Aug. 2, 1960 A. R. GRAFF ET AL 2,947,187

APPARATUS FOR THE ROTATION OF DRUMS

Filed March 15, 1957 3 Sheets-Sheet 1

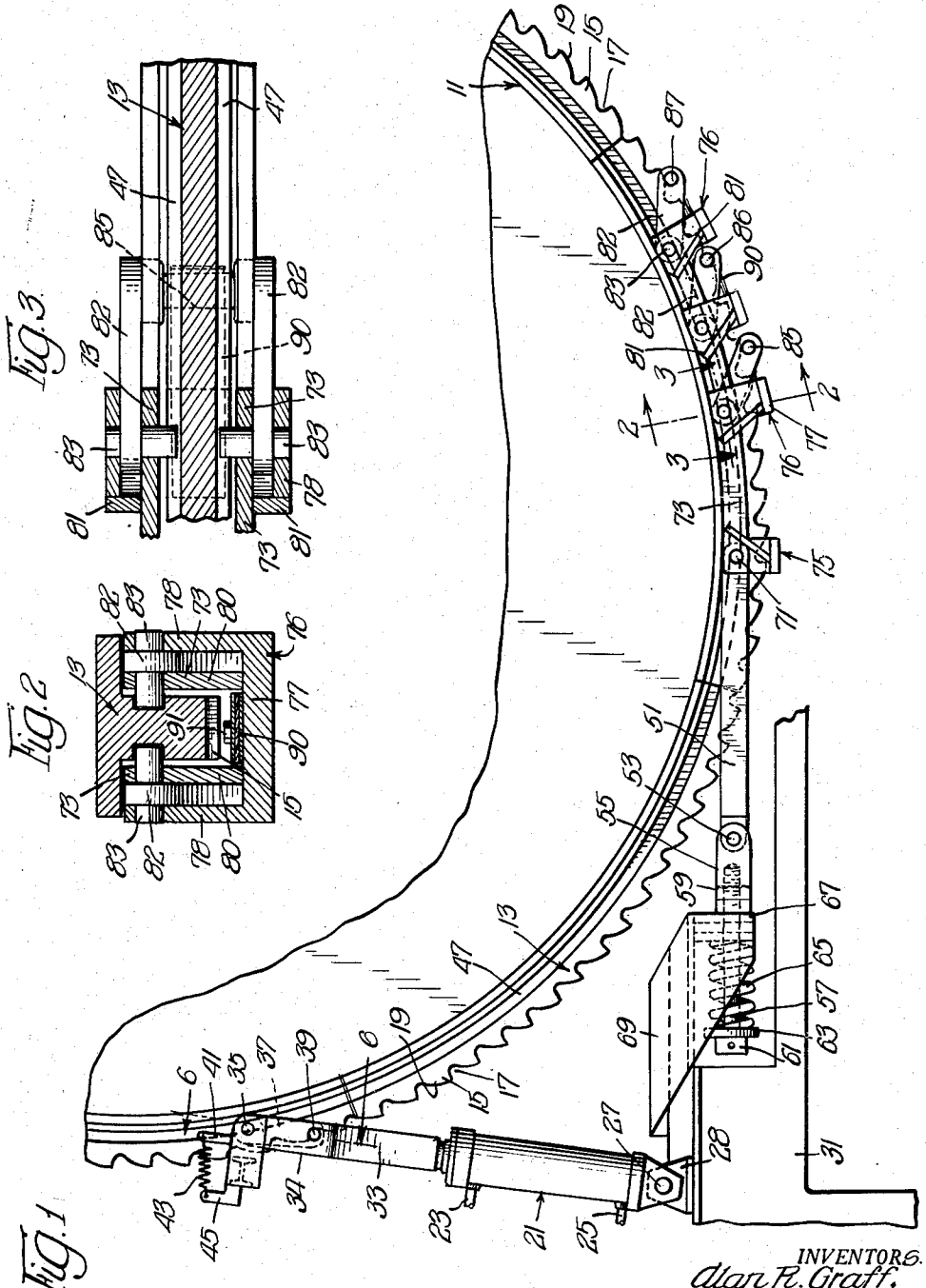

