Feb. 4, 1969 C. D. VERDE 3,425,212

QUIET CLOCKWORK ESCAPEMENT

Filed May 12, 1967 Sheet 1 of 2

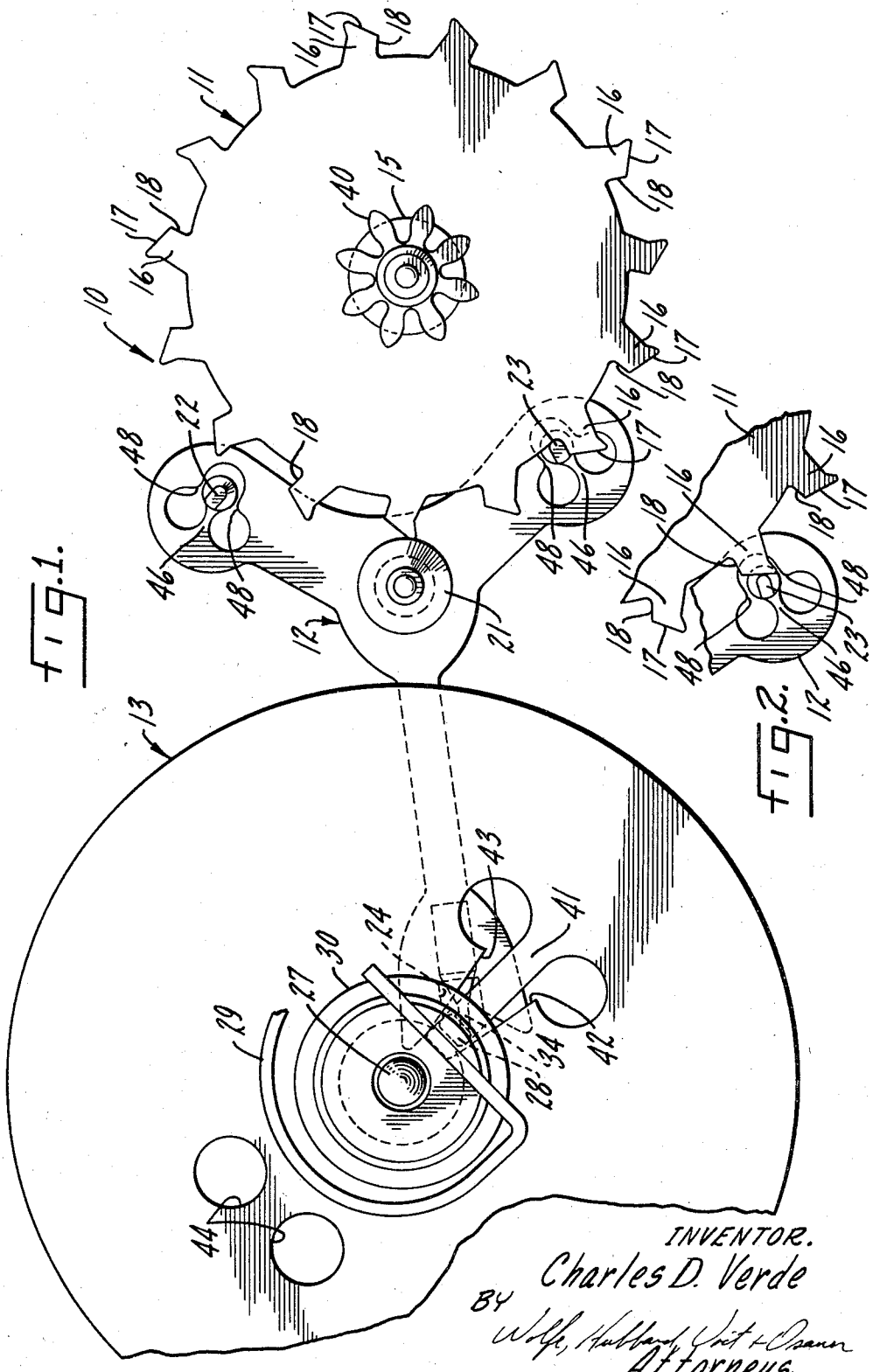


Fig. 1.

Fig. 2.

INVENTOR.
Charles D. Verde
BY
Wolfe, Hubbard, Voit & Osann
Attorneys.

