April 2, 1963

C. J. PRANGE

RECIPROCATIVE MECHANISM FOR FEEDING SEWER CLEANER DRIVE ROD

3,083,391

Filed March 8, 1961

3 Sheets-Sheet 1

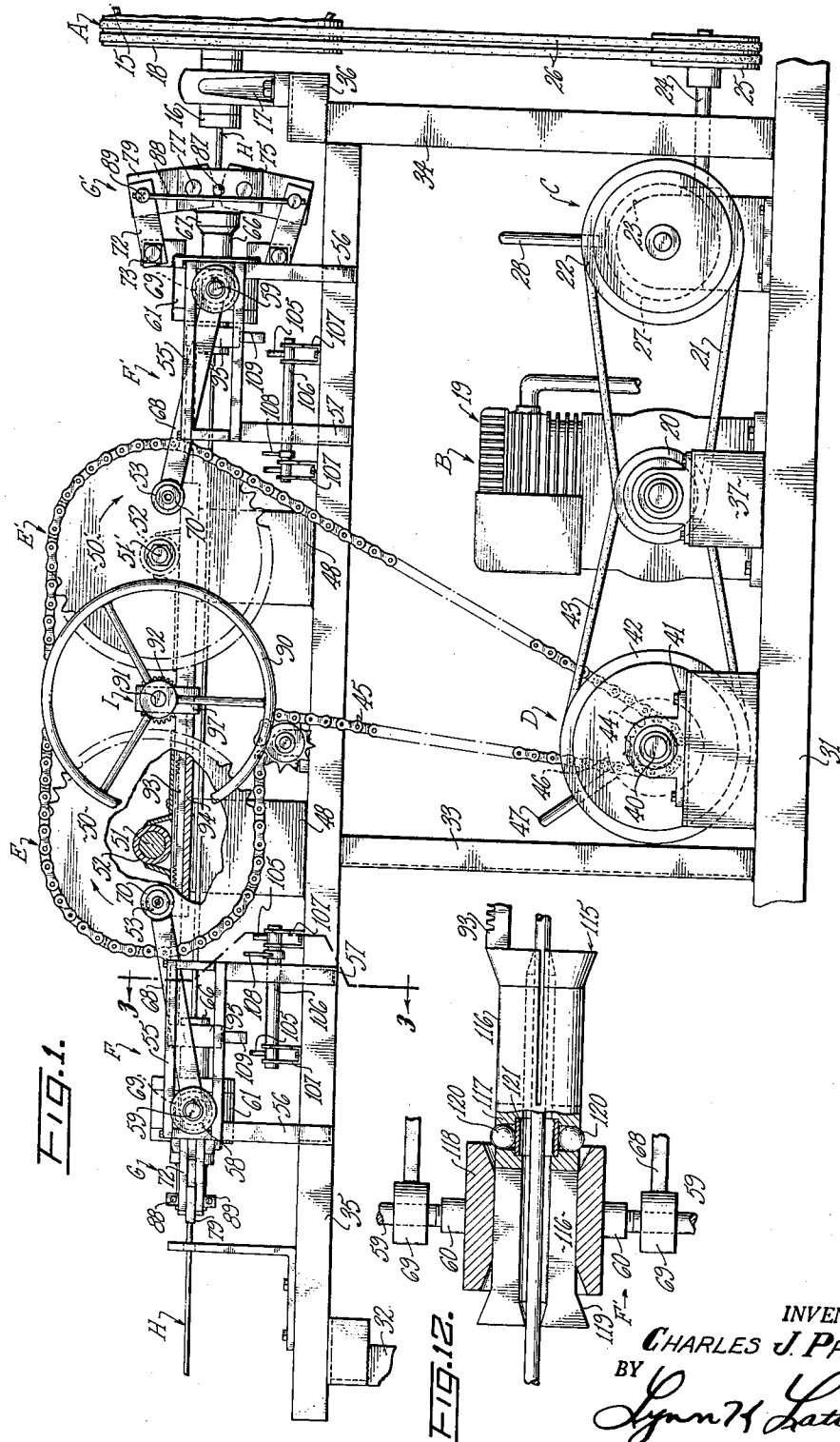

FIG. 1.

FIG. 12.

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3 Sheets-Sheet 2

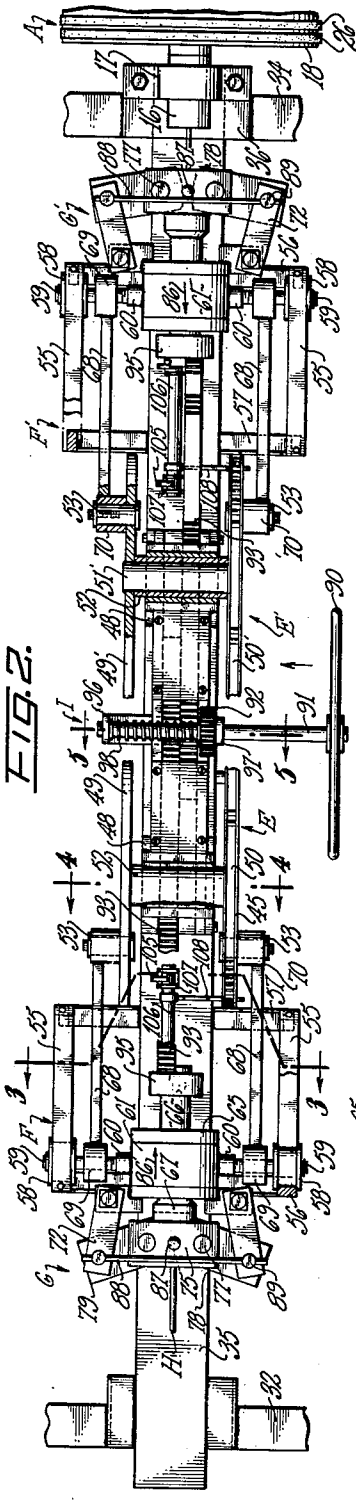

FIG. 2.

