Dec. 25, 1962 A. ARNELL ET AL 3,070,298

PREDETERMINED COUNTER

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FIG. 1

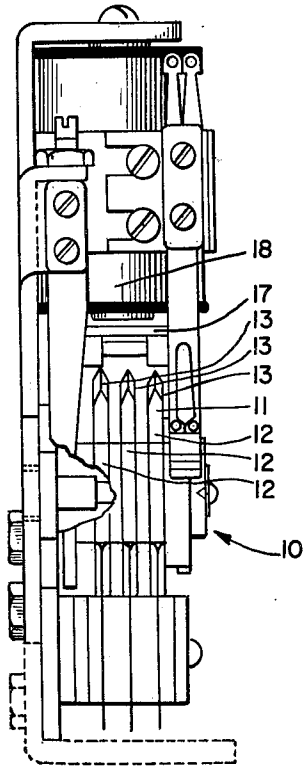
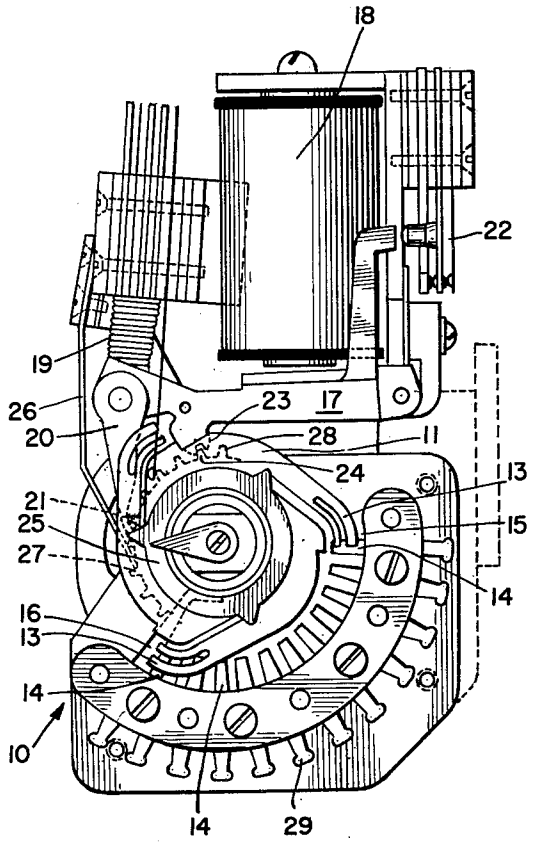


