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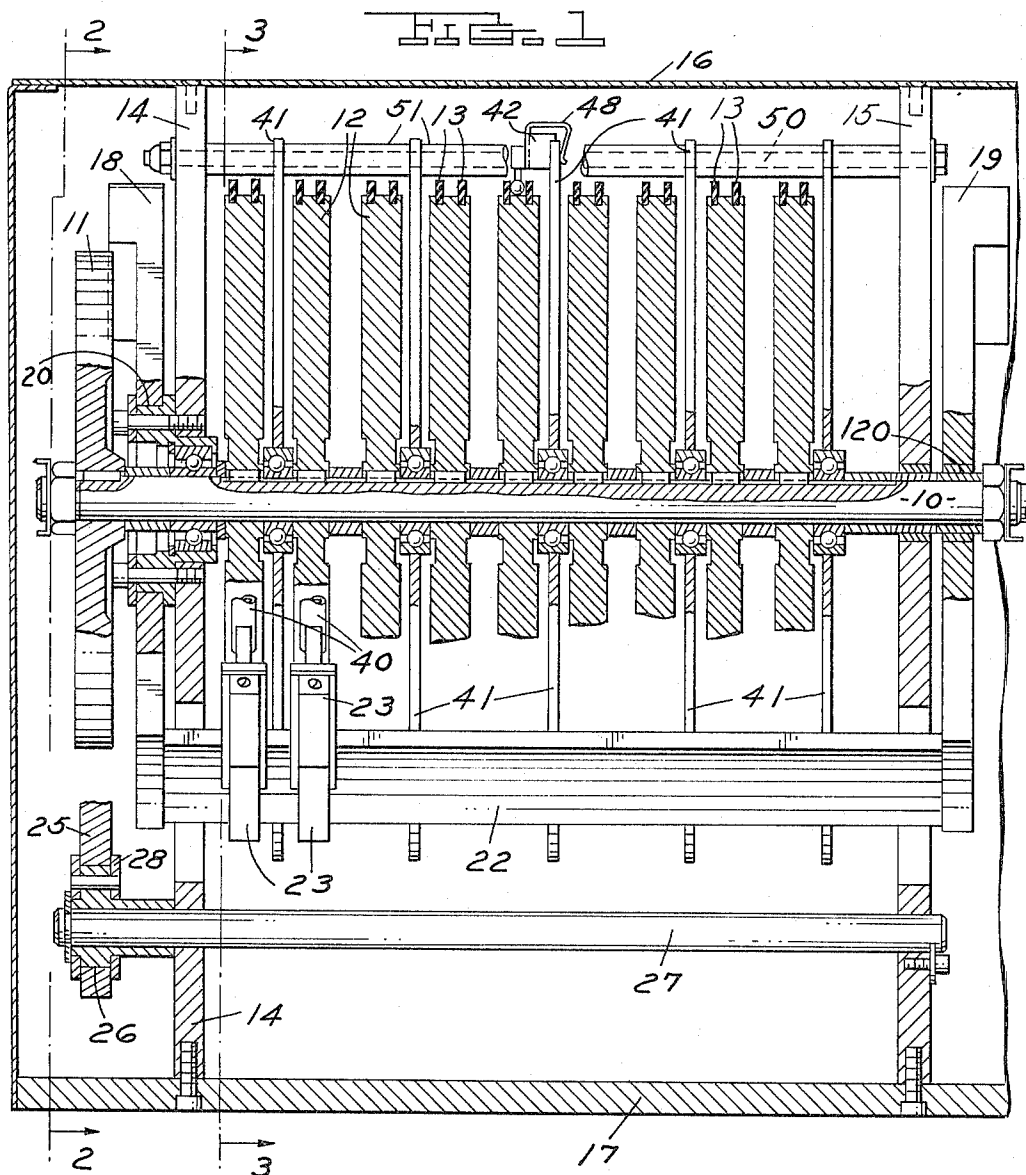
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3,274,852

