(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 036 350 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
08.04.2009 Bulletin 2009/15

(21) Application number: **99905362.2**

(22) Date of filing: **12.02.1999**

(51) Int Cl.:
G04C 1/08 *(2006.01)* ***G04C 9/00*** *(2006.01)*
G04B 1/02 *(2006.01)* ***G04B 27/00*** *(2006.01)*

(86) International application number:
PCT/NL1999/000073

(87) International publication number:
WO 1999/042909 (26.08.1999 Gazette 1999/34)

(54) PENDULUM CLOCK AND METHOD FOR THE MODIFICATION OF A PENDULUM CLOCK

PENDELUHR UND VERFAHREN ZUR VERÄNDERUNG EINER PENDELUHR

PENDULE A BALANCIER ET PROCEDE DE MODIFICATION ASSOCIE

(84) Designated Contracting States:
AT BE CH DE ES FR GB IT LI NL PT

(30) Priority: **21.02.1998 NL 1008384**
23.03.1998 NL 1008595

(43) Date of publication of application:
20.09.2000 Bulletin 2000/38

(73) Proprietor: **Spaander, Melgert**
2701 ED Zutphen (NL)

(72) Inventors:
- **SPAANDER, Melgert**
NL-7201 ED Zutphen (NL)
- **HOENCAMP, Menno, Bart**
NL-7201 EK Zutphen (NL)

(74) Representative: **Uittenbogaart, Gustaaf Adolf**
Indeig B.V.
Bloemendaalseweg 277A,
P.O. Box 3
2050 AA Overveen (NL)

(56) References cited:
DE-U- 9 406 358 **DE-U- 29 618 222**
GB-A- 670 972

- **PATENT ABSTRACTS OF JAPAN vol. 6, no. 66 (P-112), 27 April 1982 & JP 57 006382 A (RHYTHM WATCH CO LTD), 13 January 1982**

EP 1 036 350 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The invention relates to a pendulum clock in accordance with the preamble of claim 1.

[0002] Pendulum clocks of this type are well known. The invention more specifically relates to pendulum clocks of the above type with a historical or art-historical value, which are at risk and are eventually liable to disappear due to ever continuing rationalization schemes that are carried through in modern society, or which are modernized in such a way that severe damage is done to the cultural heritage.

[0003] The problem with the known pendulum clocks is that they require constant attention. They must be wound up with a crank at the location of the clock and must be regularly set right. The setting of the summer time and the winter time twice a year entails a relatively complex operation, especially because the hands of larger pendulum clocks often have to be turned with great difficulty forward or backward. In order to reduce costs it is therefore often decided to replace the entire pendulum clock by a modern clockwork and to maintain only the original hands.

[0004] The following documents describe solutions that try to improve this situation.

[0005] Document DE 29618222 discloses a device for automatically winding up a pendulum clock using an electric motor as activator. The activator can rotate the wind up drum using a chain drive with a chain wheel attached to the wind up drum.

[0006] Document DE 9406358U discloses a device for winding up a pendulum clock. A cable is looped around the wind up drum an on its one end hangs the weight and the other end can be wound up on a winch.

[0007] The disadvantage of the known devices is that during winding up of the wind up drum the pendulum keeps oscillating and this may cause damage to the clock. The object of the invention is to avoid this disadvantage. And therefore the pendulum clock is in accordance with claim 1. The advantage of this solution is that the pendulum clock as such is not modified. The only item added are in fact the arresting means to stop the pendulum. By stopping the pendulum during the winding of the wind up drum damage to the clock is avoided. Preferably, this is done in an extreme position of the pendulum, when the velocity is zero, such that there is no additional load on the pendulum clock. Stopping the pendulum is advisable during winding up, because during winding up no driving forces act on the clockwork and its behaviour is undetermined at that moment. Especially when introducing an actuator, with a limited span, necessitating frequent winding up, this could lead to an unpredictable deviation in the timekeeping. Moreover the cable or chain, originally ending at a connecting point on the drum, must be extended or a piece of cable or chain must be added. Both modifications are evidently 100% reversible and no original parts of the clock, like the weight, will be lost.

[0008] A favourable embodiment of the pendulum clock is according to claim 2. It is then possible to ascertain that the pendulum approaches an extreme position and to activate the arresting means with the pendulum substantially in an extreme position.

[0009] According to another embodiment of the invention, the pendulum clock may be set much easier. For that purpose the pendulum clock is according claim 3 wherein the control unit is provided with reference time measurement means and the pendulum clock is adjusted such that it is faster than the reference time measurement means. Setting the clock may then simply take place by activating the arresting means until the moment that the pendulum clock displays the same time as the reference time measurement means.

[0010] A favourable embodiment of the pendulum clock is according to claim 4 wherein the clock may be set completely automatically. The pendulum clock is thereto characterized in that the control unit is arranged for counting the number of oscillations of the pendulum with the sensor and for periodically activating the arresting means for synchronizing the pendulum clock.

[0011] According to another embodiment the pendulum clock is according to claim 5. In this way the adjusting of the clock to summer or winter time can be fully automated.

[0012] According to another embodiment the pendulum clock is according to claim 6. In this way the control unit can be adapted to pendulum clocks of various designs.

[0013] According to another aspect of the invention, the pendulum clock is according to claim 7. An actuator of this type is robust and will continue to work even when the mains supply incidentally fails. Moreover, a pneumatically driven cylinder entails a reduced fire risk as compared to an electromotor and it will never over wind the pendulum clock, thanks to its well-defined length. A further advantage that may be brought up is the fact that a pneumatic cylinder has a very long service life and can easily be replaced by local workers in case of failure. The same argument holds for the compressor, necessary for delivering compressed air for the pneumatic cylinder.

