

May 4, 1943.

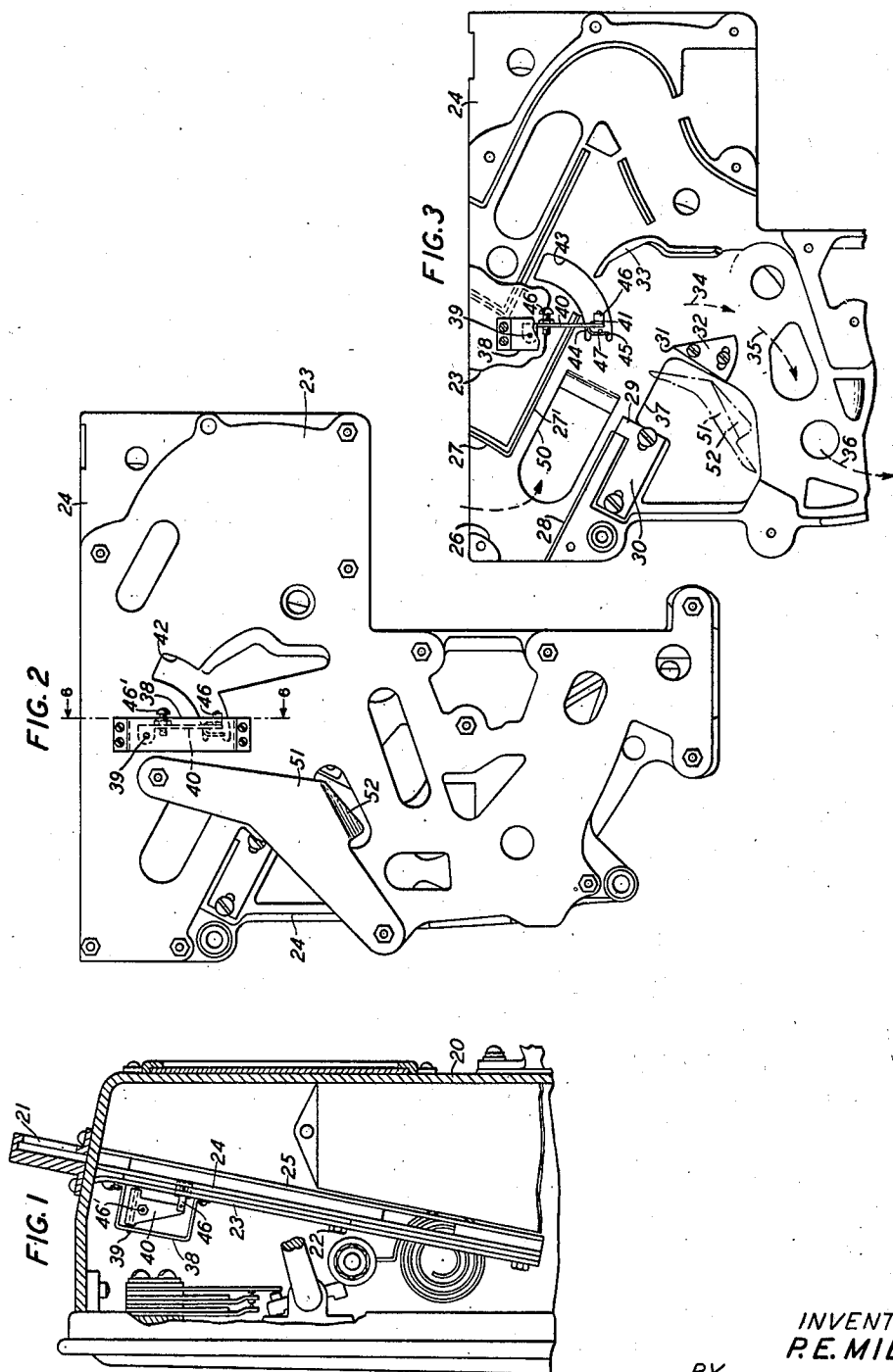
P. E. MILLS

2,318,410

COIN CHUTES

Filed Oct. 29, 1940

4 Sheets-Sheet 1



INVENTOR
P. E. MILLS
BY
T. H. Jackson
ATTORNEY

May 4, 1943.

