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COUNTING APPARATUS

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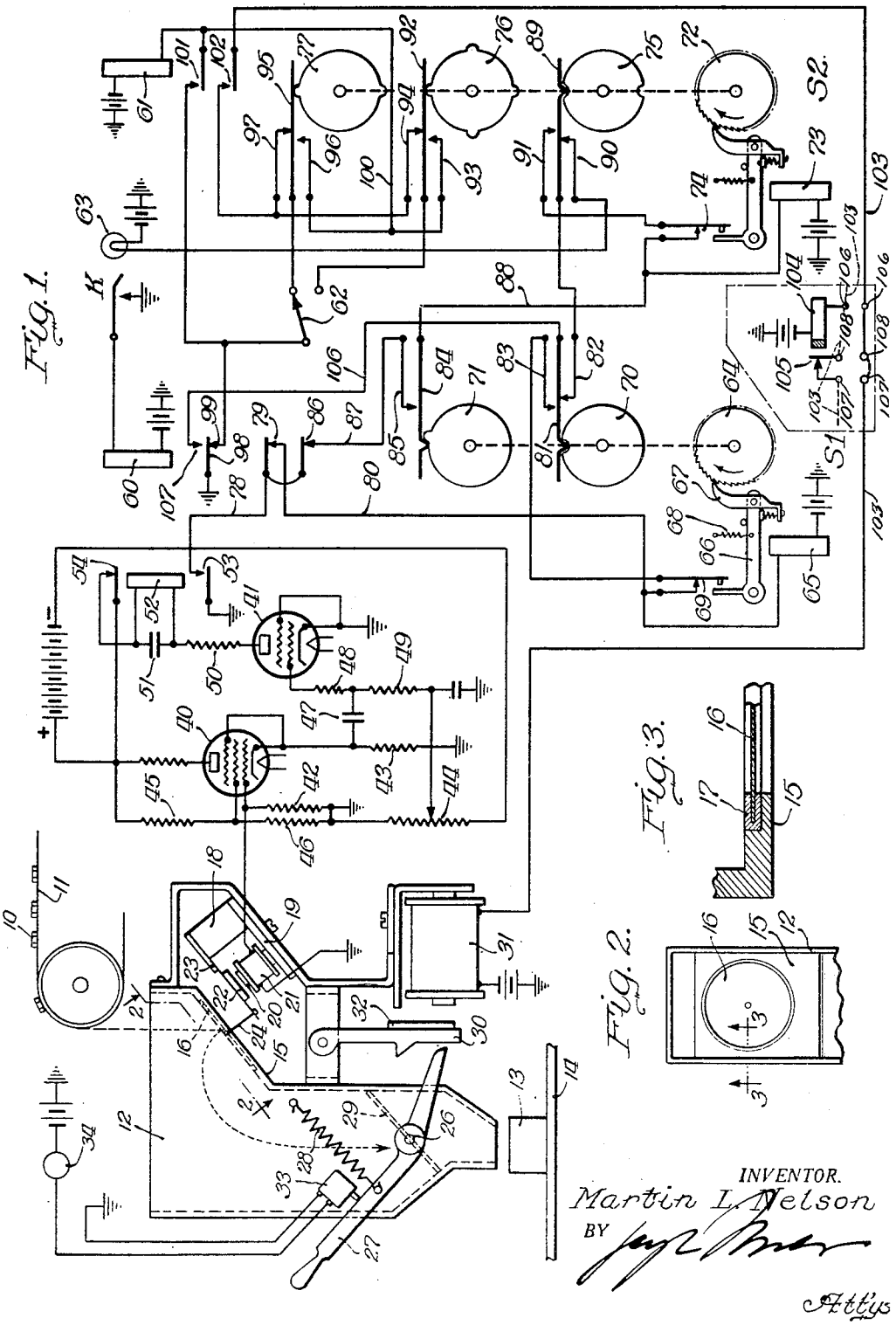


Fig. 1.

Fig. 3.

Fig. 2.

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COUNTING APPARATUS

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11 Claims. (Cl. 235—132)

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The present invention is concerned with counting apparatus of the general type as shown in Patent No. 2,487,265, dated November 8, 1949, filed as application Ser. No. 490,133, June 9, 1943, of which this application is a division.

