PATENT SPECIFICATION

DRAWINGS ATTACHED

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832,781

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COMPLETE SPECIFICATION

Timepiece Arrangement

We, Bulova Watch Company Inc., a Corporation organized and existing under the Laws of the State of New York, of 75—20, Astoria Boulevard, Flushing 70, New York, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a timepiece arrangement.

More particularly, the present invention relates to an arrangement of an electric timepiece incorporating a vibrator for driving the timepiece mechanism, which vibrator is oscillated by suitable means which are operatively associated therewith.

It is an object of the present invention to provide an electric timepiece incorporating a mechanical vibrator which timepiece is so constructed and arranged that all of the movable parts, including the vibrator, are arranged within the timepiece casing.

It is another object of the present invention to provide a vibrator actuated timepiece, such as a watch, which is so constructed that a relatively large space is provided within which the largest part of the vibrator may vibrate.

The objects of the present invention also include the provision of a timepiece which incorporates an electrically driven vibrator, wherein the source of electric energy is carried within the timepiece casing.

The objects of the present invention further include the provision of an electric timepiece wherein a very small battery carried within the timepiece casing may readily be inserted thereinto or removed therefrom.

The objects of the present invention also include the provision of an electric timepiece which is compact, which is ruggedly constructed, and which is capable of giving long periods of trouble-free service.

According to the present invention there is provided a watch or clock having a timepiece mechanism, a vibrator for actuating the same, the timepiece mechanism and the vibrator being mounted on a base plate, which is positioned within a chamber having a front and a back wall, the base plate extending substantially parallel to the front and back walls of the chamber and having an area smaller than the sectional area of the chamber in the plane of the base plate so as to leave a free chamber portion between the front and back walls which is unoccupied by the base plate, the vibrator having an oscillatable part arranged within the free chamber portion unoccupied by the base plate, the vibrator in a direction normal to the base plate has a maximum dimension which is greater than the distances between the base plate and each of the front and back walls so that the oscillatable part of the vibrator projects across the plane of the base plate and is not receivable in any part of the timepiece chamber other than the free chamber portion thereof.

In a preferred embodiment of the present invention the means for oscillating the oscillatable portion of the vibrator are electrical means which include a battery that may readily be secured to or removed from the timepiece.

For a better understanding of the invention and to show how the same may be carried into effect reference will now be made to the accompanying drawings in which:

Figure 1 is a plan view of the interior of a timepiece according to the present invention as seen from the rear;

Figure 2 is a sectional elevation view taken substantially along line 3—3 of Fig. 1; Fig. 2 including an illustration of the front and back walls of the timepiece casing and of the timepiece dial plate;

Figure 3 is a diagrammatic sectional elevational view taken substantially along line 3—3 of Fig. 1, Fig. 3 showing a modified arrange-

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ment of only certain parts of the timepiece in order more clearly to illustrate the present invention;

Fig. 4 is a fragmentary plan view of a modified embodiment of the present invention showing a mounting and retaining arrangement by means of which a battery may be secured to the base plate of the timepiece; and

Fig. 5 is a wiring diagram of an electric circuit incorporating a battery, which electric circuit is part of the electrical means capable of oscillating the vibrator.

Referring now to the drawings and to Figs. 1 to 3 thereof in particular, there is shown a timepiece encased in a flat timepiece casing having approximately circular substantially flat front and back walls 10 and 11, the former of which is transparent. A timepiece dial plate 12 is arranged behind the front wall 10 so that a flat timepiece chamber 13 is formed between the dial plate 12 and the rear wall 11, these elements thus constituting substantially flat front and rear wall means, respectively, of the timepiece chamber 13.

An approximately semi circular base plate 14 having at its flat side a boss portion 14a is arranged within the chamber 13 and extends parallel to front and back walls thereof. The base plate 14 thus has an area smaller than, and equal to about one half of, the sectional area of the chamber 13 in the plane p of the base plate 14 (Figs. 2 and 3) so as to leave an approximately semi circular free chamber portion 13a between the front and back wall means 12, 11 which is entirely unoccupied by any part of the base plate. The plane of the base plate, as used throughout the instant specification and claims, is deemed to include the entire thickness of the flat base plate 14.

