Jan. 8, 1935. G. F. CAHILL 1,987,000

BOWLING ALLEY

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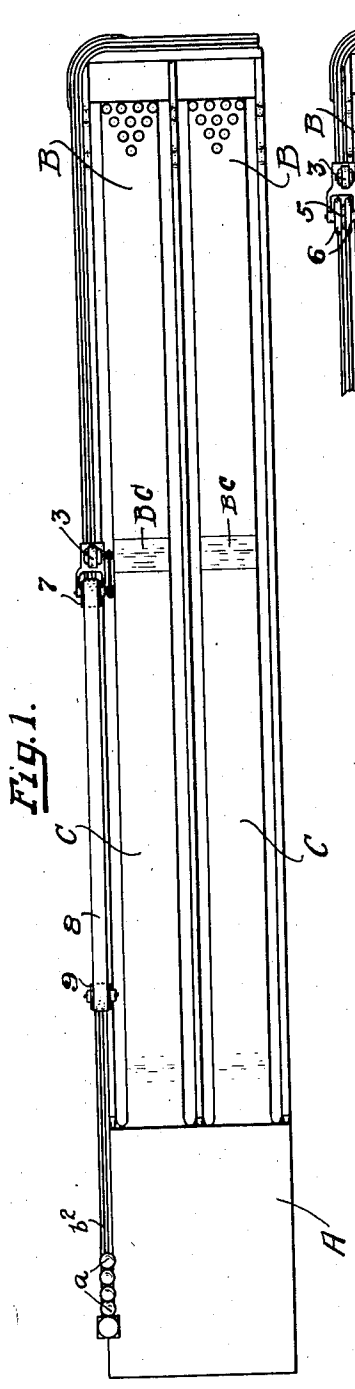


Fig. 1.

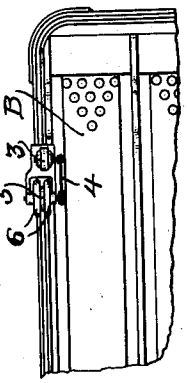


Fig. 2.

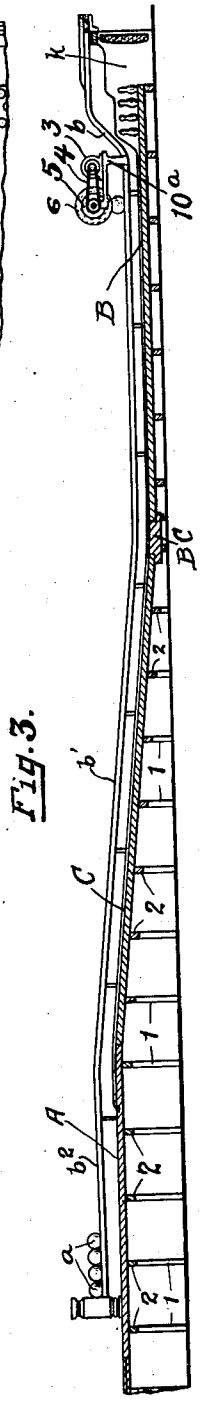


Fig. 3.

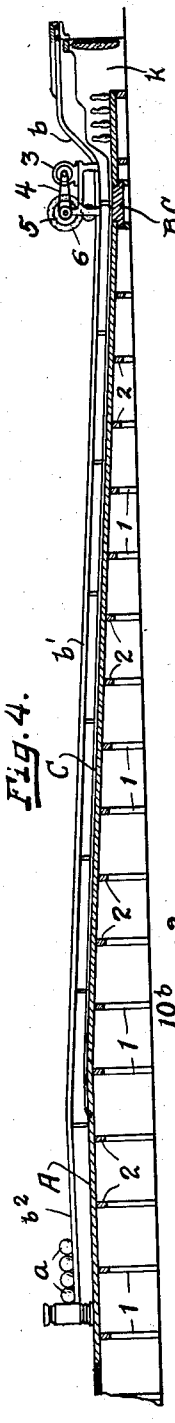


Fig. 4.

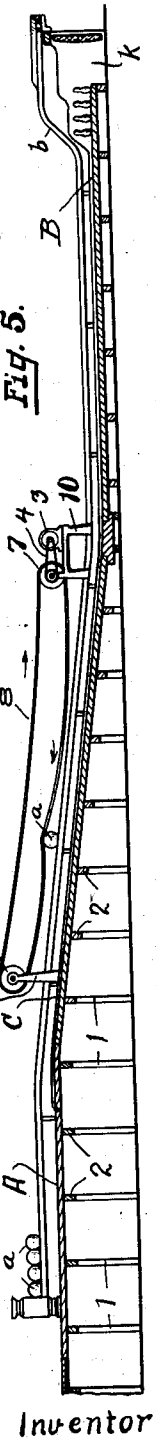


Fig. 5.

