Sept. 22, 1970 TSUNEMOTO NAKANISHI ET AL 3,529,768

DIGIT WHEELS AND PRESET COUNTERS UTILIZING THE SAME

Filed Oct. 17, 1968

2 Sheets-Sheet 1

FIG. 1 PRIOR ART

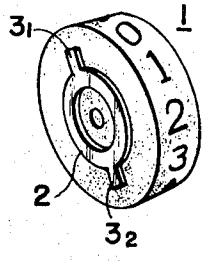


FIG. 2 PRIOR ART

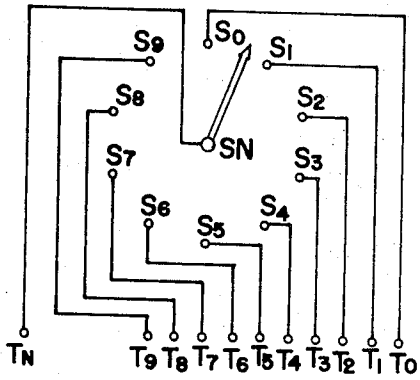
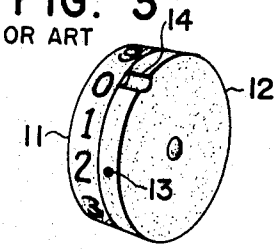


FIG. 3 PRIOR ART



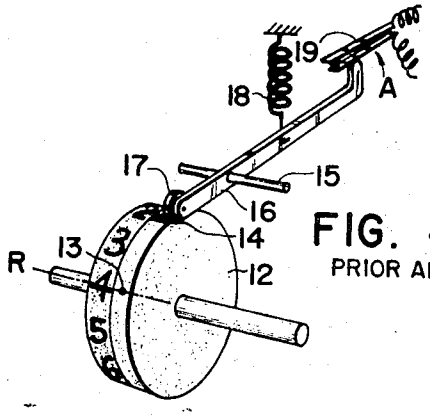
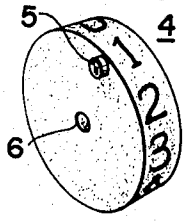


