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Feasey

[11] **3,794,151**

[45] **Feb. 26, 1974**

[54] **METHOD AND APPARATUS FOR CONTINUOUSLY SUPPLYING FLUID PRESSURE TO A PLURALITY OF FLUID DIRECTING MEMBERS**

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[73] Assignee: **Eastman Kodak Company,** Rochester, N.Y.

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[21] Appl. No.: **329,933**

[52] **U.S. Cl.** ..... **198/19,** 214/1 BS

[51] **Int. Cl.** **B65g**

[58] **Field of Search**.... 198/19; 214/1 BS; 271/74 R; 269/21; 51/110

[56] **References Cited**

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3,275,165	9/1966	Vedvik	214/1 BS
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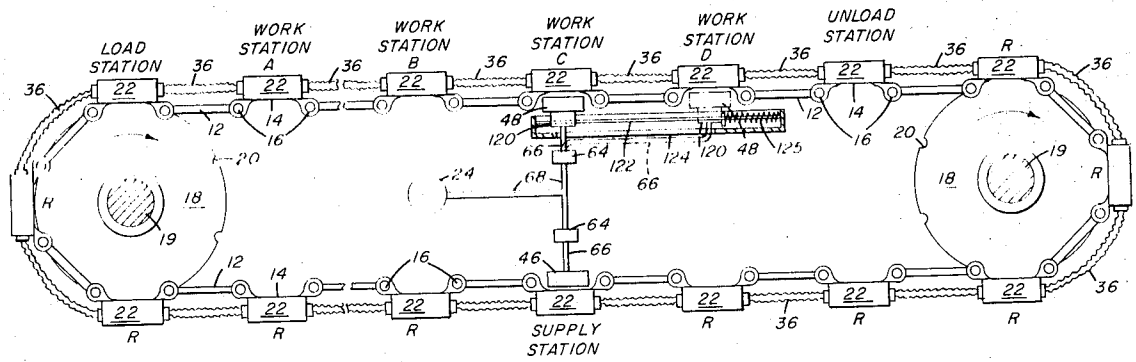
Primary Examiner—Evon C. Blunk

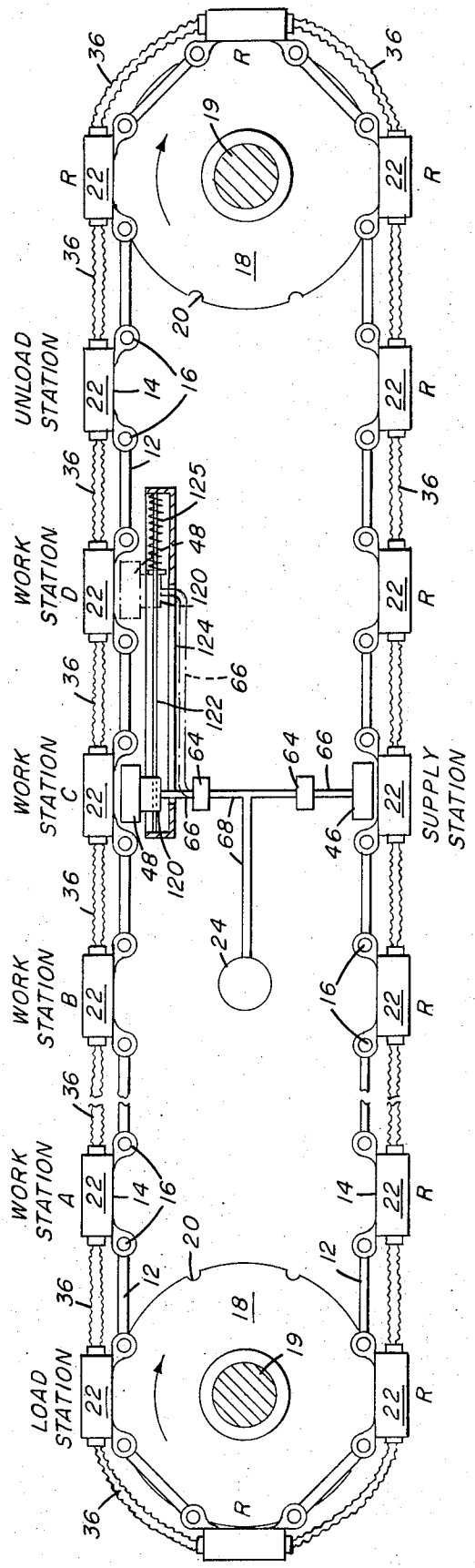
Assistant Examiner—Douglas D. Watts

[57] **ABSTRACT**

A fluid pressure supply system for continuously supplying fluid pressure to a plurality of independent, spaced apart, fluid directing members intermittently movable in unison between rest positions at various stations. A stationary valve connector located at a supply station is connectable to each of the fluid directing members in succession at the supply station for supplying fluid pressure to the members while at rest. Such pressure connection is broken to permit movement of the members in unison to succeeding rest positions. A movable valve connector located at a work station is connectable to a fluid directing member at rest at the work station for supplying fluid pressure to the members. The movable valve connector is movable along with the member to a succeeding rest position and work station to supply fluid pressure to the members while the stationary valve is disconnected and incapable of supplying fluid pressure to the members.

