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July 19, 1960 F. G. NICOLAUS 2,945,624

COUNTING NUMBER REGISTER

Filed April 26, 1954 3 Sheets-Sheet 1

FIG. 1.

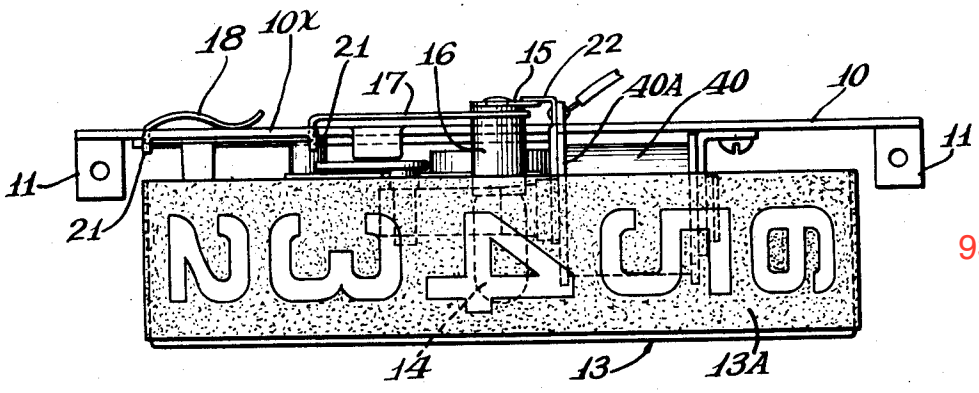

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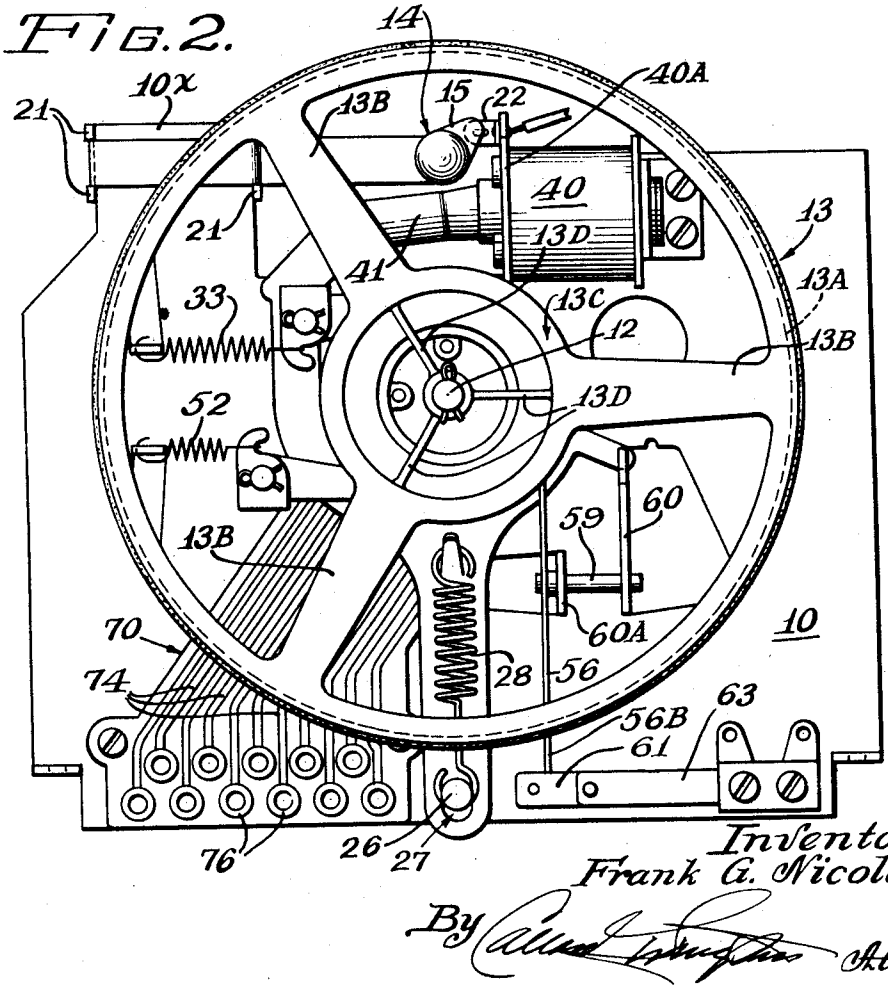
FIG. 2.



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July 19, 1960 F. G. NICOLAUS 2,945,624

COUNTING NUMBER REGISTER

Filed April 26, 1954 3 Sheets-Sheet 2

FIG. 3.

