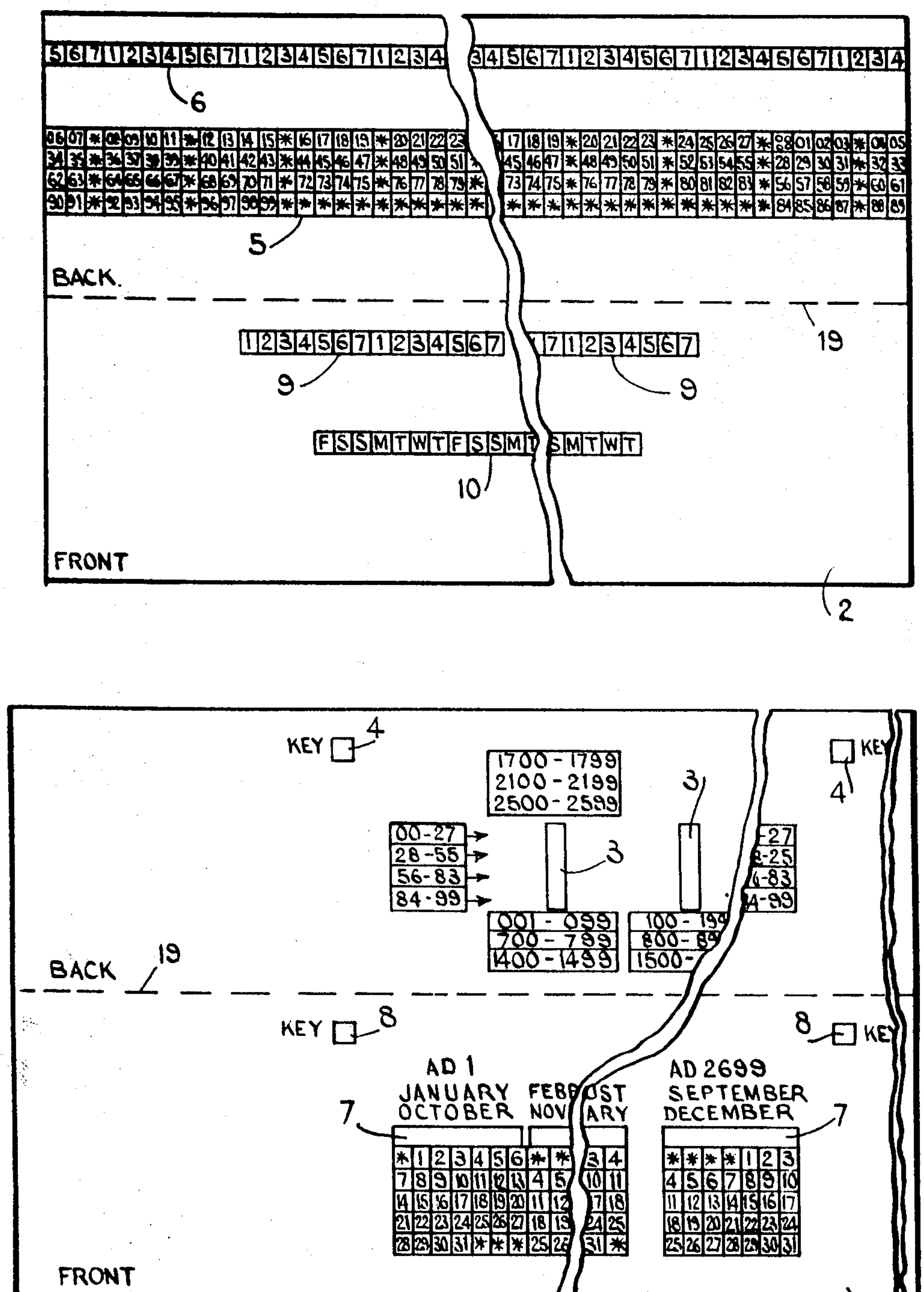


FIG.1.

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PERPETUAL CALENDARS

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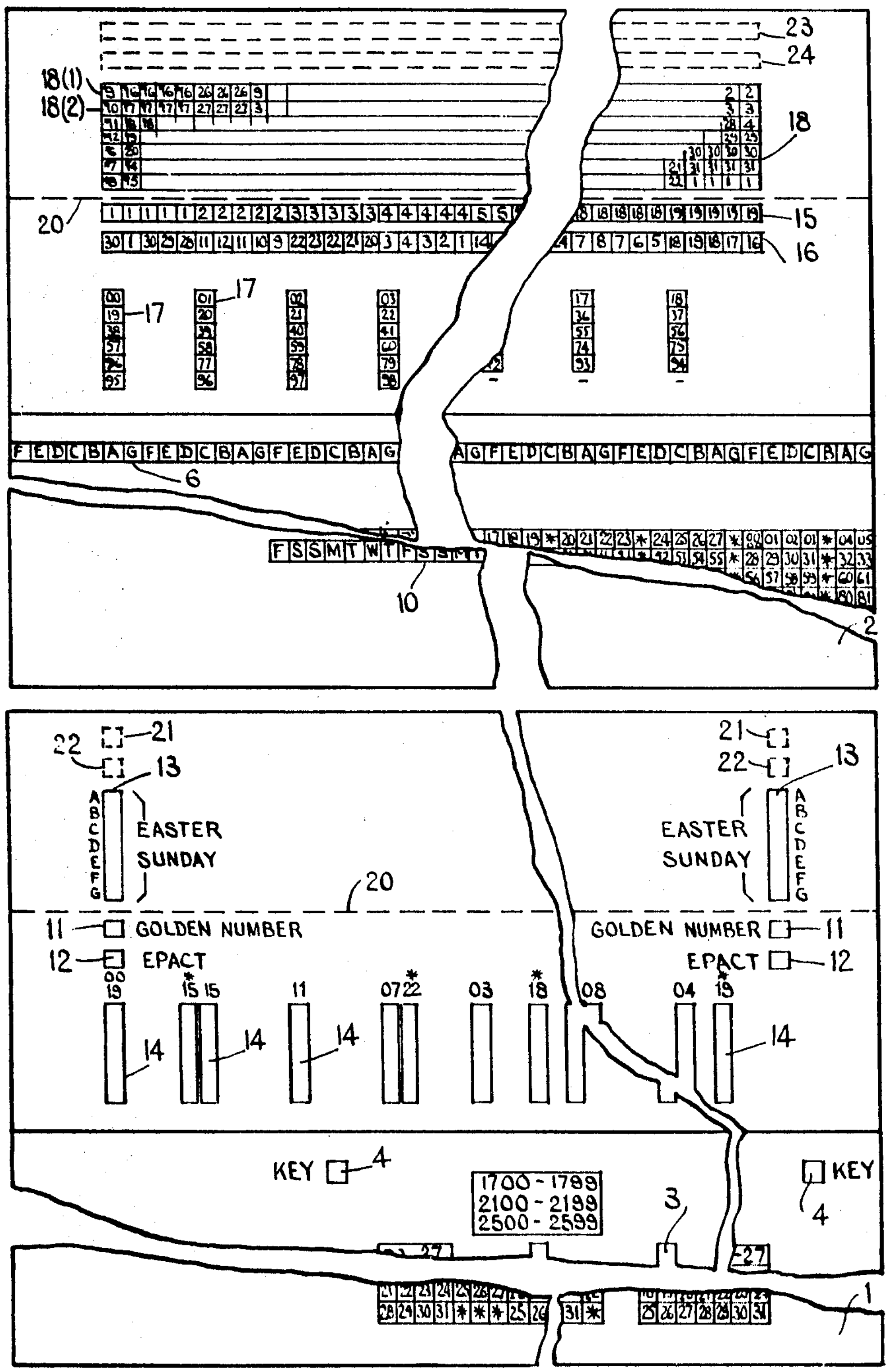


