

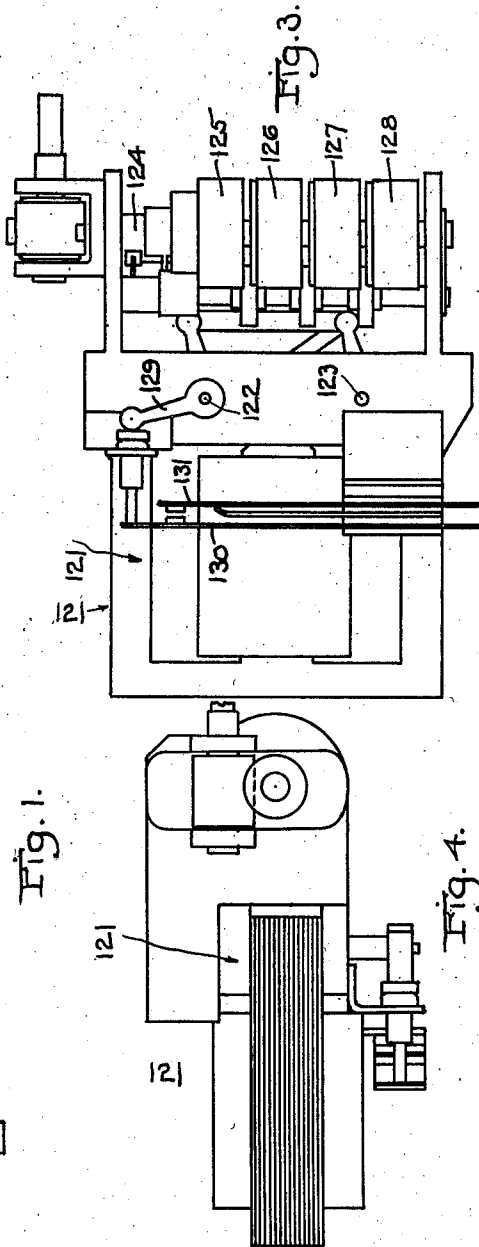
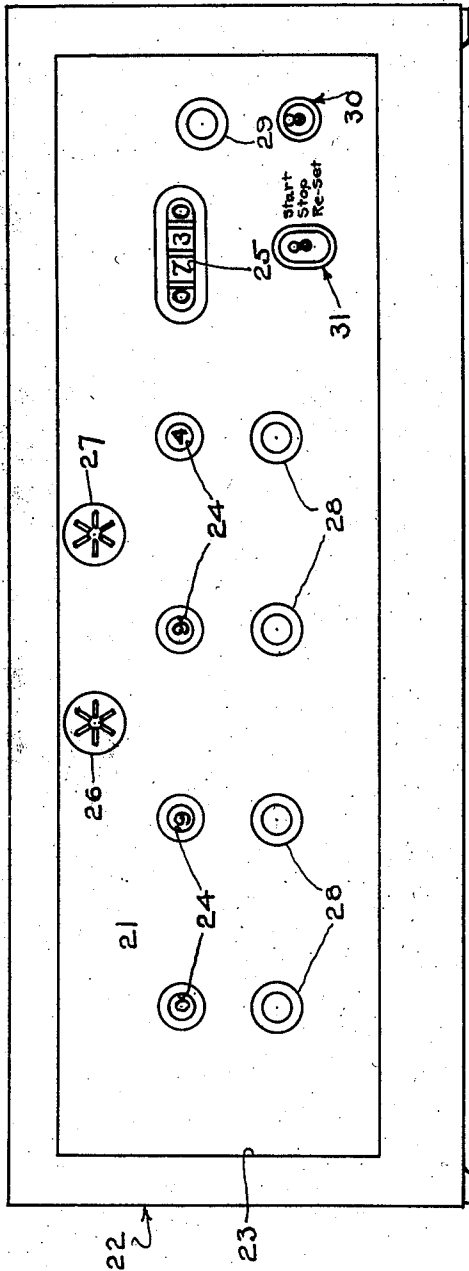
Sept. 15, 1942.

F. A. POOLE
PREDETERMINED COUNTER

2,295,968

Filed May 2, 1940

6 Sheets-Sheet 1



Inventor:
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A.T.O.

Sept. 15, 1942.

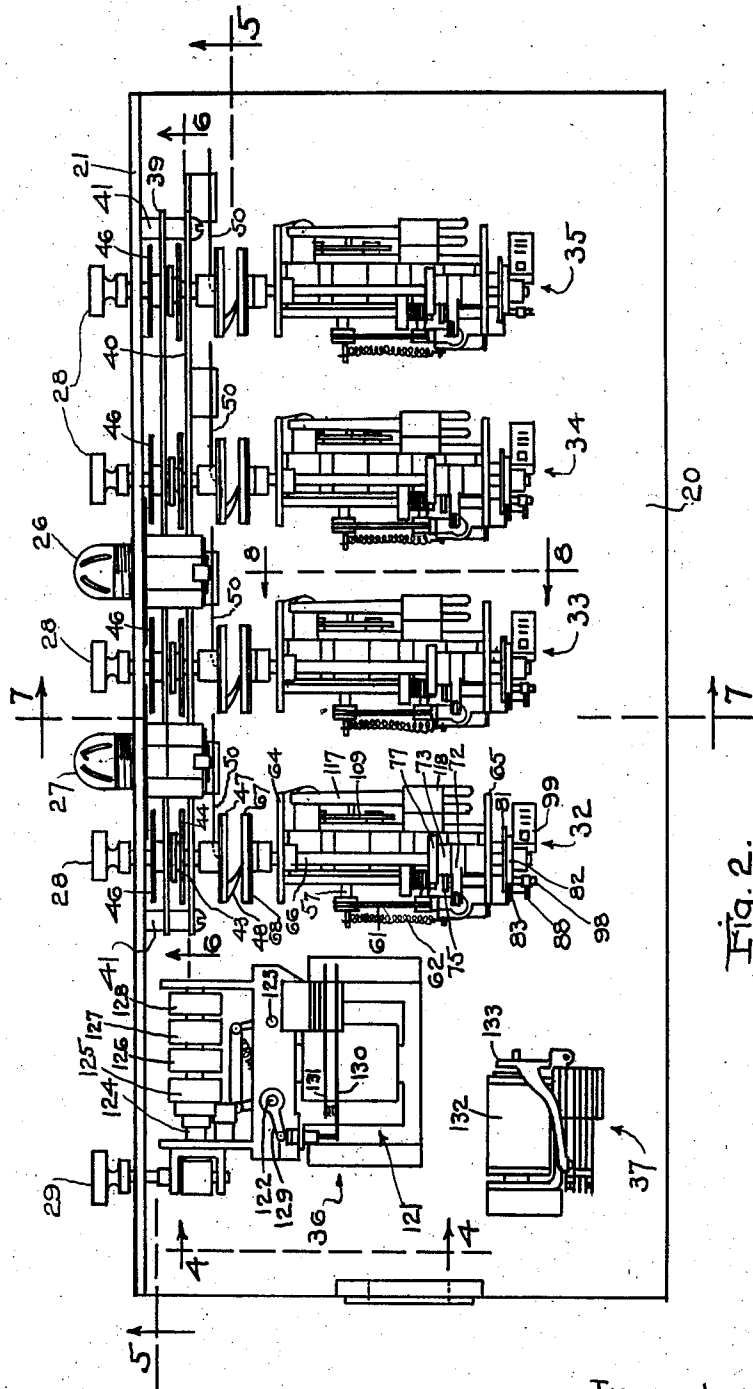
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2,295,968

