Dec. 11, 1928. 1,694,704

H. F. DUNBAR

VARIABLE SPEED CONTROL FOR PAPER MAKING MACHINES

Filed Oct. 12, 1926 6 Sheets-Sheet 1

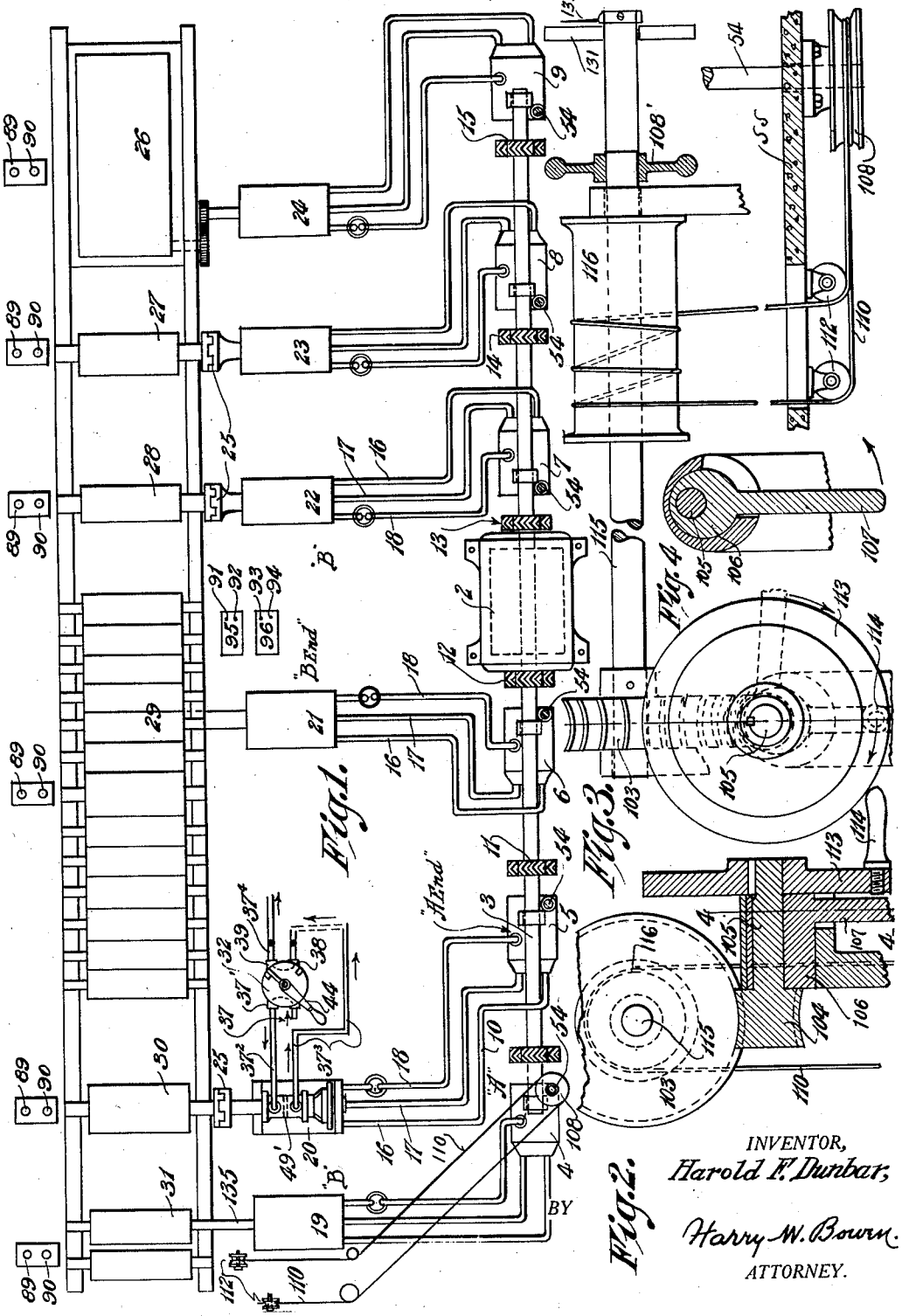


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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Filed Oct. 12, 1926 6 Sheets-Sheet 2

