Nov. 17, 1953 H. J. SKETCHLEY 2,659,540

CONDUIT REAMING MACHINE

Filed Oct. 17, 1949 6 Sheets-Sheet 1

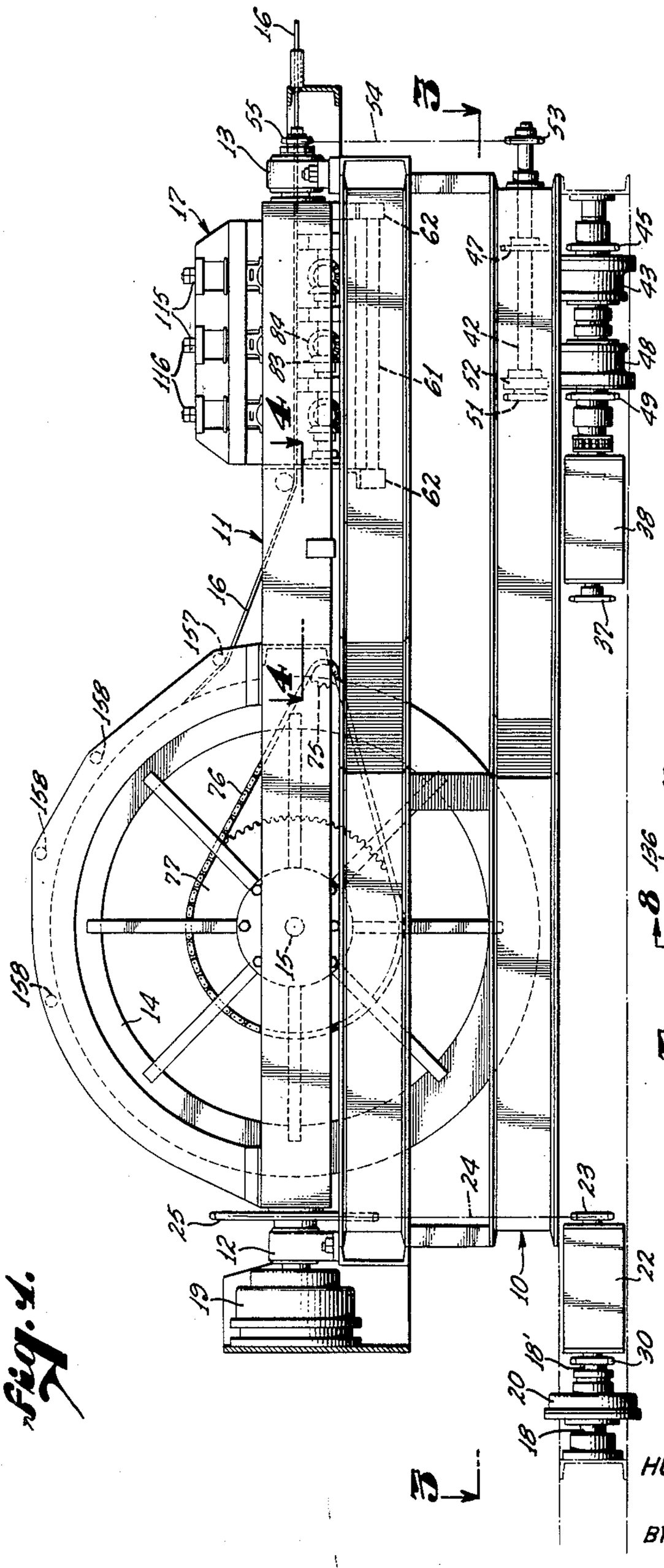

Fig. 1.

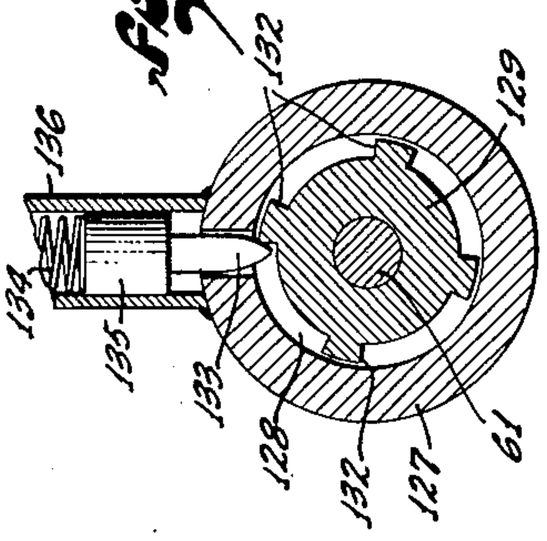

Fig. 6.

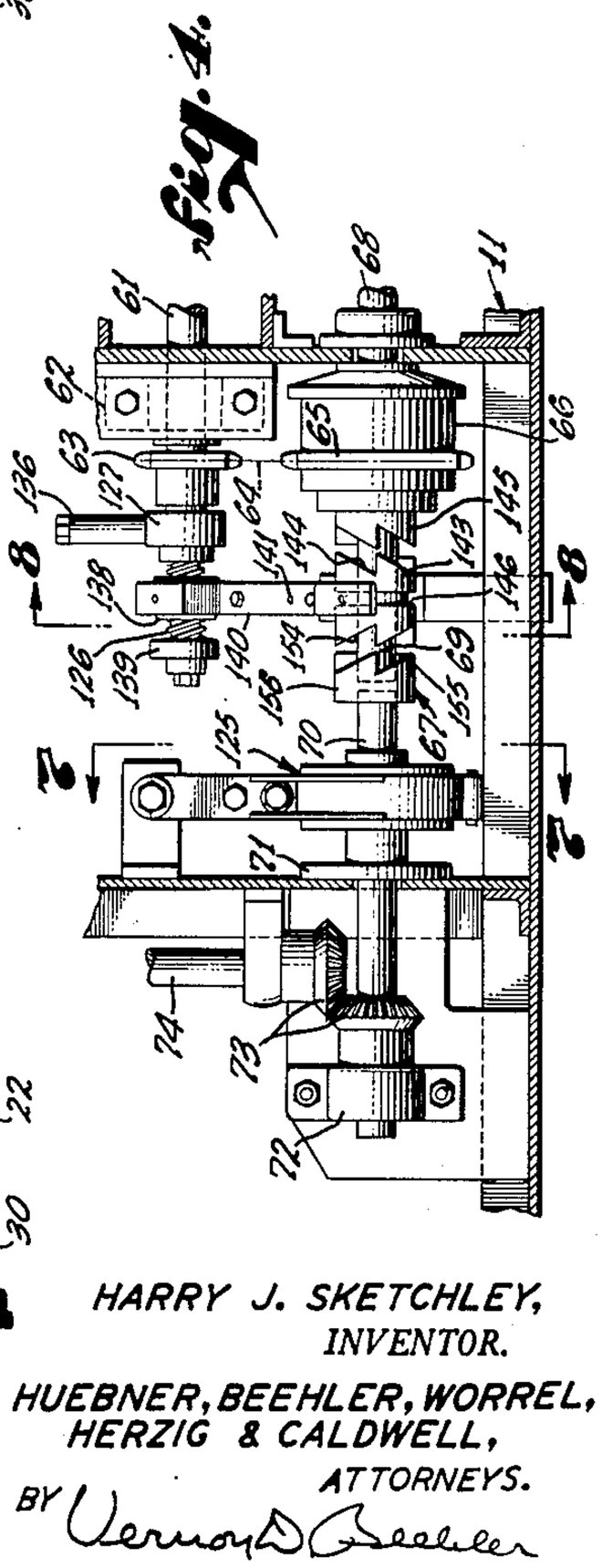

Fig. 4.

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CONDUIT REAMING MACHINE

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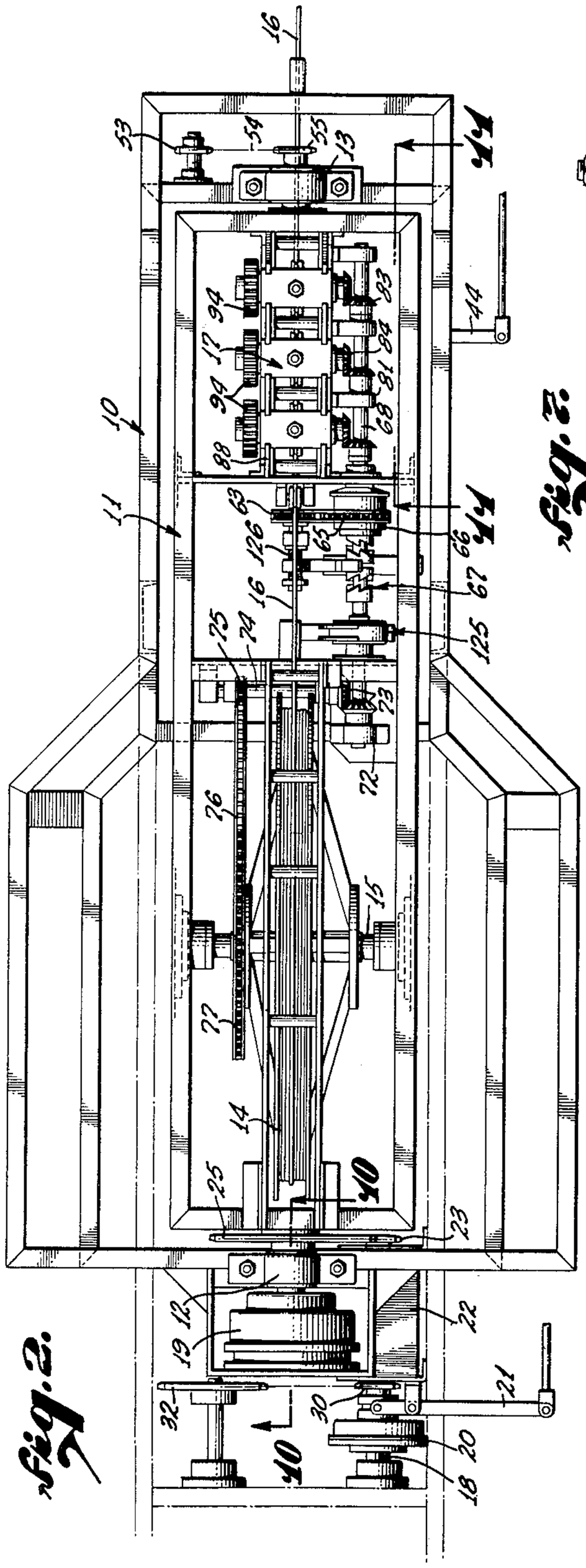

Fig. 2.