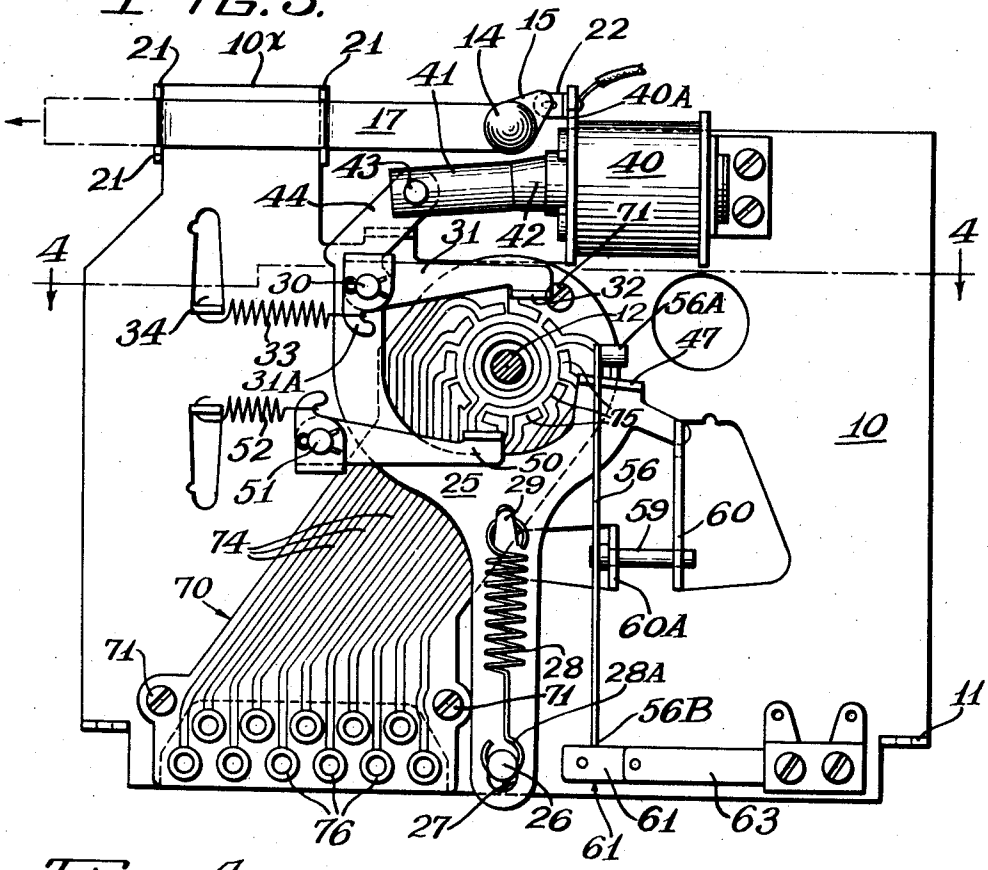
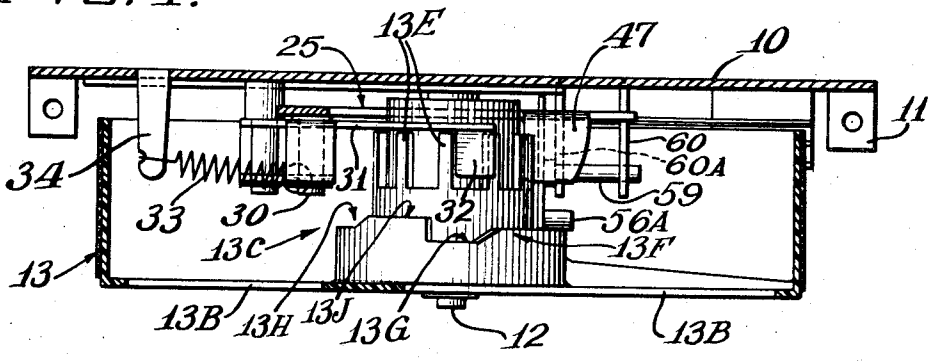


FIG. 4.



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July 19, 1960 F. G. NICOLAUS 2,945,624

COUNTING NUMBER REGISTER

Filed April 26, 1954 3 Sheets-Sheet 3

FIG. 5.

