July 21, 1964 J. J. AMBROZAITIS 3,141,611

BIDIRECTIONALLY SETTABLE IMPULSE COUNTER

Filed Nov. 20, 1962

FIG. 1

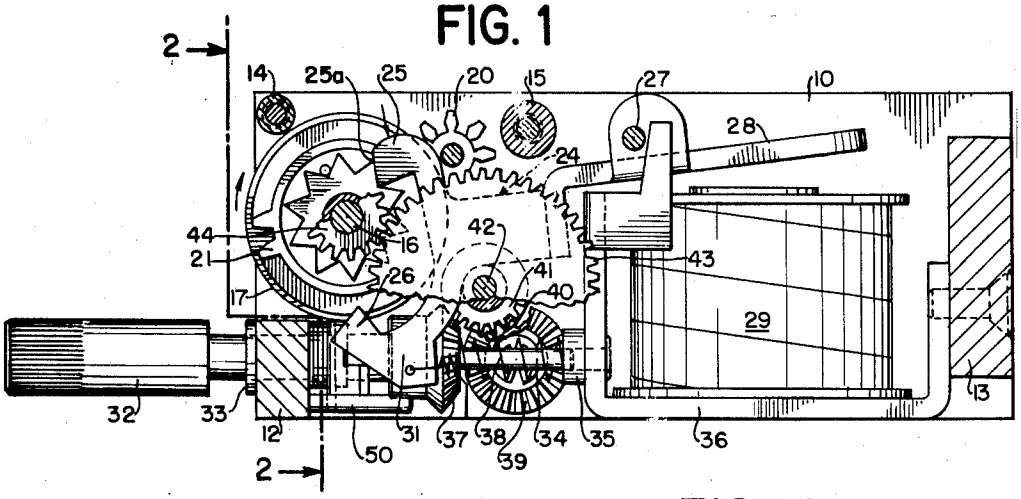


FIG. 2

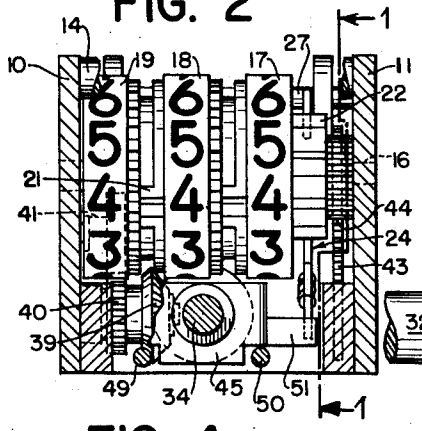


FIG. 3

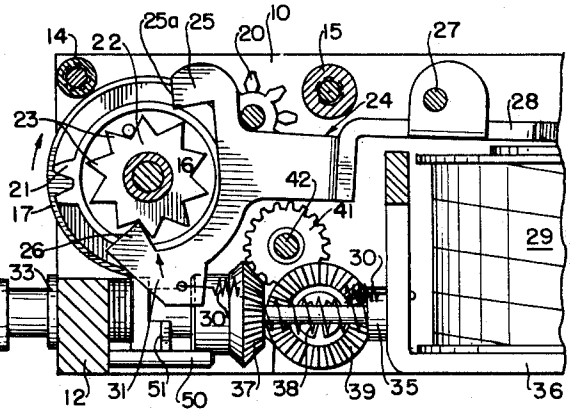


FIG. 4

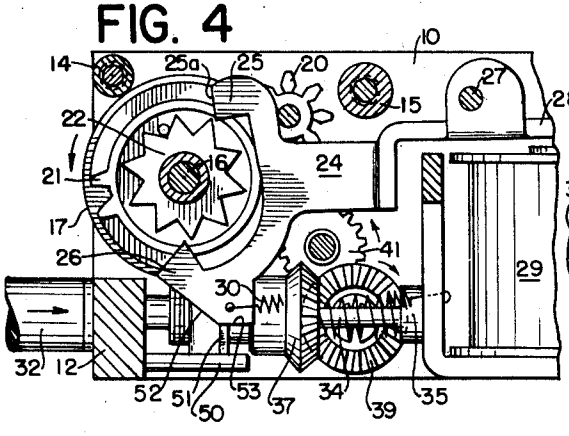
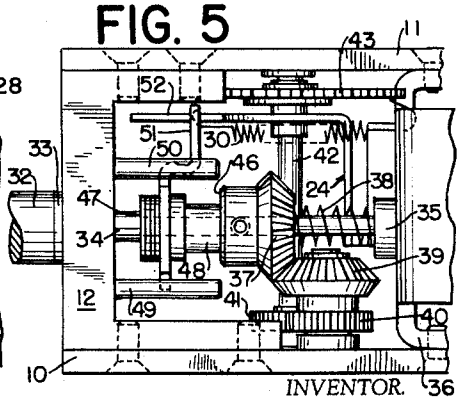