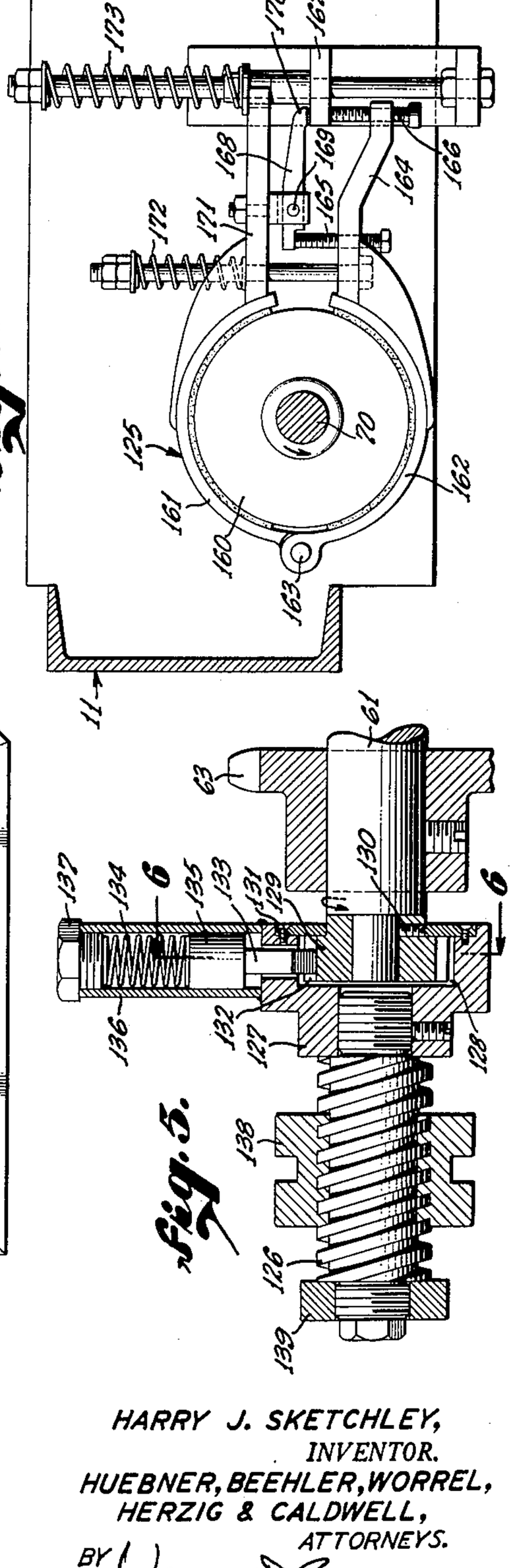

Fig. 3.

Fig. 5.

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CONDUIT REAMING MACHINE

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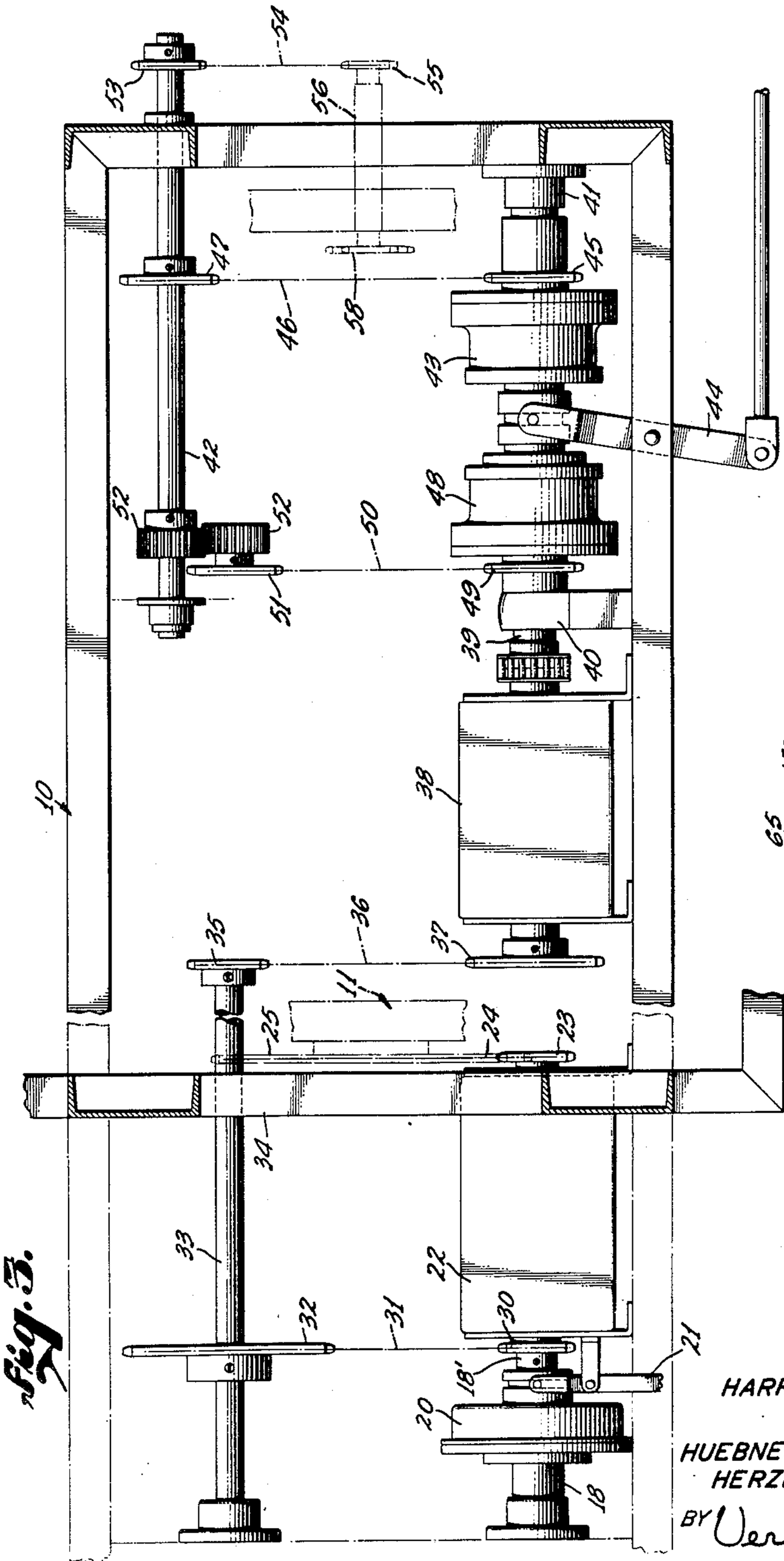

Fig. 3.

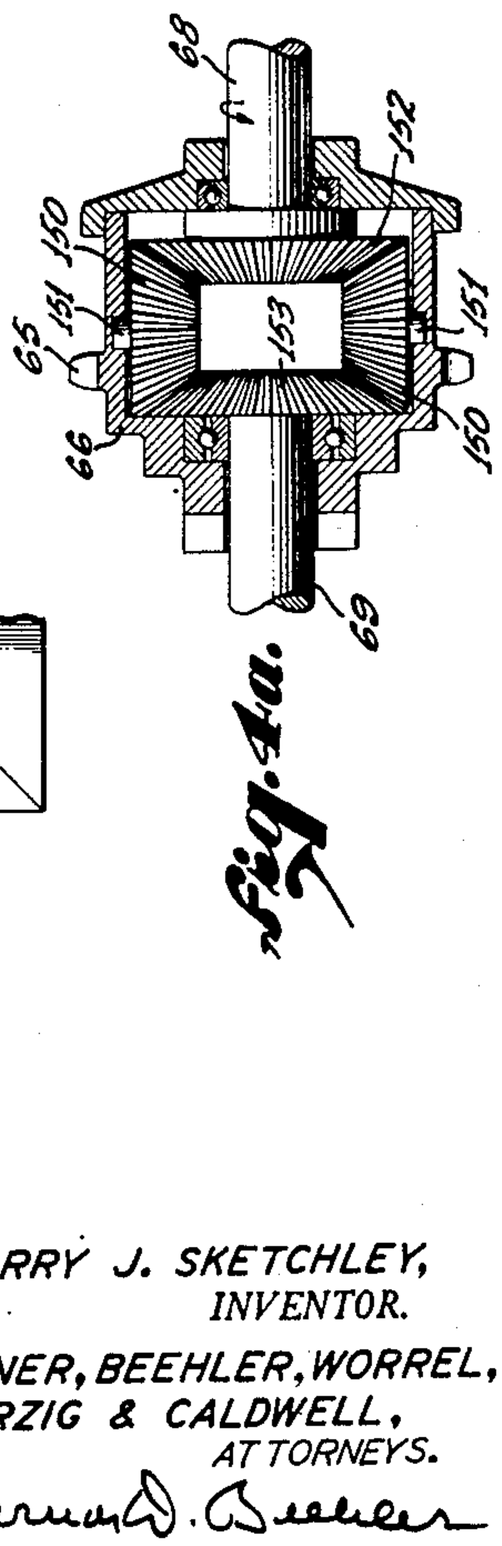

Fig. 4a.

