Dec. 27, 1966 B. L. SIEGAL 3,293,681

SEWER CLEANING MACHINE

Filed Feb. 2, 1966 6 Sheets-Sheet 1

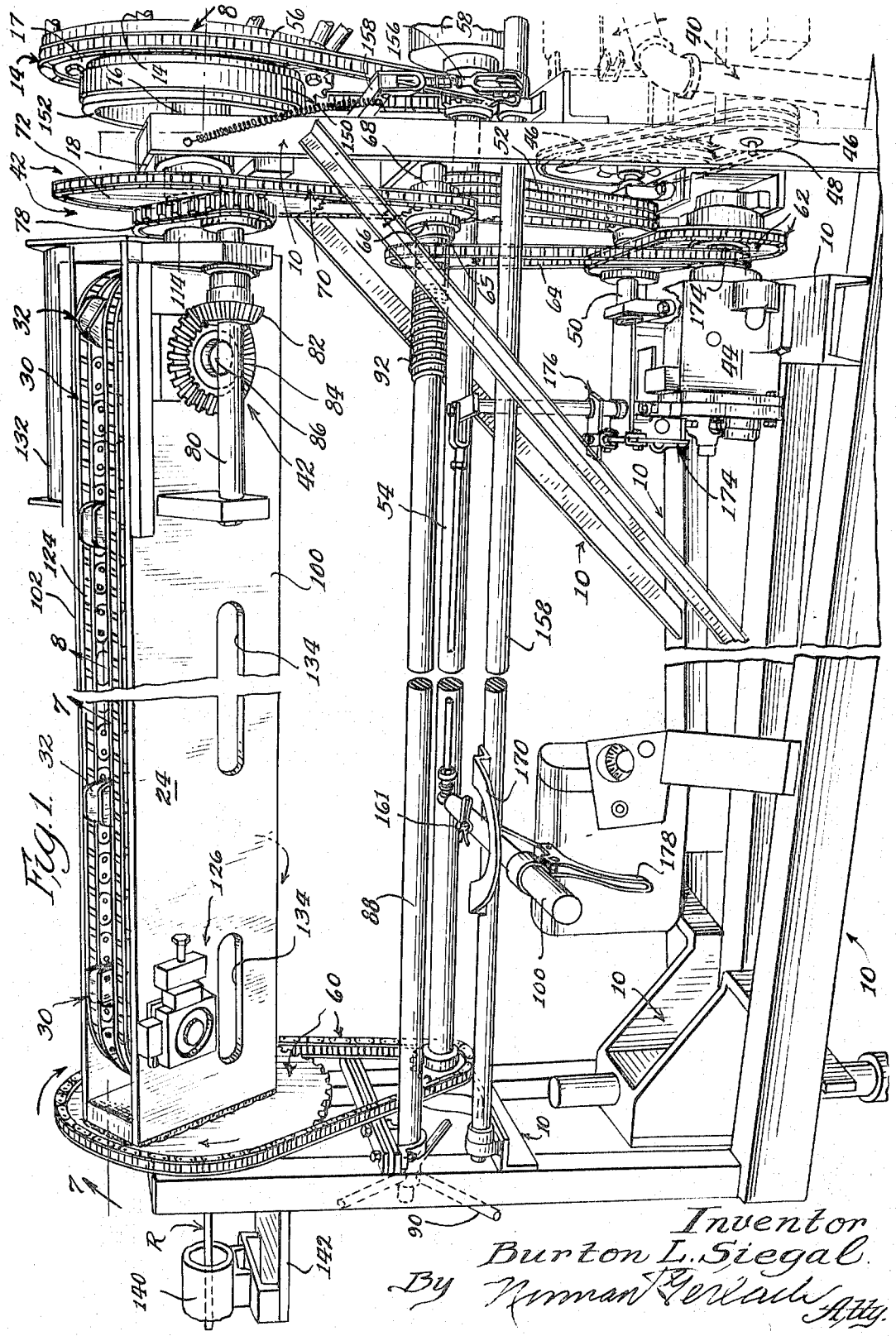


FIG. 1.

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SEWER CLEANING MACHINE

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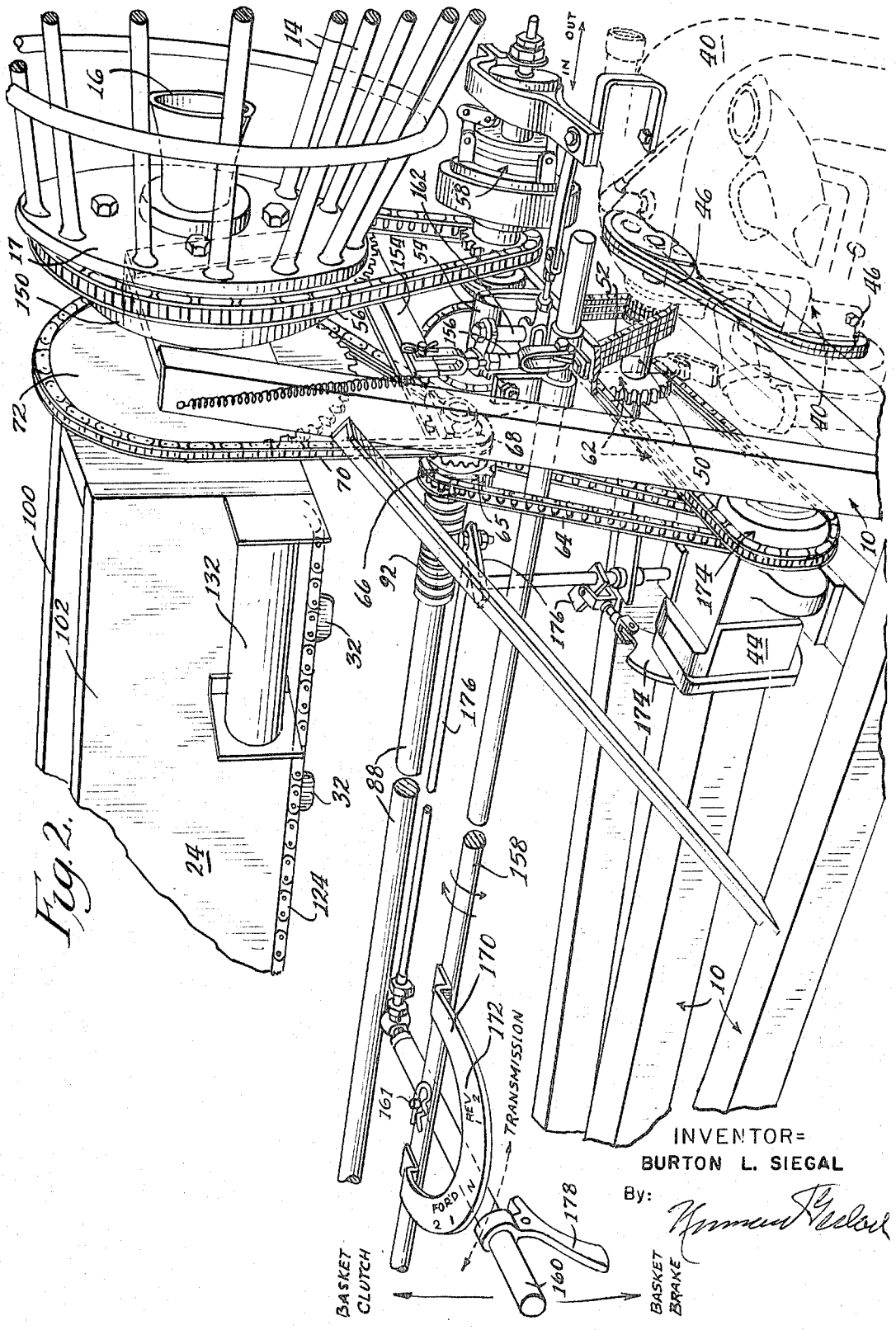


Fig. 2.