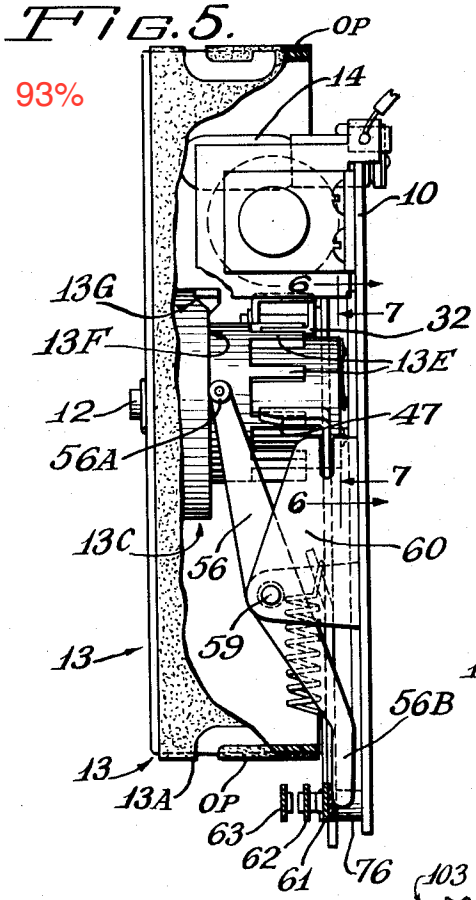


FIG. 6.

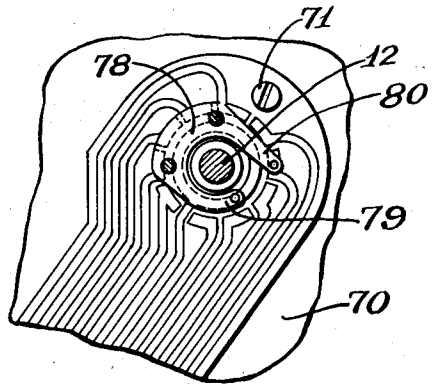


FIG. 7.

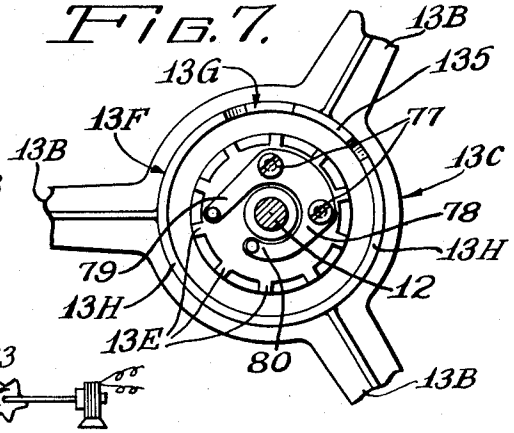
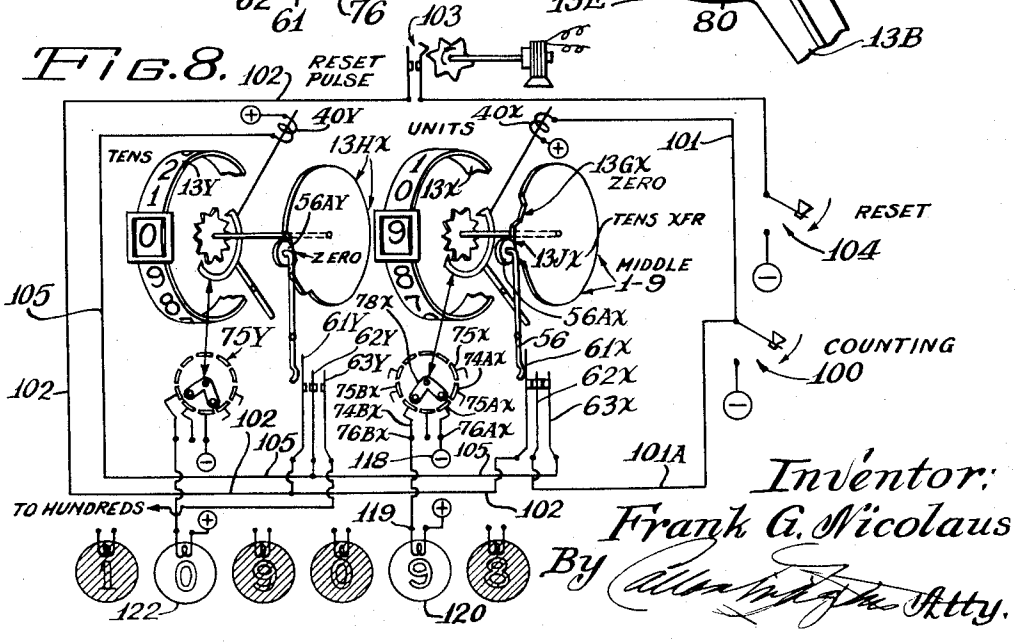


FIG. 8.



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Atty.