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CONDUIT REAMING MACHINE

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Fig. 15.

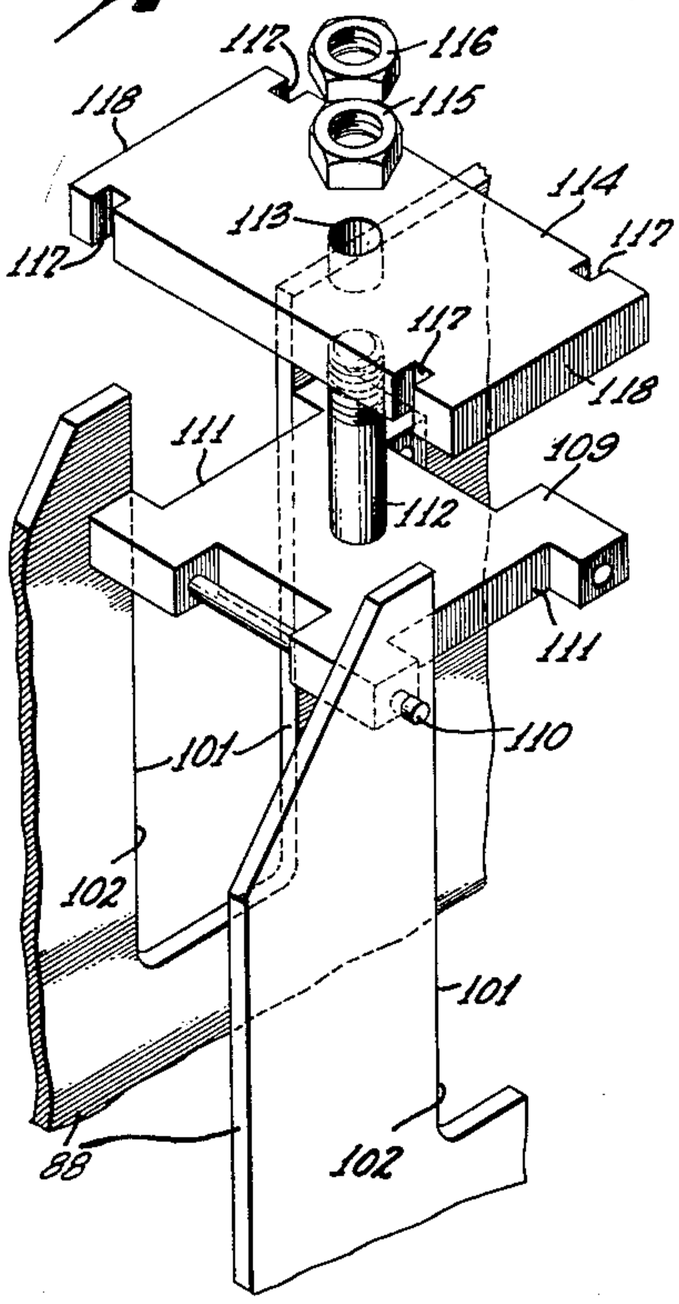


Fig. 8.

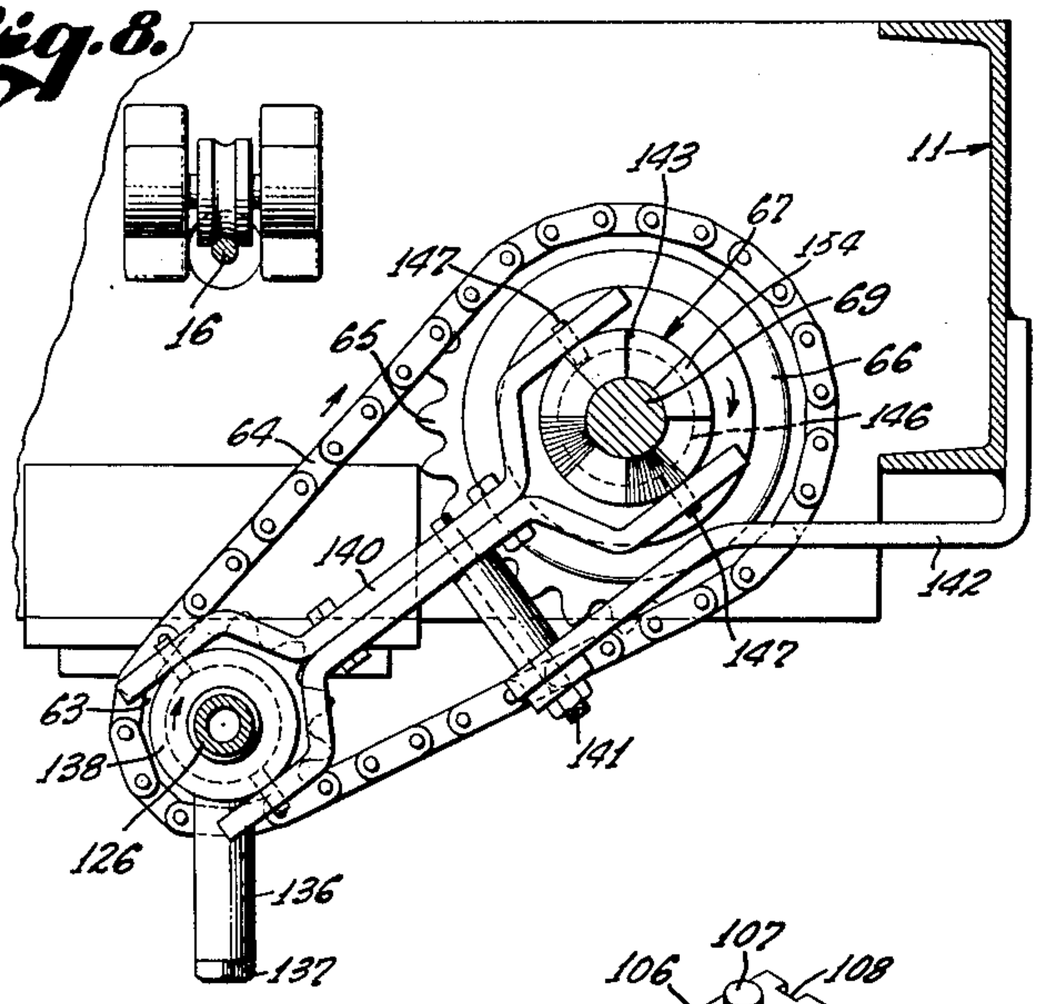


Fig. 9.

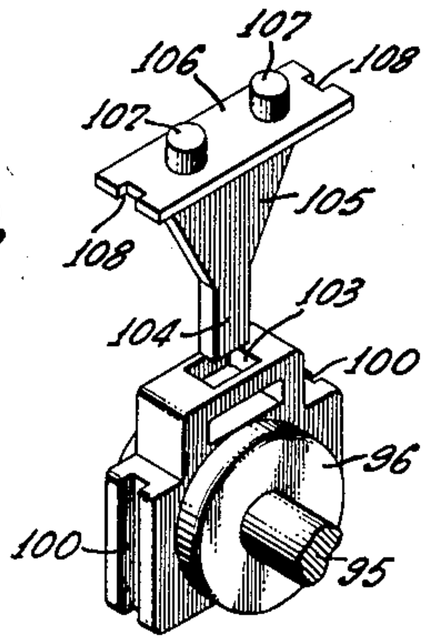
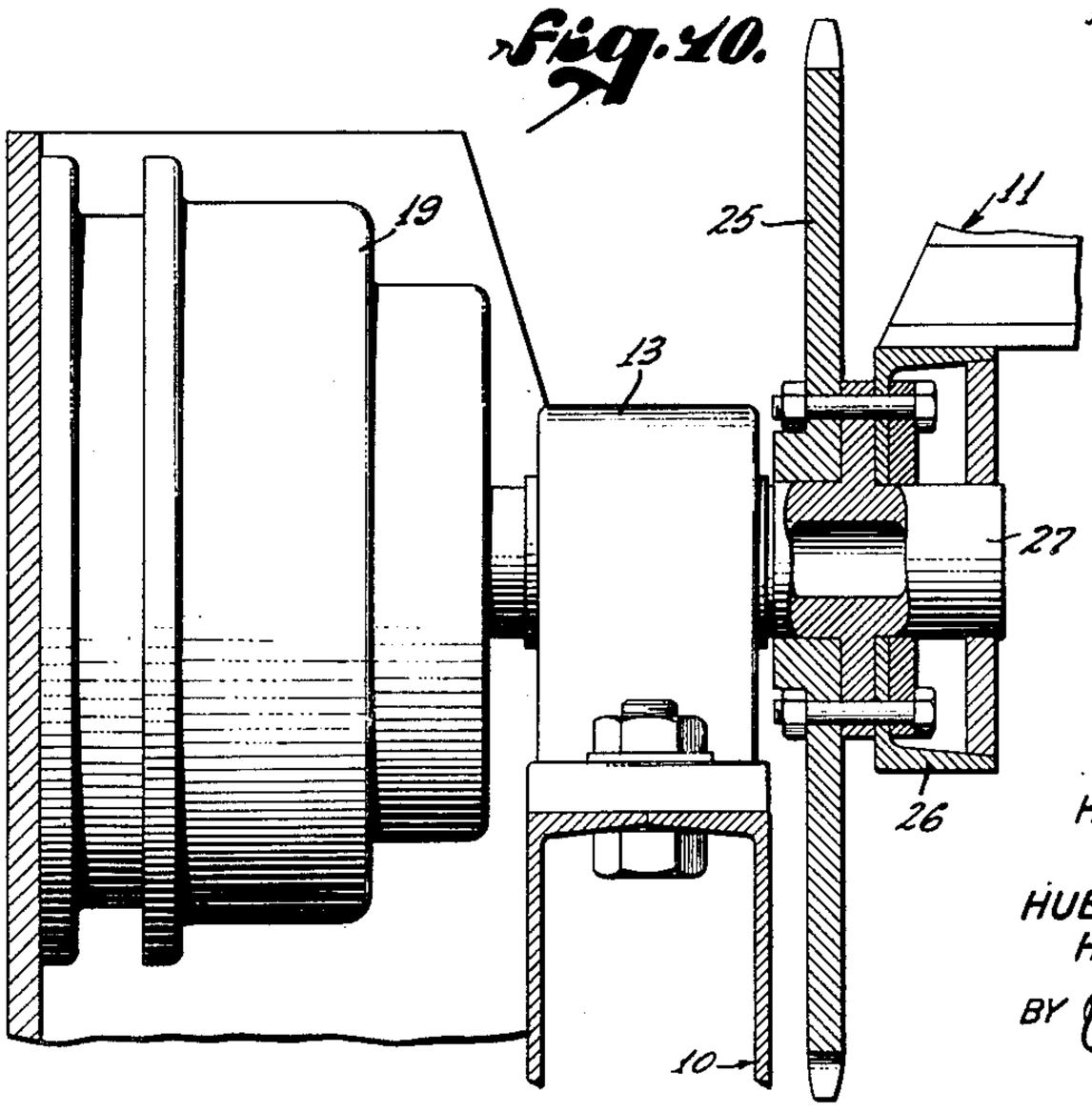