FIG. 5



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# 3,141,611
# BIDIRECTIONALLY SETTABLE IMPULSE COUNTER

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7 Claims. (Cl. 235—91)

The present invention relates to counter mechanisms, and more particularly to an improved impulse counter having novel and improved arrangements for accommodating setting of the indicator position at any time.

The mechanism of the present invention incorporates, as an information read-out element, a drum counter mechanism, which may be of conventional construction. Typically, such a mechanism includes a plurality of counter drums arranged such that each drum is driven by a drum of the next lower order, as through a suitable Geneva-type drive. Most commonly, the adjacent drums are driven through a 10:1 reduction although, for some special purposes such as timekeeping, the reduction ratio may be different. For convenience of reference, counters of this general type are referred to herein as "tens-transfer counters," it being understood, however, that the transfer ratio between drums may be other than 10:1.

The counter device incorporated in the mechanism of the invention is driven in a positive manner, according to signal impulses received, by means of a multi-tooth cam wheel and a bifurcated impulse lever. The cam wheel is connected to the lower order drum of the counter, and the impulse lever is provided with opposed driving elements arranged to be received alternately in spaces between the teeth of the cam wheel. The spacing of the driving elements and cam teeth is such that, when the impulse lever is oscillated between limit positions, the opposed driving elements are engaged alternately and asymmetrically with the teeth of the cam wheel to advance the cam wheel unidirectionlaly. Advantageously, the impulse lever is actuated in one direction by a solenoid and in the other direction by a return spring and, in accordance with the invention, the lever has a predetermined intermediate position in which its driving elements are held out of engagement with the cam wheel.

In combination with the cam wheel and impulse lever drive, described briefly above, the mechanism of the invention incorporates a counter setting control selectively movable between operative and retracted positions and having associated therewith drive means for engagement with the counter mechanism and cam means for engagement with the impulse lever. According to the invention, when the control element is moved to its operative position, the counter mechanism is engaged for setting and, simultaneously, the impulse lever is shifted by the control cam means to its predetermined intermediate position, free of the cam wheel, permitting the counter mechanism to be set freely in either direction. Upon return of the control element to its retracted position, usually by a spring, the impulse lever is once again brought into operative relation with the cam wheel, and the gear train or other mechanism involved in the setting of the counter mechanism is disengaged.

Of particular significance, the mechanism of the invention enables a positive drive impulse counter to be set conventionally by manipulation of a single control element, which simultaneously renders the counter mechanism free-running and engages it for manual setting manipulation. Thus, while counter mechanisms of known construction frequently include manually engageable setting means, the counter of the present invention provides such setting means for a positive drive impulse counter, in such a manner that the otherwise positive drive counter



is rendered free-running automatically by engagement of the setting control. In this respect, by reference to a positive drive counter it is meant that not only is the counter advanced in a positive manner, but each increment of advance is positively limited, to prevent override or coasting under the influence of sharp advancing impulses.

For a better understanding of the invention, reference should be made to the following detailed description and to the accompanying drawing, in which:

FIG. 1 is a longitudinal cross-sectional view, taken along line 1—1 of FIG. 2, of an impulse counter incorporating the features of the invention;

FIG. 2 is a cross-sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary cross-sectional view, similar to FIG. 1, illustrating the parts of the counter in an "actuated" condition;

FIG. 4 is a fragmentary cross-sectional view, similar to FIG. 1, with the parts of the counter shown in a "setting" position; and

FIG. 5 is a bottom plan view of the counter, illustrating the parts thereof in the condition shown in FIG. 4.

Referring now to the drawing, the reference numerals **10**, **11** designate spaced side plates of a frame structure, which are connected across the front and back ends by spacer walls **12** and **13** respectively. Spacer posts **14**, **15**, of appropriate number and disposition, extend between the side wall plates **10** and **11** to reinforce the frame structure.