The timepiece mechanism, which will be described more detailedly below, is driven by a mechanical vibrator 15 which is preferably of the tuning fork type having a base 16 and a pair of oscillatable tines 17 and 18. The base constitutes an attaching portion at which the vibrator is firmly secured to that side of the base plate 14 which is nearest the dial plate 12, the mounting of the vibrator being such that its axis of symmetry lies in the plane of symmetry of the base plate. Suitable attaching means, such as a screw 19 and a pair of pins 20, 21 are provided.

The tines 17 and 18 extend beyond the boss portion 14a and carry, at their respective free ends which are located in the region of the free chamber portion 13a, oscillating members 22 and 23 which are in the form of substantially cylindrical magnetic drums each having an outer diameter a. The drums are part of electrical driving means capable of oscillating the vibrator, and they are arranged in the free chamber portion 13a with the axis of each drum extending substantially parallel to the plane p. As may best be seen in Figs. 2 and 3, the outer diameter a of each drum is greater than the distance b between the front side of the base plate and the dial plate or front wall means 12 of the chamber 13 and also greater than the distance c between the rear side of the base plate and the rear wall means 11 of the chamber. Thus, the maximum dimension of each oscillating member, in a direction normal to the base plate 14, is greater than the distances between the base plate and each of the front and back wall means thereof so that the oscillating members project across the plane p of the base plate. In this way, the magnetic drums may be of relatively large size, the advantages of which will become apparent upon further consideration of the instant specification.

In practice, either of the distances b or c may be very small or even be equal to zero. For example, it will be seen from Fig. 2 that the distance b between the front side of the base plate and the dial plate 12 is very small, and that if the dial plate were in face to face relationship with the base plate, the distance b would be zero. Thus, in the embodiment shown in Figs. 1 and 2, the magnetic drums simply project into that part of the free chamber portion 13a which is between the rear wall 11 and the plane p of the base plate 14.

Each magnetic drum is composed of a cup shaped member 22a, 23a and a permanent magnet 22b, 23b located therewithin. Each cup shaped member and permanent magnet form an annular space between themselves, and a pair of coils 24, 25 extend into these annular spaces, respectively. The coils are carried by tubular carriers 26, 27, respectively, which are mounted on supports 28, 29. The latter, in turn, are fixedly secured to the boss portion 14a of the base plate 14 by means of screws 30 or the like.

In practice, the coils have a large number of turns, and each together with its tubular carrier must extend into the annular space formed by one of the magnetic drums with sufficient clearance to permit free reciprocating movement thereof relative to the coil during oscillation of the tines in a plane parallel to the base plate. Thus, the annular space should, on the one hand, be as large as possible so as readily to accommodate the coil and carrier. On the other hand, the size of the timepiece chamber, i.e., the physical space available within a timepiece casing, particularly in the case of a wrist or pocket watch, is very limited so that the size of the magnetic drums should be kept as small as possible. It has been found, however, that a relatively large magnetic drum can be accommodated within a watch casing by providing a partial rather than a full or complete base plate, i.e., a base plate which is so constructed and arranged as to leave a free chamber portion entirely unoccupied by any part of the base plate. With the magnetic drums being arranged within this free chamber portion, the maximum dimension of each drum in a direction transverse to the watch, i.e., the outer diameter in the case of a cylindrical element, can be practically the entire thickness of the watch. In this way, the magnetic drums and consequently the annular space formed between each cup-shaped member and the corresponding magnet, can be sufficiently large so as readily to receive the corresponding coil and carrier thereof with sufficient clearance to permit free movement of each magnetic drum relative to the coil associated therewith.

Clearly, if the base plate were a complete one which did not leave any free chamber portion, the outer diameter of the drums would perforce have to be considerably less than the thickness of the watch, and the annular spaces within which the coils and carriers could be received would accordingly have to be smaller.