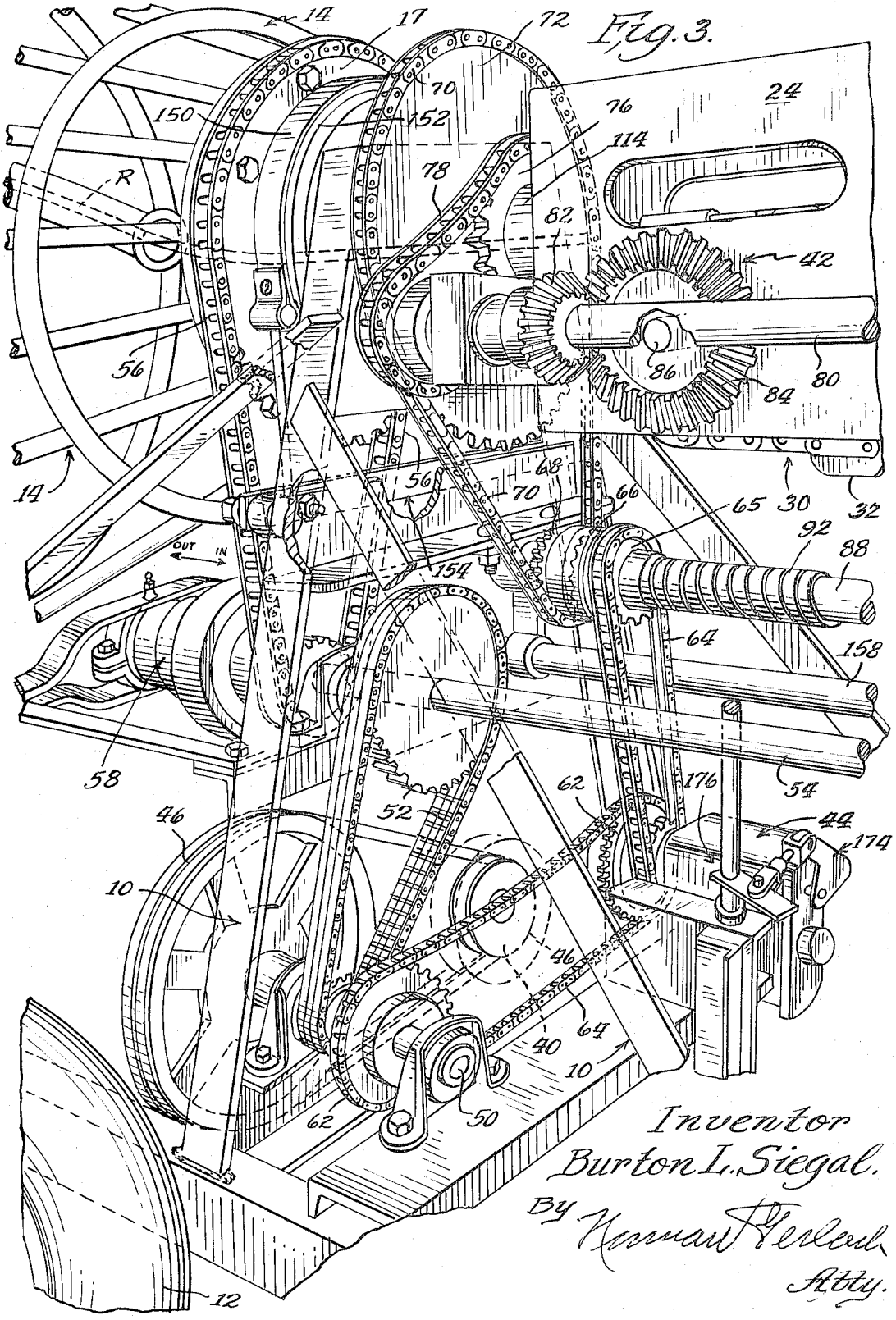
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SEWER CLEANING MACHINE

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Fig. 3.



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SEWER CLEANING MACHINE

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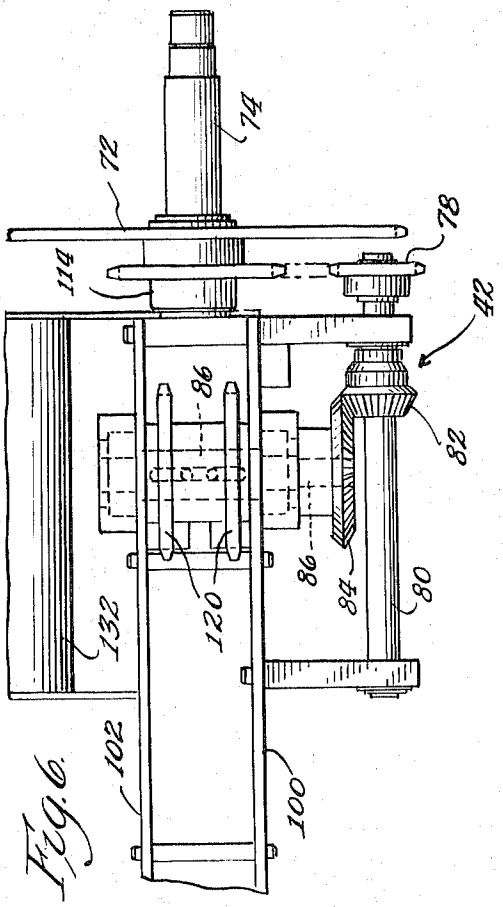


Fig. 6.

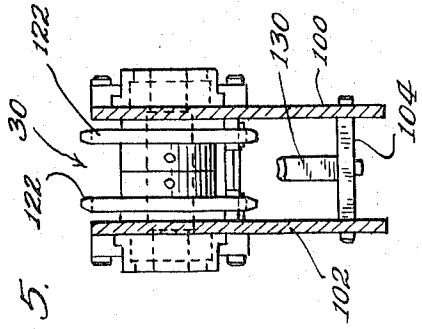


Fig. 5.

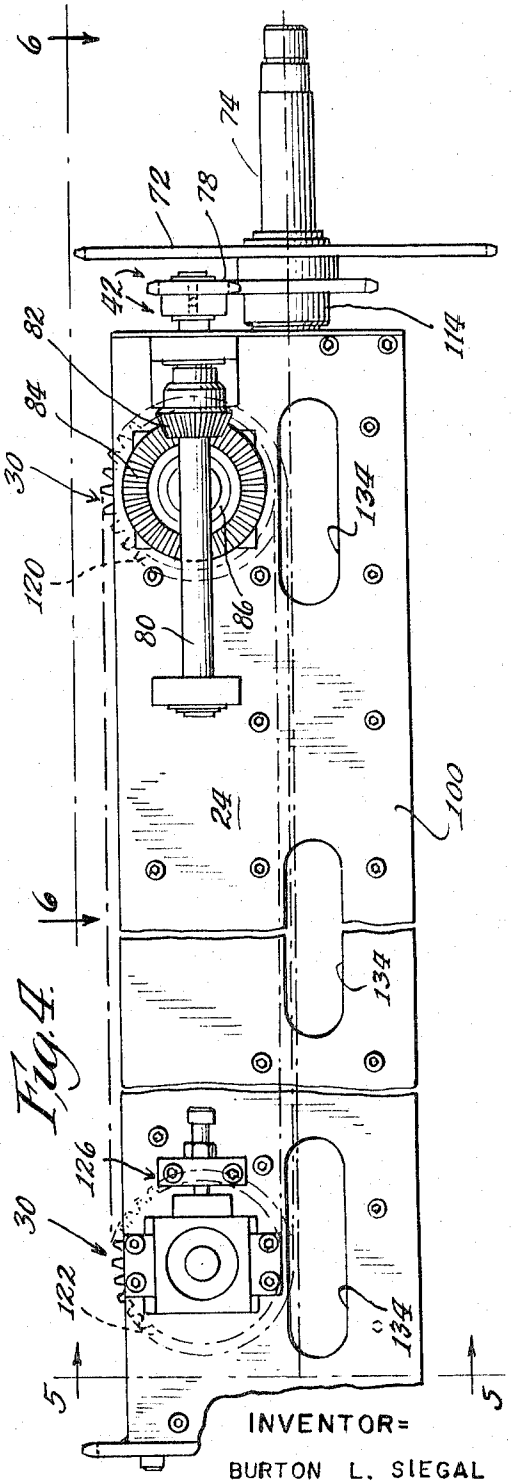


Fig. 4.

