Sept. 12, 1967 H. HEIMBERGER ET AL 3,341,694

READOUT COUNTER

Filed March 27, 1963 2 Sheets-Sheet 1

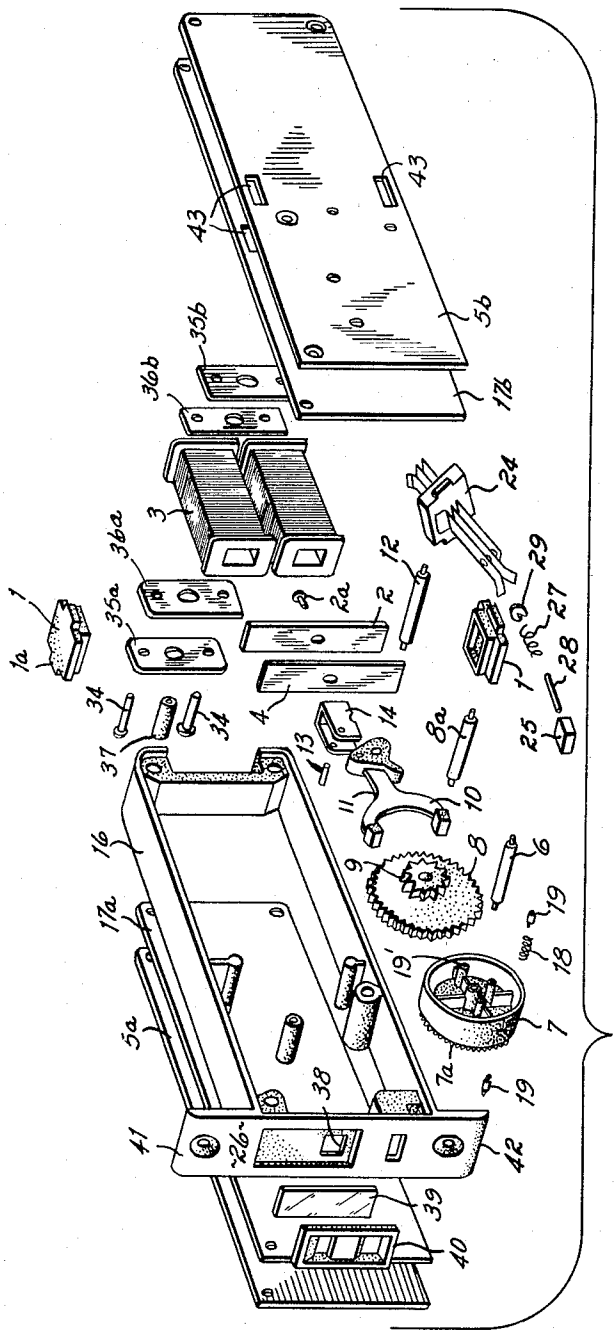


Fig. 1

INVENTORS.
Helmut Heimberger
BY Heinz Kohler
Wood, Herron and Evans
ATTORNEYS

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Filed March 27, 1963 2 Sheets-Sheet 2

