

CLOCK MOVEMENT

This invention relates to a clock movement, and more particularly to a clock movement which can detect when the hour wheel and the minute wheel are in

5 reference positions and can correct the time displayed by the hour hand and the minute hand by the time difference between times zones or by an error in the displayed time.

Known clock movements of the kind to which this
10 invention relates include those which detect when the hour hand, the minute hand and the second hand are displaying the time twelve o'clock, detect any difference (error) between the time at which this
15 twelve o'clock time is displayed and the time at which a radio time signal or similar broadcast time signal for that hour is received, and, every twelve hours, correct any error in the time displayed by the clock (Japanese Patent Publication SHO 61-118683).

In a first example shown in Figures 1 and 2 of the
20 patent publication referred to above, openings formed in intermediate wheels and in the hour wheel and the minute wheel become aligned once per revolution of the hour wheel, i.e. once every 12 hours. In this position, light from a first light beam emitting device
25 mounted on a circuit board is able to pass through the openings and is detected by a first light beam receiving device mounted remote from the circuit board. A reference position signal, which indicates that the hour wheel and the minute wheel are in their reference
30 positions, is then output by this receiving device. Furthermore, openings in an intermediate wheel and the second wheel become aligned once per revolution of the second hand, i.e. once per minute. In this position light from a second light beam emitting device mounted
35 on the circuit board is able to pass through these openings and is detected by a second light beam

receiving device mounted remote from the circuit board. A further reference position signal, which indicates that the second wheel is in its reference position, is then output by this second receiving device. When both
5 of these two reference position signals are output simultaneously it is deduced that the time twelve o'clock is being displayed.

Furthermore, in a second example shown in Figure 5 of the patent publication referred to above, in order
10 to enable both the light beam emitting devices and the light beam receiving devices to be mounted on the circuit board, the first and second light beam receiving devices are disposed in the same positions on
15 the circuit board as the first and second light beam emitting devices are disposed in the first example described above, a single light beam emitting device is also mounted on the circuit board, and two light conducting bodies are used to guide light from this
20 light beam emitting device to the positions where the first and second light beam receiving devices are disposed in the first example described above.

However, with the first example disclosed in the patent publication referred to above, a problem arises because the two light beam receiving devices are
25 disposed remote from the circuit board, and so wires have to be provided to electrically connect these receiving devices to the circuit on the circuit board. The installation of these wires is an awkward task, and so the clock movement cannot be easily mass-produced,
30 and misalignment between the light beam emitting devices and the light beam receiving devices can occur thus making it impossible for the reference positions mentioned above to be precisely detected.

Furthermore, with the second example disclosed in
35 the patent publication referred to above, a problem arises because in order to mount the single light beam

emitting device and the two light beam receiving devices on the same circuit board, two light conducting bodies have to be used, and these light conducting bodies have to be disposed in a confined space,
5 resulting in a complicated construction of the movement and increased cost of production.

The present invention aims to provide a clock movement which has a simple construction and is easy to manufacture, which is suited to mass-production, and
10 which can be manufactured at low cost.

According to the present invention there is provided a clock movement comprising:

a first motor;
a first time wheel connected to the first motor by
15 a first gear train;

first detection means comprising a light emitting portion and a light receiving portion, for detecting a reference position of the first time wheel;

a second motor;
20 a second time wheel, connected to the second motor by a second gear train; and

a second detection means comprising a light emitting portion and a light receiving portion, for detecting a reference position of the second time
25 wheel;

the second detection means being located on the same side of the gear trains as the first detection means;

wherein the first and second detection means are
30 each located at a respective position corresponding to a reflective portion of a wheel of the respective gear train, or of the respective time wheel, so that when the first or second time wheel reaches its respective reference position, light emitted from the light
35 emitting portion of the respective detection means is reflected by the corresponding reflective portion and

is received by the light receiving portion, so enabling the detection means to detect that the time wheel has reached its reference position.

Advantageously the detection means are each
5 located at a position on the respective gear train where two wheels overlap and wherein the wheel which is furthest from the detection means is fitted with the reflective portion and the wheel closer to the detection means has a portion formed therein through
10 which light can pass.

It is preferable that the first and second motors be disposed one on each side of the first and second gear trains.