18 Claims, 7 Drawing Figures




LOAD STATION
WORK STATION A
WORK STATION B
WORK STATION C
WORK STATION D
UNLOAD STATION
SUPPLY STATION
R
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19
20
22
24
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120
122
124
125

FIG. 1

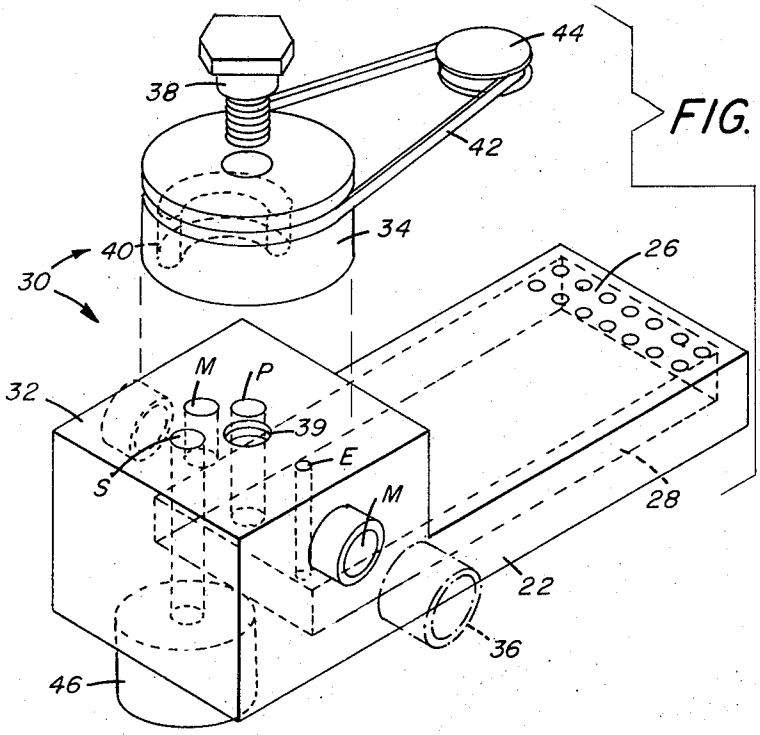

FIG. 2