The vibrator is operatively associated with the timepiece mechanism in such a manner that the same is driven during oscillation of the tines. For this purpose, the tine 17 carries a pawl 31 which cooperates with a ratchet wheel 32. The same is fixedly mounted upon a shaft 33 the free ends of which are rotatably supported by brackets 34 and 35 which are firmly secured to the base plate 14. The shaft 33 also carries a worm 36 and a friction wheel 33a which may be integral with the shaft 33. The friction wheel cooperates with a friction brake which is constituted by a leaf spring 38a one end of which is secured to the bracket 34 and the other end of which is in frictional engagement with the friction wheel. In this way, the ratchet wheel 32 and consequently the shaft 33 together with the worm 36 will be rotated during oscillation of the tines, the friction brake serving to prevent rotation of the shaft 33, either under the influence of its own inertia following a forward stroke of the pawl or under the influence of the pawl during its backward stroke.

Thus, if the length of the stroke of reciprocation of the pawl, in a direction tangential to the ratchet wheel 33 at the point of engagement between the pawl and the ratchet wheel is greater than P and smaller than 2P, with P being the pitch of the ratchet teeth of the ratchet wheel, each reciprocation of the pawl will cause the ratchet wheel to be rotated an angular distance corresponding to the pitch. With the speed of rotation of the worm 36 controlling the movement of the hands of the timepiece, as will be more detailedly set forth below, it is essential that this speed of rotation be maintained constant. This is achieved by oscillating the tines of the vibrator at such an amplitude that the length of the stroke of reciprocation of the pawl, which is dependent upon the amplitude of oscillation of the tines, is maintained between P and 2P. In this way, each oscillation of the tines brings about the same angular displacement of the ratchet wheel and consequently of the worm, so that the speed of rotation of the worm is directly proportional to the natural frequency of the vibrator. The latter has an extremely high degree of constancy, so that so long as the amplitude of oscillation of the tines is maintained within the prescribed limits, the timepiece mechanism is driven at the same high degree of constancy at which the vibrator oscillates.

The electrical means for oscillating the vibrator and which include the magnetic drums and the coils 24 and 25 are capable of maintaining the amplitude of oscillation of the tines substantially constant. The coils 24 and 25 are electrically interconnected with a capacitor C, a resistor R, a battery B and a transistor TR, as shown in Fig. 5, the electrical components cooperating with each other in such a manner that the tines are oscillated at the proper amplitude.

The worm cooperates with a worm gear 37 which is fixedly mounted upon a rotatable shaft 38 that extends through the base plate 14 so that the opposite end of the shaft 38 is in the region of the dial 12 which may be secured to the base plate in any suitable manner. The natural frequency of oscillation of the vibrator, the number of ratchet teeth of the ratchet wheel and the transmission ratio between the worm 36 and the worm gear 37 are so selected that the latter makes one revolution per minute. The shaft 38 may therefore carry a sweep-second hand.

The shaft 38 also carries a pinion 39 which drives a gear 40. The latter causes rotation of another pinion 41 which, in turn, drives a minute gear 42. The latter causes rotation of a tubular shaft 43 which encompasses the shaft 38 and carries the minute hand, the gear ratios between the gears and pinions 39, 40, 41, 42 being so selected that the minute hand rotates at one sixtieth the speed of the sweep second hand.

The tubular shaft 43 also carries a pinion 44 which drives a gear 45. The latter causes rotation of another pinion 46 which, in turn, drives an hour gear 47. The latter causes rotation of another tubular shaft 48 which encompasses the shafts 38 and 43 and carries the hour hand, the gear ratios between the gears and pinions 44, 45, 46, 47 being so selected that the hour hand rotates at one twelfth the speed of the minute hand.

A manual setting mechanism, shown schematically at 49, is provided for setting the hands of the timepiece, and includes a pinion 50 which cooperates with the gear 45 so that the latter may be rotated upon actuation of the stem 51.

While in the above-described embodiment the ratchet wheel 32 is rotatable about an axis parallel to the base plate 14, it will be understood that the ratchet wheel may be mounted for rotation in a plane parallel thereto. Moreover, both coils 24 and 25 may be associated with the same magnetic drum in which case the other magnetic drum may be replaced by a suitable counter-balance weight. In that event, the natural frequency of oscillation of the tines, and consequently the speed at which the timepiece mechanism is driven, may be adjusted.