United States Patent Office 2,945,624 Patented July 19, 1960

2,945,624

COUNTING NUMBER REGISTER

Frank G. Nicolaus, Chicago, Ill., assignor to Raymond T. Moloney, Chicago, Ill.; American National Bank and Trust Company of Chicago, executor of said Raymond T. Moloney, deceased

Filed Apr. 26, 1954, Ser. No. 425,381

10 Claims. (Cl. 235—92)

This invention pertains to number-displaying, counting, and annunciator devices of the step-by-step rotary drum type, and has as its principal object the provision of a device of this class characterized by features of improvement including a light-weight, one-piece number-displaying drum molded from a translucent thermoplastic material and having integrally formed gear teeth and control cams arranged in a certain manner.

Another feature is the provision of a ratchet drive for the drum with certain shock-relieving, dead-stop, and registering mechanisms, adapted to coact especially with the light-weight drum structure for exact advancing and arresting action thereof.

Another feature is the provision of a stencilled or etched-type commutating circuit and a hub contact means cooperable therewith.

A further feature is the provision of a novel removable lamp-mounting and contact means for trans-illuminating the drum from the inner side thereof.

Still another feature is the provision of a control cam formed integrally with the drum hub and certain cam-follower lever means for successively closing switch members to condition a homing or resetting circuit for the first nine counting positions, and thereafter to condition a tens-transfer circuit to extend the counting range to another such unit.

Additional features and aspects of novelty and utility relate to details of the construction and operation of the preferred form of the new drum indicator as described in view of the annexed drawings in which:

Fig. 1 is a front elevational view of the drum indicator or counter unit;

Fig. 2 is a side elevation of the same;

Fig. 3 is another side elevation like Fig. 2 with the number drum removed;

Fig. 4 is a cross-section looking in the direction of lines 4—4 of Fig. 3.

Fig. 5 is a side elevation similar to Fig. 1 with parts of the drum broken away to expose the came feeler switch;

Fig. 6 is a fragmentary plan detail of the hub part of the stencilled circuit and the drum contact means therefor, the view representing a section along lines 6—6 of Fig. 5;

Fig. 7 is a fragmentary plan view of the hub part of the drum looking in the direction of lines 7—7 of Fig. 5, and showing the hub commutator contact means, the ratchet teeth, and hub cam means;

Fig. 8 is a circuit diagram.

The improved indicator is of general application, but is especially adapted to use as a score indicator in amusement apparatus, such as ball-rolling games, photoelectric gun games, and the like, a preferred embodiment of the device being shown in the drawings, and as depicted in Fig. 1 comprising a metal base plate **10** with lugs **11** by which it can be secured in a cabinet, usually in the upright position shown in Fig. 2 with the plate **10** in a vertical plane.

Rotatably mounted upon a stub shaft **12** seated in the

base (Fig. 2) is a translucent number drum **13**, behind which is an especially mounted and connected electric lamp **14** adapted to trans-illuminate the drum to render brightly apparent the indicia thereon, such as the numerals shown in Fig. 1.

As viewed in Figs. 1 and 2, the drum consists of a cylindrical portion **13A** having integrally formed spokes **13B** (Fig. 2) convergent in a hub section **13C** which is hollow and projects axially inward of the drum part, as in Figs. 4 and 5, the hub being reinforced by radial webs **13D** (Fig. 2).

On the outside periphery of the hub are ratchet or gear teeth **13E** (Figs. 4 and 7).

Surrounding the central hub projection, as in Figs. 4 and 7, is an annular ledge or ridge **13F** on the top or axially-facing rim of which are molded certain tri-level control cam formations **13G, 13H, 13J**.

The entire drum structure **13–13J** is a homogeneous entity molded with relatively thin wall thicknesses from a light-weight, translucent, viscose material such as that known in the trade under the proprietary name or trademark "Nylon."

The novel indicator mechanism includes mechanism for rotatively moving the numeral drum **13** intermittently in accurately gauged steps, as well as switch and commutating contact means for changing circuits for tens-transfer and other control purposes, as will appear.

Referring to Fig. 3, the drive means for advancing the drum accurately step-by-step includes a yoke-shaped lever **25** pivotally mounted on a stud **26** projecting through an elongated slot **27** at the end of the yoke stem. A traction spring **28** is anchored at one end to a lug **29** on the stem and has a looped opposite end **28A** which hooks onto the stud and serves to prevent escape of the yoke stem from its pivotal seat, the spring acting also to pull the yoke downwardly to a normal position at one end of its elongated pivot slot **27**.

Pivotally mounted near an end of one of the yoke arms on a pin **30** (Fig. 3) is a stroke or driving pawl **31**, the offset dog **32** of which is adapted to engage in the ratchet teeth **13E** on the drum hub successively to step the latter as a result of oscillation of the yoke lever.

