Sept. 2, 1941. J. L. REUTTER 2,254,858

CLOCKWORK APPARATUS AND NEW PORTABLE GAS OR VAPOR WATCH

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Fig. 1.

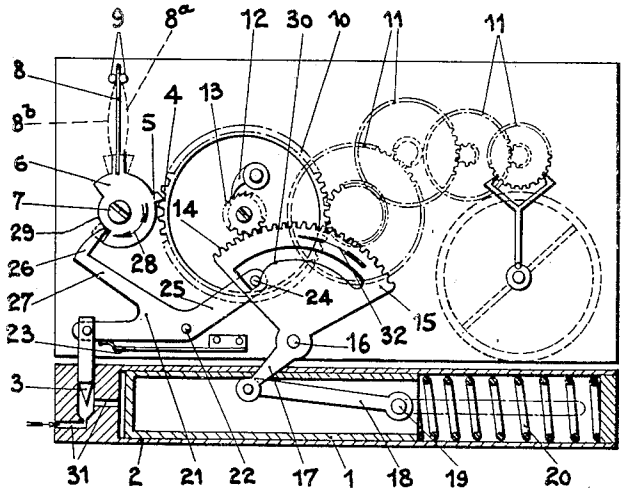


Fig. 1a

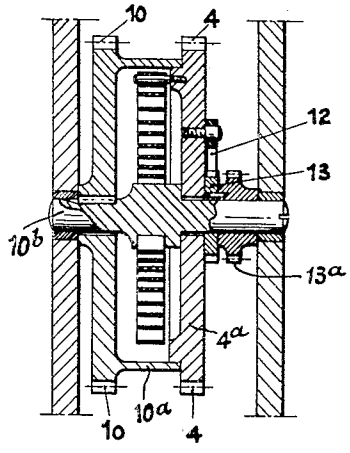
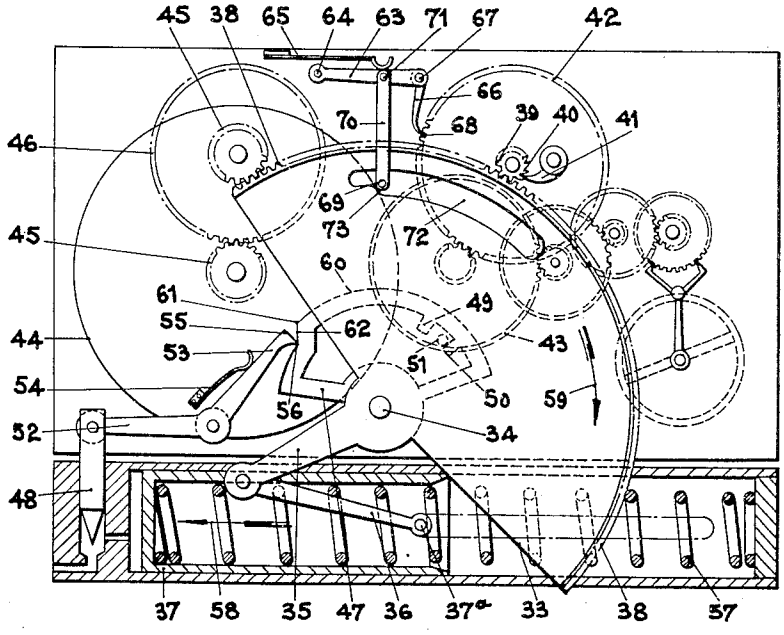


Fig. 2.



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Fig. 3.

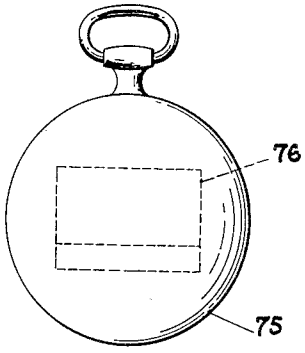


Fig. 4.

