July 29, 1930. A. L. ELLIS 1,771,750

DRIVING MECHANISM FOR ROLLING MILL WEDGES

Filed July 6, 1929 2 Sheets-Sheet 1

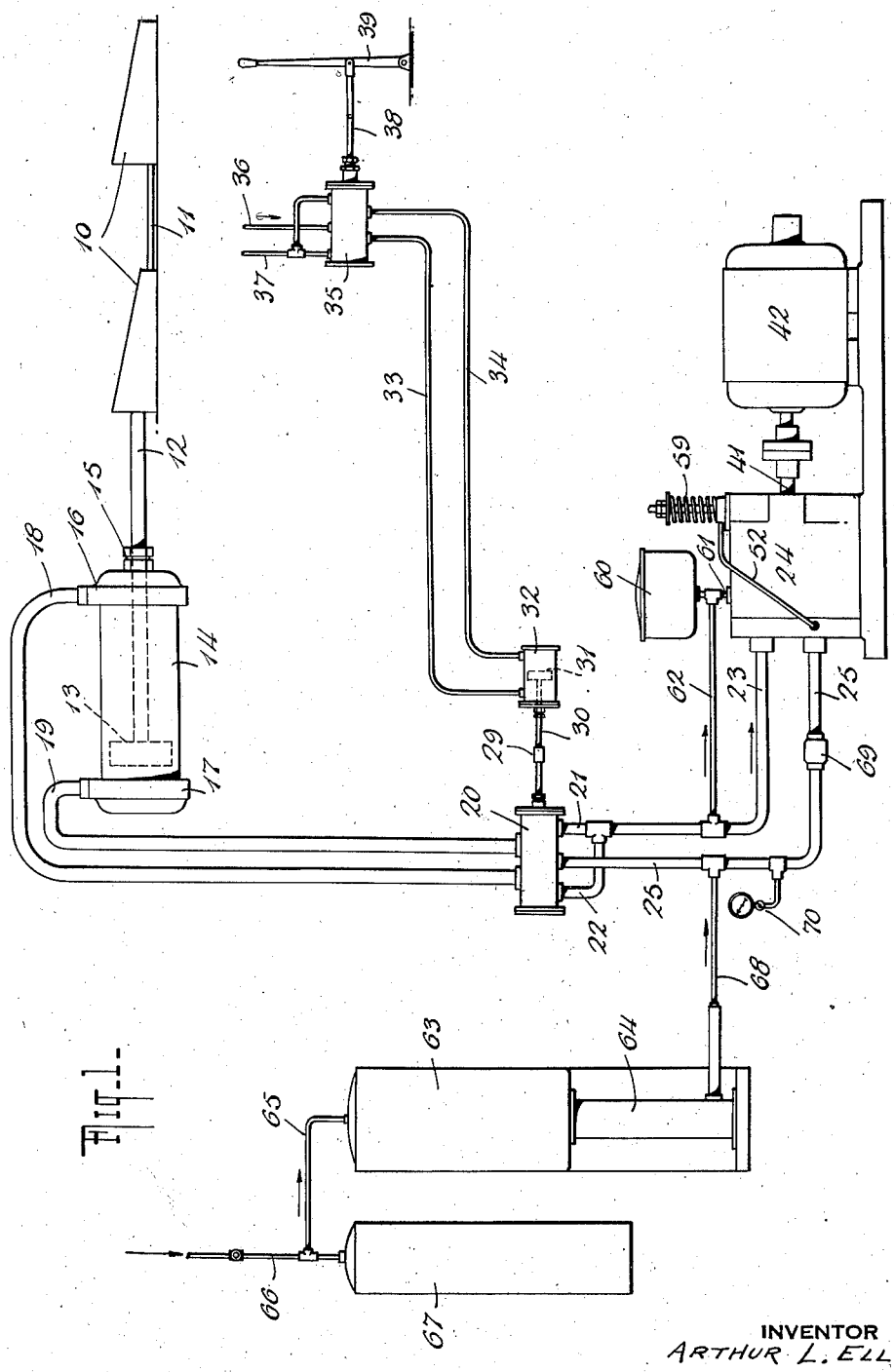


Fig. 1.