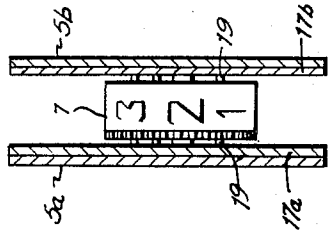


Fig. 3

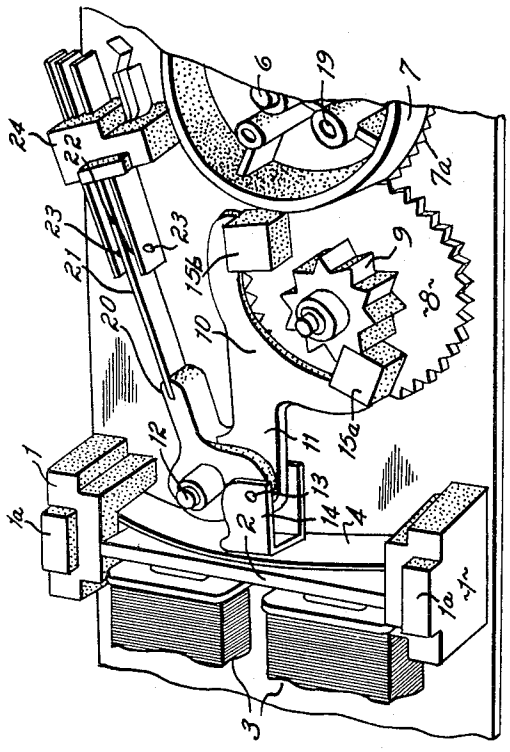


Fig. 2

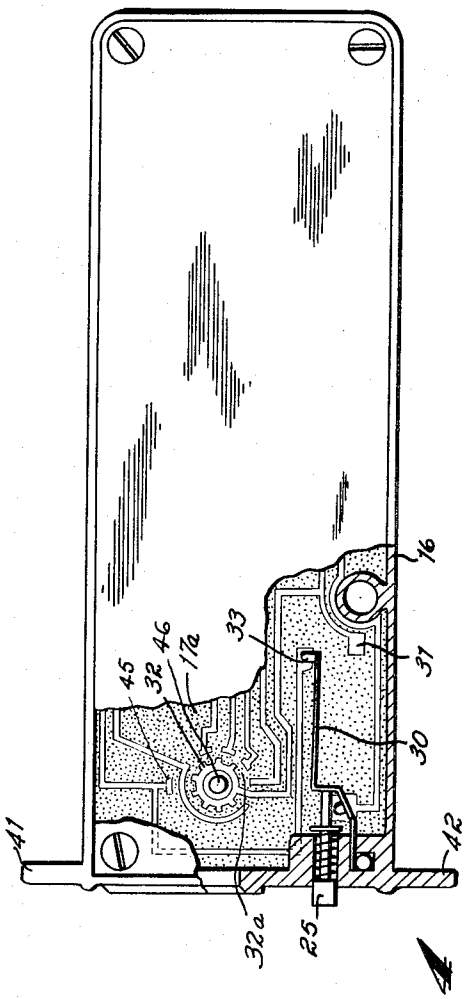


Fig. 4

INVENTORS.
Helmut Heimberger
BY Heinz Kohler
Wood, Herron & Evans
ATTORNEYS

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3,341,694

READOUT COUNTER

Helmut Heimberger, Nesselwang, and Hans Karl Heinz Köhler, Buckenhof, near Erlangen, Germany, assignors to J. Hengstler KG. (partnership corporation), a corporation of Germany

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18 Claims. (Cl. 235—92)

This invention relates to electro-magnetic pulse counting relays and has as its object the provision of such relays that are narrow in width so that a plurality of said relays can be positioned in side-by-side relationship.

It is a further object of the invention to provide a simple mechanical assembly of the various component parts constituting such relays such that said parts can be speedily assembled in accurately spaced relationship.

It is a further object of the invention to provide an electro-magnetic counting relay that has a long life, high counting speed, and facilities for zeroizing, tens-transfer and an electrical read-out of the setting of the relay.

According to the present invention an electro-magnetic relay is provided that comprises two side members or plates co-operating with an intermediate frame-like member to form a housing, said housing containing an impulse actuated electro-magnet, a pair of spaced apart support blocks supporting between them a ferrous member spaced from the electro-magnet such that when the electro-magnet receives an electrical impulse signal the ferrous member is flexed towards the electro-magnet and then released on termination of said electrical impulse, a pivoted yoke-like member adapted to be rocked by the flexing of the ferrous member, a toothed wheel arranged between the arms of the yoke-like member such that when the yoke-like member is rocked the arms thereof sequentially engage the teeth of the toothed wheel to turn said wheel by an increment of rotation about its polar axis, said toothed wheel driving a digit indicating drum.

In a preferred arrangement the digit indicating drum is arranged at the front of the housing so as to be viewed through a window in the front wall of the housing and the pivoted yoke-like member, and the toothed wheel between the arms thereof, are arranged behind the digit indicating drum to ensure a narrow overall width of the pulse counting relay.

In a further preferred arrangement the digit indicating drum and/or the driving wheels associated therewith are provided with electrical contacts that sweep over printed contact surfaces associated with the side members or plates of the housing, said contact surfaces being appropriately printed to provide means for zeroizing, tens-transfer, and an electrical read-out of the setting of the relay.

A further preferable feature is the provision of means whereby the current fed to the electrical contacts sweeping over at least some of the printed circuits is cut off just prior to said contacts leaving said printed circuits and whereby said current supply is re-established only after said electrical contacts have moved into engagement with the next contact surface in sequence of said printed circuits, thereby protecting said printed contact surfaces against burning.

