March 18, 1941. L. P. CHANEY 2,235,011

BALL CAM DEVICE

Filed Dec. 27, 1938 3 Sheets-Sheet 1

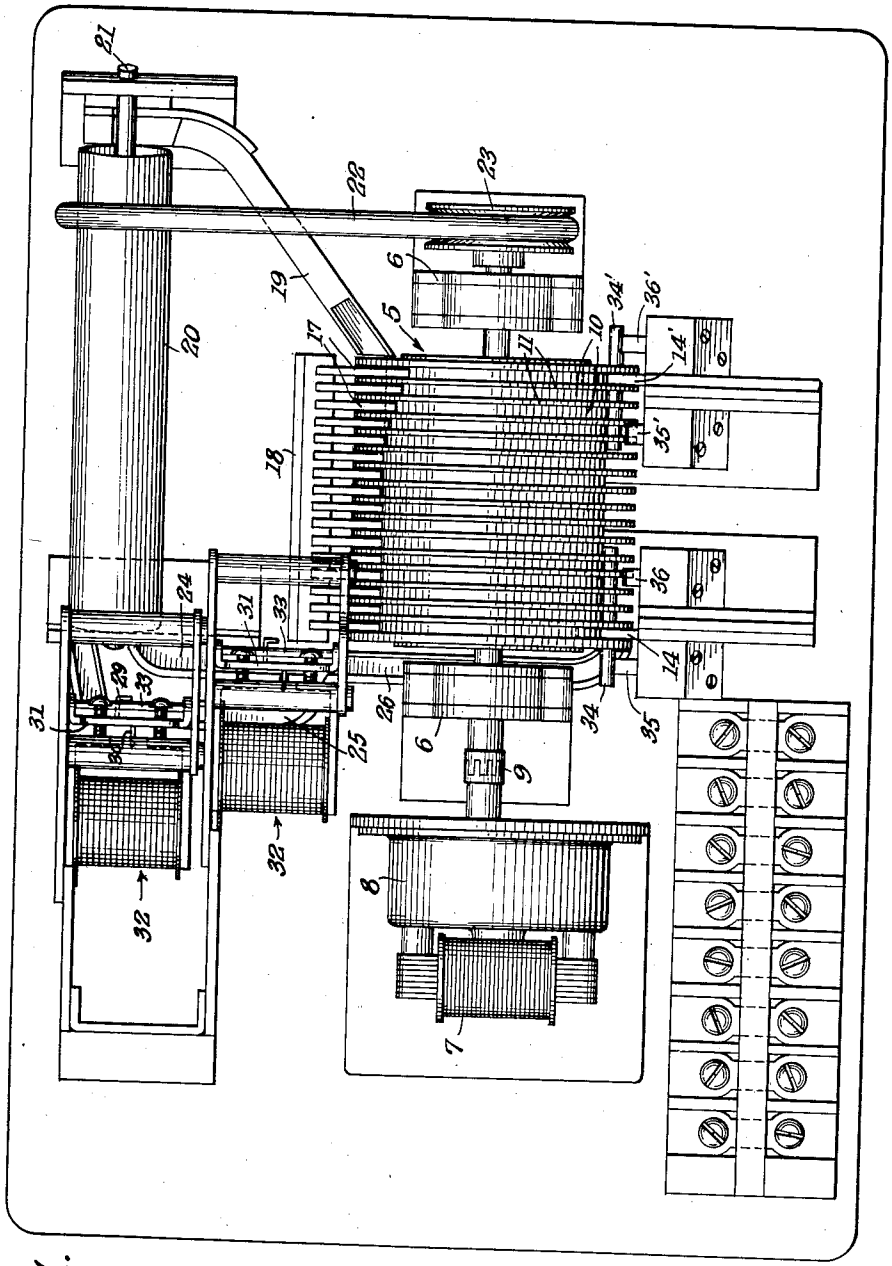



Fig. 1.