FIG. 4 PRIOR ART

FIG. 5



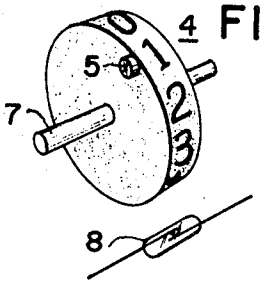


FIG. 6

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DIGIT WHEELS AND PRESET COUNTERS UTILIZING THE SAME

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FIG. 7

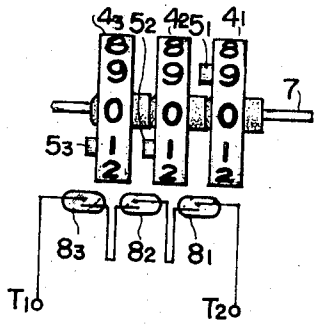


FIG. 8

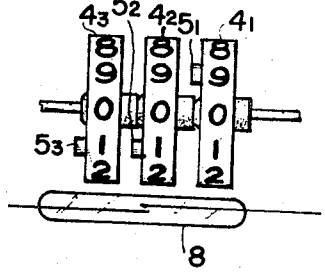


FIG. 9

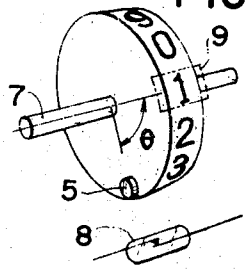


FIG. 10

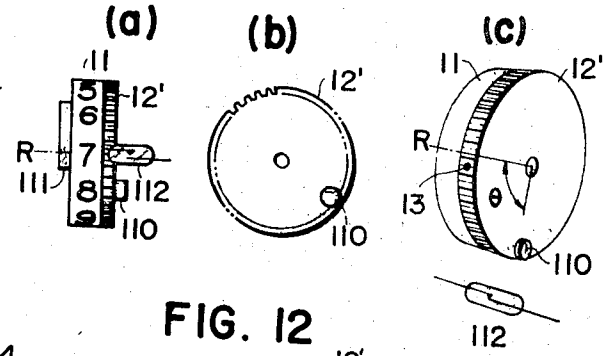


FIG. 11

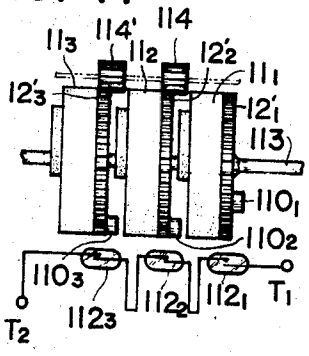
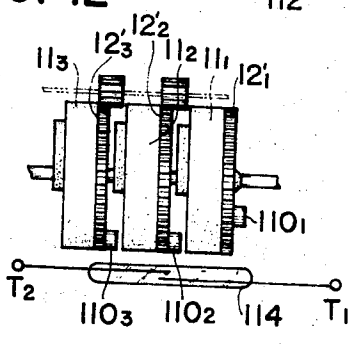


FIG. 12



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DIGIT WHEELS AND PRESET COUNTERS UTILIZING THE SAME

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Int. Cl. G06f 15/18
U.S. Cl. 235—132 5 Claims

ABSTRACT OF THE DISCLOSURE

A digit wheel is provided with a magnet at a position corresponding to a digit to be preset and a preset counter is comprised by a plurality of such digit wheels and one or more reed switches operated by the magnets on respective digit wheel.

BACKGROUND OF THE INVENTION

This invention relates to digit wheels utilized in read out counters or preset counters and preset counters utilizing such digit wheels.

A conventional digit wheel utilized in read out counters or preset counters is constructed as shown in FIGS. 1 and 3. More particularly, as shown in FIG. 1, contact rings **2** each including a pair of contact pieces 3_1 and 3_2 are attached on the opposite sides of a digit wheel **1**. As the digit wheel **1** rotates, contact pieces 3_1 and 3_2 engage contacts formed on a printed circuit board, for example, to form an electric circuit. This electric circuit is shown in FIG. 2 wherein contact piece 3_1 corresponds to the center SN while contact piece 3_2 slides along a plurality of contacts S_0, S_1, . . . S_8 and S_9 disposed on a circle around the center. In the case of a read out counter connections established between one terminal TN and either one of contacts **T0, T1, . . . T8, T9** successively display indications of the digit wheel. Whereas in the case of a preset counter output between one particular terminal corresponding to a preset digit and terminal TN is utilized to sense arrival of the preset digit.

However, as such a conventional digit wheel utilizes electrical connections between a sliding arm or piece and electric contacts it is necessary to adjust the digit wheel to provide satisfactory electric contact and there are some installations which result in poor electrical contact. Further, in order to obtain good electric contact it is necessary to apply suitable pressure between the sliding piece and the contacts of the digit wheel, and such pressure imposes a load upon the torque for driving the digit wheel. Such difficulties are caused by mechanical contact between the digit wheel **1** and electrical contacts due to construction of the digit wheel itself.

FIG. 3 illustrates another type of a conventional digit wheel for preset counters. The digit wheel is shown as comprising a main body **11** of the digit wheel and a setting wheel **12**. Around the periphery of the main body **11** are provided digits 1, 2, . . .9, 0 and as is well known in the art the setting wheel **12** is mounted coaxially with the main body and can rotate in one direction alone with respect thereto. As shown, the setting wheel **12** is provided with a single set mark **13** and a single notch **14** on its periphery. When this digit wheel is utilized as a preset digit wheel, the set digit on the periphery of the main body **11** is positioned on a reading line (the position of a display window) and then the setting wheel **12** is rotated to align said set digit with the set mark **13**. Indicating digit 0 is set on the reading line by means of a zero reset means, for example a heart shaped cam, on

the digit wheel. The digit wheel is started from this state to move stepwise from one digit to the other. When utilizing the digit wheel of this type a roller **17** shown in FIG. 4 mounted on the free end of a lever **16** pivoted at **15** is urged against the periphery of the setting wheel **12** under a bias of a spring **18**. When a particular digit that has been set, for example a digit 4, reaches a reading line R the roller **17** will be received in notch **14** of the setting wheel **12**. Consequently, the other end of lever **16** will rotate in the direction of arrow A to close contact **19**. Closure of this contact shows that the digit wheel is then indicating a preset value.