BALL TRACK TIMING DEVICE

Filed March 5, 1964

4 Sheets-Sheet 1



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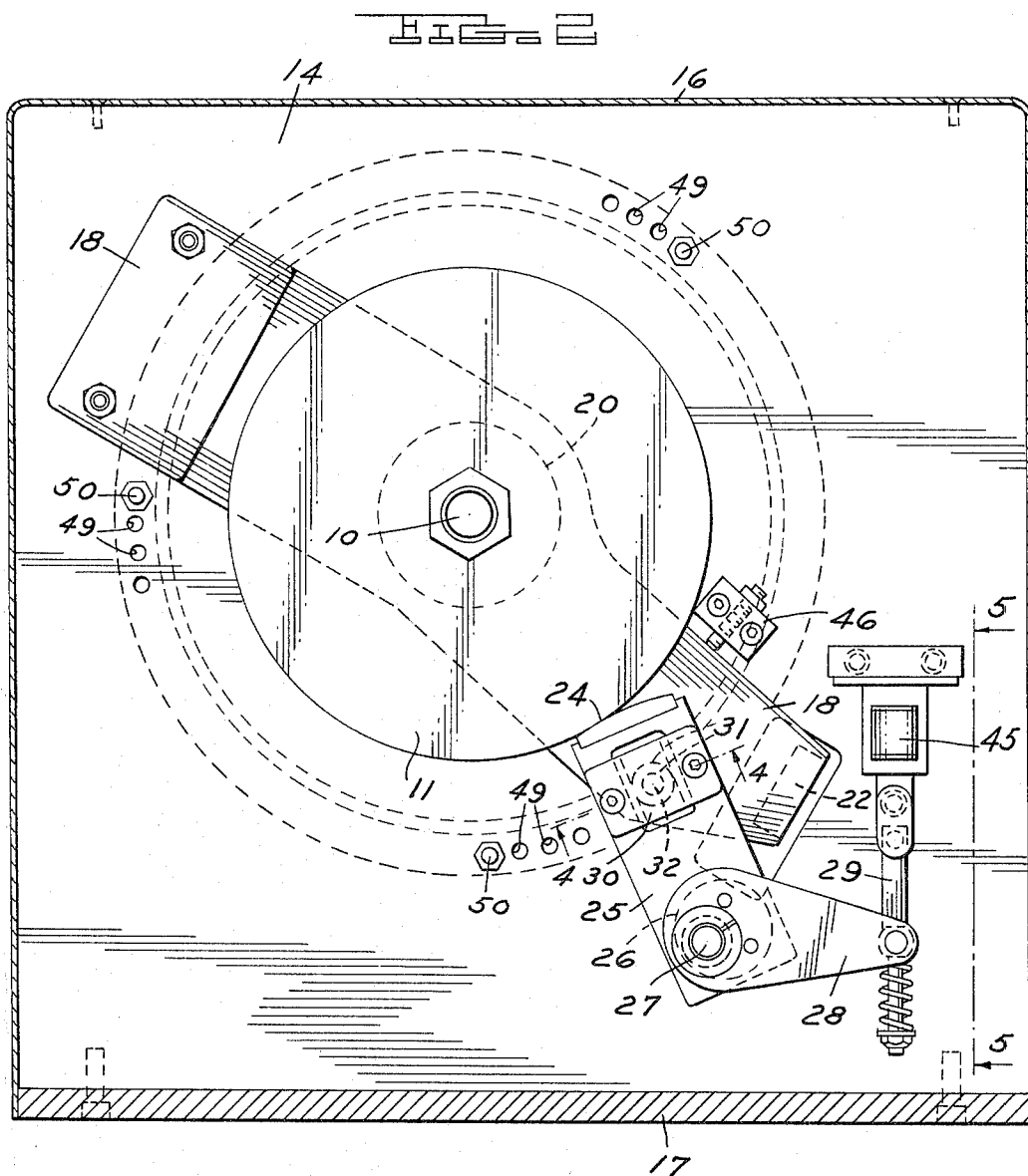
