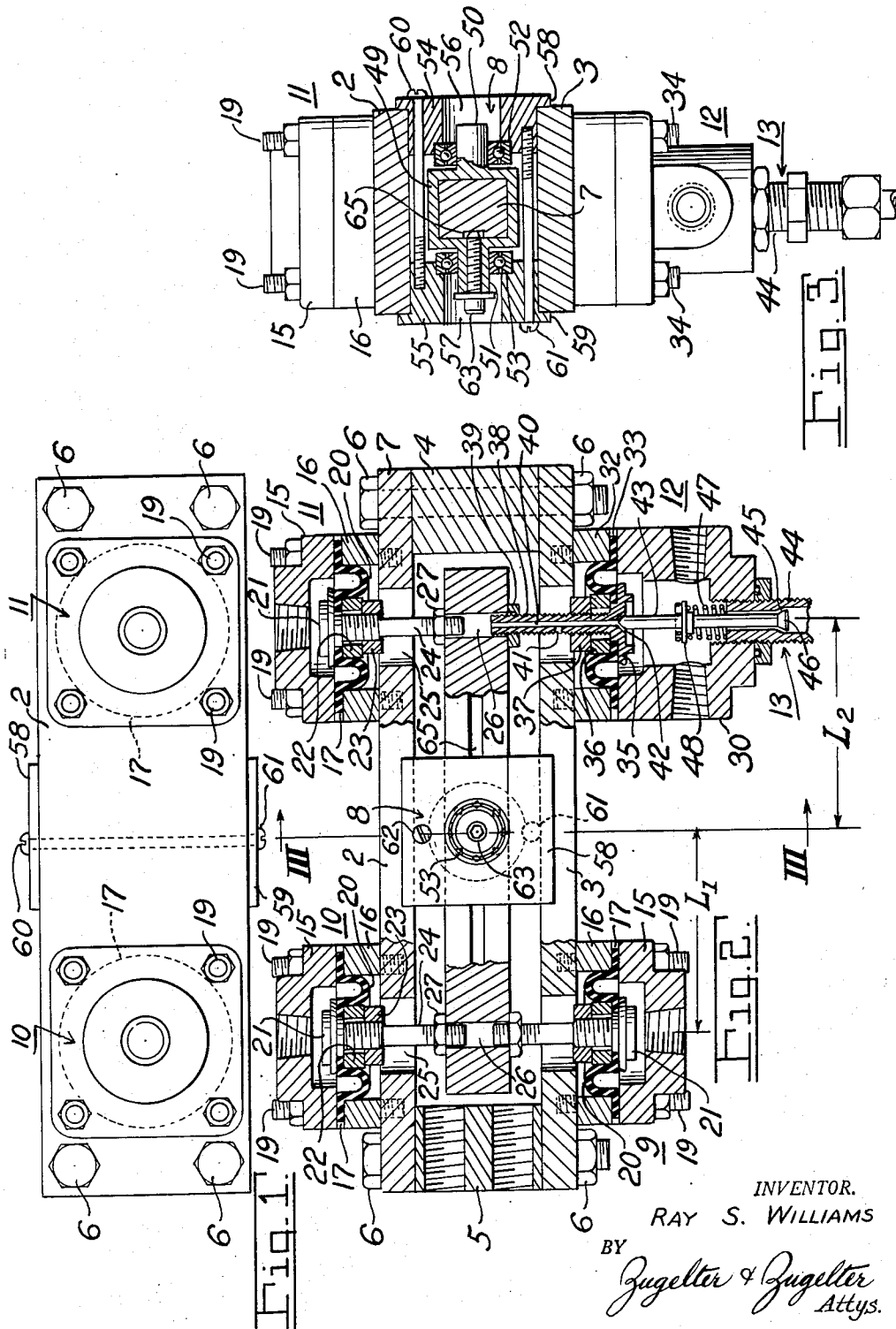


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MULTIPRESSURE TOTALIZING DEVICE AND
ADJUSTABLE FULCRUM THEREFOR
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MULTIPRESSURE TOTALIZING DEVICE AND
ADJUSTABLE FULCRUM THEREFORRay S. Williams, Orrville, Ohio, assignor to Hagan
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This invention relates to multipressure responsive devices of the adjustable ratio totalizing type which includes a beam and a double-acting fulcrum.

An object of the invention is to provide a double-acting fulcrum for an adjustable ratio multipressure device that is compact, efficient and easily adjusted along the beam.

