May 22, 1962 F. SOLARI 3,035,406

CALENDAR-CLOCK

Filed Feb. 26, 1959 2 Sheets-Sheet 1

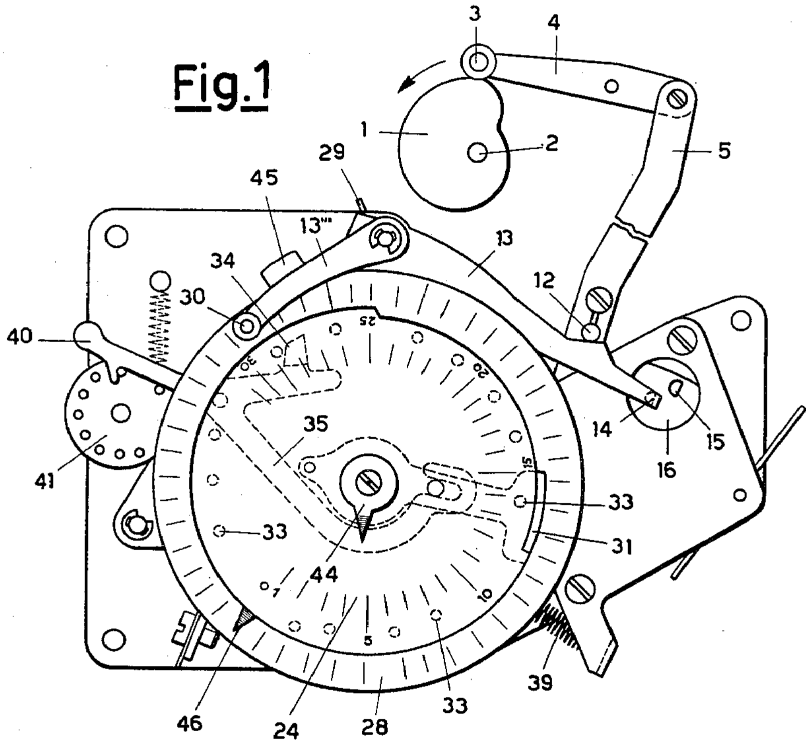

Fig.1

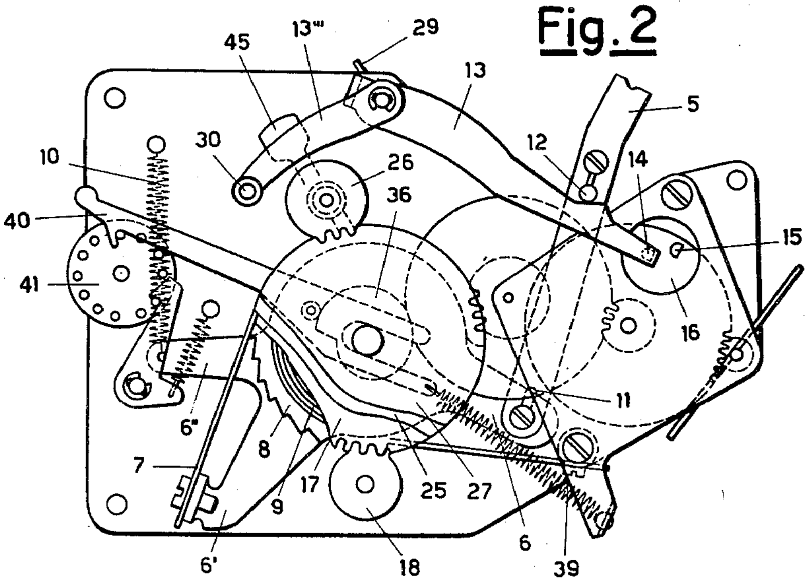

Fig.2

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Fig.3

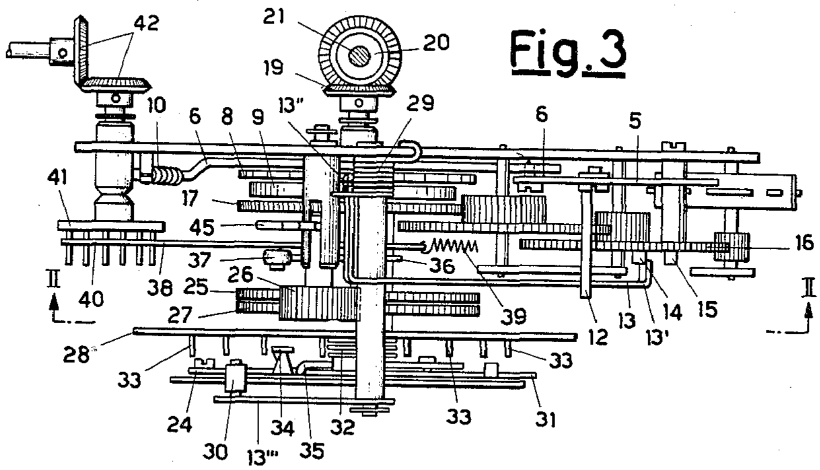


Fig.4

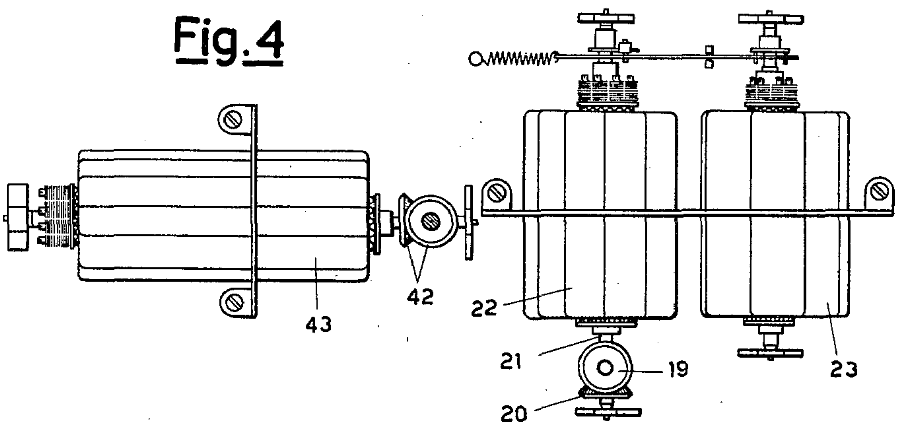
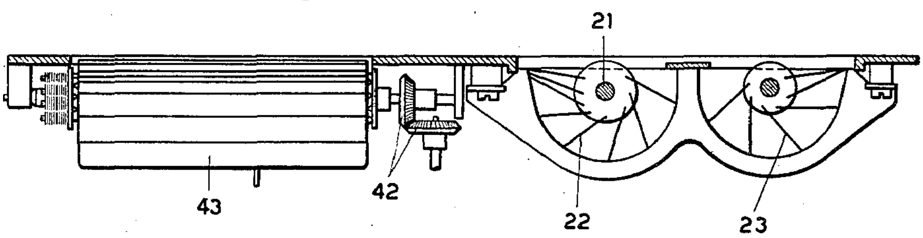


Fig.5



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CALENDAR-CLOCK

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10 Claims. (Cl. 58—6)

The present invention relates to improvements in a calendar-clock and it is an object of the present invention to provide a differential group having a mechanical operation for the automatic indication of the days and months in the calendar-clock.

Italian Patent No. 523,336 of November 17, 1954 discloses one type of electromechanical calendar-clock with which the differential group of the present invention can be operatively associated. Of course, this type of clock is merely by way of example since the differential group may be operatively associated with any type of calendar-clock.

The differential group of the present invention is constructed to be operatively associated with a calendar-clock, which by mechanical or electrical means provides the indication of the hours and minutes and also, if desired, the day of the week, for the purpose of indicating the day of the month, as in figures, and the months, which may be written in abbreviated or in full form on pallet rolls.

Thus the present invention is independent of the system of indication of the hours as well as the source of energy to operate the system, and it relates only to the automatic indications concerning the date, for all the months, including the month of February in leap-years.

One preferred embodiment is that days of the month are indicated in figures (digits) and the month is written abbreviated or in full length on pallet rolls, but obviously the indications can be in various other forms, such as for instance on parts of discs, of prismatic members, on tapes, by luminous systems and so on.

It is a characteristic feature of the invention that the operation of the differential group is of mechanical nature starting from a cam that performs a revolution every 24 hours and that is mounted in an independent clock or in a receiver clock or a synchronous motor clock with another characteristic feature of the invention being that the movement of the group in itself is originated by a spiral spring which in turn is tensioned by the action of a helical spring, with the cam controlling the times at which the actions of the aforesaid springs shall take place.