FIG. 2.

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United States Patent Office

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3,605,307

# PERPETUAL CALENDARS

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Int. Cl. G09d 3/04
U.S. Cl. 40—109 8 Claims

## ABSTRACT OF THE DISCLOSURE

A perpetual calendar is described which may be in the form of a slide rule, for example, in which two members are relatively moveable. One carries indexing positions, one for each day of the week, and the other carries an indicator, arranged in numerical sequence, of the years of a century. The indexing positions are allocated to centuries (according to the Julian and Gregorian centuries) by reference to the week-days on which they terminate, and the spacing between the positions is determined according to unit length multiples, in which a unit length is given a single-day significance and the pitch of the positions is a multiple of seven unit spaces, plus one unit. The year indicator is also spaced out, each common year indication being spaced by one unit from its predecessor in time and each leap year being spaced by two units. Thus the relative movement of the two members to associate a required year with a required century position indicates the terminal week-day of the required year. A calendar on one member with the day allocations omitted may then be completed by the assignment of days from a repetitive "day"-strip on the other member. The terminal day indications may, by predetermined association with code letters, be modified to show the dominical letter for the calculation of Easter Day in respect of the required year. A composite perpetual calendar and Easter calendar device may be formed by providing a further association of index points and indications. Taking into account epact and golden number cycles, the years of a century may be indicated at a regular spacing, and century index positions provided so that the relative movement of the two members to associate a required year with a required century will select a group of seven dates on which Easter Day might fall in the required year, and reference to the dominical letter then enables the particular date for Easter Day to be selected. The epact and golden number for the required year may also be displayed.

## BACKGROUND OF THE INVENTION

### (1) Field of the invention

The present invention relates to improvements in perpetual calendars.

### (2) Description of the prior art

It has previously been proposed to employ relatively moveable members to provide a perpetual calendar. However, the prior devices attain the required result by the use of fairly complex procedures. For example, in many cases it is necessary as a preliminary step to perform mathematical calculations or to consult pre-calculated tables in order to obtain key symbols, these symbols then being used to determine the relative displacement between two members required to show, usually, only a partial calendar. In those cases where the pre-calculation is not required it is common to require two or more separate, but linked, slides within a common cover.

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## SUMMARY OF THE INVENTION

According to the present invention a simple perpetual calendar arrangement is proposed to indicate a complete calendar for any required year according to the Julian or Gregorian system as may be required, the calendar including first and second relatively moveable members, the first member having a set of seven index positions spaced apart equally by multiples of a unit distance, each individual position corresponding to a different one of seven groups of centuries, the grouping of the centuries being arranged according to the particular day of the week on which they terminate respectively; and at least one further index position; the second member having a display of all the years of a century relatively spaced from one another by distances corresponding to one or two units in dependence upon whether a particular displayed year is a common or a leap year; and a cyclically repeated sequence of keys indicative of annual terminal days arranged to cooperate with said further index position; said first member being relatively displaceable with respect to the second member to bring a required year of the display into alignment with that index position of the set corresponding to a required century, such displacement being effective to bring said further index position into alignment with that one of said keys representing the terminal day of the required year.

The first member may also have a calendar displaying all the dates of each of the months of the year arranged in groups to correspond to each of the days of the week respectively and the second member may then have a plurality of sets of marks, each set representing the days of the week in sequence, the sets being arranged in repetitive cyclic order, the displacement of the members being effective to bring the cycles of the day marks respectively into alignment with the respective weekday groups of the calendar.

The keys may represent, respectively the dominical letter of the required year associated with Easter Day, and the perpetual calendar may then be modified to indicate the date of Easter Day for the required year.

## BRIEF DESCRIPTION OF THE DRAWINGS

A calendar device embodying the invention will now be described, by way of example, with reference to the accompanying drawings, in which,

FIG. 1 illustrates one embodiment of a perpetual calendar having two relatively movable members, and

FIG. 2 illustrates another embodiment having means for indicating the date of Easter Day.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

A "perpetual" calendar must take into account the following factors:

(A) Under the Julian calendar (in use at the commencement of the Christian era on January 1, A.D. 1—a Saturday by 7-day week reckoning— and not finally abandoned until Jan. 1, 1926, when the Gregorian calendar was officially adopted by Turkey, after proclamation of the Republic) all common years had 365 days and every fourth year was a leap year of 366 days, the extra day being included in February, the shortest month. Under the Julian calendar all centurial years (years ending in "00") were leap years.

