(12) UK Patent (19) GB (11) 2 208 018 (13) B

(54) Title of Invention

Timepiece

(51) INT CL^5; **G04C 3/14, G04B 29/00**

(21) Application No
8817226.7

(22) Date of filing
20.07.1988

(30) Priority Data

(31) **62181341**
62187315

(32) **21.07.1987**
09.12.1987

(33) **JP**

(43) Application published
15.02.1989

(45) Patent published
07.08.1991

(52) Domestic classification
(Edition K)
G3T TAAB TA7B TQA TQB
T101

(56) Documents cited
GB2056126 A
GB1537457 A
GB0928731 A
GB0339180 A
GB0278954 A

(58) Field of search

As for published application
2208018 A *viz:*
UK CL **G3T**
INT CL **G04B, G04C**
updated as appropriate

(72) Inventor(s)
Toshimasa Ikegami

(73) Proprietor(s)
Seiko Epson Corporation

(Incorporated in Japan)

4-1 Nishishinjuku 2-chome
Shinjuku-ku
Tokyo
Japan

(74) Agent and/or
Address for Service
J Miller & Co
Lincoln House
296-302 High Holborn
London
WC1V 7JH
United Kingdom

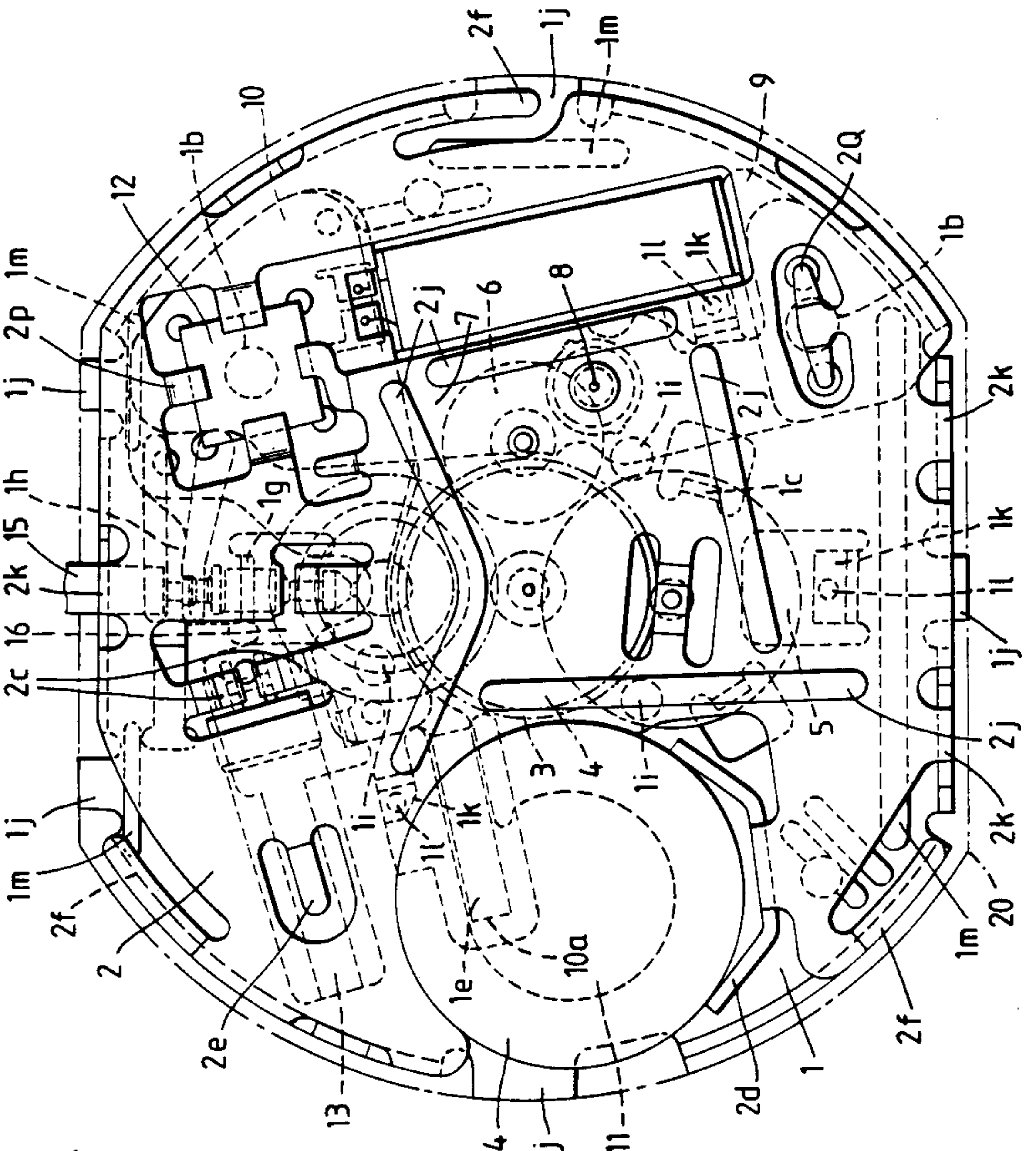

1m
2p
1j
1h
15
2k
16
2c
1j
1m
2f
2
2e
13
14
1j
11
2d
1
2f
1m
20
2k
2j
5
1i
4
3
1k
1l
1e
10a
1i
1c
2j
1i
8
6
7
2j
1l
1k
9
2Q
1b
1g
12
1b
10
2f
1j
1m
1l
1k
1j

Fig.1.

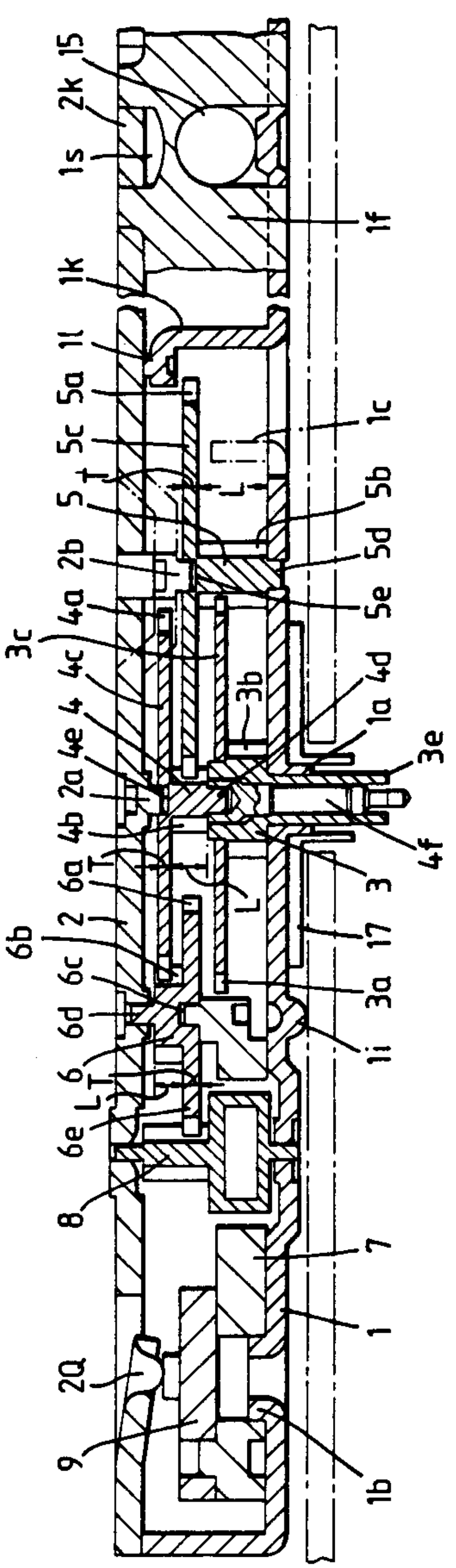

15
2k
1s
1f
1k
1l
5a
1c
5c
T
L
5
5b
2b
5d
5e
3c
4a
4c
3b
4d
1a
4
4e
3e
2a
4f
4b
3
T
6a
L
2
17
6b
6c
3a
6d
1i
6
L
T
6e
8
7
1
2Q
9
1b

Fig.2.