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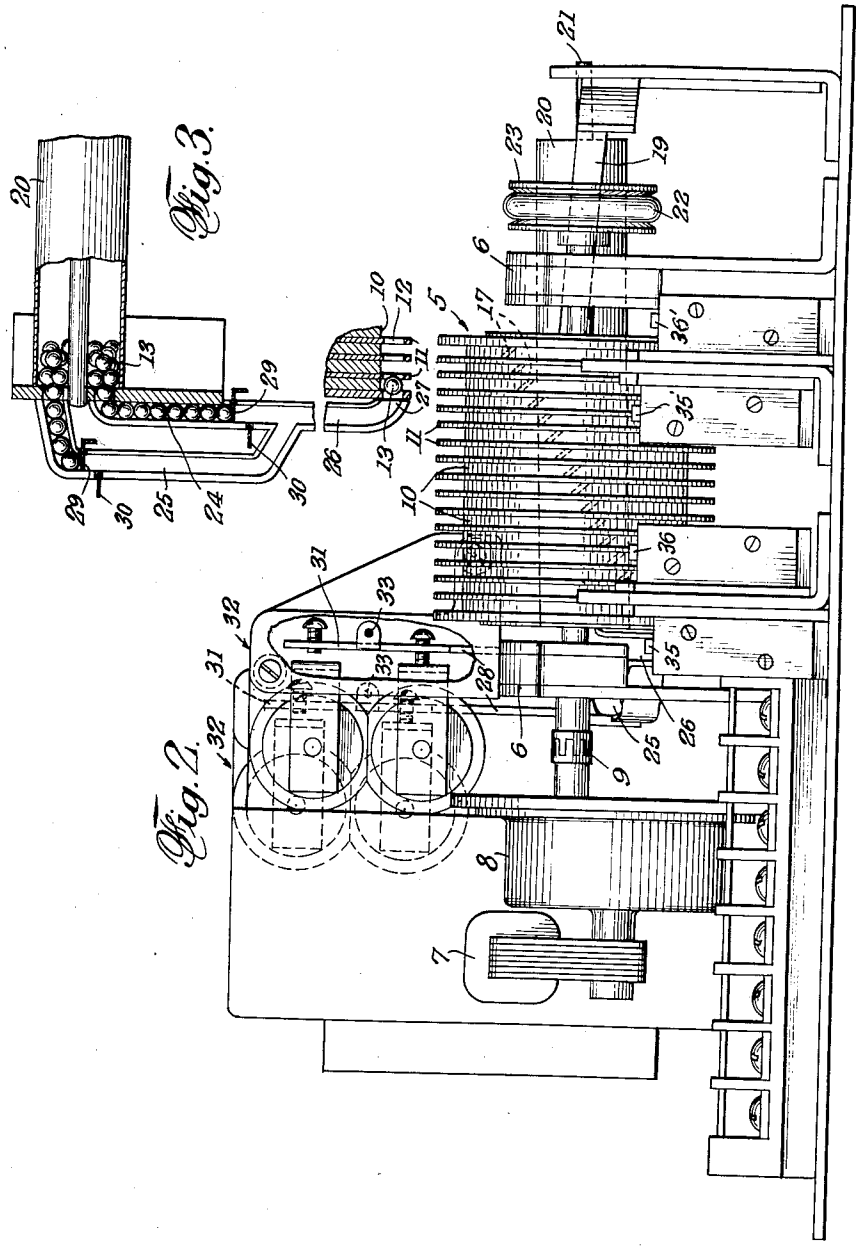


Fig. 2.