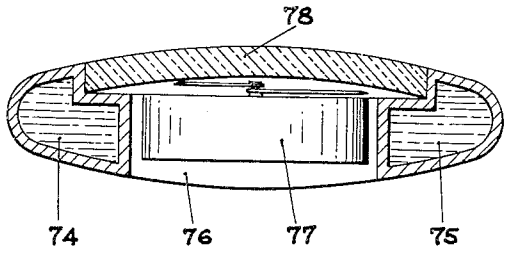


Fig. 5.

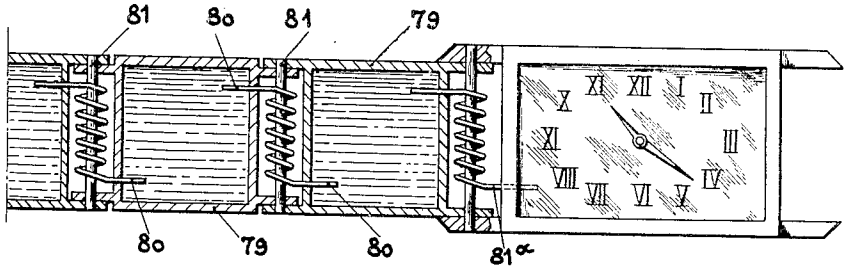
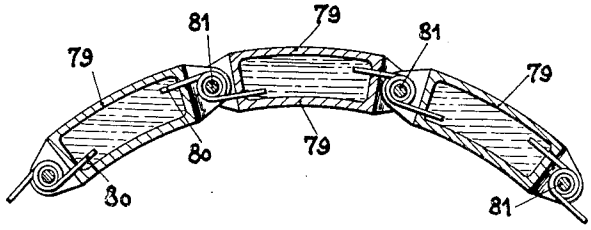


Fig. 6.



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2,254,858

CLOCKWORK APPARATUS AND NEW PORTABLE GAS OR VAPOR WATCH

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Application October 29, 1937, Serial No. 171,660
In France April 6, 1937

4 Claims. (Cl. 58—82)

The present invention relates to clockwork apparatus and more particularly to clocks, timepieces and watches.

In apparatus of this kind, the energy, which produces the operation of a clockwork proper, is supplied by the drop of a weight, by the relaxation of a spring, or by sustaining, for instance electrically, the oscillations of a driving pendulum.

The invention is applicable to the apparatus above mentioned whatever may be the principle of their operation. It is mainly characterised by the fact that the energy, which directly produces the operation of the mechanism or clockwork, or which, intermittently, is supplied to the driving members (weights or springs) which store said energy during long periods of time, arises from the expansion, either of a vapor produced by a reserve of generating liquid and the pressure of which at the surrounding temperatures is higher than atmospheric pressure, or of a gas dissolved in a liquid, or fixed, absorbed or adsorbed by a suitable support (charcoal, active carbon) or stored in a liquefied state.

The invention therefore consists in the new application to clockwork apparatus, or in the new combination with the clockwork of these apparatus, of a driving unit constituted by a generator of gas under pressure or of saturated vapor having a pressure higher than atmospheric pressure for the surrounding temperatures, and of a motor actuated by the resilient force of this vapor.

Such as defined above in its principle, the invention can be carried out in various manners in which: either the movement of the mechanism can be directly sustained, or the winding up of a driving spring can be ensured.

This latter case actually appears the most advantageous for the construction of pocket watches the cumbersomeness of which does not exceed that of ordinary watches. These watches which comprise, in one and the same unit, a movement, a generator of gas or vapor and a motor fed by this gas or this vapor for winding up the movement or directly sustaining the operation of the same, constitute new industrial products which are a particular object of the invention.

The accompanying drawings illustrate, by way of example only, forms of carrying the invention into practice applied to pocket watches.

Fig. 1 is a diagrammatic elevation, with partial section, of a movement, the winding up of which is ensured by a saturated vapor motor.

Fig. 1a is a section side view through the barrel of Fig. 1.

Fig. 2 is a view similar to Fig. 1, but shows a modification.

Fig. 3 is a diagrammatic elevation of a watch according to the invention.

Fig. 4 is a corresponding diametral section.

Fig. 5 is a partial plan view, with section, of a wrist-watch according to the invention.

Fig. 6 is a longitudinal section of a portion of the bracelet of Fig. 5.

