May 14, 1940. H. N. BLISS ET AL 2,200,831

FEEDING APPARATUS

Filed July 18, 1938 4 Sheets-Sheet 1

Fig. 1

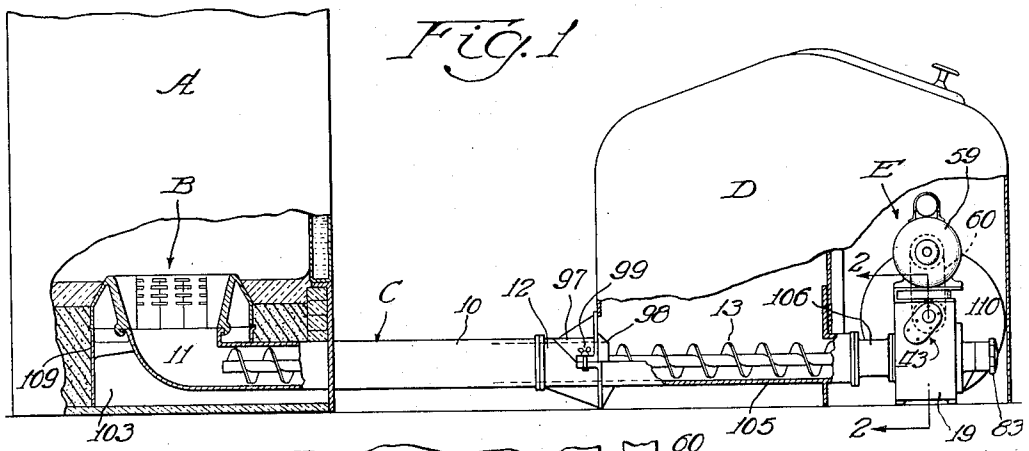


Fig. 2

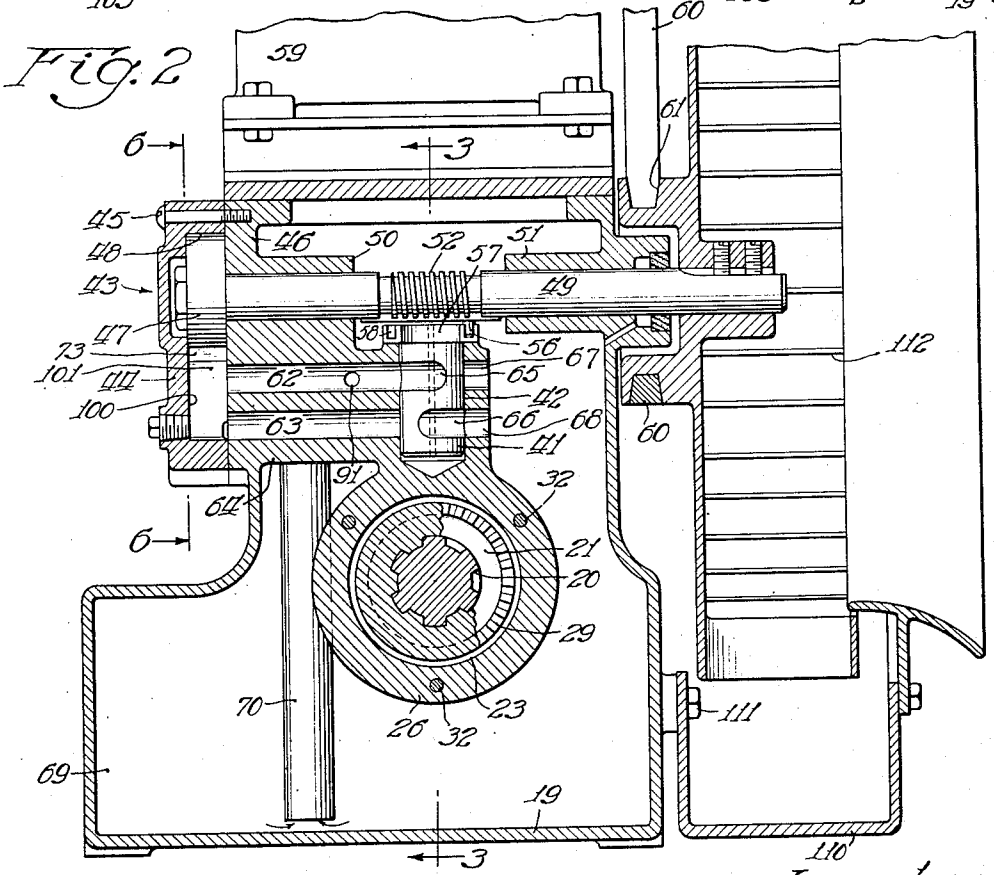
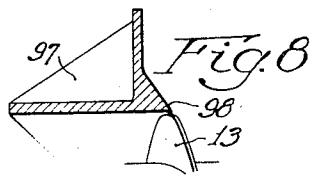