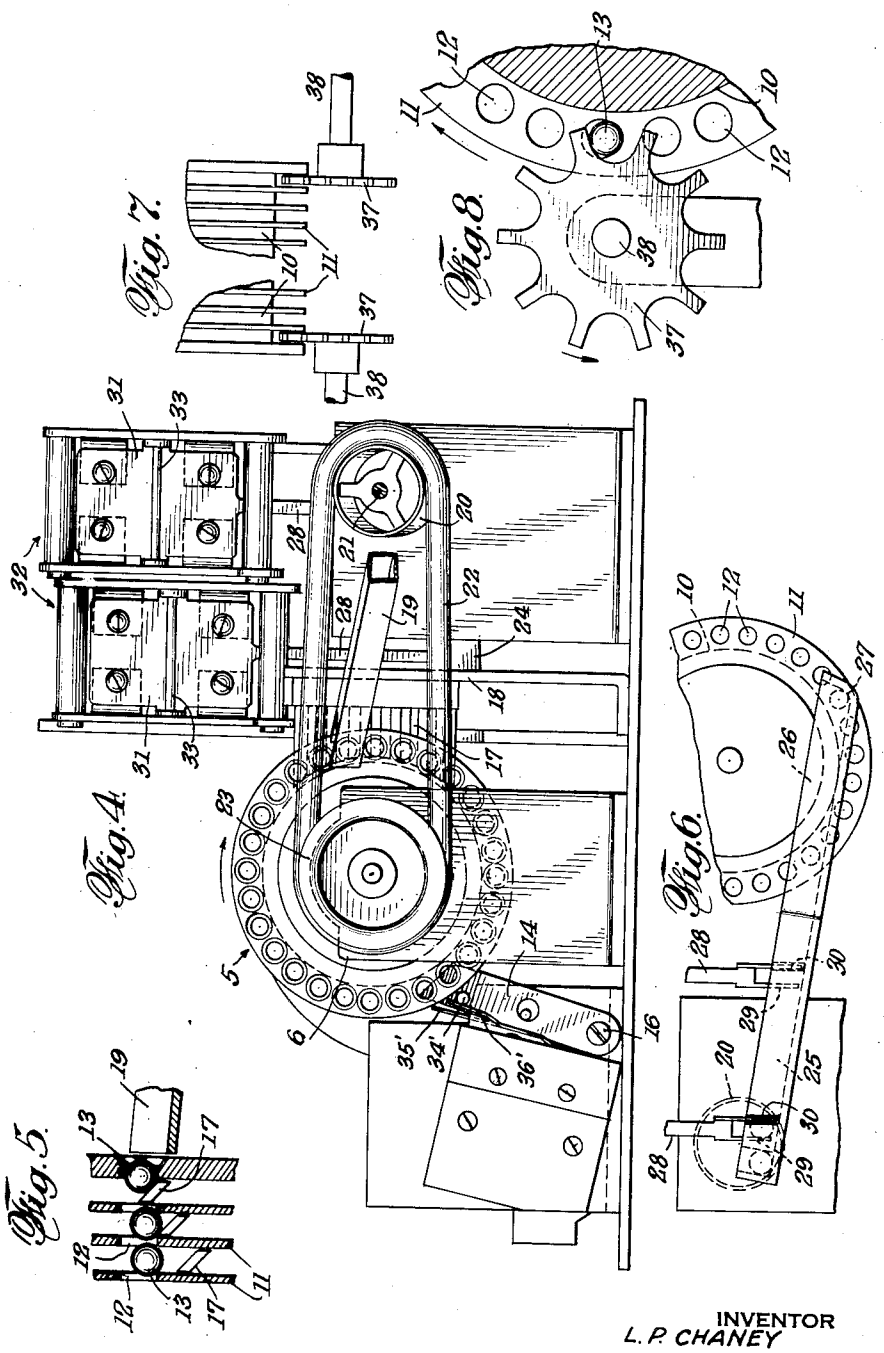
Fig. 3.

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2,235,011

# UNITED STATES PATENT OFFICE

2,235,011

## BALL CAM DEVICE

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Application December 27, 1938, Serial No. 248,017

17 Claims. (Cl. 74—1)

My invention relates to what may be termed a ball cam device.

My ball cam device may be put to many uses, among other uses being as or in connection with a relay, counter, totalizer or integrator, control device, intermittent gear, etc.

The invention contemplates the use of balls which may be fed to or otherwise positioned in a ball carrier and the ball carrier moved so as to cause the balls therein either directly or through suitable intermediaries to operate, control or affect certain parts to be actuated, controlled or affected.

An important use of an embodiment of my invention is in connection with a demand meter, wherein the balls may be fed to the ball carrier by means controlled by one or more contact making watt hour meters and the balls in the ball carrier may serve as actuators for relays to control the register of a demand meter either of the continuous curve type or the conventional definite demand period type. There are many other specific applications of my invention.

It is an object of the invention to provide a device of the character indicated wherein a great many balls may be held in a carrier of small size.

Another object is to provide a device of the character indicated, which is sturdy in construction, reliable in use, simple and exceedingly compact.

It is another object to provide a device of the character indicated in which the ball carrier is positively driven and balls therein may be caused to operate an actuated part or parts and the devices controlling the ball feeding may be relieved of work or strain.