FIG. 2



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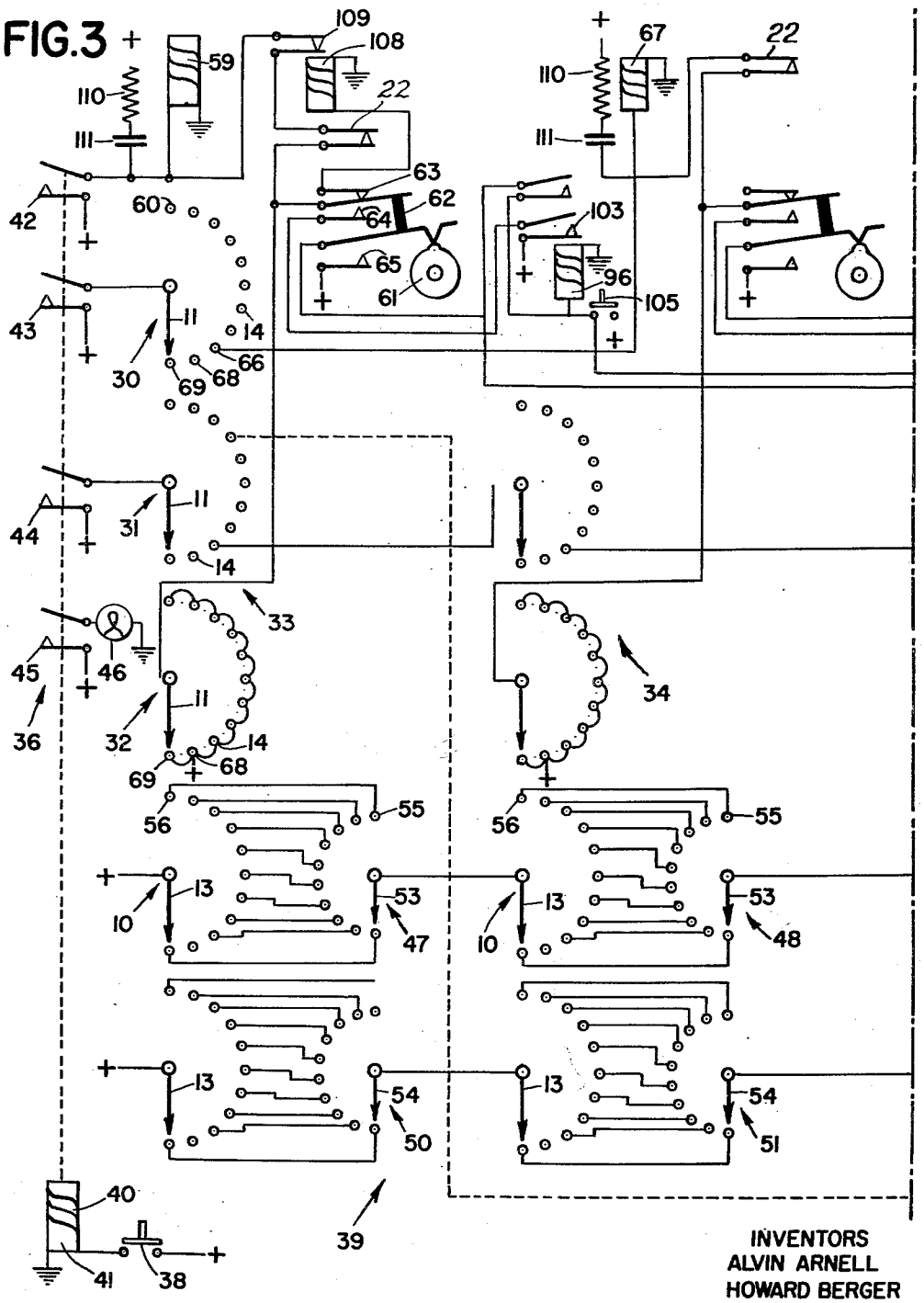
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PREDETERMINED COUNTER

Filed Feb. 12, 1958 3 Sheets-Sheet 2

FIG.3



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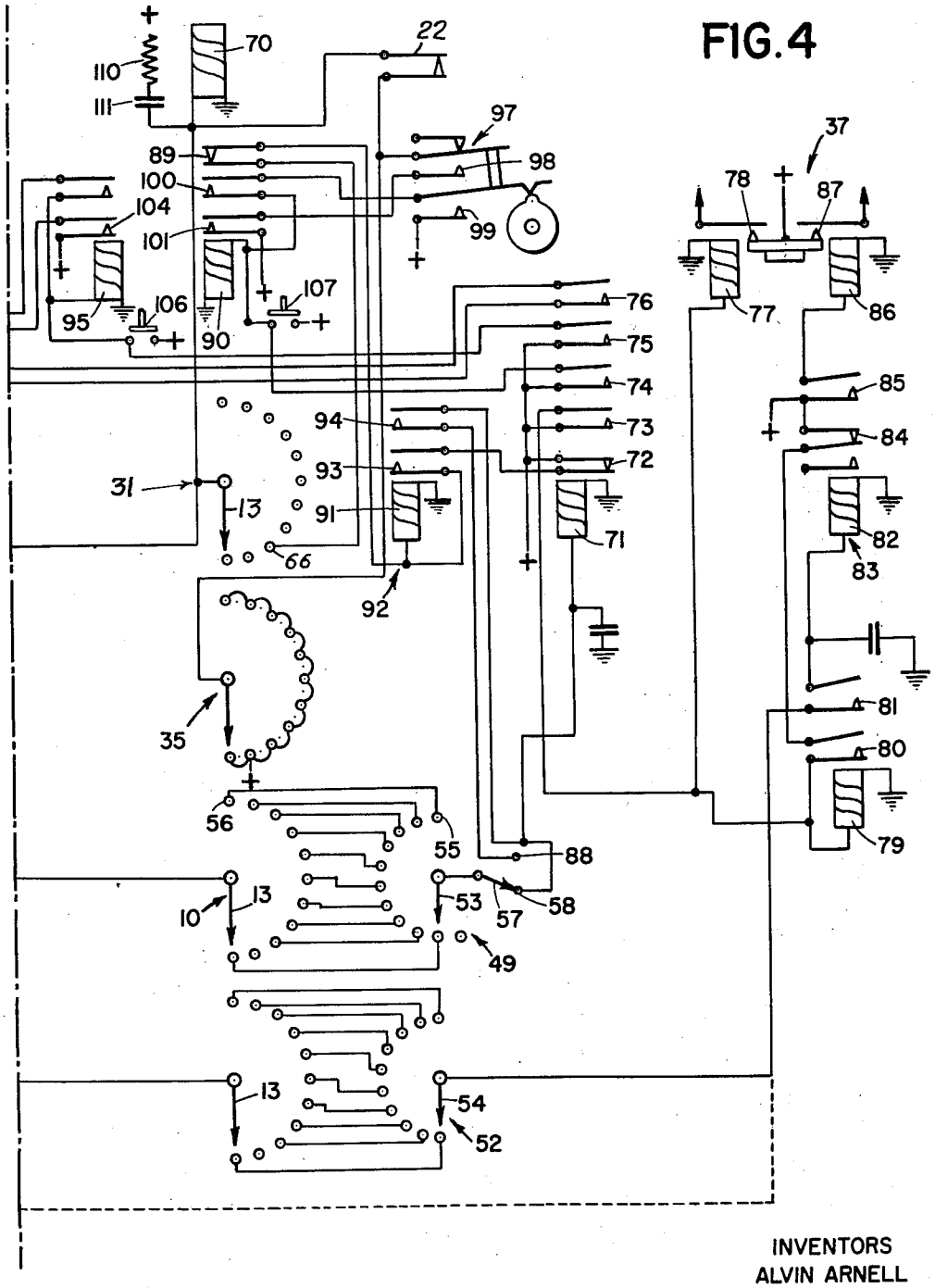
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PREDETERMINED COUNTER

