

Jan. 31, 1939.

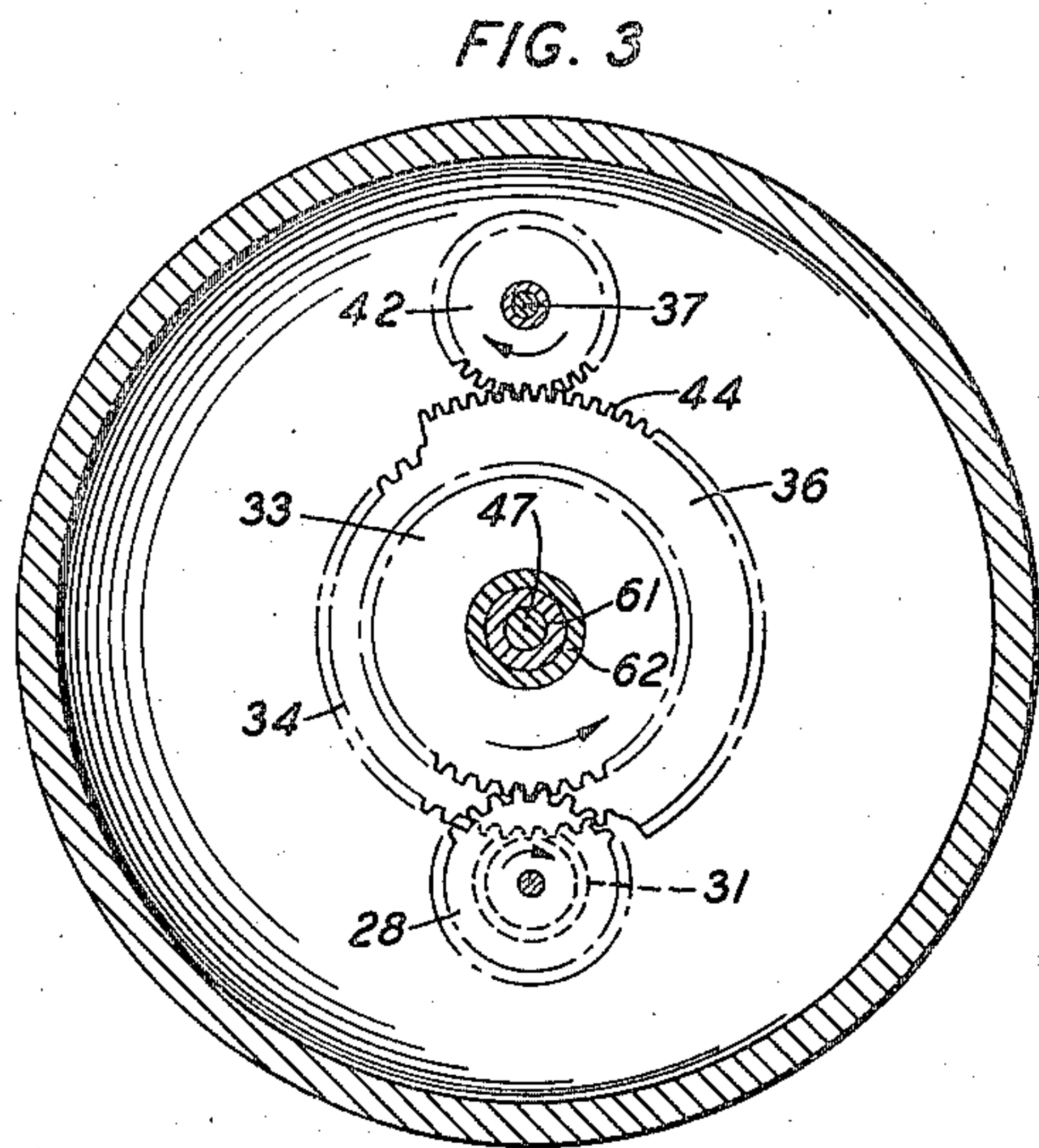
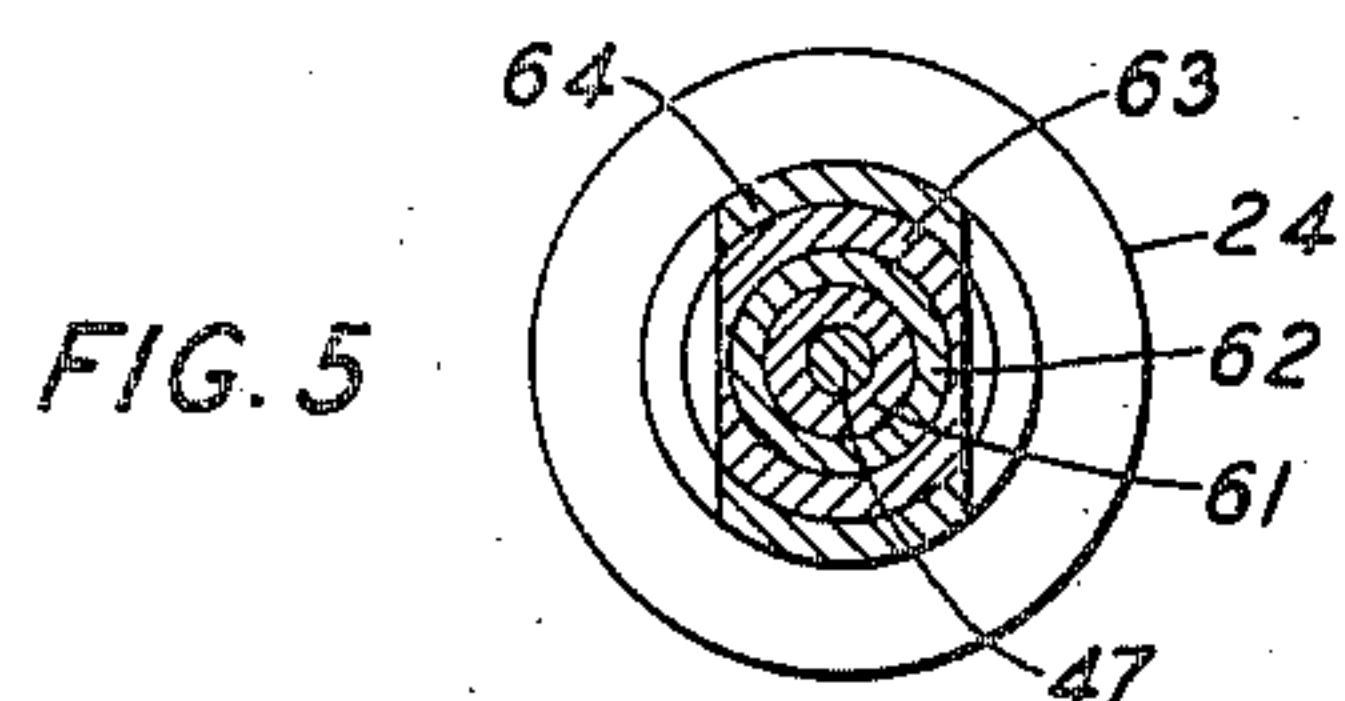
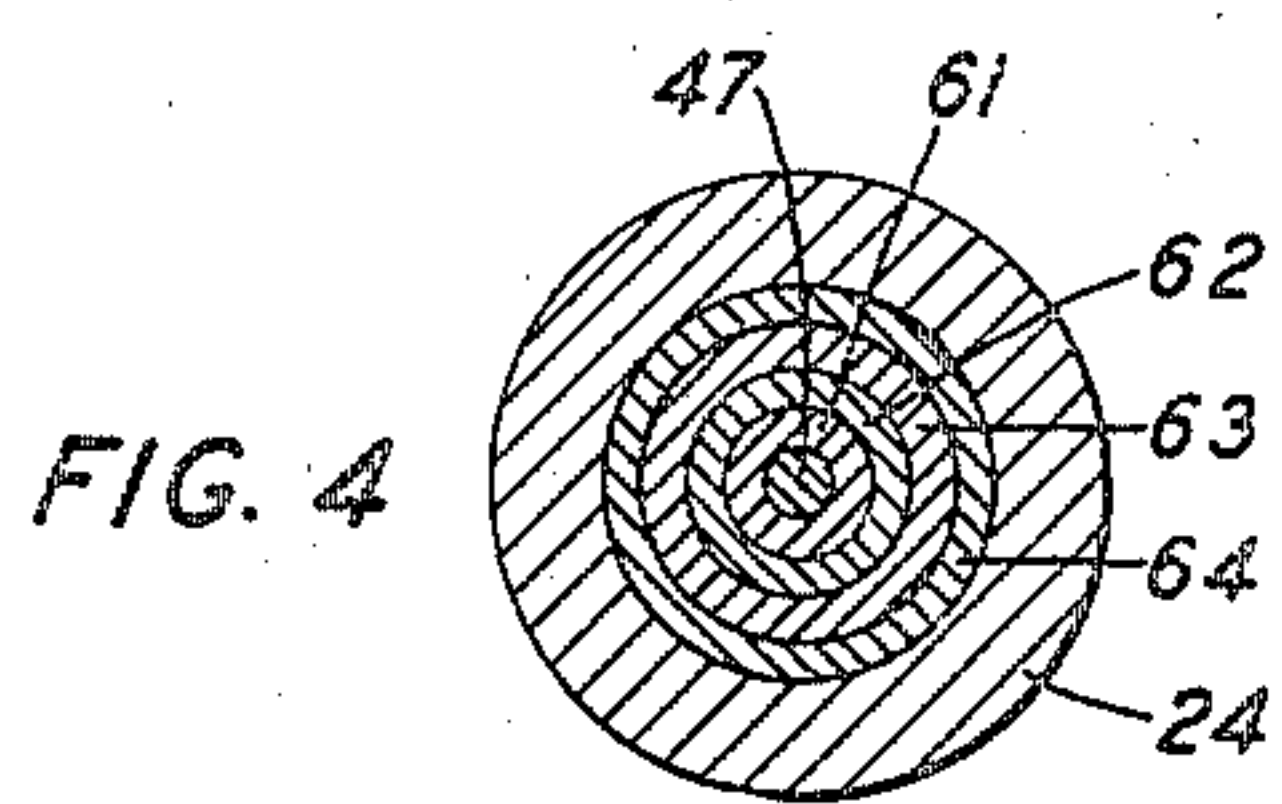