INVENTOR
ARTHUR L. ELLIS
BY
Lothrop Lehlenbeck & Darley
ATTORNEYS

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Fig. 2.

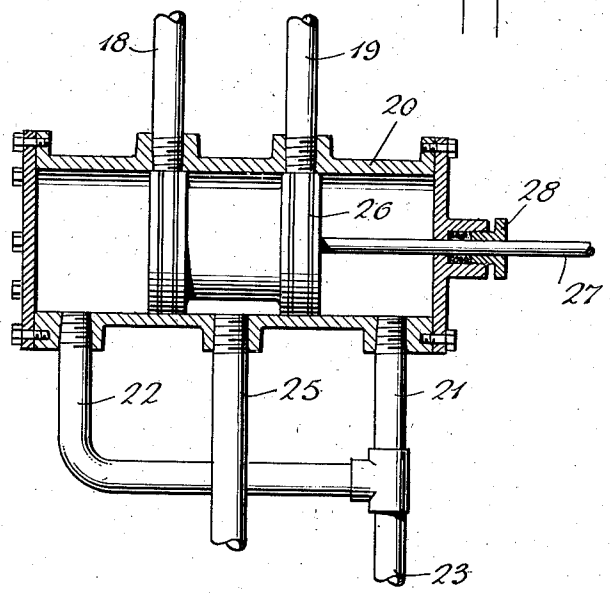
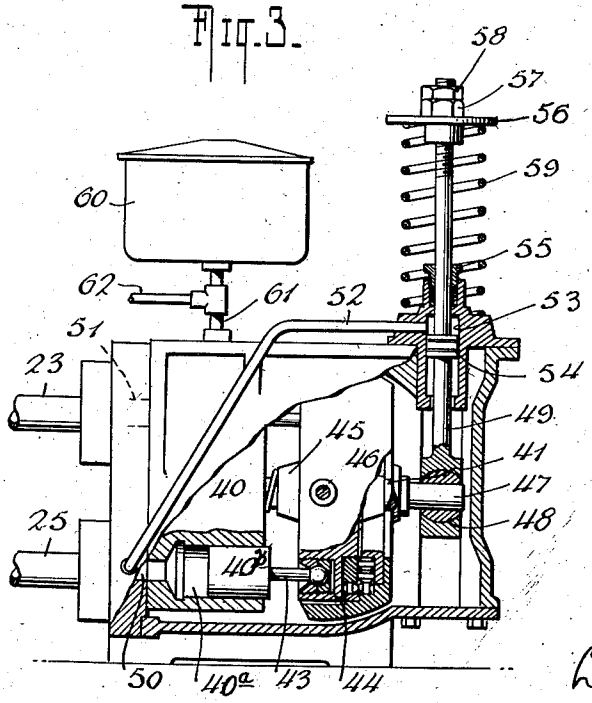


Fig. 3.



INVENTOR
ARTHUR L. ELLIS
BY
Cobb, Kehlenbeck & Burley
ATTORNEYS

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UNITED STATES PATENT OFFICE

ARTHUR L. ELLIS, OF NEW ROCHELLE, NEW YORK, ASSIGNOR TO THE WATERBURY TOOL COMPANY, OF WATERBURY, CONNECTICUT, A CORPORATION OF CONNECTICUT

DRIVING MECHANISM FOR ROLLING-MILL WEDGES

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This invention relates to driving mechanism for operating the roll setting wedges of rolling mills and has for its principal object to provide a new and improved construction by means of which such wedges may be operated practically instantly to secure the desired setting of the rolling mill rolls during the rolling operation.

In rolling mill practice it is customary to carry out a rolling operation by passing the heated steel bars or rods through the rolls in one direction with a certain setting of the rolls. After the end of the bar leaves the last roll the mill is then stopped and immediately reversed, the rolls being given another setting, either closer together or farther apart, and the heated bar is immediately shot back to the rolls. As the bar during the rolling operation is heated, it is of the utmost importance that the resetting of the rolls for the reversed travel of the steel, as above described, be accomplished with the utmost rapidity so that the steel may be practically instantly shot back to the rolls without such loss of time as would permit an appreciable cooling of the steel to take place. In order to effect as rapidly as possible this resetting of the rolls it is customary in the art to employ wedges which co-operate with the rolls for securing the desired setting thereof. The present invention as above set forth has for its principal object a new and improved construction for actuating wedges.

