July 14, 1936. J. T. NEEDHAM 2,047,285

MOTOR SPEED CONTROL APPARATUS

Original Filed Aug. 27, 1932 2 Sheets-Sheet 1

Fig. 1.

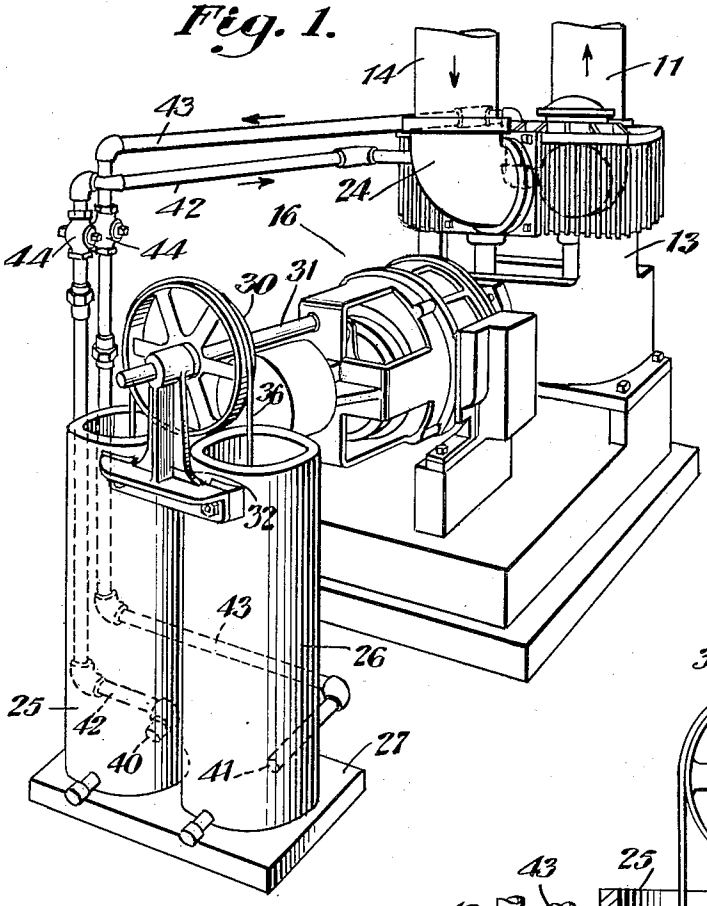


Fig. 2.

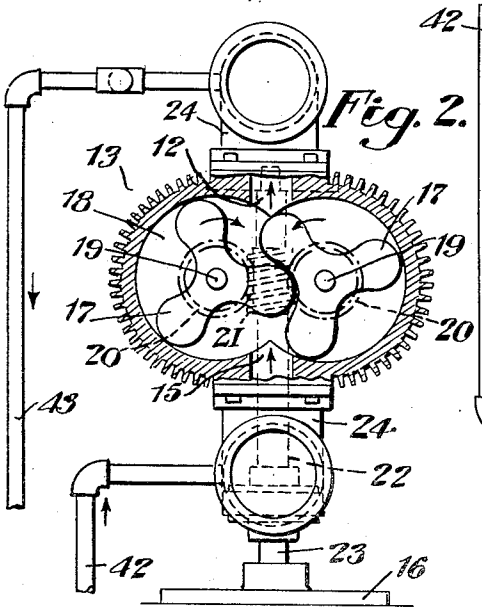
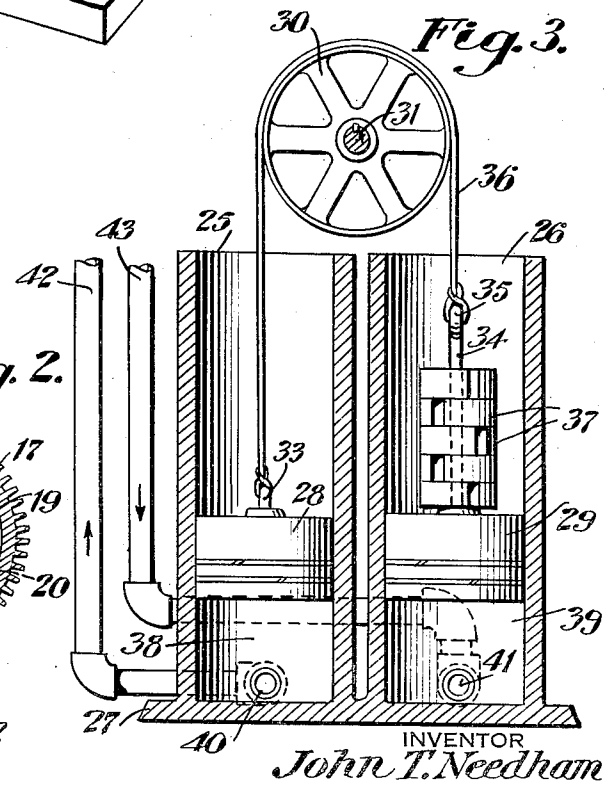