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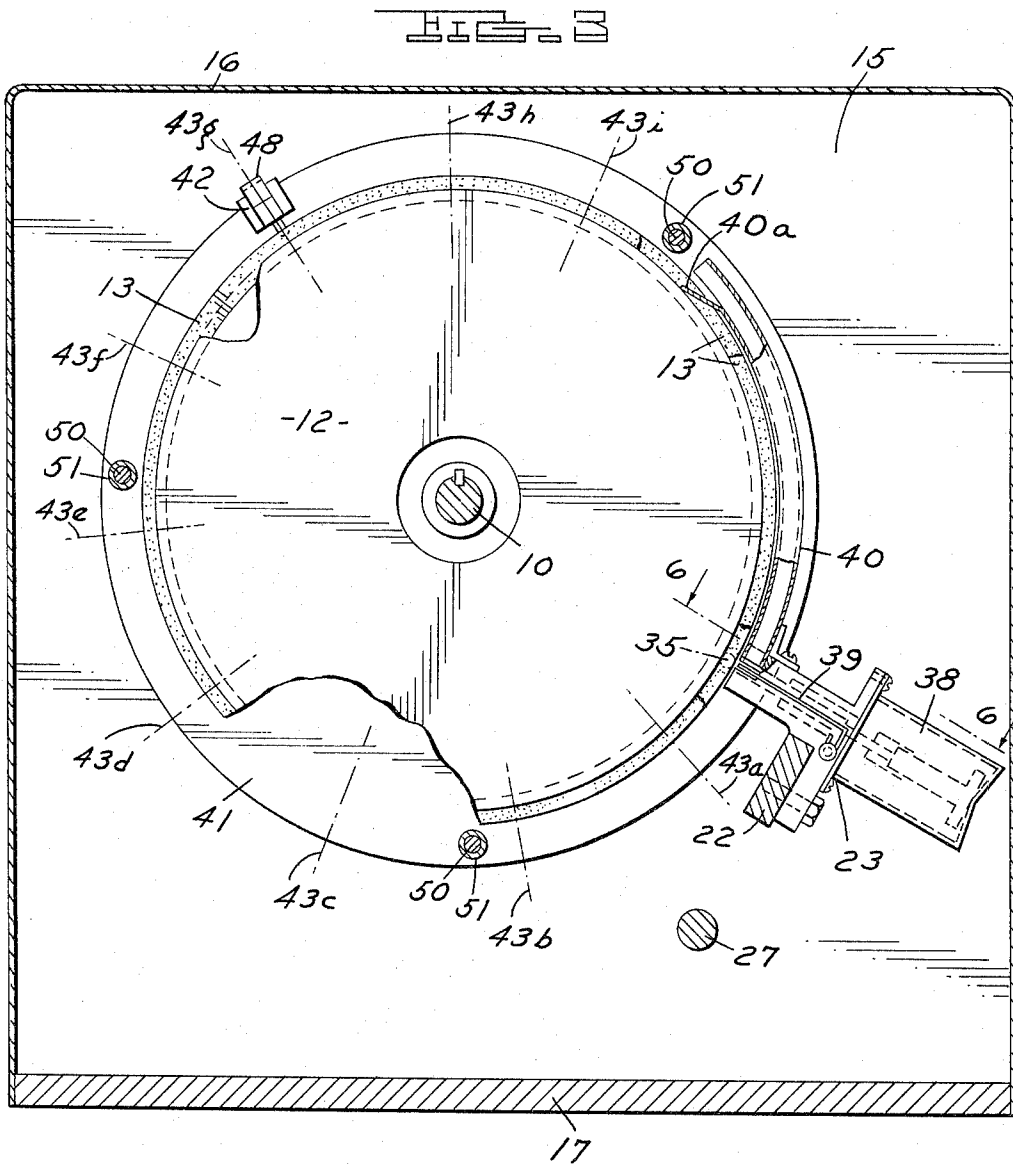
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