Filed Feb. 12, 1958 3 Sheets-Sheet 3

FIG. 4



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United States Patent Office 3,070,298 Patented Dec. 25, 1962

3,070,298

PREDETERMINED COUNTER

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Filed Feb. 12, 1958, Ser. No. 714,840
6 Claims. (Cl. 235—132)

This invention relates to an electromechanical counter apparatus and more particularly to a counter circuit for continuously counting successive alternate series of predetermined counts and for counting to 1000 with a basic three decade or digit device.

In various industrial applications it is desirable to count successive operations, for example, the number of sheets of paper being printed or otherwise processed, the number of rotations of a shaft, the number of times a valve is opened or closed, and so forth, and when a preselected count is reached to provide some sort of indication thereof, by, for example, an indicator light or the actuation of some other piece of equipment. It is also frequently desirable to count some of the above type operations in succession to alternate predetermined counts and to have one of the aforementioned indications at the end of each successive predetermined count.

It is an object of the present invention to provide an electromechanical counter having a normal three digit circuit which can be used to provide a four digit predetermined count.

Another object is to provide such a counter which counts two alternate sequences of predetermined counts continuously and resets automatically in between each successive count.

An additional object is to provide a counter of the above type in which the counter circuits for the respective digits all are reset independently of one another, or simultaneously, thereby increasing the speed of operation of the device.

Briefly, the present invention involves an electromechanical counter for continuously counting successive alternate series of predetermined counts, one being higher than the other, which comprises three electrically interconnected single-motion rotary stepping switches each representing a different decimal digit, i.e. units, tens and hundreds. A first and a second bank of selector switches are connected to the stepping switches for selecting the respective digits of the alternate series of predetermined counts. Input means is provided on the counter for receiving sequential impulses and delivering them to the units digit stepping switch.

A first relay is provided and is operable in response to each predetermined count being reached. A second and a third relay are coupled with the first relay and are operable thereby, the closure of the second relay providing an output signal representative of the higher of the two predetermined counts, and a fourth relay is operatively interconnected with the second bank of selector switches upon closure of the third relay and operates a fifth relay in response to the other of the aforesaid predetermined counts being reached to provide an output signal therefor.

Resetting means is operated by the first relay to simultaneously reset all the stepping switches to a zero or home position after each predetermined count is reached.

A sixth relay is interconnectable with the first relay and the stepping switches, and is actuated by the stepping switches reaching a predetermined count of 999, at which point the first relay is actuated by the next succeeding impuse to close the second relay and indicate 1000.

Switching means is provided in the circuit and connected to the first bank of selector switches. The switching means has a first position at which the first bank of selector switches interconnected with the first relay, and a second positon at which the sixth relay is interposed between the first bank of selector switches and the first relay. The counter successively indicates 1000 continuously with the switching means in the first position and the first bank of selector switches set to 999, and indicates successive alternate series with the switching means in its second position, the first predetermined number being 999 and the second a number less than 999, or whatever other successive alternate series might be selected by the setting of the first and second banks of selector switches.

