July 14, 1925.

1,545,638

H. C. CLAY

AUTOMATIC SPEED REGULATION

Filed Jan. 6, 1923

2 Sheets-Sheet 1

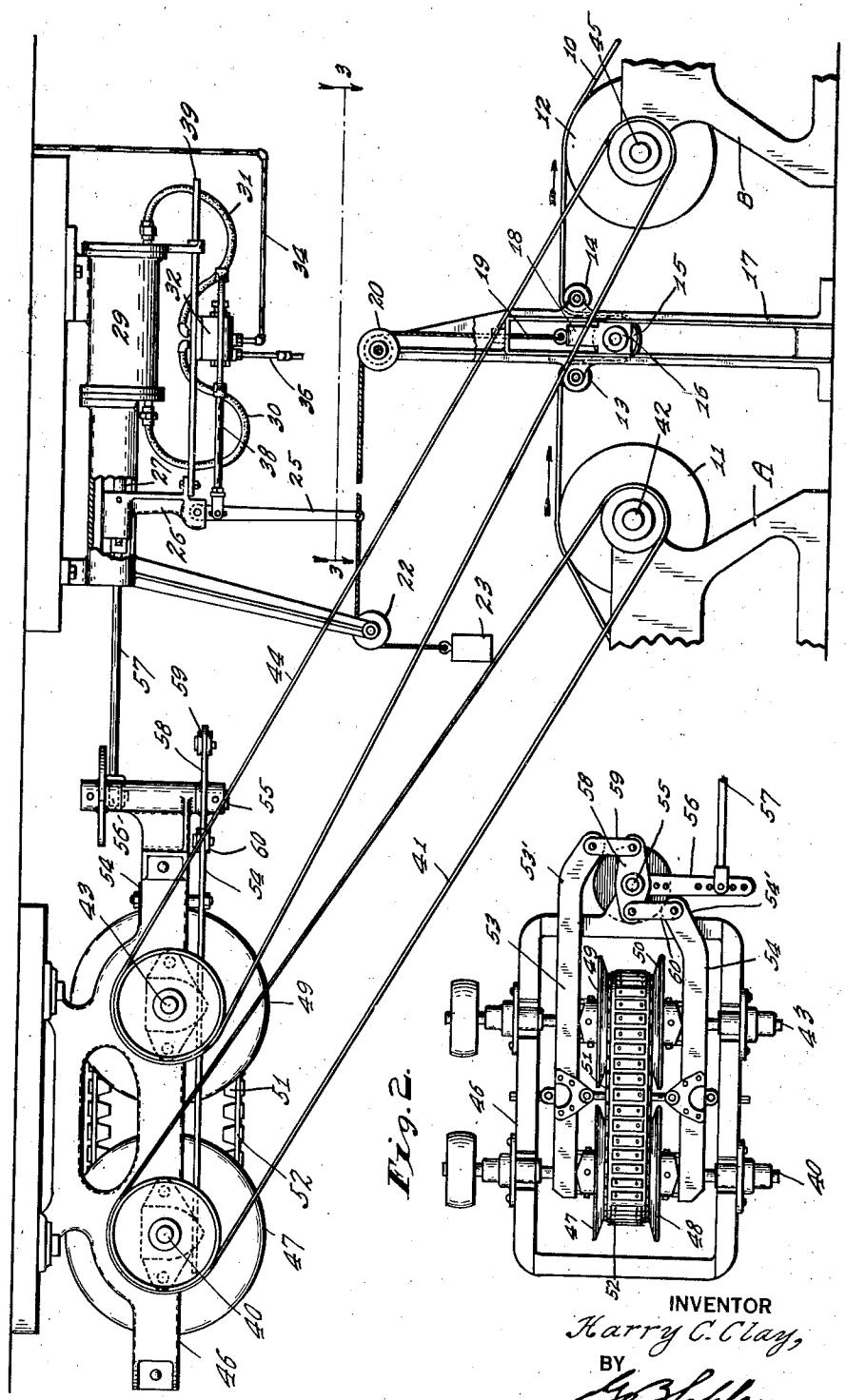


Fig. 1.

Fig. 2.