These preferred features, and others, will be described in detail hereinafter, from which description the numerous advantages of a counting relay according to the present invention will become apparent.

In order that the invention may be clearly understood reference will now be made to the accompanying drawings, wherein:

FIGURE 1 is a perspective exploded representation of the elements of the pulse counting relay;

FIGURE 2 shows a detailed view of the drive from the electro-magnet to the digit indicating drum;

FIGURE 3 is an end view of the digit drum between two circuit plates; and

FIGURE 4 is a side elevation of the pulse counting relay, partly in section, showing features relating to zero-setting.

Referring firstly to FIG. 2, it will be seen that the impulse counter comprises a pair of spaced apart support blocks **1** supporting between them an anchor plate **2** of ferrous material. The support blocks **1** may be of a non-conductive synthetic plastic. To one side of the anchor plate **2** are a pair of electro-magnets **3** and on the opposite side of the anchor plate **2**, and secured at its centre thereto by a rivet **2***a*, is a leaf spring **4** of non-magnetic material, the leaf spring **4** being supported at its two ends by the spaced apart support blocks **1**. The leaf spring **4** is preferably stamped out of rolled sheet metal such that its length, as measured between the support blocks **1**, extends transversely of the direction of rolling.

The support blocks **1** are mounted between pair of side plates **5***a*, **5***b*, FIG. 1, that also act as bearing means for the shaft **6** of a digit indicating drum **7**. The drum **7** carries gear teeth **7***a* that mesh with a drive wheel **8** concentric and rigid with a toothed wheel or ratchet **9**.

A yoke-shaped arm **10**, having a cranked stem **11**, is pivotally mounted at its cranked end on a pivot pin **12** rigidly mounted between the side plates **5***a*, **5***b*. The end of the stem **11** that is remote from the yoke-shaped arm **10** is coupled to an anchor pin **13** mounted in a U-shaped bracket **14** secured to the leaf spring **4**. The yoke-shaped arm **10** carries a pair of drive blocks **15***a*, **15***b*, one at each end of the yoke-shaped arm.

In operation, an electrical impulse transmitted to the electro-magnets **3** attracts the anchor plate **2** and thus causes a displacement of the leaf spring **4**, the U-shaped bracket **14**, and the anchor pin **13** in a manner causing a clock-wise deflection of the cranked stem **11**, about the pivot **12**, as viewed in FIG. 2. This movement causes the block **15***a* to become disengaged from, and the block **15***b* to move into engagement with, the teeth of the toothed wheel **9** such that the wheel **9** is rotated through an increment of rotation. On termination of the electrical impulse the anchor plate **2** is no longer attracted by the electro-magnets **3** and, as a result, the leaf spring **4** returns the anchor plate **2** and the yoke-shaped arm **10** back to the position shown in FIG. 2 such that the block **15***b* disengages from, and the block **15***a* engages, the wheel **9** such that the wheel **9** is rotated through a further increment of rotation. The two increments of rotation of the toothed wheel **9** are such that the drive wheel **8** drives the digit indicating drum **7** forward by one digit.

The parts described are enclosed in a frame like member **16** to which the side plates **5***a*, **5***b* are secured, one on each side, to form, in association with the frame like member **16** a housing of exceptionally narrow width.

The above described arrangement of elements, causing a step-by-step rotation of the digit indicating drum for each pulse received from the electro-magnets, constitutes the basic features of the present invention. The pulse counting relay must, of course, include an electrical circuitry that is capable of producing a transfer pulse on reaching ten digits and to zeroize when required. Such a circuit should also be capable of producing an electrical readout. For this purpose the counting relay includes a pair of printed circuit plates **17***a*, **17***b*, FIGS. 1 and 3, clamped one on each side of the rectangular housing **16** between said housing and the side plates **5***a*, **5***b*. It will be appreciated that such printed circuit plates **17***a*, **17***b* may take many forms depending upon the requirements that are to be fulfilled by the pulse counting relay and

the manner in which such circuitry may operate will therefore be described in general terms only.