Fig. 8



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FEEDING APPARATUS

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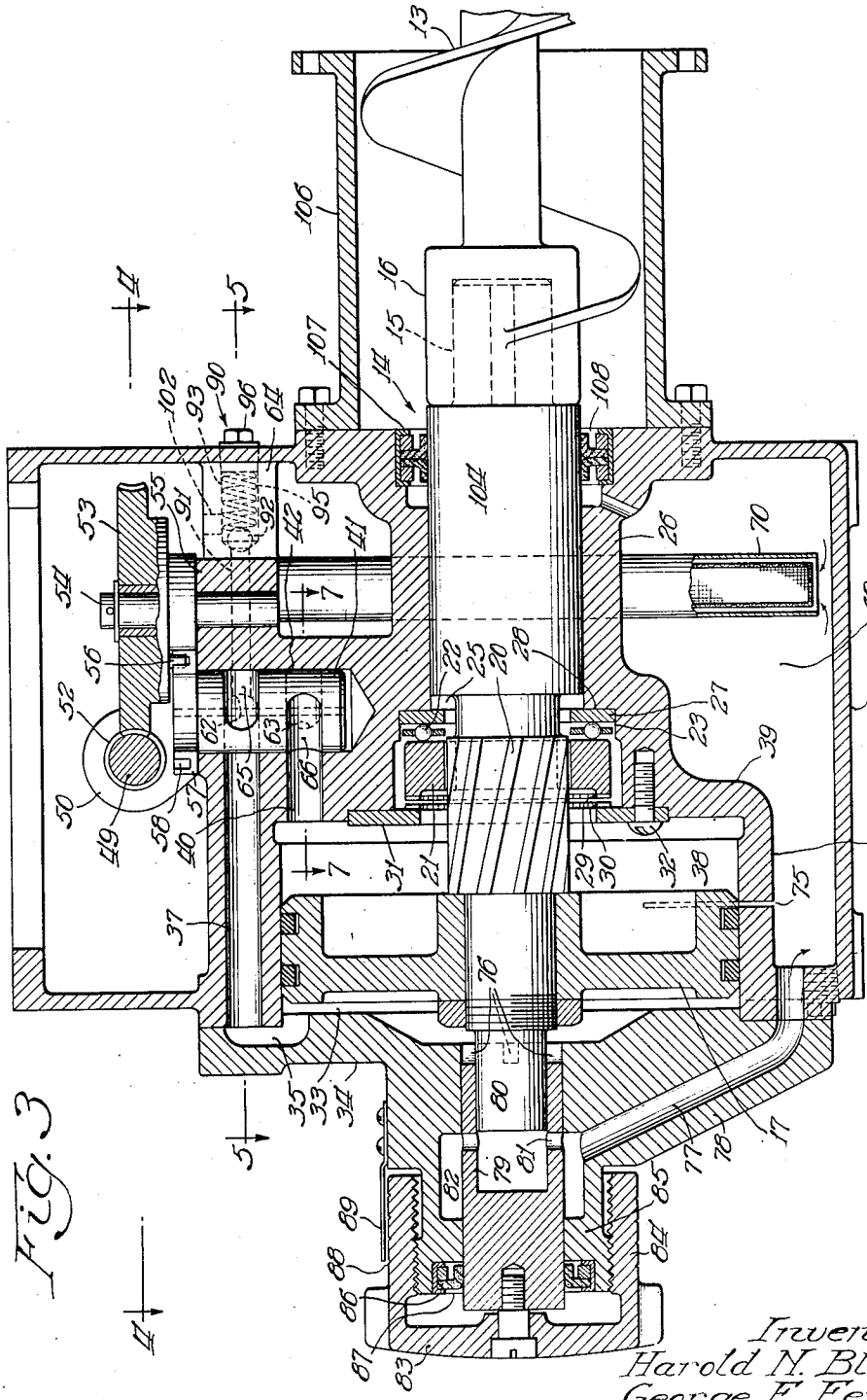