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Fig. 3

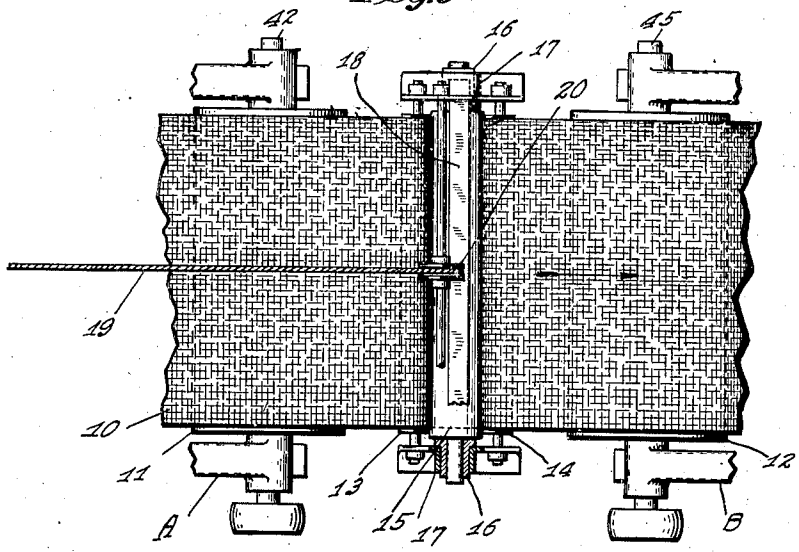


Fig. 4.

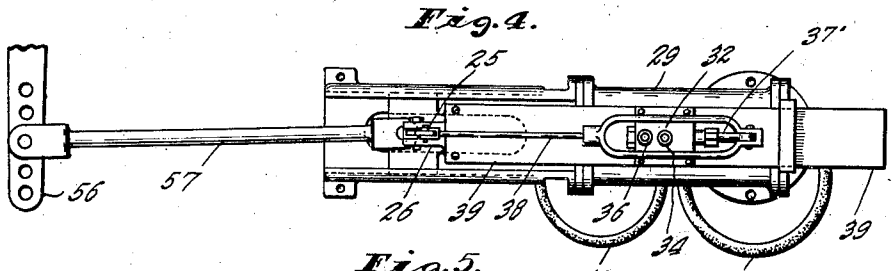
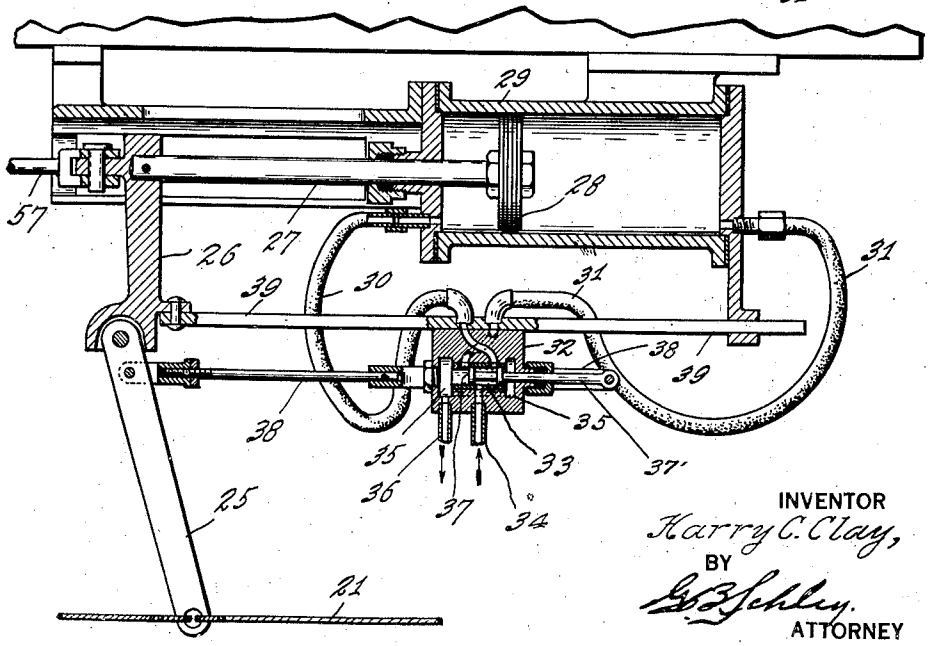


Fig. 5.



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Patented July 14, 1925. 1,545,638

UNITED STATES PATENT OFFICE.

