T. T. FITCH.

CHRONOGRAPH.

APPLICATION FILED JULY 17, 1908.

981,989. Patented Jan. 17, 1911.

Fig 1

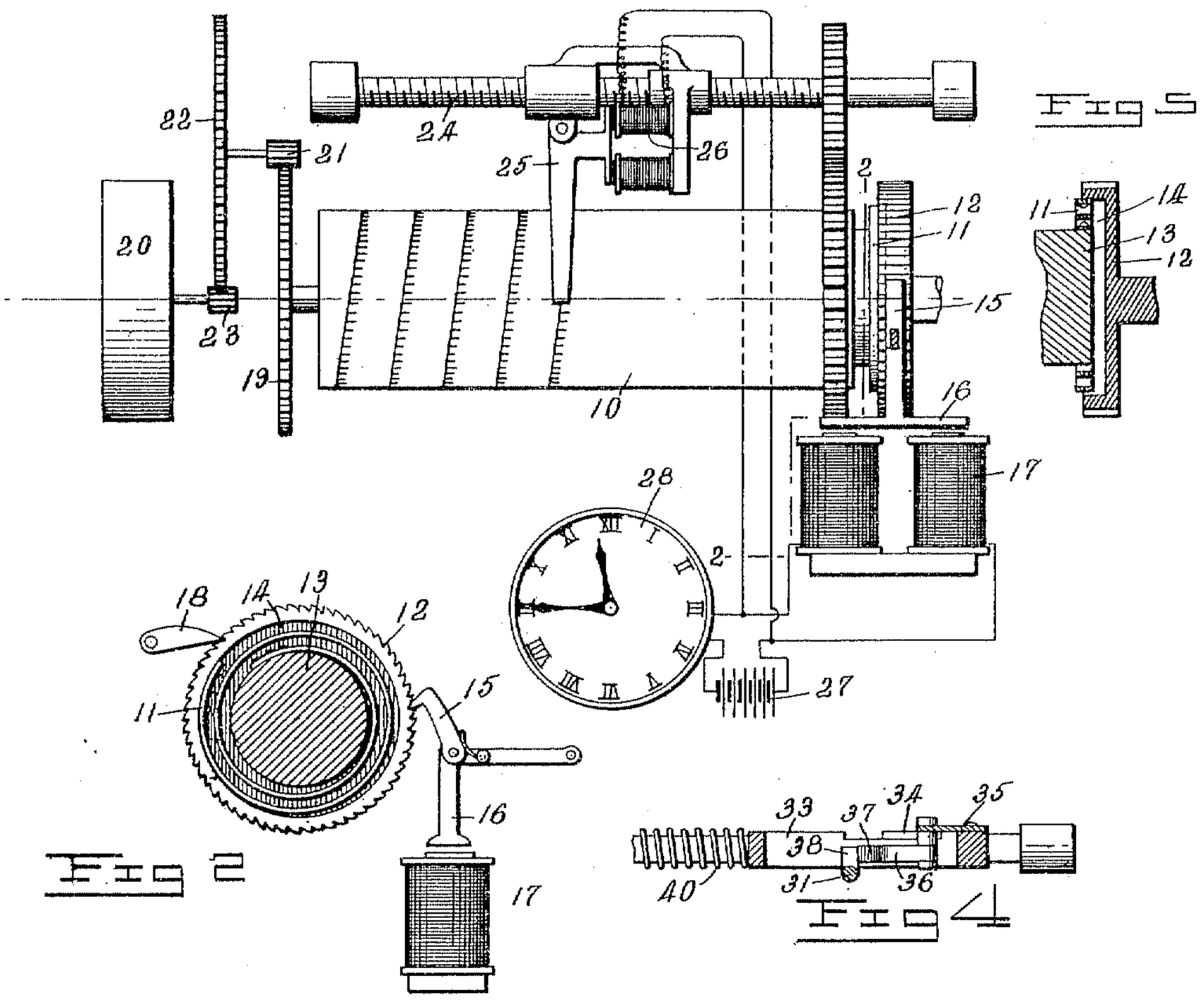
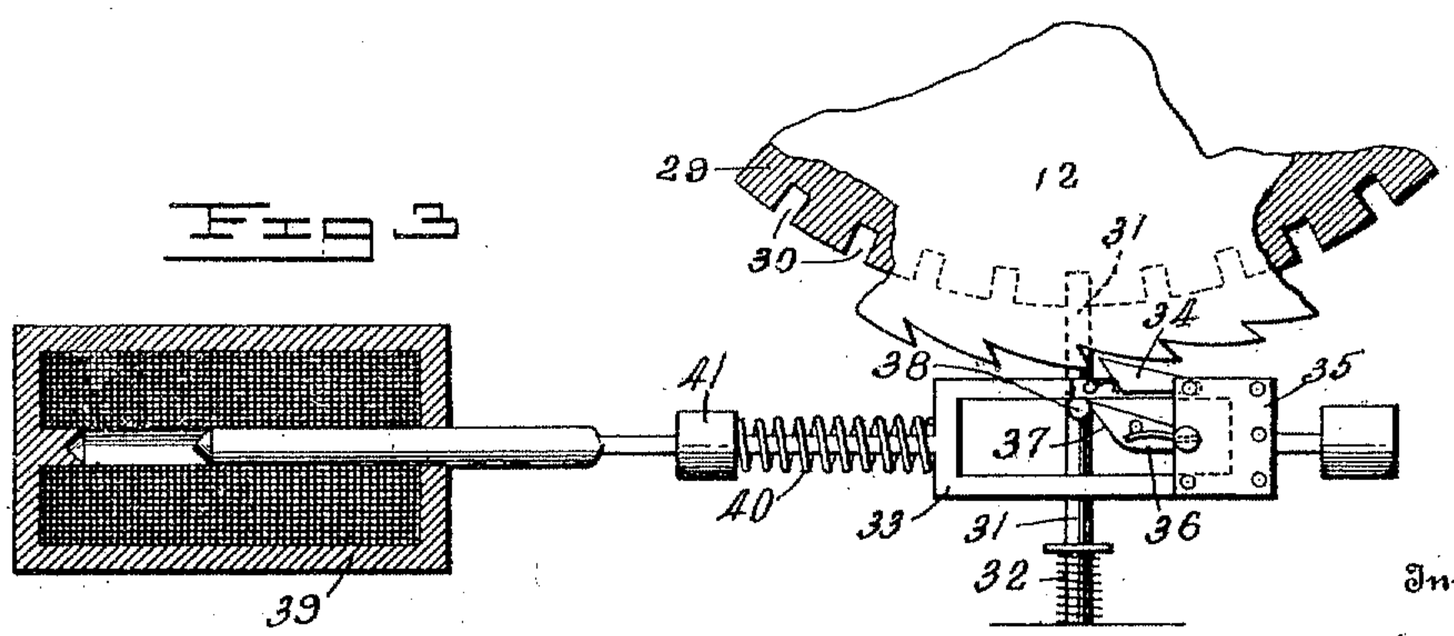