PREDETERMINED COUNTER

Filed May 2, 1940

6 Sheets-Sheet 2



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F. A. POOLE

2,295,968

PREDETERMINED COUNTER

Filed May 2, 1940

6 Sheets-Sheet 3

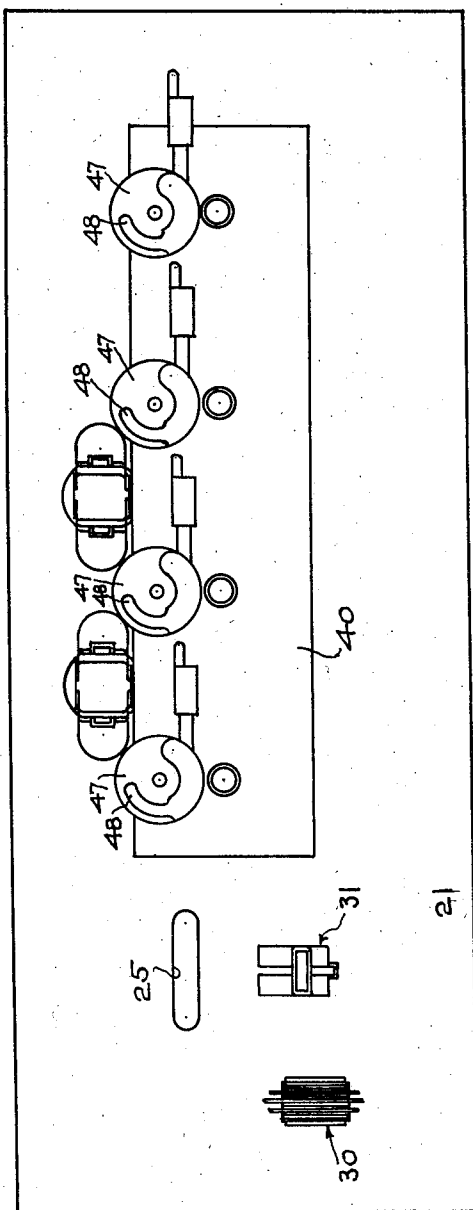


Fig. 5.

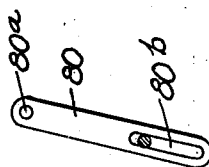


Fig. 16.

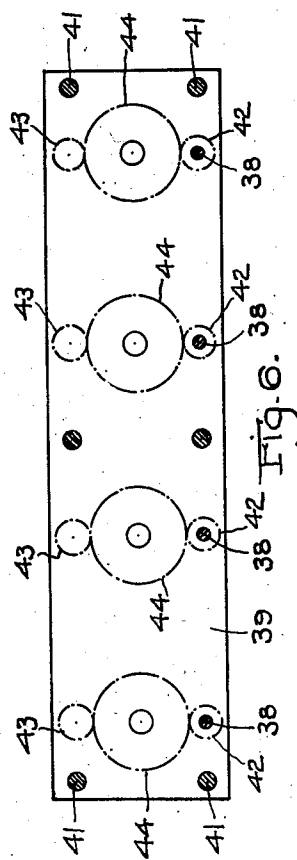


Fig. 6.

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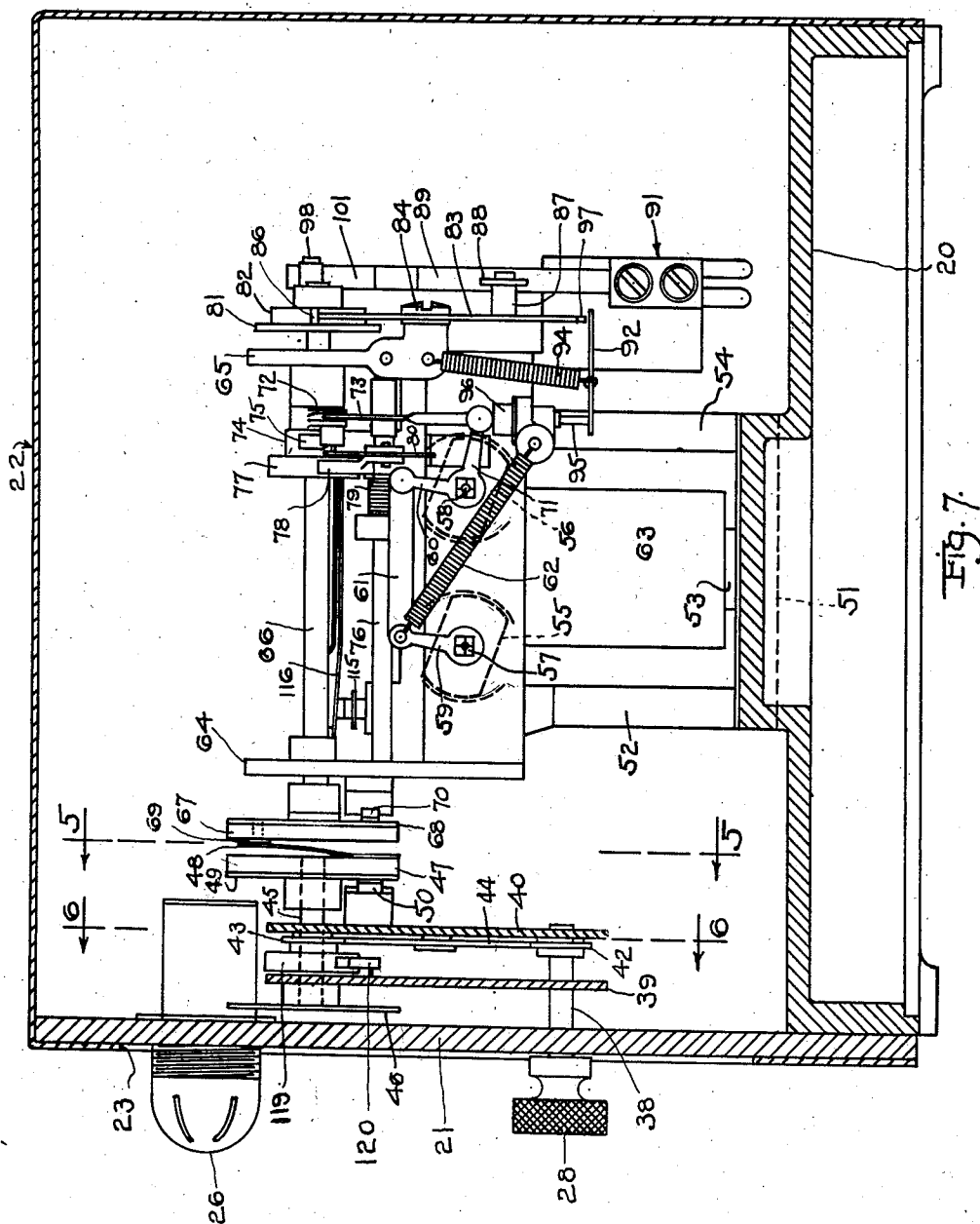
F. A. POOLE

2,295,968

PREDETERMINED COUNTER

Filed May 2, 1940

6 Sheets-Sheet 4



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F. A. POOLE

2,295,968

PREDETERMINED COUNTER

Filed May 2, 1940

6 Sheets-Sheet 5

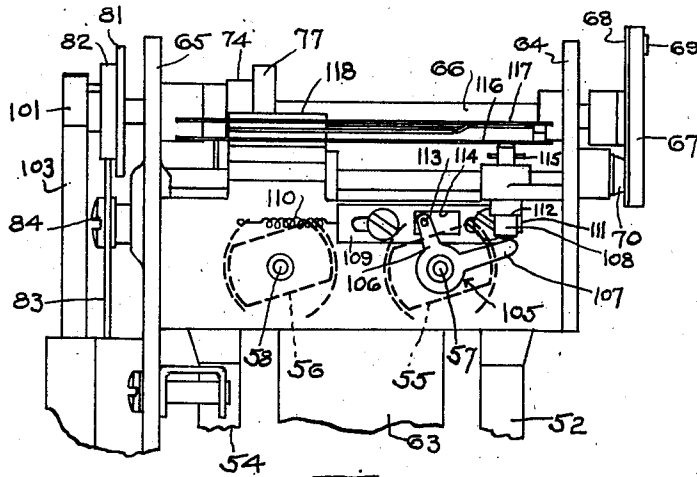


Fig. 8.

