April 15, 1958 E. M. CHRISTENSEN 2,830,762

ANALOG STORAGE MECHANISM

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FIG. 1

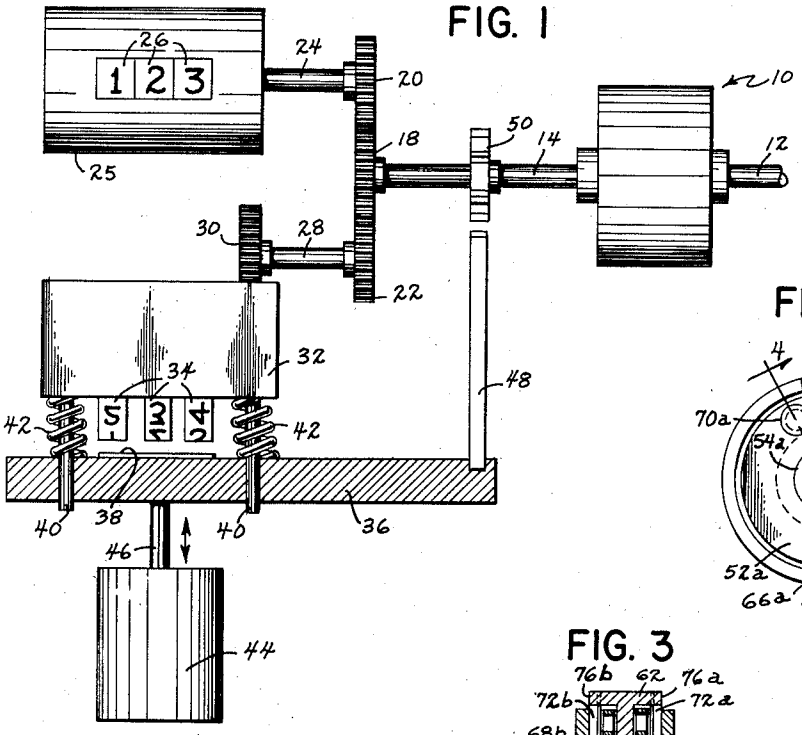


FIG. 2

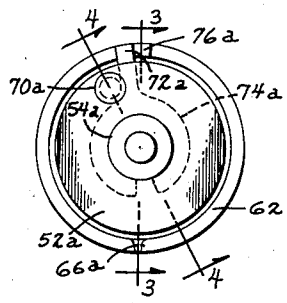


FIG. 3

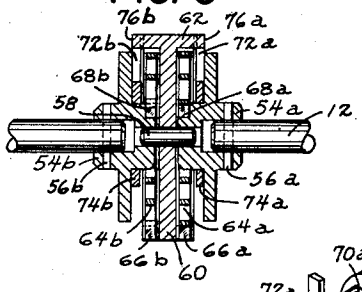


FIG. 4

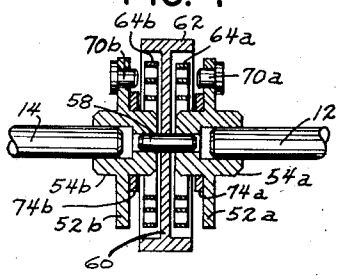


FIG. 5

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ANALOG STORAGE MECHANISM

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This invention relates generally to drive mechanisms and pertains more particularly to an analog storage mechanism capable of storing various degrees of input shaft rotations while an output shaft is temporarily held stationary.

One object of the invention is to store the rotation imparted to a drive shaft while the driven shaft is held stationary so that a driven device may be properly operated without losing the information currently being fed to the drive shaft. In this regard it is intended to utilize a form of spring action in such a way that a predetermined amount of drive shaft rotation can be stored during, for example, the time that it takes to make a static reading of a counter or to make a printed record thereof.

Another object of the invention is to provide an analog storage mechanism that will accurately store the information during the stopping operation and which information will be fully recovered after stoppage so that no errors are introduced in the system. More particularly, the invention envisages a preloading of the springs of which the mechanism is comprised, which preloading is instrumental in assuring an accurate repositioning of the output shaft once the shaft has been released.

A further object of the invention is to provide a mechanism of the foregoing character which is capable of acting in either rotative direction.

Yet another object of the invention resides in the provision of mechanism by which almost two complete revolutions of the drive shaft may be stored during stoppage of the driven shaft.

