaft 47. The opposite end of the shaft 49 is journaled for rotation in an appropriate bearing 51 which is mounted in the lower end of the long leg 53 of the bracket 42. Thus, the axis of rotation of the shafts 47, 49 are vertically offset from one another. Both shafts 47 and 49 fit very loosely in journal apertures in the frame legs 46 and 53. Although the amount of the offset of the shafts 47, 49 in FIGURE 3 is greatly exaggerated for purposes of illustration, it is to be understood that the amount of offset would depend on the amount of eccentricity that

is to be imparted to the ends of roller 44 as said roller is rotated about the axes of the shafts 47, 49. The axes of rotation of shafts 47, 49 are horizontally spaced from the axis of rotation of shaft 41 similar to that of the corresponding axes of work attachment 25.

The work attachment 40 is used with the rotating roller machine in the same manner as the work attachment 26 and therefore it will not be further described. The work attachment 40 is advantageously used when it is desired that the rotating roller machine be used to break up lumps as the ground is being packed.

In place of the types of attachments 25, 40 described heretofore, a third type work attachment generally designated 60 may be used (see FIGURE 4). The disk attachment 60 includes a castor type frame 64 made of a somewhat U-shaped mounting bracket 61 having a vertical shaft 62 secured to the web portion thereof. An inclined shaft 63 at its upper end is rotatably secured to the lower end of the short leg 61a and at its lower end rotatably secured to the lower end of the long leg 61b. A plurality of disks 66-72 inclusive of successively smaller diameters are mounted on said shaft and retained thereon and positioned by spacers 73, 74 and 65. Of course, it is to be understood that all of the disks 66-72 inclusive may be of the same diameter and the U-shaped bracket 61 accordingly modified, if desired. The inclined disk assembly 60 may be advantageously used to break or cut, as necessary, salvage bituminous materials, or for breaking ice, or for breaking or cutting vegetable materials.

In place of the types of work attachments described heretofore, there may be provided a fourth type of attachment, generally designated 75 (see FIGURE 6), that is usable with a rotating roller machine. The toothed roller attachment 75 includes castor frame 76 of the same construction as the castor frame 26, said frame 76 having a bracket 81 and a castor shaft 77 secured to the web of the bracket. A roller 78 having a plurality of spaced radially extending teeth 80 is rotatably mounted on the shaft 79. The shaft 79 at either end is attached to the lower end of the legs of the castor frame. The tooth roller attachment may be advantageously used to loosen and break up ice, rocks, etc. For example, in using the barbed type roller for breaking ice, not only does the weight of the roller tend to break the ice but also the barbs in contacting the ice tend to chip the ice and break it into small pieces. As a result, considerably less power is required to break the ice than if a conventional blade or a smooth type roller were used. A further advantage results since if any ice remains on a highway after the barbed type roller has been used, the barbs will leave "punctures" in the ice. Then after either calcium chloride salt or similar material is spread on the highway, a considerable amount will settle in the punctures rather than, for the most part, be thrown off the highway by the traffic passing thereof such as would occur if a smooth surface patch of ice remained such as is likely when a blade is used. It is to be understood that other shaped projecting portions may be used in place of cutters to obtain the improved results. Once the ice has been broken up, it can readily be blown off the highway or be otherwise disposed of as will become more apparent hereinafter.

A fifth type of work attachment usable on the rotating roller machine is a spiral knife roller attachment 85 (see FIGURE 7). The attachment 85 includes a castor frame 88 having a castor shaft 86 welded to the web portion of the castor mounting bracket 87, said castor frame being of the same construction as the castor frame 26. A roller 89 is rotatably mounted on the shaft 90 which at its either end is secured to the lower end of a leg of a mounting bracket. A spiral knife 91 is welded to the roller 89 to extend radially outwardly therefrom, it being understood that a series of knives may be placed spirally around the roller in place of the spiral knife 91. The spiral knife

roller attachment is advantageously used as a chopping device for cutting up brush or small trees.

A second embodiment of the rotating roller machine, generally designated 100, includes a main frame 101 having an enlarged central aperture 102 formed therein (see FIGURES 8 and 9). The central aperture along its axial length is concavely curved at 103. Vertical apertures of the same size and at similar locations as the vertical apertures in the main frame 16 are formed in the main frame 101 to have the castor shafts of appropriate work attachments mounted therein.

The rotating roller machine 100 includes a drive shaft 106 of the same construction as the drive shaft 16. A retainer ring 107 is welded to the lower end of the drive shaft, said retainer ring in turn being bolted to a rim 108 by bolts 109. The rim is of a substantially smaller diameter than the minimum diameter of the central aperture 102. An inflatable tire 110 is mounted on the rim to bear against the peripheral wall of the main frame forming the central aperture, the central aperture being properly contoured at 103 for mounting said tire.

