July 23, 1957 F. G. NICOLAUS 2,800,212

SHOCK AND VIBRATION-RESISTANT SWITCH

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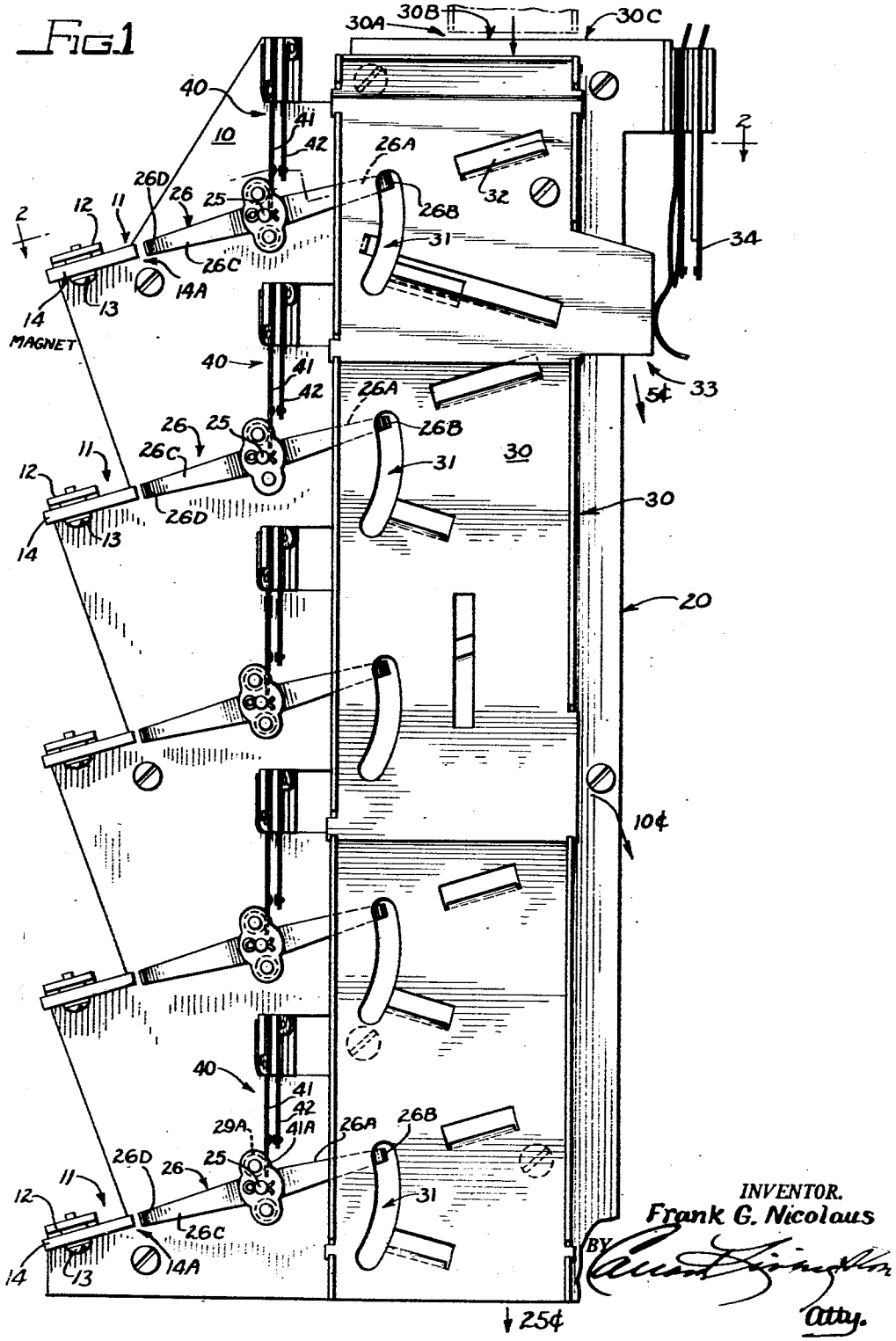
FIG. 1



INVENTOR.
Frank G. Nicolaus
BY
Atty.