Still further, it is within the contemplation of the invention to provide a drive mechanism capable of carrying out the foregoing aims which will be rugged and long-lasting, requiring little or no maintenace.

Other objects will be in part obvious, and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

In the drawing:

Figure 1 is an elevational view, partly schematic in nature, which shows one use to which the invention may be put;

Fig. 2 is an end view of the analog storage mechanism;

Fig. 3 is a sectional view taken in the direction of line 3—3 of Fig. 2;

Fig. 4 is a sectional view somewhat angularly spaced from Fig. 3 taken in the direction of line 4—4 of Fig. 2; and

Fig. 5 is an exploded perspective view of the storage mechanism illustrating in more detail the various configurations of the parts making up this storage mechanism.

Referring now in detail to the drawing, it is to be observed that the storage mechanism has been generally designated by the reference numeral **10**. In order to appreciate fully the benefits to be derived from the mechanism **10**, a system wherein the mechanism will find especial utility will first be described before going into detail as to the specific construction of the parts making up the mechanism **10**. Accordingly, it is to be observed from Fig. 1 that the system may include an input or drive shaft **12** coupled to the mechanism **10** and the system further includes an output or driven shaft **14**. The driven shaft **14** is equipped with a gear **18** which is enmeshed with two driven gears **20** and **22**. The driven gear **20** is directly connected to a shaft **24** which is in turn coupled to a counting device **25**. The counting device **25** may be of conventional construction and need not be further elaborated upon other than to say that it is equipped with a plurality of number wheels **26**. By reason of rotation imparted to the shaft **24** the number wheels **26** will register the total number of revolutions of the shaft **24** and of course the shaft **24** rotates in direct proportion to the input shaft **12** so that an accurate determination of the number of revolutions of the shaft **12** may be obtained.

Also included in the system depicted in Fig. 1 is another shaft **28**, this shaft being directly connected to the driven gear **22** and having at its other end a gear **30** by way of which a printing device **32** may be rotatively indexed. Here again, the device **32**, like the earlier described device **24**, is equipped with a plurality of rotatable wheels **34**. However, in this instance, the wheels **34** are capable of performing a printing operation, these wheels being of rubber or metal or other material having the appropriate numerical type embossed thereon.

The printing device **32** also has included as a part thereof a bed plate **36** upon which a card or tape **38** rests, which card or tape receives the printing from the number wheels **34** either by ink applied to said wheels or by a type ribbon or carbon paper thereunder. The bed **36** is disposed for vertical reciprocation by a pair of guide rods **40** having circumposed thereabout springs **42**, which springs act in a direction to urge normally the bed plate **36** in a downward direction relatively to the fixedly located device **32**. For the purpose of overcoming the action of the springs **42**, there is located subjacently the bed plate **36** a solenoid **44** having its armature **46** connected to the underside of the bed plate. When the solenoid **44** is energized the armature **46** is moved upwardly so that the springs **42** are overcome and the type on the printing wheels **34** then contacts the card or tape **38**.

From the foregoing it can be appreciated, it is believed, that if the printing wheels **34** are rotating at the time that the solenoid **44** is energized, then a clear-cut printing can not be achieved. Therefore, it is extremely desirable in order to produce a legible record to have the number wheels **34** stationary while a printing operation is taking place. To this end the bed plate **36** is provided with an upstanding pawl element **48** which is engageable with a star wheel **50** mounted on the driven shaft **14**. Hence when the solenoid **44** is energized, not only does the printing operation take place but concurrently therewith the driven shaft **14** is stopped so that there is no further movement of the printing wheels **34** and consequently a clearly readable record is produced on the card or tape **38**.

Describing now the specific construction of the storage mechanism **10** by which the above-alluded to stoppage can be achieved without loss of information being supplied via the input shaft **12**, it will be observed that the mechanism **10** comprises a pair of axially spaced discs **52***a* and **52***b*. These rotatable discs **52***a* and **52***b* are respectively equipped with hubs **54***a* and **54***b*. Rotation of the drive shaft **12** and the hub **54***a* is by reason of a transverse pin **56***a* and rotation of the hub **54***b* is in turn transmitted to the driven shaft **14** by means of a second pin **56***b*. A floating shaft **58** is journaled for rotation in

the hubs 54*a* and 54*b*. Carried by the floating shaft 58 is an intermediate disc or housing 60 having a peripheral flange or rim 62 forming recesses for the housing of a pair of coiled flat springs 64*a* and 64*b*. The outer ends of these springs 64*a* and 64*b* are received in notches 66*a* and 66*b* in the rim 62 whereas the opposite or inner ends of the springs are similarly accommodated in notches 68*a* and 68*b* disposed in the hubs 54*a* and 54*b*.

