Our invention relates to ice breaking devices or rotary scarifying means and has particular relation to a device adapted to be attached to a supporting or actuating structure such as a grader, motor patrol or the like for the purpose of breaking up sheet ice formed on highways or for scarifying earth, gravel and the like.

It is the usual practice in removing snow or ice from the highways to employ scraper blades or plow blades attached to a motorized means. In devices of this character the material moved is picked up and pushed ahead of the blade and rolled over and over until discharged from one end of the said blade.

Such devices are satisfactory in the removal of earth or snow which are not of a very cohesive structure. However, the problem of removing sheet ice is of a totally different nature. The ordinary scraper blade prevents a relatively large area of contact and the sheet ice, having relatively strong cohesive properties resists such action to such an extent that the use of such a blade is of no avail in removing sheet ice from a highway.

The reactive force of an ice sheet is practically vertical to a scraper blade along its entire extent of surface in contact with the ice and a blade of this nature is adapted to be moved only in one plane of direction. Obviously, the power required to break up the ice ahead of such a blade would be too great to enable the provision of a workable structure.

We have observed these difficulties and have decided that their solution resides in providing a device the design of which is based on the relative brittleness of ice. Such a device is preferably formed in such a manner as to have a relatively large number of contact points of small area so as to render entry of each point of contact into the ice comparatively easy. Furthermore, the breaking action is expedited if a scooping action of the contact points occurs during one stage of operation. The action described results in the breaking up and casting aside of sheet ice in relatively small pieces that may easily be removed or shoved aside. The power required for actuating such a device is no more than that necessary in operating the usual grader.

We have also observed that it apparently is economically disadvantageous to provide such a device as a unit adapted merely for the one purpose of ice removal. Such a structure would require a high initial cost with the possibility that it could be used only a few times during the year. However, such a device, capable of the action as described in the foregoing paragraphs,

would be equally as expeditious in scarifying road surfaces for treatment and would be especially useful if adapted for use with the usual grader, motor patrol or the like.

It is accordingly an object of our invention to provide a simple, inexpensive, and improved ice breaking means.

Another object of our invention is to provide a means for either breaking up sheet ice formed on highways or for scarifying road surfaces or the like.

Another object of our invention is to provide a device for removing ice that will provide a splitting action and a scooping action for breaking off and thrusting aside sections of sheet ice for removal.

Another object of our invention is to provide an ice breaking or scarifying means that requires no more power in operation than that furnished in the usual grader or motor patrol unit.

Another object of our invention is to provide, in connection with an ice breaking and scarifying device, power means for raising and lowering such devices.

According to one embodiment of our invention we provide a series of extending toothlike members mounted in spaced peripheral relationship about a shaft and extending on a chordal axis as referred to the center axis of the shaft.

The novel features that we consider characteristic of our invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Figure 1 is a view in perspective of a grader having mounted thereon an embodiment of a device constructed in accordance with the principles of our invention.

Figure 2 is a fragmentary view in perspective showing the embodiment of our invention illustrated in Figure 1.

Figure 3 is a view in side elevation showing the action of the toothed members on a surface such as ice or the like when a device constructed in accordance with the principles of our invention is in operation.
Figure 4 is a view in perspective showing a method of mounting toothed members according to another embodiment of our invention.

Figure 5 is a view in section illustrating the method of securing the teeth according to an embodiment of our invention shown in Figure 4.

Figure 6 is a view partly in section and partly in elevation of another embodiment of our invention.

Figure 7 is a fragmentary view in perspective of the embodiment of our invention shown in Figure 6.

Figure 8 is a view partly in elevation and partly in section showing still another embodiment of our invention.

Figure 9 is a fragmentary view in perspective showing an assembly of elements such as that shown in Figure 8.

Figure 10 is a fragmentary view in perspective of the supporting structure and an assembly of scarring members constructed according to another embodiment of our invention.

Figure 11 is a view in side elevation of a scarring element comprising tooth members and a retaining member such as those shown in Figure 10.

Figure 12 is a fragmentary view in perspective showing, in exploded relation, a scarring element such as shown in Figure 11 and spacer members, plates and the shaft of the assembly shown in Figure 10.

Figure 13 is a view in perspective of a tooth constructed according to a modified form of my invention.

Figure 14 is a view in end elevation of the tooth shown in Figure 13 as it appears when incorporated in the structure shown in Figures 10, 11 and 12.

