

May 23, 1939.

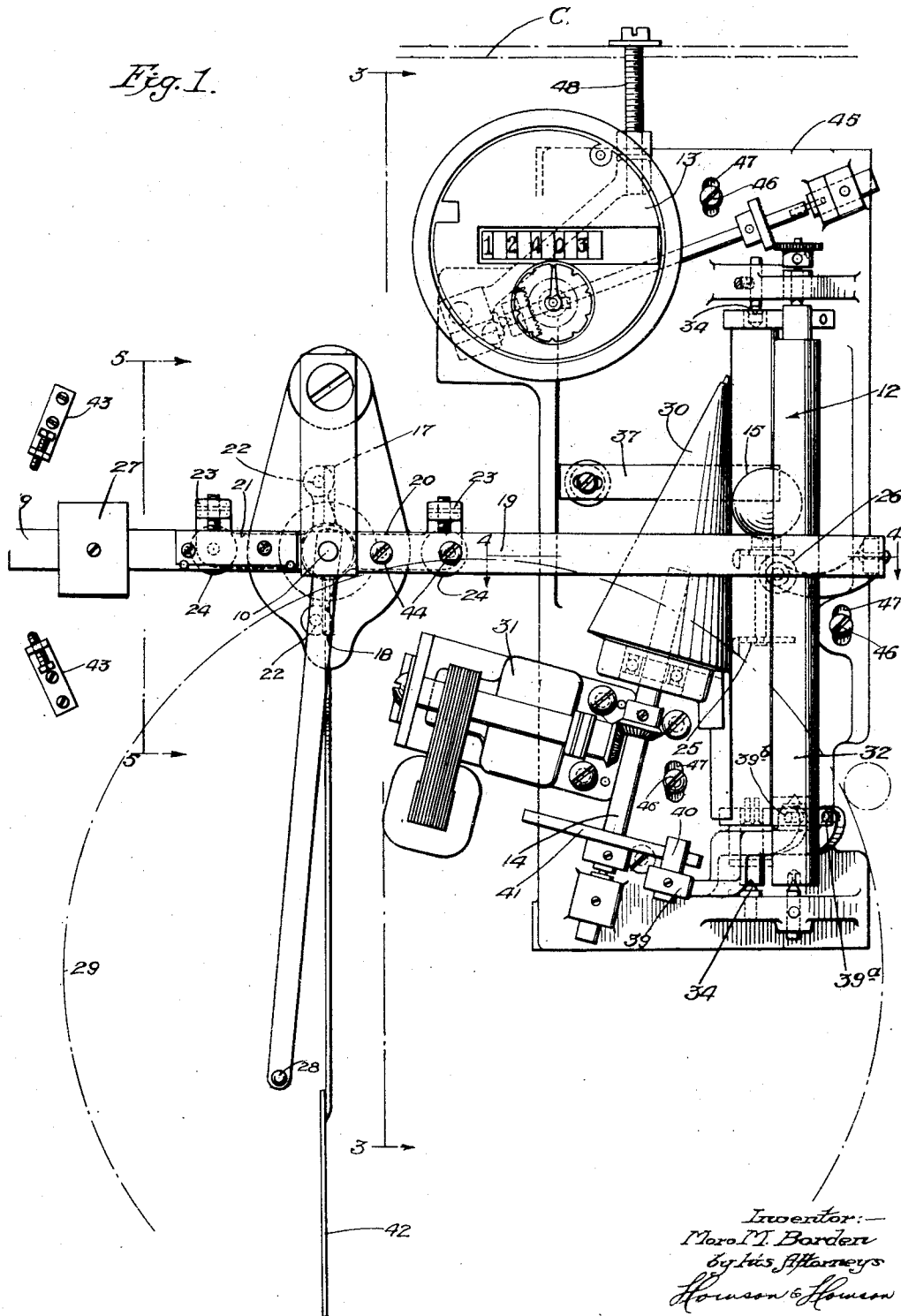
M. M. BORDEN

2,159,882

INTEGRATOR

Filed June 19, 1934

6 Sheets-Sheet 1



May 23, 1939.