[0014] According to another embodiment the pendulum clock is according to claim 8. In this way, the actuator is preferably located above the weight, or at least such that a point of application of the actuator to the cable or chain is chosen such that a force on the wind up drum caused by the actuator during winding up is aligned with a force caused by the weight. This unburdens the main axis of the wind up drum during winding up, which may significantly increase the service life of the bearing of the main axis.

[0015] According to another aspect of the invention, the arresting means may be located at some distance from the pendulum, preferably in a clean, dust free room. In this embodiment the pendulum clock is according to claim 9. The thread may be glued to the pendulum, making this operation also reversible and substantially invis-

ible.

[0016] According to another embodiment the pendulum clock is according to claim 10. In this way the brake disk can be realized as a ratchet wheel, shaped as a freewheeling bearing, on its periphery provided with saw tooth shaped teeth, the pneumatic actuator being provided with a pawl that may be placed against the outer contour for arresting the disk. This enables the pendulum to completely finish a swing, after which it will be arrested automatically. An additional advantage is that, if for some reason the compressed air supply, feeding the pneumatic actuators, should cease, the clock will stay with the pendulum in its upper position, from which position it is possible to automatically restart.

[0017] The invention also relates to a control unit for the modification of an existing pendulum clock provided with a wind up drum around which a cable or a chain is coiled, to a first end of which a weight is connected. An actuator is coupled to a second end of the cable or chain and the pendulum has arresting means. In accordance with the invention the control unit can be connected to the actuator and the arresting means and is programmed such that it periodically activates the arresting means for arresting the pendulum in a predefined position, and then activates for a short time the actuator for at least partially winding up the pendulum clock, and lastly deactivates the arresting means in order to release the pendulum. In this way, the pendulum clock with the control unit can be wound up automatically without any risk of damage to the clock.

[0018] A favourable realization of the control unit is.according to claim 12. The sensor enables the arresting means to act onto the pendulum, such that substantially no additional acceleration or deceleration of the pendulum occurs.

[0019] A further favourable realization of the control unit is according to claim 13. In this way, the pendulum clock with the control unit can be set automatically.

[0020] A still further favourable realization of the control unit is according to claim 14. In this way, the pendulum clock with the control unit can switch between summer time and winter time automatically.

The invention will now be further explained with reference to the following figures, in which:

Fig. 1 schematically shows a first embodiment of the pendulum clock according to the invention;

Fig. 2 schematically shows a second embodiment of the pendulum clock according to the invention;

Fig. 3 shows a possible embodiment of pneumatic controlled arresting means;

Fig. 4 shows a possible embodiment of electromagnetic controlled arresting means;

Fig. 5A shows a possible embodiment of arresting means, located at some distance;

Fig. 5b shows arresting means based on a pneumatical controlled ratchet wheel.

[0021] Fig. 1 schematically shows a first embodiment of the pendulum clock according to the invention. Around a wind up drum 1 a cable or chain 2 is coiled a few turns, which is on one side provided with a weight 3 that delivers a driving force for a clockwork, not shown here, that finally drives a pendulum 4 and the hands, not shown here, and possibly also periodically activates striking parts, not shown here. The second end 5 of cable or chain 2 must be periodically pulled, in order to wind up the pendulum clock. During winding up weight 3 is pulled upwards, while the clock mechanism is simultaneously decoupled with the aid of an existing slip coupling or a freewheel. In the embodiment shown with reference to Fig. 1 the second end is coupled to a pneumatic actuator 6 to which periodically compressed air is fed for winding up the pendulum clock. As during the winding up no driving force is exerted on the mechanism, its behaviour at that moment is undetermined. Therefore a sensor 7 is provided which is adapted to detect pendulum 4 for being almost in an extreme position and arresting means 8 are provided for arresting pendulum 4 in the extreme position. Control unit 9 regularly checks, for example every hour, if pendulum 4 is in an extreme position; if this is the case then arresting means 8 are activated, compressed air is then fed to actuator 6 for some time, thereby winding up the pendulum clock, and finally arresting means 8 are deactivated.

[0022] Control unit 9 is arranged for checking, with the aid of sensor 7, if the pendulum clock goes and consequently if it is functioning properly. If this is not the case, a signal may be generated for preventing actuator 6 from being activated again, in this way preventing further damage to the pendulum clock, and also for warning a person responsible for the pendulum clock. Moreover control unit 9 may activate arresting means 8 and generate a warning to the person responsible on the basis of other criteria, such as the pendulum clock being much too fast or too slow.

[0023] In the above embodiment control unit 9 is a PLC, well known in the art, provided with reference time measurement means 10, for example based on a DCF wireless control, a crystal controlled clock or an atom clock. The advantage of using a PLC is that standard sensors and standard controls are available, suitable for directly connecting to the PLC. In this way sensor 7 and a control for actuator 6 and arresting means 9 are easily realized and can even after a long time be easily replaced by a local electrician.

[0024] Fig. 2 schematically shows a second embodiment of the pendulum clock according to the invention. In this embodiment pneumatic actuator 6 has been arranged such that the winding up force acts against the force on weight 3 due to gravity. This substantially unburdens the bearing of the main axis of the wind up drum 1, further not shown, which will prolong the service life of the pendulum clock. In fact, actuator 6 may be located anywhere if one or more pulleys are applied for guiding the pulling force such that the point of application is lo-

cated exactly above weight 3, as shown in this embodiment.

[0025] In the embodiment as shown, the reference time measurement means 10 of control unit 9 are moreover used for realizing good timekeeping of the pendulum clock. For that purpose the pendulum clock is adjusted in a known manner, for example by adjusting the length of pendulum 4, such that it runs fast. If pendulum 4 should swing for example 3600 periods per hour, this value is now adjusted to 3620 periods. This implies that, without corrective measures, the pendulum clock gains about twenty seconds an hour. With the aid of sensor 7 the number of periods made by the pendulum clock in on hour is exactly registered. Once every hour, if the pendulum has swung exactly 3600 times, control unit 9 activates arresting means 8, until, according to the reference time measurement means 10, the hour is full, after which arresting means 8 are deactivated. While arresting means 8 are activated the opportunity is used for winding up the pendulum clock with the aid of actuator 6. This does not necessarily have to take place every hour. Generally speaking it is better to wind up the pendulum clock a few times a day. Therefore, under the condition that space is available, actuator 6 should preferably be chosen long.