(B) Under the Gregorian calendar (introduced by Pope Gregory XIII in A.D. 1582 but not adopted by Great Britain and the British Dominions until A.D. 1752 and by other countries at different times) all common years have 365 days and every fourth year is a leap year of 366 days, except in the case of centurial years which are not leap years unless exactly divisible by 400. Thus, under the Gergorian calendar, 1600 was a leap year but not 1700, 1800 or 1900, although under the Julian calendar all these years were leap years.

(C) When the Gregorian calendar was first introduced, Pope Gregory annulled 10 of the extra days that had accumulated under the Julian calendar and decreed that the day following Thursday, Oct. 4, 1582 (by the Julian calendar) should be followed by Friday, Oct. 15, Thus 1582 was the first year of the Gregorian calendar. There were 10 days of difference between the 2 calendars until 1700, which was a leap year under the Julian calendar but not under the Gregorian. After the Julian February 29, 1700, the difference became 11 days and, for similar reasons, the difference became 12 days in 1800 and 13 days in 1900.

(D) Since there are 7 different days of the week, with any one of which the year may commence, and since the length of a common year (365 days) exceeds that of 52 weeks by 1 day, it follows that, apart from the intervention of leap years (366 days), the dates throughout any year (including the terminal date) would fall 1 weekday later than in the previous year and the correspondence between the days of the week and the dates of the months would be repeated every 7 years. Leap years upset this uniformity by the reason of the fact that the extra day added to February advances the succeeding dates (including the terminal date) up to the end of the ensuing February by 2 weekdays instead of 1 in comparison with the dates of the same months during the previous 12-month period. The addition of the extra day every fourth year has the result that a period of 28 years (the so-called "solar cycle") is required, instead of 7 years, to bring about the cyclical recurrent correspondence between the days of the week and the dates of the months. Under the Julian system the 28-year cycle repeated with regularity, since every fourth year (including centurial years) was a leap year; but under the Gregorian system the cycle is disrupted from time to time by the intervention of centurial years that are not leap years.

(E) Taking the centuries to commence with the centurial years, it is necessary, at this point, to note how the correspondence between the terminal days of the centurial years differs under the Julian and Gregorian calendars:

(i) Under the Julian calendar every century included 25 leap years (including its centurial year), which means that every Julian century consisted of 5,200 weeks and 125 days. The 125 days are equivalent to 17 complete weeks and 6 days, which means that each Julian centurial year terminated 1 weekday earlier than the preceding Julian centurial year. The correspondence between the terminal days of the Julian centurial years was repeated, therefore, in a regular cycle of 700 years.

(ii) Under the Gregorian calendar only 1 century in every 4 (i.e. where the commencing centurial year is a leap year, being divisible by 400) includes 25 leap years and ends, consequently, with an incomplete week of 6 days. The other 3 centuries in every 4 include only 24 leap years each and therefore, end with an incomplete week of 5 days each. This means that the correspondence between the terminal days of the Gregorian centurial years is irregular, since 3 Gregorian centurial years in every 4 terminate 2 weekdays earlier than the preceding centurial year and only 1 centurial year in every 4 (i.e. where the centurial year is a leap year) terminates 1 weekday earlier than the preceding centurial year. This irregular correspondence between the terminal days of the Gregorian centuries is repeated in a regular cycle of 400 years, since this is the period required to effect the backward movement of 7 days. As a matter of interest, again assuming the centuries to commence with the centurial years, a Gregorian centurial year can terminate only on a Monday, Wednesday, Friday or Sunday and never on a Tuesday, Thursday or Saturday.



Summarising, it will be evident that a perpetual calendar capable of dealing with the variety of possible conditions must make provision for:

(a) the addition of an extra day to the month of February in leap years;
(b) the difference in treatment of centurial years as leap years under the Julian and Gregorian calendars;
(c) the diverging difference between the days of the week for any given dates under the Julian and Gregorian calenders during their period of common usage from October 1582 till December 1925;
(d) the abandonment of the Julian calendar and the adoption of the Gregorian by different countries at different times;
(e) the forward movement of the days of the week in relation to the dates of the months (including the terminal date of the year), as between one year and the next during the 28-year solar cycle, under both the Julian and Gregorian calendars, making allowance for the disruption of the cycle under the Gregorian calendar due to the intervention of centurial years that are not leap years;
(f) the backward movement of the days of the week in relation to the terminal days of the centurial years under both the Julian and Gregorian calendars, making allowance for their respective 700-year and 400-year cycles.

In the embodiment shown in FIG. 1, the perpetual calendar consists of an outer sheath or cover **1** of paper, cardboard, plastic or other suitable material, with transparent or cut-out windows and an inner movable slide **2** of similar material. For clarity of explanation, it is convenient to assume the front and back of the cover and slide to be divided horizontally and vertically into small units of equal width and height, the horizontal and vertical units on the front and back of the cover coinciding exactly with those on the front and back of the slide.

For simplicity of illustration, the cover **1** and the slide **2** are shown opened out, with the two faces marked "back" and "front" for identification. It will be appreciated that the slide may be a single sheet with the data printed on both faces, a single sheet folded in half, or two separate sheets bonded together by an adhesive.

On the back of the cover **1**, and on the same horizontal line, are seven transparent or cut-out windows **3** (referred to hereafter as "year windows") each year window **3** being one unit broad and four units high, with an interval of seven units between each pair of year windows **3**. Also on the back of the cover, at the top left and right on the same horizontal line, are two smaller transparent or cut out windows **4** (referred to hereafter as "key windows") each key window **4** being one unit broad and one unit high and the two key windows **4** being separated by an interval of sixty-nine units.

Above the year windows **3**, from left to right across the cover, are shown the Gregorian centuries in their recurrent cycle of 400 years. Thus, above the first year window **3** appear the Gregorian centuries 1700–1799, 2100–2199, 2500–2599; above the third appear 1800–1899, 2200–2299, 2600–2699; above the fifth appear 1582 (when the Gregorian calendar was first introduced) –1599, 1900–1999, 2300–2399; and above the sixth appear 1600–1699, 2000–2099, 2400–2499. Since the number of centuries in each of these groups can be extended indefinitely in the sequence indicated, it follows that the calendar may be arranged to apply so long as the Gregorian calendar remains in use. Centurial years that are exactly divisible by 400 (e.g. 1600, 2000 and 2400) are printed in contrasting colour such as red, for example, to indicate that they are leap years.