Fig 5

Fig 2

Fig 4

Fig 3



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CHRONOGRAPH.

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To all whom it may concern:

Be it known that I, THEODORE T. FITCH, a citizen of the United States, residing at Washington, in the District of Columbia, have invented new and useful Improvements in Chronographs, of which the following is a specification.

In chronographs use is frequently made of two separate and independent timing devices, one of them being very accurate and actuating a circuit closer to energize a magnet or other motor which makes the time record, and the other being used to move the record surface on which the record is made at a predetermined, and usually uniform speed. In some forms of chronographs which I have known a very accurate clock is used to control the making of the record, while the movement of the record surface is controlled by a train of gears actuated by a governor in connection with certain of the gears. This governor usually takes the form of a fly acting by virtue of its resistance to movement in the air, though it is not uncommon to use a fly-ball governor of the common type. I have found that when these two separate timing devices are used it frequently happens that the device used to move the record surface does not always move it at the same speed, owing to the fact that its adjustment varies according to variations in condition of the atmosphere and condition of the mechanism itself. A variation in temperature, for instance, may cause a variation in frictional resistance which is considerable in case a fly-ball governor and friction surfaces are used, or the mechanism may become stiff in operation due to lack of proper care. This variation in speed is very undesirable and is troublesome to correct. Moreover I have found it very convenient to have the space between record markings (for instance between successive "second marks") commensurate with the length or the circumference of the record sheet. Especially is this desirable in cases where a record is made in the form of a spiral on a cylindrical surface, or a sheet wrapped around such cylindrical surface. If the marks are commensurate with the circumference of the cylinder, an element of the cylinder drawn through one mark will pass through marks equidistant from each other on the record line, thus marking off a record sheet in time intervals of equal value. The convenience of a record made in this way so that successive time intervals will all be marked on elements of the cylinder spaced equal distances apart around the entire record surface, will be readily apparent. These records of time have quite an extended field of use in connection with records of speed, pressure, power, etc., which are most frequently contemporaneously made upon the same sheet with the time record.

