

Nov. 28, 1933.

D. H. WEST

1,937,077

REVERSIBLE HYDRAULIC DRIVING MECHANISM

Filed March 3, 1931

4 Sheets-Sheet 1

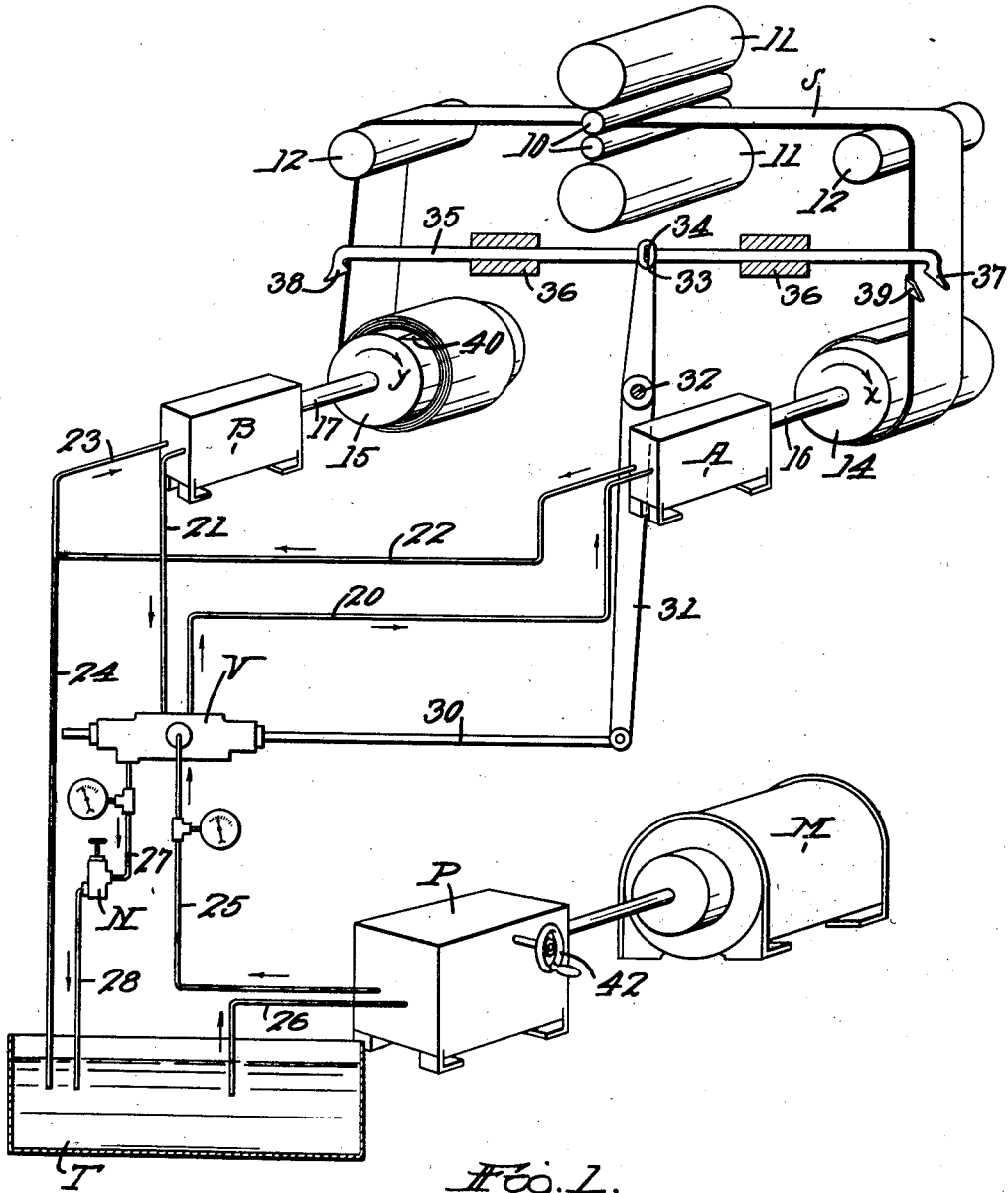


Fig. 1.