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SEWER CLEANING MACHINE

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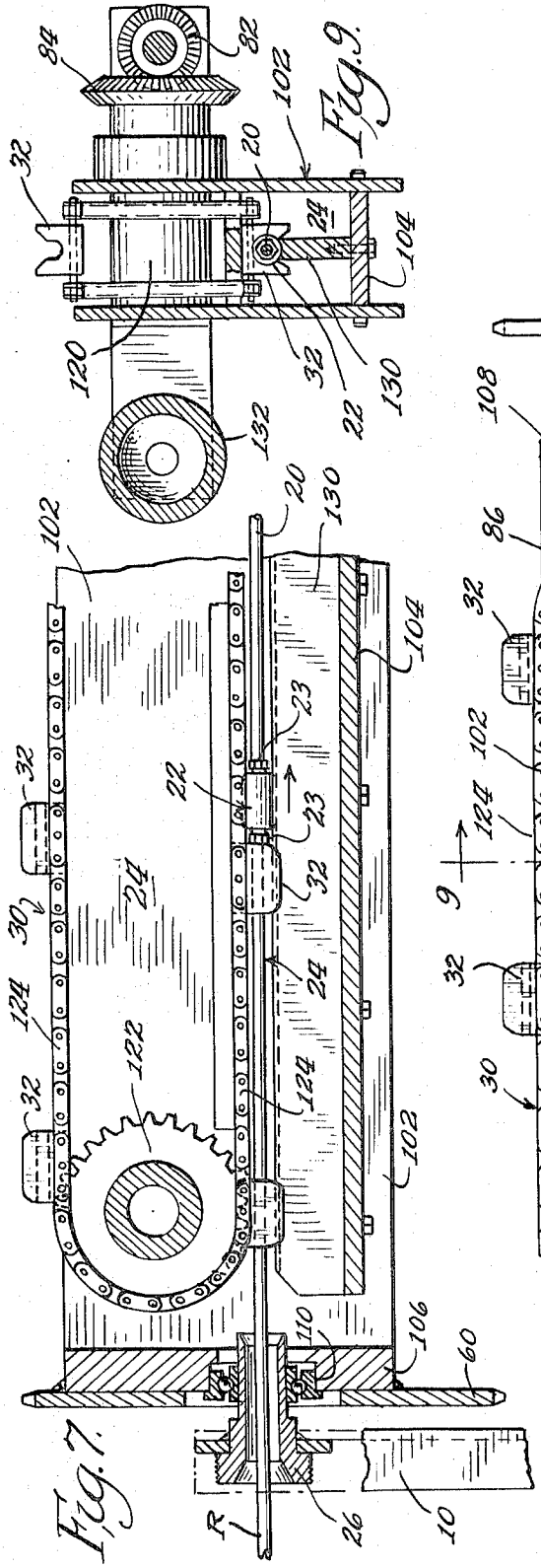


Fig. 7.

Fig. 9.

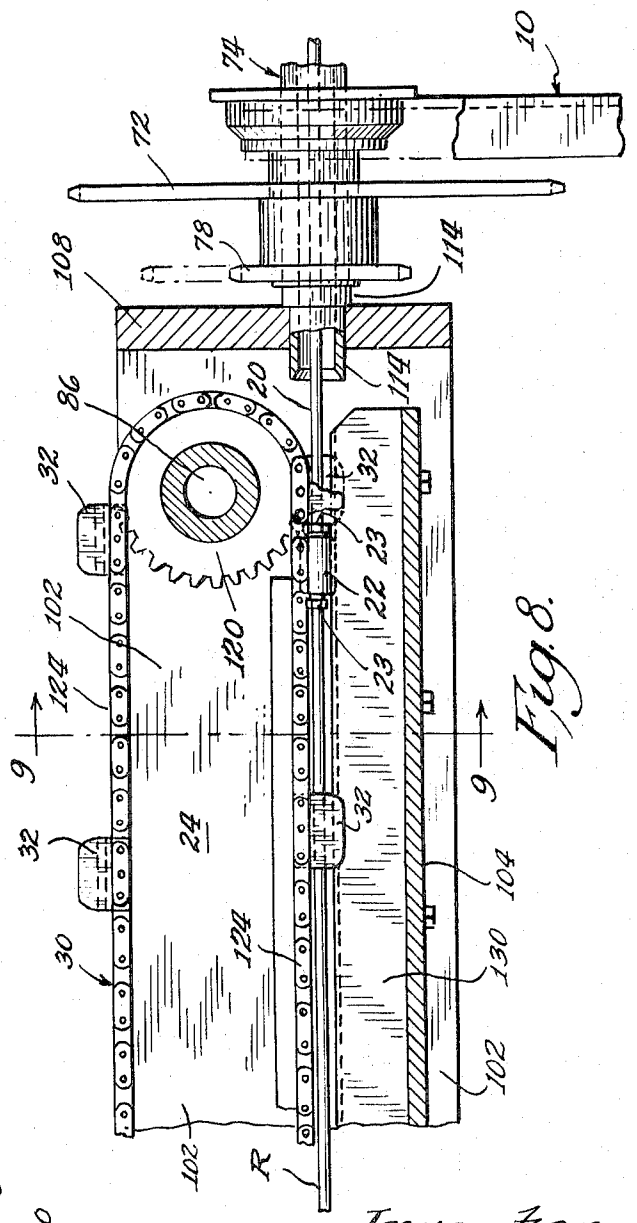


Fig. 8.