The printed circuits on the circuit plates **17***a*, **17***b*, are oppositely disposed; that is, the printed circuits face each other with the apparatus for rotating the digit indicating drum **7** therebetween. The digit indicating drum **7** carries one or more contact housings or bores parallel with the polar axis of the drum but spaced radially therefrom and in each housing is a spring **18** disposed between a pair of contacts **19** slidably disposed within the housing, the contacts **19** being biased against the oppositely disposed printed circuit plates **17***a*, **17***b* by the spring **18**. The various housings, or bores in the drum are arranged at different radial and/or angular settings on said drum. Thus, as the drum **4** is rotated step-by-step the contacts **19** make contact with oppositely disposed contact surfaces on the printed circuit plates **17***a*, **17***b* to bridge such contacts and establish an electrical circuit appropriate to the pulse counted by the relay and on reaching ten to establish a circuit sending a pulse to the next pulse counting relay in an assembly of such relays. For example, the bore of drum **7** furthest removed from shaft **6** carries contact **19'** (see FIGURE 1). At the count of nine this contact **19'** makes engagement with contact surface **45** (which lies the greatest distance away from the opening **46** in printed circuit plate **17***a* which receives shaft **6**) and a similar contact surface (not shown) to establish a bridging circuit path which sends the next (tenth) pulse to the next pulse counting relay in the array. According to the number of ancillary circuits required it is also possible for contact points to be carried by the drive wheel **8** and for these points to co-operate with additional contact surfaces on the printed circuit plate **17***a*.

The inductance of the electro-magnets **3** is such that without special precautions being taken the high voltage that would be set up in the circuitry of the pulse counting relay would effect a rapid burning away of the contact surfaces on the printed circuit plates **17***a*, **17***b*. To avoid this effect a spark quenching element (voltage-dependent resistance, variable resistor diode, condensors, or the like) are arranged in parallel across the coil. Also, the cranked end of the stem **11** of the yoke **10** is provided with a lever arm **20** from which extends a leaf spring **21** having a contact **22** rivetted therethrough that extends between a pair of stationary contacts **23** extending from a fixed terminal block **24**. The spacing between the stationary contacts **23** is such that as the leaf spring **21** oscillates with the movements of the cranked stem **11**, the rivetted contact **22** comes into contact with the stationary contact **23** only when the sliding contacts **19** have already moved onto a contact surface on the printed circuit plates **17***a*, **17***b*; and such that the rivetted contact **22** breaks with the stationary contacts **23** before the sliding contacts **19** have moved off a contact surface on the printed circuit plates **17***a*, **17***b*. Thus a currentless switching of the contacts **19** from one circuit surface to another on the plates **17***a*, **17***b* is rendered possible.

Zero-setting

To enable the digit indicating drum to be set to zero, a zero-setting button **25**, FIGS. 1 and 4, extends through the front wall **26** of the housing **16**. The button **25** is biassed outwardly by a coiled compression spring **27** housed in a recess in the front wall **26**, this spring **27** surrounding a rod **28** extending from the zero-setting button **25** to the opposite face of the front wall **26** where it is held against removal by a spring clip **29** having a snap-fit in a groove in the rod **28**.

When the button **25** is pressed inwardly the inner end of the rod **28** abuts against an angled portion of a change-over switch **30** to deflect said switch downwardly against spring means to engage a contact **31**. The change-over switch **30** is permanently coupled to a direct current electrical supply and when the switch **30** is pushed into engagement with the contact **31** a circuit is established via one of nine opposed contact surfaces **32** on the printed circuit plates **17***a*, **17***b*, via one pair of the contacts **19** on the digit indicating drum **7**, to the electro-magnets **3**. The electro-magnets **3** thus receive a pulse so that the anchor plate **2** is pulled towards the magnets and, as a result, the drum **7** is indexed by half a unit. This half-movement of the drum **7** causes the contact points **19** to move off the said opposed pair of contact surfaces **32** and the circuit to the electro-magnets is thus broken. The leaf spring **4** then returns the anchor plate **2** to its initial position and thus the second half-step of the drum **7** takes place an the contacts **19** will then have been moved to a setting where they bridge the gap between the next two contact surfaces **32** on the printed circuit plates **17***a*, **17***b*. As a result, the electro-magnets **3** receive a further pulse that results in the drum **7** being indexed by yet a further unit. This step-by-step rotation of the drum **7** continues until the drum **7** reads zero, at which stage the contact points **19** associated with the zero-setting circuit are at a setting at which there is a gap (location **32***a*) in the sequence of the nine contact surfaces **32** on the plates **17***a*, **17***b* and the rotation of the drum **7** then stops. Since the relay is capable of causing the drum **7** to rotate at the rate of 50 digits per second it will be seen that the time element required from an operator pushing the button **25** will be but a fraction of a second to cause the relay to zeroize itself. The changeover switch **30** when in its undeflected position, that is to say in engagement with a contact surface **33**, forms part of the normal circuit for feeding impulses to the electro-magnets **3**. Thus, when the zero-setting button **25** is pressed this normal pulse transmitting circuit is broken so that the zeroizing sequence of steps is not affected by any pulses received during zeroizing.

