ENERGY ABSORBING DEVICE FOR COIN HANDLING MECHANISMS AND THE LIKE

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In a coin handling mechanism or similar apparatus a device for absorbing some or substantially all of the kinetic energy of a coin moving through the mechanism includes a coin strike plate mounted on a first cushion of soft rubber, mounted in turn on a bracket member coupled to the mechanism by a second cushion of soft rubber.

8 Claims, 7 Drawing Figures
ENERGY ABSORBING DEVICE FOR COIN HANDLING MECHANISMS AND THE LIKE

This invention relates to devices for absorbing some or substantially all of the kinetic energy of a coin in a coin handling mechanism.

There are a number of types of coin handling mechanisms in which a coin, token, or similar metal article (herein referred to as a "coin") is guided through the mechanism rolling or sliding on its edge or sliding on one of its faces. Examples of this type of mechanism are the devices used in coin operated vending machines to identify and authenticate a coin deposited in the machine. In many of these coin handling mechanisms the path followed by the coin is quite serpentine, involving several abrupt changes of coin direction. Along any leg of this path, the coin may be subjected to tests (e.g., tests of coin genuineness) which depend on accurate positioning of the coin. The coin may also be required to drop from one leg of the path to another and then continue along the second leg with a minimum of coin bouncing. At many places in these mechanisms, particularly where falling coins must be intercepted or changes of coin direction effected, devices for absorbing the kinetic energy of a coin are required.

In general, the efficiency of a coin handling mechanism depends on how rapidly coins can be processed by the mechanism. Thus it is desirable to be able to move coins through the mechanism at relatively high velocities. On the other hand, as the coin velocities involved are increased, the coins possess more kinetic energy and it becomes more difficult to change coin direction without vibration and bouncing.

Efficiency also dictates that an energy absorbing device for use in mechanisms of this type not unduly delay the progress of a coin through the mechanism. Even though the energy absorbing device may be required to bring a coin to a complete stop (e.g., in reversing coin direction), this stop should only be momentary.

Many coin handling mechanisms are required to handle several different coin denominations in a coin set, processing all of these coins at least partly along a common path. The coins to be processed may vary considerably in diameter, thickness, mass, elasticity, etc. However, the energy absorbing devices (at least those along the portion of the path followed by all coins) must efficiently absorb the kinetic energy of all the coins to be processed.

It is therefore an object of this invention to provide an energy absorbing device for use in coin handling mechanisms which efficiently absorbs some or substantially all of the kinetic energy of a coin moving through the mechanism.

It is another object of the invention to provide an energy absorbing device for use in a coin handling mechanism which is effective to absorb the kinetic energy of coins varying widely in diameter, thickness, mass, elasticity, etc.

These and other objects of the invention are accomplished in accordance with the principles of the invention by an energy absorbing device comprising a coin strike plate of relatively hard, stiff, or rigid material mounted on a layer of relatively soft elastic material, which is mounted in turn on a second mem2 or of hard material coupled to a wall or frame of the coin handling mechanism by a second layer of relatively soft elastic material. The second relatively stiff member is conveniently made in the form of an L-shaped bracket to facilitate mounting the energy absorbing device on a wall of the coin mechanism. The various components of the device can be designed so that the device closely matches the characteristics of a wide variety of coins under a wide variety of conditions.

Further features of the invention, its nature and various advantages will be more apparent upon consideration of the attached drawing and the following detailed description of the invention.

In the drawings:

FIG. 1 is an elevational view partly broken away of a coin handling mechanism in which energy absorbing devices constructed in accordance with the principles of this invention are employed:

FIG. 2 is a sectional view taken along the line 2—2 in FIG. 1 showing in detail one of the energy absorbing devices constructed in accordance with the principles of this invention;

FIG. 3 is a front view of the energy absorbing device of FIG. 2;

FIG. 4 is a schematic diagram of an approximate dynamic mechanical equivalent of an energy absorbing device constructed in accordance with the principles of this invention;

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 1 showing a second energy absorbing device constructed in accordance with the principles of this invention;

FIG. 6 is a front view of the energy absorbing device of FIG. 5; and

FIG. 7 is a sectional view taken along the line 7—7 in FIG. 1 showing a third energy absorbing device constructed in accordance with the principles of this invention.

