Sept. 19, 1961 J. F. CLANCY 3,000,560

ANNULI ACCUMULATOR INSTRUMENTS

Filed June 4, 1958 2 Sheets-Sheet 1

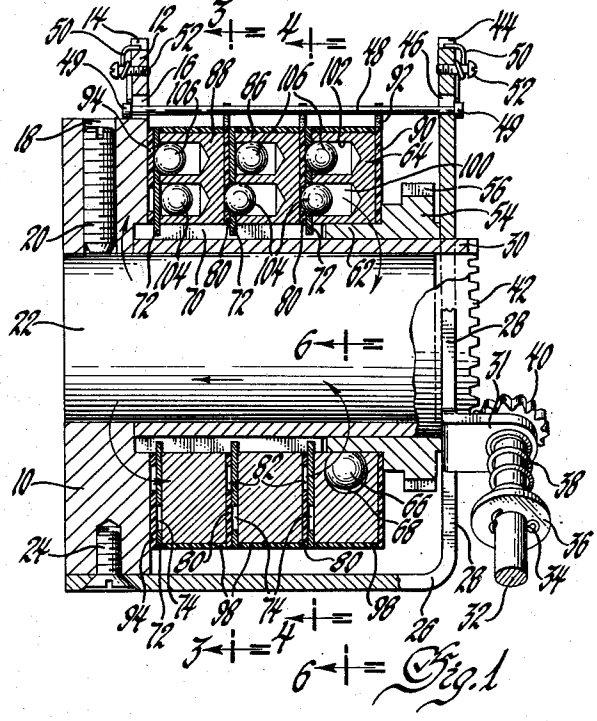


Fig. 1

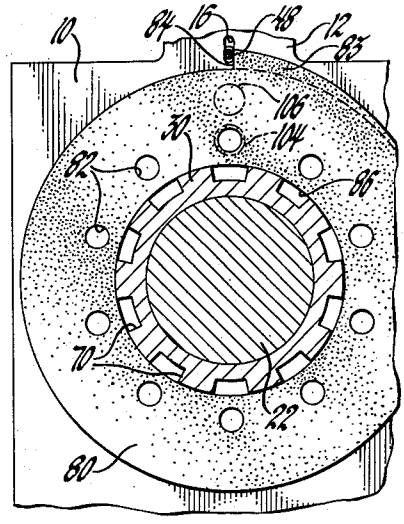


Fig. 3

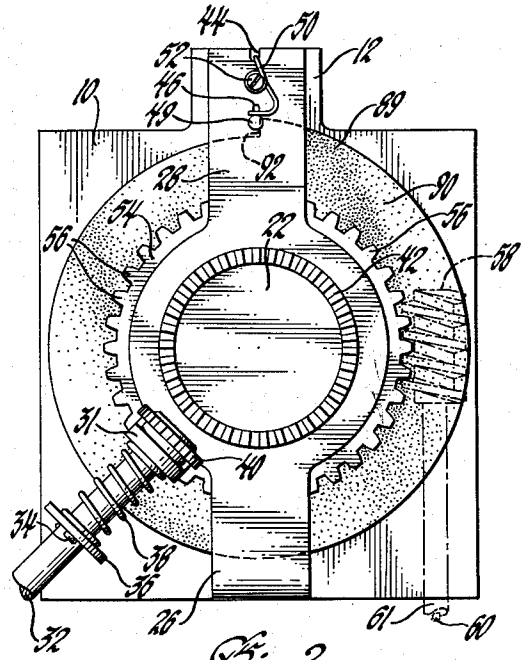


Fig. 2

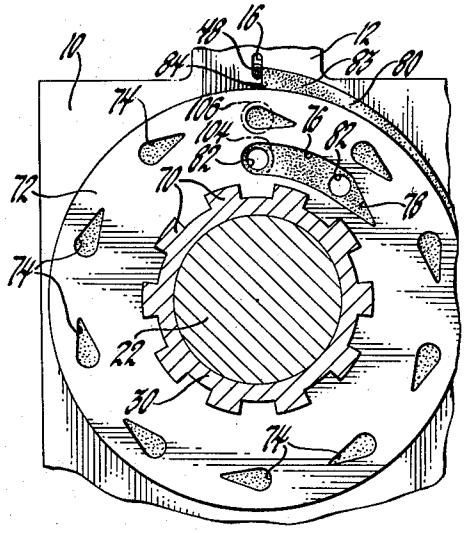


Fig. 4

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Sept. 19, 1961 J. F. CLANCY 3,000,560