Other objects and features of the invention will appear in the following specification and appended claims, and in the drawings, in which:

FIG. 1 is a front elevation of one type of rotary stepping switch used with the present invention;

FIG. 2 is a side elevation of the device shown in FIG. 1;

FIG. 3 is a schematic diagram of the input circuit, and the units and tens digit stepping switches; and

FIG. 4 is a schematic diagram of the hundreds digit stepping switch an associated circuitry.

Referring now to the drawings, FIGS. 1 and 2 show a three-level rotary stepping switch as used for each digit counter circuit in the present invention, and the mechanism is generally designated by the reference numeral 10. The switch 10 is a single-motion switch which transmits rotary motion to the wiper assembly 11 and uses this rotary motion for selection and to restore the wiper assembly 11 to a normal or home position. The wiper assembly shown is of the "11 point" type having for each bank level 12 three pairs of wipers 13 angularly spaced from one another, so that as one pair is leaving the set of bank contacts 14 at the upper end 15 as shown in FIG. 2, the other pair is moving into wiping engagement with the set of bank contacts 14 at the lower or "1" end 16. The switch 10 rotates the wiper assemblies 11 step-by-step in one direction only causing the wipers 13 to rest on each bank contact or terminal 14 in succession.

As shown in the drawings the rotary stepping switch 10 has eleven terminals 14 in each bank level 12, and three or more bank levels 12. The utilization of these bank levels 12 will be explained in greater detail hereinafter.

The stepping switch 10 is of the indirect drive type, i.e. the wipers 13 are advanced during the release of the armature 17 rather than during the actuation thereof. When the driving magnet coil 18 is energized by the reception of an electrical pulse, or when the coil is otherwise connected to a power source (not shown), it attracts the armature 17 upwardly as viewed in FIG. 2, and such upward movement of the armature compresses driving spring 19, moves the pawl 20 into engagement with the next ratchet tooth 21 and operates the interrupter contact springs 22 which opens the electrical circuit to the driving magnet coil and causes the armature 17 to be released. The upward movement of the armature 17 during energization of the coil 18 also disengages the stopping teeth 23 from engagement with its adjacent ratchet tooth 24 on the ratchet wheel 25. The wiper assembly 11 is held in place during operation of the armature 17 by a detent spring 26 which engages the ratchet tooth 27. When the coil 18 de-energizes by the movement of the interrupter contact springs 22 previously mentioned, the driving spring 19 expands, rotating the wiper assembly, via the pawl 20, one step in a counterclockwise direction as viewed in FIG. 2, to the next bank contact 14. At the end of the driving stroke, armature stopping teeth 23 mesh with the teeth 28 of the ratchet wheel 25. This automatically positions the wipers 13

on the bank contacts 14 and serves as a positive stop completely eliminating overthrow.

Electrical connections are made to the bank contacts 14 by connection to their radially outward terminal ends 29, and the other connections are made in the well-known fashion and as shown in FIGS. 3 and 4.

In the switch shown, the wiper assembly 11 for the first and second bank levels 30, 31 are of the so called "non-bridging type," i.e. the wiper 13 leaves one bank contact 14 before engaging the next. The wiper assembly 11 for the third bank level 32 is of the "bridging" type which during rotation, before breaking away from one bank contact 14, also engages the next bank contact 14 for use in "homing" in the conventional manner.

Three of the above type stepping switches are electrically interconnected as shown in FIGS. 3 and 4 to provide a units decade 33, a tens decade 34 and a hundreds decade 35, and having an input circuit 36 and an output circuit 37.

The input circuit 36 is comprised of an impulse generating switch 38 of any suitable conventional type which is actuated in response to the individual equipment with which the invention is to be used to provide the electrical counting impulses for the counting circuit designated generally by the reference numeral 39. Closure of switch 38 connects positive electricity to the coil 40 of relay 41, closing relay contacts 42, 43, 44 and 45. Such closure therefore occurs each time switch 38 is closed. The closure of contact 45 ignites indicator lamp 46 to provide visual confirmation of the generation and reception of a counting pulse by the input circuit 36.