Feb. 4, 1969 C. D. VERDE 3,425,212

QUIET CLOCKWORK ESCAPEMENT

Filed May 12, 1967 Sheet 2 of 2

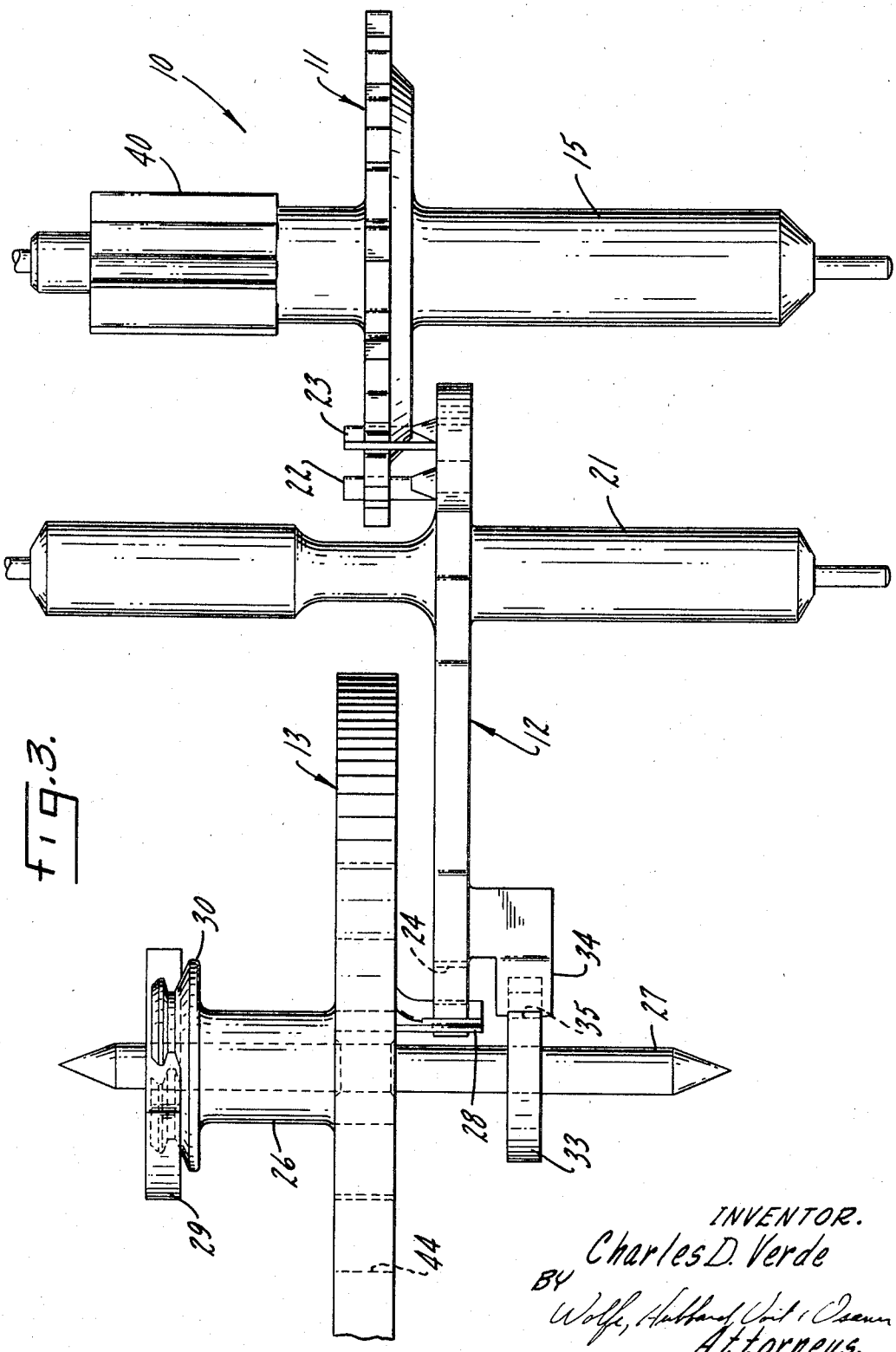


Fig. 3.

INVENTOR.
Charles D. Verde
BY
Wolfe, Hubbard, Voit & Osann
Attorneys.