ANNULI ACCUMULATOR INSTRUMENTS

Filed June 4, 1958 2 Sheets-Sheet 2

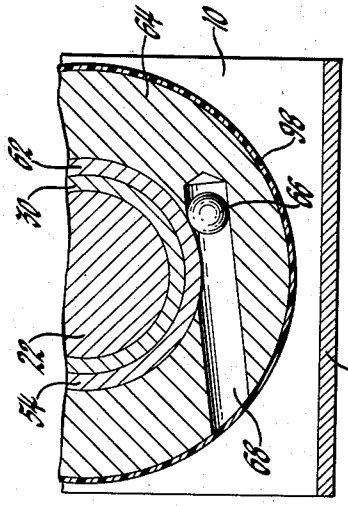


Fig. 6

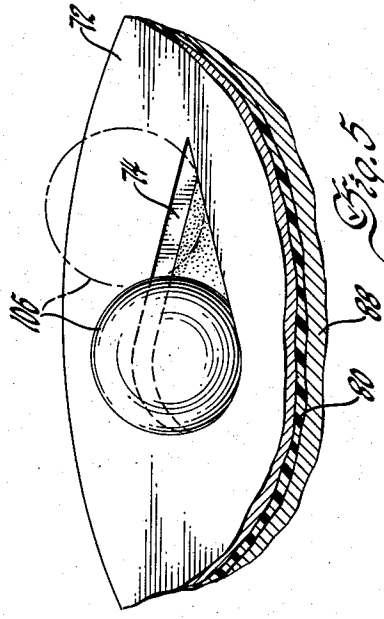


Fig. 5

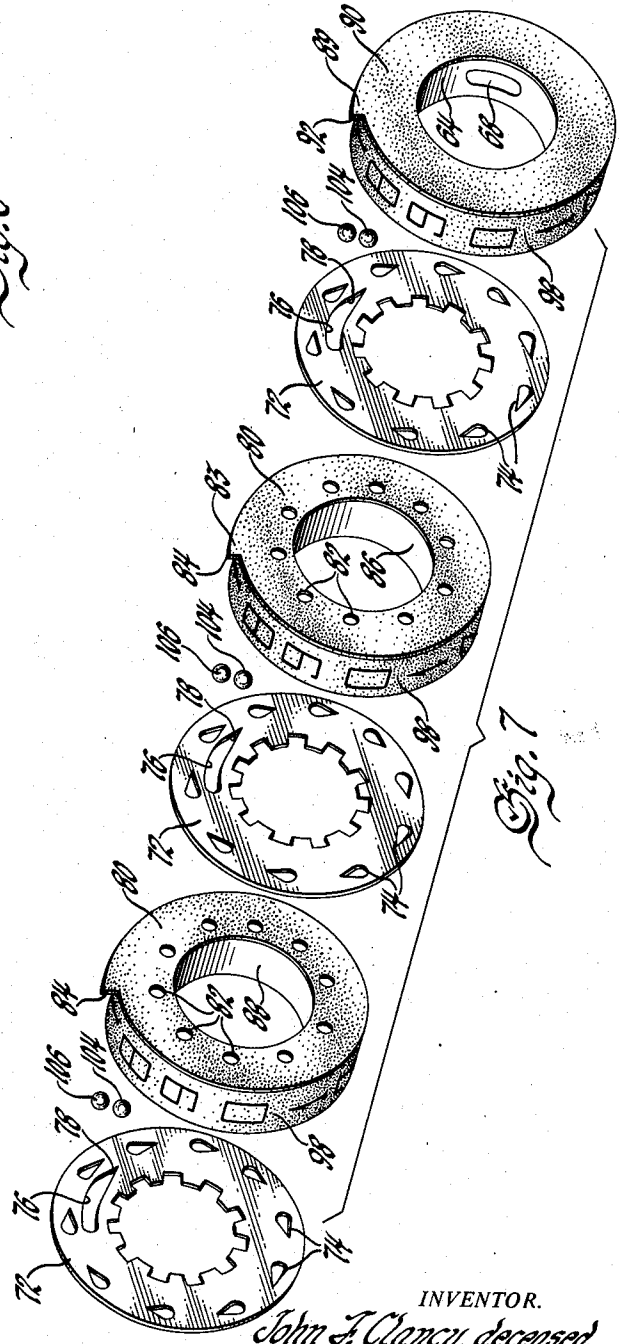


Fig. 7

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3,000,560

ANNULI ACCUMULATOR INSTRUMENTS

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11 Claims. (Cl. 235—117)

This invention relates to instruments for measuring values and more particularly to accumulators such as odometers of the coaxial annuli or numeral wheel type.

Instruments of this general type, as used on motor vehicle speedometers for registering mileage, have been mechanically operated and have proven satisfactory under difficult conditions despite their intricacies and fragile construction. Resetting of the instruments to zero has also been facilitated in various ways, one manner being as illustrated in the United States Patent 2,547,751 granted April 3, 1951, in the name of Henry H. Harada and entitled "Resetting Device." Despite the success of such prior devices, there are advantages in producing an accumulator which is not a strictly mechanized device and which yields itself to production methods of fast punch press operation and assembly by stacking.

An object of the present invention is to provide an improved accumulator instrument which is low in manufacturing cost, simple in construction, and which lends itself to the use of automatic machinery in handling and assembling the parts. Another object is to provide an instrument, such as an odometer, which may conveniently be reset to zero and without regard to the reading of the instrument.

A feature of the present invention is a coaxial annuli or numeral wheel instrument with nonmagnetic flat discs interposed between the annuli, a slot and holes being provided in the discs through which magnetic balls serve to transmit a step-by-step rotative motion from one annulus or wheel to the next thereby to effect an