Fig. 3

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FEEDING APPARATUS

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Fig. 7

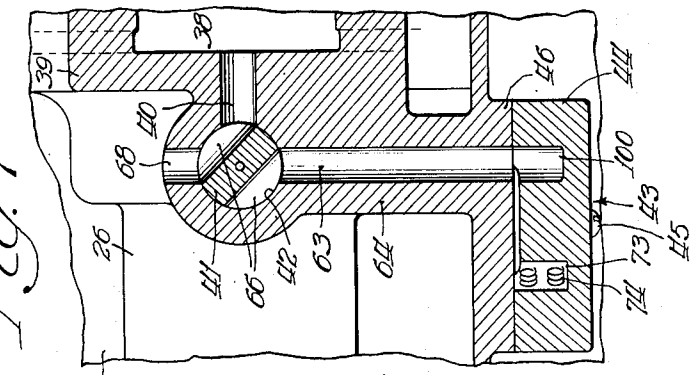
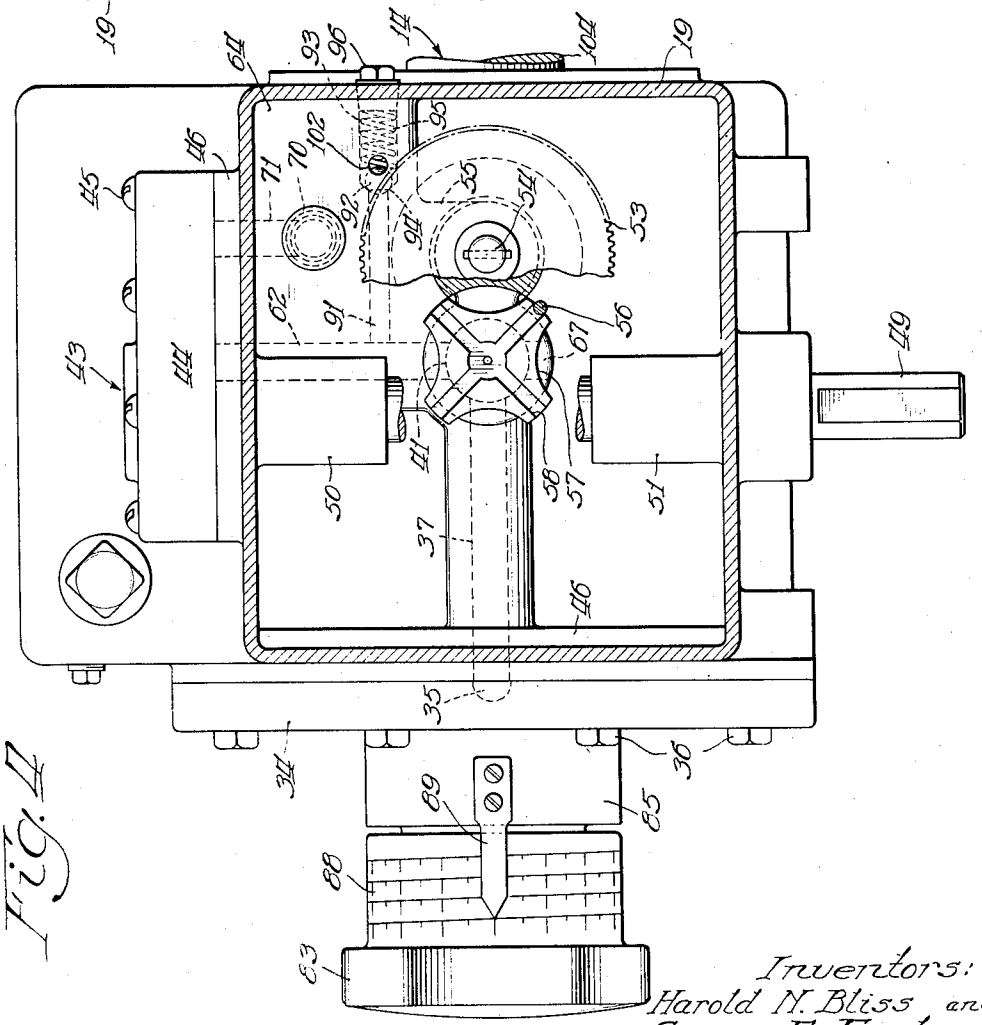


Fig. 7



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FEEDING APPARATUS

Filed July 18, 1938 4 Sheets-Sheet 4

Fig. 5

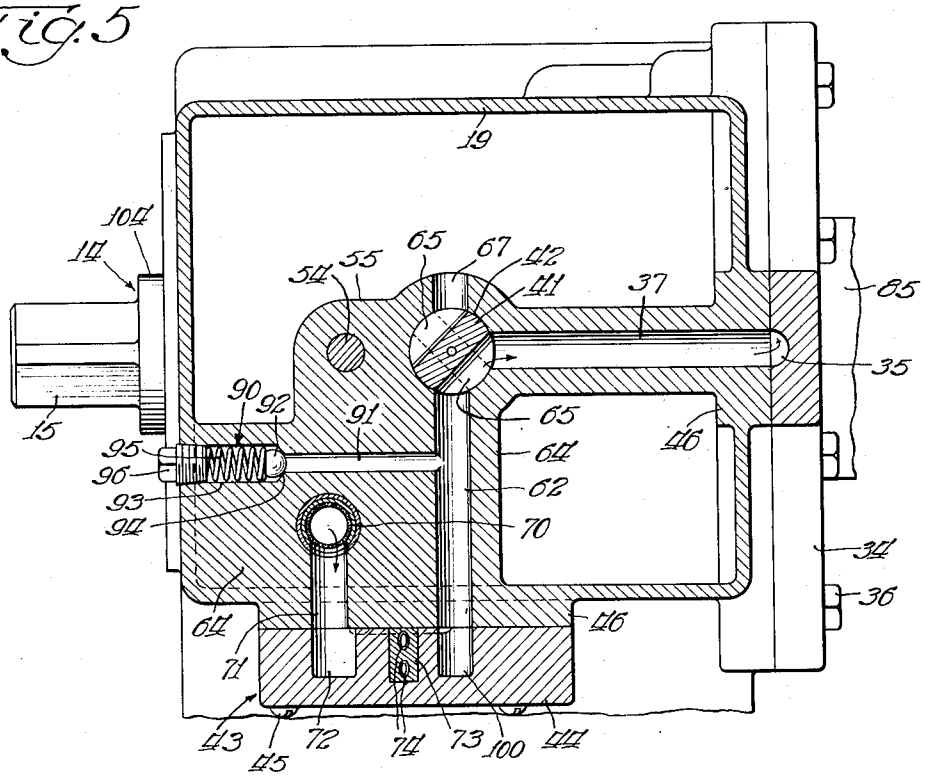
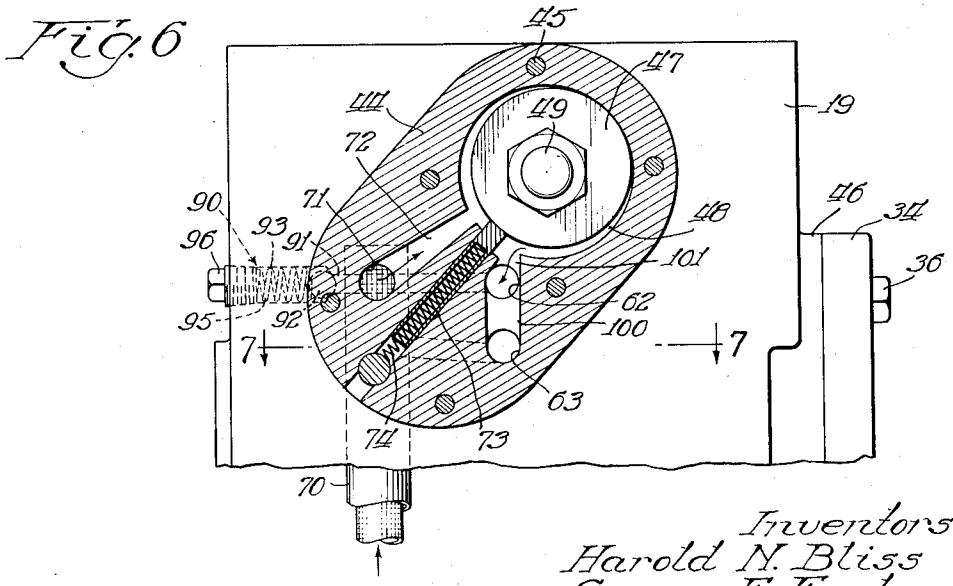