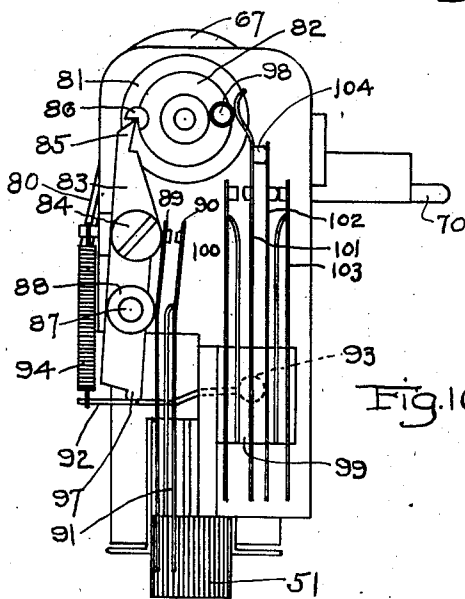


Fig. 10.

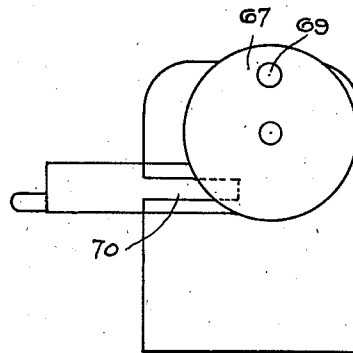


Fig. 9.

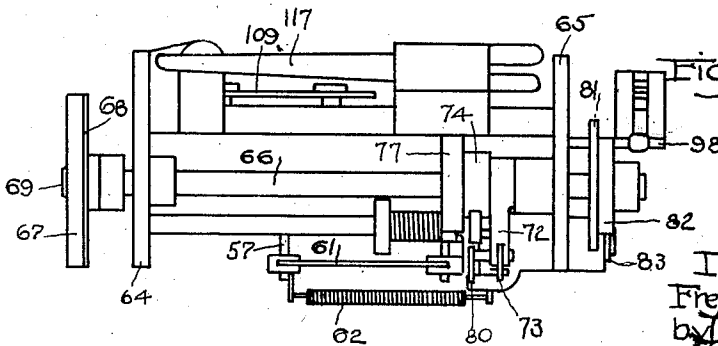


Fig. 11.

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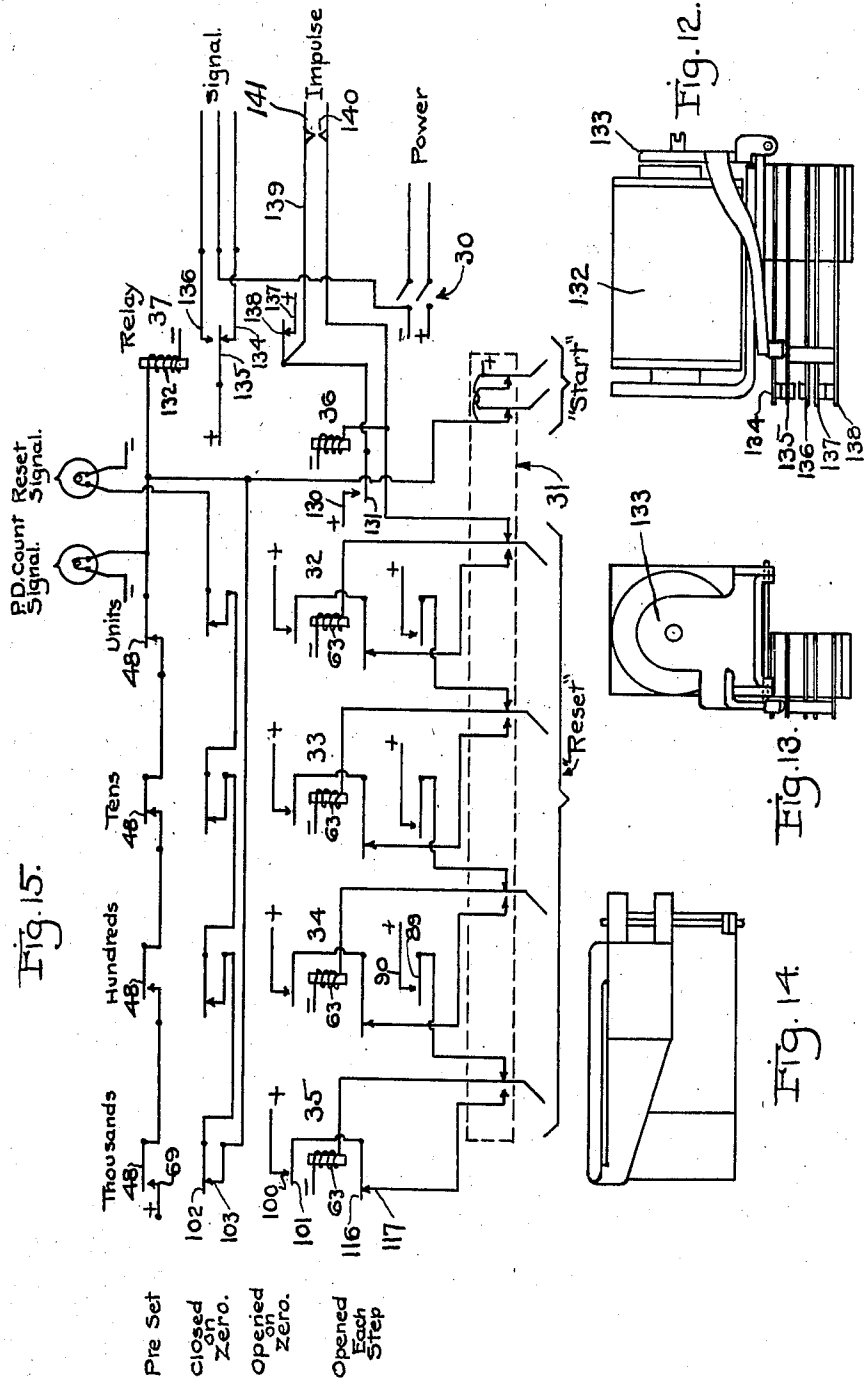
F. A. POOLE

2,295,968

PREDETERMINED COUNTER

Filed May 2, 1940

6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,295,968

PREDETERMINED COUNTER

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Application May 2, 1940, Serial No. 333,023

5 Claims. (Cl. 235—132)

This invention relates to improvements in pre-determined counters and the like, that is, counters which may be preset to a preselected amount or number, so that when such amount or number is attained during a sequence of operations, a suitable signal or controlled operation will be caused to function. In some cases certain of the improvements herein disclosed may also be used in connection with counters generally, which fact will be apparent from a study of the devices herein set out, and therefore I do not intend to limit the scope or usefulness of the invention to predetermined counting devices, except as I may do so in the claims to follow; but generally speaking these improvements will be found to be of very distinct application and usefulness in connection with predetermined counters.

In various manufacturing, industrial, commercial, and other operations it is desirable to provide means to automatically count the operations as they occur, and to make provision for giving a signal or initiating some other operation, or discontinuing some operation when a predetermined number has been reached. For example, in running through a work order on a punch or other press it may be desirable to either give a signal when the predetermined number of press operations has been completed, or it may be desirable to automatically stop the operations when such predetermined number is attained, or it may be desirable to commence some other sequence of operations when such predetermined number is attained. Or, in the case of delivering boxes of merchandise, such as bottled goods to a loading platform by a conveyor, it may be desirable to stop such conveyor when a predetermined number of such boxes has been carried past a given point; or to a loading position. Or, in a steel plant operation it may be desirable to count sheets of steel plates in piles. Many other instances of usefulness of predetermined counters might be mentioned, but the foregoing are listed as illustrative of uses to which devices embodying the features of the present invention may be placed.

One feature of the invention relates to improvements in the construction of the individual counter units which are provided for counting digits in each order. These counter units are electrically operated by electrical impulses, such impulses acting to energize solenoids or field coils which in turn drive the counting shaft through the medium of ratchet and pawl arrangements. One feature in this connection is to provide ar-

rangements permitting very rapid operations, as for example, as fast as 300-400 operations per minute, or more.