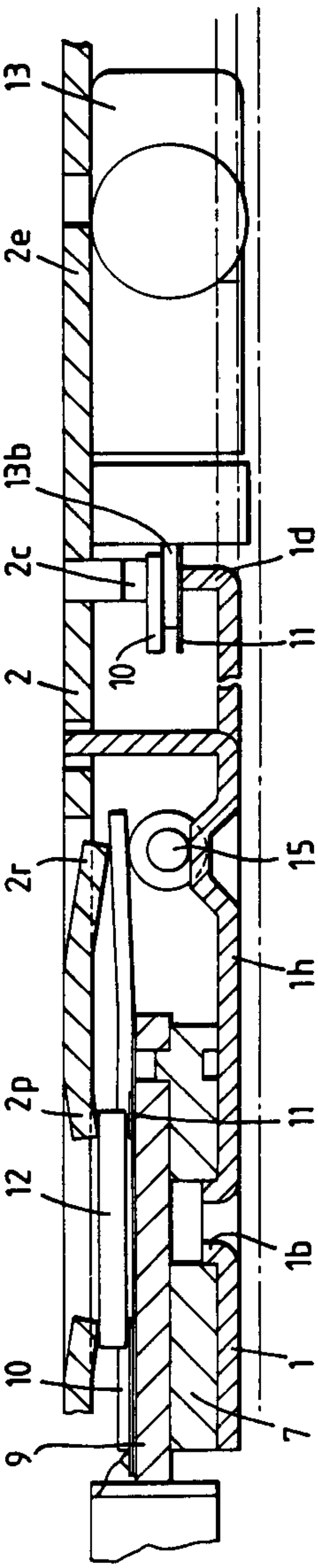

13
2e
13b
2c
1d
10
11
2
2r
15
1h
2p
11
12
1b
10
1
9
7

Fig.3.

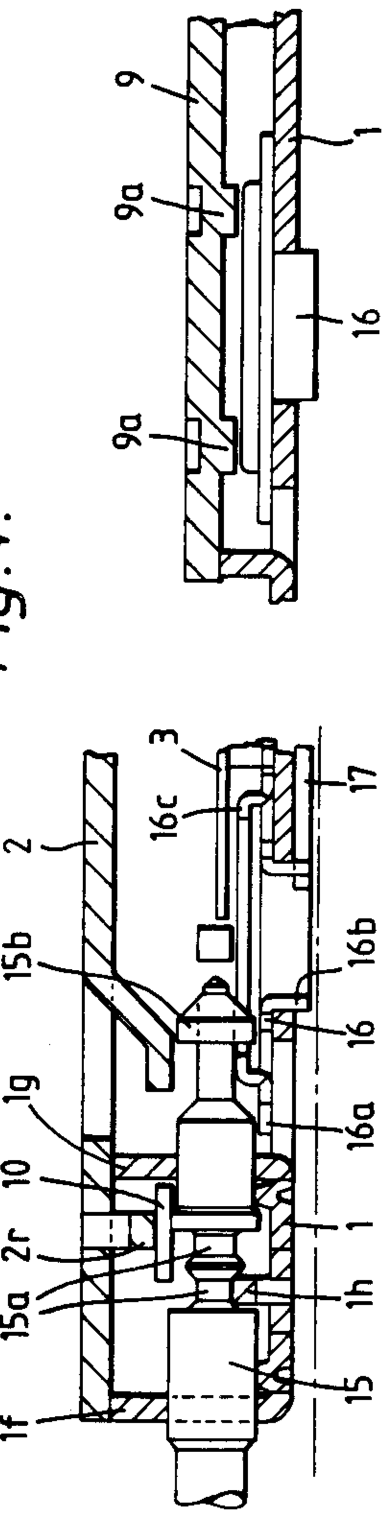

9
9a
1
16
9a
2
3
17
16c
15b
16b
16
1g
16a
10
2r
1
15a
1h
1f
15

Fig.4.

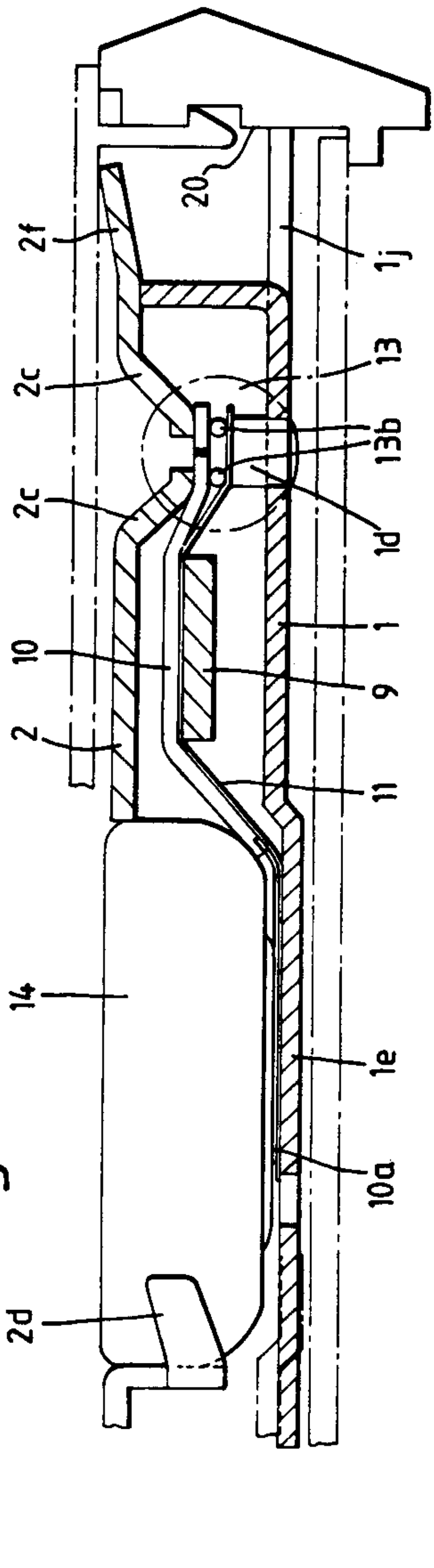

20
2f
1j
2c
13
13b
2c
1d
10
1
9
2
11
14
1e
10a
2d

Fig.5.

Fig.6.

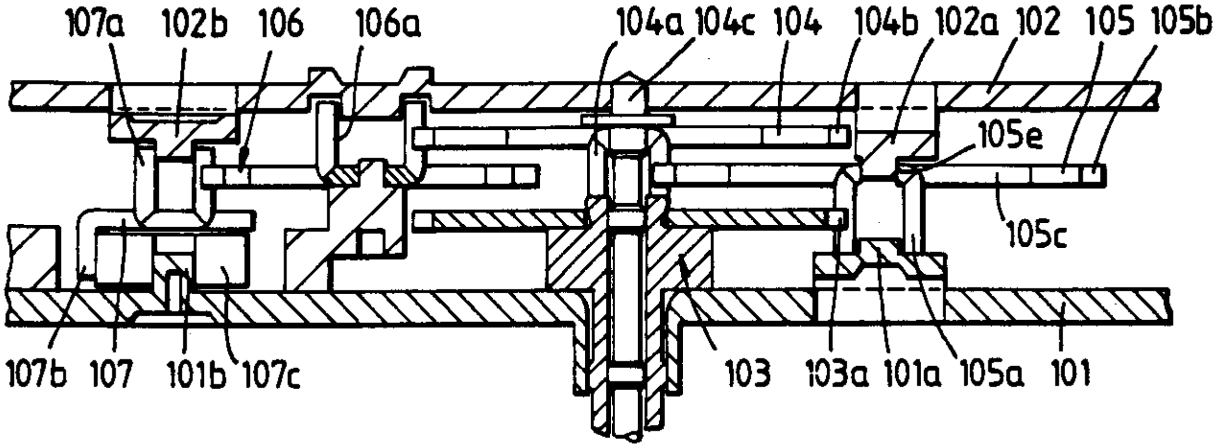


Fig.7(a).

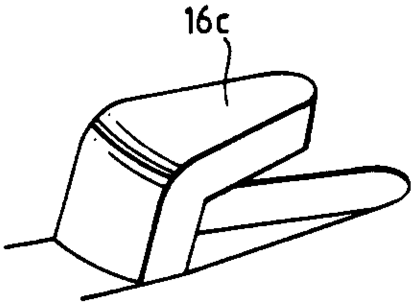


Fig.7(b).

