

Dec. 6, 1966

S. H. PITT ETAL
PNEUMATIC CAPSTAN HAVING A HIGH SPEED
ELECTRO-MAGNETIC VALVE
Filed Sept. 23, 1964

3,289,905

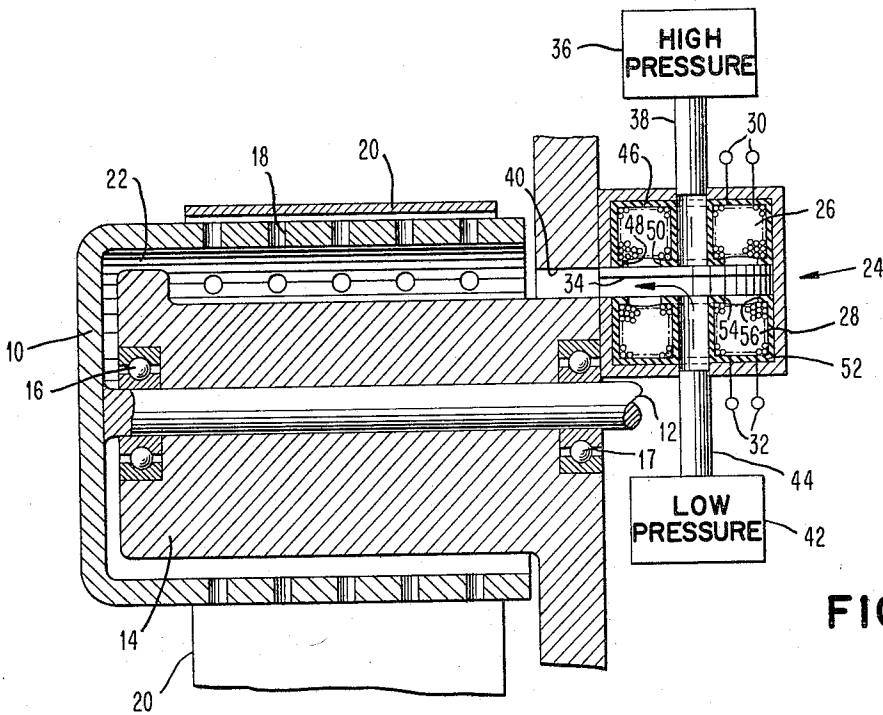


FIG. 1

FIG. 2

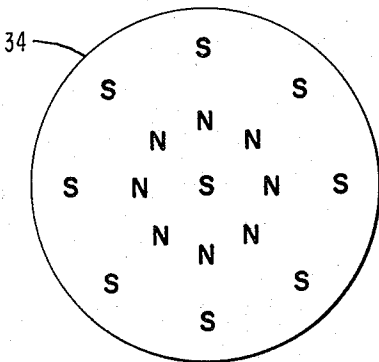
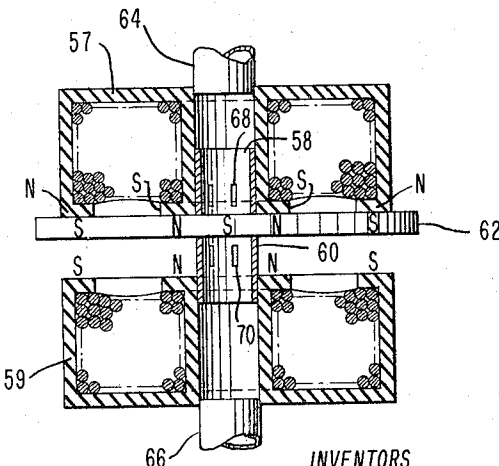


FIG. 3



INVENTORS
SOLOMON H. PITT
TREVOR D. READER

BY *Edward M. Farrell*
ATTORNEY

1

3,289,905

PNEUMATIC CAPSTAN HAVING A HIGH SPEED ELECTRO-MAGNETIC VALVE

Solomon H. Pitt, Norristown, and Trevor D. Reader, King of Prussia, Pa., assignors to Sperry Rand Corporation, New York, N.Y., a corporation of Delaware
Filed Sept. 23, 1964, Ser. No. 398,619
6 Claims. (Cl. 226—95)

This invention relates to electro magnetic valves, and more particularly to electro magnetic valves associated with tape transport systems.

In many devices employing pneumatic controls, it is often necessary to rapidly change the pressure on a given line, for instance, from a pressure wall above atmosphere to one approaching zero pressure vacuum. One such device may involve a tape transport system which utilizes a capstan. The capstan is generally driven by a motor. Means are employed by producing a fluid pressure against the tape to remove the tape from the capstan when it is desired to prevent movement of the tape. A vacuum or low pressure is applied to the capstan to pull the tape into driving contact with the capstan when it is desired to move the tape.

In many systems used heretofore, a relatively large number of parts have been employed in the valve arrangement which connect the fluid to the capstan. This has resulted in not only a relatively slowly responsive system but, in addition, has resulted in the need for using parts of critical tolerances.

It is an object of this invention to provide an improved valve arrangement.

It is a further object of this invention to provide an improved valve arrangement for a pneumatic tape handling system.