United States Patent Office

3,425,212

Patented Feb. 4, 1969

3,425,212

QUIET CLOCKWORK ESCAPEMENT

Charles D. Verde, Clifton, N.J., assignor to General Time Corporation, Stamford, Conn., a corporation of Delaware

Filed May 12, 1967, Ser. No. 638,135

U.S. Cl. 58—116 7 Claims

Int. Cl. G04b *15/14*

ABSTRACT OF THE DISCLOSURE

A clockwork escapement assembly suitable for one-piece molding of the major parts in which resilience is embodied at the points of impact, both at the pallet and the impulse pins, with the direction and extent of the resilience being controlled to minimize the loss of torque to the balance wheel.

Description of the invention

This invention relates generally to clockwork escapement assemblies and more particularly concerns an escapement in which the major assemblies can be integrally molded and formed with built-in resilience to cushion the impacts that generate tick-tock noise.

It has been recognized that less tick-tock noise will be generated by an escapement if the impacts resulting from driving the balance wheel and intermittently locking the escape wheel are cushioned by providing resilience in the inter-engaging parts. Such impacts occur when an escape wheel tooth locks against a pallet pin, and when the pallet lever fork impulses the balance wheel. Resilience in the force transmitting parts tends to extend the instant of impact so that there is a less sharp or intense collision. Also, the resilience tends to dissipate a portion of the impact energy as internal friction. As a result, less energy is transmitted from the points of impact to the frame plates, case or other large-surface portion of the clock or timer which serves as the sound radiator that generates the air-borne tick noise which can be heard.

While resilience will quiet an escapement, it also tends to reduce the amount of energy being transmitted through to the time-rate controlling balance wheel and, as a result, an undesirable drop in balance wheel motion can occur. The amount of distortion permitted by resilience in the escapement must also be controlled since escapements are often called upon to regulate great variations in torque as occur, for example, when a long-running mainspring goes from fully wound to almost run-down.

It is the aim of this invention to provide controlled and directed resilience in an escapement to obtain tick-tock quieting without appreciably affecting force transmission to the balance wheel. A collateral object is to provide an escapement of the above kind which can function effectively under varying torque loadings.

Another object is to provide an escapement of the type characterized above which can be economically manufactured in that major assemblies are adapted to be molded in one piece of inexpensive plastic material.

Other objects and advantages of the invention will be apparent upon reading the following detailed description and upon reference to the drawings, in which:

FIGURE 1 is a plan view of a clockwork escapement embodying the invention;

FIG. 2 is a fragmentary portion of the FIG. 1 elevation showing the parts in a different operating position; and

FIG. 3 is a side elevation of the escapement shown in FIG. 1.

While the invention will be described in connection with a preferred embodiment, it will be understood that various modes of carrying out the invention will be readily apparent to those skilled in the art without departing from the spirit of the invention.

Turning now to the drawings, there is shown an escapement assembly **10** embodying the invention and including an escape wheel **11**, a pallet pin lever **12** and a balance wheel **13**. The escape wheel **11** is mounted on a rotatable shaft portion **15** and has a plurality of teeth **16** each with an inclined impulse face **17** and a substantially radial locking face **18**. The pallet lever **12** is on an oscillating shaft portion **21** and at one end carries a pair of pallet pins **22** and **23** which cooperate with the escape wheel teeth **16**, and at the opposite end is formed with a fork portion **24**. The balance wheel **13** includes a hub portion **26** which is secured to a shaft **27** and the balance wheel carries an impulse pin **28** which cooperates with the lever fork portion **24**. A hairspring **29** having its outer end anchored is locked at its inner end in a slotted collar **30** formed on the hub portion **26**.

As will be apparent to those familiar with this art, when the balance wheel **13** swings counterclockwise from the position illustrated under the force of the hairspring **29**, the impulse pin **28** enters the lever fork portion **24** and swings the lever **12** clockwise so as to lift the pallet pin **23** from the locking face **18** of the adjacent tooth **16** while, at the same time, shifting the pallet pin **22** toward the path of the next escape wheel tooth. The escape wheel **11** is thus released and mainspring power drives the escape wheel clockwise. The escape wheel moves clockwise as soon as the pin **23** clears the locking face of the adjacent tooth, and hence the impulse face **17** of that tooth strikes the pin **23** (the position shown in FIG. 2) to impart a clockwise torque on the pallet pin lever **12**. This energy is transmitted from the fork portion **24** of the lever **12** in the form of a sharp blow delivered to the impulse pin **28** that tends to drive the balance wheel **13** counterclockwise. The driving energy imparted to the balance wheel is gradually absorbed by the hairspring **29** as the balance wheel makes its full, counterclockwise swing, and the tensioned hairspring then drives the balance wheel clockwise.