accumulator function. Another feature resides in a nonmagnetic disc having tapered holes and a tapered slot whereby a precise and intermittent driving action of a magnetically operated annuli or numeral wheel type accumulator or odometer may be effected. One other feature pertains to a resetting arrangement whereby a zero setting of an accumulator may be had, the arrangement comprising means for rotating the annuli or numeral wheel in one direction an extent determined by stops at the zero instrument reading.

The above and other important features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claims.

In the drawings:

FIG. 1 is a sectional view taken through the length of an odometer representing one embodiment of the present invention;

FIG. 2 is an end view of the instrument shown in FIG. 1;

FIG. 3 is a sectional view looking in the direction of the arrows 3—3 in FIG. 1;

FIG. 4 is a sectional view looking in the direction of the arrows 4—4 in FIG. 1;

FIG. 5 is a perspective view, drawn to an enlarged scale, showing a detail of the assembly;

FIG. 6 is a sectional view looking in the direction of the arrows 6—6 in FIG. 1; and

FIG. 7 is an exploded view of annuli, discs and magnetic balls used in the assembly if FIG. 1, a supporting shaft and sleeve being omitted.

The odometer illustrated in the drawings is operated magnetically and relying upon the well known principle

that magnetic lines of force will follow a circuitous iron path of a considerable length in preference to jumping a very short air gap. This magnetic force can be controlled by introducing nonmagnetic shields to reduce it and to withdraw such shields to increase it. Permanent magnets are produced in great quantities, are accurately made to stable dimensions and can be purchased at low cost. Such a magnet is preferred and used in the instant disclosure although it should be understood that a temporarily magnetized core could be used without avoiding the principles of the invention.