Since the minute detection sensor of the first
15 detection means, having a first light emitting device and a first light receiving device, and the hour detection sensor of the second detection means, having a second light emitting device and a second light receiving device, are preferably both mounted on the
20 same circuit board, all the wiring can be disposed on this circuit board.

For a better understanding of the present invention, and to show how it may be brought into effect, reference will now be made, by way of example,
25 to the accompanying drawings, in which:

Figure 1 is a cross-sectional view of a clock movement according to a preferred embodiment of the invention; and

Figure 2 is a plan view showing the clock movement of Figure 1 as seen with the lower case removed.

A preferred embodiment of the present invention will now be described, with reference to the
5 accompanying drawings.

A clock movement according to a preferred embodiment of the present invention is shown in Figures 1 and 2. In this clock movement, two independent motors M1 and M2 respectively drive a minute hand 6A
10 and an hour hand 8A. This movement can be used in a world clock which, in addition to displaying the present time in a designated city (for example, Tokyo) using the minute hand 6A and the hour hand 8A, can, when a different city (for example, New York) in a
15 different time zone from the currently designated city (Tokyo) is newly designated, correct the currently displayed time by just the time difference between the two cities, and thereby display the

present time in the newly designated city (New York). In order to make this possible, in this clock movement, the minute wheel 6 and the hour wheel 8 each have a reference position, and the clock movement can detect when the minute wheel 6 and the hour wheel 8 are in their respective reference positions.

The construction of this clock movement will now be described.

As shown in Figures 1 & 2, the case of the clock movement is made up of a lower case 1 and an upper case 2. Independent motors M1 and M2 capable of forward and reverse drive are mounted inside this case, and the rotation of these two motors is transmitted by a first gear train G1 and a second gear train G2 to the minute wheel 6 and the hour wheel 8 respectively.

A printed circuit board 5 is also mounted in the case, and a first detection means D1, for detecting when the minute wheel 6 is in its reference position (the 0 minutes position), and a second detection means D2, for detecting when the hour hand is in its reference position (the 12 o'clock position), are mounted between the printed circuit board and the first and second gear trains G1 and G2 respectively.

First, the first motor M1 and the construction of the first gear train G1, which transmits the drive of this motor

M1 to the minute wheel 6, will be described.

As shown in FIG. 2, the first motor M1 is made up of a stator 31, a coil 33 wound around a coil bobbin 32 mounted on this stator 31, and a minute driving rotor 34 rotatably mounted in a hole portion 31a in the stator 31.

The first gear train G1 is constructed as follows: the large diameter teeth portion 72a of a second wheel 72 meshes with the pinion 34a of the minute driving rotor 34; the large diameter teeth portion 73a of a third wheel 73 meshes with the small diameter teeth portion 72b, coaxial with the large diameter teeth portion 72a, of the second wheel 72; and a teeth portion 6a of the minute wheel 6 meshes with the small diameter teeth portion 73b, coaxial with this large diameter teeth portion 73a, of the third wheel 73.

Thus, the rotation of the minute driving rotor 34 is transmitted to the minute wheel 6 via the second wheel 72 and the third wheel 73 of the first gear train G1.

As shown in Figure 1, the tubular portion 6b of the minute wheel 6 projects through the lower case 1 to the outside, and the minute hand 6A is mounted on the end of this projecting portion.

Next, the second motor M2 and the construction of the second gear train G2, which transmits the drive of this motor M1 to the hour wheel 8, will be described.

As shown in Figure 2, the second motor M2 is made up of a

stator 41, a coil 43 wound around a coil bobbin 42 mounted on this stator 41, and an hour driving rotor 44 rotatably mounted in a hole portion 41a in the stator 41.

The second gear train G2 is constructed as follows: the large diameter teeth portion 92a of a second wheel 92 meshes with the pinion 44a of the hour driving rotor 44; the large diameter teeth portion 93a of a third wheel 93 meshes with the small diameter teeth portion 92b, coaxial with the large diameter teeth portion 92a, of this second wheel 92; and the teeth portion 8a of the hour wheel 8 meshes with the small diameter teeth portion 93b, coaxial with the large diameter teeth portion 93a, of the third wheel 93. The teeth portion 22a of a second hour wheel 22, having the same number of teeth as the teeth portion 8a of the hour wheel 8, meshes with another small diameter teeth portion 93c of the third wheel 93, and this second hour wheel 22 rotates in phase with the hour wheel 8.

