United States Patent

[11] 3,590,574

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[33] **Germany**
[31] **G 68 01 998 and P 18 10 596.9**

[54] **DRIVING DEVICE ON METRONOMES**
19 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** 58/130, 58/87
[51] **Int. Cl.** G04f 11/02, G04b 1/14, G04b 1/18
[50] **Field of Search** ..... 84/484; 58/130 A, 130 C, 130 E, 86, 87

[56] **References Cited**

UNITED STATES PATENTS

381,176	4/1888	Sedgwick	58/87
596,395	12/1897	Corthell	58/87
1,643,403	9/1927	Borresen	58/87
2,737,011	3/1956	Wittner	58/130
3,386,327	6/1968	Franz	58/130 X

FOREIGN PATENTS

344,891	4/1960	Switzerland	58/130

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ABSTRACT: A metronome may have most of the elements of the driving means formed of integrally molded plastic parts, such as the balance wheel and shaft, and the bell wheels may have teeth which are reinforced by semicylindrical working faces and are provided with interlocking hubs.

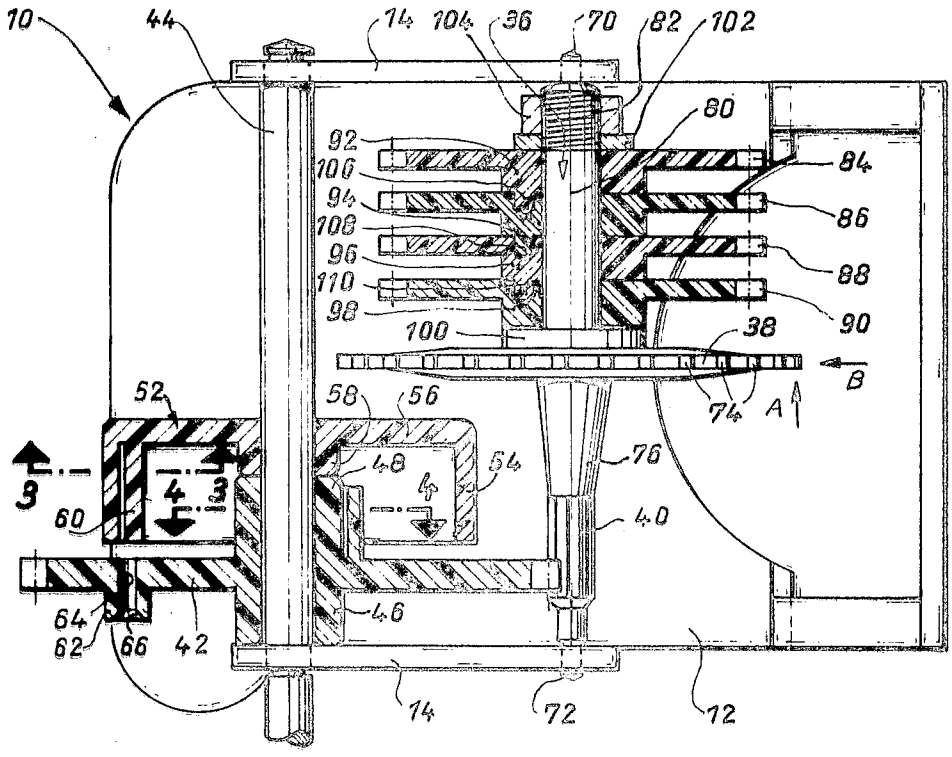

Fig. 1

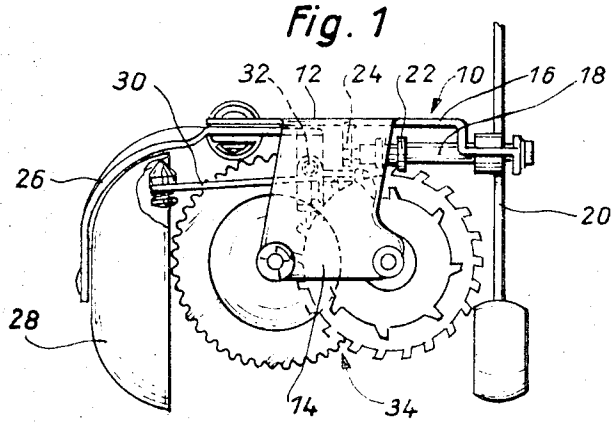
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Fig. 2

