May 30, 1967 J. E. JONES 3,322,255

MULTI-ELEMENT PNEUMATIC ACTUATOR

Filed Jan. 24, 1966

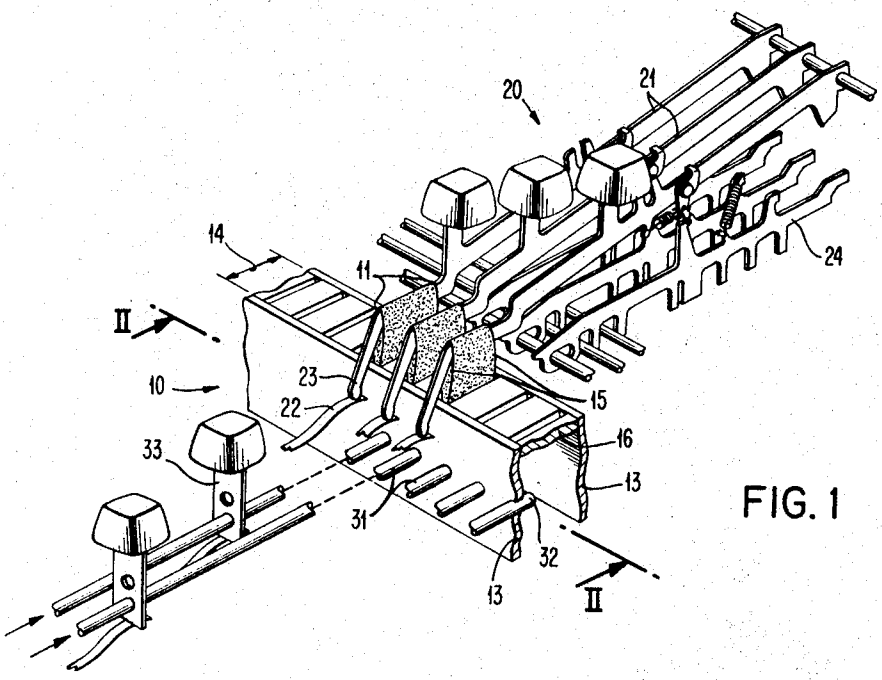



FIG. 1

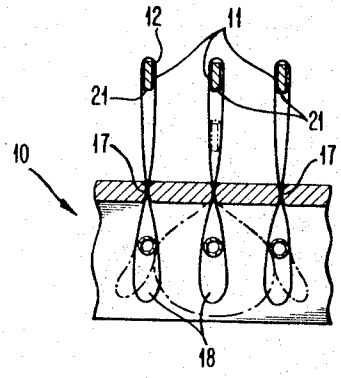



FIG. 2

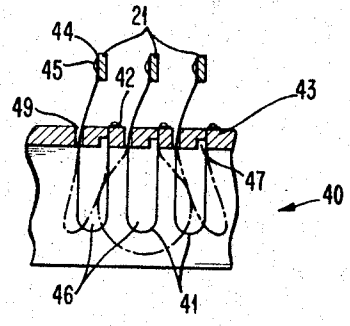



FIG. 3

INVENTOR.
JOHN E. JONES

BY E. Ronald Coffman

ATTORNEY.

United States Patent Office 3,322,255
Patented May 30, 1967



3,322,255

# MULTI-ELEMENT PNEUMATIC ACTUATOR

John Earle Jones, Lexington, Ky., assignor to International Business Machines Corporation, Armonk, N.Y., a corporation of New York

Filed Jan. 24, 1966, Ser. No. 522,614
7 Claims. (Cl. 197—19)

This simple and inexpensive actuator mechanism is particularly suited for driving a number of independently operable, closely adjacent devices, such as typewriter keylevers.

Key operated mechanisms such as typewriters, pianos, etc., are often automated by the provision of individual actuators to operate the several keylevers in response to record data. Wherever a large number of keys are involved, the manufacturing and assembly cost of the individual actuators becomes a significant consideration. Electromechanical actuators, such as solenoids, have been employed but are relatively expensive. Traditionally, player pianos and automatic typewriters have employed pneumatic-mechanical transducers as a low cost alternative to solenoid actuators.

Transduction of a pneumatic signal into an actuating force is accomplished most efficiently by an expansible chamber motor. Such motors conventionally appear as piston cylinder units, diaphragms, and bellows. Recently, thin tapes as described in U.S. patent application Ser. No. 421,032, entitled, "Monostable Fluid Logic Element and Actuator," filed Dec. 24, 1964, by William F. Voit, Jr., have been proposed to provide a novel version of an expansible chamber motor that is characterized by a very fast response due to the extremely low mass of the moving tape member.