As set forth above, the electrical oscillating means include a capacitor C, a resistor R, a transistor TR and a battery B which are electrically connected to each other, such as by wiring or grounding. The capacitor C, which may have a cylindrical shape, is also arranged in the free chamber portion 13a, adjacent the magnetic drums. A suitable carrier as provided and may be in the form of a rod 53 emanating from the boss portion 14a of the base plate. The rod extends between the magnetic drums 22 and 23 and is screwed or otherwise securely fastened to the base plate.

The resistor R (not shown) may also be arranged within the free chamber portion 13a but may, if desired, be otherwise positioned within the timepiece casing.

The base plate 14 is formed with a recess 54 within which the transistor TR (not shown) may be received. A conduit or channel 55 communicating with the recess 54 is provided for accommodating the electrical wiring (not shown) connecting the transistor base, emitter and collector electrodes to the other components of the electrical oscillating means.

In the embodiment shown in Figs. 1 and 2, the base plate 14 is formed with a recess 56 which constitutes a receiving portion adapted to receive the battery B. The battery is a very small one, preferably of the mercury-cell type. The outer casing of the battery, i.e., the bottom and sides thereof, constitute the negative terminal B^1, so that the battery is grounded to the base plate 14 which is made of electrically conductive material. A combined conductor and clamping member 57 is provided for clamping the battery to the base plate 14 and also for providing an electric connection to the positive terminal B^{11}. The member 57 is in the form of a metallic leaf spring one end of which, with the intermediary of a pair of insulating washers 58, 59 and a retaining washer 60, is firmly secured to the base plate 14 by means of the screw 19 which serves to fasten the vibrator 15 to the base plate.

The battery B may easily be removed from the recess 56 simply by raising the free end portion of the leaf spring 57 and rotating the same into a position wherein the leaf spring is out of alignment with the recess. A fresh battery may then be inserted into the recess and the leaf spring be returned into the position shown in the drawings. It will be seen, therefore, that the leaf spring is pivotable about an axis normal to the base plate 14 between operative and inoperative positions.

The embodiment illustrated in Fig. 4 differs from the above-described one in that the leaf spring 61 instead of being secured to the timepiece base plate 62 by the screw which serves to fasten the vibrator to the base plate, is mounted by a separate screw arrangement. The same includes a carrier 63 adapted to receive the screw 64, suitable insulation being provided so that the leaf spring 61 is electrically insulated from the base plate 62. The arrangement of parts is such that the screw 64 immovably retains the leaf spring 61 in position, so that in order to pivot the leaf spring the screw 64 must first be loosened.

WHAT WE CLAIM IS:—

1. A watch or clock having a timepiece mechanism, a vibrator for actuating the same, the timepiece mechanism and the vibrator being mounted on a base plate, which is positioned within a chamber having a front and a back wall, the base plate extending substantially parallel to the front and back walls of the chamber and having an area smaller than the sectional area of the chamber in the plane of the base plate so as to leave a free chamber portion between the front and back walls which is unoccupied by the base plate, the vibrator having an oscillatable part arranged within the free chamber portion unoccupied by the base plate, the vibrator in a direction normal to the base plate has a maximum dimension which is greater than the distances between the base plate and each of the front and back walls so that the oscillatable part of the vibrator projects across the plane of the base plate and is not receivable in any part of the timepiece chamber other than the free chamber portion thereof.

2. A watch or clock according to claim 1, wherein the said oscillatable part of the vibrator which is arranged in the said free chamber portion is part of electrical means for oscillating the vibrator.

3. A watch or clock according to claim 2, wherein the electrical oscillating means include a battery and retaining means for securing the battery to the base plate.

4. A watch or clock according to claims 2 or 3 wherein the base plate is formed with a receiving portion adapted to receive a battery to be connected in circuit with the electrical oscillating means.

5. A watch or clock according to claim 4 wherein the receiving portion is formed as a recess capable of receiving the battery therewithin.

6. A watch or clock according to any one of the claims 2 to 5 wherein the electrical oscillating means include a combined conductor and clamping member capable of electrically contacting one terminal of a battery received by the receiving portion of the base plate and of clamping such battery to the base plate.