Another object of the invention is to provide an adjustable double-acting fulcrum having many advantages among which are: (1) the center line or rotational axis of the fulcrum passes through the longitudinal center line of the beam; (2) the beam is rigidly fixed to the fulcrum so that the beam is always perpendicular, that is, at 90° to the axis of rotation of the fulcrum; and (3) the rotational component of the fulcrum is rigidly secured to the beam whereby the ratio of the lengths of the beam or lever arms on opposite sides of the fulcrum remains fixed for each adjusted position of the fulcrum.

The above and other objects of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a top plan view of a multipressure device of the adjustable ratio totalizing type embodying a form of the invention;

Fig. 2 is a view in side elevation, partly in section, of the device; and

Fig. 3 is a view in section taken on line III-III of Fig. 2.

In the drawings a multipressure responsive device 1 of the adjustable ratio totalizing type is shown that comprises frame members 2 and 3 having spacer blocks 4 and 5 between them at the ends thereof. The frame members and blocks are rigidly secured together as a unit by bolts 6, as shown. The device includes a beam 7 disposed between the frame members, and a double-acting fulcrum 8 on which the beam is mounted.

Turning forces are applied to the beam at opposite sides of the fulcrum by a plurality of pressure responsive input units 9, 10 and 11, and a pressure responsive balancing and output unit 12. Units 9 and 10 are secured to frame members 4 and 5, respectively, adjacent one end of beam 7 and units 11 and 12 are secured to members 4 and 5 adjacent the opposite end of the beam.

Units 9 and 10 exert opposing forces on the beam and are so placed with respect to the beam that those forces act at a distance L_1 from the rotational axis of the fulcrum. Likewise, units 11 and 12 exert opposing forces on the beam and are so placed that those forces act at a

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distance L_2 from the rotational axis of the fulcrum. Devices 9, 10 and 11 are adapted to receive pressure inputs P_1 , P_2 and P_3 . Unit 12 is provided with a valve 13 of such construction that a pressure P_4 is established therein of such magnitude as to balance the algebraic sums of pressures P_1 , P_2 and P_3 . Pressure P_4 is also referred to herein as the output pressure, as that pressure may be transmitted to indicating devices, regulators, or other apparatus, as will be understood by those skilled in this art.

The fulcrum 8 is double-acting, is adjustable longitudinally of beam 7 whereby the lever arm lengths L_1 and L_2 may be adjusted with respect to each other, and embodies features of construction described infra.

Units 9, 10 and 11 as illustrated, may be identical in construction, therefore, corresponding parts are given the same reference characters. Each of these units includes a bonnet 15 having an open side, a ring 16 and a pressure deflectable member 17. The marginal edge of the diaphragm is clamped between the bonnet and the ring by stud bolts 19, these being also threaded into the frame member on which it is placed, to secure the unit thereto. The diaphragm may be of rubber, synthetic or natural, and reinforced, if necessary, and pre-shaped to provide a slack portion 20. The central portion of the diaphragm is clamped between the head 21 of a bolt and a clamp ring 22 by means of a nut 23 threaded on the bolt shank 24. The shank 24 extends through an aperture 25 in the frame member and is long enough to engage beam 7. As shown, the end of the shank extends into a bore 26 in the beam and is provided with a nut 27 that bears on the beam. By adjusting the position of nut 27 on the bolt shank, the central portion of the diaphragm 17 may be moved up or down in the bonnet chamber to thereby adjust the effective area of the diaphragm. By that adjustment the areas of the respective diaphragms in units 9, 10 and 11 may be adjusted to equality with each other.

Unit 12 includes a bonnet 30 that is deeper than the bonnets of units 9, 10, and 11 in order to provide sufficient space to accommodate parts of valve 13, a ring 32 and a diaphragm 33. The marginal edge of diaphragm 33 is clamped between the bonnet and the ring by stud bolts 34 threaded into frame member 3. The diaphragm as shown is like the diaphragms of units 9, 10, and 11.

The central portion of diaphragm 33 is clamped between bolt head 35 and a ring 36 by means of a nut 37 threaded on the bolt shank 38. The

end of the bolt shank extends into bore 26 and is provided with a nut 39 that bears on the beam. The position of that nut may be adjusted for the purpose above described, i. e., to adjust the effective area of diaphragm 33.

A bore 40 extends through the head and shank of the bolt as shown, and a side port 41 in the shank vents the bore to the atmosphere. In the bolt head a tapered valve seat 42 is formed that is concentric with the bore 40. The bolt with its bore 40, port 41 and seat 42 forms a part of valve 13.