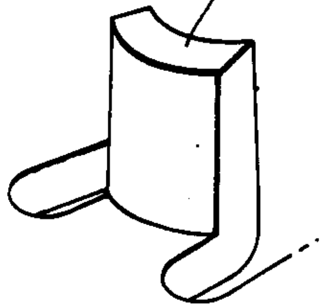


Fig.8.

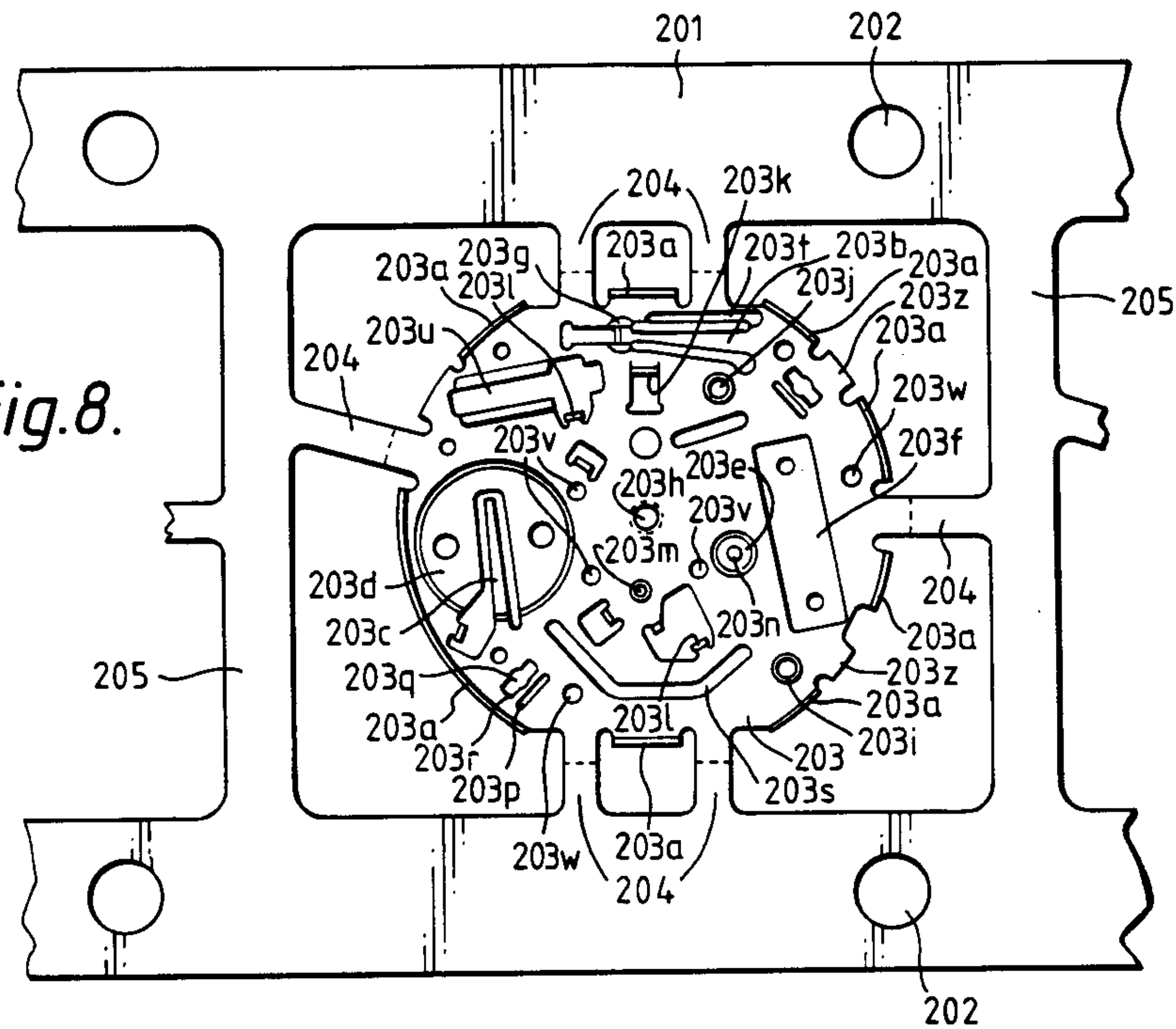


Fig.9(a)

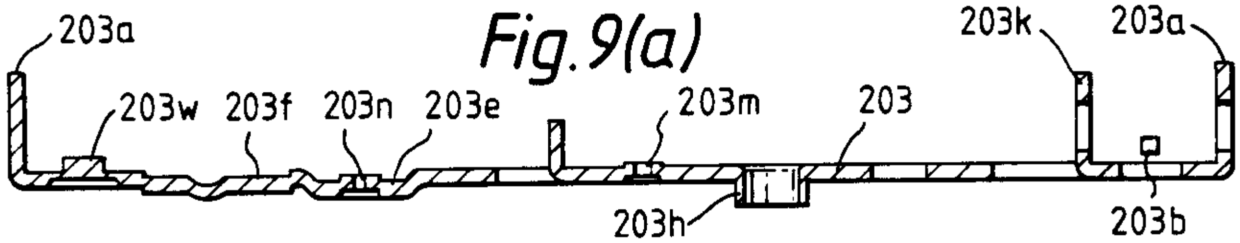


Fig.9(b)

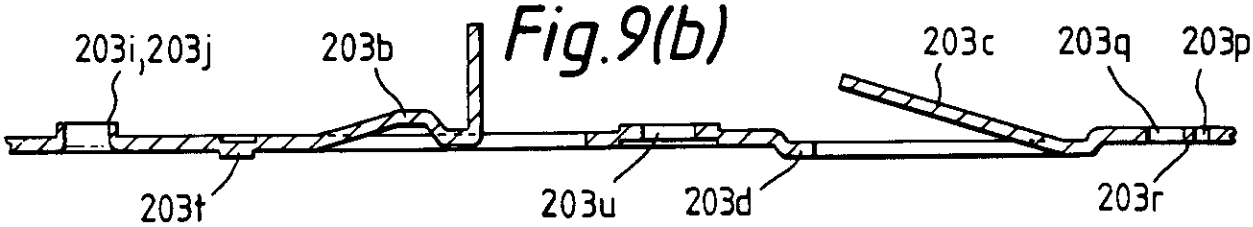


Fig.9(c)