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4 Sheets-Sheet 2

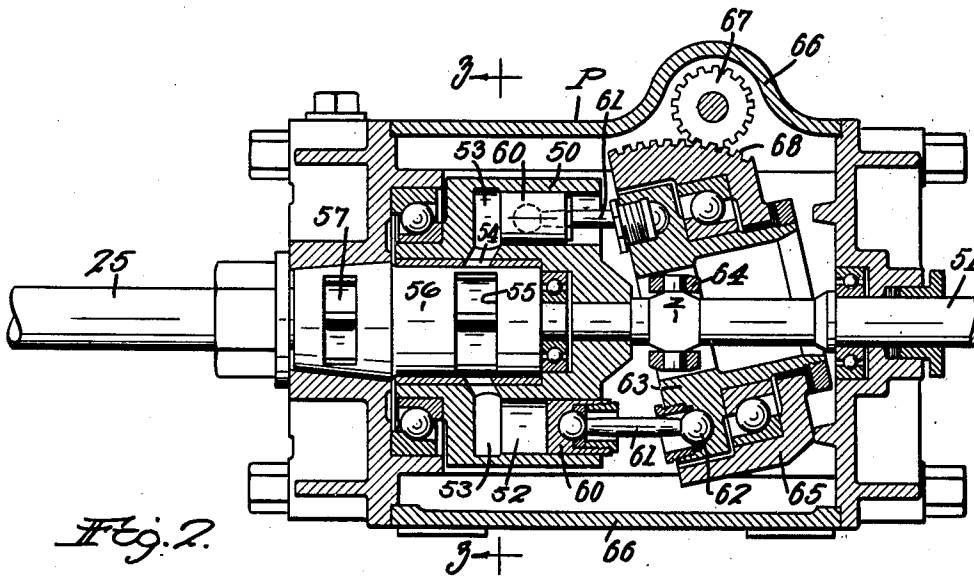


Fig. 2.

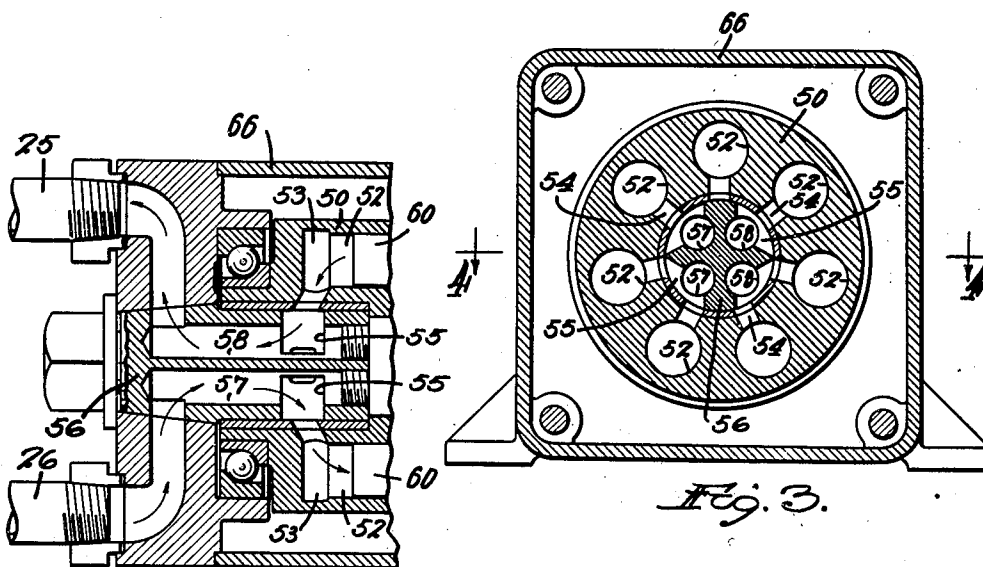


Fig. 3.

