PATENT SPECIFICATION

Convention Date (Czecho Slovakia): Sept. 4, 1929.

358,673

Application Date (in United Kingdom): Sept. 4, 1930. No. 26,457/30.

Complete Accepted: Oct. 15, 1931.

COMPLETE SPECIFICATION.

Improvements in Electromagnetic Escapements for Clock Mechanisms.

I, ROBERT MICHL, of Kosice, Ederova Ulica 6, Elektrana, Czechoslovakia, of Czechoslovakian nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It is known that in clock mechanisms driven by weights or springs, in order to allow the mechanism to run down uniformly, mechanical escapements are used, for example, a pendulum or anchor escapement. Even if these devices have reached a very high degree of perfection completely synchronous running of several clocks cannot be obtained, apart from the time-consuming regulation and controlling.

In contradistinction to this the present invention is characterised by this that the running down of the clock mechanism is checked synchronously by means of small continuously rotating electrical synchronising machines or alternating current inductors using alternating currents with chronometrically constant frequency and so the completely uniform and accurate running of clocks with such escapement is obtained.

Since, however, in practice in the alternating current supply conductors to which such clocks can be attached failures occur which would be transmitted to such clocks, it is desirable to combine with such synchronous escapement a mechanical escapement, so that the latter operates during the failure of the electrical current and thereby a stoppage of the clock and false indication of the time is avoided. The difference of running as a result of a mechanical escapement during the period of interruption can be neglected because, on account of the usual comparatively short duration of the interruption it is so small as not to be noticeable.

In the accompanying drawing a constructional example of the combination of the present synchronising escapement with pendulum escapement is illustrated diagrammatically, the clock mechanism not being shown.

In this example the driving shaft b operated by the clock mechanism, which is not shown but which includes a mainspring or driving weight, has arranged on it a differential gear which consists of the bevel wheels c, d and e. The bevel wheel e with its hub and axis f rigid on the shaft b is a planetary wheel between the two oppositely situated bevel wheels c and d which are freely rotatable on the driving shaft b so that the power of the driving mechanism is transmitted to it through the differential gear. The electric synchronising escapement is obtained, for example, by means of the synchronous rotating rotor g and the stator winding t of a small synchronous machine or a motor of the known kind (for example, the motor described in British Specification No. 191,313). The drive is effected through the one bevel wheel d and the wheel i fixed on its nave through the worm gear h on the spindle of the rotor g. The mechanical escapement is illustrated diagrammatically and by way of example by the pendulum m and the escapement wheel n. This is secured to the nave of the other bevel wheel c of the differential gear and is driven by it. The pendulum m is caught by the pin m^1 in its extreme position by means of the pawl p on the lever k which is rotatable about the pin k^1 and on the one side is loaded with the weight k^{11}. On the other side the lever k engages with the sliding sleeve w^1 which is held in its lower position by the two centrifugal pendulums w when swung outwards, as in the position illustrated, that is, when the electrical escapement is in operation, in which the pendulum m is caught in its extreme position. When the two centrifugal pendulums w fall into the position of rest the sliding ring w^1, and thereby the lever k with its pawl p, is brought into the upper position and the escapement pendulum m and the mechanical escapement are released, so that the latter at once comes into operation because the pendulum m is only caught in it extreme position. Instead of the centrifugal pendulums w an electromagnet can also control the lever k in such a manner that when the current is interrupted the escapement pendulum m is released and on the

return of the current is caught.

