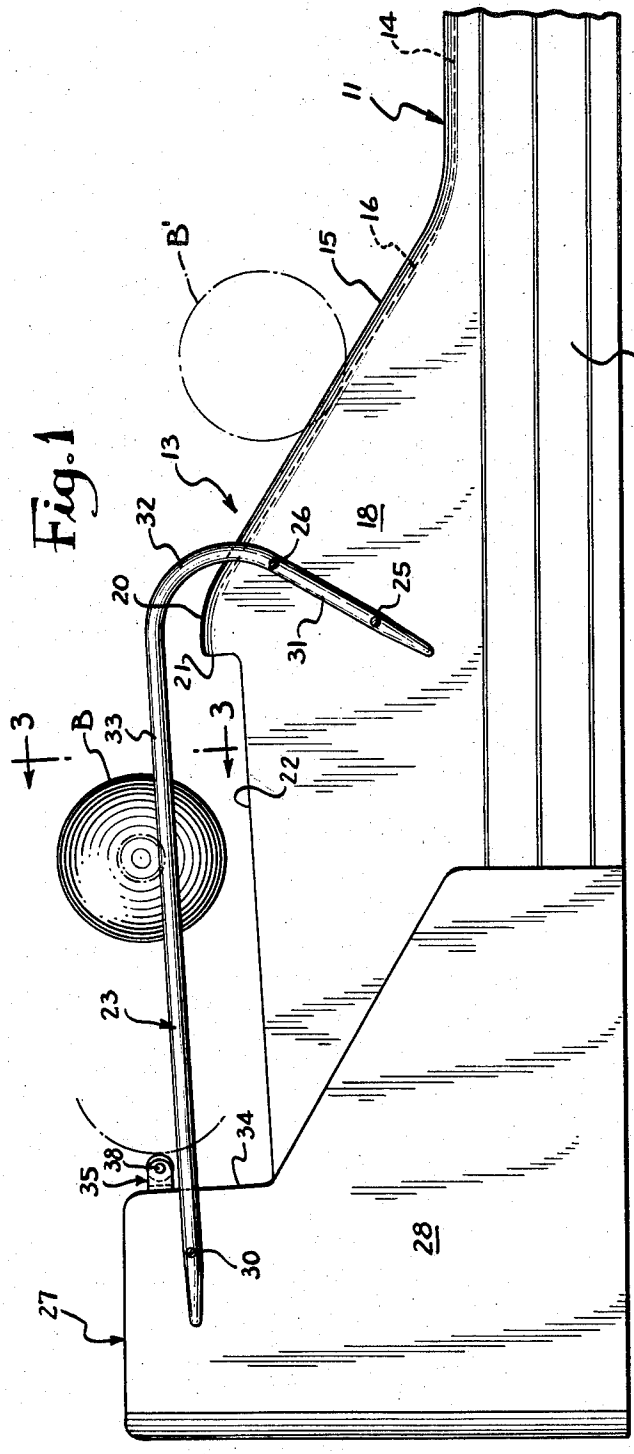
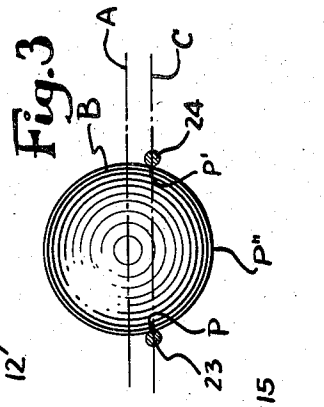
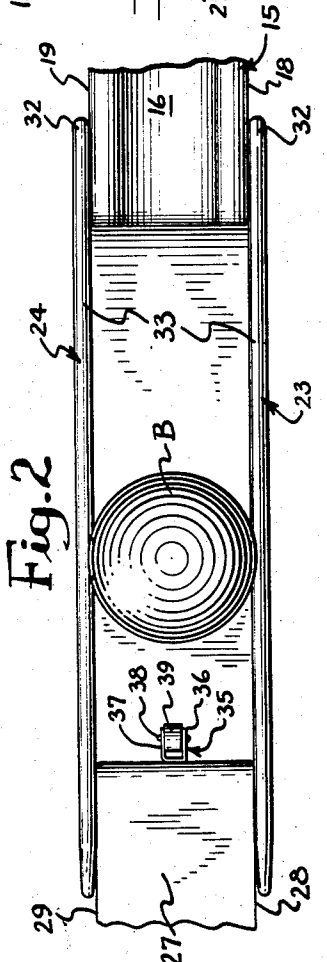
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BALL RETARDING DEVICE

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BALL RETARDING DEVICE

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This invention relates to a device for stopping the motion of a rolling sphere. The invention may be embodied, for example, in a bowling alley rack device for slowing up and stopping a spent bowling ball when the latter is returned to the player at the forward end of the alley.