Fig. 4.

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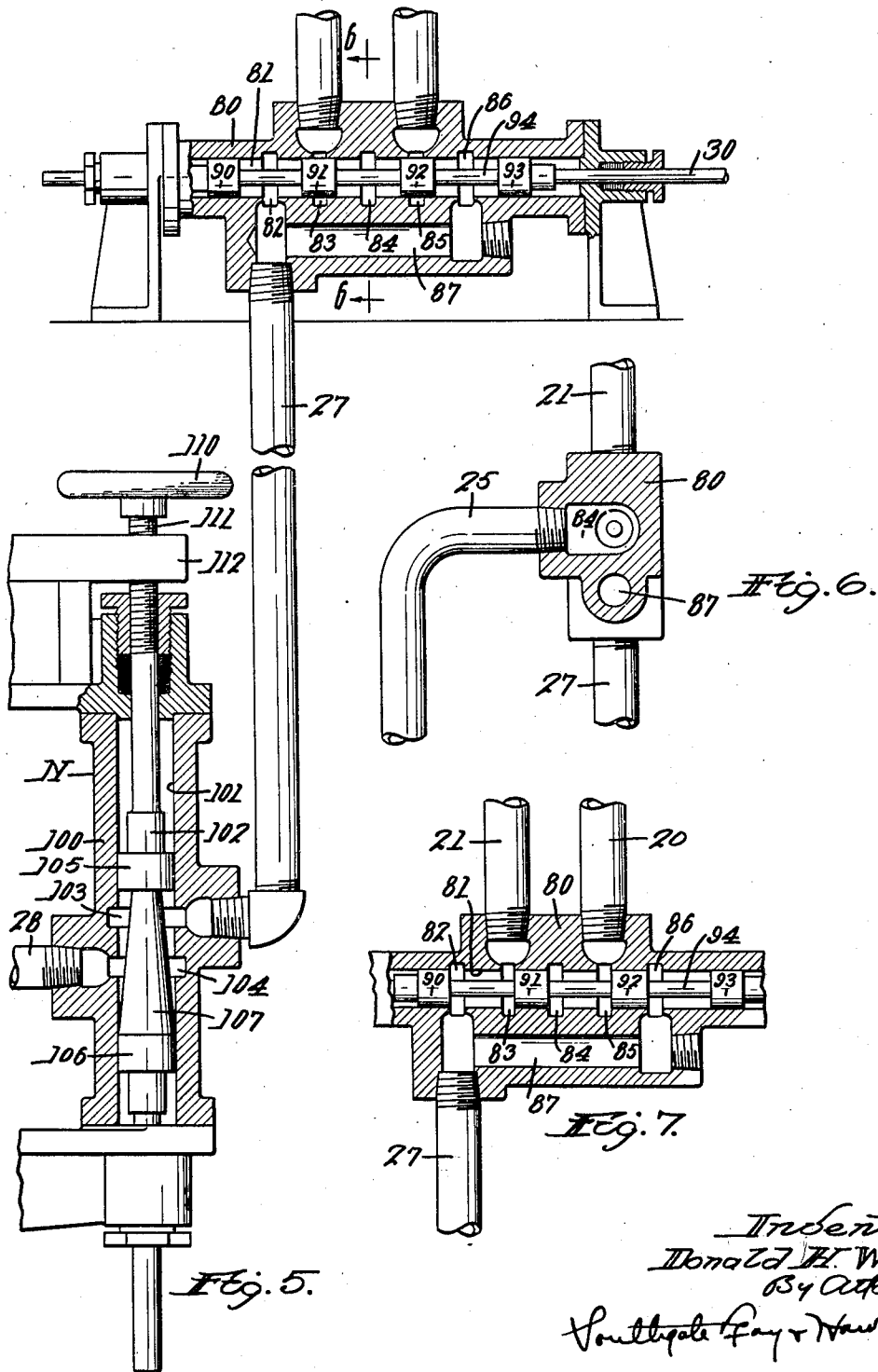
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4 Sheets-Sheet 4