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AUTOMATIC SPEED REGULATION.

Application filed January 6, 1923. Serial No. 611,016.

To all whom it may concern:

Be it known that I, HARRY C. CLAY, a citizen of the United States, residing at Columbus, in the county of Bartholomew and State of Indiana, have invented a new and useful Automatic Speed Regulation, of which the following is a specification.

In many manufacturing operations, particularly in connection with the textile and paper arts, the material being operated on passes from one machine to another, and it is necessary to maintain the machines in proper synchronism with respect to the travel of the material going through them. As stated, this is especially the case with textile and paper machinery, where fabric or paper after treatment in one machine passes in a continuous strip to another machine, so that different parts of the same strip are being acted on by a plurality of machines; and the difficulty is further increased in such machinery by the stretch and shrink of the fabric or paper under different conditions of operation.

It is the object of my present invention to time automatically relatively to each other two machines through which material, especially textile material or paper, travels in series; and to control these relative speeds automatically by the amount of material, as by the length of the bight of the strip of material, between the two machines.

In accomplishing this result, broadly speaking, I drive one of the two machines through a variable-speed transmission mechanism, and shift this variable-speed mechanism by a power-operated device which is controlled primarily by the length of the bight of the material between the two machines, in the case of textile machinery, and secondarily by the position of the variable-speed transmission mechanism.

The accompanying drawings illustrate my invention: Fig. 1 is a side elevation of a transmission and control mechanism embodying my invention, showing fragments of two associated machines, and with the transmission mechanism interconnecting such two machines; Fig. 2 is a bottom plan of the variable-speed device shown in Fig. 1; Fig. 3 is an enlarged horizontal section on the line 3—3 of Fig. 1, showing the vertically shiftable roller between the two machines, and its associated mechanism; Fig. 4 is a bottom view of the fluid-pressure mechanism shown in Fig. 1; and Fig. 5 is an enlarged central vertical section through such fluid-pressure mechanism.

The two machines A and B which it is desired to synchronize may be machines of any desired type; but my invention is especially intended for synchronizing textile and paper machinery wherein a plurality of machines act successively on a single strip of fabric passing in series through such machines, and I have indicated fragments of such machines in Figs. 1 and 3. The fabric or paper strip 10 travels in the direction of the arrow from the terminal roller 11 of the machine A to the initial roller 12 of the machine B, and the timing is controlled by the length of such strip between the two rollers 11 and 12.

To this end, the strip 10 between the two rollers 11 and 12 passes over two guide rollers 13 and 14 and under a floating roller 15 suspended in the bight of the strip 10 between the two guide rollers 13 and 14. The floating roller 15 is supported in end bearings 16 which are slidable in vertical guide-ways 17; and the two slidable bearings 16 extend downward from the two ends of a cross-bar 18 hung from a cord 19 which passes directly upward therefrom over a pulley 20 and then horizontally to and over a pulley 22 to a counter-weight 23 which holds the cord tight without interfering with the operation thereof by the weight of the roller 15.

The cord 19 between the two pulleys 20 and 22 is attached to a lever 25, which is pivotally mounted on a cross-head 26 on a piston rod 27 of a piston 28 movable in a cylinder 29. The movements of the cross-head 26 control a variable-speed mechanism as hereinafter explained, to govern the relative speeds of the machines A and B. The two ends of the cylinder 29 are connected by conduits 30 and 31, each of which includes a flexible tube, to ports in a valve-box 32, which has a pressure space 33 supplied with fluid under pressure through a supply pipe 34, and also has an exhaust space 35 connected to a waste pipe 36. A sliding valve 37 is mounted in the valve-box 32, and when in intermediate position in the valve-box shuts off both conduits 30 and 31 from both the pressure space 33 and the exhaust space 35. When the valve 37 is moved in one di-

rection in the valve-box it connects one of said conduits to the pressure space and the other to the exhaust space; and when it is moved in the other direction in the valve-box it reverses such connection. The stem 37′ of the valve 37 is connected by a looped link 38 to the lever 25, so that the valve is controlled by the position of such lever with respect to the cross-head 26 and is in neutral position only when the lever 25 is in a predetermined angular position, such as vertical. The valve-box 32 is mounted on a sliding rod 39 fixed to the cross-head 26, so that the valve-box 32 moves with such cross-head.