These and other characteristics of the invention will appear from the following description, partly implicitly and partly expressly set forth, with reference to the illustrations in the accompanying drawings, which represent a preferred embodiment of the differential group and of the pallets which it controls: and wherein:

FIGURE 1 represents a front elevation of the differential group;

FIGURE 2 represents a front elevation of the group, in a section taken along the line II—II of FIGURE 3;

FIGURE 3 represents the differential group in top view;

FIGURE 4 represents a rear elevation of the groups of pallets for indicating the date and

FIGURE 5 represents the groups of pallets in top view.

With reference to the drawings and in particular to FIGURES 1, 2, and 3, the cam 1, which constitutes the member for connection with the part for indication of the hours and minutes in an independent clock or receiver or synchronous motor clock-work and which, however, may be actuated in any manner whatsoever, executes every 24 hours one revolution around its axis 2, while the small follower roll 3 carried at one end of the lever 4 slides

along its periphery while remaining at contact with said cam.

The shape of the cam 1 is such that, as illustrated in FIGURE 1, at midnight the roll 3 is at the end of the part that has maximum radius. When midnight strikes, the roll 3 covers rapidly the peripheral descending path of the cam 1, which is supposed to rotate in the direction indicated by the arrow, namely in anticlockwise direction. Said roll stops in the bottom groove thereby causing the oscillation of the lever 4 which in turn causes a rising movement of the lever 5. The lever 5 is connected, at its opposite end, with one branch of a balance lever 6. The balance lever 6 is provided with two further arms 6′ and 6″ and the arm 6′ carries a pawl 7 which acts upon the ratchet wheel 8. The ratchet wheel 8 loads the spiral spring 9 pivoted on said wheel. It should be noted that the movement of oscillation in anticlockwise direction of the balance lever 6, produced by the rising of the lever 5, releases the pawl 7 over one or more of the teeth of the ratchet wheel 8 thereby preparing the unit for effecting the loading of the spring 9. Said spring 9, which is loaded as will be indicated, constitutes the sole motive power for the operation of the whole differential group.

The arm or extension 6″ of the balance lever carries the helical spring 10 which, when said balance lever can turn in a clockwise direction, exerts upon the arm 6″ the traction which, through the pawl 7 in engagement on the teeth of the wheel 8, produces the loading of the spring 9. The gauging of the spring 10 is such as not to allow the spring 9 to become overloaded and for that purpose the lever 5 carries at its end the eyelet 11 which constitutes a lost motion connection adapted to enable the lever 6 not to move and, therefore, not to cause the displacement of the pawl 7 on the teeth when the spring 9 is already loaded.

At about the middle of its length the lever 5 carries the stud 12 which rests on the upper surface of the arm 13 whose end 13′ is bent in square shape for the stopping of feeler teeth 14 and 15 fixed on a wheel 16. It should be noted that the rising movement of the roll 3, which follows the profile of the cam 1 after midnight, progressively displaces the lever 5 and, therefore, the stud 12, while the sudden movement at midnight causes the rapid movement of the arm 13. Said rapid movement causes—as will be made more fully clear hereinafter—the disengagement between the end 13′ of the arm 13 and the tooth 14, and the rotation of the wheel 16 until contact is made between the tooth 15 and the arm 13. Instead, the displacement of engagement of the arm 13 from the tooth 15 to the tooth 14, takes place by effect of the slow displacement which the lever 5 effects in the 24 hours, which lever 5 displaces the arm 13.

Through wheelworks of a kind known per se, the wheel 16 is connected to the wheel 17 which is attached to the spiral spring 9 and, therefore, the latter constitutes the source of motive power for the movement of the wheel 16.

The wheel 17 in turn is engaged with the sprocket 18 (FIGURE 2) which engages a first bevel wheel 19 which in turn engages a second bevel wheel 20.

The second bevel wheel 20 (FIGURE 4) is fixed to the shaft 21 for the roll of the pallets 22 which carry the figures concerning the units of the days written progressively.

Hence the connection between the wheel 16 and the shaft 21 is constituted by the aforesaid wheelworks which afford such ratios of motion that with one revolution of the wheel 16, which starts beginning from the time at which the tooth 14 is left and ends at the time at which the tooth 15 is engaged for stopping, the axis 21 performs one tenth of a revolution thereby causing the detent of a pallet 22 and, therefore, the forwarding by one day of the indication of the date. Side by side with the roll of the pallets 22 there is a roll of the pallets 23 of the decades of days which is actuated automatically by the former at the end of every 10 teeth, through a mechanical connection of a kind known per se, which, therefore, is not described herein.