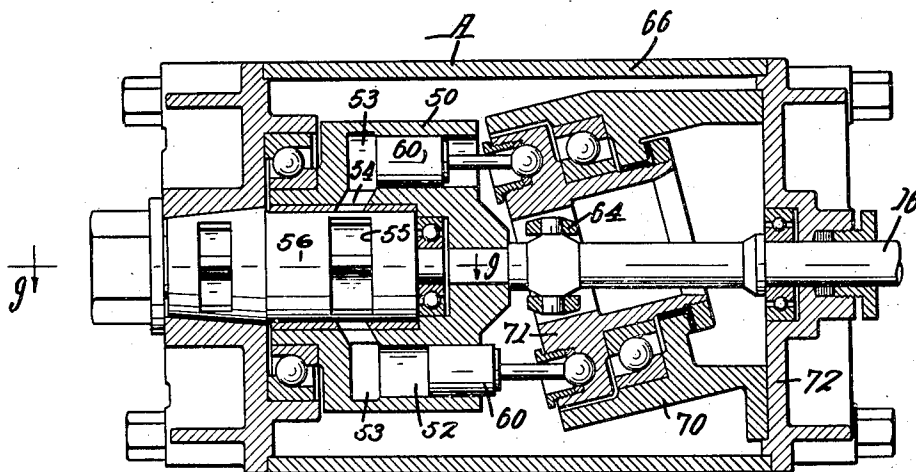


Fig. 8.

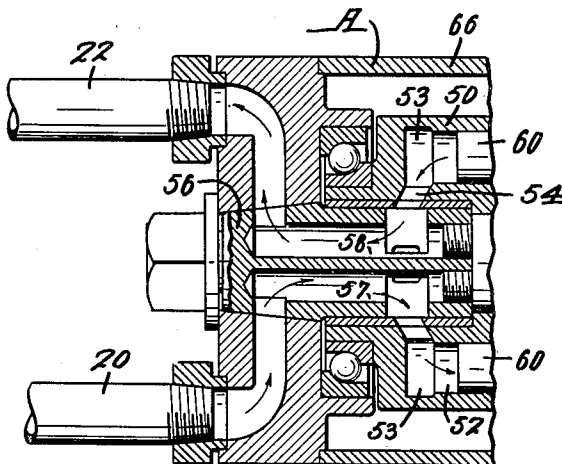


Fig. 9.

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UNITED STATES PATENT OFFICE

1,937,077

REVERSIBLE HYDRAULIC DRIVING
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Mass., a corporation of Maine

Application March 3, 1931. Serial No. 519,750

6 Claims. (Cl. 242—55)

This invention relates to mechanism for driving machines, such as sheet steel rolling mills, which are operated alternately in opposite directions.

It is the general object of my invention to provide improved hydraulic mechanism for effectively driving such alternately operated machines.

My invention further relates more specifically to the provision of hydraulic driving mechanism adapted to simultaneously exert a definite driving or pulling force with one portion of the apparatus and to exert a definite retarding force with another portion of the apparatus. These two portions of the apparatus are commonly connected to the opposite ends of the piece of material which is being rolled or otherwise operated on by the driven apparatus.

I also provide means for reversing the direction of operation of the hydraulic mechanism, for regulating the driving speed, and for variably determining the retarding force.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is diagrammatic perspective view showing the general arrangement of my improved hydraulic driving mechanism;

Fig. 2 is a sectional side elevation of the pump used in my improved driving mechanism;

Fig. 3 is a transverse sectional elevation, taken along the line 3—3 in Fig. 2;

Fig. 4 is a partial sectional plan view, taken along the line 4—4 in Fig. 3;

Fig. 5 is a sectional side elevation of certain valve mechanism to be described;

Fig. 6 is a detail sectional end elevation, taken along the line 6—6 in Fig. 5;

Fig. 7 is a detail sectional elevation showing certain parts of Fig. 5 in a different position;

Fig. 8 is a sectional side elevation of one of the hydraulic motors, and

Fig. 9 is a partial sectional plan view, taken along the line 9—9 in Fig. 8.

