PATENT SPECIFICATION

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Complete Accepted: Apr. 7, 1921.

PROVISIONAL SPECIFICATION.

Improvements in and relating to the Synchronisation of Clocks.

We, WILLIAM SAMMONS HUBBARD, of "Byfield," Stoneygate Road, Leicester, Consulting Engineer, ISAAC HARDY PARSONS, of the Croft, Kibworth Harcourt, near Leicester, Electrical Engineer, and ALFRED ERNEST JOSEPH BALL, of 212, East Park Road, Leicester, Clockmaker, do hereby declare the nature of this invention to be as follows:—

This invention relates to the synchronisation of clocks by controlling the pendulum, balance or equivalent by means of periodic impulses.

These impulses may be electric, pneumatic, hydraulic, or mechanical, and this invention is particularly applicable to periodic electrical impulses such as are employed for the operation of electric impulse clocks, or periodic impulses employed similarly for pneumatic or hydraulic clocks or the like.

In carrying this, our invention, into effect, we preferably affect the control of pendulums by applying the said control at the moment when the pendulum is at or about its most susceptible position; that is to say, at about the end of its arc.

We may utilise the said periodic impulses to control the pendulum by employing such impulses to apply friction momentarily to the pendulum when at its most susceptible position, and the control action introduced by friction operates as follows:—

In the event of the pendulum being fast, it will have reached its maximum arc, and will be travelling inward at the moment of the impulse, and will, therefore, receive a slight check from the applied friction at each periodic impulse, until brought (and held) under control.

On the contrary, if the pendulum is slow, at the moment of the impulse it will not have completed its outward swing, and, on the application of friction, it will be caused to commence its inward swing earlier than otherwise, through the earlier termination of the said swing. This action will be repeated at each impulse until the pendulum is brought (and held) under control.

As the control operates at the end of the pendulum's arc, there is no risk of the pendulum being stopped by the applied friction.

We may apply this, our invention, to either pendulums which perform an even number of beats per half minute (or other period of synchronising impulse), or which perform an even number of beats during a recurring multiple of half a minute or other periodic impulse.

For instance, if a pendulum which it is desired to control, performs, say, 35 beats per half minute, the control would not come into operation every half minute, but performing, as it would, 70 beats per minute, the pendulum would come under control once per minute only.

In like manner, a pendulum performing 36½ beats per half minute would not come under control every half minute or minute, but would come under control every two minutes. Much longer intervals of control may be successfully employed, provided that either the time-keeping error of the pendulum is not excessive, or that the magnet be of suitable power.

When starting up a clock to which this, our control, is applied, it is only necessary to set the hands to time, and in the event of the pendulum not being in synchronisation, it sooner or later gains or

[*Price* 1/-]

loses a swing or part of a swing, and so comes under the influence of the periodic impulse.

In applying this, our invention, to pendulums and when employing electrical impulses, we in one form thereof attach to one side of the pendulum a spring-supported or pivotted armature which we dispose approximately at right angles to the length of pendulum, and in the plane of its swing. The spring-supported or pivotted armature may rest on a fixed stop which may be adjustable.

We fix apart from the pendulum, and on the same side of the pendulum as the armature, an electro-magnet so disposed that the armature in swinging (with the pendulum) passes close under (or over), but does not normally touch the poles.

We preferably face the electro-magnet or the armature with non-magnetic material such as brass, and bevel off the engaging ends of such facing, to prevent butting.

We may fix two armatures to the controlling pendulum, and two control magnets or equivalent may be employed, one on either side of the pendulum, or one controlling magnet and two suitably disposed armatures may be employed.

One advantage of the dual arrangement is that more frequent control may be effected with pendulums which otherwise would only receive control at comparative long intervals.

We may provide the pendulum with a rigid bracket, and mount the armature and spring or equivalent apart from the pendulum, and dispose the parts so that an extension of the armature is able to suitably engage the above mentioned rigid bracket.

We may increase the frictional or brake control of the armature and magnet by serrating or corrugating or otherwise shaping the respective faces, or by doubling the frictional faces by allowing the armature to pass between two surfaces, so as to increase the friction, or improve the desired controlling action. We may cover one or both faces with a material having a high coefficient of friction, so as to increase the friction, and consequently the controlling effect.

We may serrate one face only, and provide the other with a chisel-shaped pointer, which may or may not be spring mounted.

It is obvious that air or water may be employed to operate the frictional brake control of the pendulum, a diaphragm or equivalent, or a plunger or piston, taking the place of the electro-magnet, and a mechanical friction appliance taking the place of the armature and its frictional face.