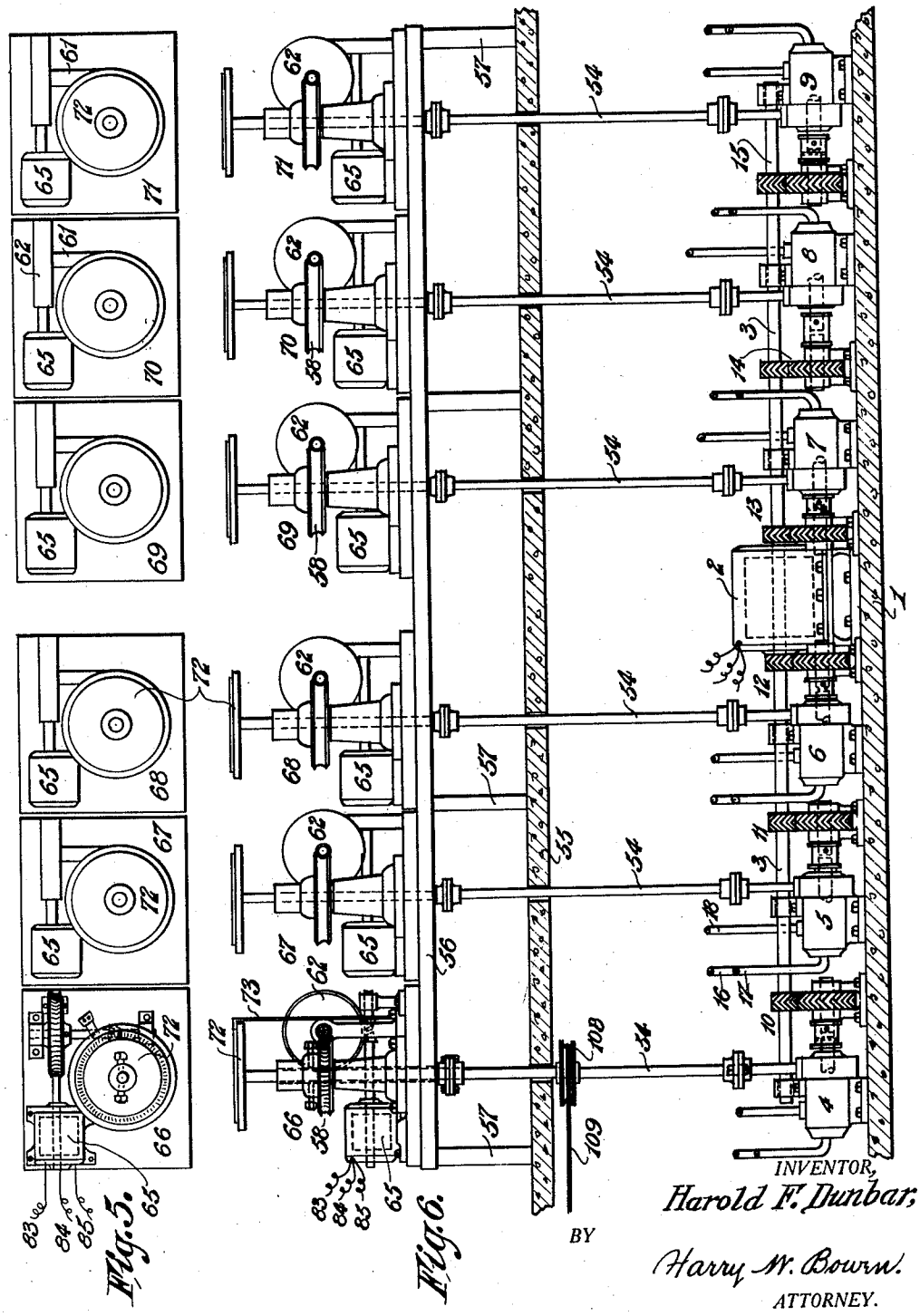


Fig. 5.

Fig. 6.

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VARIABLE SPEED CONTROL FOR PAPER MAKING MACHINES

Filed Oct. 12, 1926 6 Sheets-Sheet 3

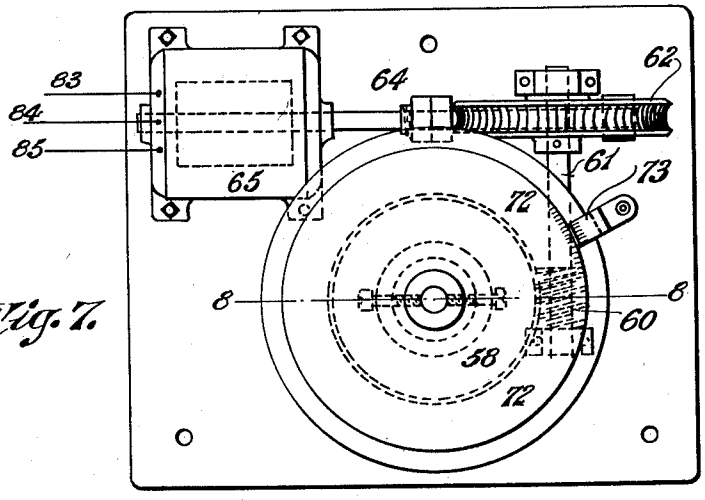


Fig. 7.

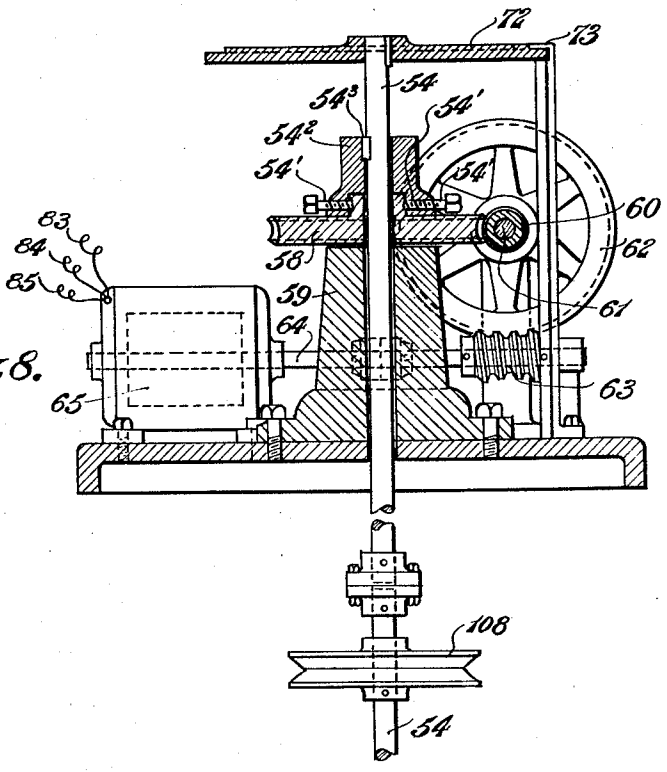


Fig. 8.