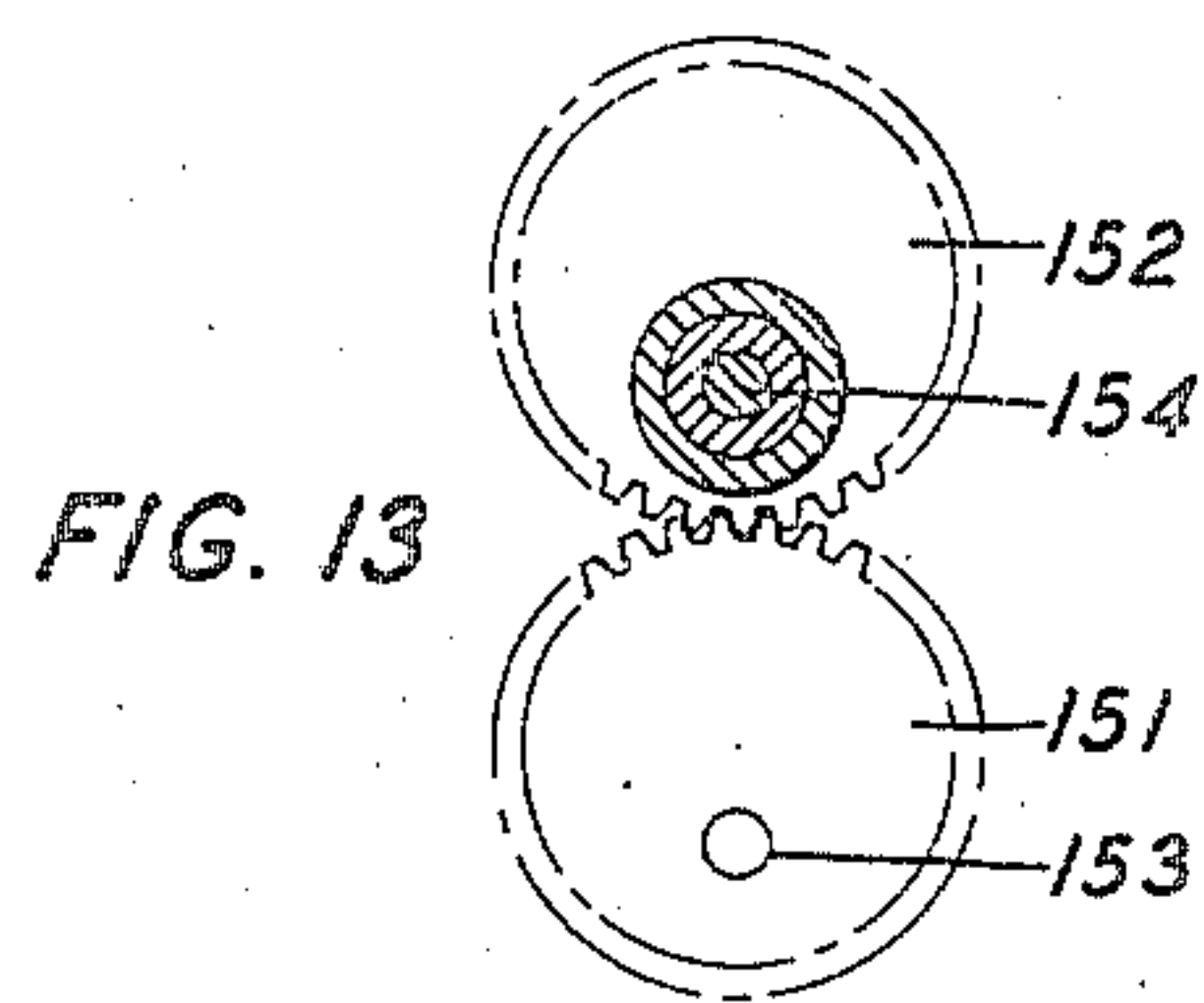
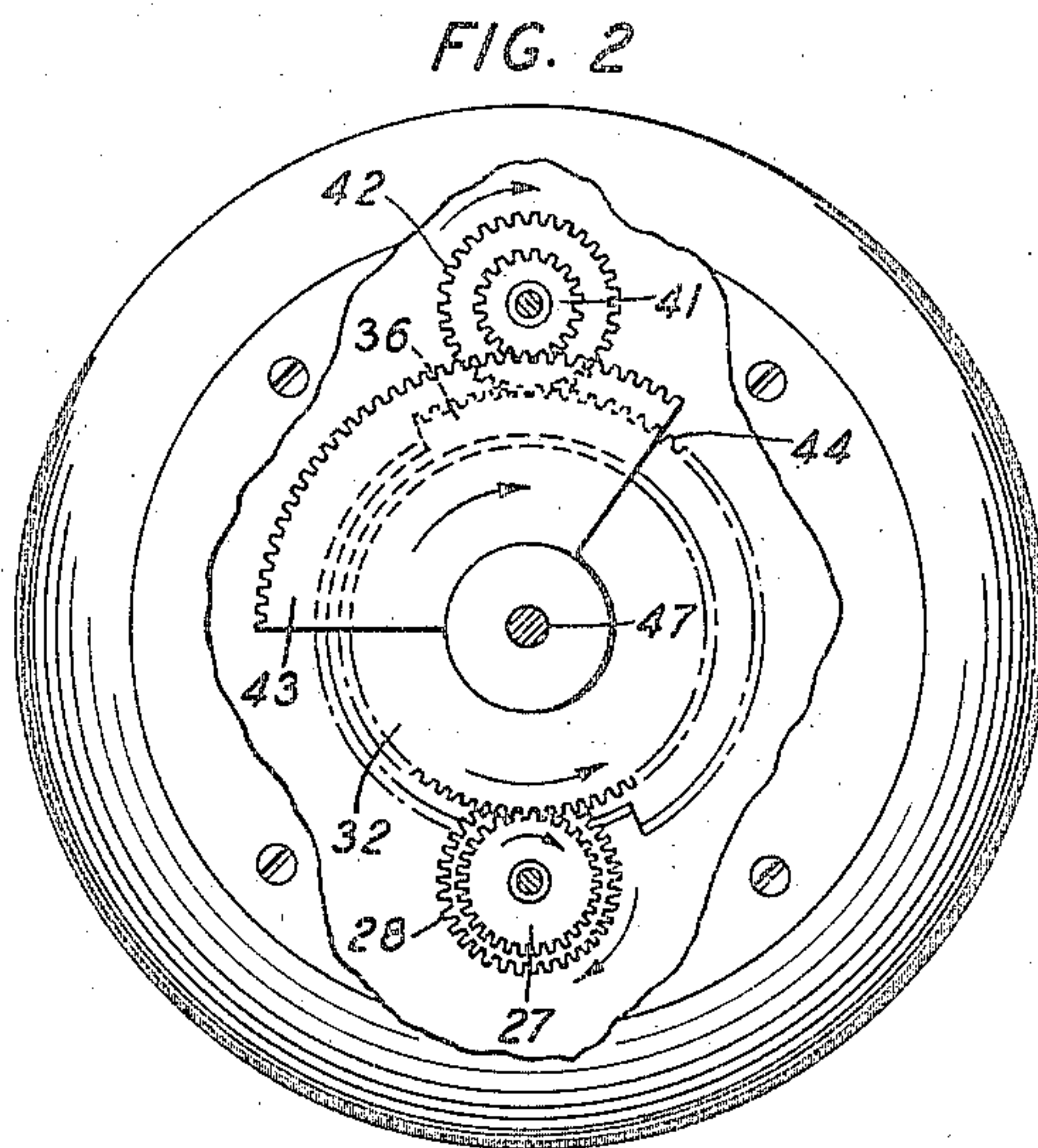
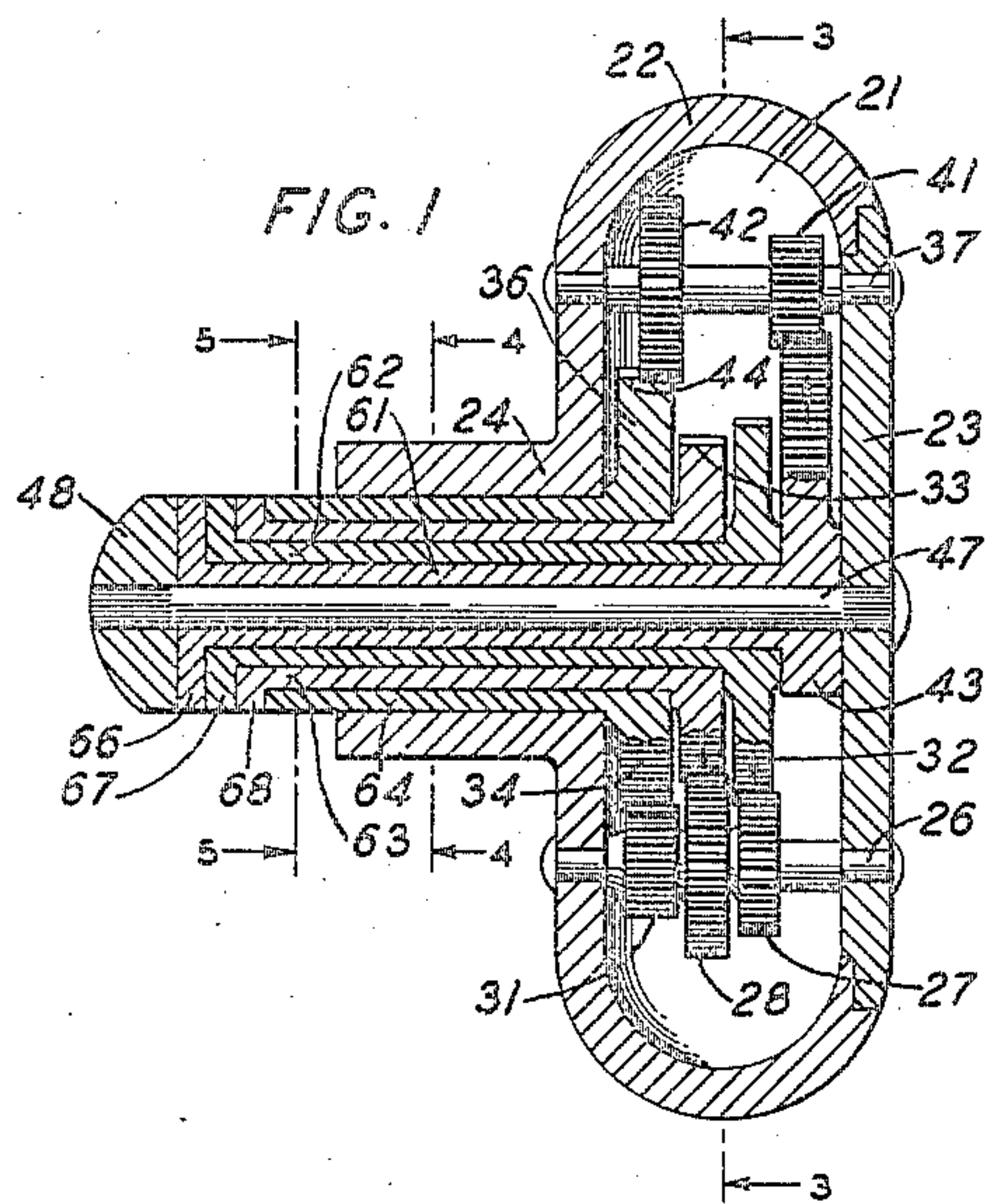
E. N. ANDERSON