A further object of the invention is to provide a mechanism in which the quick operation of the wedges may be accomplished without shock to the parts.

Another object is to provide a new and improved hydraulic or fluid pressure operated apparatus for actuating the roll setting mechanism.

The above and other objects of the present invention will appear more fully from the following more detailed description and by reference to the accompanying drawings forming a part hereof, wherein Fig. 1 is a diagrammatic plan view of an installation constructed in accordance with the principles of the present invention; Fig. 2 is a cross sectional detail on an enlarged scale of the main control valve of the apparatus and Fig. 3 is a side elevation, partly in section, of a preferred type of pump for delivering fluid under pressure to the wedge operating cylinder and piston.

As shown in Fig. 1 of the drawings the numeral 10 indicates a pair of wedges which may be of any usual or well known construction such as employed for adjusting the rolls of a rolling machine. The constructional details of the rolling machine and the rolls thereof form no part of the present invention and therefore such details have not been shown in the drawings. As is well known in the art, the rolling machine proper may consist of any desired number of pairs of rolls placed, one after the other, to operate successively upon the rod or bar as it passes through the mill. In Fig. 1 of the drawings only a single pair of wedges have been shown which wedges it will be understood operate to set or adjust adjacent rollers of a co-operating pair relatively to each other so as to vary the distance between the axes of said rollers. Obviously, the number of wedges employed in any installation will depend upon the number of pairs of rolls used in the rolling mill. These wedges are connected together by any suitable means such as the rod 11, so as to cause all the wedges to be moved in unison as an integral structure. In accordance with the present invention the end-most wedge of said structure has secured to it one end of a piston rod 12, the other end of which rod is secured to a piston 13. The piston 13 is slidably mounted for reciprocation within a fluid pressure cylinder 14; the piston rod 12 passing through a suitable stuffing box 15 formed in the cylinder head 16. The other end of the cylinder is sealed by means of a cylinder head 17. Secured to the cylinder heads 16 and 17 respectively are the ends of pipe lines 18, 19 by means of which fluid under pressure may be delivered to, and exhausted from, said cylinder. The other ends of said pipes are secured to the casing 20 of a 4-way valve, the setting of which, as will presently be described, determines the direction of flow of the fluid to the cylinder

14 and thereby the direction of motion of the piston 13 and wedges 10.

The casing 20 of the 4-way valve has also connected to it, adjacent to the ends thereof, the branches 21 and 22 of a suction pipe line 23 connected with a fluid pressure pump 24. Said pump has also connected to it one end of a pressure pipe line 25, the other end of which communicates with the interior of the valve casing 20 approximately at the center thereof.

Slidably mounted within the valve casing 20 is a piston valve 26, see Fig. 2, having secured thereto a valve rod 27. The valve rod 27 passes through a stuffing box 28 and is connected by means of a suitable coupling 29 with a piston rod 30 secured to the end of a piston 31, the latter being mounted for reciprocation within a cylinder 32. Fluid preferably under relatively low pressure from any suitable source is admitted to the cylinder 32 through either of the pipe lines 33, 34 under the control of a pilot valve 35. The pilot valve 35 may be identical in construction with the main control valve 20, therefore the constructional details of such valve 35 have not been shown in the drawings. The fluid under pressure for operating the piston 31 of the main control valve is circulated to the casing of the valve 35 by means of the pipes 36, 37. The valve rod 38 of the pilot valve 35 is adapted to be actuated by any suitable, manually operated means such, for example, as the hand lever 39.