Fig. 6



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Patented May 14, 1940 2,200,831

UNITED STATES PATENT OFFICE

2,200,831

FEEDING APPARATUS

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Application July 18, 1938, Serial No. 219,714

2 Claims. (Cl. 198—226)

This invention relates to improvements in feeding apparatus and more particularly to apparatus for feeding solid materials such as coal through a conduit from a holding device or hopper to a receiving device such as a fuel retort.

One of the major problems which has confronted manufacturers and users of conventional screw type feeding apparatus for conveying solid materials through a conduit from holding to receiving points has been failure of operation due to obstruction between the rotating conveyor screw and portions of the assembly through which the material is urged, thus to cause the screw to stall until manually cleared.

Considerable inefficiency in operation has also resulted in such prior apparatus due to the inherent elasticity of parts of the drive mechanism when under heavier than normal load at low feeding rate, such condition usually reducing the feeding rate below the prescribed low feed or in many cases totally defeating movement of the material through the conduit.

It is, therefore, one of the objects of our invention to provide an improved feeding apparatus so constructed that it has the ability automatically over a period of time determined by the nature of an obstruction to overcome the retarding influence of such obstruction by nibbling action, thus reducing the obstruction to a size permitting it to pass through the conduit.

Another object is to provide, in a feeding apparatus as described, a transmission drive mechanism, normally operable to produce any desired amplitude of feeding movement of the screw once during each cycle, but which is capable upon a failure of the screw to complete its prescribed movement to its predetermined amplitude to recover its normal starting position in readiness for the next cycle in operation.

A further object is to provide feeding apparatus as described employing a novel and highly efficient transmission drive mechanism providing for infinitely variable control of the amplitude of screw movement.

Another object is to provide, in a feeding apparatus as described, a transmission drive mechanism in which there are no parts capable of yielding under variable load condition between the conveyor screw and the screw power element of the transmission drive, thus to insure accurate feeding at low rates in terms of material feed per unit of time.

A further object is to provide a power driven feeding apparatus having a uniform power demand and which is capable of operation from a dead stop without power surge regardless of the position of the transmission parts upon first application of power.

Other objects, the advantages and uses of the invention will become apparent after reading the following specification and claims, and after consideration of the drawings forming a part of the specification, wherein:

Fig. 1 is a side elevation, partly in section, of an embodiment of our invention as applied to the stoking of coal;

Fig. 2 is a vertical sectional view of the power units thereof taken as indicated by the line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view thereof, taken as indicated by the line 3—3 of Fig. 2;

Fig. 4 is a horizontal sectional view thereof, taken as indicated by the line 4—4 of Fig. 3;

Fig. 5 is a horizontal sectional view thereof, taken as indicated by the line 5—5 of Fig. 3;

Fig. 6 is a vertical sectional view thereof, illustrating the hydraulic pump, taken as indicated by the line 6—6 of Fig. 2;

Fig. 7 is a horizontal sectional view thereof, taken as indicated by the line 7—7 of Fig. 3; and

Fig. 8 is a detail vertical axial sectional view of the receiving mouth of the conveyor.

As illustrative of one form in which the invention may be embodied, we have shown, in the drawings, a stoking apparatus installed in connection with a conventional home heater. The heater is indicated at A in Fig. 1. The stoking mechanism may include a conventional retort B, a screw conveyor unit C, extending at one end into the heater A and communicating with the retort B, a fuel hopper assembly D, with which the other end of the conveyor unit C communicates, and a power unit E for operating the conveyor unit C.

The conveyor unit C may include a cylindrical conduit 10 extending through the wall of the heater A, and terminating in an upwardly belled delivery portion 11 forming a part of the retort B. At the other end of the conduit 10 is a receiving mouth section 12 which is in register at one end with the hopper assembly D, and communicates with the interior thereof.