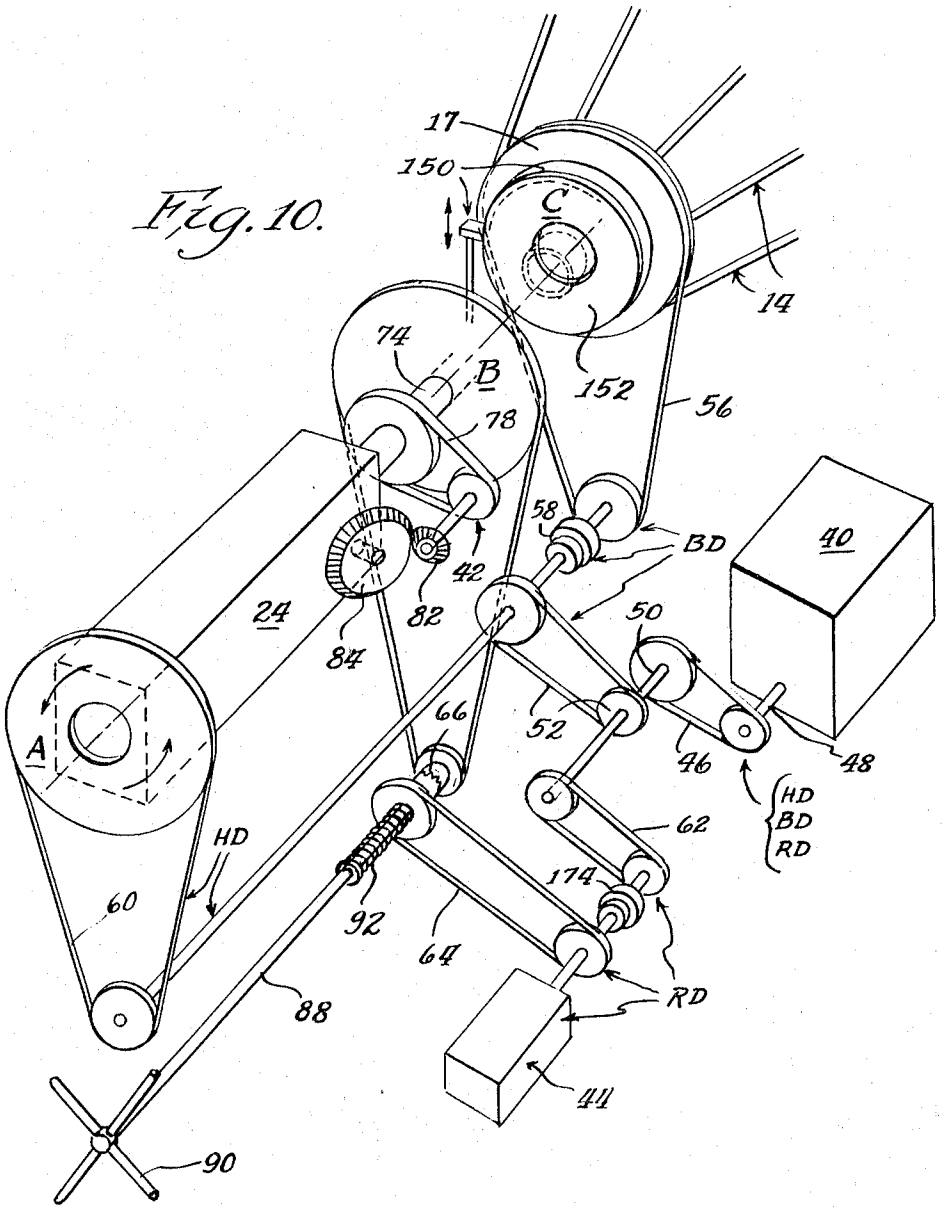
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Dec. 27, 1966 B. L. SIEGAL 3,293,681

SEWER CLEANING MACHINE

Filed Feb. 2, 1966 6 Sheets-Sheet 6

Fig. 10.



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United States Patent Office 3,293,681 Patented Dec. 27, 1966

3,293,681
SEWER CLEANING MACHINE

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Filed Feb. 2, 1966, Ser. No. 524,383
10 Claims. (Cl. 15—104.3)

The present invention relates generally to sewer cleaning machines and has particular reference to a machine of the type which is commonly referred to as a sewer rodder and embodies reversible power-actuated means for feeding a composite flexible steel sewer cleaning rod into a sewer pipe and for retracting the rod from the pipe. A composite sewer cleaning rod of the type under consideration is of fairly standardized design and consists of a series of individual rod lengths or sections with couplers between the adjacent ends of the sections. The rod sections are manufactured in standard lengths, usually in multiples of one foot and, although they may not in themselves exhibit a marked degree of flexibility when they are coupled together to produce a composite sewer cleaning rod of great length, the rod is sufficiently flexible as a whole that it may be coiled or reeled for storage either in or out of the associated machine. Such a composite sewer cleaning rod is put to use by pushing it into or pulling it from a sewer pipe to be cleaned, while at the same time effecting rotation of the rod so that a boring or other sewer-penetrating tool which is carried at the leading end of the rod may become effective within the sewer pipe to loosen the accumulated foreign material and thus pave the way for further and progressive entry of the rod into the sewer pipe.

There is currently on the market a sewer cleaning machine which comprises a wheel-equipped vehicle which is either self-propelled or tractor drawn and in which a comparatively great length of composite sewer cleaning rod is normally stored in a coiled condition within a rotatable cage or basket-like receptacle. The composite sewer cleaning rod is capable of being fed from or returned to the rotating receptacle, and the rotation of such receptacle is relied upon to effect the necessary rod rotation during sewer cleaning operations. A reversible drive unit is employed to effect longitudinal endwise movement of the rotating composite sewer cleaning rod and this drive unit embodies an endless series of pusher blocks which are carried on an endless chain conveyor and have bifurcated or yoke portions that loosely straddle successive rod sections as they move into a straight-away or reach section of the conveyor and slide along the rod sections until such time as they engage the couplers, at which time they force the couplers in one direction or the other without affecting their rotation and thus effect longitudinal shifting of the rotating sewer cleaning rod in the desired direction. It is to this particular type of sewer cleaning machine that the present invention specifically relates.

A sewer cleaning machine of the type under consideration is disclosed in United States Patent No. 3,106,734, granted on October 15, 1963 and entitled "Rod Drive for a Sewer Cleaning Machine." In such machine, as well as in all machines of the same general or character type, the axes of the sprocket wheels for the endless chain conveyor which carries the pusher blocks are fixed while the composite sewer cleaning rod together with its couplings rotate. As a consequence, the pusher blocks on the endless chain conveyor are non-rotatable while the couplers which they engage are rotatable during both in-feed and out-feed of the composite sewer cleaning rod. Such relative rotation between the couplers and the pusher blocks develops friction and, consequently, heat, the amount of heat that is developed when fast feeding or retraction of the sewer cleaning rod prevails being appreciable. The present invention constitutes an improvement over the sewer cleaning machine of the aforementioned patent, as well as over machines of the same general type wherein the conveyor head which supports the drive unit for feeding or driving the pusher blocks is stationary and, accordingly, the invention contemplates the provision of a sewer cleaning machine having a rotatable conveyor head which at all times during normal sewer cleaning operations of the machine, whether for feed-out or feed-in operations, rotates approximately in unison albeit slightly out of phase with the rod-storage receptacle and consequently with the composite sewer cleaning rod undergoing longitudinal movement. By such an arrangement, the speed of rotation of the pusher blocks and that of the couplers between the rod sections of the composite sewer cleaning rod are maintained approximately equal so that frictional forces, and consequently heat generation, is maintained at a minimum.

The sewer cleaning machine of the present invention preserves the same general basic operational features which are present in connection with the machine of said United States Patent No. 3,106,734, and it is designed to operate upon a conventional or standard composite sewer cleaning rod in which the couplers and the rod sections are connected together by threaded connections employing lock nuts against which the pusher blocks on the endless chain conveyor operate for rod-impelling purposes. The lock nuts at the opposite ends of each coupler are of reverse thread pitch so that during either paying out or pulling in of the rod the pusher blocks will exert a frictional force on the nuts tending to tighten them. This feature is preserved in the present sewer cleaning machine but its application is accomplished by entirely different means from that of the earlier sewer cleaning machine of the aforementioned patent. Whereas, in the earlier machine, the rod-storage receptacle rotates in one direction when the composite sewer cleaning rod is being payed out and in the opposite direction when the rod is being pulled in, in the present sewer cleaning machine the receptacle is unidirectional in its rotation. The conveyor head of the present machine also is unidirectional in its rotation and it rotates in the same direction as the receptacle but at a slightly greater speed of rotation. The endless chain conveyor which carries the pusher blocks is adapted to be driven at a controlled rate of speed which is dependent upon the output speed of a differential mechanism embodying two inputs. One of these differential inputs is the constant speed of rotation of the bodily rotatable conveyor head and the other differential input is a variable input which, in the present machine, is obtained from the output of a four-speed transmission. The four output speeds of the transmission are all unidirectional but their ratios are such that the differential output in connection with two of them are forward outputs which cause the pusher blocks to impel the sewer cleaning rod forwardly so as to withdraw the same from the receptacle and feed it to the sewer pipe, and the other two are rearward outputs which cause the pusher blocks to impel the sewer cleaning rod rearwardly and return the same to the receptacle, thus withdrawing the same from the sewer pipe.

