March 26, 1935. M. H. RHODES 1,995,363

ESCAPEMENT

Filed Nov. 4, 1931

FIG. 1.

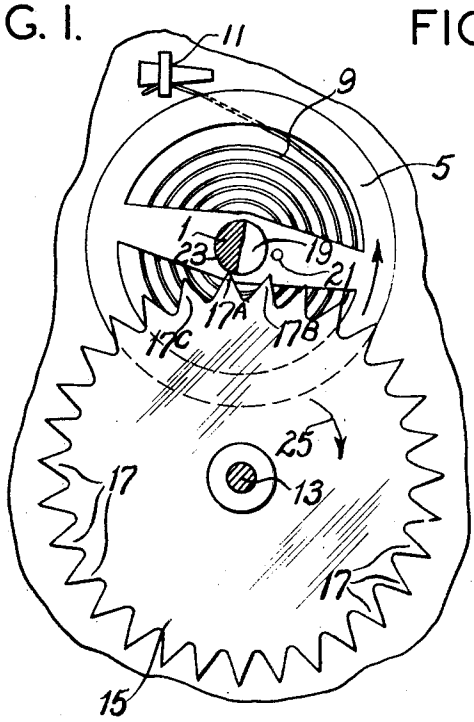

FIG. 2.

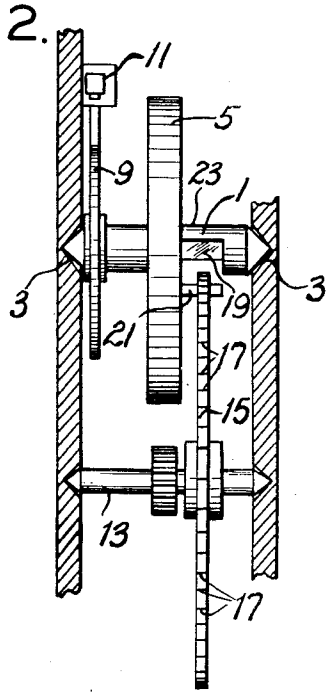

FIG. 3.

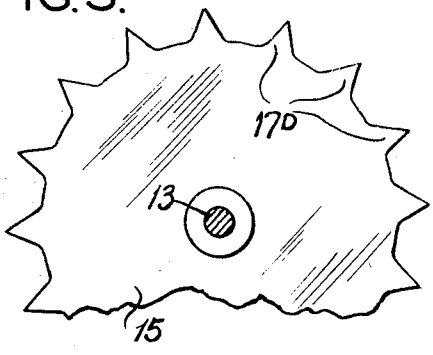

FIG. 4.

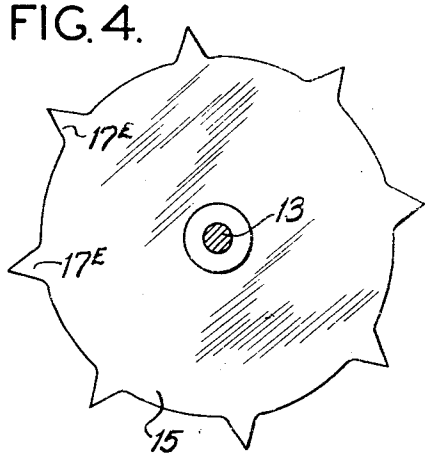

FIG. 5.

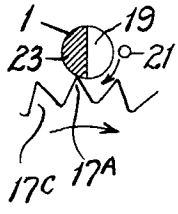

FIG. 6.

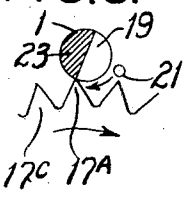

FIG. 7.

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UNITED STATES PATENT OFFICE

1,995,363

ESCAPEMENT

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Application November 4, 1931, Serial No. 572,917

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 all parts are so simplified as to be manufacturable at minimum cost, requiring but a minimum number of specialized tools; and the provision of a device of the class described in which the rate at which the device operates may be varied at will by a simple manipulation of one of the parts. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be examplified in the structures 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 several of various possible embodiments of the invention,

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

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

Fig. 3 is a elevation of an alternative form of escapement wheel;

Fig. 4 is a second alternative form of escapement wheel; and,

Figs. 5, 6 and 7, are diagrammatic views illustrating progressive positions of certain of the elements shown in more detail in Fig. 1.

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. 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 under action of a vibrating hair spring 9. The hair spring 9 is suitably attached to the staff 1 and forms a spiral therearound, 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 balance staff 1, which is relatively large in diameter, is provided with a suitable slot or notch 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 construction of the slot or notch 19 is of particular importance in the present invention. In prior escapements, and particularly in the escapements shown in the pending application of Frederick Franz, Serial No. 410,358, and having since become Patent No. 1,934,611 of Nov. 7, 1933, a balance wheel staff of a relatively small diameter is provided, and a drum is mounted upon this shaft. A special form of notch, in all of these prior devices, is machined into the drum, and it is the machining operation incident to the formation of the notch which occasions considerable increase in cost in the production of escapements of this general class. The present invention overcomes the difficulties by providing a balance wheel staff of relatively large diameter, thereby obviating the necessity for a separate drum, and makes provision for a notch or slot 19 which comprises merely a half-cut into the cylindrical staff. This slot or notch 19 may readily be formed in a simple milling operation, in contradistinction to the special tool workings required for the production of the notches of prior devices.