The mechanism 10 further includes a pair of axially directed pins 70*a* and 70*b* mounted in radial portions of the discs 52*a* and 52*b*. These pins 70*a* and 70*b* are respectively engageable with a pair of rotatable arms 72*a* and 72*b* having thereon ring portions 74*a* and 74*b* which loosely circumscribe the hubs 54*a* and 54*b*. Stop elements in the form of projections 76*a* and 76*b* are also engageable by the arms 72*a* and 72*b* inasmuch as the arms are of sufficient radial length so as to engage both the pins 70*a* and 70*b* as well as the more radially displaced stops 76*a* and 76*b*.

As hereinbefore indicated, it is possible to preload the springs 64*a* and 64*b* so as to produce an accurate transmission of power between the shafts 12 and 14. By preloading the springs 64*a* and 64*b*, the torque required in driving the output shaft 14 is adequately compensated for. More specifically, it may be explained that the devices 25 and 32 quite obviously require a certain amount of driving force for their operation and by preloading the springs so that the springs do not have to be flexed in order to transmit this amount of driving force, there is eliminated the degree of rotation of the drive shaft that otherwise would be necessary in winding up one spring in order to rotate the output shaft 14 so as to supply the necessary take-up force that would be needed in rotating the two devices 25 and 32. As long as the sum of the friction, holding, inertia and other rotational forces does not exceed the preload of the particular spring being wound, a stable position is accurately maintained.

Referring now to the manner in which the aforementioned preloading is obtained, reference should be had to Figs. 2 and 4. If we assume that Fig. 2 is an end view of Fig. 4 taken from the right side, it can readily be appreciated that by rotating the disc 52*a* sufficiently counterclockwise so that the pin 70*a* assumes its angular position shown in Fig. 2, there will have been imparted to the spring 64*a* a certain amount of distortion. This distortion or flexing of the spring 64*a* is retained by way of the arm 72*a* which is interposed between the pin 70*a* and the stop 76*a* integral with rim 62 of the intermediate disc 60. If the other pin 70*b* is rotated in the same direction, which is, of course, opposing any tendency for the pin 70*a* to return to its free position, then a preloading of the spring 64*b* will be obtained. Actually, the degree of preloading will be determined by the amount of load to which the driven shaft 14 is subjected and with this in mind, it can readily be appreciated that the pins 70*a* and 70*b* need not be fixedly located on the two axially spaced discs 52*a* and 52*b* until the requisite amount of preloading has been imparted to the springs 64*a* and 64*b*. This location of the pins 70*a* and 70*b* may be readily obtained by postponing the drilling of the apertures in which they are received until the desired amount of preloading has been ascertained. At any rate, the locating of the pins 70*a* and 70*b* is instrumental in retaining the desired amount of preloading. However, if desired, the springs 64*a*, 64*b* may be replaced with springs having different spring constants in order to vary the preloading.

Having explained how the preloading of the springs 64*a* and 64*b* is determined, it is felt that the operation of the device will be readily apparent. However, a brief outline of what transpires will unquestionably be of help in producing a facile understanding of the merits involved in the use of the exemplified analog storage mechanism labelled 10. We will therefore assume that the input or drive shaft 12 is supplying analog information to the mechanism 10. This information is to be transmitted to both the counting device 24 and the printing device 32. However, in order to produce a good record of the number of revolutions produced by input shaft 12 it is necessary to stop the driven shaft 14 while the printing operation is taking place. As already mentioned, this is accomplished by engaging the pawl 48 with the star wheel 50 through the medium of the solenoid 44.