Another object is to provide a device of the character indicated, wherein any practicable number of ball feeders may be provided for simultaneously or successively feeding balls to a ball carrier which itself may carry a great number of balls.

Another object is to provide a device of the character indicated with improved ball conveying and feeding means.

Still another object is to provide improved means for causing balls to be progressed in the ball carrier step by step so as to permit free feeding of new balls and yet retain previously fed balls in the carrier.

A further object is to provide a device of the character indicated, which may act as the driver of a gear either of the continuous or intermittent type, the number and positioning of the teeth in the driver being readily controllable.

Other objects and various features of novelty and invention will be hereinafter pointed out or will become apparent to those skilled in the art.

In the drawings which show, for illustrative purposes only, a preferred form of the invention—

Fig. 1 is a top plan view of a ball cam device, illustrating features of the invention;

Fig. 2 is a view in front elevation of the device shown in Fig. 1;

Fig. 3 is an enlarged fragmentary sectional detail, illustrating particularly ball conveying and feed means;

Fig. 4 is a view in right-hand elevation of the device shown in Fig. 1, parts being broken away;

Fig. 5 is an enlarged fragmentary sectional detail, illustrating particularly means for progressing balls through the carrier;

Fig. 6 is a fragmentary view in left-hand elevation of feed means and associated parts shown in Fig. 3;

Fig. 7 is a fragmentary view, illustrating a slightly different use of the invention;

Fig. 8 is an enlarged view in end elevation of parts shown in Fig. 7.

Briefly stated, in a preferred form of the invention I employ a ball carrier which may be in the form of a cylinder having one or a plurality of circumferentially extending grooves formed by similarly extending flanges on the outer surfaces of the cylinder. The flanges are provided with substantially registering openings forming pockets to receive balls of a diameter slightly larger than the distance between adjacent flanges so that the balls will be held in the openings and the central portions of the balls exposed. The ball carrier is preferably positively driven at a suitable rate and actuated means or means to be controlled may be positioned in the path of the balls in the carrier and be actuated or controlled as the carrier rotates. When a plurality of ball grooves are employed, I preferably provide means for progressing the balls from one groove to another and if desired balls in any or all grooves may be caused to actuate or control means in position to be actuated or controlled. The balls are discharged from the ball carrier and conveyed preferably by gravity to a ball hopper, from which they may be fed under the influence of suitable control means back to the ball carrier, also preferably by gravity. The actuated or controlled means actuated or controlled by the balls in the carrier, as heretofore indicated, may be of various kinds and be variously arranged.

In the particular form shown in the drawings

the ball carrier, designated generally 5, is in the form of a cylinder having trunnions at the ends rotatably mounted in bearings 6—6 on the base. The cylinder is rotated by suitable means, for example a synchronous motor 7 and reduction gear 8, the motor and ball carrier being connected by a suitable coupling 9. The ball carrier 5 in the form of a cylinder is provided with a plurality of ball grooves 10—10 formed in the present instance by spaced apart flanges 11—11. The grooves and flanges may be made by turning the grooves in a solid cylinder or by means of annular stampings secured together with interposed spacers and held in suitable manner, as will be understood. In the present instance there are seventeen flanges, including the two end flanges, and sixteen grooves.

The flanges are provided with transversely extending holes or openings 12—12 and such holes or openings in adjacent flanges are preferably in alignment with each other. In the preferred form each flange has a relatively large number of openings 12 so that there are a relatively large number of sets of substantially aligned openings extending through the flanges from one end of the carrier to the other. The openings 12 are of a diameter to permit the free passage of balls such as 13 and the distance between adjacent flanges 11—11 is slightly less than the diameter of the balls 13 so that when a ball is passed through the opening 12 in the end or other flange it will tend to fall through and be arrested or pocketed by the two holes in adjacent flanges and the central portion of the ball will be exposed in the groove. A ball exposed in the groove may be caused to actuate a suitably positioned member such as a lever 14 pivoted to the base at 16. Such lever, as will be later described, may actuate a switch or other device.