Fig. 1

Fig. 3

Fig. 2

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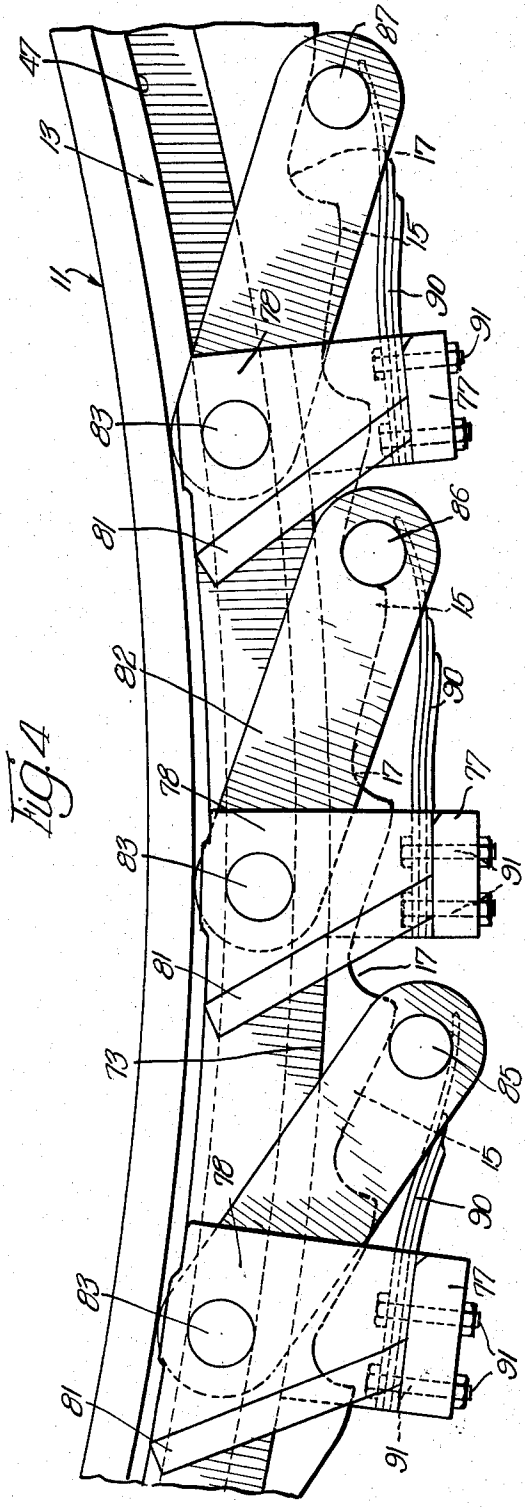

