PNEUMATIC TUBE SYSTEM FOR HIGH CARRIER SPEEDS

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This invention relates to pneumatic tube systems and more particularly to pneumatic tube systems for conveying high speed carriers. This invention relates to a pneumatic tube system for very high carrier speeds of about 40 meters per second and more. Herefore such speeds could be reached only if a compressed-air or vacuum blower was operating at both the sending and receiving station. Furthermore, the path traveled in that case was not very long. A simulated zero point may also be provided in the middle of the stretch, that is, a nonreturn flap emptying into the atmosphere that allows the compressed air to escape to some extent at that point.

When operating over longer stretches, only substantially lower average speeds are possible, if the action of the compressed-air and vacuum blower at both ends of the stretch is not to become too great, thus causing the entire system to operate inefficiently. There is also no use whatever in trying to connect a plurality of short-length stretches using compressed air and a vacuum, since the carrier, to go from one stretch to the other, must reduce its average speed considerably, something that is counter to the problem at hand.

One object of this invention therefore is to provide means that make it possible to operate a pneumatic tube system of somewhat extensive length at a high average carrier speed.

A feature of this invention is the transfer of a carrier from one section to another without loss of speed in a horizontal portion of the system.

Our invention is a pneumatic tube system for very high carrier speeds with a compressed-air source at the sending station and a vacuum source at the receiving station. This invention is designed so that two or more tube sections, each containing a compressed-air source and a vacuum source, are connected in series and joined together means of lock sections that can be traversed by the carrier with no perceptible loss in speed and that can be closed to the forward and rearward tube sections as well as to the compressed-air and vacuum source by means of controlled slide plate or valves.

The compressed-air source and the vacuum source at each connection point may consist of a single blower. Until the carrier enters the lock section, this blower is switched to vacuum, and as the carrier passes through the lock section it is switched to compressed air. To that end, the lock section is connected at two widely separated points located near its limits to a common air channel leading to the blower.

The above-mentioned and other features and objects of our invention will become apparent by reference to the following description taken in conjunction with the accompanying drawing in which is shown a schematic representation of one embodiment of our invention.

The drawing shows the arrangement of the pneumatic tube system's mode of operation in accordance with the invention and particularly the lock section connecting the two tube sections operating on compressed air and on vacuum. The lock section is between the first tube section and the second tube section. It is closed at the inlet by the slide plate and at the outlet by the slide plate.

The air channel has a connection 5 with the lock section in the vicinity of its inlet and another connection 6 at a somewhat greater distance from its outlet. Between these connections there is in the air channel a pressure release means or nonreturn valves 7, so arranged that it closes in the pneumatic tube carrier's direction of travel. The blower 15 operates in the direction of the arrow. It is connected across an air-exhaust valve 3 and across an air-intake valve 4 to air channel 13. Valves 1 and 2 lead to the open air, 1 being the exhaust valve and 2 the intake valve. An air decompressing means 7 is switched in ahead of intake valve 2. About one length of a carrier behind slide plate 11 there is a sensor 16, which senses the passage of the pneumatic tube carrier.

The arrangement shown operates as follows:

In the inoperative position, that is before the arrival of a carrier, slide control means 11a holds slide plate 11 open so that the lock section is open at its inlet. Slide plate 12, however, is closed. Blower 15 is in constant operation. The air leaves the tube through 5, flows through valve 4 through the blower and causes slight depression of the system through valve 1. When the carrier passes 5, it enters the lock section, at first without airflow, as far as slide plate 12. To minimize the braking effect on the carrier until the switchover is accomplished, 6 is provided at a sufficiently safe distance ahead of 12 (20 m. for example) through which the air being pushed upward by the carrier can escape and flow through the nonreturn valve into the space behind it. This has a deterring effect on the friction in the tube. Control means 17 associated with sensor 16 includes well known means for sequentially producing output pulses to pulses a-f inclusive in alphabetical sequence. These means may include for example a distributor and stepping means. Also time delay or timing means may be employed to cause the pulses to be initiated at desired time intervals. When sensor 16 is passed, a pulse is delivered by means well known to the art to control means 17 which initiates the sequential pulsing. This causes the following switching to take place. Pulse a operates valve control means 2a to open valve 2 exposing the blower on both sides to the atmosphere. The valve control means may consist of well known solenoid operated devices. Next pulse b causes valve control means 4a to close valve 4; then pulse c causes valve control means 11a to close slide plate 11. Slide plate control means 11a may consist of piston operated or solenoid type devices. Pulse d then causes slide control means 12a to open slide 12. Finally pulse e causes valve control means 3e to open valve 3 and pulse f causes valve control means 1a to close valve 1. This completes the switchover. The carrier now continues under compressed air. The distance between 5 and 6 must be so chosen that the entire switchover process is completed in the time it takes the carrier to cover it. The system can be reset by causing the sequence of pulses a-f to be applied in the sequence f-a-r-thus opening valve 1, closing valve 3, closing slide 12, opening slide 11, opening valve 4 and closing valve 2. Means for doing this may be controlled by a sensor stationed beyond slide 12 or time delay means which allow sufficient time for a carrier to pass plates 11 and 12.