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Fig. 10

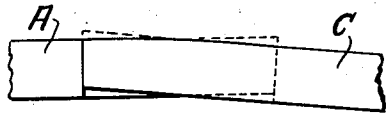



Fig. 11

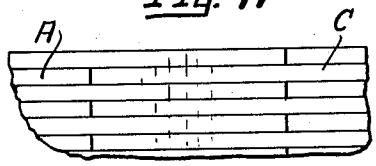



Fig. 12

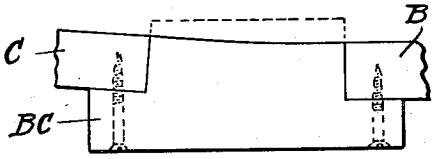



Fig. 13

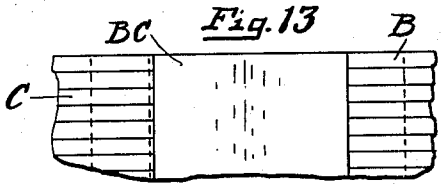



Fig. 6

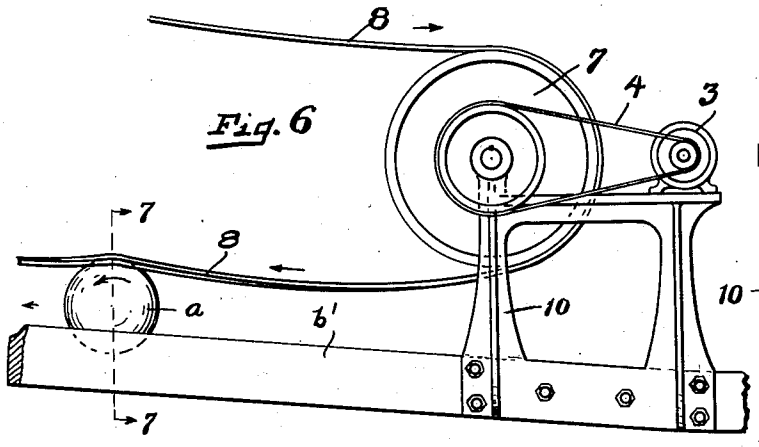



Fig. 7

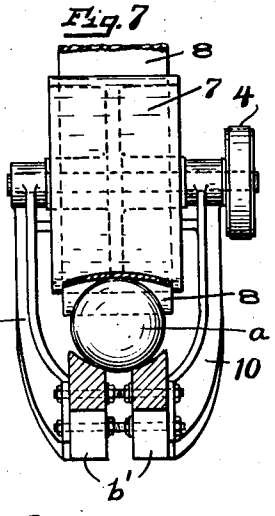



Fig. 8

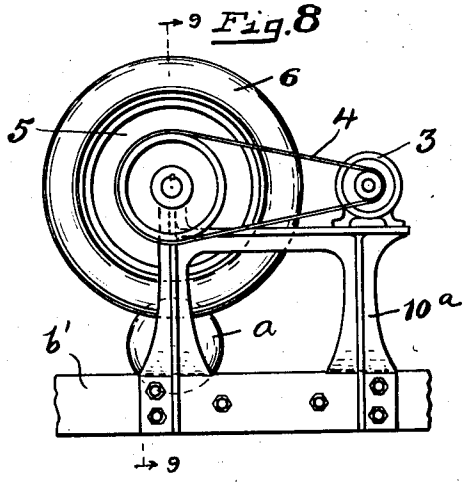
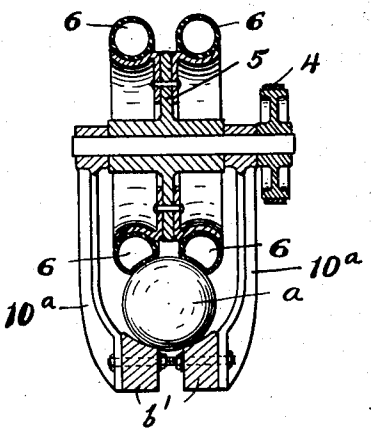



Fig. 9




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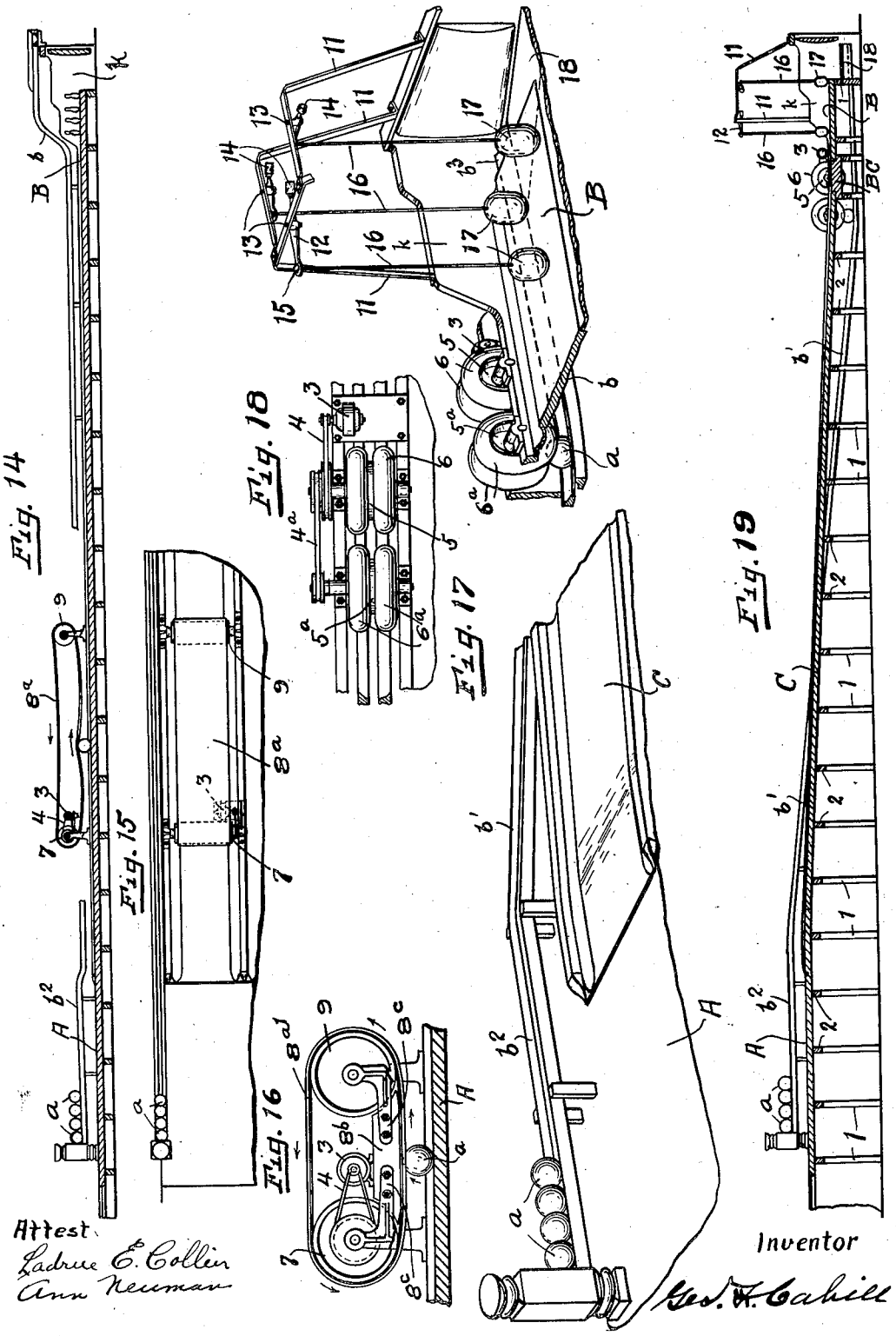
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Fig. 20