P. E. MILLS

2,318,410

COIN CHUTES

Filed Oct. 29, 1940

4 Sheets-Sheet 2

FIG. 4

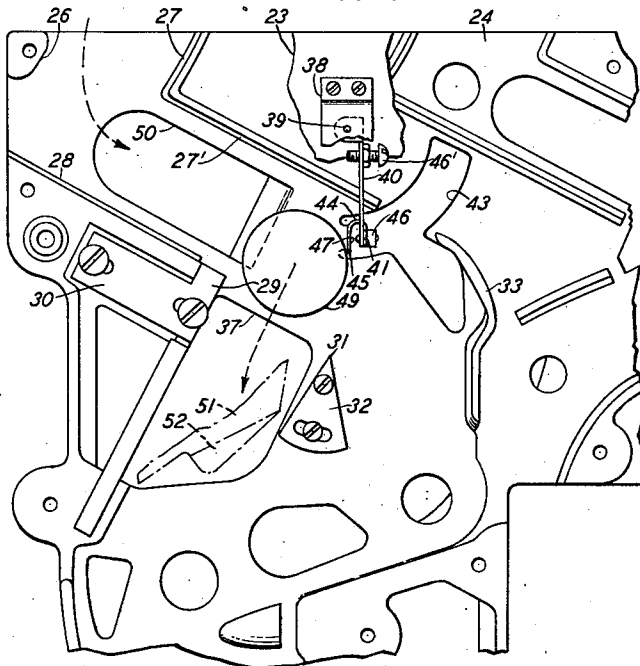
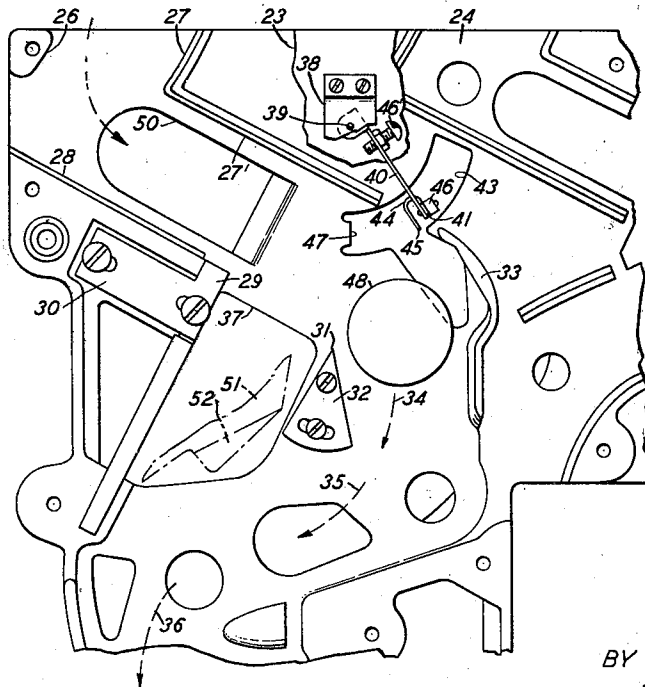


FIG. 5



INVENTOR
P. E. MILLS

BY

T. B. Jackson

ATTORNEY

May 4, 1943.