The invention is adapted for use in different situations, but is particularly well adapted for counting small articles such as nuts, screws, bottle caps, medicinal tablets or pills, etc., which are put up in packages or containers for shipment and sale. Such articles are generally sold at a price based on the quantity, as so much per thousand, for example, and it is desirable, therefore, in the case of any given article, to provide a certain definite known number in each package. An article which is sold by the thousand will usually be put up in packages or containers each containing one thousand or some multiple of that number.

So-called predetermined counters have already been devised and have been used to some extent for counting out articls in lots of desired quantity. Such counters have been physically controlled by the articles being counted, in some cases, and in other cases have been controlled by means of a light beam and photoelectric cell, and have operated satisfactorily for counting certain kinds of articles. So far as known, however, no counting apparatus has previously been made which is well adapted for counting extremely small and light articles of the above-mentioned character. It has been the practice, therefore, to count such articles by hand, if the cost is not prohibitive, or to determine the proper size of the lots by weight, the weight of the desired number being first determined by actual trial. The latter method is not very accurate, due to slight variations in the weights of the individual articles.

In order to take care of this situation I have devised an inexpensive and accurate counting apparatus, including a simple and effective arrangement by means of which the apparatus is controlled by the articles to be counted. The articles are caused to drop one at a time onto a resilient diaphragm, from which they rebound into a chute which delivers them to the package or container. Associated with the diaphragm there is a sensitive pickup device which generates electrical impulses in response to the impacts of the articles on the diaphragm. These impulses are suitably amplified and are employed to control the counting apparatus, which counts the impulses and thus counts the articles as they impinge on the diaphragm. When the predetermined number of articles has been delivered, the counting apparatus automatically releases a device which blocks the chute at the delivery end and operates a signal to call an attendant, who replaces the filled container with an empty one and then resets the chute blocking device to open position. In the meantime the counting continues, the articles for the next lot being accumulated in the chute until the fresh container has been placed in position and the chute has been opened by the attendant. The apparatus may operate in this manner without interruption for any desired time, or until the desired number of containers have been filled.

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The operation of the counting apparatus is entirely automatic except for the change in containers by the attendant, who may take care of several machines at one time. Thus it will be seen that the invention provides a highly efficient counting apparatus having an excellent field of application in industry, where it supplies a need not heretofore satisfied in any economical or practical manner.

The invention will be described more in detail hereinafter, reference being had to the accompanying drawings, in which—

Fig. 1 is a circuit drawing showing diagrammatically the various apparatus units and the electrical circuits constituting an embodiment of the invention;

Fig. 2 is a fragmentary view of the interior of the delivery chute, showing the diaphragm on which the articles are dropped; and

Fig. 3 is a partial section on the line 3—3, Fig. 2.

It is assumed, in the example shown in the drawings, that the apparatus is arranged to count articles, e. g., nuts, in lots of 500 or 1,000 units.

Referring to the drawings, the nuts 10 are delivered to the counting apparatus by a belt conveyor indicated at 11. The source of supply may be arranged to deliver the nuts to the conveyor in a single line, or at least in spaced relation lengthwise of the conveyor, or guides may be provided to line the nuts up on the conveyor belt as they move along. The rate of travel may be such that if the nuts are in contact with each other in a straight line on the conveyor belt they will be delivered at a rate equal to the safe operating rate of the counting apparatus. The apparatus will readily handle 600 to 1000 nuts per minute.

The reference character 12 indicates a chute which is supported in suitable manner and arranged to receive the nuts as they fall from the end of the belt conveyor. The shape of the chute will be readily understood from Figs. 1 and 2, but can be modified as desired so long as it

retains its function of delivering the nuts in the proper manner to the containers. One of the latter is indicated at 13, and rests on a support 14.

In the wall 15 of the chute there is inserted a resilient membrane-like member forming a diaphragm 16, which is separately shown in Figs. 2 and 3. The diaphragm is peripherally provided with a rubber gasket 17, which insulates the diaphragm from the chute, so that accidental shocks or jars to which the chute may be subjected are not communicated to it. The chute should be so disposed that the nuts falling from the conveyor will impinge on the diaphragm approximately at the center thereof, although this is not strictly necessary. As each nut strikes the diaphragm it rebounds substantially as shown by the dotted line and passes down the chute.