The receiving mouth section 12 is formed integrally with a hopper 105 forming the lower section of the assembly D. The rear end of the hopper 105 has a collar 106 by means of which it is attached to the housing 19 of the power unit E. A conveyor screw 13 extends into the hopper 105 through the collar 106, thence through the

full length of the hopper, in the semi-cylindrical bottom region thereof, and thence through the straight portion of the conduit 10. Being semi-cylindrical, the bottom region of the hopper 105 restricts the portion of the mouth section 12 against which an obstruction can jam, to the upper half thereof, which upper half presents a shearing edge 98.

Instead of the conventional rotary movement for feeding material through the conveyor unit, the screw 13 is given a combined reciprocating and rotating movement, including an advancing or feed stroke, in which its movement is purely an axial or right line movement without rotation, and a return stroke, in which it moves both rearwardly and rotates, the two movements being so proportioned that the screw will "return" itself through the body of material which it has pushed forwardly on its advancing stroke without further movement of the material it contacts.

Referring now to Fig. 3, the power unit E for imparting such movement to the screw may include a push rod 14, having a cylindrical body portion 104 rotatably and slidably journalled in a bearing 26 formed integrally with a casing 19 in which the mechanism of the power unit is mounted. The forward end of the push rod 14 has a square shank 15 secured in a correspondingly squared socket 16 formed on the rear end of the screw 13 and located within the collar 106. On the rear end of the push rod 14 is secured a piston 17 which operates in a cylinder 18 formed in the power unit casing 19.

As will shortly be described, provision is made for introducing fluid under pressure into the cylinder 18, first behind and then in front of the piston 17, so as to alternately advance and retract the push rod 14 under positive driving power in both directions. During the forward stroke, the push rod 14 simply advances axially so as to push the screw forward. During its retractile movement, the push rod 14 is forced to rotate, thereby rotating the screw 13, thus causing the screw to "turn" through the body of material in the conduit 10.

The mechanism for causing the push rod 14 to rotate during its return stroke, comprises a helically threaded portion 20 of the push rod 14, having threaded engagement with a collar 21 which is adapted freely to rotate during advancing movement of the push rod 14, and to be held against rotation during the return movement of the push rod thus forcing the rod to revolve. Rotation of the collar 21 during the advance or power stroke is provided for by an anti-friction thrust bearing 22 mounted in an enlargement 23 of the bore 25 of the bearing 26, and engaging a flat bearing washer 27 which is abutted against the shoulder 28 formed between the bores 23 and 25. The flat forward side of the collar 21 is adapted to bear directly against the bearing 22, and thereby to be freely revoluble under the action of helically splined portion 20 during the advancing stroke.

Locking the collar 21 against rotation during return movement of the push rod 14, is accomplished by clutch teeth 29 formed on the rear side of the collar 21 adjacent the periphery thereof, which are adapted to engage clutch teeth 30 formed on the forward side of an annular clutch plate 31 secured as by screws 32 to the rear side of the bearing 26. The teeth 29 and 30 are preferably V shaped so as to engage readily.

Fluid under pressure for moving the piston 17 forwardly is introduced behind the piston into a chamber 33 formed in the cylinder 18 between the piston 17 and a cylinder head 34, through an inlet port 35 formed in the head 24. The head 34 may be secured to the cylinder 18 by means of cap screws 36 as shown in Fig. 4. The fluid reaches the port 35 through a horizontal duct 37 formed in the top wall of the cylinder 18. Fluid for moving the piston 17 rearwardly is introduced into a chamber 38 formed between the piston 17 and a shoulder wall 39 which joins the cylinder 18 to the bearing 26. The fluid reaches the chamber 38 through a horizontal duct 40 in the shoulder wall 39.

The bore 25 of the bearing 26 must necessarily communicate with the chamber 38, and in order to prevent escape of fluid through this bore, we provide a packing gland 107 mounted in an annular recess 108 in the end of the bearing 26 adjacent the screw 13. The packing gland bears against the cylindrical portion of the push rod 14, as shown in Fig. 3.

The fluid, preferably oil, is directed alternately through the ports 37 and 40 by means of a cylindrical timing valve 41 rotatively mounted in a valve chamber 42 which forms an enlargement of the upper region of the shoulder wall 39.

Referring now to Figs. 2 and 6, fluid under pressure is delivered to the valve 41 by means of a rotary pump, indicated generally at 43, comprising a casing 44 secured, as by cap screws 45, to a side wall region 46 of the housing 19, and a pump rotor 47 eccentrically rotatable in the cylinder 48 thereof. The rotor 47 is mounted on a pump shaft 49, journalled on a horizontal axis in bearings 50 and 51 formed in the upper region of the housing 19. Intermediate the bearings 50 and 51, the shaft 49 is formed with a worm 52, meshing with a worm wheel 53 (see Figs. 3 and 4) journalled on a stub shaft 54, which is mounted in an ear 55 formed integrally with the valve housing 42. Fluid is drawn into the pump from a sump 69 formed in the bottom of the casing 19, through a tube 70, the upper end of which is mounted in the web portion 64, thence through a port 71 (Fig. 5) and through the inlet port 72 of the pump housing 44, into the pump chamber 48. The pump incorporates a sliding vane 73 which engages the rotor 47, under the action of a spring 74, and separates the inlet port 72 from the outlet port 101.