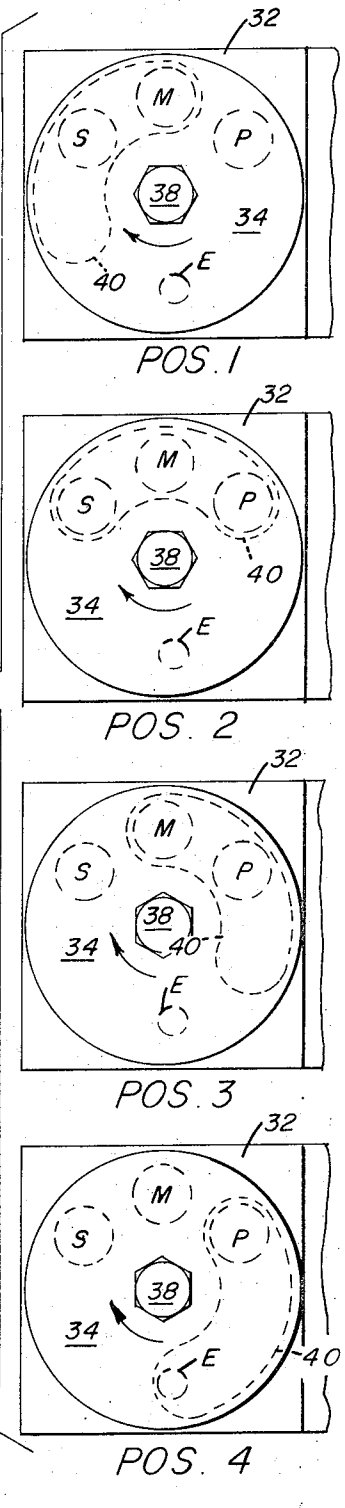

FIG. 3

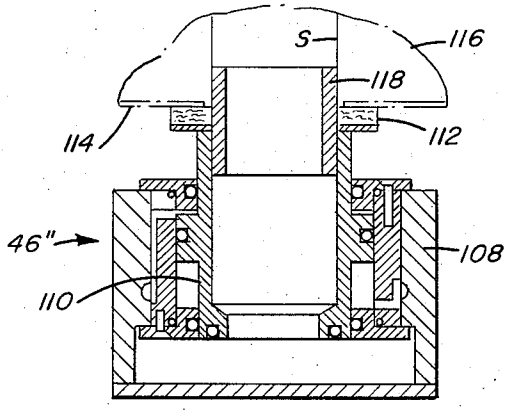

FIG. 6

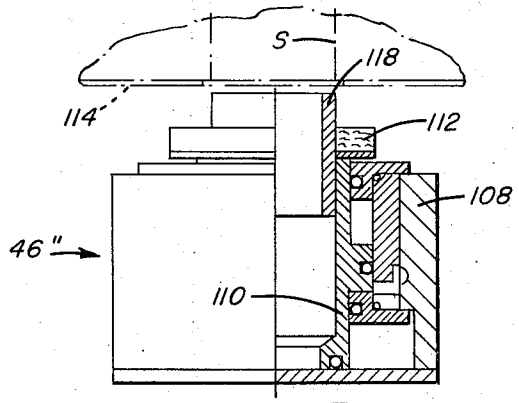

FIG. 7

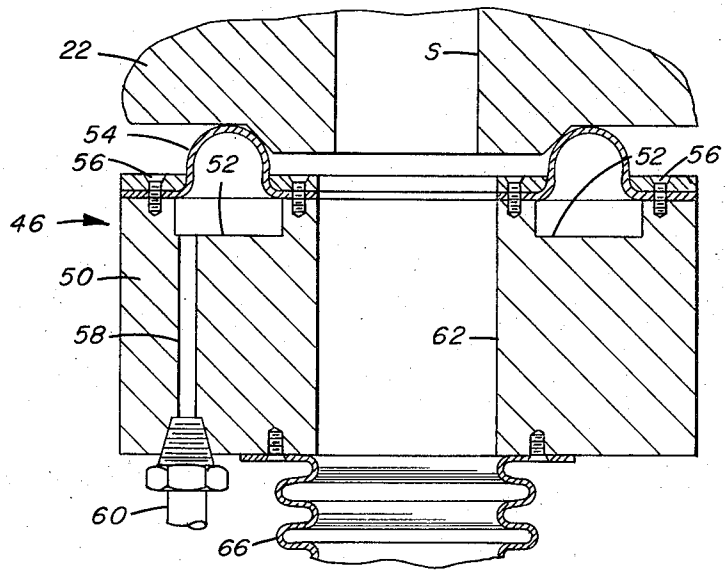
22
S
54
56
52
52
56
46
50
58
62
60
66

FIG. 4

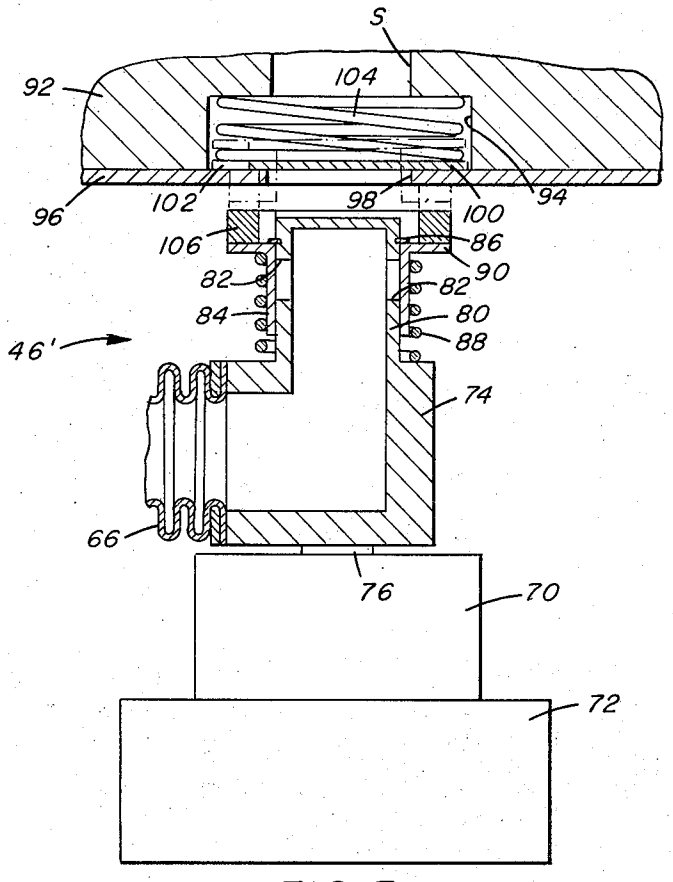
S
92
104
96
102
98
100
94
106
86
82
90
82
84
80
46'
88
74
66
76
70
72