M. M. BORDEN

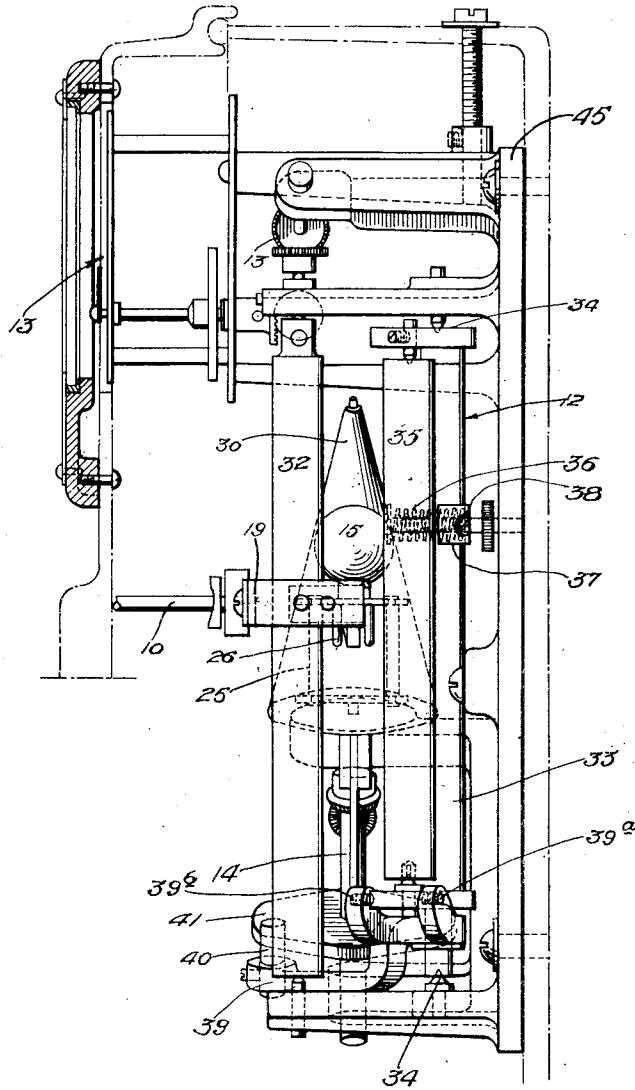
2,159,882

INTEGRATOR

Filed June 19, 1934

6 Sheets-Sheet 2

Fig. 2.



Inventor:—
Moro M. Borden
by his attorneys
Hansen Hanson

May 23, 1939.