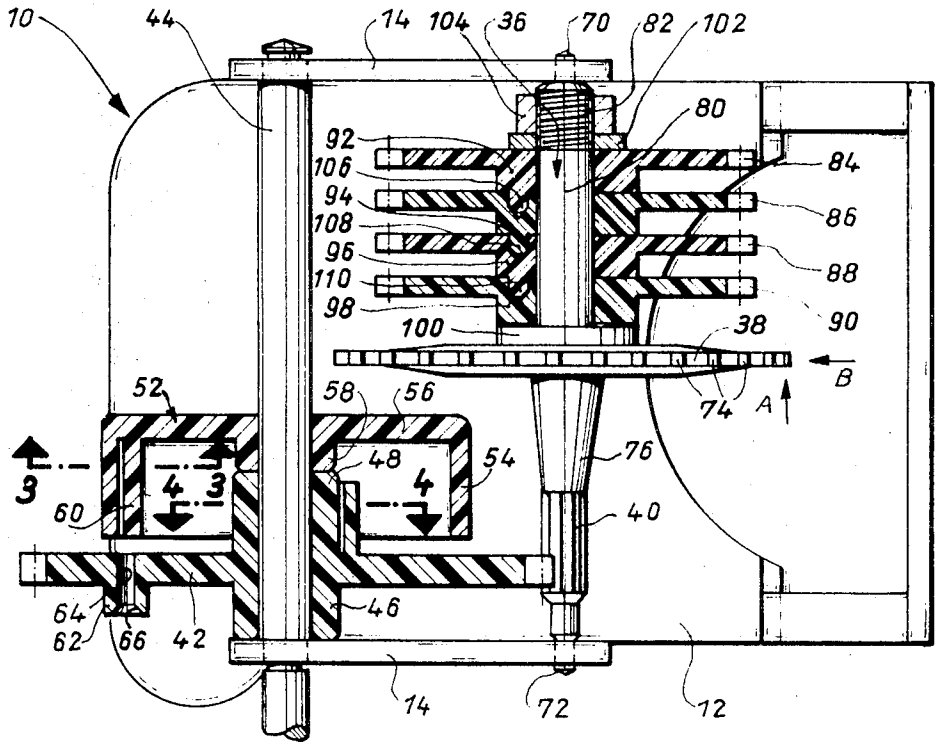
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Fig. 3