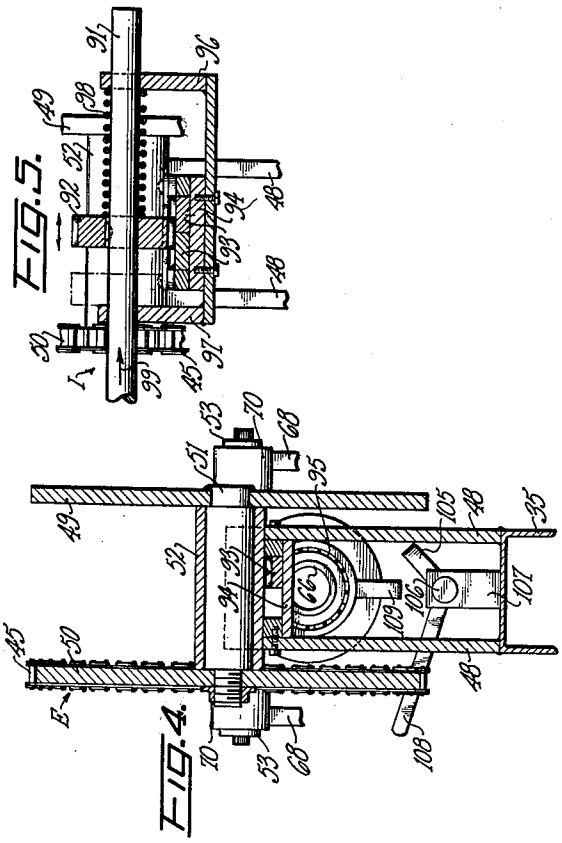

FIG. 5.

FIG. 4.

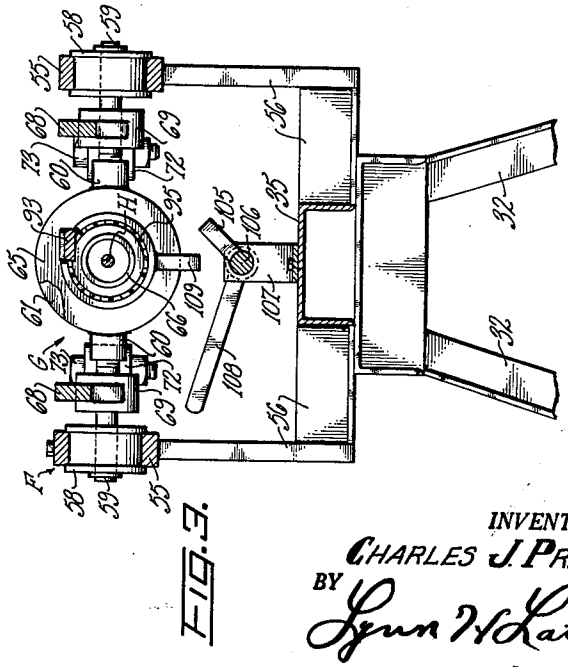

FIG. 3.

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Fig. 6.

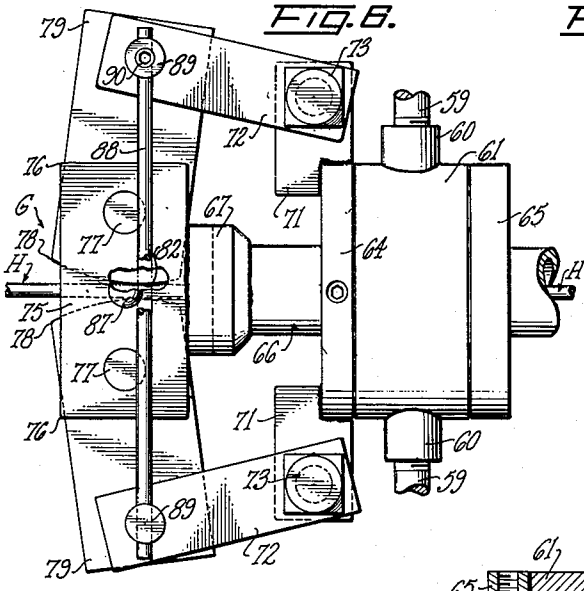


Fig. 7.

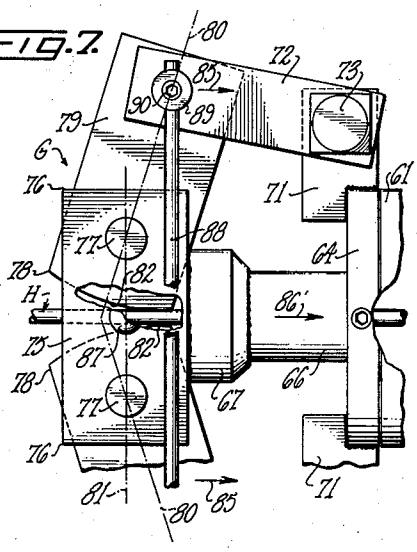


Fig. 8.

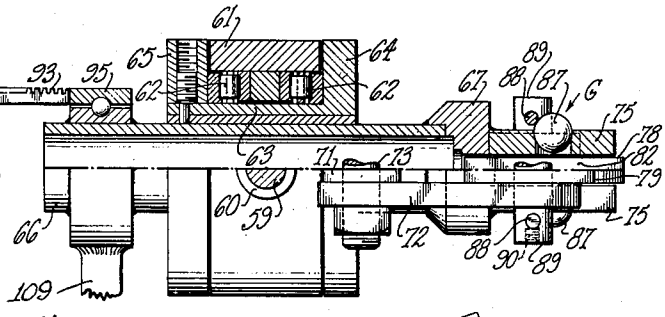


Fig. 9.

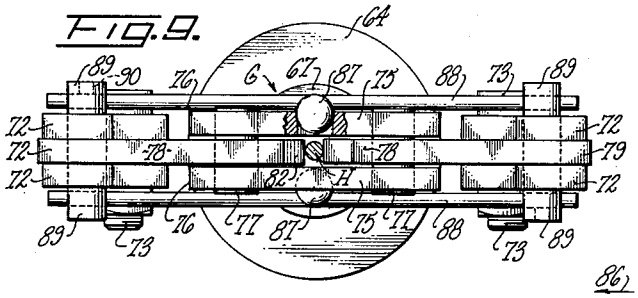


Fig. 10.

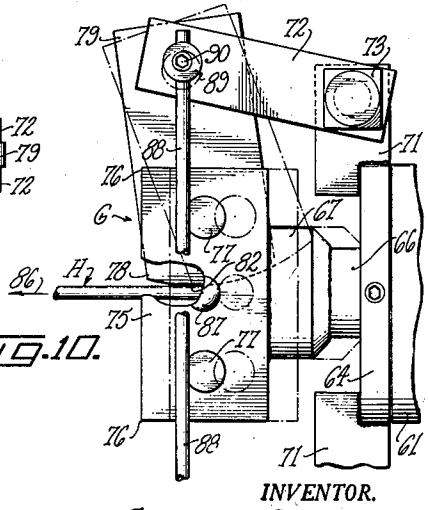
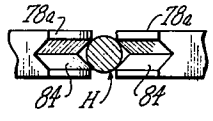


Fig. 11.