M. M. BORDEN

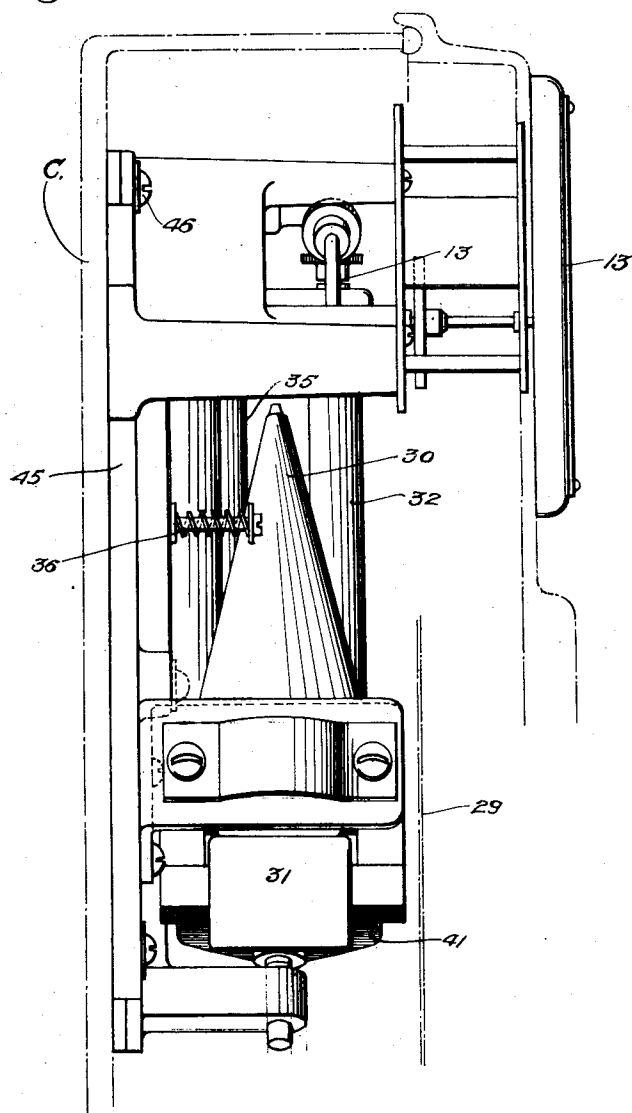
2,159,882

INTEGRATOR

Filed June 19, 1934

6 Sheets-Sheet 3

Fig. 3.



*Inventor:—
Moro M. Borden
by his attorneys
Howe & Howe*

May 23, 1939.

M. M. BORDEN

2,159,882

INTEGRATOR

Filed June 19, 1934

6 Sheets-Sheet 4

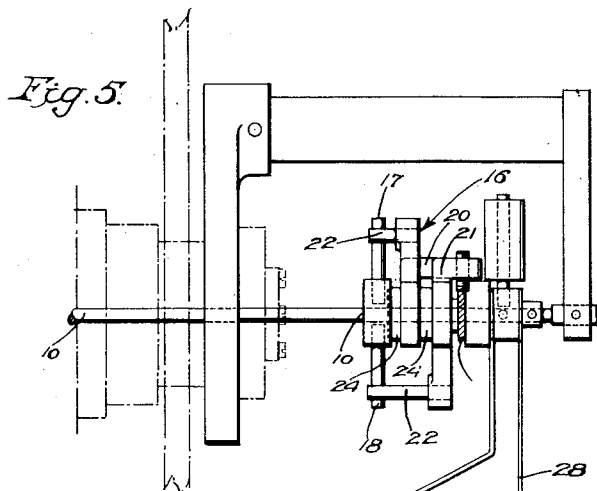
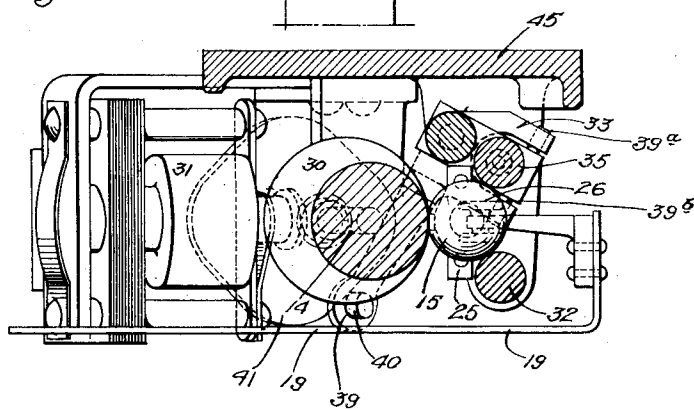


Fig. 4.



Inventor:—
Moro M. Borden
by his attorneys
Hansen & Hansen

May 23, 1939.