A return spring **33** is anchored at one of its ends to a base-plate lug **34**, and at its opposite end hooks onto an ear **31A** on the stroke pawl and serves the dual purpose of pivoting the pawl to thrust the dog **32** against the ratchet teeth, and to pull the yoke lever toward the left (Fig. 3) into its normal position of rest.

Means for pivoting the yoke lever to the right into advanced position includes a solenoid **40** having a plunger **41** with an enlarged or bulbous inner end **42** serving as an outward stop for the plunger and as a sort of pivotal internal bearing means therefore so that the plunger in its outward position of Fig. 3 can rock downwardly.

Pivotally connected to the outer end of the driving solenoid plunger **41**, as at **43**, is a link **44** pivotally connecting with the end of the longer yoke arm.

Thus, when solenoid **40** is energized, plunger **41** moves toward the right in Fig. 3 and pulls the yoke to pivot in the same direction, during which movement the driving pawl dog **32** drops behind one of the ratchet teeth **13E**, and upon deenergization of the solenoid, the return spring **33** will restore the yoke and pawl in the opposite direction so that dog **32** will engage said ratchet tooth and advance the drum counter-clockwise (Figs. 3 and 4).

A dead-stop means is provided in the form of a stopping dog **47** at the end of the other yoke arm, this dog being pitched and positioned to fall ahead of another one of the ratchet teeth just as the yoke approaches the end of its (leftward) return and driving stroke to stop the drum abruptly.

As an incident to the aforesaid stopping action, the

driving pawl and its dog **32** will still be in motion at the moment the dead-stop dog **47** is engaged by a ratchet tooth, and these opposing forces are yieldably relieved by the spring **28** in response to a resultant upward lifting effort acting upon the yoke and permitted by the oversize slot **27**.

Thus, the overdrive on the yoke lever resulting from momentum and sudden stoppage is absorbed in the spring **28**, and the drum is abruptly stopped in precise register, for the purpose, among others, that the indicia or numerals on the drum may be accurately positioned relative to a window, sight-opening or like display location (not illustrated), and for the further accurate positioning of certain switch-operating and connecting means, as will appear.

The gain of the ratchet and drum is held by a holding dog **50** (Fig. 3) pivoted on a pin **51** on the base plate and urged by spring **52** to ride upon and drop behind the ratchet teeth as the drum is advanced in the manner aforesaid. The holding dog coacts with the dead-stop dog in precisely locating the drum in positions of arrest, it being possible to make the clearance between the stop dog **47** and teeth **13** in relation to the like clearance for the holding dog **50** quite close owing to the precise stoppage of the drum and automatic absorption of the resultant (and otherwise destructive) forces by the shiftable yoke and relief means **26, 27, 28**.

Drum-controlled switch means includes a cam lever **56** pivoted on pin **59** seated in lugs **60, 60A** on the base plate.

At one end of this lever is a cam roller **56A** positioned to ride upon the annular ledge **13F** of the drum hub to rock in response to change in levels of the cam formations **13G, 13H, 13J** (see Figs. 4 and 5).

The opposite end region **56B** of the cam lever is offset and bears (Fig. 5) against one of a set of successively closable spring switch-contact blades **61, 62, 63** (Figs. 3 and 5), the bias of which normally press against the the lever to cause the roller **56A** to bear lightly but positively upon the cam ledge, and to rise from or drop into the cam roots as presented, the roller upon rising from the deepest level in notch **13G** closing the switch blade **61** against its companion blade **62** to condition a reset circuit between numerals **1** and **9** while riding upon the level indicated at **13H**; and rising still higher to the level a **13J** at the ninth step or position to close contacts **62** and **63** to condition a tens-transfer circuit, as will appear.

A further circuit control means includes the provision of an etched or stencilled commutator means including (Fig. 3) an insulating panel **70** of offset shape secured to the base plate by screws **71** and having formed thereon, by any of several available processes, including photo-engraving, etching, metallic stencilling, and the like, a plurality of thin metallic conductor ribbons **74** terminating at one end in contact segments **75** concentric with the drum shaft **12**, and at their opposite ends in terminal posts **76**.

As depicted in Fig. 7, the inner axial end of the drum hub has a face upon which is mounted, as by screws **77**, a yoke-shaped spring contact wiper **78** having a pair of contact prongs **79, 80**, each positioned to press against the metallic commutator segments **75** on the contact plate **70**, the metal wiper **78** bridging each pair of segments engaged in its rotary travel, and cross-connecting certain pairs of the conductor ribbons **74** and connections to the appertaining terminal posts **76**.

The numerals on the drum are preferably applied by silk-screen process to produce an opaque field outlining the numerals, which will be sufficiently translucent, when a thin wall of particular viscose material suggested is used, to transmit light through such thin wall and clearly illuminate the numerals.