As can be noted from the foregoing description, with the construction and arrangement of this type of prior preset digit wheel, roller **17** on lever **16** is always in contact with the periphery of the setting wheel **12** comprising the digit wheel. Thus, this contacting force imposes a load upon the rotation of the digit wheel. Furthermore, as the electrical contact **19** is exposed to the atmosphere, oxidation thereof may result in poor electric contact.

SUMMARY OF THE INVENTION

Accordingly the principal object of this invention is to provide a novel digit wheel which can cooperate with electrical contacts without utilizing any mechanical contact piece.

A further object of this invention is to provide a combination of a novel digit wheel and a reed switch wherein closure of electrical contacts does not impose any load upon the counter driving power thus obinating poor electric contact.

Still further object of this invention is to provide a novel preset counter wherein independent reed switches are disposed to oppose discrete digit wheels and cooperation of respective digit wheels and reed switches generates a signal upon arrival of a preset indicating value.

Another object of this invention is to provide a novel preset counter wherein a single reed switch is disposed to commonly oppose a group of digit wheels and cooperation of respective digit wheels and the reed switch generates a signal upon arrival of a preset indicating value.

BRIEF DESCRIPTION OF THE DRAWING

Further objects and advantages of the invention will be more fully understood from the following detailed description when taken in connection with accompanying drawing in which:

FIGS. 1 and 2 illustrate a prior art digit wheel and a simplified electric circuit cooperating therewith;

FIGS. 3 and 4 show another type of a conventional digit wheel and a simplified electrical circuit cooperating therewith;

FIG. 5 is a perspective view of a digit wheel embodying this invention;

FIG. 6 shows one application of the digit wheel shown in FIG. 6;

FIGS. 7 and 8 illustrate two types of preset counters embodying this invention;

FIG. 9 is a perspective view helpful to explain the operation of this invention;

FIG. 10 shows a modified preset digit wheel of this invention; and

FIGS. 11 and 12 are diagrammatic representations of preset counters including the digit wheel shown in FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawing, FIG. 5 shows an example of a digit wheel **4** embodying this invention and including a permanent magnet **5** near its periphery. A shaft **7** is extended through a shaft bore **6** of the

digit wheel **4** and a reed switch **8** is disposed close to the periphery thereof as shown in FIG. 6. As the digit wheel is rotated the contacts of the reed switch will be closed when they come to oppose the magnet **5**. Thus, by applying a voltage across terminals of the reed switch **8**, current will flow therethrough when contacts of the switch are closed to provide a signal indicating that the digit 1 and magnet **5** on the digit wheel are opposing the reed switch **8**. As shown in FIG. 6, as the magnet **5** is located to correspond to digit 1, this embodiment shows that the preset value is the digit 1.

FIG. 7 is a diagram illustrating a preset counter embodying this invention. The counter has three orders comprised by three digit wheels shown in FIG. 5. In FIG. 7, the digit wheel 4_1 corresponding to the first order includes a magnet 5_1 on the side surface near its digit 9. Similarly, the digit wheel 4_2 of the second order includes a magnet 5_2 on the side surface near the digit 1 while the digit wheel 4_3 of the third order is provided with a magnet 5_3 on the side surface near its digit 1. Accordingly, the present value of the preset counter shown in FIG. 7 corresponds to **119**. Reed switches 8_1, 8_2 and 8_3 are disposed to respectively oppose digit wheels 4_1, 4_2 and 4_3, which are connected in series. Shaft **7** is provided in common to respective digit wheels. Although not shown in the drawing, suitable shift means, such as pinions, are provided between respective digit wheels.