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FIG. 2

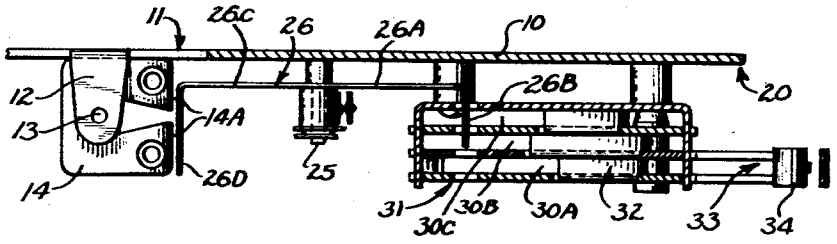


FIG. 3

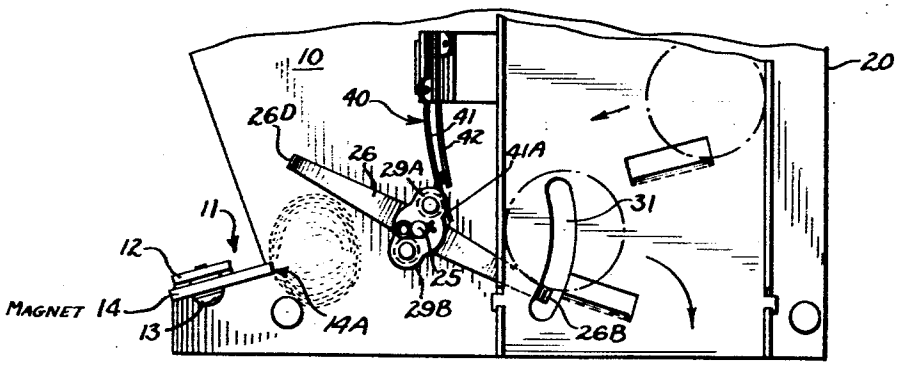
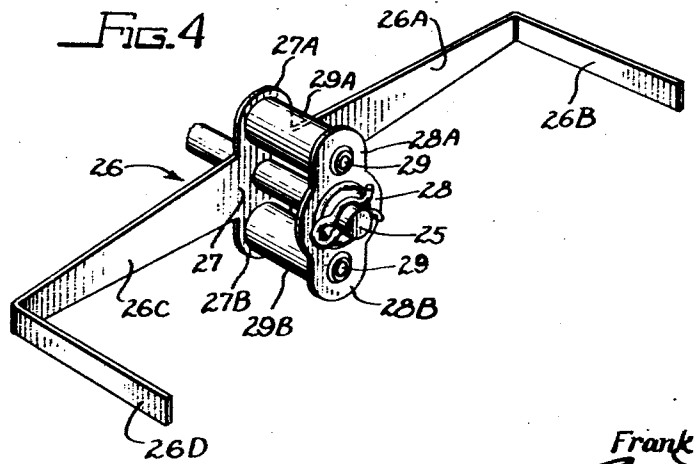


FIG. 4



INVENTOR.
Frank G. Nicolaus
BY
Atty.

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2,800,212

SHOCK AND VIBRATION-RESISTANT SWITCH

Frank G. Nicolaus, Chicago, Ill., assignor to Raymond T. Moloney, Chicago, Ill.

Application March 2, 1950, Serial No. 147,216

2 Claims. (Cl. 194—9)

This invention pertains to electric switches, and has as its principal object the provision of a vibration or shock-resistant switch especially suited for use in coin-controlled apparatus, and characterized by great stability in resistance to false or fraudulent operating forces arising from jarring, pounding, and analogous influences.

Another and more detailed object is the provision of a switch of the class described in which there is a pivoted switch-operating arm dynamically balanced so as to be resistant to shock-like displacing forces tending to impart pivotal movement to the arm.