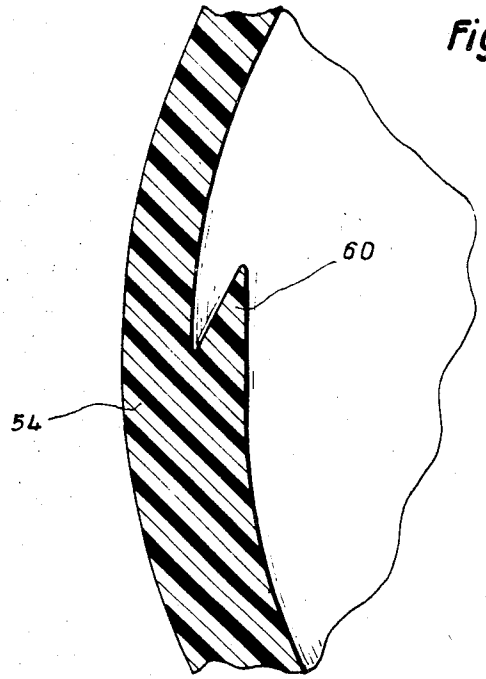


Fig. 4

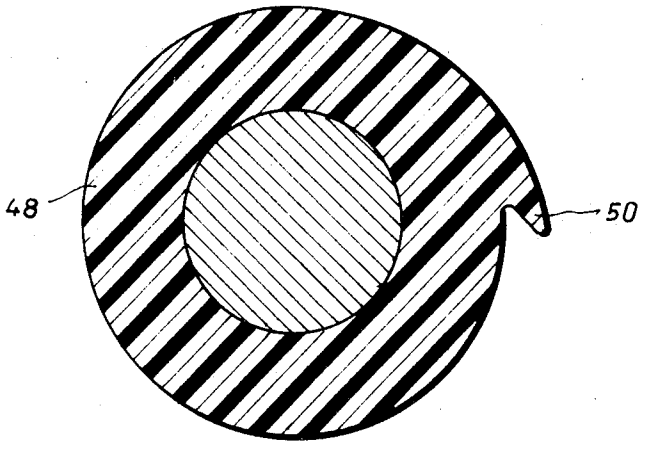


Fig. 5

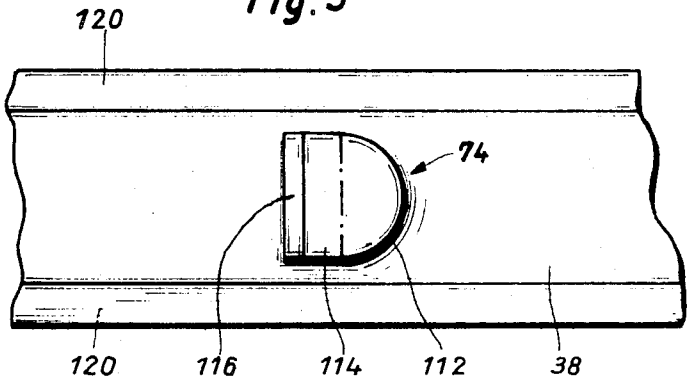


Fig. 6

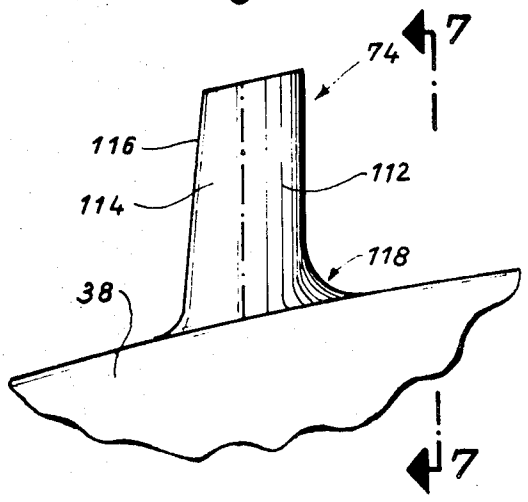
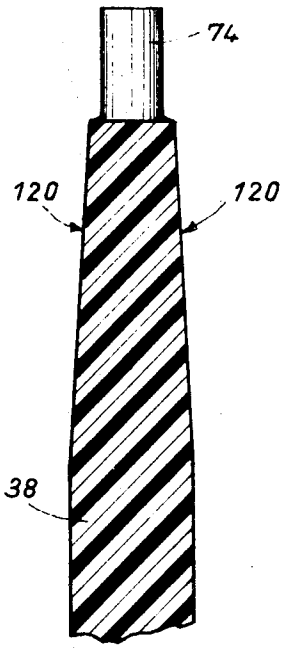