The fluid pressure pump 24 may be of any suitable construction. The pump shown in the drawings is of the well known Waterbury type and consists of a rotating barrel 40 secured to a driving shaft 41, the latter being driven preferably at a uniform, constant speed by any suitable means such as the electric motor 42. The cylinder barrel 40 is provided with a plurality of cylinders 40^a whose longitudinal axes are in parallelism with the axis of the driving shaft 41. Slidably mounted within each cylinder 40^a is a piston 40^b to which is connected one end of a piston rod 43, the other end of which piston rod is seated and secured in a suitable bearing or socket formed in a rotatable swash plate 44. The swash plate is secured to the driving shaft 41 for rotation therewith by means of a universal joint 45 which permits said swash plate to be adjusted to an angular position relatively to said driving shaft and cylinder barrel. The swash plate is rotatably mounted within a tilting box 46 which has fixed thereto a stub shaft 47. The stub shaft projects into an oscillatory bearing 48 seated within the lower end of a control shaft 49. Vertical movement of the control shaft will bring about, through the connection of the stub shaft 47 thereto, a movement of the tilting box and swash plate from the position shown in Fig. 3. When the tilting box and swash plate are perpendicular to the driving shaft, as shown in Fig. 3 of the drawings, the pistons 40^b will have no stroke and no fluid will be pumped by the pump; this is called the "neutral" position. When, however, the tilting box and swash plate are inclined from the position shown in Fig. 3, the pistons will be reciprocated, the extent of the reciprocation and therefore the output of the pump, depending upon the extent of the inclination given to the swash plate and tilting box.

In the present installation it is preferred to use a pump of the type wherein an automatic pressure control device is associated with the control shaft for the purpose of automatically actuating said control shaft towards neutral position whenever the pressure of the fluid being delivered by the pump tends to exceed a certain predetermined maximum. It will be understood that in accordance with the well known construction of the Waterbury pump that as the cylinder barrel 40 is rotated, the cylinders 40^a thereof are alternately brought into alignment with arcuate shaped outlet and inlet ports 50, 51. The outlet port 50 communicates with the pressure pipe 25 while the inlet port communicates with the suction pipe 23, hereinbefore described. The outlet port 50 also communicates with one end of a small pipe 52, the other end of which is in communication with the interior of a cylinder 53 suitably secured to the casing of the pump 24. Mounted within the cylinder 53 and fixedly secured to an extension of the control shaft 49 is a piston 54. The control shaft extension passes through a stuffing box 55 provided at the end of the cylinder 53 and said extension at its upper end passes through a cross bar 56. The outer end of the control shaft extension is screwthreaded for the reception of an adjusting nut 57 and a lock nut 58 by means of which the position of the cross bar 56 may be adjusted relatively to the control shaft. Confined between the cross bar 56 and the top of the cylinder 53 is a compression spring 59.

The spring 59 normally urges the cross bar 56 upwardly to a position such that the control shaft 49, and thereby the tilting box and swash plate of the pump are adjusted to an inclined position so as to cause the pump to deliver fluid through the port 50 to the pressure pipe 25. The strength of the spring 59 and the adjustment of the cross bar 56 is such that the pump will function automatically to deliver fluid at a certain predetermined maximum pressure under the control of the cylinder 53 and piston 54, as will presently be more fully described.

The installation furthermore includes an expansion tank 60 located at any suitable position; as shown, the expansion tank is mounted upon the casing of the pump 24

and communicates with the interior thereof through the small connecting pipe 61. The tank 60 is also in communication through the pipe 62 with the suction line 23 of the pump.

In order to secure a rapid operation of the piston 13 and wedges 10 and to obtain immediate movement of the piston 13 at its full speed; to avoid shocks due to the sudden starting and stopping of the wedges and to enable a pump of relatively small output to be employed, the present invention preferably includes the use of an accumulator. Such accumulator may be of any suitable construction. As shown in the drawings the accumulator comprises a differential cylinder consisting of an air compartment 63 and an oil compartment 64. The air compartment 63 is connected by means of a pipe 65 with an air intake line 66 which may lead to any suitable source of air under pressure. The pipe 66 also leads to an air storage tank 67. The oil compartment 64 of the accumulator is connected by the pipe 68 with the pressure line 25.

The pressure line 25 preferably includes a one-way check valve 69 which prevents back flow of the oil from the accumulator to the pump. Said line furthermore preferably includes the pressure gauge 70 for indicating the pressure of the fluid within such pipe.