Fig. 10.



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CONDUIT REAMING MACHINE

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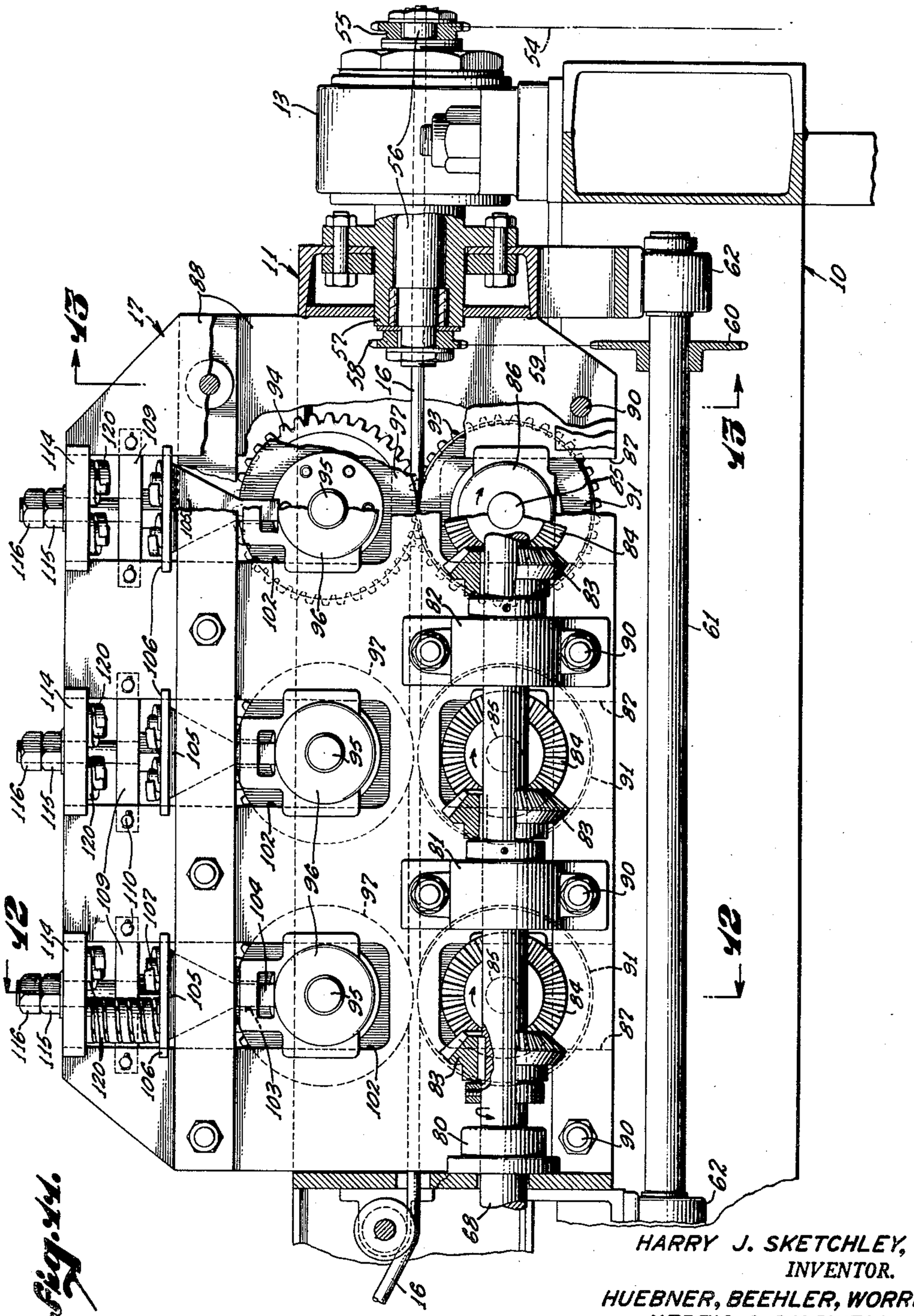

Fig. 14.

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CONDUIT REAMING MACHINE

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Fig. 12.

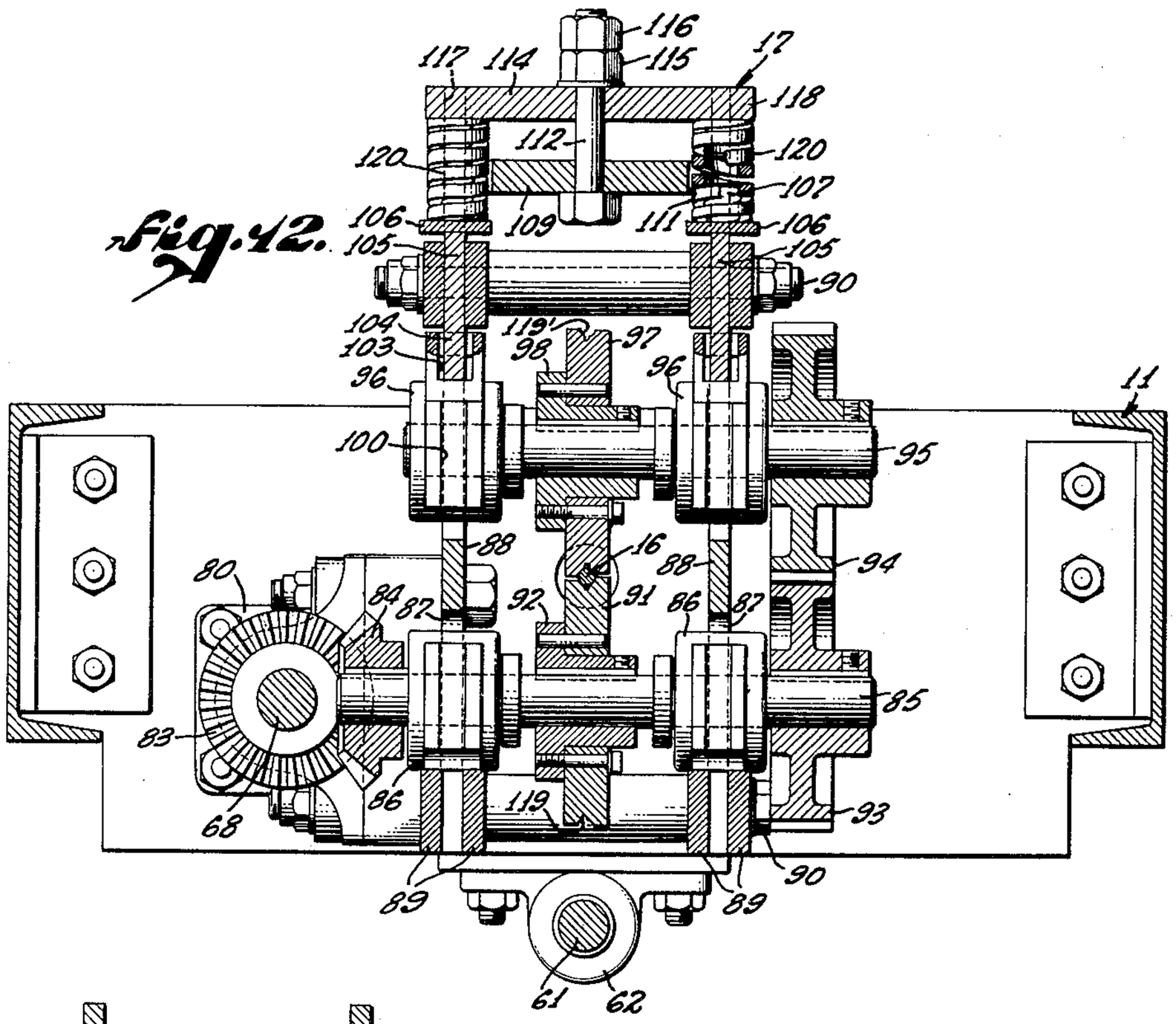


Fig. 13.