A further feature of the invention relates to the provision of improved means for carrying tens from order to order. I have provided electrical means for accomplishing this result, so that when the original impulses to be counted are delivered to the first or units order counter unit, each time such counter unit completes a series of ten an electrical impulse is thereby delivered to the next higher, or tens order counter unit, and so that when such tens order counter unit completes a series of ten an electrical impulse is thereby delivered to the next higher, hundreds order counter unit, etc. In this connection it is an object of the invention to provide means whereby such carrying impulses of current will be maintained during substantially the full duration of the counting operation of the lower order from which the impulse is being transferred to the next higher order; thereby avoiding false carrying operations due to too short impulses of the carrying current.

A further feature of the invention relates to the provision of means to lock the counting shaft of each order counter unit at the completion of the counting stroke thereof, so as to avoid overriding thereof, especially when operating at high rates of count. In this connection I have provided means whereby, as the operating stroke approaches its completion a locking dog or pawl comes into operation to lock and arrest movement of the counting shaft at the exact instant of completion of the counting movement thereof.

A further feature of the invention relates to the provision of means to reset each counter unit to zero when desired to do so. In this connection I have provided electrical means to accomplish this result by delivery of electrical impulses to the counter unit, and continuing such impulses until the counter unit reaches the zero position, whereupon such impulses are automatically discontinued. In this connection it is an object of the invention to ensure that these resetting impulses shall be of a prolonged nature, very positively controlled; and also to make provision for accurate discontinuance of such resetting impulses when the zero position is reached.

A further feature in connection with the counter units per se, relates to the design and construction thereof as respects the generation and delivery of relatively large operating power for actuation of the counting shaft from the electrical impulses. In this connection I have pro-

vided a new and powerful construction of the field and armature whereby the electrical impulses are converted into mechanical impulses. This construction includes a rotary or rocking armature arrangement, so set that when the field is energized such armature tends to move into a position directly in line with the field flux, thereby generating a very powerful operation. The arrangement is such that at the commencement of the armature operation a strong pull and torque is exerted, tapering off to zero as the stroke is finished; as distinguished from ordinary solenoid arrangements in which the pull is least at the commencement of the operation, and increases as the operation proceeds. In this connection it is a further feature of the invention that I have provided a duplex armature and field arrangement, with the two armatures linked together, and operating in a double or consequent field, with great power of operation, combined with relatively small operating current.

It is a further feature and object of the invention to provide a very simple and rugged form of the counter unit or element, and one which may be readily manufactured and assembled at low cost, and one of great durability.

The instrument includes a series of such counter units or elements equal in number to the number of numerical orders for which predetermination is required. A further feature is to so combine and relate these counter units to each other than when the predetermined number is reached the desired function will be performed. It is a feature in this connection to make provision for pre-setting suitable parts corresponding to the several orders so that the desired predetermined order may thereby be set up, and when that number or amount is attained the desired function will be performed. The arrangement is such that each numerical order may be pre-set to the proper amount or digit, which is then indicated visibly at the face of the instrument, and there is assurance that when the proper number of operations has been performed the desired function will be caused to occur.

In connection with the foregoing, it is a further feature that the pre-setting devices may be carried as a self-contained element, attached to the face plate or board of the instrument, and so related to the several counter units that the proper relationships will be assured when the said board is in place. In this connection it is a further feature of the invention that the pre-setting means includes a series circuit including elements attached to or controlled by the several counter units, and so related to each other, that when the several pre-setting indicators are set to the desired pre-setting, the counter units being restored to their several zero positions, such counter units of the several numerical orders must move around to the proper order positions in order to complete the continuity of such series circuit, to thereby give the desired indication or perform the desired function. With such arrangement it is merely necessary to change the settings of the several indicators for the different orders in order to change the pre-setting of the instrument.

In connection with the foregoing it is a further object of the invention to make provision for either or both giving a visual indication when the amount of the pre-setting has been attained, and also the closing or opening of a control circuit at such time. Such circuit, when provided,

may be used to either start or stop some other function, as for example, a motor driving a conveyor, or other function.

It is a further object of the invention to make provision for re-setting the several counter units to zero position simultaneously by operation of a suitable control switch provided for that purpose; and in this connection to so arrange the parts that in such re-setting operation each counter unit will be re-set independently of the others.

In connection with the foregoing it is a further object of the invention to make provision for giving a visual or other signal when the several counter units have reached their respective zero positions, so that the re-set is complete. Also, to make provision for extinguishing such indication when any counter unit is again moved away from its said zero position.

A further feature of the invention relates to the combination with the above features, or certain of them, of a totalizing counter unit which functions in harmony with the functioning of the several orders counter units. Such totalizing counter unit is so arranged that it may give a visual indication of the total number of operations accumulated at all times, measured from a zero setting, so that during the carrying out of a complete series of operations the operator may at any time see immediately the number of such operations which have been actually accomplished, thereby being informed as to the portion of the work order or other total which has been performed.

It is a further feature of the invention that a relay is provided in connection with the several orders counter units and the totalizing counter unit aforesaid, together with suitable circuits connecting the parts, so that the contact of said relay is normally open during the functioning of the counter units by received impulses of current, and so that at the completion of the pre-determined count, so that the series circuit is completed, such relay is thereupon energized to operate its contacts; and in this connection the arrangement is such that on the final count there is assurance that the relay operation will take place only when, and not before, the several counter units have completed their respective final count operations. Thereby there is assurance that the final count will be correct, and that no "shortage" will occur.

In connection with the totalizing counter unit I have also made provision for re-setting of the same to zero when a new set of operations is to be performed.

A further object of the invention is to provide electrically operated counter units and other parts which will function equally well on either direct or alternating current; thereby making the device of universal usability.

Sometimes the first or units order counter unit may be mechanically operated, serving then to transmit carrying impulses (for carrying tens) to the tens order counter unit by electrical means, and using electrical impulses to carry tens from each order to the next higher order of the series. In other words, the feature of carrying tens by means of electrical impulses, from order to order, may be used in connection with either electrical or mechanical operation of the first or units order counter unit. In either case, either electrical or mechanical operation of the units order counter unit, the totalizing counter unit may be electrically operated in harmony with the operations of the units or first order counter unit.

It will also be understood that, while I have herein shown and described a construction in which there are provided four counter units for four orders, still I do not intend to limit myself to that or any other number of such counter units, as manifestly the features of the invention need not be so limited.

In the drawings:

Figure 1 shows a front elevation of an instrument embodying the features of my present invention, the same being provided with four orders of pre-setting, and therefore capable of counting operations from zero to 9999; Figure 1 being on one-half scale;

Figure 2 shows a plan view corresponding to Figure 1, but with the cover or housing removed from the base plate whereon the various counter units and relay are carried;

Figure 3 shows a plan detail view of the counter unit, on full scale, or double scale as compared with Figures 1 and 2;

Figure 4 shows an end elevation of the counter unit, being in effect a section on the line 4—4 of Figure 2, looking in the direction of the arrows, but on full scale;

Figure 5 shows an inside face view of the front panel board assembly, being a longitudinal section on the line 5—5 of Figure 2, looking in the direction of the arrows, and on one-half scale;

Figure 6 shows a longitudinal section on the line 6—6 of Figure 2, looking in the direction of the arrows, and it shows the gear trains and star wheels whereby the several pre-setting shafts are operated by the pre-setting knobs from the front face of the instrument;

Figure 7 shows a cross-section on the line 7—7 of Figure 2, looking in the direction of the arrows, but on full scale or double scale as compared to Figure 2; and it shows the construction of one of the orders counter units at one side thereof in detail;

Figure 8 shows a detail view of the opposite side of the upper portion of the counter unit of Figure 7, being in effect a section on the line 8—8 of Figure 2, looking in the direction of the arrows, but on full scale or double scale as compared to Figure 2;

Figure 9 shows a front elevation of the counter unit shown in Figures 7 and 8, and it shows the rotary contact plate which is rotated by the counting operations of the counter unit, and co-operates with the contact finger which is pre-set manually from the front of the instrument to close the series circuit at the proper time in the series of operations;

Figure 10 shows a back elevation corresponding to Figures 7, 8 and 9, showing the back of the counter element;

Figure 11 shows a top or plan view of the counter unit of Figures 7, 8, 9 and 10;

Figure 12 shows a plan view of the relay, on full scale, or double scale as compared to Figure 2;

Figure 13 shows an end view of the relay of Figure 12;

Figure 14 shows a back elevation of the relay of Figures 12 and 13;

Figure 15 shows a schematic wiring diagram of the elements of the instrument of Figures 1 to 14, inclusive; and

Figure 16 shows a fragmentary section on the line 16—16 of Figures 7 and 11, looking in the direction of the arrows.