The figures are intended to be representational and are not necessarily drawn to scale.

Throughout this specification the term coin is intended to mean genuine coins, tokens, counterfeit coins, slugs, washers, and any other item which may be used by persons in an attempt to use coin-operated devices.

FIG. 1 shows part of a coin mechanism 10 for use in identifying and authenticating coins of any of several denominations in a coin set (e.g., the United States 5-, 10-, and 25-cent coins) as is required, for example, in a coin-operated vending machine.

Although a coin moves through the coin mechanism of FIG. 1 primarily by rolling on its edge along a succession of coin tracks, it will be understood that the principles of these inventions are equally applicable to absorbing the kinetic energy of coins and similar articles in many different modes of motion (e.g., sliding on an edge or face).

In the coin mechanism of FIG. 1, a coin enters the mechanism through coin entry 12. The coin drops onto coin track 14 between sidewalks 16 and 18 and rolls down the coin track on its edge under the influence of gravity. Sidewalls 16 and 18 are parallel plates spaced apart at least the thickness of the thickest coin to be processed by the apparatus (e.g., the United States 5-cent coin). If desired, sidewalks 16 and 18 may be tilted slightly from the vertical so that the face of a coin rolling down coin track 14 (and later coin track 22) bears on front sidewalk 16.

At the end of coin track 14, the coin drops edge first onto energy absorbing device 20 and then rolls down
coin track 22 between sidewalls 16 and 18 past a plurality of devices 24, 26, and 28 which test the coin to determine its authenticity and denomination (e.g., by electromagnetically sensing properties of the coin). Energy absorbing device 20 is constructed in accordance with the principles of this invention to absorb all or substantially all of the kinetic energy of any acceptable coin in the coin set (e.g., genuine 5-, 10-, and 25-cent coins) which drops onto it from the end of coin track 14. In this way a coin is effectively brought to rest on the top surface of energy absorbing device 20 and then begins to roll down coin track 22 with little if any bouncing. Since the tests performed by sensors 24, 26, and 28 may be quite sensitive to the location of coins relative to the sensors, it is very important that the motion of a coin past the sensors be sliding or rolling motion rather than bouncing motion.

As shown in greater detail in FIGS. 2 and 3, energy absorbing device 20 includes a coin strike plate 30 of relatively hard or stiff material (e.g., a thermoplastic polyester material such as glass fiber reinforced Valox 420 available from the General Electric Company) mounted on a cushion or pad 32 of relatively soft elastic material (e.g., neoprene rubber having a durometer rating in the range from 55 to 60.) Pad 32, in turn, is mounted on one leg of L-shaped bracket 34 of relatively hard material such as Valox. The other leg of bracket 34 is secured to sidewall 18 by a second cushion or pad 36 of soft elastic material such as neoprene rubber of the type described above. The various elements of device 20 are held together and to sidewall 18 by any suitable adhesive material. Plate 30, pad 32, and the associated leg of bracket 34 project through sidewall 18 at a somewhat enlarged aperture 38. Elements 30 and 32, and the associated leg of bracket 34 span the coin passageway between sidewalls 16 and 18 and fit loosely into slot 40 in sidewall 16. In this way energy absorbing device 20 is restrained only by pad 36 and is free to deflect when struck by a coin.

FIG. 4 is a schematic diagram of an approximate, lumped-parameter dynamic mechanical equivalent of energy absorbing device 20, which is typical of energy absorbing devices constructed in accordance with the principles of this invention. Mass $m_1$ represents the relative mass of strike plate 30, spring $k_1$ and dashpot $b_1$ represent the elastic and energy absorbing or energy dissipating properties of pad 32. Similarly mass $m_2$ represents the relatively large mass of bracket 34, and spring $k_2$ and dashpot $b_2$ represent the elastic and energy absorbing properties of pad 36. By comparison with pads 32 and 36, plate 30 and bracket 34 can be assumed to contribute relatively little to $k_1$, $b_1$, $k_2$, or $b_2$. To insure that this will in fact be the case, plate 30 and bracket 34 are preferably a "dead" material, i.e., a material having heavy internal damping. The glass fibers in glass fiber reinforced Valox 420, for example, provide such internal damping. Similarly, pads 32 and 36 can be assumed to contribute relatively little to $m_1$ and $m_2$.

