July 12, 1955 F. W. GUIBERT 2,712,759

ADJUSTABLE RATIO BELT DRIVE

Filed July 5, 1952

Fig. 1.

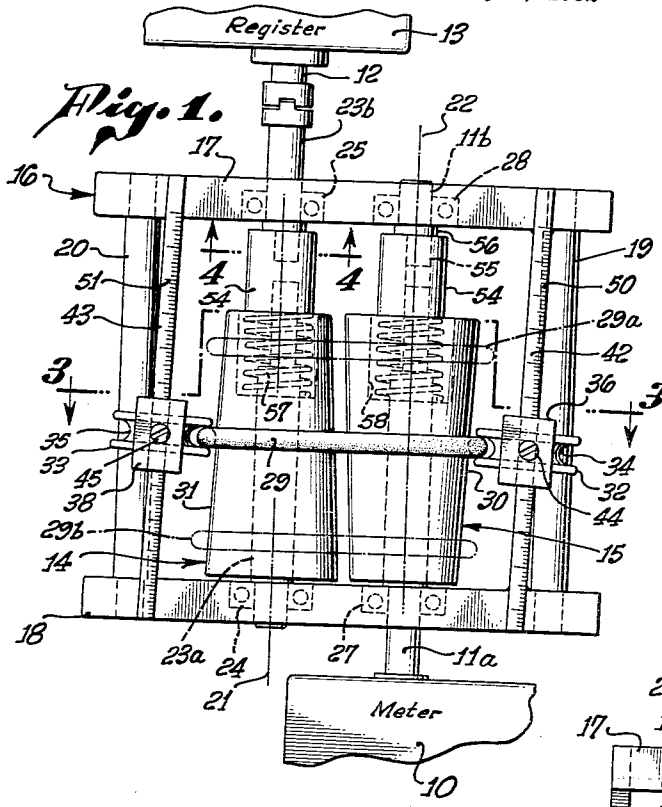


Fig. 5.

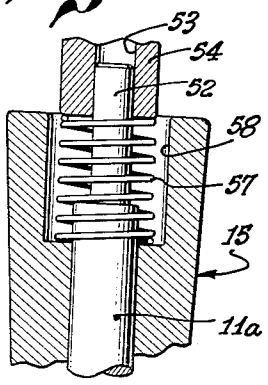


Fig. 2.

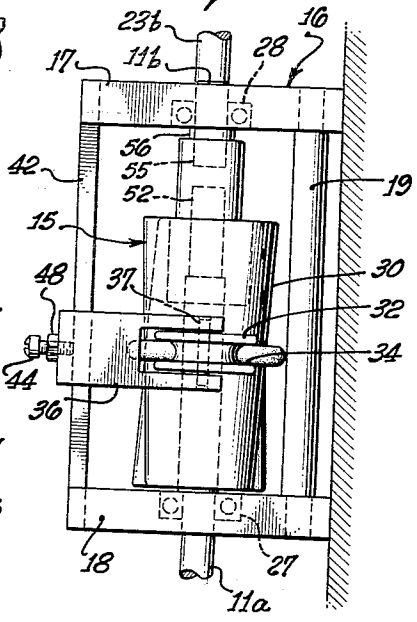
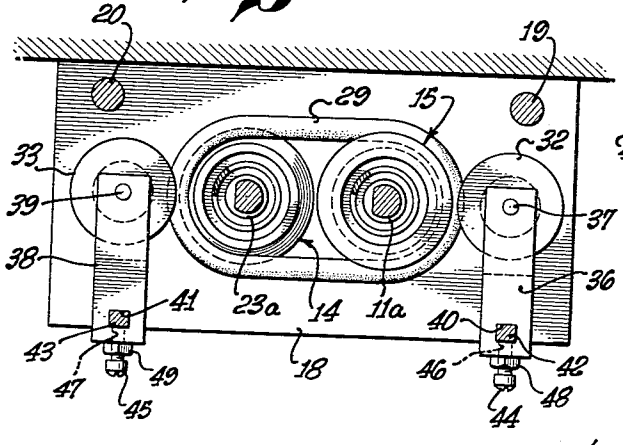


Fig. 3



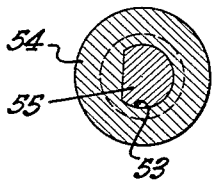


Fig. 4.

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ADJUSTABLE RATIO BELT DRIVE

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13 Claims. (Cl. 74—217)

This invention relates to metering, and particularly to meters that are provided with indicating or recording registers.