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VARIABLE SPEED CONTROL FOR PAPER MAKING MACHINES

Filed Oct. 12, 1926 6 Sheets-Sheet 4

Fig. 9.

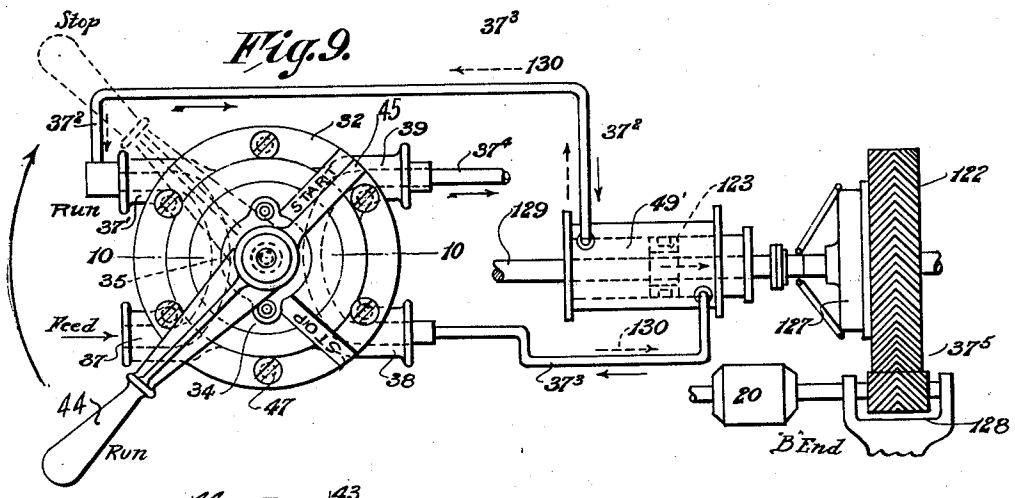


Fig. 10.

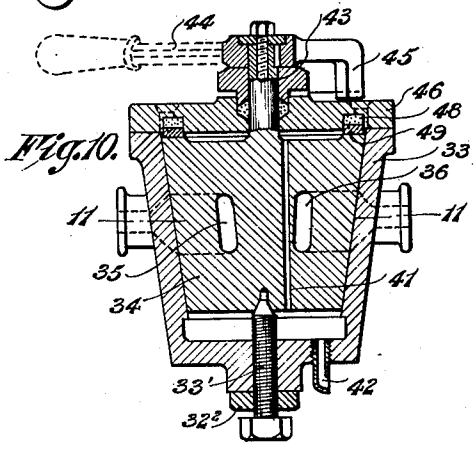
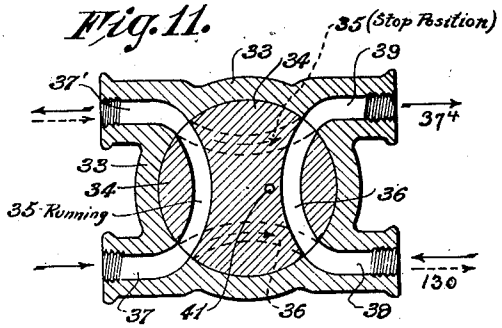


Fig. 11.