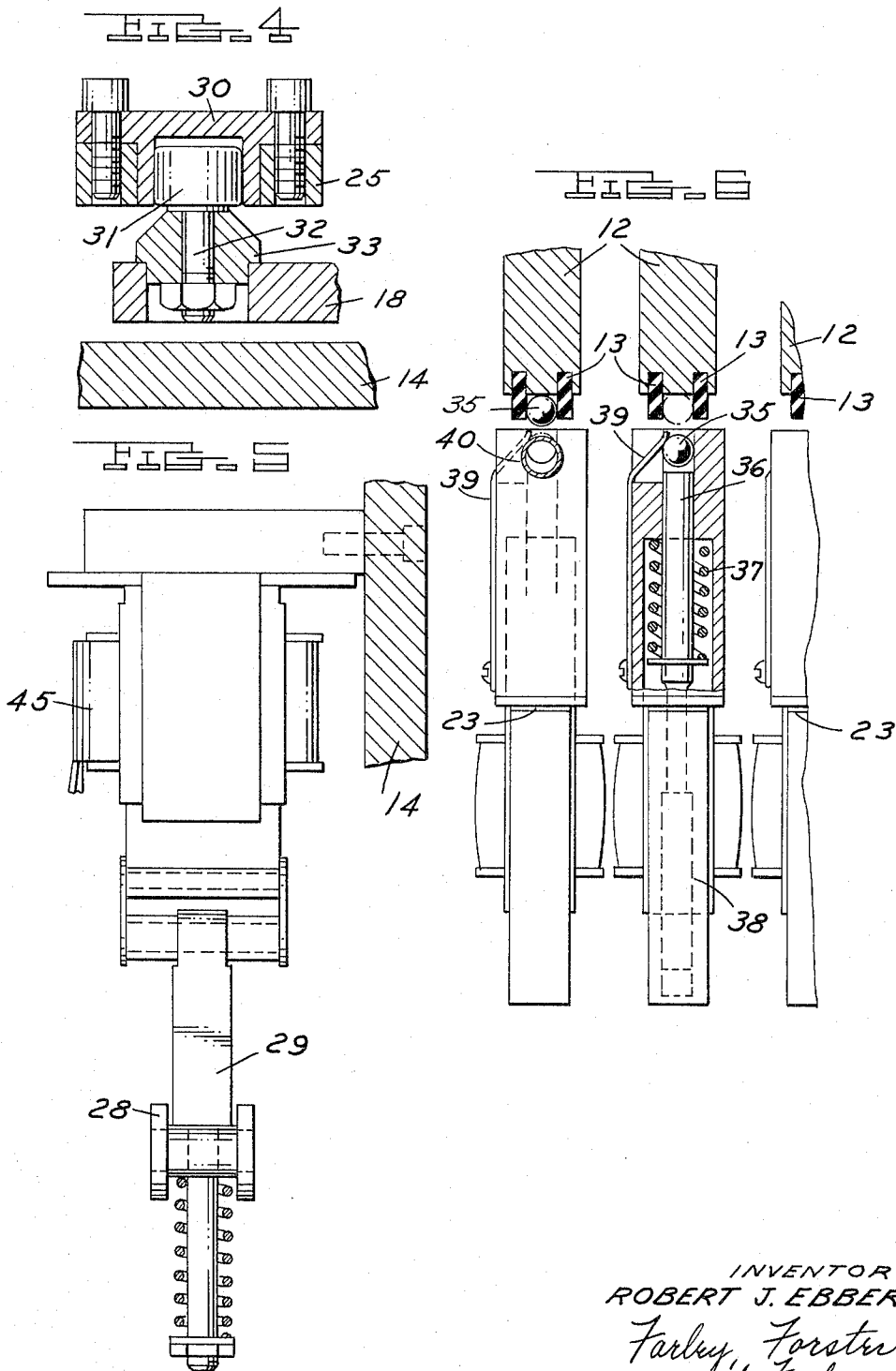
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BALL TRACK TIMING DEVICE