It is a further object of this invention to provide an improved valve arrangement requiring a minimum number of moving parts.

It is still a further object of this invention to provide an improved valve arrangement capable of high speed operation.

It is still a further object of this invention to provide an improved valve arrangement wherein friction and sliding surfaces are minimized.

In accordance with the present invention, a tape drive mechanism including a pneumatic capstan is provided. A valve arrangement is used to selectively apply high or low fluid pressure to the tape to cause it to engage or disengage the capstan. A movable metallic disc selectively blocks or unblocks the sources of high or low fluid pressure to prevent or permit engagement of the tape with the capstan. An electrical signal is selectively applied to a pair of electro-magnets to cause the disc to be selectively moved.

Other objects and advantages of the present invention will be apparent and suggest themselves to those skilled in the art, from a reading of the following specification and claims, in conjunction with the accompanying drawing, in which:

FIGURE 1 illustrates one embodiment of the present invention, partly in cross section and block diagram form;

FIGURE 2 is a front somewhat enlarged view of a disc incorporated in the embodiment of FIGURE 1, and

FIGURE 3 is a cross-sectional view illustrating a portion of another embodiment of the present invention.

Referring particularly to FIGURE 1, a capstan 10 is fixedly mounted and adapted to be driven by a shaft 12, which may be driven by suitable motor means (not illustrated). The shaft 12 is suitably mounted on a cylindrical support member 14 through suitable roller bearings 16 and 17. The capstan 12 includes a plurality of apertures 18 disposed about its periphery.

2

A magnetic tape 20 is adapted to be moved into engagement with the capstan 10 or pushed out of engagement therewith, and dependent upon whether a high or low fluid pressure is applied to the capstan. A recess 22 is provided between the cylindrical support member 14 and the capstan 10, as will be described. The recess 22 is disposed to receive fluid of relatively high or low pressure dependent upon whether or not it is desired to drive the tape 20 or maintain it stationary.

An electro-magnetic valve arrangement 24 includes a pair of coils 26 and 28 adapted to receive an electrical signal from terminals 30 and 32, respectively. The coils may be held within the frames of magnets 46 and 52, respectively, by epoxy or other suitable means. A metallic disc 34 is disposed to be moved to be attracted to one or the other coils 26 or 28, dependent upon the particular one actuated.

A source of high fluid pressure 36 is connected to a conduit 38 which leads into an outlet chamber 40. In like manner, a source of relatively low pressure, or vacuum, 42 is connected through a conduit 44 into the outlet chamber 40. The disc 34 is movable so as to block one or the other of the conduits 38 or 44.

When the disc 34 is in the upper position, as illustrated, the source of high pressure 36 is blocked. At the same time the source of low pressure 42 is unblocked causing the pressure in the chamber 40 and the recess 22 to be relatively low. Under these conditions, the magnetic tape 20 is drawn in so as to physically engage the capstan 10. This causes the tape to be moved along with the capstan, which may be motor driven through the shaft 12.

When the magnetic disc 34 is in the lower position, the source of low pressure 42 is blocked and the source of high pressure is unblocked. This causes the high fluid pressure to enter into the chamber 40, the recess 22 and the apertures 3 of the capstan 12. The relatively high pressure forces the tape 20 away from the capstan. Under these conditions, even though the capstan 12 may continue to be driven, the tape 20 will not be moved.

The coil 26 is associated with a magnet 46 which includes a pair of end pole pieces 48 and 50. Likewise, the coil 28 includes or is associated with a magnet 54 having end pole pieces 54 and 56.

The disc 34 is illustrated more clearly in FIGURE 2. The letters N and S represent different magnetic polarities. The disc 34 includes concentric regions about its axis which are permanently and oppositely magnetized with respect to each other. For example, the outer most concentric area is magnetized "S," representing a south pole. The next adjacent area is magnetized "N," representing a north pole. The inner-most area is magnetized "S," representing a south pole.

When the coil 26 receives electric current or is energized so that the end pole pieces 48 and 50 of the magnet 46 are north and south, respectively, the disc 34 will be attracted toward the magnet 46. At the same time, if desired, the coil 28 may be energized oppositely to that of the coil 26 so that the pieces 54 and 56 of the magnet 52 become magnetized south and north, respectively, to cause the disc 34 to be repelled away from the magnet 52.

The reverse situation wherein electrical signals opposite to those just mentioned are applied to the coils 26 and 28, is also true. In this case, the disc 34 may be attracted toward the magnet 52 and repelled away from the magnet 46.

In some cases, it may be only necessary or desirable to energize one of the coils 26 or 28 to maintain the disc 34 in its selected position. The amount of current applied to the coils will, of course, be dependent to some extent, upon the force of the fluid pressure which is blocked or unblocked.

3

While the disc 34 preferably should include concentric magnetized areas, in some cases a plain metal disc which is attracted by a magnetic field may prove satisfactory.

It is noted that the disc 34 disposed between the two magnets 46 and 52 is maintained permanently magnetized by the magnets. Thus, the disc 34 need never be re-magnetized.

