Oct. 2, 1956 P. T. FAXÉN 2,764,894

APPARATUS FOR TRANSLATING LINEAR MOTION INTO ROTARY MOTION

Filed Jan. 26, 1953

Fig. 1.

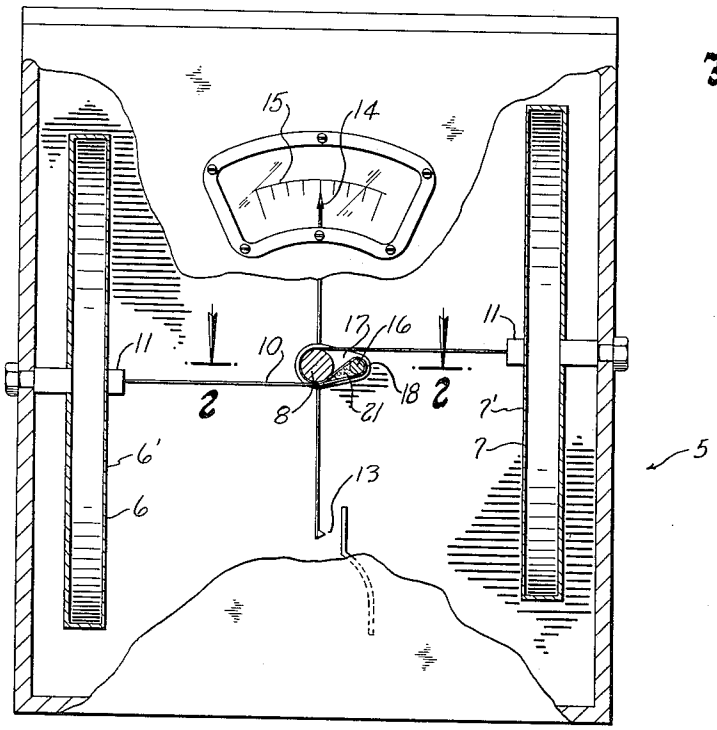


Fig. 2.

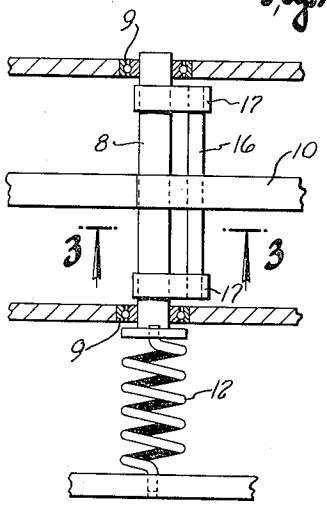


Fig. 3.

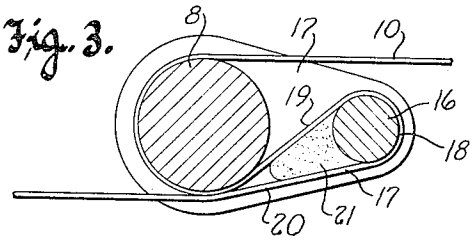


Fig. 4.

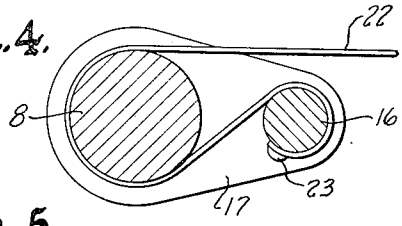
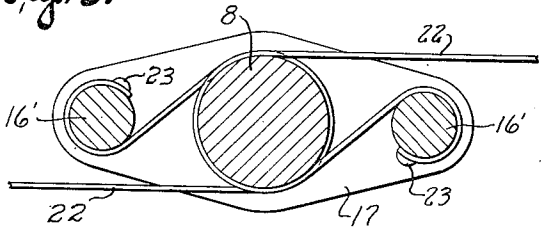


Fig. 5.



Inventor
Per Torsten Faxén
By Dreyfus Hilton Jones
Attorney

United States Patent Office

2,764,894

Patented Oct. 2, 1956

2,764,894

APPARATUS FOR TRANSLATING LINEAR MOTION INTO ROTARY MOTION

Per Torsten Faxén, Jonkoping, Sweden

Application January 26, 1953, Serial No. 333,310

3 Claims. (Cl. 74—95)

This invention relates to apparatus for translating linear motion, such as that produced for instance by the pressure sensitive membrane of an aneroid, into rotary motion, and is an improvement upon the device forming the subject matter of Patent No. 2,365,923 issued December 26, 1944, to Erik Alvar Wilkenson et al.

