May 2, 1939. B. M. BAXTER 2,156,445

PAPER MAKING APPARATUS

Filed June 3, 1936 3 Sheets-Sheet 1

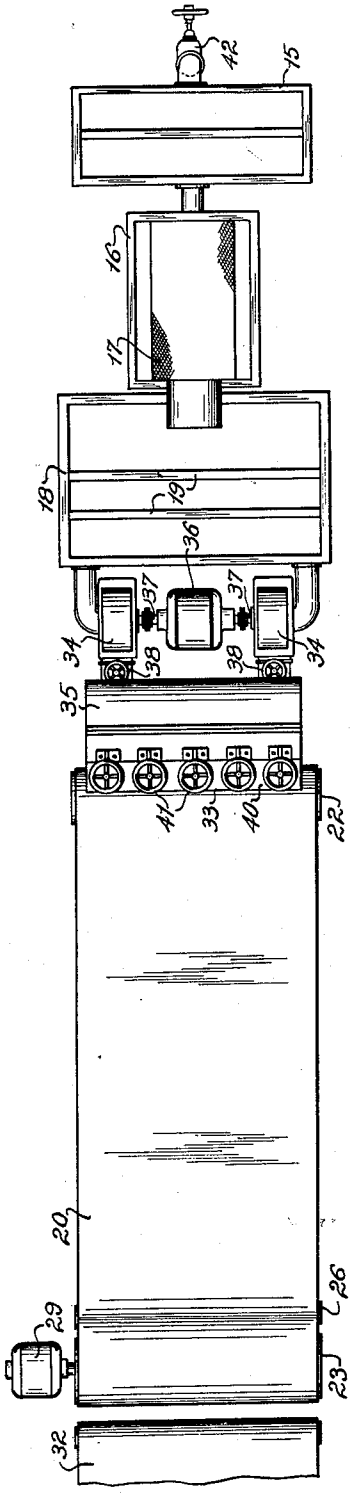


FIG. 1

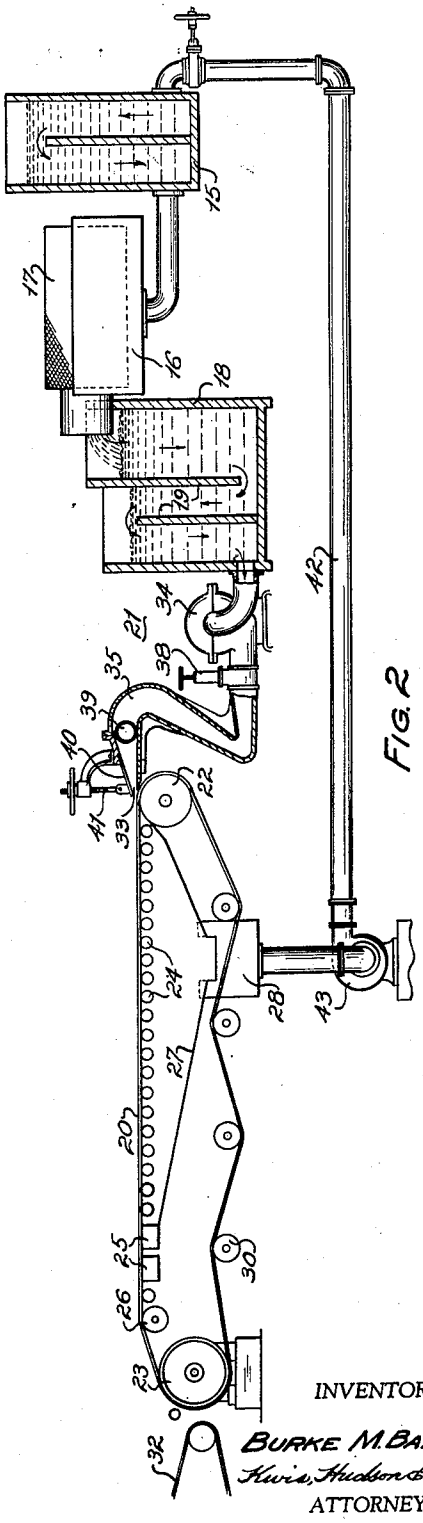


FIG. 2

INVENTOR.
BURKE M. BAXTER
Kuis, Hudson & Kent
ATTORNEYS.