After a ball in the first groove has actuated, say, the lever 14, the ball, upon rotation of the ball carrier in a clockwise direction as viewed in Fig. 4, will be carried upwardly until it engages one of the teeth 17 of a comb 18 carried by the base. The comb teeth 17 are inclined (Figs. 2, 5) and when the ball engages such inclined surface the ball will be tipped toward the right and through the hole 12 and come to rest in the next groove. When the ball reaches the last groove and the last comb tooth 17 in that groove, it will be tipped from the last groove through the right-hand end flange of the carrier and into a ball trough 19 to be conveyed back to the ball hopper 20. The comb teeth 17, as will be clear, may be arranged in echelon, the last comb tooth being at a relatively high position. With the comb teeth so arranged it will be clear that a ball in one groove will be tipped out of that groove and reach the next groove beneath the comb tooth therein. This action will be clear from Figs. 2 and 5. By having the ball tipped out of the last groove into the discharge conveyor 19 at a high level, it will be possible to have the balls descend by gravity into the inclined tubular ball hopper 20.

The hopper 20 may be mounted on suitable trunnions or bearings 21—21 and if desired vanes or ribs therein may be employed for causing the balls to be lifted therein upon rotation of the hopper 20 and thus cause agitation and progress through the hopper. The latter, if desired, may be rotated as by means of a belt 22 extending about the hopper and about a pulley 23 on the carrier trunnion. The hopper 20 is preferably inclined from the discharge end of the wheel toward the feed end thereof so that balls in the hopper will be constantly fed to the feed end of the hopper.

Extending from the feed end of the hopper there may be one or a plurality of feed troughs 24—25. These troughs may merge into a single feed chute or trough 26 positioned in close proximity to the first flange on the ball carrier, as indicated at 27. The trough 26 at the end 27 is arranged at such an angle that when a hole 12 in the end flange comes opposite the end 27, a ball in the trough will be tipped into the hole 12 and rolled therethrough into the first groove where, as explained, it is held or pocketed in the holes of adjacent flanges with the central portion exposed. The balls may be fed as desired by means of gates 28—28 in the two feed troughs 24—25. Obviously, when more troughs are provided, a gate would ordinarily be provided in each and to accommodate many feed troughs the hopper might be mounted on a vertical axis and the feed troughs might lead off therefrom all around the periphery. The gates as shown more particularly in Figs. 3 and 6 have two spaced apart plates 29—30 so that when the gate is moved to the right as viewed in Fig. 3, a ball will be admitted by a plate 29 and retarded by the plate 30. When the gate 28 is again moved toward the left, the row of balls will be split by the plate 29 and the ball retarded by the plate 30 will be released to the trough 26 and to the wheel carrier as heretofore described. The gates 28—28 if desired may be carried by or form parts of armatures 31—31 of electromagnetic devices 32—32. The gates or armatures may be pivoted at 33 and such gates are moved back and forth by the double-acting solenoid or other electromagnetic devices. The electromagnetic devices may be controlled by any suitable devices, for example contact making watt hour meters if the device is to be used as a totalizer or in connection with a demand meter.

It will be clear that when the ball carrier 5 is rotated as by means of a motor 7 holes 12 in the first flange 11 will be caused to pass the feed end 27 of the feed chute or ball conveyor. When a ball is permitted to pass to the end 27 by one of the gates 28 it immediately rolls or is tipped into the first groove. If a number of balls descend the feed chute 26 they are successively tipped or rolled into and through successive holes 12 passing before the end 27 of the feed chute. The exposed portions of the balls in the first ball groove will successively engage the lever 14 which will be cammed out or rocked each time a ball passes it. Such lever may control switches or other devices as will be later set forth. The balls in the grooves will be tipped by the comb teeth 17 from one groove successively into the next. The balls in the last or any other groove may engage and actuate a second lever 14' which in turn may actuate switches or other devices. The ball in the last groove when it reaches the last comb tooth will be tipped through the hole in the last flange and into the discharge chute 19 back to the ball hopper 20. The balls in the hopper will descend, preferably by gravity, back to the feed end of the device. Thus, by controlling the feed of the balls as by means of the gates and devices for actuating the same at the desired intervals, for example by contact making watt hour meters, the desired number of balls will be fed and for each ball fed a device such as the lever 14 will be actuated or controlled. If a second actuation

is desired, a second part such as a lever 14' is positioned in the path of the balls in one of the subsequent grooves, for example the last groove.