Since when the alternating current supplied to the coil *t* of the synchronous escapement fails, the checking action stop, in order to avoid racing of the synchronous rotor *g*, an electromagnetic brake *r* is provided on its circumference which releases its armature and thereby at once brakes the rotor when the current fails, and when the current returns, withdraws the braking armature and leaves the rotor *g* again free to rotate, whereupon it falls into synchronism under the action of the driving force of the clock mechanism by means of the centrifugal pendulums *w* when the synchronous speed is attained. Racing of the rotor *g* of the escapement when the current is interrupted can also be avoided without the brake *r* by the transmission gear *h* of the rotor *g* being fitted with a one-way worm gear, so as to be self-stopping. In this case the rotor *g* will alway stand still when the current fails, but will not start again when it returns. The starting can be effected by means of a known electromagnetic starting arrangement or, also, by means of a Ferraris disc and thereby also the synchronisation of the rotor *g* is obtained with the assistance of the synchronising pendulums *w*.

In order to secure an uninterrupted running of such clocks it is desirable to provide them with a self-winder as known by means of Ferraris discs for maintaining the mainspring wound up.

Since in the present synchronous electrical escapement and also in the braking magnet *r* only extremely small alternating currents are used, which can operate therefore quite small magnet coils, it is desirable, with the object of more convenient manufacture of these coils to operate them with a small voltage, for example, the secondary voltage of a bell transformer. Since, however, such a small voltage is not everywhere available it is desirable, in order to avoid the provision of a separate bell transformer, to use an alternating current magnet coil which is continuously traversed by current, for example, that of a known clock winder with Ferraris discs which is to be wound like a transformer coil in differential connection so that to its tappings the correspondingly wound current coils *t* and *u* of the electrical escapement and the braking magnet *r* can be connected.

A diagram of this connection is illustrated in the drawing. *s* is the current coil of the Ferraris winding device which can be attached directly to a voltage of, for example 220 volts. The coil *t* of the escapement and the coil *u* of the braking magnet *r*, as is clear from the diagram, are connected in differential connection to the tappings of this coil. Of course, this differential connection is not necessary, because the small voltage can be induced in a secondary winding separated or electrically insulated from the coil *s* by the alternating magnetic flux of the self winder.

The combined synchronous electric and mechanical clock escapement illustrated in the drawing operates in the following manner.

When there is no current the mechanical pendulum escapement operates, but as soon as the current coil *t* of the electrical escapement and the current coil *u* of the braking magnet *r* are traversed by alternating current the armature of this magnet is attracted and the rotor *g* is thereby released and then, under the influence of the driving force of the clock (for instance a spring or weight drive) is set in motion with gradually increasing speed from the differential gear. As soon as the speed of rotation has risen nearly up to the synchronous speed the rotor falls into synchronism under the influence of the already mentioned synchronising action of the centrifugal pendulum *w*. At the same time the sliding ring w^1 and thereby the lever *k* and its pawl *p* are pressed into the lower position by the centrifugal pendulum *w*, in which position the escapement pendulum *m* catches in the pawl *p* in its extreme position. The normal operating condition is thus obtained which lasts as long as an alternating current flows through the coils of the rotor *g* and the braking magnet *r*. The tendency of the main spring to drive the shaft *b* at an increasing speed is prevented by the counter action of the rotor *g* which has the tendency to check a higher speed and opposes the main spring action, and further by the pendulums *w* which swing out further and give a higher resistance. When the current fails the armature of the braking magnet *r* is released and at once brakes the rotor *g* so that the escapement pendulum *m* is released by the swinging of the lever *k* and of its pawl *p* due to the sinking of the centrifugal pendulums *w* and so the mechanical escapement is set in operation. Pawl *p* is prevented from clockwise rotation by a pin p^1 on the lever *k*. When the current returns, the cycle of operations is repeated. The present electrical synchronous escapement uses very little energy on account of the small friction in its drive but sends a small current according to the amount of the check action into the current conductor.

The synchronous escapement can, of course, be effected not only in the form

described, but also with any desired suitable small synchronous machine or synchronous motor or generator.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An escapement for clock mechanisms driven by weights or springs, characterised by the feature that the checking of the running down of the driving mechanism is effected synchronously by means of small continuously running electrical synchronous machines or alternating current inductors using alternating currents.