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20 Claims. (Cl. 74-568)

This invention relates to a timing device for use in conveyor installations and the like where it is desired to synchronize a selective discharge action, such as movement of a package from a main conveyor line to a branch line, with the arrival of such package at a suitable transfer position.

When the discharge action is a lateral translation of the package from the main conveyor line by a pusher or similar device, it is frequently important that the transfer be initiated in properly timed sequence relative to the center of the package which in case different sized packages are to be handled in the conveyor system may require timing means capable of detecting and diverting relative to the center of the package.

The present invention employs a series of annular ball retaining tracks (equal, for example, to the number of discharge stations) which move at a circumferential rate synchronized with the rate of conveyor travel, together with means for inserting a ball selectively in any one of the tracks corresponding to a pre-selected discharge station and switch means responsive to the arrival of the ball at a pre-determined circumferential position for initiating the transfer or discharge action. In order that a ball may be initially placed in a track relative to the center of the package, the ball depositing mechanism is adapted to initiate its action upon passage of a reference point by the leading edge of a package, the depositing mechanism moving along the ball track at a one-half rate speed and depositing the ball in response to the trailing edge of the package passing such reference point so that the ball's location when deposited in the track will be synchronized with the center of the package, regardless of its length.

These and other objects of the invention will be more apparent from the following detailed description of a preferred embodiment with reference to the drawings wherein:

FIG. 1 is a sectional elevation taken through a series of nine ball retaining tracks;

FIG. 2 is an end view taken along the line 2-2 of FIG. 1;

FIG. 3 is a sectional end view taken along the line 3-3 of FIG. 1;

FIG. 4 is a fragmentary sectional view taken along the line 4-4 of FIG. 2;

FIG. 5 is a fragmentary elevation taken along the line 5-5 of FIG. 2; and

FIG. 6 is a fragmentary sectional view taken along the line 6-6 of FIG. 3.

Referring to FIG. 1 a central shaft 10 of the timing device is driven by means (not shown) at a speed proportional to conveyor speed carrying with it a clutch disc 11 and nine ball track discs 12 each having a pair of resilient ball retaining annular track elements 13. The shaft 10 is journaled in bearings located in stationary end walls 14 and 15 on which an outer housing 16 is attached, the end walls and housing being mounted on base plate 17. A pair of counterweighted ball injector mechanism carrying arms 18 and 19 are pivotally mounted respectively on a hub extension 20 projecting from the end wall 14 and a bushing 120 carried by the shaft 10. The arms 18 and 19 are attached to a cross rail 22 on which a plurality of ball injector units 23 are mounted, one for each of the nine track discs 12.

The outer perimeter of the clutch discs 11 is adapted to be engaged by a clutch facing 24 mounted at one end

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of a clutch arm 25, pivotally connected to a cylindrical bearing 26 of an eccentric pivotally mounted on shaft 27 adapted for actuation by an arm 28 through a spring-loaded solenoid energized rod 29. Actuation of the clutch 24 through energizing of the solenoid rod 29 will cause the clutch facing 24 to follow the periphery of the clutch disc 11 causing articulation of the arm 25 about the pivotal connection provided by the cylindrical bearing 26 in turn moving a roller track 30 mounted on the arm 25 and a roller 31 confined therein mounted on a stub shaft projecting from a fitting 33 mounted on arm 18, thus causing, in turn, articulation of the arm 18 about the bearing hub 20 and movement of the rail 22 and ball injector units 23 mounted thereon about the periphery of the ball track discs 12. Due to the geometry of the linkage (the fractional ratio of the peripheral speed of the clutch disc 11 relative to the peripheral speed of the ball track 13, equal to approximately three-fourths, times the fractional ratio of the peripheral speed of the engagement point of the roller track 30 relative to the peripheral speed of the clutch facing 24, equal to approximately two-thirds) the relative rate of travel of the ball injector units will be substantially one-half that of the ball track discs so that when movement of the ball injector unit is initiated in timed relation to the passage of a given reference point of a conveyor by the leading edge of a package and a ball is injected between a pair of the resilient retaining elements 13 in timed relation to the passage of such reference point by the trailing edge of such package, the location of the ball as thus deposited on the disc will be the same as if the ball injector unit had not moved and the ball was otherwise deposited on the disc in response to the passage of such reference point by the center of the package.