It is also possible for the relay to be set to zero by utilizing a half-wave rectified alternating current to cause a forward stepping of the digit drum **7**. In this instance the nine interrupted contact surfaces **32** on each plate **17***a*, **17***b* are not necesary and are replaced by a single annular contact surface on each plate **17***a*, **17***b* said annular contact surfaces being concentric with the axis of rotation of the drum **7** and having each an open portion or gap (preferably located at gap **32***a*) therein such that as the half-wave rectified signals are passed through the opposed annular contact surfaces, via a pair of contacts **19** on the drum **7**, to the electro-magnets **3**, the half-wave rectified signals cause the electro-magnets **3** to rotate the digit indicating drum **7** step-by-step until the contacts **19** reach the gap or open portion in said annular contact surfaces. At this stage the circuit from the rectifier unit to the electro-magnets is broken and the digit indicating drum **7** stops. The location of said gap or open portion is so chosen that the circuit to the electro-magnets is broken when the numeral "zero" is displayed by the digit indicating drum. The said rectified signals are preferably square-topped pulses.

General assembly

The pulse counting relay has been designed to facilitate a speedy and accurate assembly of the various component parts and the individual parts have also been designed to give a long life.

So far as assembly is concerned the high degree of accuracy required has been achieved by utilizing the side plates **5***a*, **5***b* to locate the various component parts accurately with respect to each other.

To ensure an accurate mounting of the ends of the leaf spring **4** relatively to the ends of the anchor plate **2** the support blocks **1** are not only preformed with suitably spaced elongated apertures **43** to accommodate said ends but are provided with lugs **1***a* that exend into preformed apertures in the plates **5***a*, **5***b*, **17***a*, **17***b* to ensure that the support blocks **1** are accurately spaced apart to the desired degree.

As shown in FIG. 1 the electro-magnets **3** are to be clamped between two metal plates **35***a*, **35***b*, and for this

purpose screws 34 are used that extend through the side plate 5*a*, the screws 34 having countersunk heads engaging countersunk holes in the plate 5*a*. The plate 36*a* acts as a base against which the electro-magnets 3 are pressed and the plate 35*b* acts as a securing plate having threaded apertures engaged by the threaded ends of the screws 34. A spacing bushing 37 of insulating material extends between the electro-magnets 3 and through the plates 35*a*, *b*, and 36*a*, *b*. For accuracy of operation it is essential that the position of the electro-mangets 3, relatively to the anchor plate 2, is accurately determined. To this end a gauge device is initially fitted into the reception hole for the lug 1*a* in the plates 5*a* and 17*a* and said gauge means is used to hold the electro-magnets 3 accurately positioned whilst the plates 35*a*, *b* and 36*a*, *b*, and the screws 34 are assembled about the electro-magnets 3 to hold them securely in position on the plates 5*a*, 17*a*. The gauge means is then removed to enable the support block 1 to be fitted into its locating aperture in the plate 5*a* and 17*a*.

Further accuracy is obtained by drilling the U-shaped bracket 14 in a jig to ensure that the spacing of the anchor pin 13 is accurately located with respect to the anchor plate 2 and the leaf spring 4.

Since the various apertures formed in the plates 5*a*, 5*b* and 17*a*, 17*b* are also located accurately by means of a template or jig, such apertures ensure that the pivot pin 12 for the cranked stem 11, the shaft 6 for the digit indicating drum 7, and the shaft 8*a* for the drive wheel 8 are all accurately located with respect to each other and so ensure a uniform positioning of the yoke-shaped arm 10 about the toothed wheel 9.

In order to achieve high magnetic forces with small mass movement the spacing of the anchor plate 2 from the magnetic poles is made small. The working travel of the yoke-shaped arm 10 is made a little greater than that which would be necessary to drive the toothed wheel 9 through half a step of rotation.

The yoke-shaped arm 10 and the toothed wheel 9 have been placed behind the digit indicating drum 7 to ensure a narrow overall width of the pulse counting relay and to ensure a long life for the counter—that is to say the total number of pulses that it can register before normal wear affects its efficiency—wide driving blocks 15*a*, 15*b* are provided that co-operate with a wide toothed wheel 9.