7. A watch or clock according to claim 6 wherein the combined conductor and clamping member is mounted on the base plate for

movement relative thereto between an operative position wherein the member overlies the recess and is capable of electrically contacting one terminal of a battery received therewithin and of clamping the battery to the base plate, and an inoperative position spaced from the operative position, so that when the member is in its inoperative position, a battery may be inserted into or removed from the recess.

8. A watch or clock according to the claims 6 or 7 wherein the combined conductor and clamping member is mounted on the base plate for pivotal movement relative thereto between its operative and inoperative positions for movement about a pivot axis which is preferably substantially normal to the plane of the base plate.

9. A watch or clock according to any one of the claims 6—8 wherein the combined conductor and clamping member is constituted by a leaf spring.

10. A watch or clock according to any one of the preceding claims wherein the timepiece chamber is bounded by the rear wall of the timepiece casing and by the timepiece dial plate, and wherein the maximum dimension of the said oscillatable part of the vibrator which is arranged within the free chamber portion, in a direction normal to the base plate, is greater than the distance between the rear wall of the timepiece casing and the nearest face of the base plate as well as greater than the distance between the timepiece dial plate and the nearest face of the base plate, so that the oscillatable part of the vibrator which is arranged within the free chamber portion projects across the plane of the base plate.

11. A watch or clock according to any one of the preceding claims wherein the maximum dimension of the said oscillatable part of the vibrator which is arranged within the free chamber portion of the timepiece chamber is almost as great as the distance between the rear wall of the timepiece casing and the timepiece dial plate.

12. A watch or clock according to any of the preceding claims wherein the said oscillatable part of the vibrator is substantially cylindrical in shape, with the axis extending substantially parallel to the base plate so that the maximum dimension of the substantially cylindrical oscillatable part of the vibrator in a direction normal to the base plate is the diameter of the said oscillatable part.

13. A watch or clock according to claim 12 wherein the substantially cylindrical oscillatable part of the vibrator forms part of the electrical means for oscillating the vibrator, is hollow and cooperates with one or more other electrical components which are stationarily mounted on the base plate and project into the hollow oscillatable part of the vibrator and form together therewith electro-mechanical transducer means.

14. A watch or clock according to claims 12 or 13 wherein the substantially cylindrical oscillatable part of the vibrator is in the form of a magnetic drum and wherein the stationary electrical component or component are coils.

15. A watch or clock according to any one of the preceding claims wherein in the case of a tuning fork type vibrator an oscillatable part is carried at the free end of each tine, both oscillatable parts being arranged in the free chamber portion of the timepiece chamber and each oscillatable part being in a direction normal to the base plate, too great to be received in any part of the timepiece chamber other than the said free chamber portion thereof.

16. A watch or clock according to any one of the preceding claims wherein the area of the base plate is approximately one-half the sectional area of the timepiece chamber so that the free chamber portion is approximately one half as large as the entire timepiece chamber.

17. A watch or clock according to any one of the preceding claims wherein the timepiece chamber is approximately circular and wherein the base plate is approximately semi-circular so that the free chamber is also approximately semi-circular.

18. A watch or clock according to any of the preceding claims wherein the vibrator, and in the case of a tuning-fork type vibrator, its tines, are oscillatable in a plane substantially parallel to the plane of the base plate.

19. A watch having a time piece mechanism substantially as hereinbefore described with reference to the accompanying drawings.