If my ball cam device is to be employed simply as a totalizer, for example, for a plurality of contact making watt hour meters, the latter will be connected so as to energize the electromagnetic devices to feed balls to the ball carrier as heretofore described. Each ball fed in accordance with the actuation of the watt hour meters will actuate the lever 14 which in turn may have a bar 34 to actuate contact devices 35—36 of switches. Either or both switches may in turn serve to cause actuation of a counter.

If my device is to be used in connection with a conventional demand meter register having a definite demand period, one or both of the switches 35—36 may be connected to such demand meter and register the demand, after which the demand meter is returned to its zero position. If my device is to be used in connection with a continuous curve demand meter register, one of the switches 35—36 would be connected to the adding solenoid while corresponding switches 35'—36' actuated by the bar 34' and lever 14' would be connected to the subtracting solenoid. With sixteen grooves in the ball carrier and with the ball carrier rotating at one R. P. M. exactly fifteen minutes would elapse between the time any given ball actuated the lever 14 and the time the lever 14' were actuated by the same ball. Thus, each ball upon entering the ball carrier would actuate the adding solenoid and exactly fifteen minutes later would actuate the subtracting solenoid. In any fifteen minute period it is conceivable that there would be a ball in substantially each ball pocket between each pair of flanges. Such a great number of balls it will be seen will all be within the space occupied by the ball carrier itself.

Instead of actuating a lever or similar device as heretofore described, my ball carrier may be employed as the driver of a gear train either of the continuous or intermittent type. In Figs. 7 and 8, I have illustrated one form of gear device wherein I employ a plate or index gear 37 rotatably mounted on a shaft 38. Each ball in a ball pocket in the carrier will serve to rotate the shaft 38 one tooth. The shaft 38 may actuate a counter either directly or through connected mechanism, for example a switch operated by the shaft. If desired, a plurality of such index gears and shafts 38 may be employed so that instead of actuating levers as heretofore described each ball may be caused to turn the shafts 38 through one tooth. Furthermore, if one or more shafts 38 be employed for some type of control work, the operation of such shafts may be readily controlled by the number of balls in the groove and the positioning of the same. If a fixed cycle is to be imparted to the shaft 38 only a single groove may be necessary and the balls simply positioned as desired. In that case one comb tooth would ordinarily be employed for shifting the balls from such groove. The device shown in Figs. 7 and 8 may be considered as a gear train either of a substantially constant or of an intermittent type, and the number and positioning of the teeth, that is, the balls in the driver, may if desired be controlled by external means, that is to say, by the control of the feed gates or other types of ball feeders.

While a few of the uses to which my invention may be put have been mentioned or suggested, it is to be understood that the uses are in no sense limited to those mentioned or suggested. The invention is of utility in many fields and for many different purposes. The device is of utility for a variety of control purposes requiring exact timing. The number of grooves as well as the locations of the actuated parts and the speeds of rotation may all be varied to attain the desired results.

While the invention has been described in considerable detail and a preferred form illustrated, it is to be understood that various changes and modifications may be made within the scope of the invention as defined in the appended claims.

I claim:

1. In a device of the character indicated, a generally cylindrical ball carrier having spaced apart circumferentially extending flange members to define a plurality of circumferentially extending grooves between adjacent flanges, registering holes extending transversely through said flange members, whereby a ball may be held in a pair of holes in adjacent flanges with the central portion of the ball exposed between said flanges, means for rotating said ball carrier, and actuable means positioned to be actuated by the exposed portion of the ball held between said flanges, and means for automatically transferring the ball from the space between two of said adjacent flanges to the space between one of said two flanges and the next adjacent flange.

2. In a device of the character indicated, a generally cylindrical ball carrier with its axis disposed substantially horizontally and having a plurality of circumferentially extending spaced apart flanges, registering longitudinally extending holes through said flanges, whereby a ball may rest in a pair of holes in adjacent flanges and have the central portion of the ball exposed between said flanges, means for rotating said ball carrier about said horizontal axis, means for shifting a ball longitudinally through one of said registering holes and partially into the registering hole in the next adjacent flange, and actuable means positioned to be actuated by a ball held in holes of adjacent flanges.