May 2, 1939. B. M. BAXTER 2,156,445

PAPER MAKING APPARATUS

Filed June 3, 1936 3 Sheets-Sheet 2

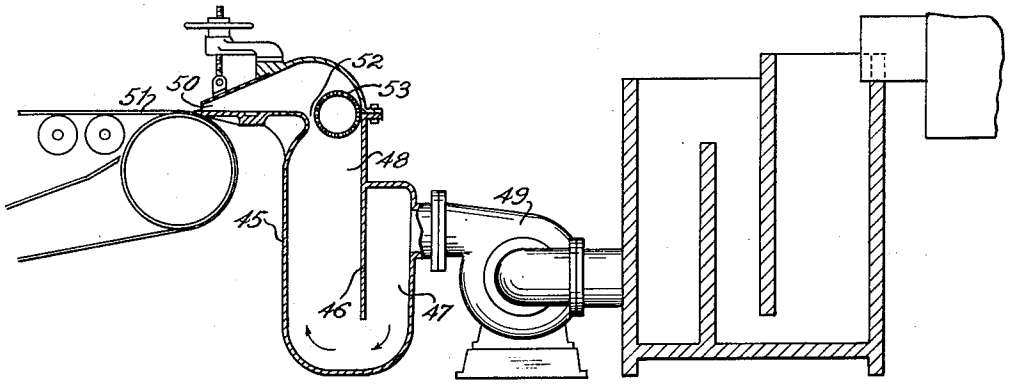


FIG. 3

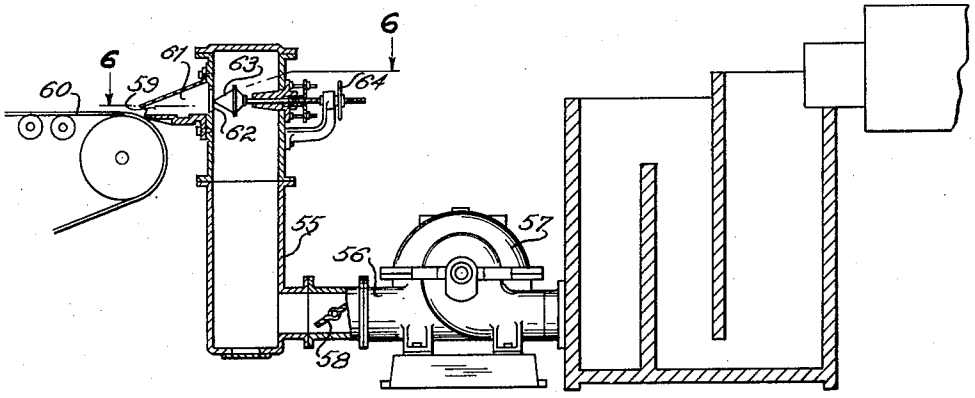


FIG. 4

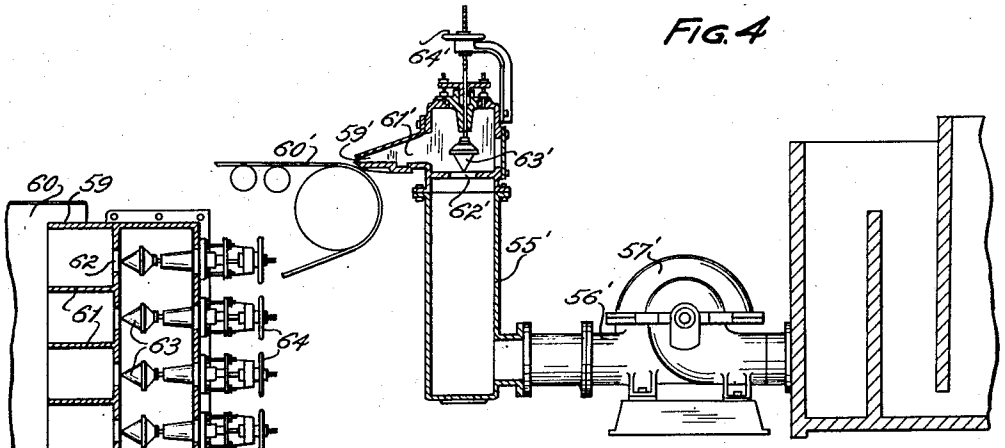


FIG. 5

FIG. 6

INVENTOR.
BURKE M. BAXTER
BY Lewis, Hudson & Kent
ATTORNEYS.