The operation of the installation is as follows: Let it be assumed that the motor 42 is operating to drive the driving shaft 41 and thereby the cylinder barrel 40 and swash plate 45; the spring 59 being adjusted normally to hold the tilting box and swash plate at an angle to the driving shaft 41, fluid under pressure will be delivered by the pump through the port 50 and pressure pipe 25 to the casing 20 of the main control valve. With the control valve in the neutral position shown in Fig. 2 no fluid will be delivered to either of the pipes 18 or 19. The fluid pumped through the pipe line 25 will therefore flow through the pipe 68 to the oil compartment 64 of the differential cylinder of the accumulator. It may be assumed for example that the pressure of the air within the compartment 63 of the differential cylinder is 100 pounds per square inch. The relative cross sectional areas of the compartments 64, 63 are so proportioned that when the pump is delivering at its maximum output, say, for example, 650 pounds per square inch, as determined by the pressure of the spring 59, a column of oil will rise within the compartment 64 against the pressure of the air. A volume of fluid under pressure will therefore be stored in the differential cylinders 63, 64 as long as the pump continues to operate with the control valve in its neutral position and until the back pressure on the air in the accumulator, storage tank 67, and air line 66 rises to a point such that the pressure of the fluid within the pressure line 25 tends to exceed the maximum working pressure of 650 pounds. Should this occur such increase being communicated through the pipe 52 to the cylinder 53 will cause the piston 54 to be moved downwardly thereof, carrying with it the control shaft 49 against the action of the spring 59 and moving the tilting box and swash plate towards the neutral position to cut down the output of the pump.

Let it be assumed that it is desired to move the wedges 10 towards the right. The handle 39 will be swung in a direction such that fluid under pressure will be delivered to the pipe 33 and thence to the left hand end of the cylinder 32 to cause the piston 31 to be moved to the right; the fluid from the cylinder 32 on the right hand side of the piston 31 being ejected through the pipe 34 and pilot valve 35 to the pipe 36. The piston 31 in its movement towards the right carries with it the valve 26 thereby moving said valve from the neutral position shown in Fig. 2 to a position such that the pressure pipe 25 will be in communication with the pipe 19. The fluid under pressure within the pressure pipe 25 and accumulator 64 will be forced rapidly into the left hand end of the cylinder 14 and will cause the piston 13 to be moved towards the right carrying with it the wedges 10. The release of the oil stored within the accumulator will tend to bring about a drop of the pressure within the pipe 25, such that if the control shaft to the pump has been automatically moved towards neutral position as herein before described, the control shaft and tilting box of the pump will be immediately restored through the action of the spring 59 to the full output position as soon as the pressure within the pressure line tends to drop below the maximum working pressure to which the installation is adjusted.

As the piston 13 moves towards the right the fluid from the right hand of the cylinder 14 will flow through the pipe 18 through the valve casing 20 about the left hand side of the valve 26 to the branch pipe 22 and suction pipe 23 to the suction side of the pump.

Any excess in the volume of fluid ejected from the right hand side of the cylinder 14 over the volume which the pump can handle will be delivered through the pipe 62 from the pipe 23 to the expansion tank 60.

Movement of the wedges towards the left will of course be effected by moving the main control valve so as to place the pipe 18 in communication with the pipe 25, the manner in which the fluid will flow being readily understood from the preceding description.

It will of course be understood that while the use of a pilot valve and operating cylinder and piston for the main control valve is desirable, with the fluid employed for actuating said main control valve from a source of relatively low pressure, thereby to enable the operator to control the actuation of the

wedges by the exertion of much less manual effort than would be required to operate the main control valve against higher pressures prevailing in the pressure line 25 and valve casing 20, the use of such pilot valve and operating piston is not absolutely essential as the main control valve can be operated directly by a manual means, if desired. Likewise, it will be understood that the invention is not limited to the specific constructional details of the control valve shown, the pilot valve or the means for actuating the pilot valve but that many changes, variations and modifications of these parts, as well as the other parts of the apparatus, may be resorted to without departing from the principles of the invention.

I claim:

1. In an apparatus for actuating the roll setting wedges of a rolling mill, an hydraulic drive comprising a cylinder and piston operatively connected with said wedges, and means for supplying instantly a large volume of fluid under a substantially constant predetermined maximum pressure to said cylinder, said means including a fluid pressure pump and an accumulator having a differential cylinder the larger compartment of which is connected to a source of fluid under pressure and the smaller compartment connected in parallel with said pump and cylinder.

