Nov. 7, 1933. F. FRANZ 1,934,611

ESCAPEMENT

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Fig. 1.

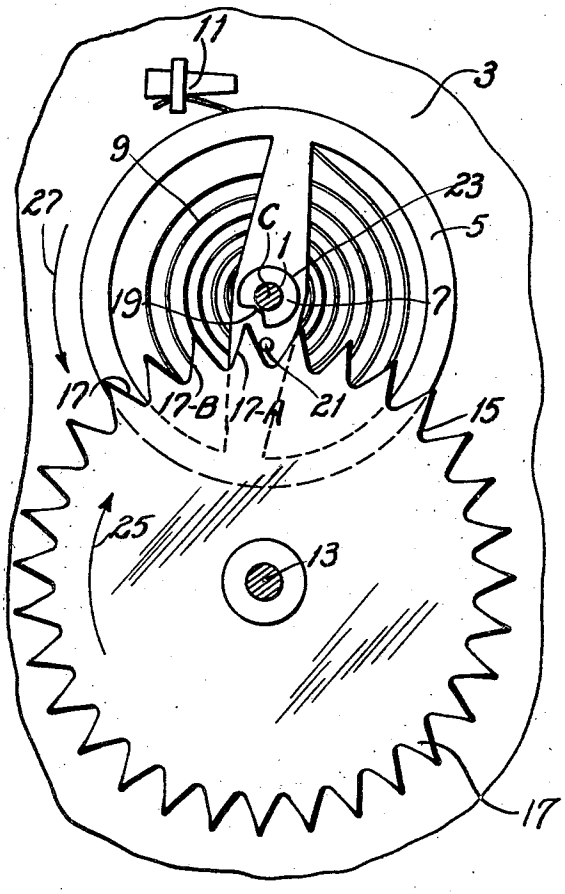
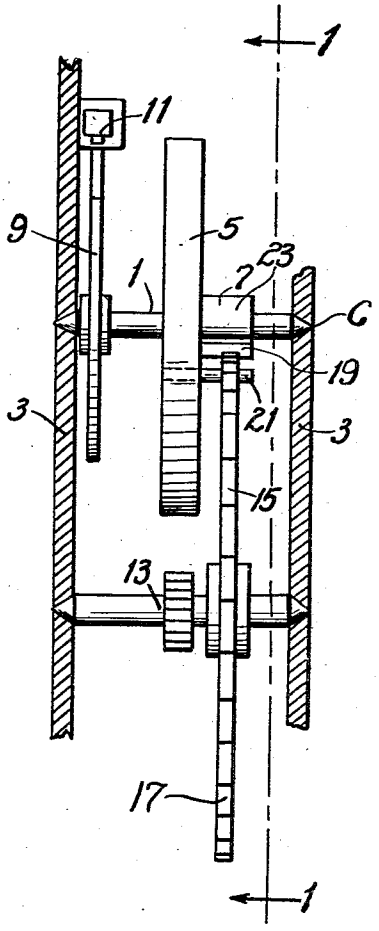


Fig. 2.



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ESCAPEMENT

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Serial No. 410,358

1 Claim. (Cl. 58—117)

This invention relates to escapements, and with regard to certain more specific features, to impulse escapements.

Among the several objects of the invention may be noted the provision of an escapement for gear trains and the like in which rocking anchors and/or pallets are eliminated and in which the radius of application of the impulse from a controlled train is effected at a greater driving radius than the braking radius of the escapement, thereby permitting the use of a stronger and more reliable hair spring and/or a relatively weaker driving spring in the said train; the provision of a device of the class described in which the braking force is reduced and impulse force increased; and the provision of a device of the class described which is exceedingly simple in construction and reliable in operation.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combination of elements, features of construction, and arrangements of parts, steps and sequence of steps, which will be exemplified in the structure hereinafter described, and the scope of the application of which will be indicated in the following claim.

In the accompanying drawing in which are illustrated one of various possible embodiments of the invention

Fig. 1 is a cross section taken on line 1—1 of Fig. 2, illustrating the invention in elevation; and,

Fig. 2 is an end elevation, certain supporting plates being shown in section.