May 2, 1939. B. M. BAXTER 2,156,445

PAPER MAKING APPARATUS

Filed June 3, 1936 3 Sheets-Sheet 3

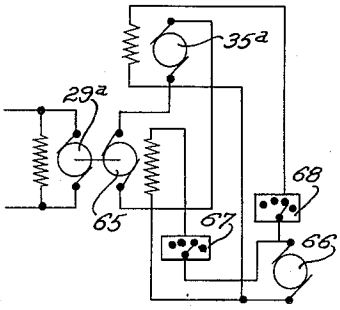


FIG. 7

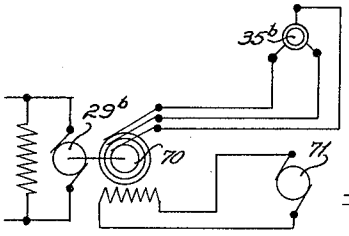


FIG. 8

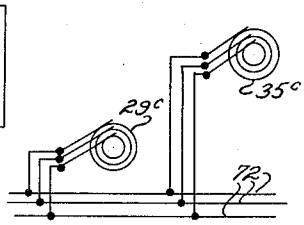


FIG. 9

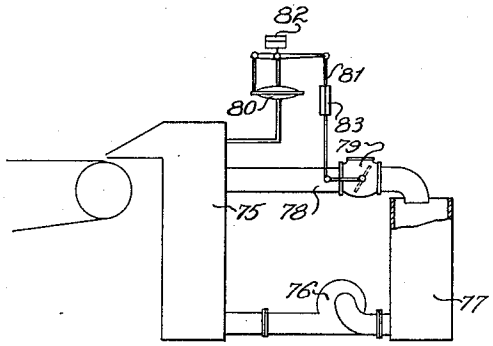


FIG. 10

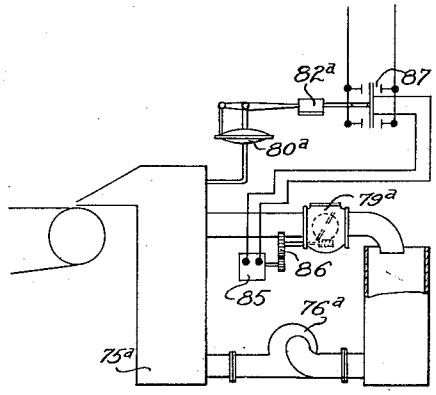


FIG. 11

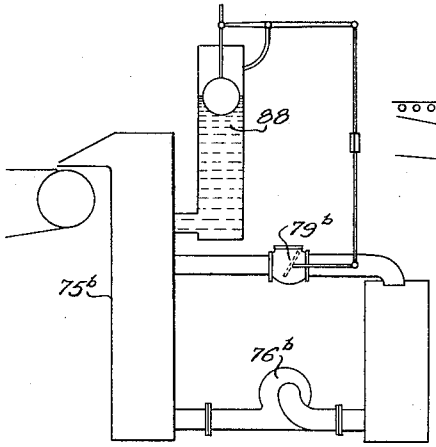


FIG. 12

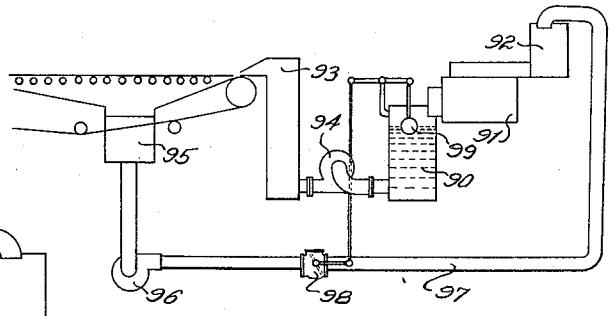


FIG. 13

INVENTOR.
BURKE M. BAXTER

BY

Lewis, Hudson & Kent
ATTORNEYS

Patented May 2, 1939 2,156,445

UNITED STATES PATENT OFFICE

2,156,445

PAPER MAKING APPARATUS

Burke M. Baxter, Detroit, Mich.

Application June 3, 1936, Serial No. 83,238

1 Claim. (Cl. 92—44)

This invention relates to the manufacture of paper, and more particularly to an improvement in paper making machines.

In the manufacture of paper on the Fourdrinier type of machine, it is essential for the proper formation of the sheet that the fluid or pulp be delivered onto the traveling web or "wire" of the machine at the speed of travel of such wire. Heretofore in paper making machines of this type, the pulp has been delivered onto the wire by means of a sluice or nozzle to which the pulp is supplied from a tank or head box. To provide a continuous supply of pulp at proper pressure at the nozzle, it has been customary to construct or arrange the head box to maintain a head of pulp sufficient to produce the desired discharge velocity and continuity of flow through the nozzle. In many instances this has necessitated the construction of head boxes of objectionable size and height.

In the case of higher speed paper making machines, the elevation of the head box required for the necessary head has become a serious matter particularly in the case of those machines which operate over a wide range of speeds and have a high maximum speed. With this latter type of machine, the head box must be elevated to a height suitable to provide sufficient head for the maximum speed of the machine, and when the machine is operated at a lower speed, it is found that great and objectionable turbulence is created by the fall of the fluid to the head or level required to produce the discharge velocity for the lower speed of operation. This turbulence is a factor even more objectionable than the factors of size and height mentioned above, because it has a detrimental effect on the formation of the paper.