The pickup device associated with the diaphragm may be mounted on the chute in suitable manner as indicated, and may be structurally similar to the well known type of loud speaker unit. As shown diagrammatically herein, it comprises a permanent magnet 18, a heel piece 19, a core 20 carrying a winding 21, and an armature 22. The armature may be supported on the permanent magnet 18 by means of a stiff reed 23 and is connected to the diaphragm 16 by means of a rod 24. Movement of the armature 22 caused by the impact of a nut on the diaphragm 16 alters the flux in the magnetic circuit of the pickup device and generates a voltage in the winding 21.

The arrangement for blocking the chute includes a shaft 26 which passes through the chute from front to rear and has bearings in the front and rear walls thereof. Inside the chute the shaft 26 carries a vane 29 of rectangular shape and adapted in the position in which it is shown to close the chute. In front of the chute there is a hand lever 27 fixed to shaft 26. This hand lever is used to rotate the shaft 26 and thereby also rotate the vane 29 to a vertical position in order to open the chute. When operated in this manner the end of the hand lever engages a pivoted latch 30 and the vane 29 is locked in open position.

An electromagnet 31 is provided for releasing the hand lever. When this magnet is energized it attracts the armature 32 attached to latch 30 and moves the latter on its pivot sufficiently to disengage the end of the hand lever. Thereupon the spring 28 restores the hand lever 27 and vane 29 to the position in which these parts are shown in the drawing.

The reference character 33 indicates a switch which is closed by the hand lever 27 when it is released. This switch controls the circuit of a signalling device 34, which may be a lamp or a bell, provided for the purpose of warning an attendant that a container has been filled.

Suitable means including the tubes 40 and 41 is provided for amplifying the impact voltages generated by the pickup device and for converting them into impulses suitable for operating the counting device. The tube 40 may be a type 6J7G pentode, while tube 41 may be a type 2051 Thyratron. The operation of such tubes is well known and hence it will be necessary to call attention only to the essential features of the circuit.

The pickup winding or coil 21 is included in a closed grounded circuit which includes the grid leak resistor 42. This circuit is connected direct to the control grid of tube 40. The resistor 43 is

the usual grid biasing resistor for the tube, which in the absence of grid excitation maintains the current now in the cathode plate circuit at a very low value. The suppressor grid may be connected direct to the cathode; while the screen grid is connected to the junction of resistors 45 and 46, forming with the potentiometer 44 a voltage divider.

The control grid of tube 41 is connected by way of resistors 48 and 49 to the movable contact of the potentiometer 44, this connection being effective to maintain a negative potential on the grid sufficient to prevent the tube from passing current. This potential may be adjusted by means of the potentiometer. The cathode plate circuit of the tube 41 includes the resistor 50 and the winding of the relay 52, the relay being shunted by the condenser 51. Relay 52 is the impulsing relay for operating the counting device.

The tube 40 controls the tube 41 by means of a condenser 47, which is connected between the cathode of tube 40 and the junction of resistors 48 and 49 in the grid circuit of tube 41.

The counting device includes two step-by-step cam switches S1 and S2.

The cam switch S1 may be of known construction and comprises a ratchet wheel 64, a stepping magnet 65, an armature 66, a pawl 67, and two cams 70 and 71 which are mounted on the ratchet wheel shaft and rotate with it. The switch is of the type in which the ratchet wheel is advanced upon the deenergization of the stepping magnet. When the stepping magnet 65 is energized the armature 66 is attracted and pawl 67 drops into the notch behind the next adjacent tooth. Upon the deenergization of the stepping magnet the armature is retracted by the spring 68 and the pawl advances the ratchet wheel through the angular distance of one tooth. It will be assumed that the ratchet wheel has fifty teeth, and that fifty impulses or energizations of the stepping magnet are required for a complete rotation of cams 70 and 71. The armature 66 also controls an interrupter contact 69, which is included in the resetting circuit of the switch. The cams 70 and 71 control certain circuits of the counting device, as will be explained presently.