The variable-speed mechanism controlled by the movements of the piston 28 is in the driving transmission for one of the machines A and B of the machine B as shown. It may receive power from any suitable source, being shown as receiving it from the other machine, the machine A, so that it interconnects the two machines A and B; but this drive of one machine from the other, though desirable, is not essential to my invention.

The variable-speed mechanism has an incoming-power shaft 40, shown connected by a belt 41 and suitable pulleys to a shaft 42 of the machine A, which shaft 42 is shown as also carrying the terminal roller 11 of such machine; and it also has an outgoing-power shaft 43 connected by a belt 44 and suitable pulleys to a shaft 45 of the driven machine, the machine B, which shaft 45 is shown as also carrying the initial roller 12 of such machine. The showing of how the shafts 40 and 43 are connected to the machines A and B respectively is merely illustrative.

The two shafts 40 and 43 are mounted in a common frame 46. Each shaft 40 and 43 has splined thereon two disks, 47 and 48, and 49 and 50, respectively, the adjacent faces of each pair of disks being oppositely and equally conical to cooperate with the oblique ends of the cross-bars 51 of an endless driving belt 52 which interconnects the two pulleys formed by such two pairs of disks. The effective diameters of these two pulleys are varied inversely, by shifting the disks of one pair, say 47 and 48, toward each other to force radially outward the cross-bars co-operating therewith while the disks of the other pair, say 49 and 50, are separated to permit the cross-bars 51 co-operating therewith to come radially inward closer to the axis, and vice versa. This shifting of the disks 47, 48, 49, and 50 is obtained by pairs of shifting levers 53 and 54, suitably swung between the shafts 40 and 43 on suitable axes transverse to the common plane of such two shafts, one of each pair being above and one below such shaft plane. The pairs of shifting levers 53 and 54 act in any suitable way on the disks 47 and 49, and 48 and 50, respectively; and are arranged to shift the two disks 47 and 48 toward each other while they permit the disks 49 and 50 to separate from each other, and vice versa. This type of variable-speed transmission, as so far described, is a standard type of transmission.

To control the transmission, a shifting shaft 55 is mounted in an extension from one end of the frame 46, perpendicular to the common plane of the shafts 40 and 43. On one end of the shifting shaft 55 is an operating arm 56, connected by a link 57 to the cross-head 26. Preferably the link 57 may be adjustably connected to the operating arm 56 at a plurality of points along such operating arm, to adjust the relative movements of the shifting shaft 55 and the piston 28. On the other end of the shifting shaft 55 is a cross-arm 58. One of each pair of shifting levers 53 and 54 is extended at the end toward the shifting shaft 55, and these extended ends 53′ and 54′ are connected to the two ends of the cross-arm 58 by links 59 and 60 respectively. The extended end 53′ is longer than the extended end 54′, as is clear from Fig. 2; and the respectively associated ends of the cross-arm 58 are of proportionately different lengths. That is, the ratio of the lengths of the two ends of the cross-arm 58 is substantially the same as that of the lengths of the different-length extensions 53′ and 54′, measuring of course to the pivot centers in all cases. In addition, the extensions 53′ and 54′ are preferably bent toward each other, so that the several pivot points of each shifting lever are substantially in line. Further, for the middle position shown where the speed-ratio of the variable-speed transmission is 1 to 1, the cross-arm 58 is parallel to the pivot lines of the shifting levers, and the links 59 and 60 are perpendicular or nearly so to the cross-arm, all as indicated in Fig. 2. As a result of this, a movement of the shifting shaft 55 shifts the disks 47 and 48 oppositely and very nearly equally along the shaft 40, and at the same time shifts the disks 49 and 50 oppositely and very nearly equally along the shaft 43. This substantially avoids any tendency to twist the belt 52 or bend it edgewise, and greatly increases the life of the belt.

The movement of the shifting shaft 55 is merely a rocking movement, from a maximum speed to a minimum speed of the shaft 45 with relation to the speed of the shaft 42. This rocking movement of the shifting shaft is obtained by the movements of the piston 28; and such movements are controlled by the position of the valve 37 in its valve box 32; and such position is controlled jointly by the vertical movements of the roller 15 and by the movements of the piston 28 itself.