[0026] If the reference time measurement means 10 are provided with a summer time and a winter time, a summer time and a winter time can easily be realized for the pendulum clock as well, by activating the arresting means 8 at the beginning of the winter time during one hour and at the beginning of the summer time during eleven hours.

[0027] Fig. 3 shows a possible embodiment of arresting means 8, where pendulum 4 is arrested in its end position by a pawl 11. Pawl 11 is rotatably mounted on an axis 12 and has two possible positions 11a en 11b, such that for position 11a pendulum 4 may pass unhindered and for position 11b pendulum 4 is arrested. Pawl 11 is controlled in turn by a pneumatic cylinder 13, which in turn is controlled by control unit 9. For a proper timing, use can be made of a sensor 7, not shown here, connected to control unit 9. This can for example be a LED and photodiode combination, well known in the art, such that the photodiode receives light emitted by the LED and reflected by the passing pendulum, or such that the pendulum interrupts an existing light path.

[0028] Fig. 4 shows a possible embodiment of arresting means 8 where pendulum 4 is arrested in its end position by means of an electromagnet 14. The poles of electromagnet 14 are preferably provided with a layer of a soft, elastic material 15, for example rubber, which layer provides for a soft landing of the pendulum 4 and also prevents pendulum 4 from getting stuck onto electromagnet 14 due to remanent magnetism after electromagnet 14 has been switched off. This embodiment is applicable only when pendulum 4 comprises a ferromagnetic material or if it is provided with a piece of this material, which is for example glued to it.

[0029] Fig. 5A shows a possible embodiment of arresting means, located at some distance, where a thin synthetic or metal thread 16 is connected to pendulum 4 which, possibly via one or more pulleys 17, is guided to a system of two mutually coupled, rotatably mounted rollers 18,19. Thread 16 is coiled a few times around roller 18 and is finally connected to it on a point 20. A second thread 21 is connected on a point 22 to roller 19 and is coiled a few times around it. The second end of thread 21 is provided with a small weight 23. Due to the movement of pendulum 4, weight 23 will successively go up and down, which movements are easily monitored by a sensor, not shown here. The stroke of weight 23 may be selected by choosing the diameters cf the rollers 18 en 19, thus reducing it to a practical or even a standard value. The arresting as such may take place by means of a brake disk 24, by breaking the disk in a known matter, for example by pressing a piece of high friction material against it with the aid of a second pneumatic actuator. For reason of clarity, brake disk 24 is shown separated from roller 19 in Fig. 5A, but in practice it is connected to it.

[0030] Fig. 5B shows arresting means in which disk brake 24 is in fact a ratchet wheel, realized as a backrun bearing. According to the invention pawl 25 is lifted up by a second pneumatic actuator 26 during normal use of the pendulum clock. If pendulum 4 is to be arrested, actuator 26 is deactivated, which causes pawl 25 to be placed onto ratchet wheel 24. Due to the sawtooth shape of the teeth, pendulum 4 can finish its pendular movement unhindered, but in the extreme position it will be arrested by pawl 25 dropping into ratchet wheel 24. The arresting can be easily ended by activating actuator 26 again.

Claims

1. Pendulum clock provided with a wind up drum (1), around which a cable or a chain (2) is coiled, to a first end of which a weight (3) is attached wherein a second end (5) of the cable or chain (2) or an added piece of cable or chain is connected to an actuator (6), which is periodically activated by a control unit (9) for at least partially winding up the pendulum clock **characterized in that** arresting means (8) are provided for arresting the pendulum (4) in a predefined position and that the control unit (9) is designed such that before the actuator (6) is activated the pendulum (4) is arrested and the pendulum (4) is released after the actuator (6) has been deactivated.

2. Pendulum clock according to claim 1, **characterized in that** a sensor (7) is provided, connected to the control unit (9), for determining whether the pendulum (4) is substantially at the predefined position.

3. Pendulum clock according to claim 2, **characterized in that** the control unit (9) is provided with reference time measurement means (10).

4. Pendulum clock according to claim 3, **characterized in that** the control unit (9) is arranged for counting the number of oscillations of the pendulum (4) with the sensor (7) and for periodically activating the arresting means (8) for synchronizing the pendulum clock with the time measurement means (10).

5. Pendulum clock according to claim 4, **characterized in that** the control unit (9) is arranged for activating the arresting means (8) during one hour for switching from summer time to winter time and for activating the arresting means (8) during eleven hours for switching from the winter time to summer time.

6. Pendulum clock according to one of the previous claims **characterized in that that** the control unit (9) is a suitably programmed PLC,

7. Pendulum clock according to claim 1, **characterized in that** the actuator (6) comprises a pneumatically driven cylinder.

8. Pendulum clock according to claim 1, **characterized in that** a point of application of the actuator to the cable or chain (2) is chosen such that a force on the wind up drum (1) caused by the actuator (6) during winding up is in line with a force caused by the weight (3).

9. Pendulum clock according to claim 1, **characterized in that** the arresting means (8) comprise a thread (16), connected to the pendulum (4), which thread (16) is coiled around a roller (18) and that the roller (18) is provided with a brake disk (24) on which a brake may act.

10. Pendulum clock according to claim 9, **characterized in that** the brake disk (24) is realized as a ratchet wheel which can be activated.