It is to the elimination of these difficulties that the present invention is directed, and, as one object of my invention, I aim to provide an improved paper making machine having novel means for supplying pulp to the wire.

Another object of the invention is the provision of novel mechanical means for supplying pulp to the delivery nozzle at a desired pressure without the need of a box or container for maintaining a gravity head of pulp.

A further object of the invention is to provide improved paper making apparatus wherein a novel pump arrangement delivers pulp to the discharge nozzle at the desired pressure value.

Still another object of the invention is to provide a novel form of nozzle and control arrangement for delivering pulp onto the wire.

A further object of the invention is to provide novel means for supplying pulp to the discharge nozzle, comprising a pump and control means for maintaining substantially uniform pressure at the nozzle.

Yet another object of the invention is to provide improved paper making apparatus having a traveling wire and a nozzle to which pulp is supplied under pressure by means including a pump, and wherein the speeds of operation of the wire and of the pump are controlled or synchronized with respect to each other.

Other objects and advantages of the invention will be apparent from the following description when taken in conjunction with the accompanying sheets of drawings, wherein;

Fig. 1 is a plan view of a paper making machine embodying my invention;

Fig. 2 is a side elevation thereof with parts of the apparatus broken away to show the construction of the nozzle and the means for supplying pulp thereto;

Figs. 3, 4, and 5 are partial longitudinal sectional views taken through other forms of pulp supply means contemplated by my invention;

Fig. 6 is a transverse sectional view taken on line 6—6 of the pulp supply means of Fig. 4;

Figs. 7, 8, and 9 are wiring diagrams showing electrical connections which may be provided for the driving motors of the pumps and wire to obtain the desired related or synchronized operation thereof;

Figs. 10, 11, and 12 are elevational views, more or less diagrammatic in form, showing pump and control arrangements for supplying pulp to the discharge nozzle at a predetermined pressure; and

Fig. 13 is an elevational view of diagrammatic form showing another pump and control arrangement for supplying pulp to the nozzle at a substantially uniform rate.