Motion is transmitted to the valve 41 by means of a "Geneva" movement, including a pin 56 mounted in the lower side of the worm wheel 53, and a "Geneva" star wheel 57 including crossed grooves 58 in which the pin 56 engages, which is carried on the upper end of the valve 41. Thus the valve is caused to rotate intermittently in timed relation to the movement of the pump piston 47.

Power is transmitted to the pump shaft 49 from a motor 59 (see Fig. 1) through the medium of a belt 60 which engages a pulley 61 mounted on the end of the shaft 49 opposite the pump 43.

A conventional blower fan is provided for delivering air within the space 103 defined between the skirt 109 of the retort B, and the belled mouth 11 of the conduit 10, such air passing into the retort for the proper feeding of the fire. This blower fan comprises a fan casing 110 secured at 111 to the power unit housing 19, and a fan rotor 112 carried with the driven pulley 61. Details of the air conducting mechanism are not shown, such mechanism being old and well known in the art.

Fluid is delivered to the valve chamber 42

through ducts 62 and 63 respectively, formed in a web 64, joining the wall region 46 and the valve chamber 42. The delivery ducts 62 and 63 at their outer ends communicate with a common passage 100 leading from the discharge port 101 of the pump 43. The duct 62 lies in the same plane with the duct 37 and the duct 63, which lies directly beneath the duct 62, lies in the same plane as the duct 40, which lies directly beneath the duct 37.

The valve 41 is provided with a pair of diametrically opposed passages 65, located in the plane of the ducts 62 and 37, one of which passages 65 is adapted, when the valve is in the position shown in Fig. 5, or in a position 180 degrees therefrom, to connect the ducts 62 and 37 so as to route fluid from the pump 43 to the port 35, and thence into the chamber 33 behind the piston 17. The valve 41 is provided also with a second pair of diametrically opposed passages 66, located in the plane of the ducts 63 and 40, adapted to establish communication between said ducts 63 and 40 when the valve is either 90 degrees or 270 degrees removed from the position shown in Fig. 5, whereby to route fluid from the pump 43 to the chamber 38 at the forward side of the piston 17.

As the piston 17 moves under the pressure of fluid admitted to one of the chambers 33 or 38, the fluid in the other of said chambers may escape back through the duct 37 or 40, as the case may be, thence through a valve passage 65 or 66, and thence through a discharge port 67 (Fig. 5) or a discharge port 68 (Fig. 7), and into the oil sump 69 formed in the lower region of the power fluid casing 19.

The limit of return movement of the piston 17 is determined by the uncovering of a port 75 in the wall of the cylinder 18. The port 75 may be in the form of a slot cut in the wall of the cylinder 18 in a plane parallel to the rear end of the piston and adapted to register with said rear end, as indicated in Fig. 3, when the piston is at starting position. Likewise, a limit of advancing movement of the piston is determined by uncovering a series of ports 76 so as to establish communication between such ports 76 and a return passage 77 formed in a boss 78 in the cylinder head 34, the return passage 77 leading back to the sump 69. The ports 76 are formed in a valve sleeve 79, which is closed, except when the piston is at the forward end of its stroke, by a valve plunger 80 formed on the rear end of the push rod 14. At the forward end of the piston stroke, the rear end of the plunger 80 reaches the ports 76, whereupon communication is established through the ports 76 between the chamber 33 and the interior of the valve sleeve 79. Thence the fluid may escape through openings 81 in the sleeve 79 into an annular chamber 82 surrounding the sleeve 79 and communicating with the return passage 77.

The length of stroke may be adjusted by adjusting the sleeve 79 axially. To this end, there is secured to the rear end of the sleeve 79 a handwheel 83 having a drum portion 84 interiorly threaded and in threaded engagement with a neck 85 projecting rearwardly from the cylinder head 34. The annular chamber 82 is formed in the neck 85. The neck 85 also serves, in connection with a packing ring 86 which is mounted in an annular recess 87 in its end, to form a packing gland for the valve sleeve 79.

On the exterior of the drum portion 84 of the hand-wheel 83 is a scale 88 which cooperates with a pointer 89 secured on the neck 85, to indicate the exact position of adjustment of the valve sleeve 79. The scale 88 is calibrated so as to read in terms of material pounds per hour that will be delivered by the apparatus in operation.

A pressure relief valve 90 normally closes a passage 91 in the web portion 64 of the housing 19, which passage 91 communicates with the duct 62 for delivering fluid for the advancing stroke of the piston. The purpose of the valve is to limit the pressure that can be applied by the power unit so as to prevent breakage in the event that the conveyor unit C becomes clogged by an obstruction. The valve 90 includes a ball 92 received in a valve chamber 93 formed in the web portion 64, and adapted to seat against a valve seat 94 formed between the chamber 93 and the passage 91. A spring 95 urges the valve against its seat, and is held under compression by a plug 96 threaded into the outer end of the chamber 93. The valve is set so as to release at a pressure amply high for the purposes of the invention, and yet well within the capacity of the motor 59. When open, the valve allows fluid to bypass to the sump 69 through a port 102 communicating with the chamber 93, until such time as the valve turns for initiation of the return stroke.