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3,083,391

RECIPROCATIVE MECHANISM FOR FEEDING SEWER CLEANER DRIVE ROD

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Filed Mar. 8, 1961, Ser. No. 94,282
19 Claims. (Cl. 15—104.3)

This invention relates to apparatus for feeding into a sewer line, a rotating drive rod carrying at its forward end a sewer cleaning tool. The present invention provides a reversible apparatus for feeding the rod forwardly into the sewer and withdrawing it from the sewer, and it may or may not embody, in addition, means for transmitting rotation to the drive rod, the apparatus being operable to simply effect the linear feed of the drive rod while another piece of apparatus transmits rotary drive thereto. The general object of the invention is to provide a reversible drive rod feeding apparatus utilizing a reciprocating head having a one way, releasable rod-gripping device which intermittently grips the rod at the beginning of a working stroke, moves the rod linearly to the end of the working stroke, and releases the rod during a return stroke.

A particular object of the invention is to provide such a rod feeding apparatus wherein the rod-gripping head is adjustable to reverse its gripping action and to reverse its cycle of feeding and return strokes so as to effect a reversal of the direction in which it feeds the rod. Further, the invention aims to provide such a reversing mechanism which is operable quickly and easily.

Another object is to provide a reciprocating drive rod feed apparatus wherein continuous feed of the drive rod in either forward feed or retracting feed is effected by utilizing two feed heads arranged for alternate feeding operations in a common direction of feed, each head being operative throughout a full half cycle of operation of the apparatus, and each head effecting its return stroke during a half cycle in which the other head is effecting a feed operation.

One of the disadvantages of existing drive rod feed apparatus is in their lack of adaptability to the use of overload release mechanism therein. For example, in those machines wherein forward feed of the drive rod is generated by the rotation of the reel unit (e.g. unit A of the apparatus shown herein) the stretch of drive rod extending back to the reel is too flexible to transmit a back load (generated from an obstruction blocking forward feeding movement of the drive rod) sufficient to actuate an overload release clutch or equivalent device. The present invention provides for the first time in a drive rod feed apparatus, an arrangement that will satisfactorily operate an overload release device in the drive transmitting portion of the device, to effectively avoid jamming or damage to the apparatus.

Other objects and advantages will become apparent in the ensuing specifications and appended drawings, in which:

FIG. 1 is a side elevational view of a drive rod feed apparatus embodying the invention, parts being broken away and shown in section;

FIG. 2 is a plan view of the apparatus;

FIG. 3 is a vertical transverse sectional view thereof, taken on the line 3—3 of FIG. 2;

FIG. 4 is a detail transverse sectional view taken on the line 4—4 of FIG. 2;

FIG. 5 is a detail transverse sectional view taken on the line 5—5 of FIG. 2;

FIG. 6 is a fragmentary plan view of one of the drive

heads with portions broken away to illustrate the rod-gripping jaws in non-driving position;

FIG. 7 is a fragmentary plan view of the same driving head with portions broken away to show the jaws in rod-gripping position;

FIG. 8 is a detail side view of the other feed head with the upper portion thereof shown in axial section;

FIG. 9 is an end view of one of the feed heads;

FIG. 10 is a fragmentary plan view of a feed head with the jaws shown in non-gripping and gripping positions in full lines and broken lines respectively;

FIG. 11 is a fragmentary end view of a pair of gripping jaws of modified form; and

FIG. 12 shows a modified form of feed head.

General Description

Referring now to the drawings in detail, and in particular to FIGS. 1 and 2, I have shown therein, as an example of one form of apparatus in which the invention may be embodied, the linear feed portion only of an apparatus for rotating and continuous, reversible feeding of a sewer tool drive rod. A fragmentary portion of the reel apparatus for storing and rotating the drive rod, located at the rear end of the feed apparatus, is indicated at A; a prime mover for driving both sections of the apparatus, is shown schematically at B; and means for controllably transmitting drive from the prime mover B to the rotating apparatus A is shown schematically at C.

In general, the rod feed apparatus comprises a controllable drive transmitting unit, shown schematically at D; a pair of rotating eccentric drive units E and E' driven in unison through the transmitting unit D; a pair of reciprocating drive transmitting units F and F' pitman-driven from the respective eccentric drive units E and E'; a pair of feed heads G and G' connected to the respective reciprocating drive units F and F' through swivel couplings which permit them to rotate with the drive rod while being reciprocated axially by the respective drive units F, F', and adapted to alternately grip the rotating drive rod and feed it in a common direction of feed in respective alternate half cycles of rod feeding operation collectively providing a continuous feed of a drive rod H in a selected feed direction; and reversing mechanism I for reversing the direction of feed by adjusting the respective feed heads G, G'.

Detailed Description

Rotary drive reel unit A may be of a known type such as that shown in Ciaccio Patent No. 2,544,256, issued March 6, 1951, wherein the drive rod is stored in a reel comprising the large diameter rear end portion of a conical drive cage having a relatively small diameter forward end fragmentarily indicated at 15, terminating in a tubular hub 16 which is suitably journalled in a pillow block bearing 17. The forward end of the reel cage also includes a drive pulley 18 to receive drive from the reel drive unit C.

Power plant B may be a gasoline engine 19 having a crank shaft driving a plurality of drive pulleys 20 from one of which the reel drive unit C may be driven through a belt 21 and a pulley 22.

Reel drive unit C may comprise any suitable reduction unit indicated at 23, receiving drive from the pulley 22 and transmitting it through a driven shaft 24 at a greatly reduced speed, to a relatively small drive pulley 25 driving the relatively large reel pulley 18 through a belt or belts 26.

Suitable clutch mechanism, indicated schematically at 27, is incorporated in the reel drive unit C, for establishing and interrupting the drive from power plant B to the reel unit A, and may be controlled by suitable clutch actuator means indicated schematically as a lever at 28.