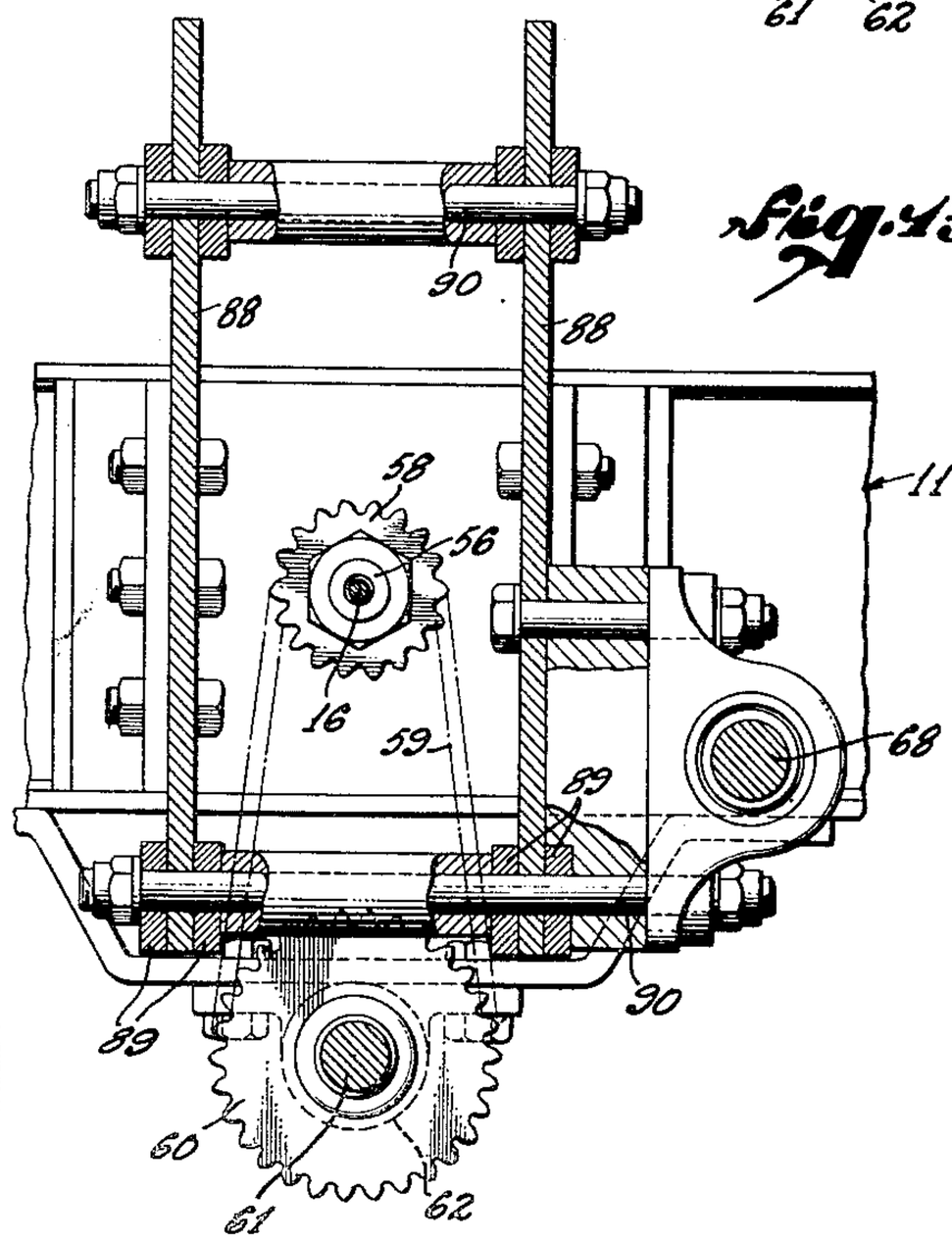
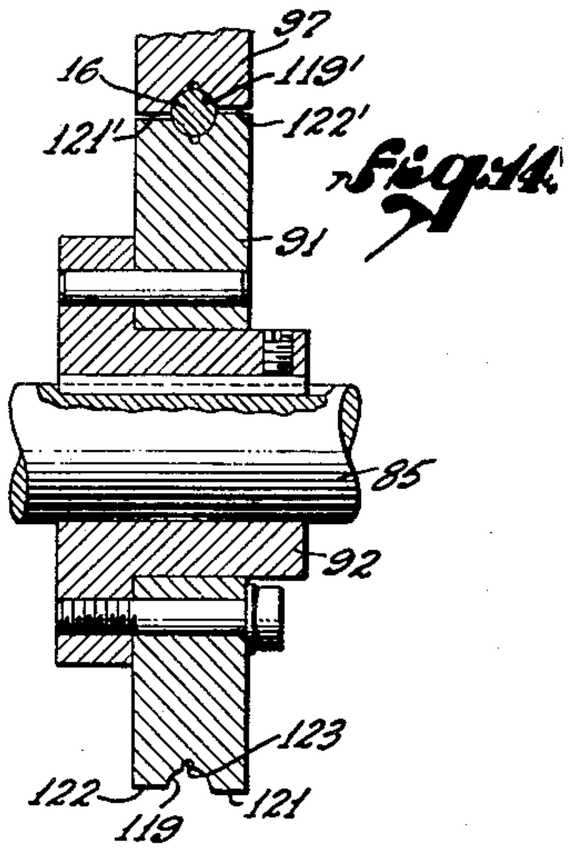


Fig. 14.



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Patented Nov. 17, 1953

2,659,540

UNITED STATES PATENT OFFICE

2,659,540

CONDUIT REAMING MACHINE

Harry J. Sketchley, Los Angeles, Calif.

Application October 17, 1949, Serial No. 121,844

1 Claim. (Cl. 242—54)

1

The invention relates to conduit reaming machines and in particular a type of machine frequently used in cleaning sewer pipes and other pipes where an accumulation of residue on the walls of the pipes over a period of time impedes the flow of water therethrough, such flow being purely a gravity flow unaccompanied by any pressure upon the water. The application is a continuation in part of application Serial No. 647,794, now Patent No. 2,488,039, for a Wire Feeding and Retracting Apparatus directed to a similar purpose.

The common practice in cleaning sewers and similar pipes is to attach a scraper or cleaner at the end of a flexible cable of some commercially acceptable manufacture and to push and force the scraper through the pipe while at the same time rotating it, this being accomplished solely by means of forcibly paying out the cable while simultaneously rotating it.

Heretofore a variety of machines have been devised suited to this general purpose and for the most part they have included a frame, usually portable, upon which is mounted a separate carriage in turn supporting a reel for the cable and pay-out rollers designed to guide and extend the cable when the scraper is extended into the pipe. To rotate the cable at the same time that it is being payed out it has been customary to mount the carriage rotatably upon the frame so that the carriage, the reel and preferably the pay-out rollers all rotate as a unit.

In a pipe cleaning operation the scraper frequently encounters obstructions which impede its extension into the pipe and also which restricts its rotation. When such obstructions are encountered it becomes necessary to work the scraper in and out until the obstruction has been removed sufficiently to permit the scraper to pass. Such operations entail considerable manipulation on the part of the operator and a repeated reversing of the pay-out mechanism in order to work the scraper in and out to clear the obstacle.

Usually a relatively large reel must be used in order to carry sufficient cable to extend through the pipe from one manhole or similar junction to another and to carry on a reel of large diameter a somewhat stiff cable which will not wind on a reel of small diameter. The carriage for a reel of such size must be of relatively large proportions. This means also that for a given speed of rotation of the reel the rate of travel of the cable will vary considerably, being relatively rapid when there are a large number of coils of cable built up on the reel and relatively slow when the

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reel is almost empty. It therefore becomes desirable to provide appropriate means for compensating for the speed change which the cable undergoes.

Also when the pay-out rollers are working so as either to pay out cable or to guide the passage of cable during a rewinding operation, because the rate of travel of the cable on the reel tends to differ from the speed of operation of the rollers there is constant likelihood of forming a kink in the cable between these two points which may result in damage to the cable and the scraper and increase the difficulty of successfully operating the cable through a long pipe. Because of the cumbersome nature of the apparatus where manual control for the application of power is relied upon entirely for working the cable in and out, it happens that many times the control is not properly exercised with the result that the machinery is likely to be damaged and the cleaning operation not properly accomplished.

In a further respect difficulty has been encountered in the pay-out rolls of machines heretofore contrived especially when the cable becomes worn and often when the cable is pulled out of a pipe coated with slime and accumulation of sand and gravel. Pay-out rolls heretofore utilized for forcing the cable into the pipe have been found to lose efficiency and gripping power as the cable becomes worn and also when anything other than a clean cable is run through the pay-out rolls.

It is therefore among the objects of the invention to provide a new and improved conduit reaming machine incorporating certain automatic features capable of maintaining a steady pull on all parts of the cable especially when the operation is reversed while at the same time making provision for the necessary apparatus to simultaneously force the cable and the scraper thereon into the pipe while at the same time rotating it.

Another object of the invention is to provide a new and improved speed compensating mechanism for a conduit reaming machine which will compensate for differences in speed at which the cable travels through the different portions of the machine and which is so constructed that the compensation will be constantly applicable regardless of changes in the differential speed as the operation progresses.

Still another object of the invention is to provide a new and improved conduit reaming machine equipped with an automatically operative clutch to the end that the storage reel for the cable may be disconnected while pay-out rolls forcibly drive the cable into the pipe and which

automatically disengages the pay-out rolls and connects the reel to the source of power whenever the operation is reversed.