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2 SHEETS
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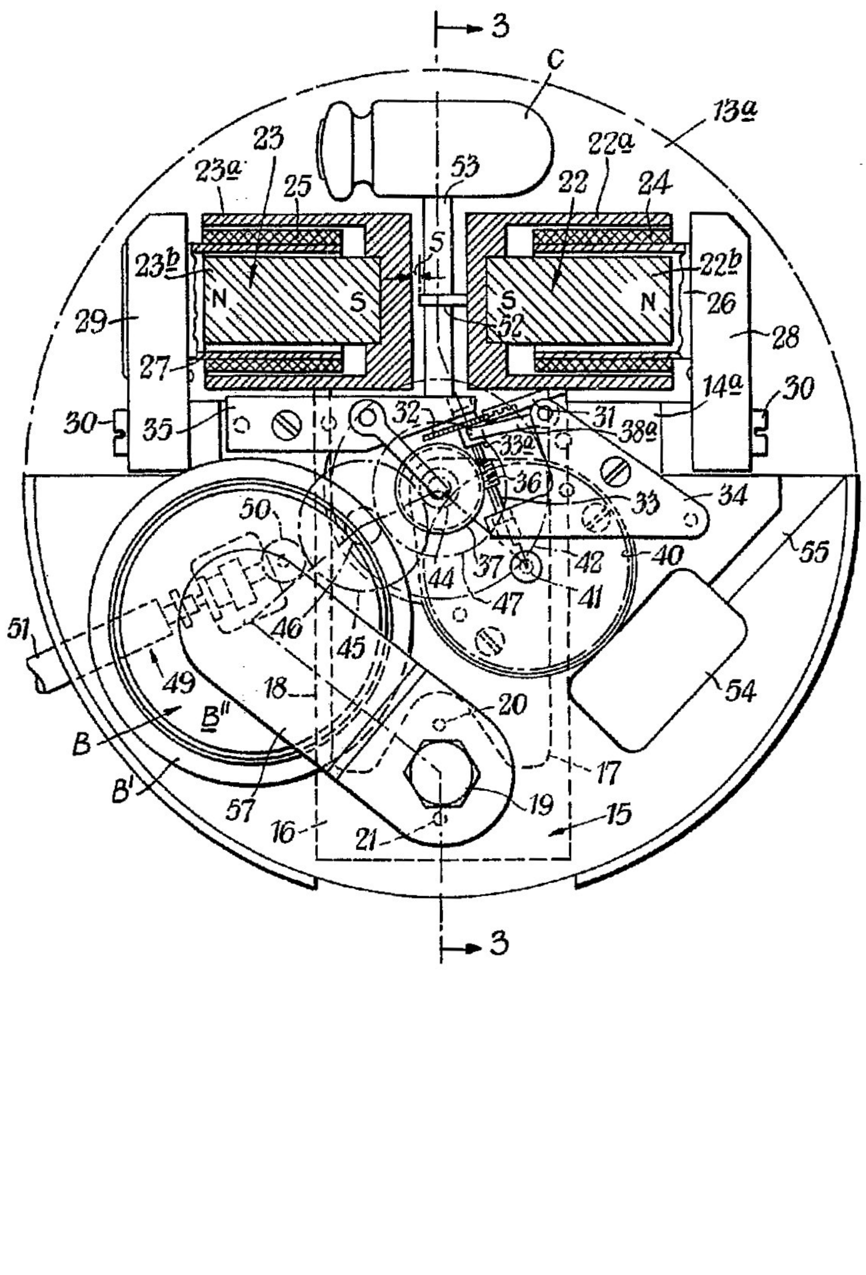
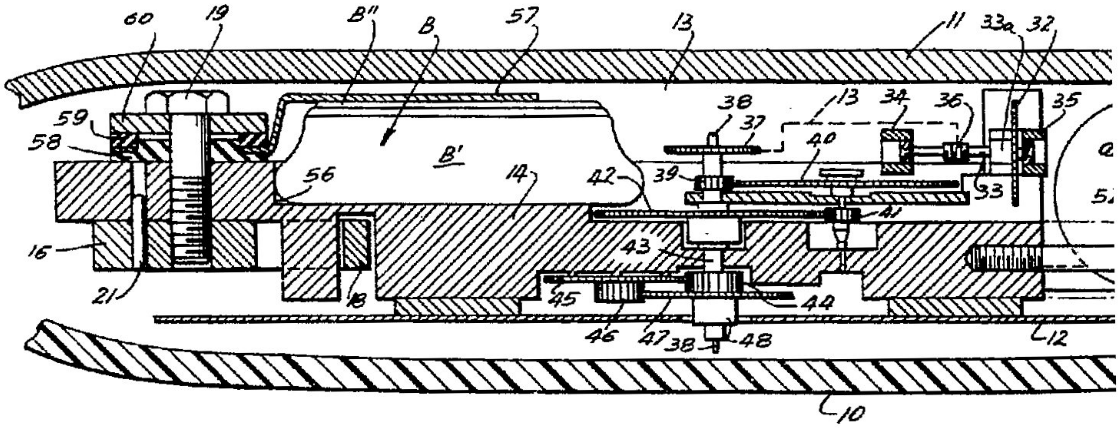
SHEET 1

FIG.1.