Dated this 14th day of January, 1920.

WILLIAM SAMMONS HUBBARD,
ISAAC HARDY PARSONS,
ALFRED E. J. BALL.

COMPLETE SPECIFICATION.

Improvements in and relating to the Synchronisation of Clocks.

We, WILLIAM SAMMONS HUBBARD, of "Byfield," Stoneygate Road, Leicester, Consulting Engineer, ISAAC HARDY PARSONS, of the "Croft," Kibworth Harcourt, near Leicester, Electrical Engineer, and ALFRED ERNEST JOSEPH BALL, of 212, East Park Road, Leicester, Clockmaker, 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:—

This invention relates to the synchronisation of clocks by controlling the pendulum, balance or equivalent by means of periodic impulses.

These impulses may be electric, pneumatic hydraulic, or mechanical, and this invention is particularly applicable to periodic electrical impulses such as are employed for the operation of electric impulse clocks, or periodic impulses employed similarly for pneumatic or hydraulic clocks, or the like.

In carrying this, our invention, into effect, we preferably effect the control of pendulums by applying the said control at the moment when the pendulum is at or about its most susceptible position; that is to say, at about the end of its arc.

We may utilise the said periodic impulses to control the pendulum by employing such impulses to apply friction momentarily to the pendulum when at its most susceptible position, and the control action introduced by friction operates as follows:—

In the event of the pendulum being fast, it will have reached its maximum arc, and will be travelling inward at the moment of the impulse, and will, therefore, receive a slight check from the applied friction at each periodic impulse until brought (and held) under control.

On the contrary, if the pendulum is slow, at the moment of the impulse, it will not have completed its outward swing, and, on the application of friction, it will be caused to commence its inward swing earlier than otherwise through the earlier termination of the said swing. This action will be repeated at each impulse until the pendulum is brought (and held) under control.

As the control operates at the end of the pendulum's arc, there is but small risk of the pendulum being stopped by the applied friction.

We may apply this, our invention, to either pendulums which perform an even number of beats per half minute (or other period of synchronising impulse) or which perform an even number of beats during a recurring multiple of half a minute or other periodic impulse.

For instance, if a pendulum which it is desired to control, performs say, 35 beats per half minute, the control would not come into operation every half minute, but performing, as it would, 70 beats per minute, the pendulum would come under control once per minute only.

In like manner, a pendulum performing $36\frac{1}{2}$ beats per half minute would not come under control every half minute or minute, but would come under control every two minutes. Much longer intervals of control may be successfully employed, provided that either the time-keeping error of the pendulum is not excessive, or that the magnet be of suitable power.

When starting up a clock to which this, our control, is applied, it is only necessary to set the hands to time, and in the event of the pendulum not being in synchronisation, it sooner or later gains or loses a swing or part of a swing, and so comes under the influence of the periodic impulse.

In applying this, our invention, to pendulums, and when employing electrical impulses, we, in one form thereof attach to one side of the pendulum a spring-supported or pivotted armature which we dispose approximately at right angles to the length of pendulum, and in the plane of its swing. The spring-supported or pivotted armature may rest on a fixed stop which may be adjustable.

We fix apart from the pendulum, and on the same side of the pendulum as the armature, an electro-magnet so disposed that the armature in swinging (with the pendulum) passes close under (or over), but does not normally touch the poles.

We preferably face the electro-magnet or the armature, with non-magnetic material such as brass, and bevel off the engaging ends of such facing, to prevent butting.

We may fix two armatures to the controlling pendulum, and two control magnets or equivalent may be employed, one on either side of the pendulum, or one controlling magnet and two suitably disposed armatures may be employed.

One advantage of the dual arrangement is that more frequent control may be effected with pendulums which otherwise would only receive control at comparative long intervals.

We may provide the pendulum with a rigid bracket, and mount the armature and spring or equivalent apart from the pendulum, and dispose the parts so that an extension of the armature is able to suitably engage the above mentioned rigid bracket.

We may increase the frictional or brake control of the armature and magnet by serrating or corrugating or otherwise shaping the respective faces, or by doubling the frictional faces by allowing the armature to pass between two surfaces, so as to increase the friction, or improve the desired controlling action. We may cover one or both faces with a material having a high co-efficient of friction, so as to increase the friction, and consequently the controlling effect.

We may serrate one face only, and provide the other with a chisel-shaped pointer, which may or may not be spring mounted.