My invention is especially applicable to paper making machines of the Fourdrinier type and, as already indicated in a general way, relates particularly to novel means for supplying the pulp to the traveling belt or web which is usually formed of woven wire and is frequently referred to as the "wire". While the drawings show what I now regard to be preferred arrangements of the pulp supply and control means contemplated by my invention, it will be understood, of course, that the invention may be embodied in various other machines and arrangements.

In Figs. 1 and 2 of the drawings I have shown my novel pulp supply and control means em-

bodied in a paper making machine of the Fourdrinier type. This apparatus may include a baffled tank 15 into which the supply of pulp or fiber is introduced. From the tank 15 the pulp may be supplied to another tank 16 in which a rotary screen 17 operates. The pulp which passes through the screen may be delivered to a third tank 18 from which it is supplied to the wire of the machine. The latter tank may, if desired, be provided with baffles 19 arranged to spread the flow of pulp uniformly and to keep the pulp fibers suspended in a mixture of substantially uniform consistency. From the tank 18 the pulp is supplied to the traveling wire 20 by my novel feed and control means 21 which will be described more in detail hereinafter.

The traveling belt or web 20 of this type of paper making apparatus may be an endless belt of woven wire or other foraminous construction, which is arranged to travel past the pulp feed and control means 21 to receive therefrom a layer or sheet of fluid pulp. The wire may be arranged to extend around a "breast" roll 22 and a "couch" roll 23 which are disposed respectively at the receiving and discharge ends of the apparatus. As is usual in apparatus of this type, the machine may have a series of "table" rolls 24 disposed between the rolls 22 and 23 and over which the wire 20 passes. In addition to the table rolls 24, the wire may pass over one or more suction boxes 25, and over a guide roll 26 disposed adjacent the couch roll 23. During the passage of the wire over the table rolls 24, water is drained from the pulp, leaving the fibers deposited on the wire in the form of a mat. The water drained from the pulp falls into a pan or tray 27 and is collected in a "back-water" box or tank 28. The suction boxes 25 also remove water from the layer or web of pulp as it passes thereover.

The wire 20 may be driven by the couch roll 23 which is in turn driven by any suitable means, such as the electric motor 29. The wire may be kept under tension by suitably located rolls 30 which also support the return portion of the wire as it passes back to the breast roll 22. When the mat or fibers arrives at the roll 23, it is of sufficient strength to be stripped from the wire and, after such stripping, passes to following sections of the machine for various succeeding operations, such as pressing, drying, calendering, and reeling. One of these succeeding machine sections is indicated at 32 adjacent the roll 23.

Reverting now to my novel pulp feed and control means, it will be seen from Figs. 1 and 2 of the drawings that this means includes a nozzle 33 for discharging a layer of pulp onto the wire. The nozzle is elongated transversely of the machine and is of such length that its ends lie just inwardly of the edges of the wire. The pulp feed and control means also includes one or more pumps 34, and a "pressure" head box 35 which receives the pump discharge and supplies the pulp to the nozzle at such pressure that it will be discharged through the nozzle with the desired velocity and continuity of flow for properly forming a mat or sheet of fibers on the traveling wire 20.

Although any suitable type of pump may be used for supplying the pulp to the head box and nozzle, I prefer to use centrifugal pumps for this purpose because I have discovered that the operating characteristics of this type of pump render the same especially suitable for use with paper making machines. In this connection, it might be noted that the head or pressure required at the point of delivery of the fluid to the wire of the machine varies with the square of the speed of the machine, and it is a characteristic of centrifugal pumps that the discharge pressure varies with the square of the speed of rotation of the impeller. It is also a characteristic of Fourdrinier paper machines that the volume of pulp or fluid required for a sheet of given width and thickness varies directly with the speed of the machine, and this corresponds with the action of a centrifugal pump in which the volume of discharge varies directly with the speed when discharging through an opening of constant area.