Referring first to Figures 1 and 2, the instru-

ment therein shown includes a suitable base plate 20 to the front edge of which is attached the front panel board 21. The base plate carries various instrumentalities to be hereinafter described; and a suitable box housing 22 is set down over these parts, and serves to frame the panel board 21 (being provided with a front opening 23), such box housing being suitably secured to the base plate. The front panel board is provided with openings such as 24 through which the various order settings or pre-settings are visible; and also with a larger opening 25 through which the digits of the totalizing counter unit are visible. There are also carried by this panel board the perforated lamp housings 26 and 27, wherein are placed lamps for the visual signals for completion of the pre-set count, and for completion of re-setting to zero, respectively; and preferably these lamps are of distinctive colors, as for example, red for the completion of the pre-set count, and green for the completion of the re-setting operation. Said panel board also carries the pre-setting knobs 28 for pre-setting the respective orders to the selected pre-set positions, and a knob 29 for re-setting the totalizing counter unit to zero. There is also carried by the panel board a main or cut-out switch 30, and a control switch 31, these being provided with the usual operating handles or finger pieces projecting from the front face of the panel board as evident.

The devices presently to be explained in detail are such that by manipulation of the several knobs 28 the selected digits of the several orders of the pre-selected number may be brought into view through the openings 24, and these numbers will remain visible until purposely and manually changed by the operator. The accumulated numerical amount will also appear through the opening 25; and by manipulation of the knob 29 this may be brought to zero. The arrangements are also such that when the switch 30 is thrown to the closed circuit position current is available to operate the several devices of the instrument; and the switch 31 is provided with three positions, namely a central or "stop" position, a raised or "start" position, and a lowered or "re-set" position. These positions of the switch are just what these names indicate, that is, when this switch is moved to the raised position the circuits are brought into condition to ensure operation of the several counter units by the impulses of current received from the machine or operation whose movements or functions are to be counted; and when this switch is moved to the lowered position the several counter units of the various orders are re-set to zero positions. It is noted, however, that such re-setting does not change the settings of the indications visible through the openings 24 of the panel board.

Manifestly the impulses of current which operate the counter units of the present instrument may come from any source which is to be measured, and it is not necessary to detail the means whereby such impulses are generated, other than to state that impulses of this nature are to be available, and will be received by and serve to control the instrumentalities of the present instrument, as will hereinafter appear in detail.

Now referring to Figure 2 in particular, there are provided the counter units 32, 33, 34 and 35 corresponding to the several numerical orders for which the instrument is designed, and these counter units are of identical construction, with

the exception that the counter unit for highest order, namely 35, does not need certain contacts which are provided on the counter units for lower orders for carrying purposes. The detailed construction of one of these counter units will be explained hereinafter.

There is also provided the totalizing counter unit 35 on the base plate, and this counter unit is provided with suitable accumulating wheels which carry digits visible through the panel board opening 25 as evident from Figure 1. The totalizing counter unit operates in harmony with the operations of the several counter units 32, 33, 34 and 35, as will be presently evident, and keeps step with said operations.

There is also carried by the base plate a relay 37, the details of which are shown in Figures 12, 13 and 14, the functions and purpose of which relay will also appear in detail hereinafter.

Each of the pre-set knobs 28 is mounted on a short stub shaft 38, which stub shaft reaches through the panel board, and also to or through a pair of panels 39 and 40 which are mounted on and spaced from the inside face of the panel board by means of the studs 41. Each of these stub shafts carries a pinion 42 at a position between the panels 39 and 40; and each of these pinions 42 drives a gear 43 directly above it, and between the panels 39 and 40, through the medium of an idler 44. Incidentally it is noted that the pinions 42 are the same size as their respective gears 43, so that each gear 43 exactly follows the rotary movements of its pinion 42 in angular extent.

Each gear 43 is carried by a stub shaft 45 which is journaled in the panels 39 and 40; and on the front end of each such stub shaft 45 there is carried a light circular plate 46 having on its front face the numerals from 1 to 9 and 0 inclusive, which digits are visible through the respective openings 24 of the panel board. Thus the setting of the stub shaft, as controlled by the knob 28 is always shown by the numeral or digit exposed through the corresponding opening 24, and as the knob is turned such exposed digit will correspondingly change. The rear end of each stub shaft 45 carries a disk 47 of insulating material, and on the rear face of each such disk there is mounted the flexible contact finger 48. Each such finger is connected to a conducting ring 49 on the front face of the disk 47 so that current may be supplied to the finger 48 by means of a stationary brush 50.

It will now be evident that the several brushes or fingers 48 for the several numerical orders will at all times occupy positions around the circle dependent on the turned positions of their respective knobs 28, and also that a like relationship will always exist between these fingers and the indications visible through the openings 24; and also that by turning any given knob 28 until a selected digit appears through the corresponding opening 24 there will be assurance that the corresponding finger 48 will occupy a corresponding or harmonious position around the circle. Also, that the momentary or adjusted positions of the various fingers 48 will depend at all times on the several knob adjustments.

These fingers 48 co-operate with corresponding contacts of the several counter units in a definite manner, and I shall now explain in detail the construction of a counter unit for that purpose, it being understood that such description is equally applicable to any one of the counter units 32, 33, 34 or 35; and for this purpose reference

may be had to Figures 7, 8, 9, 10 and 11, in particular.

The counter unit includes a vertically extending magnetic field core including the bottom horizontal leg 51 which is accommodated within a corresponding slot of the base plate 20 of the instrument; and said field core also includes the three upwardly extending cores 52, 53 and 54, respectively. The upper ends of these cores 52, 53 and 54 are curved as shown by the dotted lines in Figures 7 and 8 to establish the curved pole pieces; and the armatures 55 and 56 are carried between these pole pieces in rocking fashion, being secured to the cross shafts 57 and 58, 15 which shafts are suitably journaled in side plates carried by the upper ends of the cores. At one side of the device the shafts 57 and 58 carry cranks 59 and 60, and the upper ends of these cranks are connected together by the link 61 so that the two shafts 57 and 58 and their armatures, are compelled to rock in exact unison. There is a spring 62 connected to the end of one of the cranks 59, and tending to restore the cranks and armatures to the position shown in Figure 7, wherein said armatures stand at a tilt, so that upon creation of a magnetic flux through the system these armatures will tend to draw into horizontal position with a strong force.

There is an exciting magnet solenoid 63 mounted on the central core leg 53, so that upon passing current through this solenoid the magnetic system is established, and consequent poles are produced at the upper ends of the cores 52, 53 and 54, and both armatures are drawn into a more horizontal position with a strong force. The current impulses are delivered to the solenoids 63 of the counters for this purpose.

Carried by the upper end portions of the respective cores 52, 53 and 54 is a non-magnetic frame including the end plates 64 and 65. There is a shaft 66 journaled in these end plates and projecting beyond them at both ends of the unit. The front end of this shaft carries a disk 67 of insulating material, to the back face of which disk there is connected a conducting ring 68, and a single contact point 69 extends from this ring through the disk to the front face thereof. A contact finger 70 is mounted stationary to a convenient part, and bears against the ring 68 so as to conduct current to said ring at all positions of rotation thereof.

The shaft 66 stands in alignment with the shaft 45 and disk 47 already referred to, so that each time the shaft 66 completes a rotation its contact point 69 will come into contact with the finger 48 carried by the disk 47, thereby completing an electrical contact at such point; and since the disk 47 may be set into any pre-selected position by operation of the knob 23, which position is indicated by the digit reading through the opening 24, it follows that the position of rotation of the shaft 66 at which such circuit completion will be effected will depend on the position to which the knob 28 has been turned, and as indicated through the opening 24.