Where space is at a premium, as in typewriters having plural keylevers spaced on standard 3/16 inch centers and having positive limitations on vertical machine height, it is difficult to integrate totally independent actuators into existing design limitations.

Accordingly, an object of my invention has been to devise a machine operator that is particularly suited for operation of individual load devices located in a closely confined space.

Another object of my invention has been to devise an operator of simple construction having adequate reliability and operating speed to drive moderate load devices while maintaining an efficient materials and assembly cost.

While the objects of my invention are directed to an actuator bank for operating a plurality of closely adjacent members, attention is called to application Ser. No. 522,613 entitled, "Pneumatic Actuator," filed by J. C. Lambiotte on Jan. 24, 1966, the objects of which are directed to an individual pneumatic actuator for use where space between specific operated mechanisms is less significant.

One phase of my invention involves the provision of a plurality of closely adjacent flexible tape members, each forming an independent loop. All loops are held between common parallel sidewalls and define boundary portions of individual expansible chambers therewithin. The single pair of sidewalls define further portions of the chamber boundaries. The individual loops can be spaced as close together as any independently operable mechanical devices which they may be required to operate. The chambers formed by the individual loops are pressurized from independent fluid signals, and expand when pressurized to occupy the space of several adjacent unexpanded loops. The efficient use of the available space is thus apparent.

These and other objects, features, and advantages of my invention will be apparent to those skilled in the art upon reading the following more specific description of



a preferred embodiment of my invention wherein specific reference is made to the accompanying drawings, of which:

FIGURE 1 is a partial perspective view of a portion of a typewriter, assembled with an operator constructed in accordance with a preferred embodiment of my invention;

FIGURE 2 is a front vertical cross-sectional view of the operator shown in FIGURE 1 taken along lines II—II thereof; and

FIGURE 3 is a front vertical cross-sectional view similar to that of FIGURE 2, but showing a modified version of my invention.

Referring now more specifically to the drawings, in FIGURES 1 and 2 there is shown a keyboard operator or actuator bank **10**, including a plurality of independent, flexible actuator tape loops **11**. Each loop **11** is connected in a force transmitting relationship by its inner surface portion **12** (FIGURE 2) to an individual keylever **21** of a typewriter **20**, such as that disclosed in U.S. Patent 2,919,002, entitled, "Selection Mechanism for a Single Printing Element Typewriter," issued to L. E. Palmer, Dec. 29, 1959. The keylevers or independently operable load devices **21** are biased upwardly to their non-operated position by leaf springs **22** that engage tail portions **23** thereof. Each keylever operates an associated print character selection interposer **24**. The keylevers **21** are closely spaced to provide a compact keyboard for manual operation. The spacing between adjacent key levers usually is a standard 3/16 inch between centers.

The tape loops **11** are suspended between a pair of substantially parallel side walls **13** that are spaced a distance **14** substantially equal to the width of the tape loops **11** as defined by their parallel side edges **15** to form an effective fluid seal. Each tape loop thus provides a movable wall defining a portion of an expansible chamber boundary. A top wall or reaction member **16** is supported between the side walls **13** and is formed with individual restricted slots **17** for receiving the tape loops **11**. The edges of slots **17** engage laterally opposed outer surface portions of the tape loops **11** to form an effective seal therebetween to indirectly enclose the chamber boundary portion defined by the loops and thereby create an effectively closed pressurizeable expansible chamber **18** within each loop.

A plurality of independent signal input conduits or inlets **31**, for receiving superambient pressure fluid, are individually associated with the tape loops **11** for creating an actuating pressure within a selected expansible chamber **18**. The input conduits **31** each have an extension **32** projecting into the associated tape loops **11** to prevent misalignment therebetween which could cause a malfunction. The conduits **31** are controlled by any convenient data input device, such as selectively activatable spring-biased key valves **33**. A selected chamber **18** expands from its normal position, shown in full lines, causing a reaction between the tape loops **11** and the wall **16** at the edges of slot **17**. The tape loop **11** is moved downward to the broken line position shown in FIGURE 2, thereby actuating its associated key lever **21**.

When a tape loop **11** is in its actuated or broken line position, as shown in FIGURE 2, adjacent tape loops **11** are merely deflected, as shown by the chain lines. In this manner the tapes can be packed closely together without mutual interference. The expansible chamber **18** leaks sufficiently that upon termination of a pressure signal, residual pneumatic forces are dissipated and the spring **22** restores the associated keylever **21** and the tape loops **11** to their original or normal positions.