I will first describe the general features and method of operation of my invention, and I will thereafter describe the detail construction of certain mechanisms used therein.

In Fig. 1 I have shown my invention as applied to the rolling of sheet steel or other similar material. The rolling mechanism is indicated diagrammatically as comprising sheet-engaging or die rolls 10—10 and pressure rolls 11—11. The stock S is guided to and from the die rolls 10 by

guide rolls 12, and the ends of the stock S are secured to drums 14 and 15 mounted on driving shafts 16 and 17 which are directly connected to the rotors of a pair of hydraulic motors A and B.

The motors A and B are connected by pipes 20 and 21 to the casing of a control valve mechanism, V and are also connected by pipes 22 and 23 to a return pipe 24 which discharges into a storage tank T. The casing of the control valve mechanism V is connected by a pipe 25 to a hydraulic pump P, which is preferably driven by a direct-connected motor M. A supply pipe 26 leads from the tank T to the pump P.

An adjustable needle valve mechanism N is connected by a pipe 27 to the control valve mechanism V and by a pipe 28 to the tank T. A piston valve in the valve mechanism V is connected to a valve rod 30, extending through the head of the valve casing and connected to one end of a lever 31, pivoted at 32 and having its upper end slotted at 33 to receive a stud 34 on a bar 35 mounted to slide in fixed bearings 36.

At its opposite ends, the bar 35 is provided with depending inclined cam portions 37 and 38. These cam portions are positioned for engagement by lugs 39 and 40, formed on or secured to the edge of the strip of stock S and near the ends thereof.

The general operation of the device is as follows: The motor M preferably revolves at constant speed and drives the rotor of the pump P. This pump is preferably of the positively-acting, variable-delivery type and the rate of delivery may be adjusted by means of a hand wheel 42 or in any other convenient manner.

The oil, water or other transmission liquid in the tank T is drawn upward through the supply pipe 26 to the pump P and is delivered by the pump P through the pipe 25 to the valve mechanism V. This valve mechanism will be hereinafter described but for present purposes it may be stated that the piston valve is adjustable to connect the pump delivery pipe 25 to either of the pipes 20 or 21 leading to the motors A and B respectively.

When one of these pipes 20 or 21 is connected to the pipe 25, the other pipe 20 or 21 will be connected through the pipe 27, needle valve mechanism N and pipe 28 to the storage tank T.

Assuming that the piston valve in the control mechanism V is set in position to connect the pump discharge pipe 25 to the motor connection 20, the hydraulic motor A will be operated to turn the drum 14 clockwise or in the direction of the arrow x and to draw the strip S through the die rolls 10 and to wind the same on the roll 14. The

discharge from the motor A will flow through the pipes 22 and 24 to the storage tank T.

At the same time, the drum 15 will be turned in the direction of the arrow *y* by the pull of the stock S, thus positively rotating the hydraulic motor B in a backward or unwinding direction, causing the motor to draw in oil from the tank T through the pipes 24 and 23 and to discharge the oil through the pipes 21 and 27, needle valve mechanism N and pipe 28 back to the tank T.

By adjusting the needle valve mechanism N, the resistance to the flow of oil through this circuit may be increased or decreased as desired, and consequently any desired retarding force may be exerted on the strip S as it is unwound from the drum 15.

When a short length only of the strip S remains on the drum 15, the projection 40 on the edge of the strip engages the cam portion 38, sliding the bar 35 to the left, and reversing the position of the piston valve in the control valve mechanism V. The motor B will then operate as a motor to draw the stock S through the die rolls 10 in the opposite direction, and the motor A will exert a braking or retarding effect on the stock S as it is unwound from the drum 14.