The cam switch S2 is similar to the cam switch S1 and includes the ratchet wheel 72, stepping magnet 73, and the three cams 75, 76 and 77. The switch S2 differs from switch S1 in the number and construction of the cams, and in the number of ratchet teeth, the ratchet wheel 72 having only 40 teeth. As in the case of switch S1, the cams of switch S2 control circuits of the counting device, which will be explained in the course of the description of the operation of the apparatus.

The counting device also includes a relay 61 and a relay 60. The latter is a reset relay and is manually controlled by means of a key K. The reference character 62 indicates a hand-operated switch, while 63 indicates a signal lamp.

Suitable means is provided for supplying current to the apparatus. The tubes 40 and 41 may have plate current supplied at about 300 volts, the source of supply being indicated in the drawings as a battery. The other equipment items such as the relays (except 52), magnets and lamps may be supplied with current at 50 volts and for this purpose another battery may be provided.

The operation of the counting apparatus will now be explained. It will be assumed that the

apparatus is in the condition in which it appears in the drawing. The cam switches S1 and S2 have been reset and are in zero position. Switch 33 is closed and the signal 34 is in operation. The delivery of nuts by the belt conveyor has just started and the first nut is about to fall from the conveyor onto the diaphragm 16.

The attendant may now operate the hand lever 27 to open the chute. The lever will then be held in operated position by the latch 30. Switch 33 is opened and the operation of the signal 34 ceases. The nuts leaving the conveyor belt fall in rapid succession onto the diaphragm 16, from which they rebound and pass down the chute into the container 13.

The impact of a nut on the diaphragm 16 produces a mechanical shock which is transmitted to the armature 22 of the pickup device by the rod 24. More accurately, the impact produces a highly damped vibration of the diaphragm and armature. As a result corresponding changes are produced in the flux in the magnetic circuit of the pickup device and alternating voltages are generated in the winding 21, the wave shape of such voltages being that of a highly damped train of oscillations. The alternating voltages produce a current flow in the circuit of the winding 21 and voltages are developed across the resistor 42 which are applied to the grid of tube 40. At the first positive half wave the grid potential is raised enough so that the current flow in the cathode plate circuit of the tube is very substantially increased. This raises the potential at the cathode of the tube, and since the cathode is coupled to the grid of the tube 41 by the condenser 47, the potential at the grid of the latter tube is momentarily raised sufficiently to cause the tube to fire; that is, it begins to pass current. Due to the known characteristics of the tube, once current starts to flow it continues to flow independent of the grid and at a rate determined by the constants of the cathode plate circuit.

When the tube 41 fires, the condenser 51 starts to charge in series with the resistor 50, the resistor serving to limit the initial current flow to a safe value. Current also flows through the relay 52 which is connected in parallel with the condenser, but the relay cannot energize until the condenser becomes charged to a fairly high potential. Upon energizing, relay 52 closes its contact 53 and opens its contact 54. The opening of contact 54 stops the flow of current and extinguishes the tube. The condenser 51 now discharges through the relay and slightly delays its deenergization. The arrangement insures a single positive operation of the relay.

The foregoing describes the operations resulting from the impact of a single nut on the diaphragm 16. Each succeeding nut produces the same effect and thus the relay 52 is repeatedly energized and deenergized, once for each nut that strikes the diaphragm and passes down the chute.

Operating as above described, the relay 52 transmits impulses to the stepping magnet 65 of the cam switch S1 over a circuit which may be traced from ground by way of contact 53 of relay 52, conductor 78, contact 79 of relay 60, conductor 80, and winding of the stepping magnet 65 to the negative pole of the battery. These impulses are effective to operate the stepping magnet 65 to advance the cam switch S1 in known manner. At the end of the first impulse, when the stepping magnet deenergizes, the cam 70 causes the contact spring 81 to disengage spring 82 and to engage spring 83. These circuit changes have no effect for the time being. No other circuit changes take place as the switch continues to advance until, following the 49th impulse, the cam 71 causes the contact spring 84 to engage the spring 85. This prepares a circuit for the stepping magnet 73 of the cam switch S2.