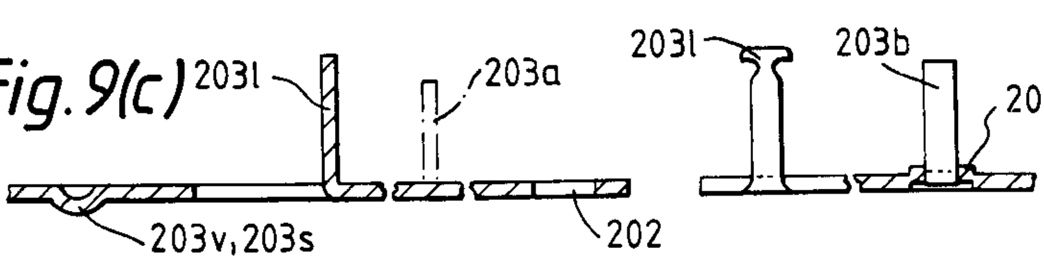
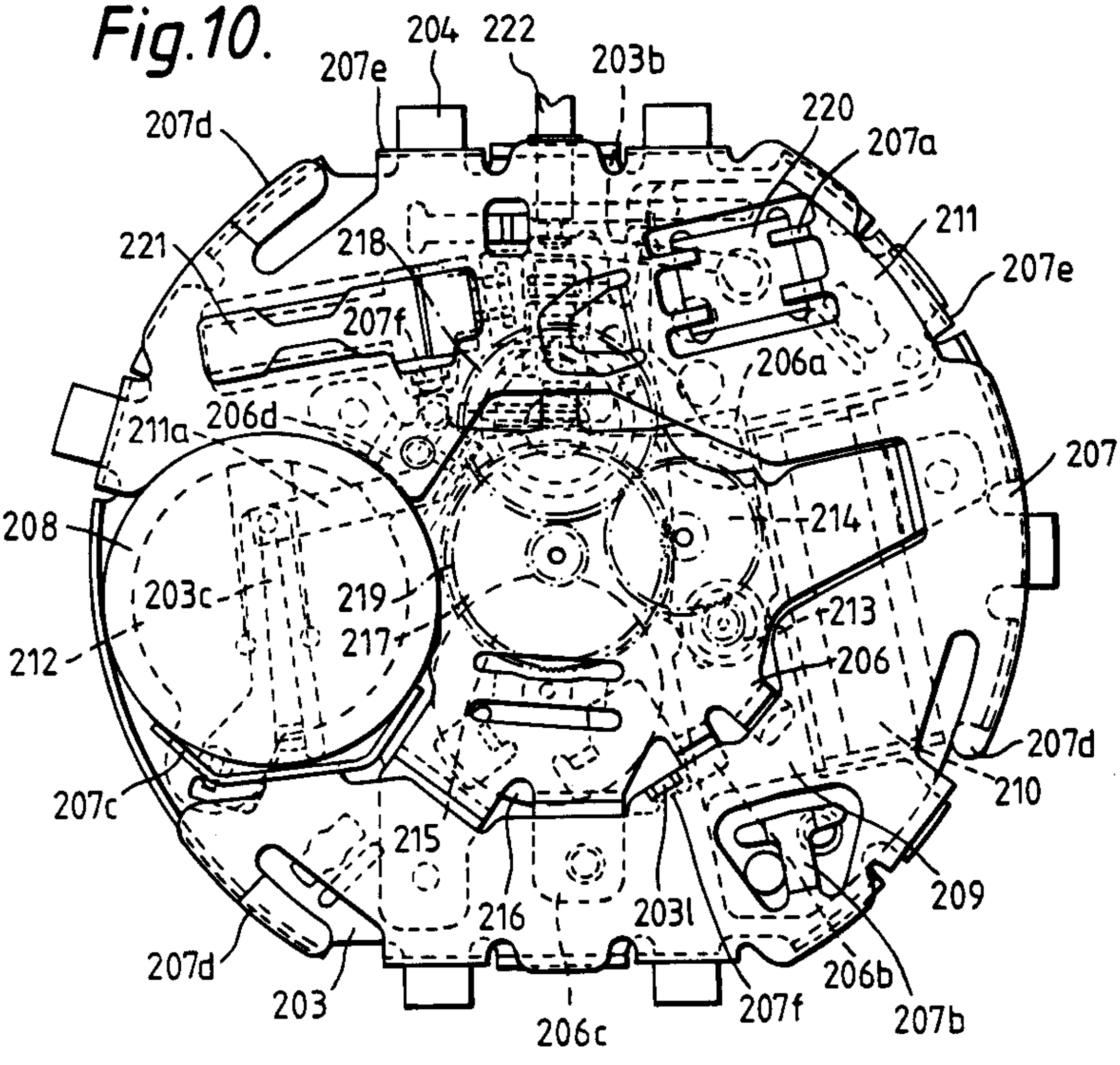


Fig.10.


204
222
203b
207e
207d
220
207a
211
207e
221
218
207f
206a
211a
206d
207
208
214
203c
219
217
213
212
206
207d
207c
210
215
209
216
203l
207d
203
206b
206c
207f
207b

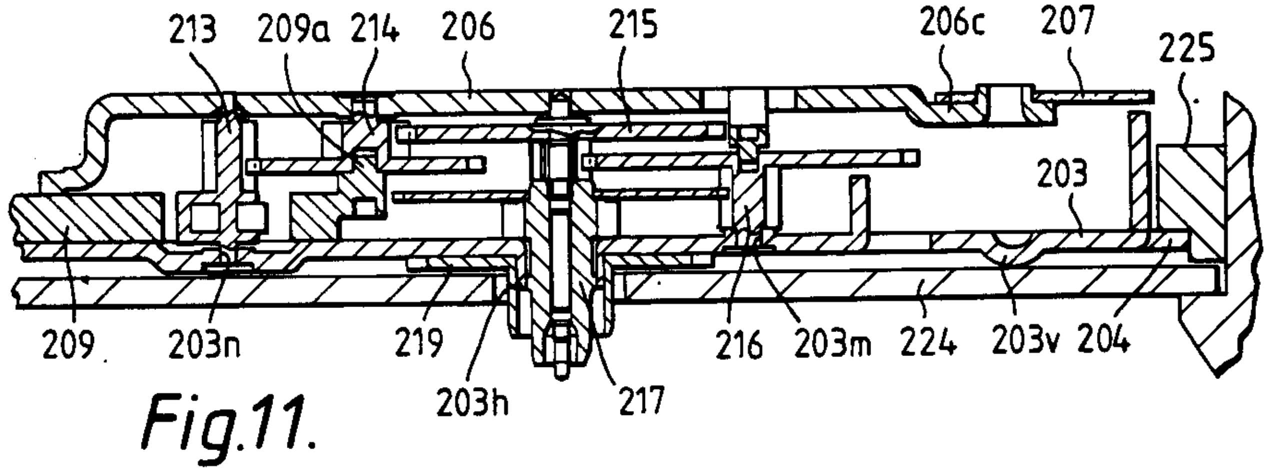

213
209a
214
206
215
206c
207
225
203
209
203n
219
203h
217
216
203m
224
203v
204

Fig.11.

 2208016

Fig.12.

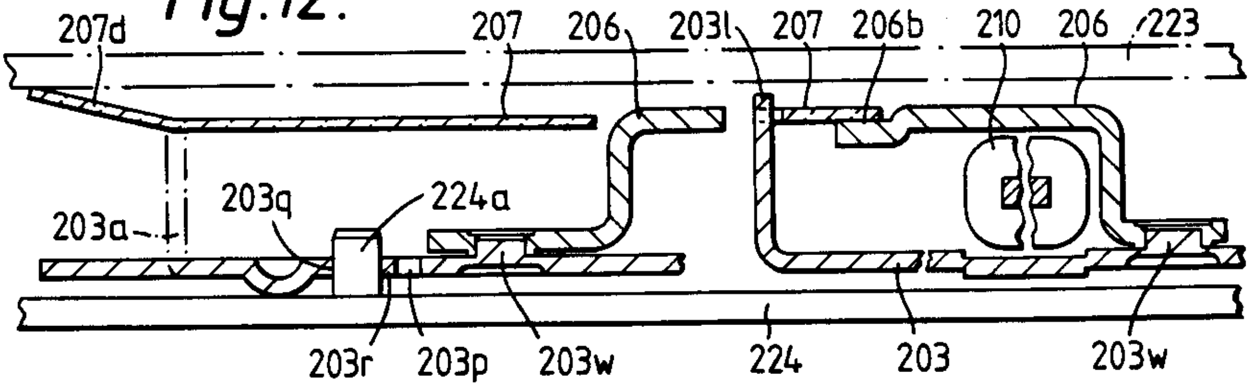


Fig.13.

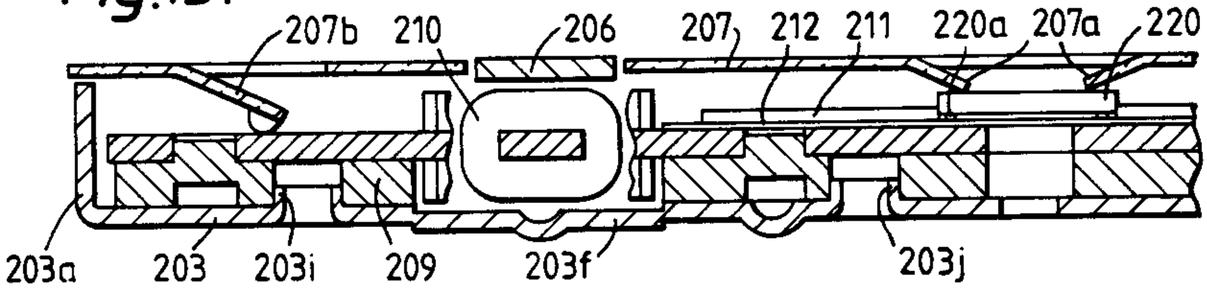


Fig.14.