It is found that this retarding effect is extremely important and that by varying the retarding action the density and structure of the metal being rolled may be substantially varied and controlled.

It is obvious that the direction of motion and point of reversal may be controlled by shifting the lever 31 manually as well as automatically. Furthermore, the automatic reversing mechanism is illustrative only and any other suitable reversing devices may be substituted therefor.

Having described the general construction and operation of my improved hydraulic driving mechanism, I will now describe certain details of the operating mechanism.

In Figs. 2, 3 and 4 I have illustrated the construction of a preferred form of positively-acting, variable-delivery pump P. In this type of pump, a rotor 50 is mounted on a motor-driven shaft 51 and is provided with an annular series of cylinders 52, connected through passages 53 and ports 54 to a series of openings 55 spaced about a fixed bearing member 56 which has passages 57 connected to the intake or suction pipe 26 and additional passages 58 connected to the discharge pipe 25 previously described.

The pistons 60 are movable in the cylinders 52 along lines parallel to the axis of the rotor 50 and driving shaft 51. These pistons 60 are connected by piston rods 61 and swivel joints 62 to a socket plate 63, which is positively rotated through a swivel connection 64 by the drive shaft 51, in unison with the rotation of the rotor 50.

The socket plate 63 is mounted in bearings in a cradle block or casing 65, which in turn is mounted in transverse bearings in the casing 66 of the pump P, the axis of these transverse bearings intersecting the axis of the shaft 51 and rotor 50 at the point Z (Fig. 2).

The cradle block of casing 65 is preferably provided with segment gear teeth 68 centered about the point Z and engaged by a pinion 67, connected to the hand wheel 42 previously described. By turning the hand wheel, the angular setting of the cradle block or casing 65 may be adjusted as desired. The greater the angle, the higher the rate of discharge of the pump for a given speed.

For a more detailed description of the pump

P, reference is made to my prior Patent No. 1,722,832, issued July 30, 1929.

The hydraulic motors A and B (Figs. 8 and 9) are preferably substantially similar in construction to the pump P, with the exception that the support 70 (Fig. 8) for the socket plate 71 is preferably fixed in the casing 72 of the motor, instead of being adjustable therein.

The angle of inclination of the socket plate 71 with respect to the rotor shaft in the motor should be fixed at the point of greatest efficiency for reversible action. Obviously, adjustment of the socket plate 71 to a position nearly perpendicular to the axis of the motor shaft would introduce such resistance that it could not be overcome by any available pressure in the cylinders of the rotor, and consequently the apparatus would be inoperative as a retarding motor but would merely lock the unwinding drum. At an angle of approximately fifteen degrees, as shown in Fig. 8, the rotor is found to operate at its greatest efficiency and to be satisfactorily reversible.

The details of the control valve mechanism V are clearly shown in Figs. 5, 6 and 7. The valve mechanism V comprises a casing 80 having a cylindrical opening 81 with a plurality of enlarged annular port openings 82, 83, 84, 85 and 86.

The pump delivery pipe 25 is connected to the middle port 84 (Fig. 6). The supply pipes 20 and 21 for the motors A and B are connected to the ports 85 and 83 (Fig. 5) respectively. The end ports 82 and 86 are connected to a common passage 87, which in turn is connected to the pipe 27 leading to the needle valve mechanism N.

The piston valve comprises cylindrical portions 90, 91, 92 and 93 and reduced connecting portions 94, the entire valve being connected as a unit to the valve rod 30 previously described.

In Fig. 5 I have shown the piston valve in its middle or neutral position, but in Fig. 7 the piston valve is shown as shifted to the right, connecting the supply port 84 to the pipe 20 leading to the motor A, and connecting the pipe 21 from the motor B to the needle valve connection 27.

If the valve is shifted in the opposite direction, the supply port 84 will obviously be connected to the motor connection 21 and the pipe 20 will be connected through the port 86 and passage 87 to the pipe 27 and needle valve mechanism N.