3. In a device of the character indicated, a generally cylindrical ball carrier having a plurality of spaced apart circumferentially extending flanges with longitudinally registering holes therein, whereby a ball may be held in the holes between adjacent flanges and the central portion of the ball exposed therebetween, means for rotating said ball carrier, means for automatically shifting a ball held between a pair of adjacent flanges to the corresponding space between one of said pair of adjacent flanges and the next adjacent flange during rotation of said ball carrier, and actuated means positioned to be actuated by a ball held between a pair of adjacent flanges.

4. In a device of the character indicated, a generally cylindrical ball carrier with its axis disposed substantially horizontally and having a plurality of spaced apart circumferentially extending flanges, said flanges having corresponding longitudinally extending registering apertures therethrough whereby a ball may be held in the registering apertures between two adjacent flanges, means for rotating said carrier, means for automatically shifting the ball longitudinally through one of said registering apertures in one flange and into the space between said last mentioned flange and the next succeed-

ing flange during rotation of said carrier, and means controlled by balls held between flanges during rotation of said carrier.

5. In a device of the character indicated, a generally cylindrical ball carrier having a plurality of spaced apart circumferentially extending flanges defining a plurality of circumferentially extending grooves, said flanges having a plurality of holes extending transversely therethrough, the holes of adjacent flanges substantially registering with each other, said holes in each flange being substantially circularly arranged therein, means for feeding balls to and through the holes in one of said flanges into the space between adjacent flanges during rotation of said carrier, means for rotating said carrier, means for successively feeding each ball from the space between two of said flanges to the space between the next two adjacent flanges, the last of said means for shifting balls through said apertures being arranged at a high level, whereby balls shifted from said carrier will emerge at a high level, a downwardly inclined gravity conveyor for receiving balls emerging from said carrier, a storage hopper for balls received from said conveyor, a feeding conveyor extending from said hopper to said ball carrier for feeding balls from said hopper to said carrier, and means controlled by balls in said carrier.

6. In a device of the character indicated, a generally cylindrical ball carrier having a plurality of spaced apart circumferentially extending flange means and oriented with its axis substantially horizontal, said flange means having a corresponding plurality of substantially registering transverse holes therein extending longitudinally of said carrier, means for conveying balls to and through apertures in one of said flange means to the space between adjacent flanges, means for rotating said carrier, and means for automatically shifting balls through successive adjacent flanges and discharging the same from said carrier through the last of said flanges at a higher level than the level at which balls are fed to said carrier, and conveyor means for conveying balls from the discharge point of said carrier back to the feed point, and means controlled by balls carried by said carrier.

7. In a device of the character indicated, a ball carrier having a plurality of ball holders, said ball carrier being of substantially cylindrical form and said ball holders being formed in substantially aligned rows longitudinally thereof and in generally circular formation therearound, means for feeding balls to ball holders at one part of said carrier, means for automatically shifting said balls from one holder to another, and means controlled by said balls in said holders upon rotation of said carrier.

8. In a device of the character indicated, a generally cylindrical ball carrier having a plurality of ball holders arranged in generally circular formation about said carrier and in substantial alignment with each other longitudinally of said carrier, means for feeding balls to the holders at one end of said carrier, means for automatically shifting balls longitudinally of said carrier into said aligned holders, means for automatically discharging balls from said holders at the opposite end of said carrier, and means actuated by balls in some of said holders upon rotation of said carrier.

9. In a device of the character indicated, a rotatable ball carrier having a plurality of ball holders in substantially longitudinal alignment with each other on said carrier, means for feeding a ball to a ball holder at one end of said carrier, means to be actuated by said ball in said holder at said end of said carrier, means for automatically shifting said ball into said longitudinally aligned holders successively, a second means to be actuated by said ball at the opposite end of said carrier, and means for automatically discharging said ball from said carrier.

10. In a device of the character indicated, a rotatable ball carrier having a plurality of ball holders therein, conducting means for conducting balls to some of said holders, means for automatically feeding balls to said conducting means, means actuated by the fed balls, and means for automatically shifting said balls from one holder to another successively and for automatically discharging balls from said carrier.

11. In a device of the character indicated, a rotatable ball carrier of generally cylindrical form, said carrier having a plurality of sets of longitudinally aligned ball holders, said sets being circularly arranged about said cylindrical carrier, means for rotating said carrier, means for feeding balls to holders at one end of said carrier, means actuated by balls at said end, means for automatically shifting balls longitudinally of said carrier in said sets of aligned holders, and a second means actuated by balls subsequent to the actuation of said first means, and means for discharging balls from said carrier.