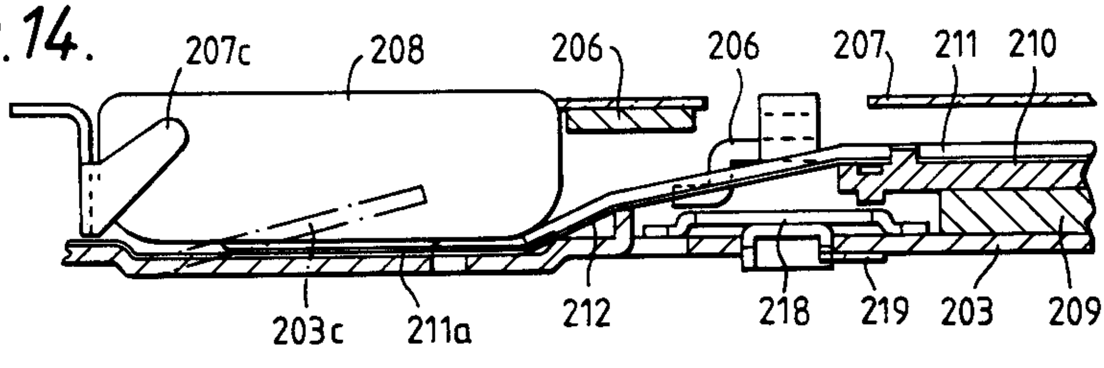
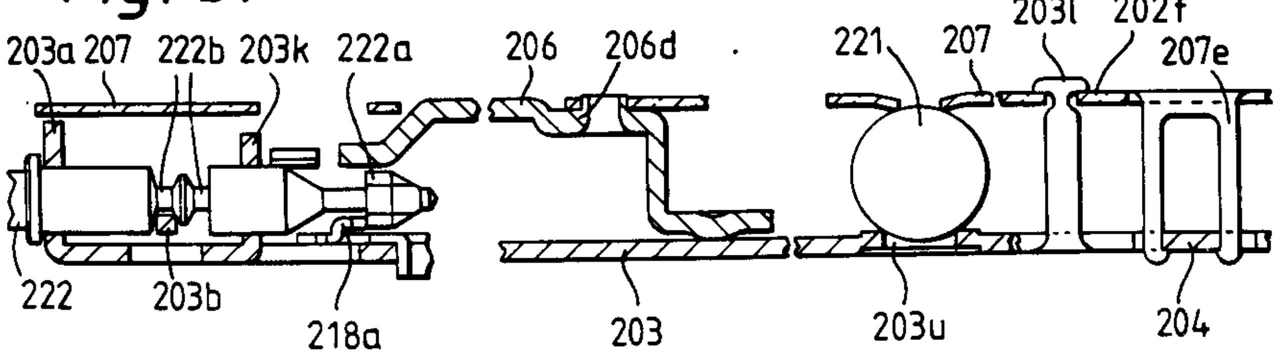


Fig.15.



"TIMEPIECE"

This invention relates to timepieces, and, in particular, to timepieces including a gear train between two plates.

In known timepieces, there is at least one resilient portion for pressing or positioning a member, which is separately formed from the gear train bridge, supporting one side of the gear train. Because a gear train bridge is formed of thick material in which a recess or the like is provided as a notch, there is a plate separately formed from thin plate material with the resilient portion. This inconveniently increases the number of parts required and the number of processing steps. Accordingly, such a structure involves high cost, and inconvenience in after service.

On the other hand, if a frame is formed of ribbon-shaped thin plate, it must be carefully treated because its strength against external forces, such as drop impact, is small. If the frame is formed of plastics material moulded into a plate, it takes a lot of time for processing, and the accuracy is not good because of heat deformation.

The present invention seeks to overcome and solve such problems, so that the bearing and the resilient portions may be formed with a frame in one body, and so that the production cost of the parts may thus be reduced, the strength of the frame may be increased, the manufacturing accuracy may be increased, the time necessary for processing may be reduced, and so that cost reduction may be achieved.

According to the present invention, there is provided a timepiece including a gear train between two plates, at least one of the plates being formed by plastic working to provide a bearing portion to support rotatably a wheel of the gear train, and at least one of the plates being provided with a resilient tongue spring to effect relative positioning of the two plates.

The tongue spring may engage part of the timepiece external to the plates to position the latter.

There may be a plurality of such tongue springs to engage part of the timepiece external to the plates to position the latter at spaced positions.

A spring or springs may engage a component or components of the timepiece between the plates to effect an electrical connection.

At least part of the circumferential portion of at least one of the plates may be bent out of the plane of the plate.

At least one of the plates may have at least two tie bar portions to engage with a case or casing ring for the timepiece.

At least one plate may have at least one flat portion in which a ridge is formed for stiffening.

Advantageously, both plates have bearing portions for rotatable support of wheels of the gear train, one plate also has resilient tongue springs to engage a rear casing part of the timepiece, the other plate has forward projections to engage a dial face plate of the timepiece, and the rear casing part and the dial face plate are connected, so that the two plates and the components they carry are pressed away from the rear casing part against the dial face plate.

Portions of at least one plate may be bent from the plane of the plate to engage the other plate to determine the spacing therebetween.

Preferably, the plate or plates are made of thin metal.

One of said plates may have a plurality of bent portions provided on the circumferential portion thereof by plastic working, and a plurality of flat portions between the bent portions.

Preferably, the circumferential portion of the bearing portion is formed by half-blanking, drawing or bending, to provide a positioning portion for the wheel in the thrust direction.

One example of a half-blanking process is a process in which a plate is provided with a projection by mounting one surface of the plate across a die, forcing a punch into the opposite surface of the plate, and stopping the travel of the punch when the leading end of the latter is within the thickness of the plate, so that the said projection is forced into the die without being removed from the base material of the plate.

How the invention can be carried into effect is hereinafter particularly described, merely by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a plan view of the assembled frame of a timepiece according to the present invention;

Figures 2 to 5 are sectional views of the frame of Figure 1;

Figure 6 is a sectional view of part of another example of the gear train portion of a frame similar to that of Figure 1,

Figures 7(a) and (b) are perspective views of the teeth of the wheel and pinion respectively of part of the gear train of Figure 1,

Figure 8 is a plan view of the main plate of another example of a timepiece according to the present invention,

Figures 9(a), (b) and (c) are sectional views of the main plate of Figure 8,

Figure 10 is a plan view of the assembled frame of a timepiece using the main plate of Figure 8; and

Figures 11 to 15 are sectional views of the timepiece of Figure 10.

In a preferred embodiment of the present invention (Figures 1 to 5 and 7), the timepiece includes a main plate 1 between which and a gear train bridge 2 on the back side of the main plate 1 there is a gear train. The gear train includes a centre or second wheel and pinion 3, a third wheel and pinion 5, a fourth wheel and pinion 4 and a fifth wheel and pinion 6. The second wheel and pinion 3 is rotatably supported by a hollow axle portion projecting through the main plate 1 and enclosed in an annular thin flange 1a (Figure 2) formed from the material of the main plate. The flange 1a is formed by a burring process in which there is formed an annular projection of substantially half the thickness of the main plate itself. As mentioned below, a burring process is a flanging process for producing an annular projection by ~~drilling~~ making a small hole in a flat plate, and thereafter bending up the portion around the hole by means of a punch having a diameter which is larger than that of the hole.

The second wheel and pinion 3 has a pinion portion on part of the axle portion thereof and a gear wheel secured on another part thereof. The latter has teeth which engage a pinion portion 5b of the third wheel and pinion 5. The wheel and pinion 5 also includes a gear wheel 5c with teeth 5a at one end of an axle portion, whose other end is formed as a pivot 5d to engage in a hole in the main plate 1. At the one end of the axle portion, there is a concave recess 5e engaged by a boss 2b carried by a small bridgelike member struck out from the bridge 2 between two short openings (Figure 1). The teeth 5a on the wheel 5c engage a pinion portion 4b on part of an axle portion 4d of the fourth wheel and pinion 4 which has a gear wheel 4c secured on another part of the axle portion thereof. At the gear wheel end of the axle portion 4d, there is a concave recess 4e which is engaged by a central boss 2a on the inner side of the bridge 2. At the other end of the axle portion 4d, a spindle 4f is an interference fit with the axle portion 4d and is supported in the hollow axle portion of the second wheel and pinion 3. The teeth 4a on the gear wheel 4c engage a pinion portion 6b of the fifth wheel and pinion 6 which has a toothed wheel 6a, an upper pivot boss 6d rotatably mounted in a hole in the bridge 2, and a lower concave recess 6c which is engaged by a boss on a stator 7 secured to the main plate 1. The pinion portion of the second wheel and pinion 3 (Figure 4) is engaged by the teeth 16a of the first wheel and pinion 16 which is rotatably supported in a hole in the main plate 1 and has a pinion portion 16b projecting therethrough with end facing teeth in engagement with an hour wheel 17 rotatably mounted on the flange 1a (Figure 2). The first wheel and pinion 16 also has upstanding teeth 16c (Figure 4). The first wheel and pinion 16 is formed by shearing. The teeth of pinion portion 16b (Figure 7(b)) are made by firstly making a shaped hole and thereafter bending. Teeth 16c (Figure 7(a)) are made by firstly shearing to the way of the plane and thereafter bending. The gear wheel with teeth 16a is made by shearing to form the shape of teeth. Therefore, the present invention is suitable for mass production and manufacturing cost can be reduced.