A preferred construction of the needle valve mechanism N is shown in Fig. 5. The mechanism comprises a casing 100 having a cylindrical opening 101 in which a piston valve 102 is axially adjustable. The cylindrical opening 101 is provided with annular port openings 103 and 104, the first being connected to the pipe 27 and the second to the pipe 28.

The piston valve 102 comprises cylindrical portions 105 and 106 connected by a tapered or conical portion 107. The piston valve may be adjusted axially by a hand wheel 110 mounted on the end of the piston rod 111, which is threaded into a fixed projection 112. By adjusting the conical portion 105 axially with respect to the port opening 104, the effective area of the port or passage between the pipes 27 and 28 may be restricted as desired, and consequently the retarding effect of the motor A or B as rotated by the unwinding of the stock S may be readily adjusted to operating conditions.

I have now described the general construction and operation of my improved hydraulic driving mechanism and the details of such parts of the mechanism as are necessary for the purposes of understanding this invention.

It will be seen that I have provided extremely simple mechanism comprising a variable-discharge, motor-driven pump P and a pair of reversible hydraulic motors A and B, together with suitable control mechanism by which the motors A and B and winding drums 14 and 15 may be alternately rotated in opposite directions, and by which the idle hydraulic motor may be utilized as a brake or drag, with the braking or retarding effect readily adjustable. The mechanism is thus extremely well adapted for driving a rolling mill or any other apparatus in which the direction of operation is frequently reversed, and particularly apparatus in which a drag or braking effect is desired.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:—

1. Reversible driving mechanism comprising a pump, a pair of hydraulic motors, and a control valve mechanism effective to connect either motor to said pump and to a fluid storage, and the other motor to said fluid storage and to a higher pressure fluid discharge.

2. Reversible driving mechanism comprising a pump, a pair of hydraulic motors, and a control valve mechanism effective to connect either motor to said pump and to a fluid storage, and the other motor to a low pressure fluid supply and to a higher pressure fluid discharge, said discharge including an adjustable flow-restricting valve.

3. In a machine for acting on an elongated piece of flexible material, a pair of hydraulic motors each adapted to either pull or retard said material, means to supply fluid under relatively high pressure to drive a selected motor to pull said piece of material through said machine, said material being attached to and turning the second motor as the material is unwound, connections supplying fluid at low pressure to said second motor, means to oppose discharge thereof at a higher pressure, and selective means to connect said higher pressure fluid supplying means to one motor and said connections and discharge opposing means to the other motor interchangeably

and alternately, whereby the operation of the machine is reversed.

4. In a machine for acting on an elongated piece of flexible material, a pair of hydraulic motors each adapted to either pull or retard said material having winding drums for said material, means to supply fluid under relatively high pressure to drive a selected motor to turn the associated winding drum and pull said material through said machine, said material being attached to the second winding drum and turning the second motor as the material is unwound from said second drum, connections supplying fluid at low pressure to said second motor, means to oppose discharge thereof at a higher pressure, and selective means to connect said high pressure fluid supplying means to one motor and said connections and discharge opposing means to the other motor interchangeably and alternately, whereby the operation of the machine is reversed.

5. In a machine for acting on an elongated piece of flexible material, a pair of hydraulic motors each adapted to either pull or retard said material, means to supply fluid under relatively high pressure to drive a selected motor to pull said piece of material through said machine, said material being attached to and turning the second motor as the material is unwound, connections supplying fluid at low pressure to said second motor, means to oppose discharge thereof at a higher pressure, and means to simultaneously reverse the operation of said two motors.

6. In a machine for acting on an elongated piece of flexible material, a pair of hydraulic motors each adapted to either pull or retard said material, means to supply fluid under relatively high pressure to drive a selected motor to pull said piece of material through said machine, said material being attached to and turning the second motor as the material is unwound, connections supplying fluid at low pressure to said second motor, means to oppose discharge thereof at a higher pressure, and means to simultaneously reverse the operation and direction of rotation of said two motors.

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