FIG. 5

METHOD AND APPARATUS FOR CONTINUOUSLY SUPPLYING FLUID PRESSURE TO A PLURALITY OF FLUID DIRECTING MEMBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to fluid pressure supply systems, and more specifically to an improved fluid pressure supply system for supplying fluid pressure continuously to a plurality of spaced apart, fluid directing members.

Description of the Prior Art

Pressure supply systems for supplying fluid pressure such as a negative fluid pressure or vacuum to one or more fluid directing members such as carrier suction members are generally well known in the art, of which U. S. Pat. No. 1,815,547 is exemplary. In this patent, a plurality of carrier suction members in the form of suction boxes are mounted on an endless conveyor chain, and slidably transported over a vacuum chamber connected to a source of negative pressure or vacuum. As the conveyor is intermittently moved between rest positions, a plurality of the suction boxes are continuously in register with the vacuum chamber, and ports in the bottom of the registering boxes are aligned with a slot in the vacuum chamber to subject the boxes to a vacuum. Each of the suction boxes has a perforated top wall through which air is sucked by the vacuum, when actuated, to releasably hold an article on the top wall. One of the disadvantages of such a system is that a sliding connection is provided between the suction boxes and the vacuum chamber which provides a source of pressure leakage.

It is also known to selectively control vacuum at a plurality of stations in vacuum drum mechanisms by spring loading a plastic manifold containing the required passages against a metal plate containing the required porting for controlling the vacuum at a desired station. Such a system is effective where the number of stations are limited and located along a circular path of small length. However, such a system is impractical where the path length is great and a large number of stations are provided as in a conveyor system. One of the problems in conveyor systems having a large number of work stations is that the manifold and valve control system becomes excessively large with an excessive number of hoses or pipes leading from the control system to the fluid directing members. These and other problems of the prior art mechanisms are solved by applicant's improved continuous fluid pressure supply system of this invention.

SUMMARY OF THE INVENTION

In accordance with a preferred method of this invention, fluid pressure such as a negative fluid pressure or vacuum is continuously supplied to a plurality of fluid directing members such as carrier suction members which are movable in unison between rest positions at various stations. To accomplish the method, a source of pressure such as a negative pressure or vacuum is provided, and stationary valve means is located at a pressure supply station for sequentially connecting and disconnecting the pressure source to each of the fluid directing or suction members in succession when at rest at the supply station. Movable valve means located at a work station is provided for connecting the pressure source to each of the members in succession when at rest at the work station. The stationary and movable valve means are initially connected to the suction members when at rest, then the stationary valve means disconnected from the member at the supply station, and the pressure connection between the movable valve means and its member retained during movement of the member from its rest position at one work station to a succeeding rest position at a succeeding work station. Accordingly, while the stationary valve means is disconnected, which occurs during movement of the members, pressure is supplied to the members through the movable valve means. When the stationary valve means is reconnected at the supply station to supply pressure to the members at rest, the movable valve means is disconnected and returned to its initial work station.

In order to practice the inventive method, an improved fluid pressure supply system in accordance with a preferred embodiment of the invention is disclosed for supplying a fluid pressure such as a negative fluid pressure or vacuum to one or more of a plurality of carrier suction members movable in unison by any suitable means past a plurality of spaced work stations. Pressure is supplied to all of the members through a flexible manifold interconnecting them. A stationary valve connector is located at a supply station, at which each of the members is brought to rest in succession, for releasably connecting the source of pressure to the manifold. A movable valve connector is located at a first work station, at which each of the members is brought to rest in succession, for releasably connecting the source of pressure to the member and manifold at that station. The movable valve connector moves along with the member as the conveyor and members are indexed one position to a succeeding second work station to continue supplying pressure to the manifold and members while the stationary valve connector is disconnected from the manifold. After the stationary valve connector is releasably secured to a succeeding member at the supply station, the movable valve connector is returned from the second station to its normal rest position at the first work station for securement to the succeeding member.

