United States Patent

[11] 3,594,009

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Benton Harbor, Mich.
[32] Priority **Sept. 8, 1966**
[33] **Spain**
[31] **330996**

[54] **AUTOMATIC RECORD REPRODUCER APPARATUS**
45 Claims, 34 Drawing Figs.

[52] U.S. Cl. 274/10
[51] Int. Cl. G11b 17/16
[50] Field of Search 274/10

[56] **References Cited**

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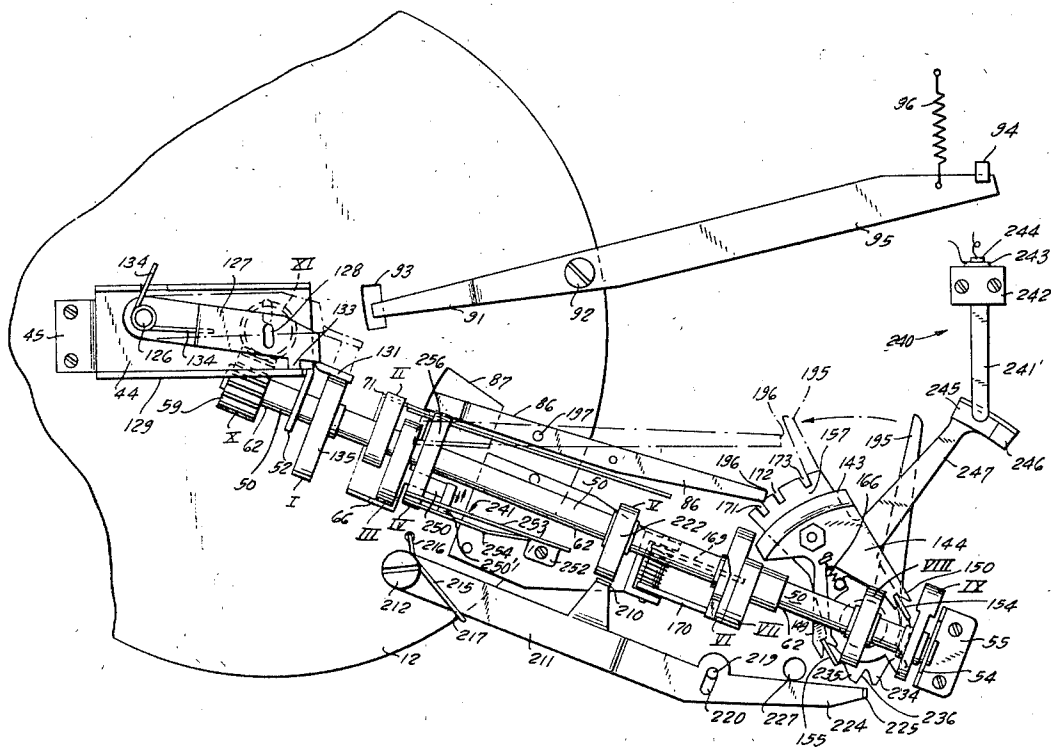
Primary Examiner—Harry N. Haroian
Attorney—Kane, Dalsimer, Kane, Sullivan & Smith

ABSTRACT: The invention relates to automatic record changers adapted particularly for reproducing records of different diameters. The records may be held in intermingled stacked relationship upon a supporting spindle element prior to release for play. A series of cams carried and supported for rotation upon a single camshaft functioning with suitable controls determines the operational sequence control. Rotation of the camshaft and its cams over a preestablished angle (usually 360°) controls the operation. Camshaft rotation is interrupted each time the shaft turns through the selected angle and is then reinitiated either manually or automatically. All normal operations are established in known sequence.



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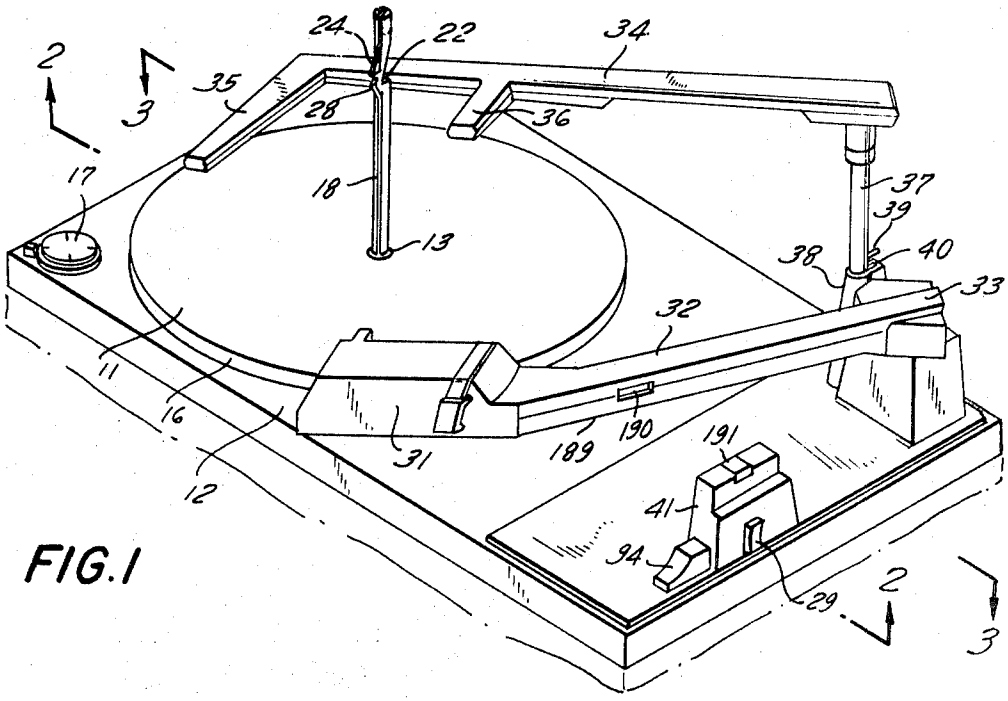

FIG. 1

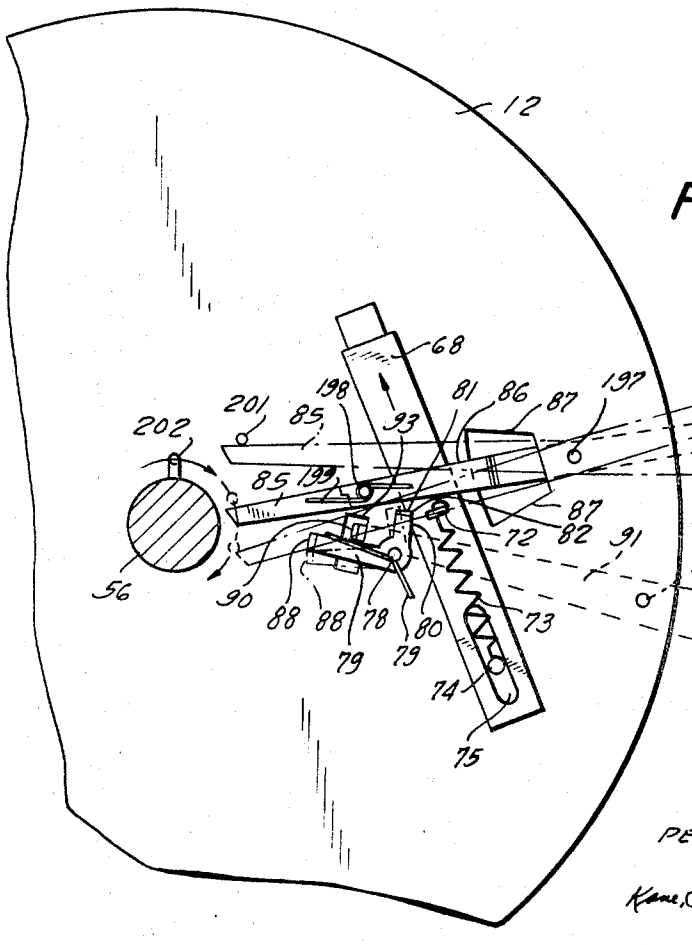

FIG. 5

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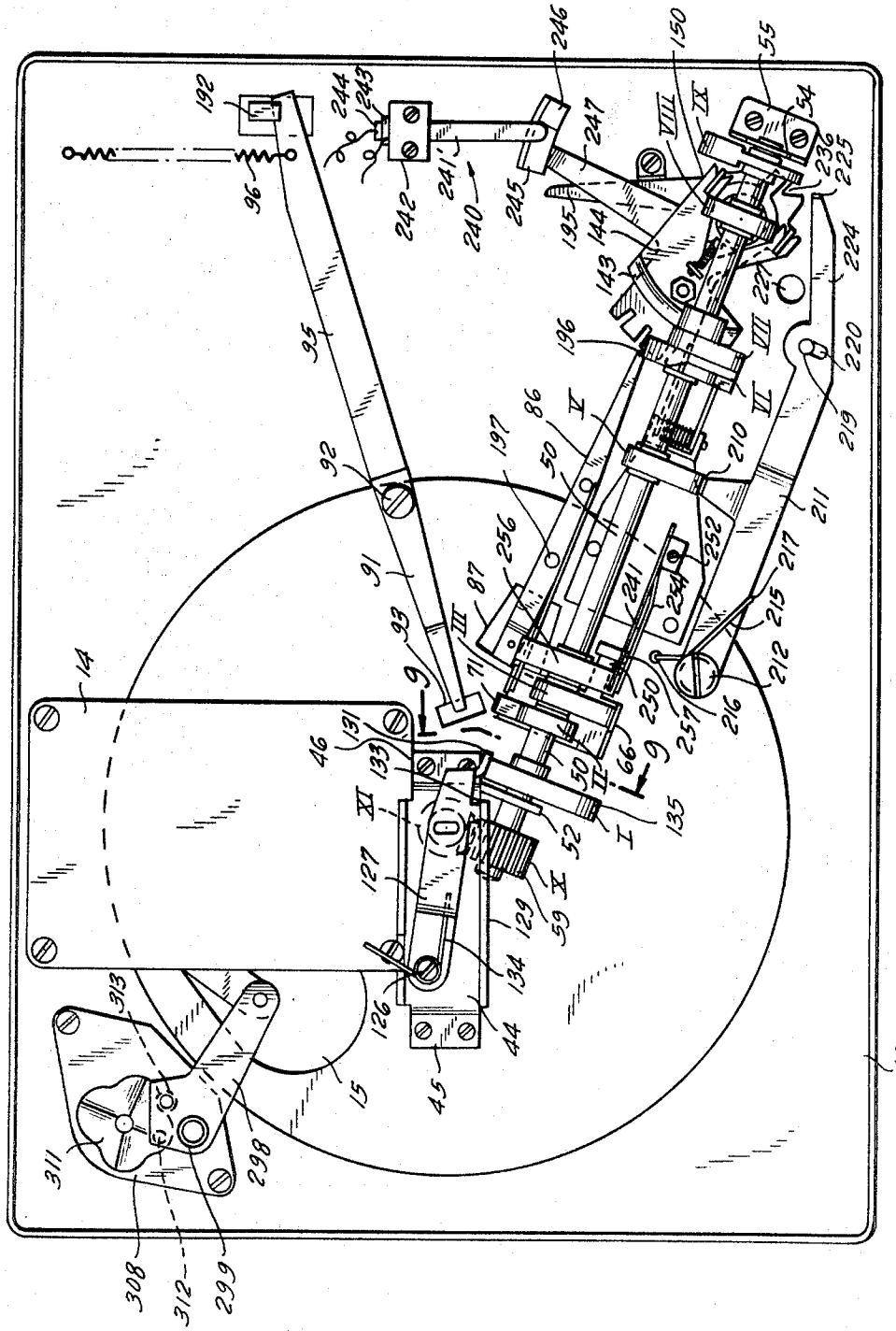

FIG. 2

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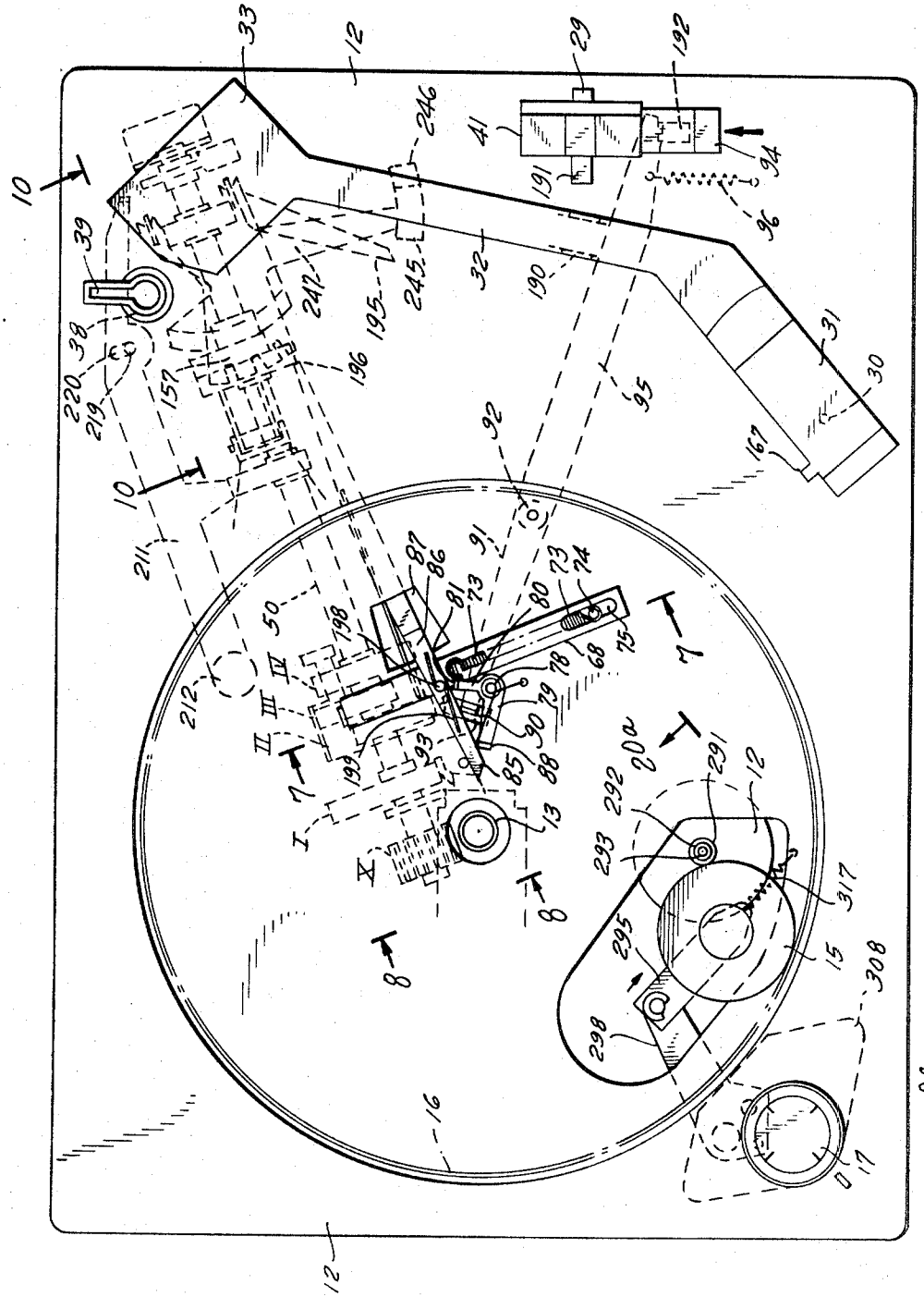

FIG.3

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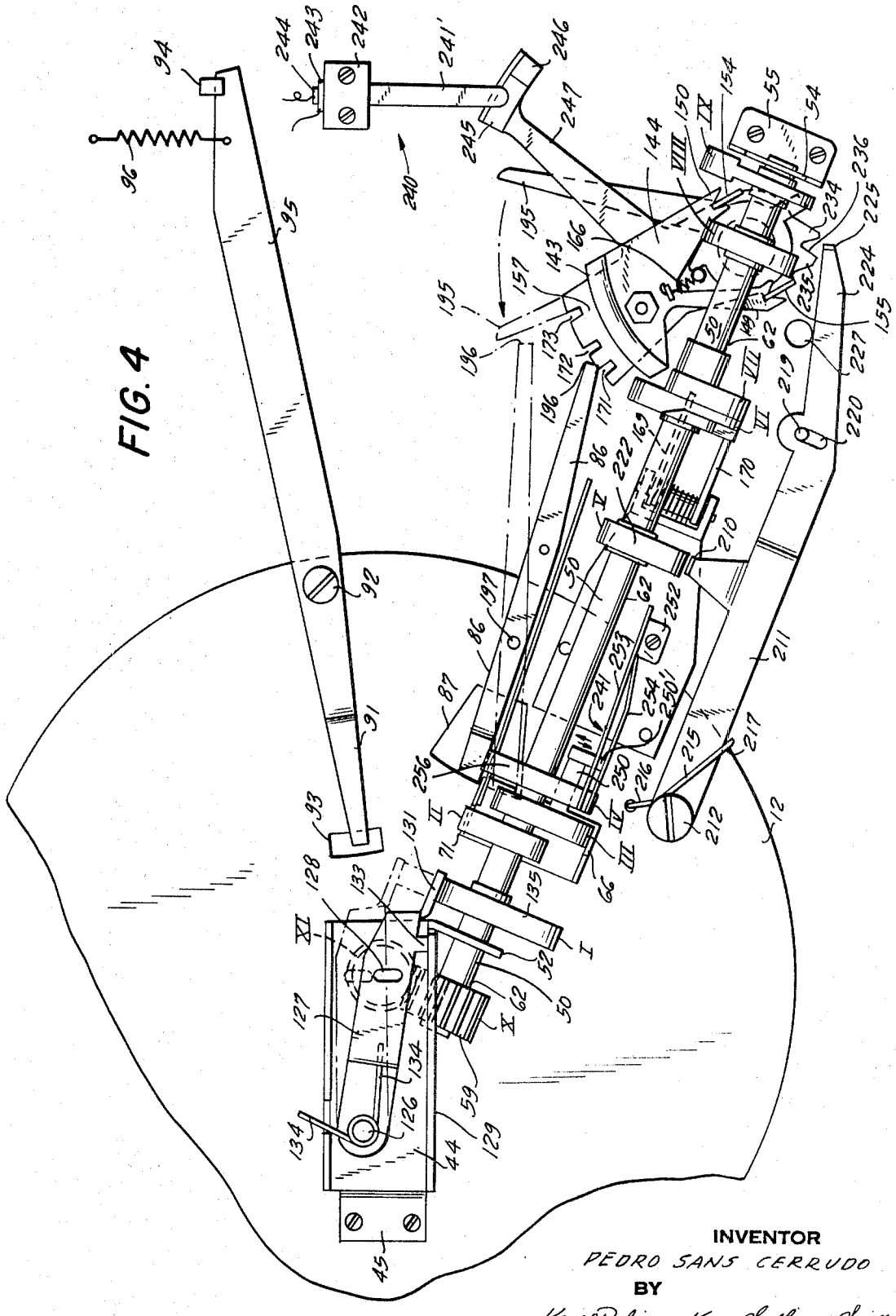
FIG. 4



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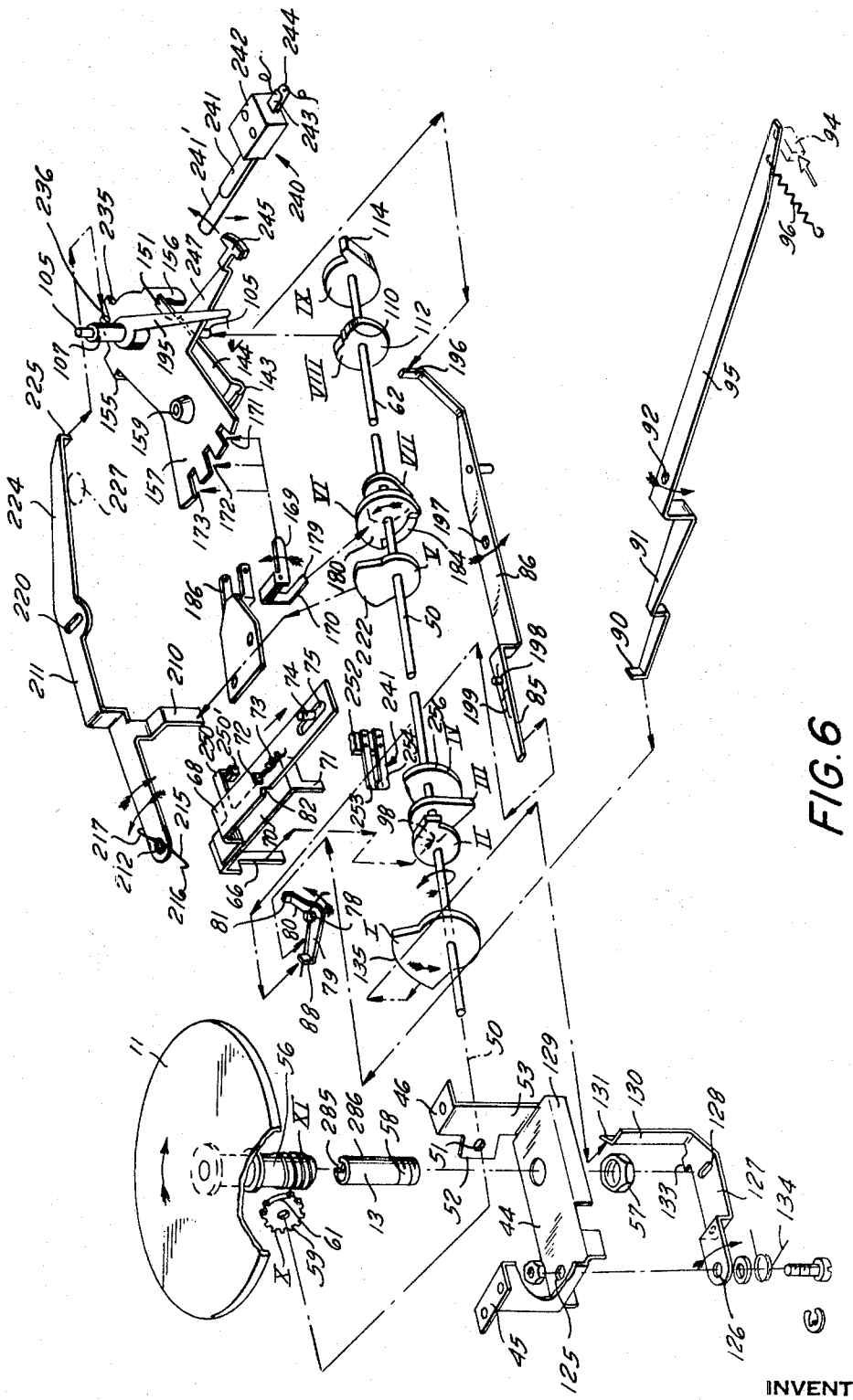