Frame structure for the apparatus may include a base 31, forward and intermediate standards 32, 33 and 34 secured thereto and rising therefrom, and an additional standard (not shown) at the rear end of the machine for supporting the rear end of the reel unit A; and a bed 35 for the feed apparatus, supported on the upper ends of standards 32, 33 and 34. Bearing 17 for the forward end of the reel unit may be supported on a suitable bracket 36 at the rear end of bed 35. Drive units B, C and D are supported on the base 31 below the bed 35 in an arrangement generally as indicated in FIG. 1. A pillow block 37 may be mounted in laterally spaced relation to power plant 19 for supporting the outer end of its crank shaft. It may be noted, by reference to FIGS. 2 and 3 that the feed apparatus is relatively narrow, that the bed 35 may consist in simply a single beam of inverted channel iron, that the base 31 may be somewhat wider, and that the standard 33 may consist in pairs of downwardly spreading legs as indicated in FIG. 3. For supporting the bearings of units E, E', the frame further includes laterally spaced pairs of support legs 48 secured to beam 35 at respective sides thereof and projecting upwardly (FIG. 4).

Feed drive unit D may comprise a countershaft 40 mounted in pillow blocks 41 on frame base 31 and having a pulley 42 driven by a belt 43 from one of the crank shaft pulleys 20 of prime mover B. Mounted on countershaft 40 is a small drive sprocket 44 which drives through a chain 45 to a pair of relatively large sprockets driving both of the eccentric units E, E'. The drive unit D also incorporates a suitable clutch unit, indicated schematically at 46, for establishing and interrupting the drive from power plant B to the feed apparatus. The clutch actuator is indicated schematically, as a lever, at 47. It will be understood that the clutch unit 27, 28 and 46, 47, may include not only clutch mechanism but also speed ratio change apparatus for selecting different drive ratios, and that the actuator linkage may be more complex than that shown. However, since the details of the units C and D form no part of the present invention, the simple schematic showing illustrated in FIG. 1 is employed to illustrate the broad combination of individually controllable drive from a single power plant to the rotating and feeding sections of the apparatus.

Eccentric drive units E, E' comprise respective pairs of eccentric discs 49, 49' and 50, 50' (FIG. 2) mounted on respective shafts 51, 51' which in turn are journalled in pillow block bearings 52 mounted upon the upper end of support legs 48 (FIG. 4). Discs 50, 50' also constitute sprockets, driven by drive chain 45. It may be noted that the operating shafts of units B, C, D, E and E' are mounted for rotation on respective axes extending transversely of the machine, with the shafts 51, 51' being disposed transversely just above the longitudinal path of travel of drive rod H as it passes through the feed apparatus; whereas the reel unit A and its tubular hub 16 (which provides a throat from which the drive rod H issues) is disposed coaxial with the feed path of drive rod H.

Each of the eccentric drive units E, E' is provided with a respective eccentric drive trunnion 53 which may be mounted directly in a respective sprocket 50, 51', projecting laterally therefrom.

Reciprocating drive units F, F' each comprises a pair of transversely spaced, longitudinally extending slideways 55 of rectangular box frame form supported upon respective pairs of forward and rear brackets 56, 57 respectively of L-form (FIG. 3) including horizontal arms secured to and projecting transversely from respective sides of the bed 35, and vertical arms rising from the outer ends of these horizontal arms, whereby the slideways 55 are offset laterally from the side of bed 35. Each of the slideways 55 includes vertically spaced parallel rails. Each of the reciprocating drive units F, F' further includes a slide head assembly comprising a pair of slide bearings 58, mounted on the outer ends of respective studs 59 the inner ends of which are anchored in diametrically opposed bosses 60 of a hub spider which includes a cylindrical collar 61. Referring now to FIG. 8, wherein the collar 61 is shown in axial section, it constitutes the peripheral casing of a swivel bearing embodying a pair of axially spaced end thrust bearings 62 which are mounted between the collar 61 and a two part containing collar of channel section comprising a cylindrical sleeve 63, and an integral radial flange 64 on one end thereof and a retainer flange 65 of flat ring form detachably secured to the other end thereof as indicated. Sleeve 63 is mounted for axial sliding movement upon a spindle 66 which is tubular so that the drive rod H can feed longitudinally therethrough. To one end of spindle 66 is secured a neck fitting 67 for mounting a feed head G. It may now be noted that the spiders 60, 61 of the drive units F, F', non-rotatably carried by the slide mechanism 55—58, are adapted to transmit axially reciprocating movements to the feed heads G, G' carried on respective spindles 66, and to permit free rotation of the spindles 66 in the swivel bearing 61—65 so that the feed heads G, while gripping the drive rod 11 and feeding it axially, may freely rotate with the drive rod as the latter is rotated by reel unit A.

Reciprocating movement is transmitted to hub spider 60, 61, by pitmans 68 each having at one end an eye 69 encircling a respective stud 59 and at its other end a bushing 70 receiving a respective eccentric drive trunnion 53 of a respective eccentric drive unit E, E' to provide a pivotal drive connection therewith. Thus, rotation of the sprockets 50, 50' develops reciprocating movement which is transmitted simultaneously to the feed heads G, G' through the reciprocating drive units F, F'. The sprockets 50, 50', in the arrangement shown, are rotated in the same direction by the drive chain 45. It is immaterial whether this direction is clockwise as viewed in FIG. 1, as indicated, or is anti-clockwise and in fact, the sprockets can as well be rotated in opposite directions by a suitably modified drive. However, it is important that the sprockets 50, 50' be driven in a manner such that their eccentric drive trunnions 53 will always maintain the same angular rate of travel and will always reciprocate the feed heads, G, G' in such a manner that they will continuously move in opposite directions. To more clearly illustrate this point, the eccentric trunnions 53 are shown in FIG. 1 at a starting point in a half cycle of operation wherein the feed heads G, G' have reached their outward limits of movement away from one another and are just commencing to return toward one another to inward limits of movement determined by the arrival of eccentric trunnions 53 at positions of maximum closeness of approach, positioned between and aligned with the centers of sprockets 50, 50'. Thus, in the operation of the apparatus, the respective feed units G, G' will move in the selected feed direction in alternate half cycles of operation, and consequently, at all times one or the other of the feed heads will be driving in the selected direction while the other feed head is executing a return movement.

Secured to diametrically opposite sides of collar flange 64 (FIG. 7) are radially projecting ears 71 for transmitting reciprocating movements to the associated feed head G or G' through pairs of push-pull links 72 connected to respective ears 71 by pivot bolts 73.