P. E. MILLS

2,318,410

COIN CHUTES

Filed Oct. 29, 1940

4 Sheets-Sheet 3

FIG. 6

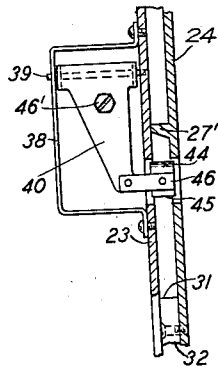


FIG. 7

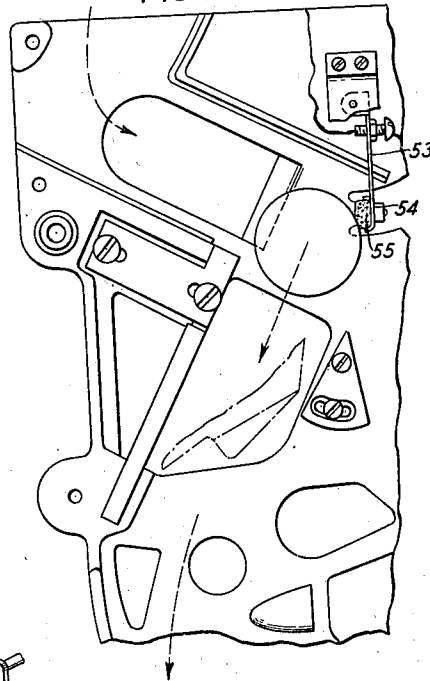


FIG. 8

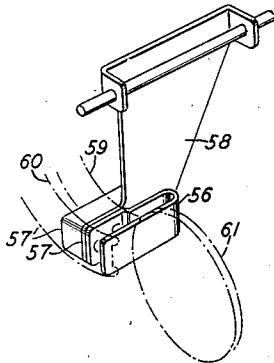


FIG. 9

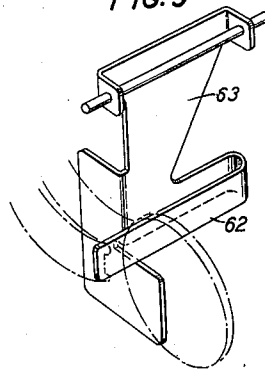


FIG. 10

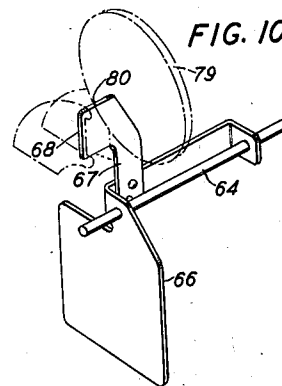


FIG. 11

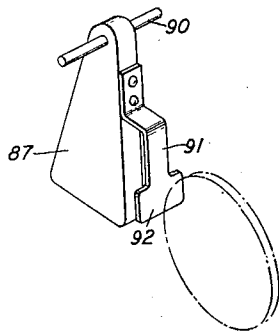
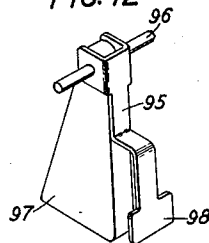


FIG. 12



INVENTOR
P. E. MILLS

BY *T. H. Jackson*
ATTORNEY

May 4, 1943.

P. E. MILLS

2,318,410

COIN CHUTES

Filed Oct. 29, 1940

4 Sheets-Sheet 4

FIG. 15

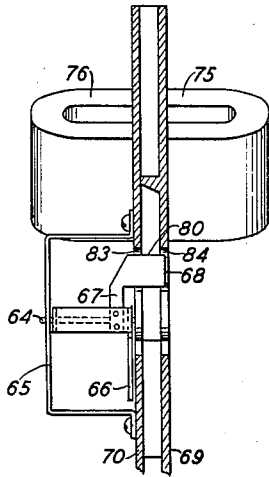


FIG. 13

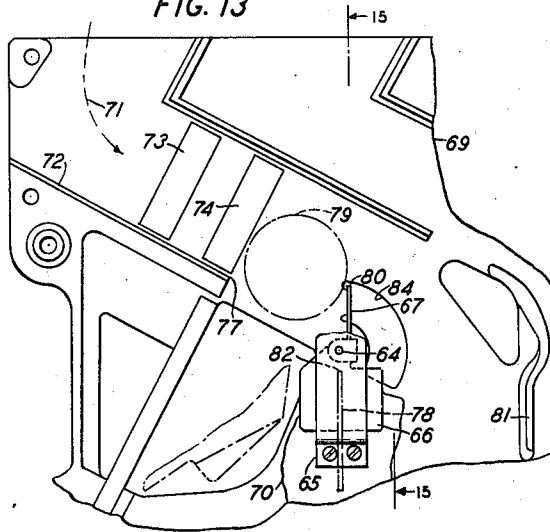


FIG. 16

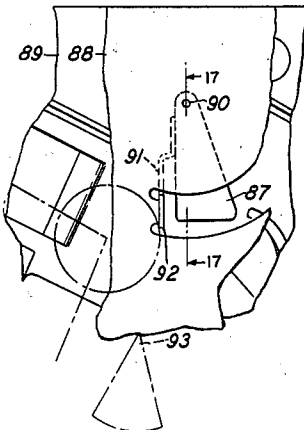


FIG. 14

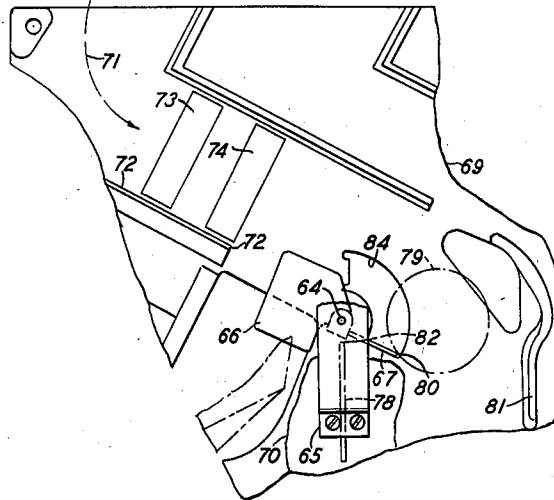
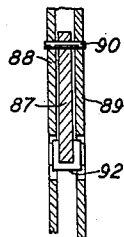


FIG. 17



INVENTOR
P. E. MILLS
BY
B. H. Jackson
ATTORNEY

UNITED STATES PATENT OFFICE

2,318,410

COIN CHUTE

Percy E. Mills, Towaco, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application October 29, 1940, Serial No. 363,236

5 Claims. (Cl. 194—103)

This invention relates to coin chutes, particularly to those intended for use in coin operated devices such as a telephone coin collector.