FIG. 6

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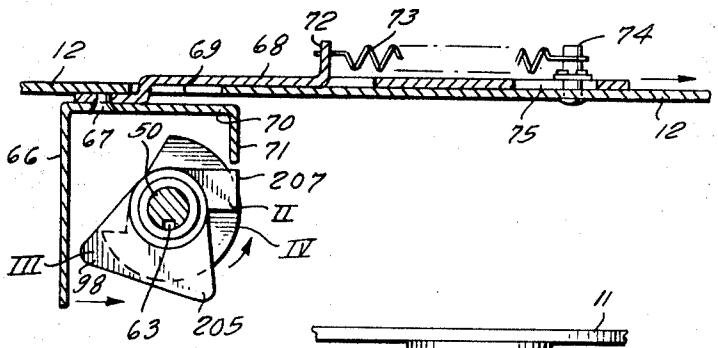
FIG.7a



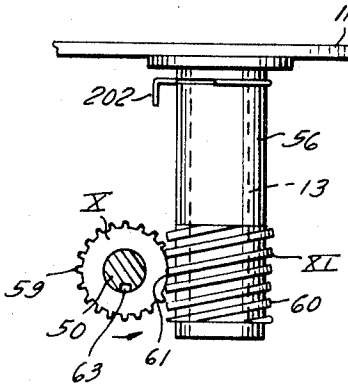
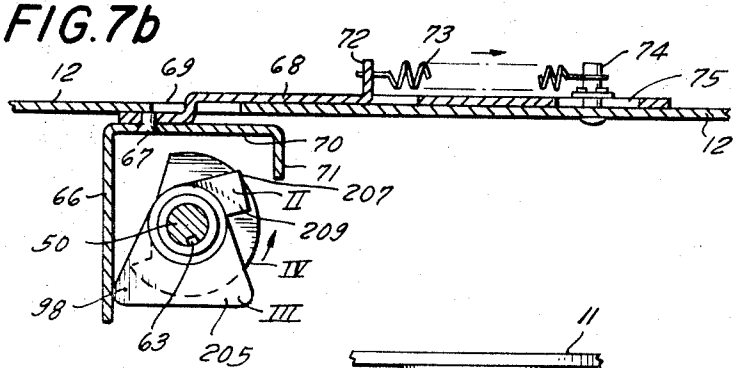


FIG.8a

FIG.7b



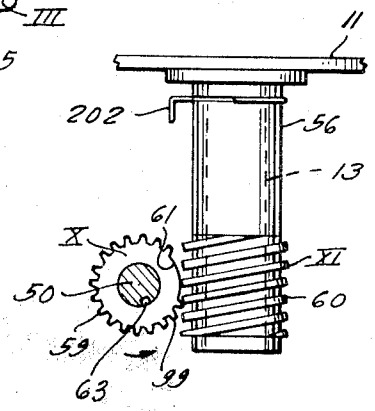


FIG.8b

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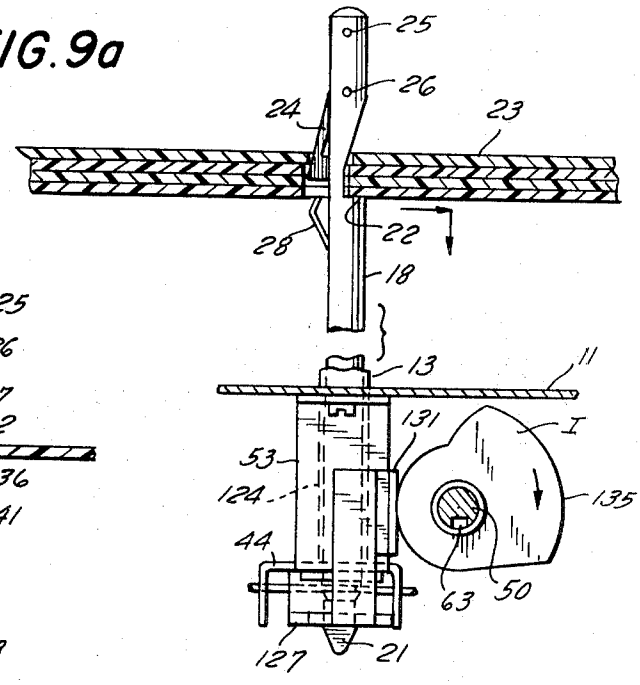
FIG. 9a



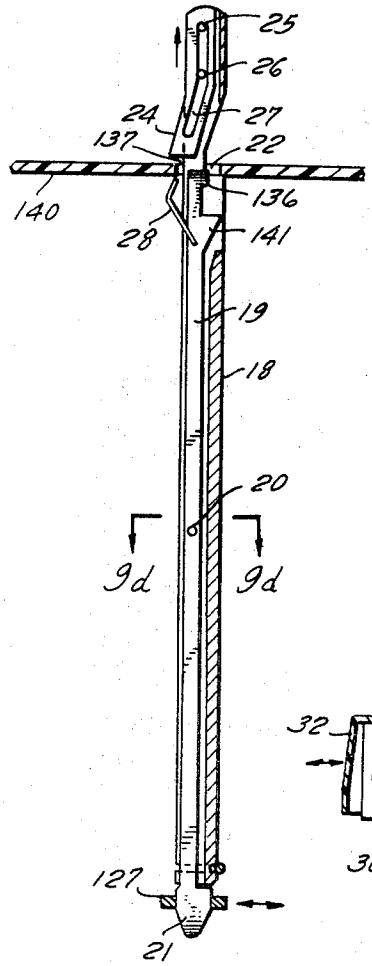


FIG. 9c

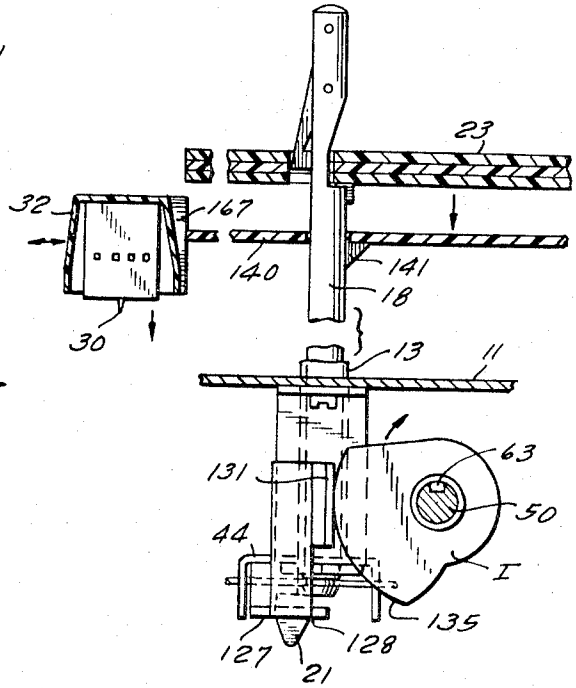


FIG. 9b

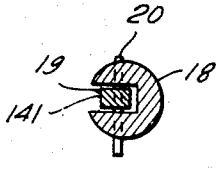


FIG. 9d

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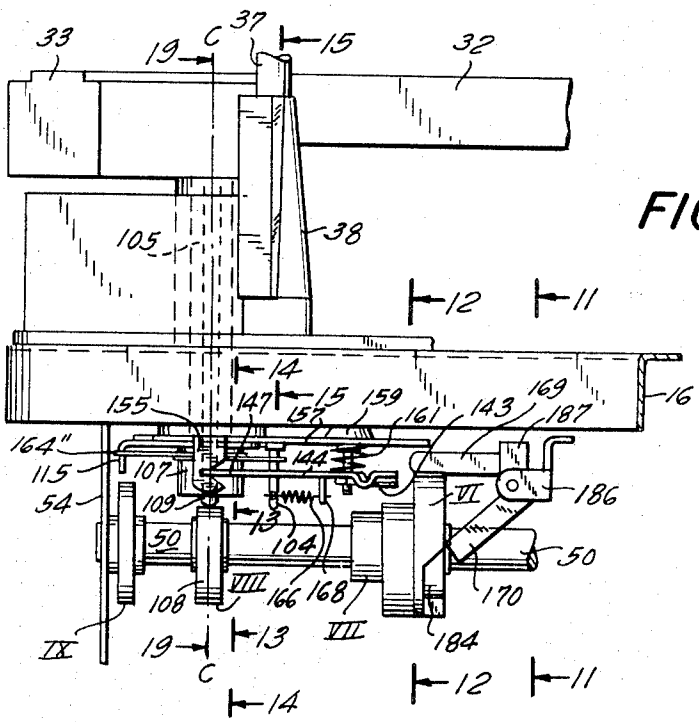

FIG.10

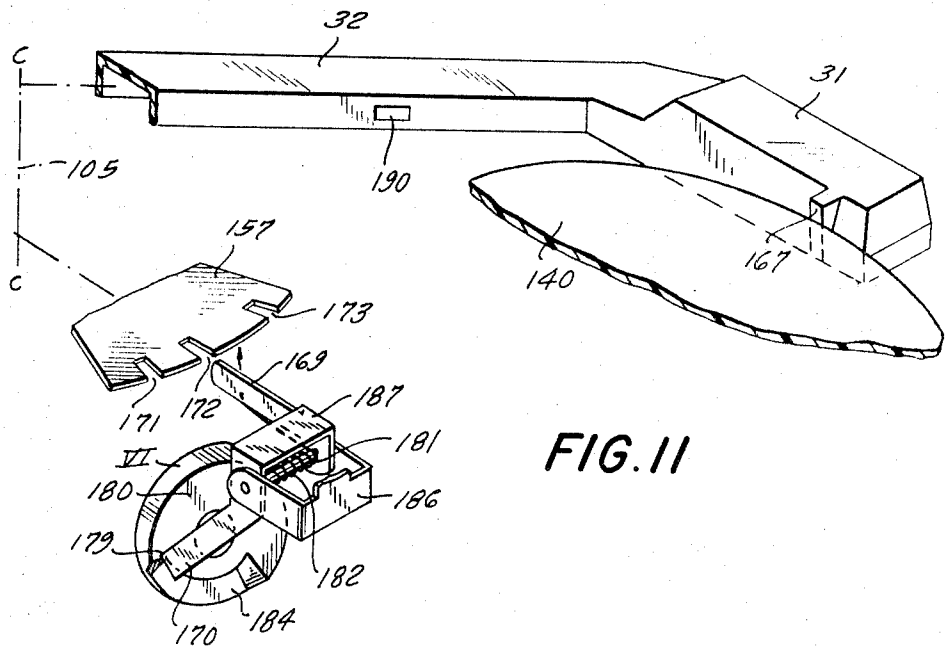

FIG.11

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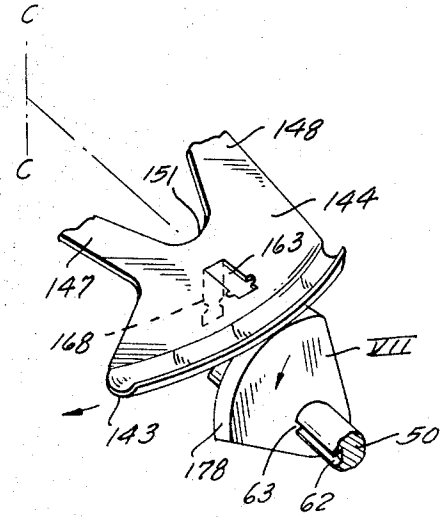


FIG. 12

FIG. 13

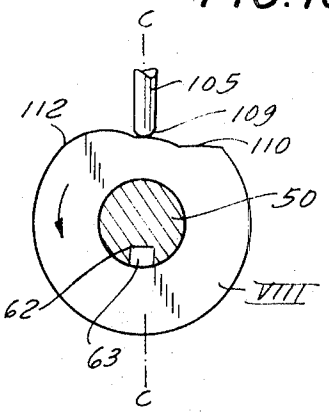
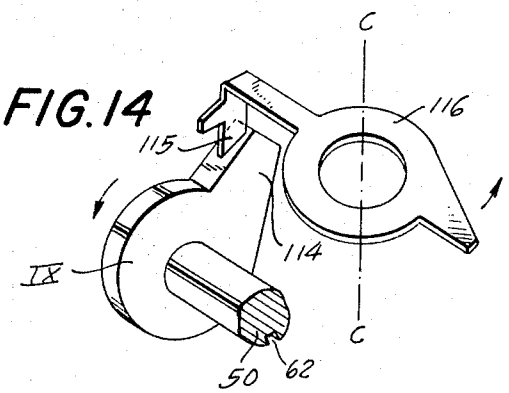


FIG. 14



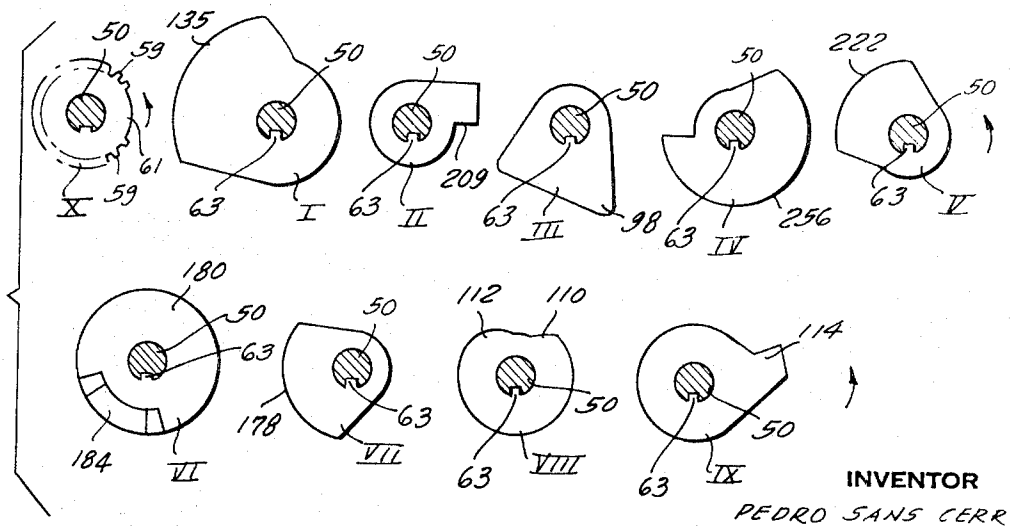


FIG. 17

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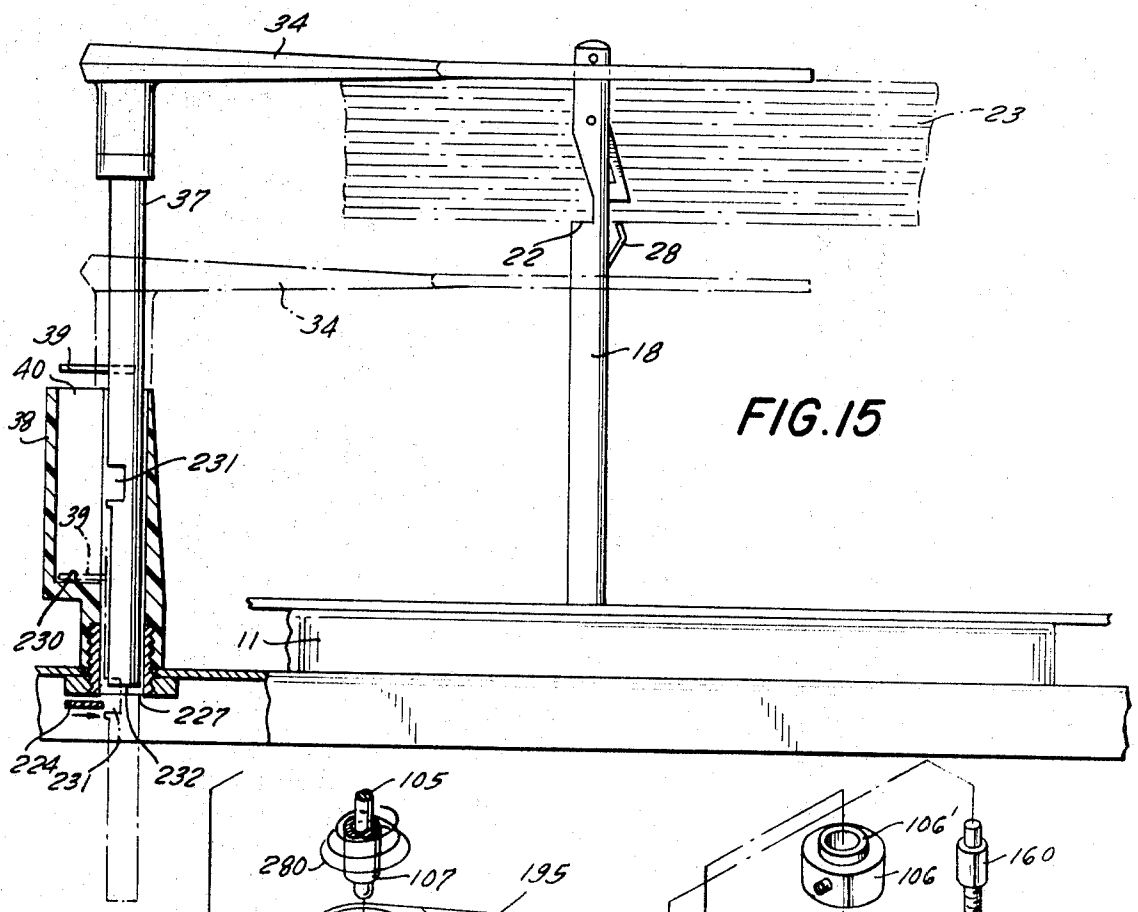