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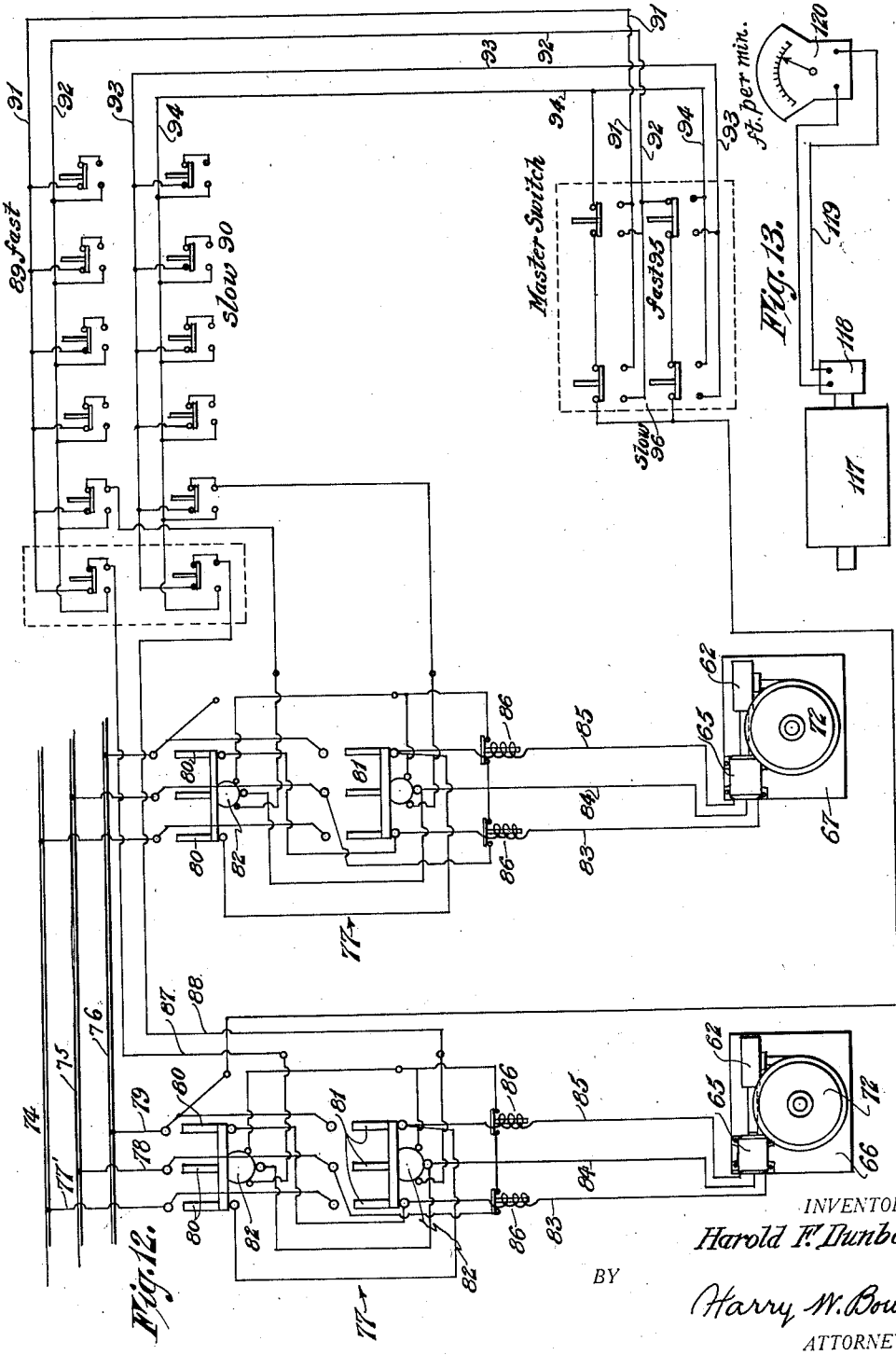
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VARIABLE SPEED CONTROL FOR PAPER MAKING MACHINES

Filed Oct. 12, 1926 6 Sheets-Sheet 6

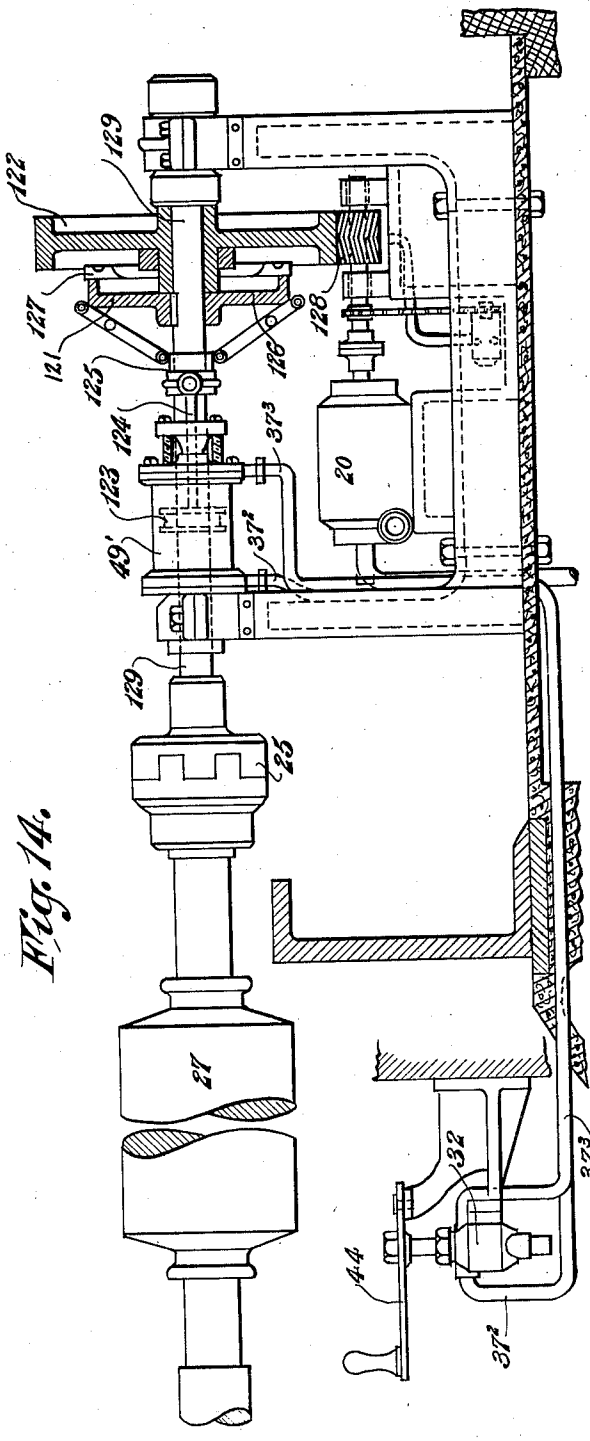


Fig. 14.