A modified operator **40** according to my invention is shown in FIGURE 3. Independent flexible tape loops **41**

are formed from elongated strips anchored at one end 42 to a stationary top wall or reaction member 43 of the operator and connected to keylevers 21 at their other ends 44 by rivets 45. A pair of parallel side walls (not shown) like 13 of FIGURE 1, form expansible, pressurizeable chambers 46 within the tape loops 41. Signal fluid is introduced by conduits 47 conveniently formed in the stationary top wall 43, and which extend within the tape loops 41. The inner surface 48 of the tapes 15 slidably engages the edges of slot 49 in the top wall 43 which directly encloses the boundary portion of the chambers 46 defined by the tape loops 41.

This modification of my invention has the advantage of requiring lower friction to provide a sealed chamber, but has the disadvantage of generating only half as much force per unit volume change. Also, it is somewhat more difficult to assemble than the embodiment shown in FIGURES 1 and 2. Operation, however, is the same in that pressurization of an expansible chamber 46 causes inflation as shown in the broken lines and takes advantage of the flexibility of its neighbors to achieve compactness inherent to my invention.

Those skilled in the art will recognize that I have provided a particularly simple and inherently compact machine operator or actuator bank that is particularly suited for operating a plurality of closely adjacent mechanical members.

While some specific preferred embodiments have been shown herein for purposes of illustration, and in compliance with statutory requirements, it will be understood that modifications, deletions, and additions can be made without departing from the scope and spirit of my invention as defined by the appended claims.

I claim:

1. An operator for a plurality of independently operable load devices and including a plurality of operably independent, pressurizeable, expansible boundary chambers and fluid inlet means coperating therewith, wherein the improvement comprises:

a plurality of independent flexible tapes, each defining a loop having a surface portion bounded by substantially parallel side edges and each defining a portion of one of the chamber boundaries,

means for operatively connecting each of said tapes in force transmitting relationship to respective ones of said plurality of load devices,

a pair of substantially parallel sidewalls common to all said tape loops and embracing the side edges thereof, said pair of sidewalls forming additional portions of the chamber boundaries, and

a stationary reaction member slidably engaging said surface portion of each of said tape loops to enclose the chamber boundary portion defined thereby.

2. An operator as defined in claim 1 wherein the fluid inlet means include the further improvement which comprises individual conduits associated with each of said loops and projecting into the interior thereof to prevent disorientation of said loops relative to said conduits.



3. An operator as defined in claim 1 wherein each of said loops have a normal position when not pressurized and an expanded position when pressurized, the spacing between adjacent loops being sufficiently small that each loop, when in its expanded position, deflects at least one adjacent loop from its normal position.

4. An operator as defined in claim 1 wherein each of said loops is formed of a strip having opposed ends, one of said opposed ends of each strip being secured to said reaction member.

5. A machine having independently operable load devices in combination with an operator therefor, said operator including a plurality of operably independent pressurizeable, expansible boundary chambers, wherein the improvement comprises:

a plurality of independent flexible tapes each defining a loop having a surface portion bounded by substantially parallel side edges and each defining a portion of one of the chamber boundaries, each of said tape loops being operatively connected in force transmitting relationship to respective ones of said plurality of load devices,

a pair of substantially parallel side walls common to all said tape loops and embracing the side edges thereof, said pair of sidewalls forming addiitonal portions of the chamber boundaries,

a stationary reaction member slidably engaging said surface portion of each of said tape loops to enclose the chamber boundary portion defined thereby, and

selectively activatable means for creating a fluid pressure within each of said chambers that is greater than the pressure outside thereof.

6. A machine as defined in claim 5 wherein said independently operable load devices comprise character print selection means of a typewriter.

7. A machine as defined in claim 6 wherein each of said loops have a normal position when its associated pressurizing means is inactive and an expanded position when its associated pressurizing means is active, the spacing between adjacent loops being sufficiently small that each loop, when in its expanded position, deflects at least one adjacent loop from its normal position.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 848,207 | 3/1897 | Rodesch | 84—29 |
| 1,003,279 | 9/1911 | MacArthur | 84—50 |
| 1,005,793 | 10/1911 | Arkinson | 84—50 |
| 1,842,883 | 1/1932 | Swanson | 197—19 |
| 2,795,668 | 6/1957 | Puckett | 200—81 |
| 2,991,763 | 7/1961 | Marette | 92—89 X |



ROBERT E. PULFREY, *Primary Examiner.*

E. S. BURR, *Assistant Examiner.*