Similar reference characters indicate corresponding parts throughout the several views of the drawing.

Referring now more particularly to Fig. 1 there is illustrated at numeral 1 a balance staff, supported in suitable bearings 3 (Fig. 2). This staff 1 carries relatively fixed thereto a balance wheel 5 and an escapement drum 7. The balance wheel 5 is of suitable diameter and weight adapted to provide a moment of inertia which will effect suitable oscillation or vibration of the staff 1 and escapement drum 7 under action of a vibrating hair spring 9. The hair spring 9 is suitably attached to the staff 1 and forms a spiral there around, the other end of said spring 9 reacting against a fixed hair spring stud 11 to which said hair spring is fastened.

Rotatable with an escapement shaft 13 is an escapement wheel 15. As is known in the art, the escapement shaft 13 is connected in a suitable gear train or other mechanical linkage or train, said train being adapted to be controlled by the escapement herein described. This mechanical train is of the type ordinarily driven by a main spring or the like, the purpose being that the main spring or the like drives the train to perform a predetermined function, such as keeping time, operating other mechanisms or the like. The main spring provides the energy for the train and the escapement permits it to run down only at a predetermined rate, rather than uncontrolledly.

In order to provide my improved escapement, the escapement wheel 15 is provided with driving teeth 17 and the drum 7 is provided with a suitable slot 19 which permits passage, one at a time, of said teeth 17. However, the teeth 17 do not drive the balance wheel assembly by contacting in said slot 19, but by engagement with an impulse pin 21 engaging near the base of the teeth 17.

The impulse pin 21, as the drawing shows, is located at a greater radius from the center C of the staff 1, than is the cylindrical surface of the drum 7 or the slot 19. Hence the escapement wheel 15, under action of its driving train, has a greater mechanical advantage in driving the balance staff assembly by way of the pin 21 than it would have in driving the balance staff assembly by way of the slot 19. Thus, from this viewpoint, a heavier hair spring 9 may be used, inasmuch as the same force at the pin 21 will overcome a greater resistance than said force applied at the slot 19, or to state the inverse proposition, for the same strength of hair spring, there will be required less driving force when the force is applied at the pin 21, than would be required if it were applied at the slot 19. Thus, for a given size of hair spring, a smaller main spring can be used and/or smaller hair spring.

The operation of the device, referring to the surface of the drum 7 as a braking surface 23, is as follows:

Let it be assumed that the escapement wheel 15 under action of its connected gear train and main spring rotates clockwise as indicated by the arrow 25. What occurs is that a tooth, such as the one designated at 17—A, engages the impulse pin 21 and drives the balance wheel staff and associated parts in a counter-clockwise direction as indicated by the arrow 27. The slot 19 is so arranged that as the tooth 17—A passes to the right, said slot 19 accommodates said passage. This is known as the escapement action. Escape of one tooth is permitted.

As the tooth 17—A escapes through the slot 19, it continues to drive the impulse pin 21 until the said tooth 17—A slips under the pin 21 which is at this time moving upwardly to the right (Fig. 1). It will be appreciated that the balance wheel assembly during this operation is partially winding the hair spring 9 to provide a reaction.

As soon as the tooth 17—A slips from under the raised impulse pin 21, the escapement wheel 15 (which is being driven by the main spring and train) is quickly driven further in a clockwise direction and this results in the next successive tooth 17—B striking against the braking surface 23. It should be remembered that the slot 19 is at this time to the right and that the braking surface presented to the tooth 17—B is cylindrical. The tooth 17—A has by this time entirely escaped from the slot 19 and from under the impulse pin 21.

It will be appreciated that the reaction of the hair spring, as soon as the tooth 17—A has escaped, tends to return the slot 19 into a position adapted to receive the next tooth 17—B, but, the moment of inertia of the balance wheel and the period of the spring are so arranged that there is some lag, and this lag is that which permits of the tooth 17—B jumping forwardly and contacting with the braking surface 23.