2,145,618

KEY

Filed July 3, 1936

2 Sheets-Sheet 1



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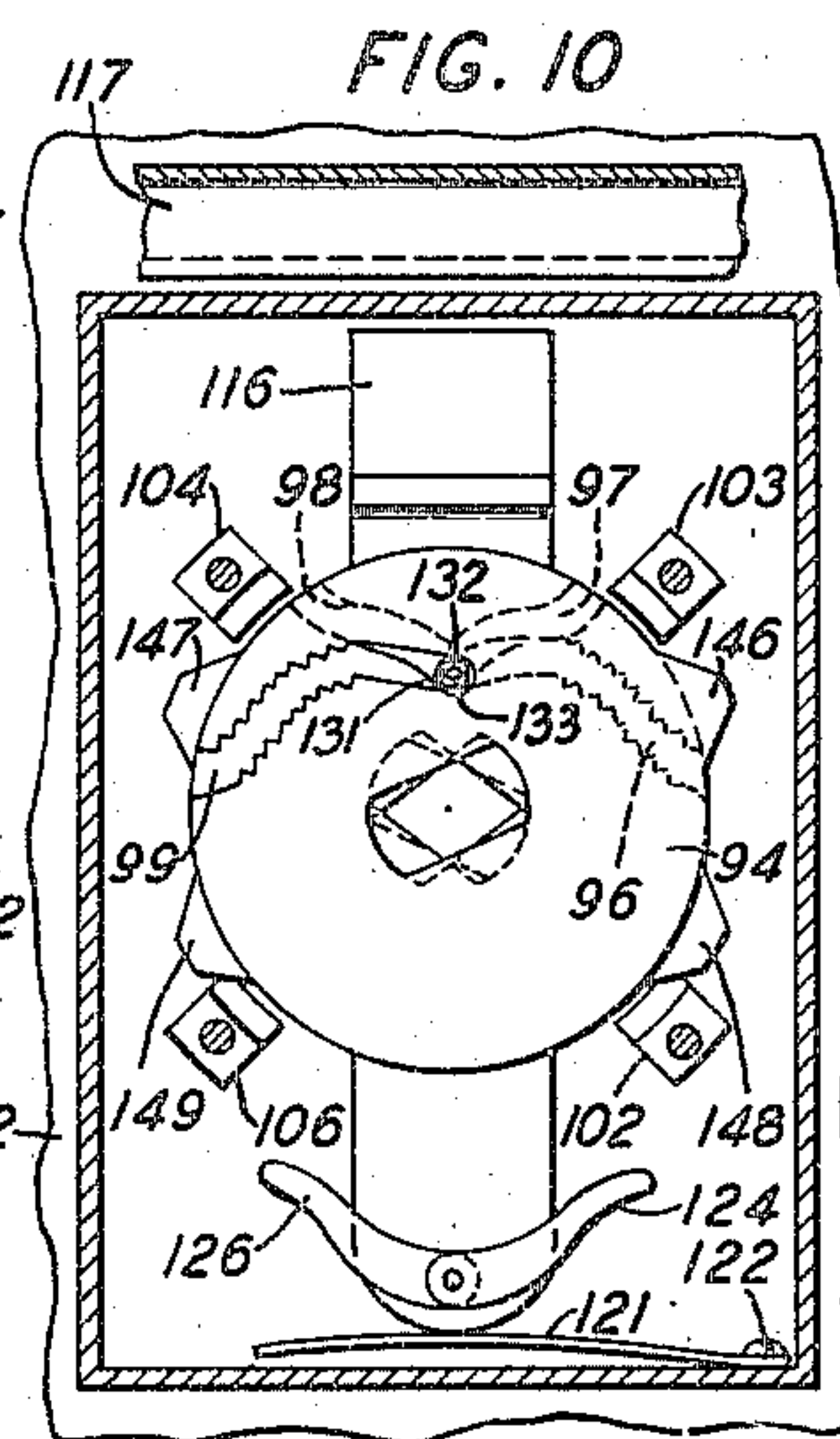