A shaft **16** extends between the wall plates **10**, **11** in the front portion of the mechanism and mounts a plurality of counter drums **17–19**. The respective counter drums are interconnected by conventional Geneva-type transfer means, including transfer pinions **20** and integral gear lugs **21**, the arrangement being such that each higher order drum is advanced through one index position upon each complete revolution of the drum of the next lower order. Typically, the drums are calibrated and designed to have ten index positions, in which case the mechanism may be described as a tens-transfer counter. However, for timekeeping and other purposes, the drums may be differently calibrated, with appropriate changes being made in the transfer gears. Thus, reference made herein to a tens-transfer type counter is intended to encompass other than decimal calibration of the drums.

In the illustrated form of the invention, the counter drum **17** constitutes the lowest order drum, through which the higher order drums **18** and **19** are driven in cascade fashion. In order to drive the lowest order drum **17**, there is fixed thereto a cam wheel **22**, generally in the form of a star wheel, having a predetermined number of star points or cam teeth **23** equal to the number of index positions of the lowest order drum.

A bifurcated impulse lever **24** having spaced, pointed driving elements **25**, **26** is pivotally mounted in the frame, by means of a transverse shaft **27**, the rear portion of the lever advantageously forming the armature **28** of a solenoid actuator **29** which is suitably secured in the frame. A suitable tension spring **30** acts upon the lower arm portion **31** of the impulse lever to urge it constantly in a counterclockwise direction, as viewed in the drawing, normally urging the upper driving element **25** of the impulse lever into a "seat" between teeth of the multi-tooth driving cam **22**, advantageously with the front edge **25***a* of the driving element lying in extended contact with the surface of a cam tooth and serving as a positive limit to rotation of the cam **22** and its associated drum **17** in a clockwise direction.

Upon energization of the solenoid **29** (through suitable circuit means not shown) the armature **28** is drawn downward, pivoting the impulse lever **24** in a clockwise

direction, to the position shown in FIG. 3. This causes the lower driving element 26 to enter a space between teeth of the driving cam 22, acting on a tooth of the cam in a manner to advance the cam slightly in a clockwise direction. Upon the subsequent deenergization of the solenoid 29, the upper driving element 25 moves downward under the influence of the spring 30 and enters the next successive tooth space in the driving cam further advancing the cam until reaching an equilibrium position, as indicated in FIG. 1, the cam 22 and its attached drum having advanced through one index position throughout the cycle.

As will be understood, the relationship between the cam wheel 22 and the driving elements 25, 26 is asymmetrical, in order to achieve reliable, unidirectional rotation of the cam wheel 22, upon oscillating motion of the impulse lever 24. Thus, in the sequence of operations involved in advancing the cam 22 through one index position, the lower driving element 26 of the illustrated device advances the cam wheel less than half of the required distance, while the upper driving element 25 advances the cam the remainder of the required distance. In the illustrated arrangement, the desired asymmetry is achieved largely through proper location of the elements, relative to the cam 22, and the pivoting movement of the driving elements.

The above described arrangement for driving the counter drums is advantageously employed in the new impulse counter to provide positive driving of the drums, without the possibility of overshooting or coasting of a drum. Thus, the impulsing of the lever 24 may desirably be sharp and rapid, causing the drum 17 to be advanced with rapid movements. Nevertheless, the drum 17 cannot advance through its own inertia, because the oscillating movements of the lever 24 to its respective limit positions result in the seating of the driving elements 25, 26 between teeth of the cam wheel 22 to form positive stops.

In accordance with the invention, a novel and improved arrangement is provided in the positively driven impulse counter thus far described for setting the counter drums independently of the impulse system while the solenoid 29 is de-energized. In this respect, the setting means of the invention includes means operative automatically to disengage the impulse lever from the cam wheel 22, to accommodate free rotation of the drums, when the drums are engaged for setting manipulation.

Referring specifically to FIG. 1, there is shown a manual setting knob 32, which is rotatably and slidably supported in a bearing 33 in the front spacer wall 12 and has fixed thereto a shaft 34, the latter being slidably and rotatably supported by a bearing 35 mounted in the solenoid frame 36. The shaft 34 carries a bevel gear 37 and is normally urged to a retracted or inoperative position by a spring 38 acting between the bevel gear and the bearing 35.