2. An escapement according to claim 1, characterised by the feature that the synchronous rotating alternating current escapement is combined with a known mechanical escapement, for example with pendulum or anchor with the interposition of a differential gear, so that when the current fails the checking or driving of the clock is not interrupted, but is effected mechanically.

3. An escapement according to claims 1 and 2, characterised by the feature that on the rotor of the synchronous rotating alternating current escapement an electrical braking device is arranged which prevents the rotation of the rotor wheel while the current is interrupted and releases it when the current returns.

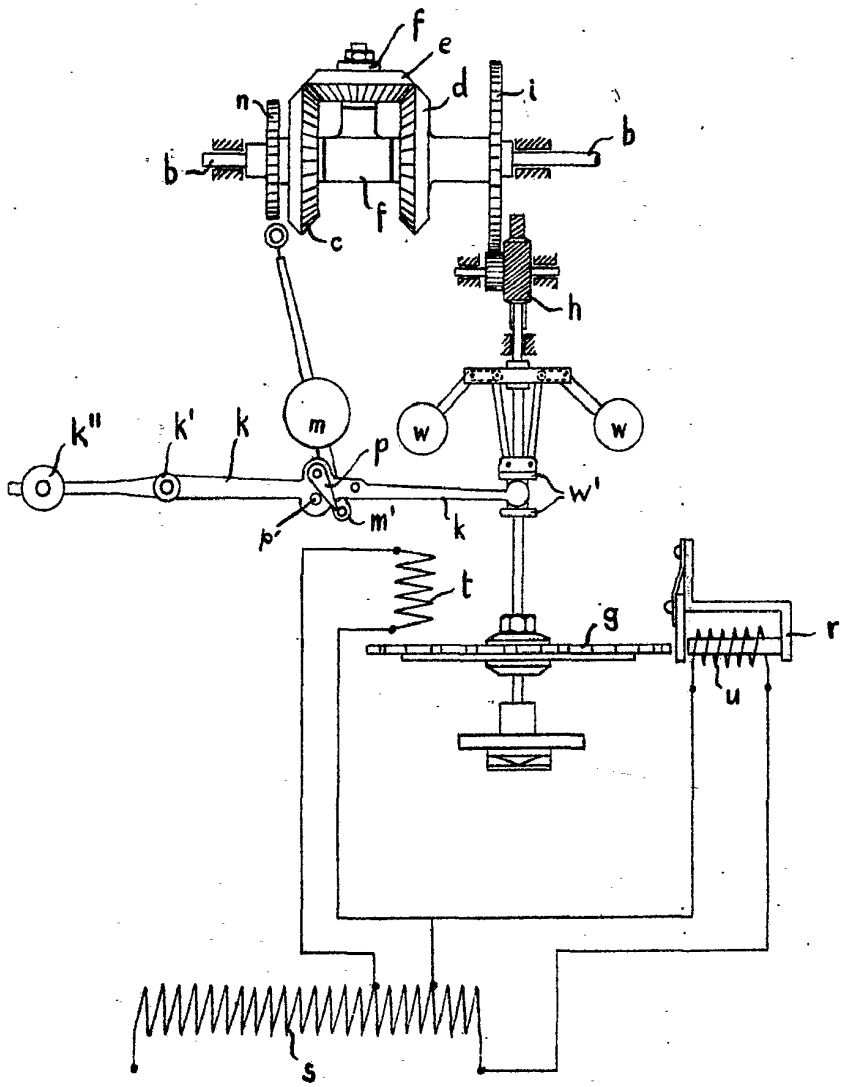
4. An escapement according to claims 1 to 3, for clock mechanisms with self-winders, characterised by the feature that the small alternating voltage required to be applied to the current coils of the synchronous escapement is induced by the alternating magnetic flux of the self-winder.

5. The improved escapement for clock mechanisms substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 2nd day of September, 1930.

MARKS & CLERK.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1931.



Charles & Read Ltd. Photo Litho