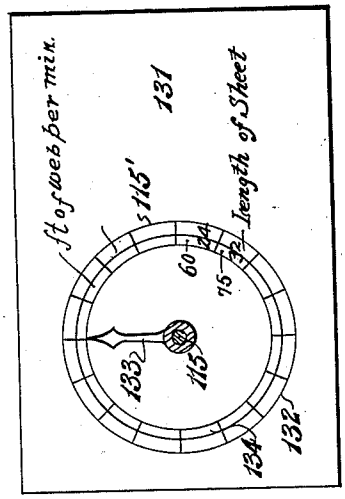


Fig. 15.

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UNITED STATES PATENT OFFICE.

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VARIABLE-SPEED CONTROL FOR PAPER-MAKING MACHINES.

Application filed October 12, 1926. Serial No 141,227.

This invention relates to improvements in variable speed control for paper making machines.

An object of the invention is to provide a hydraulically controlled driving mechanism for the different units or sections of a paper making machine in order that these parts, or sections, may be driven at different speeds or all at the same speed, as desired. It is a well known fact in the making of paper that it is very desirable to impart different rates of travel to a paper making machine, also different rates of travel to each section of a paper making machine in order to correct the draw of the web of paper while passing from one roll to the next, as for example, from the first to second press roll, or between any of the other units.

A further object is to provide means for connecting and disconnecting the individual hydraulically operated drive units of the machine from the main drive shaft, whereby the speed of each sectional unit may be carefully adjusted. After the speed of the individual units have been carefully adjusted the speed of the entire machine may be regulated from an electrically operated master control switch from a distant point for either increasing or decreasing the speed of operation.

The invention broadly comprises a primary or main drive motor and a plurality of hydraulically controlled motors which are directly driven from the main drive. These controlled motors are each made up of two units, and are of the type shown and described in catalogue No. 108 of the Waterbury Tool Company, of Waterbury, Connecticut, under the title of "Universal hydraulic variable speed gear", see U. S. Patent to Reynold Janney #1,307,819, dated June 24, 1919, entitled Driving mechanism. The two units of these motors are spoken of as the "A end" and the "B end". The "A end" of the motors being driven directly from the main drive. The "B end" being connected to the "A end" through suitable pipe connections. The "B ends" are severally connected to the different units of the machine, through suitable gears, shafting and clutches to the different sections or units of the paper making machine. Small electric motors are provided for individually adjusting the hydraulic motors for varying their speed, and consequently the speed of the different sections of the machine. These individually controlled electric motors through a reduction gearing of substantially 10,000 to 1, provides means for accurately adjusting the speed of each hydraulically operated motor and consequently the speed of each section of the machine. A vernier construction is provided for indicating the angular adjustment of each of the hydraulic motors of the machine. The "A end" and the "B end" of the hydraulic motors which are connected together by the pipe constructions have included therein, a pressure equalizing device for the liquid in these connections, as oil. The construction of these motors, however, forms no part of the present invention.

An important feature of the present invention is the electrical control of each unit of the machine, as well as the control of the speed of the machine as a whole.

Referring to the drawings:

Fig. 1 is a plan view showing the main drive, the plurality of hydraulically controlled motors which are operated directly from the main motor, the "B end" of the small motors, with the pipe connections to the "A end", the different sections of the paper making machine and the connecting means between the "B end" of the hydraulic motors and the different sections of the machine.

Fig. 2 is a detail view partly in section of the means for independently adjusting the cutter section of the machine.

Fig. 3 is a side view of Fig. 2 showing the shaft and the manual means for operating the same.

Fig. 4 is a detail sectional view on the line 4—4 of Fig. 2 showing the eccentric bearing construction for placing the worm gears into and out of mesh.

Fig. 5 is a plan view of the reduction gear mechanism for adjusting the hydraulic motors of each section and illustrating one of the vernier constructions for indicating the angular adjustment of each hydraulic motor of each section or web.

Fig. 6 is a side elevational view of Fig. 5 illustrating the depending shafts from each reduction gearing mechanism to the "A end" of the hydraulically controlled motors, also the main drive motor which directly drives the "A end" of all of the small hydraulically controlled motors.

Fig. 7 is an enlarged plan view of one of the reduction gearing mechanisms of the units, and further, the vernier construction.

Fig. 8 is a vertical sectional view on the line 8—8 of Fig. 7 illustrating the worm gearing between one of the small electric motors and a vertically arranged shaft which extends to the "A end" of each of the hydraulically controlled motors, also, the set screw construction to permit manual and independent adjustment of a hydraulic motor.

Fig. 9 is a top plan view of one of the valves for operating one of the clutches of a unit.

Fig. 10 is a vertical sectional view on the line 10—10 of Fig. 9.

Fig. 11 is a horizontal sectional view on the line 11—11 of Fig. 10.

Fig. 12 is a wiring diagram of the electrical connections and the switches for controlling the different motors,

Fig. 13 is an electrical tachometer attachment for indicating the speed of the web of paper at the drive roll section.