Still further among the objects of the invention is to provide an automatic drag on the reel which becomes operable while the reel rotates to deliver the cable to the pay-out roll and which becomes automatically inoperable when the reel is rotated to wind up the cable as it is withdrawn from the pipe.

Still another object is to provide in a conduit reaming machine pay-out rolls which are so constructed with respect to their cable-engaging perimeters that constant grip is had upon the cable at all times, the pay-out rolls being capable of automatically compensating for a reduction in size of the cable as wear increases and also capable of compensating for and accommodating an apparent temporary oversize in the cable as gravel and sand may be carried by the cable through the pay-out rolls.

The objects also include the provision of a conduit reaming machine all parts of which are adapted automatically to adjust themselves with respect to each other and thereby provide a smooth working machine, steady and efficient in its operation, easy to manipulate during a pipe cleaning operation and at the same time sufficiently simple with respect to conventional mechanisms embodied in it so that the machine can be constructed of commercially available materials readily replaceable if necessary.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a side elevational view of the conduit reaming meachine with some structural parts in section and showing the relative locations of the storage reel and the pay-out roller assembly.

Figure 2 is a plan view of the machine shown in Figure 1.

Figure 3 is a diagrammatic representation of the portions comprising the drive which are located in the stationary part of the conduit reaming machine and which shows by dot and dash lines the transfer of the power to a rotating carriage.

Figure 4 is a fragmentary plan view, slightly enlarged and partially in section taken on the line 4—4 of Figure 1 showing the automatic clutch and brake.

Figure 4A is a longitudinal sectional view of the differential mechanism.

Figure 5 is a horizontal sectional view of a portion of Figure 4 drawn to a still larger scale showing details of a ratchet drive.

Figure 6 is a fragmentary elevational sectional view taken on the line 6—6 of Figure 5.

Figure 7 is a transverse elevational view taken on the line 7—7 of Figure 4 showing details of the drag.

Figure 8 is a transverse fragmentary sectional view taken on the line 8—8 of Figure 4.

Figure 9 is a perspective view of a bearing box adapted to support the movable pay-out rolls.

Figure 10 is an elevational view partially in section taken on the line 10—10 of Figure 2 showing a sprocket for rotating the rotatable carriage.

Figure 11 is a side elevational view partially in section showing the pay-out roller assembly.

Figure 12 is a transverse sectional view taken on the line 12—12 of Figure 11.

Figure 13 is a transverse sectional view taken on the line 13—13 of Figure 11.

Figure 14 is a fragmentary sectional view showing the construction of the cable-contacting portions of the pay-out rolls.

Figure 15 is an exploded view in perspective of spring supporting parts of the pay-out roller assembly with springs and rollers removed for the sake of clarity.

An understanding of the general purpose of the device can best be achieved from an examination of Figures 1 and 2. As there shown there is a stationary frame 10 designed to be carried by some portable vehicle, not shown, upon which is mounted a carriage 11 encompassed within a rectangle of structural members which is designed to rotate upon the frame upon which it is supported by bearings 12 and 13. On the carriage 11 is a reel 14 which rotates upon a horizontal transverse axle 15 carried by the sides of the rectangular carriage 11. The reel serves as a storage reel for a flexible cable 16.

At the right end of the carriage as viewed in Figures 1 and 2 is a pay-out roller assembly 17 which includes three sets of pay-out rollers partly visible in Figure 2 over which the cable 16 is extended through the bearing 13 and thence upwardly at the right of the machine as viewed in Figures 1 and 2.

At the lower left-hand end of the machine as viewed in Figure 1 is a drive shaft 18 which derives its driving force from some conventional source of power at or adjacent the vehicle, the power in turn being utilized for two distinct purposes, one for rotation of the carriage 11, and the other for rotation jointly of the storage reel and pay-out rollers, depending upon whether the cable is being payed out or withdrawn for rewinding upon the storage reel.

Inasmuch as the application of power to the storage reel and pay-out rollers must be upon the carriage 11 which is constantly rotating during operation, the power is transferred through one set of shafts, counter-shafts, transmission, and clutch located in a stationary portion of the frame and depicted diagrammatically in Figure 3. The power, however, must be transferred to a rotating gear train in the carriage 11 and therefore enters upon the carriage 11 by transmission through appropriate means in the bearing 13. In general when the device is being operated the pay-out rollers in the pay-out roller assembly 17 are forcibly driven so as to draw the cable 16 from the storage reel and extend it forcibly into the pipe which is to be cleaned. During this phase of the operation the storage reel is unconnected to the source of power but is provided with a drag which prevents the reel from running too fast and which maintains a drag at all times upon the cable 16 so that it remains taut between the storage reel and the pay-out roller assembly.

When the apparatus is reversed for any reason the storage reel is then directly connected to the source of power and positively driven thereby while at the same time the drag is released. During this portion of the operation the application of power to the pay-out roller assembly is cut off but the pay-out rollers themselves provide a certain drag upon the cable; and by reason of a specially adapted differential connection, which will be described in detail and which is

illustrated in part in Figure 4, the speed of rotation of the pay-out rollers will always be adjusted with respect to the speed of the cable as the speed changes with an accumulation of coils of cable upon the storage reel.

The stationary drive

The location of the parts of the stationary drive is found in Figures 1 and 2 and an understanding of the transfer of power through this drive will best be appreciated from the diagrammatic representation of Figure 3. As indicated in the lower left-hand portion of Figure 1 a drive shaft 18 introduces power to the system which supplies the conduit reaming machine. The drive shaft 18 is joined through a clutch 20 to an intermediate shaft 18'. A transmission 22 of conventional design accepts power from the intermediate shaft 18' and transmits it to a sprocket 23 from which a chain drive 24 transmits the power to a larger sprocket 25 which is in turn attached to the rotating carriage 11. A clutch lever 21 may be employed to connect and disconnect the transmission 22 from its engagement with the intermediate shaft 18' thus causing the carriage 11 to rotate or cease rotation as desired. Details of the mounting of the large sprocket 25 are best illustrated in Figure 10. As there shown the sprocket 25 lying adjacent the bearing 13 is bolted to a channel 26 forming the adjacent end of the carriage 11 and both the sprocket and the channel have clamped between them a flange of a bearing shaft 27, this shaft being one extended through the bearing 13 which in turn is carried by the stationary frame 10.

For convenience a brake of conventional construction identified by the reference character 19 and suitably controlled may be employed to retard rotation of the carriage 11.

The power from the drive shaft 18 and clutch 20 is also conducted through the stationary portion of the frame to the right-hand end as viewed in Figures 1, 2 and 3 for eventual transmission to the parts carried by the rotating frame 11. Power carried in this direction is transferred first from a sprocket 30 through a chain 31 to a larger sprocket 32 which in turn is carried by a shaft 33 stationarily supported in part upon a channel 34 of the frame 10. A sprocket 35 at the right-hand end of the shaft drives a chain 36 and sprocket 37 which in turn sends the rotating source of power through a transmission 38. The transmission 38 drives a shaft 39 supported upon bearings 40 and 41 on adjacent portions of the stationary frame 10. From the shaft 39 power may follow one of two courses to a shaft 42. For pay out or forward operation of the apparatus a clutch 43 may be appropriately engaged by means of a reversing clutch lever 44 to drive a sprocket 45 which through a chain 46 and sprocket 47 rotates the shaft 42 in a corresponding direction. In reverse operation manipulation of the clutch lever 44 disengages the clutch 43 and engages a clutch 48 so that power is transferred through a sprocket 49 and chain 50 to a sprocket 51 and reversing gears 52, thereby to rotate the shaft 42 in an opposite direction. The clutch lever 44 may also be manipulated to an intermediate neutral position wherein no power is transmitted to the shaft 42. In either event rotation of the shaft 42 is transferred by means of a sprocket 53 and a chain 54 to a sprocket 55 which is connected to a hollow sleeve shaft 56 passing inside of the bearing 13 and also within

a hollow bearing shaft 57 and thence to a sprocket 58 within the rotating carriage.

The movable drive

All portions of the drive beyond the sprocket 58 are mounted upon the carriage 11 and rotate with the carriage as the carriage is rotated for the purpose of rotating the cable. The necessity for this arrangement accounts for the transmission of power from the sprocket 55 through the sleeve shaft 56 at a location such that the sleeve shaft 56 is concentric with the bearing shaft 57 comprising one of the bearings about which the carriage rotates.

From the sprocket 58 a chain 59 carries power to a sprocket 60 mounted upon a counter-drive shaft 61 which is rotatably attached to the carriage 11 by means of bearings 62. The relative location of the counter-drive shaft 61 is best shown in the full lines of Figure 11 and the dotted lines of Figure 1.

Turning now to Figure 4 it will be noted that the counter-drive shaft 61 extends beyond the adjacent bearing 62 where it supports a sprocket 63 from which a chain 64 transmits power to a sprocket 65 mounted upon and secured to a differential housing 66. By operation of a differential device within the housing 66 assisted by a reversing clutch 67, the parts and operation of which will be later described in detail, power is transmitted to a driven counter-shaft 68 for the purpose of driving the pay-out rollers. In another position of adjustment of the clutch power is transmitted through a stub shaft 69 and thence to a reel driving shaft 70. The shaft 70, journalled in bearings 71 and 72 on the carriage, transmits power through a pair of spur gears 73 to a shaft 74 which, through a sprocket 75, a chain 76, and a sprocket 77, rotates the storage reel 14 when the wheel is operated to wind up cable.