In a more specific modification of the invention, the carrier suction members are mounted on an endless conveyor chain which is indexed in step-by-step fashion through the stations by any suitable mechanism. The flexible manifold comprises a plurality of flexible hose members interconnecting the members to form an endless manifold. Each of the stationary and movable valve connectors is provided with sealing means for sealingly engaging a suction member at the supply and first work station respectively.

One of the primary advantages of the improved fluid pressure supply system is to continuously supply fluid pressure to a plurality of indexable carrier suction members with a mechanism containing few parts and with a minimum of pressure leakage. The system has the further advantage of being of simple design and construction, thoroughly reliable and efficient in operation, and economical to manufacture.

It is, accordingly, one of the objects of the present invention to provide an improved fluid pressure supply system in which the supply of fluid pressure can be selectively connected to one or more carrier suction

members on an indexing conveyor with a minimum of mechanical parts and pressure leakage.

Another object of the invention is to provide an improved fluid pressure supply system in which the pressure may be selectively connected to one or more intermittently transported fluid directing members without interrupting the supply of fluid pressure, or using slip joint connections.

The invention and its objects and advantages will become more apparent from the detailed description of the preferred embodiment presented below.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of the preferred embodiment presented below, reference is made to the accompanying drawings, in which:

FIG. 1 is a schematic side elevational view of a pressure supply system of this invention;

FIG. 2 is an exploded, perspective view illustrating a valve mounted on a carrier suction member;

FIG. 3 is a plan view illustrating four different positions of the valve of FIG. 2;

FIG. 4 (Sheet 3) is a segmental view in section illustrating a valve connector in sealing engagement with the valve on the suction member;

FIG. 5 (Sheet 3) is a segmental view in section showing another modification of a valve connector;

FIG. 6 (Sheet 2) is a segmental view illustrating still another modification of a valve connector; and

FIG. 7 (Sheet 2) is a view similar to FIG. 6 illustrating the valve connector of FIG. 6 in a retracted position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Because fluid pressure supply systems are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. Conveyor and valve elements not specifically shown or described herein should be understood to be selectable from those known in the art.

With reference to FIG. 1 in the drawings, a conveyor of known type is illustrated comprising an endless chain **10** of a predetermined width formed by a plurality of links **12, 14** pivotally secured together by stub shafts **16.** The chain **10** is mounted for rotation on pairs of axially spaced sprockets **18,** in which each pair of sprockets is secured to a rotatably supported shaft **19.** Each pair of sprockets **18** is provided with peripheral notches **20** for receiving shafts **16** of chain **10** for driving the chain upon rotation of the shafts and sprockets. Any suitable drive mechanism, not shown, may be provided for intermittently driving one or more of the shafts **19** and sprockets **18** for advancing chain **10** in a step-by-step fashion. A plurality of fluid pressure directing members such as carrier suction platens **22** (FIG. 2) are mounted on links **14** intermediate the ends thereof in spaced apart relation for receiving a work piece such as a cartridge or the like, not shown. A plurality of stations are provided adjacent the periphery of the chain such as a load station at which the cartridge is placed on a platen, a plurality of work stations A, B, C, and D at which some operation is performed on the cartridge, a cartridge unload station and a fluid pressure supply station at which a pressure source **24** can be connected to the platens **22.** The chain drive mechanism can be provided with any suitable commercially available logic control means for intermittently moving the chain between rest positions at which the platens are in register with the stations. In known work handling conveyor systems of this type, the pressure source **24** to which the fluid pressure directing member or platen **22** responds is a negative pressure or vacuum, and the platen **22,** as best illustrated in FIG. **2,** is provided with a perforated work surface **26** connected to a passageway **28** through which air may be drawn by any suitable means such as a vacuum pump to provide a suction at work surface **26** for releasably holding an article thereon.