By pushing inward on the control knob 32, the bevel gear 37 is brought into meshing engagement with a second bevel gear 39, suitably journalled on the wall 10 of the frame (see FIG. 5). The bevel gear 39 carries a pinion 40 which meshes with a gear 41 fixed to a transverse shaft 42 journalled in the opposed frame plates 10, 11. At its opposite end, the shaft 42 has fixed thereto a gear 43 which meshes with a gear 44 fixed to the driving cam 22. Thus, assuming the lower order drum 17 to be free to rotate, it may be set to any desired position (and the higher order drums along with it, through cascade operation) by pushing inwardly on the control knob 32, to engage the bevel gears 37, 39, and rotating the control knob. When the control knob 32 is released, the spring 38 returns it to its forward or negative position.

Since the driving cam and impulse lever arrangement heretofore described constitutes a positive drive for the counter drums, preventing independent advancement thereof, novel arrangements are provided, in accordance



with the invention, for rendering the positive drive means ineffective during setting. To this end, and in accordance with the invention, the spacing between the driving elements 25, 26 of the impulse lever is such as to enable the impulse lever to be moved to a predetermined intermediate position, illustrated specifically in FIG. 4, in which the teeth of the cam wheel 22 will clear both driving elements, enabling the driving cam to rotate freely within the non-engaging embrace of the impulse lever. In order to shift the impulse lever automatically to its predetermined intermediate position, a special control plate 45 is carried by the shaft 34, being fixed longitudinally on the shaft, between the base end 46 (FIG. 5) of the bevel gear 37 and a shoulder 47 formed by a step-down portion of the shaft 34. The control plate 45 is supported on the shaft 34, advantageously, in right angular orientation, by means of a bushing 48, which accommodates rotation of the shaft within the control plate.

As indicated best in FIGS. 2 and 5, a pair of guide pins 49, 50 project rearwardly from the front spacer wall 12 and underlie the control plate 45 to guide and prevent rotation thereof. Also, as shown in FIG. 4, the control plate 45 has a transversely extending control cam 51 which underlies the lower frame portion 31 of the impulse lever. This control cam cooperates with an inclined cam surface 52 and a supporting land 53 on the lower edge of the impulse arm to cause the arm to be lifted when the control plate 45 is shifted longitudinally inward with the control knob 32. The relationship between the supporting land 53 and the control cam 51 is such that, when the land and control cam are in contacting engagement, as illustrated specifically in FIG. 4, the impulse lever 24 is in its predetermined intermediate position, embracing but lying outside the peripheral extremities of the driving cam 22 to permit free rotation of the latter.

The relationship between the control cam 51, supporting land 53 and the bevel gears 37, 39 is such, in accordance with the invention, that the land 53 and cam 51 will be engaged, as illustrated in FIG. 4, when the control knob 32 has been shifted inward to an extent sufficient to engage the bevel gears. Accordingly, inward movement of the control knob to engage the gears for a setting operation simultaneously and automatically causes the impulse lever to be shifted to its intermediate position, enabling the drums to be freely rotated. Subsequently, when the control knob is released, and urged outwardly by its spring 38, the impulse lever 24 is returned to its normal, lower position by its return spring 30, to properly align the drums in exact index positions.

The device of the invention provides an impulse counter which, while being positively driven to insure counting accuracy, without danger of overtravel, is freely settable to any desired colunter indication by a simple, single manipulation. Thus, in the typical, manually settable form of the invention, a simple inward movement of the control knob, to engage the setting gears, simultaneously disengages the positive impulse drive to accommodate free rotation during setting.