Fig. 3.



INVENTOR
John T. Needham
BY Davis Davis
ATTORNEYS

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MOTOR SPEED CONTROL APPARATUS

Original Filed Aug. 27, 1932 2 Sheets-Sheet 2

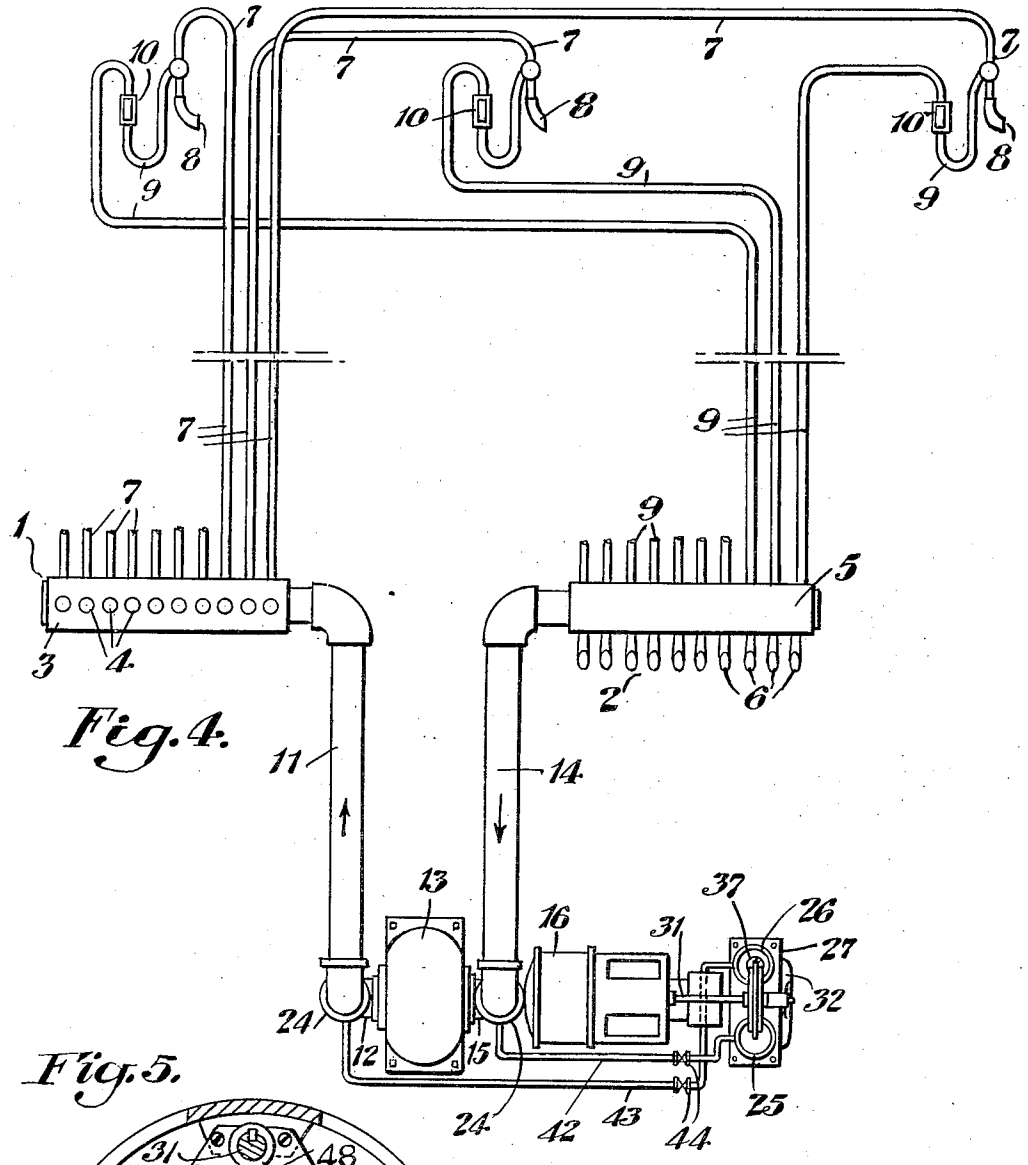
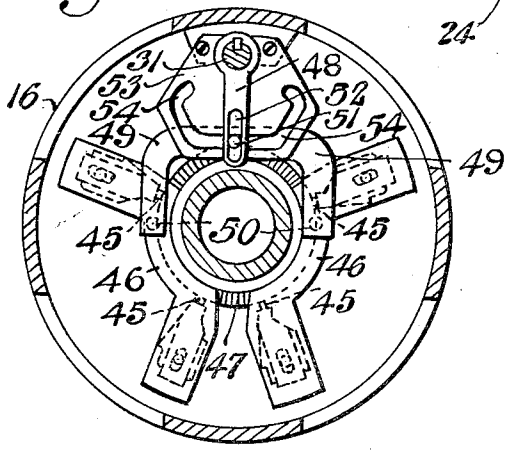