In a conveyor system of the type described, it is desirable to have the platens **22** at the load and work stations connected to pressure source **24** to provide a negative pressure or vacuum to the platen. At the rest positions designated R it is desirable to have the platens connected to atmosphere and the fluid pressure supply blocked. It is also desirable to have the capability at any one of the work stations to manually turn off the fluid pressure supply to release the work piece for inspection, discharge, or the like. To accomplish these and other objectives, a valve **30** is provided on each of the platens **22,** as best illustrated in exploded form in FIG. **2,** comprising a valve body **32** having a T-shaped manifold port designated M with one horizontal leg extending completely through a valve body **32** and a vertical leg extending from the horizontal leg to the top surface of valve body **32.** The valve body **32** further has a vertical supply port designated S extending completely through valve body **32** and platen **22,** and a vertically extending platen port designated P having one end connected to platen passageway **28** and the opposite end extending to the top surface of valve body **32.** The horizontal legs of the manifold ports M of each pair of valve bodies are connected together by known means to a flexible hose **36** (FIG. 1) of any suitable commercially available type, such as a plastic bellows hose, to provide a continuous hose manifold **36,** M interconnecting all of the valve bodies. Each of the platen valves **30** is further provided with a valve actuator **34** rotatably mounted about a shoulder screw **38** secured to a threaded bore **39** on the top surface of valve body **32.** Any suitable seal ring, not shown, is preferably interposed between the contacting surface of valve actuator **34** and valve body **32,** adjacent the outer periphery of actuator **34.** The valve actuator **34** has a crescent shaped slot **40** on the surface thereof in engagement with the top surface of valve body **32,** and movable into register with one or more of the supply, manifold and platen ports S, M and P respectively. The valve actuator **34** may be rotated by any suitable drive means such as a belt **42** trained over a groove in the valve actuator **34,** and a pulley **44** which is driven by any suitable drive means under the control of any suitable logic system. The valve actuator **34** is movable between four positions as seen in FIG. **3,** and retained in any selected position by any suitable detent means or the like, not shown. In the first position, the supply and manifold ports S, M, respectively are connected together for connecting the fluid pressure source to the hose manifold **36,** M. In the second position, the supply, manifold and platen ports S, M, and P respectively are all connected together for connecting the source of pressure to the hose manifold **36,** M and to platen **22.** In the third position of the actuator, the manifold and platen ports M, P respectively are connected together for connecting hose manifold **36,** M to platen **22.** In the fourth

position, platen port P is connected to an exhaust port designated E extending from passageway **28** to the upper surface of valve body **32** for deactivating or removing any pressure from the platen by connecting the perforated platen surface **26** to atmosphere.

The fluid pressure supply system is further provided with any suitable source of fluid pressure **24** as a vacuum pump for providing a negative pressure source. The pressure source **24** is connected to platen valves **30** through stationary and movable valve connector **46, 48** respectively. Since the stationary and movable valve connectors **46, 48** respectively can be and normally are substantially identical, only embodiments of one of such connectors will be described in detail.

In the embodiment of the valve connector **46** illustrated in FIG. **4** (Sheet 3), a valve body **50** is provided having an annular groove **52** on one surface thereof over which a flexible member **54** such as an expandable membrane of any suitable material such as rubber is secured by screws **56** or the like. The groove **52** is connected through a port **58** to an air supply line **60** for introducing air through any suitable valve to annular groove **52** for inflating the flexible membrane **54** causing it to sealingly engage a circular raised lower surface on platen **22** underlying valve body **32** (FIG. **2**). The valve body **50** has a central opening **62** register with supply port S in platen valve body **32**, and central opening **62** is preferably connected to any suitable vacuum supply valve **64** (FIG. **1**) by any suitable tubing **66** or piping such as a flexible hose. The supply valve **64** is, in turn, connected to the source of pressure **24** by any suitable tubing **68** as illustrated in FIG. **1.**

In another embodiment of a valve connector **46'** illustrated in FIG. **5**, an air cylinder **70** is provided mounted on a support **72** and having a hollow valve body **74** secured to the reciprocally movable cylinder rod **76.** The valve body **74** is connected by flexible hose **66** or the like to fluid pressure source **24** through any suitable fluid supply valve **64.** The valve body **74** is provided with a hollow stem **80** having ports **82** covered by an annular cover **84** slidably mounted on stem **80** and urged against a stop ring **86** on the stem by a helical spring **88** interposed between a shoulder of valve body **74** and a rim **90** on cover **84.** The platen valve body **92** is provided with an annular recess **94** at one end of supply port S, and a plate **96** secured to valve body **92** covering recess **94** and having an opening **98** therein complementary to stem **80** for receiving the stem when inserted therein. A disc **100** having a grooved or fluted periphery **102** is mounted in recess **94** and adjacent plate **96** and is urged thereagainst by a helical spring **104.** When it is desired to releasably secure valve connector **46'** to platen valve **92,** the air cylinder **70** is actuated by the logic control system causing stem **80** to be moved axially outwardly causing a seal **106** on rim **90** to engage plate **96** as seen dotted in FIG. **5** for sealing valve bodies **74, 92** together. The stem **80** engages and urges disc **100** upwardly against the bias of spring **104** uncovering ports **82** for connecting pressure source **24** through hoses **66, 68,** valve **64,** hollow valve body **74** and hollow stem **80** to the supply port S.