Fig. 4

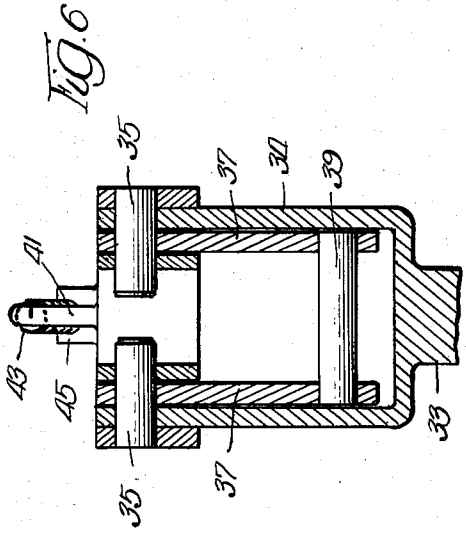

Fig. 6

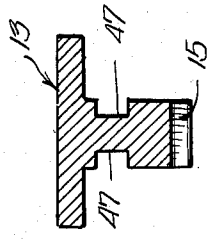

Fig. 5

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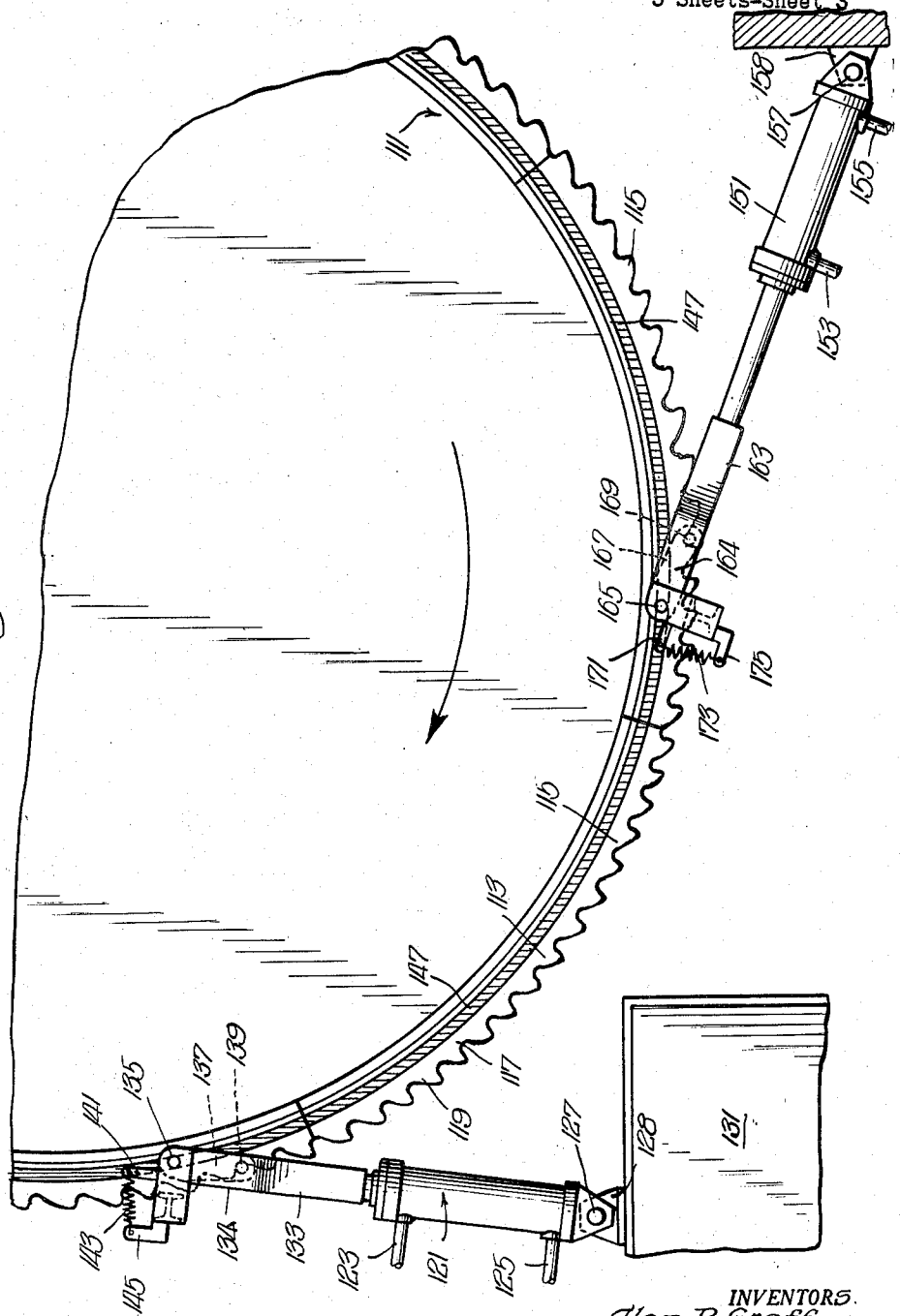
Fig. 7



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APPARATUS FOR THE ROTATION OF DRUMS

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The present invention relates to a new and improved apparatus for the rotation of drums or kilns.

In a number of industries heating, drying and other processes such as malting of grain are carried out in large horizontal or inclined drums. These operations normally require that the drum be rotated, usually at comparatively slow speed. The drums themselves are large and heavy and they may contain loads of heavy material. As the drum is rotated the contents present an unbalanced load, piling up on the rising side of the drum and sliding back toward the low side. This movement may not be continuous and may impart severe shocks to the drum rotating mechanism. Worm and gear drives have been used and also chain drives, but they have been difficult to maintain when handling the larger and heavier rotating drums. The present invention is especially adapted for use with such heavy drums carrying large loads of wet or damp malting grain, but it may be advantageously used with any type of rotating drum.