In addition, since the contacts 19 carried by the digit indicating drum 7 extend from both sides thereof to contact simultaneously opposed contact surfaces on the printed circuit plates 17*a*, 17*b*, the stresses set up on the two side faces of the digit indicating drum 7 are balanced and this, in turn, leads to a longer life for the pulse counting relay.

In place of the spring biased contacts 19 the digit indicating drum 7 may carry wire spring stirrups held in guide slots in the drum.

Also, whereas two electro-magnets are illustrated in the drawings it will be appreciated that such magnets may comprise a double winding on a U-shaped core of soft iron plates.

The housing includes a viewing aperture 38 covered by a glass panel 39 held in position by a frame 40, the aperture 38 enabling the setting of the digit indicating drum 7 to be noted.

Upper and lower lugs of tongues 41, 42, on the front face of the housing enable several of the counting relays to be secured side-by-side to a common framework.

What we claim is:

1. An impulse responsive stepping device comprising:
- a support element,
- a driven toothed wheel rotatably mounted on said support element,
- an electromagnetic device fixed to said support element and having an armature mounted for rectilinear motion in a first direction in response to electric impulses,
- a spring mounted to said support element in biasing relationship to said armature for biasing said armature in a direction opposite to said first direction, and
- a yoke having a crank stem pivotally mounted at different points to said spring and to said support for rocking said yoke in response to impulse-induced movement of said armature, said yoke also having a pair of arms extending from said crank stem into selective and alternative engagement with the teeth of said toothed wheel for positively incrementing said driven toothed wheel in response to rocking of said yoke, said spring including a resilient leaf member mounted at its ends to said support element and at a point intermediate its ends to said crank stem.

2. The impulse responsive stepping device of claim 1 further comprising:
- an electrical contact mounted for movement between a plurality of different positions, each position corresponding to a different angular orientation of said driven toothed wheel,
- a first plurality of discrete stationary contacts, each contact located at a different one of said different positions and alternatively connectable to said movable contact,
- an arc preventing switch including first and second contacts and an operator normally electrically coupling said first and second fixed contacts and mounted for movement to decouple said first and second contacts in response to rocking of said yoke; and
- selectively interruptible first circuit means serially connecting said first and second contacts, said movable and stationary discrete contacts, and said electromagnetic device in circuit with a source of potential for arclessly impulsing said electromagnetic device and thereby incrementing said driven toothed wheel when said first and second contacts are coupled in the absence of yoke rocking movement.

3. The impulse responsive stepping device of claim 1 further comprising:
- an electrical contact mounted for movement between a plurality of different positions, each position corresponding to a different angular orientation of said driven toothed wheel,
- a first plurality of discrete stationary contacts, each contact located at a different one of said different positions and alternatively connectable to said movable contact,
- an arc preventing switch including first and second contacts and an operator normally electrically coupling said first and second contacts and mounted for movement to decouple said first and second contacts in response to rocking of said yoke; and
- selectively interruptible circuit means serially connecting said first and second contacts, said movable and stationary discrete contacts, and said electromagnetic device in circuit with a source of potential for arclessly impulsing said electromagnetic device and thereby incrementing said driven toothed wheel when said first and second contacts are coupled in the absence of yoke rocking movement.

4. The impulse responsive stepping device of claim 2 further comprising a second plurality of discrete stationary contacts corresponding in number to said first plurality of discrete stationary contacts, said contacts of said second plurality arranged to be successively and alternatively coupled to different ones of said discrete stationary contacts of said first plurality by said movable contact as said toothed wheel is incremented, each of said contacts of said second plurality being connectable in use in circuit with one of said first and second contacts and a readout device; and
- second circuit means connecting said second plurality of stationary discrete contacts in series with a source

of potential and said first and second contacts, enabling an electrical readout to be arclessly obtained by said readout device when said movable contact is coupling a pair of stationary discrete contacts and said yoke is stationary.