Beneath the year windows **3**, from left to right across the cover, are shown the Julian centuries in their recurrent cycle of 700 years. Thus, beneath the first year window **3** appear the Julian centuries 001–099, 700–799, 1400–

1499; beneath the second appear 100–199, 800–899, 1500–1599; beneath the third appear 200–299, 900–999, 1600–1699; beneath the fourth appear 300–399, 1000–1099, 1700–1799; beneath the fifth appear 400–499, 1100–1199, 1800–1899; beneath the sixth appear 500–599, 1200–1299, 1900–1925 (after which the Julian calendar was finally abandoned); and beneath the seventh appear 600–699 and 1300–1399. All the centurial years are shown in red (or other contrasting colour, as noted above), to indicate that they are leap years.

It will, of course, be appreciated that the Gregorian centuries can, if desired, be shown beneath the year windows **3** instead of above and, similarly, the Julian centuries can be shown above instead of beneath. With the Gregorian and Julian centuries grouped and positioned in the manner indicated, according to their respective recurrent cyclical sequences, each year window **3** can be regarded as representing the day of the week on which the centurial years shown above and beneath that window ended, or will end. Thus, reading from left to right, the year windows can be said to represent Friday, Thursday, Wednesday, Tuesday, Monday, Sunday and Saturday, which makes the necessary provision for the backward movement of the weekdays in relation to the terminal days of the centurial years under both Julian and Gregorian calendars and, as will later be explained, also provides the necessary starting points for the forward movement of the weekdays in relation to the terminal days of the years within the centuries.

When the slide **2** is positioned within the cover **1** so that both ends of the slide and cover exactly correspond, the figures

"00
00"

of a year table **5** are shown in the top quarter of the first (or Friday) year window **3**. One pair of figures are printed in black, and the other pair in red, to indicate that the same position refers to both centurial common years and leap years.

The digits 1, 2, 3, 4, 5, 6, 7 are repeated in sequence horizontally across the back of the slide, to form a key scale **6**. Each digit occupies a space one unit wide and one unit high with no space between adjacent digit, and the digit sequences so arranged and positioned that a "1" will coincide with the key window **4** at the top left of the back of the cover. Because of the interval of sixty-nine units between the two key windows **4**, it will be found that a "1" will also coincide with the other key window **4** at the top right of the back of the cover, so that key readings can now be taken from either of the key windows. The same result can be achieved by any other space interval between the two key windows which is one unit less than any multiple of seven units (e.g. 62, 76 or 83). The provision of two key windows **4** is convenient because the movement of the slide, with the particular dimensions shown, can frequently result in one or other of the key windows **4** showing no key. It will be appreciated that, alternatively, a single centrally positioned key window may be used.

Although the positioning of the repeated sequence of the digits 1 to 7 has been so arranged that a "1" appear in both key-number windows when

"00
00"

appears in the first year window, it will be apparent that any other digit may be positioned so to appear, so long as the correct association is established between the key sequence and the days of the week. Equally, any set of seven different symbols may be used instead of the digits 1 to 7. In particular, as will be described in relation to FIG. 2, the letters A to G may be used as keys. The correct association is determined by relating the keys to the terminal days of the centurial years. As already stated, the



Gregorian and Julian centuries have been grouped above and beneath the year windows according to their respective recurrent cycles of 400 and 700 years and according to the days of the week on which their centurial years terminate, the year windows **3** representing in sequence from left to right the terminal days: Friday, Thursday, Wednesday, Tuesday, Monday, Sunday and Saturday. Therefore, whichever key appears in the key windows **4** when

"00
00"

appears in the first year window **3** must be regarded as the key for Friday, since all the centurial years above and beneath the first year window **3** terminate on that day of the week. With the present arrangements, the association that has been established between the keys (the digits 1 to 7 as shown in FIG. 1 or the letters A to G as shown in FIG. 2) and the days of the week is as follows:

Key: 1 or Key: C—Friday
Key: 2 or Key: B—Saturday
Key: 3 or Key: A—Sunday
Key: 4 or Key: G—Monday
Key: 5 or Key: F—Tuesday
Key: 6 or Key: E—Wednesday
Key: 7 or Key: D—Thursday

If the slide is now moved so that

"00
00"

appears in the second year window, the key will require to represent Thursday, since all the centurial years above and beneath the second year window terminate on that day of the week and as shown in FIG. 1 will require to be the digit "7." The key which now appears in the key windows **4** will, in fact, be seen to be "7." This backward movement of the key digits to accord with the backward movement of the terminal days of the centurial years has been achieved by the space interval of 7 units between each pair of year windows **3**. For the same reason, and in the same way, the keys when

"00
00"

appear in the third, fourth, fifth, sixth and seventh year windows will be seen to be respectively 6 (Wednesday), 5 (Tuesday), 4 (Monday), 3 (Sunday) and 2 (Saturday).

An alternative way of arranging for the backward movement of the keys to accord with the backward movement of the terminal days of the centurial years, is to utilise a space interval of six units between each pair of year windows **3** instead of seven units, with the positioning of the Gregorian and Julian centuries above and beneath the year windows running from right to left instead of from left to right as in the present arrangement.

Suitable provision having been made for the backward movement of the terminal days of the centurial years, it is now necessary to make provision for the forward movement of the terminal days of the other 99 years in every century. To achieve this, further use is made of the slide and the seven year windows **3** and the two key windows **4** on the back of the cover.