In still another embodiment of valve connector **46''** illustrated in FIGS. **6** and **7** (Sheet 2), a valve body **108** is provided with a built-in reciprocally movable, air cylinder **110** which is movable from a normal retracted position (FIG. **7**) to an engaged position (FIG. **6**) in which a seal **112** secured to cylinder **110** engages a plate **114** on a platen valve body **116,** and tubular end **118** on cylinder **110** is inserted in supply port S to connect the supply source **24** to supply port S. Although there is an instant when the main vacuum supply **24** is open to atmosphere during shifting of air cylinder **110,** it is felt that the pressure loss would be inconsequential. A commercial valve **64** could be used in the supply line to effect closing of the fluid supply if this were found to be necessary.

As best illustrated in FIG. **1,** one of the aforementioned valve connectors **46, 46'** or **46''** is mounted on any suitable frame or the like, not shown, in alignment or register with one of the platens at the supply station to form a stationary valve connector. Another valve connector **48** similar to one of the connectors **46, 46'** or **46''** is secured to a carriage **120** slidably mounted on rods **122** or the like supported by a platform **124** to form a movable or shuttle valve connector. The valve connector **48** is slidably movable between a first position, in which the valve connector is in register or alignment with one of the platens **22** at work station C and a second position, in which the valve connector **48** is in register and alignment with the next succeeding work station D. Any suitable means may be interposed between valve connector **48** and platform **124,** such as a resilient bellows type tubing or spring **125** for returning valve connector **48** to its initial position. The valve connectors **48** may be directly connected to the source of fluid pressure **24** through any suitable hose tubing **66** or the like which is of sufficient length to permit movement of valve connector **48** between stations C and D. Any suitable commercially available valve **64** may be interposed between valve connector **48** and fluid pressure source **24.**

In the operation of this invention, let us assume that the conveyor **10** is in the position illustrated in FIG. **1** with the stationary and shuttle valve connectors **46, 48** respectively in sealing engagement with the platen valves **32** at the fluid pressure supply station and work station C respectively. The platen valve actuators **34** at the unload station and rest positions R are moved to their fourth position (FIG. **3**) exhausting the platens **22** to atmosphere. Valve actuator **34** at the fluid pressure supply station is moved from its previous fourth position to its first position connecting fluid pressure source **24** to hose manifold **36,** M. The platen actuator **34** at the load station is moved from its previous forth position to its third position connecting hose manifold M to platen port P causing a suction to be generated at the platen work surface **26** for holding an article placed thereon. The platen valve actuators **34** at work stations A and B are retained in their previous third positions generating suction at the platen work surfaces **26** for holding articles in various stages of operation. The platen valve actuator **34** at work station C is moved from its previous third position to its second position for connecting pressure source **24** to hose manifold and platen port M, P respectively for holding a work article at station C. Platen valve actuator **34** at work station D is moved from its previous second position to its third position generating suction at work surface **26** for holding an article. After the work has been performed at the various work stations, the sealing engagement between stationary valve connector **46** and platen valve **32** is broken, and conveyor **10** is indexed one step to place the work platens **22** at the next succeeding stations. As soon as stationary valve connector **46** is disconnected

from platen **22**, the connection between pressure source **24** and hose manifold **36**, M is broken. However, the pressure source connection to hose manifold M is maintained through shuttle valve connector **48** and actuator **34** in its second position at work station C, and is retained as shuttle valve **48** moves along with platen **22** during the indexing of conveyor **10**. Accordingly, the pressure source **24** is connected to hose manifold **36**, M during the operation of conveyor **10** to continue to supply pressure to platens **22**. When the conveyor has completed its indexing step and shuttle valve **48** is in the dotted position at work station D as shown in FIG. **1**, the stationary valve connector **46** and platen valve **32** are coupled together at the fluid pressure supply station, and valve actuator **34** at the supply station moved from its previous fourth position to its first position. Since the pressure source **24** is now connected to hose manifold **36**, M through supply port S at the fluid pressure supply station, shuttle valve connector **48** may be disconnected from platen valve **32** at work station D, and returned to its normal position for coupling to a new platen **22** at work station C. The platen valve actuator **34** at work station C is moved from its previous third position to its second position, and platen valve actuator **34** at work station D is moved from its previous second position to its third position. The sequence of operation is repeated for each indexing of the conveyor.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove.

I claim:

1. In a fluid pressure supply system for continuously supplying a source of fluid pressure to a plurality of intermittently movable members, the combination comprising:

a plurality of members intermittently movable in unison between rest positions;

a source of fluid pressure;

manifold means interconnecting said members and through which fluid pressure is supplied to all of said members;

stationary means for connecting said source of pressure to said manifold means at one of said rest positions and disconnecting said source of pressure during movement of said members between rest positions; and

movable means for connecting said source of pressure to said manifold means at another of said rest positions and moving with said member to the succeeding rest position to continue the pressure connection while said stationary means is disconnected.