In order to mount the tire in the central aperture 102, the tire would, under normal circumstances, be deflated and inserted adjacent the curved portion 103. Next the tire is inflated to the "proper" pressure. The proper pressure would in part depend upon the size of the machine, the work to be done, and the "shock" resulting from the machine moving under rough terrain. Thus, if a substantial amount of shock, under normal circumstances, would be transferred to the subframe through the drive shaft, the tire would be inflated to a relatively small pressure, and as a result would absorb a great deal of the shock. However, if only a minimum amount of shock were to be encountered from the work attachment going over a surface, then the tire may be inflated to greater pressure. Similarly, if a good deal of torque is required for rotating the main frame, the tire would be inflated to a greater pressure than would otherwise be necessary. By using the tire 110, the main frame may be driven from a vertically extending shaft 106, while at the same time a controlled amount of "tiltable" play in the frame relative to the surface is permitted. By using the tire for mounting the main frame on the drive shaft, it is frequently possible to do away with providing a universal joint since a sufficient amount of "play" of the frame is obtained. Any one of the work attachments described heretofore, may be mounted on the main frame 101, or other appropriate types of tools or attachments may be used with the main frame.

Although the various embodiments of this invention have been described with respect to being mounted on a motor grader, it is to be understood that the embodiments may be mounted on the front or in back of a tractor, or on the front or back of a truck by providing an appropriate frame. However, by mounting the rotating roller machine on a motor grader, the machine may be shifted from side to side and the pressure applied to the machine may be readily controlled from a few pounds to many hundreds of pounds per square inch. Further, by mounting the rotating roller machine on a motor grader, it can be used very close to a building or a concrete curve.

When the various appropriate attachments of this invention are used for ice removal, the ice can be broken up into small pieces and can be blown off or picked up and loaded into the truck. This is in contrast to prior art devices wherein commonly a blade is used for scraping the ice off the pavement. In such cases, the removing force exerted on the ice is generally parallel to the road and thus is not very effective in removing thin layers of ice and leaves smooth patches of ice.

It is to be understood that the rotating roller machine such as illustrated in FIGURE 2 may be constructed on a smaller scale and advantageously be used in rolling newly sodded areas. Also, a rotating roller machine may

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be constructed on an even smaller scale such as illustrated in FIGURE 10 and generally designated 120.

The third embodiment of rotating roller machine 120 includes a main frame 121 and roller attachments 122 that may be of the same configuration as the main frame 16 and attachments 25, except as to size. A drive shaft 123 is bolted to the main frame at 124, the upper end of the drive shaft being constructed to be mounted in the chuck 125 of a hand power drill 126. By properly weighting the machine and/or drill, the machine 120 can be used in industrial and home buildings where linoleum or tile is to be laid. The roller 127 of the attachment would apply pressure to the tile or linoleum to cause said tile or linoleum to properly adhere to the surface on which it is being laid. Also, the machine 120 can be used to obtain "complete area adhering" of wall coverings of all types to the supporting surface. The rotating roller equipment provides proper rotating action which covers all the area quickly and produces the desired result.

From the foregoing it is apparent that by using a main frame of the proper size and appropriate attachments attached to the main frame, the various embodiments of the rotating roller machine of this invention may be used for compacting earth, breaking up bituminous materials for salvage, loosening and breaking up ice, soil, rocks, compacted snow etc., for aerating and mulching filled materials and "rolling" table tops or wall surfaces that have been covered with, for example, Formica, tile, or any one of various other materials.

As many widely apparently different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments herein.

What I claim is:

1. Apparatus for compacting or applying pressure to a worked area comprising a motor grader having a motor grader frame, a subframe and linkage means connecting said subframe to the motor grader for moving said subframe relative to the motor grader frame, and a rotating roller machine mounted on said motor grader, said rotating roller machine including a roller main frame, drive shaft means for connecting said roller main frame to the subframe for rotation about a generally vertical axis, said drive shaft means including a drive shaft mounted for rotation on the subframe, said drive shaft having a universal joint therein between the subframe and the roller main frame, and means for driving said drive shaft, and at least one castor attachment having a castor frame pivotally connected to the roller main

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frame to depend therefrom and having a generally vertical castor axis spaced a substantial distance from the rotary connection means of the roller main frame to the subframe, said castor frame having generally horizontal roller axis spaced from the castor axis and a revolving ground engaging implement mounted for rotation on the roller axis.

2. The apparatus of claim 1 further characterized in that there is provided means for operating said linkage means to apply a pressure in the range of a few pounds to many hundreds of pounds to said subframe to thereby apply said pressure to the roller main frame.

3. A rotating roller machine comprising a generally horizontal roller frame having large central apertures formed therein, a drive shaft, means for securing the drive shaft to the central portion of the roller main frame to extend upwardly therefrom, said securing means including a rim attached to the drive shaft and an inflatable tire mounted on the rim so as to be driven thereby, said central aperture being contoured to tightly receive the periphery of said tire in an inflated condition, a plurality of vertical shafts rotatably secured to said roller main frame to depend therefrom and located equal radial distances from the central axis of said drive shaft and at equal angular increments around the drive shafts axis, a mounting bracket secured to the lower end of each of the drive shafts to depend therefrom and means rotatably secured to the mounting bracket to have a horizontal axis of rotation for applying pressure to the surface being worked, said horizontal axis being spaced from the axis of the vertical shafts.

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