As in the invention of said patent a flexible tension member having its ends connected to the pressure responsive membranes of two opposed aneroids, or more broadly, two opposed driving members, has its medial portion connected to a rotary shaft in such a way that opposite motions of said driving members result in a corresponding and proportionate rotation of the shaft, it being appreciated that the shaft turns through but a few degrees.

In the device of the patent the flexible tension member which is preferably a steel band has its medial portion received in a diametrically extending slot in the shaft, and a torsion spring acting upon the shaft yieldingly holds the same in a position at which all portions of the tension member or band are taut and its medial portion defines substantially an S so that opposite simultaneous movement of the driving members effects the desired rotation of the shaft.

Although this arrangement of the patent provides a simple and inexpensive means of attaching the band to the shaft, it is often not satisfactory, particularly since the shaft is generally very small and consequently to cut a slot diametrically therethrough greatly weakens it. Moreover, the need for threading the tension member through the slot results in a difficult assembly operation.

It is, therefore, an object of this invention to provide an improved manner of securing the tension band to the shaft whereby the weakening of the shaft caused by the construction it replaces is overcome, and in addition assembly of the band with the shaft is greatly facilitated.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates several complete examples of the physical embodiments of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a front view of an aneroid type pressure gauge having this invention incorporated therein;

Figure 2 is a sectional view through Figure 1 on the plane of the line 2—2;

Figure 3 is a cross sectional view through Figure 2 but on an enlarged scale;

Figure 4 is a view similar to Figure 3, illustrating a slightly modified embodiment of the invention; and

Figure 5 is a cross sectional view similar to Figure 3 but illustrating still another adaptation of the invention.

Referring now particularly to the accompanying drawing, the numeral 5 designates generally the housing of an instrument having a pair of aneroid capsules 6 and 7 mounted upon opposite side walls thereof with their pressure sensitive membranes 6′ and 7′ facing one another. Between the aneroid capsules is a rotatable shaft 8 freely rotatably mounted in bearings 9 (see Figure 2) with the axis of the shaft substantially perpendicular to the direction of the linear motion produced by the pressure sensitive membranes.

A flexible tension member 10, preferably a steel band, has its opposite ends affixed as at 11 to the membranes 6′ and 7′ and has its medial portion connected to the shaft in such a way that simultaneous opposite linear motion produced by the membranes 6′ and 7′ in coaction with a torsion spring 12 connected to the shaft effects rotary motion of the shaft. Such rotation of the shaft may be used to close a pair of electric contacts 13 or to swing a needle 14 across a scale 15.

In any event it should be understood that for the instrument to be accurate the rotary motion or oscillation of the shaft resulting from the flexure of the membranes 6′ and 7′ must be in strict accordance with such flexure. Hence, the manner in which the tension member is connected to the shaft is highly important. It must also be borne in mind that the shaft is generally quite small. To meet these requirements, the connection of the tension member to the shaft 8 involves the provision of a part 16 which may be considered an anchor for the tension member since it takes the place of the diametrically extending slot of the structure shown in the aforesaid patent. This part is preferably a round shaft or pin substantially smaller in diameter than the shaft 8 mounted thereon in parallel radially spaced relation thereto by a pair of crank arms 17.

The medial portion of the tension band is looped upon itself as at 18 and around the part 16. One stretch 19 of the band extends tangentially from the part 16 to the underside of the shaft 8, around the shaft 8, and tangentially from the top side thereof to the membrane 7′. The other stretch 20 of the tension band extends from the part 16 back across the underside of the stretch 19 and is thus substantially tangential to the bottom of the shaft 8 from where it extends to the membrane 6′.

The torsion spring 12 has one end thereof connected to the shaft 8 and its other end suitably anchored and applies a torque upon the shaft in the direction tending to wind the tangentially extended end portions of the tension band onto the shaft and thus at all times keeps all portions of the tension member taut.

Accordingly, the simultaneous movement of the pressure sensitive membranes 6′ and 7′ away from one another as a result of an increase in the pressure thereon imparts a clockwise rotation to the shaft 8 while simultaneous movement of the membranes in the opposite direction allows the spring 12 to effect a counterclockwise rotation of the shaft 8.

Since accuracy requires the maintenance of a uniform ratio between the linear motion produced by the membranes and the resulting rotary motion of the shaft, the radius of the lever through which the torque is applied to the shaft must be the same throughout the entire range of rotary motion of the shaft. Hence, the part 16 must be smaller in diameter than the shaft 8 and in addition must be so located with respect to the shaft and the tangentially extended stretches of the tension member that it always lies between the planes of tangency defined by the extended end portion of the tension band.