Feed heads G, G' each comprise a hub spider consisting of a pair of transversely elongated plates 75 each secured at the center of its one side to a respective neck fitting 67. The two plates 75 are disposed in parallel relationship and in equal spacing on opposite sides of the axis of spindle 66, forming a cross-head which provides two clevises 76 that are diametrically opposed across the spindle axis. Mounted in the respective clevises, and pivoted thereto on pivot pins 77, are opposed clutching jaws 78 which have respective integral tail levers 79 projecting outwardly from pivots 77 in approximately dia-

metrically opposite directions, such that the longitudinal axes of the jaw-tail lever elements (indicated by broken lines 80 in FIG. 7) may be shifted to opposite sides of "dead center" relationship to the common transverse axis of pivot pins 77, indicated by the broken line 81. Jaws 78 have clutching surfaces 82 (FIG. 7) constituting the inner end surfaces of the straight bars constituting the jaw-tail lever elements and thus disposed in adjacent opposed relationship for clutching engagement with diametrically opposite sides of the drive rod H. The clutching surfaces 82 are arcuate, are each symmetrical across the respective jaw axis 80 so that opposite corners of the jaws 78 are equidistant from the respective pivot 77, and may be contoured as arcs of circles having centers disposed on the respective jaw axes 80 at substantial distances outwardly from the pivots 77, so that the central areas of the clutching surfaces 82, at the jaw axes 80, will remain clear of contact with the drive rod H as the jaws swing "over center" with respect to the transverse pivot axis 81. It will now be apparent that, from its respective jaw axis 80, a clutching surface 82 will extend laterally in both directions, spirally (or on a loxodromic curve) of progressively increasing radius from the respective pivot 77, whereby on both sides of the jaw axis 80 there is provided a clutching surface adapted for clutching engagement with a respective side of drive rod H and cooperative with a paired clutching surface of the opposite jaw to grip the drive rod for feeding it in one direction or the other in response to tilting of the tail levers 79 in one direction or the other with respect to the longitudinal axis of drive rod H, followed by the application of leverage to the tails 79 such as to press the respective pair of clutching surfaces tightly against opposite sides of the drive rod.

The invention provides for developing such leverage by a pull (or push) applied in a common direction to the outer ends of tail levers 79 through a respective reciprocating drive unit F or F', which is initially effective to swing the pair of clutching surfaces 82 toward one another from a non-clutching spacing into engagement with the drive rod H, and upon continued application of movement from the respective reciprocating drive unit in the same direction, to pull the drive rod H along with the feed head to the end of the feed stroke. For example, a pull applied to tail levers 79 in the direction indicated by arrows 85 in FIG. 7 will effect tilting of the tail levers to the corresponding side of the transverse pivot axis 81, resulting in bringing the clutching surfaces 82 on that side of the jaws 78 inwardly into clutching engagement with drive rod H as indicated in FIG. 7, and thereupon, continued movement of the feed head will effect feeding at the drive rod in that direction (withdrawal into reel) as indicated by the arrow 86', until the end of the reciprocating stroke in that direction is reached. Then, as the reciprocating drive unit reverses its direction of movement, commencing to transmit a push to the tail levers 79 in the opposite direction, the first effect will be to tilt the tail levers 79 back toward the transverse pivot axis 81, drawing the engaged clutching surfaces 82 away from contact with the drive rod H and releasing the same so that the other drive head, just commencing its half cycle of feed operation, can establish clutching engagement with the drive rod H and feed it in the direction 86' through its respective half cycle of feed operation, without restraint from the drive head that has just completed its feed stroke.

In the movement of the jaw-tail lever units in the release direction, the tail levers will approach but will not arrive at registration with the transverse pivot axis 81. They are arrested at a position short of such registration, and are held there in a full release position for the full return stroke of the respective drive head. To this end, the invention provides a stop mechanism comprising a stop projection 87 in the center of each of the cross head

plates 75, and a coacting stop bar 88 the respective ends of which are anchored in pivot studs 89 mounted in the outer ends of the respective tail levers 79. The ends of the stop rods 88 are extended through diametral bores in the pivot studs 89. One end of the stop rod 88 may be secured in its respective stud 89, as by means of a set screw 90, while the other end of the respective rod 88 is freely slidable in its respective pivot stud 89, as indicated in FIG. 6, to accommodate the variation in transverse spacing between the pivot studs 89 as they swing arcuately around the pivots 77. The stop projection 87 intersects the plane of movement of the respective stop rod 88 as it shifts parallel to the axis of drive rod H in response to tilting movements of tail levers 79, and obstructs the path of movement of rod 88 sufficiently to effectively arrest the movement of the tail levers toward alignment with transverse pivot axis 81, normally preventing an "over center" movement. However, for the purpose of reversing the drive, the stop rods 88 are of spring metal, the stop projections 87 present crowned (e.g. segmental spherical) surfaces, the surfaces of stop rods 88 are also curved (e.g. cylindrical) and the extent of intersection of the surfaces of projection 87 and the path of movement of the opposed surface of stop rod 88 is such that, by the application of a substantial amount of force, the stop rod 88 will be cammed to an outwardly bowed condition in which it will pass over the stop projection 87, thus crossing "dead center" and permitting the tail levers 79 to tilt in the opposite direction with respect to transverse pivot axis 81, to bring the alternate pair of clutching surfaces 82 into positions for clutching engagement with drive rod H, for feeding the rod in the reverse direction. Stop projections 81 may be formed as hardened steel balls (e.g. bearing balls) set tightly, as by press fitting, into cylindrical bores in cross head plates 75, as indicated in FIG. 9.

FIG. 10 illustrates in full lines the release position of the jaws 78, and in dotted lines, the driving position for feeding the drive rod H in the forward feed direction indicated by arrow 86'.

Each of the pivot studs 89 serves the primary function of providing a pivotal connection between respective pairs of push-pull links 72 and the outer end of a respective tail lever 79.

Clutching faces 82 may be of cylindrical surface contour as indicated in FIGS. 6 and 9, or, as indicated in FIG. 11, may be arranged as opposed frusto-conical surfaces having circumferential configuration corresponding to that of the surfaces 82 and defining between them, V-grooves 84 as indicated in cross section in FIG. 11, the modified jaws being indicated at 78*a*.