Fig. 7



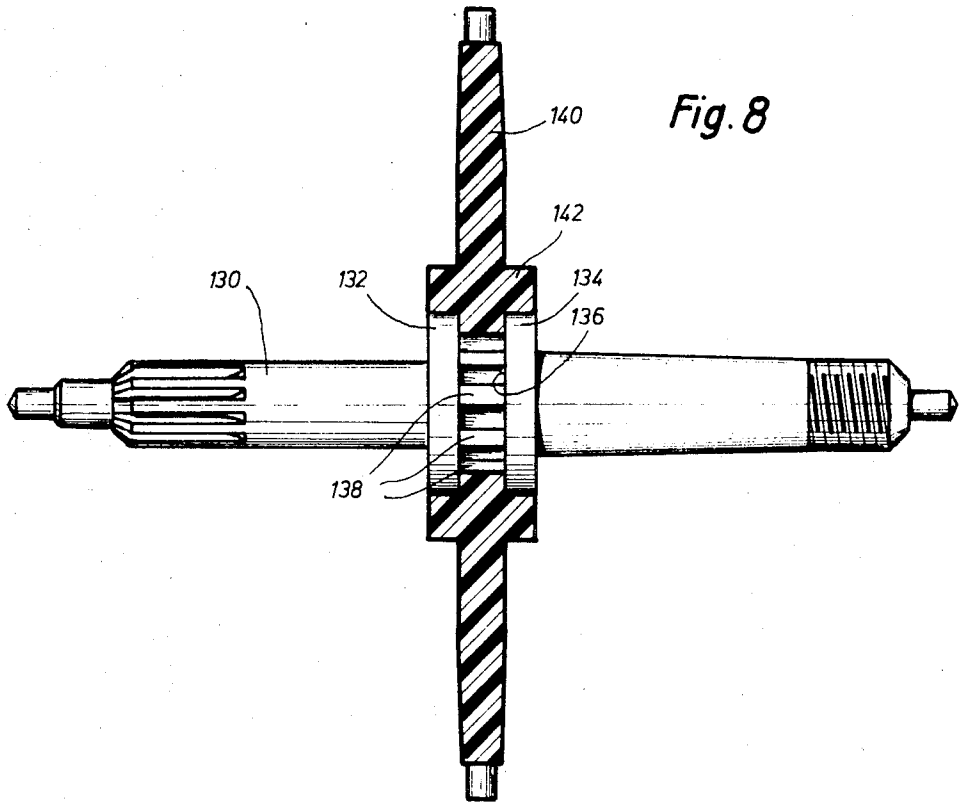


Fig. 8

DRIVING DEVICE ON METRONOMES

The invention concerns a driving device for metronomes, with a shaft on which a spring barrel is mounted which contains a driving spring. One end of this spring is fastened to the inside of the spring barrel and the other end on the hub of a spring barrel wheel which is mounted on and turns on the spring barrel shaft, and with a balance wheel coordinated with an anchor. The balance wheel is firmly mounted on a balance wheel shaft. On a part of this shaft a set of bell wheels is firmly mounted.

In driving devices of this kind the spring barrel is usually made of sheet metal and has to be mounted on a spring barrel shaft which is fastened in a frame of the metronome. Inside this spring barrel a spirally wound driving spring is provided of which one end is fastened to the inside of the spring barrel and the other end is firmly attached to a spring barrel wheel which is also made of metal. The balance wheel, on the other hand, is produced from a brass blank and then fastened correspondingly on the balance wheel shaft. The manufacture of these parts, particularly the spring barrel wheel and the balance wheel, which are cog wheels, is, accordingly, expensive and awkward, and the teeth of the balance wheel wear out rather soon. Besides, it is difficult to provide the proper fastening devices on the spring barrel in order to hook on, securely, the ends of the driving spring.

It is the aim of the present invention to shape the spring-barrel wheel and spring barrel as well as, at least, the balance wheel so that they can be manufactured in a simple way, that both wheels show minimum wear and that the balance wheel and the balance wheel shaft can be firmly connected, without taking additional steps, so that they are interlocked against turning and sliding.

According to the invention this is effected in such a way that the spring barrel and the spring barrel wheel, and of the other wheels at least the balance wheel, are made of one piece of plastic material such as acetal resin. This results in an extraordinarily simple way of manufacture because these parts can receive their final shape without any further finishing, such as by injection molding. Machining of the teeth of the balance wheel and spring barrel wheel is no longer necessary, due to the extreme exactness of this type of fabrication. Besides, the acetal resin produces a surface which is extremely abrasion resistant so that the wear on these wheels is reduced to a minimum, in any case to such an extent that in the course of the usual life span of a metronome the abrasion has no effect on the functioning of the metronome. In addition to the minimal abrasion which, by the way, is less than in brass, this shape, in accordance with the invention, is of particular advantage for the balance wheel and the spring barrel wheel because the friction coefficient is also less than in the case of brass, which has a favorable effect on the functioning of these wheels and on the bearings of the balance wheel shaft.

As far as the acetal resin is concerned, this is a polyoxmethylene polymer which is marketed by several firms. For instance, Farbwerke Hoechst, A.G., vormals Meister, Lueius & Brueneing, 6 Frankfurt/Main-Hoechst, are marketing an acetal resin under the trademark "Hostaform" and DuPont de Nemours, Wilmington, Delaware, U.S.A., are distributing another suitable acetal product under the trademark "Delrin."