The model of FIG. 4 serves to illustrate that there are a fairly large number of parameters in the design of energy absorbing devices constructed in accordance with the principles of this invention, and also that each element of an assembled energy absorbing device determines only one or at most two of these design parameters. Accordingly, there is a great deal of flexibility in the design of energy absorbing devices constructed in accordance with the principles of this invention. The various elements of a given device can readily be chosen so that the overall characteristics of the device closely match the requirements of a wide variety of situations. For example, in applications where coins varying greatly in physical properties are to be processed, it is advantageous to design the $m_1 - k_1 - b_1$ system for the lighter coins in the coin set and to design the $m_2 - k_2 - b_2$ system for the heavier coins in the coin set. The coupled system $m_1 - k_1 - b_1$ plus $m_2 - k_2 - b_2$ function for intermediate coins in the coin set. In this way a wide range of coin sizes can be readily accommodated.

In the case of energy absorbing device 20 in the apparatus of FIG. 1, which is designed to absorb substantially all of the kinetic energy of United States 5-, 10-, and 25 cent coins dropped from a height of approximately 1/8 inches, elements of the materials mentioned above and having the following dimensions have been found satisfactory:

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strike plate 30</td>
<td>length 1.00&quot;</td>
<td>width .56&quot;</td>
</tr>
<tr>
<td>Pad 32</td>
<td>length and width same as above</td>
<td>thickness .07&quot;</td>
</tr>
<tr>
<td>Bracket 34</td>
<td>horizontal leg</td>
<td>overall length and width same as above</td>
</tr>
<tr>
<td>Pad 36</td>
<td>overall length 0.91&quot;</td>
<td>width .54&quot;</td>
</tr>
</tbody>
</table>

With an energy absorbing device constructed as described above, strike plate 30 and pad 32 appear to absorb most of the kinetic energy of the 10-cent coin, which has little effect on the larger, stiffer components beneath. The larger 25-cent coin appears to be affected most by system components 34 and 36. The intermediate 5-cent coin displaces both parts of the system to some extent. In all cases, the damping is close to critical, that is, coins stop bouncing after just two or three short hops and well before they have rolled off strike plate 30.

Returning to the coin mechanism of FIG. 1, by the time a coin reaches the end of coin track 22, a decision has been made as to whether the coin is acceptable or not; and if acceptable, it has been identified as to denomination. The coin leaves the end of coin track 22 in an almost horizontal trajectory and strikes energy absorbing device 42. Like energy absorbing device 20, device 42 absorbs substantially all of the kinetic energy of the coin, allowing it to drop almost vertically toward coin accept gate 44. If the coin has been identified as acceptable, coin accept gate is withdrawn into sidewall 18 (e.g., by a solenoid not shown in FIG. 1) and the coin is allowed to drop onto energy absorbing device 46. Like energy absorbing devices 20 and 42, device 46 absorbs most of the kinetic energy of the coin, allowing it to roll without bouncing down coin track 48. As described, for example in British specification No. 8387/72, coins may be physically separated by size as they roll down coin track 48 by having a series of progressively larger windows in one of the sidewalls along track 48. Coins too large to enter any window enter
chute 50 (parallel to and behind chute 54 as viewed in FIG. 1) leading to a coin box of the machine.

If as a coin leaves the end of coin track 22, it has not been found acceptable, coin accept gate 44 is not retracted. Gate 44 therefore intercepts the coin dropping from energy absorbing device 42 and diverts it onto coin track 52. At the lower end of coin track 52, the rejected coin enters coin chute 54 leading to the coin return window of the machine.