The 50th impulse energizes magnet 65 like previous impulses and also energizes the stepping magnet 73 over a circuit extending from ground by way of contact 53, conductor 78, contact 86, conductor 87, springs 85 and 84, conductor 88, and winding of stepping magnet 73 to the negative pole of the battery. The energization and deenergization of the stepping magnet 73 is effective to advance the cam switch S2 one step, with the result that cam 75 causes the contact spring 89 to disengage spring 90 and engage spring 91. These circuit changes are of no effect at present. The cams 76 and 77 also advance one step, causing the contact springs 92 and 95 to disengage springs 94 and 97, respectively, and engage springs 93 and 96, respectively. A circuit is now completed for relay 61, extending from ground by way of contact spring 98, contact 99, switch 62, springs 95 and 96, conductor 100, and winding of relay 61 to the negative pole of the battery. Upon energizing, relay 61 establishes a locking circuit for itself at its contact 101, and at contact 102 prepares a circuit for the release magnet 31.

Fifty impulses have now been counted, corresponding to fifty nuts delivered to the container 13, and the cam switch S2 has been advanced one step. The cam switch S1 has been restored to its original starting position.

The cam switch S1 continues its response to impulses from the relay 52 and advances step by step, as described. Following the 99th impulse the cam 71 closes the springs 84 and 85 again, with the result that the 100th impulse operates the stepping magnet 73 of cam switch S2 to advance the switch S2 another step.

The cam switch S2 continues to be advanced in this manner, once for each fifty steps of the cam switch S1, until finally, in response to the 1000th impulse, it takes its 20th step, corresponding to twenty full rotations of cam switch S1. One thousand nuts have now been delivered to container 13. As previously mentioned, the ratchet wheel 72 of cam switch S2 has forty teeth, from which it will be understood that after the switch has taken twenty steps the lower lobe of cam 77 will have changed places with the upper lobe and the contact spring 95 will have been re-operated to the position in which it is shown in the drawing.

The operation of cam switch S2 as described above results in the closure of a circuit for the release magnet 31 which may be traced from ground by way of contact 98, contact 99, switch 62, springs 95 and 97, contact 102, conductor 103, and winding of magnet 31 to the negative pole of the battery. The conductor 103 has been shown in dotted line between the points 107—108 to indicate a jumper wire which connects these points. This jumper wire may be removed for a purpose which will be presently described. Upon energizing over the circuit including the conductor 103 with its dotted jumper wire, magnet 31 attracts its armature 32 and causes the latch 30 to release the hand lever 27, which is restored by spring 28 to the position in which it appears in the drawing. The release of the hand lever ro-

tates the vane 29 to closed position, thus blocking the chute and preventing the delivery of additional nuts to the container 13.

The release of the hand lever 27 also closes the switch 33 to operate the signal 34. Being notified in this manner that the container has been filled with the required number of nuts, the attendant withdraws the filled container 13 and replaces it with an empty one. The attendant then operates the hand lever 27 as before to open the chute, whereupon the nuts which have been counted while the chute was closed are released for delivery to the new container.

In view of the continuous delivery of nuts by the conveyor, it will be understood that following the closure of the circuit of magnet 31 as described in the foregoing the cam switch S1 continues operation to count the nuts which are to make up the second lot. When fifty nuts of the second lot have been counted, the cam switch S2 is advanced one step as before (its 21st step) and the cams 76 and 77 restore the contact springs 92 and 95, respectively. The restoration of contact spring 95 breaks the circuit of magnet 31, which accordingly deenergizes. On the assumption that the nuts are being delivered at a fairly high speed, as will usually be the case, the magnet 31 will become deenergized before the attendant has had time to change the containers and operate the hand lever 27, with the result that when the hand lever is operated it is retained by the latch 39, as previously described.