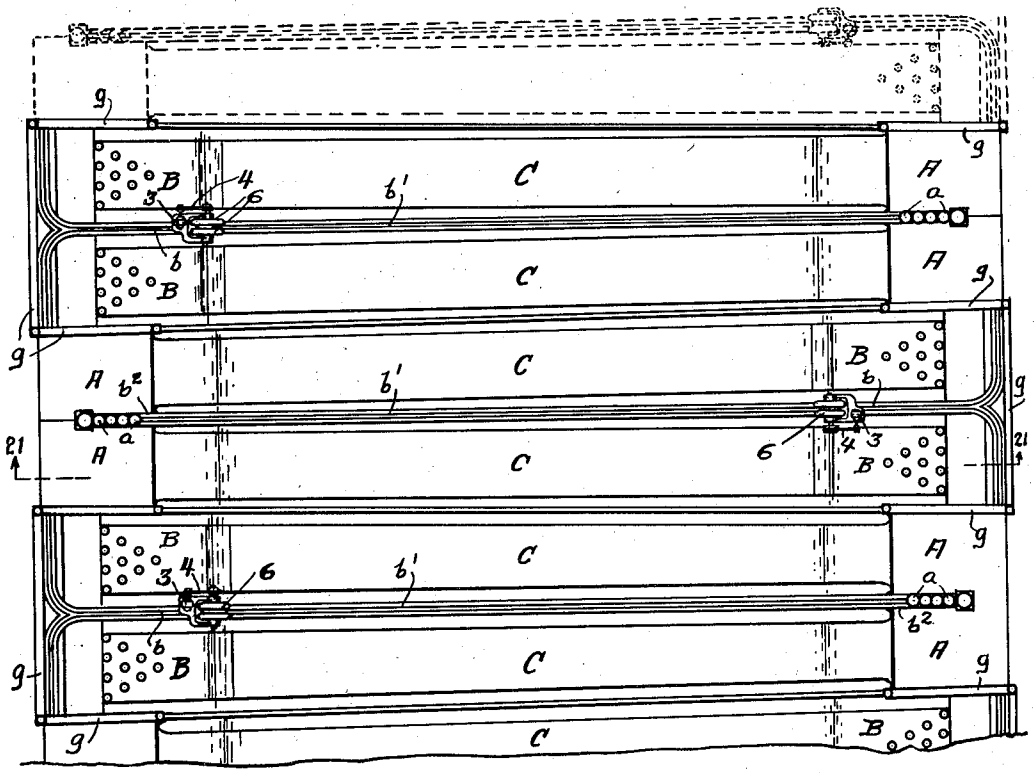



Fig. 21

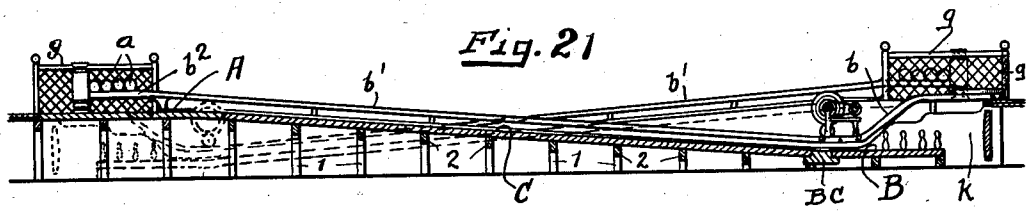
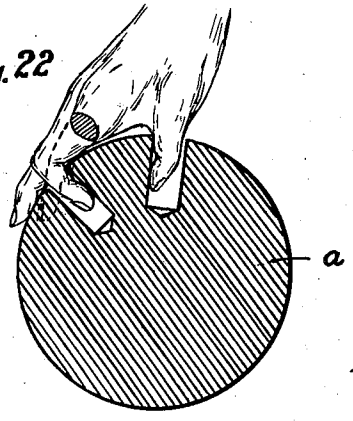



Fig. 22




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# UNITED STATES PATENT OFFICE

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## BOWLING ALLEY

George F. Cahill, New York, N. Y.

Application February 11, 1933, Serial No. 656,237

18 Claims. (Cl. 273—37)

In the most popular form of the ancient game of bowling, and that which is also the regulation form, the players impel along long, narrow, level alleys, balls which are twenty-seven inches in circumference. Those balls were originally made of lignum vitæ, one of the heaviest of known woods. They are now generally made of some composition, and weigh as much as sixteen pounds. Probably the great majority of those who bowl regularly, use the sixteen-pound ball. Into that ball are generally drilled a hole for the thumb and a hole for the middle finger, into which holes are inserted the two outer and weaker joints of those fingers. (See Fig. 22.) Sometimes, but not frequently, holes for the thumb and two fingers are drilled. Commonly those holes are drilled radially into the ball, although sometimes, with a view to getting a better grasp of the ball, they are so drilled that the tips of the thumb and finger come somewhat nearer together than if the holes had been drilled radially.