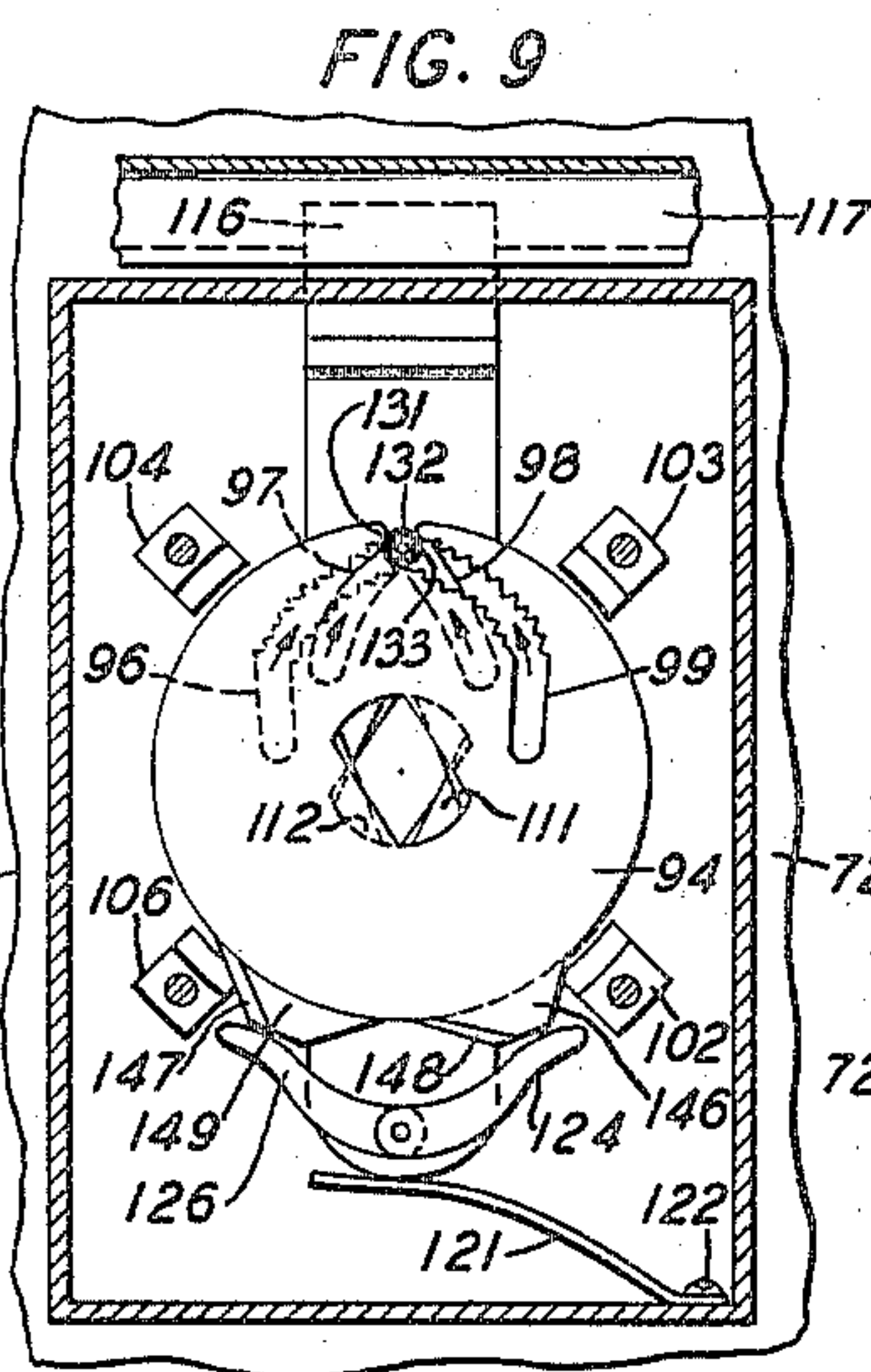
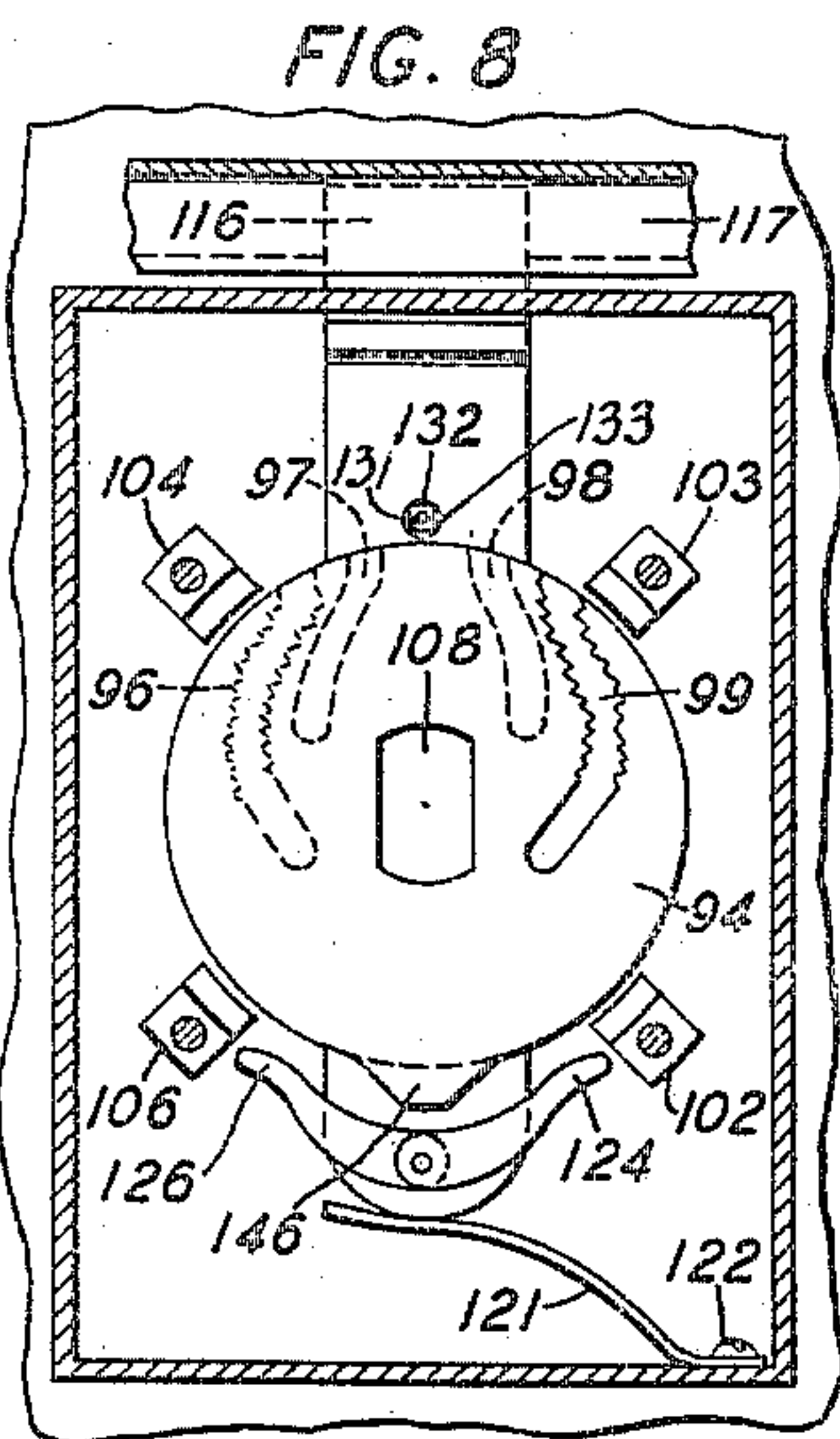
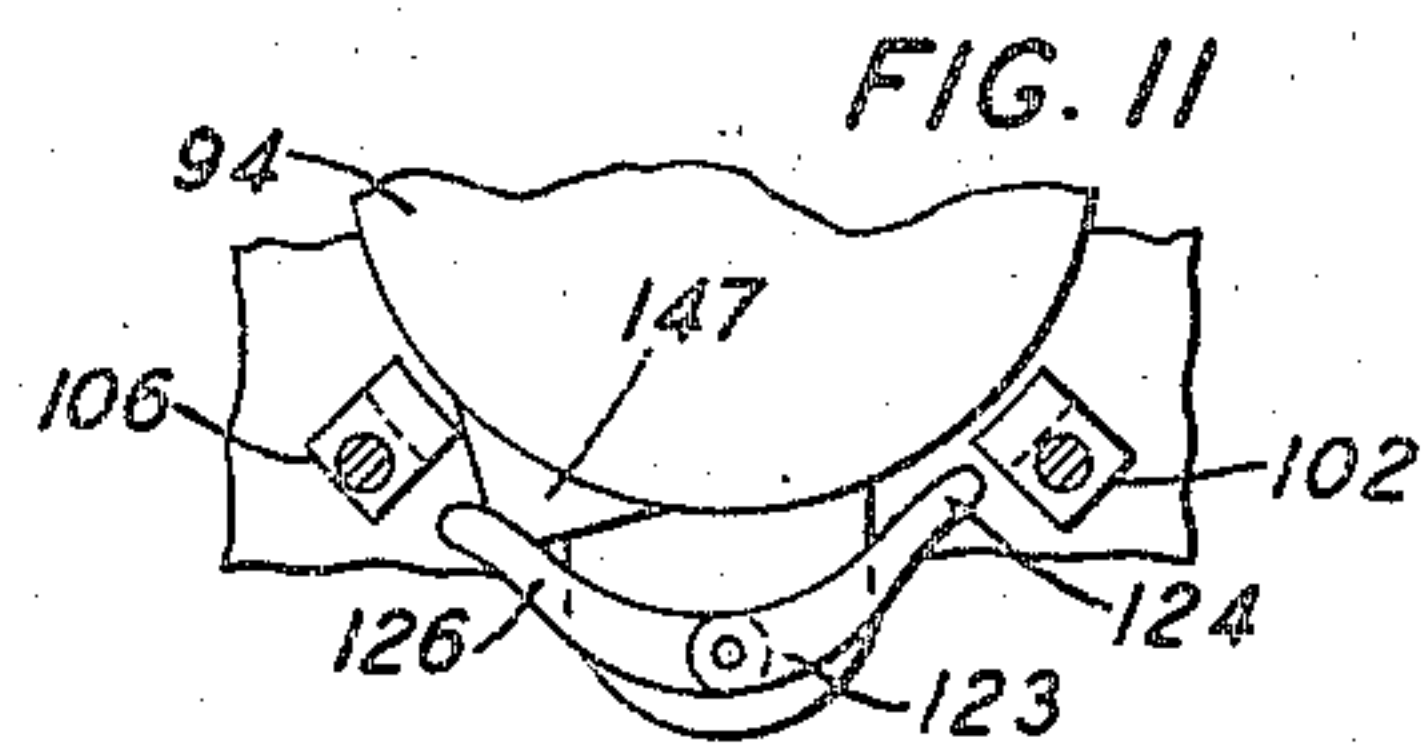