FIG. 15

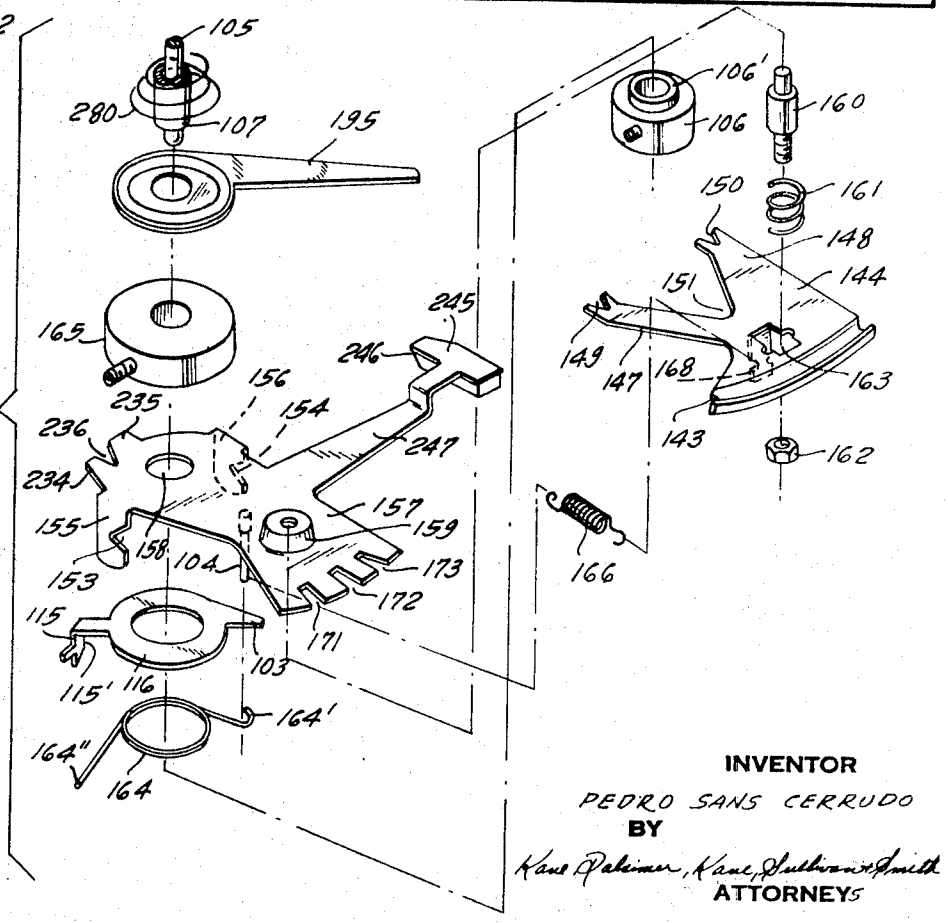

FIG. 16

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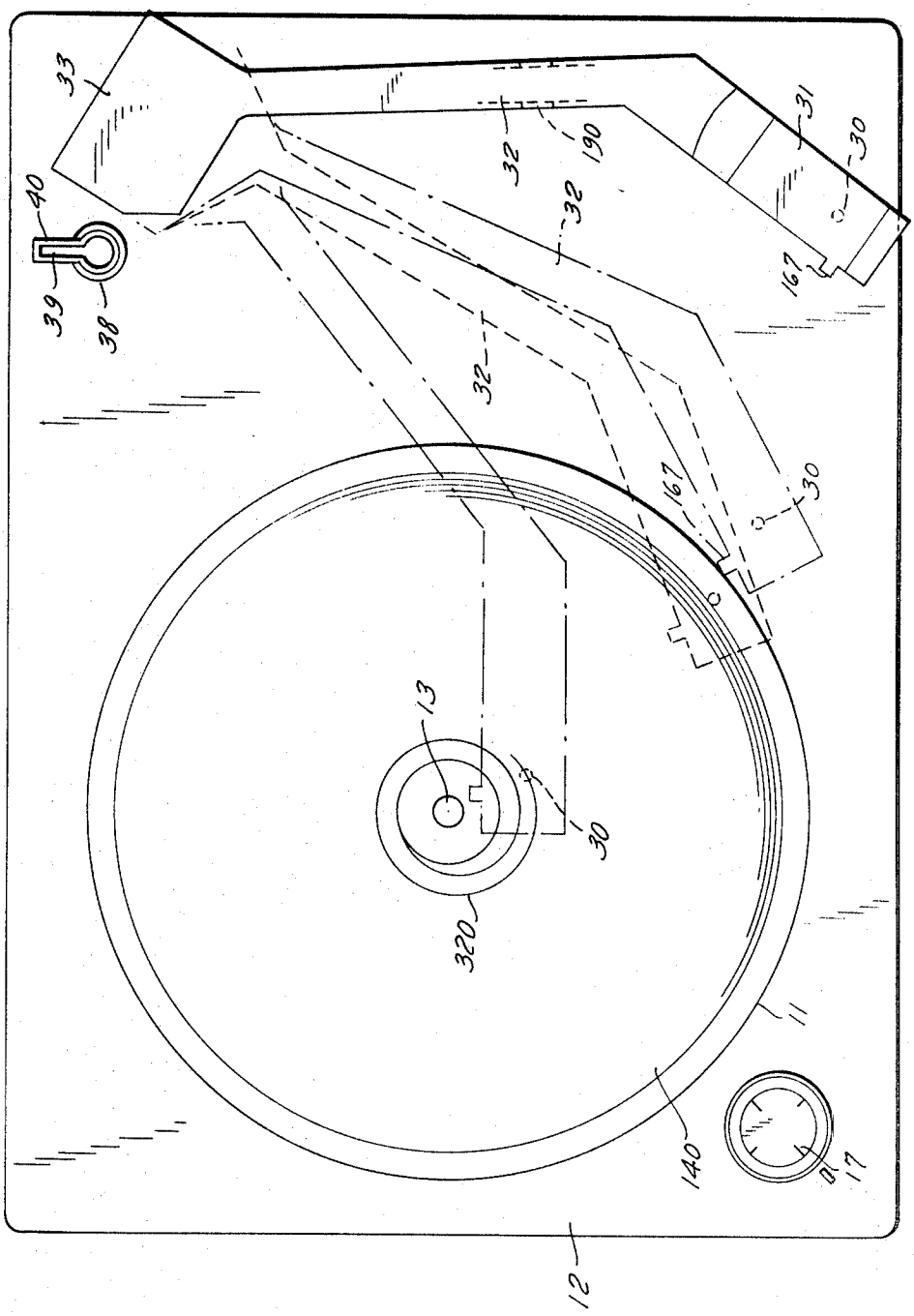

FIG. 18

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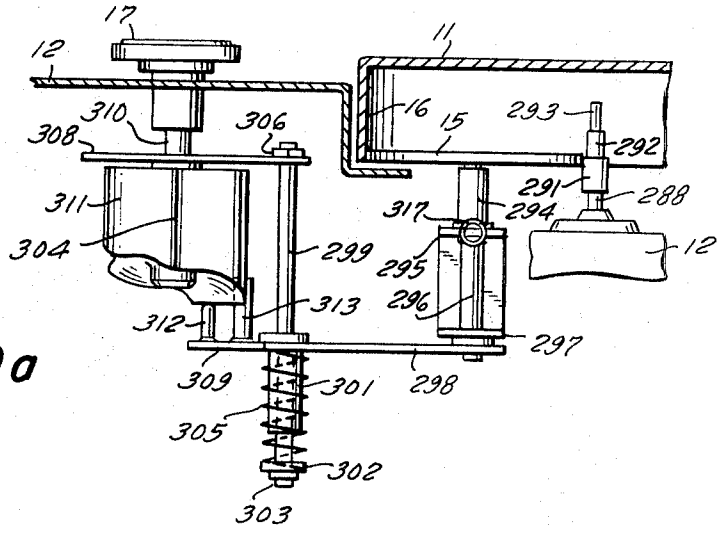

FIG. 20a

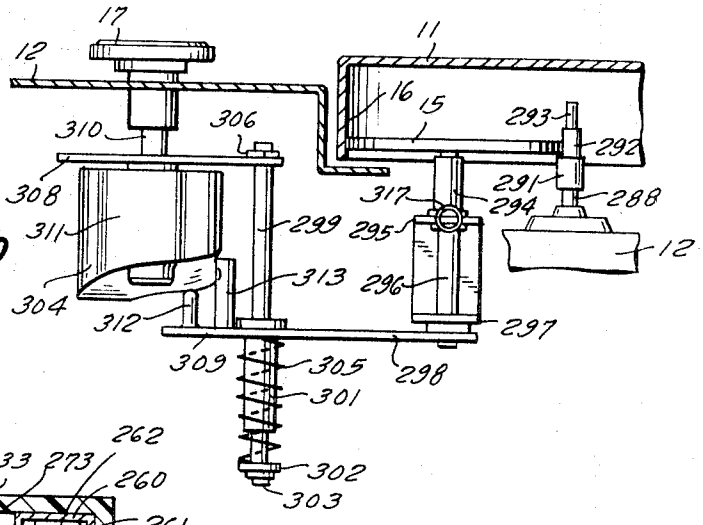

FIG. 20b

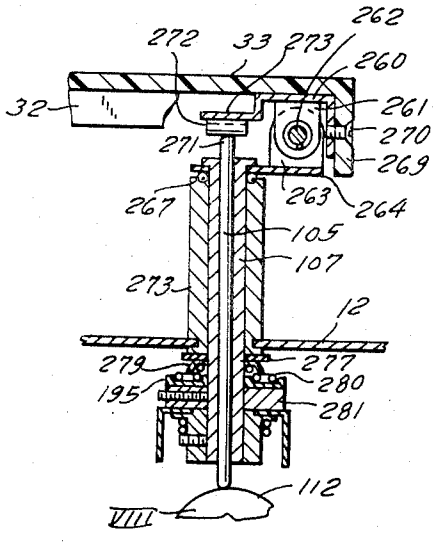

FIG. 19

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FIG. 21a

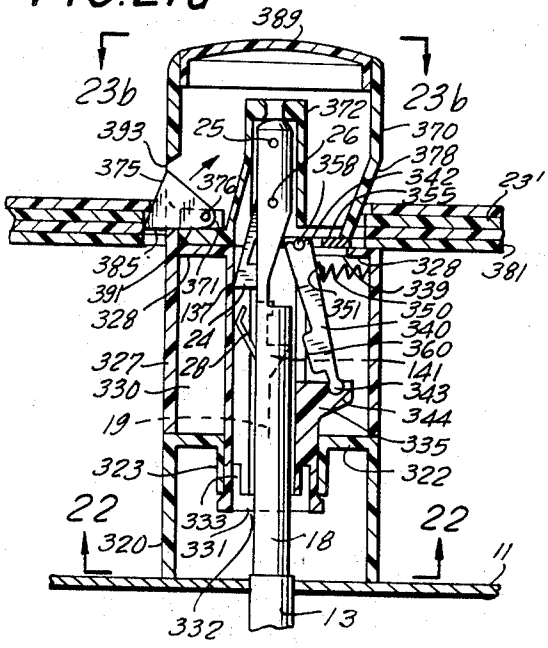
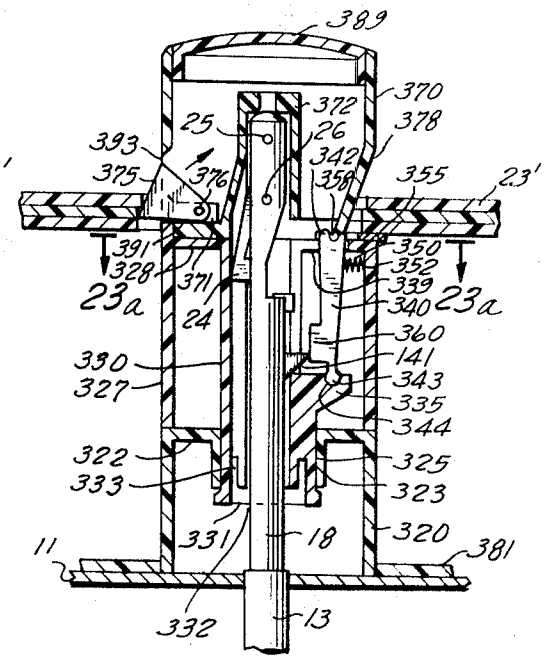


FIG. 21b



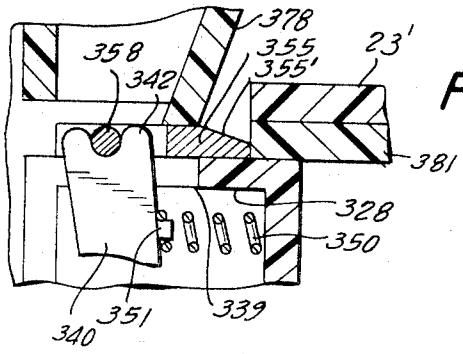


FIG. 25

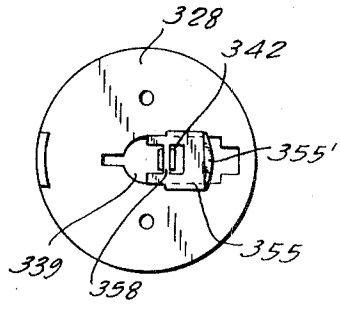


FIG. 23a

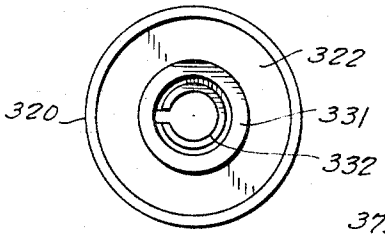


FIG. 22

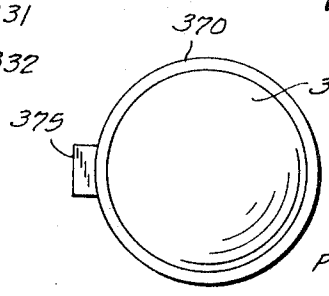


FIG. 23b

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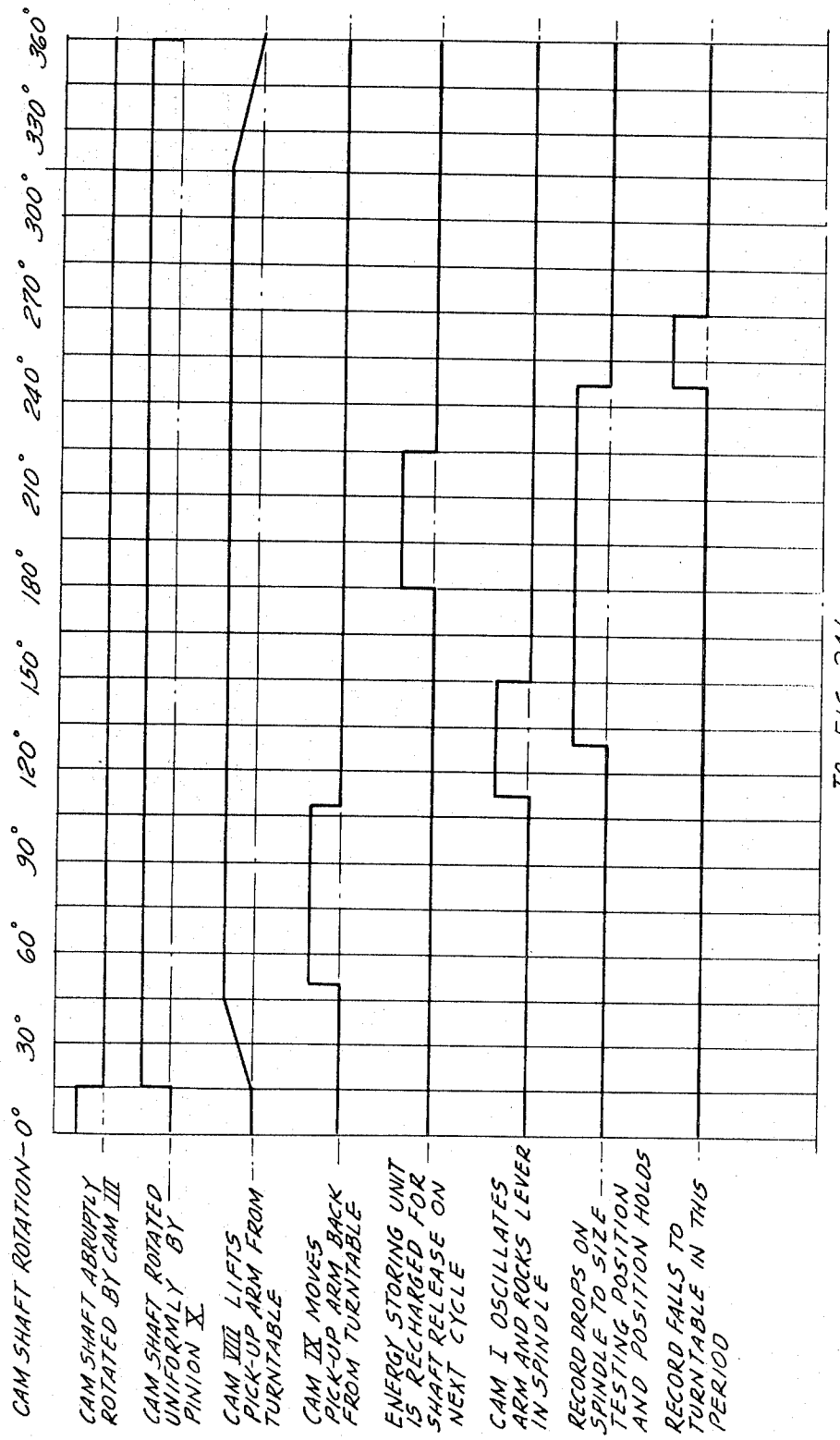

FIG. 24A

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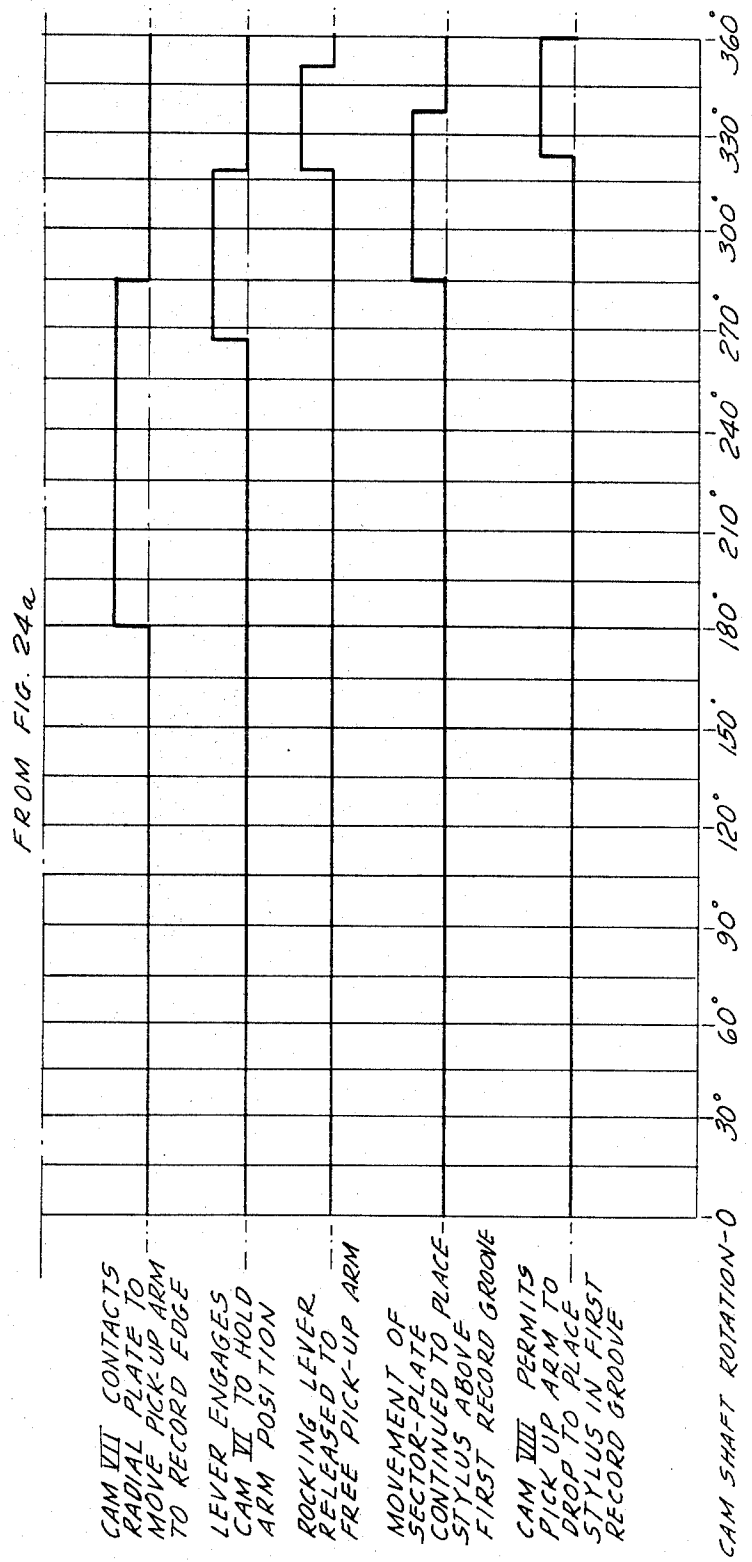

FIG. 24b

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AUTOMATIC RECORD REPRODUCER APPARATUS

GENERAL DISCUSSION OF THE INVENTION

The present invention relates to a record player device adapted for sequentially positioning records of various and randomly selectable size in stacked relationship for release to a turntable for reproduction, as controlled by a pickup arm and record-tracking stylus.

In the art of record players, many devices suitable for automatically playing records in sequence and substituting one record for another following record play have been proposed. The devices usually operate by moving the record to be played to the surface of a turntable that is rotating at a selected speed. A stylus element carried by a pickup arm is then moved to contact the grooving in the record surface in order that the recorded intelligence upon the record may be reproduced. Where the records are of randomly chosen sizes each is size-tested or sensed prior to reproduction in order that the pickup stylus may be placed at the starting position of the record grooving when contact with the record is established.

It has been customary in order to achieve the desired operating sequence and the necessary timing to provide a drive mechanism for controlling the movement of the pickup or playback arm that is arranged to carry the stylus which tracks the record groove. Various forms of structures have been used to remove records from the stack and position the records so removed for reproduction. Suitable devices are provided for testing the record size by moving a measuring component adjacent to the record. A suitable form of memory unit provides for adjustment of the final positioning of the pickup arm relative to the record as contact is made.

As a general rule, the apparatus through the use of which some of the foregoing results have been achieved, has been of a complicated variety. Numerous cams and gearings have usually been provided to control the sequence of operations of the different components. Cams carried upon shafts whose motional speeds are interrelated have been used to achieve one or another of the foregoing types of operations. These factors have led to costly structures. In addition, the necessity of driving a multiplicity of cams, as well as camshafts, from some suitable common source has made operation difficult both as to timing and as to number of components. The result has been that the art has lacked a reliable low-priced component with which substantially foolproof operation is achievable.