It will be understood that the specific form of the invention herein illustrated and described is intended to be representative only, as certain changes may be made therein without departing from the clear teaching of the disclosure. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

I claim:

1. A bidirectionally settable impulse counter mechanism comprising, in combination,

(*a*) a tens-transfer type counter having a low order counter drum and one or more counter drums of higher order arranged for cascade operation,

(*b*) a multi-tooth cam wheel drivingly connected to said low order drum,

(*c*) a bifurcated impulse lever pivotally mounted in

operative association with said cam wheel and having opposed driving elements received alternately between teeth of said cam wheel,

(*d*) said driving elements, upon reciprocating pivotal movement of said impulse lever, being alternately and asymmetrically engaged with said teeth in a manner to effect unidirectional advancement of said cam wheel,

(*e*) said impulse lever normally being urged to one of two alternate limit positions and having a predetermined intermediate position in which said opposed driving elements are free of said cam wheel,

(*f*) actuating means for controllably moving said impulse lever alternately between said limit positions,

(*g*) bidirectional setting means comprising gear means selectively engageable with the low order drum for rotating the drum in either direction and a rotary setting element for engaging and rotating the gear means and the low order drum in a desired manner, and

(*h*) control means operatively associated with said setting element and said impulse lever and operative, upon manipulation of said setting element for engagement of said gear means with said low order drum, to move said impulse lever to said predetermined intermediate position to free said drums for setting movement in either direction.

2. The counter mechanism of claim 1, in which

(*a*) said actuating means comprises spring means urging said lever to a first limit position and solenoid means for moving said lever to a second limit position,

(*b*) said cam wheel has a predetermined number of teeth equal to the number of index positions for said low order drum, and

(*c*) said control means comprises a control cam carried by said setting element and engageable with said impulse lever to move said lever against the action of said spring means to said predetermined intermediate position.

3. The counter mechanism of claim 2, in which

(*a*) said setting element is mounted for rotary and axial movement, and

(*b*) said control cam is movable by axial movements of said setting element to engage said gear means.

4. A settable impulse counter mechanism comprising, in combination,

(*a*) a counter drum having a plurality of predetermined index positions,

(*b*) a multi-tooth cam element drivingly associated with said drum and having a predetermined number of teeth equal to the number of index positions of the drum,

(*c*) a bifurcated impulse lever pivotally mounted in operative association with said cam element and having a pair of spaced driving elements arranged to be alternately and asymmetrically engaged with the teeth of said cam element whereby, when said lever is pivotally reciprocated between predetermined alternate limit positions, said cam element and drum are unidirectionally advanced,

(*d*) said drum being advanced from one index position to the next successive index position upon reciprocation of said impulse lever from a first limit position to a second limit position and back to the first limit position,

(*e*) spring means urging said impulse lever into said first limit position,



(*f*) solenoid means for moving said impulse lever into said second limit position upon being energized,

(*g*) a setting element movable selectively to a setting position while said solenoid means is de-energized for rotating selectively in either of two directions said counter drum independently of said impulse lever, and

(*h*) control means operative automatically when said setting element is moved to said setting position to move said impulse lever to a predetermined position intermediate said first and second limit positions in which said driving elements are disengaged from said cam element.

5. The counter of claim 4, in which

(*a*) said setting element comprises a shaft disposed at right angles to the axis of said counter drum and movable along its own axis,

(*b*) a bevel gear is carried by said shaft and is positioned for operative engagement with another bevel gear, upon axial movement of said shaft in a predetermined direction into setting position, and

(*c*) said control means comprises a cam carried by said shaft and operative to engage and move said impulse lever to said intermediate position, upon said axial movement of said shaft to setting position.

6. A settable impulse counter mechanism comprising in combination

(*a*) a counter drum having a plurality of index positions,

(*b*) said drum being mounted for rotation about a transverse axis,

(*c*) a multi-tooth cam element drivingly associated with said drum,

(*d*) a bifurcated impulse lever pivotally mounted in operative association with said cam element and having a pair of spaced driving elements arranged to be alternately and asymmetrically engaged with teeth of said cam element whereby, when said lever is pivotally reciprocated, said cam element and drum are unidirectionally advanced,

(*e*) a setting element movable selectively to a setting position for rotating said counter drum independently of said impulse lever,

(*f*) said setting element including a shaft mounted for rotation about and axial movement along a longitudinal axis and having a portion projecting forward of the mechanism for manual access, and

(*g*) control means operative automatically when said setting element is moved to said setting position to move said impulse lever to a position disengaged from said cam element and accommodating free rotation thereof,

(*h*) said control means comprising a cam movable longitudinally with said shaft for engaging and moving said impulse lever.

7. The counter of claim 6, in which

(*a*) a first gear is carried by said shaft, and

(*b*) a second gear is positioned to be engaged by said first gear, upon axial movement of said shaft to setting position,

(*c*) said second gear being drivingly associated with said drum.

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