In order to impel the ball rapidly enough to maintain its course along a horizontal wooden runway at least sixty feet from the hand of the player to the nearest pin, the player swings his ball before releasing it, or swings it while running with it, before starting it on its long course. The centrifugal force resulting from that swinging of the ball may easily raise the effective weight of the sixteen-pound ball, or its tendency to slip out of the player's fingers, from sixteen pounds to forty or fifty pounds, or more, when the ball is impelled rapidly, since the centrifugal force increases rapidly with the increase of the speed imparted to the ball. Yet that ball, with a tendency at times to slip out of the hand equal to one-fourth the weight of a barrel of flour, and held merely by a frictional grasp of the ends of two fingers against hard, smooth surfaces that are semi-lubricated by perspiration and the natural oil of the hand, is given to men and women who come to bowl or to learn to bowl, although many of them do little or no physical work and have had no exercise to develop a sufficiently-firm grip in their hands and fingers for so heavy a ball.

Further, when a beginner, especially if his hand and arm be weak, attempts to roll his ball along so long and narrow an alley-bed, he finds that, as the ball loses its forward momentum, it frequently rolls completely off the bed sidewise, due to some revolution of the ball, or to its lack of balance, wholly apart from the direction which he originally imparted to it. The weakness of his attempt, and this tendency of his ball to roll off into the gutter when it is not moving rapidly enough to maintain a fairly straight line of movement, adds to the discouragement of the beginner, and causes him to be laughed at.

The commercial game of bowling, in which millions of dollars are invested, now labors, therefore, under the practical disadvantage of discouraging or effectually barring a very large part of those who might otherwise become bowlers. The great weight of the ball, the necessity of swinging it rapidly before starting it on its course, and the impossibility of holding it in one hand in any way that employs the full strength of the hand, or even of the two fingers used, discourage many beginners and effectually disqualify a large percentage of those who might otherwise be attracted to the game. And, should a player who would like to bowl, but who cannot well handle the usual sixteen-pound ball, attempt to use a smaller and lighter ball, he is apt to feel that that is a public confession of weakness and that, in any event, he cannot compete successfully with a small and light ball, against players who are able to handle large and heavy balls. So he turns permanently from bowling.

The principal object of my invention is to enable players to enjoy the game of bowling with big balls and pins, who cannot now do so for the reasons above stated, although they impart a lesser initial velocity to their balls than is required for successful bowling upon the standard type of bowling alley now in commercial use.

Again, bowling is a game almost wholly of marksmanship, and in marksmanship, steadiness of aim and steadiness of the body while aiming, are of the highest importance. Yet careful observation of thousands of bowlers shows that the necessity of imparting so much energy to so heavy a ball throws a very large proportion of even those who continue the game off their balance when impelling the ball, and that the disturbance of balance is very much greater when the ball is started forward rapidly than it is when the ball is started forward slowly.

Another object of my invention is to enable bowlers, who are using the large, heavy balls, to aim their balls at the targets with less disturbance of balance, or tendency to be thrown off their balance, at the moment of delivering the ball than with the apparatus now in use.

Further, generally speaking, any improvement in the apparatus of a game which is conducted as a business (such as bowling, billiards, skee ball, table tennis, etc.) which would improve the playing or score of poor players without materially, or at least so greatly, improving the playing or

score of good players, would encourage the great majority of players, heighten the interest in the play, and benefit the game greatly from a commercial standpoint.

Another object of my invention, therefore, is to so construct a bowling alley as to help the game of a poor player more than it helps the game of an accomplished player.

Experience has shown that the pleasure in bowling is greatly reduced if the beds of the alleys on which the balls slide and roll, are not frequently washed and oiled. In many commercial establishments, therefore, the rolling surface of every alley is washed and re-oiled every day.

Another object of my invention is to so construct bowling alleys that alleys which are not washed and oiled frequently enough, will not be at so great a disadvantage in comparison with well-kept alleys as they are with alleys of the present construction.

Another object of my invention is to somewhat reduce or overcome the tendency of beginners' balls to roll off into the gutter, although not properly aimed originally.

Another object of my invention is to reduce the time which is now required for the playing of a game, especially in the case of beginners and players with weak hands and arms.

These things I do by automatically accelerating the speed or forward movement of the ball after it has left the hand of the player. And this accelerating I preferably effect (1st) by elevating the players' end of the alley considerably above the pin-end of the alley, and connecting these two parts of the alley by a downwardly-inclined section which materially accelerates the speed of the ball; or (2d) by providing a power device that acts to impel the ball forward toward the pins, after it has left the player's hand; one means for this purpose is to provide, above the playing surface of a regulation alley, whose bed is substantially horizontal throughout its length, an accelerating device or devices which accelerate the speed or forward-movement of the ball upon the bed of the alley; or (3d) by tilting down part of the alley somewhat and also accelerating the speed of the ball by other means than gravity.

Another object of my invention is to accelerate the return of the ball from the pin-end of the alley to the players' end of the alley, and particularly to enable it to climb to the elevated players' end of my alleys, in which the players' end is elevated above the pit-end of the alley.

Another object of my invention is to dispense with the need of a pin-boy, to reset the pins. This I do by providing targets at the pin-end of the alley, which generally change their positions with relation to each other when one or more of them is struck by the player's ball, and which require no resetting.

Another object of my invention is to provide greater space or width at the pin-end of the alley-bed, so that the pins or other targets will not need to be crowded so closely together as they are in the regulation game of ten-pins.

Another object of my invention is to provide greater space or width at the pin-end of the alley-bed, preferably without increasing the width of the space required for a pair of alleys, or for several pairs of alleys.