The receiving mouth section 12 of the conduit 10 includes a separate upper section 97 of extremely hard and tough material, preferably a steel forging, which is provided with a shearing lip 98 adapted to coact with the screw 13 in shearing off any obstruction that may become lodged between the screw and the mouth of the conduit. The section 97 is removably attached, as at 99, to the body of the section 12, whereby it may readily be detached for grinding of the lip 98, or for replacement where necessary.

During operation of the feeding apparatus, the motor 59 and pump 43 are adapted to run continuously. Pressure fluid will be drawn from the sump 69 through the inlet tube 70, the connecting passage 71 and the inlet port 72 into the pump chamber 48 of the pump 43 from which it will be delivered by the piston 47 through the discharge port 101, and into the common passage 100 leading to the passages 62 and 63. When the distributing valve 41 is turned to the position shown in Fig. 5, pressure fluid will be delivered from the common passage 100 through the duct 62, the valve passage 65, the duct 37, and the port 35, into the chamber 33 on the rear disc of the piston 17. When the valve 41 is in this position, the lower region of the valve, lying in the plane of the passages 40 and 63 leading to the forward side of the piston 17, will close the connection between said passages, and the valve passages 66 of said lower region of the valve, will be in position, as indicated in dotted lines in Fig. 5, and full lines in Fig. 7, to allow escape of fluid from the forward chamber 38 through the passages 40 and 68 into the sump 69.

The valve 41 will remain stationary in this position, while the worm wheel 53 rotates through approximately 270 degrees of rotation. During this period, the pump 43 will deliver fluid into the chamber 33, gradually advancing the piston 17, until the limit of its stroke, determined by the position of the sleeve valve 79, is reached.

When the hand-wheel 83 is screwed up to the limit of its possible movement toward the right, as viewed in Fig. 3, the piston 17 will make a full stroke. As the handwheel 83 is backed off, moving the valve sleeve 79 away from the valve plunger 80, the stroke of the piston will be shortened for the reason that the end of the plunger 80 will reach the port 76 at an earlier period in

the advance stroke of the piston. The shortening of the stroke of the piston will correspondingly shorten the stroke of the screw 13, and thereby reduce the rate of feed through the conveyor unit.

Forward movement of the push rod 14 will move the collar 21 away from clutching engagement with the clutch face 31 and bring it into bearing engagement with the bearing 22. Being unable to move further in an axial direction, the collar 21 will rotate freely as the threaded portion 20 advances axially through it. The resistance to rotation offered by the collar 21 is many times less than that of the screw 13, and as a result, the screw 13 will be pushed forwardly without rotation.

During this advancing movement of the screw 13, the material in the conduit 10 will be engaged by the flights of the screw, and pushed bodily forwardly without slippage relative to the screw. As a result, the tendency of the material to pack toward the forward end of the conduit, is entirely eliminated, with a consequent elimination of the likelihood of temporary stalling due to packing.

In the event that a large bit of material becomes lodged between the screw and the receiving mouth 12 of the conduit 10, it will be disposed of by the shearing action between the screw and the shearing lip 98. If the material is too hard or too thick to be sheared off in one stroke of the screw, the screw will advance until the pressure rises to the "blow-off" point, whereupon the valve 90 will open and excess fluid will be allowed to escape through the passage 91. Under such condition, further advance movement of the screw will cease. When the worm wheel has completed 270 degrees of revolution, the pin 56 will enter a groove 58 of the star wheel 57, and will commence to rotate the valve to a position removed 90 degrees from its former position. During this period, the fluid delivered by the pump will be by-passed back to the sump 69, either through the return passage 77 (the piston having reached the end of its stroke, and the valve 79—80 having opened prior to the time that the valve 41 commences to move), or will be allowed to escape back to the sump 69 through the pressure relief valve 90 in the event of an obstruction being present in the conveyor unit.

During the operation of the "Geneva" movement, the valve 41 will be shifted 90 degrees. Prior to the completion of this shifting movement, communication between the passages 37 and 62 will have been cut off, and communication established between the passages 40 and 63. Flow of fluid to the chamber 33 will then terminate, and the flow directed to the chamber 38, whereupon the piston 17 will commence its return stroke. Preferably, the passages 65 and 66 are so proportioned that there will be a short period of overlap during which both of the chambers 33 and 38 will be in communication with the pump, so that there will be no point in the cycle of operation in which exit of oil from the pump is completely shut off.

As the push rod 14 moves rearwardly, the collar 21 will be carried with it, until the clutch teeth 29 and 30 make engagement with each other. Thereupon further axial movement of the collar 21 will be prevented, and rotation of the collar also will be prevented, so that the push rod 14 will be forced to rotate in order that the portion 20 may thread its way through the collar 21. Such rotation will be transmitted through the square socket connection 15, 16 to the screw 13. Reacting against the material which is packed between its flights, the screw 13 will screw itself from such material, and follow the push rod 14 in its retrograde axial movement. The pitch of the screw 13 is so correlated to the pitch of the threaded portion 20 of the push rod, that the rotating movement of the screw 13 will keep pace with that of the push rod 14. Thus at the end of the return stroke, the screw will be ready to receive thrust from the rod 14 on the next advance stroke.