In the meantime, as soon as the pin **23** clears the adjacent tooth impulse face **18**, the escape wheel **11** is completely freed and the full power of the mainspring drives the wheel clockwise until the pin **22** is struck by the locking face **18** of the next tooth. The escapement remains locked until the balance wheel **13** returns in its clockwise swing and the impulse pin **28** swings the lever **12** counterclockwise. This unlocks the escape wheel **11**, impulses the balance wheel clockwise, and returns the parts to their FIG. 1 positions.

As can be seen in FIG. 1 and as will be appreciated by those skilled in this art, the locking faces **18** of the escape wheel teeth **16** are somewhat undercut rather than being truly radial. Thus, the lever **12** is banked by engagement of a pallet pin with the cylindrical root portion of the escape wheel **11** and is held locked by the undercut locking face **18** of the adjacent tooth that is

pressed against the pin under mainspring force. For shock protection, a safety roller **33** is mounted on the balance wheel shaft **27** in position to cooperate with a guard finger **34** at the forked end of the lever **12**. The roller **33** has a peripheral slot **35** alined with the impulse pin **28**, and the finger **34** is alined with the fork portion **24**. When the pin **28** enters the fork portion **24**, the finger **34** also freely enters the slot **35**. Thus, if a jar dislodges a pallet pin from a locking face **18** while the pin **28** is free of the fork portion **24**, the guard finger **34** will engage the periphery of the safety roller **33** and prevent overbanking.

In carrying out the invention, the major units of the escapement **10** are molded of resilient plastic material, preferably as integral parts. The escape wheel **11** and its shaft portion **15** are formed integrally, and an enlarged portion of the shaft **15** is shaped to define a pinion gear **40** which couples the escape wheel **11** to the timing train and the mainspring force. The lever **12**, pallet pins **22** and **23**, fork portion **24** and guard finger **34** are all preferably molded integrally. The balance wheel **13**, impulse pin **28** and hairspring collar **30** are formed integrally of resilient plastic, and, in the illustrated construction, the shaft **27** on which the balance wheel assembly is mounted, is formed of steel which constitutes a better bearing material and hence facilitates accurately-timed oscillations of the balance wheel.

In accordance with the invention, the pallet pins **22**, **23** and the impulse pin **28** are supported through narrowed- or necked-down pin support portions which give resilience to quiet the escapement, but the resilience is directed and limited so as not to adversely affect the timekeeping functions of the escapement. The impulse pin **28** is formed at the end of a pin support portion **41** lying radially, and in the plane of, the balance wheel **13**. The portion **41** is faired smoothly into the body of the wheel **13** so as to serve as a spring when the fork portion **24** strikes the impulse pin at right angles to the support portion **41** as the balance wheel is driven to wind up the hairspring **29**. The pin end of the support portion **41** is closely sandwiched by a pair of shoulders **42** and **43** on the body of the balance wheel **13** so that flexure of the portion **41** is limited and controlled.

To keep the mass of the balance wheel assembly **13** centered on its shaft **27**, a pair of lightening holes **44** are preferably formed on the opposite sides of the shaft from the impulse pin **28**. The material removed to form the holes **44** about equals that portion of the material emoved to define the impulse pin support portion **41**.

The pallet pins **22**, **23** are supported on narrowed- or necked-down, resilient pin support portions **46** disposed along lines generally parallel to the locking face and generally perpendicular to the impulse face of the escape wheel tooth then acting on the pins. In this way, the portions **46** act as springs giving maximum resilience to the pins **22**, **23** when they are struck by the locking faces **18** of the adjacent teeth **16** (see pin **23** in FIG. 1), whereas the portions **41** afford little resilience to the pins **22**, **23** when the pins are struck by the impulse faces **17** of the adjacent teeth (see FIG. 2). As a result of this arrangement, the locking collision between the locking faces **18** of the teeth **16** and the pallet pins **22**, **23**, which does no useful work and which is the greatest cause of tick-tock noise, is cushioned by the resilience of the pallet pin support portions **46**. However, the force imparted by the impulse faces **18** of the escape wheel teeth on the pallet pins to drive the balance wheel **13** is not dissipated by the appreciable flexure of the pin support portions **46**. Thus, the resilience which helps achieve quieting of the escapement does not also tend to reduce balance wheel motion.