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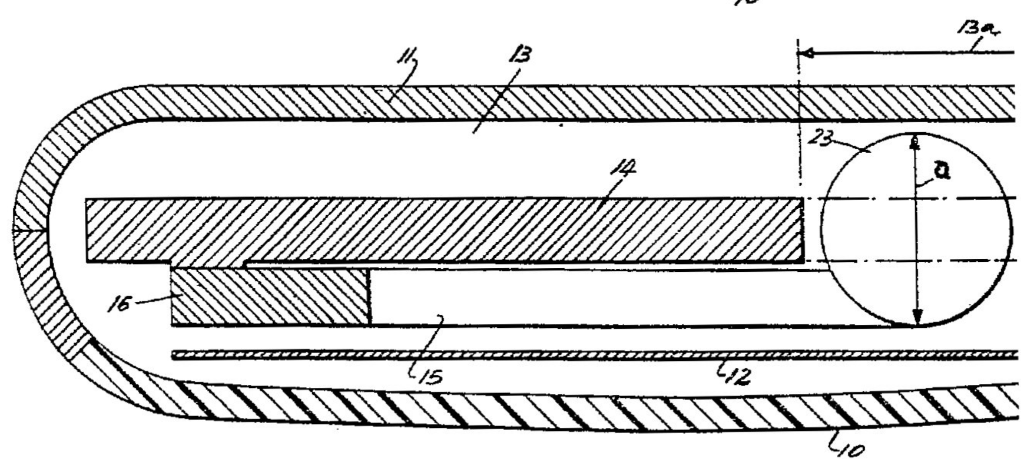
13a
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FIG.4