Fig. 14 is a view showing the clutch construction, and

Fig. 15 is a dial for indicating revolutions per minute of the cutter shaft and length of sheet cut.

Referring to the drawings in detail:

1, see Fig. 6, designates the base portion of the control drive as a whole. 2 the main drive motor which is secured to the base portion and having the oppositely extending main shaft 3. Secured to the base portion are the hydraulic motors 4, 5, 6 , 7, 8, and 9. Each of these motors is driven from the main shaft 3 by means of the herring bone gears 10, 11, 12, 13, 14, and 15. Connected to and extending from each of the motors 4 to 9 inclusive are the pipes 16, 17, and 18 which are connected to the "B end" of each of the hydraulic motors 19, 20, 21, 22, 23, and 24, which motors are connected to the different units of the paper making machine through the square jawed clutches 25.

The different sections of the paper making machine are as follows: The wire screen being indicated at 26; the first press roll at 27; the second press roll at 28; the series of drier rolls at 29; the sizing press roll at 30 and the cutter rolls at 31. For the purpose of operating the friction clutches on the herring bone gear hub, (see Fig. 14), a control valve 32 is provided, the details of which are shown in Figs. 9, 10, and 11. Fig. 14 shows the details of the clutch gear and "B end" of motor.

The valve comprises a casing 33 which is preferably tapered as shown with the valve plug 34 having the passageways 35 and 36. In the full line positions shown in Fig. 11, 35 serves as the inlet and 36 as the outlet. The inlet supply opening is indicated at 37 and the outlet supply opening at 37′, 38, and 39 are the return and discharge openings. The details of operation of the valve and friction clutch will be stated later. Extending through the plug 34 is an opening 41 which is termed the bleeder or leakage opening for the plug and a pipe 42 to carry off any of the leakage from the valve for relieving any pressure on the plug, should ony occur. 43 is a valve stem to which the operating handle 44 is connected. The downwardly extending part 45 serves as an index for the stopping and starting positions of the valve when in pressure and exhaust position at either end of hydraulic cylinder shown in Fig. 14. The cover 46 is attached to the casing 33 by suitable bolt constructions shown at 47 and suitable packing material, as soft rubber shown at 48 and hard wood as lignum-vitæ at 49. The outlet opening 37′ is connected to one end of the hydraulically operated clutch cylinder 49′ by means of the pipe 37^2. The supply is connected at 37. The pipe 37^3 is connected to the other end of the cylinder 49′ at one end and to the return opening 38 at its other end. A discharge or exhaust pipe 37^4 is connected at 39. The full line arrows in Figs. 9 and 11 indicate the flow in running and stopped positions of the clutch gear 37^5. 33′ is a threaded pin for forcing the valve plug 34 from its seat in the casing. 32^2 is a lock nut.

Referring now to the control mechanism for each of the hydraulic motors, 4, 5, 6, 7, 8, and 9, 54 is a shaft which extends from each of the motors upward through openings in the floor 55 and supported on this floor is a platform 56 by means of the columns 57. Each of the shafts 54 has secured thereto a worm gear wheel 58. Each shaft is located in a bearing 59. Meshing with the gear 58 is the worm 60. The shaft 61 carries a worm gear 62, and, meshing with this gear is the worm 63 on the shaft 64 of the small electric motor 65. The gear reduction between the speed of the motor 65 and the shaft 54 is designed to be substantially 10,000 to 1, whereby when the motor 65 is operated through the electrical connections shown in Fig. 12 the shaft 54 will be very slowly driven and the adjustment of the small hydraulic motors 4, 5, 6, 7, 8, and 9 will be operated and the speed of these motors and the rate of travel of the web of paper very accurately controlled.

It is to be understood that this gear reduction construction is employed for each one of the small hydraulic motors 4 to 9 inclusive, as shown in Fig. 6, and this gear reduction control is indicated by the numerals 66, 67, 68, 69, 70, and 71. For the purpose of accurately determining the angular adjustment of each of the hydraulic motors 4 to 9 inclusive and consequently the rate of rotation of each section of the machine and the rate of travel of the web, a vernier construction is employed comprising the graduated disk 72 and pointer 73, whereby when the motor 65 is operated the disk 72 will be ro-

tated through an angle and the vernier reading will be observed. The disk 72 is graduated in degrees or any other notation to indicate angular movement. 54′ are set screws in the collar 54^2 which may be loosened if the shafts are to be manually operated by turning the disks 72. The collar 54^2 is keyed to the shaft 54 at 54^3.

These two hydraulically connected motors are known in the art as the "Universal hydraulic variable speed gear" referred to in the above mentioned catalogue, which gear in general comprises two rotating disks therein, one of which is capable of being adjusted and set in planes at different angles relative to the axis of the shaft, whereby the rate of rotation of the driven or "B end" motors inclusive may be very accurately adjusted. The construction of these sectional driving motors or what is known as the "Universal hydraulic variable speed gear" do not, however, form any part of my present invention. They are utilized specifically for the purpose of accurately adjusting the rate of rotation of a paper machine or any particular sectional part or unit of a paper making machine so that the stretch or slack of a strand of paper of any part of the machine may be adjusted independently of the rate of rotation of any part of a paper making machine. Each one of the driving motors may therefore be adjusted in order that each one of the driven motors may be rotated at a definite speed for operating the different rolls or parts, etc., of a paper machine.