The units, tens and hundreds decades 33, 34 and 35 have a first bank of selector switches 47, 48 and 49 respectively, and a second bank of selector switches 50, 51 and 52 respectively, each of the first bank of selector switches having adjustable indicators 53 which may be manually preset for the particular digits in each decade for the first predetermined count, and each of the second bank of selector switches having similar manually adjustable indicators 54 for selecting the digits of the second and alternate predetermined count. The stationary contacts 55 of the selector switches are wired to corresponding stationary contacts 56 on the stepping switches 10 in the decades 33, 34 and 35 as shown to apply positive voltage through the interconnected contacts 55, 56 when the wiper 13, which is connected to the positive voltage, engages the respective contacts 56.

The counting circuit 39 ordinarily may be employed to count continuously, and in alternate fashion, two predetermined counts, the first being 999 or less, and the second being at least one number less than the first. The first predetermined count is determined by the setting of the adjustable indicators 53 on the first bank of selector switches 47, 48 and 49, and the second predetermined count is determined by the setting of the adjustable indicators 54 on the second bank of selector switches 50, 51 and 52. For normal operation to provide the predetermined counts just described, switch 57, any conventional single pole double throw switch, is placed in its position shown in FIG. 4, closing contact 58.

At the start of the counting operation for the first of the alternate predetermined counts, the impulse generating switch 38 closes for each counting pulse and actuates relay 41 as previously mentioned. Positive voltage is delivered to the wipers 13 of the first and second bank levels 30, 31 of the units decade stepping switch 33, and in addition, through contact 42 of relay 41, connects positive voltage to the driving magnet coil 59 for the units decade 33 as described above and upon release of the magnet coil 59, i.e. its de-energizing by opening of relay contact 42, the units decade stepping switch 10 is rotated one step indicating a count of one, being thereby moved from its home position as shown in FIG. 3 to the No. 1 stationary contact 60 in each bank level 12. This likewise rotates cam 61 clockwise from the position shown in FIG. 3 thereby permitting arm 62 to move downwardly as viewed in FIG. 3, thereby opening contact 63 and closing contacts 64 and 65 which provide necessary connections for the subsequent resetting operation which will be described in greater detail hereinafter.

When nine impulses have been received in the above manner by the units decade, the wipers 13 in each level 12 thereof are positioned against No. 9 stationary contacts 66. Since, as previously explained, the wiper is not moved until after the pulse has been received, the reception of the tenth pulse connects positive voltage through contact 43 of relay 41 through wiper 13 and No. 9 stationary contact 66 of the first bank level 30 of units decade 33 to driving magnet coil 67 of the tens decade 34, thereby effecting a carry operation and registering a one in the tens digit by moving wipers 13 of the respective bank levels 12 thereof to their No. 1 stationary contact 60.

The tenth pulse also causes the units decade switch to move to the No. 10 stationary contact 68, and by virtue of the bridging third bank level 32 as shown causes the switch to advance to its home position against No. 11 stationary contact 69 in preparation for reception of the next impulse.

Similarly, when the tens decade 34 reaches a setting of nine, i.e. the wipers 13 in each level being in engagement with No. 9 stationary contacts 66 thereof, then upon receiving the tenth pulse energizing voltage is delivered through the wipers 13 of the second bank level 31 of the units and tens decade 33, 34, for the driving magnet coil 70 in the hundreds decade 35.

In this invention the impulses are received at the input circuit 36 and successively counted by the units, tens and hundreds decades 33, 34 and 35 until the hundreds decade wipers 13 stand against the stationary contacts 56 corresponding to the predetermined count indicated by the hundreds adjustable indicator 53, and the tens and units decades have correspondingly reached their predetermined positions, so that positive voltage is connected through all of the first bank of selector switches 47, 48 and 49 to switch 57 and through contact 58 thereof to relay 71, thereby energizing the latter relay, opening its associated contact 72 and closing contacts 73, 74, 75 and 76 thereof. Closure of contact 73 supplies positive energizing voltage to output relay 77, the closure of contact 78 thereof providing positive voltage at the output circuit 77 for further utilization.

Simultaneously with the actuation of relay 71, closure of contact 73 thereof also energizes relay 79, and close contacts 80 and 81 of the latter, thereby connecting the second bank of selector switches 50, 51 and 52 through contact 81 to the coil 82 of relay 83 and providing lock-in voltage for relay 79 through contact 80 and normally closed contact 84 of relay 82.

The closure of contacts 74, 75 and 76 of relay 71 supply positive voltage to the units, tens and hundreds decades 33, 34 and 35 for simultaneous resetting thereof to their respective home positions, the resetting operation to be described below.