It is obvious that air or water may be employed to operate the frictional brake control of the pendulum, a diaphragm or equivalent, or a plunger or piston, taking the place of the electro-magnet, and a mechanical friction appliance taking the place of the armature and its frictional face.

Referring to the annexed drawings in which like letters indicate like or equivalent parts, Fig. 1 shows in front elevation a form of the device operated electrically, and Fig. 2 shows a side view thereof.

Fig. 3 shows in front elevation a form of the device operated pneumatically, while Fig. 4 shows a side view thereof.

Referring to Fig. 1, A shows the pendulum of the clock to be controlled, and B an armature which is attached to the pendulum by the spring B^2 and rests on the fixed adjustable stop shown at B^3, which latter is carried by the bracket B^4 attached to the pendulum A.

The armature B is faced with a non-

magnetic facing B^1, and, in swinging with the pendulum, the armature passes close under, but its facing does not touch the poles of the magnet C. The poles are better shown in Fig. 2.

C^4 shows a bracket which secures the magnet C to the back of the clock case, or to other convenient fixture. Referring to Fig. 2, A shows the pendulum, and C the magnet, and C^1 and C^2 the poles, which are preferably brought comparatively close together, as shown, so that the armature may be narrow, and consequently the frictional disturbance which occurs on the armature being attracted is kept as central as possible in relation to the pendulum.

This synchronising device operates as follows:—

At each half minute or other period of periodical impulse as hereindescribed, or at each such effective impulse, the armature passes close under the poles C^1 and C^2 of the magnet C, with its non-magnetic face just clearing the said poles.

At such instant of impulse, an electric current flows momentarily through the magnet C, and the armature being attracted, it contacts momentarily with the poles C^1 and C^2. In the event of the pendulum being fast, it will have reached the end of its swing, and would be returning, with the result that it would receive a slight check by the frictional contact between the armature and the magnet poles, and the pendulum would, in consequence, be retarded.

If, on the other hand, the pendulum be slow, at the instant of the momentary periodic flow of current, the pendulum will not have quite reached the end of its swing, and in consequence of the slight check it receives, that particular swing will be terminated sooner, with the result that the succeeding swing is also commenced sooner and consequently the pendulum will be advanced and maintained in synchronisation by the repetition of this action, as hereindescribed.

Referring to Fig. 3 which shows the pneumatic equivalent of the foregoing electrically operated device, A shows the pendulum, B^4 a rigid bracket carrying the friction block B, and C^1 a corresponding friction block mounted on a pivotted lever C^5, which lever is fulcrumed at C^6 and connected to a pneumatic bellows C, by a connecting piece C^7. C^4 shows a bracket which secures the bellows to the back of the clock case or equivalent fixture. C^8 shows an air-duct which connects the bellows C, with the air pressure system controlled by the pneumatic master clock not shown, but which is well known to the art.

The device operates as follows:—On the periodical pneumatic impulse being received by the bellows C, the lever C^5 is depressed by the elongation of the said bellows, and the under-surface of the friction block C^1 is brought into contact with the upper surface of the block B, and the resulting frictional check produced brings about the synchronisation of the pendulum as hereinbefore described.

It is understood that the lever C^5 may be operated by hydraulic or mechanical means, instead of pneumatically.

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

1. A pendulum controlling and synchronising device comprising a fixed member receiving periodic electrical, pneumatic, hydraulic, or mechanical impulses, and arranged to co-act with a member attached to and swinging with the pendulum, a friction device adapted to introduce friction between the fixed member and the swinging member, the whole being disposed and adapted so that the periodic impulse operates the friction means at or near the end of the pendulum's swing on the receipt of the momentary impulse as hereindescribed.

2. In a pendulum controlling and synchronising device comprising an electro-magnet fixed at the side of the pendulum in a line with its path, an armature pivotally mounted, attached to the pendulum, and swinging therewith, and disposed so that it passes across, but does not touch the poles of the electro-magnet, and adapted so that it comes into momentary and frictional contact with the said poles on a momentary current flowing at periodic intervals.

3. Improved pendulum synchronising devices constructed and operated as hereindescribed and shown.

Dated this 15th day of October, 1920.