The impulse pin 21, as the drawing shows, is located at a greater radius from the center of the staff 1, than is the cylindrical surface of the staff 1 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 over-

come 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 staff 1 as a braking surface 23, is as follows:

Let it be assumed that the initial position of the device as shown in Fig. 1, that is, a tooth 17—A of the escapement wheel 15 is obstructed from motion by the braking surface 23 of the staff 1. The main spring (not shown) urges the escapement wheel 15 in a clockwise direction, as indicated by the arrow 25. In the position shown in Fig. 1, the impulse pin 21 has just passed from engagement with a tooth 17—B in advance of the tooth 17—A. It is rotating, together with the balance wheel 5, in a counterclockwise manner against the tension of the balance spring 9. With the escapement wheel 15 stopped by reason of the braking engagement described, the balance wheel 5 rotates counterclockwise until its impulse is counteracted by the reverse impulse of the balance spring 9 and the braking effect on the staff 1. For an instant, then, the balance wheel 5 is stationary, its position then being that indicated diagrammatically in Fig. 5.

Instantaneously after the Fig. 5 position is reached, the now reversing action of the hair spring 9 causes the balance wheel to commence rotation in a clockwise manner, the device proceeding to the Fig. 6 position. As shown in Fig. 6, the staff 1 is in the instantaneous position just prior to the release of the tooth 17—A from braking engagement with the surface 23 of said staff 1. The balance wheel, and impulse pin 21, are still rotating in a clockwise manner.

From the Fig. 6 position the device passes to the Fig. 7 position, at which time the clockwise rotation of the balance wheel assembly has proceeded sufficiently far to turn the notch 19 into position to permit the passage of the tooth 17—A, which is no longer braked. The escapement wheel thus moves forward under the influence of the main spring. As the tooth 17—A moves forward, it encounters the still clockwise rotating impulse pin 21, as shown in Fig. 7. The main spring being stronger than the hair spring 9 causes the advancing face of tooth 17—A to engage the impulse pin 21, stop its clockwise rotation, and, through a camming action, to force the balance wheel to rotate backwards, or in a counterclockwise direction. The device passes from the Fig. 7 position directly to the Fig. 1 position, in which the braking surface 23 is again brought into position in sufficient time to brake the next succeeding tooth 17—C of the escape wheel 17.

The balance wheel and impulse pin are prevented from rotating too far in a clockwise direction, and thus becoming out of adjustment, at all times by the ever presence of one of the teeth of said escapement wheel 17, under the influence of the main 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).

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 a slot and braking surface were used, every time that the impulse force was to be made greater by increasing the radius of the then-used drum, the braking force also became proportionally larger. With the present invention, when the pin 21 is moved out from its center 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—C continues between successive teeth, the balance wheel 5 oscillating back and forth and permitting the escape 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.

Another object of the present invention is to permit ready adjustment of the speed of which the escapement 15 runs. It will of course be understood that the speed of the escapement wheel 15 is the controlling factor of the speed at which the gear train appended thereto rotates, and thus the speed of the escapement wheel 15 is the controlling factor for the speed of the entire mechanism in which it is mounted. Wide variation of such speed is of primary importance in certain fields (excluding horology), particularly in the field of timed electric switches and the like.

In the prior forms of escapements, a slight variation in the speed of the escapement wheel 15 was permitted by adjusting the hair spring stud 11 to place greater or less tension on said hair spring 9, and thus to cause the balance wheel 5 to rotate at a greater or less speed. However, this adjustment is effective only over a very slight range, and changes in the speed of the escapement wheel of the order of doubling or trebling or halving have heretofore been unknown.

The present invention accomplishes such speed variation with minimum difficulties. The manner in which this is done is shown more particularly in Figs. 3 and 4. In Fig. 3 the balance wheel 15 is shown having alternate teeth 17 removed, thereby leaving only spaced teeth 17—D. For a further illustration, Fig. 3 shows an escapement wheel 15 in which three out of every four teeth 17 are removed leaving only eight teeth 17—E spaced around the entire periphery of the wheel. The effect of the removal of the teeth is to speed up the time consumed during a complete rotation of the escapement wheel 15. It will be appreci-

ated if the total time consumed in one rotation of the escapement 15 is equal to the fundamental time of escapement of one tooth, as controlled by the balance wheel assembly, multiplied by the total number of teeth on the wheel. Thus, when the total number of teeth is reduced to one-half, as in Fig. 3, the total time required for the escapement wheel 15 to complete one rotation is likewise reduced to one-half. Similarly in the Fig. 4 embodiment, the total times consumed in one rotation of the escapement 15 is one-quarter of that required for the wheel having a full set of teeth.

Following the above principles, I have found it advantageous to manufacture, as by stamping, a suitable stock number of full teethed escapement wheels 15 as shown in Fig. 1, and a set of dies by which certain of these teeth may be removed at will in order to provide the necessary time factor for the particular instance. The advantage of such an arrangement is that with a single stock escapement wheel, timing trains of a large variety of running speeds may be made with minimum difficulty.

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

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 comprising a half-cut into said staff, 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.

MARCUS H. RHODES.