

Dec. 2, 1969

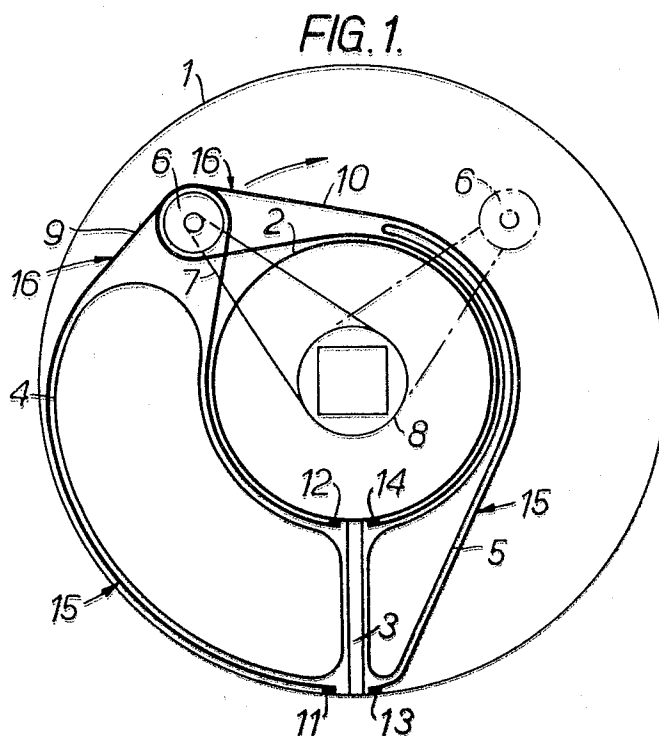
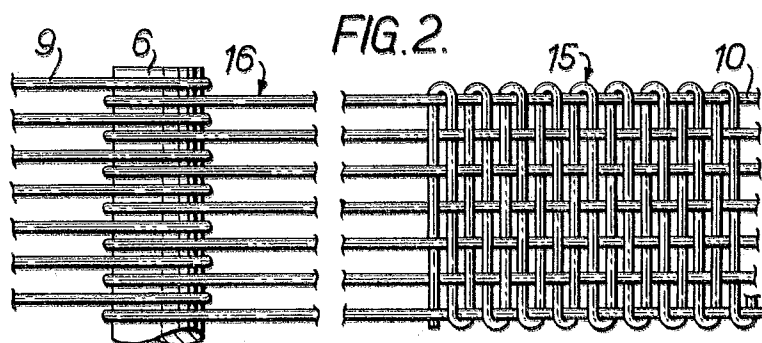
T. J. FLOYD

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FLUID POWER ACTUATORS

Filed Jan. 22, 1968

2 Sheets-Sheet 1



INVENTOR
TERENCE JOHN FLOYD

By: Morris Bateman, Atty

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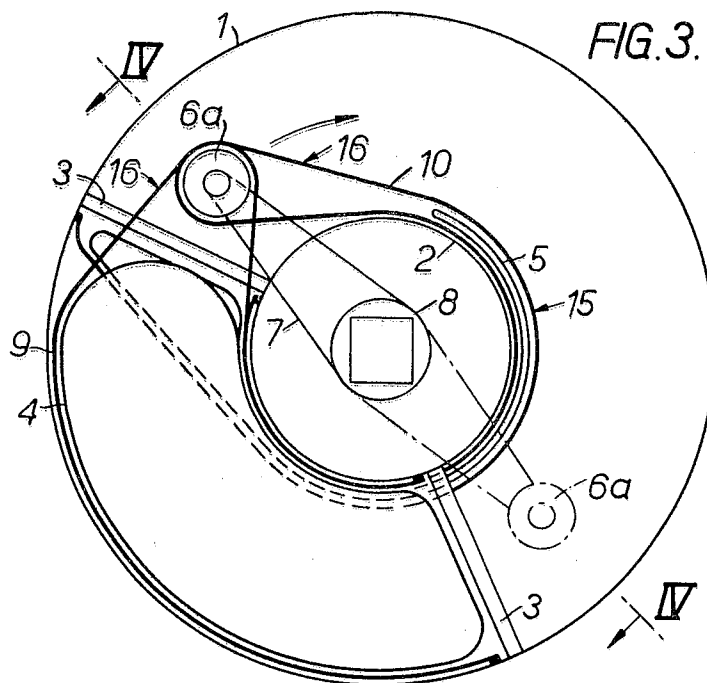
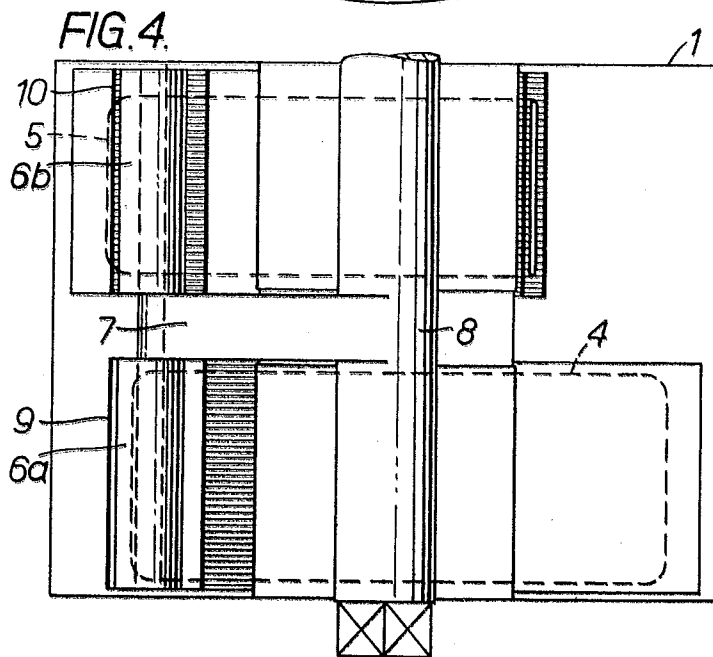
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INVENTOR
TERENCE JOHN FLOYD
By: Norris + Bateman, Attys