Thus, the rotation of the hour driving rotor 34 is transmitted to the hour wheel 8 via the second wheel 92 and the third wheel 93 of the second gear train G2.

As shown in Figure 1, the tubular portion 8b of the hour hand 8 is fitted coaxially over the tubular portion 6b of the hour hand 6 and passes through the lower case 1 to the outside, and the hour hand 8A is mounted on the end of this projecting portion.

As shown in Figure 2, the first motor M1 and the second motor M2 are mounted one on each side of the first and second gear trains G1 and G2.

Next, the construction of the first detection means, for detecting when the minute wheel 6 is in its reference position (the 0 minutes position), will be described.

As shown Figures 1 & 2, a minute detection sensor 11, which is a reflection-type photosensor having both a light emitting device and a light receiving device, is mounted on the upper surface (the surface which faces upward in Figure 1) of the circuit board 5. The light emitting device and a light receiving device are mounted on the underside of the sensor 11 and face towards the gear train G1 (downward direction of Figure 1) through the circuit board 5.

A rectangular opening 72c is formed in the portion of the second wheel 72 which overlaps with the minute wheel 6. A circular reflector 6c is mounted on the portion of the minute wheel 6 which overlaps with the second wheel 72. This circular reflector becomes aligned with the opening 72c once only per revolution of the minute wheel 6.

So that light emitted from the light emitting device of the minute detection sensor 11 is reflected to the first light receiving device only when the opening 72c and the reflector 6c have become aligned with each other and light emitted from the light emitting device of the

minute detection sensor 11 passes through the opening 72c and is reflected by the reflector 6c and passes back through the opening 72c and into the light receiving sensor of the minute detection sensor 11, the surface of the second wheel 72 and the minute wheel 6 are made anti-reflective, for instance by having black paint painted on their surfaces or by being made of black plastic.

Next, the construction of the second detection means, for detecting when the hour wheel 8 is in its reference position (the 12 o'clock position), will be described.

As shown in Figures 1 & 2, an hour detection sensor 21, which is a reflection-type photosensor having both a light emitting device and a light receiving device, is mounted on the lower surface (the surface which faces downward in Figure 1) of the circuit board 5. This second light emitting device and second light receiving device are mounted on the underside of the sensor 21 and face towards the gear train G2 (the downward direction of Figure 1).

A rectangular opening 92c is formed in the portion of the second wheel 92 which overlaps with the second hour wheel 22. A circular reflector 22c is mounted on the portion of the second hour wheel 22 which overlaps with the second wheel 92. The circular reflector becomes aligned with the opening 92c once only per revolution of the second hour wheel 22.

So that light emitted from the light emitting device of the hour detection sensor 21 is reflected into the

light receiving device only when the opening 92c and the reflector 22c have become aligned with each other, and light emitted from the light emitting device of the hour detection sensor 21 passes through the opening 92c and is reflected by the reflector 22c and passes back through the opening 92c and into the light receiving sensor of the hour detection sensor 21, the surfaces of the second wheel 92 and the second hour wheel 22 are made anti-reflective, for instance by having black paint painted on their faces or by being made of black plastic.

During ordinary clock running, a pulse signal is inputted into the coil 33 of the first motor M1 once every 15 seconds, causing the minute wheel to rotate through one revolution every sixty minutes, and a pulse signal is inputted into the coil 43 of the second motor M2 once every 3 minutes, causing the hour wheel to rotate through one revolution every twelve hours.

When this clock movement is built into a world clock, when a city in a different time zone from the city currently designated is newly designated, the minute hand 6A and the hour hand 8A move to display the time in the newly designated city. To achieve this, it is necessary that the minute wheel 6 and the hour wheel 8 first be rapidly moved to their respective reference positions. Ordinary clock running is interrupted and high frequency pulse signals are input into the coils 33 and 43 of the first and second

motors M1 and M2 to cause the minute hand 6A and the hour hand 8A to rotate quickly until the minute wheel 6 reference position signal from the minute detection sensor 11 and the second hour wheel 22 reference position signal from the hour detection sensor 21 are detected simultaneously.

The above is the construction of a clock movement according to a preferred embodiment of the present invention. The operation of this clock movement will now be described.