It is the object of my invention to produce a chronograph which will obviate the above named difficulty and insure a definite invariable relation between the number of time intervals recorded by marking on the record surface and the distances or number of rotations through which the record surface moves. Broadly speaking I accomplish this result by causing the same timing device to operate both the record making means and the means for moving the record surface. The usual type of chronograph used consists of a rotating drum carrying a record sheet, a mechanism for driving said drum at a uniform speed, an electro-magnetically controlled stylus for making the record, and an accurate timing device for periodically actuating the magnet by closing its circuit through a convenient source of power at definite time intervals.

More specifically speaking, I accomplish my invention by doing away with the mechanism used at the present time for moving the record surface and provide an electric motor for operating the drum. This electric motor I connect in parallel with the electro-magnet controlling the stylus, or connect it in other relations in such a manner that the timing device controlling the stylus, also controls the movement of the record surface. The particular motor which I use for moving the record surface is an electro-magnet acting through the intermediary of a ratchet and pawl, and giving to the ratchet and tending to impart to the record surface, an intermittent movement. This intermittent movement I so transform by auxiliary devices, which I shall describe, as to cause the record surface to be moved at a continuous and uniform speed.

For a more detailed description of my invention reference is to be had to the accompanying drawing, in which,

Figure 1 is a diagrammatic view of my improved chronograph; Fig. 2 is a section

taken on line 2—2 of Fig. 1; Fig. 3 is a view of a modified form of actuating means for the record surface; Fig. 4 is a sectional view of a detail of the same; and Fig. 5 is a sectional view of a portion of the end of the drum carrying the record surface of the chronograph showing the connection of the drum with the actuating motor.

10 is a drum which carries the usual record surface or sheet. This drum is journaled in suitable bearings. At one end it is connected by means of a spiral spring 11 to a ratchet wheel 12, which is suitably mounted concentric with the drum. The end 13 of the drum projects into the hollow 14 of the ratchet wheel, and the spiral spring 11 is mounted within the hollow. A pawl 15 attached to the armature 16 of an electromagnet 17 coöperates with the ratchet 12. A second pawl 18 pivoted to a fixed point serves to prevent reverse rotation of the ratchet wheel when it has been actuated by the pawl 15. On the end of the drum 10, opposite the ratchet 12 is a gear 19 which drives a fly-wheel 20 through the intermediary of the step-up gears 21, 22, 23. The fly-wheel 20 is mounted independently of the drum 10 so that it may rotate at a much higher speed.

Parallel to and geared in a suitable manner to the drum 10 is a shaft 24 carrying a stylus 25 which bears upon the record surface, and the electro-magnet 26 which actuates the stylus. The shaft 24 is a screw shaft on which is screw-threaded the frame carrying the stylus 25 and its actuating magnet 26, the stylus being thus moved along the record surface as the shaft 24 is rotated. This electro-magnet 26 is connected in parallel with the electro-magnet 17 across a battery or other source of power 27, and they are both controlled by a clock or other timing device 28.