Referring now to the electric control features of the machine. The three phase feed wires are indicated at 74, 75, and 76 in Fig. 12. These are connected to the automatically operated electro-magnetic control switches 77 by means of the wires 77′, 78, and 79. The three blades of the switches being indicated at 80 and 81. 82 conventionally represents the coils for throwing the blades 80 or 81 depending upon whether the speed of the machine as a whole or any sectional unit is to be increased or decreased, 83, 84, and 85 represent wires connected to each of the speed control motors 65 which operate the reduction gears 66, to 71. 86 represent circuit breakers. Connected to the switches 77 are the wires 87 and 88, which lead to the two sets of switches 89 and 90 which correspond in number with control motors 65 which operate the gear reduction control indicated at 66 to 71, which, in turn control the speed of the hydraulic motors 4 to 9 inclusive. The switches 89 being for increasing the speed of the machine and 90 being for decreasing the speed. The switches 89 are connected in parallel with the wires 91 and 92. The switches 90 are connected in parallel with the wires 93, and 94. These wires extend to the two master control switches 95 and 96 which are for the purpose of increasing or decreasing the speed of all of the sections or units of the machine when operated. The sectional control switches are conventionally indicated in Fig. 1 by the reference numerals 89 and 90.

The speed of the machine as a whole may, therefore, be controlled from the master switches 95 or 96 which are located at a convenient point on the frame of the machine as adjacent the drier rolls 29, (see Fig. 1). Since the group of master control switches fast and slow 95 and 96 are connected in parallel with the sectional control switches 89 and 90 all of the sectional units will be operated at the same time. These group switches will in turn operate the knife blades 80 or 81 of the automatic electro-magnetic switches 77. These switches will through the wire connections 83, 84 and 85 to each of the small electric motors 65 set the gear reduction mechanisms 66 to 71 in operation. These will adjust through the shaft connections 54 all of the hydraulic motors 4 to 9 inclusive, whereby the speed of all of the sections of the machine will be either increased or decreased. The vernier readings shown in Figs. 7 and 8 should now be observed in order to ascertain if all of the shafts 54 have been turned through the same angle. If not, they may be adjusted manually, as described.

It is to be understood that the electrical connections shown in Fig. 12 are duplicated for each section or unit, although only the connections for two sections are shown. It is, of course, obvious that the attendant can by closing any individual one of the switches 89 or 90 in order to increase or decrease the speed of that particular section of the machine should all of the motors 65 not operate the same. By observing the reading on the vernier wheel 72 of that particular section he can accurately determine the speed required for that section or unit of the machine. After each unit has been adjusted, then the speed of all of the units or sections may be simultaneously controlled, either faster or slower from the master switches 95 or 96 shown in Fig. 12.

Referring to Figs. 2, 3, and 4 in which provision is made for manually adjusting the cutter section 31 in order to vary the length of the severed sheet. 103 is a worm wheel which is attached to the shaft 115, 104 a worm meshing with the worm wheel; 105 the shaft for the worm 104; 106 an eccentric bearing for this shaft; 107 a handle for moving the eccentric bearing for throwing the worm 104 out of mesh with the worm wheel 103. The shaft 54 may be manually operated from a distance by the hand wheel 108′ and cable 110. 108 is a pulley. 110 is a cable which passes around the grooved pulley 108 and around sheaves 112 and extends through openings in the floor 55. The wheel 113 and handle 114 is for the purpose of manually rotating the shaft 115 to which the drum 116 is secured whereby

the shaft 54 of the "A end" of the motor 4 is operated. It is, of course, to be understood that the worm 104 is out of mesh when the shaft 54 of the motor 4 is operated by the electric motor 65 of the gear reduction member 66 or the hand wheel 108′ is in use.

For the purpose of visibly indicating the speed or rate of travel of the web of paper a small electric generator 117 is attached to the drier rolls portion of the machine. 118 is a commutator with which the wires 119 contact; 120 a volt meter which is calibrated to indicate the revolutions per minute or feet per minute that the web of paper travels.

The operation may be described as follows: After the hydraulic motors 4 to 9 inclusive have been carefully adjusted for the required speed of each section, the operator by means of the handle 44 of the valve 32 (see Fig. 14) throws in the clutch member 121 of the friction gear 122. This is accomplished by the water flowing through the pipe 37^2 to one end of the cylinder 49′ which causes the piston 123 through the links 124, collar 125, disk 126 to engage the friction plate 127 on the gear 122. Now, when the main drive motor is started the herring bone gear 128 will drive the gear 122, which gear through the shaft 129 operates the clutches 25 that operate each unit. In order to disconnect the friction gear 122 the operator throws the valve handle 44 into the position shown in dotted lines in Fig. 9. Water now flows through the pipe 37^3 to the other end of the cylinder 49′ and moves the piston 123 in the opposite direction, indicated by the dotted lines 130.

Referring to Fig. 15, 131 designates a stationary plate having a graduated index circle 132. The shaft 115 extends through the plate. A pointer 133 is secured to the shaft 115 which rotates in front of the index circle. The graduations 134 represent the length of the severed sheet at any rate of speed that the web of paper may be travelling to the cutter and its knife. As for example, the numeral "32" on the circle 132 represents the length of the severed sheet when the web is travelling 75 feet per minute to the cutter 31.