M. M. BORDEN

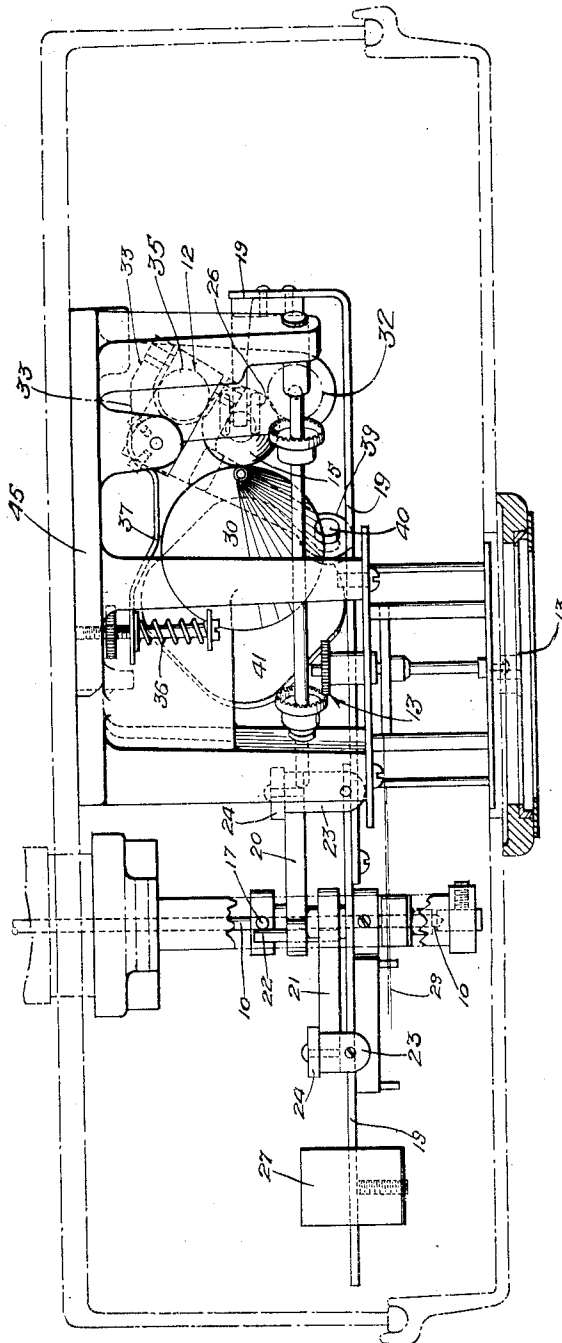
2,159,882

INTEGRATOR

Filed June 19, 1934

6 Sheets-Sheet 5

Fig. 6.



Inventor:
Moro M. Borden
by his Attorneys
Hanson & Hanson

May 23, 1939.