In the form of construction of Fig. 1, a usual watch movement comprises a barrel modified so that the tension of the spring or the winding up is produced by the displacements of a piston 1 movable in a cylinder 2 in which the driving vapor is admitted under the control of a valve or needle-valve 3.

On the stopple 4a of the barrel are provided teeth 4 meshing with a finger or pawl 5 of a cam 6 journalled at a fixed point 7 and restored to a mean position by a leaf spring 8 held, at its end, between two abutments 9. The spring of the barrel is attached on the one hand, to the stopple of the barrel and, on the other hand, to the barrel proper 10a which carries teeth 10 connected to the set of wheels 11 of the movement. The stopple of the barrel carries a pawl 12 in engagement with a ratchet 13 journalled on the arbor of the barrel and fastened upon a gear wheel 13a meshing with teeth 14 formed on a rack 15 pivotally mounted at a fixed point 16. This rack is pivoted by its tail piece 17 on a link 18 which connects it to the pin 19 of the piston 1 subjected to the action of a spring 20 which tends to restore it to its extreme forward position. In fact, the spring of the barrel is not attached directly to the barrel. It is attached to the arbor of the barrel which barrel is keyed upon the said arbor.

The valve 3 is connected, preferably in a resilient manner, to one of the arms of a lever 21 pivoted at 22 and subjected to the return movement of a spring 23 which tends to act for lifting the valve. A stud 24 provided at the end of the arm 25 of the lever comes in contact, in the conditions stated later on, with the incline or cam of the rack 15, while a nose 26 of the arm 27 presses against cam 6, due to the action of spring 23.

The operation is as follows:

The stopple of the barrel, subjected to the reaction of the driving spring, is held stationary by its teeth 4 bearing on the pawl 5 of cam 6 which is urged in the direction of the arrow 28, the

leaf spring 8 being cambered in the position 8a. The nose 26 presses against the high periphery of cam 6 and the valve 3 is applied on its seat.

When the tension of the driving spring of the barrel has diminished sufficiently, the leaf spring 8 resumes its mean position and the nose 26 is in front of the notch 29; the spring 23 acts and lifts the valve 3 the upward movement of which is limited by the stud 24 coming in contact with the most depressed portion of the incline 30 of rack 15.

The vapor, arising from a fluid-tight reservoir which contains the generating liquid, enters, through conduit 31, the cylinder 2 and pushes back the piston in the direction for compressing the spring 20. The translation of the piston 1 produces an angular displacement of the rack in the direction of the arrow 32. As soon as the stud 24 has touched the high portion of the incline 30, the valve 3 is closed and the vapor which has entered the cylinder 2 expands pushing back the piston 1 which compresses the spring 20.

The rack 15, by rotating, drives, through the ratchet 13 and the pawl 12, the stopple of the barrel the teeth 4 of which slide on the pawl 5 by cambering the spring 8 in the position 8b and the driving spring of the barrel is wound up. As soon as the pressure of the vapor enclosed in the cylinder 2 has sufficiently lowered owing to leakages, normal or induced, the spring 20 restores the piston 1 towards the position it occupies in the drawing. The rack 15 then drives the ratchet 13 which slides on the pawl 12 and the reaction exerted by the teeth 4 on the pawl 5 holds the cam in such a position that, when the stud 24 is opposite to the depressed portion of the incline 30, the valve 3 cannot open owing to the fact that the nose 26 abuts against the high periphery of cam 6.

Valve 3 again opens for allowing the cycle of operations just described to take place over again, when the driving spring of the barrel has sufficiently relaxed. For regularizing the expansion of the vapor in the cylinder, a fly can be provided. It is the case of the embodiment shown in Fig. 2 in which, moreover, the driving barrel is done away with, its action being replaced by that of the spring which restores the piston to its extreme forward position.

A rack 33, pivoted at 34, is connected, by its arm 35 and the link 36, to the pin 37a of the piston 37. Its teeth 38 mesh with a pinion 39 rigid with a ratchet 40, in engagement with a pawl 41, which is pivoted to a wheel 42 which drives the center wheel 43 of the usual movement.