Fig. 4.

Fig. 5.



INVENTOR
John T. Needham
BY
Daniel Davis
ATTORNEYS

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MOTOR SPEED CONTROL APPARATUS

John T. Needham, North Plainfield, N. J., assignor to Lamson General Conveyors Limited, Montreal, Quebec, Canada, a corporation of Canada

Original application August 27, 1932, Serial No. 630,672. Divided and this application July 17, 1934, Serial No. 735,624

9 Claims. (Cl. 171—221)

An important object of the present invention is to provide improved means operable by fluid pressure to govern the speed of an electric motor in accordance with varying service demands made upon the motor.

Other objects of the invention will appear hereinafter.

This application is a division of my co-pending U. S. patent application, Serial No. 630,672, filed August 27, 1932 and which has matured into Patent No. 1,977,737, issued Oct. 23, 1934.

In the drawings, Fig. 1 is a perspective view of the blower of a pneumatic dispatch tube system, an electric motor for driving the blower and a control device to automatically control the speed of the motor;

Fig. 2 a sectional plan view of the blower and the piping which connects the inlet and outlet of the blower with the motor speed control device;

Fig. 3 a vertical sectional view of the motor speed control device;

Fig. 4 a diagrammatic view of a pneumatic dispatch tube system and including the blower, the motor and the automatic motor speed control device; and

Fig. 5 a transverse section taken through the commutator portion of the motor showing the operative connections between the shaft of the speed control device and the commutator brushes.

In order to make clear the purpose of the invention, as employed in a pneumatic dispatch tube system, the dispatch tube system shown in Fig. 4 will first be generally described. The system is one in which the invention may be employed very advantageously. It may, however, be employed in other connections also. The system shown includes a main sending terminal unit 1 and a main receiving terminal unit 2. Unit 1 includes an air pressure manifold 3 and a number of sending terminals 4. Unit 2 includes an air suction or vacuum manifold 5 and a number of discharge terminals 6. From the sending terminals 4 outgoing dispatch tube lines 7 lead to discharge terminals 8 at outlying stations. Return dispatch tube lines 9 lead from the outgoing lines 5 at said stations to the discharge terminals 6 of the receiving unit and communicate with the vacuum manifold 5. Each return tube line has a sending terminal 10. The pressure manifold 3 is supplied with air under pressure through a large pipe 11 leading from the outlet 12 of a blower or air pump 13. From the vacuum manifold 5 a large suction pipe 14 leads to the inlet 15 of the blower or pump. The latter is driven by an electric motor 16.