Meters, such as those measuring the flow of electricity, gas, water, or the like, are now in extensive use. Although such meters are carefully designed to operate accurately, normally it is necessary to calibrate them, or to apply a correction factor.

It is one of the objects of this invention to make it possible readily to compensate for errors, so that the register or dial will indicate or record accurately.

It is another object of this invention to make it possible to adjust the correction factor in a simple and accurate manner.

In order to accomplish these results, there is interposed between the meter and the indicator or register an adjustable ratio motion transmitting device that can be set at any value within limits, say, from a ratio of .8 to a ratio of 2.0. These limits are ample to include any correction factor that might possibly be required for compensation.

Such an adjustable ratio device is disclosed and claimed in my copending application filed June 22, 1951, Ser. No. 233,036, now Patent Number 2,638,008, and entitled Adjustable Compensator for Registering Meters, of which this application is a continuation-in-part.

In my above-mentioned copending application, there is disclosed a variable transmission utilizing a pair of rotatable cone elements connected together by a belt that is adjustable in a direction parallel to the axes of the cones. It is an object of this invention to improve such an adjustable ratio transmission device.

It is another object of this invention to provide a device of this character that is of extremely simple construction, and that can be adjusted within quite narrow limits by simple manipulations.

It is still another object of this invention to provide a device of this character in which the belt coupling the rotating cone elements is prevented from being accidentally displaced.

It is another object of this invention to provide a device of this character that is easily disassembled for replacement of parts. For this purpose, the rotating cone elements are mounted on two-part shafts that are easily separated from each other, whereby the belt can be readily removed or inserted.

It is another object of this invention to provide a device of this character having means adjustably mounting the belt that serve not only for this purpose, but also as a structural part of the frame for the mechanism, thereby promoting a compact and economical structure.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. The form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a plan view of an apparatus incorporating the invention;

Fig. 2 is a side elevation of the device illustrated in Fig. 1;

Fig. 3 is a sectional view, taken along the plane indicated by line 3—3 of Fig. 1;

Fig. 4 is an enlarged sectional view, taken along the plane indicated by line 4—4 of Fig. 1; and

Fig. 5 is an enlarged sectional view illustrating the two-part shaft construction for the transmission mechanism.

A meter **10**, illustrated in Fig. 1, measuring, for instance, the flow of electricity, water, gas, or the like, has a shaft **11***a* intended to operate, through a transmission mechanism, a shaft **12** of a register **13**.

Interposed between the meter **10** and the register **13** is the compensating device, by the aid of which the ratio of transmission from the shaft **11***a* of the meter to the shaft **12** of the register is adjusted within very close limits.

For this purpose, there are a pair of conical members **14** and **15** operatively connected to the shafts **12** and **11***a*, respectively, of the register **13** and meter **10**. A box-like frame **16**, comprising upper and lower spaced plates **17** and **18**, and joined together by posts **19** and **20**, mounts the conical members **14** and **15**.

The conical member **14** is carried in the frame for rotation by a two-part shaft **23***a*, **23***b*. One portion **23***a* of the shaft mounts the conical member **14** for rotation therewith. The shaft **23***a* extends axially through the conical member **14**, and is rotatably mounted by the aid of a bearing structure **24** in the lower plate **18**. The upper portion **23***b* of the shaft extends through the upper plate **17**, and is in driving engagement with the shaft **12** of the register **13**. The manner in which the shaft parts **23***a*, **23***b* are held together will be described more fully hereinafter. A suitable roller bearing **25**, carried by the upper plate **17**, mounts the shaft **23***b* for rotation.

The conical element **15** is mounted for rotation between the plates **17** and **18** on the meter shaft **11***a* and a separate cooperating shaft part **11***b*. The meter shaft **11***a* extends axially of the conical member **15**, and is secured thereto for rotation of the conical member **15** therewith. The meter and cone mounting shaft **11***a* extends through the lower plate **18**, and is rotatably mounted by the aid of a roller bearing **27** carried by the plate. The other part **11***b* of the shaft is carried for rotation by a roller bearing structure **28** in the upper plate **17**.

The shafts **23***a*, **23***b*, **11***a*, **11***b* mount the conical members **14**, **15** about parallel axes, and in spaced side-by-side relationship. One of the conical members **14** converges in one direction along its axis **21**. The other conical member **15** converges in an equal extent in the opposite direction along its axis **22**.