The point to be stressed here is that while the stoppage of the star wheel is taking place, intelligence or information is still being imparted to the drive shaft 12 and this information must be stored for subsequent release if the next printing operation is to be a correct one. In this regard, it will be remembered that the preloading of the spring 64*a* was in a counterclockwise direction when viewed from the right in Fig. 4. If we now assume that the input or drive shaft 12 is rotating counterclockwise and the output shaft 14 is held stationary, the disc 52*a* will be so rotated that the pin 70*a* will move away from the arm 72*a* and will rotate substantially a full revolution before it engages the opposite side of this arm 72*a*. Once this has occurred, then the pin 70*a* will continue to rotate in the same direction but will cause the arm 72*a* to move therewith. The arm 72*a* can therefore move almost a complete revolution before it engages the opposite side of the stop 76*a*. It is the engagement of the opposite side of the stop 76*a* that causes a direct mechanical drive to then be produced. Consequently it can be seen thatt here is introduced a storage of almost two complete revolutions of the drive shaft 12, being less than two revolutions by only the width of the arm 72 and the width of the stop 76*a*. All the while that this is taking place, the spring 64*a* is being wound up inasmuch as the shaft 14 is being held stationary by virtue of the energization of the solenoid 44. Of course, during this period the stop 76*b* attempts to rotate, but its rotational tendency is restrained by the arm 72*b* and the pin 70*b*, the latter being unable to move owing to its location on the now stationary disc 52*b*. When the solenoid 44 is deenergized, then the spring 64*a* releases its stored energy, unwinding itself, and this unwinding action is transmitted via the intermediate disc 60 through the stop 76*b*, arm 72*b*, and pin 70*b* to the disc 52*b*.

On the other hand, if the rotation of the shaft 12 should be in the opposite direction, then the stop 76*b* moves in a direction away from its arm 72*b* and winds up this latter spring 64*b*. By the same token, then, release of the shaft 14 by reason of the deenergization of the solenoid 44 will cause the spring 64*b* to unwind itself and advance the number wheels 26 and the printing wheels 34 to the correct position that they would have been rotated to if the stopping action had not been introduced.

From the foregoing operational sequence it is believed quite apparent that the shaft 12 may rotate in either direction and the particular direction in which this shaft rotates determines which spring 64*a* and 64*b* is to become operative as far as storing energy therein is concerned. Further, it will be manifest that the shaft 12 may rotate almost two full revolutions before a direct mechanical drive is inaugurated, thereby leaving ample time for the printing operation to take place.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. An analog storage mechanism comprising a drive shaft, a driven shaft and an intermediate member mounted for relative rotation between said shafts, a first spring connecting the drive shaft to said intermediate member, a second spring connecting said intermediate member to said driven shaft, and means for preloading each of said springs, said preloading means including a stop element on each side of said intermediate member, a stop element offset from the axis of rotation of each shaft and rotatable in unison with its associated shaft, and an arm on each side of said intermediate member, each arm being engageable with one of said intermediate stop elements and the stop element associated with the shaft on that side.

2. An analog storage mechanism comprising first, second and third relatively rotatable discs, a first spring connecting the first disc to the second, a second spring connecting the second disc to the third, an axial projection on each side of said second disc at one radius, an axial projection on each of said first and third discs at a lesser radius than the projections on said second disc, a rotatable arm intermediate the first and second discs, and a rotatable arm intermediate the second and third discs, said first arm being of sufficient length so as to be engageable by the projection on said first disc and the adjacent projection on said second disc and said second arm being of sufficient length so as to be engageable by the projection on said third disc and the other projection on said second disc, whereby a selected rotation of said first and third discs in one direction will preload said springs, engagement of the projections on said first and third discs with their associated arms and engagement of said arms in turn with the projections on said second disc maintaining a preloaded spring relationship.

3. An analog storage mechanism comprising a pair of discs each having a hub connected with a shaft for rotation therewith, a third disc between said pair of discs journaled for relative rotation with respect thereto, said third disc having a projection on either side at a location radially spaced from its center of rotation, a coil spring on each side of the third disc having one end anchored to said third disc and its other end anchored to one of said pair of discs, respectively, an arm associated with each of said pair of discs having a portion thereof freely encircling the hub of that particular disc, a projection on each of said pair of discs engageable with one of the arms, whereby said coil springs may each be preloaded by flexing said springs and having said arms normally engage the projections on said pair of discs and on said third disc in the flexed condition of said springs.

4. An analog storage mechanism in accordance with claim 3 in which the projections on said third disc are located at a greater radius from the center of rotation than are the projections on said pair of discs, whereby rotation of one of said pair of discs can occur while the other of said pair of discs is held stationary.

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