The present invention comprises a ratchet step by step drive which is hydraulically operated. The drive is positively connected to the drum and means are provided for cushioning and limiting slip-back of the drum.

It is an object of the present invention to provide a new and improved drive for rotating drums or the like.

It is a further object to provide a construction of this character designed to handle heavy unbalanced loads.

It is an additional object to provide such a drive including hydraulic operating means and spring cushioned holding means.

It is also an object to provide a construction in which the ratchet and holding means have a permanent connection to the drum to be rotated, the connection permitting the drum to rotate relative to the operating and holding means.

It is another object to provide a construction including holding means having a plurality of spaced holding elements so as to closely limit slip-back when the operating thrust is released.

An additional object is to provide a power actuated piston yoke to which is pivotally connected a thrust bar for contact with the teeth of the rack for effecting intermittent rotation of the drum, and wherein the pivoted thrust bar has pulling action on the rack teeth, the said action together with the pivot pins helping to maintain the structure in associated relation with the rack and to maintain the thrust bar in contact with the teeth of the rack.

It is a further object to provide apparatus which is simple in design and construction and adapted for commercial production and use.

Another object of the invention resides in the provision of separate and independent power cylinders for rotating drums and the like and which are operated in an alternate manner and so arranged with respect to the peripheral rack on the drum as to impart continuous rotation to the drum in the same direction.

Other and further objects will appear as the description proceeds.

We have shown a preferred embodiment of our invention in the accompanying drawings, in which

Figure 1 is a fragmentary side elevation showing the apparatus applied to a drum;

Figure 2 is a fragmentary section taken on line 2—2 of Figure 1;

Figure 3 is a fragmentary section taken on line 3—3 of Figure 1;

Figure 4 is a fragmentary view of the spaced holding means for limiting slip-back of the drum and which has been enlarged to better illustrate constructional details;

Figure 5 is a sectional view of the rack;

Figure 6 is a sectional view taken along line 6—6 of Figure 1 and showing the pivoted levers and thrust bar construction; and

Figure 7 is a fragmentary side elevation showing a modification of the invention which employs two power cylinders for continuously rotating the drum.

In the drawing, a portion of a drum has been shown at 11 with a circular rack 13 permanently and rigidly secured to its outer circumference. This rack as shown is made up of sections which may be riveted to the drum, or otherwise secured thereto. The drum is mechanically rotated in a clock-wise direction, and the teeth 15 of the rack have steep faces 17 against which the operating mechanism thrusts. The teeth have sloping faces 19 over which the mechanism rides during the reverse movement of the mechanism.

The thrust mechanism comprises an hydraulic cylinder 21, which, as shown, is double acting, fluid inlet and outlet pipes 23 and 25 being connected to its opposite ends. The cylinder 21 is pivotally supported by a pin 27 bearing in a bracket 28 secured to the floor or other supporting structure 31. The piston in the cylinder 21 serves to move a yoke 33, the arms 34 of which are spaced sufficiently so that they extend on opposite sides of the rack 13. The arms of yoke 33, as seen in Figures 1 and 6, carry pivot pins 35 on which are pivoted the levers 37. The thrust bar 39 is carried between the levers 37, this bar being adapted to thrust against the abrupt faces 17 of the rack teeth 15. The levers 37 are connected by an oppositely extending arm 41 and which is joined by a tension spring 43 to a bracket 45 carried by the yoke 33. It will be apparent that the tension spring 43 by pulling against arm 41 urges the thrust bar 39 against the rack 13. The rack 13 is provided on each side with a circumferentially extending groove 47 and the pins 35 extend into the grooves respectively to retain the yoke and its assembled parts permanently in proper relation to the rack.

The holding mechanism is shown in the lower portion of Figure 1 and in the enlarged fragmentary view of Figure 4. A pull bar 51 is pivotally connected at 53 to a yoke 55. The spring pull rod 57 passes through the cross portion of yoke 55 and is held in adjusted position by nut 59. The head 61 of rod 57 carries a thrust washer 63 which bears against one end of a compression spring 65. This spring 65 surrounds the rod 57 and its opposite end bears against a depending portion 67 of a bracket 69 which is permanently and fixedly secured to the base structure.