Horizontally across the back of the slide from the extreme left to the extreme right, in four parallel lines so positioned as to be seen simultaneously through all the year windows **3** on the back of the cover, are shown the undernoted figures (representing the tens and units of each year of a century) in repeated sequences according to the 28-year solar cycle, to form the year table **5**. Each pair of figures occupies a space one unit wide and one unit high, with no space between adjacent pairs of figures except that the figures

"00
00"

and such other figures (shown in red, for example, to indicate that they are leap years) as are evenly divisible by 4 are preceded by a space interval one unit wide and one unit high, with the figure sequences so arranged and positioned that "28," "56," and "84" will fall immediately beneath the

"00
00"

thus:



The space of two units preceding September; December is inserted to enable the dates of these months to commence as shown. If the space were not so inserted, the commencing dates of these months would run – – – – – – 1 and would require six lines, instead of five as in every other case, to complete the dates to "31." When two months are grouped together, dates which are not common to both months are shown in brackets, thus: FEBRUARY; NOVEMBER 25 26 27 28 (29) (30) –.

| | | | | | | |
|---|---|---|---|---|---|---|
| 00 | | | | | | |
| 00010203 | 04050607 | 08091011 | 12131415 | 16171819 | 20212223 | 24252627 |
| 28293031 | 32333435 | 36373839 | 40414243 | 44454647 | 48495051 | 52535455 |
| 56575859 | 60616263 | 64656667 | 68697071 | 72737475 | 76777879 | 80818283 |
| 84858687 | 88899091 | 92939495 | 96979899 | | | |

The years "01" to "99" in each century, in repeating cycles of 28 years, are seen to be positioned in relation to the centurial year "00," with each common year positioned one unit to the right of the preceding year (since each common year ends one weekday later than the preceding year) and each leap year positioned two units to the right of the preceding year (since each leap year ends two weekdays later than the preceding year). As a result of this arrangement, when the tens and units figures of any year are positioned in the year window **3** for any century, the key for the year "00" in the same year window **3** will be automatically advanced by one for every common year and by two for every leap year (from "01" till the selected year, inclusive). In other words, allowance will be made for the forward movement of the terminal days of the ensuing years in relation to the terminal day of the centurial year and the key appearing in the key number window **4** will be the key of the terminal day of the selected year.

Suitable arrangements having been made to obtain automatically the key for the terminal day of any year of any century (Gregorian or Julian), it remains only to provide for the display of the calendar appropriate to any key, making due allowance for the additional day in February in leap years.

The present embodiment uses a grouping of the months in two rows, which (apart from the leap year January and February) arranges the months in their normal sequence:

Also on the front of the cover are two key windows **8**, positioned similarly as the two key windows **4** on the back of the cover.

The sequences of digits " 1, 2, 3, 4, 5, 6, 7, 1, 2, 3, 4, 5, 6, 7" are printed at the top left and the top right of the front of the slide, each number occupying a space one unit wide and one unit high with no space between adjacent digits. The digits are positioned to appear in the windows **8**.

The symbols "F, S, S, M, T, W, T" forming a day scale **10** (representing the days of the week commencing with Friday and ending with Thursday) are repeated in sequence horizontally across the slide to coincide exactly with the day windows **7** on the front of the cover, each symbol occupying a space one unit wide and one unit high with no space between adjacent symbols. The sequence is so arranged that the first "F" in the weekday sequence falls in the same vertical line as the first "5" in the top left key position of the sequence **9** and the last "T" in the weekday sequence falls in the same vertical line as the second "4" in the top right key position of the sequence **9**.

It will be seen that when the key "1" appears in the key windows **8** December 31 will be a Friday and similarly, for "2" a Saturday; "3" a Sunday; "4" a Monday; "5" a Tuesday; "6" a Wednesday and "7" a Thursday, which is the association required under the present arrangement to enable the calender corresponding with any key to be automatically displayed.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
| OCTOBER | NOVEMBER | | | | | *JANUARY | *FEBRUARY | DECEMBER |

The two months January and February indicated by the prefix * are printed in red, for example, and these groups are intended to be used only in the case of leap years.

This arrangement of the months printed on the front of the cover **1**, the names of the months in each of the nine groups occupying a space seven units wide and two units high. Between the last two groups (August; *February and September; December) is a space of two units. Beneath each of the nine groups is a transparent or cut-out window **7** (referred to hereafter as "day window") seven units wide and one unit high and beneath each of the nine windows **7** is a rectangle seven units wide and five units high, divided into thirty-five squares each one unit wide and one unit high to accommodate the dates of the respective months. To ensure that each of the months, in relation to one another, starts on the correct day of the week, the commencing dates of the various months are arranged as follows:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| JANUARY; OCTOBER | – | 1 | 2 | 3 | 4 | 5 | 6 |
| FEBRUARY; NOVEMBER | – | – | – | – | 1 | 2 | 3 |
| MARCH | – | – | – | – | 1 | 2 | 3 |
| APRIL | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| MAY | – | – | 1 | 2 | 3 | 4 | 5 |
| JUNE | – | – | – | – | – | 1 | 2 |
| JULY; (*JANUARY) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| AUGUST; (*FEBRUARY) | – | – | – | 1 | 2 | 3 | 4 |
| SEPTEMBER; DECEMBER | – | – | – | – | 1 | 2 | 3 |

To find the day of week corresponding to any date from the beginning of the Christian era or any future data, according to either the Julian or Gregorian systems during their respective periods of operation it is only necessary to:

(a) set the figures representing the tens and units of the selected year in the appropriate year window **3** beneath or above the selected century;

(b) note the key which appears in either of the key windows **4**; and

(c) set or maintain that key in either of the key windows **8**.

The calendar for the corresponding year will now be exhibited, with the days of the week and the months of the year displayed in normal sequence. If the selected year is a leap year under either the Julian or Gregorian calendar, the red-printed January (beneath July) and the red-printed February (beneath August) should be used and for all common years under either calendar the black-printed January and February should be used.

The perpetual calendar can be used not only to display the calendar for any selected year but also, when a particular arrangement of days in a month is known, to find the corresponding year for that particular arrangement of days. For example, suppose that it is required to ascertain when was the last time that January 1 fell on Sunday in a leap year. The slide is set so that the first day of the month under the red-printed January is a Sunday and the key showing in either of the key windows **8** is noted. The slide on the Gregorian scale is then set for the leap year that has last occurred and is moved backward (if necessary) to each preceding leap year until the key noted appears in either of the key windows **4**. This will be seen to occur at the setting for 1956—so 1956 was the last time that January 1 fell on Sunday in a leap year. By moving forward, instead of backward, it will be found that January 1 will not again fall on Sunday in a leap year until 1984.