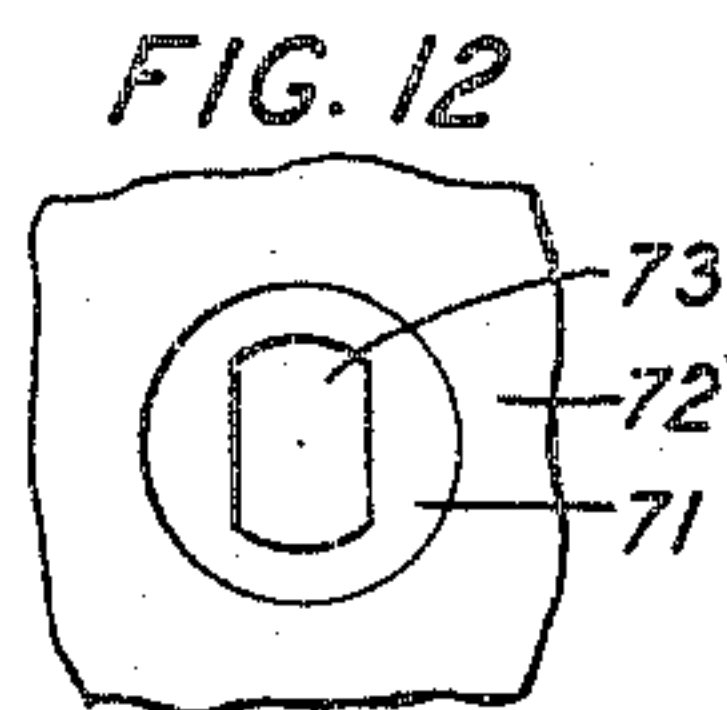
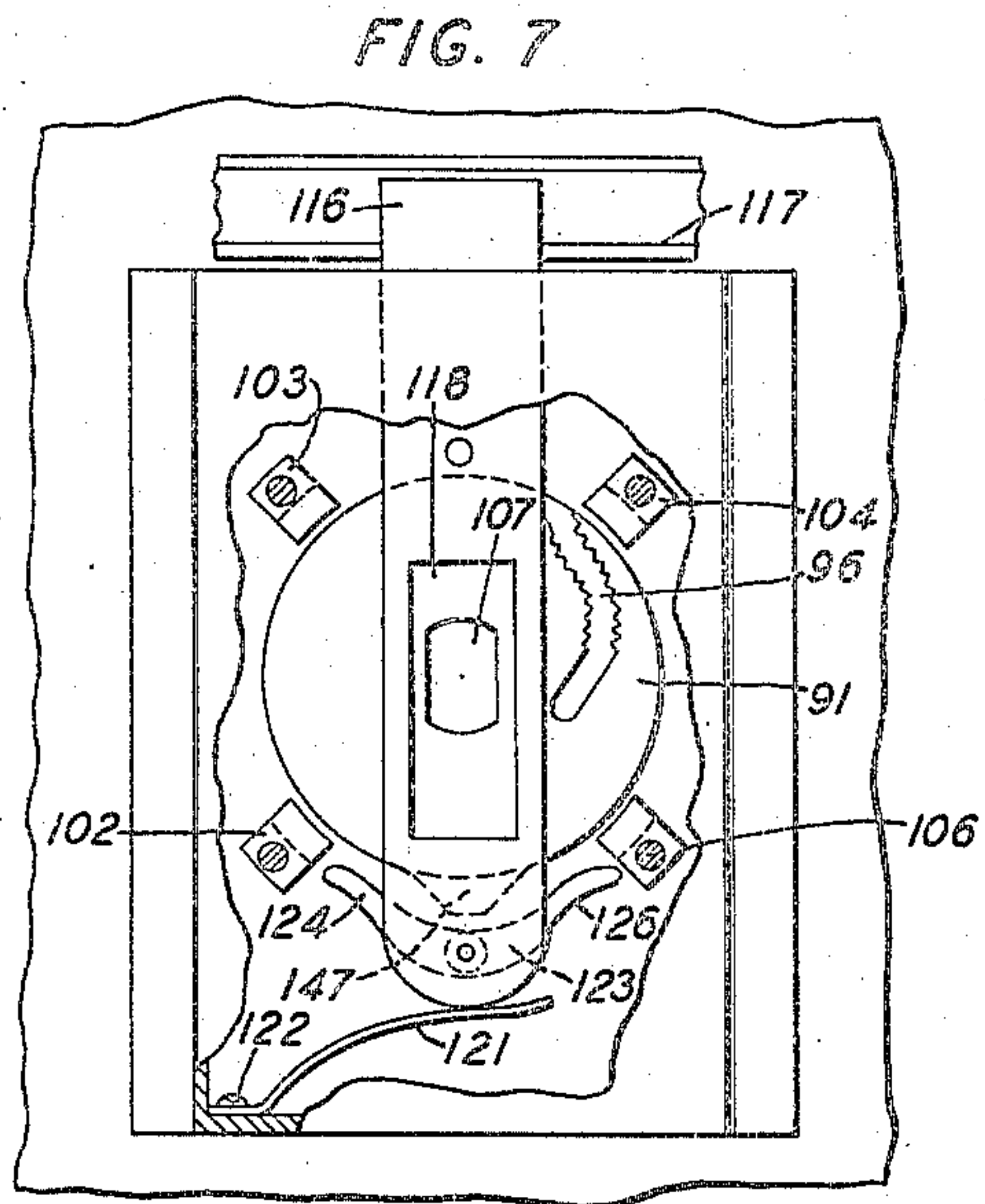
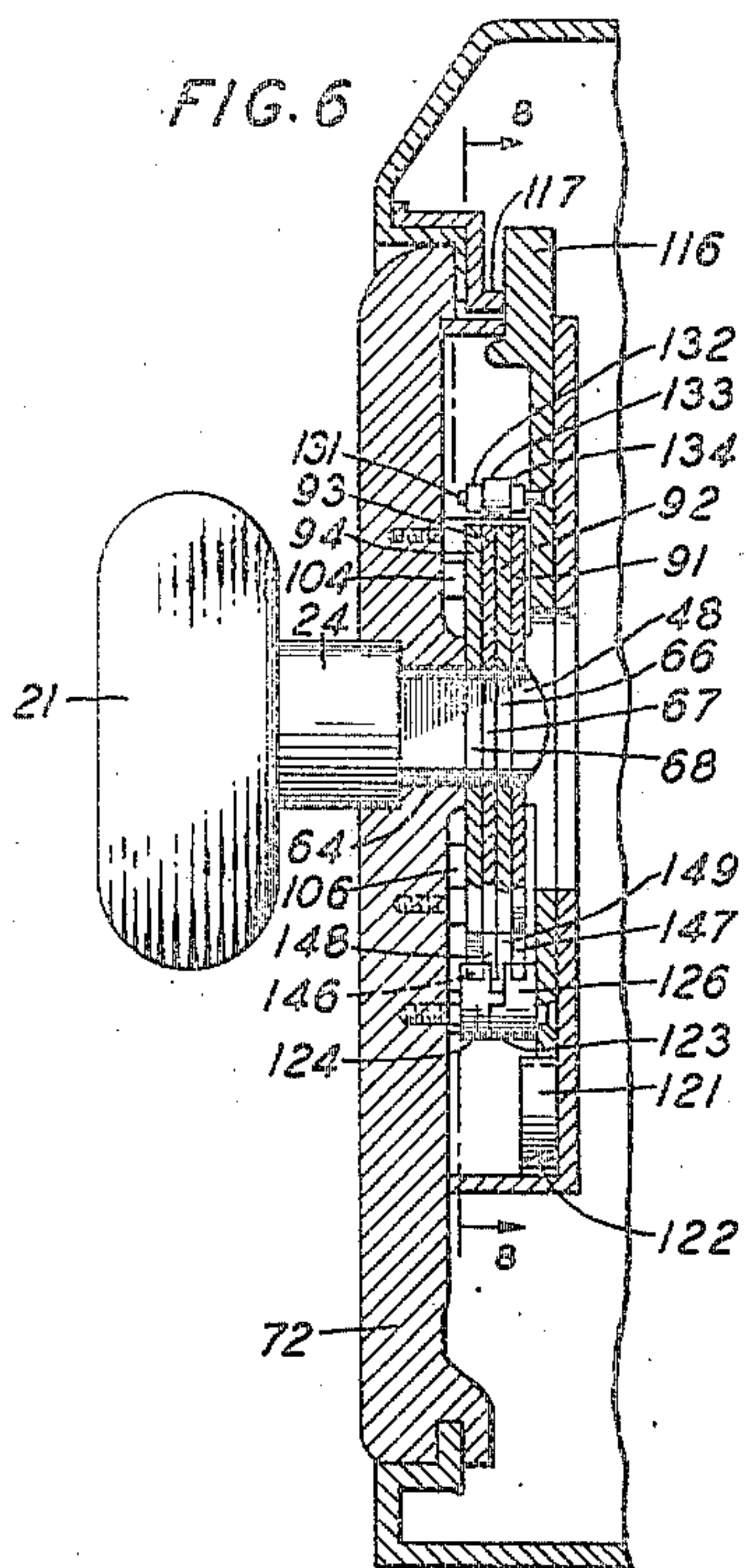
E. N. ANDERSON