Because of the above mentioned characteristics of a centrifugal pump as related to the characteristics of a Fourdrinier type paper machine, I have discovered that the operation of the pump may be synchronized, that is, controlled with respect to the operation of the traveling wire 20 so that when the rate of production of the paper sheet being formed is varied by changing the speed of the wire, a proper supply of pulp to the feeding nozzle will be made available by proportionately changing the speed of the pump. This may be accomplished by a suitable arrangement of line-shafting from which the roll 23 and the pumps 34 are driven, or, as shown in Fig. 1, the pumps 34 may be driven by an electric motor 36, and the operation of this electric motor controlled or synchronized with respect to the operation of the motor 29 by means which will be described hereinafter.

Although any suitable number or arrangement of pumps may be used for supplying the pulp from the tank 18 to the pressure head box 35 and the nozzle 33, in this instance I have shown two pumps 34 for this purpose. These pumps are direct-connected to opposite ends of the shaft 37 of the motor 36 which may be disposed between the pumps. The delivery openings of these pumps are individually connected to the pressure head box 35 which supplies the pulp to the nozzle 33. The pumps may be connected with the head box by suitable pipe connections or fittings which include a valve 38 in the discharge of each pump such that the pulp delivery can be regulated in accordance with the requirements at the nozzle 33.

The pressure head box 35 is an important part of my novel pulp supply and control means and comprises a casing or surge chamber which receives the pulp from the pumps and conducts the same smoothly to the nozzle 33. As shown in Figs. 1 and 2, the pressure head box may be of Z-like shape and of such form that the pulp flows smoothly therethrough without turbulence or interruption. To assist in maintaining a uniform flow of pulp to all parts of the nozzle opening, I may provide a perforated roll 39 which is rotatably mounted in the upper part of the pressure head box and extends across the throat opening thereof. A substantial part of the pulp flows through the perforations of this roll and is thereby directed and distributed so that a uniform flow of pulp of the same consistency is available at all portions of the nozzle 33.

The delivery nozzle may be of different shapes and forms of construction, and it may be desirable to provide for regulation of the nozzle opening or width so that the flow of pulp therefrom can be controlled or varied during the operation of the machine to regulate the thickness of the sheet being formed. For this purpose I construct the upper lip or edge of the nozzle in the form of a flexible plate 40. To vary the width of the nozzle

opening, the outer edge of the plate is moved toward or away from the lower lip or edge of the nozzle by flexing the plate. The plate may be flexed for this purpose, as by means of adjusting screws 41 which are provided in suitable number and spaced along the nozzle transversely of the machine.

In the operation of the machine, the pulp supplied to the pressure head box 35 by the pumps 34 is discharged through the nozzle 33 and onto the traveling wire 20 to form a mat or sheet of fibers, as explained above. The water which is drained or extracted from the pulp deposited on the traveling wire may be returned to the tank 15 by means of suitable piping 42 and a pump 43 having its suction in the back-water box 28.

In Figs. 3, 4, and 5 of the drawings, I have shown other forms of construction for the pressure head box of my improved paper making apparatus. The head box shown in Fig. 3 comprises a vertically disposed casing 45 having a depending baffle 46 therein which divides the interior casing into passages 47 and 48. Pulp is delivered into the passage 47 by the centrifugal pump 49 and flows upwardly through the passage 48 to the opening of the transversely extending nozzle 50 for delivery to the traveling wire 51. The upper end of the passage 48 may be somewhat constricted to provide a throat 52 in which a perforated roll 53 is rotatably mounted.

It will be noted that, in the pressure head box 35 of Fig. 2 and the pressure head box 45 of Fig. 3, the wall is curved at or adjacent the top of the box, and also that the converging top wall of the nozzle is substantially tangent to the curved wall portion. The pulp flowing upwardly in the head box strikes the curved wall portion and the direction of flow is thereby changed smoothly and substantially without shock or turbulence to follow the tangential wall portion.