A friction belt **29**, which may be of flexible material, such as rubber, or the like, encompasses the conical members **14** and **15** simultaneously, and forms a driving connection therebetween. The belt **29** is in simultaneous engagement with an outside element **30** of the conical member **15** and an outside element **31** of the conical member **14**. Accordingly, as the conical member **15** is rotated by the meter shaft **11***a*, the belt **29** transmits rotary motion to the conical driven member **14** of the register shaft **12**.

The ratio of transmission between the conical members **14**, **15** is dependent upon the longitudinal position of the belt **25** along the parallel axes **21**, **23** of the conical members **14**, **15**. Thus, assuming the belt **29** to be in

an upper position, indicated by the dotted lines **29***a* in Fig. 1, the ratio of transmission is in excess of unity, since that portion of the outside element **30** engaged by the belt **29** is at a greater distance from its axis **22** of rotation than is the outside element **31** from its axis of rotation **21**. The ratio of transmission then corresponds to the ratio of the distance of the outside elements from their respective axes of rotation.

In a lower position of the belt, indicated by the dotted lines **29***b* in Fig. 1, the ratio of transmission is substantially less than unity, since the distance of that portion of the outside element **30** which the belt **29***b* contacts is at a lesser distance from its axis **22** of rotation than is that portion of the outer element **31** of the driven member **14** that is engaged by the belt **29***b*. In the full-line position of the belt **29**, the ratio of transmission is substantially unity, the belt **29** being intermediate the length of the conical elements **14**, **15**.

For adjusting the longitudinal position of the belt **29** to control the ratio of transmission, a pair of slidable belt guiding rollers or shifters **32** and **33** are provided. The rollers **32** and **33** have annular recesses **34** and **35**, respectively, that partially receive those portions of the belt **29** that are then in engagement with the outside elements **30** and **31**, respectively, of the driving and driven conical members **15** and **14**. The rollers **32** and **33**, if maintained in predetermined positions, ensure that the belt **29** cooperates with a definite portion of the outside elements **30** and **31**.

As shown most clearly in Figs. 2 and 3, the roller **32** is rotatably mounted between bifurcations of a yoke **36** by the aid of a shaft **37**. Similarly, the roller **33** is mounted between bifurcations of a yoke **38** by the aid of a shaft **39**.

Each of the yokes **36**, **38** is movable in a direction parallel to the tapering outside elements **30** and **31**, respectively. For this purpose, the yokes **36** and **38** have through apertures **40** and **41** of non-circular configuration slidably mounting the yokes **36**, **38** on bars **42** and **43**, respectively, that have corresponding non-circular sections (Fig. 3). These bars **42**, **43** are parallel to each other and to the outside elements **30**, **31** of the conical members **15**, **14**. Opposite ends of each of the bars are secured to the upper and lower plates **17** and **18** of the frame **16** and cooperate with the struts **19**, **20** to determine a rigid configuration for the frame **16**.

For locating the yokes **36** and **38** at a definite position along the bars **42**, **43**, set screws **44**, **45**, carried by the yokes **36** and **37**, are provided. These set screws extend through appropriate apertures **46**, **47** in the yokes **36**, **38** for engagement with the bars **42**, **43**. Lock nuts **48**, **49** ensure against accidentally loosening of the set screws.

The yokes **36**, **38** are separately adjustable, and it is not required that they be at precisely the same level. A rough setting of the desired ratio of transmission can be achieved by simultaneously moving the yokes **36** and **38** longitudinally to position the belt **29**. After such rough setting is achieved, a fine adjustment can be achieved by adjusting the position of only one of the yokes. Thus, assuming that the full-line position in Fig. 1 corresponds to the rough ratio of transmission correction desired, a fine adjustment can be achieved.

Should this rough setting be such as to make the ratio of transmission too high, the belt guiding roller **32** may be lowered in small increments by adjusting only the position of the yoke **36**. Such adjustment reduces the distance of that portion of the outer element **30** of the driving cone **15** with which the belt **29** cooperates. Accordingly, the ratio of transmission is reduced. Optionally, to secure such a fine adjustment, the belt guiding roller **35** may be moved downwardly by small increments through adjustment of its yoke **38**. Such adjustment will increase the radial distance of that portion of the outer element **31** of the driven cone **14** from the axis **21**. The ratio of transmission is thus reduced. Alternately, both guiding rollers can be separately adjusted.

Should the rough setting be such as to make the ratio of transmission too low, the rollers **32** or **35**, both, may be separately raised.