The present invention provides a structure by which the number of operating components has been substantially reduced. In addition, the general nature of the drive and control has been simplified through the use of a single cam or control shaft which times and governs each and operation operation of the unit. The structure of the invention provides a multiplicity of cams, all mounted in appropriate angular positions relative to each other, upon a single elongated cam or control shaft. A driven pinion element to control the operation of the complete unit is provided at an appropriate location on the shaft. The pinion is moved to an operative position relative to the rotating record turntable each time a new record is to be reproduced. The transition is automatically achieved with the initiation of a start or following a completion of a record play in order to carry the next record to a "play" position.

This driven pinion for the cam or control shaft has teeth over the major portion of its periphery to engage a suitable driving element which is preferably on the turntable spindle. It also has a sequence of several adjacent teeth missing along a small portion of its periphery. For the portion of the peripheral arc where teeth are missing, normal engagement between the driving element and the pinion is impossible. The camshaft rotation stops as soon as the driven pinion turns to that position where there are no engaging teeth on the driven unit. Such stoppage occurs during the period of record reproduction. The drive is reinitiated as soon as a new record is ready for play.

Immediately at the end of record play a tripping mechanism causes the driven pinion to be abruptly rotated, under the release of stored energy, through an angle sufficient to rotate the unit with its missing teeth for an angle which brings the driving teeth into reengagement with the teeth of the driven pinion element of the turntable. This is achieved through an appropriate type of clutch drive mechanism. The initiated drive then continues until the driven pinion element again turns through an angle sufficient to bring the portion having missing teeth opposite the driving unit. When this condition occurs the drive is once more disengaged. The camshaft drive is always interrupted while records are being reproduced and the pickup arm and stylus are tracking the record grooving.

Any and various means may be provided to control the several operations. At this point suffice it to state that by providing a plurality of cams supported in preestablish angular positioning relative to each other on a driving cam or control shaft, the desired sequence of operation is achieved. Stated very broadly, the sequence involves a suitable movement of the pickup or control arm from an end-of-play position to a start-of-play position, while making provisions during the movement for utilizing the pickup arm itself to sense the size of the next record to be played. The operation also involves a control of the release of records, one at a time, from a supported stack of randomly chosen sizes, with one record only being released during each rotating of the camshaft. With the release of a record from the stack it is immediately moved to a testing position between the stack and the turntable. The pickup arm is then moved adjacent to the record edge and thereby the size of the record is determined. The mechanism then is set automatically so that following size testing the record is moved promptly from its size-testing position to the turntable. The control then initiated places the pickup arm with the reproducing stylus upon the record at the start of the grooving so that the reproduce operation is commenced.

The release of the records individually from a stack held upon a support spindle that is located coaxially with the axis upon which the turntable is driven is preferably achieved by the sequential removal of the lowermost record. Then, after play, and following the operation here briefly outlined the next record in the stack or sequence is selected.

The record release is achieved in the preferred apparatus through the movement of a lever positioned within the support spindle which serves in one position to hold the complete stack of records elevated relative to the turntable and in a second position to draw or shift the lowermost record from the stack to a dropped position along the shaft. With the release of the record, the lever is adapted to hold the record to the spindle so that the sensing or pickup arm may determine the record size and then permit the record to drop to a playing position.

CERTAIN ADVANTAGES AND OBJECTIVES OF THE INVENTION

The prior art, as a general proposition, has depended for an operation control upon the use of various and numerous different drive and cam shafts. This has made the reproducing apparatus far more expensive than is generally desired. It has also made servicing operations frequently necessary to maintain satisfactory quality.

By the present invention, many of the deficiencies of the prior art have been overcome through a greatly simplified construction and arrangement of parts. One principal improvement arises from the use of a single driving and control shaft mechanism which tends to bring about essentially foolproof operation. A generally horizontally positioned control cam shaft is positioned immediately beneath the frame plate of the machine. This makes possible a rigorous control of all operational sequences and phases in a greatly simplified manner. It results in the achievement of one of the main objectives of the invention which is that of providing a greatly simplified control unit through the use of which substantially im-

proved and faithful record reproduction may be achieved without fear of breakdown or erroneous operational timing of the sequence of events.

A further object of the invention is that of providing a simplified structure by which the movements of the pickup stylus and its associated pick-arm can be faithfully carried out in a substantially foolproof manner and still make possible a utilization of the pickup arm itself as a means for record-size testing, thereby to make operation more efficient and yet feasible with a substantially cheaper structure.

Other advantages and objectives of the invention are those of providing a greatly improved and simplified structure for record-reproducing components which will permit manufacture and sale of the units on a more economical basis than heretofore possible, and to couple therewith an increase in the efficiency of the overall working.

Still another objective of the invention is that of providing a simplified structure adapted to reproducing records of different sizes which can be driven at different speeds so that the unit is usable with equal facility both for the newest types and size records manufactured, as well as those heretofore used, of which many are still held within the record portfolios of the buying public.

Objective still further objective of the invention is that of providing a simplified structure which is capable not only of use with records of different diameters but which, through the addition of a simplified adapter structure, can be used without further modification for reproducing records of relatively small diameter and having a large central guiding hole.

Other objectives of the invention are those of providing a compact, efficient, lightweight record changing and reproducing device having a high quality performance characteristic that can be manufactured and sold on a more favorable economic basis than record players now customarily offered to the buying public.

Other objectives and advantages of the invention will become further apparent and suggest themselves to those skilled in the art, to which this invention is directed following a reading of the following description and the accompanying claims in connection with the drawings.

THE DRAWINGS

The invention has been illustrated in certain of its preferred forms by the accompanying drawings wherein:

FIG. **1** is a general isometric view of the record reproducer looking from above it and showing particularly the pickup arm, the record support spindle and the record compressor positioned relative to the turntable and base member;

FIG. **2** is a plan view looking at the turntable and control mechanism from beneath FIG. **1** in the general direction of its line **2–2**;

FIG. **3** is a plan view of the record reproducer in approximately a neutral position looking at the structure in the general direction of the line **3–3** of FIG. **1** with the turntable removed and the general control mechanism of FIG. **2** shown in phantom;

FIG. **4** is a view of generally schematic form of the FIG. **2** components looking from the same general direction with some components shown in slightly out-of-phase relationship for descriptive purposes;

FIG. **5** (appearing on sheet **1**) is also a generally schematic view of the start-control unit looking at the mechanism with the turntable removed;

FIG. **6** is an exploded view, somewhat in schematic layout, particularly showing the general operative relationship of selected components thereby depicting the general operative sequence as particularly emphasized by the dot-dash lines showing more specific relationship;

FIGS. **7***a* and **7***b* represent sections taken on the line **7–7** of FIG. **3**, with FIG. **7***a* showing the clutch control in a neutral and energized state prior to initiation of rotation of the camshaft, and with FIG. **7***b* showing the initiation of camshaft rotation as controlled by the release of the stored drive energy;

FIGS. **8***a* and **8***b* represent the camshaft drive pinion, as seen along the line **8–8** of FIG. **3**, showing a neutral position (corresponding to that of FIG. **7***a* and FIG. **8***a*) and in a driving position, as in FIG. **8***b*, after camshaft rotation has been initiated by the released drive (corresponding to FIG. **7***b*);

FIG. **9** shows by its various parts *a* through *d* the record support and locating spindle, with FIG. **9***a* being an elevational view with the spindle lever in a generally neutral position and a stack of records supported thereon for release in sequence, FIG. **9***b* being an elevational view showing the rocking lever moved to release the lowermost record of the supported stack to a size-testing position between the supported stack and the record turntable, FIG. **9***c* being an elevational sectional view of the spindle to show particularly the rocking lever for controlling the record release and position, and FIG. **9***d* being a cross section on the line **9***d*–**9***d* of FIG. **9***c*;

FIG. **10** is an elevational view seen in general direction of line **10–10** of FIG. **3** to show the elevating and rotating cam controls for the pickup arm;

FIG. **11** is a simulated isometric exploded view of the pickup arm and the position-locking arm as seen substantially along the line **11–11** of FIG. **10** when looking in the direction of the arrows;

FIG. **12** is an isometric view of the driving cam and control disc for controlling pickup arm movement with the view taken generally along the section **12–12** of FIG. **10**;

FIG. **13** is an end view of the pickup arm elevating rod and the control cam as seen along section **13–13** of FIG. **10** looking in the direction of the arrows;

FIG. **14** is an isometric view as seen generally along the path **14–14** of FIG. **10** when looking in the direction of the arrows and shows the cam control to move the pickup arm away from the record turntable and the record support and positioning spindle;

FIG. **15** is an elevational view, partly in section, taken along line **15–15** of FIG. **10** looking in direction of the arrows and illustrates the record support spindle and supported records in use with the record compressor arm to maintain the stack position;

FIG. **16** is an exploded isometric view along support axis of pickup arm to show movement control and control elements driven thereby to control operational cycle in part;

FIG. **17** (appearing on sheet **9** with FIGS. **12** to **14**) represents by its parts X and I through IX, respectively, the drive pinion with certain missing teeth and nine separate cams arranged in the order shown on the camshaft of the exploded view of FIG. **6** with all cams and the pinion shown the substantially the preferred angular relationship to each other when supported upon the camshaft;

FIG. **18** is a plan view of the tone arm rotated to the turntable and supported record with the pickup shown in its rest position and then in phantom in positions of record size sensing, start of record play and end of record play;

FIG. **19** is a sectional view taken on the line **19–19** of FIG. **10** looking in the direction of the arrows to show the control by which the pickup arm is elevated and turned.

FIG. **20** by its parts *a* and *b* represents sections taken along the line **20***a* looking from the direction of the line with FIG. **20***a* showing the unit adapted for one playing speed and FIG. **20***b* showing the unit adapted for a different speed.

FIG. **21** by its parts (*a*) and (*b*) shows an adapter in sectional elevation to enable the device shown by FIGS. **1** through **20** to be used with small records having a large center hole, with parts **21***a* showing a record stack in a supported position and part **21***b* showing the lowermost record about to be released to the turntable for play;

FIG. **22** is a sectional bottom view along the path of line **22–22** of FIG. **21***a* looking in the direction of the arrows;

FIG. **23**, by its part FIG. **23***a* is a view of the cylinder with the top turret removed and looking in the direction of arrows **23***a* of FIG. **21***a* and part FIG. **23***b*, is a top view of the turret

looking along line 23–23 of FIG. 21*a* to show the adapter turret and spindle with its record displacing cam element;

FIG. 24 in its parts FIG. 24*a* and FIG. 24*b* constitutes a chart to show the operation sequence of the various components, with time shown as extending from left to right and angular rotation of the camshaft similarly depicted, with each individual operation shown as effective for that portion of the camshaft rotation shown above each datum line for each depicted operation step. By this showing the operation, except for the lifting and replacement of the pickup arm relative to a record on the turntable, are shown to begin and end abruptly and in substantially zero time. This is for convenience of showing the broad operational principals and the general timing of the events. No inference should be made from these curves relative to the precise operating times since some events start and end faster than others. The chart is intended to present general arrangements only and is merely to aid in understanding the timing of different events; and

FIG. 25 is an enlargement of the upper portion of FIG. 21*a* to show the manner of removal of the bottom record of the stack by the lever-operated slide element.

A PREFERRED EMBODIMENT OF THE INVENTION

If reference is now made to the drawings for a further understanding of the invention, consideration may first be given to FIG. 1, which constitutes a generally isometric view of the unit as it would be viewed from the top in its operation. The turntable 11 is supported for rotation on a base 12 to turn on an axis 13. This axis of rotation is generally centered on the base member 12 which is depressed in its central portion to accommodate the turntable 11. The support axis provides for the turntable being rotated in any suitable fashion by a suitable and selected form of drive.

The general turntable drive will be seen particularly from FIGS. 2 and 3. It is provided by a motor, schematically indicated at 14, which is adapted to drive a puck element 15 in any suitable fashion (not shown). The puck is rotated by the motor and is positioned and held internally of the downwardly extending rim 16 of the turntable 11. With rotation of the puck, the turntable is also appropriately rotated. It will be later explained that the turntable is adapted to be driven at different speeds, each of which is essentially constant, depending upon the type and size of the record to be reproduced. For the purpose, the control knob 17 has been schematically represented so that, if turned, it may be assumed that the puck is made to contact one of a plurality of different diameter sections of the rotor shaft of the motor. The ratio between the circumference of the different motor shaft areas of contact with the puck circumference sets the speed at which the turntable can be driven. There is speed reduction between each of the circumference of all of that of the motor rotor shaft the puck and the turntable. Thus, with a given diameter for the turntable, the puck and the shaft, the motor speed may readily be set. The driving motor is appropriately a constant speed unit so that different turntable speeds result when the driven puck contacts the rotor shaft at regions of different diameter. Normally, the records for reproduction are rotated at speeds of 33⅓ r.p.m. for present day records of both the 10 inch and 12 inch types, 78 r.p.m. for older records, particularly of the 10 inch and 12 inch variety and 45 r.p.m. for small records of approximately 7 inch diameter type with the large center holes. The knob 17 is adapted to set the record turntable speed by a cam action shifting the puck 15 to contact different diameter sections of the motor shaft as it is driven. This will later be explained in further detail. The support shaft 13 for the record turntable is usually of tubular variety so that a spindle element 18 may be supported and positioned internally thereof. The spindle (as will be more particularly described in connection with FIGS. 9*a* through 9*d* inclusive is provided with an internal pivotal lever element 19 adapted to pivot about the pin 20 as an axis. The pivotal movement is controlled by means of the outer end 21 of the lever. The end 21 acts as a cam follower and is adapted to be moved in a manner later to be described.

The pivotal lever 19 extends upward internally of the spindle. Toward the upper portion the spindle provides shoulder or guide shelf 22 upon which a stack of records 23 (see FIG. 9*a*) is adapted to rest. The upper portion of the spindle has an upper slidable holder member 24 (see FIG. 9*c*) which is adapted to slide about the guide pins 25 and 26 by way of the slot 27, thereby to hold and position supported records prior to their being dislodged from the guide shelf and the set spring element 28. The spring element 28 extends internally from the upper part of the pivoted lever 19 and terminates at about the level of the shoulder or guide shelf 22, thereby to aid in holding the lowermost record of the stack 23.

The records thus supported are adapted for play by being dropped to the turntable in a fashion later to be explained. When on the turntable, the record grooves are adapted to be contacted by the stylus element 30 (see FIG. 18) which is supported near the outer end 31 of the pickup arm 32. The pickup arm 32 is pivotally supported and mounted at its rear portion 33 so as to be raised from the surface of the record on the turntable at the time of completion of record play and to be lowered to the turntable and the record at the time when record play is started, to so remain until record play is completed. Arcuate movement about the support is also provided, thereby to permit tracking the record across the record face. Whenever a stack of records is held upon the spindle 18 and supported in the fashion already stated by the shoulder 22 and the spring element 28, the record compressor arm 34 through its outwardly extending fingers 35 and 36 rests upon the uppermost record. As is well known, the arm 34 thereby serves as a stabilizing component.

The holder-compressor arm 34 is supported from one end upon a spindle 37 which extends downwardly into a holder 38 (see FIG. 15). The holder 38 serves both to guide the spindle and, in a manner later to b5 described, arrest further downward movement of the pickup or tone arm. At this time, it might be mentioned that a pin 39 extends outwardly from the spindle in substantially a radial direction. The pin locates the position of the compressor arm. The pin 39 is adapted to move downwardly into the slot 40 (see FIG. 18) with the playing of the records, while the spindle 37 moves within the holder 38. At a time when the last record of the stack has been released the spindle 37 is at its lowest position. Then, by means of a locking arm (later to be described) the operation is stopped when the end of the locking arm contacts a notch of a disk element secured to the spindle which supports the pickup arm, as will later be described. When the pickup or tone arm 32 is in a rest position and prior to starting the mechanism, it is adapted to be positioned and rest upon the support post 41. It can be locked in this position by a lateral movement of a suitable locking button 29 pushed in one position and released when the button is in the opposite position.

Having now considered broadly the general appearance of the apparatus, reference may be made to the mechanism by which the unit is adapted to function. To this end, it is appropriate to note again that all elements of the device are preferably driven by a single drive motor 14. This motor drives the puck 15 (see FIG. 20) which in turn, bears upon the inner wall of the turntable element 16, thereby to rotate it. The rotational speed of the puck is changed by a cm mechanism which caused it to contact the motor shaft at regions of different diameter.

At about the center of the location from which the turntable 11 is supported, there is a hollow shaft member 13 which extends up through the turntable base. This shaft is mounted at its lower end in a bracket 44 which is hung from the lower side of the base member 12 by appropriately supporting ears 45 and 46. The upper surface of the base member has a circular depression or recess formed therein into which the turntable element 11 is adapted to be positioned. From the underside, this recessed section extends downwardly. The supporting ears 45 and 46 of the bracket 44 are attached to such underside, as can be seen from the exploded view of FIG. 6.

The bracket 44 extends beneath the bottom of the recessed portion into which the turntable fits. There it forms a support-

ing structure for holding one end of a cam shaft **50** which serves as a unitary control shaft for establishing essentially the operation of the entire unit. The camshaft **50** extends through a bearing surface **51** in a protruding tab **52** which extends outwardly from one of the upright sections **53** of the bracket **44**.

The camshaft **50** extends from a position in the bearing support substantially along a generally diagonal path beneath the base of the unit. At its remote end it is supported in the upstanding section of a bracket **54** which, in turn, is also supported by an angle section **55** from the lower portion of the base **12**.

The turntable element **11** is supported at its center and a hollow shaft **56** of an inside diameter sufficient to slide over and position the turntable on and about the hollow spindle **13**. This hollow section may be appropriately secured to the turntable in any desired fashion. It extends down slightly from the lower turntable surface. The hollow shaft **56** terminates at its lower end in a worm element XI. The lower end of the hollow shaft **56** is adapted to rest over and be positioned upon a bushing member (not shown) supported from the upper surface of the bracket **44** through which bushing the spindle **13** is adapted to protrude to be held at its lower end by a fastening nut **57** supported immediately beneath the bracket and threading on to the threaded end **58** of the spindle **13**. The spindle **13** with the worm surrounding it provides a spacing element between the lower side of the frame and the upper portion of the bracket. It also limits the position of the worm XI. With the construction provided, the worm XI is keyed to the shaft **56** and thereby turned through the turntable. The worm is adapted to mesh with and drive a pinion X that is located along the camshaft **50** in a position of engagement with the worm. Accordingly, with engagement between the teeth of the worm XI and the pinion X, assuming the pinion to be keyed to the camshaft **50**, as is the case, camshaft rotation is by the drive motor **14** and puck **15**.

Continuous camshaft rotation would result because of engagement between the teeth **59** and the worm teeth **60** were it not for the fact that a drive interruption occurs after each 360° rotation of the cam shaft because of the omission of a few (usually three or four) adjacent teeth as at area **61** on the periphery of the driven pinion (see FIGS. **8***a* and **8***b*.) The number of teeth omitted from the periphery of the pinion X is sufficient so that after the pinion reaches neutral position relative to the driving worm (see FIG. **8***a*) following a 360° rotation there is no longer engagement between the teeth and the drive stops. However, if a slight rotation or jog can be provided for the driven pinion by rotating the shaft to which it is keyed in the direction as shown by the arrow on FIGS. **8***a* and **8***b*, the rotational drive between the worm and the pinion will be reengaged for another turn and pinion X will rotate through the remaining portion of a 360° angle. There is an appropriate gear reduction provided between the worm and the pinion which may be of any selected and chosen relationship, as will be well recognized.

Considering now that the cam or control shaft **50** is in a position to be turned by the drive provided through pinion X, there is provided by this invention a multiple series of cams supported upon and keyed along the shaft. The cams are so located and their followers are arranged in such relationship that for each 360° rotation of the camshaft the rotating cams provide for the operation of all control features necessary for the control of a full change of records for reproduction and the interchange of records from a stacking position to a playing position on the turntable **11**.

For indicating the general pattern of operation, reference may momentarily be made to the timing sequence shown by the curves of FIGS. **24***a* and **24***b*, together with the exploded schematic and generally isometric-type operational diagram of FIG. **6**. FIG. **6** depicts the various components and the approximate relative relationship of each so as to show in a most general sense the functioning and relationship of the various component parts herein to be described. In this respect, nine separate cam elements, schematically represented by the Roman numerals I through IX, are provided on the shaft **50**. Each of these cams is shown in more detail by FIG. **17** where each is turned to appropriately the angular relationship which each cam bears to each other cam on the camshaft so that the desired operational sequence is achieved.

The camshaft **50** is provided throughout its length with a longitudinally extending groove **62**. Each of the cams I through IX, as well as the driven pinion X, is provided with an outwardly extending projection or spline **63** which is adapted to fit within such elongated slot or guide **62**. The slot and spline thereby set the precise angular position of each cam relative to each other cam. Any appropriate form of longitudinal spacing components, such as spacing rings and setscrews, or any other form of recognized spacing unit, may be provided to maintain the desired longitudinal spacing of all of the cams between the two ends of the shaft.