In operation, the machine A is driven in any suitable manner; and the machine B is driven through the variable-speed mechanism above described, from the machine A as shown. The speed of the machine B is varied in relation to that of the machine A by the operation of the variable-speed mechanism, to maintain the proper relation of the speeds of the two machines in accordance with the amount of material between the two machines—which in the machine shown is in accordance with the length of the bight of the strip 10 of fabric or paper in which the roller 15 hangs. If for any reason the speed of the machine B is relatively too slow, as compared to that of the machine A, the bight in which the roller 15 hangs is lengthened, which lowers such roller 15 so that the lower end of the lever 25 is swung from its neutral or vertical position toward the right, as indicated in Fig. 5. This shifts the valve 37 to the right in the valve-box 32, to connect the conduit 30 to the pressure space 33, and the conduit 31 to the exhaust space 35, so that the fluid under pressure supplied from the pipe 34 is admitted to the left-hand end of the cylinder 29 to force the piston 28 and cross-head 26 also toward the right. This movement of the piston 28 has two effects. First, it shifts the operating arm 56, in a counter-clockwise direction in Fig. 4, to shift the disks 49 and 50 further apart and the disks 47 and 48 closer together; which increases the speed of the shaft 43 with relation to that of the shaft 40, and thereby speeds up the machine B with relation to the machine A, so that the lengthening of the bight supporting the roller 15 will cease. Second, it shifts the valve-box 32 and the upper end of the lever 25 to the right, thereby to return the lever 25 to its neutral or vertical position, and to produce a relative shifting of the valve 37 to the left (though an actual shifting to the right) to close again the ports of the conduits 30 and 31, and thus to shut off the supply of fluid under pressure to the cylinder 29; which shutting off occurs when the upper end of the lever 25 has caught up with the lower end thereof, so that the normal position of such lever with respect to the cross-head 26 is restored.

If the speed of the machine B is too great with respect to that of the machine A, the bight supporting the roller 15 is shortened, and the roller 15 is lifted, and the counterweight 23 shifts the lower end of the lever 25 from its neutral position toward the left. This shifts the valve 37 to admit fluid under pressure to the right-hand end of the cylinder 29, to move the piston 28 and cross-head 26 also to the left. This movement to the left of the cross-head 26 produces first, a shifting of the variable-speed transmission mechanism to slow down the machine B relative to the machine A; and second, a shifting of the valve-box 32 and of the upper end of the lever 25 to shut off the supply of fluid under pressure to the cylinder 29 and a stoppage of the movement of the piston 28 when by such movement the lever 25 with respect to the cross-head 26 is restored to its neutral or vertical position.

In this way, the speeds of the machines A and B are maintained in proper relation to each other, to maintain the proper amount of material, or the proper length of fabric or paper strip 10, between the two machines, so that such material or strip will neither accumulate too greatly nor be reduced to too small a value with a resultant rupturing of the fabric strip.

I claim as my invention:

1. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, and means for controlling said power-operated means jointly by the accumulation of material between the two machines and by the position of said power-operated means.

2. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, control means for controlling the supply of power to said power-operated means, and means for governing said control means by the accumulation of material between the two machines.

3. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, control means for controlling the supply of power to said power-operated means, and means for governing said control means jointly by the accumulation of material between the two machines and by the position of said power-operated means.

4. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, control means for controlling the supply of power to said power-operated means, said control means comprising two movable members, and means for moving one of said movable members in accordance with the accumulation of ma-

terial between the two machines and for moving the other of said two members by the movements of said power-operated means.

5. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, control means for controlling the supply of power to said power-operated means, said control means comprising two relatively movable members, and means for producing a relative movement of said two members by the accumulation of material between the two machines and for producing the reverse relative movement of said two members by the movement of said power-operated means which is produced in response to the first-named relative movement.

6. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, a fluid-pressure-operated device for operating said variable-speed mechanism, a valve for controlling said fluid-pressure-operated device, and means for controlling said valve by the accumulation of material between the two machines.

7. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, a fluid-pressure operated device for operating said variable-speed mechanism, a valve for controlling said fluid-pressure-operated device, and means for controlling said valve jointly by the accumulation of material between the two machines and by the position of said fluid-pressure-operated device.

8. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, a fluid-pressure operated device for operating said variable-speed mechanism, a valve for controlling said fluid-pressure-operated device, said valve comprising two movable members, means for moving one of said valve members by the accumulation of material between the two machines, and means for moving the other of said valve members by the movement of said fluid-pressure-operated device.

9. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, a fluid-pressure-operated device for operating said variable-speed mechanism, a valve for controlling said fluid-pressure-operated device, said valve comprising two relatively movable members, and means controlled by the accumulation of material between the two machines for producing a relative movement between said two valve members to produce an operation of said fluid-pressure-operated device and for producing a reverse relative movement between said two valve members by the operation of said fluid-pressure-operated device caused by the first-named relative movement.

10. In combination, two machines operating on the same strip of material in series, said strip being arranged in a bight between the two machines, a control member arranged to be carried in said bight and to be movable by the lengthening and shortening of the bight, a variable-speed mechanism through which one of said two machines is driven, and means for controlling said variable-speed mechanism by the movements of said control member.

11. In combination, two machines operating on the same strip of material in series, said strip being arranged in a bight between the two machines, a control member arranged to be carried in said bight and to be movable by the lengthening and shortening of the bight, a variable-speed mechanism through which one of said two machines is driven, and means for controlling said variable-speed mechanism jointly by the vertical movements of said control members and by the condition of said variable-speed mechanism.

12. The mechanism set forth in each of claims 1 to 12 inclusive, in which the material operated on by the machines travels in a strip from one of the machines to the other, in combination with means for forming a bight in the intermediate section of the strip between the two machines, a control member hung in said bight and movable transversely of its axis by the lengthening and shortening of the bight, and means operated by said movements of said control member for producing the control in response to the accumulation of material between the two machines.

13. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, control means for controlling the supply of power to said power-operated means, said control means comprising two movable members, and means for moving one of said movable members in one direction or the other according as the accumulation of material between the two machines increases or decreases, respectively, and for subsequently moving the other member in the same direction to restore the normal relation between

said two members by the operation of said power-operated means.

14. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, power-operated means for operating said variable-speed mechanism to vary the relative speeds of said two machines, control means for controlling the supply of power to said power-operated means, said control means comprising two movable members, and means for moving one of said movable members in one direction or the other according as the accumulation of material between the two machines increases or decreases, respectively, and for subsequently moving the other member in the same direction to restore the normal relation between said two members.

15. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, a fluid-pressure-operated device for operating said variable-speed mechanism, a valve for controlling said fluid-pressure-operated device, said valve comprising two movable members, means for moving one of said valve members in one direction or the other according as the accumulation of material between the two machines increases or decreases respectively and for subsequently moving the other valve member in the same direction to restore the normal relation between said two valve members by the operation of said fluid-pressure-operated device.

16. In combination, two machines arranged to operate on the same material in series, a variable-speed mechanism through which one of said two machines is driven, a fluid-pressure-operated device for operating said variable-speed mechanism, a valve for controlling said fluid-pressure-operated device, said valve comprising two movable members, means for moving one of said valve members in one direction or the other according as the accumulation of material between the two machines increases or decreases respectively, and for subsequently moving the other valve member in the same direction to restore the normal relation between said two valve members.

17. In combination, a power-operated device, control means therefor, said control means comprising two movable members, and means for moving one of said movable members in one direction or the other in accordance with variations in a determining quantity and for subsequently moving the other member in the same direction to restore the normal relation between said two members.

18. In combination, a power-operated device, control means therefor, said control means comprising two movable members, and means for moving one of said movable members in one direction or the other in accordance with variations in a determining quantity and for subsequently moving the other member in the same direction to restore the normal relation between said two members by the operation of said power-operated device.

19. In combination, a fluid-pressure-operated device, a valve for controlling it, said valve comprising two movable members, means for moving one of said valve members in one direction or the other in accordance with variations in a determining quantity and for subsequently moving the other valve member in the same direction to restore the normal relation between said two valve members.

20. In combination, a fluid-pressure-operated device, a valve for controlling it, said valve comprising two movable members, means for moving one of said valve members in one direction or the other in accordance with variations in a determining quantity and for subsequently moving the other valve member in the same direction to restore the normal relation between said two valve members by the operation of said fluid-pressure-operated device.

In witness whereof, I have hereunto set my hand at Columbus, Indiana, this 29th day of December, A. D. one thousand nine hundred and twenty-two.

HARRY C. CLAY.