11. Control unit (9) suitable for the modification of an existing pendulum clock provided with a wind up drum (1), around which a cable or a chain (2) is coiled, to a first end of which a weight (3) is connected, wherein an actuator (6) is coupled to a second end of the cable or chain (2) **characterized in that** the pendulum (4) has arresting means (8), and further **characterised in that** the control unit (9) can be connected to the actuator (6) and the arresting means (8) and is programmed such that it periodically activates the arresting means (8) for arresting the pendulum (4) in a predefined position, and then activates the actuator (6) for at least partially winding up the pendulum clock, and lastly deactivates the arresting means (8) in order to release the pendulum (4).

12. Control unit (9) according to claim 11, **characterized in that** the control unit (9) includes a sensor (7) for determining a predefined position of the pendulum (4).

13. Control unit (9) according to claim 12, **characterized in that** the control unit (9) includes reference time measurement means (10) and a synchronisation program that determines a number of oscillations of the pendulum (4) detected by the sensor (7) in a predefined time span measured with the reference time measurement means (10), and which synchronisation program activates the arresting means (8) for temporary arresting the pendulum (4) for obtaining a synchronisation between the pendulum clock and the reference time measurement means (10).

14. Control unit according to claim 12, **characterized in that** a time switching function is added for switching from summer time to winter time and from winter time to summer time, which switching function activates the arresting means (8) during one hour or during eleven hours.

Patentansprüche

1. Pendeluhr, mit einer Wickeltrommel (1), auf welcher ein Kabel oder eine Kette (2) aufgewickelt ist, wobei an ein erstes Ende ein Gewicht (3) angeschlossen ist, und wobei ein zweites Ende (5) des Kabels oder der Kette (2) oder eines zusätzlichen Stückes des Kabels oder der Kette mit einem Antrieb (6) verbunden ist, der periodisch von einer Kontrolleinheit (9) aktiviert wird und die Pendeluhr wenigstens teilweise aufzieht, **dadurch gekennzeichnet, dass** Blockiermittel (8) vorgesehen sind, um ein Pendel (4) in einer bevorzugten Position festzusetzen, wobei die Kontrolleinheit (9) so eingerichtet ist, dass vor einer Aktivierung des Antriebes (6) das Pendel (4) blockiert ist und das Pendel (4) freigegeben wird, nachdem der Antrieb (6) deaktiviert wurde.

2. Pendeluhr nach Anspruch 1, **dadurch gekennzeichnet, dass** ein an die Kontrolleinheit (9) angeschlossener Sensor (7) realisiert ist, um festzustellen, ob sich das Pendel (4) im Wesentlichen in der bevorzugten Position befindet.

3. Pendeluhr nach Anspruch 2, **dadurch gekennzeichnet, dass** die Kontrolleinheit (9) mit einem Referenzzeitmessmittel (10) ausgerüstet ist.

4. Pendeluhr nach Anspruch 3, **dadurch gekennzeichnet, dass** die Kontrolleinheit (9) eingerichtet ist, um die Anzahl der Schwingungen des Pendels (4) mittels des Sensors (7) zu zählen und um das Blockiermittel (8) periodisch zu aktivieren, damit die Pendeluhr mit dem Referenzzeitmessmittel (10)

synchronisiert wird.

5. Pendeluhr nach Anspruch 4, **dadurch gekennzeichnet, dass** die Kontrolleinheit (9) eingerichtet ist, um das Blockiermittel (8) während einer Stunde zu aktivieren für eine Umschaltung von Sommerzeit auf Winterzeit und um das Blockiermittel (8) während elf Stunden zu aktivieren, damit von der Winterzeit auf die Sommerzeit umgeschaltet werden kann.

6. Pendeluhr nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** es sich bei der Kontrolleinheit (9) um eine geeignet programmierbare PLC handelt.

7. Pendeluhr nach Anspruch 1, **dadurch gekennzeichnet, dass** der Antrieb einen pneumatisch beaufschlagten Zylinder beinhaltet.

8. Pendeluhr nach Anspruch 1, **dadurch gekennzeichnet, dass** ein Angriffspunkt des Antriebes (6) am Kabel oder der Kette (2) ausgewählt wird, so dass eine an der Wickeltrommel (1) angreifende und von dem Antrieb (6) während des Aufwickelvorgangs erzeugte Kraft gleichgerichtet ist im Vergleich zu einer Kraft, welche durch das Gewicht (3) verursacht wird.

9. Pendeluhr nach Anspruch 1, **dadurch gekennzeichnet, dass** das Blockiermittel (8) einen an das Pendel (4) angeschlossenen Faden (16) aufweist, wobei der Faden (16) um eine Spule (18) gewunden ist und die Spule (18) eine Bremsscheibe (24) aufweist, auf welche eine Bremse einwirken mag.

10. Pendeluhr nach Anspruch 9, **dadurch gekennzeichnet, dass** die Bremsscheibe (24) als Ratschenscheibe ausgebildet ist, die sich aktivieren lässt.

11. Kontrolleinheit (9) geeignet zur Modifikation einer bestehenden Pendeluhr, die mit einer Wickeltrommel (1) ausgerüstet ist, auf welche ein Kabel oder eine Kette (2) aufgewickelt ist, wobei an ein erstes Ende ein Gewicht (3) angeschlossen ist, und wobei ein Antrieb (6) an ein zweites Ende des Kabels oder der Kette (2) angeschlossen ist, **dadurch gekennzeichnet, dass** das Pendel (4) ein Blockiermittel (8) aufweist und ferner **dadurch gekennzeichnet ist, dass** die Kontrolleinheit (9) an den Antrieb (6) und das Blockiermittel (8) angeschlossen werden kann und sich so programmieren lässt, dass sie das Blokkiermittel (8) periodisch aktiviert, um das Pendel (4) in einer bevorzugten Position festzusetzen und dann den Antrieb (6) aktiviert, um die Pendeluhr wenigstens teilweise aufzuziehen und schlussendlich das Blockiermittel (8) deaktiviert, um das Pendel (4) freizugeben.