As will be apparent from what is to follow, the constructural features make it desirable in some instances for certain cams to be positioned adjacent or substantially adjacent to each other. In other instances, the cams may be spaced appropriately along the camshaft. Because wide variances in constructural features are contemplated, the particular spacing illustrated in any of the drawings should be regarded as generally schematic although exemplary of a preferred embodiment of the invention. However, in the exploded view of the character of FIG. **6**, the cam spacings and shapings must be regarded as generally schematic. A more precise reference to the cam shapings is found in the various cams of FIG. **17**. The relative angular positioning of the several cams is also set out with close approximation to that most preferred. In the showing of FIG. **17**, it may be considered that the cams, as well as the driven pinion X, are all positioned in a neutral relationship with respect to operation. This is to say that a record is in the "play" state and no shift is under way at the depicted time. For the purpose of controlling the sequence of operating the cams may be assumed to be positioned upon the cam shaft **50** in such fashion that each rotates simultaneously in a counterclockwise direction, as more particularly exemplified by FIG. **6**. The cam followers have not been depicted generally in a precise following relationship in either of FIGS. **6** or **17** although it is to be noted that the exploded schematic view of FIG. **6** shows generally the components which act as followers for the majority of the cams.

The operation is so depicted that when the camshaft and its cams is in the neutral or camshaft position, the missing teeth of the driven pinion are opposite the worm teeth.

Operation and rotation of the camshaft **50** is initiated by providing an abrupt rotation through an external activating means capable of rotating the shaft **50** through an angle adequate to turn the mutilated gear sufficiently to move the first tooth of the driven pinion X into a position to make contact with the teeth of the driving worm XI. For illustrative purposes this is shown as being about 15° but this must be regarded as illustrative of principle and not a structural limitation. In this condition it will be assumed that the drive motor **14** is in operation to turn the drive puck **15** through the motor shaft and thereby rotate the turntable **11** and, with it, the worm XI. The worm XI is rigidly secured to the turntable shaft and rotates at all time that the turntable is driven.

In one preferred form of the invention the jogging motion of the camshaft **50** is provided by means of a generally triangular-shaped cam III, appropriately keyed to the camshaft. In a rest or neutral position, the cam III is supported so that it is substantially adjacent to a depending bracket **66**. The bracket is secured at **67**, in turn, to a sliding plate member **68** which is, in turn, supported to rest in part upon the upper surface of the base member **12**. A downwardly turned end of the sliding member **68** extends through a slot **69** in the base member **12**. The downwardly depending portion then connects by the pin connection **67** with the channel section **70** which has the already mentioned downwardly depending portion **66** on one side and a second downwardly depending section **71** on the other side. The channel section **70** has its downwardly de-

pending elements extending sufficiently far down generally to envelope and straddle the camshaft **50**.

The sliding member **68** which is mainly on the opposite side of the plate member **12** is upturned at **72**. This end **72** connects by way of a spring element **73** to a pin **74** that extends through the base member **12** in a rear slot **75** in the member **68**. The sliding member **68** is tensioned by the spring member **73** so that it tends to move in a direction to the right (looking at FIG. *7b*) unless held in position by a suitable locking medium. Normally, locking is achieved by a small bellcrank element **79** of which one arm **80** terminates at a projecting point **81** adapted to fit into a notch **82** on the sliding member. As long as the bellcrank element **79** has its pointed end **81** engaged in the notch **82**, the position of the sliding member is maintained. Consequently, the depending arm **66** is clear of engagement with the periphery and outer point of the triangular cam III. However, if the bellcrank element **79** is caused to disengaging the connection or engagement between the end of its arm **80** and the notch **82** is broken the spring **73** is so positioned that it pulls the sliding member to the right (see FIG. *7b*.)

The specific components for disengaging the projecting point **81** of the bellcrank element **79** from the slider element **68** will be discussed later herein. However, for the moment, suffice it to say that the outwardly extending lever portion **85** which is pivotally supported at the forward end of the arm element section **86** which extends through the slot **87** in the base **12** is adapted to contact the outer end **88** of the bellcrank element **79** when the arm **86** is turned in a counterclockwise direction (looking at FIGS. **3** and **5**, for instance). The full movement will later be explained. Contact is sufficient to release the point **81** from the notch **82**.

In the alternative, and in the starting position of the operation, the bellcrank **79** is moved in a generally similar fashion when the outer end **82** of the bellcrank is contacted by the upturned end **90** of a starting lever **91**. The lever is pivoted on a pivot point or support axis **92**. The upturned end **90** which extends through the slot **93** in the base element will also contact the outer end **88** of the bellcrank **79** when lever **91** turns in a counterclockwise direction about pivot axis **92** (see FIG. **5**).

The first described control component for turning the bellcrank **79** in the counterclockwise direction about the axis **78** (looking at FIGS. **3** and **5** in particular) is utilized following the completion of one record play to initiate a change to the next record. The second described control is that which is provided at a start of play condition by an operational movement of the control button **94** which, as will later be described in further detail, moves the rearward portion **95** of the lever to turn the complete lever about its pivot point **92** against the restraining force of a spring element **96**.

A release of the point **81** of the bellcrank from the notch **82** and the resultant motion of the sliding member **68** under the force of spring **73** immediately retracts the channel section **70** to move it to the right, as shown by FIGS. *7a* and *7b*. This movement of the channel section **70**, with its downwardly depending bracket **66**, establishes a contact with the outer point **98** of the triangular-shaped cam III. Since the cam III is secured tightly to the camshaft **50**, the movement to the right of the depending portion **66** of the channel section **70** immediately serves to turn the cam III to a limited extent as the point **98** is engaged. The camshaft **50** is then turned for a like angular amount, which for illustrative purpose was assumed as about 15°.

Prior to the contact between the depending portion **66** and the point **98** of the triangular cam III, the camshaft had been in its position such that the missing tooth portion **61** of the driven pinion **59** was adjacent to the teeth **60** of the driving worm XI (see FIG. *8a*). The rotation given to the camshaft **50** is limited but adequate to turn the the sufficiently to bring the first tooth **99** into driven contact with one of the teeth **60** of driving worm XI. When engagement between the teeth occurs, the camshaft **50** will be turned by the driving worm for the remainder of the complete 360° rotation. The camshaft **50** is positively driven from the worm XI. The operational effects then achieved follow in a general sequence according to the pattern explained by the curves of FIGS. *24a* and *24b*. Making brief reference to the curves of FIGS. *24a* and *24b* before returning to the structural considerations, it may be seen that in the uppermost curves of FIG. *24a*, an assumed period of 15° is allotted for an abrupt rotation of the cam III to initiate the camshaft drive. The second curve shows that the camshaft rotation continues for the remainder of the 360° period. With rotation of the cam having commenced, it is next possible to raise the pickup arm from the record or turntable surface (if the arm is not already raised by having been positioned on the post **41**.) Raising and lowering of the pickup arm is brought about under control of cam VIII. To achieve this objective, the pickup arm **32** which is pivoted for rotation relative to the frame in its support at its end **33** is rested upon a spindle **105** which preferably is spring-pressed in any desired fashion (not shown) downwardly as it extends through the base number **12**. This shaft is positioned to extend through suitable bushings **106** with its outer end **109** rested upon the outer periphery **108** of the cam element VIII. Since the turning of camshaft **50** carries the cam VIII the end **109** of the slidable shaft **105** serves as a cam follower. An upward movement raises the shaft **105** slowly until the cam shaft is turned about 45° from its initial position of rest. By this time the exposed end **109** will have reached the outer periphery **108** of the cam. At this time the spindle **105** is raised to the maximum extent.

The pickup arm **32** is raised and lowered as if it were essentially a third class lever having the upper extremity of the lifting rod or spindle **105** contact it outwardly just a slight distance beyond its pivot point (see FIG. **19**.) Under the circumstances and considering the length of the arm, a relatively small up-and-down movement of the lift rod **105** is all that is required to raise the outer end of the pickup arm **32** an adequate distance to remove the stylus **31** from the record surface. As can be seen from the shape of the cam VIII (see particularly FIG. **17**) and from the third curve down from the top of FIG. *24a*, the pickup arm and stylus lifts from the turntable rather gradually while the end **109** of spindle **105** follows the curvature **110** of the cam VIII. Then, until the cam VIII is rotated to a point, such as **112**, on its periphery, the pickup arm is held in an elevated position. With further rotation of the cam VIII, the follower spindle **105** and its follower end **109** gradually reaches a position substantially like that shown in FIG. **13**. At this time, the pickup arm is gradually lowered until at the completion of one more revolution of the camshaft **50**. The stylus **30** contacts the record when the arm is lowered.

The next operation which occurs is that of providing for moving the pickup arm from the innermost track or groove on the record upon the turntable to a position where it is carried away from the turntable. This operation is achieved substantially by the rotation of the cam IX. The outer end **114** of cam IX contacts a depending detent **115** extending outwardly from the disc **116** which surrounds the slidable spindle **105**. The disc **116** surrounds the spindle **105** and has also a projecting section **103** which is adapted to turn against a pin **104** extending downwardly from plate **157**, later to be discussed. Suffice it at the moment to note that any rotation provided for it is transmitted to the pickup arm through the plate and the other assembled components. In this respect reference may be made to FIG. **16**, which is an exploded view showing the relationship between components for elevating the pickup arm, turning the pickup arm and then finally returning the pickup arm to a record size-sensing position and providing for holding the arm in the proper position later to rest the stylus in the starting groove of the record on the turntable when the cycle is restarted.

In the operation, it may be noted, particularly from the showings of FIGS. **2**, **4**, **6** and **10**, as well as the exploded view of FIG. **16**, that the cam IX turning on the camshaft contacts the depending detent **115** only for a portion of a camshaft revolution. The turning provided for the disc **115** is through an angle sufficient to move the pickup arm to a position where its

stylus member **30** moves to a position outside the periphery of the recordeholding turntable and any record that might be carried upon it. This movement, as can be seen from the schematic representation of the motion provided by cam IX, as seen by FIG. **24**, starts at an angle of about 50° of camshaft rotation. By the time the camshaft has rotated about 110° (almost one-third of a revolution), the pickup arm and its stylus has been moved arcuately to a position where it is removed from the region of the record or the turntable. At this point, contact between the cam IX and the depending detent **115** is interrupted. Other cams are provided to control a return of the pickup arm to a position in the region of the record.

At this point it is appropriate briefly to mention the further movement of the pickup arm. After the pickup arm has once been raised and arcuately moved away from the record turntable, the invention provides for placing a previously unplayed record upon the turntable. As of either a starting time or a time when additional records are to be played, the record play is to be changed from one record to another and one or a plurality of records are held upon the support spindle, as depicted by FIG. **9** in its various parts. When the pickup arm has been moved away from the turntable, the lowermost record held upon the support on the shoulder **22** is brought into a size-testing position.

If reference is now made again to FIG. **9** and its various parts, the stack of records **23** is held so that the lowermost record of the stack rests against the shoulder **22** and is adjacent to and rested upon the spring member **28**. This resting position is adequate to provide a support for all the records of the stack from the lowermost record. The records are held normally in a substantially horizontal position on the support by the record compressor arm **34** (see FIG. **1**) and located by its outwardly extending fingers **35** and **36**. As already stated, spindle **37** carries the arm **34**. Spindle **37** is permitted to ride up and down in the guide and holder **38**. The angular position of the spindle **37** and the arm **34** is set by the pin **39** which is adapted to position itself in the slot **40** of the guide and holder **38**. The vertical positioning of the spindle in the slot is determined by the movement of records from the stack which permits the spindle to move lower and lower (see FIG. **15**) as each record is removed. This movement continues in a generally step-by-step fashion until the record supply held by the spindle is exhausted and the last record is moved to the turntable from the stack.

Considering now that the mechanism is started by providing an engagement between the driven pinion X and the driving worm XI, all of the cams I through IX start to rotate. Each time a record is removed from the bottom of the stack **23** it is brought to a size-sensing position (see FIG. **9***b*) prior to the time the pickup arm is again carried back toward the turntable. This record shifting operation is achieved by establishing a pivotal movement of the end **21** of the lever **19** to pivot the lever about its support point **20** in the spindle **18**. In the support for the turntable, the lower end of the shaft **124** for supporting the turntable and the worm thereon, as already noted, is carried in a bracket **44** and is held by a fastening knob **57**.

There is also positioned beneath the bracket **44** and pivotally mounted therefrom through an aperture **126** a follower bracket **127** which has a slot **128** aligning itself essentially with the turntable shaft. The outer end **130** of the follower bracket **127** is upwardly turned with the bracket **127** held beneath bracket **44**. The upturned end **130** is positioned substantially at 90° to the protruding tab **52** through which the cam shaft is passed. As diagrammatically depicted by the exploded schematic of FIG. **6**, the cam element I, when rotated to contact the innerside of the face **131** of the upturned bracket provides a means to move the bracket about a pin (not shown) extending through the aperture **25** and the pivot point **126** to be movable beneath the bracket **44**. An outwardly extending tab **133** is provided on the bracket **127** to abut the inside of the downwardly depending flange **129** and a spring **134** secured about the pin **126** maintains the position except with cam I bearing against the face **131** changes it. The spindle **18** for holding the records is positioned through the hollow shaft **13** and extends downwardly to position the end **21** of the lever **19** within the slot **128** of the pivoted bracket **127**. The end **21** of lever **19** can thus be moved if the pivoted member **127** is moved.

As soon as the cam I turns with the cam shaft, rotation to a position where its outer surface **135** contacts the inwardly turned portion **131** of the bracket starts the movement by which the complete bracket swings about the pivot point **126** to move the pivoted lever **19** about its pivot point or axis **20**. With this occurring, it may be assumed (looking at FIG. **9***c*) that the lever **19** rotates in a clockwise fashion about its pivot point **20**. With this occurring, the upper hooked shaped end **136** which extends interiorly of the spindle **18** and into the opening center hole **137** of the record is able to move the lowermost record (illustrated in FIG. **9***c* at **140**) laterally to the right and away from the shoulder **22** on the spindle **18**. So moved, the spring support **28** is carried interiorly of the periphery of the spindle **18** and the record is then shifted laterally as its center **137** aligns itself with the outer periphery of the spindle **18**. In this position the record drops gravitationally and comes to rest about the spindle **18** on one side and is held above the projecting ledge **141** of the pivoted lever.

The spindle **18** is so formed that it has a slot in its upper portion (see particularly FIG. **9***d*) through which ledge **141** can project. As the record falls to be held about the spindle **18** on the ledge **141** it is in a plane between the record stack and the turntable. It is held in this position until the lever **19** is moved in a counterclockwise direction about its pivot point **20** thereby to retract the ledge **141** into the interior of the spindle **18** and to move the spring member outwardly to hold the next record of the stack. Size-sensing or testing of the record occurs in this position with the pickup arm **32** moving into an abutting relationship with the record edge. As herein considered, size-sensing and size-testing are to be regarded as equivalent terms.

The size-testing will be further explained. However, assuming for the moment that this has occurred, and turning now to the diagrammatical showing of FIG. **6** for consideration along with FIG. **9***a*, it hook-shaped be assumed that the spring biased pivoted member **127** is returned to its normal position (see FIG. **4**) as soon as the cam I has rotated on the camshaft to a position where the cam periphery **135** no longer contacts the turned edge **131** of the bracket. At this position the spring pressure member **134** moves the pivoted member **127** free of the cam action and with it lever **19** to a position such that the record can drop to the turntable **11**. The record drop occurs because lever **19** is pivoted about point **20**. In such movement the hook-shaped end **136** moves to the right (looking at FIGS. **9***a*, **9***b* and **9***c*) and moves the innermost record of the stack **23** to the right. The record drops to position **140** (see FIG. **9***b*) when the edge **136** is at the periphery of spindle **18**. The record then drops to be caught on ledge **141** and the hook-shaped end then moves to hold the next record. With return motion the spring **28** holds the next record until it is also held on ledge **22**.

As can be appreciated from the timing diagram of FIG. **24***a*, the initial oscillation of the lever **19** under control of cam I and the bracket section **131** as a cam-follower occurs after the camshaft has rotated approximately 110° from its starting position. This action (see FIG. **24***a*) commences substantially simultaneously with the completion of the "out" movement of the pickup arm and stylus away from the turntable. Actually, a little more time is usually allotted to permit the record to drop than is necessary but this provision is made to reduce tolerances in the overall operation.

As shown by FIG. **9***a*, the timing operation preferably provides for cam I to oscillate the rocking lever **19** within the spindle **18**. This starts the downward movement of the lowermost record on the stack **23**. As the record falls to a size-testing position (see FIG. **9***b*) when it is pushed by the hook-shaped end **136**, it is held on the ledge **141** for a relatively long period of time. This time period is normally sufficient to per-

mit the camshaft **50** to turn from about a 130° position following its start to a position of about 245° from the start. Ample time is allowed within this angle of rotation for achieving the size-testing operation by the inwardly moved pickup arm **32** and its edge **167**.

Following the dropping of the lowermost record of the stack **23** to the testing position **140** upon ledge **141** record diameter sensing starts. This commences with a movement of cam VII into contact with an outwardly extending ridge **143** on the generally semisector-shaped plate **144** (FIG. **12**). Plate **144** has a pair of outwardly forked arms **147** and **148** (see FIG. **16**) which straddle the hollow shaft **107** within which the spindle **105** is housed. Movement of spindle **105** upwardly by cam VIII controls the raising of the pickup arm **32**. This movement occurs, however, independently of movement of the housing shaft **107**. When the cam VII rotates to a position of where its surface **178** contacts the ridge **143**, (from the viewing direction of FIG. **12** of the drawings, for instance, the cam appears to be rotating on the shaft **50** in a counterclockwise direction) the semisector-shaped plate is turned in a direction which is generally clockwise relative to the pickup arm support axis.

As particularly shown by the FIG. **16** exploded view, the semisector-shaped plate **144** is held free of any direct contact with the pickup arm support axis or the hollow spindle **107**. The two forked arms **147** and **148** terminate in the generally fork-shaped ends **149** and **150**. The substantially V-shaped recessed section **151** separates the arms. The forked ends **149** and **150** of the arms are held in engagement with the complementary shaped notches **153** and **154** formed in downwardly extending ears **155** and **156** of the semisector-shaped plate element **157** which is normally positioned above the plate **144** (see, for instance, FIGS. **10** and **16**). The plate **157** has a central aperture **158** toward its rear portion. The support spindle **107**, in the assembled structure, is passed through this aperture. A boss section **159** is raised in the forward portion of the sector-shaped element **157**. A pin **160** extends through this boss. It is spring-fastened and tensioned in the plate **144** by a suitable spring **161** which surrounds part of the sleeve **160** with the lower end of the pin being fastened by the nut **162**. This sets up a resilient connection between the plates **144** and **157**. This spring connection permits a limited movement between the plates due to the arrangement of the enlarged opening **163**. Any rotation of the cam VII tends to turn the semisector-shaped plate **144** and, with it, the semisector-shaped plate **157**.

When connected as shown, the semisector-shaped plate **157** is adapted to rest over the disc **116** which is positioned between the plates **144** and **157**. In this position the pin **104**, which extends downwardly from the underside of the plate **157**, extends also below the plane of the disc to pass on the inside of the extension **103** (see FIG. **16**). A spring member **166** is then provided for loosely connecting the pin **104** with the downwardly depending extending tab **168** of the plate **144**. This spring connection is adequate to maintain engagement between the forked ends **149** and **150** of arms **147** and **148** and the notches **153** and **154**. At one end **164'** the spring **164** is wrapped about the pin **104**. Its other end **164''** extends over the edge **115'** of the depending tab **115** of the disc **116** and maintains the connection. The spring thus causes the disc **116** to turn with the plate **157**.

The relative position of the components on the record spindle support shaft **107** is established by the indicated collars and setscrews **106** and **105**. Any rotation of the semisector-shaped plate **144** originating with the rotation of the cam VII when its surface **178** bears against the raised edge **143** will move the pickup arm **32** and tend to return it to a position over the turntable.

The disc **116**, in assemblies, is secured between the collar **106** and the plate **157**. The collar is provided with a setscrew to clamp it to the spindle **107**. It also has an upwardly extending shoulder **106'** which fits interiorly of the opening **158** in the plate **157** and is preferably secured in any desired manner, as by welding to the plate member **157**. Accordingly, any turning of the plate member **157** turns with it the shaft or spindle **107** for controlling the inward and outward movement of the pickup arm.

In the turning of the plate **144**, the pickup arm **32** is moved inwardly toward the record stack. It makes contact with the edge of the record **140** after the record has been dropped to its size-sensing position as already mentioned (see FIG. **9**). There, the pickup arm **32** is held in an elevated position relative to the turntable by the cam VIII, raising the internal spindle **105** (see also FIG. **19**). With the pickup arm **32** thus raised during the major portion of each revolution of the camshaft, it can be moved inwardly toward the turntable axis while so held. The inward movement is controlled by the plate **144** causing the spindle **107** to turn until the arm comes into an abutting contact with the edge of the dropped record in the size-testing position.

The dropping of the record has already been discussed. It was also noted that all remaining records of the stack then rest upon shoulder member **22** which extends above any height to which the pickup arm **32** can be raised. Therefore, regardless of the inward movement of the pickup arm, it cannot contact any record except that record which is dropped to the testing position (see FIG. **9***b*.

At this point, it is desirable to note also that pin **20** about which the lever **19** pivots aids in aligning the angular position of the spindle within the support member sleeve **13**. The position of the pin is set by the notch **285** in the sleeve **286** about which the worm XI is held. This notch also sets the depth to which the lever can extend. In addition, it sets the alignment of the follower **21** with the slot in the follower bracket **127**. With this position obtained, as the pickup arm **32** is moved inwardly under the motion imparted to it by the rolling contact established between surface **178** of cam VII and the raised portion **143** of the semisector-shaped plate **144**, contact is finally established as schematically represented by each of FIGS. **9***b* and **18**.