When a carrier is inserted into any one of the sending terminals for transmission the tube connected to the terminal is opened to the pressure manifold 3 and, by means not shown, the connected return tube 9 is simultaneously opened to the vacuum manifold 5. These tubes are also opened to the manifolds when a carrier in inserted into a terminal 10. If a number of the tubes are in service simultaneously there will be a decided drop in pressure in the manifold 3 and a reduction of the vacuum in the manifold 5 unless the speed of the blower is increased. Consequently the carrier transmission speed will be materially reduced. In order to provide adequate pressure and suction for rapid carrier transmission regardless of the number of tubes in service, I have provided a pneumatically operable device to automatically control the speed of the motor in accordance with the service requirements of the system. This device is operable in response to changes in air pressure in the system to speed up or slow down the motor as the number of tubes in service increases or decreases.

The blower 13 is of the standard type. It has cooperating rotary impellers 17 in a compression chamber 18 in communication with the inlet 15 and the outlet 12. Each impeller is fixed to a shaft 19 and the shaft has a gear 20 fixed to it below the compression chamber. Both gears are driven by a worm 21 fixed to a drive shaft 22. The shaft 23 of the motor 16 has a direct drive connection with the drive shaft 22 of the blower. The outlet and inlet of the blower have elbow pipe unions 24 to which the large pressure and suction pipes 11 and 14 respectively are joined.

The electric motor 16 is a motor known commercially as a "Brush-Shifting Motor, Type 'BTA'". Such a motor has its commutator brushes supported in a rotatable mounting enabling the brushes to be shifted around the commutator axis to vary the speed of the motor. Ordinarily the brush mounting is rotated by means of a hand lever or by means of a small pilot motor to change the speed of the main motor. In the present case my automatic speed control device effects the shifting of the commutator brushes to adjust the motor speed in accordance with the pneumatic requirements of the tube system.

The automatic speed control device includes a pair of vertical cylinders 25 and 26 open at their upper ends and closed at their lower ends and supported by a base 27. In the present instance a single casting forms the base and cylinders; said parts may be formed separately, however. A piston or plunger 28 is fitted for vertical reciprocation in cylinder 25, and a piston or plunger 29 is fitted for vertical reciprocation in the cylinder 26. Disposed over the upper ends of the cylinders, in an intermediate position, is a pulley 30. This pulley is fixed to a shaft 31 one end of which is supported by a bearing bracket 32 attached to the cylinders. The opposite end of

the shaft is supported by a bearing borne by the motor structure and is operatively connected to the mountings of the commutator brushes. This shaft replaces a short shaft to which either a hand lever or a pilot motor is ordinarily connected. The operative connections between the shaft and the brush mountings are conventional parts of the motor. The plunger 28 has an eye 33 at its upper side and the plunger 29 has an upwardly extending stem 34 provided with an eye 35 at its upper end. A flexible tension strand or cable 36 is trained over the pulley 30 and has its ends anchored to said eyes. On the stem 34 is a plurality of weight disks 37 radially slotted to permit their removal from the stem. These weights rest upon the plunger 29.

The lower portion of cylinder 25 and its plunger 28 define a suction or vacuum chamber 38 and the lower portion of cylinder 26 and its plunger 29 define a pressure chamber 39. Chamber 38 has a port 40 and chamber 39 has a port 41. From the elbow 24 of the blower inlet a small suction pipe 42 leads to the port 40 of said vacuum chamber and from the elbow of the blower outlet a small pressure pipe 43 leads to the port 41 of said pressure chamber. Each of said pipes has a valve 44 to adjust its capacity.

Any suitable mechanism may be employed to operatively connect the shaft 31 to the commutator brushes to shift the latter. Fig. 5 shows a mechanism similar to that embodied in a standard commercial motor of the BTA type. There are two pairs of brushes 45. Each pair is carried by a yoke 46 shiftably mounted to move the brushes circumferentially around the rotor 47 of the commutator. A radial arm 48 is affixed to the shaft 31 and two angular links 49 operatively connect said arm to the yokes 46. At one end said links are pivotally connected to the yokes, as at 50. At the opposite end the links are pivotally connected to each other and to the radial arm 48 by a pintle 51. The arm has a radial slot 52 through which the pintle extends. Between said arm and the links there is a plate 53 rigidly affixed to the motor casing. Said plate has a cam slot 54 through which the pintle extends. When the shaft 31 is rocked the mechanism just described causes the brushes to be shifted around the rotor of the commutator in a manner to vary the speed of the motor. The shift of the brushes by the arm 48 and the links 49 is constrained in a peculiar manner by the cam slot 54 to properly govern the direction of shift of the brushes and the degree of shift thereof for a given movement of the arm 48. Such a mechanism and its action is more fully disclosed in U. S. Patent No. 1,734,907, dated November 5, 1929.