In Fig. 5 the opaquing layer is indicated sectionally at OP, and in this view, as well as in Fig. 1, this layer is also indicated superficially by stippling.

Trans-illumination of the drum is effected by a small

lamp **14** seated in a socket **16** (Fig. 1); and the socket in turn is attached to the end of a flat metal strip or arm **17** having a clip hook **18** formed at its opposite end. Between the hook and the socket there is formed an offset **19** defining a stop shoulder, which, together with the hook, forms a mounting seat dimensioned to receive and substantially embrace a narrowed complementary fragment **10X** of the base plate (as in Figs. 1 and 3), said base portion **10X** having a set of spaced offset lugs **21** situated to flank the clip portion of the socket strip or arm to prevent all lateral motion of said arm. The shell of the socket is electrically connected or grounded to the base plate through this mounting clip means.

As depicted in Figs. 1 and 2, the socket **16** has a spring metal contact lug **15** which projects to bear upon a terminal lug **22** carried on the insulating header **40A** of the driving solenoid.

In order to service the indicators for renewal of lamps **14**, it is not necessary to remove the drum **13**, it being merely required to slip the socket clip means **17—18** from the base part **10X** for the purpose, it being observed that no wires or other connections need be manipulated, since one electrical connection is broken upon separation of the metal socket clip from the metal base plate upon which it is grounded, and the remaining connection is similarly broken by withdrawal of the socket contact lug **15** from the solenoid header lug **22**; and connection of the lamp circuit is automatically restored upon reseating of the socket clip.

The socket strip **17** is of light, somewhat springy metal, as also are the contact lugs **15, 22**, by reason of which, together with the elongated, leverage-character of the arm **17**, the lamp **14** is somewhat resiliently supported to alleviate a substantial amount of objectionable shock otherwise resulting from the hammering of the solenoid plunger **41** in rapid action of the counter unit.

In the illustrative circuit shown in Fig. 8, closure of switch contacts **100** energizes the stepping solenoid **40X** via conductor **101** to advance the units-counting drum **13X** so that it displays the numeral "9," for example.

At this time, let it be assumed that another counter unit, for counting tens values, has its drum **13Y** standing at zero.

The switch-control hub-cam of the units drum **13X** at this time will present the highest cam level or rise **13JX** to condition the tens transfer circuit for operation upon the tenth counting step of drum **13X**, the cam roller **56AX** lodging upon said highest rise and causing switch-operating lever **56** to close both sets of contacts **61X—62X, 62X—63X** of the appertaining cam switch means, thus establishing a resetting circuit via conductors **101A, 102** to the motor-driven pulsing switch contacts **103**, which can be effectively connected to power by closure of the reset switch **104** to cause repetitious pulsing of the step coil **40X** so long as reset switch **104** is held closed or until the cam switch roller **56A** drops into the deepest cam notch **13GX**, corresponding to the zero indication of the drum, and at which position both sets of cam-switch contacts **61X—62X, 62X—63X**, will be opened.

The aforesaid closure of contacts **62X—63X** will set up a tens-transfer circuit from counting switch **100** via conductors **101A**, said contacts **62X—63X** closed, conductor **105** to the stepping coil **40Y** of the next or tens counting unit drum **13Y**.

The condition of Fig. 8 is that existing just before the units drum **13X** makes its tenth step (to indicate zero) and causes the tens unit to step to "1," so that the count will change from "9" to "10"; as soon as this occurs, the tens cam roller **56AY** will ride upon the long middle cam rise **13HX** and cause closure of its cam-switch contacts **61Y—62Y** connected to shunt conductors **102, 105** and thereby set up a reset circuit to pulsing contacts **103**, as previously described for the units counter.

From this juncture subsequent closures of the counting switch contacts **100** will cause the coil **40X** of the units

counter to be pulsed for each closure of the counting switch means **100**, it being recalled that during the count between zero and 9 the corresponding tens transfer switch contacts **62X—63X** are open, so that no counting pulses will be applied to the second coil **40Y** until the latter contacts again close at the next zero-reading position of drum **13X** and its integral switch cam.

Certain of the commutator contacts **75X** are shown connected to energize number-indicating lamps such as **120** associated with drum **13X**, and **122** associated with drum **13Y**. In the condition represented in Fig. 8, commutator contacts **75AX, 75BX**, for example, are connected by their respective etched leads **74AX, 74BX** to corresponding terminal posts **76AX, 76BX**, the latter in turn connecting to power at **118** and a terminal **119** of a lamp **120** corresponding to the number "9" being displayed by the drum, said lamp being energized by the hub contactor **78X** bridging the commutator contacts **75AX, 75BX**, as shown.