As best shown in FIGS. 3 and 6 injection of a ball 35 between the annular retaining elements 13 is effected by a solenoid operated push rod 36, retracted by compression spring 37 upon de-energizing the solenoid 38, a spring detent 39 retaining the ball delivered from a return chute 40 preparatory to actuation of the push rod 36. A plurality of stationary annular discs 41 mounted between the respective ball track discs 12 serve to mount ball sensing limit switches 42 in any position around the periphery of the disc between a first station 43a and a last station 43i, corresponding to the last delivery station of the conveyor. Thus, as in the present case where nine equally spaced delivery stations along the conveyor are contemplated, the drive of the ball disc 12 is synchronized with the conveyor drive to advance a ball from one station position, e.g. 43b to 43c, in the same time it takes the conveyor to pass between such delivery stations and likewise to move from the first station 43a to the last 43i in the same time it takes the conveyor to traverse all nine delivery stations.

It will now be understood that if the reference point at the dispatch end of the conveyor, which may be any suitable sensing device such as an electric eye beam projecting across the conveyor, is employed to deposit a ball in a ball track in timed sequence relative to the passage of such reference point by the center of a package, the placement of a ball detecting switch 42 at an appropriate position relative to a discharge station or branch line may be employed to sense the arrival of the center of the package at the desired discharge point and the discharge operation initiated thereby. It will also be understood that where as in the present case nine separate ball tracks and injector units are employed, a different peripheral location for the respective switches 42 may be employed corresponding to each of nine delivery points on the conveyor so that by selecting which of the nine ball tracks will be used for a given package moving

through the dispatch station and by employing the center locating mechanism described above, a control unit is provided for selective delivery and remote control of a discharge operation relative to the center of packages of different random lengths and locations on any conventional conveyor such as an endless belt conveyor.

As best shown in FIG. 3 after passing the ball detecting switch 42 each ball continues past the last station position and is deflected by a finger 40a into the return chute 40 which returns it to injecting position. It is, of course, possible to have a number of packages en route to the same delivery station for each of which a ball is deposited at the dispatch station and the return chute 40 is made of appropriate length to store a number of balls equal to the maximum number of packages which could be en route at a given time.

Since the application of this ball track timing device to specific requirements and suitable control circuits relating thereto will be readily apparent to those skilled in the art, the present disclosure is limited to an embodiment of the inventive subject matter per se which is claimed herein. Nevertheless, in order to further clarify the operation of this device a typical sequence will now be described with reference to a hypothetical conveyor system.