Considering the new material and the possibility of molding it, it is now possible, without difficulty, to position a hook on the inner circumference of the spring barrel, the hook and spring barrel being in one piece, on which the one end of the driving spring may be hooked. This hook also can be made in a simple way in its final shape so that no further reshaping is necessary.

It is furthermore of advantage if the spring barrel wheel has a one-piece hub pivot jutting out inside the spring barrel provided with an integrally formed hook to which the other end of the driving spring may be hooked. This hub pivot and the hook positioned on it can also be manufactured in their final shape without further reshaping.

On the spring barrel itself, in order to improve its fastening on the spring barrel shaft, a hub may be formed, either on the outside and/or inside of the frontal wall. This would also be integral with the spring barrel.

Due to the new manufacturing process of the above mentioned parts of a driving device it is possible, for the spring barrel wheel and balance wheel, to form their teeth without considering the necessity for milling them. In this connection, on the balance wheel, the previously fully cylindrical teeth can be replaced by teeth which are formed as half-cylinders on the side acting together with the anchor in the sense of rotation, and as a rectangular block on the side opposite to the sense of rotation. The advantages of the new shape are a higher stability, and, rather surprisingly, a greater impact strength of the teeth, possibly caused by the higher stability. Due to the lessened friction it is also possible to have the balance wheel run at a lower beat per minute. While up to now 40 beats per minute represented an absolute minimum, it is now possible to reduce the number of beats to 20 per minute. It is of particular advantage that, due to the greater running accuracy a more consistent beat is obtained.

In order to improve the stability of the teeth it is of advantage if the rectangular cross section of the block increases radially toward the foot of the tooth and if the foot of the tooth is reinforced, preferably on the half-cylinder.

The balance wheel and the balance wheel shaft can be manufactured according to further aspect of the invention in one piece out of plastic material, such as acetal resin. This construction assures a minimum of abrasion of the balance wheel shaft in its bearings.

The balance wheel shaft may also be made of metal, particularly of steel. In this case a favorable way of construction is obtained if on the balance wheel shaft, in order to receive the balance wheel, a circumferential groove is provided, the base of the groove being milled, or splined so that the position of the molded-on balance wheel is secure against turning.

Because of the small cross section usually exhibited by balance-wheel shafts it is recommended here to form the groove by providing two flanges axially spaced from each other and formed upon the shaft circumference where the balance wheel with its hub part, is to be positioned. The bell wheels may be made of any suitable material, also, as heretofore, of metal. However, it is of advantage if also the bell wheels which are positioned on the shaft extension of the balance wheel shaft, each together with a circular hub extension, are made of plastic material, in this case acetal resin. Here also result particular advantages in view of the high stability, low abrasion, and lower friction because of a lower friction coefficient, so that the life of the bell wheels is lengthened.

When fastening the bell wheels on the shaft extension it is of advantage if this is partially tapered and that its cross section diminished toward the end of the shaft which is opposite to the balance wheel; onto this piece the bell wheels are firmly attached, preferably by a pressure fit.

For further improved fastening of the bell wheels it may be of advantage if they are pressed against the balance wheel by a nut screw on the balance wheel shaft. It is of additional advantage if the bell wheels engage in the sense of rotation so that their relative position is assured. This latter design is advantageously formed so that the hub extensions of those bell wheels which are contiguous to another bell wheel have at least one protruding pin which interlocks in a corresponding hole of the neighboring bell wheel hub.

Further advantages and characteristics of the invention can be seen from the description here below in connection with the drawing which contains an illustrative example of the invention. In the drawings:

FIG. 1 is a side view of a driving device according to the invention;

FIG. 2 is a plan view from below of the device shown in FIG. 1 where only the driving parts proper, are shown, and the spring barrel and the appertaining spring barrel wheel are shown in cross section;

FIG. 3 is a fragmentary cross section on Line 3–3 of FIG. 2;

FIG. 4 is a fragmentary cross section on Line 4–4 of FIG. 2;

FIG. 5 is a fragmentary view in the direction of FIG. 2;

FIG. 6 is a fragmentary in the direction of arrow B of FIG. 2;

FIG. 7 is a cross section on line 7–7 of FIG. 6, in reduced scale, and;

FIG. 8 is a metal balance wheel shaft with a balance wheel formed on it, in acetal resin, shown in longitudinal section and greatly enlarged.