12. Kontrolleinheit (9) nach Anspruch 11, **dadurch gekennzeichnet, dass** die Kontrolleinheit (9) einen Sensor (7) aufweist, um eine bevorzugte Position des Pendels (4) zu bestimmen.

13. Kontrolleinheit (9) nach Anspruch 12, **dadurch gekennzeichnet, dass** die Kontrolleinheit (9) ein Referenzzeitmessmittel (10) und ein Synchronisationsprogramm aufweist, welches eine Anzahl von durch den Sensor (7) erfassten Schwingungen des Pendels (4) innerhalb einer vorgegebenen Zeitspanne bestimmt, die mit Hilfe des Referenzzeitmessmittels (10) erfasst wird, wobei das Synchronisationsprogramm das Blockiermittel (8) zur zeitweisen Blockade des Pendels (4) aktiviert, um eine Synchronisation zwischen der Pendeluhr und dem Referenzzeitmessmittel (10) herzustellen.

14. Kontrolleinheit nach Anspruch 12, **dadurch gekennzeichnet, dass** eine Zeitschaltfunktion hinzugefügt wird, um von Sommerzeit auf Winterzeit und von Winterzeit auf Sommerzeit umzuschalten, wobei die Zeitschaltfunktion das Blockiermittel (8) während einer Stunde oder während elf Stunden aktiviert.

Revendications

1. Horloge à pendule, munie d'un tambour de remontage (1) autour duquel est enroulé un câble ou une chaîne (2) ayant un poids (3) fixé à une première extrémité de celui/celle-ci, dans lequel une seconde extrémité (5) du câble ou de la chaîne (2) ou une pièce rapportée du câble ou de la chaîne est reliée à un actionneur (6), qui est périodiquement activé par une unité de commande (9) pour remonter au moins partiellement l'horloge à pendule, **caractérisée en ce que** des moyens d'arrêt (8) sont prévus pour arrêter le pendule (4) dans une position prédéfinie et **en ce que** l'unité de commande (9) est conçue de telle sorte qu'avant l'activation de l'actionneur (6), le pendule (4) est arrêté et le pendule (4) est libéré après la désactivation de l'actionneur (6).

2. Horloge à pendule selon la revendication 1, **caractérisée en ce qu'**un capteur (7) est prévu, relié à l'unité de commande (9) pour déterminer si le pendule (4) est sensiblement à la position prédéfinie.

3. Horloge à pendule selon la revendication 2, **caractérisée en ce que** l'unité de commande (9) est munie de moyens de mesure de temps de référence (10).

4. Horloge à pendule selon la revendication 3, **caractérisée en ce que** l'unité de commande (9) est configurée pour compter le nombre d'oscillations du pendule (4) au moyen du capteur (7) et pour activer

périodiquement les moyens d'arrêt (8) pour synchroniser l'horloge à pendule avec les moyens de mesure du temps (10).

5. Horloge à pendule selon la revendication 4, **caractérisée en ce que** l'unité de commande (9) est configurée pour activer les moyens d'arrêt (8) pendant une heure pour passer de l'heure d'été à l'heure d'hiver et pour activer les moyens d'arrêt (8) pendant onze heures pour passer de l'heure d'hiver à l'heure d'été.

6. Horloge à pendule selon l'une des revendications précédentes, **caractérisée en ce que** l'unité de commande (9) est un contrôleur logique programmable (CLP) programmé de manière appropriée.

7. Horloge à pendule selon la revendication 1, **caractérisée en ce que** l'actionneur (6) comprend un vérin pneumatique.

8. Horloge à pendule selon la revendication 1, **caractérisée en ce qu'**un point d'application de l'actionneur sur le câble ou la chaîne (2) est choisi de manière à ce qu'une force sur le tambour de remontage (1) exercée par l'actionneur (6) pendant le remontage soit alignée avec une force exercée par le poids (3).

9. Horloge à pendule selon la revendication 1, **caractérisée en ce que** les moyens d'arrêt (8) comprennent un fil (16) relié au pendule (4), ledit fil (16) étant enroulé autour d'un rouleau (18), et **en ce que** le rouleau (18) est muni d'un disque de frein (24) sur lequel peut agir un frein.

10. Horloge à pendule selon la revendication 9, **caractérisé en ce que** le disque de frein (24) est conçu comme une roue à rochet qui peut être activée.

11. Unité de commande (9) adaptée pour la modification d'une horloge à pendule existante munie d'un tambour de remontage (1) autour duquel est enroulé un câble ou une chaîne (2), à une première extrémité duquel ou de laquelle est relié un poids (3), dans laquelle un actionneur (6) est couplé à une seconde extrémité du câble ou de la chaîne (2), **caractérisée en ce que** le pendule (4) comprend des moyens d'arrêt (8), et **caractérisée en outre en ce que** l'unité de commande (9) peut être reliée à l'actionneur (6) et aux moyens d'arrêt (8) et elle est programmée de telle sorte qu'elle active périodiquement les moyens d'arrêt (8) pour arrêter le pendule (4) dans une position prédéfinie, et elle active ensuite l'actionneur (6) pour remonter au moins partiellement l'horloge à pendule, et elle désactive enfin les moyens d'arrêt (8) afin de libérer le pendule (4).

12. Unité de commande (9) selon la revendication 11, **caractérisée en ce que** l'unité de commande (9) comprend un capteur (7) pour déterminer une position prédéfinie du pendule (4).

13. Unité de commande (9) selon la revendication 12, **caractérisée en ce que** l'unité de commande (9) comprend des moyens de mesure de temps de référence (10) et un programme de synchronisation qui détermine un nombre d'oscillations du pendule (4) détectées par le capteur (7) au cours d'un laps de temps prédéterminé mesuré par les moyens de mesure de temps de référence (10), ledit programme de synchronisation activant les moyens d'arrêt (8) pour arrêter provisoirement le pendule (4) afin d'obtenir une synchronisation entre l'horloge à pendule et les moyens de mesure de temps de référence (10).