2,145,618

KEY

Filed July 3, 1936

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,145,618

KEY

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Application July 3, 1936, Serial No. 88,857

11 Claims. (Cl. 70—393)

This invention relates to keys for operating locks.

This application is a continuation in part of my application Serial No. 69,390 filed March 17, 1936 on "Locks and keys for operating the same."

An object of the invention is to provide a key to aid in preventing the fraudulent operation of locks.

A more specific object of the invention is the prevention of fraudulent operation of a lock by the unauthorized duplication of the key designed for operation of the lock.

It is, of course, well known that unscrupulous persons often attempt to gain access to locked enclosures for fraudulent purposes by "picking" the lock. In order to defeat such attempts improvements in the lock mechanisms in order to render them as nearly "pick-proof" as possible have been made from time to time. The keys for operating the locks, however, have not, in general, been improved as have the locks themselves and persons, balked in their attempts to "pick" the lock by the improved mechanism thereof, have in many instances found it a comparatively simple and inexpensive matter to produce a duplicate key by means of which the lock may be operated.

In accordance with the present invention the key is so designed that it is relatively complicated and expensive, these characteristics which are ordinarily avoided so far as possible being, in the present instance, introduced intentionally in order that duplication of the key may be rendered difficult. The lock with which the key is adapted to be used while of simple and inexpensive construction as compared to the key is nevertheless so designed that "picking" is prevented.

In accordance with one specific arrangement of the lock as described in the copending application referred to above the tumblers are in the form of rotatable discs each of which is provided with a slot which follows an irregular path. The key in accordance with a specific embodiment of the present invention comprises a plurality of concentric tubes or sleeves each of which terminates in a flange. When the key is inserted in the lock each flange is individually associated with a tumbler. The tubes or sleeves are driven through gears by the rotatable knob or hand grip of the key; the flanges of the key individually rotating the tumblers of the lock at such relative speeds that corresponding portions of all the slots are progressively aligned to cause and to permit the linear movement down the slots of a pin carried by the bolt, this movement resulting in a retraction of the bolt.

A complete understanding of the operation of the key contemplated by the invention and of the various advantageous features thereof may be gained from a consideration of the following detailed description and the annexed drawings in which:

Figure 1 is a central sectional view of a key embodying features of the invention;

Fig. 2 is an end view of the key, a portion of the end cover plate being broken away to show parts of the operating mechanism;

Fig. 3 is a sectional view of the key taken on line 3—3 of Fig. 1;

Fig. 4 is a sectional view of the key taken on line 4—4 of Fig. 1;

Fig. 5 is a sectional view of the key taken on line 5—5 of Fig. 1;

Fig. 6 is a view of the key positioned in a lock of a type with which it is adapted to be used, the lock being shown mounted on a cash receptacle housing door, said lock and door being shown in section;

Fig. 7 is a rear view of the structure shown in Fig. 6, a portion of the door casing being broken away to show parts of the lock;

Fig. 8 is a sectional view taken on line 8—8 of Fig. 6, showing the positions of parts of the lock when the bolt is in fully projected position;

Fig. 9 is a view similar to that of Fig. 8, the bolt, however, being in partially retracted position;

Fig. 10 is a view similar to that of Fig. 8, the bolt, however, being in fully retracted position;

Fig. 11 is a view of the lowermost portions of the bolt and one of the tumblers showing the result of a fraudulent attempt to operate the lock without the proper key;

Fig. 12 is a view of a portion of the cash receptacle housing door shown in Fig. 6, showing the arrangement of the key receiving aperture therein; and

Fig. 13 is a sectional view of a portion of the key mechanism showing a modified form of driving gears.

Referring now to the drawings, a key 21 is shown in Fig. 1 which comprises a hand grip portion 22 the shape of which is similar, in general, to that of an ordinary door knob. The hand grip portion is provided with an opening on one side, this opening being normally closed by plate 23, and terminates at its opposite side in hub portion 24. Several gear wheels, the arrangement and operation of which will be described in detail in the following paragraphs, are positioned within hand grip portion 22 while sleeve-like exten-

sions of certain of these gears project through hub portion 24 and form, so to speak, the core of the key structure.

A shaft 26 (Fig. 1) is positioned within hand grip portion 22, upon which shaft are fixedly mounted gear wheels 27, 28 and 31. These gear wheels are in mesh, respectively, with gear wheels 32 and 33 and geared segment 34 of plate 36 (Figs. 1, 2 and 3). A second shaft 37 (Fig. 1) is also positioned within the hand grip portion, gear wheels 41 and 42 being fixedly mounted on this shaft. Gear wheels 41 and 42 are in mesh respectively with geared sector 43 and with geared segment 44 of plate 36.

A pin 47 passes through the center of the key being anchored at one of its ends in cover plate 23 and at its other end in tip portion 48 of the key. This pin, therefore, operatively connects tip 48 of the key to the hand grip portion so that, when the latter is rotated, tip 48 rotates in a corresponding manner.

As shown in Figs. 1 and 4, the core of the key structure is formed by a plurality of sleeve-like extensions of certain of the gear wheels and plates housed within the hand grip, namely, sleeve 61 the extension of geared sector 43, sleeve 62 the extension of gear wheel 32, sleeve 63, the extension of gear wheel 33 and sleeve 64 the extension of plate 36.

