June 24, 1930. D. R. FRANCIS 1,767,788

DRIVING GEAR FOR PAPER CALENDERS

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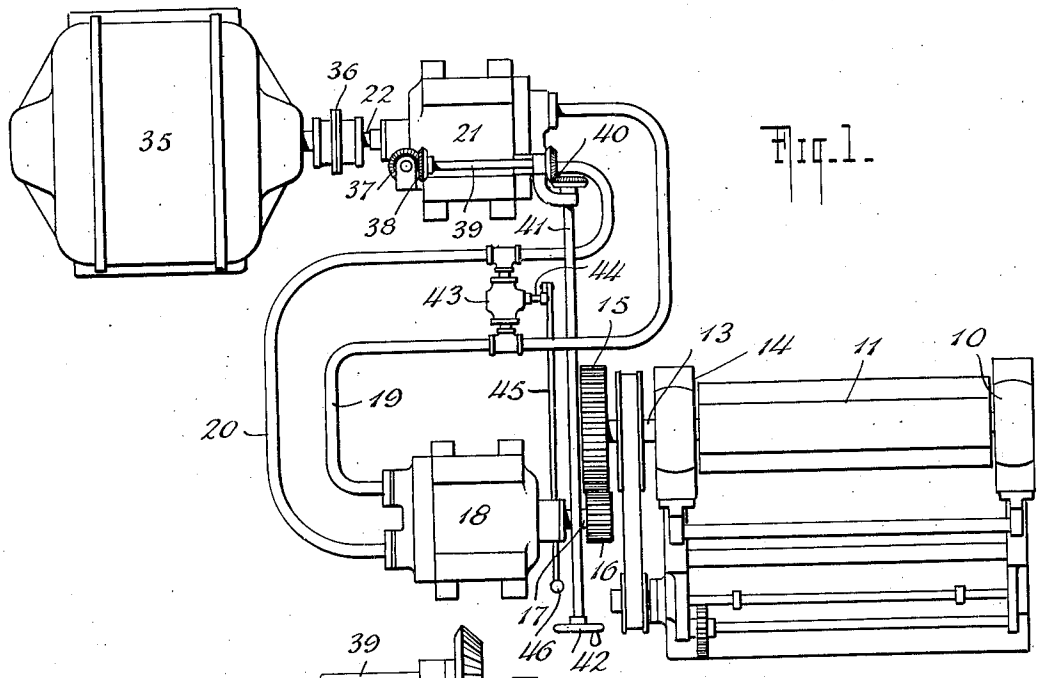


Fig. 1.

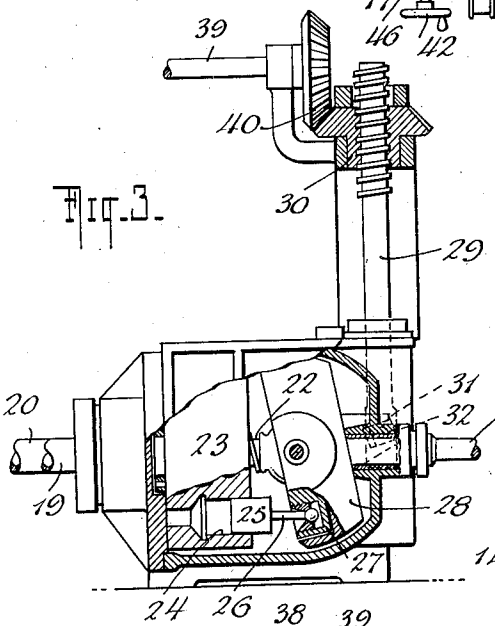


Fig. 3.