An object of the invention is to prevent the use of non-standard coins or slugs for fraudulently obtaining goods or services from coin controlled devices.

Swinging impactor devices have heretofore been proposed to prevent the acceptance of underweight slugs by causing the coins or slugs in traversing a coin chute to collide with a solid pendulum with the intent that the impact should produce changes in the velocities of the coins or slugs in accordance with their respective weights so that the resulting divergence in their trajectories would make possible the desired discrimination. For example, the bottom of the coin channel immediately preceding and below the pendulum may contain a gap so arranged that the momentum of a genuine coin is sufficient to permit the coin to leap the gap and continue on down the coin passage in spite of the loss incurred in knocking the pendulum out of the coin channel. A lightweight slug, however, in striking the pendulum will lose so much momentum that it will be unable to leap the gap and hence will be rejected through this opening.

The present invention is concerned with securing a sharper degree of selectivity between slugs and genuine coins than can be secured by the solid pendulum type of impact device previously described; where the improvement is secured by modifying the coin contacting portion of the swinging member in such a manner as to make the path of a coin or slug after impact substantially independent of the resilience of the coin or slug. If the coin contacting portion of the swinging member is of solid material the slugs will tend to bounce backward upon striking it, the amount of the rebound depending upon the resilience of the coin or slug and the shape of the surfaces which happen to come into contact. Since it has been found that genuine five-cent pieces are more resilient than most of the lightweight slugs encountered in coin operated devices, it follows that this reversing tendency will be greater for a genuine five-cent piece than for the usual slug thereby increasing the difficulty of satisfactory discrimination against lightweight slugs.

In accordance with the preferred form of this invention this resilience factor is substantially eliminated by providing an effective cushion as the coin contacting portion of the swinging member, which cushion may comprise a buffer spring to soften the coin impact.

Referring to the drawings,

Fig. 1 is a side view of the upper housing of

a coin collector employing a coin chute in accordance with the present invention;

Fig. 2 is a rear view of the coin chute of Fig. 1;

Fig. 3 is a view of the upper portion of the nickel channel disclosing one form of this invention as applied to the rejection of lightweight slugs from the nickel channel;

Fig. 4 is similar to Fig. 3 and discloses further the path taken by a lightweight slug deposited in the nickel channel;

Fig. 5 is similar to Fig. 4 except that it shows the path taken by a genuine nickel;

Fig. 6 is a view partly in section of the lightweight slug rejector and associated coin chute taken along the line 6—6 of Fig. 2;

Figs. 7 to 12, inclusive, disclose alternative forms of the cushioning device for the lightweight slug rejector;

Fig. 13 is a view of the upper portion of a coin channel in which the swinging member of Fig. 10 is employed to reject lightweight slugs, with the swinging member shown in its normal position;

Fig. 14 is similar to Fig. 13 except that the swinging member is shown in its coin operated position;

Fig. 15 is a sectional view of Fig. 13 taken along the line 15—15;

Fig. 16 is a view of the upper portion of a coin channel in which the swinging member of Fig. 12 is employed to reject lightweight slugs, with the swinging member shown in its normal position; and

Fig. 17 is a sectional view of Fig. 16 taken along the line 17—17 of Fig. 16.

Fig. 1 represents a side view partly in section of the upper housing of a telephone coin collector of the general type disclosed in the O. F. Forsberg United States Patent 1,043,219, issued November 5, 1912. The lower portion of the collector is not shown since the present invention is concerned with the coin chute usually located in the upper housing. Referring to Fig. 1, the upper housing 20 has the usual multiple coin gauge 21 into which nickels, dimes and quarters may be inserted after which the coins traverse individual channels in the laterally inclined coin chute 22 for selectively actuating a signaling device such as a gong or bell before reaching a coin hopper where the coins are held in suspense for subsequent collection or refund depending upon conditions occurring after coin deposit. The coin chute assembly comprises a cover plate 23, a nickel and dime channel plate 24 and a quarter channel plate 25 with the cover plate 23 on the upper side of the chute as assembled in the collector. A rear view of the chute assembly is shown in Fig. 2 while the upper portion of the nickel and dime channel plate 24 is shown in Fig. 3.

In these drawings the lightweight slug rejector of this invention is disclosed as forming a part of the nickel runway but it will be obvious that the invention is equally applicable to coin channels for coins of other denominations.