When the digit wheel 4_1 of the first order is driven by a suitable driving means to bring its magnet 5_1 to a position to oppose reed switch 8_1, contacts thereof will be closed. However, as the magnets 5_2 and 5_3 of the second and third orders are not in positions to oppose reed switches 8_2 and 8_3, respectively, terminals T1 and T2 remain open. Upon one complete revolution of digit wheel 4_1 magnet 5_2 of the digit wheel 4_2 will be brought to the position opposing the reed switch 8_2 by the shifting operation to close the contacts thereof. However, as the magnet 5_3 of the digit wheel 4_3 of the third order does not oppose reed switch 8_3, terminals T1 and T2 still remain opened. By continuing such rotation and when the digit wheel of the first order revolves through 119 digit positions, there is a chance for these magnets to come to oppose respective reed switches at the same time. At this time all of thru reed switches close simultaneously to close a circuit between terminals T1 and T2 thus providing a coincidence current. Each of reed switches employed in this counter may be an extremely small reed switch that can be operated by a single magnet. Further, the provision of independent reed switches for respective orders enables to check the cooperation between the reed switch and the magnet for respective orders.

FIG. 8 shows a modified preset counter of this invention employing a single reed switch **8** which is constructed such that its contacts are closed only when all magnets 5_1, 5_2 and 5_3 of digit wheels 4_1, 4_2 and 4_3 for respective orders come to oppose the reed switch at the same time. Thus, by employing a single reed switch which is constructed to be closed only when all magnets come to oppose it, it is possible to reduce the member of component parts as well as the physical dimension of the device.

While in the above embodiments magnets are provided at positions corresponding to preset digits, preset counters are generally constructed to observe by eyes the indicating digits. In such a case magnets are not located adjacent digits to be preset, but instead, as shown in FIG. 9, may be located as a position of A from the preset digit where θ represents an angle subtended by a display window **9** and the magnet **5**.

FIG. 10*a* shows a side elevation of a modified digit wheel comprising a main body **11** and a setting wheel **12'** which is coaxial with the main body and can rotate in one direction alone with respect thereto. Different from the conventional setting wheel shown in FIGS. 3 and 4, this setting wheel **12'** is not provided with any notch on its periphery. However, a magnet **110** is provided on its

side surface near the periphery of the setting wheel as shown in FIG. 10*b*. A heart shaped cam **111** is provided on one side surface of the main body **11** of the digit wheel in the same manner as the well known digit wheel. Presetting of the novel preset digit wheel can be performed by positioning a digit to be set (for example a digit 7) on the reading line R and then rotating the setting wheel **12'** until the magnet **110** comes to coincide with the set digit 7 in the same manner as in the prior digit wheel. In this case, the digit wheel is restored to zero by means of the heart shaped cam **111**, and the counting operation is commenced starting from the digit 0, to provide digits 1, 2, . . . successively on the reading line R. Thus, by disposing a reed switch **112** on the reading line R and close to the periphery of the setting wheel **12'**, when the set digit 7 comes to the reading line R, magnet **110** will also be brought to the reading line R thus closing reed switch **112** by the action of magnet **110**. Closure of the reed switch provides a signal. Thus the digit wheel constructed according to this invention can be used as a preset counter.

While in the above described embodiment the position of the magnet **110** on the setting wheel **12'** coincides with the preset point to place the reed switch **112** on the reading line it is to be understood that this invention is not limited to this particular arrangement. For example, as shown in FIG. 10*c* a preset mark **13** acting as a preset point may be provided on the periphery of the setting wheel **12'** and the reed switch **112** may be positioned at a position displaced by an angle θ from said set mark **13**, where θ represents the angle subtended by the magnet **110** and the set mark **13** with respect to the axis of the digit wheel.