The pull bar 51 is pivotally connected by pins 71 to the arcuate bars 73 which carry the hold-back mechanism. The yoke 75 is actuated a welded-in cross member for the arcuate bars 73. The pins 71 extend into the circumferential grooves 47 and the said cross members are thus maintained in proper relation on the rack. Additional yokes 76, substantially identical in construction to yoke 75, are provided as supporting means for the hold-back mechanism and which maintain the holding means of said mechanism in proper relation with the teeth of the rack. Each yoke is a built-up structure es-

sentially including a transverse bottom member 77, a pair of spaced exterior and interior side walls 78 and 80, respectively, suitably welded to the bottom member and wherein the interior walls are in turn welded to the arcuate bars 73. Each pair of spaced exterior and interior walls is closed at the left end of the end wall member 81. Each of the yokes 76 has associated therewith a pair of links 82 having location between the respective exterior and interior side walls 78 and 80 of the yoke and said links are pivotally connected to its yoke and to the arcuate bars 73 by the pivot pins 83 which additionally extend into the grooves 47 formed in the rack member, as best shown in Figures 2 and 3. Hold-back cross bars join the links and for individual designation the cross bars for the three yokes carry the numerals 85, 86 and 87. Each yoke also carries a flat spring 90 suitably fixed to the bottom member 77 of its respective yoke by the screws 91 and at its free end the spring has resilient contact with the cross bar either 85, 86 or 87 of its yoke. It will be apparent therefore that the springs 90 serve to resiliently urge the hold-back cross bars into engagement with the teeth 15 of the rack 13. The spacing of the three cross bars is such that the drum and rack can never move in the counter-clockwise direction more than one-third of the space between adjacent teeth.

In the operation of the apparatus, the hydraulic cylinder 21 has fluid under pressure applied to its lower end through pipe 25, the piston and piston rod thus forcing the yoke 33 upwardly. The thrust bar 39 thrusts against the adjacent face 17 of a tooth 15 to move the whole drum in the clockwise direction a distance determined by the length of movement of the piston in cylinder 21. During this rotation of the drum, the cross bars 85, 86 and 87 ride over the teeth 15, being held against the teeth by the springs 90 and snapping down against the steep face 17 of each tooth as the cross bar passes over it. After the movement has been completed by the completion of the thrust stroke from cylinder 21, the piston is retracted by releasing fluid through pipe 25. If a double-acting cylinder is used, fluid will be forced in through pipe 23.

As soon as the pin 39 moves away from the tooth 15 against which it has thrust, there will be a tendency for the drum to rotate in the counter clockwise direction. This is due to the fact that any loose contents of the drum will tend to be carried up to the left side as seen in Figure 1, by the rotation of the drum and this side will therefore be heavier. This counter rotation of the drum is stopped quickly, however, by one of the hold-back cross bars, either 85, 86 or 87, whichever is closest to the steep face 17 of a tooth. The jar or shock of this stopping will be cushioned by the spring 65 and due to the spacing of the cross bars the travel can only be for a short distance.

Cushioning of this backward movement can also be accomplished or assisted by providing a restricted flow for the hydraulic fluid leaving the under side of the piston in cylinder 21 when the yoke 33 is being retracted for another stroke. This restriction in flow need only be effective for a retraction distance of less than one tooth, in view of the spacing of the hold-back cross bars 85, 86 and 87.

The pivoted levers 37 and the thrust bar 39 constitute a structural combination which is of considerable importance to the invention and which materially adds to its successful operation. If the pivoted levers and thrust bar were not employed, then a relatively heavy spring would have to be applied to the upper end of the cylinder 21 to hold the piston yoke 33 in contact with the teeth of the rack. Such structure would be unsatisfactory in operation since a heavy spring would produce bending stresses in the piston yoke. Also the mass of these parts would be such as to prevent rapid movement. The levers 37 and thrust bar 39 are relatively light in weight and so they move rapidly, which is desirable for riding over and latching with the teeth of the rack. Further, the size of the spring that is required is materially reduced as a small light spring will hold the thrust bar in operative relation with the teeth and in addition the pivot pins 35 for the levers serve a dual function as they ride in the grooves 47 and so maintain the piston yoke in proper associated relation with the rack.