Figure 15 is a view in end elevation of a yoke supporting means and scarring means as it appears when mounted on a motor patrol or the like in front of the scaper blade.

Figure 16 is a view in perspective showing a modified form of attaching means.

Figure 17 is a view in end elevation illustrating further the structure shown in Figure 16.

Figure 18 is a fragmentary view illustrating a modified form of attaching means.

Figure 19 is a view in perspective of still another means for attaching the scarring device to a road patrol or the like, and

Figure 20 is a view in end elevation of the device shown in Figure 19.

Referring to the drawings and more particularly to Figure 1 the usual grader motor patron 10 includes a main frame or supporting structure 11 and a cab structure 12. The framework 11 is supported at its front end by tandem wheels 13 and 14, and at the rear by means of drive wheels 16 and 17.

The cab 12 is mounted over the rear drive wheels 16 and 17 and the motor 18, for actuating the drive wheels, extends forwardly of the cab and is supported in the framework 11.

In the structure shown in Figure 1 a frame 19 is engaged with the framework 11, and is adapted to be moved up or down with the framework 11 by means of members indicated generally at 25.

The framework 19 is in turn adapted to engage and support a circle or bull ring 27 which is suspended beneath the framework 19 by supporting members which permit the circle to rotate.

The circle or bull ring 27 in turn serves as a support for a mold board or for a similar structure such as a discing device such as shown in Patent No. 1,906,076, issued to P. M. Hargrave, April 2, 1935. This is later yoke structure is that preferably employed for mounting our device. In such a case the disc members are removed and a structure embodying the principles of our invention is substituted in the remaining yoke structure.

The structure here shown employed for mounting our drive includes a horizontally disposed yoke member 28, having forwardly extending hangers 29 and 31 secured thereto. The hangers 29 and 31 are formed with an enlarged cylindrical portion 32 adapted to house bearings in which a square shaft 30 (Figures 6 and 7) is journaled.

In the embodiment of our invention shown in Figures 1 and 2, we preferably mount a cylindrical member 36 on the square shaft 30 (Figures 6 and 7) described in connection with the supporting structure. We preferably secure engage tooth members 37 about the periphery of the cylinder and these are arranged in any preferred number of spiraled rows and of any desired spacing. The teeth 37 are preferably formed of hardened steel adapted to resist shock, and comprise a pick element 38 and a curved base 39. The toothed members 37 may be secured to the cylinder 36 by any suitable means such as bolts or rivet members 41 extending through the base portion 39 into the cylindrical member. The teeth 37 are preferably arranged in staggered relationship and are formed so that they extend outwardly from the periphery of the cylinder 36 on an axis coincident with an extended chord of the cylinder 36.

We preferably employ this construction rather than having the teeth 37 extending radially for the following reason: The action desired for the best results may be best described as occurring in two stages. That is, the tooth member first will make contact with the ice sheet on a vertical plane as shown at 42 in Figure 3 to perform a splitting or picking action. Upon continued operation induced by forward movement of the actuating structure and rotation of the cylinder 36, a scooping action by tooth 37 follows and the ice split in the first action of the tooth is kicked rearwardly and to one side on the follow through in the second stage of action as shown in dotted lines at 43.

It may readily be understood that our arrangement of the teeth in spiral rows about the cylinder will cause the cylinder to rotate as the conveying vehicle progresses forwardly and will necessitate a much smaller expenditure of power than if the teeth were arranged in a straight line across the cylinder on a line parallel with the axis of the cylinder 36.

It may be understood that we may provide any desired spacing of the teeth in any desired number or rows about the face of cylinder 36. It is also evident that our device may be equally well employed for scarring graveled road surfaces or the like.

In another embodiment of our invention shown in Figures 4 and 5 we may employ a different arrangement for mounting the tooth members. In this embodiment we preferably employ the channel members 44 to the cylinder 36 by welding or any other desired means. Teeth 46 are provided having extending pick portions 47 and square base portions 48. The portions 48 are adapted to be received in close cooperative relation within the channel members 44. The teeth 46 are secured
within the channel members 44 by any suitable means such as bolts 45. The cylinder 36 has end plates 50 and 55 therein and these plates slidingly receive the square shaft 30.

5 It may readily be understood that such construction will expedite the replacement of teeth that become worn or broken in service. The same principles are followed in mounting the teeth as to location and spacing as pointed out in connection with the embodiment shown in Figures 1 to 3.