In connection with the foregoing it may be mentioned that, if the articles to be counted are delivered at a rather slow rate or if the delivery is apt to be interrupted frequently, a situation may arise in which ground from contact 98 is maintained on the conductor 103 for a prolonged interval due to delay in the delivery of the impulse signifying the delivery of the first nut of the next lot to the diaphragm 16 and consequent delay in the operation of the switch S2 to rotate its cams a corresponding step so as to cause opening of contacts 95, 97 and therewith prompt release of magnet 31, as described in the preceding paragraph. Such condition would prevent prompt release of magnet 31 and therewith the latch 39 to place it in readiness to lock the lever 27 after actuation thereof by the attendant so as to permit delivery of the nuts of the next lot to the new container. A control and supervisory relay 104 may be provided to assure quick release of magnet 31 so as to avoid trouble resulting from such condition. This relay may be placed in parallel with the magnet 31 by connecting it to conductor 103 at the terminal point 106. The jumper wire shown in dotted lines between the terminal points 107—108 of the conductor 103 is removed and the pair of contacts 105 of relay 104 are inserted in conductor 103 at the correspondingly marked points. Accordingly, relay 104, when thus connected to the conductor 103, energizes in parallel with the magnet 31, and the latter attracts its armature 32 to unlatch the lever 27. Relay 104, upon energizing, opens its contacts 105, thereby opening the conductor 103 leading to the magnet 31, causing deenergization of this magnet to release its armature 32 and therewith the latch 39 to normal position so that the latch is in readiness to lock the lever 27 again in response to operation thereof by the operator. The provision of relay 104 thus obviates any trouble the attendant might have in the situation mentioned, due to failure of the magnet 31 to energize promptly and the consequent failure of the hand-lever 27 to become latched when operated.

Continuing with the explanation, the operation proceeds as described, the second, third, etc. lots being counted off in the same manner as the first. After each lot is counted the attendant is notified, a fresh container is moved to position in place of the one just filled, and the chute is opened to start delivery to the new container.

Eventually the supply of nuts to the conveyor will stop and the counting operations will be suspended. The supply of nuts may become temporarily exhausted, for example; or the required number of containers may have been filled. Assuming that operations are not to be resumed immediately, it will usually be desirable to return the unfinished lot in the last container to the source of supply and reset the counting device to zero, so that it will be ready to count a full lot when counting is resumed.

In order to reset the counting device the attendant operates the key K, thereby closing a circuit for the reset relay 60. Upon energizing, relay 60 opens the locking circuit of relay 61, which accordingly deenergizes, opens its locking circuit at contact 101, and at contact 102 opens a point in the circuit of magnet 31. Relay 60 also closes a circuit for the stepping magnet 65 of the cam switch S1, extending from ground by way of contact 98, contact 107, conductor 106, contact springs 81 and 83 (assuming that switch S1 is not in zero position), interrupter contacts 69 of switch S1, and winding of the stepping magnet 65 to the negative pole of the battery. This circuit is broken at the interrupter contacts 69 each time the magnet 65 energizes and accordingly the magnet is rapidly alternately energized and deenergized to advance the switch to zero position, whereupon the cam 70 breaks the circuit at contact springs 81 and 83. The cam switch S1 is now reset and ready to start a new count.

The cam 70 upon reaching zero position causes contact spring 81 to engage spring 82, which extends or transfers the resetting circuit to the stepping magnets 73 of the cam switch S2. The extended resetting circuit includes the contact springs 89 and 91 associated with cam 75 and the interrupter contacts 74 and is effective to advance the cam switch S2 to zero position. Upon arriving in this position the cam 75 opens the circuit at contact springs 89 and 91 and the operation of the switch ceases. Both switches S1 and S2 have now been reset and stand in the positions in which they are shown in the drawing.

In zero or reset position the cam 75 causes the contact spring 89 to engage spring 90 which transfers the resetting circuit to the signal lamp 63. The lamp 63 accordingly is lighted up and the attendant is thereby notified that the resetting operation has been completed. The key K may now be restored, relay 60 is deenergized, and the lamp 63 is extinguished.

As mentioned hereinbefore, the counting device is arranged for counting lots of 500 as well as lots of 1000. When it is desired to count lots of 500, the switch 62 is shifted to its alternate position. In this position of the switch the circuit of magnet 31 is controlled by the cam 76 of the cam switch S2 rather than by cam 77. Since the cam 76 has four lobes instead of two, the size of the lots counted is reduced by one-half.

It will be understood that the apparatus may be arranged to count lots of various other sizes by changing cams. For instance, if a single-lobed cam is substituted for cam 77, the apparatus will

count lots of 2000. As another example, the single-lobed cam 71 may be replaced by a double-lobed cam, adapting the apparatus to count lots which are multiples of 25 instead of multiples of 50.