In the accompanying drawings—

Fig. 1 is a plan view of a pair of my new bowling alleys, showing, inter alia, apparatus for assisting the ball to return up-grade to the elevated or players' end of the alley;

Fig. 2 is a detail, a plan view, of the pit-end of my new bowling alley, showing a different type of apparatus for assisting the ball to return up-grade to the elevated or players' end of the alley;

Figs. 3, 4 and 5 are longitudinal sectional views of different forms of my improved downwardly-inclined bowling alley, and showing also different apparatus to assist the ball to return up-grade to the players' end of the alley;

Fig. 6 is a side elevation, while Fig. 7 is an end elevation, partly in section, on the line 7, 7, in Fig. 6, illustrating part of the mechanism (shown, for instance, in Figs. 1 and 5) to assist the ball to return up-grade to the players' end of the alley;

Figs. 8 and 9 are similar views of another type of such mechanism; seen also in Figs. 2, 3 and 4;

Fig. 10 is a side elevation, and Fig. 11 a plan view, both in detail, illustrating one way of joining the horizontal part of the alley on which the players stand or run, to the downwardly-inclined part of the alley, and shaping the junction into a convex curve;

Figs. 12 and 13 are similar views of one means for connecting the downwardly-inclined part of the alley to the horizontal part, on which the pins stand, with such constructions as are shown in Figs. 3, 4 and 5, so that the junction shall be formed into a concave curve;

Fig. 14 is a longitudinal section of another embodiment of my invention, in which the speed of the ball moving upon a substantially horizontal alley, is automatically accelerated after the ball leaves the hand of the player;

Fig. 15 is a detail plan view of a small section of the alley and the accelerating mechanism, shown in Fig. 14;

Fig. 16 is a detail view, partly in section, partly in elevation, of another construction for accelerating the speed of the player's ball;

Fig. 17 is a perspective view, partly in section, of one of my improved downwardly-inclined alleys, in which targets, constructed to assume different positions with relation to each other when hit by the player's ball, are used in place of the regulation pins. In this figure a portion of the downwardly-inclined section of the alley is broken away by reason of limitations of space on the sheet. In that figure also is shown a ball-accelerating mechanism, which differs from the ball-accelerating mechanism shown in Figs. 3 and 4, chiefly in that it is a multiple or two-stage accelerator instead of a single-stage accelerator;

Fig. 18 is a detail plan view of the two-stage ball-accelerating mechanism shown in Fig. 17;

Fig. 19 is a longitudinal section of the construction shown in Fig. 17;

Fig. 20 is a plan view of a group of downwardly-declining alleys, generally, but not necessarily, shorter than the alleys previously shown, in which the pin-space or space for the targets has been widened beyond the regulation distance, and the players' end of the alley correspondingly narrowed, in order that a pair of such alleys, or a larger number of such alleys, may go into substantially the same space crosswise as do a pair or an equal number of regulation alleys;

Fig. 21 is a longitudinal section on the line 21, 21, of Fig. 20; and

Fig. 22 is a cross section of a ball illustrating the manner in which it is usually held by the hand while being impelled forward.

Similar reference characters refer to similar parts in all the drawings.

In the accompanying drawings—

A represents the players' end of a bowling alley, which I, preferably build in a substantially horizontal plane;

B represents the pin-end of a bowling alley, which I also, preferably build in a horizontal plane, but at a substantially-lower level than the players' end A; for example, two to four feet lower; but it may be either more or less than this;

C represents the tilted or downwardly-inclined portion of my bowling alley, which connects the players' end and the pin-end of the alley. The relative lengths of the three sections may vary greatly, as illustrated in Figs. 3, 4 and 5, and the point at which the downwardly-inclined part of the alley commences may approach to, or recede from, the customary foul line in different constructions, but the construction of Fig. 3 accelerates the ball more rapidly during the early part of its travel and allows it to make a considerable part of its whole travel at substantially maximum speed.

Should strong reason for it exist, the downward-inclination of the alley may extend right through the pin-space, provided that the angle of tilt is not too great. The lower parts of the alley may be constructed according to the present standard constructions, while the elevated parts of the alley are carried up from the ordinary floor of the building in any suitable manner, as for instance, on the uprights 1, 1, and cross-pieces 2, 2, seen in Figs. 3, 4, etcetera.

Where the players' end A joins the downwardly-inclined part C, I preferably conform the surface of the alley to a convex curve of large radius, by planing or otherwise reducing the surface of the alley at the junction point, as illustrated in Figs. 10 and 11.

Where the downwardly-inclined part C of the alley joins the pin-end B of the alley, I preferably plane, or otherwise conform the surface of my alley to a concave curve, preferably by inserting a cross-piece or block BC, as seen in Figs. 3, 5, 12 and 13. The dotted part of Fig. 12 is intended to indicate the shape of the section or block before being reduced to the pre-determined concave curve.

As far as the pin-end of the alley is concerned, I generally, preferably, use runways for the return of the player's ball, of the conventional type, as illustrated in Figs. 1 to 5. In the conventional type of bowling alley, where the bed of the alley is substantially horizontal throughout its entire length, the speed which the ball attains in running down the part of the runway marked *b* is sufficient to cause it to roll to the players' end of the alley and there to climb on to a ball-rack at the side of the alley.

But since the players' end of the types of my alley, illustrated in Figs. 1 to 5, is raised considerably above the pin-end of the alley, I preferably accelerate the speed of the ball *a*, in returning to the players' end of the alley, by any suitable device, as for instance, one or other of the devices shown in Figs. 3, 5 or 17. In the devices, especially of Figs. 2, 3 and 4, an electric or other suitable motor 3, is connected by a belt 4, to a fly-wheel 5, which has a yielding frictional face or parts 6, 6, which yieldingly grip the ball as it passes under it, to serve to sufficiently accelerate the speed of the ball to cause it to run up the tilted part of the runway *b'* on to the ball-rack $b^2$; see also Figs. 8 and 9. The face or part of the wheel 5, which contacts with the ball, may be made of any suitable construction, such as of a heavy rubber band or sponge rubber, or of two resilient, inflated tubes, the latter of which are illustrated especially in Fig. 9.