The arrangement of months shown in the drawing is convenient because they are arranged in the normal sequence. However, other arrangements may be used. For example, one suitable arrangement which occupies less space on the cover is:

| | | | | | | |
|---|---|---|---|---|---|---|
| JANUARY* APRIL JULY | JANUARY OCTOBER | MAY | FEBRUARY* AUGUST | FEBRUARY MARCH NOVEMBER | JUNE | SEPTEMBER DECEMBER |

as in the previous example, the suffix* indicates that the name of the month is printed in red and is to be used only in relation to leap years.

Using this arrangement of months, the rectangular areas for each month are spaced apart by one unit, and the dates are uniformly arranged with the first of the month occurring in the top left-hand corner of the rectangle.

The embodiment which has been described is constructed in a form generally similar to that of a slide rule. Other forms of construction may be more suitable for particular purposes. For example, the cover and slide may be circular and be held together for relative rotation by a central rivet. The scales are arranged in the same sequences as is illustrated, but are positioned along arcs of a circle. In another form, the cover and slide may be cylindrical, the slide being positioned within the cover and being rotatable about the cylindrical axis within the cover. In another case, the opened out slide and cover form shown in the drawing may be used, so that the two faces are visible simultaneously, the cover being provided with a blank back to provide accommodation for the slide. In this last case, provided that the two sets of data are provided in the same relative positions as shown the keys are not required for transferring the setting of the slide and, in consequence, only a single pair of key windows **4** or **8** need be provided. The back face of the perpetual calendar may then be used for other purposes.

For example, it is possible to improve the usefulness of the perpetual calendar heretofore described by making provision for the determination of Easter Day in any year and to show the golden number, the dominical (or Sunday) letter, the epact and the appropriate cycle of Easter dates according to the different ecclesiastical calendars.

The exhibition of such relevant data must take into account the following factors:

(I) Since the year A.D. 325 the general rule for the celebration of Easter has been that Easter Day is to be celebrated on the first Sunday after the full moon (known as the Paschal or Easter Full Moon and reckoned always as the fourteenth day of the new moon) that happens upon or next after March 21 but, if the full moon happens on a Sunday, Easter Day is not to be celebrated on that Sunday but on the following Sunday. This means, in effect, that Easter Sunday can fall on any one of the 35 dates from March 22 till April 25 inclusive.

(II) Because the Easter full moon can happen on different dates in different places (depending upon the longitude of any particular place) the early Church Fathers had to devise some method whereby Easter Sunday could be celebrated on the same day by all Christian communities, wherever located. To this end, an Eccelesiastical calendar was prepared, from which the date of the Easter full moon could be determined in advance for any year, based on the supposition that the dates of the full moons repeated themselves in exactly the same sequence in recurrent lunar cycles of nineteen years. Dates for the Easter full moons were assigned to each of the nineteen years of the cycle and these dates were repeated for centuries, cycle after cycle, so long as the Julian calendar continued to be used. The series of nineteen-year cycles is assumed to have commenced in 1 B.C. (from which date the Easter full moons were also computed) and to have continued without a break from then until the present time, although the system of dating the Easter full moons was changed with the introduction of the Gregorian calender. It is to be noted, however, that the full moon of the ecclesiastical calendar is not the astronomical full moon but is, in fact, an imaginary full moon which does not always exactly coincide with the astronomical full moon.

The nineteen years of each cycle, from the earliest times, have been numbered successively from 1 to 19, so that the position of any year in its particular cycle is indicated by its number termed the *golden number*. The purpose of the golden number is to indicate the ordinal position of any year in its appropriate nineteen-year cycle and so to enable the date of the relevant Easter full moon to be ascertained by reference to the ecclesiastical calendar.

(III) By using the golden number it is possible only to find the date of the Easter full moon in any year (and consequentially the only seven possible dates for Easter Sunday in all years of that same golden number), so the Church Fathers provided a further device called the *dominical* (or *Sunday*) *letter* whereby, the date of the Easter full moon having been determined for any particular year, the actual date of Easter Sunday in that particular year can easily be ascertained by further reference to the ecclesiastical calendar. This is done by indicating the seven days of the week by the first seven letters of the alphabet, the letter "A" being always allocated in each year to the day of the week upon which January 1 falls, and the letter "B" to "G" to the next six days, after which the sequence recommences with the letter "A" allocated to January 8 and so on throughout the year until December 31. In any year the recurrent letter allocated to Sunday is known as the dominical (or Sunday) letter. In leap years, however, where the normal sequence of dates is interrupted by the intercalation of leap year day, it is the custom to regard leap year day as having the same letter as the day immediately preceding. The effect of this is that, after leap year day, the letters appropriate to the particular days of the week in that year all move back one place and, consequently, every leap year has two Sunday letters—the first referring to the Sundays before February 29 and the second to the Sundays after that date. In leap years it is the second Sunday letter that is always used to determine the date of Easter Sunday according to the ecclesiastical calendar. For example, the year 1968 had the Sunday letters GF (all the Sundays in January and February being G-days and all the Sundays in the other months being F-days) but, for the purpose of determining the date of Easter Sunday, 1968 is taken only to have the Sunday letter F.

(IV) Over the centuries the dates fixed for the celebration of Easter fell into error because the full moons did not, in fact, repeat themselves exactly in cycles of nineteen Julian years and because the length of the average year under the Julian calendar was also incorrect. When the Gregorian calendar was introduced in 1582, arrangements were made to correct the accumulated Easter error and to prevent a similar error from occurring in future. The recurrent cycle of nineteen years was still retained but the system of golden numbers was officially abandoned by papal decree and superseded by a new system of *epacts*, which gives to each year in the ninteen-year cycle a number representing the age of the moon on January 1 and from which, by reference to the new ecclesiastical calendar and the use of the Sunday letter, it is now possible to ascertain the date of Easter Sunday for any year under the Gregorian calendar. The error due to the continuing use of the nineteen-year cycle under the Gregorian calendar is adjusted from time to time, whenever necessary, by introducing a new series of epacts as the beginning of a new century. Thus the series of epacts introduced in 1582 was changed in 1700 and 1900 and will be changed again in 2200.