2. In an apparatus for actuating the roll setting wedges of a rolling mill, an hydraulic drive comprising a cylinder and piston operatively connected with said wedges, and means for supplying instantly a large volume of fluid under a substantially constant predetermined maximum pressure to said cylinder, said means including a fluid pressure pump having an adjustable control shaft for varying its output and an automatic fluid pressure device connected with the pressure line of said pump and with said control shaft, and an accumulator connected with said pressure line for maintaining a reserve supply of fluid under such pressure.

3. In an apparatus for actuating the roll wedges of a rolling mill, a fluid pressure cylinder and piston operatively connected with said wedges, means for maintaining a relatively large volume of fluid under pressure for actuating said piston and wedges substantially instantly, said means comprising an accumulator and a fluid pressure pump for supplying fluid under pressure to said cylinder and said accumulator, a valve under manual control interposed between said cylinder and said pump and accumulator for selectively governing the direction of movement of said piston and a device responsive to the pressure of the fluid passing to said cylinder for automatically adjusting the output of said pump to maintain a substantially constant predetermined maximum pressure in said accumulator and pressure line.

4. In an apparatus for actuating the roll setting wedges of a rolling mill, a fluid pressure cylinder and piston operatively connected with said wedges, means for supplying fluid under pressure to said cylinder, comprising a fluid pressure pump, means for maintaining a substantially constant predetermined maximum pressure at the pressure side of said pump, and means under manual control for selectively governing the direction of flow of said fluid to said cylinder, said last named means including a four-way valve and fluid pressure operated means for actuating said valve.

5. In an apparatus for actuating the roll setting wedges of a rolling mill, a fluid pressure actuated mechanism operatively connected with said wedges, a fluid pressure pump for supplying fluid under pressure to said cylinder, an accumulator connected with the pressure side of said pump, and a valve interposed between said cylinder and said pump and accumulator for selectively placing either end of said cylinder in communication with said pump and accomulator simultaneously when said wedges are actuated.

6. In an apparatus for actuating the roll setting wedges of a rolling mill, a fluid pressure actuated mechanism operatively connected with said wedges, a fluid pressure pump for supplying fluid under pressure to said cylinder, an accumulator having a permanent communicating connection with the pressure side of said pump, and means for automatically reducing the output of said pump when the pressure within said accumulator tends to exceed a predetermined maximum.

7. In an apparatus for actuating the roll setting wedges of a rolling mill, a fluid pressure actuated mechanism operatively connected with said wedges, a fluid pressure pump for supplying fluid under pressure to said cylinder, an accumulator connected in parallel with said cylinder to said pump, and a fluid pressure responsive device connected with the pressure line of said pump for maintaining a predetermined substantially constant maximum pressure in said line.

8. In an apparatus for actuating the roll setting wedges of a rolling mill, a fluid pressure actuated mechanism operatively connected with said wedges, a fluid pressure pump for supplying fluid under pressure to said cylinder, an accumulator connected in parallel with said cylinder to said pump, a fluid pressure responsive device connected with the pressure line of said pump for maintaining a predetermined substantially constant maximum pressure in said line, and a valve under manual control for shutting off the communication between said cylinder and said pump and accumulator, and for selec-

tively establishing such communication with either end of said cylinder.

9. In an apparatus for actuating the roll setting wedges of a rolling mill, a fluid pressure actuated mechanism operatively connected with said wedges, a fluid pressure pump for supplying fluid under pressure to said cylinder, an accumulator connected in parallel with said cylinder to said pump, a fluid pressure responsive device connected with the pressure line of said pump for maintaining a predetermined substantially constant maximum pressure in said line, a valve for selectively placing either end of said cylinder in communication with said pump and accumulator, or for shutting off such communication, fluid pressure responsive members for actuating said valve, a source of fluid under relatively low pressure for actuating said members, and a pilot valve for selectively governing the direction of flow of said low pressure fluid to said members.

In testimony whereof I have hereunto set my hand.

ARTHUR L. ELLIS.