Where the elevation of the players' end of the alley is especially large, or where the ball is not originally accelerated by rolling down the tilted part *b* of the runway, I sometimes use the construction illustrated in Figs. 1, 5, 6 and 7, in which the motor 3 impels a fly-wheel 7, which pulls the belt 8 over the idle wheel 9, so that the lower side of said belt 8 contacts with the ball for a much greater length of time than does the periphery of the wheel 5 of Figs. 3 and 4.

In the different embodiments of my invention, illustrated in Figs. 1 to 5, as also in Figs. 17, etcetera, the players' end of the alley is elevated substantially above the pin-end of the alley. In Fig. 14 is illustrated another embodiment of my invention, as applied to an alley of the usual construction, which is substantially horizontal from end to end, in which the player rolls his ball under and into contact with a ball-accelerating mechanism which may be much of the general character of the ball-accelerating mechanism shown in Fig. 5, except that, in Fig. 14, the belt $8^a$ is wide enough to cover the whole surface of the bowling alley (see Fig. 15) instead of being wide enough simply to accelerate the up-hill climb of the ball, as seen in Figs. 1 and 5.

Where extreme shortening of the belt $8^a$ is desired, I preferably construct my ball-accelerating mechanism somewhat as shown in Fig. 16, in which a belt $8^{a'}$, with a thick resilient surface is prevented from rising too far from the alley by the lower surface of the part $8^b$, which is supported a fixed distance from the alley by the supports $8^c$, $8^c$. In such a construction, unusually heavy fly-wheels 7 and 9 should be used.

The embodiments of my invention so far described contemplate the use of the customary bowling pins, pit, pit-cushion, kick-backs and other parts at the pin-ends of regulation alleys, as shown, for example, in Figs. 1 to 5.

Figs. 17, 18 and 19 illustrate a construction in which a plurality of targets 17, 17, used in place of the customary bowling-pins, are suspended by the bars 16, 16, from frictional retarding devices 15, in the outer ends of freely moving levers 12, set upon vertical axes 13, 13, firmly suspended from the framing 11, 11, which framing is in turn securely bolted to the kick-backs *k*, *k*, and the back framework of the bowling alley. Preferably the weight of the targets upon the outer ends of the levers 12, 12, is counterbalanced by the weights 14, 14. The construction illustrated in Figs. 17 and 19 is such that when one or more targets 17, 17, are struck by the player's ball *a*, said targets will change their positions under the impact of said ball.

Since no pin-boy is to be employed with the construction shown in Figs. 17 and 19, the bottom or floor of the pit 18 is formed to slope to the left in the drawings and to deliver the ball into the trough $b^3$, which trough in turn tilts downward toward the two-stage ball-accelerating mechanism shown in perspective in Fig. 17, and in plan in Fig. 18. The movement of the ball is first accelerated by contact with the revolving surfaces 6, 6, and by them delivered under the revolving surfaces $6^a$, $6^a$, which, as seen in Fig. 18, are belted to run at a higher peripheral speed than do the contact surfaces 6, 6.

The width of the bed of a regulation bowling

alley should be not less than forty-one inches, nor more than forty-two inches; the gutters not less than nine nor more than nine and one-half inches wide each. The total width of the bed and gutters, that is, the space between the kick-backs, is sixty inches. On such an alley, the centers of the pins are twelve inches apart. Those dimensions and proportions and the size of the regulation pins have been slowly worked out with relation to the space in commercial buildings available for alleys, and to the great length of a regulation alley, which requires a minimum of eighty-three feet, not including passage ways. In many buildings in desirable locations, however, there is not room for bowling alleys of regulation length. But when an alley is shortened, it becomes easier to hit the targets, and there come to be strong reasons why the pins or targets should be further apart, without increasing, or materially increasing, the width of a given number of alleys. By the constructions illustrated in Figs. 20 and 21, I obtain a larger width at the pin-end of the alley, so that the pins may be set more than twelve inches apart, and I preferably contract the players' end of the alley about as much as I expand the pin-end of the alley, so that two alleys set end to end, go into substantially the same space as do a pair of regulation alleys now. Thus, I raise the distance between pin-centers from twelve inches to as much as fifteen inches by increasing the width of the bed at the pin-end to, say fifty inches (41 inches plus 9 inches). And I preferably keep the bed the regulation forty-one inches wide at the players' end and cut the gutters down at that end from nine and one-half inches each to, say, five inches, although the gutters may be widened to six inches or even more and the players' end of the alley-bed narrowed accordingly.

Where such short, downwardly-inclined alleys are desired, the two alleys of a pair may be set with the narrow high end of one alley beside the wide low end of the next alley, as suggested by the alley in dotted lines at the top of Fig. 20. But when several such alleys are built side by side, it is more economical to build them with two wide and low ends together as a pair matching with to high and narrow ends as a pair, as illustrated in Fig. 20. When a pair of tapered alleys are built to form a rectangle, a ball runway, and ball-accelerating mechanism are needed for each alley. But where two wide and low ends, or two narrow and high ends are put together to form a pair, but one ball runway and ball-accelerating mechanism are needed for the pair.

On an alley so constructed, and whether of full length or reduced length, I use either the regulation pins, as shown in Figs. 1 to 5, or my new circulating targets, as illustrated in Figs. 17 and 19.

When desired, a rail, wall or guard may be built along the high end of alleys such as those shown in Figs. 1 to 5. Such protection is needed, especially in the construction of Figs. 20 and 21, when a guard *g* is shown and marked in the drawings.