14. Unité de commande selon la revendication 12, **caractérisée en ce qu'**une fonction de changement de l'heure est ajoutée pour passer de l'heure d'été à l'heure d'hiver et de l'heure d'hiver à l'heure d'été, ladite fonction de changement activant les moyens d'arrêt (8) pendant une heure ou pendant onze heures.

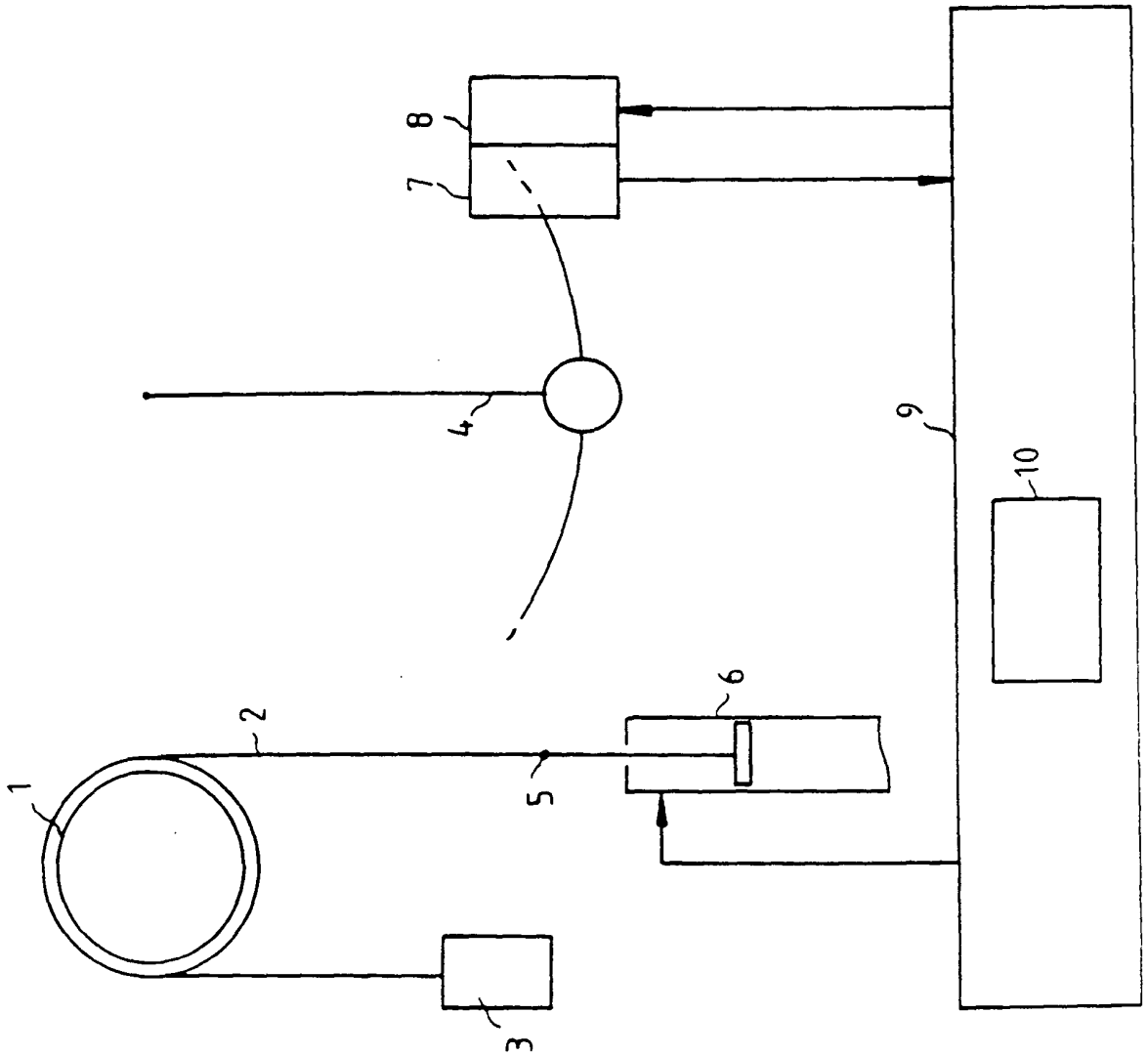

FIG.1

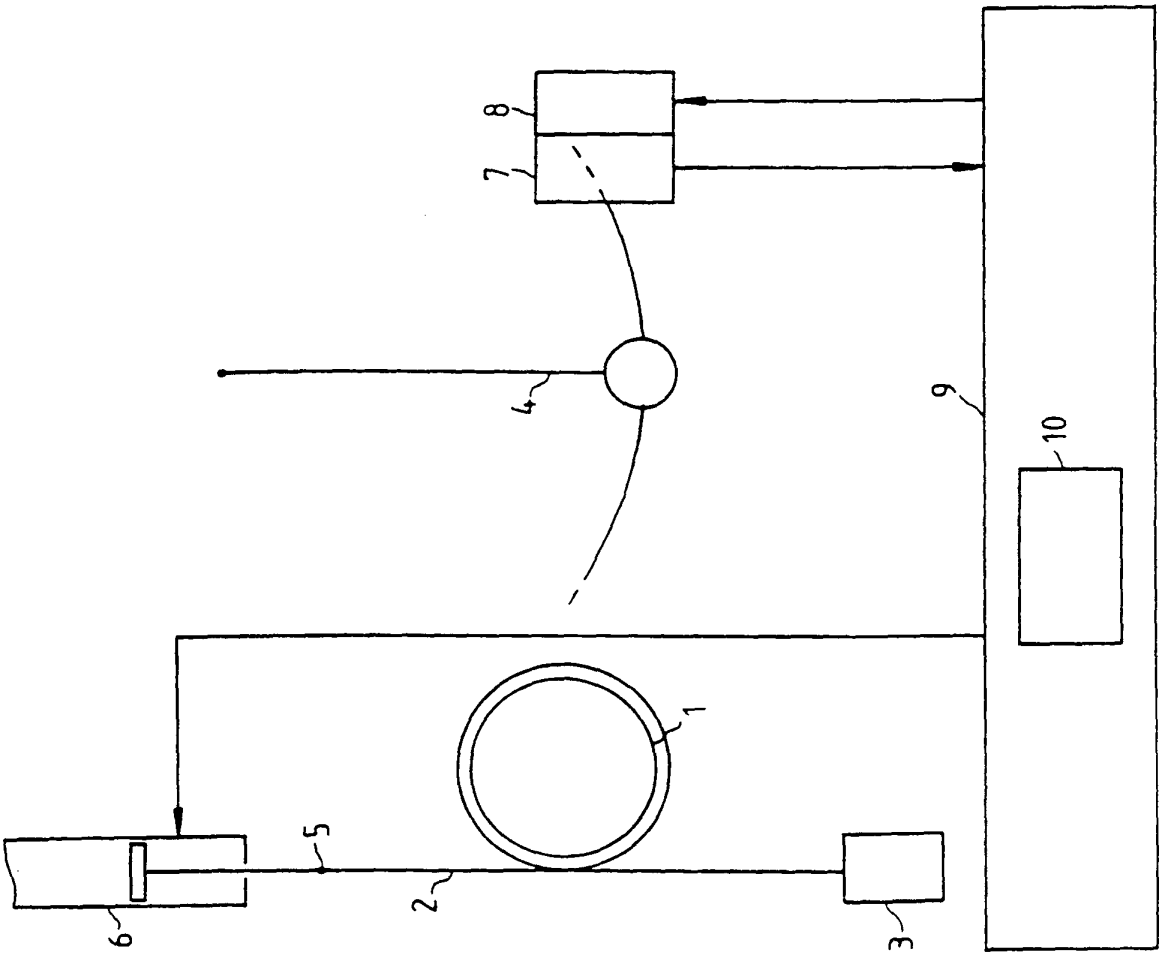

FIG.2

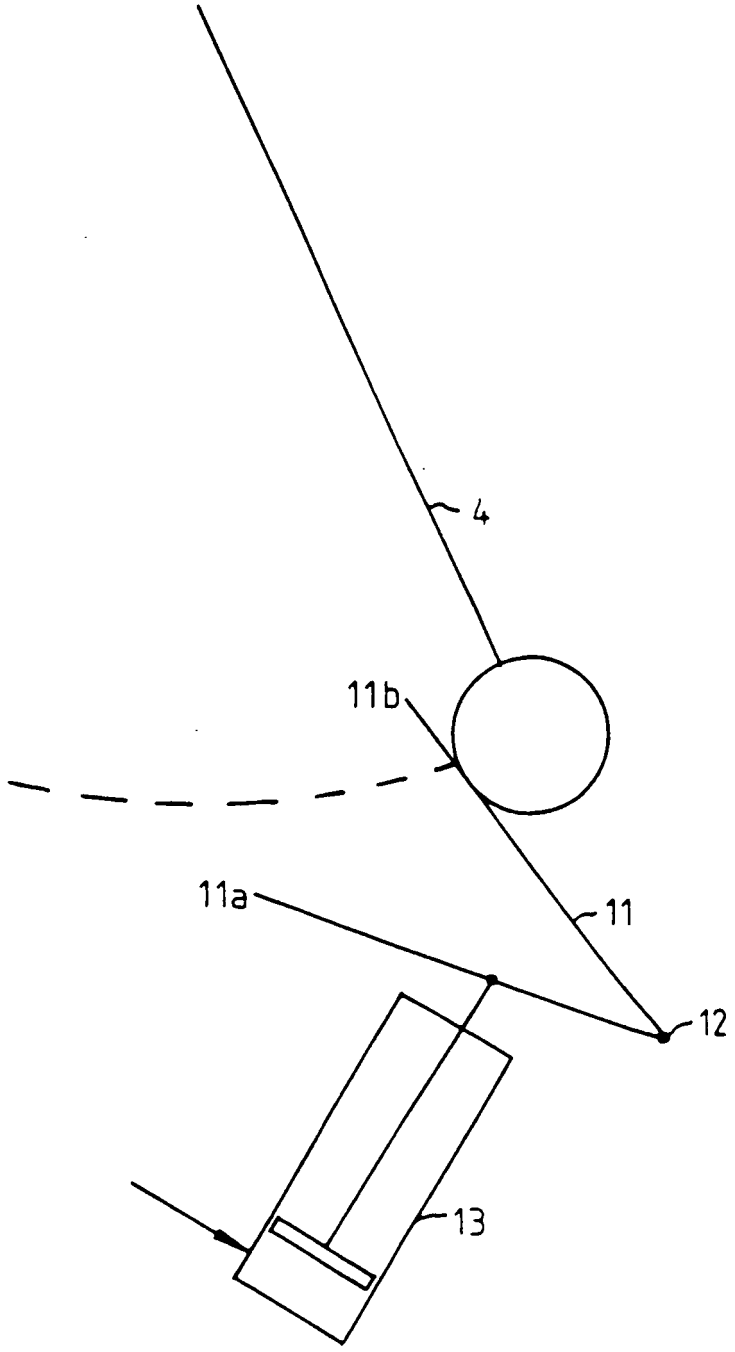

FIG.3

