

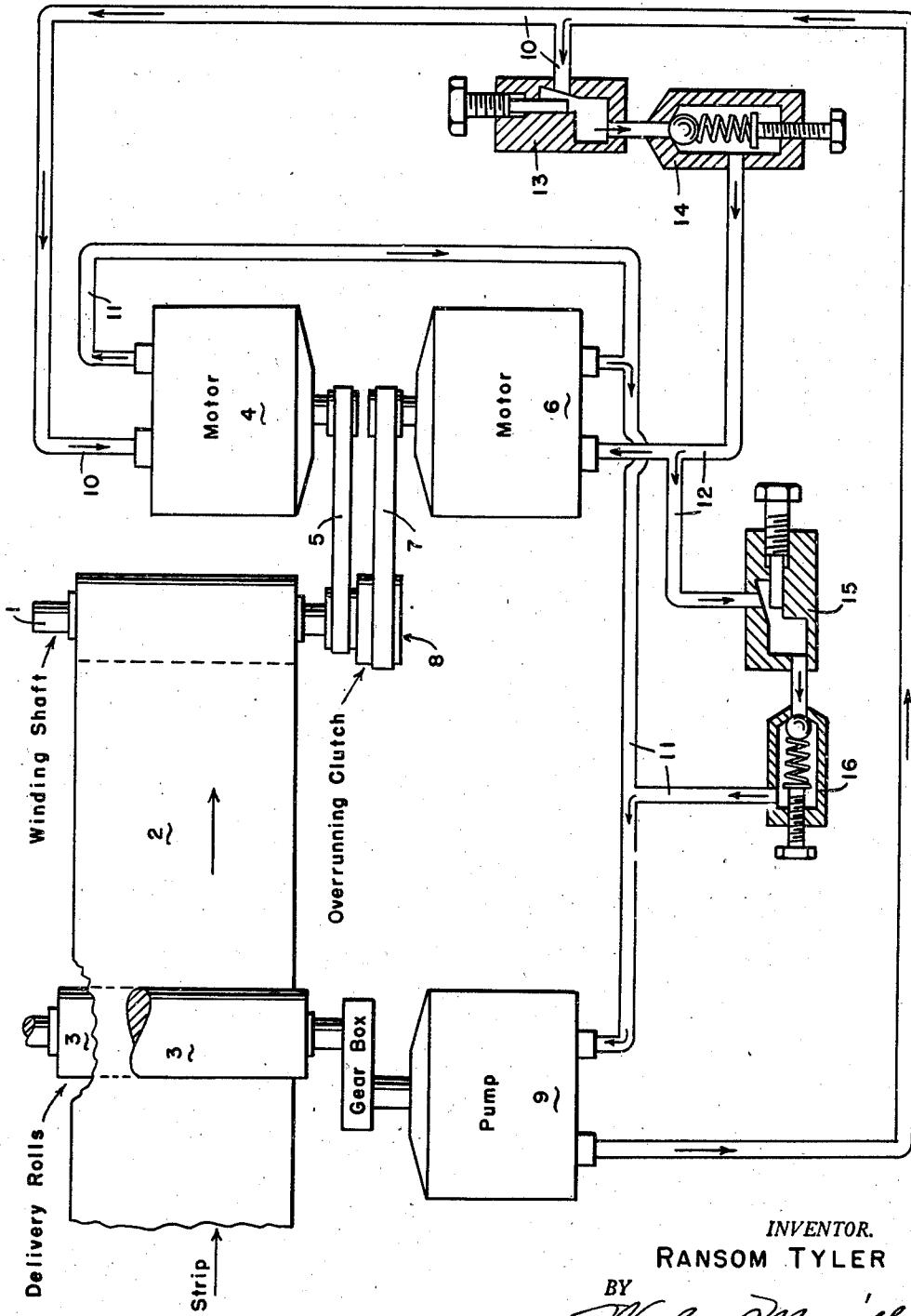
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WINDER DRIVE

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WINDER DRIVE

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This invention relates to hydraulic drives of the type employed to drive a winding roll upon which strip material is wound as fast as it is delivered thereto from another machine or from another part of the same machine of which the winding roll forms a part.

A winder drive must maintain tension upon the strip during the winding operation and the tension must be maintained within certain limits in order to produce a finished roll of strip material having the proper density and to prevent the inner turns of the strip from moving axially during the winding of the outer turns.

The present invention has as an object to provide a hydraulic drive which will wind strip material into large diameter rolls upon small diameter cores and maintain the tension upon the strip within the proper limits.

Other objects and advantages will appear from the following description of an embodiment of the invention shown schematically in the accompanying drawing.

The drive chosen for illustration is adapted to drive the winding shaft 1 of a machine which winds a sheet or strip 2 of material into a roll as it is delivered thereto by the delivery rolls 3 of the same or a different machine. Since the machine or machines form no part of the present invention, only the winding shaft and the delivery rolls thereof have been shown in the drawing.