In the example of the invention shown in FIGS. 1 and 2 a frame fastened inside a metronome housing (which is not shown) is marked 10, with bottom 12, supporting wings 14 and a bridge 16.

In the bridge is the bearing of one end of an anchor shaft 18 which carries a pendulum 20. The other end of the anchor shaft, carrying an anchor 22 is turning in an extension 24 of the frame 10. Furthermore, in FIG. 1 an arm 26 is shown carrying a bell 28 which works in connection with a hammer 30. The hammer 30 is attached in swivel position at 32 to the frame 10 and is activated by means of the bell wheels 34.

The bell wheels are mounted on a balance wheel shaft 36 which is rotatably mounted in the supporting wings. The balance wheel shaft 36 carries a balance wheel 38, which works in connection with anchor 22, and, also, on its lower end (FIG. 2) carries a pinion 40.

The pinion 40 engages with a spring barrel wheel 42 which is positioned on a fixed spring barrel shaft 44 so that it can rotate. The spring barrel wheel 42 has hub extensions 46 and 48 on each side. The latter is provided with a hook 50, clearly visible in FIG. 4, the purpose of which will be explained later on.

On the spring barrel shaft 44 is also fastened a spring barrel which has a housing 54 and a frontal wall 56. In order to give a better hold to the spring barrel the inside of the frontal wall 56 carries a hub extension 58. On the inner circumference of the housing 54 a hook 60 is positioned which is clearly visible in FIG. 3 and is formed integrally with the spring barrel.

The two hooks 50 and 60 provide connections for the two ends of a spiral driving spring (not shown) which serves to drive the metronome.

The spring barrel as well as the spring barrel wheel are each made in one piece with their hubs and hooks, out of acetal resin. On the front side opposite to the spring barrel 52 the spring barrel wheel 42 has, spaced radially away from the axle, a cam 62 (formed integrally with the wheel) which also has a bore 64 which penetrates the spring barrel wheel. This bore 64 includes a countersink on the side of the cam at 66. The bore will receive the shaft of a star wheel which is not shown in the drawing. In this way an accurate positioning with an exceptionally low bearing friction are obtained.

In both supporting wings 14 the balance wheel shaft 36 is supported by pivots 70 and 72. Formed in one piece with the balance wheel shaft 36 is the balance wheel 38, with teeth 74, both being made of acetal resin. The balance wheel shaft, as shown in FIG. 2, has an upper and a lower shaft part. The lower shaft part has a tapered piece 76 and the pinion 40 which meshes with the spring barrel 42. The upper shaft part also has a tapered part 80 which, according to FIG. 2, tapers only slightly toward the upper end and has also a threaded portion 82.

Upon the tapered portion 80 four bell wheels made of acetal resin 84, 86, 88, and 90 are attached, each having an integral circular hub extension 92, 94, 96 and 98. The hub extensions 92, 94, 96 immediately adjoin the neighboring bell wheel while the hub extension 98 of the bell wheel 90 immediately adjoins a hub extension 100 of the balanced wheel. The bell wheels may be positioned by pressure fit on the balance wheel shaft 36 and are furthermore held in position by a nut 104 which is screwed on the threaded piece 82 over a flat washer 102 so that the bell wheels are pressed against the balance wheel.

The three hub extensions 92, 94 and 96 each have an integral pin 106, 108, and 110 which engages in the respective holes of the hub of the neighboring bell wheel. In FIG. 5 and 6 the shape of the balance wheel teeth 74 is shown in detail. It follows that, while the balance wheel teeth are a single unit, they consist each of a half-cylinder 112 and a rectangular block which are in both figures separated by a dotted line. It also follows clearly from the Figures that the cross section of the block increases steadily toward the foot of the tooth so that the rear surface 116 of the balance wheel tooth is inclined toward the radial direction. The half-cylinder of the balance wheel tooth 74 is at the foot of the tooth, at 118, reinforced. Both provisions serve to improve the durability of the teeth.