The crank 60 already referred to is a bell-crank, having the arm 71. Rockingly mounted on the shaft 66 is the rock arm 72, and a light link 73 connects the bell-crank arm 71 to this arm 72. There is a ratchet wheel 74 connected to the shaft 66, and a spring pressed pawl 75 is carried by a laterally projecting pin on the arm 72, so that as said arm is raised by operation of the link 73 the ratchet wheel and therefore also

the shaft 66 are advanced one step; and said ratchet wheel is provided with ten teeth.

There is a rod 76 carried by the end plates 64 and 65 of the frame of the counter unit; and a star wheel 77 is connected to the shaft 66, at a position alongside of the ratchet wheel 74. Rockingly mounted on the rod 76 is the pawl 73, having a V-shaped tooth adapted to engage a notch of the star wheel. There is an arm 79 projecting out from the pawl 73; and a link 80, carried by the same pin 80a which receives the upper end of the link 73, hangs down into co-operative relation to the said arm 79. This link 80 is slotted as shown at 80b in Figure 10, so as to provide a lost motion between the movements of the link and the arm 79 (and therefore the pawl 73); and the amount of this lost motion is such that during the major portion of the upward movement of the pawl 73 the shaft 66 and ratchet 74 and star wheel 77 may freely turn so as to bring the next notch of the star wheel past the V-shaped tooth of the pawl 73, whereupon the lost motion aforesaid is completely taken up, and the further and final upward movement of the link 80 (which accompanies the feeding movement of the pawl 73 and link 73 under the impulse of the energized field) serves to rock the V-shaped tooth over into definite engagement with the star wheel and thereby lock said star wheel against any further rotating movement until the pawls are again restored to their initial position upon de-energization of the solenoid, and under the impulse of the spring 62.

The foregoing arrangement effectively prevents any over-ride of the shaft and ratchet wheel during very rapid operations, and prevents possible false readings which might be due to such an over-ride.

Now, manifestly the rotation of the shaft will be a measure of the number of impulses received by the solenoid, and thus also the position of the disk 67 is such a measure.

Mounted on the back end of the shaft 66 is a disk 81 having a cylindrical projection 82. There is an arm 83 pivoted to the frame of the counter unit at the point 84, so that said arm may perform slight back and forth rocking movements. The upper end of this arm has a sharp tooth 85, and the projection 82 carries a shoulder 86 which is adapted to travel past such tooth 85 during normal rotation of the shaft 66, thereby rocking the arm momentarily in a counter-clockwise direction when viewed as in Figure 10. This arm carries a pin 87 on which there is the insulating wheel 88; and certain flexible contacts 89 and 90 are carried by an insulating block 91 and project up to a location adjacent to this wheel 88. Normally these contacts 89 and 90 are slightly separated as shown in Figure 10, but it is clear that when the arm 83 is rocked by the shaft rotation these contacts will be brought together for an interval of time dependent on the duration of the rocking movement of the arm. These contacts serve to transmit an impulse of current to the solenoid of the counter unit for the next higher order (numerically), and it is desirable that when the carrying operation is to be performed (upon completion of a rotation of the shaft 66) said contacts should remain in engagement for a sufficient length of time to assure a definite operation of such next higher order counter unit. For this purpose I have provided a light plate 92, pivoted to the frame at the point 93, and a light spring 94 tends to raise this plate. There is a pin 95 vertically slidable in the frame of the de-

vice, and the upper end of this pin carries an enlargement 96 which engages the end of the bell-crank arm 71 already referred to. Each time the bell-crank is rocked due to energization of the solenoid, the pin is released, and its restraining action is thereby removed from the plate 92, which might therefore rise under the impulse of the spring 94; but such rising movement is prevented due to engagement of said plate with the heel 97 on the lower end of the arm 83. The plate 92 is, however, provided with a recessed portion which will receive and accommodate the heel 97 when the arm 83 has been rocked by the shoulder 86, so that when the shaft 66 has rotated around to the position where a carrying operation is to be effected to the next higher order we have the following conditions; as soon as the solenoid is energized, thereby rocking the bell-crank and arm 71, the spring 94 raises the plate against the heel 97, and immediately thereafter the shaft 66 is rotated, carrying the shoulder 86 against the tooth 85 and causing the arm 83 to rock counter-clockwise, thereby forcing the insulating wheel 88 against the contact finger 89 and bringing it into contact with the finger 90. At the same time the heel 97 of the finger or arm 83 will pass into the recessed portion of the plate 92, allowing said plate to rise under the impulse of the spring 94, and thus temporarily latching the arm 83 against restoring movement even though the shoulder 86 has passed away from the tooth 85 of the arm 83. Thus the arm 83 will be retained in its rocked condition, and with the contacts 89 and 90 still in engagement, and such condition will continue as long as the plate 92 is in its raised position. It will be lowered when the bell-crank arm 71 lowers at the de-energization of the solenoid, but it will be seen that with this arrangement I have provided means whereby the duration of the impulse of current for the carrying function is made substantially as great as the duration of the original impulse. This will ensure very definite and positive carrying operations from order to order.

The disk or cylindrical extension 82 also carries a pin 93 having thereon an insulating sleeve. There is an insulating block 99 carried by the frame of the device; and there are two pairs of light spring contacts, namely, 100-101 and 102-103 reaching upwardly from such block. The contact 101 carries an insulating block 104 which engages the upper end of the contact 102, the arrangement being such that normally the contacts flex towards the left in Figure 10, thereby closing the contacts 100 and 101 together, but upon flexing the contact 101 towards the right in Figure 10, the contacts 100 and 101 are separated and the contacts 102 and 103 are brought together. These contacts are used for certain functions to be presently explained, including the re-setting to zero. The upper end of the contact 101 has an extension in position for engagement by the insulating sleeve of the pin 93, so that when the shaft 66 comes around to the zero position, indicated by the position of the pin 93 in Figure 10, the contacts are forced into the position shown in said Figure 10. On the other hand, as soon as the shaft is rotated even one digit movement away from the position of Figure 10 the positions of the two pairs of contacts will reverse.

In order to ensure that impulses of current delivered to the field coil of the counter unit during the pre-setting operation will be maintained as long as possible to ensure definite operation of the counter unit armature for full

stroke I have provided the following arrangements; one of the shafts 57 or 58 extends through the counter unit frame to the side thereof opposite to the crank arm 59 or 60; in the present case it is the shaft 57 which is so extended. On the end of said shaft there is placed a bell-crank 105, having the arms 106 and 107. There is a vertical pin 103 carried in the frame and vertically slidable therein. The arm 107 underlies this pin and will raise said pin as the shaft 57 is rocked in the restoring direction, and will allow the pin to fall as the shaft is rocked under the impulse of the solenoid. There is a horizontal slide 109 slidably mounted on the face of the frame, and normally drawn to an initial position by a light spring 110. This slide has a finger 111 which may underlie a shoulder 112 of the pin when the pin is raised sufficiently by rocking movement of the bell-crank, thereby locking the pin in raised position as shown in Figure 8. The arm 106 of the bell-crank carries a pin 113 which engages a slotted opening 114 of the slide plate 109, so that as the bell-crank rocks during the rocking movement of the shaft 57, due to energization of the field solenoid, the slide plate 109 is not moved to disengage the finger 111 from the shoulder 112 until the armature and shaft rocking movement is almost completed. Thereupon the pin 113 engages the end of the opening 114 and forces the slide plate 109 slightly over, releasing the pin 103 which thereupon drops until limited by the stop 115.

Above the pin 103 there are provided the flexible leaf contacts 116 and 117, carried by the insulating block 113 on the frame of the counter unit; and when the pin 103 is locked in its raised position these contacts are held in engagement with each other to close a circuit. This circuit is a part of the solenoid circuit for resetting the counter unit. It is thus seen that as far as the contacts 116 and 117 are concerned they remain in closed position until just before the completion of the rocking movement of the counter unit armatures, whereupon these contacts are permitted to disengage and thereby suddenly open the circuit at that point. This will ensure holding of current on the solenoid as long as consistent with the correct armature operation. It is here noted that this contact arrangement is a part of the re-setting to zero operation, and it ensures a very definite delivery of long pulses of current to the field solenoid during the re-setting operations.