With the elements of my improved chronograph arranged as just described the operation is as follows: Assuming that the circuits of the electro-magnets 26 and 17 are closed once every second, the stylus will be actuated to mark "seconds" on the record surface and the ratchet 12 will be moved one tooth forward every second. I prefer to provide sixty teeth on the ratchet wheel 12 so that it will be caused to make one complete revolution every minute. At each actuation of the ratchet 12 the spring 11 is put under tension, having energy imparted to it, and tends to rotate the drum or cylinder 10 in the same direction as the ratchet 12 has been moved. When the chronograph is first started in operation the friction of the drum and its connected gears, and the inertia of the fly-wheel 20 cause a certain amount of lag in the movement of the drum 10 and it may be that the ratchet 12 is actuated several times and moved forward several teeth before the drum moves an appreciable amount. The spring 11 is thus put under considerable tension tending to rotate the drum 10. Gradually the friction of the gears and inertia of the fly-wheel 20 will be overcome, and the speed of the drum 10 will increase until it reaches a certain fixed amount. This speed which the drum reaches will be exactly one revolution per minute when the ratchet wheel is proportioned as just described. The speed will moreover be constant and substantially uniform as when this speed is reached the friction of the parts in their bearings and the resistance to motion of the fly-wheel 20 are just overcome by the tension of the spring 11. The movement of the ratchet wheel is very slight at each actuation and the tension of the spiral spring 11 which consists of several turns is thus substantially constant after the drum 10 has reached its normal speed of rotation.

Any slight tendency of the drum 10 to vary from its substantially constant speed of rotation, such tendency for instance as is caused by the actuation of the ratchet wheel 12, which is intermittent, is taken care of by the fly-wheel 20. While the drum 10 revolves only once a minute the fly-wheel 20 is so geared to it that it revolves at a much higher speed, as high as several hundred times per minute. By virtue of this step-up gear between the drum and the fly-wheel slight impulses transmitted to the drum by the actuation of the ratchet 12 are scarcely perceptible, they being almost entirely eliminated by the inertia of the fly-wheel 20. Under these conditions the drum rotates continuously and at a speed determined by the timing device of the chronograph, the markings which are made by the stylus 25 on the record sheet thus bearing a definite relation to the rotation of the drum or movement of the record sheet, and in case the ratchet wheel 12 is made with sixty teeth, as described above, sixty seconds will be marked on the record surface per revolution. On account of this definite relation of the distance between marks on the record and the movement of the record, the distance between marks and the length of one spiral of the record will always be commensurate and an element of the cylinder carrying the record surface or sheet drawn through one mark will divide the record into equal parts. Thus is secured the object of my invention. It is obvious that this relation will remain true no matter what the variations in conditions.

In Figs. 3 and 4 I have shown a modified form of ratchet and pawl for operating the drum. 12 indicates the ratchet to which in this case is attached a concentric disk 29 provided with a number of notches 30 equal to the number of teeth on the ratchet wheel.

A stop-rod 31 guided in bearings in a fixed part is pressed by a spring 32 toward the disk 29 and is adapted to enter one of the notches 30 and hold the ratchet 12 in a position to which it has been moved. A frame 33 carries a pawl 34 adapted to engage the teeth of the ratchet wheel and move it one tooth at a time. This frame has secured to it a plate 35 to the underside of which is pivoted a spring-pressed switch member 36 having a surface 37 for engaging the pin 38 which projects into the frame 33 from the stop-rod 31. 39 is an iron-clad magnet whose core is attached to the frame 33 and 40 is a retractile spring between the frame and the fixed part 41. The operation of this modification is as follows: When the magnet 39 is energized it draws its core in and pulls the frame 33 forward. It will be observed that there is a slight space between the pawl 34 and the tooth of the ratchet wheel which it is next to engage. During the movement of the frame 33 through this distance the stop-rod 31 is lifted out of the notch which it engages, by the engagement of surface 37 with the pin 38 on the rod. The remaining movement of the frame 33 carries the ratchet forward one tooth, when the pin 38 slips around the end of the member 36 and the stop-rod 31 drops into the next notch and holds the ratchet in position. Upon the deënergization of the magnet 39 the frame 33 is moved back to its original position by the spring 40 and the pawl 34 ratchets past the next tooth and into position for engaging it upon the next energization of the magnet. Many other mechanisms for actuating the ratchet may be of course used with equal facility. The essence of my invention I do not regard as this actuating means. The essence of my invention is the control of the means for making a record and the means for moving the record surface by the same timing device, and the means which are used in order to obtain a definite constant relation between the distance between markings and the movement of the record surface, and the means which are used to obtain a uniform movement of a record surface, despite the slight variations which may be due to the particular form of actuating means operating the moving surface.