Movement of the first wheel and pinion 16 from the hole in the main plate 1 is limited by a half-blanked portion 9a (Figure 4). The hour wheel 17 is between the main plate 1 and a dial face plate. The space between the main plate 1 and the face plate, and thus the limit of movement of the hour wheel 17 is set by three projections 1i which are made by drawing or half blanking.

The looseness of the fourth wheel and pinion 4 and the second wheel and pinion 3 in the shaft direction is determined by the half-blanked or pressed portion. The pinion portion 4b, axle portion 4d and concave recess 4e are formed by forging (including the case of non-heating). Teeth 4a are formed by shearing or blanking the gear wheel 4c. The pinion portion 5b is formed by forging, and the teeth 5a are formed by blanking. The boss 2b acting as upper pivot for the concave recess 5e is made by drawing, plastic working and/or half blanking. Main plate 1 has bent up portions 1c for limiting the inclination of the third wheel and pinion during assembly. The portion 1c is bent up from the tongue formed by a U-shaped opening in the plate 1. The fifth wheel and pinion 6 is made in a similar manner to the third wheel and pinion 5.

Because there is a relation ($D1/D2 < 3$) between the external diameter D1 of the gear wheel 6a, and the external diameter D2 of the pinion portion 6b, all the teeth of the wheel 6d can be produced merely by forging. The hole in which the upper pivot boss 6d is mounted in the gear train bridge 2 is punched. The pinion thickness L of each of the above forged pinions should not be less than 0.4mm. The number of pinion teeth should be not more than eight. The material for the components is desirably copper alloy, or brass or aluminium. In order to make a timepiece thinner, the ratio of gear wheel thickness T with respect to pinion thickness L, i.e. T/L, is desirably not more than one half. The purpose of half-blanking the gear train bridge 2 to support the fourth wheel 4 and the fifth wheel 6 is to reduce the contact resistance of the portions for determining the looseness of the wheels and pinions to control the looseness of the wheels and pinions without the use of a jewel or the like. The purpose of the recess formed by effecting half-blanking around the hole which supports the upper pivot boss 6d of the fifth wheel and pinion 6 is to provide an oil reservoir.

The stator 7 has a rotor 8 made of plastics and magnetic material with its lower pivot supported in a hole in the main plate 1 formed by half-blanking, and with its upper pivot supported in a hole having a slope portion provided in a half-blanked portion of bridge 2. The stator 7 is positioned in the horizontal direction by two burred portions 1b provided in the main plate. On the stator 7 (Figure 3) is a coil block comprising a magnetic core 9, a coil frame, a coil lead, an insulating plate 11, and a coil lead substrate 10 with connecting portions to the ends of the coil. Coil lead substrate 10 also has a pattern on the side of the magnetic core 9, and a hole to receive an IC chip 12. With the IC chip 12 in the hole in the coil lead substrate 10, it is pressed by IC chip pressing springs 2p on the gear train bridge 2. The spring force makes a conductive contact between the IC chip 12 and the pattern. The magnetic core 9 is pressed against the stator 7 by spring force from core pressing springs 2q. A crystal unit 13 (Figure 3) is positioned in a longitudinal seating hole provided in the main plate 1 (Figure 5). The crystal unit has two terminals 13b. A bent-up portion 1d of the main plate supports the crystal terminals 13b, being insulated therefrom by part of the insulating plate 11. On the other side of the terminals 13b, a pattern on the coil lead substrate 10 is pressed into conductive contact with the terminals 13b by springs 2c pressed out of the bridge 2. The body of the crystal unit 13 is pressed by a crystal pressing spring 2d (Figure 3). A copper portion 10a (Figure 5) protrudes from the edge of coil lead substrate 10 and is disposed in conductive contact with the cathode of a battery 14 by the spring force of a negative terminal spring 1e in the main plate 1. A two-pronged positive terminal 2d is formed from the gear train bridge integrally and resiliently contacts the positive electrode casing of the battery 14 (Figure 5).

A stem 15 (Figure 4) is guided for reciprocation in one direction in holes in an end flange 1f and a bracket 1g bent up from the main plate. The main plate 1 is upset by drawing or half-blanking to form two upwardly projecting guide portions for the stem 15. The reason for this structure is to overcome any defects caused by misalignment of the guide holes. Because the guide holes for the stem 15 are near the bent portions of the flange 1*f* and bracket 1*g*, the guide holes punched before bending may be deformed when bending takes place. As a result, the accuracy of the hole diameters is not always obtained.

The stem 15 has two grooves 15*a* separated by a sloping sided annular land, and a toothed portion 15*b* A tongue-like detent or "click" spring 1*h* is pressed out of the main plate 1 to engage resiliently in one of the grooves 15*a*, its end being bent. In order to remove the stem 15, the end of the detent spring 1*h* can be pressed down by an instrument to disengage the click spring 1*h* from the groove 15*a* and to remove it from the path of the stem 15 which can thus be removed. Normally, however, when the stem 15 is pulled out, the detent spring 1*h* rides over the sloping sided annular land into the other of the grooves 15*a*. When the detent spring 1*h* is engaged in the other groove 15*a*, the position of the stem 15 is such that the toothed portion 15*b* is engaged with the teeth 16*c* of the first wheel and pinion 16 and the hands can be rotated to adjust the time displayed. During manual rotation of hands by the stem 15, electric operation is terminated, part of the stem 15 bearing on the coil lead substrate 10 pressed against it by tongue springs 2*r* (Figure 4). In order to correctly pull out the stem 15, one part of the detent 1*h* is cut so that there is almost no gap between the spring portion and the main plate rigid portion after cutting (such a cut is called a zero cut). The thrust force of the stem 15 being moved is received by the zero-cut portion of the spring in order to prevent the distortion of the end portion of detent spring 1h in the thrust direction.

The main plate 1 is manufactured from a long strip of ribbon-shaped material which passes through metal working tools. First, the outline shape of a main plate is cut together with holes therein. This outline shape is joined to the body of the strip by tie bars 1j. The main plate is then sequentially or simultaneously treated to form perforations, upset portions,bent portions and cutaway portions to receive the components of the timepiece which are to be disposed between the main plate 1 and the gear train bridge 2. The other components are made separately and placed in position on the main plate 1, for example, the stator 7, the rotor 8, the first, second, third, fourth and fifth wheel and pinions 16, 3, 5, 4 and 6, the IC chip 12, the crystal unit 13 and the electrical and electronic connections. Then the gear train bridge 2 is placed in position upon the components,and the tie bars 1j, having been cut to release the main plate 1, are bent up and over the edge of the gear train bridge 2 to hold the latter in place on the main plate 1 with the components properly positioned and held therebetween.

To determine the space between the main plate 1 and the gear train bridge 2, several double bent portions 1k (Figure 2) are formed from the main plate 1, and their end portions are drawn or half-blanked to form projections 1ℓ to engage the bridge 2. Generally, there is much variation or tolerance in bending and, therefore, the bending process is not suitable for determining the looseness of the wheels. However, this variation can be absorbed if the height of the double bent portion 1k is controlled by the height of the projections 1ℓ. To locate the bridge 2 on the main plate 1, the latter has a concave portion 1s cut out of the flange 1f (Figure 2) to form a pair of fingers to engage a portion 2k of the gear train bridge 2.

Except for the tie bars 1j, the circumferential portions of the main plate 1, when formed as a thin plate, are formed by bending or drawing in order to strengthen the edges to prevent distortion and to improve the rigidity of the main plate. Additionally, thickened ridges 1m are formed by drawing or half blanking, particularly near circumferential portions which have no bent or drawn portions. On the gear train bridge 2, ridges 2j are formed near the pivot holes, thereby improving the rigidity and preventing distortion of the main plate.