As shown in Fig. 4 the core portion of the key, when viewed as a section through hub 24, is composed of a series of concentric circular elements, namely pin 47, the several sleeves referred to above and hub 24. However, as shown in Fig. 5, the sleeves are, upon emergence from hub 24, flattened on two sides so that the portion of the core which projects from hub 24 presents a surface bounded on two sides by parallel straight faces and on the other two sides by arcs. The reason for the provision of these flat faces will be apparent from the subsequent description of the operation of the key and lock.

Sleeve 61 terminates in flange 66 (Figs. 1 and 6), sleeve 62 in flange 67 and sleeve 63 in flange 68. Each of these flanges, due to the flattening of the sides of the core of the key described above, presents a surface bounded on two sides by parallel straight faces and on the other two sides by arcs.

Subsequent to the description of the lock mechanism which is to follow, the operation of the key, the arrangement of which has been described above, will be described in detail. However, while still on the subject of the key it may be of interest to consider very briefly its general method of operation. It is contemplated that, when the key is inserted in the lock (Fig. 6), the circular hub portion 24 will be positioned in circular aperture 71 (Fig. 12) of cash receptacle door 72 while the flattened projecting portion of sleeve 64 will be positioned in aperture 73 of the door, aperture 73 being of such a shape and size that the end of sleeve 64 fits snugly therein.

Tip 48 and flanges 66, 67 and 68 of the key will, when the key is inserted in the lock, be positioned in intimate contact with apertures in the rotatable tumblers of the lock in such a manner that rotation of the tip and flanges causes a corresponding rotation of the respective associated tumblers. As tip 48 is connected to cover plate 23 by pin 47 (Fig. 1) the tip will, of course, be rotated in the same direction and at the same speed as hand grip 22. The gearing arrangement is such (exact arrangement will be described subsequently) that flange 66 is also ro-

tated in this same direction but at only one-half the speed while flanges 67 and 68 are rotated in the opposite direction, the speed of rotation of flange 67 being the same as that of flange 66 and the speed of rotation of flange 68 being the same as that of tip 48. When the key is inserted in the lock and rotated therefore, the tumblers associated with tip 48 and flange 68 are rotated at the same speed but in opposite directions while the tumblers associated with flanges 66 and 67 are also rotated at the same speed but in opposite directions. This rotation causes operation of the lock in a manner which will be described in detail subsequently.

Turning now for the present from consideration of the key to that of the lock, there is shown in Fig. 6 a lock structure mounted on the door of the cash receptacle housing of a coin collector of the general nature described in Patent No. 1,043,219 issued November 5, 1912 to O. F. Forsberg. The lock structure includes four rotatable disc-like tumblers 91, 92, 93 and 94, each of which tumblers is provided with a slot which follows an irregular path, the paths of slot 96 in tumbler 91 and of slot 99 in tumbler 94 being of similar contour but extending in opposite relative directions and the paths of slot 97 in tumbler 92 and of slot 98 in tumbler 93 being of similar contour but extending in opposite directions. The four tumblers are supported in proper axial alignment by four supporting tabs 102, 103, 104 and 106 (Fig. 7). The tumblers are so supported that each is free to rotate with respect to the others. Each of the tumblers is provided with an aperture, aperture 107 of tumbler 91 (Fig. 7) being of proper size and shape to receive tip 48 of key 21, aperture 108 of tumbler 94 being of proper size and shape to receive flange 68 of the key, aperture 111 of tumbler 92 (Fig. 9) being of proper size and shape to receive flange 66 of the key and aperture 112 of tumbler 93 (Fig. 9) being of proper size and shape to receive flange 67 of the key.

A bolt 116 is slidably supported in the lock casing, being adapted when projected to be positioned back of flange 117 of the cash receptacle housing (Fig. 6) in order to prevent removal of the door from the housing. A rectangular opening 118 (Fig. 7) is provided in bolt 116. A leaf spring 121 is mounted in the lower part of the lock casing by means of screw 122 (Fig. 7) its free end being in contact with the lower end of bolt 116 and normally holding said bolt in fully projected position.

A grapple shaped member 123 is pivotally mounted on the lower end of bolt 116 and comprises two arms 124 and 125 which arms are, as shown in Fig. 6, offset with respect to each other. Member 123 forms an important link in the mechanism included for preventing fraudulent operation of the lock as do also the serrated edges of slots 96 and 99. This fact will be evident from the subsequent description of the operation of the lock.

A pin 131 (Fig. 6) is carried by bolt 116, a round rotatable bearing member 133 being mounted on the pin between the two square shank portions 132 and 134.

Now that the general arrangement of the key and that of the lock have been considered let us assume that the key be inserted in the lock (Fig. 6) and that hand grip 22 be rotated in a clockwise direction in order to unlock the lock. As briefly described above this clockwise rotation of hand grip 22 will result in rotation of tip 48 in

a clockwise direction and at the same speed as hand grip 22, rotation of flange 66 in a clockwise direction at one-half the speed of hand grip 22, rotation of flange 67 in a counter-clockwise direction at one-half the speed of hand grip 22 and rotation of flange 68 in a counter-clockwise direction at the same speed as hand grip 22. We will now see just how these relative speeds and directions of rotation are brought about.

As pointed out above, when hand grip 22 is rotated, rotation of sleeve 64 (and plate 36) is prevented due to contact of the flattened end portion of the sleeve with aperture 73 of door 72 (Fig. 12). As hand grip 22 is rotated in a clockwise direction we have, therefore, (plate 36 remaining stationary), rotation of gear wheel 31 in a clockwise direction, as it is meshed with geared segment 34, and rotation of gear wheel 42 in a clockwise direction as it is in mesh with geared segment 44.

Now as gear wheels 31, 28 and 27 are all keyed to shaft 26, rotation of gear wheel 31 in a clockwise direction causes rotation of gear wheels 28 and 27 in a clockwise direction and at the same speed as gear wheel 31 and, as gear wheels 42 and 41 are both keyed to shaft 37, rotation of gear wheel 42 in a clockwise direction causes rotation of gear wheel 41 in a clockwise direction and at the same speed as gear wheel 42.

Rotation of gear wheel 28 in a clockwise direction causes rotation of gear wheel 33, as well as sleeve 63 and flange 63, in a counter-clockwise direction, the ratio of the gears being such that the speed of rotation of gear wheel 33 is the same as that at which hand grip 22 is rotated. Flange 68 and tip 48 therefore rotate at the same speed but in opposite directions.

Rotation of gear wheel 27 in a clockwise direction causes rotation of gear wheel 32, as well as sleeve 62 and flange 67, in a counter-clockwise direction, the ratio of the gears being such that the speed of rotation of gear wheel 32 is one-half that at which hand grip 22 is rotated. Flange 67, therefore, rotates at one-half the speed of tip 48 and in the opposite direction.

Rotation of gear wheel 41 in a clockwise direction results in rotation of geared sector 43, as well as sleeve 61 and flange 66, in a clockwise direction, the ratio of the gear wheels being such that the speed of rotation of geared sector 43 is one-half that of hand grip 22. Flange 66, therefore, rotates in the same direction as tip 48 but at only one-half the speed. Rotation of sector 43 in the same direction as gear wheel 41 is due to the difference in speed of rotation of gear wheel 41 and that of hand grip 22.

As pointed out above, tip 48 is, when the key is inserted in the lock, positioned in aperture 107 of tumbler 91, flange 68 is positioned in aperture 108 of tumbler 94, flange 67 is positioned in aperture 112 of tumbler 93 and flange 66 is positioned in aperture 111 of tumbler 92, so that, when hand grip 22 is rotated, each of the tumblers is rotated in the same direction and at the same speed as that of the particular flange which is associated with it.

The relative positions of the tumblers at the time the key is inserted and before rotation thereof is shown in Fig. 8. It will be seen that retraction of the bolt is prevented due to contact of pin 131 and the upper edge of tumblers 91, 92, 93 and 94. It will also be apparent from casual inspection of this figure that slot 99 of tumbler 94 and slot 96 of tumbler 91 are of equal

length and slope but extend in generally opposite directions with respect to the vertical center line of the bolt, that slot 98 of tumbler 93 and slot 97 of tumbler 92 are also of equal length and slope and extend in opposite directions and, further, that the lengths and slopes of the two last-mentioned slots are one-half those of the two first-mentioned. It will be apparent from this that, in order to secure the progressive coincidence of the slots necessary to permit retraction of the bolt, tumblers 91 and 94 should be rotated at the same speed but in opposite directions, that tumblers 92 and 93 should be rotated at the same speed but in opposite directions and that the speed of rotation of the last-mentioned pair of tumblers should be one-half that of the first-mentioned pair. As described above, key 21 is adapted, when rotated, to produce this exact movement of the lock tumblers.