In the apparatus shown in Fig. 4 of the drawings, the pressure head box comprises an upright casing 55 having the lower end thereof connected with the discharge 56 of the centrifugal pump 57. A valve 58 provided in the pump discharge controls the delivery of pulp into the head box. It will be understood, of course, that there may be one or more of the pumps 57 and that the valves 58 may be operated to obtain the desired volume and distribution of the pulp supplied to the head box. The upper end of the head box is provided with a transversely extending nozzle 59 which delivers the pulp onto the traveling wire 60. The opening of the nozzle is divided longitudinally thereof into sections, as shown in Fig. 6, by means of spaced webs or ribs 61. Each of the nozzle sections communicates with the chamber of the head box 55 through one of the openings 62 formed in the front wall of the head box. A valve 63 is arranged to control each of the openings 62 so that the delivery pulp into the several sections of the nozzle can be regulated by manipulation of the valves which are operable from the exterior of the head box by means of the handwheels 64. By means of this arrangement of nozzle sections and control valves 63, it will be seen that sheets of paper of different width can be formed on the apparatus by opening the proper number of valves necessary for the width of sheet to be formed.

In Fig. 5 I have shown a pressure head box 55' which is generally similar to that of Fig. 4 with the exception that the spaced valves 63' are mounted vertically and the openings 62' which are controlled by these valves are formed in a transverse wall adjacent the top of the head box. In the construction shown in Fig. 5, the webs or ribs 61' which divide the nozzle 59' into sections also divide the upper end of the head box into corresponding sections with which the respective openings 62' communicate.

I have explained above that the speed of the pump which supplies the pulp to the nozzle may be synchronized or controlled with respect to the speed of the traveling wire of the machine. This synchronization may be accomplished in various ways, as, for example, by line-shafting or by providing an electric motor for driving the wire and an electric motor for driving the pump, and operating such motors in synchronism. In Figs. 7, 8, and 9 of the drawings, I have shown wiring diagrams for operating the pump and wire motors in synchronism. In Fig. 7 I show the wire motor 29a as also driving a generator 65 which supplies current to the pump motor 35a. An exciter 66 supplies field current for the generator 65 and for the motor 35a. Rheostats 67 and 68 provided in the field circuits of the generator 65 and the motor 35a serve as a means for varying the speed of the pump motor with respect to the speed of the wire motor whenever a change is desired in the set-up or adjustment of the machine. With the electrical arrangement just described, it will be seen that the pump motor 35a and the wire motor 29a may be operated in synchronism and the desired speed relation between the motors can be maintained.

Fig. 8 of the drawings shows another electrical arrangement for operating the wire motor 29b and the pump motor 35b in synchronism. In this arrangement, the wire motor 29b also drives an alternator 70 which supplies current to the pump motor 35b, the latter motor being preferably but not essentially a synchronous motor. An exciter 71 supplies field current for the alternator 70. With this arrangement it will be seen that a desired speed relation between the wire motor 29b and the pump motor 35b can be maintained.

In Fig. 9 I have shown another electrical arrangement which may be employed for operating the wire motor 29c and the pump motor 35c in synchronism. In this arrangement, the motors 29c and 35c are both synchronous motors which receive current from the same line conductors 72. Since the motors 29c and 35c are synchronous motors and are connected with a common line, they will be operated in synchronism with each other.

In Figs. 10, 11, and 12 I have shown diagrammatically different arrangements for maintaining the supply of pulp at proper pressure in the head box to produce the desired velocity and continuity of flow through the nozzle opening.

In the arrangement shown in Fig. 10, pulp is supplied to the head box 75 by the centrifugal pump 76 which has its suction in the tank 77. A return or by-pass connection 78 extends between the head box 75 and the tank 77 and is controlled by a valve 79. A diaphragm device 80 is connected with the head box 75 and responds to variations in pressure therein such that when the pressure rises above a predetermined value in the head box, it acts through rod 81 and adjusting sleeve nut or turnbuckle 83 and lifts the weight 82 to cause opening or partial opening of the valve 79 to allow excess

pulp to return to the tank 77, that is, to the suction side of the pump 76. When the pressure in the head box falls below a predetermined value, the diaphragm device 80 responds thereto and allows the weight 82 to be lowered to cause closing or partial closing of the valve 79, thereby permitting the pressure in the head box 75 to be built up by the pump 76.