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FLUID POWER ACTUATORS

Terence J. Floyd, Wolverhampton, England, assignor to Serck Industries Limited, Birmingham, England

Filed Jan. 22, 1968, Ser. No. 699,643

Claims priority, application Great Britain, Jan. 26, 1967, 3,893/67

Int. Cl. F15b 15/08, 15/02

U.S. Cl. 92—64

15 Claims

ABSTRACT OF THE DISCLOSURE

A fluid power actuator in which an expansible envelope for the fluid and a power take-off member are surrounded and linked by an energy-transmission tape so that a large proportion of the envelope surface is utilised.

This invention relates to a fluid power actuators of the kind in which the energy in the fluid is transmitted to a power take-off member through an expansible envelope to which the fluid is supplied, and has for its object to provide such an actuator in which a very large proportion of the surface of the envelope can be utilised for the transmission of the energy.

To this end, according to the invention, a flexible tape is passed around a substantial part of the surface of the envelope and also around a power take-off member and is operable under tension created therein by fluid expansion of the envelope to move the power take-off member.

Embodiments of semi-rotary fluid power actuators according to the invention are illustrated in the accompanying drawings wherein:

FIG. 1 is an end view of a first embodiment,

FIG. 2 shows a form of tape and its connection in the embodiment shown in FIG. 1,

FIG. 3 is an end view of a second embodiment, and FIG. 4 is a section along the line IV—IV in FIG. 3.

The semi-rotary fluid-power actuator shown in FIG. 1 comprises a cylindrical actuator casing provided with a central hub portion 2 of cylindrical form connected to the peripheral wall of the casing by a web 3 which forms a partition across the space between the hub portion and the peripheral wall. Adjacent to and on opposite sides of the web there are arranged in the space two expansible envelopes 4 and 5 the interiors of which are adapted to be selectively connected to a source of power fluid, and angularly movable on the side of the huge portion opposite the web is a roller 6 carried by the outer end of a lever arm projecting through a slot in the hub 2 and the inner end of which is secured to a shaft 8 pivoted along the axis of the hub portion. Passing around the roller in opposite directions are two flexible tapes 9 and 10 each of which extends most of the way around the periphery of one of the expansible envelopes 4 and 5 and has its ends secured to the hub portion and to the outer casing wall at points 11–14 adjacent to the respective side of the web 3.

As shown in FIG. 2 that portion 15 of each tape which makes contact with the surface of one or other envelope is woven or otherwise produced to enable it to conform to the changing shape of the envelope without distortion. The rest of the tape, or at least that part 16 which is at any time in contact with the roller 6 may be formed of a plurality of longitudinal strands which can interlock with similar strands on the other tape when passing around the roller.

In operation, pressurisation of one envelope will cause it to expand and apply a tensile stress to the associated

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tape which will pull the roller and arm towards the pressurised envelope and will rotate the shaft 8 whereupon the other type will act on the surface of the other envelope to expel fluid therefrom. This action will be reversed each time the flow of power fluid is reversed.