M. M. BORDEN

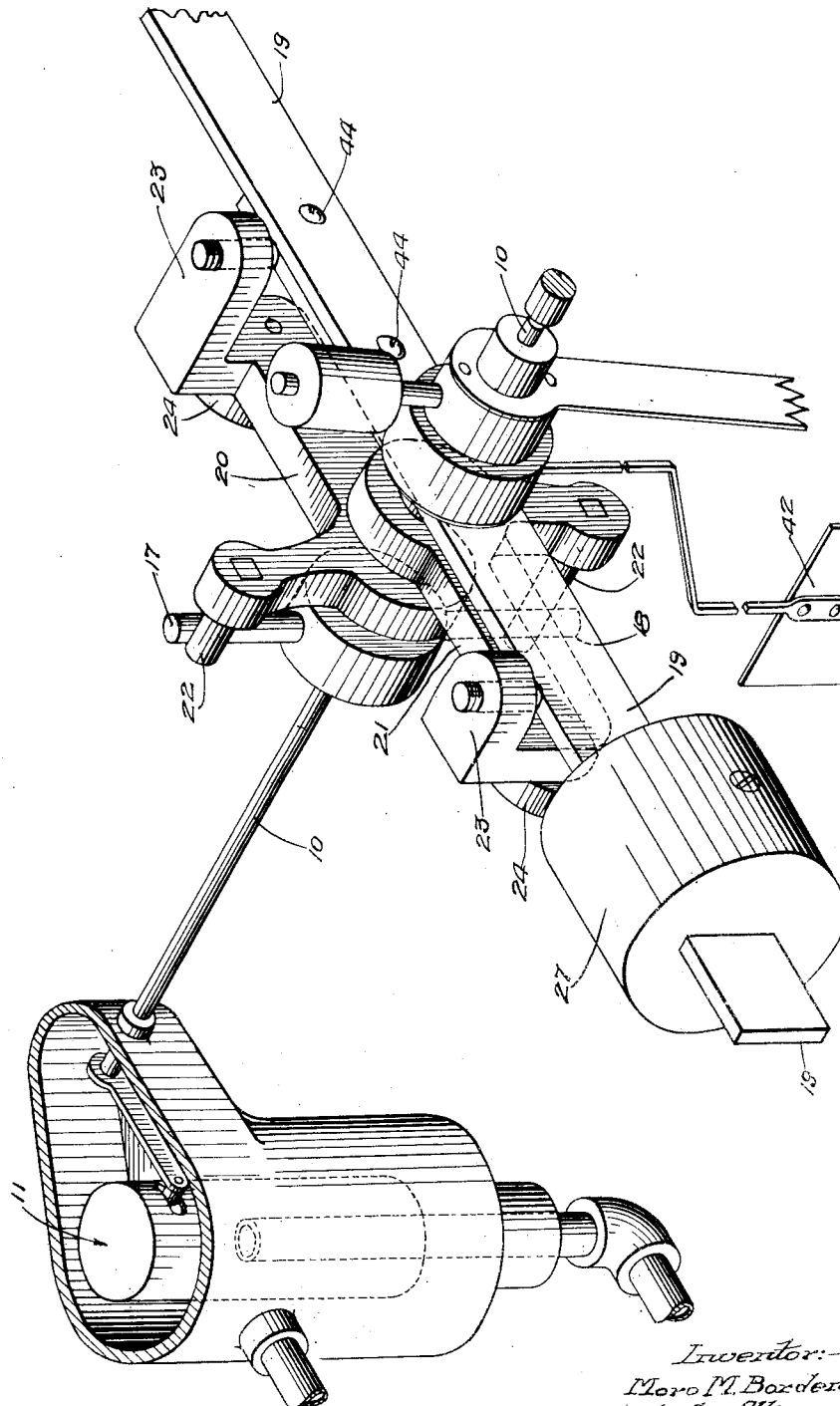
2,159,882

INTEGRATOR

Filed June 19, 1934

6 Sheets-Sheet 6

Fig. 7.



Inventor:
Moro M. Borden
by his attorneys
Hanson & Hanson

UNITED STATES PATENT OFFICE

2,159,882

INTEGRATOR

Moro M. Borden, Philadelphia, Pa., assignor to
Simplex Valve and Meter Company, Philadel-
phia, Pa., a corporation of Delaware

Application June 19, 1934, Serial No. 731,359

11 Claims. (Cl. 234-2)

This invention relates to integrators, and more particularly to apparatus for providing a total closely approximating accuracy, which total is based on two or more factors one or more of which are variable.

In many instances where a reasonably accurate total reading is desired, one or more variable factors in the total render it extremely difficult to mechanically produce the same. For example, flow meters which are employed in connection with pulsating flows offer considerable difficulty. The usual apparatus employed comprises a counter mechanism bodily moved over the surface of a disc, which is rotated by a clock, and a friction wheel which is continually engaged with the disc and drives the counter mechanism. Variations of the total result from movement of the counter mechanism in accordance with variations in flow. Obviously, with rapid variation in the flow rate, a considerable portion of the friction wheel's movement upon the disc is diametral to the disc with resulting inaccuracies in the total. Furthermore, the excessive diametral movement results in rapid deterioration of the friction wheel with consequent failures and lack of totalization and high upkeep costs. Accordingly, where such flows are to be totalized, it is common practice to employ the record sheet as a means for obtaining the total flow rather than any mechanical totalizing mechanism. In accomplishing the totalization from the record sheet, the flow rate at common terminals of uniform time intervals is employed as the rate during such time intervals. Such procedure is time consuming and offers no means of determining the total flow except at periods when the chart is removable from the machine.

An important object of this invention is the provision of an apparatus which may be employed in providing a total based on factors of this character and by means of which the averaging, ordinarily manually effected, is accomplished automatically and a continuous total record provided.

A further and more specific object of the invention is the provision of totalizing mechanism and a means for impressing on this totalizing mechanism at predetermined intervals the various factors comprising the total, and which includes an arrangement whereby that factor which is acutely variable is prevented from variation in the mechanism proper during the period of operation of the totalizing mechanism.

A further object of the invention is the provision of a structure of this character in which

mechanism representing the variable factor of the total is employed in the operation of the shifting element of a micrometrically variable transmission and is so arranged that it may be periodically rendered ineffective to shift the shifting element of the transmission so that the position of the shifting element at the beginning of such period may be employed in determining the output speed of the transmission which is impressed upon the totalizing mechanism.

A further object of the invention is the provision of novel means for disconnecting the shifting element of the transmission.