The progression of days succeeds until the last day of the month, which may comprise 28, 29, 30 or 31 days, and it is a characteristic feature of the invention that it comprises means for allowing the automatic passage of the indication of the last day of a month to the indication of the first day of the subsequent month, including the case of a leap-year.

That result is attained, as will be described, by a pair of discs, namely by a disc of the days **24** which is rigid with the drive wheel **17**, on which the spring **9** acts, and rigid also with the wheel **25** so that the three elements cited perform at midnight of each day together a rotation of $1/40$ of revolution, unless the passage from the last day of the month to the first day of the subsequent month is involved, as will be described hereinafter.

The other disc of the pair cited is the month disc **28** whose function will be illustrated hereinafter. The tooth wheel **25** is engaged at its periphery with a pinion **26** which in turn is engaged with a tooth wheel **27**. The wheel **25** is provided with 48 teeth and the wheel **27** has 49 teeth whence the latter progresses at each one of its rotations by one-fortieth of revolution with respect to the disc of the days **24** with which the wheel **25** is rigid.

The wheel **27** is rigid with the disc of the months **28** and, therefore, said disc of the months progresses by $1/48$ of revolution at every rotation with respect to the disc of the days **24**.

The disc of the months **28** is subdivided into 48 notches corresponding to the months of four years, while the disc of the days **24** (FIGURE 1) is divided respectively into 40 parts and partly into 31 notches on two circumferential sectors having different radii: the larger radius having an angular amplitude of $27/40$ and the smaller radius having an amplitude of $13/40$.

At the striking of midnight, as said previously, the lever **5** rises and the lever **13** follows it, the lever **13** being held on the stud **12** by the spiral spring **29** (FIGURE 3) which acts on an extension **13''** of the lever **13**, close to the fulcrum of the latter. From that fulcrum there originates the arm **13'''** which carries at its end the small roll **30**, which by action of the spring **29** rests on the periphery of the disc **24**. When the small roll **30** is on the sector with larger radius of the disc **24**, the bent end **13'** of the lever **13** is in the desired position for stopping the feeler tooth **15**, and, consequently, the wheel **16**. In that way, there occurs the progression by $1/40$ of revolution of the disc of the days **24** and, consequently, the detent of a pallet of the roll of the units of the days **22**.

When instead the roll **30** rests on the peripheral part of the sector, having the smaller radius, the terminal tooth **13'** of the balance **13** stops beyond the periphery of the wheel **16**. The latter is free to rotate and continues rotating until the small roll **30** returns on the sector having the larger radius of the disc **24**, thereby returning the end **13'** of the lever **13** to a position wherein it stops the wheel **16** by acting upon the tooth **14**.

As aforedescribed, the disc of the days **24** is formed by two sectors of which one is of 27/40 and the other of 13/40. This subdivision originates from the fact that on the 28th February of a year that is not a leap year, the disc must move rapidly from the twenty-seventh division to the fourtieth division of said disc, so as to make the pallets stop on the rolls of the days, **22** and **23**, contemporaneously (FIGURE 4 and FIGURE 5) from the 28th to the 1st of the subsequent month of March, by making the pallets turn not only from the 8th to the 1st but also by one complete revolution of all the units in order that it is possible to obtain automatically the accurate indication also of the decade of the days.

For the months having 29, 30 and 31 days, of course, the amplitude of the sector having larger radius must be limited respectively by $1/40$, by $2/40$ and by $3/40$ to shorten the sector with free speed of the disc **24**, allowed by the small roll **30** that acts upon its periphery.

That object is attained by means of the member having a circular sector **31** fulcrumed to the center of the rear surface of the disc **24** and that is terminated in correspondence with the sector having a larger radius of the said disc **24**.

The element **31** has an arc development equal to $3/40$ of the disc of the days **24** on its sector having a larger radius and this is in order to reduce respectively to $12/40$. to $11/40$ and to $10/40$ the sector having a smaller radius, in the months having 29, 30 and 31 days. Contemporaneously there takes place the rapid stopping of the rolls **22** and **23** (FIGURES 4 and 5) of the days from the 29th, from the 30th and from the 31st to the 1st of the subsequent month, in the manner indicated for the month having 28 days.