Each envelope is preferably made up of a large number of interconnected cylindrical cells of a length equal to the depth of the bag in a direction parallel to the pivotal axis of the roller, each cell being non-extensible in this direction, but collapsible in a direction at right angles thereto. In this way the force applied by the power fluid to the surfaces of the envelope not retained by the tape is restrained by the construction of the envelope itself and not by the static structure of the actuator, thus eliminating the friction which would result from the envelope sliding relative to the casing.

The arm carrying the roller may be shortened so that the latter remains within the perimeter of the hub portion, in which case a much greater angular movement can be obtained for a given amount of movement of a tape. In such a case a second roller would be required to guide the tapes from the envelopes outside to the required location inside the perimeter of the hub portion.

In the embodiment of FIGS. 3 and 4, in which like numerals are used to indicate parts corresponding to similar parts in FIG. 1, the two pressure envelopes 4 and 5 are staggered along the axis of the shaft 8 with the associated tapes passing around different rollers 6a and 6b carried by the common lever arm 7. In this way each envelope in turn occupies almost the entire periphery of the hub portion, thus providing angular movement of 180° for the lever arm.

I claim:

1. A fluid operated actuating device comprising means mounting an expansible envelope adapted for connection to a source of fluid under pressure, a movably mounted power take-off member, and a flexible tape secured at opposite ends to said mounting means and having an intermediate portion passing around a substantial part of the surface of said envelope and operably connected to said member so that introduction of fluid under pressure into said envelope to expand the envelope results in tape movement displacing said member in a predetermined direction.

2. In the device defined in claim 1, said mounting means comprising a casing enclosing said envelope, with the ends of said tape being secured to the casing and located adjacent one end of said envelope, and said power take-off member being a pivoted arm having a free end disposed within the intermediate portion of said tape adjacent another end of said envelope.

3. A device according to claim 2, wherein the envelope and tape are contained within an annular casing compartment concentric with the axis of said pivoted arm and the ends of said tape are attached to a radial web in the casing.

4. In the device defined in claim 2, a roller at said end of the arm around which said tape passes.

5. A device according to claim 4, comprising an expansible envelope disposed on each radial side of the pivoted arm, each envelope being associated with a flexible tape, which tapes act upon said roller to pull said arm in opposite directions.

6. A device according to claim 5, wherein the two envelopes are staggered axially whereby the pivoted arm may be rotated through an angle of 180° or more during actuation.

7. A device according to claim 5, wherein the two envelopes occupy the same axial zone, the tapes interlocking in the region of said roller.

8. In the device defined in claim 1, said tape being

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constructed at part of said intermediate portion to conform to the shape of said envelope.

9. In the device defined in claim 8, said tape having a woven intermediate portion part engaging the surface of said envelope and a longitudinally stranded portion passing around said roller.

10. A fluid-operated actuating device comprising a casing, an expansible envelope mounted in said casing adapted for connection to a source of operating fluid, a power take-off shaft rotatably mounted in said casing, an arm secured at one end to said power take-off shaft and provided at its other end with a rotatable roller and a flexible tape passing around a substantial part of the surface of said envelope and said roller and secured at its ends to said casing whereby tension created in said tape by fluid expansion of said envelope acts through said arm to cause angular movement of said power take-off shaft.

11. A device according to claim 10, comprising two expansible envelopes mounted in said casing for alternate connection to a source of operating fluid and two flexible tapes each passing around a substantial part of the surface of one of said envelopes and both passing in opposite directions around said roller, whereby tension created in said tapes by alternate fluid expansion of said envelopes acts through said arm to cause angular movement of said power take-off shaft in opposite directions.

12. A device according to claim 11, wherein said casing comprises a cylindrical hub portion in which said power take-off shaft is mounted and a cylindrical outer wall, said hub portion and said outer wall defining between them an annular compartment containing said envelopes.

13. A device according to claim 12, wherein said annular compartment is divided into two arcuate sections by a radial web extending between said hub portion and

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said outer wall and the ends of each flexible tape are secured to said hub portion and said outer wall at points adjacent to and on opposite sides of said web.

14. A device according to claim 11, wherein that part of each tape which passes around said roller is formed of a plurality of longitudinally extending strands and the strands on both tapes interlock in their passage around said roller.

15. A device according to claim 12, wherein said envelopes are arranged in circumferentially staggered side-by-side relationship in said annular casing compartment with said tapes passing around axially aligned rollers on said arm and secured at their ends to said hub and said outer casing wall at points adjacent to circumferentially spaced radial webs extending between said hub portion and said outer wall.

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MARTIN P. SCHWADRON, Primary Examiner

IRWIN C. COHEN, Assistant Examiner

U.S. Cl. X.R.

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