Valve 13 includes a valve stem 43 and a bushing 44, the latter being threaded into the bonnet 30 and provided with an inlet port valve seat 45. One end of stem 43 is disposed to seat in valve seat 42. The opposite end of the stem is provided with valve 46 disposed to seat on valve seat 45. A coil spring 47 on the stem 43 and confined between a flange 48 secured to the stem biases the stem in a direction for seating valve 46 on the inlet port seat 43. The outer end of bushing 44 is designed to be coupled to a supply pipe to which a source of supply of compressed air of constant pressure, is connected.

When a force is applied to diaphragm 33 in such direction as to move the central portion of the diaphragm into the bonnet, the exhaust seat in the bolt head 35 moves the stem in a direction to unseat valve 46 from the inlet port seat 45. While the inlet port is uncovered, compressed air passes into the chamber of the bonnet until the pressure P_4 therein has increased to such a value that it exerts a force sufficient to deflect the diaphragm in the opposite direction until valve 46 reseats on and closes the inlet port seat of the valve. If the original force has not changed in value, the opposing force produced by the pressure will balance the former when the inlet port is closed. At balance the exhaust port 42 is closed by the valve stem.

If the balancing pressure P_4 does not change but the original force decreases, the force of pressure P_4 on the diaphragm causes the diaphragm to move outwardly, whereby the exhaust port seat 42 is uncovered. Air is then discharged to the atmosphere until pressure P_4 decreases the force on the diaphragm to a value equal to the opposing force applied through beam 7. When that balance occurs, the exhaust seat is reclosed by the stem. The balancing pressure is trapped in the bonnet so long as the exhaust and inlet ports are closed.

If the diaphragms of units 9, 10, 11 and 12 have equal effective areas and if these areas are assumed to be unit areas, say, 1 sq. in., and that pressure P_1 , P_2 and P_3 (in p. s. i.) are applied to the diaphragm of those units, the value of balancing pressure P_4 is equal to

$$\frac{L_1}{L_2}(P_1 - P_2) + P_3$$

When the diaphragm areas are unit areas the values of the pressures P_1 , P_2 , P_3 and P_4 are equal to the forces exerted by the diaphragms on beam 7.

P_4 is derived by summing up the moments of P_1 , P_2 , P_3 and P_4 to zero about the fulcrum 8 as follows:

$$P_1 L_1 - P_2 L_1 + P_3 L_2 - P_4 L_2 = 0$$

$$L_1(P_1 - P_2) = -L_2(P_3 - P_4) = 0$$

$$\therefore P_4 = \frac{L_1}{L_2}(P_1 - P_2) + P_3$$

Since

$$\frac{L_1}{L_2}$$

is constant for any setting of the fulcrum 8,

$$P_4 = K(P_1 - P_2) + P_3$$

Fulcrum 8 comprises a yoke having a loop 49 that embraces beam 7, and journals 50 and 51 that extend outwardly from opposite sides of the loop. The fulcrum includes anti-friction bearings 52 and 53, in which the journals 50 and 51 are mounted. The anti-friction bearings, as illustrated, are ball bearings, the outer races of which are secured to supports 54 and 55. As shown, the supports 54 and 55 have bores 56 and 57 that are concentric with the journals.

The outer ends of supports 54 and 55 are provided with flanges 58 and 59, respectively, that abut the sides of the frame members 2 and 3. The supports 54 and 55 are releasably secured to the frame members 2 and 3 by means of clamp bolts 60 and 61 that extend into the supports from opposite sides of the frame members 2 and 3, as shown. Clamp bolt 60 passes through a bore in support 54 and is threaded into the inner end of support 55. Clamp bolt 61 passes through a bore in support 55 and is threaded into the inner end of support 54.

The shape of the loop 49 and the shape of the beam in transverse section may be of any desired form. As illustrated, the transverse section of beam 7 is rectangular. The depth of the beam is greater than its width so that the major and the minor axes of any transverse section extend vertically and horizontally, respectively. The longitudinal axis of the beam is in a plane containing the minor axis of any transverse section of the beam.

The shape of the loop 49 is preferably made to conform to the shape of the transverse section of beam 7. The journals are so located on the loop that the rotational axis of journals pass through the intersection of the major and minor axes of any section of the beam, as shown.