In Fig. 3 most of the cover plate 23 has been removed to expose the paths taken by a deposited dime or nickel in the upper portion of the channel plate 24. A nickel deposited in coin gauge 21 will drop down between retaining ledges 26, 27 to strike a longitudinally inclined rail 28 down which the coin will roll on its edge. Between bottom rail 28 and top rail 27' is located the usual opening 50 for the rejection of under-diameter slugs. At the lower end of rail 28 is located the pole-piece 29 of a permanent magnet 30 for retarding the speed of magnetic slugs to secure their rejection in the usual manner. Beyond pole-piece 29 is a gap extending between pole-piece 29 and the upper point 31 on a wedge-shaped divider 32. The path for a genuine coin is to the right of wedge 32 and is defined by the channel between wedge 32 and the curved retaining wall 33 so that a genuine coin after leaping gap 29-31 takes the path indicated by the series of dotted arrows 34, 35, 36. Any coin or slug which has insufficient velocity to leap over dividing point 31 will, of course, be diverted into the reject opening 37. An arrangement will now be described by means of which lightweight slugs may be diverted into reject opening 37 while still permitting a standard coin to pass into the acceptance channel 34, 35, 36.

Mounted on the cover plate 23 of the chute assembly is a bracket 38 for supporting a pin 39 lying perpendicular to the face of plate 23. This pin 39 (see Fig. 6) pivotally supports a downwardly extending member 40 having an arm 41 which extends laterally through an arcuate slot 42 (Fig. 2) in cover plate 23, across the nickel runway and partially into a corresponding arcuate slot 43 (Fig. 3) in the intermediate plate 24. Fastened to that part of arm 41 within the nickel runway is one branch of an inverted U-shaped spring 44, the free end 45 of which constitutes the coin contacting portion of swinging member 40. Spring 44 is preferably of negligible mass as compared to the mass of a standard coin. The normal position of member 40 is shown in Fig. 4 with spring arm 45 against the end wall 47 of slot 43. It will be apparent from Figs. 3 and 4 that the mass of member 40 should be such that a standard coin 48 after rolling down ledge 28 will strike buffer spring 44 with sufficient force to move member 40 to an advanced position such as in Fig. 5 with the coin 48 still retaining sufficient velocity after this impact to pass to the right of dividing point 31 and into the acceptance channel indicated by arrows 34, 35, 36. On the other hand, any lightweight slug such as slug 49 of Fig. 4 which after impact with buffer spring 44 has insufficient forward velocity to pass to the right of point 31 will, of course, be rejected by being diverted into reject opening 37. The impact device 40, therefore, serves to reject through opening 37 any coin or slug of a weight substantially less than that of a standard coin and as will be explained later this rejection of lightweight slugs is made substantially independent of the resilience of the slug material by the use of the buffer spring 44.

As shown in Fig. 4, for example, the coin contacting portion of buffer spring 44 is preferably spaced from the adjacent edge of the pole-piece of magnet 29 a distance somewhat greater than

the diameter of a standard coin. Any slug diverted into reject opening 37 is positively guided out of the chute assembly by means of a bracket 51 mounted on the cover plate, which bracket 51 has an inwardly turned lip 52 projecting across plates 23, 24 at the lower edge of opening 37.

In a swinging member, such as member 40, the best performance will be obtained when its effective mass (measured at a distance from its pivot equal to the distance between the pivot and the point of coin impact on the buffer spring 44) is substantially equal to the mass of the standard coin to be accepted by member 40 and when the greater part of the actual mass is concentrated directly behind the point of coin impact. Member 40 is shown with a concentrated mass 46 directly behind the point of coin impact. The threaded bolt 46' mounted on member 40 adjacent the pivoting axis is used as an adjustable counterweight to bias swinging member 40 to its desired normal position.

The advantages of employing a buffer spring on the coin impactor as compared to having the coin strike a solid pendulum may be more fully understood by the following theoretical considerations.

As given on page 272 of "Mechanics" by W. F. Osgood (published in 1937 by the Macmillan Company) the commonly accepted formula for the resultant velocity of a body following its direct impact with another body is as follows:

$$v_1 = \frac{(m_1 - em_2)u_1 + (1+e)m_2u_2}{m_1 + m_2} \quad (1)$$

where m_1 represents the mass of the striking body (such as coin or slug) having a velocity u_1 before impact and a velocity v_1 after impact; where m_2 represents the mass of the struck body (the swinging impactor) having a velocity u_2 before impact; and where the factor e is the coefficient of restitution for the particular two bodies in impact, which factor will vary in value from unity for the ideal case of perfectly elastic bodies to zero for the ideal case of fully inelastic bodies.