During ordinary clock running, a pulse signal is input to the coil 33 of the first motor M1 once every fifteen seconds, the minute driving rotor 34 rotates through a fixed angle each time a pulse is input to the coil 33, this rotation is transmitted by the first gear train G1 to the minute wheel 6, and the minute wheel 6 is caused to rotate through 1.5° every fifteen seconds, i.e. 360° (one revolution) per hour, in the forward direction (clockwise). Also, a pulse signal is input to the coil 43 of the second motor M2 once every three minutes, the hour driving rotor 44 rotates through a fixed angle each time a pulse is input into the coil 43, this rotation is transmitted by the second gear train G2 to the hour wheel 8, and the hour wheel 8 is caused to rotate through 1.5° every three minutes, i.e. 360° (one revolution) every twelve hours, in the forward direction (clockwise).

With the clock running in this ordinary state, when a

city (for example, New York) in a different time zone from the city currently designated (for example Tokyo) is newly designated, and the Tokyo time being displayed by the current ordinary running of the clock is to be corrected by just the time difference between Tokyo and New York (ten hours) so that New York time is displayed, it is necessary that the minute wheel 6 and the hour wheel 8 be rotated rapidly around to their respective reference positions, and to achieve this the ordinary clock running described above is interrupted and high frequency signals are inputted into the coils 33 and 43 of the first and second motors M1 and M2.

These high frequency signals cause the minute wheel 6 and the hour wheel 8 to rotate more quickly than they do during ordinary clock running.

When the opening 72c and reflector 6c of the first detection means D1 become aligned with each other, as they do once and once only per revolution of the minute wheel 6, light from the light emitting device of the minute detection sensor 11 passes through the opening 72c and is reflected by the reflector 6c, passes back through the opening 72c and into the light receiving device of the minute detection sensor 11, and the minute wheel 6 reference position signal is output from the minute detection sensor 11.

And, when the opening 92c and reflector 22c of the

second detection means D2 become aligned with each other, as they do once and once only per revolution of the hour wheel 8, light from the light emitting device of the hour detection sensor 21 passes through the opening 92c and is reflected by the reflector 22c, passes back through the opening 92c and into the light receiving device of the hour detection sensor 21, and the hour wheel 8 reference position signal is output from the hour detection sensor 21.

When the minute wheel 6 reference position signal and the hour wheel 8 reference position signal are both output at the same time, it is deduced that the time exactly twelve o'clock is being displayed, the high frequency pulse signals to the coils 33 and 43 are stopped, and the minute hand 6A and the hour hand 8A stop in their exactly twelve o'clock positions.

From this state, in order to rotate the minute hand 6A and the hour hand 8A into positions in which they display the newly designated city (New York) time, the necessary number of pulse signals are inputted into the coils 33 and 43. As a result, the minute hand 6A and the hour hand 8A rotate rapidly until they display New York time, and ordinary clock running is then resumed.

As explained above, with this invention, because the minute detection sensor 11 and the hour detection sensor 12

are both mounted on the same printed circuit board 5, all the wiring can be disposed on this circuit board 5.

It is noted that although in this preferred embodiment the second hour wheel 22 and the hour wheel 8 have the same number of teeth, and the second hour wheel 22 meshes with the third wheel 93 with which the hour wheel 8 also meshes, the invention is not limited to this construction, and different configurations can be adopted as long as the second hour wheel 22 rotates in phase with the hour wheel 8.

Also, instead of forming the openings 72c and 92c as the light-passing portions in the second wheels 72 and 92, transparent components can be mounted there.

And, although in this preferred embodiment the second wheel 72 is disposed between the minute wheel 6 and the printed circuit board 5, this configuration can be reversed and the minute wheel 6 disposed between the second wheel 72 and the printed circuit board 5 instead. When this is done, a light-passing portion is provided in the minute wheel 6, and a reflector is mounted on the second wheel 72. And similarly, although in this preferred embodiment the second wheel 92 is disposed between the second hour wheel 22 and the printed circuit board 5, this configuration can be reversed and the second hour wheel 22 disposed between the second wheel 92 and the printed circuit board 5 instead. When this is done, a light-passing portion is provided in the second

hour wheel 22, and a reflector is mounted on the second wheel 92.