A still further object of the invention is the provision of a transmission mechanism more conveniently adaptable to an apparatus of this character than the transmission mechanisms now commonly employed in such devices.

These and other objects I attain by the construction shown in the accompanying drawings wherein, for the purpose of illustration, I have shown a preferred embodiment of my invention and wherein:

Fig. 1 is a front elevation of mechanism constructed in accordance with my invention;

Fig. 2 is a side elevation thereof;

Fig. 3 is a section on line 3-3 of Fig. 1;

Fig. 4 is a section on line 4-4 of Fig. 1;

Fig. 5 is a section on line 5-5 of Fig. 1;

Fig. 6 is a plan view of the mechanism; and

Fig. 7 is a diagrammatic perspective illustrating the connections between the meter shaft and the operating arm.

Referring now more particularly to the drawings, the mechanism comprises generally a shaft 10 oscillated by and in accordance with the variable factor, in the present instance changes in the rate of flow in a flow line, such oscillation being accomplished by any suitable mechanism such as a float 11 operatively connected with the shaft; 12, a transmission mechanism having its output shaft connected to a counter mechanism 13 and its input shaft 14 driven by and in accordance with an element representing the second factor of the desired total, and 15, the shiftable element of the transmission which is operated from shaft 10 through clutch mechanism generally designated at 16 which permits the shiftable element to be periodically held in any given position.

The complete connections between shaft 10 and shiftable element 15 comprise a pair of pins 17 and 18 fixed to shaft 10 and at present shown as oppositely extending therefrom, an operating arm 19 rotatable about the shaft and engaged

with the shiftable element 15 and a pair of shifting arms 20 and 21 rotatable on shaft 10 and each having a lateral projection 22 arranged in the path of a pin 17 or 18, and a lateral projection 23 to vertically align with the operating arm 19 and overlying the same. The engagement of the lateral projections 22 is with corresponding sides of the pins 17 and 18; that is to say, these projections engage the arms at the inner side of the included angle between the arms with the result that upon rotation of shaft 10 in either direction a pin 17 or 18 will forcibly engage one of the lateral projections while the other of these arms will recede from the lateral projection. Due, however, to the fact that the shifting arms 20 and 21 are counterweighted as at 24 upon those ends thereof bearing the lateral projections 23, the lateral projection 22 of the arm from which the pin 17 or 18 is receding will follow the pin and in so doing will place its weight against the operating arm 19 causing the same to rotate by and in accordance with the rotation of shaft 10. Operating arm 19 supports the shifting element 15 which is in the form of a sphere for vertical movement through a cage 25, the cage being engaged by the arm through a roller 26. The weight of the cage and sphere are carefully counterbalanced, as indicated at 27, the counterbalancing being such that with removal of the weight of the sphere from the cage the counterweight will at all times maintain the cage in engagement with the sphere without regard as to whether pressure is being placed on the operating arm through one or the other of the shifting arms 20 and 21. The mechanism just described, provides, therefore, a means for operating the movable element 15 by and in accordance with oscillation of shaft 10 while still permitting the operating element to be held stationary during continued operation of the shaft 10. Since the shaft may be continually in operation, it may be employed in operation of the usual chart pen 28 co-acting with a chart 29.

The transmission mechanism is of the micro-metrically variable type, comprising a cone 30 driven by the input shaft 14 which is at present illustrated as being driven by a synchronous motor 31. The use of such a motor as a drive for shaft 14 is, of course, possible wherever the second factor of the desired total is uniform and must, obviously, be replaced by other mechanism where the second factor is likewise a variable. Paralleling the face of the cone is a shaft 32 constituting the output shaft of the transmission. A bracket 33 is mounted for oscillation in suitable bearings 34 and bears a roller 35 paralleling shaft 32. A spring 36 acting through a plate 37 secured to bracket 33 at 38 constantly urges roller 35 in a direction to cause this roller to clamp sphere 15 between roller 35 and cone 30 so that cone 30 may, through sphere 15, drive the shaft 32 at a speed determined by the speed of rotation of the cone and the position of the sphere. Bracket 33 has an arm 39, the position of which with relation to the bracket may be adjustably determined by screws 39a and 39b, and this arm is equipped with a pin 40 co-acting with a multi-lobe cam 41 at present shown as mounted on shaft 14, the lobes of this cam serving when in engagement with the pin 40 to rotate the bracket 33 and disengage roller 35 from the sphere so that the drive between the cone 30 and shaft 32 is interrupted. The adjustment of arm 39 permits regulation of the clearance between

roller 35 and the cone, and thus provides for regulation of the time of driving contact.