Obviously, the magnitude of the distances between openings 5 and 6, of the distance of slide plate 11 from the sensor and the distance from opening 6 to slide plate 12 must be adapted to the given conditions, that is to the paths the carrier must travel in the time it takes to perform the switching operations. It can further be seen that when the lock section and the other elements connected to it are properly dimensioned, a carrier can travel through the lock section with no perceptible loss in speed. In this way, average carrier speeds of 40 meters per second and more can be reached for stretches of any desired length.
While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. A pneumatic tube system for high speed carriers comprising: a forwarding tube for conveying a carrier, an entrance slide plate disposed at the entrance end of said tube, an exit slide plate disposed at the exit end of said tube, a blower producing compression on one of its sides and producing vacuum on its other side, a first valve means connecting said blower to said tube to subject said tube alternately to the compression and vacuum of said blower and means responsive to the presence and absence of said carrier within said tube to control said valve means.

2. A pneumatic tube system for high speed carriers comprising: a forwarding tube for conveying a carrier, a first slide plate disposed at the entrance to said tube, a second slide plate disposed at the exit of said tube, a blower producing compression on one of its sides and producing vacuum on its other side, a first connection located in said tube near said entrance slide plate, a first valve connected between said first connection and the vacuum side of said blower to apply suction to said tube, a second valve connected between the compression side of said blower and the atmosphere, said first and second valves normally being open before a carrier has entered said tube, a third valve connected between said first connection and the compression side of said blower, a fourth valve connected between said vacuum side of said blower and the atmosphere, said third and fourth valves normally being closed before a carrier has entered said tube, a sensor for sensing the presence of a carrier within said tube coupled to control said valves, whereby when a carrier is approaching said tube, a sensor and said first and second valves apply suction to said carrier, and whereby when said carrier is within said tube said first and second valves close and said blower and said third and fourth valves open to apply compression to said carrier.

3. A pneumatic tube system according to claim 2 further comprising a second connection having one opening disposed adjacent to said second slide plate and having its second opening connecting with said first connection, said passage having a non-return valve closing in the direction of travel of said carrier.

4. A pneumatic tube system according to claim 3 further comprising a dehumidifier disposed between said fourth valve and the atmosphere.

5. A pneumatic tube system for high speed carriers comprising: a forwarding tube for conveying a carrier, a first slide plate disposed at the entrance to said tube, a second slide plate disposed at the exit of said tube, a blower producing compression on one of its sides and producing vacuum on its other side, first valve means connecting the suction side of said blower to said tube, and second valve means connecting the compression side of said blower to said tube, a sensor for sensing the presence of a carrier within said tube connected to control said first and second valve means whereby when a carrier is approaching said tube section suction is applied to said carrier and whereby when a carrier is within said tube compression is applied to said carrier.

6. A pneumatic tube system for high speed carriers comprising: a forwarding tube section, a blower producing compression on one side and producing vacuum on its other side, valve means connected between said tube and said blower to selectively apply suction to said tube when said carrier is approaching said tube, and to selectively apply compression to said tube when said carrier is within said tube.

7. A pneumatic tube system according to claim 6 wherein said valve means comprises four valves, two of said valves connected to said vacuum side of said blower and two of said valves connected to the compression side of said blower.

8. A pneumatic tube system for high speed carriers comprising: a forwarding tube, first and second slide plates disposed respectively at the entrance and exit ends of said tube, a blower operating continuously, four valves connected to said blower to apply suction and compression to said tube depending on the presence and absence of a carrier within said tube.

9. A pneumatic tube system for high speed carriers comprising: a forwarding tube, first and second slide plates disposed respectively at the entrance and exit ends of said tube, a blower operating continuously, four valves connected to said blower, two of said four valves being connected to said tube, whereby said blower applies suction and compression to said tube depending on the presence of a carrier within said tube.

10. A pneumatic tube system for high speed carriers comprising: a forwarding tube, first and second slide plates disposed respectively at the entrance and exit ends of said tube, a blower operating continuously, first and second valves connected between said tube and said blower, third and fourth valves connected between said blower and the atmosphere, whereby when a carrier is approaching said tube, said first and third valves operate to apply the suction of said blower to said carrier and whereby when said carrier is within said tube, said second and fourth valves operate to apply the compression of said blower to said carrier.

11. A pneumatic tube system according to claim 10 further comprising an air channel connected between a point adjacent to said exit slide plate and the point of connection of said valves to said tube, said air channel having a non-return valve therein.

12. A pneumatic tube system according to claim 10 further comprising means for relieving the pressure in said tube caused by a carrier as it enters said tube and approaches the exit slide plate of said tube.

13. A system according to claim 12 wherein said relieving means comprises a non-return valve which closes in the carrier's direction of travel.

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