In the modification of Figure 7 the drum 111 is provided with a circular rack 113 permanently and rigidly secured to the outer periphery of the drum and which is preferably made up of sections, each section having teeth 115. Said teeth, as previously described in connection with Figure 1, have the steep faces 117 against which the operating mechanism thrusts and said teeth also have the sloping faces 119 over which the mechanism rides during the reverse movement of the same.

In this modification the drum 111 is continuously rotated in a clockwise direction and accordingly the hold-back mechanism may be employed or the same may be eliminated. In order to illustrate the two power cylinders to the best advantage, Figure 7 does not show the hold-back mechanism. In place of one operating power cylinder and said hold-back mechanism the drive mechanism for the drum consists of two power cylinders which operate alternately and which are so related with the peripheral rack of the drum as to produce continuous rotation thereof in the same direction, as, for example, in a clockwise direction, as illustrated in Figure 7. The hydraulic power cylinder 121 is double-acting, having pipes 123 and 125 at respective ends for the inlet and outlet of a pressure fluid to thus effect reciprocation of the piston, not shown, and which accordingly produces similar movement of the yoke 133. The cylinder 121 is pivotally supported by pin 127 in bracket 128, preferably secured to the floor or similar supporting structure 131. The yoke is bifurcated at its upper end to provide a pair of arms 134, Figure 6, and which arms carry the pivot pins 135. In accordance with the invention, the pivot pins pivotally secure the levers 137 in place and said pins project within the circumferentially extending groove 147 to thus retain the yoke and the assembled parts in proper relation with respect to the rack. The connecting arm 141 is joined by coil spring 143 to the bracket 145 and in this manner the thrust bar 139, provided by the levers 137, is resilient maintained in operative contact with the teeth of the rack.

The second power cylinder is identified by numeral 151 and the same is likewise double-acting, being provided with pipes 153 and 155 at respective ends for the inlet and outlet of a pressure fluid to thus actuate the piston of the cylinder and impart reciprocating movement to yoke 163. The cylinder 151 is pivotally connected by the pin 157 to a bracket 158 which may be suitably supported by the structure 131. The yoke 163 is bifurcated at its upper end to provide a pair of spaced arms 164 similar in all respects to the spaced arms 34, as shown in Figure 6. Likewise, said arms pivotally support the levers 167 by means of the pins 165, and said levers carry the thrust bar 169 for contact with the teeth of the rack. The levers 167 are resiliently biased by the coil spring 173 and this maintains the thrust bar 169 in contact with the teeth of the rack. Said coil spring is secured at one end to the lever connecting arm 171 and at its opposite end to the bracket 175. Also said pins 165 ride within the circumferential groove 147.

The cylinders 121 and 151 alternate as regards their power strokes so that when one cylinder is operative to produce rotation of the drum 111, the other cylinder is retracting its yoke to its initial position. As shown in Figure 7, it will be observed that the second power cylinder 151 has about completed an operative stroke in an outward direction toward the left, thus effecting rotation of the drum 111 in a clockwise direction. The thrust bar 169 is in contact with the steep faces 117 of the rack and with the pivot pins 165, having location within the circumferential groove 147, a pull is exerted on the

thrust bar which is approximately a straight line pull due to the particular angular relation which the power cylinder has with this bottom side of the drum. When the second cylinder **151** completes its operative stroke, the first power cylinder **121** will be ready for its operative outward stroke. Here again a pulling action is exerted by the thrust bar **139** on the teeth of the rack and the clockwise rotation of the drum **111** is continued.

The power cylinders accordingly operate intermittently to produce continuous rotation of the drum and while one is performing its operative stroke the other cylinder has a retracting movement to locate its thrust bar in a position for starting such a stroke. For example, as explained in connection with Figure 7, as cylinder **121** starts its power stroke, effecting movement of the yoke and thrust bar in an outward, that is, an upward direction, the second cylinder **151** will be presently energized to locate its yoke and thrust bar in a retracted position so that movement can be again effected in a direction toward the left, the same constituting an operative stroke for this cylinder.