By an arrangement of this character, the inertia problems which are prevalent in connection with conventional sewer cleaning machines are almost completely eliminated. According to the present invention, the principal massive components of the machine are unidirectional in their rotation whether the sewer cleaning rod is being fed from or returned to the receptacle. These components are the cage or basket-like receptacle, the sewer cleaning rod within the receptacle, the conveyor head, and all of the gearing or other power train components which are associated with and form operative components of the machine. The only involved reversible mo-

tion is the result of a change in direction of the output of the differential mechanism, this change taking place as a result of a different but unidirectional input feed being applied thereto. Thus, in order to reverse the sewer cleaning rod drive, it is not necessary to resort to stopping and starting up operations as has heretofore been necessary with conventional sewer cleaning machines of the same general type or character.

Despite the fact that no reversal of direction of the rotational movement of the rod storage receptacle, and consequently of the rod itself, is involved, the aforementioned phenomenon whereby the pusher blocks act upon the coupling nuts in a tightening direction is still preserved. A fixed ratio is maintained between the rotation of the receptacle and of the conveyor head whereby the head rotates at a slightly faster rate of speed than the receptacle. These two factors are constant factors and thus during paying out of the composite sewer cleaning rod, the pusher blocks place an impetus on the block-engaged or associated lock nuts tending to tighten them. Conversely, during retraction of the sewer cleaning rod, the pusher blocks (still rotating slightly faster than the rod and in the same direction) bear against the lock nuts at the opposite ends of the couplers. Since these lock nuts are reversely threaded, the same tightening impetus is placed thereon and, moreover, as previously outlined, since the speed of rotation of the pusher blocks is only very slightly greater than the speed of rotation of the sewer cleaning rod, only very small frictional forces are involved and thus heat generation is maintained at a minimum.

These two features of the invention, namely, a material reduction in frictional forces acting on the lock nuts of the couplers and the almost complete elimination of inertia problems constitute the salient features of the sewer cleaning machine constituting the present invention. An additional feature of the present invention resides in the fact that the rod storage cage or basket-like receptacle, although normally operatively connected to the differential input which comprises the drive for rotating the conveyor head, is capable of being disconnected by means of a receptacle clutch. When the receptacle is thus disconnected and remains stationary the conveyor head may be driven and the conveyor mechanism that is carried thereby operated so that the pusher blocks will effect rod-feeding or rod-retracting operations, as desired, with the composite sewer cleaning rod being held against rotation. Such operation of the present sewer cleaning machine is resorted to when short feed-out operations are desired such, for example, as during feeding of the rod from the machine to a sewer entrance or when progressive rod inspection is necessary. More importantly, however, feed-in operations without rod rotation is resorted to in instances where the composite sewer cleaning rod is used for threading purposes as, for example, when it is necessary to pull the rod through a sewer from one sewer entrance to another remote sewer entrance for bucket dredging operations and it is essential that the rod be not rotated during the threading operation.

An additional feature of the present invention resides in the manner in which rod feeding operations in either direction may be terminated, either with or without receptacle rotation. According to the invention, the aforementioned differential mechanism which is associated with the rotatable conveyor head is capable of being operated in a neutral condition wherein no power is applied to its output. Since this output ordinarily constitutes one of the inputs of the differential mechanism, lack of an input to the differential mechanism from this source creates a condition wherein the rotating conveyor head is the only differential input while, at the same time, the reaction force that is exerted by the friction in the power train and by the inertia of the sewer cleaning rod acting against the pusher blocks, maintains these pusher blocks

immobile insofar as their impelling force is concerned with the result that a portion of the differential mechanism acts as an escapement and simply idles while the conveyor head continues to rotate without effect. Stated otherwise, with the differential mechanism in its neutral condition, there is no power at the output of the differential mechanism and this mechanism thus idles freely much in the manner in which an automotive differential mechanism idles when one of the traction driving wheels is elevated from the ground with no forward movement of the vehicle.

The provision of a sewer cleaning machine such as has briefly been outlined above and possessing the stated advantages, constitute the principal object of the present invention. Other objects of the invention and the various advantages and characteristics of the present sewer cleaning machine, not at this time enumerated, will readily suggest themselves as the nature of the invention is better understood from a consideration of the following detailed description.

In the accompanying six sheets of drawings forming a part of this specification, one illustrative embodiment of the invention is shown.

In these drawings:

FIG. 1 is a fragmentary side perspective view of a sewer cleaning machine embodying the improved rod drive mechanism of the present invention, only a portion of the machine chassis being shown in order to avoid needless description of conventional chassis structure;

FIG. 2 is a similar enlarged fragmentary side perspective view of the improved sewer cleaning machine but taken from a different angle;

FIG. 3 is a further enlarged fragmentary side perspective view taken from the opposite side of the machine and illustrating certain parts which do not appear in FIGS. 1 and 2;

FIG. 4 is a fragmentary side elevational view of the rotatable conveyor-supporting head that is employed in connection with the present invention, together with the associated differential mechanism;

FIG. 5 is a transverse sectional view taken on the line 5—5 of FIG. 4, the chains of the endless chain conveyor being omitted in the interests of clarity;

FIG. 6 is a longitudinal sectional view taken on the line 6—6 of FIG. 4;

FIG. 7 is a longitudinal fragmentary sectional view taken centrally and vertically through the conveyor-supporting head and on the vertical plane indicated by the line 7—7 of FIG. 1;

FIG. 8 is a longitudinal sectional view similar to FIG. 7 but on the vertical plane indicated by the line 8—8 of FIG. 1;

FIG. 9 is a transverse sectional view taken on the line 9—9 of FIG. 8; and

FIG. 10 is a perspective view, entirely schematic in its representation, illustrating certain power trains that are employed in connection with the present invention, the power trains being equivalent power trains rather than the actual power trains disclosed in the other views of the drawings.

Referring now to the drawings in detail and in particular to FIGS. 1 to 3, inclusive, the sewer cleaning machine of the present invention is of the same general type that is shown and described in aforementioned United States Patent No. 3,106,734, and reference may be had to such patent for a full understanding of the nature and operation of a sewer cleaning machine having many of the same basic components of the present machine. Briefly, and with reference to the common basic characteristics of the two machines, the present machine involves in its general organization a framework 10, only a portion of which appears in FIGS. 1 and 3 and the rear end of which is supported by means of wheels 12 (see FIG. 3), the front end of said framework being adapted for attachment to a tractor or other propelling

vehicle (not shown). At the rear of the framework 10 there is disposed a relatively large and generally frusto-conical rod-storage receptacle 14 which is commonly referred to in the art as a "basket." The small end of the frusto-conical basket is located adjacent to the framework 10 and has associated with it a guide funnel 16 (see FIG. 2), such small front end of the basket being identified by the reference numeral 17. The basket 14 is rotatably supported at its front end by a bearing 18 (see FIG. 1) at the rear end of the framework 10. The large rear end of the basket is not shown in the drawings and is supported by a suitable bearing arrangement to the end that the basket as a whole is rotatable about its axis.