The guide bars **42** and **43** have formed thereon appropriate calibrations **50** and **51** to aid in the adjustment of the mechanism.

To facilitate simple replacement of parts, the shafts **23***a*, **23***b* and **11***a*, **11***b* are of two-part construction, as hereinbefore mentioned. Referring to Figs. 4 and 5, the shaft part **11***a* has a non-circular extension **52** accommodated in a corresponding bore **53** of a sleeve coupling member **54**. The other part **11***b* (Fig. 1) has a downwardly extending non-circular projection **55** accommodated in the through bore **53** of the coupling sleeve **54**. By means of the sleeve **54**, the shaft parts **11***a*, **11***b* are coupled together.

The coupling sleeve **54** is held in operative engagement with both projections **52** and **55** and against a collar **56** of the upper shaft part **11***b* by the aid of a compression spring **57** engaging the coupling sleeve **54** on its lower side. This coil spring **57** is disposed in a circular recess **58** disposed in the end of the cone driving member **15**. This recess **58** is of sufficient size such that it may receive the sleeve **54**. Thus, for uncoupling the shaft parts **11***a*, **11***b*, the coupling sleeve **54** is urged into the cone recess **58** and against the force of the spring **57**. The shaft extension **55** of the upper shaft **26***b* is then out of engagement with the sleeve. Such two-part shaft construction is also used for the driven cone **14**, and it is identical in every respect to the construction described in connection with the spring shaft **11***a*, **11***b*.

Such shaft construction facilitates replacement of the belt **29**. To replace the belt, the rollers **32** and **33** are moved toward the uppermost portions of the guiding bars **42** and **43**. In such position, the belt **29** is out of engagement with the conical surfaces of the driving and driven members. The belt **29** can then be moved between the shaft parts **11***a*, **11***b* when the sleeve coupling member **54** is depressed. In a similar manner, the belt **29** can be moved past the two-part shaft **23***a*, **23***b* for the driven member. Similarly, a replacement belt can be inserted.

The present construction provides an extremely simple device that has a minimum of operating parts. It can be set to an adjusted position with a minimum of difficulty and with extreme accuracy.

The inventor claims:

1. In a compensating device for indicating or recording meters: a pair of members having surfaces of substantially conical form; means mounting said members for rotation in side-by-side relation; the surface of one of said members continuously converging in one direction, and the surface of the other of said members continuously converging in substantially the opposite direction; a flexible belt in engagement with the opposite outside elements of both of said surfaces of said members; a pair of belt shifters cooperable with the belt and determining that portion of the outside elements of said surfaces with which the belt cooperates; said shifters being independently adjustable along the respective outside elements; and releasable means securing the shifters in adjusted position.

2. In a compensating device for rotary meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation in substantially side-by-side relation; the surface of one of said members continuously converging in one direction, and the surface of the other of said members continuously converging in substantially the opposite direction; a flexible belt in engagement with the opposite outside elements of said surfaces respectively; a pair of belt shifters spaced from the outside elements of said surfaces respectively, and accommodating the belt; said shifters being independently adjustable parallel to said

outside elements respectively; and releasable means securing the shifters in adjusted position.

3. In a compensating device for rotary meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation in substantially side-by-side relation; the surface of one of said members continuously converging in one direction, and the surface of the other of said members continuously converging in substantially the opposite direction; a flexible belt in engagement with the opposite outside elements of said surfaces respectively; a pair of grooved rollers, the grooves of which respectively engage the belt at the outside elements; means mounting the rollers for independent adjustment in a direction substantially parallel to said outside elements respectively; and releasable means securing the rollers in adjusted position.

4. In a compensating device for meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation in substantially side-by-side relation; the convergence of the surfaces of the members differing for a direction longitudinally of the members; a flexible belt in engagement with the opposite outside elements of the surfaces respectively; a pair of belt guiding structures independently adjustable longitudinally of said outside elements respectively; and releasable means securing the belt guiding structures in adjusted position.

5. In a compensating device for meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation about parallel axes and in substantially side-by-side relation; the convergence of the members in one direction parallel to said axes differing; a flexible endless belt having an arcuate cross section engaging the opposite outside elements of the surfaces respectively; and a pair of independently adjustable belt guiding structures cooperable with the outside elements respectively for determining a confined space for the belt for shifting the belt longitudinally of said elements.