When this contact is made, the edge **167** of the pickup arm **32** (here slightly exaggerated in each last-named figure in order to emphasize the contacting element) contacts the record periphery. At this point any further inward movement of the pickup arm (thus, movement as in FIG. **9***b* from left to right) is arrested so long as the record **140** holds in its testing position on ledge **141**. When the edge **167** of arm **32** contacts the record edge, slip occurs between the surface **178** of cam VII and the raised portion **143** of the semisector-shaped disc **144**. The spring pressed contact provided between the plate elements **144** and **157** is tight enough to insure rotation of the semisector-shaped plate **157** in the absence of any impeding force which would act against this type of motion due to contact between the record edge and the pickup arm.

In the present apparatus, the pickup arm support at its end **33** is on a bracket **260** (see FIG. **19**) which has downwardly depending end pieces **261** at each end. These end pieces provide a bearing surface for the spindle or cross shaft **262**, which anchors in the upstanding ends **263** of a bracket member **264**. This bracket member extends outwardly from and is riveted or otherwise fastened to the upper portion of the support spindle **107** through which the lifting pin **105** extends. Bearing members **267** secured between the bracket and sleeve **107** provide rolling contact. The ball race is schematically illustrated by FIG. **19**.

The pickup arm **32** proper has a generally channel-shaped surface and a downwardly depending rear portion **269** secured in any appropriate fashion, as by the setscrew **270**, to the bracket **260**, thereby to permit the pickup arm to turn in a vertical plane about the spindle **262** as a center. The riveting or welding of the bracket **264** to the upper end of the tubular element **107** insures that the complete assembly of the pickup arm can rotate about the spindle **105** as an axis. Because of the mounting of the pickup arm to the brackets **261** and **263**, the heretofore mentioned arcuate movement of the pickup arm **32** about the spindle **262** is permissive. The movement is pro-

vided when the spindle **105** is moved up and down in the direction of the arrow by the cam VIII.

The lower portion of the spindle **105** rides as a follower upon the cam surface **112** of this cam. Its upper end **271** contacts a layer of resilient material **272** which is secured in any appropriate manner to the lower side of an extended portion **273** of the bracket **260** that holds the pickup arm. Thus, an upward movement of the spindle **105** raises the pickup arm **32** about the shaft **260** as an axis. This permits its outer end **31** to be elevated quite substantially due to the arm length. Any turning of the hollow shaft **107** also turns the complete assembly about the spindle **105** as an axis. The pickup arm itself is sufficiently heavy to provide downward movement in the absence of an upward force in the spindle **105**. A tight fit between the upper surface of the support frame **12** and the bracket **264** upon which the pickup arm structure is secured is provided by the bushing **273** which rests between the bracket and the base **12**. The upper portion forms part of the bearing surface upon which the bearings **267** are permitted to roll. A spacing washer **277** is supported to surround the tubular spindle **107** and also to rest upon the lower end of the bushing **273**. Immediately beneath the spacing washer **277** in this position there is a downwardly turned washer element **279** beneath which there is a suitable bearing provided by the arm. This combination is held tightly together by a coil spring **280** which holds the tripping arm **195** tightly against the staking collar **281**, which is keyed to the hollow spindle **107**. The raising and lowering of the pickup arm, as already mentioned, is under the influence of the pin component **105**. The bracket or yoke which holds the pickup arm and is secured to it thus is rotated with the pickup arm about the spindle **105**. The pickup arm is turned about the axis **105** initially by the action provided by the cams and later by the fact that the carried stylus element **30** is tracking the grooves of the record.

At the end of the period over which the record is held above the turntable for testing, it is next dropped along spindle **18** as a guide by retraction of the ledge **141** to a point within the spindle **18**. This occurs at about 270° of rotation of the camshaft **50** from its starting position. The record **140** then drops to the turntable **11** in a position where it is ready for play. After the pickup arm is moved so that its edge portion **167** is carried adjacent to the periphery of the record **140** thereby to be tested (see FIG. **9***b*), even a continued rotation of the camshaft and the cam VII is insufficient to turn the semisector-shaped plate element to any further extent about its support points. Because of the fact that the pickup arm through the above-described brackets and the connections for securements to the hollow shaft **107** are such as to preclude such rotation of the plate **144**, some slip occurs between it and the driving cam VII. Thus, contact between the pickup arm and the record edge temporarily halts any further rotation of plate **144**.

As soon as the camshaft **50** rotates to a further extent, from which the record support spindle can drop the size-tested record to the turntable (that is, at a time no later than when the camshaft is turned 270° from its position of start, as shown by FIG. **22***a*) the cam VII is still in contact with the plate **144**. This permits slight further inward movement of the pickup arm. The stylus then moves along an arc which approximates a radial path toward the turntable center for perhaps another 10° of a cam shaft rotation. At this time, due to the spring connection between the plate elements **144** and **157**, as already discussed, there is a slight further turning of one plate with respect to the other. Arm **169** of the bellcrank combination, comprising arms **169** and **170** which are displaced by about 45° relative to each other, positions itself within one of the slots **171**, **172** or **173** which extend inwardly from the edge of the semisector-shaped element **157**.

Positioning of one arm in one of the slots limits the amount of rotation that the pickup arm **32** then can make relative to the support axis **107**. With this limitation in movement, it is apparent that slip must occur with further rotation of the contacting edge **178** of the cam VII relative to the ridge **143**. While this is occurring, cam VI continues to turn on the camshaft **50**. At this time the outer edge **179** of the lever **170** is pressed against the surface **180** of the cam member VI. Under these conditions, and despite the fact that the spring member **181** held upon the spindle **182** tends to rotate the arms **169** and **170** in a clockwise pattern (see, for instance, FIG. **10**), the engagement between arm **169** and one of the notches **171**, **172** or **173** continues until cam VI turns to its recessed portion **184**. When the arm **170** reaches the recessed portion **184**, the spring **181** turns the shaft **182** so that the arm **169** can move out of the slot. This is possible because the short spindle **182** is held within a bracket **186** which is supported in any desired fashion (not shown) from the underside of the base **12** from which the remainder of the apparatus is hung. The arms **169** and **170** are normally joined by a yoke **187** to which the spring member **181** attaches so that both arms normally turn in unison and arm **169** moves out of the notches at the same time that the arm **170** follows the cam surface to its recessed part **184**.

Any engagement between the arm **169** and one of the notches **171**, **172**, or **173** ends by the time the camshaft has rotated 320° from its start position. At this time the pickup arm is freed and can drop toward the turntable. From a consideration of the curves as in FIG. **24***b* it will be evident that the movement of the sector plate **157** commences at about 20° following the initial engagement between the arm **170** and the cam surface **184** of the Cam VI. The engagement between the lever **170** and the surface **184** of cam VI continues for a further period of about 50° of rotation of the camshaft, but during this time period the rocking lever can be released to free the pickup arm. The cam VIII by this time has turned sufficiently far to permit the contact point **109** of the spindle **105** to move downward due to the weight of the pickup arm to place the stylus **30** in the first record groove.

The foregoing discusses particularly cam elements I, III, VI, VII, VIII and IX. Specific reference may now be given to the controls affected by cams II, IV and V. The conditions obtaining when it is desired to initiate the operation to carry the first record (the lowest one) of the stack (shown illustratively by the stacked position on the spindle **18**, as in FIG. **15**) into a position for reproduction will first be reviewed. For such condition the pickup arm **32** is in the position shown in solid outline in FIG. **18** and rested upon the support **41**.

Normally, the pickup arm **32** is formed as an elongated, generally U-shaped section. It is turned slightly inwardly along its edge **189** so that when rested upon the support **41**, a lateral movement of the catch **29** will move the contactor **191** left or right to release or catch the arm **32** by withdrawing from or entering slot **190** in the inwardly turned edge. When in a nonplay position the pickup arm rests upon the support **41** and the catch element **29** is positioned inwardly to pivot contactor **191** to hold the arm position fixed and in a nonplay state. With movement of the catch **29** the contactor **191** is released from slot **190** and the pickup arm is releasably held on the support **41**. At this time a movement of the control button **94** toward the support **41** and against the force of the spring **96** acting upon the outer end of the lever **95** will be effective to bring the unit into an operative position, assuming electrical connections later to be mentioned are established.

As can be seen from the combination of FIGS. **2** and **3**, the control button **94** projects through the turntable base **12** and terminates in a generally U-shaped section **192** in which the outer end of the arm **95** is spring-held when the device is in a nonplay position. The arm **95**, pivoted at **92**, extends forward beyond the pivot point. Its section **91** is bent so that it can be extended through the slotted opening **93** in the base **12**. The outer end of the arm, as shown in dotted outline in FIG. **3**, has its end **90** project upwardly through the base in a region substantially adjacent to the arm **79** of the bellcrank combination pivoted at **78**.

The outer end of one arm **80** of the bellcrank engages the notch **81** in the slider element **68**. The spring **96** is attached to the underside of the frame **12** and to the outer end of the lever

section 95 to hold the arm in engagement with the U-shaped end of the catch 94. Forward movement of the catch 94 (see FIG. 1) moves the arm 95 against the force of the spring in a manner to move the end 90 into contact with the arm 79. Contact releases engagement between the outer end 81 and the notch 82 in the slider 68. With such movement the bellcrank turns counterclockwise about pivot 78, as seen by FIG. 3. When this occurs, the spring element 73, acting through its downwardly turned portion 66, causes the triangular-shaped cam III to be rotated with shaft 50 to an extent sufficient to rotate the driven pinion X to establish engagement between it and the drive worm XI. This starts the entire control operation.

However, if one or more records had been previously played from the stack 23, automatic operation is provided to continue record play. The control arm 95 is used to initiate an operation of the mechanism but after a start the automatic control takes over.

Now making reference to FIGS. 2,3,4,5,6, and 16 in particular, it will be noted that a turntable control lever 195 is secured to the pickup support axis which turns with the pickup arm. After the pickup arm 32 and its mounted stylus has tracked to the innermost portion of the recording last dropped to the turntable, the stylus moves into a section of record grooving of high pitch 320 (see FIG. 18) a few turns of which finally usually end in a circular track adjacent to the central hole in the record through which the supporting spindle is positioned. With the record turning and the stylus tracking it, the pickup arm swings rather abruptly as the stylus reaches the high pitch turns. This provides what is generally termed a "-velocity trip." Such rapid movement is then transmitted through the group of components (see FIG. 16) which control pickup arm movement. The arm 195, which is secured to move with the hollow spindle 107, is then moved very abruptly in a counterclockwise direction (see FIG. 2) until its outer end contacts an upturned end 196 of the lever arm 86. This contact turns the lever arm 195 about its axis 197 in a counterclockwise direction (looking at FIGS. 4, 5 and 6, for instance).

As previously stated, the outer end of the lever arm section 86 is bent (see FIG. 6) and extends through the generally sector-shaped opening 87 in the base 12. The forward portion 85 of the arm section 86 is a separate pivoted section held to the spindle 198 and normally held in alignment with the end 86 by means of a spring member 199. The spring is wrapped about the pivot spindle 198 with its ends attached and terminating in a small opening (not shown) in each of the extension end 85 and the upturned forward end 86. When contact is made between the swinging lever 195 and the outer end 196 of the pivot lever 86, the pivot lever moves away from a normal rest position against a pin 201 extending outwardly from the base. When so moved, the lever is brought toward the outer end 88 of the bellcrank arm 79.

There is attached to the hollow drive spindle 56 for the turntable a downwardly depending short wirelike pin 202 (see FIGS. 5, 8*a* and 8*b*) which turns with the turntable shaft. With the outer end 85 of the lever arm 86 resting in its normal position against the pin 201, (a position of play of the record and a position other than that corresponding to the high pitch on the record grooving during which portion of record tracking the trip occurs,) the downwardly turned spring pin 202 is always clear of the outer end of the section 85 during its rotation. However, as the tracking stylus 30 reaches the high pitch grooving on the record, following the completion of play of the record, the arm 86 is turned or moved under contact of lever 195 to place the end 85 in a position (see FIG. 5) where contact is made between the downwardly turned spring pin 202 and the end 85. This movement causes the end 85 of the lever to turn about the pivot point 198 against the force of the spring 199 while contact is held due to the rotation of the turntable shaft 56 until the outer end 88 of the bellcrank 79 is contacted, at which time the pin 202 clears the lever.

This contact acts similarly to the already explained action for the manual start. It immediately releases the point 81 of the arm 80 from the notch 82 in the spring controlled slidable member 68. The slidable member then moves forward in the fashion already explained until its depending section 66 contacts the triangular-shaped cam III to jog the cam and the shaft keyed thereto to bring about engagement again between the drive worm XI and the driven pin X.

While this is occuring, of course, the bellcrank 79 is turned in a counterclockwise direction, looking at FIG. 6, so that its outer end 88 is rotated sufficiently far to permit the end 85 to move also counterclockwise about its pivot point 198 to permit the downwardly depending catch 202 to clear. The control action, however, is precisely the same as occurs when the movement of the bell crank 79 is initiated by the movement of the control button 94 turning the arm 95.

Depending upon whether or not the machine is first starting or has been operating and a new record is to replace an old, establishes whether or not the recycling occurs by virtue of the lever 86 or the lever 95.

No matter which operation occurs, the camshaft, as shown by the upper 72) of FIG. 22*a*, is rotated for about its first 15° under the influence of stored energy of the spring 73 acting through the depending section 66 to turn the triangular cam. With the energy of the spring 73 having been released, provision must be made prior to a completion of a 360° rotation of the camshaft again to compress the spring 73 and to hold it in its compressed position by engagement of the outer end 81 of the bellcrank in the notch 82 of the slider element 68 if the device is again to function in similar style. Such spring reengagement is established by the turning of cam III upon the camshaft to force the slider element to the left (looking at FIG. 7*a*) until the spring pressed end 81 of the bellcrank 79 again engages the notch 82. The energizing of the spring 73 then occurs when the cam III turns on shaft 50 so that its second point 205 engages the depending section 66. Then, as soon as the slider element moves to a position where the spring pressed end 85 can engage the notch 82, the position is held with spring 73 energized.

The cam element II has its outer point 207 engage against the downwardly depending lip 71 of the slider element which controls the tensioning of the spring 73. It can be seen particularly from FIG. 4 that the depending sections 66 and 71 are slightly displaced longitudinally along the cam shaft as are the positionings of the cams II and III. This positions the depending lip 71 slightly closer to the turntable axis than is the depending lip 66, the difference being approximately the width of the cams and the displacement of them along the cam shaft. The structure just described serves to lock the operation and preclude disengagement of the catch on the slider during periods of record play. When there is disengagement, and the stylus reaches the end of play position on the record or the manual start is elected, the lever 95 is so turned that the depending section 66 is laterally displaced and consequently the portion 209 of the cam cannot hold and prevent further rotation of the camshaft.

Cam V next will be discussed. As can be seen (particularly from FIGS. 2 and 4 through 6) this cam normally abuts a depending arm 210 extending downwardly from a lever element 211. The lever is pivoted at a pivot pin point 212. The downwardly depending arm 210 is normally moved against the cam surface by means of a spring element 215. Spring 215 is anchored at one end 216 into the base 12. At its central portion it is wrapped about the pivot pin 212. Its upper end 217 wraps around the inner portion of the arm. The lever is guided toward its forward end by a support pin 219 extending through a slot 220, thereby to permit a limited degree of arcuate movement about the pivot 212. With the lever resting against the cam V, it tends to move about the pivot point 212 against the force of the spring 215 each time the cam edge surface 222 presses against the depending lip 210. As the cam rotates beyond the surface 222, the spring 215 tends to move the outer end 224 and its downwardly depending lip 225 in a clockwise direction, looking at FIG. 6.

As can be seen, particularly by FIGS. 2 and 4, however, the outer end 224 of this lever tends to close the opening 227 through which the spindle 37 of the record compressor is adapted to move in a downward direction relative to the support base as records are released from the stack. When the support spindle 37 on which the record compressor is positioned moved downwardly, its position changes from that which is shown in solid outline on FIG. 15 to that shown in dot-dash outline. The pin 39 which extends outwardly from the spindle 37 initially is placed so that it fits into the slot 40 which extends through the bracket 38 and finally moves down to a rest position 230 at the bottom of the bracket. The spindle 37 has a notch 231 formed therein part way between its lowermost point 232 and the outwardly extending arm 34. This notch extends approximately halfway into the spindle. It is finally moved to a position within the support end through the opening 227 where the notch 231 is opposite the outer end 224 of the lever arm 211.

For conditions prior to the time when the notch 231 is opposite the outer end 224 of the lever 211, it will be apparent that no matter what force is exerted by the spring element 215 tending to move the arm about its pivot point 212 (the movement being in a counterclockwise direction looking at FIGS. 2 and 4) the inner edge of the arm can move only to the periphery of circular spindle 37. In this position the outer depending lip cannot contact any element in its movement about the pivot point due to the action of the cam V and the spring 215. However, at a time when the spindle 37 moves within its support so that the notch 231 is brought opposite the outer end 224 of the lever 211, the lever can move inwardly an additional distance and, with it, carry the depending lip through an arc greater than at any other time.

The rear portion of the generally sector-shaped disc element, through which the pickup arm support spindle 107 is placed at the center opening 158, is formed with a second pair of projecting points 234 and 235 which meet to form an open V-shaped section 236. Because of the movement provided for this generally sector-shaped component 157 by the cam VII riding on the curved ridge 143 of the sector-shaped element 144, the projecting teeth 234 and 235 and the notch 236 turn so that at a time when the outer end 224 of the lever finally can move within the notch 231 of the spindle 37 (i.e., after the last record on stack 23 is released,) the downwardly depending lip 225 and the notch 236 are brought into engagement so that the pickup arm cannot move. Accordingly, element 195 cannot contact the end 196 of the lever 86 to move the end 81 of arm 80 out of the notch 82 to release slider element 68, thereby to jog the driven pinion X into engagement with the worm XI. There being no provision to jog the camshaft at such time, the automatic record feed from the stack and a record-changing operation stops.

With this condition obtaining and the plate 144 being held stationary for the moment by reason of the engagement of the downwardly depending lip 225 and the notch 236, the cam VII merely slides across the raised portion 143, but no turning effect occurs. Consequently, the pickup arm is not moved inwardly toward the record. This holding effect is maintained so long as there is contact between the surface 222 of the cam V and the depending lip 210 of the lever element 211. This continues for a period which is slightly later than that over which the cam VII contacts the raised rib 143. However, the period of contact between the downwardly depending lip or segment 210 of the lever 211 terminates prior to the end of the cycle of rotation of the cam shaft, as can be seen from the relationship of the cams shown by FIG. 17.

As soon as the outer surface 222 of cam V turns beyond the point of contact with the outwardly depending lip 210, the force of the spring 215 turns the lever 211 in a direction (looking at FIG. 4) about its support end pivot point 212 to free the engagement between the outer end 224 of this lever in the slot 231 of the compressor arm spindle 37. It also disengages the downwardly depending lip 225 from the notch 236 and thereby frees the operation. This, however, has no effect upon further turning of the pickup arm because engagement between the cam VII and the raised portion 143 of the sectorshaped disc element 144 has already terminated. However, the cam shaft can and does continue its rotation until the 360° cycle of turning has been completed. This, then, at about the end of the cycle permits the pickup arm to be lowered by reason of the shaping of cam VIII and the contact made by it with the spindle 105 to rest and lower the pickup arm (see FIG. 10.)

Since the pickup arm has not been carried inwardly due to the arrested movement of the sectorlike-shaped plate element 144, the effect, which at any other phase of the operation would be a lowering of the pickup arm to the record surface, now merely places the arm on the rest element 41 with further rotation of cam VIII. Following this, when the cam shaft 50 completes its single turn to bring the missing tooth area 61 of the driven pinion 59 adjacent to the teeth 60 of the driving worm XI, cam shaft rotation stops.

To this point, no detailed mention has been made of the switching components. Since the entire mechanism is driven by the motor 14, switching is confined to the motor and normally to the pickup which tracks the record. The drive is so set up that the energizing motor circuit from the plug-in point (not shown, but any suitable connection) to the driving motor 14 closes through either or both of two parallelly connected switch elements 240 or 241. The switch elements are represented schematically on the drawings at 240 and 241. (See, for instance, FIGS. 2 and 4.) While not shown specifically by the drawings, it may be assumed that these two switches are parallelly connected as regards each other and serially connected as a parallel combination with the circuit connections from the connected power supply (not shown) to drive the motor 14. Consequently, the motor 14 will be driven when either or both switch 240 and 241 is closed. Disengagement or opening of both switches concurrently is required to interrupt the motor drive.

If consideration is first given to the switch 240, it comprises two spring-pressed arms 241 and 241′ supported from an insulating bracket 242 to which the electric connections are made from a suitable power source (not shown at appropriate terminal points 243 and 244. One terminal connection leads to one switch armature and the other terminal to the second switch armature. These connections are in series with the motor. The switch arms are normally spring-pressed to a closed or contacting position as they extend out from the bracket 242. However, the switch armatures are of different length, the arm 241′ being longer. The contact is opened each time a generally arcuate-shaped insulator component 245 attached to the outer end of an arm 247 extending outwardly from the plate 157 is moved relative to armature 241′.