The basket 14 is adapted to receive therein in a coiled condition a composite sewer cleaning rod R which forms a part of the machine and comprises a large number of elongated rod sections 20 (see FIGS. 7 and 9). Such rod sections are arranged in series form and are joined together in end-to-end relationship by intervening couplers 22. The latter are provided at the ends thereof with lock nuts 23 having screw threads of reverse pitch for a purpose that will be made clear presently. The sewer cleaning rod R may be of comparatively great length, in which case it will consist of a large number of rod sections 20 and intervening couplers 23. The individual rod sections 20 are relatively rigid but they are capable of such limited flexibility that when a large number of them are rigidly connected together in end-to-end fashion by the intervening couplers 22, the composite sewer cleaning rod as a whole is sufficiently flexible as to enable it to become coiled in the basket 14 in a manner well-known in the art, the coiling taking place automatically as the rod is fed back into the basket through the aforementioned funnel 16. Conversely, as the rod is fed forwardly from the basket, the rod becomes automatically uncoiled from the basket. In either instance, the basket 14 usually is rotated during the coiling and uncoiling operations and, as a consequence, the rod is rotated in unison with the basket. Feeding of the rod R in either direction is accomplished by means of a bodily rotatable drive unit or head 24. Such head extends lengthwise of the framework and, as described in detail hereafter, is suitably supported at its ends so that it is rotatable about a horizontal axis.

As is customary in connection with sewer cleaning machines of the type with which the present invention is concerned, a suitable boring, reaming or other tool (not shown) is adapted to be applied to the leading end of the composite sewer cleaning rod R for entry into the sewer pipe undergoing cleaning. The drive unit or head 24 is positioned immediately forwardly of the basket 14, receives the rod directly from the funnel 16, impels the rod forwardly, ejects the rod through an outlet throat tube 26 (see FIG. 7), and projects the rod directly into the sewer pipe during a rod paying out operation. During a rod retraction operation, the head 24 engages the rod, draws the rod forwardly through the throat tube 26, and then forces the rod through the funnel 16 and into the basket 14 where it becomes coiled for storage.

The drive unit or head 24 serves to support a longitudinally extending endless conveyor assembly 30 which in turn supports an endless series of bifurcated pusher blocks 32 in such manner that the pusher blocks 32 when traveling in the straight lower reach of the conveyor assembly straddle the rod sections 20 of the composite sewer cleaning rod R and move into engagement with the lock nuts 24 at the ends of the couplers 22 as shown in FIGS. 7 and 8 and impel the rod R either forwardly or rearwardly, depending upon the direction of movement of the conveyor assembly. Such assembly (see FIGS. 7, 8 and 9) comprises a pair of side-by-side but spaced apart endless chains which extend lengthwise of the head 24 and are supported and arranged

so that they have straight outer and inner reaches. The pusher blocks 32 are disposed between and suitably connected to certain opposed pairs of links of the two chains.

The arrangement of parts thus far broadly considered is common to both the present sewer cleaning machine and that of aforementioned United States Patent No. 3,106,734. Both machines are designed to operate upon a conventional or standard composite sewer cleaning rod by means of bifurcated pusher blocks on an endless chain-type conveyor assembly which is operatively mounted in an elongated box-like drive unit or head through which the sewer cleaning rod is impelled by the pusher blocks. The present sewer cleaning machine differs from that of said patent principally in the construction and operation of the rod-impelling head 24 which, unlike the stationary head of the sewer cleaning machine of the patent, is bodily rotatable in side-over-side fashion about a horizontal and longitudinally extending axis, and which, by reason of its rotation and of its differential rotational relationship with respect to certain other associated rotary devices, performs many of the functional operations of the earlier machine in an improved manner and also performs additional operations which are lacking in the earlier machine.

Still referring to FIGS. 1 to 3, inclusive, the present machine has associated with it three principal power trains, namely, a basket drive for rotating the basket 14, a head drive for rotating the head 24, and a sewer rod feed drive for effecting forward or reverse movement of the pusher blocks 32. These three power trains are powered from a common source of power in the form of an internal combustion engine 40 having the usual engine components and controls including a throttle (not shown) by means of which the speed of the engine may be regulated. The speed of operation of the various power trains will, of course, be a function of the speed at which the internal combustion engine 40 is operated but, for simplification of description herein, it may be assumed that the engine when in operation is maintained at a fixed predetermined speed. These three power trains are schematically illustrated in FIG. 10 but in a somewhat simplified form. The first power train which comprises the basket drive is designated in FIG. 10 as BD and it is a fixed ratio unidirectional drive. The second power train which comprises the head drive is also a fixed ratio unidirectional drive and is designated as HD. The third power train which comprises the sewer rod feed drive is designated as RD and it constitutes one input drive to differential mechanism 42, the output of which is the conveyor assembly 30 which carries the pusher blocks 32. This input drive leads from a four speed variable transmission mechanism 44 and it is also a unidirectional drive. The differential mechanism 42 has a second input drive, this drive being the head 24.

The drive ratios selected for the variable speed transmission 44 are such that either of two of them, when coupled with the head drive input to the differential mechanism 42, establish respective forward speeds for the endless conveyor assembly 30, tending to shift the pusher blocks 32 in a forward direction along the operative straightaway portion or inner reach of the conveyor assembly where they engage the couplers 22. The other two ratios, when similarly coupled with the head drive input to the differential mechanism, establish reverse speeds for the conveyor assembly 30, tending to shift the pusher blocks 32 in a rearward direction along such straightaway portion or inner reach of the conveyor assembly.

The transmission mechanism 44 is also capable of being shifted to a neutral condition where no power is transmitted to the output thereof. In such an instance, the first differential input, i.e., rotation of the head 24 is the only input for the differential mechanism 42. Thus, since the second differential input is in an idling condition and

without power, no impelling force is transmitted through the differential mechanism, to the conveyor assembly 30 and a portion of the gearing of the differential mechanism is free to idle under the reaction force that is applied to the differential output by reason of the inertia of the composite sewer cleaning rod R the couplers of which bear against the pusher blocks and assimilate the small frictional drag of said differential mechanism.

Considering now the various power trains in detail, the basket drive power train BD of FIG. 10 is shown in detail in FIGS. 1 to 3, inclusive. This power train includes a chain and sprocket connection 46 which extends between the output shaft 48 of the engine 40 and a first jack shaft 50, a second chain and sprocket connection 52 which extends between the jack shaft 50 and a second jack shaft 54, and a third chain and sprocket connection 56 which extends between the second jack shaft 54 and the small front end 17 of the basket 14. A clutch 58 is interposed in this power train and when this clutch is disengaged the basket 14 ceases to rotate while the second jack shaft 54 continues to rotate and apply power to the head 24 as will be described presently.

The power train HD for driving the head 24 extends from the internal combustion engine 40, through the medium of the chain and sprocket connection 46, the first jack shaft 50, the chain and sprocket connection 52, and the second jack shaft 54, to a chain and sprocket connection 60 which extends between the second jack shaft 54 and the head 24.

The power train RD which drives the chain-type endless conveyor assembly 30 and, consequently, the pusher blocks 32, is inclusive of the differential mechanism 42 and it also includes a different input train which extends from the engine 40, through the chain and sprocket mechanism 46 and the first jack shaft 50, to a chain and sprocket connection 62. The latter constitutes the input of the aforementioned four speed transmission mechanism 44. The power train RD further includes the transmission mechanism 44 itself and a chain and sprocket connection 64 leading from such mechanism to the yieldable jaw element 65 of a spring-loaded overload jaw clutch 66. The latter has a fixed jaw element 68 which is connected by a chain and sprocket connection 70 to a large differential input sprocket 72 on a shaft 74. A small differential sprocket 76 on the shaft 74 constitutes an element of a chain and sprocket connection 78 which drives a shaft 80 with a bevel gear 82. The latter meshes with a bevel gear 84 on a shaft 86, such shaft constituting the driving shaft of the conveyor 30. The overload clutch 66 is adjustable as to its torque limiting characteristics and, accordingly, an elongated torque-adjusting rod 88 extends forwardly of the machine framework 10 and carries a manipulating handle 90. The rod 88 is threadedly adjustable in the framework 10 to vary the compressional force of a spring 92 which effectively bears against the yieldable jaw element 65 of the clutch in the usual manner of yieldable jaw-type torque limiting clutches.