Although the disclosed embodiment is in the form of a bowling alley return rack, it will be understood that this is merely illustrative of one of the many applications of the present invention which may be utilized in any type of device where it is desired to slow down or stop the motion of a rolling sphere.

After the player throws a bowling ball down the alley in an attempt to knock down the pins of a regulation bowling alley, or to actuate scoring switches or simulated bowling pins in a coin-operated bowling game, the ball must be returned from the far end of the alley back to the player at the forward end thereof. In conventional regulation bowling alleys and coin-operated bowling games, the ball is returned along a return gutter extending parallel to the alley longitudinally along one side thereof. The returning ball rolls forwardly along the return gutter at a relatively high translatory velocity in order to assure that the ball will reach the forward end of the alley and be properly racked until removed by the player for the next throw.

Due to the large mass of the bowling ball and its relatively high translatory velocity when rolling down the return gutter, the ball has considerable momentum and kinetic energy which poses a serious problem in stopping the ball at the forward end of the alley. That is, the large mass and high kinetic energy of the returning ball makes it difficult to rack the ball without causing a severe impact when the ball is stopped in the return rack.

Numerous attempts to solve this problem in the prior art have resulted in disadvantages and unreliable operation of the return rack. In some of these prior art arrangements the operation of slowing up and stopping the ball in the return rack depends upon the size and/or weight of the ball so that balls of a size or weight slightly different from the design norm either fail to rise up into the rack and instead roll back down the return gutter toward the far end of the alley, or go into the rack with too great a velocity so as to cause a severe impact.

Other prior art arrangements are disadvantageous in that they utilize moving parts which frequently get out of adjustment or become misaligned as a result of continuously repeated impacts by the heavy fast-moving bowling balls.

It is therefore a primary object of the present invention to provide a device for slowing up and stopping a rolling ball by means of a structure which is simple, rugged and reliable in operation. In accordance with the present invention, the rolling ball is slowed by a novel arrangement which converts part of the translatory kinetic energy of the ball into rotational energy.

This is accomplished in the disclosed embodiment by a pair of rails for supporting the ball as the latter rolls

therealong. The rails are spaced apart a predetermined distance so as to contact the surface of the ball at points spaced apart a distance slightly less than the ball diameter, whereby the ball will roll about a horizontal chord spaced from but closely adjacent to the horizontal axis of the ball. That is, the effective rolling radius of the ball when rolling on the rails is considerably less than the full radius of the ball about which it rolls when it moves forwardly along the return gutter. As a result, when the ball rolls along the rails its translatory velocity is reduced considerably below its original translatory velocity along the return gutter.

Another important feature of the present invention resides in the novel arrangement for stopping the ball after it has been slowed in the manner described above. This feature comprises a ball stop, preferably in the form of a freely rotatable roller. As the ball rolls along the rails, it eventually strikes this stop and would tend to rebound therefrom in a direction toward the far end of the alley. However, the free rotatable mounting of the roller permits the ball to continue to rotate in a forward direction, and this forward rotation of the ball either eliminates the rebound or reduces the rebound to a negligible amount. In the event of any slight rebound the forward rotation permitted by the roller slows up the rebound motion and eventually stops the rebound motion and causes the ball to roll forwardly again to the forward end of the rack where the ball is then finally rendered motionless.

Other objects and advantages of the present invention will become obvious to those skilled in the art as the description proceeds, or are inherent in the structure described below and shown in the accompanying drawings wherein:

Figure 1 is a side elevational view showing an illustrative embodiment of the invention in the form of a ball return device located adjacent the forward end of a conventional bowling alley return gutter;

Figure 2 is a top plan view of the device shown in Figure 1; and

Figure 3 is a vertical sectional view taken on line 3—3 of Figure 1.

