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ROLL-DRIVING MECHANISM FOR A NAPPING MACHINE
AND TORQUE CONTROL DEVICES THEREFOR

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Fig. 3

Fig. 4

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This invention relates to napping machines of the planetary type in which pile and counter-pile napping rolls are arranged alternately in a circular series in a rotated drum or carrier and engage the adjacent surface of a piece of cloth which is drawn at a definite speed through the machine.

The napping surfaces of the rolls move in the same direction as the cloth but at such relative speeds as will produce a slight pull or a slight drag relative to the cloth, for pile and counter-pile napping effects.

It is the general object of my present invention to provide a roll-driving mechanism and torque-control devices for a napping machine by which the napping action of the rolls is made responsive to the torque applied to produce the desired napping effect. A given torque applied to a cloth structure which offers a given resistance results in a particular roll speed.

The net applied torque is controlled by the operator but the actual rotational speed of the rolls may vary as a consequence of the nature of the load. In the known prior art, the operator, on the contrary, selected a given roll speed which was thereafter approximately maintained and with but slight response to changes in load or operating conditions.

To the attainment of this general object, I preferably provide a constant-volume-output pump, separate hydraulic motors for the two sets of rolls, and separate means to vary the effective torque of each motor by increasing or decreasing the net operating pressure on said motor, and with said two motors operating substantially in parallel.

In a modified construction, the motors operate in series in a substantially closed circuit, and a single pressure-control device is provided.

In a third form of the invention, provision is made for selective operation of the two hydraulic motors in either parallel or series relation. Mechanism may also be provided for automatically maintaining substantially constant roll speeds during a continued napping machine operation.

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

Preferred forms of the invention are shown in the drawings, in which

Fig. 1 is a sectional end view of a planetary type napping machine with certain parts omitted for clarity;

Fig. 2 is a partial axial section, taken along the line 2—2 of Fig. 1;

Fig. 3 is a diagrammatic view showing hydraulic connections for independently controlling and driving the pile and counter-pile napping rolls respectively;

Fig. 4 is a similar diagrammatic view showing the connections for controlling and driving the pile and counterpile napping rolls at a fixed speed ratio but responsive to cloth-resistance;

Fig. 5 is a diagrammatic view showing additional valves and connections by which the two sets of rolls may be operated independently, or a predetermined roll-speed ratio may be attained; and

Figs. 5a to 5d indicate different valve settings to be explained.

Referring to Figs. 1 and 2, I have shown parts of a planetary type napping machine which is in general of commercial form and which comprises a casing 10 in which a main shaft 11 is mounted in fixed bearings for continuous rotation at a uniform speed.

A plurality of pile napping rolls R and counter-pile napping rolls R2 are alternated in a circular series in heads 12 fixed to the shaft 11 and rotated thereby.

Each counter pile roll R2 is provided with a pinion 20 (Fig. 2) which meshes with and is driven by a spur gear 21, and each pile roll R is provided with a pinion 22 meshing with and driven by a spur gear 24.

In Fig. 2, the pinion 20 is shown as having twenty-five teeth and the gear 24 as having 221 teeth, while the pinion 22 is shown as having twenty-two teeth and the gear 24 as having 225 teeth. These gear ratios facilitate roll assembly and are illustrative only.

The spur gear 21 which drives the counter-pile napping rolls R2 is loosely mounted and has a pinion 30 associated therewith which is engaged by a gear 32 driven by a commercial type hydraulic motor H2. The spur gear 24 which drives the pile napping rolls R has an extended hub or bushing 33 loosely mounted on the main shaft 11, and this hub is provided with a pinion 35 engaged by a gear 36 corresponding to the gear 32 previously described and driven by a second and independent hydraulic motor H (Fig. 1).

The cloth C approaches the machine over a guide-roll 40 (Fig. 1) and then passes around a front feed roll 41.

After substantially encircling the series of napping rolls, the cloth C then passes around a rear feed roll 42 and over a guide-roll 43 to suitable folding or other disposal mechanism (not shown).

The feed rolls 41 and 42 are connected by pulleys 44 and 45 and a belt 46. They rotate at substantially the same surface speed but maintain a desired tension on the cloth. The belt pulley 44 has an associated gear 47 meshing with a pinion 48 which is connected by pulleys 49 and 50 to the main driving shaft 11. The hydraulic motor H2 is supplied with liquid by a pump P which has a constant volume output.

In the operation of the machine, the main shaft 11 rotates the heads 12, thus moving the circular series of napping rolls around a circular path. The main shaft 11 is also connected as described to drive the cloth-engaged feed rolls 41 and 42 and thus passes the cloth through the machine at a predetermined rate which is coordinated with the travel of the napping rolls in their circular path.

The net or resultant rotation of the counter-pile napping rolls R2 about their own axes is produced by the combination of the rotational movement of the head or carrier 12 and the action of the motor H2 through the gear 32, pinion 30, spur gear 21 and roll pinions 26. The rotation of the pile napping rolls R is similarly effected but involves the motor H acting through the gear 36, pinion 35, spur gear 24, and roll pinions 22.

The hydraulic connections by which the motors H and H2 are controlled and operated are shown diagrammatically in Fig. 3, in which the constant-volume-output pump P is connected to the hydraulic motor H2 through a pipe having portions 50 and 51. The motor H2 is also provided with a discharge pipe 52 and with a pressure-regulating relief valve V which is connected at the junction of the pipe portions 50 and 51 as shown.

A handle 54 is provided for manual setting of the valve V, and the valve V discharges through a pipe 55 into the pipe 52 previously described.