Considering now the nature of the drive unit or head unit 24, and referring additionally to FIGS. 4 to 9, inclusive, the head is generally of elongated rectangular box-like configuration and includes a pair of spaced apart side plates 100 and 102 which are maintained in their spaced relationship by a spacer plate 104. The head further includes front and rear end plates 106 and 108. The front end of the head 24 is rotatably supported by means of a ball bearing 110 around the outlet throat tube 26, such throat tube being suitably fixedly supported on the front end of the machine framework 10. The rear end of the head 24 is similarly rotatably supported by means of an inlet throat tube 114 which, in effect, constitutes an extension of the rod-guiding funnel 16.

The driving shaft 86 of the endless conveyor assembly 30 is rotatably supported on the side plates 100 and 102 and it carries a dual drive sprocket 120 near the rear end of the head. At the front end of the head a similar dual driven sprocket 122 is rotatably mounted between the side plates of the head 24. The two aforementioned chains of the conveyor assembly 30 are designated by the reference numeral 124, extend around the sprockets 120 and 122, and carry between them the pusher blocks 32 as heretofore mentioned. A conventional chain tightening mechanism 126 (see FIGS. 1 and 4) is provided for maintaining proper chain tension. As previously set forth, the various pusher blocks 32, when traveling along the inner reach of the conveyor chains 124, are adapted to move into a position in straddling relation with respect to the rod R as they enter such lower reach, and to impel the rod either forwardly or rearwardly (depending upon the direction of movement of the conveyor assembly 30) as they engage the adjacent couplers 22.

It is to be noted at this point that the head 24 is rotatably supported so that its rotational axis coincides with the horizontal rotational axis of the basket 14 and also the centers of the throat tubes 26 and 114. It is also to be noted that the inner reach of the conveyor chains 124 likewise coincides with such axis so that, regardless of the angular position that the head 24 assumes at any given instant, this inner reach section of the conveyor chains will be in operative register with the rod R. The pusher blocks 32 which lie within the confines of this inner reach of the conveyor chains 124 are thus constrained to revolve in orbital fashion about the rod R during their endwise travel therealong. To stabilize the conveyor chain, an elongated guide keel 130 is mounted on the spacer plate 104 and enters between the furcations of the pusher blocks 32 when the latter are traveling along the inner reach of the two conveyor chains.

As best seen in FIGS. 1, 2, 6 and 9, a weight 132 is secured to the side plate 102 in order to counterbalance the mass of the bevel gears 82 and 84 of the differential mechanism 42, as well as the weight of their supporting structure. A series of elongated inspection openings in the form of elongated longitudinally extending slots 134 is formed in the side plates 100 and 102 at appropriate places therealong. A forward guide tube 140 on a fixed platform 142 at the front end of the framework 10 constitutes an additional minor functional feature of the present machine.

Referring again to FIGS. 1 and 2, the previously mentioned basket clutch 58 is disposed in interlocked relationship with a basket brake mechanism including a brake band 150 which is adapted to be tightened upon and to cooperate with a fixedly mounted brake drum 152 on the front small end of the basket. Tightening of the brake band 150 is effected under the control of a brake lever 154 which is connected by an adjustable linkage 156 to an elongated brake rod 158. The latter is in the form of a rock shaft which is rotatably supported in the machine framework 10 and extends longitudinally of the machine. Rocking movements of the brake rod 158 may be effected under the control of a radially extending combined brake and clutch lever 160 which has the portion thereof immediately inwards of its inner or proximal end pivoted by a pin 161 to the brake rod 158 and is capable of swinging movement in both vertical and horizontal planes as indicated by the four arrows in FIG. 2. When the outer or distal end of the lever 160 is lowered so as to swing the lever downwards in a vertical plane, the brake rod 158 is caused to rock about its horizontal axis in such a direction as to actuate the linkage 156 and apply the brake band 150 to the drum 152, thereby effecting a braking action on the basket 14. At the same time, a second linkage mechanism 162 is actuated to disengage the basket clutch 58 and disconnect the basket from the power train BD (see FIG. 10). Conversely, when the outer or distal end of the lever 160 is raised, the brake rod 158 is caused to rock in the opposite direction and thus effect release of the brake band 150 through the medium of the linkage 156 and also engagement of the clutch 58 through the medium of the linkage 162.

The combined brake and clutch lever 160, when swung forwards or rearwards with respect to the framework 10, is adapted to cooperate with an indicia segment 170 which is fixedly mounted on the brake rod 158 and has stamped or otherwise marked thereon suitable indicia 172 representing two forward speed drives for the sewer cleaning rod R and two reverse speed drives for the rod, as well as a neutral position for the lever where the rod remains stationary insofar as its longitudinal feed is concerned. These five positions of the lever 160 are apparent by the character of the markings on the segment 170 (see FIG. 2). The four speed transmission mechanism 44 has associated therewith a normally engaged clutch 174 which is operable under the control of a sheathed cable assembly 175, including a pivoted hand grip lever 178 on the outer or distal end of the lever 160. The inner extremity of the combined brake and clutch lever 160 is operatively connected to the four speed transmission mechanism 44 by a linkage 176 in order that forward or rearward swing movement of said lever will serve will serve to shift such mechanism into the five positions thereof. Upon squeezing of the hand grip lever 178, the normally engaged clutch 174 is adapted to become disengaged, this operation being conducted each time a change in the horizontal position of the lever 160 is effected and serving to facilitate shifting operations so far as the transmission mechanism 44 is concerned.

The sewer cleaning machine of the present invention may be provided with additional controls which have not been illustrated herein since they constitute no part of the present invention. For example, the engine 40 is preferably provided with a conventional centrifugal clutch which is ineffective to apply power to the output shaft 48 until the engine crankshaft has attained a predetermined minimum speed. As previously stated, the engine is provided with a suitable control throttle which may be mounted upon the framework 10 at any location that is convenient and accessible to the operator. If the machine is embodied in a self-propelled vehicle, a suitable driven train extending from the engine 40 to the traction wheels 12, together with suitable controls therefor may be provided.

While the operation of the herein described sewer cleaning machine may readily be ascertained by reference to FIGS. 1 to 9, inclusive, FIG. 10, considered alone, affords sufficient basis for an adequate description and, therefore, in order to avoid needless detailed description, reference may be had to FIG. 10 for such a description. In the operation of the machine, assuming the control lever 160 to be in its neutral condition, as soon as the engine 40 is started and caused to run at the desired speed, the previously mentioned power train BD leading from the engine 40 to the clutch 58 and exclusive of the basket 14, will be set into motion. With the clutch 58 disengaged, the basket will remain stationary. At the same time, the complete power train HD will be set into operation and the head 24 will immediately commence to rotate in the direction indicated by the arrows. Such rotation of the head is continuous, unidirectional and at the rate of speed dictated by the setting of the engine throttle. Because the lever 160 is in its neutral position, the transmission mechanism 44 will be in its neutral condition and only that portion of the power train RD that leads from the engine 40 to the input to the transmission mechanism 44 will be set into operation. There thus will be no power output from the transmission mechanism 44 but the large differential sprocket 72 will be constrained to rotate or idle freely at the same rate of speed as that of the head 24 due to the previously described differential phenomenon whereby the inertia of the sewer cleaning rod R acts as a reaction force on the pusher blocks 32 and stalls the differential output, i.e., the conveyor 30, so that idling of the sprocket 72 in unison with the head 24 will take place. It will be understood, of course, that preparatory to operation of the machine for sewer cleaning purposes, the coiled and stored sewer rod R will have been manually pulled from the basket 14 and threaded through the two throat tubes 26 and 114 so as to lie in the path of movement of the pusher blocks 32.

In order to commence rotation of the basket 14, the lever 160 is raised by swinging the same upwardly in a vertical plane, after which it may be restored to its neutral position. This causes the basket clutch 58 to become engaged so that drive of the chain and sprocket connection 56 will commence, thus completing actuation of the entire power train BD.