The yoke loop 49 is releasably secured to the beam by means of a bolt 63. As shown, this bolt is threaded through journal 51 so that its inner end engages a side of beam 7. The side of the beam that is engaged by the end of bolt 63 is provided with a slot 65 that extends longitudinally of the beam. Bolt 63 engages the slot wall at a point on the center line or rotational axis of the journals 50 and 51.

The fulcrum assembly may be moved lengthwise of the beam 7 in either direction whereby the lengths of the lever arms L_1 and L_2 may be adjusted in accordance with the ratio constant

$$\frac{L_1}{L_2}$$

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required to produce a given operating characteristic of the device 1. When it is desired to adjust the position of the fulcrum, bolts 60, 61 and 63 are loosened to unclamp beam 7 from the yoke and to release flanges 58, 59 from the sides of the frame members 2 and 3. The fulcrum may then be moved as a unit toward either end of the beam. When it has been adjusted to the proper position, the bolts are tightened whereby the fulcrum supports are clamped to the frame members 2 and 3 and beam 7 is clamped to yoke loop 49.

In the form of yoke described, the rotational axis of the journals is always on center with the center line of beam 7. Also, the longitudinal

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center line of beam 7 is always at a fixed and constant distance from the exhaust port seat 42 of pressure balancing and output unit 12. Therefore, the output and balancing pressures established in unit 12 will always be proportional to the forces acting on beam 7 whether those forces act in one direction or the other on the fulcrum. By means of the fulcrum construction described and illustrated, the totalizing device 1 may be mounted in a horizontal position as shown in Fig. 2, or it may be mounted in a vertical position, or the device may be inverted with reference to the position shown in Fig. 2 and mounted horizontally.

The device 1 may be put to many uses, some of which are illustrated in the co-pending applications of Alfred A. Markson, serially numbered 158,278 filed April 26, 1950; 156,986 filed April 20, 1950, now Patent No. 2,631,599 issued March 17, 1953; and 157,272 filed April 21, 1950, all assigned to Hagan Corporation, Pittsburgh, Pennsylvania.

Having thus described the invention, it will be apparent to those skilled in this art, that the illustrated embodiment of the invention is subject to modification without departing from either the spirit or the scope of the invention.

Therefore, what is claimed as new and desired to be secured by Letters Patent is:

1. In a multipressure responsive device having spaced frame members, a beam between the frame members, a fulcrum for the beam secured to the frame members, pairs of housings on the frame members on opposite sides of the fulcrum, each housing having a pressure deflectable member connected to exert a force on the beam, diaphragms on each side of the fulcrum acting oppositely to each other and at the same distance from the fulcrum, said fulcrum comprising a yoke embracing the beam and slidable on the same, said yoke having journals extending outwardly from opposite sides of the beam, an antifriction bearing for each journal, a support for each bearing disposed between said frame members and having flanges engaging the same, means for releasably securing the yoke to the beam and means for releasably securing the bearing members to said frame members whereby the fulcrum may be moved along the beam to one side or the

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other of the mid-point between the lines of action of the pairs of pressure deflectable members on said beam.

2. A device as set forth in claim 1, characterized by the fact that means are provided for so securing the beam to the yoke that the axes of rotation of said journals pass through the point of intersection of the major and minor axes of the beam at any section transversely of the beam.

3. A pressure totalizing device comprising a frame having spaced frame members, a beam located between the members, a fulcrum secured to said frame members and said beam, pairs of pressure actuated force developing members on said frame members, said members being so arranged thereon as to form opposing couples acting on the beam at opposite sides of the fulcrum, each member of a couple acting on the beam at equal distances from the fulcrum, said fulcrum comprising a yoke having a loop slidable along and embracing said beam, said yoke having journals projecting outwardly from opposite sides thereof, the longitudinal axes of said journals being colinear and passing through a plane disposed at right angles to the line of action of said couples and containing the major axis of the beam, an anti-friction bearing on each journal, means for releasably securing the yoke to the beam and a support member for each bearing releasably secured to said frame members, said support members being movable as a unit with said yoke journals and bearings along said beam whereby the lever arms between said pairs of couples and the fulcrum may be adjusted relative to one another.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
Re. 19,745	Baselt	Nov. 5, 1935
856,784	Kolstram	June 11, 1907
1,587,522	Hedgecock	June 8, 1926
1,780,713	McEwan	Nov. 4, 1930
2,078,106	Temple	Apr. 20, 1937
2,127,663	Kilkemeier	Aug. 23, 1938
2,136,454	Miller	Nov. 15, 1938
2,231,696	Wolfe	Feb. 11, 1941