In the device under consideration the swinging impactor m_2 can be assumed to be at rest before impact so that its initial velocity u_2 is equal to zero thereby simplifying Equation 1 as follows:

$$v_1 = \frac{(m_1 - em_2)u_1}{m_1 + m_2} \quad (2)$$

Since the device is to be used with coins or slugs having various values of mass, m_1 , which collide in turn with the same impactor m_2 , it is desirable to rewrite (2) in terms of the ratio of the mass m_1 to the mass m_2 . Let

$$R = \frac{m_1}{m_2}; \text{ or } m_1 = Rm_2 \quad (3)$$

By use of the relation (3) in Equation 2 the expression for the velocity of the coin after impact becomes

$$v_1 = \frac{R - e}{R + 1} u_1 \quad (4)$$

From a study of Equation 4 it will be apparent that the different resultant velocities which are counted on for discrimination purposes will depend not only on the relative weights of the coins or slugs through the factor R , but also on their relative degrees of elasticity through the factor e .

For example, let us assume that a certain impactor is made with the same mass as a standard United States five-cent coin, so that with

the standard five-cent coin the ratio $R=1$, and further assume that the impactor is of such a material that, in impact with a United States five-cent coin the coefficient of restitution $e=0.7$. Then the resultant velocity of the five-cent coin after impact will be from Equation 4

$$v_1 = \frac{1-0.7}{1+1} u_1 = 0.15 u_1 \quad (5)$$

That is, its resultant velocity will be 0.15 times its initial velocity.

Now, if we assume the same impactor to be struck by a slug having a mass only 60 per cent of the mass of the impactor but with the slug made of a softer material so that its coefficient of restitution e , in collision with the impactor, is only 0.36 then the velocity of the slug after impact will be from Equation 4

$$v_1 = \frac{0.6-0.36}{0.6+1} u_1 = 0.15 u_1 \quad (6)$$

Since the resultant velocity for this slug is the same as the resultant velocity for the five-cent coin, it is obvious that the lighter slug will have the same trajectory after impact as the nickel and, therefore, can not be discriminated against by any means dependent upon this trajectory. By the same reasoning it follows that still lighter slugs would be accepted the same as a nickel in the event that they were soft enough to have still lower values for the factor e .

Now, if the assumed coin impactor is modified so that a resilient spring of relatively negligible mass is interposed between the coins or slugs and the swinging mass, the expression (4) will still apply except that the elasticity of the coins or slugs will no longer be of moment; and the factor e now represents the equivalent coefficient of restitution of the spring; and for the spring this coefficient will be almost equal to unity since the internal losses in the spring will be quite small.

Assuming a factor $e=0.9$ for the spring in the modified impactor, in the example under consideration the velocity of a five-cent piece after impact will now be (from Equation 4)

$$v_1 = \frac{1-0.9}{1+1} u_1 = 0.05 u_1 \quad (7)$$

or the final velocity for the nickel is .05 times its initial velocity.

For the previously assumed softer slug with 60 per cent of the mass of the five-cent coin or of the impactor, the resultant velocity will now be

$$v_1 = \frac{0.6-0.9}{0.6+1} u_1 = -0.19 \quad (8)$$

so that the lightweight slug after impact is traveling in the opposite direction to that taken by the nickel after impact and at a velocity of 0.19 times its initial velocity.

In the case under consideration it will be seen that for all slugs whose mass is less than 90 per cent of the mass of the impactor ($R<0.9$), the resultant velocity will always be negative and the reversal of travel must occur regardless of the nature of the material of which these slugs are made. Moreover, the acceptance of such slugs cannot be forced by merely increasing their initial velocity, u_1 , because although the resultant velocity, v_1 , would undoubtedly be increased, the direction of travel would still be reversed, thus insuring that these faster moving light slugs would also be projected toward the reject side of the discriminating point.

From the above explanation it is apparent that by having the coins or slugs strike a light flexible spring 44 fastened to the swinging weight 40 the device functions to reject lightweight slugs in a manner substantially independent of the material of which they are made.

In order to prevent the resilience of a coin or slug from being a factor in its acceptance or rejection the buffer spring 44 may be replaced by alternative arrangements such as shown in Fig. 7 where the swinging mass 53 is similar to pendulum 40 of the previous figures except that its lateral arm 54 supports within the coin runway a block 55 of soft rubber which serves as a cushion to receive the impact of a deposited coin or slug. Except for this substitution the lightweight slug rejector of Fig. 7 is similar to that of the earlier figures.

A further modification of the lightweight slug rejector is shown in Fig. 8 where the device is substantially identical with that of Fig. 6 except that the U-shaped buffer spring 56 is mounted horizontally instead of vertically on the lateral arm 57 of swinging member 58. The dotted lines 59, 60 indicate the arcuate slots in the cover plate and nickel plate respectively, while the coin or slug 61 is shown in its position of impact with the free end of spring 56. The swinging member 58 may be mounted on the cover plate by a suitable bracket in substantially the same manner as member 40 of Fig. 6. If desired, member 58, similar to pendulum 40, may have a concentrated mass 57' located behind the region of coin impact, with the effective mass of member 58 being substantially equal to the mass of a standard coin by which it is to be operated.