The pay-out roller cage assembly

The driven counter-shaft 68 is supported upon bearings 80, 81 and 82 on the carriage 11. A set of bevel gears 83 keyed to the driven counter-shaft 68 mesh with corresponding bevel gears 84 as shown in Figures 11 and 2, the bevel gears 84 being carried by pay-out roller shafts 85, as perhaps best shown in Figure 12. The pay-out roller shafts 85 in each case are supported in bearing boxes 86 and these in turn are slidably received in slots 87 which extend upwardly into plate-like side members 88 of the pay-out roller cage. The blocks are held upwardly by means of strips 89 which may be anchored in place by bolts 90. Mounted in this manner the bearing boxes have a limited downward movement but are provided with a certain freedom to move upwardly under certain circumstances.

Midway between oppositely disposed bearing boxes 86 there is mounted on each of the pay-out roller shafts 85 a pay-out roller 91 bolted to a bushing 92 which is in turn keyed to the respective pay-out roller shaft 85. The circumference of the pay-out roller is adapted to engage the cable 16.

As is best portrayed in Figure 12 the right-hand ends of the pay-out roller shafts 85 as there shown have keyed thereto in each case a gear 93 which meshes with a corresponding gear 94 of the same diameter and number of teeth, the gear 94 being keyed to a corresponding shaft 95, the shafts 95 being equal in number and comprising a set of pay-out roller shafts located on the op-

posite side of the cable 16 from the pay-out roller shafts 91.

The shafts 95 are also supported in bearing boxes 96 illustrated in greater detail in Figure 9 but illustrated best as to location on the roller cage in Figure 12. Midway between the bearing boxes 96 on each shaft 95 is located a pay-out roller 97 which is complementary to the pay-out roller 91 and the perimeter of which also engages the cable 16. The pay-out roller 97 is bolted to a bushing 98 which is keyed to the shaft 95 in each case.

In order that the cable 16 may be successfully manipulated between the pay-out rollers in a manner which will compensate for wear and will also assure continuity of grip upon the cable when it becomes covered with slime in which sand and gravel has become embedded, pressure is placed upon the pay-out rollers 97 in order to push them against their opposite pay-out rollers 91. The pressure is exerted by a set of springs which are designed to exert their influence upon the bearing boxes 96 and thus urge the shafts 95 carrying the pay-out rollers 97 downwardly as viewed in Figures 11 and 12. The spring retention mechanism is best shown in Figure 15.

Referring once again to the bearing boxes 96, as illustrated in Figure 9, it will be noted that these bearing boxes are provided with slideways 100 on each side which are adapted to slide along vertical edges 101 which form the sides of slots 102 extending downwardly from the upper edge of the plate-like side members 88. The bearing boxes are provided with apertures 103 designed for the reception of a pilot 104 at the lower end of a push plate 105. The push plate in turn includes a guide plate 106 carrying springkeepers 107 and is also provided with slideways 108 which are adapted to slide along the edges 101 of the slots 102.

To provide the necessary support for compression springs spring bed plates 109 are securely mounted between the side members 88 by means of pins 110. These spring bed plates have recesses 111 at the sides for the accommodation of springs 120. At the centers of the bed plates are bolts 112 anchored thereto and which extend upwardly through apertures 113 in spring cap plates 114. By means of a nut 115 and lock nut 116 the spring cap plates 114 may be anchored in a position higher or lower with respect to the bed plates 109 as occasion demands. The cap plates 114 are also provided with slideways 117, these slideways also being designed to slide up and down along the edges 101 of the slots 102. The cap plates, however, include extensions 118 which project outwardly upon the side members 88 so that the heavy compression springs 120 may engage beneath the extensions 118 at the upper ends and may press against the guide plates 106 at the lower ends where they are retained in proper position by the springkeepers 107.

It will be self-evident that when pressure is built up in the springs 120 they press downwardly upon the guide plates 106, the push plates 105 and thence through the pilot 104 and press downwardly upon the shaft 95 in the bearing boxes 96. Pressure thus exerted presses the pay-out rollers 97 smoothly and evenly against the cable.

If for any reason it should be necessary to adjust or change the spring tension, it is necessary only to take up or release the nut 115 and lock nut 116 on the bolt 112, thus moving the spring cap plate 114 downwardly or upwardly, depending upon the change in spring tension desired.

Pay-out roller design

The pay-out rollers are specially constructed for the purpose of assuring a firm grip upon the cable 16 at all times. Details of the construction are illustrated in Figure 14. An inspection of the configuration of the pay-out rollers 91 and 97 there shown will reveal the utilization of complementary grooves 119 and 119'. It will be noted in comparing the radii of the grooves with the radius of the cable 16 that the radii of curvature of the grooves may be slightly less than the radius of the cable 16. It is also important to note that on the right side as viewed in Figure 14 the pay-out roller has a perimeter 121 having a slightly greater radius than a perimeter 122 on the opposite side of the pay-out roller. On the pay-out roller 97 the relationship is reversed so that a perimeter 121' which is opposite the perimeter 122 is greater in circumference than the oppositely disposed perimeter 122 and a perimeter 122' is less than the perimeter 121. The perimeters referred to are thus complementarily disposed with the axes of the respective shafts being so located that the perimeters do not touch. Hence pressure will be exerted by the grooves 119 and 119' upon the cable with the pressure being greatest at the edges of the grooves.

At the bottoms of the grooves 119 and 119', respectively, there are provided auxiliary annular grooves 123 substantially smaller in cross-sectional area but defining edges at the junction of the groove 123 with the groove 119 for example.

By providing a relationship of the type described a firm grip can be had upon the cable 16. Should the cable begin to wear, the cable will do no more than set deeper in the grooves and the pressure of springs 120 will be exerted upon the bearing boxes 96, thus tending perpetually to move the shafts 95 and corresponding pay-out rollers 97 toward the pay-out rollers 91. Acting in this way there is always the pressure of the pay-out rollers upon the cable. The pressure, however, is a releasable pressure to the end that should a dirty cable carry upon it small particles of gravel or sand, the pay-out roller 97 may be forced upwardly against spring pressure in order to permit the gravel or sand to pass without excessive pressure being apt to damage the cable. Pressure of the same springs 120 likewise tends to maintain a frictional grip between the pay-out rollers and the cable as the diameter of the cable grows smaller after being subjected to wear.

The automatic clutch

In order for the device to operate in the manner necessary to achieve its objects it is necessary that when the pay-out rolls are being driven so as to feed the cable 16 outwardly into a pipe, the storage reel should be disconnected from the drive. Running freely, however, the storage reel would not pay out the cable properly so that a braking device or drag need be employed. An automatic drag 125 serves this purpose, details of which are best illustrated in Figure 7 and the location of which is best shown in Figure 2. Furthermore, when it is desired to retract the cable, it is necessary to disconnect the power from its driving relationship with the pay-out rolls and to connect the power so that the storage reel is driven in a wind-up or reel-in direction. To dispense with the reliance upon manual control of this phase of operation of the machine there is provided an automatic clutch 67, detailed

parts of which are shown in Figures 4, 5 and 8. The location of the automatic clutch 67 is also clearly illustrated in Figure 2.

During a pay-out operation when the cable is being fed into a pipe, the counter-drive shaft 61 is being rotated in the direction of the arrow illustrated in Figures 4 and 5. To operate the automatic clutch there is provided a separate threaded end comprising a screw element 126. The screw element is mounted in a special bushing 127, shown also in Figure 6, and includes a space 128 within which a ratchet wheel 129 is adapted to rotate. The ratchet wheel is fastened non-rotatably to the counter-drive shaft 61 by means of a set screw 130, the bushing being retained in position by application of a plate 131 over one side of the ratchet wheel, as illustrated in Figure 5.

Teeth 132 on the ratchet wheel are adapted to cooperate with a detent 133 spring pressed into position by a coil spring 134 acting against a piston 135. A spring housing 136 is adapted to contain the spring which is held in position by a nut 137. The spring tension is maintained relatively light so that when the rotation in either direction of the bushing 127 is arrested, the ratchet wheel may continue to rotate with the teeth 132 passing successively beneath the detent 133.

When the apparatus is being driven in a forward or pay-out direction and the driven counter-shaft 61 is rotating in the direction of the arrow, as illustrated in Figure 5, action of the screw 126 in a reversing block 138 tends to shift the reversing block from right to left as viewed in Figure 5 until the block strikes against a stop 139. While the reversing block is being shifted by rotation of the screw, the detent 133 temporarily engages one of the teeth 132 so that the screw 126 and bushing 127 rotate simultaneously with the driven counter-shaft 61, the reversing block in turn being held non-rotatably by an automatic clutch lever 140 in turn connected to the reversing clutch. As soon as the reversing block 138 strikes the stop 139, rotation of the screw is arrested and thereafter as the counter-drive shaft 61 continues to rotate the teeth 132 will continue to pass beneath the detent.

The automatic clutch lever 140, being pivotally anchored by a bolt 141 to a bracket 142, pivots about the bolt. Therefore when the reversing block 138 is shifted from right to left, as viewed in Figure 4 for example, the lever shifts a clutch block 143 from left to right. The clutch block is provided with a serrated clutch base 144 with teeth facing in a direction such that they are adapted to engage corresponding teeth in a serrated clutch face 145 forming part of the housing 66. In this connection it should be noted that the clutch block is keyed to the stub shaft 69 and rotates with the shaft, an annular groove 146 being provided to slidably accommodate pins 147 of the automatic clutch lever 140. In this position of adjustment the stub shaft 69 is caused to rotate simultaneously with the housing 66 by reason of engagement of the clutch faces wherein the clutch block 143 is driven by rotation of the housing.