Although generally similar to energy absorbing device 20, devices 42 and 46 do differ from device 20 in certain minor respects. As shown in detail in FIGS. 5 and 6, the strike plate 60 of energy absorbing device 42 is mounted on pad 62 on the inside of the shorter leg of bracket 64, primarily because of space limitations. In addition, bracket 64 is mounted using two small pads 66 instead of a single large pad as in the case of device 20. Finally, the various components of device 42 are differently proportioned, reflecting the different requirements for an energy absorbing device at this location. The materials of device 42 are, however, entirely similar to the materials of the analogous components of device 20. Sizes of the various components of energy absorbing device 42 are as follows:

strike plate 60
length 1.06”
width .37”
thickness .12”

pad 62
length and width same as above
thickess .07”

bracket 64
vertical leg (as viewed in FIG. 5)
length 1.06”
overall width .56”
overall thickness .12”
horizontal leg (as viewed in FIG. 5)
length 1.06”
overall width .87”
thickness .12”

pads 66 (each)
length .31”
width .25”
thickness .07”

Energy absorbing device 46 (shown in detail in FIG. 7) is quite similar to, although generally larger than, energy absorbing device 20. Again, the various components of device 46 are made of the same materials as the corresponding components of device 20. Sizes of the components of device 46 are as follows:

strike plate 70
length 1.25”
width .56”
thickness .12”

pad 72
length and width same as above
thickness .07”

bracket 74
horizontal leg
overall length and width same as above
thickness .12”
vertical leg
length 1.25”
overall width .57”
thickness .12”

pad 76
length 1.25”
width .25”
thickness .07”

My experiments have indicated that superior results are obtained, at least when a set of coins of different masses is to be accommodated by disposing one cushion and contiguous strike plate and bracket leg substantially normal to the path of the approaching coin and disposing another cushion and contiguous bracket leg substantially normal to the first cushion, as shown.

It is to be understood that the embodiments shown and described herein are illustrative of the principles of this invention only and that various modifications may be implemented by those skilled in the art without departing from the scope and spirit of the invention. For example, various sizes, shapes, and materials may be selected to meet the requirements of a wide variety of applications.

1 claim:
1. A device in a coin apparatus for abruptly stopping the motion of a coin along its path of travel comprising a strike plate, a support for the strike plate positioning the plate in the path of the coin to intercept its travel, a first cushion layer contiguous to and interposed between the strike plate and support to be compressed by and to yield under impact of the coin with the strike plate, and a mounting for the support adapted to yield resiliently under the energy of impact transmitted to it by said support.

2. The device of claim 1 in which the strike plate, as supported by the cushion layer, has a predetermined mass adapted to absorb the kinetic energy of a relatively light coin while restraining bounce and the support has a predetermined mass greater than that of the strike plate which together with said mounting is adapted to absorb the kinetic energy of a relatively heavy coin while restraining bounce.

3. The device of claim 1 in which the mounting comprises a second cushion layer.

4. The device of claim 1 wherein the mounting comprises a rigid frame member of the coin apparatus and a second cushion layer of soft elastic material interposed between and secured to the frame member and a surface of the backing plate opposite the surface to which the first cushion layer is contiguous.

5. The device of claim 1 wherein the support is a bracket having legs substantially perpendicular to each other, the first leg is disposed substantially normal to the path of the coin and back the first cushion layer and supports against the back of the strike plate and cushion upon such impact, the second leg is disposed substantially parallel to the path of the coin.

6. The device of claim 5 wherein the mounting comprises a frame member of the coin apparatus and a second cushion interposed between the frame element and the second leg of the bracket.

7. The device of claim 2 wherein the support is a bracket having legs substantially perpendicular to each other, the first leg is disposed substantially normal to the path of the coin and back the first cushion layer and supports it against the thrust of the strike plate and cushion upon such impact, the second leg is disposed substantially parallel to the path of the coin.

8. The device of claim 7 wherein the mounting comprises a frame member of the coin apparatus and a second cushion interposed between the frame element and the second leg of the bracket.

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