With the slotted sector-shaped plate 157 in a position generally shown in FIG. 2, just prior to the time it has been rotated to any significant extent by the cam VII, the arm 247 is swung to the position where the chamfered edge 246 of the insulator section 245 moves over armature 241′. The two contact strips of switch 240 are in a closed state. Movement of the insulator 245 depresses armature 241′ and separates the two contacts to break any circuit which otherwise would be established between them and the drive motor.

At a time when movement of cam VII over the raised edge 143 of the plate 144 turns the plate 144 and, with it, plate 147 in a counterclockwise direction (looking at FIG. 2,) the circuit connection to motor 14 is reestablished through the spring contact armatures of switch 240. Thus, as the downwardly depending lip 225 of the lever 211 locks into the notch 236 to preclude turning of plate 157 the arm 247 and the insulated contact breaker section 245 is in a position where the insulator section 245 breaks contact between the contact strips 240. With this condition obtaining, the motor 14 cannot be supplied with operating current through this switching element. Otherwise contact is made and broken as explained.

Considering now the second switching contact arrangement, and again making reference particularly to FIG. 2, the

extension 250, which is part of the slidable bracket 70, having downwardly turned sections 66 and 71, is positioned laterally of cam IV. This strip extension 250 ends in an insulator element 250'. An insulated support bracket 252 is also carried on the underside of the base 12. A pair of spring-pressed contact armatures 253 and 254 supported from separate locations on the insulating racket extend outwardly therefrom. (See FIGS. 2 and 4.) Each armature has a generally "L-shaped" end. Each end forces the other so that the armatures normally make contact during driven periods of the cam shaft 50. As was suggested with switch 240, one contact armature element 253, for instance, connects with the power supply line. The other contact armature 254, for instance, connects with the motor, thereby to drive it when contact is established between the two armatures. The switch 241 is thus serially connected with the motor in the circuit of the power supply to the motor. The switch 241 is connected in parallel with the switch 240 so that motor 14 can be energized for operation by closure of a circuit through either switch.

The switch contact elements or armatures 253 and 254 are normally held closed during all periods when the pinion X is being driven by the worm XI. When the cam shaft turns, however, so that the missing teeth on the driven pinion X are adjacent to the teeth on the driving worm XI, contact is broken by reason of the positioning of the Cam IV relative to the switch armatures 253 and 254 which overlap the cam surface. Further than this, the bracket 250 which extends outwardly from the slidable element 70 carries an insulating end section 250' which at such times moves the lower switch armature 254 away from armature 253 to separate the switch armatures and open the circuit.

With this construction, it can be seen that whenever the mechanism is tripped to start a new revolution of the cam shaft the contacts of the switch 240 will close because the arm 247 is moved in a counterclockwise direction (looking at FIG. 2) by the fact that the pickup arm is carried away from the record. This closure will maintain a circuit through to the motor. However, if the last record has been played, the switch contacts of the switch 240 cannot open by reason of the insulator 245 separating them.

Similarly, the switch contacts 253 and 254 will be maintained open whenever the drive is disconnected but will be closed during each period that the cam shaft is making its one turn. This combination permits the motor to be driven during the time the camshaft is stationary while the record is in a play position on the turnable. It also insures that the motor is kept operating during the nonplay position of the record between the completion of one record play and the start of the next record play during which time the cam shaft 50 is being rotated.

It is thus established that there are two switching means 240 and 250 which are connected in parallel. The switch means 250, as above-described, is operated by the cam 256 to close when the clutch is released and it remains closed until the clutch is disengaged and again charged. The switch 240 is closed while the pickup arm is operative but it remains open when the pickup arm is in its rest position.

To this point, discussion has not been given for mechanism to control the rotational speed of turntable 11, thereby to make the described unit generally universal in character from the standpoint of its ability to play records designed for reproduction at different replay speeds.

At the present date, a substantial majority of records are pressed to be replayed at a drive speed of 33⅓ r.p.m. These records are usually of the 10 inches and 12 inches diameter variety, with by far the majority being of the larger size. Prior to the advent of records designed for replay at 33⅓ r.p.m. speed, the most common record was that of either the 10 inches or 12 inches variety that was played at a replay speed of 78 r.p.m.

Another record type very common to the market and in wide use is the smaller size record of a7 inches diameter that is pressed for replay at about 45 r.p.m. The record player here described is adaptable to adjustment to play records of all of the foregoing varieties at the proper speed merely by an adjustment of the speed control knob 17 on the base of the unit.

By the drawings, FIGS. 20*a* and 20*b* in particular show the general arrangement for effecting speed change of the driven turntable 11. The speed at which the replay is provided must at all times be set in accordance with the type of record selected for play. The unit here described is exemplified by providing for speeds of 33⅓ r.p.m., 45 r.p.m., and 78 r.p.m., with each speed being individually selectable. These speeds are illustrative and should not be regarded as limited, for more or less appropriate speeds may be provided by following the teachings of this disclosure.

It was above explained in brief, in the discussion of FIGS. 3—8, that the turntable 11 is driven by a driving puck 15 which is arranged to roll against the inner rim or surface of its downwardly extended edge. The puck 15, in turn, is driven and controlled as to its periphery rotational speed. The rate of puck rotation establishes the turntable speed. Different puck speeds are had by moving the puck, with speed selection, in a direction to cause it to be driven from different size hub sections of the shaft 288 of the drive motor. As can be seen particularly by FIGS. 20*a* and 20*b*, these different size hub sections are represented at 291, 292, and 293. The speed changes are effected by shifting the driven puck 15 from one to another of these hub sections. Shift is accomplished by turning the vertical cam 311 through control knob 17 to effect such speed change.

Considering first FIG. 20*a*, it will be observed that the puck 15 is adapted to rotate on the shaft or spindle 294 which is carried on a generally U-shaped bracket 295. A pin 296 is supported in the upper arm of the U-section 295 and also extends through to the lower arm 297 of the same bracket. The spindle 294 is carried preferably on the outwardly extending portion of the bracket acting generally as a cantilever element. There is a hinge connection between the lower section 297 of the U-shaped bracket and the outwardly extending arm 298 which is supported in spring-pressed fashion upon a support rod 299. The bracket is suitably secured to a sleeve element 301 which surrounds the rod 299 so that the rod can slide therethrough.

The lower end of the rod 299 terminates in a washer ring 302. A fastening nut 303 is threaded to the bottom end of the rod 299 to hold the washer 302 about the rod. There is a coiled spring 305 wrapped about the sleeve 301. The spring is secured at its lower end to the washer 302 and pressed against the lower surface of the bracket 298. The upper end of the rod 299 is fastened in any suitable fashion, as by the fastening nut 306, about a bracket 308 which is fastened, in turn, in any desired fashion (not shown) to the underside of the frame 12 so that the bracket is spring-pressed upwardly toward the frame by the action of spring 305. Bracket 298 is actually formed generally as a bellcrank, with an arm 309 extending outwardly at approximately 90° to the bracket 298.

The control knob 17 is appropriately fastened to a spindle 310 which passes through the base 12 and terminates at its lower portion by connection to a vertical cam 311. The pin 312 carried by the arm extension 309 is adapted to rest upon the under surface of this cam. The underside of cam 311 is appropriately curved in three steps to accommodate the three speeds customarily used in record play. If more than three speeds are desired it can have more than three steps. When the knob 17 is turned it also turns the cam 311. Then, the follower pin 312 forces the arms 309 and 298 of the bellcrank downwardly in the event that the low section of the cam 311 contacts the pin (see FIG. 20*a*) or permits these parts to move upwardly under the force of spring 305 when it contacts the upper portion of the cam 311. An intermediate portion of the cam surface contacting with the pin 312 is shown by FIG. 20*b*. As the control arm 17 is turned to select a different speed, the pin 312 always follows the bottom surface of the cam. A guide pin 313 is also secured to the arm 309 and it is arranged to make contact with the vertical outer surface of cam 311, thereby to rotate the arms 309 and 298 with the turning of the

cam **311** by the control knob **17**. Contact at the outer cam edge is generally maintained by the pin **313** acting under the force of a spring **317**. The spring is anchored to the underside of the frame **12** and to the end of the bracket **295** which supports the puck-carrying shaft **294**. This spring holds the puck tightly between the motor shaft and the inner depending section **16** of the turntable at all times when the speed selection has been made.

Any rotation of the control knob **17** raises or lowers the arm **298** and with it the puck **15** because of the construction of the lower face of the cam **311**. With the follower puck positioned and held on the spindle **294** which is carried on the arm **295**, rotation of the control knob **17** first tends to rotate to a very limited extent the support arm and thus carry the puck away from the hub sections **291**, **292** and **293** of the motor shaft **288**. However, as soon as the cam **311** is being turned and by virtue of the recessed regions **304** thereof, the follower **313** tends to press within the inner depressed region and the spring **305** tends to unwind immediately upon release of the knob causing the puck **15** to locate itself tightly between the inner wall **16** of the turntable and one of the motor shaft hub sections. Thus, no matter in which position the cam happens to be, the puck receives its rotational motion from the motor drive shaft and transmits rotation to the turntable. As shown by FIG. **20***b*, the puck is on the midsection **292** of the motor shaft and, thus drives the puck at a slightly slower rate than is the case of the puck position of FIG. **20***a*, it being assumed, of course, that the motor turns at a constant drive speed.

For the periods of driving control established, the continued operation of the unit becomes automatic following the drop of the lowermost record on the stack through to the playing of what originally started as the uppermost record on the stack. The velocity trip provided by the rapid movement of the pickup arm **32** as it comes to the end of the useful play period of the record and enters on to the high-pitch spiral track **320** causes the inner portion **33** of the pickup arm to move rather rapidly. This rapid movement is then promptly transmitted through the resultant movement of the lever **195** contacting the outer end of the arm **86** to initiate the trip operation already described. In such operations to retain the particularly automatic type of control, it is, however, desirable that all records stacked on the record support spindle at any one time be records that are to be replayed at the same replay speed. Lacking this, the reproduction pitch of the played record might or might not be correct. This apparatus provides for a manual change in the record speed as above explained. This depends upon the setting provided and is, of course, selectable in accordance with the type of record immediately under consideration.

Records adapted to be reproduced at a record rotational speed of either 33⅓ r.p.m. on the turntable are all dropped to the turntable by the mechanism which has already been described herein. This mechanism was discussed primarily in connection with the reference to the operation of the spindle feed as set forth particularly by FIGS. **9***a* through **9***d*, inclusive. Records of smaller diameter than 10 inches usually have a large center hole and are adapted to fit over an enlarged hublike spindle when stacked prior to play. The record control of this type is provided by the present invention through the inclusion of an adapter construction (see particularly FIGS. **21***a* and **21***b*) which is positioned on the turntable to surround a record support spindle of the general character shown by FIG. **9***c*.

The adapter has an enlarged hub section formed of a lower generally tubular section **320** having at its upper end an inwardly turned flange section **322** that has a reentrant center section **323**. This provides a central hole through which the spindle **18** can be positioned. There is rested on the lower section **320** a second generally tubular section **327** which has a transverse closure top section **328**. The top section is formed into a central tubular region **330** that extends downwardly and fits interiorly of the reentrant section **323**, thereby to provide for anchoring within the hub proper. The lower end of the formed cylindrical section **330** is closed by a closure member **331**, having a central opening **332** of a size to accommodate the spindle **18** and an outer diameter to fit into the cylindrical section **330**.

Within the closure member **331** and between its upturned edge **333** and the wall of the spindle **18**, it is desirable to position a bracket member **335** whose inner surface is generally curved to correspond to the spindle curvature and whose outer surface fits tightly against the inwardly turned wall **323** of the lower tubular section **320**. All of the components formed by the inwardly turned wall **323**, the closure member **331** and its upwardly turned edge and the bracket member are tightly secured together in any desired fashion, thereby to be supported in substantially fixed location one with respect to the other.

The closure member **328** formed inwardly from the upper end of section **327** is provided with a slot **339** through which a small pivoted lever member **340** is extended. The upper end of the lever terminates in a fork-shaped end **342**, as will later be explained. The lower end **343** is generally ball-shaped and fits within a socket **344** in the bracket element **335**. The lower end of the lever **340** formed as the ball **343**, is capable of turning within the socket **344** in any direction. However, positioning the upper fork-shaped end **343** in the slot **339** limits the movement of the lever element to substantially a movement to the left or right, looking at FIGS. **21***a* and **21***b*.

Normally, the lever **340** is moved in a generally counterclockwise direction under the expanding force of the spring **350** which has one end attached to the lever at point **351** and the other end **352** held adjacent to the inner wall of the section **327** of the hub about an anchoring pin (not shown for convenience) or held in any other suitable fashion. A sliding plate member **355** terminates in a generally fork-shaped section (looking at FIGS. **21***a* and **21***b* and therefore not shown in plan). The ends or tines of the fork-shaped member are connected by a cross-pin **358** which is straddled by the fork-shaped end of the lever **340**.

The lever **340** acting against the pin **358** is adapted to move the slider piece in and out relative to the upper closing ledge **328**. This movement occurs at times when the lever arm **19** contained within the spindle **18** is rocked in the fashion explained in connection with FIGS. **9***a* through **9***d* in particular. The rocking movement is provided in a way to force the lever ledge **141** to the right, looking at FIGS. **21***a* and **21***b*, and thus to bear against the inwardly turned section **360** of the lever **340**. At times when the ledge **141** comes to bear against the edge **360** of lever **340**, it is apparent that the lever will pivot about the ball **343** supported in socket **344** and thereby move to the right against the force of the spring **350**. This movement provides for feeding records in sequence from the stack.

The top section **370** is of generally cylindrical form and fits over the upper end of the generally cylindrical section **327**. Attachment of the two sections is made in any desired way such as by fastening screws connected between the lower closure transversely extending member **371** and the portion **328** of the cylindrical section **327**. For convenience, these are not shown but any form of fastening may be used. The inward portion of the transverse member **371** is formed as indicated at **372** into an inwardly turned piece into which the upper end of the spindle **18** extends as shown.

The upper end of the spindle **18**, as particularly represented by FIGS. **9***a* through **9***d*, supports the slidable holder **24** and the diameter of an inwardly extended section **330** is formed to take care of the greatest laterally positioning point **137** on the holder **24**. The top member **370** has a small section of the wall cut away to permit positioning of a record camming piece **375** which is suitably pivotally fastened on a pin **376** supported in the inwardly turned portion of the top member **371** as it rests upon the section **328**. The camming piece **375** in FIGS. **21***a* and **21***b* is shown only in elevation. However, it is formed as a component whose width is approximately one-half that indicated by the sloping edge **375** as is shown more particularly by FIG. **23***b*. The diameter of the top piece **370** is very slightly

under that of the center hole in the usual size 7 inch record, thereby to make it easy to fit the record over the top of the adapter section. In this form, the records can slide downwardly over the generally cylindrical portion of the top section **370** and then by contacting the sloping edge of the camming piece **375** pivoted at **376** move laterally to the left (looking at FIGS. **21***a* and **21***b*). This movement is permitted by reason of the inwardly turned opposite edge **378** of the top member **370**. Then, as the records are placed over the top of the top section **370**, they tend to drop downwardly to the position shown by the stack **23'** and by reason of the camming piece **375** in their path move to the left, looking at the figures. This movement to the left is permitted by the inward slope of the edge **378**. The lowermost record of a stack, which prior to starting the play would be the first record placed over top, is then brought to rest in the position schematically indicated by the record **381** (see FIG. **21***a*).

With the record's inner edge supported on the top crossmember **328** and held generally in flat position both by the compressor arm (not shown in FIGS. **21***a* and **21***b*) and the weight of other records at a time when it is desired to start the record play or when it is desired to fit another record to the turntable after the play of one record, the inner lever arm **19** of the spindle **18** is moved in the fashion already explained. This movement forces the ledge **141** from the position shown in FIG. **21***a* to that shown in FIG. **21***b*. Consequently, the ledge movement turns the lever **340** about its ball end **343** as a pivot point and moves the upper end of the lever to the right against the force exerted by the spring **350**. As shown by FIG. **21***a* the lowermost record **381** in the stack **23'** is first supported upon the upper edge **328**. It is rested in a plane at the elevation or just slightly lower than the position of the slidable yoke **355** which has the cross-pin **358** positioned in the fork-end **342** of lever **340**. Accordingly, with the movement of the lever, and its turning in a generally clockwise direction (looking at FIGS. **21***a* and **21***b*), the outer edge of the slider piece **355** contacts the inner edge of the center hole of the record **381** and moves it to the right. The recess formed by the inwardly sloping section **378** extends approximately one-half way around the generally cylindrical section **370** so that the record rested on the upper ledge **328** is shifted laterally for a distance sufficient to align its central hole with the cylindrical section **327**, thereby to permit the record to drop. The lowermost edge **385** of the camming piece **375**, as shown, is slightly above the top of the lower record held in the stack and rested on the edge **328**. This edge **385** is also slightly below the upper surface of the second record on the stack. Thus, any movement of the slider piece **355** to the right (looking at FIG. **21***a*) moves only the lowermost record of the stack and brings that record to the right to a position where its center hole aligns itself with the cylindrical edge of the adapter section **327**, thereby to permit the record to fall gravitationally to the turntable **11**.

At the time the record falls, the next record of the stack can first drop no further than to the upper surface of the slider **355** but when the slider is retracted to the position shown by FIG. **21***a*, then the lowermost record of the stack assumes the position shown by record **381** in this figure.

The entire assembly of the adapter and the upper section **370** thereof is closed by a cap member **389** which fits internally of the section **370**, as shown.

The camming member **375** cannot move lower than the upper edge **391** of the crossmember **371** and, therefore, records rested above this section are shifted by the slope of the cam member **375** and the inward slope of the wall **378**. This procedure follows until all records of the stack are delivered to the turntable. The camming piece is suitably spring-biased in any desired fashion by a spring member (not shown) surrounding its pivotal axis **376** which spring action tends to move the camming piece against the edge **391**.

When it comes time to remove records from the turntable which have previously been dropped thereto by the adapter structure, the records are lifted vertically along the adapter spindle. The camming piece **375** is turned clockwise about its pivotal axis **376** from the position shown by FIGS. **21***a* and **21***b* through an angle of about 90° when the records are lifted. In this position the flat edge **385** is brought internally of the opening **393** in the cylindrical wall through which the camming piece is extended. This permits ready removal of the records.

The slider member **355**, is more particularly shown in the enlarged section of FIG. **25** where the chamfered outer edge **355** is emphasized. This is to insure that a single record only will be slid to the right from the position shown in FIG. **21***a* with a movement of the slider. Records at times vary slightly in thickness and the chamfer insures the movement of a single record only. This is despite the fact that the penultimate record of the stack is held normally by the camming piece **375** and it permits the penultimate record to be lifted very slightly to the slope surface provided by the chamfer as against the record being shifted laterally.

In summation it may be stated that the described invention incorporates distinct features of (*a*) providing automatic start, (*b*) providing for cyclic speed changes and (*c*) providing automatic stopping. The automatic start feature, as has already been set out, can be initiated through the movement of the control button **94** thereby to release the lever **95** to control and initiate operation of the tripping mechanism. With this the switch **241**, which is one element to energize the motor drive, is closed and the device starts. The automatic stop is effected following the release of the last record of the stack, and through the control by the switch elements **240** and **241** already above discussed. Continuity of operation is maintained under control of the switches **240** and **241** which in the described parallel connection arrangement switch **241** remains closed during time periods when the clutch mechanism is operating and the switch **240** remains closed except when opened by movement of the armature **247** and the insulator component **245**. In the normal operation and assuming the single turn of the controlled cam shaft during the playing cycle with one revolution of the driven cam shaft **50** occurring in the illustrated example, the switch **240** remains open for about the period between approximately 90° and 210°. During this period of time, the switch **241** is closed so the device keeps driving.

It has already been mentioned that the illustrative curves of FIGS. **24***a* and **24***b* set out various actions as if occurring substantially instantaneously. This, of course, has been only for the sake of ease of illustration, as well as explanation. Wherever mechanical motions occur, they do not occur absolutely instantaneously. For example, while the camshaft **50** is generally abruptly operated to initiate its movement at a time when a projecting point **81** moves out of the notch **82**, either due to a manual or an automatic start, necessarily some extremely short time period is required to effect this rotation. Likewise, the constant rotation of the camshaft following the engagement of the contacting teeth of the shown drive worm and the driven pinion beyond its mutilated section also takes place during extremely short time lapses although this, solely for illustration is shown as being substantially instantaneous. The movement of the pickup arm back and forth has been shown as occurring over a longer allowable time for raising and lowering but it, like other movements depicted, can occur over relatively short time periods.

Further than this, while the invention is described as involving a control effected with a driven-controlled camshaft making one 360° revolution during each control cycle, this also is illustrative, and without departing from the principles set forth the structure could be modified to turn for a lesser distance of say 180° for each sequence provided adequate modifications are provided in the shape of the cams and their followers and the switching controls. The drawings thus show a favored embodiment but are not intended to depict necessary or inherent limitations.

The invention has been shown in a preferred form with its various parts related and arranged according to a practical form. However, there should not be any inference that the

various parts are scaled to the precise size of exact spaced relationship despite the fact that operation is generally contingent upon a controlled timing. The showing is representative and should be interpreted together with the description in all reasonable scope.