12. In a device of the character indicated, a rotatable ball carrier having a plurality of sets of longitudinally substantially aligned ball holders, said sets being circularly arranged about said carrier, a ball hopper for holding a supply of balls, electromagnetic means for feeding balls from said hopper to holders at one end of said carrier, electric switch means positioned to be actuated by balls in holders at one end of said carrier, means for shifting balls successively from one holder to the next substantially aligned longitudinal holder, electric switch means positioned to be actuated by balls shifted to said longitudinally aligned holders, means for discharging balls from said holders at a relatively high level, and gravity means for conveying discharged balls back to said hopper.

13. In a device of the character indicated, a ball carrier having a plurality of sets of substantially aligned ball holders, said sets extending longitudinally of said carrier, said sets being arranged in generally circular formation about said carrier, means for rotating said carrier at a definite rate, a feed chute for conveying balls to holders in said carrier, a plurality of means for controlling the feed of balls to said feed chute, means actuated by balls in said carrier at one end, means for automatically shifting balls from holder to holder longitudinally of said carrier, means actuated by balls when shifted to the opposite end of said carrier means for discharging balls from said carrier at a relatively high level, gravity means for returning balls to the ball hopper, and gravity means extending from said ball hopper to said hopper conveyor, and means for causing the balls in said hopper to be agitated to facilitate feeding to said conveyor means.

14. In a device of the character indicated, a ball carrier including a rotatable generally cylindrical member having a plurality of circumferentially extending flanges thereon, said flanges having substantially aligned holes therein to receive balls of a diameter greater than the distance

between adjacent flanges, whereby balls will be held between said flanges with the central portion thereof exposed, electric switch means having a part positioned adjacent the groove between the first flanges on said carrier, fixed means extending between said flanges for automatically shifting balls successively through said holes in said flanges, a second switch means positioned in the space between the last flanges, whereby balls shifted successively through said flanges may act on said switch means upon rotation of said balls past said switch means, means for discharging balls through the last flange in said carrier, a ball hopper, a conveyor means for conveying balls from the discharge end of said carrier to said hopper, conveyor means from said hopper to the feed end of said carrier, and electromagnetic means for controlling the feed of balls through said conveyor means to said carrier.

15. In a device of the character indicated, a generally cylindrical ball carrier mounted for rotation about a substantially horizontal axis and having a plurality of circumferential generally radially projecting flanges thereon to define a plurality of spaced apart grooves circumferentially of said carrier, the flanges between adjacent grooves having generally longitudinally extending ball passages therethrough, said passages being of a size to permit the passage of balls and said grooves being of a width to prevent radial passage of balls, whereby balls may be exposed in said grooves and held by the passages in adjacent flanges, means for feeding balls to one of said grooves through passages in the flange defining one side of said groove, means for rotating said carrier, and a fixed ball-tipping member extending into a groove for engagement with a ball to tip the latter out of its support in one groove through a passage in one flange and into a similar support in the next adjacent groove.

16. In a device of the character indicated, a generally cylindrical ball carrier mounted for rotation about a substantially horizontal axis and having a plurality of circumferential generally radially projecting flanges thereon to define a plurality of spaced apart grooves circumferentially of said carrier, the flanges between adjacent grooves having generally longitudinally extending ball passages therethrough, said passages being of a size to permit the passage of balls and said grooves being of a width to prevent radial passage of balls, whereby balls may be exposed in said grooves and held by the passages in adjacent flanges, means for feeding balls to one of said grooves through passages in the flange defining one side of said groove, means for rotating said carrier, and a plurality of ball-tipping members extending into a plurality of said grooves for tipping balls through the passages in said flanges from one groove to another, said ball-tipping members being arranged longitudinally of said carrier in progressively higher planes, whereby a ball shifted from one groove can enter the next groove below the ball-tipping member therein.

17. In a device of the character indicated, a ball carrier, means for progressively shifting balls along said carrier, a ball hopper, discharge means from said hopper to the feed portion of said carrier, ball discharge means from the discharge portion of said carrier back to said hopper, and means for agitating balls in said hopper to prevent clogging of the balls at the discharge means from said hopper.

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