As above described, the novel digit wheel operates electrical contacts without utilizing any mechanical means as has been the prior practice; it is able to greatly reduce the mechanical load imposed upon the digit wheel.

FIG. 11 is a diagram to show an elevation of a modified preset counter of this invention. In this embodiment, three digit wheels shown in FIG. 10 are mounted on a common shaft **113** which are combined with shift means, illustrated as pinions **114** and **114'**. FIG. 11 shows a digit counter of three orders and a numeral of three orders can be set by rotating three setting wheels for respective digits in the same manner as has been described in connection with FIG. 10. The peripheries of three setting wheels $12'_1$, $12'_2$ and $12'_3$ for digit wheels of the first, second and third orders are associated with reed switches 112_1, 112_2 and 112_3 respectively closed by magnets 110_1, 110_2 and 110_3 on setting wheels, and these reed switches are connected in series. When the digit wheel of the first order is driven by a suitable means, the digit wheels of the second and third orders are driven through shift means. However, magnets 110_1, 110_2 and 110_3 can simultaneously oppose the respective reed switches 112_1, 112_2 and 112_3 only for the preset numeral, at which time terminals T1 and T2 of the reed switches can provide an output signal. Again, each of the reed switches employed in this preset counter may be very small one operated by a single magnet and the provision of a reed switch for each order enables to check the operation of the reed switch and magnet for each order.

FIG. 12 shows a still further modification of the novel preset counter which is identical to that shown in FIG. 11 except that a single reed switch **114** is employed which is arranged to be closed only when three magnets 110_1, 110_2 and 110_3 on digit wheels for respective orders simultaneously come to oppose it. Thus, this modification can reduce the number of component parts as well as the physical size of the preset counter.

While in the illustrated embodiments, the magnets are secured to the side surface of setting wheels, it should be understood that these magnets may be embedded in the periphery or side surface of the setting wheels.

Thus, the novel preset counter utilizes digit wheels which are quite free from the load caused by the mechani-

cal contact and one or more reed switches operated by the magnet carried by the digit wheel. Accordingly, proper selection of the actuating force of the reed switch and the magnetic force provided by the magnet assures accurate operation of the counter. Further, different from conventional design absence of poor contact and the mechanical load on the digit wheel enables rapid operation of the counter with small force. In addition, the novel counter is more simple in construction and more inexpensive than prior counters. Thus, the novel counter finds many applications such as telemetering.

What is claimed is:

1. A manually operated preset counter comprising:

a plurality of digit wheels each having peripheral indicia thereon and being rotatably mounted for decade counting relation;

means for selecting index positions for said digit wheels corresponding to a predetermined count of said peripheral indicia;

magnetic means carried by each said wheel for producing a localized field extending from the periphery of said wheel and individual to a selected one of said peripheral indicia; and

reed switch means located adjacent said periphery having contacts which are spring biased to normally open position and actuable to closed position when magnetized by said localized field of all of said digit wheels in predetermined position corresponding to a particular selected position of all said wheels representing said predetermined count for completing a conductive circuit through said contacts which is operable to switch an external circuit connected thereto independent of the nature of said external circuit, said contacts reopening under the influence of the spring bias when any of said magnetic means moves out of said predetermined position.

2. Apparatus according to claim 1 in which said reed switch means comprises a plurality of reed switches one for each said digit wheel and said contacts of said plurality of reed switches are connected in series.

3. Apparatus according to claim 2 in which said digit wheels each comprise a main body display wheel having said indicia thereon, a setting wheel rotatable with respect to said main body display wheel to establish predetermined relative position and a magnet on said setting wheel.

4. Apparatus according to claim 1 in which said reed switch means comprises a single reed switch adjacent to said plurality of digit wheels and operable to close the contacts of said single reed switch only when all of said magnetic means of said digit wheels are opposed to said single reed switch.

5. Apparatus according to claim 4 in which said digit wheels each comprise a main body display wheel having said indicia thereon, a setting wheel rotatable with respect to said main body display wheel to establish predetermined relative position and a magnet on said setting wheel.

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