Let it be assumed, for illustration, that cam 41 allows a fifteen-second clamping of the sphere to the shaft and cone of the transmission, and then disengages for a period of five seconds; under these conditions, the sphere when released will assume a new position corresponding to any variation which may have occurred in the position of shaft 10, being impelled to its new position through movement of the arm 19. At the close of the five-second period, the sphere is clamped to the shaft and cone and will remain in its new position due to the clamping action so that the arm 19 is relieved of the weight of the sphere. Shaft 10 may continue to oscillate, but since the driving connections between this shaft are by means of counterweighted arms 20 and 21 and weight 27 is sufficient to maintain the sphere-engaging end of the arm 19 in elevated position against the action of either of these arms, the position of operating arm 19 will not change. With the close of the fifteen-second period, the arm again assumes the weight of the sphere and will move to its new position. The driving connections between output shaft 32 and the counter 13 will, of course, be regulated to suit the proportionate lengths of driving and idle periods; that is to say, in the present illustration will be so proportioned that during the fifteen-second driving period the counter is driven at a rate of one-third higher than the actual rate of drive shaft 32 so that the record provided is for an actual twenty-second period. It will be understood that the timing as above referred to is, and should be, capable of immediate variation in any meter produced for commerce, since the various requirements of different situations will necessitate changes in the timing. It is to this end that the cam is made removable from shaft 14 and replacement of this cam will permit any timing variation which may be desired. Shaft 14 has at present been illustrated as the drive for cam 41, this being possible in the present illustration due to the fact that shaft 14 is driven at a uniform rate. Where the rate of rotation of shaft 14 is variable, a constant speed drive for the cam must be employed.

In order that arm 19 may not move too rapidly in shifting from one to another of its positions, a damper 42 is preferably provided for preventing too rapid oscillation thereof. The swinging movement of the arm is, furthermore, limited by positive stops 43 when in its maximum and minimum positions. To facilitate assembly of the structure and repair or replacement of the transmission unit this arm is formed in two sections connected by screws 44. To this same end, the transmission unit is mounted upon a plate 45, which plate is secured to the wall of case C by screws 46. The screws 46 extend through slots 47 which are elongated in a direction perpendicular to the arm when in its central position illustrated in Fig. 1. Through the upper wall of the case C a screw 48 is directed, this screw permitting vertical adjustment of the transmission and, accordingly, providing a means for correlating the zero position of the pen and the zero position of the transmission unit.

Since the construction illustrated is capable of considerable modification without departing from the spirit of my invention, I do not wish to be understood as limiting myself thereto except as hereinafter claimed.

I claim:

1. In mechanism of the type described, the combination of a meter, a totalizer, a drive for said totalizer, means to intermittently connect said drive and totalizer comprising a micrometrically-variable speed transmission including a shiftable element controlling variation of the speed at which the totalizer is operated and means controlled by the meter for shifting said shiftable element, said means being inoperative to shift said element upon connection of the drive to the totalizer.

2. In mechanism of the type described, the combination of a meter, a totalizer, a drive for said totalizer, means to intermittently connect said drive and totalizer comprising a transmission affording micrometric variation of delivered speed, means controlled by said meter controlling the delivered speed of the transmission, and means to render the meter inoperative to control the transmission during connection of the drive to the totalizer.

3. In combination, a transmission comprising a driving and a driven element rotating about non-parallel axes and having substantially parallel working faces, a friction element movable along said faces, meter-controlled means to move said friction element along said faces and means to intermittently force said friction element into frictional driving engagement with said faces and to hold said element against movement by said meter-controlled means while the said element is in frictional driving engagement with said faces.