The automatic speed control device operates as follows in conjunction with the dispatch tube system: The pipes 11 and 43 place the pressure manifold 3 of the system in constant communication with the pressure chamber 39 of the control device so that substantially the same pressure will exist in said chamber as in the manifolds. Similarly, the pipes 14 and 42 place the vacuum manifold 5 of the system in constant communication with the vacuum chamber 38 of the control device, so that substantially the same degree of vacuum will exist in both the manifold and chamber. Ordinarily one or a small number of the tubes 7 and 9 will be kept constantly open to the manifolds 3 and 5 respectively. The blower may be kept running at a low speed to keep a certain desired degree of pressure in the manifold 3 and vacuum in the manifold 5. This normal or idle pressure and vacuum are determined by the weights 37 of the control device. By changing the number or size of the weights the normal position of the commutator brushes may be varied. Thereby the speed of the motor is adjusted to obtain the desired normal pressure and vacuum.

When additional dispatch tubes are placed in operation there will be a drop in pressure in the manifold 3 and in the connected pressure chamber 39 of the control device. The weighted plunger 29 will then move downward to rotate the pulley 30 and shaft 31 clockwise, with reference to Figs. 1 and 3, and cause the commutator brushes to be shifted to increase the speed of the motor and drive the blower faster to build up the pressure. When an increased number of dispatch tubes are placed in operation the consequent drop in pressure in manifold 3 and in pressure chamber 39 will cause the plunger 29 to move farther down to further increase the motor speed. As the dispatch tubes go out of operation the consequent rapid build up of pressure in manifold 3 and in pressure chamber 39 causes the plunger to move upward. An increase in pressure in chamber 39 is accompanied by an increase of vacuum in chamber 38 and atmospheric pressure on top of piston 28 forces it down to rotate the shaft 31 counter-clockwise and shift the commutator brushes to slow down the motor.

The control device is sensitive and responsive to pneumatic fluctuations in the system and operates to automatically govern the speed of the motor in accordance with the widely varying pneumatic requirements of the system. Rapid transmission of the carriers is obtained regardless of the number of dispatch tubes in simultaneous operation.

The motor speed control device is responsive to pressure and vacuum acting together and it constitutes a very sensitive and flexible means for quickly and nicely adjusting the speed of a motor through many gradations, in accurate accordance with varying service demands upon the motor.

Features of the invention shown and described but not claimed in the present application are claimed in my co-pending application Serial No. 630,672.

What I claim is:

1. In combination, an electric motor having commutator brush means shiftable to change the speed of the motor; and a fluid pressure operated motor speed control device operatively connected to the commutator brush means to shift same and including a pressure chamber and a vacuum chamber, means in said chambers shiftable in response to variations in the degree of pressure and in the degree of vacuum in said chambers, and means operatively connecting said pressure-vacuum responsive means to the brush means to shift same in response to changes in the degree of pressure and vacuum in said chambers.

2. In combination, an electric motor having commutator brush means shiftable to change the speed of the motor; and a fluid pressure operated motor speed control device operatively connected to the commutator brush means to shift same and including a pressure chamber and a vacuum chamber, means in said chambers shiftable in response to variations in the degree of pressure and in the degree of vacuum in said chambers,

means operatively connecting said pressure-vacuum responsive means to the brush means to shift same in response to changes in the degree of pressure and vacuum in said chambers, and adjustable means to vary the relative normal positions of the pressure-vacuum responsive means to thereby vary the normal position of the brush means to establish any desired normal motor speed.

3. In combination, an electric motor having commutator brush means shiftable to change the speed of the motor; and a fluid pressure operated motor speed control device operatively connected to the commutator brush means to shift same and including a pressure chamber and a vacuum chamber, means in said chambers shiftable in response to variations in the degree of pressure and in the degree of vacuum in said chambers, means operatively connecting said pressure-vacuum responsive means to the brush means to shift same in response to changes in the degree of pressure and vacuum in said chambers, and adjustable weights adapted to be applied to the pressure responsive means to vary the normal position of the brush means to establish any desired normal motor speed.