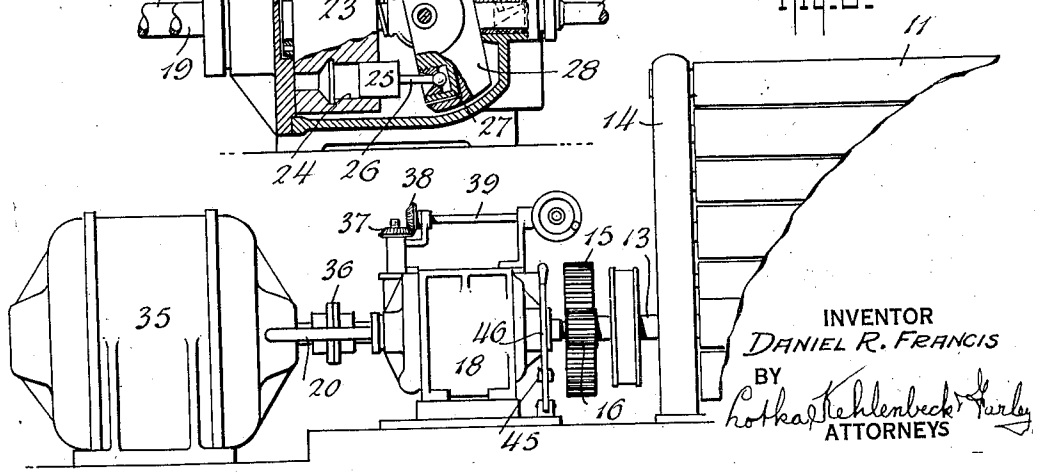


Fig. 2.

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UNITED STATES PATENT OFFICE

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DRIVING GEAR FOR PAPER CALENDERS

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As heretofore constructed, it has been the common practice to employ a driving gearing for paper calenders consisting of a main gearing, usually including speed change devices, for driving the calender rolls at a relatively high speed during the normal operation of the machine and also to provide what is known as a back gear for driving the rolls at a relatively slow speed for threading in the paper through the rolls. With both the main and back gears, a clutch is provided for throwing each set of gears into and out of operation. As the roll speed obtained by the back gear is quite slow, the speed reduction desired necessarily involves the use of large, complicated gearing in addition to the main gear.

The principal object of the present invention is to provide a new and improved construction of a driving gear for a paper calendering machine which enables the complicated gearing arrangements heretofore employed to be eliminated. Another object is to provide a new and improved driving gear by means of which a much wider speed range of the calender roll travel can be secured than was heretofore possible with the prior art constructions, thus enabling a wide variety of grades and finishes of paper to be secured which heretofore were not obtainable.

These and other objects will appear more fully from the following more detailed description and by reference to the accompanying drawing forming a part hereof, and wherein Fig. 1 is a plan view showing an illustrative example of a paper calender machine having a roll drive constructed in accordance with the principles of my invention; Fig. 2 is a side elevation, and Fig. 3 is a sectional detail through the pump of the hydraulic variable speed transmission gear.

As shown in the drawings, the numeral 10 indicates a paper calender machine having a plurality of rolls 11 between which the paper is led and subjected to the calendering action thereof. One of said rolls has its shaft 13 extended beyond the frame 14 and has secured thereto a spur gear 15, with which meshes a spur pinion 16.

The spur pinion 16 is secured to the rotatable driving shaft 17 of a fluid pressure motor 18, to which fluid under pressure is circulated through the pipes 19 and 20 by the variable delivery pump 21.

The variable delivery pump 21 is of the well known type of pumps employed for variable speed gears, such as shown in the United States Patent to Harvey D. Williams, No. 1,044,838, granted November 19, 1912. Such pumps consist of a driven shaft 22 to which is secured a rotary barrel 23 having a plurality of cylinders 24 bored therein parallel to the shaft 22. Each cylinder 24 has slidably mounted therein a piston 25 which is connected, by means of a piston rod 26, with a swash plate 27, rotatably mounted in an adjustable tilting box or race 28. The latter, and with it the swash plate, may be adjusted to different angles of inclination with the driven shaft to vary the stroke of the pistons 25 and therefore the output, or the amount of fluid delivered by the pump for each revolution of the cylinder barrel 23. The means for adjusting the inclination of the swash plate comprises a control shaft 29, and a nut 30, the latter being threaded on the shaft and suitably held against longitudinal movement but being free to rotate relatively to the shaft. The control shaft is connected with the swash plate by a bearing block 31 slidable in a forked arm integral with the tilting box and said block having engaged therewith a stub shaft 32 connected with the control shaft 29. When the tilting box and swash plate are perpendicular to the shaft 22, or in the "neutral position," the pistons 25 have no stroke and no fluid is pumped. Adjustment of the control shaft 29 to tilt the swash plate causes the stroke of the pistons and the output of the pump to be increased as the angle of inclination of the swash plate increases. When the swash plate is inclined in one direction the port, to which the pipe 19, for example, is connected, becomes the pressure port, while the port to which the pipe 20 is connected be-

comes the suction port, while when the swash plate is inclined in the opposite direction, the pressure and suction ports are reversed, that is to say, the port which was formerly the pressure port becomes the suction port, and the port which was the suction becomes the pressure port.