The hour wheel 17 is placed in position on the projecting flange 1a of the main plate 1, and the dial face plate is then located on the main plate against the projections 1i. The gear train bridge 2 has a number of tongue springs 2f (Figures 1 and 5) on its periphery, which project outwardly therefrom. A back cover is then placed in position and is engaged by the tongue springs 2f. The back cover is then secured to the dial face plate by electrically insulating connectors (Figure 5), the hands secured in place and the glass front cover secured. The movement of the watch is thus fixed in the case 20 through the intermediary of the springs 2f and the need for an intermediate frame avoided.

In a modification of the foregoing example, shown in Figure 6, more use is made of blanking and bending in the manufacture of wheel and pinions. Thus, a rotor 107 has a central portion from which teeth 107a are cut and struck upwardly to form a pinion portion, whilst portions 107b are bent downwardly to grip and hold a magnet 107c. A main plate 101 has a boss 101b formed thereon to engage in a hole in the magnet 107c to provide a lower pivot for the rotor 107. The teeth 107a of the pinion portion engage a boss 102b on a downwardly projecting portion of a gear train bridge 102, which boss forms an upper pivot for the rotor 107. Teeth are cut out of the periphery of a fifth wheel and pinion 106 to engage with the teeth 107a of the rotor 107. Teeth are also cut and struck upwardly to form the pinion portion of the wheel and pinion 106. A fourth wheel and pinion 104 has peripheral teeth 104b cut out and engaged with the teeth of the pinion portion of the fifth wheel and pinion 106. The central portion of the wheel and pinion 104 is cut and struck downwardly to form teeth 104a of a pinion portion thereof. The fourth wheel and pinion 104 is mounted on a shaft 104c which carries the seconds hand of the watch. The shaft 104c is rotatably mounted in a hole formed in the bridge 102 and in the hollow spindle of a second or central wheel and pinion 103, which itself is rotatably mounted in a flanged hole in the main plate 101. A third wheel and pinion 105 has peripheral teeth 105b in engagement with the teeth 104a of the pinion portion of the fourth wheel and pinion 104. The central portion of the third wheel and pinion 105 is cut and bent to form teeth 105a of a pinion portion of the wheel and pinion 105. There is a central pivot hole in the wheel and this engages an upper pivot boss 102a formed on a downwardly projecting portion of the bridge 102 which is cut and drawn. A similar lower pivot boss 101a is formed from the main plate 101 and is engaged by the teeth 105a. The latter are engaged by the peripheral teeth on the wheel of the second wheel and pinion 103. The remainder of the watch is similar to that described above.

The pinion teeth 105a of the third wheel and pinion 105 are formed by bending after it is cut around the pivot hole, so that it is bent after being zero-cut. The gear teeth 105b are formed by blanking in the shape of teeth around the pinion teeth 105a. The burr of the pinion teeth 105a is oriented to the circumferential direction. The burr of the pinion teeth 104a is oriented in the central direction. The number of teeth on each pinion is desirably not more than eight, in view of the size of the pinions and the manufacturing requirements. The desirable thickness of the material is not more than 0.2mm to enable manufacture by pressing.

In another example of the present invention (Figures 8 and 9), main plates are made sequentially by presses acting upon a ribbon-like strip of suitable metal, which may be coiled or flat depending upon the convenience for manufacture and the length thereof. The metal is preferably brass, or phosphor bronze or beryllium-copper or SnBs or the like, and the thickness of the strip is desirably no more than 0.35mm.The strip 201 has pilot holes 202 in its edges, by which the strip may be located in a machine for stamping, drawing, cutting, bending or other metal treatment. The outline shape of the main plate 203 is first cut in the strip 201 between two bridge pieces 205 extending from edge to edge of the strip to be handled with ease even after cutting. The main plate 203 is connected to the edges of the strip 201 and to the bridges 205 by six tie bars 204 which are eventually cut at the dotted lines to allow removal of the main plate 203.

Figure 8 shows the configuration of the main plate 203 just before completion and removal by cutting the six tie bars 204. Main plate 203 has upwardly bent portions 203a around its periphery formed by bending or drawing, except for tie bars 204 and one small flat portion. Inside of the bent portions 203a are provided springs 203b (Figure 9(b)), 203c and 203r, drawn portions 203d and 203e (Figure 9(a)), half-blanked portions 203f and 203g (Figure 9(c)) which are formed by half shearing burred portions 203h, (Figure 9(a)), 203i (Figure 9(b)) and 203j, bent portions 203k (Figure 9(a)) and 203 ℓ (Figure 9(c)), sheared holes 203m (Figure 9(a)), 203n, 203p (Figure 9(b)), 203q and 203u, ridges 203s and 203t which are formed by drawing (half-blanking is also applied), drawn projections 203v (Figure 9(c)), boss 203w formed by forging or the like. The burred portions 203h, 203i and 203j may be formed by a "burring" or flanging, process in which a small hole is made ~~drilled~~ in a flat plate, and the portion of the plate around the hole is thereafter bent up by a punch having a diameter larger than that of the hole. Because all the processes can be effected by press working, it takes only about 0.5 second to process a main plate. Further, with respect to strength, because the bent portions 203a are provided circumferentially, the resultant main plate has good durability when, for example, the hands are pushed onto their shafts in assembling, and especially when the hour hand is pressed onto the hour wheel, when the hands are pulled out, and otherwise when external forces,such as impact on dropping, are applied. Furthermore, as the ridges 203s and 203t formed by half blanking, drawn portion 203d and half-blanked portion 203f are provided in the flat portion of the main plate 203, its strength is increased. Because the tie bars 204 are in the same plane as the reference plane of the largest area in the main plate 203, sufficient processing accuracy is obtained. The bent portions 203a and drawn ridges 203s and 203t prevent warping of the main plate.

Besides the main plate just described, the watch includes a gear train bridge 206 and a circuit pressing plate 207, and the main components are between the main plate 203 and the bridge 206 and plate 207 which are in substantially the same plane. The components include a battery 208, a stepping motor comprising a stator 209 and rotor 213, with a coil block including a magnetic core 210, a coil frame, an insulating plate 212, and a coil lead substrate 211, a gear train including first, second, third, fourth and fifth wheel and pinions 218, 217, 216, 215 and 214, respectively, an MOS-IC chip 220, a quartz crystal unit 221 and a stem 222.

The fourth wheel and pinion 215 (Figure 11) supports the second hand whilst the second or central wheel and pinion 217 supports the minute hand. An hour wheel 219 is mounted below the main plate and supports the hour hand. The hands are located below the dial face plate 224. The dial face plate 224 has two bosses 224a (Figure 12) on its back side which are interference fits in holes 203q. The bosses are gripped by the

strip springs 203r which are able to give way because of the holes 203p. The quartz crystal unit 221 is fixed to the coil lead substrate 211 so that it is connected to the battery and to the electronic circuitry. The stem 222 (Figure 15) has grooves 222b to be engaged alternately by detent spring 203b to position the stem at two alternative steps. The stem 222 also has a pinion 222a which is engaged with a crown gear 218a of the first wheel and pinion, when the stem 222 is taken out one step.
The stator 209 is horizontally positioned on the flanges of burred portions 203i and 203j. The MOS-IC chip 202 is mounted on coil lead substrate 211 and is pressed by four springs 207a (Figure 13) on circuit pressing plate 207. With this pressure conductors on the body 220a of MOS-IC chip 220 are electrically connected with conductors forming the pattern on coil lead substrate 211. The pressure of these springs 207a also helps the magnetic connection between the magnetic core 210 of coil block and the stator 209. This magnetic connection between the stator 209 and magnetic core 210 is further assisted by the pressure of spring 207b formed in the circuit pressing plate 207.

Rotor 213 (Figure 11) is rotatably supported in a lower pivot hole 203n in the main plate 203 and in an upper pivot hole in the gear train bridge 206. The fifth wheel and pinion 214 is rotatably supported on a lower pivot boss 209a, and in an upper pivot hole in the gear train bridge 206. The second or central wheel and pinion 217 is rotatably supported in the hole with the flange 203h in the main plate 203 and on the spindle of the fourth wheel and pinion 215. The spindle of the fourth wheel and pinion 215 is rotatably supported in an upper pivot hole in the gear train bridge 206, and in the central hole in the wheel and pinion 217. The third wheel and pinion 216 is rotatably supported in an upper pivot boss on a bridge cut and pressed out of the gear train bridge 206, and in a lower pivot hole 203m in the main plate 203. The looseness is determined by engagement of a downturned edge portion of the gear train bridge 206 with one part of magnetic core 209 (Figure 11). Quartz crystal unit 221 (Figure 15) is located and supported by the edges of hole 203u in the main plate, with one part of hole 203u formed by half-blanking. The crystal unit 221 is pressed down by tongue springs formed in the circuit pressing plate 207.