Normally the friction between the band and the shaft

and the part **16** is adequate to preclude any slippage but to afford further assurance against this objectionable consequence a wedge-shaped friction block **21** may be confined between the portions **19** and **20** of the band, and the part **16**.

The arrangement described is perhaps the simplest embodiment of the inventive concept and in addition has the advantage of balancing the forces applied upon the shaft **8**. Where such balance is not too important the construction shown in Figure 4 could be employed. In this case the rotation imparted to the shaft is produced by a single driving member, such as the pressure sensitive membrane of an aneroid capsule, to which one end of the tension band **22** is attached. The other end of the tension member is wrapped about the side of the shaft remote from the driving member and then extended around and secured to the part **16**. The securement may be effected in any suitable manner as by means of a pin **23**.

The operation of this form of the invention is substantially the same as described except that, as noted, the desired balance of forces on the shaft will not be had. Such balance, however, is had with the arrangement shown in Figure 5 where two anchor parts **16'** are provided at diametrically opposite sides of the shaft **8** and the arrangement shown in Figure 4 is duplicated.

From the foregoing description taken in connection with the accompanying drawing it will be readily apparent to those skilled in the art that this invention provides a simple and highly effective manner of translating linear motion into rotary motion of a shaft in a small precision instrument such as a pressure gauge used in aircraft.

What I claim as my invention is:

1. Means for translating linear motion produced simultaneously and in opposite directions by two opposed driving members into rotary motion, comprising: a rotatable shaft; means mounting the shaft between the two opposed driving members for free rotation about an axis substantially perpendicular to the direction of linear motion produced by the driving members; two flexible tension members each having one end fixed to one of the driving members and extending from its point of connection to the driving member tangentially to each of two opposite sides of the shaft and around a part of the circumference of the shaft; anchors for the tension members disposed symmetrically on opposite sides of the shaft and fixed with respect thereto in spaced relation to the shaft circumference, one of said anchors being between the shaft and one of the driving members and the other anchor being between the shaft and the other driving member; means securing the adjacent ends of the flexible tension members to said anchors; and a spring connected to the shaft and applying a torque thereon in a direction tending to wind the tension members upon the shaft to thereby maintain the tension members taut, so that said spring coacts with the driving members to impart rotation to the shaft in accordance with simultaneous opposite movement of the driving members.

2. Means for translating a linear motion produced by a driving member into rotary motion, comprising: a round shaft; means mounting the shaft for free rotation about an axis substantially perpendicular to the direction of the linear motion produced by the driving member; a flexible tension member having a stretch thereof extending tangentially from the shaft toward the driving member; means securing the tension member to the driving member; and means for constantly holding the tension member tightly wrapped about more than 180 degrees of the shaft surface with said stretch of the tension member taut so that a pull exerted thereon by the driving member imparts a torque upon the shaft, the magnitude of which is always the product of the pull times the radius of the shaft, said means comprising a part mounted on the shaft in radially spaced relation thereto and lying between the shaft and the driving member, the flexible tension member extending from the point of tangency of its taut stretch with the shaft around the side of the shaft remote from the driving member and then tangentially from a point on the shaft more than 180° from said first designated point of tangency to said part and having initial contact with said part at a point lying between two spaced planes tangent to diametrically opposite surfaces of the shaft and parallel to said taut stretch of the tension member, and a spring connected to the shaft and imparting a yielding torque thereon in the direction opposite to that produced by a pull exerted on the tension member by said driving member.

3. Means for translating linear motion produced simultaneously by two spaced apart driving members moving in opposite directions into rotary motion, comprising: a round shaft; means mounting the shaft between said driving members for rotation about an axis substantially perpendicular to the direction of linear motion produced thereby; a flexible tension member having one end connected to one of the driving members and its other end connected to the other driving member, the medial portion of the flexible member being looped upon itself; and means for constantly holding the flexible tension member taut and tightly wrapped about more than 180 degrees of the shaft surface with a stretch thereof extending tangentially from one side of the shaft to one of the driving members and its medial looped portion overlying the other side of the shaft and extending straight to the other driving member, a pin fixed with respect to the shaft in parallel spaced relation thereto, and lying between the shaft and one of the driving members, the pin being embraced by the loop of the tension member, and a spring connected to the shaft and applying a torque thereon in a direction tending to wind the tension member onto the shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

1,254,981	Cater	Jan. 29, 1918
2,225,845	Richolt	Dec. 24, 1940
2,365,923	Wilkerson	Dec. 26, 1944

FOREIGN PATENTS

54,470	Netherlands	Apr. 16, 1943