Referring to the drawings, the reference numeral **11** designates generally a conventional bowling alley return gutter. The invention is illustrated as embodied in a bowling game of the coin-operated type, although it may be embodied in a regulation bowling alley, or other type of game or apparatus, and the gutter **11** is shown mounted along a side edge of a supporting base **12** which also supports the alley (not shown) and a ball return rack indicated generally by the reference numeral **13**.

The return gutter **11** is provided with a shallow groove in the usual manner, the bottom of the groove being seen as the dotted line **14**. Extending forwardly and upwardly from the rear end of return gutter **14** is an inclined ramp **15** also having a groove **16** continuous with the groove **14**. It will thus be seen that the returning ball will roll forwardly along groove **14** of return gutter **11** and then upwardly along groove **16** of inclined ramp **15**, as shown in dash-dot lines at B'. During this rolling movement, the ball will contact gutter **11** and ramp **15** substantially at or adjacent the bottom surface of the ball, so that the effective rolling radius of the ball will be substantially equal to the actual ball radius.

Ramp **15** is provided with vertical exterior side walls **18, 19**. The upper end of ramp **15** is rounded as at **20** and leads to a vertical shoulder **21**. The upper end of return rack **13** is recessed rearwardly of shoulder **21** along a horizontal surface **22** to provide clearance for a purpose to be described below.

A pair of rack rails **23, 24** have their rearward ends secured respectively to the exterior side walls **18, 19** by means of screws **25, 26**. The forward end of base support

12 is fixedly secured to an end support indicated generally by the reference numeral 27 and having side walls 28, 29 to which are secured the forward ends of rails 23, 24 by means of screws 30.

It will be noted that the rear ends 31 of rails 23, 24 extend upwardly and rearwardly and lead to arcuate portions 32 which curve upwardly and forwardly and in turn lead to straight portions 33 which extend forwardly and preferably at a slight downward inclination.

End support 27 is provided with a rear vertical wall 34 to which is fixedly secured a bifurcated bracket 35 having a pair of horizontal spaced arms 36, 37. A horizontal pin 38 has its opposite ends mounted to arms 36, 37 and a cylindrical roller 39 is freely rotatably mounted on pin 38.

As the bowling ball approaches the upper end of inclined ramp 15, it then rolls onto rails 23, 24. As best seen in Figure 3, bowling ball B contacts rails 23, 24 at the points indicated at P and P' located on a horizontal chord C. The chord C is spaced slightly below the horizontal axis A of ball B. When ball B rolls along return gutter 11 and inclined ramp 15, the ball rolls substantially along its lowermost surface at the point indicated by the reference letter P'', in which event the rolling radius of the ball is substantially the actual radius thereof, namely, the distance from the ball center to the bottom point P''. This rolling radius is considerably greater than the reduced effective rolling radius as the ball rolls along rails 23, 24. In the latter case the effective rolling radius is merely the distance between the ball center and chord C.

It has been discovered that the translatory velocity of the ball as it rolls along rails 23, 24 is substantially less than its initial translatory velocity along return gutter 11 and inclined ramp 15. The theoretical explanation of this substantial reduction in translatory velocity is believed to be as follows:

The translatory velocity of the ball is directly proportional to the product of its rotational velocity and its effective rolling radius. Therefore, reduction of the effective rolling radius as the ball rolls forwardly along rails 23, 24 will result in a lower translatory velocity for a given rotational velocity.

Although it is observed that the rotational velocity of the ball is greater as it rolls along rails 23, 24 than as it rolls along return gutter 11 and inclined ramp 15, this increase in rotational velocity is insufficient to off-set the slowing up effect created by the reduction in the effective rolling radius.

Furthermore, this increase in the rotational velocity of the ball in the position shown at B as compared with the position shown at B' offers a further theoretical explanation for the observed fact that the ball has a reduced translatory velocity along rails 23, 24. That is, the increased rotational velocity indicates that a portion of the translatory kinetic energy of the ball has been converted into rotational kinetic energy.

As the ball rolls forwardly along rails 23, 24, it spins in a forward counter-clockwise direction as viewed in Figure 1. The ball eventually strikes roller 39. Due to the fact that roller 39 is freely rotatable, the ball continues to spin in its original counter-clockwise forward direction after impact with roller 39. This spinning movement of the ball tends to urge it in a forward direction and thereby opposes any tendency of the ball to rebound rearwardly. If the tendency of the ball to rebound rearwardly is less than the effect of the continued forward rotation of the ball tending to urge it in a forward direction, the ball upon contact with roller 39 will not rebound rearwardly but instead will continue to spin while roller 39 rotates thereagainst in the opposite direction until the rotary energy of the ball is entirely dissipated by friction.