It will now be seen that each counter unit is so constructed that it will operate its shaft 63 with a step by step operation, under influence of pulses of current delivered to its solenoid; that provision has been made for carrying tens from each counter unit to the counter unit of next higher numerical order by an impulse of current delivered by the completion of a rotation of the shaft 66 of the counter of lower order; that provision has been made for ensuring that such impulse of current shall be of a sustained nature so as to ensure certain and definite carrying operation; that provision has been made for opening one circuit and closing another upon completion of a rotation of the shaft 63, for use in connection with the re-setting to zero operation; that provision has been made for delivery of sustained pulses of current to the field solenoid during the re-setting to zero operation; that provision has been made for turning the contact 67 always in harmony with the shaft rotations of the counter, for use in connection with the pre-determining of a set of counts; and that other fea-

tures have been provided in the construction of the counter unit. It is further noted that all the counter units 32, 33, 34 and 35 are of identical construction, with the exception that the unit 35 does not need the carrying tens contacts 89 and 90, nor the rock arm 83 and immediately related parts, which are therefore not shown in Figure 2 on the counter 35.

In order to prevent reverse rotations of the shaft 45 which carries the disk 47, I have shown the ratchet wheel 119 on said shaft 45, and the pawl 120 carried by a suitable stationary part to permit uni-direction rotation of the shaft and connected parts, only. Thus it will be seen that during the pre-setting rotations of the knobs 23 rotations thereof must always be in the same direction.

Reference may now be had to Figures 3 and 4 for disclosure of the construction of the totalizing counter unit 36. The same includes a field and solenoid arrangement, together with the dual or double armature arrangement, similar to that already explained with reference to the other counter units. This field and parts are shown at 121. The two shafts which are rocked by the armature movements are shown at 122 and 123, respectively. It is here noted that as a matter of convenience this totalizing counter unit is placed and supported on its side instead of vertically as in the case of the counters 32, 33, 34 and 35. The totalizing counter unit 124 is rotated with a step by step operation by the successive armature rockings; and thereby the several counting wheels 125, 126, 127 and 128 for the several numerical orders are progressively advanced, step by step, in the well understood manner, suitable carrying devices being provided between these numerical orders for carrying tens from order to order in the well understood manner.

The order wheels 125, 126, 127 and 128 are provided with the usual numerals or digits on their faces, and these numerals or digits are visible through the opening 25 of the front panel of the instrument. A suitable re-set knob 29 is provided for re-setting the wheels 125, 126, 127 and 128 to zero in the well understood manner, and the details of this construction need not be here stated, as they are well known in this art.

This totalizing counter unit is provided with the crank arm 129 on the shaft 122, which corresponds to the crank arm 107 of one of the counter units 32, 33, 34 and 35 already explained; and this crank arm 129 of the totalizing counter unit operates the contacts 130 and 131 in manner similar to the operation of the contacts 116 and 117 of the counter units 32, 33, 34 and 35. It is, however, here noted that whereas the contacts 116 and 117 of the counter units 32, 33, 34 and 35 are normally closed, and are permitted to open at the completion of the half rocking stroke of the armatures of the unit, the reverse is true of the contacts 130 and 131 of the totalizing counter unit. These are normally open as shown in Figure 3, and are permitted to close during the operating half stroke of the armatures of this totalizing counter unit, and are again opened when the armatures of this counter unit are restored to their initial position when the solenoid is de-energized. At this point I mention that these contacts are interlocked with the relay to ensure correct operation of the relay at the completion of the final count.

The field solenoids of the totalizing counter, and of the units counter unit 32, are connected

in parallel, so that when impulses of current arrive at the instrument from the outside, these impulses serve to operate the armatures of both the totalizing counter unit and the counter unit for units order, so that the shafts of these two units advance simultaneously, step by step. In this manner the totals accumulated in the totalizing counter unit show at all times the number of operations performed, and show the rate at which the predetermined total is approaching.

The relay 37 is shown in detail in Figures 12, 13 and 14. It includes the solenoid 132, the armature 133 influenced thereby, the contacts 134 and 135, and the contacts 137 and 138, which are normally closed, and the contact 136 which is normally away from the contact 135; and the excitation of the relay solenoid serves to rock the armature 133 thereof, thereby reversing the connections of these pairs of contacts, opening the contacts 134 and 135, and 137 and 138 and closing the contacts 136 and 135. These contacts are of the flexible spring type, and their spring nature serves to restore the armature to its released position when the solenoid is de-energized.

Having thus described the principal elements of the instrument I shall now explain certain of the operations which they perform in their joint functioning, and shall then explain some of the electrical connections for accomplishing these inter-relationships.

As each impulse of current arrives at the instrument from the source or device whose operations are to be counted up to a predetermined number, such impulse passes to the solenoids of the totalizing counter unit and of the units counter unit 32. Each such impulse then rocks the armatures of these two units, advancing their respective shafts step by step. As the units counter unit reaches completion of a shaft rotation the arm 83 thereof rocks over and closes the contacts 89 and 90 together thereby delivering a sustained impulse of current to the solenoid of the counter unit 33 for the tens order. Such sustained impulse serves to advance the tens counter unit shaft one step, and a successive step of that shaft is advanced with completion of each rotation of the shaft 66 of the units order counter unit. Finally, when the shaft 66 of the tens order counter unit has completed a rotation, its arm 83 will swing over and bring together its contacts 89 and 90, to thereby deliver a sustained impulse of current to the solenoid of the hundreds order counter unit. These operations will be readily understood from this simple example.

Now, the turning of each counter unit shaft 66 serves to carry with it the disk 67 mounted thereon, and there will arrive, during each complete rotation of the counter unit shaft 66 a time when the contacts 69 and 48 of such order will come together to thereby close a circuit at that point. These sets of contacts are all connected together into a series circuit, and the continuity of that circuit will never be complete until all the sets of contacts 69—48 of the various counter units 32, 33, 34 and 35 have come together due to the rotations of the several counter unit shafts 66. Now the time when such condition will occur will depend on the settings to which the several shafts 45 have been brought by the knobs 25, and as shown by the digits appearing through the openings 24 of the panel board. Such being the case, if we start from zero setting of all the counter unit shafts 66, it will be necessary to receive a total number of impulses equal

to the numerical setting of the several digits appearing at the openings 24, in order to bring all the sets of contacts 69—48 together and thereby establish the complete series circuit of which these contacts constitute a part. When such series circuit is thus completely established other operations and functions will occur.

Furthermore, if the totalizing counter unit is set to zero at the commencement of such a series of operations as just above explained, then the accumulated total shown by such totalizing counter unit at any time will be the number of impulses received and counted up to that time, and will be equal to the number which has operated on the several counter units 32, etc., of the series.

Now, in order to re-set the counter units to zero the following operations are provided for: When the reset position of the switch 31 is closed, that is, when said switch is moved to the reset position, current is delivered to the solenoids of all the counter units 32, 33, 34 and 35 in parallel, but the current flowing to each of these counter unit solenoids passes through the contacts 116 and 117 of such counter unit. Such flow immediately energizes the solenoid of such counter unit and thereby causes separation of said contacts to occur, whereupon the solenoid winding is de-energized and the armatures return to their normal position, and thereupon the contacts 116 and 117 are again closed and the local circuit of the solenoid winding is again re-established, and a new and similar operation is performed, the action being similar to that of an ordinary electric bell or buzzer. These impulses serve to cause the counter unit to advance with a step by step movement in the forward direction of shaft rotation. Now the contacts 100 and 101 of such counter unit constitute a portion of this re-setting to zero circuit, and whenever the shaft of such counter unit is turned to some position other than its zero position the pin 98 moves away from the contact 101 and permits the two contacts to come into engagement with each other, whereas as soon as the shaft again reaches its zero position these contacts are separated, and the re-setting circuit for such counter unit is thereby opened. Thus, the re-setting operation will continue, for such counter unit, until it reaches the zero position, whereupon the operation will stop, notwithstanding that the switch 31 may still be held at the re-set position. In this way each counter unit will re-set to its zero position independently of the other counter units, assuming that the switch 31 is held to the re-set position long enough to meet the requirements of all the counter units.