4. In combination, a motor; and a fluid pressure operated motor speed control device including a pressure chamber and a vacuum chamber, means in said chambers shiftable in response to variations in the degree of pressure and in the degree of vacuum in said chambers, and means operatively connecting said pressure-vacuum responsive means to the motor to vary the speed of the motor in response to changes in the degree of pressure and vacuum in said chambers.

5. In combination, an electric motor having commutator brush means shiftable to change the speed of the motor; and a fluid pressure operated motor speed control device operatively connected to the commutator brush means to shift same and including a pressure chamber and a vacuum chamber, means in said pressure chamber shiftable in response to changes in the degree of pressure in said chamber, means in said vacuum chamber shiftable in response to the degree of vacuum in said chamber, means operatively connecting said pressure responsive means and said vacuum responsive means to the brush means to shift same in response to changes in the degree of pressure and vacuum in said chambers, and an adjustable means to vary the normal position of said pressure responsive means to vary the normal position of the brush means to establish any desired normal motor speed.

6. In combination, an electric motor having means operable to control its speed; and a fluid pressure operated device comprising a rotatable shaft operatively connected to said speed control means, a pulley fixed to said shaft, a pair of upright cylinders disposed beneath said pulley, a plunger in each cylinder, one cylinder and its plunger defining a fluid pressure chamber beneath the plunger and the other cylinder and its plunger defining a vacuum chamber beneath the plunger and both plungers being exposed to atmospheric pressure at their upper sides, a flexible tension strand attached at its opposite ends to said plungers and trained over said pulley, a fluid pressure connection for said fluid pressure chamber, and a suction connection for said vacuum chamber, to shift the plungers and thereby operate said speed control means to change the speed of the motor in response to changes in pressure and changes in vacuum in said chambers.

7. In combination, an electric motor having commutator brush means shiftable to change the speed of the motor; and a fluid pressure operated control device to shift said brush means, comprising a pair of upright cylinders, a plunger in each cylinder, one cylinder and the plunger therein defining a pressure chamber beneath the plunger and the other cylinder and the plunger therein defining a vacuum chamber beneath the plunger, each plunger being exposed to atmospheric pressure at its upper side, a fluid pressure connection for said pressure chamber, a fluid suction connection for said vacuum chamber, the plungers being operatively connected to shift vertically in unison but in opposite directions in response to variations in the degree of pressure in the pressure chamber and variations in the degree of vacuum in the vacuum chamber, and an operative connection between the plungers and the brush means to shift the latter, for the purpose set forth.

8. In combination, an electric motor having commutator brush means shiftable to change the speed of the motor; and a fluid pressure operated control device to shift said brush means, comprising a pair of upright cylinders, a plunger in each cylinder, one cylinder and the plunger therein defining a pressure chamber beneath the plunger and the other cylinder and the plunger therein defining a vacuum chamber beneath the plunger, a fluid pressure connection for said pressure chamber, a fluid suction connection for said vacuum chamber, the plungers being operatively connected to shift vertically in unison but in opposite directions in response to variations in the degree of pressure in the pressure chamber and variations in the degree of vacuum in the vacuum chamber, an operative connection between the plungers and the brush means to shift the latter, for the purpose set forth, and means to impose a constant yieldable resistance to upward shift of the compression chamber plunger, said resistance means being adjustable to vary the resistance to plunger shift.

9. In combination, an electric motor having means operable to control its speed; and a fluid pressure operated device to operate said speed control means comprising a pair of cylinders, a plunger in each cylinder, one cylinder and the plunger therein defining a pressure chamber and the other cylinder and the plunger therein defining a vacuum chamber, a fluid pressure connection for said pressure chamber, a fluid suction connection for said vacuum chamber, the plungers being operatively connected to shift in unison in response to variations in the degree of pressure in the pressure chamber and variations in the degree of vacuum in the vacuum chamber, and means operatively connecting the plungers to said speed control means to vary the speed of the motor in response to shift of the plungers.

JOHN T. NEEDHAM.