5. The impulse responsive stepping device of claim 1 further comprising:

an electrical contact mounted for movement between a plurality of different positions, each position corresponding to a different angular orientation of said driven toothed wheel,

a first plurality of discrete stationary contacts, each contact located at a different one of said different positions and alternatively connectable to said movable contact,

an arc preventing switch including first and second contacts and an operator normally electrically coupling said first and second contacts and mounted for movement to decouple said first and second contacts in response to rocking of said yoke; and

a second plurality of discrete stationary contacts, said contacts being located adjacent to different ones of said contacts of said first plurality and adapted to be alternatively coupled by said movable contact to the adjacent contact of said first plurality, said contacts of said second plurality being connectable in use in circuit with one of said first and second contacts and a readout device; and

circuit means connecting said second plurality of stationary discrete contacts in series with a source of potential and said first and second contacts, enabling an electrical readout to be arclessly obtained by said readout device when said movable contact is coupling a pair of stationary discrete contacts and said yoke is stationary.

6. The impulse responsive stepping device of claim 1 wherein each of said arms engages said wheel once per yoke rocking cycle incrementing said wheel one-half increment, said engagements being sequential and combining to increment said wheel one full increment per yoke rocking cycle.

7. A counter comprising:

at least two stepping devices, each of said stepping devices including:

a support element,

a driven toothed wheel rotatably mounted on said support element,

an electromagnetic device fixed to said support element and having an armature mounted for rectilinear motion in a first direction in response to electric impulses,

a spring mounted to said support element in biasing relationship to said armature for biasing said armature in a direction opposite to said first direction, and

a yoke having a crank stem pivotally mounted at different points to said spring and to said support for rocking said yoke in response to impulse induced movement of said armature, said yoke also having a pair of arms extending from said crank stem into selective and alternative engagement with the teeth of said toothed wheel for positively incrementing said driven toothed wheel in response to rocking of said yoke,

an electrical contact mounted for movement between a plurality of different positions, each position corresponding to a different angular orientation of said driven toothed wheel,

a first plurality of discrete stationary contacts, each contact located at a different one of said different positions and alternatively connectable to said movable contact,

an arc preventing switch including first and second contacts and an operator normally electrically coupling said first and said second contacts and mounted

for movement to decouple said first and second contacts in response to rocking of said yoke;

selectively interruptible first circuit means serially connecting said first and second contacts, said movable and stationary discrete contacts, and said electromagnetic device in circuit with a source of potential for arclessly impulsing said electromagnetic device and thereby incrementing said driven toothed wheel when said first and second contacts are coupled in the absence of yoke rocking movement, and

transfer circuit means connecting one pair of adjacent discrete stationary contacts of one of said stepping devices to a pair of adjacent discrete stationary contacts of the other of said stepping devices for impulsing said second stepping device once per full revolution of said toothed wheel of said first stepping device thereby providing at least a two order counter.

8. The impulse responsive device of claim 4 wherein said first and second plurality of discrete stationary contacts are arranged in circles on opposed surfaces of a pair of printed circuit boards, said boards being in sandwich relation to said movable contact.

9. The impulse responsive device of claim 8 further including a numeric display drum driven by said toothed wheel for supporting said movable contact.

10. The impulse response device of claim 9 wherein said circuit boards have apertures for locating pins about which said toothed wheel, drum and yoke rotate.

11. The impulse responsive device of claim 10 further including a switch connected in circuit with said electromagnetic device and said first circuit means, said switch being operable in response to said first circuit means for preventing impulsing of said electromagnetic device by other than said source of potential associated with said first circuit means.

12. In a counter having a wheel angularly rotatable step by step in response to electrical impulses:

a movable electrical contact,

means electrically connecting said contact to a source of potential,

a plurality of discrete stationary contacts spaced from each other and engageable by said movable contact,

means for stepping said movable contact into engagement with said stationary contacts in response to angular movement of said wheel,

an arc preventing switch comprising first and second contacts,

an operator engageable with at least one of said first and second contacts and movable between a first position in which said first and second contacts are coupled and a second position in which said first and second contacts are decoupled,

means connecting said first and second contacts when coupled in series with said source of potential, and

means interconnecting said operator and said wheel to move said operator to said second position as said wheel moves and before said movable contact leaves a stationary contact and to return said operator to said first position after said movable contact engages an adjacent stationary contact,

whereby a circuit including said movable contact, one of said discrete stationary contacts, and said first and second contacts is interrupted when said movable contact initiates making and braking engagement with said discrete stationary contacts thereby preventing arcing between said movable and discrete stationary contacts.