The lightweight slug rejector of Fig. 9 is of substantially the same construction as that of Fig. 8 except that the buffer spring 62 constitutes an integral part of the swinging member 63 and that the only portion of the member 63 projecting into the coin runway is the free outer end of spring arm 62.

Figs. 10, 13, 14 and 15 represent a further modification in which the pivoting pin 64 for the swinging member is mounted below rather than above the path traversed by a genuine coin. Pin 64 is supported by a suitable bracket 65 and the swinging member 66 pivotally mounted about pin 64 has an upwardly extending arm 67 of resilient sheet metal with a laterally extending portion 68 located in the coin runway between the channel plate 69 and cover plate 70 in such a position as to be struck by genuine coins or slugs.

In the coin chute of Fig. 13 the swinging member 66 assists in the rejection of metal slugs having an electrical conductivity greater than that of a standard coin as well as assisting in the rejection of slugs of other non-standard characteristics. As in the earlier figures, most of the cover plate 70 has been removed in Fig. 13 to expose the coin channel. A deposited nickel or slug enters the coin chute as indicated by arrow 71 and rolls down the longitudinally inclined ledge 72. Channel plate 69 has slots 73, 74 for receiving the poles of a horseshoe magnet 75 and cover plate 70 has similar slots for receiving the poles of another horseshoe magnet 76 whereby these eddy current magnets 75, 76 will exert a retarding force on the coins and slugs of an amount dependent upon their electrical conductivity. Slugs having a higher electrical conductivity than a nickel will be retarded more than a nickel so that a nickel in leaping the gap between ledge end 77 and dividing wall 78 will fol-

low a higher trajectory than slugs of higher conductivity. The arrangement is preferably such that a nickel 79 will strike arm portion 68 near its upper edge 80 with sufficient momentum to rotate member 66 from its position of Fig. 13 to its tilted position of Fig. 14 whereby the coin rolls off the upper edge 80 of arm 68 and proceeds on down the acceptance channel defined by the ledges 78, 81. It will be noted that the upper end 82 of dividing wall 78 lies immediately below the pivoting pin 64. As shown in Fig. 15 arm portion 68 extends through an arcuate slot 83 in cover plate 70 across the coin channel and partially into a corresponding arcuate slot 84 in channel plate 69.

If a slug is deposited having the same mass as a standard nickel but of higher conductivity, it follows that the speed of such a slug will be retarded by the eddy current magnets more than a nickel, will traverse a lower trajectory than a nickel, will strike arm 68 nearer the pivoting axis 64, will be unable to rotate member 66 to an extent sufficient to roll over arm 68 into acceptance channel 78, 81 and hence will be diverted back into gap 77, 82 for rejection. That is, the swinging weight 66 of Fig. 13 has the additional advantage that the acceptance or rejection of a given slug or coin will depend not only upon the momentum of a slug on impact with arm 68 but will also depend upon the distance between the pivoting axis 64 and the point on arm 68 where impact is made.

The distance between ledge end 77 and arm 68 in its normal position (Fig. 13) is preferably greater than the diameter of a standard coin whereby any deposited lightweight slug having insufficient momentum to cause any appreciable movement of arm 68 will be free to fall back into gap 77, 82. It will be obvious that in the full operated position of member 66 (Fig. 14) the distance between wall 81 and the upper edge 80 of vane arm 68 should be substantially greater than the diameter of a standard coin to permit the coin to freely fall into the acceptance channel 78, 81 and permit member 66 to be restored by gravity to its normal position of Fig. 13.

It will also be apparent that the inverted type of swinging member 66 of Figs. 13 and 15 will also serve as a lightweight slug rejector in addition to its above-described use in an eddy current type of coin selector. Thus, if there is deposited in channel 72 a slug whose electrical conductivity is substantially the same as a standard coin, but whose mass is substantially less than a standard coin, it follows from the previous description that such a lightweight slug will not be able to rotate member 66 far enough from its normal position to permit the slug to roll over arm 68 into the acceptance channel 78, 81 and hence will fall back into gap 77, 82 for rejection. Since arm 68 is flexible, it also follows that arm 68 acts as a cushioning spring between the swinging weight 66 and the deposited coin or slug in the same manner as previously described for spring 44 (Fig. 3); that is, the flexibility of arm 68 improves the discrimination obtainable between a genuine coin and lightweight slugs, since arm 68, by reason of its flexibility, serves to make acceptance or rejection substantially independent of the coefficient of restitution of any deposited coin or slug.