2. The invention according to claim **1** and further including an endless conveyor along which said members are mounted in spaced apart relation.

3. The invention according to claim **1** wherein said stationary connecting means comprises a valve connector adjacent one of said rest positions.

4. The invention according to claim **3** wherein said valve connector is provided with sealing means for sealing and unsealing said valve connector to each of said members at said one rest position.

5. The invention according to claim **4** wherein said sealing means comprises an inflatable flexible membrane.

6. The invention according to claim **1** wherein said stationary connecting means comprises a stationary valve connector adjacent said one rest position, and said movable connecting means comprises a movable valve connector.

7. The invention according to claim **6** wherein each of said stationary and movable valve connectors is provided with sealing means for sealing said valve connector to a member at said one and another rest positions respectively.

8. The invention according to claim **6** wherein said movable valve connector is slidably mounted adjacent said another and succeeding rest positions for reciprocal movement therebetween.

9. In a fluid pressure supply system for continuously supplying a source of fluid pressure to a plurality of intermittently movable platens, the combination comprising;

an endless conveyor;

a plurality of spaced apart platens mounted on said conveyor, and each platen having a passageway leading to a perforated surface;

means for intermittently driving said conveyor in unison between rest positions to successively position said platens at said rest positions;

a source of fluid pressure;

first valve means on each of said platens connectable to said source of fluid pressure and said passageway;

manifold means for connecting each of said first valve means to the next adjacent first valve means to form an endless manifold, said first valve means being movable to a first valve position for fluidly connecting said source of pressure to said manifold and a second valve position for fluidly connecting said source of pressure to said manifold and said passageway;

stationary valve means positioned adjacent one of said rest positions for connecting said source of fluid pressure to each of said first valve means in succession at said one rest position and disconnecting said source of pressure from said first valve means during movement of said platen between rest positions; and

movable valve means positioned adjacent another of said rest positions for connecting said source of fluid pressure to each of said first valve means in succession at said another rest position, and being movable with each of said first valve means and platens to the next succeeding rest position to continue the fluid pressure connection while said stationary valve means is disconnected.

10. The invention according to claim **9** wherein means are provided for returning said movable valve means to said another rest position after said stationary valve means is connected to said first valve means.

11. The invention according to claim **9** wherein said first valve means on said platen at said one rest position is moved to said first valve position, and said first valve means on said platen at another rest position is moved to said second valve position.

12. The invention according to claim **9** wherein each of said stationary and movable valve means is provided with sealing means for sealing and unsealing said sta-

tionary and movable valve means to said first valve means at said one and another stations respectively.

13. The invention according to claim **9** wherein each of said first valve means is further movable to a third valve position connecting said passageway to said manifold means, and a fourth valve position connecting said passageway to atmosphere.

14. The invention according to claim **9** wherein said fluid pressure is a negative fluid pressure to generate suction on said perforated surface, said manifold means comprises a plurality of flexible hose members interconnecting said first valve means to form an endless manifold, said stationary valve means is a stationary valve connector, and said movable valve means is a movable valve connector.

15. The invention according to claim **14** wherein each of said stationary and movable valve connectors is provided with sealing means for sealing said valve connector to said first valve means at said one and another stations respectively.

16. The invention according to claim **14** wherein said movable valve connector is slidably mounted adjacent said another and succeeding rest positions for reciprocal movement therebetween.

17. A method for continuously supplying pressure to a plurality of fluid pressure directing members movable in unison between rest positions, comprising the steps of:

providing a source of fluid pressure;

providing stationary conduit and valve means for sequentially connecting and disconnecting said source of fluid pressure to each of said fluid pressure directing members in succession at a first rest position thereof;

providing movable conduit and valve means for connecting said source of fluid pressure to each of said fluid pressure directing members in succession at a second rest position thereof;

substantially simultaneously connecting said stationary and movable conduit and valve means to said fluid pressure directing members at said first and second rest positions respectively; then

disconnecting said stationary conduit and valve means from said fluid pressure directing member at said first position; and then

moving said fluid pressure directing members to succeeding rest positions, and

retaining said pressure connection between said fluid pressure directing member and said movable conduit and valve means at said second rest position during movement of said fluid pressure directing members to said succeeding rest positions.

18. The method according to claim **17** comprising the additional steps of reconnecting said stationary conduit and valve means to said fluid pressure directing member at said first rest position, and then returning said movable conduit and valve means from said succeeding rest position to said second rest position.

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