FIG. 5 and 7 show further that at 120 the balance wheel 38, beginning at the teeth 74, is reinforced obliquely, so that greater stability and running trueness—compared with the known metal balance wheels—are obtained.

FIG. 8 shows a balance wheel shaft 130 made of metal. In its, approximately, middle part it has two flanges 132 and 134 shaped onto its outside circumference in axially spaced relation which leaves an annular groove 136. The bottom of this groove is splined to provide ridges 138 which lie parallel to the axis of the shaft.

Onto this balance wheel shaft a balance wheel 140 made of acetal resin is molded and is held secure against turning in the circumferential groove 136. The hub 142 preferably overhangs the circumference of the two flanges 132 and 134.

I claim:

1. In driving devices for metronomes, the combination including a spring barrel fixedly mounted on a base and provided with hook means for connection with one end of a driving spring, a spring barrel wheel concentrically and rotatably mounted with respect to the spring barrel and being provided with hook means for connection with the other end of a driving spring, a balance wheel shaft means rotatably mounted on the base in driven engagement with the spring barrel wheel, said balance wheel shaft means including a balance wheel fixedly secured to a shaft in operative engagement with an anchor means and a plurality of bell wheels fixed on said shaft, at least one of said elements including the balance wheel being formed of a single piece of plastic material.

2. The invention defined in claim 1, wherein said plastic material is an acetal resin.

3. The invention defined in claim 1, wherein said spring barrel is a generally cup-shaped element formed of plastic material, the inner periphery of said cup-shaped element having said hook means integrally formed therewith.

4. The invention defined in claim 1, wherein said spring barrel wheel is formed of plastic material and includes a central integrally formed hub means provided with said hook means integrally formed therewith of plastic material.

5. The invention defined in claim 4, wherein said spring barrel wheel is generally disc-shaped and includes a elongated integrally formed cam means spaced from the central axis, said cam means being provided with a bore adapted to support a shaft.

6. The invention defined in claim 3, wherein said cup-shaped element includes an integrally formed central hub means projecting in an axial direction.

7. The invention defined in claim 1, wherein said balance wheel includes a plurality of radially projecting teeth, said teeth having a generally semicylindrical surface configuration on the side facing the direction of rotation, the other side of said teeth having a generally flat surface.

8. The invention defined in claim 7, wherein the cross-sectional area of said teeth increases towards the base of the teeth where they join the periphery of the balance wheel.

9. The invention defined in claim 7, wherein said balance wheel comprises a solid generally disc-shaped body having an axial thickness which increases in a radially inward direction.

10. The invention defined in claim 1, wherein said balance wheel and balance wheel shaft are integrally formed in a single piece of plastic material.

11. The invention defined in claim 10, wherein said plastic material comprises an acetal resin.

12. The invention defined in claim 1, wherein said balance wheel shaft includes an elongated piece of metal having a plu-

rality of medially located splines, and a radially extending disc-shaped portion of plastic material intimately engaged with said splines.

13. The invention defined in claim 12, wherein said elongated piece of metal includes two longitudinally spaced radial flanges associated with said medially located splines for intimate engagement with said disc-shaped plastic portion.

14. The invention defined in claim 1, wherein said bell wheels comprise generally disc-shaped bodies of plastic material having an integrally formed hub portion extending axially from one side thereof.

15. The invention defined in claim 14, wherein said plastic material is an acetal resin.

16. The invention defined in claim 14, wherein that portion of the balance wheel shaft extending from one side of the balance wheel includes a conically tapered portion, and said bell wheels are press-fitted on said tapered portion.

17. The invention defined in claim 16, wherein the narrower end of said tapered portion of the balance wheel shaft includes a threaded portion, and a locking nut for said bell wheels.

18. The invention defined in claim 14, wherein said bell wheels are arranged in interlocking engagement with one another.

19. The invention defined in claim 18, wherein said bell wheels include a projection extending axially from one side of the hub portion, and a recess provided on the opposite side of the hub portion to receive the projection on an adjacent hub portion.