4. In mechanism of the type described, the combination of a meter, a totalizer, a drive for said totalizer, means to intermittently connect said drive and totalizer comprising a micrometrically-variable speed transmission including a shiftable element controlling variation of the speed at which the totalizer is operated, a shifter for said element, a connection between the meter and the shifter including a yielding clutch permitting the shifter to remain stationary during continued operation of the meter and means to hold the shiftable element against movement by said shifter when the drive is connected to the totalizer.

5. In mechanism of the type described, a shiftable arm, a meter, a yieldable controlling connection between the meter and arm permitting the arm to be maintained stationary during continued operation of the meter, a friction type transmission including driving and driven elements and a shiftable element to variably connect said driving and driven elements, said arm operatively engaging the shiftable element to shift the same, and means to intermittently render the shiftable element operative to connect the driving and driven elements and maintaining the shiftable element against shifting by said arm when in its connecting position.

6. Means to provide a totalized meter record, said means comprising a friction type transmission including driving and driven elements and a shiftable element to establish driving connection therebetween, shifting of said shiftable element providing variation of the speed of the driven element, means to register movements of the driven element, means to intermittently move the shiftable element into and out of operative engagement with the driving and driven elements and holding the shiftable element against shifting movement when in operative engagement with the driving and driven elements, means to shift the shiftable element by and in accordance with

variations of said meter including clutch mechanism permitting the shiftable element to remain stationary as regards changes of its position as a result of variations of said meter, and means to drive the driving element of the transmission.

7. Means to provide a totalized meter record, said means comprising a friction type transmission including driving and driven elements and a shiftable element to establish driving connection therebetween, shifting of said shiftable element providing variation of the speed of the driven element, means to register movements of the driven element, means to intermittently move the shiftable element into and out of operative engagement with the driving and driven elements and holding the shiftable element against shifting movement when in operative engagement with the driving and driven elements, a member moving in accordance with the variations of the meter, means to shift the shiftable element by and in accordance with movements of said member, including clutch mechanism permitting the shiftable element to remain stationary as regards changes of its position as a result of variations of said meter, and means to drive the driving element of the transmission.

8. Means to provide a totalized meter record, said means comprising a friction type transmission including driving and driven elements and a shiftable element to establish driving connection therebetween, shifting of said shiftable element providing variation of the speed of the driven element, means to register movements of the driven element, means to intermittently move the shiftable element into and out of operative engagement with the driving and driven elements and holding the shiftable element against shifting movement when in operative engagement with the driving and driven elements, means to shift the shiftable element by and in accordance with variations of said meter including clutch mechanism permitting the shiftable element to remain stationary as regards changes of its position as a result of variations of the position of said member, means to drive the driving element of the transmission and means providing a continuous record of variations of the meter.

9. Means to provide a totalized meter record, said means comprising a friction type transmission including driving and driven elements and a shiftable element to establish driving connection therebetween, shifting of said shiftable element providing variation of the speed of the driven element, means to register movements of the driven element, means to intermittently move the shiftable element into and out of operative engagement with the driving and driven elements and holding the shiftable element against shifting movement when in operative engagement with the driving and driven elements, a member moving in accordance with the variations of the meter, means to shift the shiftable element by and in accordance with movements of said member, including clutch mechanism permitting the shiftable element to remain stationary as regards changes of its position as a result of variations of the position of said member, means to drive the driving element of the transmission, and means including a device shifted by said member providing a continuous record of variations of the meter.

10. In combination, a transmission comprising a driving and a driven element rotating about non-parallel axes and having substantially parallel working faces, a friction element mov-

able along said faces, meter-controlled means to move said friction element along said faces and means to force said friction element into frictional driving engagement with said faces and to hold said friction element against shifting by said meter-controlled means.

11. In mechanism of the type described, a shiftable arm, a meter, a controlling connection between the meter and arm constructed and arranged to permit the arm to be maintained sta-

tionary during continued operation of the meter, a transmission comprising driving and driven elements rotating about non-parallel axes and having substantially parallel working faces, a friction element movable along said faces, means to move the friction element along the said faces by said arm, and means to intermittently force said friction element into frictional engagement with said faces.

MORO M. BORDEN. 10