In the assembly of FIG. 1, a steel plate **10** is provided to act as a support and to be fixed to a bracket (not shown) or some other element associated with an instrument panel where the odometer is to be mounted for visual observation by an operator. This plate is substantially rectangular in configuration except for an ear **12** extending upwardly from the top thereof. This ear is notched as at **14** and also defines a vertically extending slot **16** close to the main body of the plate **10**. Extending downwardly into the plate **10** is a threaded aperture **18** in which is received a set screw **20** for engaging one end of a permanently magnetized cylindrical shaft **22** received in the plate. This shaft is in the form of an "Alnico" magnet. Extending upwardly into the bottom of the plate **10** is a screw **24** which serves to support one end of an L-shaped bracket **26**, a vertical leg **28** of which is apertured rotatably to receive the smooth surfaced cylindrical end of a sleeve **30** which is splined for a part of its length and is preferably made of brass. The bracket **26** has an ear portion **31** which is apertured slidably to receive a resetting shaft **32**. The latter has a cotter pin **34** to hold a washer **36** and the latter is retained in position on the shaft by a coil spring **38**. One end of the shaft **32** is provided with a gear **40** the side of which normally bears against the ear **31** because of the spring **38**. The teeth of the gear **40** are adapted to mesh with teeth **42** on the end of the sleeve **30** when the shaft **32** is moved axially by a hand knob (not shown) to promote such engagement. Release of the shaft **32** will, of course, cause disengagement of the two sets of teeth and assumption of the normal position of the gear **40** as shown in FIG. 2. The upper end of the bracket leg **28** bears an open notch **44** in alignment with the notch **14**. It also is provided with a vertical slot **46** in alignment with the vertical slot **16**.

Stop means in the form of a rod **48** is provided at the top of the odometer. The ends of this rod extend through the vertical slots **16** and **46** and heads **49** are provided on the ends of the rod to prevent axial displacement of the latter. Tensioning springs **50** are retained in position by means of screws **52** and the notches **14** and **44** for the purpose of urging the heads **49** and hence the rod **48** downwardly as permitted by the extent of the vertical slots **16** and **46**.

On the cylindrical portion of the sleeve **30** and abutting the bracket leg **28** is a steel gear member **54** having radial teeth **56**. These teeth are adapted to mesh with a worm **58** to be rotated by a cable **60** which transmits, from its source, the value to be measured by the instrument. In the case of an odometer, the shaft **60** would be protected by a flexible conduit **61** and be connected to the transmission and transmit the requisite data in values to be indicated by the instrument as expressed in terms of miles traveled.

Rotatively mounted on a cylindrical portion **62** of the gear **54** is an annulus **64**. A one-way clutch arrangement is provided between the gear **54** and its portion **62** and the annulus **64** by means of a ball **66** retained in a bore **68** penetrating the annulus **64** in a direction tangential to the exterior of the cylindrical portion **62**. This is a conventional one-way clutch arrangement and it will be

appreciated that when the gear **54** is rotated in a clockwise direction, as viewed in FIGS. 2 and 6, the ball **66** will frictionally be engaged by the cylindrical portion **62** and thereby cause the annulus **64** to rotate with the gear **54** and in the same direction. A rotation of the latter in a counterclockwise direction, as viewed in FIG. 6, will cause disengagement of the ball **66** and the annulus **64** will remain stationary.

The sleeve **30** is splined as at **70** for a part of its length non-rotatively to engage the inner peripheries of three aluminum discs **72**. These discs are similar and, therefore, only one need be described. Each of these discs is circular, thin and flat and bears an annular series of holes **74** which are tapered in one direction as seen in FIGS. 4 and 7. Within the diameter of this series of holes **74** is located a slot **76** of arcuate configuration and one end of this slot is tapered as at **78**.