Assuming for the moment that the resetting has been accomplished, the succeeding impulses are received in a similar fashion as previously described until the second predetermined count, as indicated by the position of the second bank of selector switches 50, 51 and 52, is reached, at which time positive voltage is connected through all of the latter selector switches and through closed contact 81 of relay 79 to energize the coil 82 of relay 83 and close contact 85 thereof to energize in turn relay 86 and provide positive voltage through closed contact 87 of the latter for further utilization at the output circuit 37. The energizing of relay 83 simultaneously opens contact 84 and removes the lock in voltage from relay 79, thereby returning relays 79, 83 and 86 to their normal de-energized condition.

In lieu of the second bank of selector switches, it is pos-

sible to provide a fixed second predetermined count of a number less than nine by making the dotted connection shown in FIGS. 3 and 4 whereby, for example, the No. 4 stationary contact of the second bank level 31 of the units decade is connected to contact 31 of relay 79, in which case upon reaching the fourth pulse of the second count, an output pulse is similarly provided through relay 86 in the output circuit 37.

One of the unique features of the invention is that a count of 1000 can be made utilizing only three decades, and that is accomplished as follows. Switch 57 is turned so that its other contact 88 is closed and the first bank of selector switches 47, 48 and 49 is set for a predetermined count of 999, i.e. its adjustable indicators 53 are moved to engagement with the No. 9 stationary contacts 55. After the 999th pulse has been received the wipers 13 of the second bank levels 31 of all decades close a circuit from contact 44 of relay 41 through normally closed contact 89 of relay 90 to the coil 91 of relay 92. Upon reception of the 1000th pulse, positive voltage is delivered through closed contact 44, through the circuit just described, energizing relay 92 and delivering positive voltage through the first bank of selector switches 47, 48 and 49, through closed contact 94 of relay 92 to energize relay 71 and cause an output pulse to be delivered by relay 77 in the manner previously described. Closure of other contacts 93 of relay 92 provides lock-in voltage for relay 92 from the reception of the 999th pulse and until reception of the 1000th pulse, such lock-in voltage being removed by energization of relay 71 when the 1000th pulse is received.

With switch 57 closing contact 88 in the above manner, the counter circuit 39 counts to 1000 each time and an output signal is provided only at output relay 77. With switch 57 set against contact 58, the counting circuit 39 provides an output pulse at relay 77 for a first predetermined count if 999, and a second predetermined count of the lesser number pre-selected by the second bank of selector switches 50, 51 and 52 with a corresponding output pulse at relay 86, and continuous alternate counts of 999 and the lesser number are thereby provided.

Positive D.C. voltage may be supplied to the above circuit by any conventional means such as a full-wave rectifier connected to the output of a step-down transformer connected through its primary to a conventional 110 or 220 volt A.C. supply.

Resetting is accomplished upon reaching each predetermined count by the energizing of relay 71 as mentioned above. Closure of contacts 74, 75 and 76 of relay 71 energizes respective relays 90, 95 and 96 in the hundreds, tens and units decades 35, 34 and 33, relay 96 only being energized when the off-normal cam 61 is in the off-normal or other than the home position as shown in FIG. 3.

Although resetting in each decade is accomplished simultaneously with the other decades, we will, for convenience, first consider the hundred decade circuit 35. Since resetting is only necessary when the circuit is at a position other than zero or home, the off-normal contacts 97 are therefore, closed by the contacts 98 and 99.

The closure of contacts 99, together with the closed contacts 100 of relay 90 maintain relay 90 energized throughout the resetting operation. Closed contacts 98 of off-normal contacts 97 apply positive voltage to driving magnet coil 70 through interrupter contact spring 22 to cause the advancement of the hundreds decade wipers 13 to the home position as shown in FIG. 4 in the well-known fashion.

Normally closed contact 89 of relay 90 is interposed between No. 9 stationary contact 66 of the second bank level 31 of the hundreds decade 35, and relay 92, in order to prevent relay 92 being energized when the wiper 13 associated with the latter No. 9 stationary contact 66 passes such contact during the resetting operation.

It should be noted that respective contacts 103, 104 and 101 of relays 96, 95 and 90 respectively, lock such relays to the positive source of voltage throughout the resetting operation. This is necessary by virtue of the fact that as soon as the hundreds decade 35 is reset to its home position, relay 71 is de-energized, which thereby disconnects relay 71 from its source of positive voltage.

Switches 105, 106 and 107 are manual reset switches which can be used when it is desired to manually reset any of the decades 33, 34 and 35 individually for any reason.