13. Counter means comprising:

first rotatably mounted gear means having gear teeth around its entire periphery;

second rotatably mounted gear means driven by said first gear means and having gear teeth around its

entire periphery for continuously engaging the gear teeth of said first gear means;

a rotatable number wheel secured to and rotatable with said second gear means;

said number wheel being a substantially hollow cylindrical shell integral with and extending from one side of said second gear means;

a ratchet secured to and rotatable with said first gear means;

drive means engaging said ratchet for rotatably moving said ratchet;

electromagnet means for operating said drive means in incremental fashion responsive to input pulses;

first printed circuit means positioned adjacent at least one of said gear means;

said first printed circuit means comprising a plurality of contacts arranged in spaced fashion about an arcuate path for providing output signals;

second printed circuit means positioned adjacent said one of said gear means for providing input signals;

contact means resiliently mounted upon said one of said gear means for coupling said input signals to said first printed circuit means in sequential fashion.

14. Electromagnetic drive means for counters comprised of:

a rotatably mounted ratchet;

movably mounted mechanical drive means selectively engaging said ratchet for driving said ratchet into rotation;

a first gear coupled to rotate with rotation of said ratchet;

a second rotatably mounted gear engaging and rotationally driven by said first gear;

a number wheel coupled to rotate with said second gear;

said electromagnetic drive means comprising electromagnet means energized by input drive pulses;

elongated leaf spring means; means engaging said leaf spring means adjacent the ends thereof;

a magnetic anchor plate mounted for reciprocating movement under control of said electromagnet means and said leaf spring means;

bracket means coupling said drive means to said magnetic anchor plate;

said leaf spring means being coupled to said bracket means for normally urging said magnetic anchor plate in a first direction away from said electromagnet means;

said electromagnet means urging said magnetic anchor plate in a second direction opposite said first direction when energized to move said mechanical drive means;

said leaf spring means urging said anchor plate, said bracket means and said drive means generally in said first direction when said electromagnet is deenergized.

15. The device of claim **14** wherein said mechanical drive means is further comprised of:

an arm; first means pivotally mounted to said arm near a first end thereof;

said bracket means being pivotally coupled to said arm near said first end at a point lying a spaced distance from said first pivotally mounting means;

at least one drive member mounted near the second end of said arm for selectively engaging said ratchet imparting rotational movement to said ratchet under control of the reciprocal movement of said bracket means.

16. A counter comprising:

electromagnetic means energized by input pulses for stepping the counter;

a stepping mechanism comprising

a first arm pivotally mounted at one end thereof;

first rotatably mounted gear means comprising a first gear and a toothed wheel secured to one another for rotation therewith;

a second end of said first arm having at least one portion thereof adapted to selectively engage said toothed wheel;

an armature coupled to said first arm near said first end;

spring biasing means for urging said armature away from said electromagnetic means and for urging said second arm toward said toothed wheel;

each input pulse energizing said electromagnetic means to urge said armature toward said electromagnetic means causing said first portion of said first arm to move away from said toothed wheel against the force of said biasing means;

the removal of each input pulse causing said biasing means to urge said armature away from said electromagnetic means and said first arm first portion into engagement with said toothed wheel to rotate said toothed wheel and said first gear in incremental steps;

a second rotatably mounted gear means comprising a second gear being engaged and rotatably driven by said first gear, and

a number wheel being secured to rotate with said second gear;

contact means carried by at least one of said gear means;

printed circuit means positioned to have said contact means make wiping engagement with said printed circuit means for establishing electrical paths representative of the angular position of said number wheel.

17. The counter of claim **16** further having a zero setting capability such that said printed circuit is further comprised of first and second contact surfaces:

a power source;

one of said contact surfaces being coupled to said power source;

the remaining contact surface being coupled to said electromagnetic means;

said second contact means being carried by one of said gear means to electrically couple said first and second contact surfaces until said number wheel reset position is reached;

at least one of said first and second contact surfaces having a gap to prevent further energization of said electromagnetic means once said reset position is reached.

18. The counter of claim **16** further having a transfer capability such that said printed circuit means is further comprised of first and second contact surfaces:

a power source,

one of said first and second contact surfaces being coupled to said power source;

the remaining one of said first and second contact surfaces being adapted to be coupled to the input of a second counter;

second contact means carried by one of said gear means electrically coupling said first and second contact surfaces after receipt of a predetermined number of input pulses to couple the next input pulse to the next counter.

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DARYL W. COOK, *Acting Primary Examiner.*

MAYNARD R. WILBUR, JOHN F. MILLER, *Examiners.*

G. MAIER, *Assistant Examiner.*