Now as the key is rotated in a clockwise direction as mentioned above, lug 146 carried by tumbler 94 and lug 147 carried by tumbler 91 are brought into contact with the tips of arms 124 and 126, respectively, contact being made at exactly the same moment with each arm so that, as shown in Fig. 9, bolt 116 is drawn down a certain distance against the action of spring 121. Due to the synchronized movement of the tumblers which is caused by the key mechanism as described above, the open ends of slots 96, 97, 98 and 99 are brought into full coincidence just as pin 131 is brought into position to enter said slots by partial retraction of the bolt (Fig. 9). Thereupon, bearing surface 133 of pin 131 is engaged by the sides of slots 97 and 98 and, as movement of the tumblers continues, this engagement is effective to pull the pin down, and to cause retraction of bolt 116.

Keeping in mind the relative lengths and slopes of slots 96, 97, 98 and 99 and the relative rates and directions of rotation of tumblers 91, 92, 93 and 94, the progressive movement of the slots from the position of Fig. 8 (bolt fully projected) to that of Fig. 9 (bolt partially retracted) and finally to that of Fig. 10 (bolt fully retracted) may be easily visualized.

It is believed that it will be clear from the above that retraction of the bolt can only be brought about by rotation of the tumblers at exact predetermined speeds and directions which rotation can, as a matter of fact, be achieved only by the use of a properly designed key. That is to say, it would be next to impossible for an unlawful person to individually manipulate the tumblers by any other means in such a manner that the bolt would be retracted. In the first place tumblers 94 and 91 must be so rotated that lugs 146 and 147 will contact the respective arms 124 and 126 of member 123 at exactly the same instant in order that bolt 116 will be retracted sufficiently to bring pin 131 into the path of slots 97 and 98. (It will be evident, of course, that rotation of the tumblers when the bolt is in the position shown in Fig. 8 will have no tendency to cause retraction of the bolt inasmuch as pin 131 is out of the path of the slots.) As shown in Fig. 11 should the tumblers be so rotated that lug 147 contacts arm 126 at a time when lug 146 is not in contact with arm 124, member 123 will merely rotate about its pivot and allow lug 147 to pass, no retraction of the bolt being caused. The same action results, of course, if lug 146 contacts arm 124 at a time when lug 147 is not in contact with arm 126.

Lugs 146 and 147, in addition to their "safety"

feature just referred to, serve also in the capacity of counterweights to normally hold the associated tumblers in the position of Fig. 8. A like service is rendered by lugs 148 and 149 provided on tumblers 93 and 92 respectively. It is desirable that the tumblers normally be in the position shown in Fig. 8 in order that the apertures 107, 108, 111 and 112 will be aligned whereby the key may be readily inserted.

In addition to the synchronized movement of tumblers 91 and 94 just referred to it is further necessary for retraction of the bolt that tumblers 92 and 93 be so rotated that, at the instant of contact between lugs 146 and 147 and arms 124 and 126, the open ends of slots 97 and 98 will coincide with the open ends of slots 96 and 99 in order that pin 131 may enter therein. The four tumblers must then be so rotated that portions of the four slots are progressively aligned in order to provide a path for pin 131. The serrated edges of slots 96 and 99, which were referred to above, render fraudulent operation of the device even more difficult for if the slots are not aligned at the exact predetermined rate the square shank portions 132 and 134 carried by the pin 131 will engage in the teeth of the slots and prevent further movement of the pin and bolt. The slots are so designed, however, that when the tumblers are rotated by a properly designed key, the pin will "clear" the edges of slots 96 and 99.

While simple gear forms producing regular movements of the key parts have been described, it will be understood that other gear forms producing irregular movements of the key parts may be used. For example, it is well known that a variable speed mechanism will result if two gears of equal diameter be meshed, their shafts each being placed off center an equal distance from the center of the respective gear. Such a well known expedient may be made use of in the key invented by applicant in order to produce a variable movement of desired parts of the key. For example, as shown in Fig. 13, two of the gears of the key, gear 151 (corresponding to gear 28 of key 21), and gear 152 (corresponding to gear 33 of key 21), may be mounted on shafts 153 and 154 respectively which shafts are each off center an equal amount with respect to the centers of the respective gears. Operation of the key will then of course result in a variable speed movement of the part driven by gear 152. It is not believed necessary to show other parts of the key or to describe the operation of the modified form in detail inasmuch as the use of off-center gears is, as mentioned above, well known and it will be understood that the general arrangement and operation of the modified type of key will be similar to that of the key shown in Fig. 1 and described in detail previously.

While the above description relates primarily to the unlocking operation, it will be evident that the locking operation is just the reverse of the unlocking procedure. For example, it will be apparent that counter-clockwise rotation of the key, after the fully retracted position of Fig. 10 has been reached, will cause rotation of the tumblers in directions opposite to those described in connection with the unlocking method, the resulting action of slots 97 and 98 being to force pin 131 and bolt 116 back to the position at which the pin emerges from the path of the slots. When this point is reached and the pin is freed of restraint by the slots, spring 121 acts to urge bolt 116 into the fully projected position of Fig. 8.

While certain specific embodiments of the invention have been described above, the invention is by no means limited in its application to those embodiments described. The embodiments described should be considered as illustrative of the invention rather than as restrictive thereof.

A lock of the type with which the key of the present invention is adapted to be used is disclosed in Patent 2,094,574 issued to me October 5, 1937 entitled "Locks."

What is claimed is:

1. A key comprising a plurality of rotatable members, a rotatable handle and commonly controlled means positioned within said handle for individually rotating said members at substantially different relative speeds.

2. A key comprising a plurality of rotatable projections, a rotatable handle and means positioned within said handle and controlled thereby for causing rotation of said projections at substantially different relative speeds.

3. A key comprising a plurality of rotatable flanges, a rotatable handle, a plurality of gears positioned within said handle, means for connecting said gears to said handle whereby rotation of said handle causes rotation of said gears and individual connecting and driving means between said gears and each of said flanges.

4. A key comprising a rotatable handle portion, a hub portion, a plurality of rotatable projections, a plurality of gears positioned within said handle portion, and means extending through said hub portion for operatively connecting said rotatable projections and said gears.

5. A key comprising a rotatable handle portion, a hub portion, a plurality of rotatable projections, a plurality of gears positioned within said handle portion, and means extending through said hub portion for operatively connecting said rotatable projections and said gears, said connecting means being in the form of concentric tubes within said hub portion, certain of said connecting means being flattened upon emergence from said hub portion to present a surface bounded on two sides by parallel straight faces and on two sides by arcs.

6. A key comprising a rotatable handle portion, a plurality of rotatable projections, a plurality of gears positioned within said handle portion, means for operatively connecting certain of said gears and said handle portion whereby rotation of said handle portion causes rotation of the gears so connected, others of the gears being driven by said connected gears, and means for operatively connecting said driven gears and said rotatable projections whereby rotation of said handle portion will cause rotation of said projections.

7. A key comprising a handle portion, a plurality of rotatable projections, a plurality of gears positioned within said handle portion, means for operatively connecting certain of said gears and said handle portion whereby rotation of said handle portion causes rotation of the gears so connected, others of the gears being driven by said connected gears, and means for operatively connecting said driven gears and said rotatable projections whereby rotation of said handle portion will cause rotation of said projections, the arrangement and ratio of the gears being such that the direction and speed of rotation of certain of said projections are different than the direction and speed of rotation of others of said projections.

8. A key comprising a rotatable handle portion, a stationary plate positioned within said handle portion, teeth on a surface of said stationary plate, an extension on said plate, teeth on the surface of said extension, a plurality of gear wheels positioned within said handle portion, one of said gear wheels being in mesh with said teeth on the surface of said plate and another of said gear wheels being in mesh with said gears on the surface of said extension whereby relative rotation of the handle portion about said stationary plate causes rotation of said two meshed gear wheels, others of said gear wheels positioned within said handle portion being driven by said two meshed gears, a plurality of rotatable projections, means for operatively connecting one of said projections directly to said handle portion,

and means for connecting others of said projections to said driven gears.

9. A key comprising a plurality of rotatable members and commonly controlled means for individually rotating said members in different relative directions.

10. A key comprising a plurality of rotatable projections, a rotatable handle and means controlled by said handle for causing rotation of said projections in different relative directions.

11. A key comprising a plurality of rotatable members, a rotatable handle, and geared means positioned within said handle for individually rotating certain of said members at a varying speed when said handle is rotated at a constant speed.

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