Relay 108 is utilized in connection with the units decade to remedy an operational difficulty otherwise encountered when, for example, the tenth and eleventh pulse is being received at the input 36. Whereas the tens and hundreds decades each have a substantial period of time for resetting, the units decade must be reset instantaneously in order to count subsequent pulses after any tenth pulse is received. In practice it was found that the tendency was for the units decade 33 to overshoot and thereby erroneously indicate higher numbers for the pulses actually received. Therefore, relay 108 is energized by the closure of contact 63 associated with off-normal cam 61, which in turn interconnects with the positive voltage through bridging wiper 13 of the third bank level 32 in the units decade circuit 33 and No. 10 stationary contact 68 thereof to open contact 109 of relay 108, and thereby disable driving magnet coil 59 as soon as the home position is reached by off-normal cam 61 of the units decade 33. Otherwise, there is the possibility that interrupter contact spring 22 would deliver an extra pulse to the driving magnet coil 59 at the home position.

Upon any of the decades reaching their home positions, their associated circuitry is returned to the condition as shown in FIGS. 3 and 4, and the counting circuit 39 is then ready for the indication of the next predetermined count, whichever it might be.

Resistors 110 and condensers 111, connected to the respective driving magnet coils 59, 67 and 70 serve as spark suppression circuits to protect interrupter contact springs 22 in the decades 33, 34 and 35.

An additional relay (not shown) may be inserted in the circuit between relay 71 and relay 77 to isolate the latter relays from one another, if so desired.

The above circuit can be assembled in a very compact portable unit of relatively inexpensive parts and it should be apparent that it can have a wide variety of uses. It is relatively fool-proof in operation and can be easily assembled in association with various types of industrial equipment, such as the printing press heretofore mentioned, to provide the desired predetermined count indications.

While one embodiment of the invention has been shown and described above, it is to be understood that certain changes and additions can be made by those skilled in the art without departing from the scope and spirit of this invention.

We claim:

1. An electromechanical counter comprising a plurality of rotary stepping switches, means interconnecting said switches in cascade for counting first and second alternate series of predetermined counts of impulses, a first and a second bank of selector switches on said stepping switches adjustable for selecting said first and second alternate series of predetermined counts, the selector switches on said second bank, predetermining the count of said second series, being adjustable only for a number lower than that set on said first bank, a first relay coupled to said first bank and operable in response to the first of said predetermined counts to produce an output signal, and relay means operably coupled to said first relay and operably coupled to said second bank upon closure of said first relay and operable in response to the second of said predetermined counts to produce an output signal.

2. An electromechanical counter for continuously

counting successive alternate series of predetermined counts comprising a plurality of rotary stepping switches each representative of a different digit, means electrically interconnecting said stepping switches in cascade selector switches connected to said stepping switches for selecting the respective digits of one of said alternate predetermined counts, input means on said counter for receiving sequential impulses and energizing the units digit stepping switch in response thereto, a first relay coupled to said stepping switches and operable in response to each predetermined count, a second and a third relay coupled with said first relay and operable thereby, the closure of said second relay providing an output signal representative of one of said predetermined counts, a fourth relay operatively coupled with said stepping switches upon closure of said third relay, and a fifth relay coupled with said fourth relay and operable in response to actuation of said fourth relay by the other of said predetermined counts being of a number less than nine, thereby providing an output signal representative of the latter, resetting means coupled with said stepping switches and operable by said first relay to reset said stepping switches to a zero position after each predetermined count is reached, a sixth relay interconnectable with said first relay and said stepping switches and operable by the latter reaching a predetermined count of nines, said first relay being actuatable by the next succeeding impulse to close said second relay and indicate a 1 in the next digit higher than the number of stepping switches, switching means connected to said selector switches and movable from a first position interconnecting said first relay to said stepping switches and by-passing said sixth relay, to a second position interposing said sixth relay between said stepping switches and said first relay, said counter successively indicating the aforementioned 1 continuously with said switching means in said second position and said first bank of selector switches set to nines, and indicating said successive alternate series with said switching means in said first position.