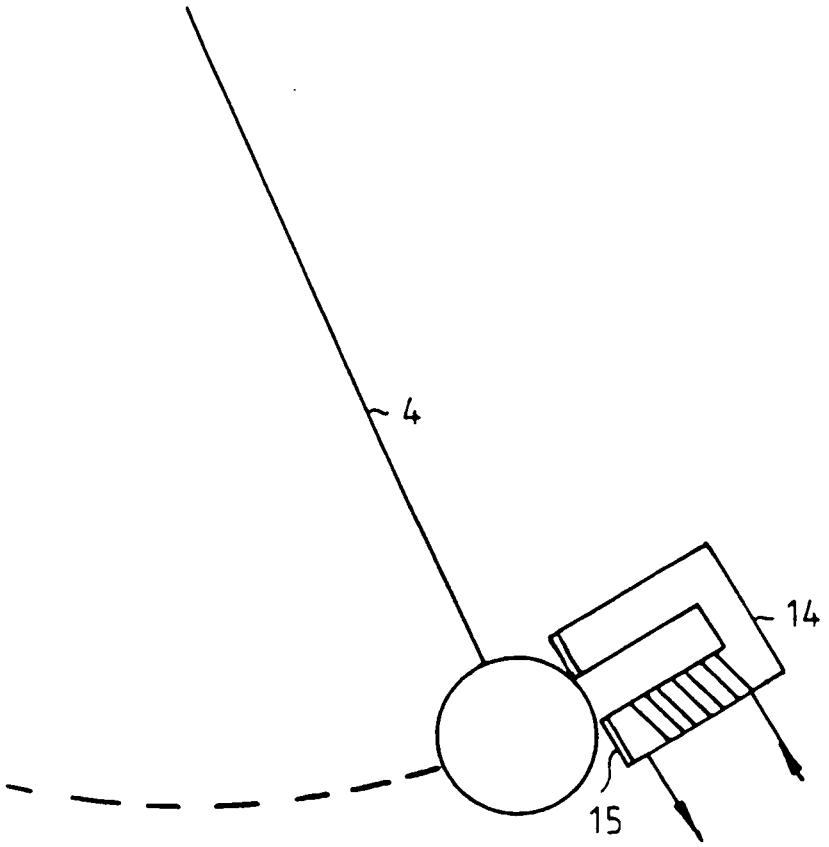

FIG.4

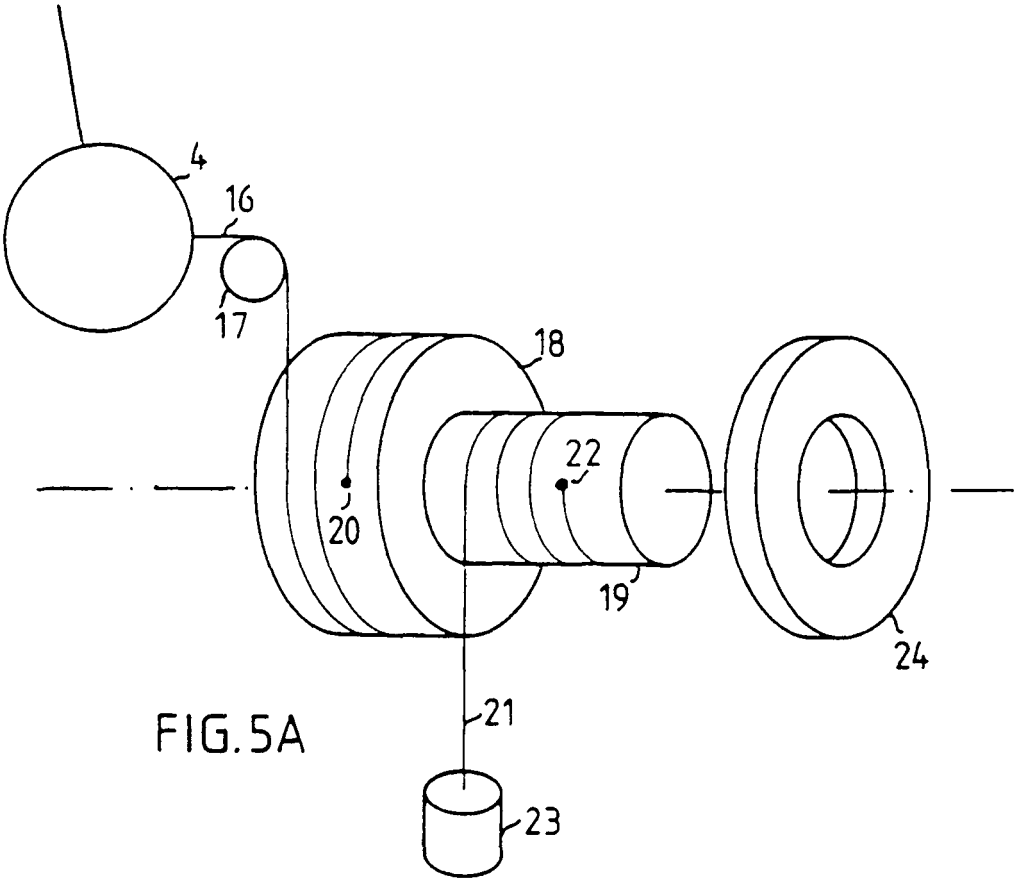

FIG.5A

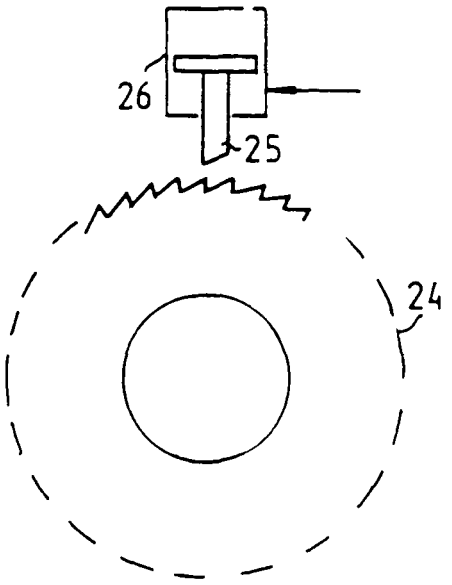

FIG.5B

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 29618222 **[0005]**
- DE 9406358 U **[0006]**