In the forms of the invention so far described the major portion of the swinging member has been located outside the path of coin travel. However, in Figs. 11, 12, 16 and 17 the swinging

members are of a type which may be located substantially entirely in the coin runway. Referring to the modification shown in Figs. 11, 16 and 17, the swinging weight 87 is mounted between the cover plate 88 and the nickel channel plate 89 with the weight 87 pivotally supported on a pin 90 passing between plates 88 and 89. Fastened on the coin receiving side of member 87 is a spring 91 bent to space its lower enlarged portion 92 away from the adjacent face of member 87. A genuine coin upon striking spring portion 92 will have sufficient momentum to permit the coin to pass to the right of dividing point 93 into the acceptance channel while a lightweight slug after impact with spring 91 will be diverted back to the left of point 93 into a reject opening similar to opening 37 of Fig. 3. The enlarged spring portion 92 is preferably of a width sufficient to partially enter the arcuate slots 88, 89 in the cover plate and nickel channel plate as seen in Fig. 17.

The form of the invention shown in Fig. 12 is similar to that of Fig. 11 except that the buffer spring 95 is pivoted on the same pin 96 as the swinging weight 97 with its coin contacting portion 98 spaced away from mass 97 in the same manner as portion 92 of Fig. 11.

The present invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential character of the invention; and the embodiments described above should, therefore, be considered in all respects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

What is claimed is:

1. In a coin operated device, a downwardly inclined coin runway down which a deposited coin rolls on its edge until the lower end of the runway is reached, a substantially rigid pivoted member adjacent the lower end of said runway, cushioning means mounted for rotation with said member for transferring momentum to said member from a coin discharged from said runway, said cushioning means being normally positioned in the path of a standard coin and a lightweight slug discharged from said runway to receive directly the impact of the standard coin and lightweight slug discharged from said runway for rotating said member about its pivoting axis a greater amount when said means is engaged by a standard coin than when engaged by a lightweight slug, whereby the trajectory of the standard coin after impact is substantially different from the trajectory of a lightweight slug after impact and the velocity of a lightweight slug after impact is substantially independent of the resilience of the slug material, an acceptance channel for receiving a standard coin after impact with said cushioning means and a reject channel for receiving said lightweight slug after impact with said cushioning means.

2. A coin operated device in accordance with claim 1 in which the effective mass of said member is of the same order of magnitude as the mass of a standard coin and said cushioning means is of negligible mass compared to the effective mass of said member.

3. A coin operated device in accordance with claim 1 in which said cushioning means comprises a U-shaped spring of negligible mass, one branch of said spring being fastened to said member, the other branch of said spring being nor-

mally positioned for engagement by a standard coin or lightweight slug discharged from said runway.

4. In a coin operated device, a coin runway having opposed side walls and a downwardly inclined bottom wall down which a deposited coin rolls on its edge, a substantially rigid pivoted member mounted adjacent the lower end of said runway and having its main body portion external to said side walls, one of said side walls adjacent said runway having an arcuate slot, said member having an arm projecting through said slot and across the space between said side walls, said arm having a resilient spring portion located between said side walls and normally positioned to receive the impact of standard coins and lightweight slugs discharged from said runway for rotating said member about its pivoting axis a greater amount when said spring portion is struck by a standard coin than when said spring portion is struck by a lightweight slug whereby the trajectory of a standard coin after impact is substantially different from the trajectory of a lightweight slug after impact, and the velocity of a lightweight slug after impact is substantially independent of the resilience of the slug material, a reject channel for receiving a lightweight slug after impact with said spring portion and an acceptance channel for receiving said standard coin after impact with said spring portion.

5. In a coin operated device, a downwardly inclined coin runway down which a deposited coin rolls on its edge until the lower end of the runway is reached, a stiff pendulum pivotally mounted for rotation adjacent the lower end of said runway and having an effective mass of the same order of magnitude as the mass of a standard coin for said runway, said pendulum having a coin engaging portion of resilient material and negligible mass normally positioned beyond the lower end of said runway for direct engagement by a standard coin and by a lightweight slug discharged from said runway for rotating said pendulum about its pivoting axis a greater amount when said arm is engaged by a standard coin than when engaged by a lightweight slug, whereby the trajectory of a standard coin after impact is substantially different from the trajectory of a lightweight slug after impact and the velocity of a lightweight slug after impact is substantially independent of the resilience of the slug material, an acceptance channel for receiving said standard coin after impact with said resilient portion and a reject channel for receiving said lightweight slug after impact with said resilient portion, a substantial portion of the actual mass of said pendulum being concentrated behind the point of coin impact on said resilient portion.

PERCY E. MILLS.