As best illustrated in FIG. 4, the length of the slot corresponds with the spacing of the holes **74** as will be better understood when the description proceeds.

Two of the aluminum discs **72** are each paired to a thin, flat disc **80**. This disc is best shown in FIG. 3 and carries a series of circular holes **82** as well as a peripheral cam flange **83** and a shoulder **84**. The disc is preferably of plastic material and is conveniently joined to an adjacent annulus such as **86** or **88** by means of an adhesive. It will be noted that the inner periphery **86** of each disc is circular enabling the disc to be rotated freely over the splines **70**. Each shoulder **84** faces a counterclockwise direction, as viewed in FIG. 3, which is opposite to the normal direction of drive by the gear **54**.

Interposed between an annular shoulder on the gear **54** and the annulus **64** is a plastic disc **90** which is similar to the discs **80** except that it has only one opening—a central one for the reception of the cylindrical portion **62**. It is provided with a shoulder **92** which is similar in function to each shoulder **84**; i.e., for engagement with the stop rod **48**. A fourth plastic disc **94** is similar to each of the discs **80** except that it is cemented to one face of the plate **10** and is not provided with a cam surface and stop shoulder **84** as in the case of the other three plastic discs.

Cemented to the periphery of each of the annuli **64**, **86** and **88** is a plastic strip **98** forming a cylindrical surface upon which is printed symbols from zero to nine, as illustrated in FIG. 7.

Two pockets **100** and **102** are formed in the annulus **64** by drilling from one side thereof. Linearly movable in each of these pockets is a ball **104** or **106**. The pockets are of sufficient diameter to permit free linear movement of the balls but with substantially no movement with respect to the annulus **64** other than in the direction of the axis of each respective pocket.

It will be noted that the ball **104** is adapted to register with the arcuate slot **76** formed in the metal disc **72**. The ball **106**, on the other hand, is adapted to register with one of the holes **74** in that disc. Each of the annuli **86** and **88** has balls **104** and **106** adapted to act in the same way with respect to the corresponding thin and flat discs adjacent to them.

During normal operation of the odometer the cable **60** serves to rotate the worm **58** which in turn causes the gear **54** to rotate in a clockwise direction, as viewed in FIG. 2. As a result, the ball **66** wedges in place to effect clutch engagement and the first annulus **64** is caused to rotate with the gear **54**. When the ball **104** reaches the slot **76** in the nonmagnetic metal disc **72**, it is attracted toward the second annulus **86** because of the magnetic forces existent. Upon continued rotation of the annulus **64** the ball will roll along the slot **76** until the ball snaps into one of the holes **82**. When this occurs a much stronger attractive force exists between the two annuli **64** and **86** with the result that the annulus **86** will rotate with the annulus **64**. When the ball **104** reaches the tapered end **78** of the slot, the sides of the slot will serve to wedge or cam the ball **104** out of registration with the hole **82** and, as the ball continues its rotation with the annulus **64**, it is separated from the annulus **86** by not only one disc, but by the two discs **72** and **80**. This separation is equivalent to an air gap in its action. The travel of the ball in the slot is made approximately 36 degrees around the axis of the shaft **22** or one-tenth of a revolution about the odometer annuli axis. Accordingly, for every complete revolution of the first annulus **64**, the second annulus **86** will be rotated 36 degrees or one-tenth of a revolution.

The question then arises as to the positive retaining of the second annulus **86** in its definite position after its rotation for 36 degrees. This is effected by virtue of the action of the ball **106** for, when the 36 degrees rotation has occurred, the ball **106** snaps into a hole **74** but never contacts the annulus **86**. It is at all times separated from the annulus by the plastic disc **80**. A separator, such as the latter, even if it be only .010 inch thick, reduces the attraction of the ball **106** to the adjacent annulus to only a fraction of the pull exerted on the ball **104** when the latter is in direct contact with the annulus **86** or **88** or the plate **10**.