Said sector-element **31** is urged towards the mentioned position and shortens the development of arc of the sector having the smaller radius of the disc **24**, by the spring **32** (FIGURE 3) and is instead pushed partly or completely behind the sector having the larger radius, by the pins **33** which are carried by the disc **28** of the months. Hence said pins follow said disc in its rotation, which as said hereinbefore advances in each of its revolutions by $1/48$ of revolution over the disc of the days **24**. The pins **33** concern the months of 30, 29 and 28 days and since they relate to a period of four years they are in number of 16 (4×4) for the months having 30 days, one for the month having 29 days and three for the months having 28 days. The pins are arranged along three different radii.

The excess of rotation of the disc of the months **28** as compared with the disc of the days **24** results that in the days preceding the end of the month, one of the pins touches a peripheral lug **34** on the lever **35** which is attached to the element **31**.

In correspondence with the months having 31 days there are no pins and, therefore, the element **31** is totally exposed and, therefore, there is minimum development of the circular sector having the smaller radius of the disc of the days.

In the months having 30 days, the respective pins are fitted more peripherally on the disc of the month **28**, and the position is such as to cause, by means of the aforesaid pins, the backward push by one-third of the element **31**.

In the only month having 29 days the pin which concerns it pushes back by two-thirds the element **31**, and in the three months of 28 days, finally the pins which concern them are in a position more towards the center so that the element **31** moves totally behind the circular sector having a large radius of the disc of the days **24**.

The disc of the days **24** performs an entire revolution every month and with the disc the eccentric **36**, rigid with the disc, performs a complete revolution (FIGURES 2 and 3).

On the periphery of the eccentric **36** there slides a small roll **37** which is fixed to the lever **38** and is maintained in contact with the eccentric by the spring **39**.

When, at the end of the month, the small roll **37** falls into the notch of the eccentric **36** under the action of the spring **39**, the lever **38**, rigid with the eccentric, shifts and its hooked end **40** forwards the cage sprocket **41** by $1/12$. Said sprocket **41** is fixed to the bevel wheels **42** which effect the same movement thereby causing the stepping of a pallet of the rolls of the month **43** (FIGURES 4 and 5).

Having so described the structure of the differential group and its operation, the following procedure is carried out to put said group in phase. To put in phase the day of the month, by means of a slight pressure upon the lever **13**, one obtains the forwarding by a day; the operation must be effected as many times as are needed to make the index **44** (FIGURE 1) fixed at the center of the disc 24 correspond to the notch of the desired day on said disc. Contemporaneously with the progressing of the disc 24, also the rolls of the days 22 and 23 progress, which are connected mechanically.

To put the month in phase, by means of a slight push of the lever 45 (FIGURES 1 and 2), one displaces downwards the pinion 26 so as to permit the rotation of the disc of the months 28. Said disc is made to turn until making the index 46 (FIGURE 1), fixed to the disc of the days 24, correspond with the underlying notch of the month in which the operation is performed. It is important to note that this month must be the accurate one with reference to the leap year, since the disc of the month comprises the months of four years. The roll of the months 43 does not progress automatically with the aforesaid operation and it is necessary, therefore, to lift then the lever 38 to leave the cage sprocket 42 free and to rotate the latter to the extent necessary to render visible the roll 43, the month to be indicated.

At the end of that phasing operation, the differential group is ready to give the automatic indications of the days and months.

The present invention has been illustrated and described in a preferred embodiment but it is understood that constructive variants may be embodied in practice without departing from the scope of the present invention.

I claim:

1. In a calendar-clock, means for continuously indicating the day and the month comprising indicating means representing the days of the month and the months of the year, a mechanically operated differential group controlling the sequential movements of said indicating means and a cam having means providing it with a motion to accomplish one revolution every twenty-four hours and being formed with a shape so as to control the mechanical operation of the differential group at the end of its one revolution, a contact roll engaging the cam and being moved in accordance with the shape of the cam, a first balance lever moved by said contact roll, a second balance lever, a connecting rod and lost motion connection connecting the first and second balance levers, a ratchet wheel, a pawl on the periphery of the ratchet wheel displaced by the actuation of the second balance lever, and a spiral spring which constitutes the sole motive power for operation of the group, said spring being tensioned by the movement of the ratchet wheel, said second balance lever having an arm, a helical return spring acting on said arm so that when the movement of rotation of said second balance lever is permitted, said helical spring provides through said pawl the rotation of the ratchet wheel to which the spiral spring is connected, thereby providing the loading of the spiral spring while said lost motion connection disables the loading if it has already taken place.