Next, the inertia of the balance wheel 5 having been expended in storing energy in the hair spring 9 and the lag period being over, the hair spring 9 vibrates back and drives the balance wheel assembly in a clockwise direction, thus returning the slot to its original position for admitting the next tooth which, in the present argument, is said tooth 17—B. It will be noted that braking energy is expended by the hair spring 9 on the return stroke. This is because of the friction between the braking tooth 17—B and the braking surface 23. In order that the mechanism may continue to run, this energy must be re-supplied on the next impulse stroke by the escapement wheel 15. It is desirable to have the braking surface 23 at as short radius as is possible, in order to eliminate the possibility of tooth 17—B applying sufficient energy to stall the hair spring.

It will be seen, that by placing the impulse pin 21 at a greater radius than the braking surface 23, that impulse energy is delivered from the escapement wheel 15 to the balance wheel 5 at a better mechanical advantage, and that the braking energy used between a tooth surface and the braking surface 23 is expended with less mechanical advantage (or at an optimum mechanical advantage) on the system with respect to the mechanical advantage of the impulse energy. This is what permits the use of either a heavier hair spring or a heavier main spring or both under given conditions. In other words, there is provided a device in which the driving radius is greatly increased (to a desirable degree) and the braking radius is held to a minimum (to a desirable degree).

It might be thought that, after the tooth 17A has imparted its impulse to the pin 21 and escapes, and the tooth 17B is in braked position against the drum 7, the returning pin 21 (now travelling in a clockwise direction) would overrun the tooth 17B and become blocked thereby. Such an action cannot in fact occur, for the following reason: Before the pin 21 can commence its clockwise movement, the escapement wheel 15 must move angularly until the crest of tooth 21A is located a distance from the center of the balance wheel equal to the distance of the pin 21 therefrom. When the wheel 15 has moved this far, the crest of tooth 17B is less distant from the center of the balance wheel than the pin 21, thus providing a barrier past which the pin 21 cannot rotate. Obviously, when the main spring is wound, the hair spring 9 is not nearly powerful enough to force the escapement wheel backwards by the engagement of the pin 21 on the approaching face of tooth 17B. Even should the main spring become unwound, or run down, the hair spring is still not sufficiently powerful to overcome the inertia of the escapement wheel and the timing train geared thereto. Thus under no conditions could the balance wheel force the escapement wheel into counterclockwise rotation, and, by reason of the thus immovable barrier of the tooth 17B, overrunning of the pin 21 is positively prevented under all conditions.

Another advantage of the invention is that it is quite a simple procedure of mechanics or design to change the position of the pin 21. Its positioning is quite independent of the radius of the braking system 23. Thus these different elements of the escapement design may be varied at will. Heretofore, when merely the slot 19 and braking surface 23 were used, every time that the impulse force was to be made greater by increasing the radius of the drum 7, the braking force also became proportionally larger. With the present invention when the pin 21 is moved out from the center C, the impulse force is made greater without making the braking force greater.

It will be understood that the action above set out for the two teeth 17—A and 17—B continues between successive teeth, the balance wheel 5 oscillating back and forth and permitting the ecape through slot 19 of tooth after tooth. Also, tooth after tooth engages the braking surface 23, so that the rate of running down of the gear train connected with the shaft 13 is accurately controlled. It will be seen that I have eliminated oscillating elements such as pallets and anchors which operate satisfactorily in only a limited number of positions, preferably upright. The present escapement will operate in any position into which the attachment is placed.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results obtained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:

An escapement comprising driving escapement teeth, an oscillable balance staff, a vibrating spring connected with said staff, said staff having an escapement slot cut therein, said slot permitting escapement of said teeth successively, but without contacting said teeth, said staff also having a braking surface thereon, said braking surface being positioned to be contacted by said teeth successively, and impulse means comprising a pin associated with said staff and positioned to receive the entire impulse of each of said teeth successively, said impulse means being located at a greater radius from the center of oscillation than said braking surface, whereby said impulse is at all times delivered to said staff at a greater mechanical advantage than is obtained at said braking surface.

FREDERICK FRANZ.