Another object is the provision of a switch-operating formation near the pivot of the arm, and which formation is also part of the dynamic balance means.

Another object is the provision of a magnetic normalizing means for the switch-operating arm, and which is so situated and arranged with respect to the arm, its pivot, and its switch-operating and coin-operated aspects, as to assist in maintainance of the dynamic balance.

Additional aspects of novelty and utility reside in details of the construction and operation of the parts of the embodiment, as described hereinafter in view of the annexed drawings, in which:

Fig. 1 is a front elevation of a coin control chute employing a plurality of the novel switches;

Fig. 2 is a horizontal section taken along lines 2—2 of Fig. 1;

Fig. 3 is a fragmentary elevational detail of the chute showing one of the switches in coin-operated condition;

Fig. 4 is an enlarged perspective detail of one of the dynamically balanced, coin-displaced switch-operating arms.

Referring to Fig. 1, in which a plurality of the novel switches are employed in a multiple-coin control unit, the structure there depicted includes a main base or back plate **10** having a plurality of edgewise step formations **11** angled inwardly of the plate in a sense toward the opposite vertical side **20** thereof.

Each step has an offset flange **12** correspondingly appropriately angled to provide a magnet-mount, to which is secured, by bolt means **13**, a horseshoe permanent magnet **14** having its poles **14A** (see Fig. 2) facing inwardly of the plate and at an upward angle for purposes to appear.

Pivoted on pins **25**, each mounted on the back plate **10** in the line of the inclined plane of a corresponding magnet **14**, are switch-operating arms **26**, having forward portions **26A** respectively projecting into certain coin passages in a multi-channel chute structure generally indicated at **30**.

Each of said forward arm portions has a coin-engaged offset **26B** disposed in the path of a descending coin in the corresponding chute passage, arcuate side slots **31** being provided in the outer chute wall plates to accommodate said offsets.

Each of said operating arms also has an opposite portion **26C** projecting normally toward a corresponding magnet **14**, with an offset armature projection **26D** aligned before the pole faces **14A** of the corresponding magnet.

Associated with each switch-operating arm is a leaf-spring switch **40** appropriately mounted on the base plate so that the switch blades **41, 42** project in a transverse sense toward the corresponding arms and toward the

pivots **25** thereof, and cooperate with the operating arms in particulars hereinafter brought out.

In the general assembly shown in Fig. 1, it may be pointed out that the coin chute structure **30** includes (Fig. 2) three distinct passage sections into the entrances **30A, 30B, 30C**, of which are respectively directed five-cent, ten-cent, and twenty-five-cent coins, each traversing its own passage.

Accordingly, a five-cent coin would ordinarily be guided to engage the offset **26B** of the upper coin switch **40**, only; however, for purposes not relevant to the invention, and hence not detailed herein, the embodiment illustrated is arranged so that the coin offset **26B** of the uppermost switch **40** is spaced from the five-cent runway ledge **32** so that this coin misses said offset and travels out the sidewise exit **33** to operate a special five-cent switch **34** of ordinary construction.

However (Fig. 2), a ten-cent coin is guided into chute passage **30B** to engage the coin offsets **26B** of the two uppermost switches **40**; and a twenty-five cent coin is guided into chute passage **30C** to engage each coin offset **26B** of all five of the switches **40**.

Referring now to Fig. 4, the detailed construction of the dynamically balanced switch-operating arms **26** is shown to magnified scale to include a mid-portion **27** having oppositely projecting lateral wings **27A, 27B** flanking the pivot pin **25**; and a stud plate **28**, having the same configuration as said mid-portion and wings, is mounted on the arm in spaced relation to, and alignment with, said mid-portion by means of studs **29** and spacing collars **29A, 29B**, thereon, said studs being peened to secure the assembly rigidly.