Although the third finger is also sometimes inserted into a third hole in a bowling ball, in Fig. 22 the manner almost universal among regular bowlers of grasping a bowling ball while swinging it, preparatory to starting it on its long course, is illustrated. That drawing illustrates how feebly the fingers grasp a heavy bowling ball which, on account of gravity and centrifugal force, often has a tendency to slip out of the fingers equal to fifty pounds, in comparison with the way that the whole hand commonly grasps weights of even a few pounds when simply lifting them or carrying them. But here it should be remembered that the tendency of the ball to slip out of the hand increases greatly as the speed to be imparted to the ball increases, since the ball itself weighs but sixteen pounds of the fifty or more pounds above mentioned. In view of this, it will be understood that a principal object of my invention, briefly and roughly stated, is to enable a player, the grip of whose fingers, when swinging the ball, can comfortably resist only say about a twenty-pound tendency of the ball to slip out of his fingers, to start his ball forward slowly and easily, impelling it somewhat and determining its direction, with means provided to accelerate the speed of movement of his ball until it has attained a speed equal to one which would have implied a tendency of the ball to slip out of the hand of the player, equal to perhaps forty pounds; but it may be much more or much less than this.

From the foregoing description of the several embodiments of my invention illustrated in the drawings, the way that I have accomplished the different objects of invention stated in the early part of this specification, has probably already been made clear, unless possibly as to one or two of those objects of invention:

One object of invention was stated to be "to somewhat reduce or overcome the tendency of beginners' balls to roll off into the gutter, although not properly aimed originally". Probably it is already clear that, on my downwardly-inclined alley, the forward component of the movement of the ball is accelerated without any acceleration of the sidewise component. Stated briefly, a ball which is so aimed from the center of the foul-line as to normally pass completely off the bed near the pin-space, follows an inwardly-curving path as it rolls down the incline and passes across the pin-space, while, upon a perfectly horizontal surface, it would have passed off into the gutter before reaching the pin-space. This greatly improves the player's efforts, raises his score, and increases the interest in the game.

Another object of my invention was stated to be "to so construct bowling alleys that alleys which are not washed and oiled frequently enough will not be at so great a disadvantage in comparison with well-kept alleys as they are with alleys of the present construction". On my improved alley, not only does gravity add speed to the ball thrown by a weak or indifferent player, and so help it overcome the resistance of an unkept alley, but it keeps continually helping throughout a considerable part of the travel of the ball, whereas, on alleys of the types so far found in commercial use, all the energy must be put into the ball before it starts on its long journey.

Another object of my invention was stated to be "to so construct a bowling alley as to help the game of a poor player more than it helps the game of an accomplished player". Obviously, of course, a given gravitational pull or acceleration increases the speed of a very slowly-impelled ball by a far larger percent than it does the speed of a rapidly-impelled ball. Thus, a downward inclination of say four feet in the bed of the alley, may double or even triple the speed of a very slowly-impelled ball, while it would add but fractionally to the speed of a rapidly-impelled ball. An unkept horizontal alley, with a high frictional resistance, offers a greater obstacle to a weak and poor player than to a strong and experienced player. Further, while the accelera-

tion of the forward component of movement of the ball, without acceleration of the sidewise component, materially increases the score of a poor player, the same physical principle interferes somewhat with the aim of a strong, accomplished player, who controls his ball definitely and would prefer not to have his aim interfered with by the gravitational pull, especially when he causes his ball to curve upon the alley as the great majority of accomplished players now do, or when he directs his ball cross-wise of the alley, as players also frequently do. To very materially assist the game of poor and weak players by an improvement in the field on which the game is played, without thereby correspondingly improving the game of the good players, is a very unusual accomplishment and of great importance in any game which is conducted as a business, commercially.

Many modifications and variations of my apparatus hereinbefore described and illustrated in the accompanying drawings, may be made, without departing from the essential principles, or at least, from certain of the essential principles, of my invention.

What, therefore, I claim herein as my invention and desire to secure by Letters Patent is—

1. A bowling alley, which includes (*a*) a players' runway, on which a player may run while delivering his ball; (*b*) a bed for said ball to traverse on its way from the hand of the player to the pins, which bed includes a downwardly-inclined portion whereby gravity accelerates the speed of the ball after it has left the hand of the player and before it reaches the pins; and (*c*) a pin space for pins at a level materially lower than the level of the players' runway aforesaid.

2. A bowling alley which includes (*a*) a substantially horizontal runway on which the player may run while delivering his ball; (*b*) a substantially horizontal pin-space for pins, at a level materially lower than the level of the player's runway aforesaid; and (*c*) a bed for said ball to roll upon from the player's runway aforesaid to the pin-space aforesaid; a portion of said bed being inclined downwardly whereby gravity accelerates the speed of the ball after it has left the hand of the player and before it has reached the pins aforesaid.

3. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) a players' runway on which the player may run while delivering his ball; (*b*) a pin-space for pins at the opposite end of the alley; and (*c*) means which permit gravity to accelerate the speed of the ball after it has left the hand of the player and before it has reached the pins.

4. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) a players' runway on which the player may run while delivering his ball; (*b*) a pin-space for pins at the opposite end of the alley; and (*c*) means which permit gravity to accelerate the speed of the ball after it has left the hand of the player and before it has reached the pins, the player's ball and the whole surface of the alley being visible to said player at all times.

5. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) an elevated, substantially horizontal players' runway on which the player may run while delivering his ball; (*b*) a lower, but substantially horizontal pin-space for pins at the opposite end of said alley; and (*c*) a downwardly-inclined portion, connecting said elevated players' runway and said lower pin-space, whereby the player's ball is accelerated by gravitation after it has left the hand of said player and before it strikes the pins.

6. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) an elevated substantially horizontal players' runway on which the player may run while delivering his ball; (*b*) a lower, but substantially horizontal pin-space for pins at the opposite end of said alley; (*c*) a downwardly-inclined portion, connecting said elevated players' runway and said lower pin-space, whereby the player's ball is accelerated by gravitation after it has left the hand of said player and before it strikes the pins; and (*d*) a power device to assist the ball to return to the elevated players' runway from the depressed pin-space.

7. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) an elevated, substantially horizontal players' runway on which the player may run while delivering his ball; (*b*) a lower, but substantially horizontal pin-space for pins at the opposite end of said alley; and (*c*) a downwardly-inclined portion, connecting said elevated players' runway and said lower pin-space, whereby the player's ball is accelerated by gravitation after it has left the hand of said player and before it strikes the pins, the player's ball and the whole surface of the alley being visible to said player at all times.

8. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) an elevated, substantially horizontal players' runway on which the player may run while delivering his ball; (*b*) a lower, but substantially horizontal pin-space for pins at the opposite end of said alley; (*c*) a downwardly-inclined portion, connecting said elevated players' runway and said lower pin-space, whereby the player's ball is accelerated by gravitation after it has left the hand of said player and before it strikes the pins, the player's ball and the whole surface of the alley being visible to said player at all times; and (*d*) a power device to assist the ball to return to the elevated players' runway from the depressed pin-space.

9. A bowling alley having a straightaway playing surface continuous from end to end, and which includes (*a*) a players' runway on which the player may run while delivering his ball; (*b*) a pin-space for pins located at the opposite end of the alley from the players' runway; and (*c*) means for accelerating the speed of the ball after it has left the hand of the player and before it reaches the pins at the opposite end of the alley, the player's ball, during its entire travel from the hand of the player to the pin-space aforesaid, being on the straightaway playing surface continuous from end to end, above mentioned, and being visible to the player during all such travel.

10. A bowling alley having a players' runway at one end and a pin-space for pins, located at the other end of the same; said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of the alley; the pins being at a substantially lower level than the players' runway, so that the force of gravitation serves to accelerate the movement of the ball after it leaves the player's hand and

before it strikes the pins located at the opposite end of the alley.

11. A bowling alley having a straightaway playing surface, continuous from end to end, which includes a players' runway on which the player stands, at one end of said alley, and a pin-space for pins, located at the other end of the same; said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of said alley; said pins being at a substantially lower level than the players' runway, so that the force of gravitation serves to accelerate the movement of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley; the player's ball, during its entire travel from the hand of the player to the pin-space aforesaid, being on the straightaway playing surface continuous from end to end, above mentioned.

12. A bowling alley having a straightaway playing surface, continuous from end to end, which includes a players' runway on which the player stands, at one end of said alley, and a pin-space for pins, located at the other end of the same; said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of said alley; said pins being at a substantially lower level than the players' runway, so that the force of gravitation serves to accelerate the movement of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley; the player's ball, during its entire travel from the hand of the player to the pin-space aforesaid, being on the straightaway playing surface continuous from end to end, above mentioned, and being visible to the player during all such travel.

13. A bowling alley having a players' runway at one end and a pin-space for pins at the other end of the same; said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of said alley; whereby the force of gravitation accelerates the speed of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley, and a power device acting to return the ball after it has reached the pins, to the players' end of the alley.

14. A bowling alley, having (*a*) a players' runway at one end and a pin-space for pins at the other end of the same, said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of said alley; whereby the force of gravitation accelerates the speed of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley; (*b*) a track for returning the ball from the pin-end of the alley to the players' end of the same; and (*c*) a power device acting to impel the ball from the pin-end of the alley to the players' end, so that it can be used again.

15. A bowling alley having (*a*) a players' runway at one end and a pin-space for pins at the other end of the same, said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of said alley; whereby the force of gravitation accelerates the speed of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley; and (*b*) a track for returning the ball from the pin-end of the alley to the players' end of the same; said return track being located on a higher level than the corresponding part of the bed of the alley, adjacent to said return track.

16. A bowling alley having a players' runway at one end and a pin-space for pins, located at the other end of the same; said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of the alley; the pins being at a substantially lower level than the players' runway, so that the force of gravitation serves to accelerate the movement of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley, the playing surface of the alley-bed being shaped as a convex curve where the ball passes from the horizontal elevated players' runway on to the downwardly-inclined portion of the alley-bed, and shaped as a concave curve where the ball passes from the downwardly-inclined portion to the lower level at which the pins are located.

17. A bowling alley having a players' runway at one end and a pin-space for pins located at the other end of the same; said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of the alley; whereby the force of gravitation is made to accelerate the movement of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley; the playing surface of the alley-bed being shaped as a convex curve, where the ball passes from the horizontal elevated players' runway on to the downwardly-inclined portion of the alley-bed, and shaped as a concave curve where the ball passes from the downwardly-inclined portion to the lower level at which the pins are located; and a power device acting to return the ball after it has reached the pins, to the players' end of the alley.

18. A bowling alley having (*a*) a players' runway at one end and a pin-space for pins located at the other end of the same, said alley being constructed with a downwardly-inclined portion intermediate the players' runway at one end of the alley and the pins at the opposite end of said alley, whereby the force of gravitation serves to accelerate the movement of the ball after it leaves the player's hand and before it strikes the pins located at the opposite end of the alley; the playing surface of the alley-bed being shaped as a convex curve where the ball passes from the horizontal elevated players' runway on to the downwardly-inclined portion of the alley-bed and shaped as a concave curve where the ball passes from the downwardly-inclined portion to the lower level at which the pins are located; (*b*) a track for returning the ball from the pin-end of the alley to the players' end of the same; and (*c*) a power device acting to impel the ball from the pin-end of the alley to the players' end of the same, so that it can be used again.

GEO. F. CAHILL.