While I have described my invention with respect to the most common form of chronograph known to me, *i. e.* that in which a record is carried to a rotating cylinder and that in which the record is made by an electro-magnetically controlled stylus, it is of course obvious that my invention may be applied to other forms of chronographs, such for instance as those in which the record surface is a plane surface and moves along a straight line or reciprocates, and where the stylus is actuated by means other than electro-magnetic means.

Many modifications may be made in the general structure of the mechanism and arrangement which I employ without departing in any way from its generic spirit. I desire by the annexed claims which are intended to point out the particular novel features of my invention, to cover all such modifications.

What I claim is:

1. In a chronograph, a record member to be moved at uniform speed, an actuating device, a coil spring, one end of said spring being connected to said member and the other end to said device, said spring being intermittently energized by said actuating device, and means for causing said member to be continuously moved at uniform speed by said spring.

2. In a chronograph, a member to be moved at uniform speed, an intermittently energized motor connected to said member and which tends to impart impulses to said member, means comprising a fly-wheel for causing said member to be moved by said motor at the uniform speed, and step-up gearing between the record member and the fly-wheel.

3. In a chronograph, a record surface, a motor for moving the same, means for making a time record on said surface, and a single timing device for controlling both said motor and said means for making a record on said surface.

4. In a chronograph, a record member to be driven at uniform speed, an intermittently energized motor connected to said record member, and which imparts impulses to said member, means also connected to said member for causing said member to be continuously moved at uniform speed by said motor, and means for making a time record upon said member as it is moved.

5. In a chronograph, a record surface to be driven at uniform speed, an intermittently energized motor connected to said surface and which imparts impulses to said surface, means also connected to said surface for causing said surface to be continuously moved at uniform speed by said motor, a second motor for making a time record on said surface as it is moved by the first motor, and a timing device common to both motors for controlling their operation.

6. In combination a chronograph comprising a record bearing member, suitably mounted to rotate, an electro-magnet for rotating said member, a ratchet wheel moved intermittently by said magnet, a coiled spring connection between said ratchet member and record member, a fly-wheel geared to the record member for insuring the revolution of said record member at absolutely constant and uniform speed, means for making a time record on said member, a clock for controlling said means, and means

whereby said electro-magnet is energized simultaneously with the making of a record on said member.

7. In combination a record bearing member, a motor for rotating the same geared thereto by a yielding connection, a means for making a record on said surface, and a time piece which causes the simultaneous operation of said record making means, and said motor.

8. In combination, a record bearing member, an electro-magnet for driving the same, an intermittent grip device between said electro-magnet and said record bearing member, a yielding connection from said intermittent grip device to said drum, electrically operated means for making the time record on said member, a chronometer, and electric circuits closed by the chronometer at regular intervals to cause the simultaneous energization of the electrical recording means and the driving electromagnets.

9. A record bearing member, means for electrically driving the same, means for electrically operating a recording device, and a chronometer which simultaneously energizes said electric driving means, and said electrically operated recording device.

10. In a chronograph, a cylindrical record bearing member, a record making device, means for operating said record making device at regular intervals to record those intervals, means for moving said record making device and cylinder record relatively, whereby a record of time intervals is made on the cylindrical member in helical form, and a common controlling means which controls simultaneously both said means for operating said record making device, and said means for moving said device and cylinder record relatively.

11. In a chronograph, a record bearing member, recording means, and a motor which causes relative movement of said recording means and record bearing member, whereby a continuous linear record is formed, and a chronometer which controls said motor and also controls the operation of the recording means at regular intervals.

12. In a chronograph, a record bearing member, an electrical recording means, an electro-magnet for moving said recording means and record member relatively to each other, circuits from a source of power both to said recording means and to said magnet, and a chronometer which causes the closing of said circuits to energize the electric recording means to record and said magnet to cause a relative movement of the recording means and record bearing member.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

THEODORE T. FITCH.

Witnesses:
THOMAS DURANT,
JOHN R. TARBOX.