The foregoing construction and assembly of the operating arm **26** and mid-portion means **27A,B—28A,B—29A,B**, flanking the pivot pin **25** constitutes a dynamic balancing means which affords practical stability within a non-critical range of manufacturing tolerances making possible volume production of these members **26**, it being observed, of course, that the armature and coin-offsets **26B, 26D** are calculated not to disturb the balance.

In the detailed view of Fig. 3, one of the coin-switch spring contact blades **41** has an extended end portion **41A** which rides on the periphery of the upper balancing collar **29A** to exert a turning moment on the arm **26**, which tends to normalize said arm by rotating it anti-clockwise to dispose and return the armature offset **26D** well into the field of force of magnet poles **14A** from the coin-operated condition shown in Fig. 3, the said armature offset **26D** being strongly, but yieldably held in full alignment with said pole faces **14A** in the normal, non-operated condition of the switches, as depicted in Figs. 1 and 2.

Apart from the effect of the magnets **14**, the switch-operating arms **26** tend to resist the effects of jarring, vibration, and like forces to rock the same; but this stability is agumented by the constant attractive force exerted by the associated magnet **14** along a line parallel with a longitudinal axis of the extensions **26A, 26C** through the pivotal axis at **25**; and such stability is further enhanced by the effort of the spring switch blade portion **41A** acting at a near-minimum on the arm at a point radially offset (i. e. on collar **29A**) from the pivotal axis thereof; near-minimum in this usage meaning that the switch-blade portion **41A** is preferably adjusted so that it is nearly in full normal, and hence non-tensioned or relaxed condition so as to exert only enough pressure on collar **29A** to remain positively in engagement therewith and yet exert a minimized turning effort on the arm in this normal condition.

Thus, switch-blade portion **41A** (as in the lower part of Fig. 1) is intended preferably, in normal condition, to exert a minimum effort on collar **29A** in a direction

toward the left; and it will appear from this view that the situation of the piovtal axis 25 of the arm, and the disposition of collar 29A, relative to the spring blade portion 41A, in this normal condition, is such that when the armature offset 26D is fully held in alignment with the pole pieces 14A, the collar 29A is disposed toward the left, or anticlockwise beyond a line through the center of the axis through pivot 25 and the normal, longitudinal (vertical) axis on the riding side or face of blade 41, so that any slight turning effort on arm 26 in an anti-clockwise direction will not be materially assisted by the switch blade, as the collar 29A tends to draw away therefrom in this direction; while a slight clockwise turning effort would tend to be resisted by the switch blade, and only the weight of a coin on the lever effects motion clockwise.

Anticlockwise displacement of the operating arm 26 is limited by engagement of the coin-offsets 26B with the ends of the associated chute-wall slots 31, there being, however, a slight clearance so that the armature offsets, in seating home in the magnetic field, will not bounce on said terminal portions of the arcuate slots 31.

The magnets 14, being held by a central screw and bushing means 13 in the bight of the horseshoe, are fully adjustable relative to said armature offsets.

In the prior art (e. g. U. S. Patents Nos. 2,442,174; 1,989,277; 1,798,854; 1,081,884) magnets have been variously used heretofore in combination with coin-operated and other types switches, but so far as is known, such prior arrangements have always utilized the magnetic effect with the polar axis or axes (in cases of horeshoe magnets) extending at an angle to the lever axis for the purpose of imparting a turning moment to the lever by forces acting more or less transversely of the long axis of the lever. Such arrangements also utilize the magnet, acting transversely as aforesaid to hold the lever in some normal position.

The polar axes of the magnets 14, it is important to observe, extend in approximate parallelism with the long axes of levers 26, such that when the latter are in normal position (Fig. 1), the long axis of any lever 26 is aligned with an axis projected through any pole piece or face, and there is a zero turning moment acting on the lever, the latter being in a state of both magnetic and mechanical equilibrium, it being recalled that the levers 26 are dynamically balanced, and the spring switch blades 41 are intended to remain in approximately relaxed condition so as to exert zero turning effort on collars 29A.