Assume, for example, that a conventional conveyor belt passes a dispatch station and nine equally spaced delivery stations, at each of which a pusher mechanism is situated to engage a package from the side and move it laterally off of the conveyor belt and onto a branch gravity conveyor at the delivery station. Assume further that an electric eye is situated at the dispatch station, the beam of which is interrupted by the leading edge of a package (a first event) and re-established by the passage of the trailing edge of the package (a second event) and that either a manual or automatic dispatch system pre-selects the delivery station before this package arrives at the electric eye, for example, by manually depressing one of nine push buttons whereupon the interruption of the electric eye light beam will energize the solenoid 45 and rod 29 (FIG. 2) engaging the clutch face 24 and initiating the movement of the bar 22 carrying the ball injecting unit. When the beam is re-established by the passing of the trailing edge of the package, the ball injecting solenoid 38 is energized, depositing a ball into one of the nine ball discs corresponding to the pre-selected delivery station and the solenoid 45 is de-energized, releasing the clutch 24 whereupon the counter-weighted arm 18 will return to its starting position established by adjustable stop 46. Each successive package will likewise re-energize solenoid 45 initiating movement of the ball injecting units and a corresponding succession of balls will be deposited at positions corresponding to package centers (the median of first and second events) passing the conveyor reference point established by the electric eye. As the conveyor proceeds the balls will reach respective ball detection switches corresponding to the pre-selected delivery stations at the time required for engagement of the package center by the pusher mechanism at the delivery station (a third event) the actuation of which may be made responsive to the detection switch 42 by power and control means well known in the art. Although location of the switches 42 may be pre-calculated from the conveyor layout and dimensional relationship of the ball track timing device, a fine adjustment in the field may be desired which is accommodated by spring clamp 48 permitting the switch to be moved to any position on the perimeter of the mounting discs 41. Several alternative mounting holes 49 for each of the three tie bars 50 extending between the end plates 14, 15, (which also pass through and space the discs 41 with spacers 51) provide sufficient flexibility of tie bar location to accommodate any required positioning of the various ball detection switches 42.

While one specific embodiment of the ball track timing device forming the subject matter of this invention has

been shown and described above in detail, it will be understood that numerous modifications may be resorted to without departing from the scope of the invention as defined in the following claims.

I claim:

1. A timing device for determining the interval between the median of two events having a variable interval therebetween and a third event of known interval relative to the first event, comprising means for sensing the first event, means for sensing the second event, standard rate means operating during the interval between said first and third events, one-half rate means responsive to said respective sensing means operative during the interval between said first and second events, and means responsive to said one-half rate means upon the occurrence of said second event for determining the interval between the median of said first and second events and said third event.

2. A timing device as set forth in claim 1 including selective means for establishing said third event as any one of a plurality of events having known different intervals relative to said first event.

3. A timing device as set forth in claim 1 wherein said standard rate means comprises an element moving at a standard rate along a predetermined path between a first reference point and a second reference point corresponding to the interval between said first and third events, and wherein said one-half rate means includes means movable from said first reference point along said path at one-half of said standard rate starting with said first event and continuing until the occurrence of said second event, whereby the location of said one-half rate means upon the occurrence of said second event will correspond to the position of the median of said first two events relative to said third event.

4. A timing device as set forth in claim 1 wherein said standard rate means comprises an annular element rotating at a standard rate, and said one-half rate means comprises an element movable along the periphery of said annular element in the direction of and at substantially one-half of the peripheral speed of said annular element.

5. A timing device as set forth in claim 4 including means associated with said one-half rate means adapted to deposit a timing element on the periphery of said annular element upon the occurrence of said second event, and pre-positioned fixed means for detecting said timing element upon the occurrence of said third event.

6. A timing device as set forth in claim 5 including means for removing said timing element from the periphery of said annular element after the occurrence of said third event.

7. A timing device as set forth in claim 5 including multiple annular elements and multiple fixed detecting means at relatively different spacings along said path, and a distinct one-half rate means for each of said annular elements.

8. A timing device as set forth in claim 7 including common drive means for each of said one-half rate means.

9. A timing device as set forth in claim 4 wherein said one-half rate means includes a clutch disc driven at the same angular velocity as said annular element, and including means engageable with the periphery of said clutch disc for driving said one-half rate means.

10. A timing device as set forth in claim 4 wherein said one-half rate means includes a clutch disc driven at the same angular velocity as said annular element, and including means engageable with the periphery of said clutch disc for driving said one-half rate means, together with pivotal linkage engageable with the periphery of said clutch disc adapted to drive said one-half rate means.