Since many and various modifications of the invention may readily be made without, in any respect, departing from either the scope or spirit of this disclosure, it is believed, accordingly, that the invention will be understood to encompass each and every modification that falls fairly within a reasonable interpretation of the claims hereinafter appended when considered in the light of the existing prior art and this description.

I claim:

1. In record changer and cycling apparatus with which there is provided a record-support spindle means for supporting a plurality of records of permissively intermingled sizes in stacked relationship for individual release and playback by stylus means following release for support in a playback position upon a rotatable turntable having controllable speed drive means, the said spindle means and the turntable axis of rotation being substantially axially aligned, and in which the stylus is carried by an elevatable and arcuately movable pickup arm adapted in its active position to rest on and follow the grooving of the playing record, the combination comprising,

a single control camshaft means,

means to limit the said camshaft rotation to one rotational cycle preparatory to playing the lowermost record of the stacked plurality, the said single shaft controlling the complete sequence of the operational cycle,

means operable during a selected portion of the rotation of the control camshaft for moving the said lowermost record of the stacked group along the spindle to a temporary support position between the record support means and the turntable,

means also controlled from the control camshaft for moving the pickup arm arcuately toward the turntable axis to a position to abut the record held in the temporary support position for contacting the record edge and thereby sensing the record size,

a further means operated from the control camshaft for retracting the support means holding the record in the temporary position for sensing to permit the record to move to the turntable,

means also driven from the control camshaft for subsequently moving the pickup arm toward the turntable and locating the stylus carried by the pickup arm upon the deposited record, and

means to interrupt rotation of the control camshaft during the record-play period.

2. The record changer claimed in claim 1 wherein the means for moving the pickup arm comprises

a frictional drive means, and

means to permit slip in the drive during the period within which record sizing occurs.

3. The record changer claimed in claim 1 comprising, in addition,

a record-supporting spindle axially aligned with the turntable drive axis for supporting a group of records for play, said spindle including an internally positioned movable lever adapted for releasing records individually from the stacked plurality at times of lever movement,

cam means on the control shaft for pivoting the internally positioned lever to arrest movement of each released supported record from the stack at a size-testing position following the initiation of rotation of the control shaft, and

means for subsequently releasing the size-tested record to the record turntable.

4. The combination claimed in claim 1 comprising, in addition,

follower means to elevate the pickup arm from the turntable surface during record-recycling operation.

5. The apparatus claimed in claim 1 comprising drive means associated with the driven turntable for driving the control shaft.

6. The apparatus claimed in claim 1 comprising, in addition,

cam control means to release a size-sensed record to the turntable following size measurement, and

means to delay return of the pickup arm to the plane of the record turntable for a time period sufficient to permit the size-sensed record to position itself upon the turntable.

7. The record changer claimed in claim 1 comprising, in addition,

means to coordinate the substantially constant rotational speed of the control shaft to the rotational speed of the turntable.

8. Record changer apparatus as claimed in claim 1 wherein the inward drive means for the pickup arm comprises

cam means supported upon the control shaft, and

a frictionally engageable element carried upon the pickup arm support means which said cam means is adapted to engage for a selected angular portion of the shaft rotation and wherein slippage between the cam means and the frictionally engageable element is permitted during the period of angular rotation of the cam exceeding that required to bring the pickup arm adjacent to the record periphery.

9. The apparatus claimed in claim 8 comprising, in addition,

a slotted stop means associated with the frictionally movable means,

a movable arm adapted to engage the slotted member following slippage between the cam drive and the frictionally driven element thereby to limit the arcuate movement of the pickup arm and stylus toward the turntable axis following contact between the pickup arm and the periphery of the record next to be played thereby to gauge the record diameter, and

cam means supported upon the control shaft for subsequently releasing the engagement of the arm within the slotted element to permit a movement of the pickup arm and stylus to a record-contacting position for the selected record size.

10. The record changer claimed in claim 1 comprising, in addition,

a record-supporting spindle axially aligned with the turntable drive axis, said spindle including an internally positioned movable lever adapted for releasing records individually from the plurality at times of lever movement, and

cam means on the cam control shaft for pivoting the internally positioned lever to release stacked records one by one from the plurality stacked to a size-testing position following the initiation of rotation of the control shaft.

11. The record changer apparatus as claimed in claim 10 comprising, in addition,

means to align the record supporting spindle to one angular position only relative to the turntable.

12. The apparatus claimed in claim 1 comprising, in addition,

record compressor means to hold the records closely stacked and substantially parallel prior to play.

13. The apparatus claimed in claim 12 comprising, in addition

interlock means between the lever to control the repeat cycle and the movement of the record compressor means.

14. The apparatus claimed in claim 1 comprising, in addition,

cam and lever means to control the repeat cycle.

15. The apparatus claimed in claim 14 comprising, in addition

cam means to preclude initiation of the repeat cycle prior to repositioning the stylus member in the record grooving.

16. The drive means claimed in claim 1 comprising a gear means supported upon the driven control shaft and

having one arcuate portion mutilated to preclude drive and means to drive the control shaft from the turntable drive through the said gear during periods of time within which unmutilated portions of the mutilated gear are moved to engage the turntable drive.

17. The drive means claimed in claim 16 comprising, in addition,

cam-controlled spring-operated means driven from the control shaft for rotating the mutilated gear following a completion of an operational sequence for an angle such that gear reengagement is provided between the driving shaft of the turntable and the driving pinion of the control shaft.

18. The apparatus claimed in claim 17 comprising, in addition,

cam operated lever means connected to rotate the pickup arm away from the turntable axis following a completion of record play.

19. The apparatus claimed in claim 1 comprising, in addition,

cam-operated means driven from the control shaft for returning the pickup arm to a position toward the turntable center and means for temporarily interrupting the return path for a time period sufficient to test the diameter of the record next to be reproduced, and

cam control means to return the pickup arm and stylus to the plane of the record turntable for record contact following record size testing.

20. The apparatus claimed in claim 19 comprising, in addition,

cam-controlled means to place the pickup arm stylus at substantially the initiation point of record grooving at the time of return of the pickup arm to the plane of the last previous size-sensed record.

21. The apparatus claimed in claim 20 comprising, in addition,

cam-controlled switch means to arrest operation of the cycling means following the completion of play of the lowermost stacked record.

22. The combination claimed in claim 1 comprising, in addition,

trigger means to initiate operation.

23. The combination claimed in claim 22 comprising, in addition,

spring-controlled trigger means to initiate operation.

24. The combination claimed in claim 22 comprising, in addition,

manually operated trigger means for starting operation.

25. The combination claimed in claim 24 wherein manually operated trigger means comprises a releasable lever means, and

means normally to hold the lever in a state of rest.

26. The apparatus claimed in claim 25 comprising, in addition,

means driven from the turntable rotating means to control the trigger lever movement.

27. The apparatus claimed in claim 24 comprising, in addition

cam and lever means to control the time period of reinitiation of the record play cycle.

28. The apparatus claimed in claim 27 comprising, in addition,

switching means to control the drive period.

29. The apparatus claimed in claim 28 wherein the switching means comprises two switches parallelly connected,

cam means to control one of the switches to close at a selected time and to hold the switch closed until the drive is again disengaged after recharge.

30. The apparatus as claimed in claim 28 wherein means is provided with the second switch means for closing the said switch while the pickup arm is operative, and

means for reopening the said second switch when the pickup arm is in a rest position.

31. In record-changer apparatus wherein flat records of permissively different randomly chosen sizes are adapted to be stacked and moved one by one in stacking order from a record support means to a playing position on a rotary turntable where a stylus element carried upon a movable pickup arm is adapted to track the record grooving between the start and finish positions thereby to play back the recording thereon, the combination comprising,

a single control camshaft,

means to rotate the control camshaft through an angle of 360° within a selected time interval between a completion of play of one record and a start of play of the next record for conditioning the apparatus for the playback,

elevating means driven from the control camshaft for raising the pickup arm and its stylus from a record-contacting position during the said selected time interval,

means also driven from the control camshaft during its rotation following pickup arm elevation for moving the pickup arm and its stylus outwardly from the axis of the turntable to a position beyond the periphery of the largest diameter record to be played,

means operated from the control camshaft at a time period when the pickup arm is positioned outwardly from the turntable axis for shifting the lowermost support record from its initially supported position to a second supported position between the initial position and the turntable,

means driven from the said control camshaft at a time when the record is in the second supported position for moving the pickup arm in its elevated position inwardly toward the turntable axis with the stylus following approximately a radial path toward the turntable axis to a point of contact at the record edge to sense record diameter at which time the drive for said pickup arm temporarily slips and further movement of the pickup arm is arrested,

means also operating under control of the control camshaft to release the sensed record from its second position of support during the period of arrest of movement of the pickup arm to place the record upon the turntable for reproduction,

means also controlled from the control camshaft to move the pickup arm and its stylus to a contacting position on the grooved portion of the record following size-testing and then to free the pickup arm to permit the stylus to follow the record groove path,

and means to interrupt rotation of the control shaft following stylus contact with the grooved portion of the record.

32. The record changing apparatus claimed in claim 31 comprising, in addition,

a drive member supported for rotation with the turntable and turning concurrently with the turntable,

a driven member supported upon the end of the control shaft and arranged for engagement with the said drive member thereby to be rotated, said driven member having a region wherein for a selected angle its rotation by the drive means is interrupted following engagement, and

means to establish the engagement between the driving and driven means following each record play.

33. The record changer claimed in claim 32 which also includes

means to produce an abrupt initial angular rotation of the control camshaft at time periods following completion of record play when at least one additional record is stacked for play, the produced rotation being of the order of 5 percent of one 360° cycle of rotation of the control shaft, and

means to provide a substantially constant speed of rotation of the control camshaft for the remainder of the angle completing the full 360° rotation of a cycle.

34. The record changer claimed in claim 31 which also includes

means to provide an abrupt rotation of the initial angular movement of the order of 5 percent of one 360° cycle of rotation of the control shaft, and

means to provide a substantially constant speed of rotation of the control shaft for the remainder of the angle completing the full 360° rotation of a cycle.

35. In record changer apparatus wherein flat records of permissively different randomly chosen sizes are adapted to be moved one by one from a stacking position on a record support means to a playing position on a driven rotary turntable where a stylus element carried upon a movable pickup is adapted to be supported to track the record grooving between start and finish positions thereby to play back the recording thereon, the combination comprising,

a single cam control shaft positioned to extend in a plane substantially parallel to the record support,

means to rotate the cam control shaft through an angle of 360° over a selected time interval for conditioning the apparatus for the record playback,

cam means driven from the cam control shaft for elevating the pickup arm and its stylus from a record-contacting plane for the time interval between an end-of-play and a start-of-play position for playback,

another cam means also driven from the cam control shaft during its rotation following pickup arm elevation for moving the pickup arm and its stylus outwardly from the axis of the turntable with the stylus following approximately a radial path relative to support of the pickup arm,

a further means operated from the cam control shaft at a time period when the pickup arm is positioned outwardly from the turntable axis for shifting the lowermost supported record from its initially supported position to a second supported position between the initial position and the turntable,

means driven from the cam control shaft at a time when the record is in the second supported position for moving the pickup arm in its elevated position inwardly toward the turntable axis with the stylus following the said approximately radial path toward the turntable axis to a point where the arm contacts the record edge in its inward movement, at which contact point the drive for said pickup arm temporarily slips and movement of the pickup arm is arrested,

means to release the record from its second position of support following edge contact by the pickup arm when further movement of the pickup arm is arrested so that the record is adapted to fall gravitationally to the turntable,

means provided by the cam control shaft and operative following the record drop for continuing limited movement of the pickup arm inwardly through its drive means with the stylus moving along the said approximately radial path toward the turntable axis to a temporary locking position coordinated with the diameter of the sensed record, said position being that which aligns the stylus with the outer edge of the grooved portion of the record,

further cam means driven by the cam control shaft for subsequently disengaging the temporary locking means,

means to permit the stylus carried by the pickup arm to move to a contacting position on the grooved portion of the record following said disengagement and then to free the arm for movement along the grooved path toward the final tracking position,

means to interrupt rotation of the control shaft following stylus contact with the grooved portion of the record, and

means for conditioning the control shaft during the period of its rotation for repeating the cycle following a movement of the pickup arm stylus to the innermost grooved portion of the record.

36. The record changer claimed in claim 39 comprising, in addition,

means to coordinate the substantially constant rotational speed of the cam control shaft to the rotational speed of the turntable.

37. The record-changing apparatus claimed in claim 36 comprising, in addition,

a worm drive member supported for rotation with the turntable and turning concurrently with the turntable,

a driven pinion supported upon the control camshaft and arranged for engagement with the said worm thereby to be rotated, said pinion having an absence of pinion teeth for a selected angle of its periphery, whereby rotation of the pinion by the drive worm is interrupted due to the absence of driving pinion teeth following engagement of the teeth and the worm through a selected angle, and

means to establish the engagement period between the worm and driven pinion following each record play.

38. The record-changing apparatus claimed in claim 37 wherein the driven pinion is supported upon the end of the controlled camshaft adapted for engagement with the teeth of the driving worm for the turntable.

39. The record changer claimed in claim 35 wherein the means to drive the camshaft control includes

means to produce an abrupt initial angular shaft rotation at time periods following completion of record play when at least one additional record is stacked for play, the produced rotation being of the order of 5 percent of one turning cycle of rotation of the control shaft, and

means to provide a substantially constant speed of rotation of the control shaft for the remainder of the angle completing the full cycle of rotation.

40. The record changer claimed in claim 39, including, in addition,

means to store mechanical energy during the driving period of the control camshaft rotation for release at selected time periods,

a yoke means connected for driving the energy storing means,

a cam means on the cam control shaft for shifting the position of the yoke means between limits for energy storage and for triggering for energy release, and

means operated under the control of the pickup arm movement at the end of record play during which high pitch grooving on the record produces rapid movement of the pickup arm for releasing the stored energy under control of the yoke thereby to jog the control shaft through a limited angle of turning to reengage the drive member with the driven control shaft.

41. In record changer and cycling apparatus with which there is provided a spindle having means for supporting a plurality of records of permissively intermingled sizes in stacked relationship for individual release and playback by a stylus following release to a driven rotary turntable for support in a playback position, the said spindle means and the turntable axis of rotation being substantially axially aligned, and in which the stylus is carried by an elevatable and arcuately movable pickup arm and is adapted in its active position to rest on and follow grooving of the playing record, the combination comprising,

a single control camshaft means adapted to make one rotational cycle following the playing of a record and preparatory to playing the next record of the plurality, the said control camshaft having thereon a multiplicity of cams for controlling the complete sequence of the change cycle,

one cam means operable following a rotation of the control shaft means to a selected angular position within its complete rotational cycle when the pickup arm is moved away from the record turntable for moving a portion of the spindle means to transfer the said lowermost record of the stacked group along the spindle to a temporary support position upon the spindle between the record support means and the turntable,

contact means for moving the pickup arm from its position away from the turntable arcuately toward the turntable axis to a position to abut the edge of any record held between the initial support position and the turntable for contacting the record edge and thereby sensing the record size,

further means operated from the control camshaft for retracting the support means holding the record in the sensing position to permit the record to fall gravitationally along the spindle to the turntable for the remaining distance between the sensing position and the turntable surface during further control shaft rotation,

means driven from the control camshaft for continuing the inward arcuate movement of the pickup arm toward the turntable axis following record drop for locating the stylus carried by the pickup arm directly above an outer grooved area of the deposited record following movement of the record to the turntable,

means for moving the pickup arm downward in the last-named position until the stylus contacts the grooved record surface, and

means to interrupt rotation of the control camshaft during record-play period.

42. In record changer and cyclicing apparatus with which there is provided a spindle having means for supporting a plurality of records of permissively intermingled sizes in stacked relationship for individual release to a support position in which playback by a stylus occurs following release and wherein a record-supporting turntable is driven at a chosen speed, the stylus member being adapted in its active position to rest on and follow the record grooving and being carried by an elevatable and arcuately movable pickup arm, the combination comprising

a single control camshaft means adapted to make one rotational cycle during the period between completion of one record play and that of the next record of the stack and during the rotation to release the lowermost record of the stack,

a plurality of cam means on the said control shaft and follower means for each cam for collectively controlling the complete sequence of the cycle in which the record play is initiated,

follower means operated from one of the cams on the shaft for controlling the removal of the lowermost record of the supported and stacked group to transfer the said record to the turntable as the next record to be played,

cam-controlled follower means operable at a selected angular position in the complete rotational cycle of the camshaft for moving the lowermost record of the stacked group to a temporary support position between the position of stacking and the turntable,

means for moving the pickup arm arcuately toward the turntable axis to a position temporarily to abut the record held between the stack position and turntable for contacting the record edge and thereby sensing the record size,

means operated from the control shaft for retracting the support means holding the record in the sensing position to move the record along the spindle to the turntable for the remaining distance between the sensing position and the turntable during further control shaft rotation,

means for moving the pickup arm substantially vertically downward following record size-sensing until the stylus contacts the record surface grooving,

means to interrupt rotation of the control shaft and associated cams during a record-play period, and

means normally to reinitiate the control following the play of all records until such time as the last record of the stack has been played.

43. The record-changer apparatus claimed in claim **42** comprising, in addition, manual means to recycle the selection means and camshaft rotation thereby to omit from the automatic cycle manually selectable records.

44. The record player claimed in claim **42** wherein the intermingled records are each of a character to be reproduced at like speed; and means to change the turntable drive speed selectively.

45. A record-cycling apparatus for controlling the reproduction of prerecorded messages by a stylus element tracing into the groovings on a record element, where the stylus is carried upon a movable arm controllably adapted to contact a range of selected character on the record between its edge and center regions under conditions where the record and stylus are supported for relative movement with respect to each other upon a turntable, which comprises, in combination,

means to rotate the turntable and, with it, the supported record,

a control shaft and means associated therewith to drive the record-supporting turntable,

a plurality of cam elements secured to the control shaft and to turn therewith under preselected conditions,

a cam follower means for contacting each separate cam element,

control means for initiating camshaft rotation at selected time periods and, with it, rotation of the cam elements,

a pickup arm and reproducing stylus element supported to be positioned substantially adjacent to the turntable,

means provided by one of said cam follower means to bring the stylus into contact with the record surface from an elevated position of the pickup arm at a selected position in its grooves and at a selected time and record groove position of the record upon the turntable,

a further cam follower means for elevating the arm and stylus above the record following a selected period of contact, and

means to reproduce the recording on the contacted grooved record portion.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,594,009 Dated July 20, 1971

Inventor(s) Pedro Sans Cerrudo

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 52, "operation", first occurrence, should read -- every -- . Column 2, line 16, "preestablish" should read -- preestablished -- ; line 27, "rotating" should read -- rotation -- . Column 3, line 25, "Objective", first occurrence, should read -- A -- . Column 4, line 51, after "the", second occurrence, insert -- in -- ; line 62, "line" should read -- arrow -- . Column 6, line 2, before "shoulder" insert -- a -- ; line 60, "cm" should read -- cam -- . Column 7, line 12, "and" should read -- upon -- . Column 8, line 37, "operating" should read -- operation -- ; line 46, "camshaft" should read -- non-driving -- . Column 9, line 18, "disengaging" should read -- disengage -- . Column 12, line 41, "hook-shaped" should read -- may -- . Column 17, line 31, "termed a "-" should read -- termed a " -- . Column 18, line 21, "72)" should read -- curve -- . Column 21, line 74, "a7inches" should read -- about 7" -- . Column 23, line 53, before "on" insert -- or 78 r.p.m. -- . Column 27, line 1, "of" should read -- or -- .

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,594,009 Dated July 20, 1971

Inventor(s) Pedro Sans Cerrudo -- 2 --

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 27, before line 29, insert -- a plurality of cams secured to the cam shaft with a cam to control each operation -- ; line 33, after "operable", insert -- and controlled from one of the cams -- ; line 38, after "camshaft", insert -- and controlled from another cam -- ; line 43, after "from" insert -- another cam on -- ; line 49, after "arm", insert -- under the control of another of the cams -- . Column 30, line 9, insert the following as a new line -- a plurality of cams secured to the cam shaft with a cam to control each operation, -- ; line 14, after "from" insert -- one of the cams on -- ; line 17, after "from", insert -- another cam on -- ; line 22, after "from", insert -- a further cam on -- ; line 28, after "from" insert -- still another cam on -- ; line 36, after "means" insert -- operated from another independent cam -- ; line 41, before "means" insert -- another cam -- . Column 31, line 17, after "means", insert -- supported upon and -- ; line 21, after "also", insert -- supported upon and -- ; line 26, before "means", insert -- cam -- ; same line , cancel "operated"; line 26, before "from", insert -- a further cam means operated and driven -- ; line 31, after "driven", insert -- and controlled -- ; same line, after "from", insert -- another cam on -- ; line 41, after "means", insert -- controlled by a further cam -- ; line 46, before "means", insert -- control -- ; same line, cancel "provided" and insert -- operated from another cam supported -- . Column 34, line 35, after "means", insert -- associated with each cam -- .

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,594,009 Dated July 20, 1971

Inventor(s) Pedro Sans Cerrudo --3--

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Signed and sealed this 19th day of December 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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