W. S. HUBBARD.
I. HARDY PARSONS.
ALFRED E. J. BALL.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1921.

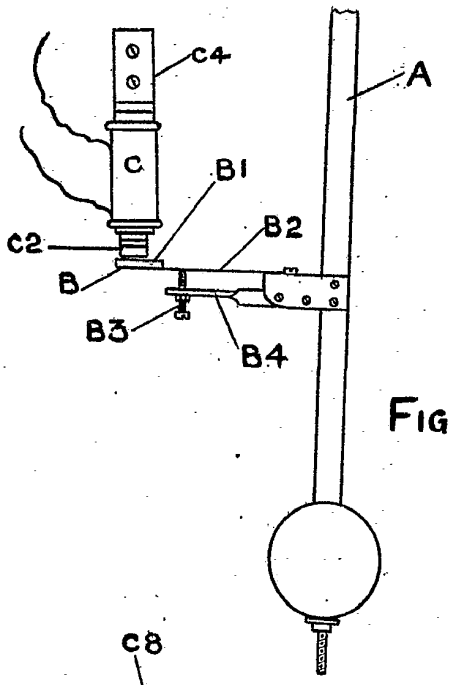

FIG. 1

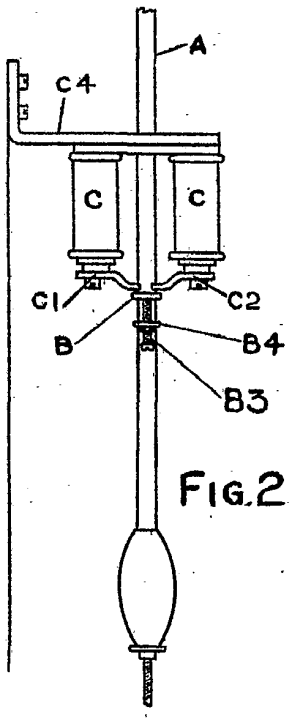

FIG. 2

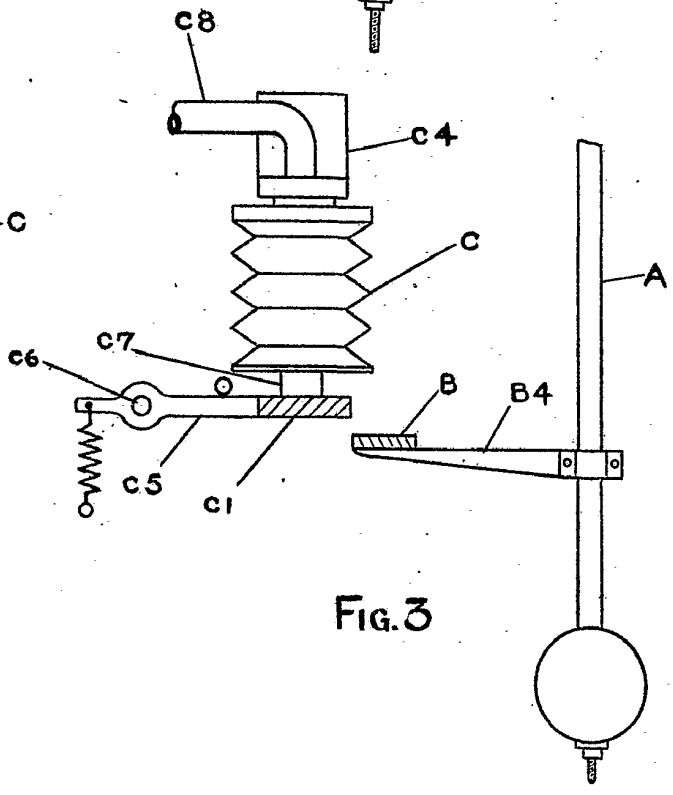

FIG. 3

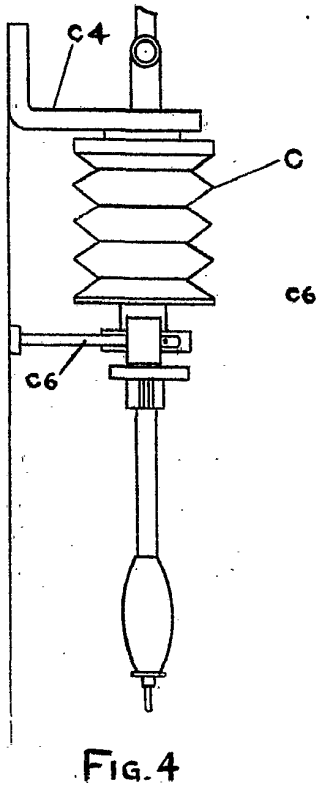

FIG. 4

Malby&Sons, Photo-Litho