In many applications the ball will have a large mass and a high initial velocity along the trackway or gutter 11, such as may be the case in a regulation bowling alley or a coin-operated bowling game, and the roller 39 and its mounting may not be particularly resilient so as to absorb a substantial portion of the impact energy of the ball. In this situation, the rebound effect may be somewhat greater than the effect caused by the continued forward spinning movement of the ball which tends to urge it in a forward direction after impact with roller 39, so that the ball will rebound rearwardly after striking roller 39. However, it has been observed that this rebound is limited to a very slight amount, usually about one-half inch, because the continued forward spinning movement of the ball quickly stops the rebound movement and then causes the ball to roll forwardly again until the ball contacts roller 39 for the second time with little or no impact. The forwardly extending portions 33 of rails 23, 24 may incline downwardly in a forward direction (to the left as viewed in Fig. 1) to a slight degree so that the ball will eventually come to rest in contact with roller 39 after its rotary energy has been dissipated by friction and the ball becomes motionless.

It will be understood from the above theoretical explanation that the reduction in translatory velocity along rails 23, 24 will be approximately proportional to the ratio of the effective rolling radius (the distance between axis A and chord C) to the actual radius. In order to effect a large reduction in translatory velocity, chord C will be sufficiently close to axis A whereby the contact points P, P' lie on radii extending from the ball center at an obtuse angle with respect to each other.

Although in the drawing the forwardly extending portions 33 of rails 23, 24 are shown to be approximately parallel to each other, portions 33 may diverge in the forward direction so as to gradually reduce the effective rolling radius of the ball as the latter rolls forwardly toward roller 39 on rail portions 33.

It is to be understood that the specific embodiment shown in the drawing and described above is merely illustrative of one of the many forms which the invention may take in practice, and there will readily occur to those skilled in the art numerous variations and modifications thereof within the scope of the invention as delineated in the appended claims which are to be construed as broadly as possible in view of the prior art.

I claim:

1. A ball return rack device comprising a return gutter adapted to extend parallel to a game alley longitudinally thereof and providing a rolling support along which a thrown ball may roll from the far end of the alley back toward the forward end thereof so as to return to the player, an inclined ramp extending upwardly and forwardly from the forward end of said return gutter and being continuous with the latter to permit the returning ball to roll upwardly on said ramp, means for supporting the ball as the latter rolls forwardly thereon, said means extending forwardly from the upper forward end of said ramp, said means comprising a pair of horizontally-spaced rails each having a longitudinal surface for supportably contacting the surface of the ball, said longitudinal surfaces being spaced apart a distance slightly less than the diameter of the ball, said longitudinal surfaces when supporting the ball thereon being located on two radii of the ball extending at an obtuse angle with respect to each other, mounting means located adjacent the forward end of said rails, and a roller rotatably mounted to said mounting means for free rotary movement about a horizontal axis, said roller being located in the path of movement of said ball as the latter rolls forwardly along said rails, whereby a substantial portion of the translatory energy of the ball is converted to rotational energy as the ball rolls forwardly on said rails and whereby said rotational energy opposes rebound movement of the ball after the latter strikes said roller.

2. A ball return device comprising a trackway for guiding a ball as the latter rolls forwardly therealong, an inclined ramp extending upwardly and forwardly

from the forward end of said trackway and being substantially continuous with the latter, means for supporting the ball as the latter rolls forwardly thereon, said means extending forwardly from the upper forward end of said ramp, said means comprising a pair of horizontally-spaced parallel rails each having a longitudinal approximately horizontal surface for supportably contacting the surface of the ball, said two surfaces being spaced apart a distance slightly less than the diameter of the ball, and stop means located at the forward end of said last-recited means and in the path of movement of the ball, said stop means comprising means movable in response to rotation of the ball striking thereagainst to permit the ball to continue rotating in the forward direction as the ball strikes said stop means, whereby the rotational energy of the ball tending to move the latter in a forward direction is opposed by the rebound energy of the ball after the latter strikes said stop means.