3. An electromechanical counter for continuously counting successive alternate series of predetermined counts, one being higher than the other, comprising a plurality of rotary stepping switches each representative of a different digit, means electrically interconnecting said stepping switches in cascade first and second banks of selector switches connected to said stepping switches for selecting the respective digits of said alternate predetermined counts, input means on said counter for receiving sequential impulses and energizing the units digit stepping switch in response thereto, a first relay coupled to said stepping switches and operable in response to each predetermined count, a second and a third relay coupled with said first relay and operable thereby, the closure of said second relay providing an output signal representative of the higher of said predetermined counts, a fourth relay operatively coupled with said second bank of selector switches upon closure of said third relay, and a fifth relay coupled with said fourth relay and operable in response to actuation of said fourth relay by the other of said predetermined counts, thereby providing an output signal representative of the latter, resetting means coupled with said stepping switches and operable by said first relay to reset said stepping switches to a zero position after each predetermined count is reached, a sixth relay interconnectable with said first relay and said stepping switches and operable by the latter reaching a predetermined count of nines, said first relay being actuatable by the next succeeding impulse to close said second relay and indicate a 1 in the next digit higher than the number of stepping switches, switching means connected to said first bank of selector switches and movable from a first position interconnecting said first relay to said first bank of selector switches and by-passing said sixth relay, to a second position interposing said sixth relay between said first bank of selector switches and said first relay, said counter successively indicating the aforementioned 1 continuously with said switching means in said second position and said first bank of selector switches set to nines, and indicating said successive alternate series with said switching means in said first position.

4. An electromechanical counter for continuously counting successive alternate series of predetermined counts, one being higher than the other, comprising three single-motion rotary stepping switches each representative of a different decimal digit, means electrically interconnecting said stepping switches in cascade first and second banks of selector switches connected to said stepping switches for selecting the respective digits of alternate predetermined counts, input means on said counter for receiving sequential impulses and energizing the units digit stepping switch in response thereto, a first relay coupled to said stepping switches and operable in response to each predetermined count, a second and a third relay coupled with said first relay and operable thereby, the closure of said second relay providing an output signal representative of the higher of said predetermined counts, a fourth relay operatively coupled with said second bank of selector switches upon closure of said third relay, and a fifth relay coupled with said fourth relay and operable in response to actuation of said fourth relay by the other of said predetermined counts, thereby providing an output signal representative of the latter, resetting means coupled with said stepping switches and operable by said first relay to simultaneously reset said stepping switches to a zero position after each predetermined count is reached, a sixth relay interconnectable with said first relay and said stepping switches and operable by the latter reaching a predetermined count of nines, said first relay being actuatable by the next succeeding impulse to close said second relay and indicate 1000, switching means connected to said first bank of selector switches and movable from a first position interconnecting said first relay to said first bank of selector switches and by-passing said sixth relay, to a second position interposing said sixth relay between said first bank of selector switches and said first relay, said counter successively indicating the aforementioned 1000 continuously with said switching means in said second position and said first bank of selector switches set to nines, and indicating said successive alternate series with said switching means in said first position the first predetermined number being 999 and the second less than 999.

5. An electromechanical counter for counting alternate series of predetermined counts of electrical pulses, comprising a plurality of stepping switches operable in response to said pulses, each of said switches having successive positions representing decimal numbers from 0 to 9, means interconnecting said switches in cascade relation for counting said alternate series of predetermined counts, a bank of selector switches on said stepping switches adjustable for selecting one of said predetermined counts, a fixed selector circuit connected to the units digit stepping switch establishing the other of said predetermined counts at a number less than 9, a first relay coupled to said selector switches and rendered operable when all of said switches are at their positions representing nines, a second relay coupled to said first relay and operated by the next succeeding pulse after operation of said first relay, relay means coupled to said stepping switches and operable in response to the impulses representative of each of said predetermined counts for delivering electrical impulses external of said counter for further utilization, and resetting means operable by said relay means for resetting said stepping switches to zero after each predetermined count.

6. An electromechanical counter for counting alternate series of predetermined counts of electrical pulses comprising three rotary stepping switches operable in re-

sponse to said pulses, each of said switches having successive positions representing decimal numbers from 0 to 9, means interconnecting said switches in cascade relation for counting said alternate series of predetermined counts, a bank of selector switches on said stepping switches adjustable for selecting one of said predetermined counts, a fixed selector circuit connected to the units digit stepping switch establishing the other of said predetermined counts at a number less than 9, a first relay coupled to said selector switches and rendered operable when all of said switches are at their positions representing nines, a second relay coupled to said first relay and operated by the one thousandth pulse, relay means coupled to said stepping switches and operable in response to the impulses representative of each of said predetermined counts for delivering electrical impulses external of said counter for further utilization, and resetting means to reset all of said stepping switches simultaneously to their zero positions after reception of said succeeding pulse.

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