In the embodiment of the invention described above the rotation of the hour wheel 8 is detected indirectly
5 by means of the detection of the rotation of second hour wheel 22 which rotates in phase with the hour wheel 8. However the second hour wheel 22 is not necessary, and the second detection means 21 may be located directly above the hour wheel 8 (as viewed in
10 Figure 1) provided that the intervening portion of the minute wheel 6 is transparent.

By means of the construction of the present invention, the minute detection sensor of the first detection means, which comprises the first light
15 emitting device and the first light receiving device, and the hour detection sensor of the second detection means, which comprises the second light emitting devices and the second light receiving device, are both mounted on the same circuit board, and all the wiring
20 can be disposed on this circuit board. Therefore, the clock movement has a simple construction and is easy to manufacture, is suited to mass-production, and can be made at low cost.



CLAIMS

1. A clock movement comprising:
 - a first motor;
 - a first time wheel connected to the first motor by
 - 5 a first gear train;
 - first detection means comprising a light emitting portion and a light receiving portion, for detecting a reference position of the first time wheel;
 - a second motor;
 - 10 a second time wheel, connected to the second motor by a second gear train; and
 - a second detection means comprising a light emitting portion and a light receiving portion, for detecting a reference position of the second time
 - 15 wheel;
 - the second detection means being located on the same side of the gear trains as the first detection means;
 - wherein the first and second detection means are
 - 20 each located at a respective position corresponding to a reflective portion of a wheel of the respective gear train, or of the respective time wheel, so that when the first or second time wheel reaches its respective reference position, light emitted from the light
 - 25 emitting portion of the respective detection means is reflected by the corresponding reflective portion and is received by the light receiving portion, so enabling the detection means to detect that the time wheel has reached its reference position.
- 30 2. A clock movement as claimed in claim 1 wherein the first and second detection means are each located at a respective position on the respective gear train where two wheels overlap and wherein the wheel which is furthest from the detection means is fitted
- 35 with the reflective portion and the wheel closer to the detection means has a portion formed therein through



which light can pass.

3. A clock movement as claimed in claim 2 wherein the wheel closer to the detection means has a cut out portion.

5 4. A clock movement as claimed in any preceding claim wherein at least one reflective portion is carried by a wheel which rotates in phase with either the first or second time wheel.

10 5. A clock movement as claimed in any preceding claim wherein the first and second detection means are located at respective positions corresponding to reflective portions carried either by the respective time wheel or by a gear wheel overlapped therewith, and wherein whichever of the first and second time wheels
15 that is closer to the detection means has a portion defined therein through which light from the detection means associated with the other time wheel can pass during detection of the reference position of the other time wheel.

20 6. A clock movement as claimed in any preceding claim wherein the or each detection means is mounted on a circuit board.

7. A clock movement, comprising:
independent first and second motors capable of
25 forward and reverse drive;
a circuit board;
a minute wheel, connected to the first motor by a first gear train;
an hour wheel, connected to the second motor by a
30 second gear train;
first detection means, for detecting when the minute wheel is in a reference position, comprising: a minute detection sensor, mounted on the circuit board, having a first light emitting device and a first light
35 receiving device;
a first transparent portion, through which light



from the first light emitting device passes, mounted on one of the following first two overlapping wheels: the minute wheel, and a gear of the first gear train which overlaps with the minute wheel; and

- 5 a reflector, mounted on the other of said first two overlapping wheels, which becomes aligned with the first transparent portion once only per revolution of the minute wheel; and

- 10 second detection means, for detecting when the hour hand is in a reference position, comprising: an hour detection sensor, mounted on the circuit board, having a second light emitting device and a second light receiving device; a second hour wheel, which rotates in phase with the first hour wheel; a second
15 transparent portion, through which light from the second light emitting device passes, mounted on one of the following second two overlapping wheels: the second hour wheel, and a gear of the second gear train which overlaps with the second hour wheel; and a reflector,
20 mounted on the other of said second two overlapping wheels, which becomes aligned with the second transparent portion once only per revolution of said first hour wheel.

8. A clock movement according to claim 7, in
25 which the first and second motors are disposed one on each side of the first and second gear trains.

9. A clock movement substantially as herein described with reference to Figures 1 and 2 of the accompanying drawings.