Although the annuli and discs are mechanically held together by the plate **10** and the leg **28**, the magnetic shaft **22** serves to pull the assembly together and holds it as a unit. The annuli **64**, **86** and **88** are magnetic being conveniently made of steel with the flux lines running as indicated with arrows in FIG. 1. Each ball **106** in each annulus (except in annulus **64**) meshes with a hole **74** in a stationary disc serves to hold the numbers or symbols of the instrument in proper alignment at all times between the rotative steps. As for the last annulus **88**, the ball **104** provides a strong attraction, not to drive a following annulus, but to insure that only a tenth of a revolution is given to the annulus **88** in a given step. The ball **106** in that annulus holds the position of all the annuli between steps.

The number of annuli or numeral wheels is, of course, determined by the number of digits to be registered on the instrument. The provision of additional annuli is simply a matter of repetition. In the arrangement shown, the annulus **88** will rotate one revolution to each ten revolutions of the annulus **86** and to each one hundred revolutions of the annulus **64** as will be understood.

Resetting of the instrument may be instantly brought about by rotating the splined bushing or sleeve **30** by means of the rod **32**. The latter is moved axially to compress the spring **38** and mesh the gear **40** with the teeth **42** on the splined sleeve **30**. The rod **32** is then rotated to rotate the sleeve in a counterclockwise direction as viewed in FIGS. 2 and 3. The cam flange **83** on each of the two discs **80** and the similar flange **89** on the disc **90** are so placed that the corresponding shoulders **84** and **92** will be stopped by the bar **48** when the three annuli **86**, **88** and **64** arrive at their zero positions. A further rotation of the sleeve **30** will have no effect as the steel balls merely move into their pockets without exerting any undue driving force on the annuli. There are various other and obvious ways of resetting the annuli to zero and it is not necessary to glance at the instrument to insure that the zero reading has been attained. During normal operation of the odometer the cam flanges **89** and **83** deflect the stop rod **48** upwardly against the springs **50** so that the rod is ineffective.

The annuli or numeral wheels **64**, **86** and **88** are identical except for the clutch provision in one of them. This permits rapid production as they may be cut with ease and exactitude from cold drawn tubing. The forming of the pockets **100** and **102** is easily undertaken by drilling. Tolerances need not be close and a smooth running, noiseless device is attained. The thin, flat discs of aluminum and plastic material lend themselves to high quantity production, and assembly is merely a

matter of stacking the annuli or wheels and discs around the coaxial shaft and splined sleeve.

I claim:

1. An accumulator instrument comprising a shaft, two numeral wheels mounted for rotation on said shaft, means for rotating one of said wheels, two flat discs of nonmagnetic material interposed between said wheels, one of said discs being fixed and in contact with said one wheel, the other of said discs being attached to the other wheel to rotate therewith, an annular series of holes in each of said discs, the two series of holes being arranged coaxially and with different radii, an arcuate slot in said one disc, said one wheel having two pockets, a ball linearly movable in each of said pockets, one of said balls being adapted to register with a hole in said fixed disc, the other of said balls being adapted to register with said slot and a hole in said rotatable disc, the said wheels and balls being of magnetic material, and said wheels being mutually attracted magnetically.

2. An accumulator instrument comprising a shaft nonrotatively fixed to a support, coaxial wheels mounted for rotation around said shaft, means at one end of said coaxial wheels connected to one wheel for rotating the latter, two thin discs of nonmagnetic material interposed between each set of adjacent wheels, one of said discs being fixed and in contact with one wheel, the other of said discs being attached to another wheel to rotate therewith, an annular series of holes in each of said discs, an arcuate slot in said one disc, said one wheel having two pockets, a ball linearly movable in each of said pockets, one of said balls being adapted to register with a hole in said fixed disc and to contact said rotatable disc, the other of said balls being adapted to register with said slot in said fixed disc and a hole in said rotatable disc, and the said wheels and balls being mutually and magnetically attracted.