The pipe 52 is also connected into the junction of two
pipe portions 56 and 57. The portion 56 connects into a reducing valve V2 which may be permanently set for a desired back-pressure and which discharges to an open tank T.

Pipe 57 is connected into the pile motor H, and this motor H discharges through a pipe 58 and a relief valve V3 to a pipe 59 connected to discharge into the tank T. A hand wheel 60 provides for manual setting of the valve V3.

Considering now the counter-pile motor H2, it will be seen that the discharge or back-pressure in the pipe 53 is controlled by the valve V2 which is permanently set at any desired back-pressure, such as 100 p. s. i.

As liquid is supplied by the pump P at a constant volume output, the speed of the motor H2 will depend on the ratio of oil delivered to the motor and oil by-passed through the valve V to the back-pressure pipe 52.

The motor pull and consequently the pull of the counter-pile napping rolls R2 is exerted against the resistance of the cloth during the napping operation. If this resistance increases, the rolls and the hydraulic motor will slow down and an additional volume of oil will be by-passed through the valve V. Consequently, a substantially constant torque or reaction to the cloth resistance is maintained.

In the case of the pile napping rolls R, the pull of the cloth tends to increase the proportionate speed of the pile rolls and to make the motor H function as a pump, and with a braking rather than a driving action. Back-pressure oil is supplied through the pipe 57, and the motor H, acting as a pump, discharges this oil at a higher pressure which is determined by the pressure-regulating valve V3, now on the discharge side of the motor.

Gauges G and G2 may be connected into the pipes 51 and 53 and the operator conditions may be reproduced at any time by adjusting the valves V and V3 so that the same gauge readings are achieved. In the described construction of Fig. 3, it will be noted that the oil discharged by both motors is returned to the open tank T.

In the construction shown in Fig. 4, a normally-closed circuit is provided between the hydraulic motors H and H2, and in this combination also the motor H acts as a pump or brake. In this construction, the pump P discharges a constant volume output into a pipe 70 connected to the intake of the motor H. A discharge pipe 71 connects the outlet of the motor H to the intake of the motor H2, and the discharge pipe 72 of the motor H2 is connected into the feed pipe 70 for the motor H.

A single pressure-relief valve V6 is provided in the pipe 70 but adjacent the pump P, and the discharge pressure may be regulated by the hand wheel 73 as previously described. The valve V6 discharges into an open tank T2.

With this construction, the pump P provides relatively low pressure through the pipe 70 for the motor H, and the motor H acting as a pump, supplies relatively high-pressure oil through the pipe 71 to the motor H2. This motor in turn discharges through the pipe 72 at the lower pressure in the pipe 70. This lower pressure may be regulated by the valve V6, and any surplus output of the pump P will be discharged through the valve V6 to the tank T2.

This construction will conserve power as the pile motor H runs regeneratively but it is less flexible than the construction shown in Fig. 3, as the motors H and H2 must rotate in a fixed speed relation, and the pile and counter-pile napping rolls must correspondingly rotate in a fixed speed ratio. The speed of the motors will be determined by the load or cloth-resistance, as in the previous construction, but any change in the speed of the pile rolls must be associated with a similar change in the speed of the counter-pile rolls.

In the napping of certain types of fabric, this fixed speed relation is not objectionable, and the pump P may operate at a much smaller delivery rate, as it merely maintains a relatively low pressure and replaces leakage.

The arrangement shown in Fig. 3 is found most desirable for relatively light napping operations on cloth of relatively uniform weight and texture, while the construction shown in Fig. 4 is somewhat better adapted for relatively hard or heavy napping operations.
means also provides a by-pass for excess liquid supply.

3. The combination in a napping machine as set forth in claim 1, in which cross connections provide for regenerative operation of the pile motor, and manually-operated valves provide selective determination of the type of operation.

4. In a planetary-type napping machine having a set of pile napping rolls and a set of counter-pile napping rolls, in combination, a separate hydraulic motor for each set of rolls, a pump to supply a constant volume output of operating liquid for said motors, and connections through which said liquid operates to drive the counter-pile motor and to retard the rotation of the pile motor.

5. In a planetary-type napping machine having a set of pile napping rolls and a set of counter-pile napping rolls, in combination, a separate hydraulic motor for each set of rolls, a pump to supply a constant volume output of operating liquid for said motors, connections through which said liquid operates to drive the counter-pile motor and to retard the rotation of the pile motor, and separate means to control and maintain a selected net torque for each motor.

6. In a planetary-type napping machine having a set of pile napping rolls and a set of counter-pile napping rolls, in combination, a separate hydraulic motor for each set of rolls, a pump to supply a constant volume output of liquid to said motors, and connections effecting closed circuit and regenerative operation of said two motors in series and in a fixed speed ratio.

7. In a planetary-type napping machine having a set of pile napping rolls and a set of counter-pile napping rolls, in combination, separate driving means for each set of rolls, means to establish the net torque for each set of rolls, and automatic torque-maintaining means utilizing the pull on the cloth on the pile rolls and effective to vary the speed of each set of rolls inversely with respect to cloth resistance and to thereby automatically maintain substantially uniform torque.

8. In a planetary-type napping machine having a set of pile napping rolls and a set of counter-pile napping rolls, in combination, a separate hydraulic motor for each set of rolls, a pump to supply a constant volume output of operating liquid for said motors, connections through which said liquid operates to drive the counter-pile motor and to retard the rotation of the pile motor, separate means to control and maintain a selected net torque for each motor, devices to adjust said separate control means, and gauge means to indicate the adjusted pressures.

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