The teeth of the rack 38 are connected to the fly 44, having a large moment of inertia, by the set of pinions 45 and the wheel 46. A cam 47, freely mounted on the pin of the rack 33, controls the valve 48. The cam 47 comprises two teeth 49 and 50 between which is arranged a stud 51 of the rack 33. The valve 48 is connected, preferably in a resilient manner, to the lever 52 the arm 53 of which is subjected to the action of a spring 54 which tends to open the valve when the nose 55 encounters the depressed portion 56 of cam 47.

The operation is as follows:

It will be assumed that the driving spring 57 has relaxed by moving back in the direction of the arrow 58 the piston 37 which has not yet reached its extreme position. The rack 33 rotates in the direction of the arrow 59 and drives, through the ratchet 40 and the pawl 41, the wheel 42 in the suitable direction.

The nose 55 is on the portion 60 of cam 47 and the valve 48 is closed. When the nose 55 encounters the point 61 of the cam driven by the stud 51 which acts on the tooth 50, the relaxation of the spring 54 takes place: It opens the valve 48, and, by the action of nose 55 on the incline 62, it pushes cam 47 in the direction of the arrow 59, until the tooth 49 abuts against the stud 51.

The vapor, admitted in the cylinder, pushes the piston 37 in the direction for compressing spring 57 and displaces the rack 33 in the direction reverse to the arrow 59. The ratchet 40 slides on the pawl 41 and the wheel 42 is not affected by the displacement of the rack which drives the fly 44. The vapor is admitted in the cylinder until cam 47, driven by the thrust of the stud 51 on the tooth 49, has presented the inclined portion 61 of member 60 in front of the nose 55 for closing the valve 48. The expansion of the vapor admitted in the cylinder takes place, regularized by the intervention of the fly 44 and the spring 57 is compressed until the leakages, normal or induced, allow it to relax by moving the piston 37 towards the position it occupies in the drawing. During this relaxation, the rack 33 rotates in the direction of the arrow 59 and drives the wheel 42 and the movement in the suitable direction; the fly 44, the rotation of which has been reversed, then intervenes for regularizing the relaxation of the spring 57.

The rack 33 which, at the beginning of the relaxation of spring 57, has first moved alone, comes in contact, through the stud 51, with the tooth 50 of cam 47 which is driven, but with the valve 48 closed.

The latter opens when the piston 37 has sufficiently approached its extreme position and the nose 55 encounters the point 61. The cycle of operations already described then takes place over again as explained.

It has been noted that during the movement of the rack 33, in the direction reverse to the arrow 59, the movement of the watch no longer receiving any impulse, stops. Among the arrangements which can be used for remedying this inconvenience, the following will be described, which is illustrated in the drawings.

A lever 63 pivoted at a fixed point 64, is subjected to the action of a spring 65 which moves it in such a manner that, through the medium of a finger 66 pivoted at 67, it drives the wheel 42 in the suitable direction. The nose 68 of the finger 66 can act on the teeth of the wheel 42 or on a special set of teeth rigid with this wheel, when the pin 69 carried by an arm 70 pivoted at 71 on the lever 63 is located in the wide portion of a notch 72 formed in rack 33, the amplitude of oscillation of said finger 66 being determined by the width of the wide portion of said notch. The spring 65 is tensioned, towards the end of the movement of relaxation of spring 57, by the action of an incline 73 of rack 33 on the pin 69. It relaxes by driving the wheel 42 while spring 57 is being energized.

The reservoir containing the liquid generating vapor which acts on the piston can be provided, at any suitable point of the clockwork apparatus to which the invention is applied. In the example of Figs. 3 and 4, relating to a pocket watch, the reservoir is constituted by the space 74 available, in a case 75 around a central location 76 which receives a movement 77 and its

motor such as shown particularly in Figs. 1 and 2. The dial with its hands is arranged behind a protecting glass **78**.

An opening, obturated in a fluid-tight manner, can be provided for recharging the reservoir when the reserve of liquid has become exhausted. It is to be noted that this recharging is necessary only after very long intervals of time. By way of example, use can advantageously be made of propane as generating liquid.