11. A timing device as set forth in claim 4 wherein said one-half rate means includes a clutch disc driven at the same angular velocity as said annular element, and including means engageable with the periphery of said

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clutch disc for driving said one-half rate means, together with pivotal linkage engageable with the periphery of said clutch disc adapted to drive said one-half rate means, said linkage including an eccentric bearing pivoted on a fixed axis and resilient means for actuating said bearing in a clutch-engaging direction.

12. A timing device as set forth in claim 4 including means associated with said one-half rate means adapted to deposit a timing element on the periphery of said annular element upon the occurrence of said second event, and pre-positioned fixed means for detecting said timing element upon the occurrence of said third event, said annular element including a peripheral groove having at least one resilient sidewall, and said timing element comprising a ball insertable at any peripheral position of said groove.

13. A timing device as set forth in claim 4 wherein said one-half rate means includes a clutch disc driven at the same angular velocity as said annular element, and including means engageable with the periphery of said clutch disc for driving said one-half rate means, and solenoid means adapted to actuate said clutch.

14. A timing device as set forth in claim 4 including means associated with said one-half rate means adapted to deposit a timing element on the periphery of said annular element upon the occurrence of said second event, and pre-positioned fixed means for detecting said timing element upon the occurrence of said third event, said annular element including a peripheral groove having at least one resilient sidewall, said timing element comprising a ball insertable at any peripheral position of said groove, and solenoid actuated means for inserting said ball upon the occurrence of said second event.

15. A timing device as set forth in claim 1 wherein said standard rate means comprises an annular element rotating at a standard rate, and said one-half rate means comprises an element movable along the periphery of said annular element in the direction of and at substantially one-half of the peripheral speed of said annular element, mounted on a counter-weighted arm pivotally mounted on the same axis as said annular element.

16. A timing device as set forth in claim 1 wherein said standard rate means comprises an annular element rotating at a standard rate, and said one-half rate means comprises an element movable along the periphery of said annular element in the direction of and at substantially one-half of the peripheral speed of said annular element, mounted on a counter-weighted arm pivotally mounted on the same axis as said annular element, and an adjustable stop limiting the return movement of said arm upon release of said clutch means.

17. A timing device as set forth in claim 7 including annular disc means adjacent each of said annular elements, and switch means adjustably mounted on said annular discs for sensing the occurrence of said third event.

18. A timing device comprising a plurality of like annular discs mounted on a common rotatable shaft continuously driven at a standard rate, each of said discs having a peripheral groove with at least one resilient side-

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wall, a ball inserter carrier yoke having arms, said yoke being pivotally mounted on the axis of said shaft for limited articulation, a ball inserter mounted on said yoke in radial alignment with said groove for each of said annular discs moving in unison with the articulation of said arms, selectively engageable clutch and driven means adapted to move said yoke at substantially one-half the annular velocity of said annular discs in the same direction starting from a fixed limit position of said yoke, selectively operable means for actuating one of said ball inserters to insert a ball in said groove as said yoke is moving at said one-half speed relative to said annular discs, and adjustably mounted fixed switch means adjacent said groove for each of said annular discs having relatively different circumferential spacing, said switch means being adapted to detect the arrival of said ball, whereby the position of said ball when inserted will be substantially one-half way between the peripheral point on said annular disc opposite said ball inserted when said yoke movement started and a like point at the moment of ball insertion.

19. A timing device for determining the interval between the median of each pair of successive events (the first and second events of each pair having variable intervals therebetween) and a third event of known interval relative to the first of each pair of events, comprising means for sensing the first of each pair of events, means for sensing the second of each pair of events, standard rate means operating continuously, one-half rate means responsive to said respective sensing means operating during the interval between the first and second of each pair of events, means responsive to said one-half rate means upon the occurrence of the second of each pair of said events for determining the interval between the median of such pair of events and said third event, and means for restoring said one-half rate means to its original condition upon the occurrence of the second event of each pair of events.

20. A timing device as set forth in claim 19 including selective means for establishing said third event as any one of a plurality of events having a known interval relative to the first of each of said pair of events.

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