In Figures 6 and 7 is illustrated still another embodiment of our invention. In this construction here shown we employ an octagonal member 51. In this case the rows of teeth may be arranged spirally about the member 51 as shown in Figure 7 and before described in connection with the other embodiments. The teeth 52 are secured by any suitable means such as bolts 53 with one portion 54 of each tooth in close co-operative engagement with the face of the hexagonal form 51. This provides an extremely simple form of mounting the teeth and also permits the employment of a simple form of tooth members.

In Figures 8 and 9 there is shown still another embodiment of our invention. In this embodiment we preferably employ integrally cast disc-shaped members 61 formed with octagonal openings 62 therethrough. The disc members 61 are formed with offset portions 63 and 64 which have holes 65 cored therein. Teeth 67 are formed with shoulder portions 68 adapted to be received in close co-operative engagement in holes 66. Any suitable securing means such as bolts 70 are used to engage the teeth 67 with the holes 66.

In the embodiment here shown we have indicated disc members adapted to receive two teeth but it is obvious that the members 61 may be so formed as to provide for the mounting of any desired number of teeth consistent with the dimensions of the disc.

It is evident that the disc members 61 may be arranged with square roots 30 in any desired position such as that shown in Figure 9. The octagonal opening in the disc 61 is so dimensioned that the diagonal distance across two corners is substantially the same as the dimension of a side of the squared shaft 30 on which the disc is mounted. Thus the position of the disc and in turn the teeth may be arranged in any desired form by rotating the disc on the shaft 30. Spacing along the shaft may be regulated by the thickness of the disc members 61 or by spacer members 71 and 72 shown in Figures 11 and 12 in connection with another embodiment of our invention.

In Figures 10, 11 and 12, we show another preferred embodiment of our invention, now more particularly described. In Figure 10 there is shown a fragmentary view of the grader and supporting structure somewhat similar to that shown in Figure 2.

However, in this case, the structure used for supporting the device with which our invention is concerned is better shown and described in the pending application 112 201 of Fred H. Hargrave. In this case, a yoke member 73, in which a square shaft 74 (Figure 12) is provided, is secured for adjustable movement to a mold board 75, which is in turn movably secured to the bull ring 77.

An embodiment of our invention here shown, we preferably employ hexagonal members 76 adapted for use as a retaining means for teeth 77 to form a scarifying assembly 80, indicated in Figure 11. The members 76 have substantially rectangular recesses 78 formed therein on both faces 79 and 81. The recesses 78 are formed with an extending lug portion 82, which is adapted to fit in to a notch 83 in the tooth member 77. The teeth 77 are adapted to be closely received within the recessed portions 78 and are retained and restrained from movement in one plane by the engagement of the portion 82 of the member 76 and the notch 83 in the teeth 77. The member 76 may have an octagonal or other poly-sided opening at 84 in order that it may be received on the shaft 74 in a plurality of positions.

In the completed assembly as shown in Figure 10 the spacing members 71 and 72 serve to retain the teeth 77 in the member 76. The members 71 and 72 also act as spacing members to provide for the proper relation of the scarifying assemblies 80 on the shaft 74.

In order to facilitate the replacement of teeth that may become broken without disassembly of the entire tooth holding structure, and in order to strengthen the teeth at the point where the greatest strain occurs we may employ two-part teeth such as illustrated in Figures 13 and 14. These teeth are comprised of a bit or tooth 91 and a shank 92 on which the bit 91 is removably engaged. The shank is engaged in the retainer 76 in the same manner as before but grooves 93 are provided in the side walls of the shank 92 to receive tongues 94. The base of the tooth 91 being hollowed out as indicated at 95. The teeth 91 are flared at the tom as indicated at 97 and 98 to furnish a broad base to bear against the face of the retainer 76. The teeth may be locked in place by bolts 99.

The grooves 93 are preferably inclined slightly with regard to the faces of the retainer 76 so that when the teeth 91 are placed on the shank they may be driven thereon to form a wedge fit and the action of the teeth in scarifying tends to drive them on the shank and against the retainer 76 to lock them in place. The pins 99 serve to hold the teeth on the shank when backing up with the scarifier.