3. A ball return device comprising a return gutter adapted to extend parallel to a game alley longitudinally thereof and providing a rolling support along which a thrown ball may roll from the far end of the alley back toward the forward end thereof so as to return to the player, an inclined ramp extending upwardly and forwardly from the forward end of said return gutter and being continuous with the latter to permit the returning ball to roll upwardly on said ramp, means for supporting the ball for rolling of the latter therealong, said means extending forwardly from the upper forward end of said ramp, said means contacting said ball only at two points located on a horizontal chord of the ball located adjacent to the horizontal axis thereof, and stop means located at the forward end of said last-recited means and in the path of movement of the ball, said stop means comprising means movable in response to rotation of the ball striking thereagainst to permit the ball to continue rotating in the forward direction after the ball strikes said stop means, whereby the rotational energy of the ball tending to move the latter in a forward direction is opposed by the rebound energy of the ball after the latter strikes said stop means.

4. A ball return device comprising a return gutter adapted to extend parallel to a game alley longitudinally thereof and providing a rolling support along which a thrown bowling ball may roll from the far end of the alley back toward the forward end thereof so as to return to the player, means for supporting the ball for rolling of the latter along said means about a horizontal chord of the ball located adjacent to the horizontal axis thereof, said means extending forwardly from adjacent the forward end of said gutter, and a roller rotatably mounted for free rotary movement about a horizontal axis, said roller being located in the path of movement of said ball as the latter rolls forwardly along said means, whereby a substantial portion of the translatory energy of the ball is converted to rotational energy as the ball rolls forwardly on said means and whereby said rotational energy opposes rebound movement of the ball after the latter strikes said roller.

5. In a game of the type having a return gutter adapted to extend longitudinally and providing a rolling support along which a spent ball may roll with a first rotational velocity and a first translatory velocity from the far end of the game back toward the forward end thereof so as to return to the player, and an inclined ramp extending upwardly and forwardly from the forward end of said return gutter and being continuous with the latter to permit the returning ball to roll upwardly on said ramp, the improvement comprising means providing a rolling support for the ball and extending forwardly from the upper end of said ramp, said means comprising means for converting part of the translatory kinetic energy of the ball into rotational energy so as to impart to the ball a second rotational velocity higher than said first rotational velocity and a second translatory velocity lower than said first translatory velocity, and a rotatably mounted stop member located at the forward end of said support means and in the path of rolling movement of the ball for causing the latter to rebound rearwardly without absorbing the forward rotational energy of said ball which is thereby permitted to oppose the rebound translatory energy.

6. In a bowling alley of the type having a return gutter adapted to extend parallel to the alley longitudinally along one side thereof and providing a rolling support along which a spent bowling ball may roll with a first rotational velocity and a first translatory velocity from the far end of the alley back toward the forward end thereof so as to return to the player, the improvement comprising means providing a rolling support for the ball and extending forwardly from adjacent the forward end of said gutter, said means comprising means for converting part of the translatory kinetic energy of the ball into rotational energy so as to impart to the ball a second rotational velocity higher than said first rotational velocity and a second translatory velocity lower than said first translatory velocity, and stop means located at the forward end of said support means and in the path of rolling movement of the ball for converting the forward translatory energy of the ball to rearward translatory energy while permitting the ball to continue to rotate in the forward direction whereby the forward rotational energy will be expended in opposing the rearward translatory energy.

7. In a bowling alley of the type having a return gutter adapted to extend parallel to the alley longitudinally along one side thereof and providing a rolling support along which a spent bowling ball may roll with a first rotational velocity and a first translatory velocity from the far end of the alley back toward the forward end thereof so as to return to the player, and an inclined ramp extending upwardly and forwardly from the forward end of said return gutter and being continuous with the latter to permit the returning ball to roll upwardly on said ramp, the improvement comprising means providing a rolling support for the ball and extending forwardly from the upper end of said ramp, said means comprising means for converting part of the translatory kinetic energy of the ball into rotational energy so as to impart to the ball a second rotational velocity higher than said first rotational velocity, and a second translatory velocity lower than said first translatory velocity, said means comprising a pair of horizontally spaced longitudinal surfaces for supportably contacting the ball surface at points thereon spaced from each other a distance slightly less than the diameter of the ball, a roller, means mounting the roller for free rotatable movement about a horizontal axis at the forward end of said support means and in the path of rolling movement of the ball to convert the forward translatory energy of the ball to rearward translatory energy which will in turn oppose and absorb the forward rotational energy of the ball.

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