Gear train bridge 206 has an apertured and downturned edge portion (Figure 12) positioned by boss 203w in the main plate 203. The boss 203w is formed by pressure from the rear side of the main plate 203. The gear train bridge 206 also has recessed portions 206a (Figure 14), 206b (Figure 12), 206c (Figure 11) and 206d (Figure 15) to receive overhanging portions of the circuit pressing plate 207, by which bridge 206 is pressed towards main plate 203. An extension 211a of coil lead substrate 211 lies under battery 208 (Figure 14) and is pressed into electrical contact with the cathode by the underlying spring 203c. The extension 211a leads to the VSS electrode of MOS-IC chip 220. Insulating plate 212 is provided between extension 211a and spring 203c in order to prevent short-circuiting. The anode of battery 208 is resiliently engaged by positive terminals 207c which are formed integrally with circuit pressing plate 207. Thus power can be supplied to the circuitry.

Besides the pressing springs 207a (Figure 13), 207b, crystal unit springs (Figure 15) and positive terminals 207c (Figure 14), the circuit pressing plate 207 has three tongue springs 207d (Figures 10 and 12) outwardly directed for directly contacting a back cover 223 of the case and seven pairs of hooks 207e (Figure 15) to engage the five tie bars 204 and two plane projections 203z (Figure 8) of the main plate 203 and thus to hold the parts together. These hooks 207e provide limitation of relative movement at the external circumference. Inside that circumference, the circuit pressing plate 207 is resiliently affected by the IC chip pressing springs 207a, the core pressing spring 207b and the crystal unit pressing springs. Accordingly, at two positions in main plate 203 (Figure 8), hooks 203ℓ are struck up and engaged in notches 207f (Figure 15) in the circuit pressing plate 207 to limit the effect of the springs. The ends of the hooks 203b are twisted during assembly to engage the body of the plate 207.

Stem 222 (Figure 15) is supported in a hole in bent portion 203a and in a hole in bent portion 203k. The spring 203b enters into one or other of two grooves 222b, between which is a sloping sided land.

Spring 203b (Figure 9(b)) is initially distorted so that it presses stem 222 (Figure 15) up. When the stem 222 is to be taken out by one step to rotate the hands, spring 203b is pressed down by the slope of the land between grooves 222b, and enters the other groove 222b. Then pinion 222a of the stem 222 is engaged with crown gear 218a of the first wheel and pinion 218, thereby enabling the hands to be rotated by rotation of the stem. For assembly or removal purposes the spring 203b has an upward extension (Figure 9(b)) by which it can be manually depressed out of the path of the stem 222.

Three drawn portions 203v are projections to keep appropriate looseness for the hour wheel 219 (Figure 11) between the main plate 203 and the dial face plate 224. Hour wheel 219 is rotatably supported on the external circumference of burred flange portion 203h.

The tie bars 204 (Figure 11) on the main plate 203 are used to engage the plate to the casing. Tie bars 204 are engaged by part of a casing ring 225 so that the main plate is positioned in the casing ring 225 by the cut surfaces of the tie bars 204 shown by the dotted lines in Figure 8.

Whilst the above description with reference to Figures 8 and 9 relates to the main plate, similar methods of construction can be applied to thin plates, such as the gear train bridge and circuit pressing plate, used in a timepiece. Further, if the number of tie bars is not less than two, there is no problem in sequential processing.

As will be appreciated from the foregoing, the main plate and/or gear train bridge and/or other plates can be processed from thin plate material. Their rigidity is improved by bending portions and forming drawn ridges. Resilient portions forming springs can also be formed in a single body, so that the number of members can be reduced. Because the thin plate material can be press worked (forging, bending, drawing or shearing), the possibilities of mass production are improved and lower cost timepieces can be obtained.

CLAIMS

1. A timepiece including a gear train between two plates, at least one of the plates being formed by plastic working to provide a bearing portion to support rotatably a wheel of the gear train, and at least one of the plates being provided with a resilient tongue spring to effect relative positioning of the two plates.

2. A timepiece as claimed in claim 1, in which the tongue spring engages part of the timepiece external to the plates to position the latter.

3. A timepiece as claimed in claim 2, in which a plurality of such tongue springs engage the external part of the timepiece at spaced positions.

4. A timepiece as claimed in any preceding claim in which a spring or springs engages a component or components of the timepiece between the plates.

5. A timepiece as cliamed in claim 4, in which the component or components is or are pressed to effect an electrical connection.

6. A timepiece as claimed in any preceding claim, in which the plate is formed with a hole to rotatably receive part of the wheel of the gear train.

7. A timepiece as claimed in any preceding claim, in which the plate is formed with a boss to be received by a rotatable part of a wheel.

8. A timepiece as claimed in any preceding claim, in which at least part of the circumferential portion of at least one of the plates is bent out of the plane of the plate.

9. A timepiece as claimed in any preceding claim, in which at least one of the plates has at least two tie bar portions.

10. A timepiece as claimed in claim 9, in which the tie bar portions engage with a case or casing ring for the timepiece.

11. A timepiece as claimed in any preceding claim, in which at least one plate has at least one flat portion in which a ridge is formed for stiffening.

12. A timepiece as claimed in any preceding claim, in which both plates have bearing portions for rotatable support of wheels of the gear train, one plate also has resilient tongue springs to engage a rear casing part of the timepiece, the other plate has forward projections to engage a dial face plate of the timepiece, and the rear casing part and the dial face plate are connected, so that the two plates and the components they carry are pressed away from the rear casing part against the dial face plate.

13. A timepiece as claimed in any preceding claim, in which portions of at least one plate are bent from the plane of the plate to engage the other plate to determine the spacing therebetween.

14. A timepiece as claimed in any preceding claim in which one of said plates comprises a plurality of bent portions provided on the circumferential portion thereof by plastic working, and a plurality of flat portions between the bent portions.

15. A timepiece as claimed in any preceding claim in which the circumferential portion of the bearing portion is formed by half-blanking, drawing or bending, to provide a positioning portion for the wheel in the thrust direction.

16. A timepiece substantially as hereinbefore particularly described with reference to the accompanying drawings.

REGISTER ENTRY FOR GB2208018

Form 1 Application No GB8817226.7 filing date 20.07.1988

Priorities claimed:
21.07.1987 in Japan - doc: 62181341
09.12.1987 in Japan - doc: 62187315U

Title TIMEPIECE

Applicant/Proprietor
SEIKO EPSON CORPORATION, Incorporated in Japan, 4-1 Nishishinjuku 2-chome, Shinjuku-ku, Tokyo, Japan [ADP No. 00712323001]

Inventor
TOSHIMASA IKEGAMI, 3-5 Owa 3-chome, Suwa-shi, Nagano-ken, Japan [ADP No. 00197384001]

Classified to
G3T
G04C G04B

Address for Service
J MILLER & CO, Lincoln House, 296-302 High Holborn, LONDON, WC1V 7JH, United Kingdom [ADP No. 00001149001]

Publication No GB2208018 dated 15.02.1989

Examination requested 20.07.1988

Patent Granted with effect from 07.08.1991 (Section 25(1)) with title TIMEPIECE

11.11.1993 Notification of change of Address For Service address of J MILLER & CO, Lincoln House, 296-302 High Holborn, LONDON, WC1V 7JH, United Kingdom [ADP No. 00001149001]
to
J MILLER & CO, 34 Bedford Row, Holborn, LONDON, WC1R 4JH, United Kingdom [ADP No. 00001149002]
dated 11.11.1993. Written notification filed on GB2249723
Entry Type 7.3 Staff ID. AW Auth ID. AA

**** END OF REGISTER ENTRY ****

RENEWAL DETAILS

PUBLICATION NUMBER GB2208018

PROPRIETOR(S)

Seiko Epson Corporation, Incorporated in Japan, 4-1 Nishishinjuku
2-chome, Shinjuku-ku, Tokyo, Japan

DATE FILED	20.07.1988
DATE GRANTED	07.08.1991
DATE NEXT RENEWAL DUE	20.07.1994
DATE NOT IN FORCE	
DATE OF LAST RENEWAL	12.07.1993
YEAR OF LAST RENEWAL	06
STATUS	PATENT IN FORCE