In the structure shown in Figure 15 the yoke member 73 is pivotally engaged to the scraper blade 75 by means of a pivotum connection 103 located near the top of the blade 75, which connects the bracket 103 on the yoke and blade engaging bracket 104 on the scraper blade. In order to provide power means for raising and lowering the scarifying device we may provide a hydraulic jack indicated at 106, the cylinder of which is pivotally engaged to a bracket 107 on the front of the scraper blade and the ram of which is engaged to a flange 108 on the yoke member 73 as indicated at 109. Fluid for operating the jack is driven into or removed from the cylinder 108 by means of conduits 111 and 112.

In Figures 17 and 18 we have illustrated a means by which our scarifying device may be engaged on the bull ring or circle of a motor. In this device the yoke 73 is pivotally engaged to angle iron 113 which is pre-engaged in turn to a depending ring structure 114 which is secured to the circle 27 of the motor. Brackets 116 are provided on the rear of the scraper blade 75 and these brackets are adapted to pivotally receive the cylinder 117 of hydraulic jacks. The rams 118 of the jacks are pivotally engaged to the flanges 108 of yoke 73 and the jacks may be actuated by means of a control 75.
mechanism and hydraulic pump (not shown) to raise and lower this scarifying device.

In the modification shown in Figure 18 the hydraulic jacks 117 are received in links 112 which are engaged directly to the horns 122 which form parts of the circle 127 and in this way the scarifying device need not be fastened to the scraper blade in any manner.

In Figure 19 we have illustrated a means for attaching the scarifying device directly to the circle 27. This is accomplished by pivotally engaging the yoke 73 to depending brackets 124 which are in turn engaged to the circle 27. The hydraulic jacks 125 are pivotally received on brackets 127 and the rams 128 of the hydraulic jacks are pivotally engaged to the flanges 108 of yoke 73. The scarifying device may be thus raised and lowered by introducing fluid into the jacks by means of the conduits 129 and 131.

It is apparent that we have provided a simple, inexpensive, and practical means for removing sheet ice or for scarifying road surfaces or the like and that the device may be readily attached to mold boards or supporting frames of road patrols and like structures as desired.

Although we have shown and described certain specific embodiments of our invention we are fully aware that many modifications thereof are possible. Our invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and the spirit of the appended claims.

We claim our invention:

1. In a scarifying device, a retaining member, a shank engaged by the retaining member, a tooth, and means for engaging the tooth on the shank comprising interfitting grooves and flanges on the respective members, the flanges and grooves being at an angle with regard to the base of the retaining members to thereby cause a wedging action of the tooth on the shank.

2. In a scarifying device, a supporting member, a yoke, a shaft rotatably mounted therein, a plurality of retainers mounted thereon for rotation therewith, said retainers being in the form of thick disk-like plates, a plurality of recesses in the sides of the plates, sharpened teeth having the butt ends thereof received in the recesses, a notch in the butt end of each tooth, a lug formed in each recess to be received in each notch, said lug adapted to prevent the teeth from lengthwise movement in the recesses, and spacing plates between adjacent retainers adapted to prevent lateral displacement of the teeth.

3. In a scarifying device, a shaft, a plurality of disc-like plates mounted on the shaft, the discs having tangentially arranged recesses in at least one side face of each disc, teeth having the butt ends thereof received in the recesses, retaining means for holding the teeth in the recess against tangential or radial displacement, means for preventing transverse displacement of the butt ends of the teeth comprising spacing plates, and means for locking the spacing plates and discs on the shaft whereby the teeth are held against lateral or radial displacement.

4. In a scarifying device, a supporting member, a shaft rotatably mounted on the supporting member, a plurality of disc-like retaining plates mounted on the shaft for rotation therewith, the retaining plates having recesses in at least one side face thereof, teeth having the butt thereof received in the recesses, means including notches and lugs for preventing radial and tangential displacement of the teeth, means for preventing lateral displacement of the teeth comprising spacing plates also on the shaft, and means for locking the spacer plates against the faces of the retainers to hold the teeth to prevent lateral displacement thereof.

5. In a scarifying device, a shaft, a tooth shank retaining member on the shaft, a tooth shank received in the retaining member, a tooth adapted to fit over the end of the shank, and means for securing the tooth on the shank comprising interfitting grooves and flanges on the respective members with the end face of one of the members at a different angle than the interfitting grooves and flanges, to thereby cause a wedging action of the tooth on the shank when the tooth is used in scarifying.

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