2. In a calendar-clock, as claimed in claim 1, wherein the connecting rod actuated by the cam is lowered progressively and slowly in the twenty-four hour interval through a stud, a lever having one end bent and a wheel having first and second feeler teeth and the bent end of the lever adapted to engage the first or second feeler teeth.

3. In a calendar-clock, as claimed in claim 2, wherein a second wheel is integral with the spiral spring and a wheelworks connects the wheel with the two feeler teeth to said wheel, the wheel with the two feeler teeth, if left free by a tooth, accomplishing rapidly one revolution before being stopped by the other tooth, making the second wheel which is integral with the spring move, a roll of pallets corresponding to the units of the days, a gear connecting the roll of pallets to the wheel and the gearing causing the progressing by one-tenth of a revolution of the roll of pallets.

4. In a calendar-clock, as claimed in claim 3, wherein the wheel upon which the spring acts is rigid with a disc that carries a graduation in days so that the wheel and disc progress at midnight by one-fortieth of a revolution thereby moving along with them another wheel having 48 teeth and meshing through a tooth pinion with a wheel having 49 teeth, so that the progressing of the two wheels last mentioned differs by one-forty-eighth of a revolution from each other.

5. In a calendar-clock, as claimed in claim 4, the differential group characterized in that the disc of the days has two sectors of different radii, the larger radius sector and the smaller radius sector having extents equal to 27/40 and 13/40, respectively, of the circumference of the discs of the days, a lever which strikes at midnight, a small roll rigidly connected to the last mentioned lever, a spring retaining said small roll in engagement with the disc of the days, said last mentioned lever and the bent end lever being interconnected and adapted to act at midnight on the wheel having two feeler teeth to allow a single revolution thereof when said small roll is engaged with said larger radius sector.

6. The differential group of claim 5 characterized in that when said small roll is engaged with said smaller radius sector the said bent end lever is out of the path of the feelers of the wheel having two feeler teeth whereby the last mentioned wheel is free to rotate until the small roll again engages said larger radius sector to move said bent end lever into engagement with one of the feeler teeth and thereby stop the last mentioned wheel.

7. A differential group according to claim 6 characterized in that a circular sector member fulcrumed at the center of the disc of the days is located immediately therebehind, and urged by a spring to a position exposed in the smaller radius sector so as to shorten, as a maximum possible value, the action of the smaller radius sector by 3/40, said complete smaller radius sector in the months having 31 days being increased by the total exposure of the mobile sector, said small roll having a path on the smaller radius sector during only 10/40 of a revolution, thereby causing the shifting of the pallets of indications of the days from the 31st to the 1st of the subsequent month through one complete revolution of the roll of the pallets which by that complete revolution effect the automatic elimination of the digit 3 of the roll whereon the decades of the days are marked.

8. In a calendar-clock, as claimed in claim 4, the differential group characterized in that pins arranged in three different circumferential rows project from the rear of said disc of the months, a balance lever rigid with said mobile circular sector and in engagement with one of said pins at all times, said pins acting through said balance lever to advance said mobile circular sector by $\frac{1}{40}$, $\frac{2}{40}$ and $\frac{3}{40}$ of a revolution in accordance with the particular pin engaged by the last mentioned balance lever to thereby provide for variations in revolution of the wheel having the feeler tooth and thereby provide for months having 30 days, 29 days and 28 days, respectively.

9. In a calendar-clock, as claimed in claim 4, the differential group characterized in that an eccentric is incorporated with said disc of the days to rotate therewith, a small roll spring urged into engagement with said eccentric, a cage sprocket, a hooked lever engaged with said cage sprocket, said small roll being connected with said hooked lever, said eccentric having a step engageable by said small roll to move said hooked lever and thereby advance said cage sprocket, a roll of pallets of indication of the months, and means connecting the last mentioned roll of pallets to said cage sprocket for rotating said last mentioned roll of pallets $\frac{1}{12}$ of a revolution for each movement of said cage roller.

10. In a calendar-clock, as claimed in claim 4, togeth-

er with phasing means connected to said disc of the days for phasing the same, and other phasing means connected to said disc of the months for phasing the same.

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