6. In a transmission for compensating indicating or recording meters: a frame; a pair of members having surfaces of substantially conical form; means mounting said members on said frame for rotation about substantially parallel axes; the convergence of the surfaces being substantially equal, but opposite; said frame including a pair of non-circular bars extending in directions parallel to the opposite outside elements of the surfaces respectively; a flexible belt, the interior of which is in engagement with said opposite outside elements; a pair of arms having belt guiding members cooperable with the belt at those portions of said belt that are in engagement with said opposite outside elements; said arms each having apertures guidingly receiving said bars for adjustably mounting said arms on said bars respectively for independent movement longitudinally with respect to said bars to adjust the position of said belt with respect to said outside elements; and releasable means for securing said arms in adjusted position.

7. In a transmission for compensating indicating or recording meters: a frame; a pair of members having surfaces of substantially conical form; means mounting said members on said frame for rotation about substantially parallel axes; the convergence of the surfaces being substantally equal, but opposite; a pair of non-circular bars mounted on the frame and extending in directions parallel to the opposite outside elements of the surfaces respectively; a flexible belt, the interior of which is in engagement with said opposite outside elements; a pair of grooved rollers, the grooves of which respectively engage the belt at those portions of the belt that are in engagement with said outside elements; brackets rotatably mounting said rollers, said brackets being adjustably mounted on said bars respectively for independent movement longitudinally with respect to said bars to adjust the position of said belt with respect to said outside elements; and releasable means for securing said brackets in adjusted position.

8. In a compensating device for meters or the like: a frame; a pair of members having surfaces of substantially conical form; means mounting said members for rotation in substantially side-by-side relation, comprising a pair of two-part shafts, and a coupling member for each of said two-part shafts; said surfaces of said members differently converging for a direction longitudinally of the members; a flexible belt in engagement with the outside elements of the surfaces respectively; and a pair of belt guiding structures independently adjustable longitudinally of said outside elements respectively; said belt guiding structures being movable to an extreme position in which said belt is out of engagement with said elements.

9. In a compensating device for meters or the like: a pair of members having surfaces of substantially conical form, said members each being of two-part construction; an axially separable connection between the parts of each member; means mounting said members for rotation in substantially side-by-side relation; the convergence of the surfaces of the members differing for a direction longitudinally of the members; a flexible belt in engagement with the outside elements of the surfaces respectively; and a pair of belt guiding structures independently adjustable longitudinally of said outside elements respectively.

10. In a compensating device for meters or the like: a frame; a pair of members having conical surfaces; a pair of two-part shafts for each of said members, one part of each of said two-part shafts extending through said members respectively, and rotatably mounted by said frame, the other part of each of said two-part shafts being substantially aligned with and spaced from said one part respectively, the contiguous ends of said shaft parts being non-circular in section; a connector sleeve for each of said pair of two-part shafts, and having non-circular recesses simultaneously receiving said contiguous ends; means forming an abutment limiting movement of said sleeve in one direction; resilient means urging said sleeves respectively toward said one direction, said two-part shafts being engaged by said sleeves when said sleeves are urged toward said one direction, but being out of simultaneous engagement with said shaft parts upon movement of said sleeve in the opposite direction; a flexible belt in engagement with the outside elements of the surfaces of the members respectively; and a pair of independently adjustable belt guiding structures carried by said frame and determining that portion of the outside elements with which said belt cooperates.

11. In a compensating device for meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation about parallel axes and in substantially side-by-side relation; the convergence of the members in one direction parallel to said axes differing; a flexible belt in engagement with the outside elements of the surfaces respectively; a pair of independently adjustable belt guiding structures cooperable with the outside elements respectively for determining a confined space for the belt for shifting the belt longitudinally of said elements; and releasable means for securing said belt guiding structures in adjusted position.

12. In a compensating device for meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation in substantially side-by-side relation; the convergence of the surfaces of the members differing for a direction longitudinally of the members; a flexible endless belt having an arcuate cross section, the belt engaging opposite outside elements of the surfaces respectively; and a pair of belt guiding structures independently adjustable longitudinally of said outside elements respectively.

13. In a compensating device for meters or the like: a pair of members having surfaces of substantially conical form; means mounting said members for rotation in substantially side-by-side relation; the convergence of the surfaces of the members differing for a direction longitudinally of the members; a flexible endless belt having an arcuate cross section, the belt engaging opposite outside elements of the surfaces respectively; a pair of belt guiding structures independently adjustable longitudinally of said outside elements respectively; and releasable means securing the belt guiding structures in adjusted position.

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