In the embodiment of FIGURE 1, the disc 34 is made relatively light and designed to move only a relatively short distance between selected positions. Consequently, it may not always be necessary to provide separate means to guide the disc when it is moved from one position to another. In between the applications of electrical signals, disc 34 will remain suspended at one or the other electro-magnets 46 or 52.

It is seen that the valve described involves only a single moving part. This moving part is relatively light. Because of this, the reaction time of the valve to applied signals is extremely fast. Also, it is seen that the valve does not involve complicated or expensive elements.

Referring particularly to FIGURE 3, a slightly different form of valve arrangement involving the present invention is illustrated. The various polarities of magnets 57 and 59 and the disc 62 are marked N and S are the appropriate points to more clearly illustrate the operation already described. It is seen that the opposite poles of the disc 62 are attracted to the poles of the magnet 57 and repelled away from the poles of the magnet 59. Again the coils within the magnets may be secured with epoxy or other suitable material.

Of course, if signals are applied to the coils so that the pole pieces of the magnets 57 and 59 become opposite to that illustrated, the disc 62 will be in the opposite position and attracted to the lower magnet 59. Thus, the disc 62 may be quickly moved from one position to another by the application of the proper electrical signals to the coils.

Cylindrical tubes 58 and 60 are attached coaxially to the disc 62 by any suitable means. The tubes 58 and 60 are adapted to ride within the inner peripheries of outlet conduits 64 and 66, respectively. Slots 68 and 70 are provided in the cylindrical tubes 58 and 60, respectively, to permit the flow of fluid to the under side of a magnetic tape, such as discussed in connection with the arrangement illustrated in FIGURE 1.

The operation of the embodiment of FIGURE 3 is basically the same as that described in connection with FIGURE 1 and therefore will not be described in detail. The essential difference between the arrangements of FIGURE 1 and 3 is in the fact that cylindrical tubes are provided in FIGURE 3 to guide the movement of the magnetic disc 62.

What is claimed is:

1. A valve arrangement comprising a pair of inlets, at least one outlet, means for connecting said inlets to said outlet, a movable magnetized element disposed to block one of said inlets, said magnetized element including concentric magnetized areas in opposite polarity, and electro-magnetic means for selectively moving said element to block one or the other of said inlets.

2. A valve arrangement comprising sources of high and low fluid pressure, inlets, at least one outlet, means for connecting said inlets to said outlet, a movable magnetized element disposed to block one or the other of said inlets, said magnetized element including concentric

4

magnetized areas in opposite polarity, and electro-magnetic means for selectively moving said element to block one or the other of said inlets and to unblock the other of said inlets to apply the fluid pressure from the unblocked inlet to said outlet.

3. A valve arrangement comprising a pair of fluid inlets for relatively high and low pressure, at least one outlet, means for connecting said inlets to said outlet, a movable flat magnetized disc disposed to block one of said inlets, said magnetized disc including concentric magnetized areas in opposite polarity, a pair of electro-magnets disposed to move said flat magnetized disc when energized, and means for selectively energizing one of said electro-magnets to selectively move said flat magnetized disc to block one or the other of said inlets whereby either high or low fluid pressure is applied to said outlet.

4. In combination with a tape drive mechanism including a pneumatic capstan, a valve arrangement for selectively causing said tape to engage or disengage said capstan comprising a housing having a chamber, means for directing fluid from said chamber to said capstan, a pair of electro-magnets disposed within said housing, sources of high and low fluid pressure leading into said chamber, a movable metallic disc disposed within said chamber for selectively blocking one or the other of said sources of fluid pressure to prevent or permit fluid pressure from entering said chamber, said metallic disc including concentric magnetized areas in opposite polarity, and means for selectively applying an electrical signal to said electro-magnets to cause said disc to be moved to block one or the other of said sources.

5. In combination with a tape drive mechanism including a pneumatic capstan, a valve arrangement for selectively applying negative or positive fluid pressure to said tape to cause said tape to engage or disengage said capstan comprising a housing including a chamber, means for directing fluid from said chamber to said capstan, a pair of electro-magnets disposed within said housing, sources of high and low fluid pressure leading into said chamber, a pair of outlets leading from said sources of high and low fluid pressure, a movable magnetized metallic disc disposed within said chamber for selectively blocking one or the other sources of fluid pressure to prevent or permit fluid pressure from entering said chamber, guide means attached to said metallic disc disposed to ride in said pair of outlets to guide said metallic disc during the movement thereof, and means for selectively applying an electrical signal to said electro-magnets to cause said disc to be moved to block one or the other of said sources.

6. The invention as set forth in claim 5 wherein said magnetized metallic disc includes concentric areas magnetized in opposite directions.

References Cited by the Examiner

UNITED STATES PATENTS

2,860,850	11/1958	Rhodes et al.	251—141 X
2,954,911	10/1960	Baumeister et al.	226—95
3,120,943	2/1964	Donelan	251—139
3,151,795	10/1964	Gwillim	226—95
3,206,160	9/1965	Bennett	251—137 X

M. HENSON WOOD, JR., *Primary Examiner*.

ALLEN N. KNOWLES, *Examiner*.