The "zero" lamp **122** for the tens unit is illustrated as energized at the time represented. It will be understood that a complete set of lamps for the numbers 0 to 9 for each drum or counter are not shown, but would be connected in like manner to those described; it being further contemplated that the commutator switch means could be connected to control desired instrumentalities or circuits other than the lamps **120, 122**, etc.

If it is desired to restore the counters to a zero-zero condition, the reset switch **104** is held closed and the motor-driven pulsing switch means **103** will pulse all of the stepping coils, e.g. **40X, 40Y** which are disposed between positions 1 to 9, until their respective cam-switch contacts **61X—62X, 61Y—62Y** open at zero position, as aforesaid.

The counting switch **100** and:or the reset switch **104** may be actuated manually or by any other suitable control means, as will be understood by those skilled in the art.

I claim:

1. A counting mechanism comprising a number wheel having a hub with ratchet teeth formed thereon; and stepping means including a yoke-shaped member with a stem extending therefrom, means including an elongated slot near the end of the stem and a pivot member therein pivotally mounting said member with said yoke straddling said hub, a stepping dog pivotally mounted on one side of the yoke to engage in said teeth, a spring urging said yoke away from said pivot in the direction of length of the latter, a dead-stop dog carried on the opposite side of said yoke from the stepping pawl, and means including a driving member and a yieldable device opposing the effort of said driving member to oscillate said yoke and step the drum to an arrested position determined by engagement of said dead-stop dog with one of said ratchet teeth, said elongated slot and yoke-urging spring providing yieldability for the stopping action of said dead-stop dog.

2. A display counter of the class described including a hollow one-piece drum bearing number indicia and having connected at one axial end thereof an integral hub disposed substantially within the drum and with a cylindrical surface concentric with the rotative axis of the drum and having integrally formed ratchet teeth on said surface, said hub having a surrounding integral ledge in which are formed cam surfaces; a base plate and spindle means carried thereby upstanding from the plane thereof and engaging in said hub to rotatably support the drum close to the plate; stationary electrical contact means carried on said base plate concentrically of said spindle means opposite an axial end of said hub; wiper contact means on said axial end of the hub engageable with said stationary contact means; electromechanical stepping mechanism on said base plate including driving-pawl means drivingly engageable with said ratchet teeth on the hub and disposed substantially entirely within said drum; a lever mounted on said base and including a cam follower riding said ledge and cam surfaces therein, a major portion of said lever being enclosed in the hollow of the drum; and switch means operated by said lever in accordance with the movements thereof effected by said cam surfaces, said electromechanical mechanism and said switch means being adapted for connection in a counting circuit.

3. In a display counter, a number drum of one-piece, light-weight, construction including an outer annulus with a cylindrical periphery, a central cylindrical hub member integrally joined to said outer annulus at an axial end of the latter; an annular ledge circumambient of, and integral with, said hub member and including at least one integral cam formation thereon; and said hub member having integral ratchet teeth formed on the cylindrical periphery thereof, the remaining axial end of said drum being open and the space between the annulus and the hub being substantially unobstructed to admit of access to operating means cooperable with said cam formation and with said teeth.

4. In a display counter of the class described, a display drum having a hub part of lesser diameter than the drum; spindle means engaged in said hub supporting the drum for rotative movement; ratchet teeth on said hub concentric of said spindle means; and stepping mechanism for the drum including a combination driving and dead-stop pawl means in the form of a forked member having a stem with a pair of forking arms projecting from one end thereof and an elongated slot spaced from said arms toward the other end of the stem and extending in the general direction in which said arms project; stationary stud means projecting into said slot providing a pivot for said pawl means and relative to which said stem can shift linearly lengthwise of said slot, said stud means being positioned relative to said hub part to position said forked member with said hub part between said projecting arms; a driving pawl mounted on one of said projecting arms; a dead-stop pawl on the other of said arms, said pawls being respectively engageable in said ratchet teeth responsive to oscillatory movement of said forked member relative to said stud; spring means urging said forked member lengthwise of said slot away from said hub part to a normal position determined by an end of the slot, said driving pawl and said dead-stop pawl being spaced in relation to each other and said hub part and ratchet teeth thereon such that said dead-stop pawl engages in the ratchet teeth near the end of the driving stroke of the driving pawl, and said spring means permits the forked member to yield and move toward the hub part during completion of said driving stroke whereby to relieve shock from the action of the dead-stop pawl; and means for oscillating the forked member as aforesaid.