The reference numeral "24" for example, on the circle 132 represents the length of a severed sheet when the web of paper is traveling, say at the rate of 60 feet per minute; it being understood that the cutter 31 is rotating the same number of revolutions per minute in both cases. The pointer 133 being moved by the shaft 115, which shaft, as already described, operates the shaft 54 which adjusts the speed of the cutters 31 (see Fig. 3).

The operator can therefore set the pointer 133 correctly for severing different lengths of sheets of paper after the speed of the machine has been determined, that is to say, the rate of travel of the web at the drier rolls 29.

What I claim is:

1. In a paper making machine, the combination with the several sectional units, means for controlling the rate of rotation of each section, and means for simultaneously controlling the rate of rotation of all of the units, comprising a main motor, a plurality of hydraulically operated and smaller motors operated from the main motor, and means for individually operating the units of the machine from the said smaller motors.

2. In a paper making machine, the combination with the several units or sections of the machine, means for independently adjusting the speed of each unit comprising a hydraulically operated motor, a shaft for each unit, an electric motor for each unit, reduction gearing between each of the electric motors and the shafts, a source of electric energy, switches for each electric motor of said gearing, an electro-magnetically operated switch between each of said switches and the electric motors, the switches being so constructed and arranged that upon the closure of some of the switches, the electric motors will be operated to increase the speed of the units and upon closure of others the electric motors will be operated to decrease the speed.

3. In a paper making machine the combination with each unit, or section thereof, means for independently controlling the speed of each unit comprising a main drive motor, a hydraulically controlled motor for each section, a second hydraulically controlled motor and operated from the main motor, pipe connections between the two hydraulically operated motors, the said second motor being severally connected to the said units, a shaft for adjusting the speed of each first mentioned hydraulically controlled motor, reduction gearing means for operating the shafts, vernier means for indicating the adjustment of the shafts, and means for manually operating the reduction gearing for adjusting any individual shaft and its motor.

4. In combination, in a paper making machine, a hydraulically operated motor for each unit, an electric motor for driving the hydraulically operated motor, means for independently varying the speed of each electrically operated motor comprising a reduction gearing construction between the electric motor and each hydraulically operated motor and means for operating the latter motors including a main motor.

5. In combination, in a paper making machine, a hydraulically operated motor for each unit, an electric motor for driving the hydraulically operated motor, means for independently varying the speed of each first mentioned motor comprising a reduction gearing construction between the electric motor and each hydraulically operated motor, means for operating the latter motors

including a main motor, and a vernier construction for indicating the adjustment of the hydraulically operated motor for each of the sections of the machine.

6. In combination, in a paper making machine, means for varying the speed of all of the units at the same time, comprising a shaft for each unit, a worm reduction gearing connected to each shaft, a vernier device for indicating the adjustment of the shaft, a motor operating the said gears, a series of fast and slow switches for the control of the motor of each unit, a master switch for said series of switches, and electrical connections between the master switch and said switches.

7. In a paper making machine, the combination, a shaft, a motor for operating the shaft, reduction gearing between the shaft and the motor, a vernier construction for indicating the angle of rotation of the shaft, means for operating the motor, and means for manually operating the shaft independently of the motor.

8. In combination, a shaft, a worm gear on the shaft, a second shaft for adjusting the speed of a motor, a worm engaging the worm gear, a pointer attached to the first shaft for indicating its adjustment of the second shaft, and means for disconnecting the worm from its gear.

9. In combination, a hydraulically operated clutch device for connecting and disconnecting a section of a paper making machine which comprises a cylinder, a piston therein, a herring bone gear, a shaft on which the gear is loosely mounted, a friction clutch plate attached to the said gear, means connected to the piston and operated thereby for engaging the plate for connecting the gear to the shaft, a drive motor, a pinion driven by the motor and in mesh with the teeth of the said gear, a valve, piping connected to the opposite ends of the cylinder and to the valve, the valve having openings for directing a fluid under pressure to the opposite ends of the cylinder for throwing the said clutch into and out of operation, whereby the motor will operate a section of the machine.

10. In combination, a cylinder a piston therein, a shaft extending through the cylinder and piston, a section of a paper making machine to which the shaft is connected, a gear loosely mounted on the shaft, a clutch device between the piston and the gear for connecting the gear to the shaft, a valve, pipe connections between the cylinder and valve for directing a fluid under pressure to and away from the cylinder for throwing the clutch into or out of operation, a motor and connecting means between the motor and said gear.

11. In a paper making machine, means for varying the length of a severed sheet, which comprises a cutter, a shaft, hydraulic drive means for adjusting the speed of the shaft, hydraulic drive means for varying the rate of travel of the web of paper, a pointer attached to the cutter adjusting shaft, a graduated scale adjacent the cutter having thereon graduations representing the length of the severed sheet and speed of the web of paper.

12. In combination, a shaft, a drum thereon, a cable on the drum, a cutter adjusting shaft operated by the cable, a plate having graduations thereon representing the length of a severed sheet at different speeds of a web of paper, a pointer on the shaft and movable over the graduations to indicate the length of a sheet to be severed, and means for operating the shaft and its drum.

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