In the event of the presence of an obstruction between the screw 13 and the shearing lip 98, unsheared by one stroke of the screw, the unthreading movement of the screw will present a new portion of the thread of the screw for engagement with the obstruction on the next advance stroke, and will relieve the pressure of the screw against the obstruction so that on the next forward stroke, the screw thread may take a fresh bite into the obstruction. In actual test of a full-size machine embodying the invention, a heavy wood stake has been inserted between the screw and the shearing lip, and after a number of cycles of operation, has been completely sheared through. The screw simply advances until the resistance of the obstruction overcomes the resistance of the valve 90, whereupon the valve will open and the screw will stop, and, at the prescribed time for the return stroke, back off for a fresh attack upon the obstruction. This may occur a large number of times with a final shearing of the obstruction, whereupon the screw will immediately resume its full stroke and the proper feeding of material through the conveyor unit C. In acting against an obstruction, the edge of the screw will cooperate with the extremity 98 of the hopper during each advance stroke so as to exert against the obstruction, a slicing shear tending to sever the obstruction and a lateral thrust tending, under repeated assaults, in the event that the obstruction is not too long, to gradually move the obstruction to a non-obstructing position wherein it may pass on through the conduit along with the fuel.

In addition to serving as a pressure relief means, the valve 90 also functions as a warning signal to indicate the presence of the obstruction. If desired, the valve may be so designed that the "blow-off" may be heard a distance from where the apparatus is installed.

One of the advantages of the invention is that the power unit E operates on a substantially uniform power demand, even during the process of disposing of an obstruction. Instead of the load mounting indefinitely upon the occurrence of an obstruction, the screw simply diverts the energy that normally would be expended in advancing the material in the conveyor C, concentrates it on the removal of the obstruction up to the limit determined by the resistance of the valve 90.

An important feature of our improved feeding apparatus is its ability to maintain constant feeding rate under varying load conditions. This is particularly important when the regulating valve sleeve is set for low feeding rate, and consequently the advance or power stroke of the screw is but a small fraction of an inch. In prior devices, under low feeding rate, the slight movement which must be imparted to the screw to accomplish such rate, frequently permits increased load conditions to result in a torsional flexing of the screw itself, or a yielding of the mechanical parts of the drive to either materially reduce or to defeat feeding of

the material. In the present apparatus, the screw is directly coupled by inflexible instrumentality to the fluid operated piston and is not subjected to torsional strain, and there can therefore be no yielding, so to speak, of the mechanism to defeat feeding movement of the screw, though the movement be of the slightest amplitude. The piston during each power stroke must move until it uncovers the relief ports 76 of the regulating valve sleeve before such movement may cease.

In addition to extremely constant feeding rate under varying load conditions and throughout the entire feeding range, the mechanism permits of an infinitely variable control of the length of stroke of the screw during its feeding operation by a regulating valve and band spread indicator of the type permitting very accurate control of length of stroke.

The nature of the transmission drive incorporated in our feeding device is such that there is no tendency to establish a so-called "dead center," so that without regard to the position of the parts at the time the power is shut off, the drive may resume operation without throwing abnormal load upon the motor, a condition which does not exist in transmission drives incorporating crank arms or cam and lever assemblies for intermittent advance of the screw. This feature is but one factor contributing to the ability of the apparatus to operate under uniform power demand, and it becomes of great importance as the size of the installation is increased, as for example, in the case of industrial coal stokers.

If desired, the rate of feed per unit of time may be regulated, as distinguished from the method heretofore described, by using an adjustable metering valve in the pump outlet line, in which event the adjustable regulator valve sleeve could be replaced by a fixed limit relief similar to the relief operable to limit the return stroke of the piston 17.

We claim:

1. In a material feeding apparatus, a conveyor including a conduit and a conveying screw extending thereinto, a fluid motor including a cylinder and a piston reciprocable therein, means connecting said piston to said screw to positively reciprocate the same, means operative to cause said screw to rotate with an unthreading movement on the return stroke and to advance with a non-rotating movement, a prime mover, a pump driven thereby, means for directing fluid under pressure from said pump to said motor on opposite sides of said piston alternately whereby said motor may maintain continued operation of the screw in the presence of an obstruction, a pressure relief valve adapted to relieve excess pressure in said motor so as to allow such continued operation, and a hopper having an extremity with which the edge of said screw is adapted to cooperate during each advance stroke so as to exert against an obstruction, a combined shearing action tending to sever such obstruction and a lateral thrust tending, under repeated assaults, to gradually move said obstruction to a non-obstructing position.

2. In a material feeding apparatus, a conveyor including a conduit and a conveying screw extending thereinto, a fluid motor including a cylinder and a piston reciprocable therein, means connecting said piston to said screw to positively reciprocate the same, means operative to cause said screw to rotate with an unthreading movement on the return stroke and to advance with a non-rotating movement, a prime mover, a pump driven thereby, means for directing fluid under pressure from said pump to said motor on opposite sides of said piston alternately whereby said motor may maintain continued operation of the screw in the presence of an obstruction, a pressure relief valve adapted to relieve excess pressure in said motor so as to allow such continued operation, and a hopper having an extremity with which the edge of said screw is adapted to cooperate during each advance stroke so as to exert against an obstruction, a combined shearing action tending to sever such obstruction and a lateral thrust tending, under repeated assaults, to gradually move said obstruction to a non-obstructing position, said fluid directing means including timing mechanism controlling the reciprocation of said screw at a fixed timing interval independent of the length of stroke of the screw.

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