It will be understood also that the switch S2 may be provided with as many cams such as 76 and 77 as may be desirable or necessary in any given situation. The switch 52 will have as many selective positions as there are cams.

The thickness and strength of the diaphragm 16 must, of course, be suited to the weight of the articles to be counted, but is not critical. That is, a given diaphragm may be used for counting different articles having weights which differ within a considerable range.

The invention having been described, that which is believed to be new and for which the protection of Letters Patent is desired will be pointed out in the appended claims.

I claim:

1. In a counting device, a counting switch responsive to individual impulses to be counted, a second counting switch of higher numerical order, means controlled by said first switch for causing said second switch to count said impulses by groups, a control circuit adapted to be closed at one point by said second switch in a particular position thereof, a control relay energized responsive to the advance of said second switch from said position to close said circuit at another point after the circuit is opened at the first point, and a locking circuit for maintaining said relay energized, whereby said circuit is completed the next time said second switch reaches said position.

2. In a counting device, a counting switch responsive to individual impulses to be counted, a second counting switch of higher numerical order, means controlled by said first switch for causing said second switch to count said impulses by groups, a control circuit adapted to be closed at one point by said second switch in a particular position thereof, a control relay energized responsive to the advance of said second switch from said position to close said circuit at another point after the circuit is opened at the first point, a locking circuit for maintaining said relay energized, whereby said circuit is completed the next time said second switch reaches said position, a reset relay, means including said reset relay for advancing said second switch to said position when the impulses to be counted have ceased, and means whereby said reset relay opens the locking circuit of said control relay.

3. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet, and contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet over said prepared control circuit.

4. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, a locking circuit for maintaining said control relay energized, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet, and contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet over said prepared control circuit.

5. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a supervisory relay connected in parallel with said control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet and said supervisory relay, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet and said supervisory relay over said prepared control circuit, and contact means operable by said supervisory relay upon actuation thereof for effecting release of said control magnet.

6. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a supervisory relay connected in parallel with said control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet and said supervisory relay, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet and said supervisory relay over said prepared control circuit, contact means operable by said supervisory relay upon actuation thereof for effecting release of said control magnet, and signal means operatively effective upon release of said control magnet.

7. A counting device comprising a counting switch responsive to impulses to be counted, a

control circuit terminating in a control magnet, a slow-to-energize supervisory relay connected in parallel with said control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet and said supervisory relay, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet and said supervisory relay over said prepared control circuit, and contact means operable by said supervisory relay upon actuation thereof for opening part of the path of said control circuit to release said control magnet.

8. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a first control relay, circuit means for energizing said first control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, contact means operable by said first control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet over said prepared control circuit, a second control relay, manually operable means for effecting energization of said second control relay, and contact means operable by said second control relay for disabling the means for selectively rendering one of said control means effective at will.

9. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a first control relay, circuit means for energizing said first control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, contact means operable by said first control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet over said prepared control circuit, a second control relay, manually operable means for effecting energization of said second control relay, and contact means operable by said second control relay for releasing said first control relay to disable said control circuit.

10. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, a locking circuit for maintaining said control relay energized, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet over said prepared control circuit, a reset relay, manually controlled means for energizing said reset relay, and contact means operable by said reset relay upon energization thereof for opening said locking circuit to release said control relay and to advance said counting switch into normal position.

11. A counting device comprising a counting switch responsive to impulses to be counted, a control circuit terminating in a control magnet, a plurality of control means operable by said counting switch for closing energizing paths of said control circuit at different successive stages of its operation, means for selectively rendering one of said control means effective at will, a control relay, circuit means for energizing said control relay upon initial operation of said counting switch through the medium of the control means which has been rendered effective, a locking circuit for maintaining said control relay energized, contact means operable by said control relay for closing a point in the control circuit of said control magnet to prepare said control circuit for subsequent operative actuation of said control magnet, contact means subsequently operable by said counting switch for effecting the operative actuation of said control magnet over said prepared control circuit, a reset relay, manually controlled means for energizing said reset relay, contact means operable by said reset relay upon energization thereof for opening said locking circuit to release said control relay and to advance said counting switch into normal position, and means for signalling the normal position of said counting switch.

MARTIN L. NELSON.

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Number	Country	Date
343,021	Great Britain	Feb. 6, 1931