Fig. 11 shows a control arrangement generally similar to that of Fig. 10 except that the valve 79*a* is operated by an electric motor 85 through suitable gearing 86. The diaphragm device 80*a* operates a reversing switch 87 which controls the electric motor 85. When the pressure in the head box 75*a* increases above a predetermined value, one set of contacts of the switch 87 is closed by operation of the diaphragm device to cause the motor 85 to run in a direction to produce opening or partial opening of the valve 79*a*. When the pressure in the head box 75*a* falls below a predetermined value, the diaphragm device permits the weight 82*a* to operate the reversing switch 87 to close a different set of contacts which causes the motor 85 to run in the opposite direction and thereby produce closing or partial closing of the valve 79*a*.

The control arrangement illustrated in Fig. 12 is also similar to that of Fig. 10, but. instead of a diaphragm device, it embodies a float device 88 which responds to pressure in the head box 75*b* and operates the valve 79*b*. When the pressure in the head box increases, the float device causes opening or partial opening of the valve 79*b*, and when the pressure in the head decreases, the float device causes closing or partial closing of the valve 79*b*.

With the control arrangements of Figs. 10, 11, and 12, as just described, it will be seen that the pump is capable of maintaining a substantially constant pressure in the head box, with the result that pulp will be delivered to the traveling wire through the nozzle at substantially uniform velocity.

In Fig. 13 I have shown another form of control for the pulp supply to the head box wherein the desired regulating action is obtained by controlling the discharge of the back-water pump. In this arrangement, pulp is supplied to the tank 90 by the screen device 91 which receives pulp from the tank 92. From the tank 90 the pulp is supplied to the head box 93 by the centrifugal pump 94. Provision is made for returning water from the back-water box 95 to the tank 92 by means of the pump 96, and the piping 97 having a valve 98 therein. For controlling the supply of pulp to the head box 93, I vary the supply of pulp in the tank 90 in which the pump 94 has its suction. I accomplish this by arranging a float 99 to respond to the level of fluid in the tank 90 and to operate the valve 98 in response to such variations. When the fluid level in the tank 90 falls, the float 99 increases the opening of the valve 98 to allow an increased flow of water into the tank 92, which results in an increased supply of pulp to the tank 90. When the level in the tank 90 rises, the float 99 decreases the opening of the valve 98 which results in a decrease in the supply of pulp to the tank 90. By this means the fluid level in the tank 90 is maintained substantially constant and therefore the pressure of the pulp supplied to the head box 93 by the pump 94 will be substantially constant.

From the foregoing description and the accompanying drawings, it will now be readily understood that I have provided improved paper making apparatus having novel means for supplying the pulp to the traveling wire. It will be seen furthermore that I have provided a novel pump and pressure head box arrangement for supplying pulp under pressure to the nozzle, and have also provided novel means for regulating the pressure of the pulp supplied to the nozzle. A further characteristic feature and advantage of my invention is that it provides means for controlling or synchronizing the operation of the pulp supply means with respect to the operation of the traveling wire. This is an important feature because it contributes to the smoothness and efficiency of operation and enables paper making machines to operate satisfactorily with less manual attention.

While I have illustrated and described the improved paper making apparatus of my invention in a more or less detailed manner, it will be understood, of course, that the invention is not to be regarded as limited to the particular arrangements illustrated and described but includes all changes and variations which do not constitute a departure from the spirit of the invention and the scope of the appended claim.

Having thus described my invention, I claim:

In a paper making machine, the combination of a wire, a nozzle elongated transversely of the wire for supplying pulp thereto, said nozzle being divided interiorly thereof into a plurality of contiguous passages, and valves individual to said passages for controlling the flow of pulp therethrough.

BURKE M. BAXTER.