Although not officially adopted for ecclesiastical purposes until 1582, the epact was known long before the Gregorian reform and the series of epacts applicable to the Julian calendar is assumed to have commenced in 1 B.C. and to have continued over the centuries without alteration so long as the Julian calendar continued to be used. It is to be noted, however, that under the Julian calendar the epact for any year denotes the age of the moon on March 22, and not on January 1 as under the Gregorian calendar.

The new arrangements for the determination of Easter Sunday, introduced by Pope Gregory XIII in 1582, have now been adopted by all the Western churches (both Roman Catholic and Protestant) but not by the Eastern Orthodox churches. In the English Prayer Book the complete table of epact cycles is shown, covering a period of 7000 years, but the calendar for determining the date of Easter Sunday continues to use the old system of golden numbers and Sunday letters.

Summarising these factors it will be evident that a perpetual Eastern calendar capable of dealing with the variety of possible conditions must make provision for exhibiting:

(i) The golden number for each year of the recurrent nineteen-year lunar cycle;

(ii) The Sunday letter for each year according to either the Julian or Gregorian reckoning;

(iii) The epact for each year of the recurrent nineteen-year lunar cycle according to either the Julian or Gregorian reckoning, making allowance for the different epact series operative from 1 B.C., A.D. 1582, 1700, 1900 and 2200.

In the embodiment shown in the drawing, the epact series is given only until the year 2299 in order to keep the perpetual Easter calendar to the same size and format as the perpetual calendar previously described. It will be realised however, that the epact series may be carried as far into the future as may be desired.

(iv) The seven possible dates for Easter Sunday appropriate to each golden number or epact.

Referring now to FIG. 2 an Easter calendar is shown appended to the perpetual calendar previously described. The cover **1** and the slide **2** are extended to include the Easter calendar. For convenience the cover and slide are shown, as in the earlier description, opened out so that the relative positions of the data markings and windows on the slide and cover respectively, can more readily be seen. The markings and windows of the appended calendar will now be described in greater detail.

On the front of the cover and on the same horizontal lines respectively are: a first pair of windows **11** (referred to hereafter as "Golden Number Windows"), each window **11** being one unit wide and one unit high; a second pair of windows **12** (referred to hereafter as "Epact Windows"), each window **12** being one unit wide and one unit high; and a third pair of windows **13** (referred to hereafter as "Easter Sunday Windows"), each window **13** being one unit broad and seven units high; beside the Easter Sunday Windows are recorded the letters "A, B, C, D, E, F, and G" (representing the seven Sunday letters) in a vertical column reading downwards as shown, each letter occupying a space one unit wide and one unit high.

Corresponding ones of the three pairs of windows **11**, **12** and **13** are arranged in vertical alignment and the individual windows of each pair are respectively horizontally separated by an interval of 94 units. In other words, if a window of a pair occupies a notional first position, then the other window of that pair occupies the ninety-sixth position. As in the case of the perpetual calendar previously described, two windows **11**, **12** and **13** respectively, are provided because the sideways movement of the slide, with the particular dimensions shown, always results in one or other of the windows of a pair showing no calendrial data.

The cover also has, positioned in FIG. 2 below the windows **11**, **12** and **13**, twenty-seven further windows **14** (referred to hereafter as ("Century Windows"), each window being one unit wide and six units high. As will be explained, nineteen of these windows are allocated to the twenty centuries of the Julian calendar, the appropriate century being indicated above each window, and eight of the windows to eight centuries of the Gregorian calendar, again with the appropriate century being indicated above each window. In order to distinguish between the Julian and Gregorian centuries where they overlap, it is preferred to provide these indications in different colours respectively, such as for example black for Julian and red for Gregorian centuries. The positions of the Century Windows **14** are so located in relation to calendrial data provided on the slide that, when the slide is moved to bring the last two figures of any particular year into the appropriate Century Window **14**, then the golden number, epact and Easter Sunday dates for that year appear in the appropriate windows **11**, **12** and **13** respectively. The horizontal positions occupied by the Century Windows **14** will be described in detail hereinafter.

The data printed on the slide will now be described in detail. In a horizontal line **15** chosen to correspond to the Golden Number Windows **11** on the cover, the golden numbers 1–19 are recorded in successive order, each number occupying a space one unit wide and one unit high; since the recurrent series of golden numbers is assumed to have continued without break or alteration from 1 B.C. till the present time, each of the golden numbers is repeated five times in adjacent unit space positions of the line **15**, once for each of the five epact cycles covering the period 1 B.C.–A.D. 2299, so that irrespective of the epact from any particular cycle applicable to any particular year, the corresponding golden number for that year simultaneously appears in the one of the Golden Number Windows **11**. In a horizontal line **16**, chosen to correspond to the Epact Windows **12** on the front of the cover, the nineteen numbers of each of the five successive epact cycles, each number occupying a space one unit wide and one unit high; each of the nineteen numbers of the first epact cycle (commencing with "30") occupies, in cyclic order, the first of the five positions respectively under each of the nineteen successive golden numbers in the line **15**; and similarly the second epact cycle (commencing with "1"), the third (commencing with "30"), the fourth (commencing with "29") and the fifth (commencing with "28") occupy respectively the second, third, fourth and fifth positions under each of the nineteen successive golden numbers recorded in the line **15**. In each epact cycle one of the numbers from one to thirty is allocated to each position in the cycle, the succeeding positions in the same cycle, from left to right being allocated a number which is eleven in excess of the preceding position of that cycle, subject to the subtraction of thirty from the newly calculated number each time it exceeds this sum. Thus, the successions of numbers of each of the epact cycles is as follows:

In the first epact cycle: 30, 11, 22, 3, 14, 25, 6, 17, 28, 9, 20, 1, 12, 23, 4, 15, 26, 7, 18;

In the second epact cycle: 1, 12, 23, 4, 15, 26, 7, 18, 29, 10, 21, 2, 13, 24, 5, 16, 27, 8, 19;

The third epact cycle sequence corresponds to that of the first cycle.