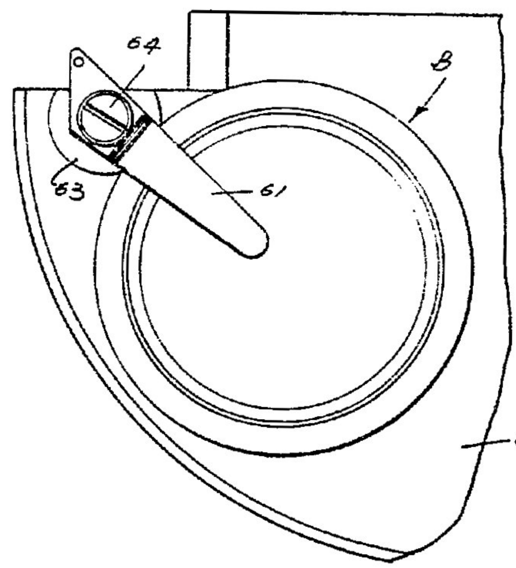


FIG.2

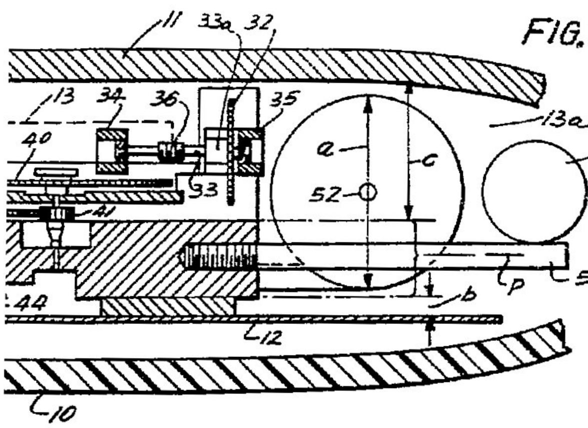


FIG.3

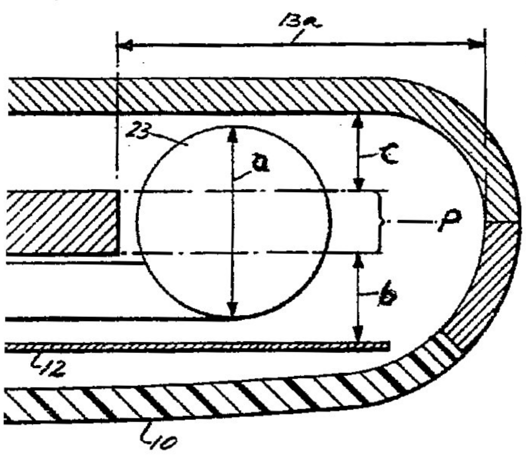
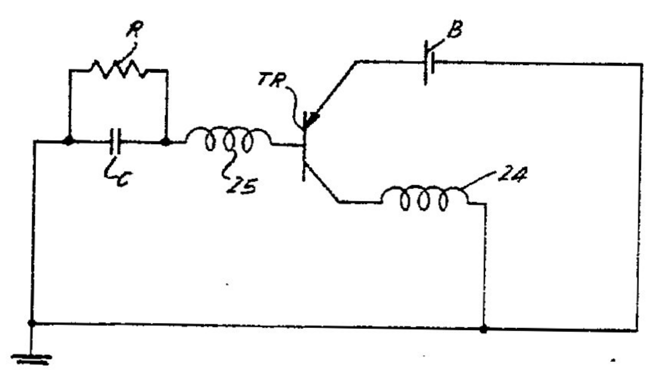


FIG.5



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2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

FIG. 4

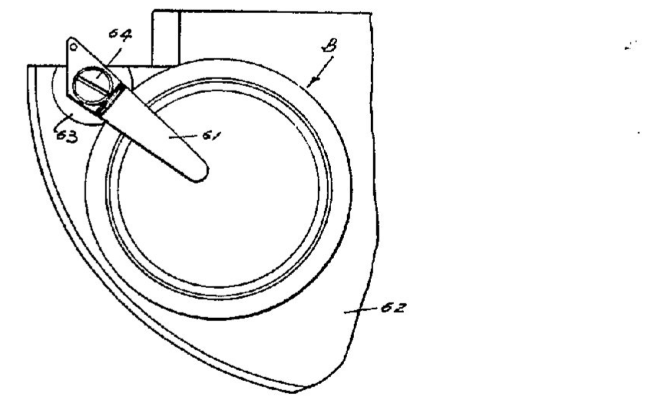

FIG. 2

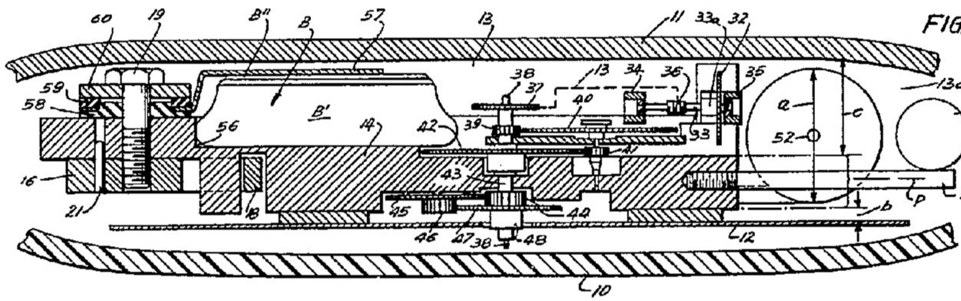

FIG. 3

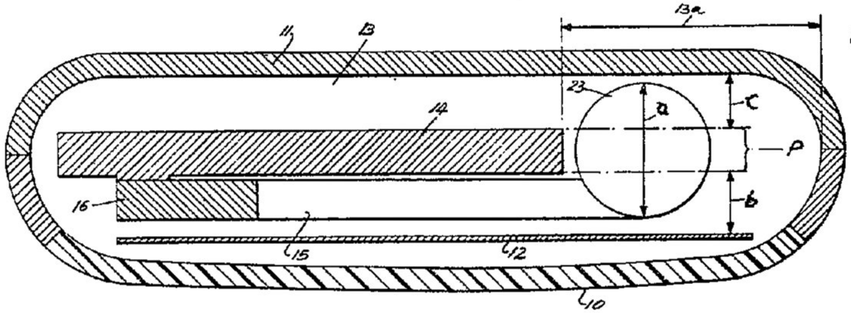

FIG. 5