When a wrist-watch is under consideration, as shown in Figs. 5 and 6, the bracelet can be formed by a series of links **79** each of which constitutes a liquid reservoir. These reservoirs are connected together by tubes **80**, helically wound on each of the pins **81** of the pivotal connections, and the ends of which enter each of the adjacent links. The last link of the series communicates through a tube **81***a* with the conduit admitting vapor to the motor of the watch.

In the embodiment just described, a piston motor has solely been contemplated. The invention is not limited to this kind of motor. It includes in its scope all motors or machines adapted to convert the expansion of a vapor into mechanical energy.

What I claim as my invention and desire to secure by Letters Patent is:

1. In a watch or a timepiece, in combination: a clockwork mechanism including a barrel and a toothed stopple, a spring interposed between the barrel and the stopple of the said barrel, said mechanism being actuated by said spring, a reservoir adapted to contain a generating liquid producing a vapor under pressure, a cylinder, a valve for controlling the delivery of the vapor to the said cylinder, a spring retracted piston movable in the cylinder, a rack connected to the piston and having an inclined portion, means including a ratchet-pawl device for connecting the said rack to the stopple in order to tension the actuating spring of the clockwork when the piston is pushed by the expansion of the vapor, a cam pivoted at a fixed point, a pawl on the said cam and meshing with teeth provided on the stopple, said spring shifting the cam to one side of a mean position when the winding force of the expanding gases in the cylinder ceases, the escapement mechanism of the clockwork mechanism serving substantially as a stop against which the spring reacts so that the free end of said spring rotates said stopple and thereby causes biasing of the cam in a forward direction, resilient means for restoring the said cam to said mean position, a lever connected to the valve and controlled by the inclined portion of the rack and by the cam, and a spring acting upon the said lever in order to open the said valve when the piston has been retracted by its spring and when the tension of the actuating spring of the clockwork has sufficiently diminished.

2. In a watch or a timepiece, in combination: a clockwork mechanism, a reservoir adapted to contain a generating liquid producing a vapor under pressure, a cylinder containing a reciprocable piston, a valve for controlling the delivery of the vapor to the said cylinder, a rack connected to the piston, means including a ratchet-pawl device for connecting the said rack to the clockwork mechanism, a spring adapted for retracting the piston and for actuating the said clockwork mechanism when the said piston has been pushed by the expansion of the vapor, a pivoted cam, a lever connected to the valve and controlled by said cam, means for connecting the cam to the rack so as to cause the same to operate upon predetermined operation of said rack, a spring acting upon the said lever in order to open the valve when the piston has been retracted by the retracting spring, and means for actuating the clockwork mechanism during the tensioning of the said retracting spring.

3. In a watch or a timepiece in combination: a clockwork mechanism, a reservoir adapted to contain a generating liquid producing a vapor under pressure, a cylinder containing a reciprocable piston, a valve for controlling the delivery of the vapor to the said cylinder, a rack connected to the piston, means including a ratchet-pawl device for connecting the said rack to the clockwork mechanism, a spring adapted for retracting the piston and for actuating the said clockwork mechanism when the said piston has been pushed by the expansion of the vapor, a cam, a lever connected to the valve and controlled by said cam, means for connecting the cam to the rack, a further spring acting upon the said lever in order to open the valve when the piston has been retracted by the retracting spring, a toothed wheel in said clockwork mechanism, a fly rotatably mounted and driven from the rack, a spring and a finger pushed by said last named spring and meshing with the teeth of said wheel of the clockwork mechanism, and an inclined portion associated with the rack for tensioning the last named spring when the piston reaches the end of its stroke under the action of its retracting spring and for allowing the said finger to actuate the clockwork mechanism during the tensioning of the first named retracting spring.

4. In a wrist-watch, in combination: a spring actuated clockwork mechanism, a bracelet having hollow links adapted to contain a generating liquid producing a vapor under pressure, a cylinder, a valve for controlling the delivery of the vapor to the cylinder, link, lever and rack mechanism connected to said clockwork mechanism, a piston movable in the said cylinder and connected to said link, lever and rack mechanism so as to be thereby adapted to tension the actuating spring of the clockwork mechanism when pushed by the expansion of the vapor, and means interposed between the piston and the said valve for controlling the same.

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