Modified feed head construction may be employed in lieu of that described above. For example, a collet type of reversible unidirectional feed mechanism, as shown in FIG. 12, may comprise a double-ended collet-jaw sleeve 115 consisting in circumferential arrays of spring jaws 116 extending axially in both directions from a waist 117, and a closer collar 118 encircling the sleeve 115 and carried by a reciprocating drive assembly F' similar to the drive units F disclosed in FIGS. 1–3 as indicated by corresponding numerals designating corresponding parts. Collar 118 may have a cylindrical bearing throat receiving and supporting the sleeve 116, and slidable selectively on either end thereof, between limits determined by alternate engagement with the conical shoulders 119 at the ends of the jaw and with stop balls 120 mounted in radial bores in the waist 117 and spring-loaded outwardly by a cylindrical split ring 121 retained in a shallow internal annular groove in waist 117. Engagement with stop balls will normally arrest the sliding movement of collar 118 on sleeve 115, and will then transmit a return stroke from collar 118 to sleeve, returning it to a starting position for a drive stroke. Upon moving in the opposite direction (feed stroke) collar 118 will engage conical collet shoul-

ders 119, wedging the set of jaws 116 at that end of the collet sleeve 115 inwardly into clutching engagement with drive rod H and then transmitting feeding movement to the drive rod for the remainder of the feed stroke.

Reversing procedure may be the same as in the previously described form of the invention, and may utilize similar mechanism, such as a rack bar 93 attached to one of the jaws 116 at one end of collet sleeve 115 and adapted to be actuated axially to force the center of the sleeve 115 through the collar 118, balls 120 yielding inwardly, until the collar is in position to operate on the opposite end of the sleeve.

The reversing mechanism I may be either manually operable or automatically operable under manual control. Both types of mechanism are shown herein and may, in fact be both used in a single installation. The manually operable reversing mechanism comprises a suitable manually operable hand wheel or the like 90 driving a shaft 91 to which is affixed a pinion 92 simultaneously engaging a pair of rack bars 93 which are slidably mounted side by side (FIGS. 2 and 5) in a slideway 94 of channel section disposed just above the path of linear feed of drive rod H and parallel thereto. Slideway 94 extends between and is supported by the supporting feet 48 of the pillow block bearing 52, and are utilized as bridging connection between the upper ends of feet 48, as best shown in FIG. 4.

Rack bars 93, at their remote ends, are attached to the outer races of respective end-thrust bearings 95, the inner races of which are secured to the adjacent ends of spindles 66 (FIGS. 2 and 8). Thus each rack bar 93 is adapted to transmit axial shifting movement to a respective spindle 66, to force the hub spiders 75 of the feed heads G, G' "over-center" from positions for feed in one direction to positions for reverse feed, the stop projections 81 being forced beneath and past the respective stop bars 88 as previously described. In making this adjustment, the two hub spiders 75 are moved in the same direction. To illustrate, if the feed heads are to be reversed from their feed positions shown in FIG. 2, (in which they will feed forwardly as indicated by arrow 86), both rack bars 93 are shifted leftward as viewed in FIG. 2 (at a time when the operation of reciprocating drives F, F' has been arrested) and, with the reciprocating drive transmitting pivots 89 held stationary, the jaw pivots 77 will be shifted leftwardly to bring the jaw-tail lever units to the rightward-feed position shown in FIG. 7, wherein return feed, as indicated by arrow 86', will be effected upon resumed operation of the apparatus.

To effect such shift of rack bars 93, the pinion 92 is adapted to engage both rack bars as shown in FIG. 5. Normally, however, the pinion 92 is positioned out of engagement with the rack bars as illustrated in FIG. 2, so that the two rack bars may freely reciprocate in the slideway 94 in unison with the reciprocating drive units F, F'. To effect engagement of the pinion 92 with the rack bars 93, the pinion shaft 91 is slidably mounted in bearing brackets 96 and 97 secured to and projecting upwardly from the respective sides of slideway 94 (FIG. 5) and a coil spring 98, surrounding that portion of shaft 91 between pinion 92 and bracket 96, bears against pinion 92 to yieldingly bias it toward its normal, disengaged position shown in FIG. 2. Thus in shifting the pinion 92 to its operative position, pressure is exerted through hand wheel 92 to push the shaft 91 in the direction indicated by arrow 99, compressing spring 98.

The simplest method of utilizing the reversing mechanism is to shift pinion 92 successively into engagement individually, with the rack bars and in each position to rotate the pinion to slide the engaged bar longitudinally to effect reversal of its respective feed head.

However, it is also possible to actuate both rack bars simultaneously by shifting the pinion 92 to a bridging position simultaneously meshing with both bars, as in FIG. 5. After having thus established engagement with both bars, the hand wheel 90 is rotated to shift the two rack bars in unison in a common direction to effect the reversal of the feed heads as above described.

Automatic reversal mechanism is also provided, in the form of stop fingers 105 each mounted at one end on a crank shaft 106 pivoted in a suitable bracket 107 (FIGS. 2 and 3) mounted upon the frame beam 35, and having a handle lever 108 or other suitable means for rotating the crank shaft 106 to raise the stop finger 105 into a position for engagement by a stop lug 109. Lug 109 is secured to and projects downwardly from a respective thrust bearing raise 95, and is held in a position, avoiding circumferential displacement, by positioning action of the respective rack bar 94. For each of the feed heads, two of the stop fingers 105 are provided, on opposite ends of a crank shaft 106 of sufficient length to space the stop fingers apart a distance corresponding roughly to the length of stroke of the respective feed head, one stop finger being raised for effecting reversal at the end of stroke in one direction and the other being raised to effect reversal at the end of stroke in the other direction. Reversal is effected by engaging the lug 109 against a stop finger 105 slightly in advance of the end of a return stroke of a respective spindle 66, causing that feed head spindle to be reversed. The reversed spindle will then return on a non-driving stroke at which time the other feed head spindle 66 is completing a return stroke. At a proper time, the stop finger 108 for this other feed head is elevated into the path of return movement of the stop lug 109 of said other feed head spindle, thus effecting reversal of said other spindle, and completing the reversal of both feed heads. In a subsequent reversing procedure in which the two feed heads are again reversed back to their previous direction of feed, the alternate stop fingers 105 will be utilized for engagement with the respective stop lugs 109, the reversals now being accomplished at the opposite end of stroke from the previous reversals.

Instead of utilizing, for each feed head, a pair of stop fingers 105 spaced axially apart approximately the length of stroke, there may be provided for each feed head a pair of the stop lugs 109, spaced apart approximately the length of stroke (in which case one of them can if desired be secured to a respective rack bar 93) and a single stop finger 105 may then be employed for alternate engagement with the respective stop lugs 109.