As shown, winding shaft 1 is adapted to be driven by a hydraulic motor 4 through a suitable drive 5 and also by a second hydraulic motor 6 through a suitable drive 7 which should include an overrunning clutch 8. Drives 5 and 7 have been shown as being of the belt and pulley type solely for the purpose of illustration as any suitable type of drive will suffice. Drive 7 has been shown as having a greater ratio than drive 5 so that motor 6 will run faster than motor 4 when both motors are driving shaft 1 but this is necessary only under certain conditions.

Liquid for energizing motors 4 and 6 is supplied by a pump 9 which is driven at a speed proportional to the speed of strip 2 such as by being connected to delivery rolls 3.

Motor 4 has its inlet connected to the outlet of pump 9 by a channel 10 and its outlet connected to a channel 11 through which liquid is returned to pump 9. Motor 6 has its outlet connected to channel 11 and its inlet connected to channel 10 by a channel 12 and an adjustable choke 13 and an adjustable resistance valve 14 which are connected in series. Liquid is bypassed around mo-

tor 6 through an adjustable choke 15 and an adjustable resistance valve 16 which are connected in series between channels 11 and 12. Chokes 13 and 15 are preferably of the orifice type.

Operation

The end of the strip extending through delivery roll 3 is fastened to a core on a shaft 1 with as little slack as possible. Delivery rolls 3 are then started and pump 9 will start to operate. The liquid delivered by pump 9 will flow through channel 10 and cause motor 4 to rotate shaft 1 which will wind strip 2 thereon.

Resistance valve 14 will at first prevent delivery of liquid to motor 6 so that all the liquid discharged by pump 9 will flow to motor 4 until the slack is pulled out of strip 2 and tension is exerted thereon. The pull on strip 2 will cause pump pressure to rise high enough to open resistance valve 14 which is adjusted to open at the pressure necessary to enable motor 4 to have just enough torque to exert the proper tension upon strip 2 when the roll of material upon shaft 1 is of minimum diameter. Overrunning clutch 8 permits motor 4 to drive shaft 1 independently of motor 6.

As delivery rolls 3 accelerate to full speed, the speed and volumetric delivery of pump 9 will correspondingly increase and cause motor 4 to run fast enough to wind up strip 2 and to maintain tension thereon. The liquid discharged by pump 9 in excess of the liquid required to operate motor 4 flows through choke 13, resistance valve 14 and channel 12 to motor 6 and causes it to operate but it will not run fast enough to assist in driving shaft 1 until the roll of material thereon reaches a predetermined diameter. For example, if the core on shaft 1 is three inches in diameter, the parts may be so proportioned that motor 6 is not effective until the roll of material on shaft 1 is about seven and one half inches in diameter.

As the roll of material upon shaft 1 gradually increases in diameter, more motor torque is required to rotate it and its rotary speed decreases relative to its peripheral speed and causes the speed of motor 1 to correspondingly decrease and the rate at which liquid is bypassed through choke 13 and resistance valve 14 to correspondingly increase.

Continued rotation of shaft 1 causes the roll of material thereon to gradually increase in diameter so that the motor torque must gradually increase in order to maintain tension upon strip 2. Since strip 2 is delivered to shaft 1 at a substantially uniform rate after the machine is

brought up to speed, increasing the diameter of the roll of material on shaft 1 decreases its rotary speed and consequently decreases the speed of motor 4 which causes a corresponding increase in the rate at which liquid is bypassed through choke 13 and resistance valve 14.

The resistance offered by choke 13 to the flow of liquid therethrough is small when the roll of material on shaft 1 is of minimum diameter but, as the flow therethrough gradually increases due to the roll of material gradually increasing in diameter, the resistance of choke 13 gradually increases and causes pump pressure to gradually increase and thereby gradually increase the torque of motor 4 so that tension is maintained upon strip 2.

All of the liquid bypassed through choke 13 and resistance valve 14 enters motor 6 but the rate of flow is insufficient to cause motor 6 to operate fast enough to assist in driving shaft 1 until the roll of material reaches a predetermined diameter so that at this time the pressure in channel 12 is just high enough to cause motor 6 to operate idly.

When the roll of material on shaft 1 reaches the predetermined diameter, the speed of motor 4 will have been decreased to such an extent that the flow of liquid through choke 13 and resistance valve 14 will have been increased sufficiently to cause motor 6 to operate fast enough to pick up the load through overrunning clutch 3. Shaft 1 will then be driven by both motors.

Since the speed of motor 4 is gradually decreasing so that the flow of liquid to motor 6 is gradually increasing, motor 6 will tend to accelerate but its speed will be limited by the speed of strip 2. The resistance offered by strip 2 to the operation of motor 6 causes the pressure in channel 12 to rise and open resistance valve 16 and then the liquid delivered to motor 6 in excess of its requirements flows through choke 15 and resistance valve 16 into return channel 11.