3. An accumulator instrument comprising a shaft, two numeral wheels mounted for rotation coaxially with said shaft, one-way clutch means for rotating one of said wheels in one direction, two flat discs of nonmagnetic material interposed between said wheels, one of said discs being fixed and in contact with said one wheel, the other of said discs being attached to the other wheel to rotate therewith, an annular series of holes in each of said discs, the holes in one of said discs being one distance from said shaft and the holes in the other of said discs being at another distance from said shaft, an arcuate slot in said one disc, said one wheel having two pockets, a ball linearly movable in each of said pockets, one of said balls being adapted to register with a hole in said fixed disc, the other of said balls being adapted to register with said slot and a hole in said rotatable disc, stop means fixed in position relative to said shaft, a shoulder on said other disc arranged upon rotation of the latter to engage said stop means, means for rotating and thereby resetting said other disc and wheel, the said wheels and balls being of magnetic material, and said shaft being permanently magnetized.

4. An instrument such as set forth in claim 2, and including resetting means for rotating said numeral wheels independent of said rotating means.

5. An accumulator instrument comprising a permanently magnetized shaft non-rotatively fixed to a support, two numeral wheels mounted for rotation about said shaft, means for rotating one of said whels, two flat discs of nonmagnetic material interposed between said wheels, one of said discs being normally fixed in position with relation to said shaft and in contact with said one wheel, the other of said discs being attached to the other wheel and adapted to rotate therewith, an annular series of holes in each of said discs, an arcuate slot in said one disc, said one wheel having two pockets, a ball linearly movable in each of said pockets, one of said balls being adapted to register with a hole in said fixed disc and to contact said rotatable disc, the other of said balls being adapted to register with said slot and a hole in said rotatable disc, and the said wheels and balls being of magnetic material.

6. An accumulator instrument comprising a shaft, two numeral wheels mounted for rotation about said shaft, means for rotating one of said wheels, two flat discs interposed between said wheels, one of said discs being of nonmagnetic metal and normally fixed in position in contact with said one wheel, the other of said discs being of nonmagnetic material such as plastic and being attached to the other wheel to rotate therewith, an annular series of holes in each of said discs, an arcuate slot in said metal disc, said one wheel having two pockets, a ball linearly movable in each of said pockets, one of said balls being adapted to register with a hole in said metal disc and to contact said other disc, the other of said balls being adapted to register with said slot in said metal disc and a hole in said other disc, and the said wheels and balls being mutually attracted magnetically.

7. An accumulator such as set forth in claim 1 in which the means for rotating said one wheel comprises a one-way clutch arrangement.

8. An accumulator instrument such as set forth in claim 1, in which the means for rotating said one wheel comprises a one-way clutch arrangement for rotating the wheels in one direction, and in which resetting means are included for rotating said wheels in the other direction.

9. An accumulator instrument such as set forth in claim 1, and the said arcuate slot having a tapered end.

10. An accumulator instrument such as set forth in claim 1, the arcuate slot having one tapered end and each of the holes in said fixed disc being tapered.

11. An accumulator instrument such as an odometer comprising a permanently magnetized shaft fixed to a support, coaxial numeral wheels mounted for rotation about said shaft, gearing connected to one of said wheels for rotating the same in one direction, said gearing being effective through a one-way clutch arrangement, two flat discs interposed between adjacent wheels, one of said discs being of nonmagnetic metal and normally fixed in position and in contact with one wheel, the other of said two discs being attached to another wheel to rotate therewith, two annular series of holes in said discs the said two series of holes being coaxial and arranged at differing diameters, an arcuate slot in said one disc and having a tapered end, said one wheel having two pockets, a ball linearly movable in each of said pockets, one of said balls being adapted to register with a hole in said normally fixed disc, the other of said balls being adapted to register with said slot and a hole in the series of holes in said rotatable disc, resetting means associated with said wheels for rotating the latter in another direction, and the said wheels and balls being of magnetic material.

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