To illustrate the automatic reversal procedure reference may be made to FIG. 2, wherein the two feed heads may be regarded as being located at positions remote from one another, with the feed head G' commencing a forward feed stroke as indicated by arrow 86 and with the feed head G beginning a return stroke as indicated by arrow 86'. The visible finger 105 for the feed unit G will be shifted to position for engagement by stop lug 109 at a point near the end of the return stroke 86'. The reversal of head G thus having been effected, simultaneously with the completion of the last feed stroke of head G' in the direction 86, the two feed heads will now be at their positions of maximum approach, and as they commence to separate, the head G' will commence its regular return (non-driving) stroke and the head G will simultaneously execute an extra non-driving stroke (since it is now in a reversed condition). As the two heads move apart, the drive rod H will remain stationary until the heads again reach their positions of maximum separation as shown in FIG. 2 (but with the head G reversed from its position shown in FIG. 2). Just prior to the end of this stroke of the two heads away from one another, the stop finger 105 for feed head G' which is located at the opposite end of crank shaft 106 from the finger visible in FIG. 2, will be elevated into the path of the moving stop lug 109 on the spindle 66 of feed head G', and will effect the reversal of feed head G'. This completes the reversal procedure, both feed heads being now reversed with re-

pect to their former positions, and as the two feed heads commence another cycle of movement in which they approach one another, the feed head G', in a non-driving position because of its reversal just effected, will execute a non-driving stroke as the feed head G resumes driving operation in the reverse direction indicated by arrow 86'. At the end of this half cycle of operation, feed head G' will also resume its feed operation, likewise in the reversed direction 86'.

I claim:

1. Sewer drive rod feeding apparatus comprising: a plurality of feed heads arranged in axially spaced relation for reciprocation on a common feed axis, each of said heads having unidirectional drive means for clutching and feeding a drive rod along said feed axis in the same direction; means for reciprocating said feed heads in unison in opposite directions so as to effect respective feed strokes of said heads in alternating succession in respective partial cycles of feed operation in which each feed head executes a non-feeding return stroke during the feed stroke of the other head; and means for effecting reversal of said unidirectional drive means for unidirectional feed in both forward and reverse directions.

2. Apparatus as defined in claim 1, wherein said reciprocating means includes eccentric drive means disposed between said feed heads, and respective pitmans connecting said eccentric drive means to the respective feed heads.

3. Apparatus for feeding a rotating sewer-cleaner drive rod along a linear feed axis, comprising: a feed head having unidirectional drive means for clutching and feeding a drive rod along said feed axis; means mounting said feed head for rotation in unison with the drive rod during feed strokes; and means for imparting reciprocation to said mounting means along said feed axis.

4. Apparatus as defined in claim 3, wherein said feed head includes lever means transmitting the reciprocating movement of said heads, and clutching jaws actuated by said lever means into tight clutching engagement with the drive rod during each feeding stroke and actuated by said lever means to release positions during each return stroke.

5. Apparatus as defined in claim 3, including means for effecting reversal of said unidirectional drive means for unidirectional feed in both forward and reverse directions.

6. Apparatus for feeding a rotating sewer-cleaner drive rod along a linear feed axis, comprising: a feed head havnig unidirectional drive means for clutching and feeding a drive rod along said feed axis; a tubular spindle carrying said feed head, through which said drive rod is axially movable; a swivel bearing through which said spindle extends and in which it is mounted for rotation in unison with the drive rod during feed strokes; and means for imparting reciprocation to said swivel bearing along said feed axis.

7. Apparatus for feeding a rotating sewer-cleaner drive rod along a linear feed axis, comprising: a feed head including a tubular spindle through which said drive rod is longitudinally slidable, a hub spider carried on one end of said spindle; a plurality of circumferentially spaced rod-clutching jaws pivoted in said spider on circumferential axes, having inner ends positioned and contoured for establishing clutching engagement with said drive rod upon tilting of said jaws on their pivots, and having respective tail levers extending generally radially outwardly; a reciprocating drive unit including a swivel bearing having a rotatable part and a non-rotatable part, said spindle being mounted in said rotatable part for rotation in unison with the drive rod during feed strokes; means for transmitting axially reciprocating movement to said non-rotating part and thence through said bearing to said rotating part; and means linking said rotating part to said tail levers to transmit said reciprocating movement thereto whereby to first tilt said jaws into clutching engagement with said drive rod and thereafter to transmit an axial feed stroke to said feed head and thence through said clutching engagement to said drive rod.

8. Apparatus as defined in claim 7, wherein each jaw has an inner end face of convex curvature providing a pair of clutching surfaces extending laterally with loxodromic curvature on both sides of the intermediate area of said end face for respective forward feed and reverse feed engagement with said drive rod; means for normally restraining each jaw from tilting past a neutral position between the positions of said forward and reverse feed engagement so as to confine the jaw to movements between a non-feed position and a position for feed in one direction in response to said transmission of reciprocating movement; and reverse means for effecting shift of each jaw past said neutral position to a position in which it will be actuated for feeding in the opposite direction in response to said transmission of reciprocating movement.

9. Apparatus as defined in claim 7, wherein said spider includes a pair of diametrically opposed clevises in which said jaws are pivoted, wherein said rotating bearing part has diametrically opposite ears disposed in a plane of the axis of said bearing, and wherein said linking means comprises respective push-pull links extending generally parallel to the axis of said spindle between the outer ends of said tail levers and said ears and pivoted to each of them.

10. Apparatus as defined in claim 7, wherein said jaws and tail levers are disposed in a common plane of the axis of said spindle, wherein each jaw has at its inner end a pair of clutching parts disposed on respective sides of an intermediate area of said inner end for respective forward and reverse feed engagement with said drive rod; and means for normally restraining each jaw from tilting past a neutral position between the positions of said forward and reverse feed engagement, so as to confine the jaw to movements between a non-feed position and a position for feed in one direction in response to said transmission of reciprocating movement, said last means comprising pivot pins in the outer ends of said tail levers connecting said linking means thereto, a spring stop rod attached to one of said pivot pins, extending transversely between the two tail levers and slidably extended through the other pivot pin, and a stop projection on said hub spider, interposed in the path of shifting movement of said stop rod in a plane parallel to said common plane, in response to tilting of said jaws, said stop rod adapted to be sprung over said stop projection, whereby to effect shift of said jaw past said neutral position to a position in which it will be actuated for feeding in the opposite direction in response to said transmission of reciprocating movement.