Since the locking faces of escape wheel teeth are somewhat undercut rather than being truly radial, an escape wheel must normally back up slightly to permit the pallet pins to unlock the escapements. In the present case, because of the resilience of the pin support portions **46**, unlocking can be accommodated by flexure of the pin support portions, and thus reverse movement of the escape wheel and the gear train against the force of the mainspring is avoided. It has been found that by avoiding this reverse, unlocking movement of the escape wheel, a smooth, more regular flow of power is obtained which results in better timekeeping accuracy.

In forming the pallet pin lever **12**, the pin support portions **46** and the pallet pins **22**, **23**, pairs of shoulders **48** are disposed to closely embrace the bases of the pallet pins. In this way, the amount of pin flexure is closely controlled and thus the escapement is able to handle varying torque loadings as might be obtained through the unwinding cycle of a mainspring.

It can thus be seen that an escapement has been provided in which there is controlled and directed resilience to obtain tick-tock quieting without appreciably affecting force transmission through the balance wheel. Moreover, the positioning of the shoulders adjacent to the resilience producing supports for the pallet pins and the impulse pin enable the escapement to function effectively under varying torque loadings.

While the resilience of the portions **41** and **46** lessens the factor which creates noise, it is also true that the configuration of the parts acts in other ways to reduce the sound which is eventually heard. First, it can be seen that impact energy, in order to reach the shaft portions and the sound radiating frame plates, must follow curved paths through the necked-down portions **41**, **46** so that the energy is more readily dissipated in internal friction. Second, instead of there being one sharp impact, a multiple impact results from first the pins **23**, **28** being struck and then the adjacent shoulders **42**, **43**, **46** being engaged. The resulting multiple vibrations coming from different points at slightly different instants creates a sort of energy wave impedance that tends to decay the total amount of energy before it reaches the larger, sound radiating portions of the movement in which the escapement is used.

It can also be appreciated that an escapement of this kind can be very economically formed in that the major assemblies can be injection molded in one piece of inexpensive plastic material.

I claim as my invention:

1. An escapement for minimizing the generation of tick-tock noise comprising, in combination, a journalled escape wheel having teeth with substantially radial locking faces and inclined impulse faces, a pallet lever journalled adjacent said escape wheel and having a pair of pallet pins extending at right angles to, and alternatively in the path of, said escape wheel teeth, said pins being connected to said lever by narrowed, resilient pin support portions, and said portions being disposed along a line generally parallel to the locking face and generally perpendicular to the impulse face of the escape wheel tooth then acting on the pins of the respective pin support portions.

2. The combination of claim **1** in which said pin support portions lie in the plane of said lever and the lever is formed with shoulders on either side of said portions so as to limit the flexure thereof.

3. The combination of claim **1** in which said lever, said pins and said pin support portions are formed integrally of resilient material.

4. The combination of claim **1** in which said lever has a forked end, and the combination including a balanced wheel journalled adjacent the forked end of the lever, an impulse pin on said balance wheel extending through said forked end of the lever, said impulse pin being connected to said balance wheel by a resilient pin support portion lying radially, and in the plane of, said balance wheel.

5. The combination of claim **4** in which said balance wheel, said impulse pin and said impulse pin support portion are formed integrally of resilient material.

6. In an escapement assembly including an escapement wheel, pallet pin lever with pallet pins and balance wheel with impulse pin, the improvement comprising, said lever and pallet pins being formed integrally of resilient material, said balance wheel and impulse pin being formed integrally of resilient material, and said pins being repectively mounted through narrowed portions of said material constituting resilient mountings for said pins.

7. The improvement of claim 6 in which said portions are disposed between opposed shoulders formed on the lever and the wheel, respectively, to limit flexure of the portions and resulting movement of the pins.

References Cited

UNITED STATES PATENTS

1,895,666	1/1933	Junghans	58—117
2,099,414	11/1937	Whitehead	58—121
2,274,724	3/1942	McCullough	58—117
2,408,998	10/1946	Rhodes	58—117
2,717,488	9/1955	Linard	58—121
3,137,122	6/1964	Dinerstein et al.	58—116

FOREIGN PATENTS

757,820	1/1934	France.
63,575	9/1955	France.

OTHER REFERENCES

German printed application, 1,233,783.

RICHARD B. WILKINSON, *Primary Examiner.*

S. A. WAL, *Assistant Examiner.*

U.S. Cl. X.R.

74—1.5; 58—121