5. Display counting mechanism including at least a first and a second number-displaying drum each of which includes an integral hub with ratchet teeth formed around the periphery thereof, and at least said first drum having integral cam formations adjoining an axial end of its hub; electromagnetic stepping mechanism for each drum and including a driving pawl operating in the ratchet teeth thereof; a counting circuit connected with said electromagnetic mechanism for stepping said drums in dependent counting relation in which the second drum displays the multiples of ten counted by the first drum to the limit of ten; supervisory switch means for each drum; a switch-operating lever for each of said drums and including a cam follower working in said cam formations thereof, said cam formations determining three positions for said levers, and said supervisory switch means having three operating conditions each corresponding to, and determined by, one of said lever positions; said switch means being connected in said circuit to disable said stepping mechanism for the second drum while the lever of the first drum is in the first two positions, and to connect the second stepping mechanism for operation by

said circuit when said first drum lever is in the third position; the first position of all levers corresponding to the display number zero on any drum; said second lever positions corresponding to the display of numbers including 1 to 8 thereof; said third positions corresponding to the display position of said drums for the number 9, and also being the tens transfer position; and a counting switch in said circuit normally connected for counting operation to energize said first stepping mechanism at each counting operation up to a count of nine, and further connected by said supervisory switch means of the first drum operated by the appertaining lever in the third position thereof to energize said second stepping mechanism only while said first drum stands in the position to display the number 9.

6. Mechanism as set forth in claim 5 further characterized by the provision of a resetting circuit for said drums and including a source of stepping pulses connected with a normally open reset switch; said supervisory switches of both drums respectively connecting their corresponding stepping mechanisms in said reset circuit with the reset switch when the appertaining switch-operating levers are in the second and third position.

7. In a ratchet stepping mechanism, a dead-stop ratchet drive comprising a revoluble ratchet gear, a yoke-shaped drive lever for said gear including opposite yoke arms joined by a bight and having a radial stem projecting from the bight radially away from the axis of rotation of said ratchet gear; a relief pivot means for the yoke including a fixed pivot for said stem located at one side of said axis; a radially-extensive slot on the stem engaging said pivot; a spring device urging the yoke radially away from said axis to a normal position; a first pawl means carried by one arm of the yoke engageable with said gear to step the latter responsive to oscillation of said pawl; and a second pawl means carried by the other arm of the yoke for engagement in the gear teeth to effect a dead-stop action thereon at a time during each said oscillation while said gear is in motion under influence of said first pawl means; and means for oscillating said drive lever, the latter being shiftable relative to said pivot responsive to stopping engagement of the second pawl with said ratchet teeth to relieve shock and wear on the ratchet gear and dead-stop pawl from stopping action.

8. In combination, a plastic ratchet gear and drive means therefore including a member having a drive pawl and a dead-stop pawl spaced therefrom for disposition at points on said gear which are approximately a quadrant apart; and a pivotal relief mounting for said member comprising a fixed pivot located at one side of the pivotal axis of said gear and in approximate triangular array with said pawls; said member having an elongated slot extending radially of said axis and in an approximate triangular array with said pawls and being engaged with said pivot; spring means acting on said member to urge the same to a normal position away from said axis, and means for oscillating said member to bring said pawls into engagement with the teeth of the ratchet gear to alternately step and stop the same, said member being yieldable

owing to action of said relief mounting to prevent damage and reduce wear on the plastic teeth arising from stopping action of the dead stop pawl, at least.

9. In a display counter of the class described, a one-piece number drum having a substantially hollow interior and an internally-contained hub with integrally formed ratchet teeth and a cam formation thereon, and adapted for cooperation with a stepping pawl drivingly engageable with said teeth, and a control member adapted to engage said cam formation for movement by the latter responsive to turning of the drum certain amounts, said hub being attached to the drum at one axial end of the latter whereby to leave the hollow interior part of the drum about said hub substantially unobstructed for entrance and cooperation of said pawl and control members with the ratchet and cam parts as aforesaid.

10. A dead-stop ratchet pawl mechanism comprising: a fork-shaped lever having approximately parallel opposite side arms projecting from a connecting part, a stem projecting from said connecting part in a direction oppositely away from said side arms, the latter each having a free end portion remote from said connecting part, means mounting said lever for both linear and oscillatory movement relative to a center located within the body of the lever, spring means urging said lever in a linear sense to a predetermined normal limit of linear displacement in a certain direction generally away from the direction of projection of the side arms; a first pawl member situated near the free end of a first one of said side arms; a second pawl member pivotally mounted near the free end of the second one of said side arms and projecting in a direction generally toward the opposite side of the lever at which the first side arm is located; and a third pawl member pivotally mounted at one side of said lever adjacent said second side arm to project in the same general direction as the second pawl member, each of said three pawl members having a ratchet-tooth engaging part and all three of the latter being situated so as to be radially located relative to a ratchet-wheel center situated between said side arms for cooperation with a rotatable ratchet wheel adapted to turn about said last mentioned center; and spring means urging said second and third pawl members into a normal operating position relative to said ratchet wheel center.

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