Whereas, cylinder **121** has a power stroke in an outward and upward direction, the second cylinder **151** has a power stroke in an outward direction to the left. This, of course, comes about by reason of the particular relation which the cylinders have with the circumferential rack of the drum, one being located adjacent the left side of the drum and the other adjacent the underside of the drum. For effecting the same continuous rotation of the drum in a clockwise direction both cylinders could be located for coaction with the bottom of the circumferential rack or for coaction with the rack at the left side, or at the right side of the drum.

The apparatus shown is to be understood to be illustrative only as it is capable of variation to meet differing conditions and requirements, and we therefore contemplate such modifications as come within the spirit and scope of the appended claims.

We claim:

1. Apparatus for the rotation of drums comprising a rack secured to the drum and extending circumferentially around the drum, said rack having teeth formed thereon and each tooth being uniformly spaced from adjacent teeth and having a steep face and an inclined face, power means for rotating the drum including a yoke adapted to reciprocate for producing a power stroke and a return stroke, a pivot pin provided by the yoke, a thrust bar suspended from the yoke by levers which are pivotally connected to the yoke by said pivot pin, said thrust bar having operation to engage the steep face of a tooth during a power stroke whereby to effect rotation of the drum and to ride over the inclined faces of the teeth when the reciprocating yoke is retracted, said rack having a circumferential groove formed in a latheral face thereof, said pivot pin extending into the groove whereby to maintain the yoke permanently connected to the rack throughout the rotation of the rack and drum, and hold back means in operative association with the rack and adapted to engage the teeth thereof to limit reverse movement of the drum during the return stroke of the yoke.

2. Apparatus for the rotation of drums comprising a rack secured to the drum and extending circumferentially around the drum, said rack having teeth formed thereon and each tooth being uniformly spaced from adjacent teeth and having a steep face and an inclined face, power means for rotating the drum including a yoke adapted to reciprocate for producing a power stroke and a return stroke, a pair of pivot pins carried by the yoke in spaced relation, a pair of levers suspended by the pins, a thrust bar fixed to and connecting the levers, said thrust bar having operation to engage the steep face of a tooth during a power stroke whereby to effect rotation of the drum and to ride over the inclined faces of the teeth when the reciprocating yoke is retracted, said rack having a circumferential groove on each lateral face thereof, each pivot pin extending into a groove whereby to maintain the yoke permanently connected to the rack throughout the rotation of the rack and drum, and hold back means in operative association with the rack, said means comprising a plurality of bars each pivotally connected to a supporting member and disposed transversely of the rack, whereby the bars are adapted to engage the teeth thereof to limit reverse movement of the drum during the return stroke of the yoke, said bars being spaced apart so that the drum never moves in a reverse direction more than about one-third of the length of a tooth.

3. Apparatus for the rotation of drums as defined by claim 2, additionally including a pair of pivot pins for pivotally connecting each bar to the supporting member, said pins extending into the circumferential grooves respectively for permanently connecting the supporting member to the rack throughout the rotation of the drum, and means for resiliently urging the bars into contact with the teeth of the rack.

4. Apparatus for the rotation of drums comprising a rack secured to the drum and extending circumferentially around the drum, said rack having teeth formed thereon and each tooth having a steep face and an inclined face, power means including a yoke adapted to reciprocate for producing a power stroke and a return stroke, said yoke providing a pair of spaced arms, a pivot pin fixed to each arm, a lever disposed inside the yoke adjacent each arm and being pivotally connected thereto by a pivot pin, a thrust bar fixed to and connecting the levers, said rack having a circumferential groove on each lateral face thereof, each pivot pin extending into a groove whereby to maintain the yoke permanently connected to the rack in a manner permitting rotation of the rack and drum and whereby the thrust bar is disposed transversely of the rack, and resilient means maintaining the thrust bar in contact with the teeth of the rack, whereby the thrust bar has operation to engage the steep face of a tooth during a power stroke to effect rotation of the rack and thus the drum and to ride over the inclined faces of the teeth when the reciprocating yoke is retracted.

5. Apparatus for the rotation of drums as defined by claim 4, additionally including hold back means in operative association with the rack, said means comprising a plurality of bars each pivotally connected to a supporting member and disposed transversely of the rack, whereby the bars are adapted to engage the teeth thereof to limit reverse movement of the drum during the return stroke of the yoke, and said bars being so spaced longitudinally of the rack that reverse movement of the drum is limited to less than the length of a tooth.

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