11. Sewer cleaner drive rod feeding apparatus comprising: a plurality of feed heads arranged in axially-spaced relation for reciprocation on a common axis, each feed head having unidirectional drive means for clutching and feeding a drive rod along a feed axis in one direction and releasing said drive rod when moving in the opposite direction; and means for transmitting reciprocating movements in unison in opposite directions to said feed heads so as to effect respective feed strokes of said heads in alternating succession in respective partial cycles of feed operation in which each head executes a non-feeding returning stroke during the feed stroke of the other head and means mounting the respective feed heads for rotation in unison with the drive rod during feed strokes.

12. Apparatus as defined in claim 3, wherein said head includes a spider coaxial with said feed axis, wherein said unidirectional drive means comprises a plurality of jaws disposed in radial planes of said feed axis and in the form of flat bars pivoted to said spider on circumferentially extending pivots for tilting movements in said radial planes, and having, at their inner ends, clutching faces extending on loxodromic curves with respect to their pivots for clutching engagement with the drive rod in response to said tilting movements, said flat bars having

portions extending outwardly from said pivots and constituting levers for transmitting said tilting movements to the jaws; and said reciprocating movement transmitting means including means acting against the outer ends of said levers.

13. Apparatus as defined in claim 3, wherein said head includes a spider coaxial with said feed axis, wherein said unidirectional drive means comprises a plurality of jaws disposed in radial planes of said feed axis and in the form of flat bars pivoted to said spider on circumferentially extending pivots for tilting movements in said radial planes, and having, at their inner ends, clutching faces extending on loxodromic curves with respect to their pivots for clutching engagement with the drive rod in response to said tilting movements, said flat bars having portions extending outwardly from said pivots and constituting levers for transmitting said tilting movements to the jaws; and said reciprocating movement transmitting means including means acting against the outer ends of said levers; and wherein said reciprocating movement transmitting means comprises push-pull links each pivoted at one end to the outer end of a respective lever and extending therefrom generally parallel to said feed axis, and a reciprocable hub to which the other ends of said links are pivoted for transmitting reciprocating movement through said links and said levers to said feed head, and for alternately tilting said jaws to rod-clutching and release positions respectively.

14. Apparatus for feeding a rotating sewer-cleaner drive rod along a linear feed axis, comprising: a plurality of feed heads arranged in axially spaced relation for reciprocation on a common feed axis, each of said heads including a tubular spindle through which said drive rod is longitudinally slidable, a hub spider carried on one end of said spindle, and a plurality of circumferentially spaced rod-clutching jaws pivoted in said spider on circumferential axes, having inner ends positioned and contoured for establishing clutching engagement with said drive rod upon tilting of said jaws on their pivots, and having respective tail levers extending generally radially outwardly; respective reciprocating drive units each including a swivel bearing having a rotatable part, said spindle being mounted in said rotatable part for rotation in unison with the drive rod during feed strokes, and a non-rotatable part, and means linking said rotating part to said tail levers of a respective feed head to transmit said reciprocating movement thereto whereby to first tilt said jaws into clutching engagement with said drive rod and thereafter to transmit an axial feed stroke to said feed head and thence through said clutching engagement to said drive rod; and means for transmitting reciprocating movements to said non-rotating bearing parts in timed relation such as to reciprocate said feed heads in unison in opposite directions so as to effect respective feed strokes of said heads in alternating succession in respective partial cycles of feed operation in which each feed head executes a non-driving return stroke during the feed stroke of the other head.

15. Apparatus as defined in claim 14, wherein each of said jaws has at its inner end a pair of clutching parts one on either side of an intermediate area of its said inner end, adapted for respective forward and reverse feed engagements with the drive rod upon tilting of the jaw to respective sides of a neutral position; spring-loaded means for normally preventing shifting of the jaws past said neutral positions so as to confine them to movements between release positions and positions for feed in one direction, said last means being yieldable in response to a load greater than normal reciprocating drive loads to effect shift of the jaws past said neutral positions to reverse feed positions; and reversing means for simultaneously effecting said reversing shift of the jaws.

16. In a sewer drive rod feeding apparatus, in combination: a feed head comprising a spider having an axial passage through which a drive rod may feed on a feed axis, and a pair of rod-clutching jaws mounted on circumferentially disposed pivots in said spider for tilting in planes of the axis of said passage, said jaws having respective tail levers extending generally radially outwardly; means for transmitting reciprocating movements to the outer ends of said levers, and through the levers to said head; support means in which said spider is supported for axially reciprocating movements; each of said levers having at its inner end a pair of clutching parts, one on either side of an intermediate area of its said inner end, adapted for respective forward and reverse feed engagements with the drive rod upon tilting of the jaw to respectvie sides of a neutral position and for transmitting forward and reverse feed strokes to the rod after having established engagement; spring-loaded means for normally preventing shifting of the jaws past said neutral positions so as to confine them to movements between release positions and positions for feed in one direction, said last means being yieldable in response to a load greater than normal reciprocating drive loads to effect shift of the jaws past said neutral positions to reverse feed positions; and reversing means for simultaneously effecting said reversing shift of the jaws.

17. Apparatus as defined in claim 15, wherein said reversing means comprises a pair of toothed rack bars mounted side by side for longitudinal sliding movements parallel to said feed axis, said racks having remote outer ends attached to respective reciprocating drive transmitting units for reciprocation in unison therewith, a pinion adapted for simultaneous meshing engagement with both said rack bars, means mounting said pinion for axial shifting thereof between the position of said meshing engagement and a position in which the rack bars are slidable free of engagement with the pinion, and means for shifting the pinion axially and for transmitting rotation thereto.

18. Apparatus as defined in claim 16, wherein said reversing means comprises stop means moving axially with said spider and stop means in a position fixed against movement parallel to said feed axis for engagement with the other stop means when the feed head is nearing the end of a return stroke, one of said stop means being adjustable transversely of the feed axis between a position wherein said engagement of the stop means will occur so as to effect said reversing shift of the jaws past their said neutral positions, and a normal position wherein the stop means moving with the feed head will pass the other stop means without engaging it.

19. Apparatus as defined in claim 16, wherein said reciprocating movement transmitting means comprises push-pull links each pivoted at one end to the outer end of a respective lever and extending therefrom generally parallel to said feed axis, and a reciprocable hub to which the other ends of said links are pivoted for transmitting reciprocating movement through said links and said levers to said feed head, and for alternately tilting said jaws to rod-clutching and release positions respectively.

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