Should temperature changes and like conditions affect the switch and other parts unfavorably in this connection, the operation of the devices will not be noticeably affected, first, because the relative disposition of the pivots and application of the various turning forces (by magnet and switch blade) is contrived to minimize the effect of such changes; and, second, because the magnetic efficiency of the arrangement, with regard to the axial direction in which the magnetic field acts, is at a maximum to maintain magnetic equilibrium, regardless of whether the disturbing, turning moments arise from internal causes or from shocks, and pounding efforts to effect fraudulent operation of the switches.

Modifications of the specifically described structure are contemplated within the fair scope of the appended claims. Among other things, a bar magnet, axially aligned with the axis of the lever 26, may be used; or an electromagnet having similar polar alignment may be substituted. The armature structure at 26D may be modified in shape or may be an attachment; and the dynamic balance may be achieved in modified forms. And while the switch is especially suited for use in coin-controlled devices, it is also generally applicable where there are problems of vibration, shock or false operation, and in other applications to which the switch may be adapted; other forms of stop may be substituted for the terminal margins of the arcuate slot 31.

It is also possible to eliminate the armature offset 26D altogether, provided the elongated lever arm 26 is of magnetically attractable material, and the described polar and lever axis relations are maintained so that the magnetic field emanates in a polar sense toward or in substantial alignment with the axis through the lever and pivot thereof, so that the lever tends to align itself lengthwise with the magnetic axis to dispose an end region of the lever into the field of maximum flux density to resist turning efforts in either direction tending to withdraw said end from said field.

I claim:

1. In a switch of the class described, an elongated lever pivoted between its ends and having a magnetic portion at an end thereof, an eccentric switch-operating formation at the pivot of said lever, a switch including an operating member engageable with part of said eccentric formation for actuation responsive to pivoting of said lever, and magnetic means positioned opposite said magnetic portion on said lever to attract and yieldingly hold the same with said lever in a condition of normal pivotal balance against turning in either direction, said eccentric formation exerting a minimized force on said switch-operating member in said normal balance, said lever being pivotable from said normal condition to move said operating member and effect actuation of said switch, said lever being provided with a balanced pair of said eccentric formations on opposite sides of the pivotal axis therethrough, and said formations and the portions of said lever on opposite sides of said axis being of calculated weight to dynamically balance the lever when the same and said switch-operating member are in a predetermined normal position, inclusive of the first-mentioned normal condition, to render the lever in a normal condition of substantial dynamic balance against shock and vibration displacements, apart from, and inclusive of, the attractive effects of said magnetic means in normal position as aforesaid.

2. In a coin switch, an elongated lever arm of magnetically attractable material and having offsets at both ends, one offset affording an armature part, and the other affording a coin-engaging part, said arm having an enlarged hub part near its middle, a pivot extending through said hub part, a pair of dynamic balancing members on said hub part and flanking said pivot, a magnet opposite said armature part of the lever arm and having a polar axis aligned with the length of the lever arm and acting on the latter to center the same in a normal position of dynamic and magnetic balance, and switch means including an elongated spring arm to be actuated and projecting in a direction approximately radial to the pivot of said arm so as to lie closely at one side of a particular one of said balancing members in the normal position of said arm, and positioned to exert a substantially zero turning movement on the lever arm so as not to disturb said normal condition of balance, and means for guiding a coin transiently onto the coin engaging offset part of said lever in a direction to pivot the lever to move said particular balancing member against said spring arm and actuate the switch, and means for limiting the throw of said lever arm in either direction of pivotal movement thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

926,312	Baker	June 29, 1919
2,101,546	Johnson	Dec. 7, 1937
2,213,651	Hall	Sept. 3, 1940
2,260,992	Henry	Oct. 28, 1941
2,586,129	Wallin	Feb. 19, 1952

FOREIGN PATENTS

440,795	Great Britain	Jan. 6, 1936