In the particular constructional example illustrated herein, the motor 18 is similar in construction to the pump 21, except that the swash plate and tilting box of the motor are held at a fixed angle of inclination.

The pump 21 is driven by any suitable means, such as the electric motor 35, the armature shaft of which is connected with the driven shaft 22 of the pump by a flexible coupling 36.

Manually operable means are provided for adjusting the control shaft 29 of the pump and such means consist of a bevel gear 37 integral with the nut 30 and meshing with a bevel gear 38 on one end of a shaft 39, mounted in bearings carried by the pump casing. The other end of shaft 39 is connected by bevel gearing 40 with one end of a shaft 41. Shaft 41 has its other end provided with a handwheel 42, located at a conveniently accessible point adjacent to the calendering machine.

In order to permit the machine to be shut off instantly, a by-pass valve 43 is connected across the pipes 19 and 20 between the pump 21 and motor 18. The rod 44 of said valve has connected thereto one end of an actuating rod 45, the other end of which is pivotally connected to a lever 46 having its lower end pivotally supported in a bracket 47 secured to the base of the motor 18 and its upper end terminating in a hand grip located adjacent to the handwheel 42.

The operation of the installation is as follows: Let it be assumed that the control shaft 29 of the pump is set in its neutral position and that the electric motor 35 is started, the rotation of said motor causes the pump barrel 23 to be rotated. The pump, however, will not pump any fluid to the motor 18, because of the setting of the control shaft in neutral, consequently there will be no rotation of the hydraulic motor 18. If it is desired to run the rolls 11 at a very slow speed for threading in the paper, the handwheel 42 is turned slightly to set the control shaft 29 to a position such that a small amount of fluid will be pumped to the motor 18 to cause the same to rotate slowly and through the gears 15, 16 rotate the rolls 11 at the desired speed. For normal operation the handwheel 42 is turned through a greater angle of rotation to cause the output of the pump 21 to be increased and thereby the motor 18 and calender rolls to rotate at a faster speed.

If for any reason it is wished to stop the machine quickly the hand lever 46 is actuated to open the by-pass valve 43, thus causing the fluid from the pump 21 to be by-passed through said valve without passing to the motor 18.

It will be seen that with the construction herein disclosed only a single driving gear train, consisting merely of a pair of gears, is employed between the motor 18 and the calender rolls. As the hydraulic variable speed gear may be operated at all speeds between zero and full speed, the speed changes can be made gradually without the use of multiple gear trains, variable belt drives or clutches. The construction is therefore of marked simplicity and has but few parts which require repair or replacement. In addition, it is more positive and smoother in operation than those in which friction or gear speed change devices are employed, and as the hydraulic speed gear can also be operated within a much wider speed range than is possible with the friction or gear speed devices, finishes not obtainable when such devices are used can be easily secured with an installation constructed in accordance with the principles of my invention.

It will be understood that changes, variations and modifications of the particular constructional example herein disclosed may be resorted to without departing from the principles of my invention.

I claim:

In combination with a paper calendering machine having a plurality of rolls, a hydraulic variable speed transmission gear, comprising a pump, a motor actuated by fluid under pressure from said pump, said pump and motor each having intake and outlet ports, a pair of conduits connecting the ports of the pump with the ports of the motor, said pump having adjustable means for reversing the direction of flow through said conduits and for gradually varying the output of said pump, thereby reversing the direction of rotation and varying the speed of said motor driving shaft, a single gear train connecting the motor with the rolls of the calendering machine, a by-pass connecting said pairs of conduits, a valve adapted to be instantaneously opened in said by-pass, manually operable means located adjacent said calendering rolls for controlling the adjustable means on said pump, and manually operable means located adjacent said calendering rolls for controlling said valve in said by-pass, whereby said calendering rolls may be quickly stopped.

In testimony whereof I have hereunto set my hand.

DANIEL R. FRANCIS.