Now suitable arrangements have been made to give signals, either visual or audible, or otherwise, on the happening of certain events. Thus, when the pre-determined count has been reached such a visual signal is given, and when the various counter units have been re-set to zero another visual signal is given. In the former case the complete establishment of the series circuit through contacts 48 and 69 will effect the visual signal for completion of the pre-determined count. For the case of a signal upon completion of re-set to zero, use is made of the contacts 102 and 103 of each counter unit. These are brought together whenever the shaft 66 of such unit reaches the zero position, and they are separated whenever such shaft is moved away from such zero position. These sets of contacts for the several counter units are all connected into a series

circuit which constitutes or controls the operation of a visual signal for the re-set to zero operation, so that as soon as all the counter units 32, 33, 34 and 35 reach the zero positions such zero re-set signal will be given.

Suitable arrangements have also been made to give either signals or remote controls at some distant point when the pre-determined count is reached. For this purpose the relay 37 may be used. The arrangement is such that when the switch 31 is thrown to the starting position for normal counting functions the relay solenoid is de-energized so that its armature moves to a position to close the contacts 134—135 and open the contacts 135—136. Such being the case the signals or impulses coming from the outside can reach the totalizing counter unit and the units counter unit 32. The relay solenoid, however, is placed in the series circuit of the several counter units so that when the final count of the pre-determined number is reached the relay solenoid will be energized and its armature will move to reverse the said contacts, thereby opening the contacts 134—135 and closing the contacts 135—136. Said contacts 136—137 may be used as part of, or to control, the remote circuit, and thereby either give a signal or cause a function at such remote location, as for example, to stop a motor or the like.

Reference may now be had to the wiring schematic diagram of Figure 15 to show a typical set of connections for use in connection with the elements heretofore referred to. In this diagram the various elements are numbered with the same numbering as heretofore used in descriptive matter, and the operations will be readily understood from the detailed description heretofore given.

Referring to Figure 15, the operation of impulses to be counted is as follows: Each time the contacts 140 of some device whose operations are to be counted are closed, the circuit including the contacts 137 and 138 and the line 139 and the line 141 is closed through the solenoid 36 of the totalizing counter unit and the solenoid 63 of the units counter unit in parallel before the relay can function to open contacts 137 and 138. Immediately the totalizing counter unit closes its contacts 130 and 131 together thereby maintaining the impulse circuit in closed condition notwithstanding that in the meantime the relay 37 may have been operated by reason of the completing of the series circuit for the final count with consequent opening of the contacts 137 and 138. By this means there is assurance that on the final count the relay operation will not cause premature opening of the impulse circuit such as might cause failure of the counter units to properly register the final count of the final unit to be counted.

When the impulse ceases by opening of the contacts 140, then the totalizing solenoid 36 is released and its contacts 130 and 131 open so that the impulse circuit is now open at two points, namely, the contacts 130—131 and 137—138, and no more impulses can be received under this condition.

Where in this specification and the claims to follow, I use the expression "electrical solenoid means" or similar expressions in connection with a counter unit or units it will be understood that I contemplate any suitable electro-magnetic means for operation of the counter unit or units, since the solenoid or magnet constitutes a portion of any such means, or is typical of such electro-magnetic means.

While I have herein shown and described only

a single embodiment of the features of my present invention, still I do not intend to limit myself thereto, except as I may do so in the claims to follow.

I claim:

1. A predetermined counter comprising in combination a plurality of counter units for a series of orders, each counter unit including a shaft and step-by-step electromagnetic means to advance said shaft, a pre-set shaft corresponding to each counter unit shaft, co-operating contacts in connection with each counter unit shaft and the pre-set shaft therefor for engagement with each other at angular rotated position of the counter unit shaft corresponding to the momentary rotated position of the said pre-set shaft, a series circuit including the co-operating contacts of each counter unit and its pre-set shaft aforesaid and also including a relay having a solenoid, said relay including normally closed counter unit solenoid impulse actuating current supply contacts, said impulse actuating current supply contacts moving to open circuit position upon energization of the relay solenoid upon closing of said series circuit at completion of the pre-determined count, a totalizing counter unit including a shaft and step-by-step electromagnetic means to advance said shaft, means to deliver current impulses to the electro-magnetic means of the totalizing counter unit simultaneously with delivery of said impulses to the electro-magnetic means of the units order counter unit of the series of counter units aforesaid, a movable contact in connection with said totalizing counter unit and movable to closed circuit position during each actuation of said electro-magnetic means of said totalizing counter unit, together with means to supply current from said movable contact of the totalizing counter unit to the impulse actuating current supply contact of the relay during each actuation of the totalizing counter unit and independently of the relay position at such time, substantially as described.

2. A predetermined counter comprising in combination a plurality of counter units for a series of orders, each counter unit including a shaft and step-by-step electromagnetic means to advance said shaft, a pre-set shaft corresponding to each counter unit shaft, co-operating contacts in connection with each counter unit shaft and the pre-set shaft therefor for engagement with each other at angular rotated position of the counter unit shaft corresponding to the momentary rotated position of the said pre-set shaft, a series circuit including the co-operating contacts of each counter unit and its pre-set shaft aforesaid and also including a relay having a solenoid, said relay including normally closed counter unit solenoid impulse actuating current supply contacts, said impulse actuating current supply contacts moving to open circuit position upon energization of the relay solenoid upon closing of said series circuit at completion of the predetermined count, a totalizing counter unit including a shaft and step-by-step electromagnetic means to advance said shaft, means to deliver current impulses to the electro-magnetic means of the totalizing counter unit simultaneously with delivery of said impulses to the electro-magnetic means of the units order counter unit of the series of counter units aforesaid, together with means to supply current to the impulse actuating current supply contact of the relay during each actuation of the totalizing

counter unit and independently of the relay position at such time, substantially as described.

3. A predetermined counter including in combination a plurality of counter units each having a shaft and step-by-step electromagnetic means to advance said shaft, means to establish a closed series circuit when all of said counter units stand at pre-selected positions, said series circuit including a relay having normally closed impulse actuating current supply contacts, said contacts moving to open circuit position upon energization of the relay upon closing of said series circuit, a totalizing counter unit having a shaft and step-by-step electromagnetic means to advance said shaft, means to deliver current impulses to the electromagnetic means of said totalizing counter unit and the units order counter unit of said plurality of counter units simultaneously, together with means to supply current to the impulse actuating current supply contact of the relay during each actuation of the totalizing counter unit and independently of the relay position at such time, substantially as described.

4. A predetermined counter including in combination a plurality of counter units for a series of numerical orders, a totalizing counter unit, all said counter units including shafts and step-by-step electromagnetic means to advance said shafts with successive current impulses delivered thereto, means to establish a closed series circuit when all of said counter units stand at pre-selected positions, said series circuit including a relay having normally closed impulse actuating current supply contacts, said contacts moving

to open circuit position upon energization of the relay upon closing of said series circuit, together with means in conjunction with the totalizing counter unit effective to supply current to the impulse actuating current supply contact of the relay during each actuation of the totalizing counter unit and independently of the relay position at such time, substantially as described.

5. A predetermined counter including in combination a plurality of counter units for a series of numerical orders, all of said counter units including shafts and electromagnetic step-by-step means to advance said shafts with successive current impulses delivered thereto, means to establish a closed series circuit when all of said counter units stand at pre-selected positions, said series circuit including a relay having normally closed impulse actuating current supply contacts, said contacts moving to open circuit position upon energization of the relay upon closing of said series circuit, another step-by-step electromagnetic device in connection with said impulse actuating current supply contacts and working in harmony with said plurality of counter units, together with means in conjunction with said last named step-by-step electromagnetic device effective to supply current to the impulse actuating current supply contact of the relay during each actuation of the said last named step-by-step electromagnetic device and independently of the relay position at such time, substantially as described.

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