It is to be noted at this point that the rate of rotation of the basket 14 is slightly less than the rate of rotation of the head 24. This decrease of speed of the basket over that of the head may be accomplished in various ways according to engineering experiences, one way being to utilize sprockets on the second jack shaft 54 which have an equal number of teeth and to provide a sprocket for the terminal basket drive which has a few more teeth thereon than does the terminal sprocket which drives the head 24.

With the basket 14 now rotating at a speed slightly less than the speed of the head, forward rod feeding operations may be instituted by moving the control lever 160 to either of its two forward positions, depending upon the desired rate of rod feed. Such movement of the lever 160 will establish a gear ratio through the transmission mechanism 44 and set the power train RD into operation. Both of the gear ratios through the transmission mechanism 44 are such that the power train RD leading from the transmission mechanism to the sprocket 72 will cause rotation of this sprocket at a rate of speed which is greater than that of the head 24. It is here pointed out that when the speed of the sprocket 72 exceeds that of the head 24, the pusher blocks 32 will travel forwardly along the inner reach of the conveyor chains 124 and impel the rod forwardly to draw the rod R from the basket 14. When the speed of the sprocket 72 is less than that of the head 24, the pusher blocks 32 will travel rearwardly along said inner reach and impel the rod rearwardly to return the same to the basket 14. Exemplary of two gear ratios which may obtain through the transmission mechanism 44 to establish two different forward drives for the rod R are a first gear ratio of 1.85:1 wherein the rod will be impelled forwardly at a rate of 17 feet per minute, and a second gear ratio of 2.76:1 wherein the rod will be impelled forwardly at a rate of 80 feet per minute. These ratios are predicated upon a mean speed of the engine 40 and they will effect a greater or lesser rod feed speed if the speed of the engine is increased or decreased.

In moving the control lever 160 from one position to another for the purpose of changing gear ratios, the hand grip lever 178 will be squeezed in order momentarily to disengage the transmission clutch 174 and thereby facilitate gear shifting operations

Reverse rod feeding operations are effected by shifting the control lever 160 in the manner previously described to either of its two reverse positions, in which case there will obtain through the transmission mechanism 44 a gear ratio which is effective to set the portion of the power train RD extending from the transmission to the sprocket 72 into motion and cause rotation of the latter sprocket at a rate of speed which is less than that of the head 24. As previously set forth, this will result in a reversal of the movement of the conveyor chains 124 so that the pusher blocks 32 carried thereby will travel rearwardly along the inner reach of the conveyor chains and impel the rod R rearwardly and effect coiling thereof in the rotating basket 14. Exemplary of two gear ratios which may obtain through the transmission mechanism 44 to establish two reverse drives for the rod R are a first gear ratio of 1.36:1 wherein the rod will be impelled rearwardly at a rate of 22 feet per minute, and a second gear ratio of 1:1 wherein the rod will be impelled rearwardly at a rate of 95 feet per minute.

Because, as previously set forth, the basket 14 rotates at all times at a speed which is slightly less than that of the head 24, the pusher blocks 32, when moving forwardly and urging the rod R forwardly, will engage the right-hand threaded lock nuts 24 and, by their slow frictional engagement therewith, tend to tighten them in the associated sockets in the couplers. Conversely, when the pusher blocks 32 move rearwardly to retract the rod R, the same phenomenon obtains because the pusher blocks 32 engage the left-hand lock nuts and tend to tighten them in their associated coupler sockets. Little if any heat of friction is generated because of the small speed differential between the pusher blocks and the lock nuts of the couplers.

If it is desired to operate the machine with the rod in a non-rotating condition, it is merely necessary for the operator to depress the control lever 160 and thus disconnect the basket 14 from the power train BD by disengaging the basket clutch 58 through the medium of the linkage 162. Such depression of the lever 160 also operates through the linkage 156 to apply the brake band 150 to the brake drum 152 and thereby stop rotation of the basket. With the basket 14 thus disengaged and in a non-rotating condition, the rod R will not rotate and by manipulating the control lever 160 the desired gear ratio d ive through the transmission mechanism 44 may be imparted to the sprocket 72 to attain the proper differential output for actuating the endless conveyor assembly 30 in either direction, as desired. In such an instance, with the rod remaining in a non-rotating condition, the speed differential between the rotating pusher blocks and the non-rotating rod R will be materially increased. However, the machine is ordinarily operated with the rod R stationary only when the rod is being fed to, or being retracted from, a sewer, or when it is pulling a cable through a sewer for subsequent bucket dredging operations. In such instances, the reaction force on the rod is not excessive.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit or scope of the invention. Therefore, only insofar as the invention is particularly pointed out in the accompanying claims is the same to be limited.

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

1. In a sewer cleaning machine for selectively feeding in opposite directions to and from a sewer or the like an elongated composite sectional rod in the form of a series of alternately arranged rod sections and couplers, in combination, a rod-storage basket adapted to receiving the rod in a coiled condition, having a forward feed aperture for the rod, and rotatable about a horizontal axis passing through the feed aperture, a rod drive unit positioned forwardly of the basket and comprising a reversible chain and sprocket conveyor having its chain provided with a reach section disposed in coextensive horizontal register with the feed aperture, and adapted to receive the rod coextensively therealong for rod-impelling purposes, a series of pusher blocks mounted on said chain and selectively engageable with the leading and trailing end faces of the couplers for impelling the rod to and from the feed aperture, said rod drive unit being mounted for side-over-side rotation bodily about the horizontal axis of said reach section whereby said pusher blocks are constrained to revolve in orbital fashion about the rod in substantial contiguity therewith, a motor for effecting rotation of said drive unit and basket, a first power train operatively connecting the motor and basket, a second power train operatively connecting the motor and drive unit, and a third power train having a reversible output operatively connecting the motor and conveyor for driving the latter in opposite directions.

2. A sewer cleaning machine as set forth in claim 1 and wherein the drive unit and basket are each rotatable unidirectionally.

3. A sewer cleaning machine as set forth in claim 2 and wherein the gear ratio established by said first power train is slightly less than the gear ratio established by said second power train whereby the drive unit is constrained to rotate at a speed slightly greater than the speed of rotation of the basket.

4. A sewer cleaning machine as set forth in claim 2 and including a differential mechanism common to said second and third power trains and having two differential inputs and a single differential output, said second power train serving to feed one of said differential inputs, said third power train serving to feed the other differential input, said reversible output of the third power train constituting the differential output.

5. A sewer cleaning machine as set forth in claim 4 and wherein said third power train includes a variable speed transmission having its input side connected to the motor and its output side connected to said other differential output.

6. A sewer cleaning machine as set forth in claim 5 and wherein said variable speed transmission has an effective speed ratio range effective at a low speed ratio to drive the conveyor in one direction and effective at a high speed ratio to drive the conveyor in the opposite direction.

7. A sewer cleaning machine as set forth in claim 6 and including, additionally, a basket clutch interposed in said first power train and effective upon disengagement thereof to terminate rotation of the basket.

8. A sewer cleaning machine as set forth in claim 6 and including, additionally, a spring-loaded overload clutch interposed in said third power train.

9. A sewer cleaning machine as set forth in claim 6 wherein said first power train includes first and second jack shafts, a first chain and sprocket connection extending between the motor and first jack shaft, a second chain and sprocket connection extending between the first and second jack shafts, and a third chain and sprocket connection extending between the second jack shaft and the basket, and wherein the second power train includes said first and second jack shafts, a fourth chain and sprocket connection extending between the first jack shaft and the input side of the variable speed transmission, a fifth chain and sprocket connection extending between the output side of said transmission and said other differential output.

10. A sewer cleaning machine as set forth in claim 9 and wherein said fifth chain and sprocket connection has interposed therein a spring-loaded overload clutch.

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