As an aid in understanding the operation of the differential housing 66 attention is directed to Figure 4A which illustrates the interior arrangement of the housing. As there shown the housing 66 is provided with idling miter gears 150 freely rotating on stub shafts 151 secured to the inside circumference of the housing 66. Meshing with the idling miter gears on one side is a larger miter gear 152 which in turn is keyed to the driven counter-shaft 68. A second larger miter gear 153 is keyed to the stub shaft 69. It will thus become apparent that when the clutch faces anchor the clutch block 143 to the housing, the stub shaft 69 will be forced to rotate with the housing. This anchored relationship in turn restricts rotation of the idling miter gears and consequently rotation of the larger miter gear 152 will be restricted relatively to the stub shaft 69 and as a result rotation of the housing 66 will be transferred to the counter-driven shaft 68 which will continue rotation at the same rate of speed as the housing 66 and in the same direction. This is the direction shown by the arrow in Figures 4A and 11 and is the direction of rotation necessary to rotate the pay-out rollers in a pay-out direction.

When the operation of the device is to be reversed so as to withdraw the cable from its extended position in the pipe, operation of the drive is reversed by shifting the clutch lever 44 to an opposite position so that the clutch 48 engages the shaft 49 and the clutch 43 is released from engagement. In this position of adjustment rotation of the shaft 39 is transmitted to the reversing gears 52 causing the shaft 42 to operate in a reverse direction of rotation and this reversal is in turn transmitted through the chains and sprockets heretofore referred to to the driven counter-shaft 61. When rotation of the driven counter-shaft is reversed, the direction of rotation of the screw 126 is also reversed and this causes the screw to rotate in the reversing block 137 and draw the reversing block away from the stop 139, shifting it from left to right until it strikes the bushing 127. During this operation the detent 133 again comes into play engaging one of the teeth 132 to cause the screw to rotate with the counter-drive shaft 61 until axial motion of the reversing block 138 is stopped, at which point the ratchet wheel again continues to rotate past the detent.

As the reversing block 138 changes position, the clutch block 143 is shifted from right to left as shown in Figure 4, which shift releases the clutch faces 144 and 145 from engagement and extends a serrated clutch face 154 on the opposite side of the clutch block so that the teeth engage teeth on the serrated face 155 of a clutch block 156 keyed to the reel driving shaft 70. It will be noted from this description that a reversal in rotation from the pay-out adjustment automatically disengages the clutch block 143 from the housing 66 and engages the clutch block with the reel driving shaft. In this position of adjustment rotation of the housing 66 in the opposite direction causes the idling miter gears 150 to rotate in a corresponding direction with the housing. Since the idling miter gears mesh with both the miter gears 152 and 153, the stub shaft 69 is rotated in a reverse direction as is also the driven counter-shaft 68. Consequently the pay-out rollers would be rotated in a reverse direction tending to draw in on the cable. The stub shaft 69, being rotated in a reverse direction, forces the reel driving shaft 70 to be rotated in a corresponding direction and thus power is applied to the storage reel so that the storage reel rotates in a direction pulling the cable inwardly and coiling it upon the circumference of the reel. The cable is carried upon the reel by transverse guide pins 157 and during the course of operation the coils upon the storage reel are prevented

from looping outwardly by pins 158 included for reasons of safety.

It will be appreciated that when the storage reel is substantially empty of cable as power is applied to the reel, the cable will be wound around the circumference of the wheel but that the circumference where the cable lies will be relatively small. As the cable begins to build up on the storage reel the circumference of the reel becomes relatively larger as the cable is rolled upon itself so that for a given rate of rotation of the storage reel the circumferential rate of travel is faster and the cable is withdrawn at a correspondingly faster rate. Because of a tight grip of the pay-out rollers upon the cable it becomes necessary to compensate for this change of speed in the rate of rotation of the pay-out rollers. This is accomplished by the interposition of the differential mechanism in the housing 66 which operates on much the same principle as the differential at the rear axle of an automobile. As the speed of withdrawal of the cable 16 tends to increase with the growing circumference of the storage reel, tension is built up in the length of cable between the reel and the nearest pay-out roll. This tension has a tendency to retard the rate of rotation of the storage reel which causes a retardation in the rate of rotation of the large miter gear 153. At the same time because of the fact that the large miter gear 152 is geared to the large miter gear 153, the rate of rotation of the driven counter-shaft 68 tends to increase to a point where the tension on the cable between the storage reel and the pay-out rollers is minimized. As the building up of the coils of cable on the storage reel continues, the rate of withdrawal of the cable constantly varies but this variation is continuously compensated for automatically by the differential mechanism in the manner described. Because of the fact that the grip of the pay-out rollers is maintained upon the cable while the storage reel is being operated, a tension will always be maintained on the length of cable between the storage reel and the pay-out rollers so that there will be no likelihood of the cable slackening or kicking during a reverse operation. This will be true even though the cable may be worked back and forth between pay-out and reel-in positions in order to work the scraper past an obstruction in the pipe. The compensating factors and the reversing operation by virtue of the automatic reversing clutch 67 will always take place automatically so that all of the moving parts will remain in proper operative adjustment.

The automatic drag

To further assure a complete automatic adjustment of all of the parts the automatic drag 125 illustrated in Figure 7 connects and disconnects without the necessity of any manual adjustment. When the cable is being payed out and the reel is running free from the source of power, the reel driving shaft 70 will be rotating counter-clockwise in the direction of the arrows shown in Figure 7. Rotation of the reel driving shaft is transmitted to a brake drum 160 about which are retained an upper brake shoe 161 and a lower brake shoe 162 pivotally secured together by a pin 163. A brake shoe arm 164 connected to the brake shoe 162 includes adjustable screws 165 and 166, the adjustable screw 166 being adapted to engage a stop 167 and the adjustable screw 165 being adapted to engage one end of a lever 168 at a point such that the lever rotating about a pin 169 is shifted so that its end 170 presses downwardly upon the stop 167. The tendency of the brake shoe 162 to rotate will thus be sharply arrested and a slight friction between the brake shoe 162 and the brake drum 160 will be maintained sufficient to retard, without stopping, the rotation of the reel driving shaft 70 and thus exert a retarding effect upon the rotation of the storage reel during a pay-out operation.

When the operation of the device is reversed, rotation of the reel driving shaft 70 is reversed and the reel driving shaft is then driven through the reversing clutch 67 clockwise as viewed in Figure 7. Operating in this direction such initial frictional force as may exist between the brake drum and either the brake shoe 162 or the brake shoe 161 tends to rotate the brake shoe arm 164 directly as well as tending to rotate downwardly a second brake shoe arm 171 attached to the brake shoe 161. This tendency assisted by compression springs 172 and 173 tends to move the brake shoe arm 170 downwardly which tends to move the lever 168 downwardly pressing upon the adjusting screw 165 which in turn tends, through the brake shoe arm 164, to release the brake shoe 162 from frictional engagement with the brake drum 160. The same tendency of the brake shoe arm 164 to move downwardly is transmitted to the brake shoe 161 and its corresponding brake shoe arm 171 but this tendency is again transmitted and with added force to the adjusting screw 165, thus tending to increase the release of the brake shoe from the brake drum. It will be apparent that this action begins to and continues to take place automatically as promptly as the reel driving shaft is reversed. On the contrary, as the reel driving shaft is released from its driving relationship with the reversing clutch block upon a reversal of rotation of the stub shaft 70, the automatic brake or retarding device immediately becomes operative to exert a drag upon rotation of the reel driving shaft and thus maintain a tension upon the cable. Operation in either direction of the mechanism will automatically bring into play the brake mechanism causing it either to brake or release and also will cause the reversing clutch block automatically to take either one of two positions, namely, a position driving the pay-out rollers through a feeding movement or driving the reel through a rewind or take-up movement. The compensating effect of the differential becomes automatically operable upon release of the clutch faces 144 and 145.

In the mechanism thus described there has been provided the cable mechanism adapted to pay out cable to a length as great as can be accumulated on the storage reel while at the same time rotating the cable and assuring a smoothness of operation by elimination of all tendency to create slack which might result in kinks. By reason of the automatic features comprising an automatic reversing differential device and an automatic operable drag a tension is maintained on the cable in a reverse direction as well as in a pay-out or forward direction without it being necessary to release the grip of the pay-out rollers upon the cable. The means thus provided automatically releases the drag upon the reel when power is applied to it for reeling in the cable and effectively compensates for changes in speed of the different rotating parts without it being necessary to disengage any of them and without likelihood of damage to parts of the device which might otherwise result

from excessive tension on the cable. All of the features described and particularly the automatic shift remain operable at all times while the carriage is being rotated in order to rotate the cable and work with equal effectiveness whenever the carriage might be maintained stationary. Rotation of the carriage is separately controlled through an independent transmission and clutch.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claim so as to embrace any and all equivalent devices.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

A reversible cable pay-out and rotating mechanism comprising a carriage, a pay-out roller cage on the carriage, oppositely disposed rollers therein having complementary cable gripping grooves and spring means between the cage and the grooves adapted to press said rollers into contact with the cable in all adjustments of the mechanism, a reversible source of power including a reversible drive shaft on the carriage, a combined clutch and differential device including a two-way clutch and differential gearing subject to operation by the drive shaft, said drive shaft having a permanent connection through the differential gearing to the pay-out rollers and an intermittent connection through the differential gearing to the cable storage reel, an automatically operable friction drag on the cable storage reel having an operative position when the intermittent connection is broken and an inoperative position when the intermittent connection is made, and an automatically reversible clutch arm for the two-way clutch responsive to the direction of rotation of the reversible drive shaft having one position wherein the two-way clutch makes said intermittent connection and another position wherein the two-way clutch breaks said intermittent connection and locks the differential gearing.

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