The resistance offered by choke 15 is negligible at first for the reason that the flow therethrough is very small at first but the speeds of motors 4 and 6 will gradually decrease as the roll of material on shaft 1 gradually increases so that the flow through choke 15 gradually increases and thereby causes pump pressure to gradually increase and enable motors 4 and 6 to maintain tension upon strip 2.

The tension on strip 2 is thus automatically controlled by chokes 13 and 15 and resistance valves 14 and 16 which are preadjusted to provide a tension of the desired characteristics. If a strip is to be wound into a roll of large diameter upon a small diameter core, such as a roll ten times the diameter of the core, the chokes and resistance valves are preferably so adjusted that the tension upon the strip is maximum at the beginning of winding operation and automatically decreases as the roll increases in diameter so as to prevent the inner turns of the strip from moving axially during the winding of subsequent turns of the strip.

A hydraulic drive constructed according to the invention is capable of winding larger rolls of the proper density upon relatively small cores than is possible with the prior hydraulic drives.

The winder drive described herein may be modified in various ways and adapted to various uses without departing from the scope of the invention which is hereby claimed as follows:

1. A transmission for driving a shaft upon which strip material is to be wound as fast as

it is delivered thereto, comprising a pump, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive connecting said second motor to said shaft and including an overrunning clutch, means for delivering liquid from said pump to said second motor including means to resist the flow of liquid thereto, and resistance means for bypassing liquid around said second motor.

2. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto, comprising a pump, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive having a greater ratio than said first drive connecting said second motor to said shaft and including an overrunning clutch, means for delivering liquid from said pump to said second motor including means to resist the flow of liquid thereto, and resistance means for bypassing liquid around said second motor.

3. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto, comprising a pump, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive connecting said second motor to said shaft and including an overrunning clutch, means connecting said second motor to said pump in parallel with said first motor and including a choke and a resistance valve connected in series between said second motor and said pump, and resistance means for bypassing liquid around said second motor.

4. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto, comprising a pump, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive having a greater ratio than said first drive connecting said second motor to said shaft and including an overrunning clutch, means connecting said second motor to said pump in parallel with said first motor and including a choke and a resistance valve connected in series between said second motor and said pump, and resistance means for bypassing liquid around said second motor.

5. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto, comprising a pump, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive connecting said second motor to said shaft and including an overrunning clutch, means for delivering liquid from said pump to said second motor including means to resist the flow of liquid thereto, and means including a choke and a resistance valve for bypassing liquid around said second motor.

6. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto, comprising a pump, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive having a greater ratio than said first drive connecting said second motor to said shaft and including an overrunning clutch, means connecting said second motor to said pump in parallel with said first motor and including a choke and a resistance valve connected in series between said

second motor and said pump, and means including a choke and a resistance valve for bypassing liquid around said second motor.

7. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto by a machine, comprising a pump driven by said machine, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive connecting said second motor to said shaft and including an overrunning clutch, means for delivering liquid from said pump to said second motor including means to resist the flow of liquid thereto, and resistance means for bypassing liquid around said second motor.

8. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto by a machine, comprising a pump driven by said machine, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive having a greater ratio than said first drive connecting said second motor to said shaft and including an overrunning clutch, means for delivering liquid from said pump to said second motor including means to resist the flow of liquid thereto, and resistance means for bypassing liquid around said second motor.

9. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto by a machine, comprising a pump driven by said machine, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive connecting said second motor to said shaft and including an overrunning clutch, means connecting said second motor to said pump in parallel with said first motor and including a choke and a resistance valve connected in series between said second motor and said pump, and resistance means for bypassing liquid around said second motor.

10. A transmission for driving a shaft upon

which strip material is to be wound as fast as it is delivered thereto by a machine, comprising a pump driven by said machine, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive having a greater ratio than said first drive connecting said second motor to said shaft and including an overrunning clutch, means connecting said second motor to said pump in parallel with said first motor and including a choke and a resistance valve connected in series between said second motor and said pump, and resistance means for bypassing liquid around said second motor.

11. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto by a machine, comprising a pump driven by said machine, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive connecting said second motor to said shaft and including an overrunning clutch, means for delivering liquid from said pump to said second motor including means to resist the flow of liquid thereto, and means including a choke and a resistance valve for bypassing liquid around said second motor.

12. A transmission for driving a shaft upon which strip material is to be wound as fast as it is delivered thereto by a machine, comprising a pump driven by said machine, a first hydraulic motor connected to said pump, a first drive connecting said motor to said shaft, a second hydraulic motor, a second drive having a greater ratio than said first drive connecting said second motor to said shaft and including an overrunning clutch, means connecting said second motor to said pump in parallel with said first motor and including a choke and a resistance valve connected in series between said second motor and said pump, and means including a choke and a resistance valve for bypassing liquid around said second motor.

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