In the fourth epact cycle: 29, 10, 21, 2, 13, 24, 5, 16, 27, 8, 19, 30, 11, 22, 3, 14, 25, 6, 17;



and in the fifth epact cycle: 28, 9, 20, 1, 12, 23, 4, 15, 26, 7, 18, 29, 10, 21, 2, 13, 24, 5, 16.

In a group 18 of seven horizontal lines chosen to correspond to the seven Sunday letters recorded beside the Easter Sunday Windows **13** on the front of the cover, and vertically tabulated immediately above the appropriate one of the golden numbers in the line **15** and epact numbers in the line **16** respectively, are recorded the seven possible dates of Easter Sunday according to the various ecclesiastical calendars (the vertical tabulation in each case being headed by the date appropriate to Sunday letter "A") for each of the nineteen numbers of each of the five successive epact cycles, each date occupying a space one unit wide and one unit high. For convenience, and to avoid overcrowding the available space, it is preferred to use contrasting colours, for example, red and black, to distinguish between dates falling in the months of March and April respectively. Thus, for example, the dates recorded in the individual horizontal lines are as follows, the March dates being indicated by an asterisk:

In the topmost line 18 (1), reading from left to right as shown in the figure:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9; | 16; | 16; | 16; | 16; | *26; | 2; | 9; | 9; | 9; | 16; | *26; | *26; | *26; | *26; |
| 9; | 16; | 16; | 16; | 16; | *26; | 2; | 2; | 2; | 2; | 16; | 23; | 23; | 23; | *26; |
| 2; | 9; | 9; | 9; | 16; | 23; | 2; | 2; | 2; | 2; | 9; | 16; | 16; | 23; | 23; |
| 2; | 9; | 9; | 9; | 9; | 16; | *26; | *26; | *26; | 2; | 9; | 16; | 16; | 16; | 16; |
| *26; | 2; | 2; | 9; | 9; | 16; | 23; | *26; | *26; | *26; | 2; | 9; | 16; | 16; | 16; |
| *26; | 2; | 2; | 2; | 2; | 16; | 23; | 23; | 23; | 23; | 2; | 9; | 9; | 9; | 9; |
| 23; | *26; | 2; | 2; | 2; | | | | | | | | | | |

In the second line 18 (2):

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10; | 17; | 17; | 17; | 17; | *27; | 3; | 3; | 10; | 10; | 17; | *27; | *27; | *27; | *27; |
| 3; | 10; | 17; | 17; | 17; | *27; | 3; | 3; | 3; | 3: | 17; | 24; | 24; | 24; | *27; |
| 3; | 10; | 10; | 10; | 10; | 24; | *27; | 3; | 3; | 3; | 10; | 17; | 17; | 17; | 24; |
| 3; | 10; | 10; | 10; | 10; | 17; | *27; | *27; | *27; | *27; | 10; | 17; | 17; | 17; | 17; |
| *27; | 3; | 3; | 3; | 10; | 17; | 24; | *27; | *27; | *27; | 3; | 10; | 10; | 17; | 17; |
| *27; | 3; | 3; | 3; | 3; | 10; | 27; | 24; | 24; | 24; | 3; | 10; | 10; | 10; | 10; |
| 24; | *27; | *27; | 3; | 3. | | | | | | | | | | |

In the third line:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11; | 18; | 18; | 18; | 18; | *28; | 4; | 4; | 4; | 11; | 18; | *28; | *28; | *28; | *28; |
| 4; | 11; | 11; | 18; | 18; | *28; | 4; | 4; | 4; | 4; | 11; | 18; | 25; | 25; | *28; |
| 4; | 11; | 11; | 11; | 11; | 25; | *28; | *28; | 4; | 4; | 11; | 18; | 18; | 18; | 18; |
| *28; | 4; | 11; | 11; | 11; | 18; | *28; | *28; | *28; | *28; | 11; | 18; | 18; | 18; | 18; |
| *28; | 4; | 4; | 4; | 4; | 18; | 25; | *28; | *28; | *28; | 4; | 11; | 11; | 11; | 18; |
| *28; | 4; | 4; | 4; | 4; | 11; | 18; | 18; | 18; | 25; | 4; | 11; | 11; | 11; | 11; |
| 18; | *28; | *28; | *28; | 4. | | | | | | | | | | |

In the fourth line:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12; | 19; | 19; | 19; | 19; | *29; | 5; | 5; | 5; | 5; | 19; | *22; | *29; | *29; | *29; |
| 5; | 12; | 12; | 12; | 19; | *29; | 5; | 5; | 5; | 5; | 12; | 19; | 19; | 19; | *22; |
| 5; | 12; | 12; | 12; | 12; | 19; | *29; | *29; | *29; | 5; | 12; | 19; | 19; | 19; | 19; |
| *29; | 5; | 5; | 12; | 12; | 19; | *29; | *29; | *29; | *29; | 5; | 12; | 19; | 19; | 19; |
| *29; | 5; | 5; | 5; | 5; | 19; | 19; | *22; | *29; | *29; | 5; | 12; | 12; | 12; | 12; |
| *22; | *29; | 5; | 5; | 5; | 12; | 19; | 19; | 19; | 19; | 5; | 12; | 12; | 12; | 12; |
| 19; | *29; | *29; | *29; | *29. | | | | | | | | | | |

In the fifth line:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6; | 13; | 20; | 20; | 20; | *30; | 6; | 6; | 6; | 6; | 20; | *23; | *23; | *30; | *30; |
| 6; | 13; | 13; | 13; | 13; | *23; | *30; | 6; | 6; | 6; | 13; | 20; | 20; | 20; | *23; |
| 6; | 13; | 13; | 13; | 13; | 20; | *30; | *30; | *30; | *30; | 13; | 20; | 20; | 20; | 20; |
| *30; | 6; | 6; | 6; | 13; | 20; | *30; | *30; | *30; | *30; | 6; | 13; | 13; | 20; | 20; |
| *30; | 6; | 6; | 6; | 6; | 13; | 20; | *23; | *23; | *30; | 6; | 13; | 13; | 13; | 13; |
| *23; | *30; | *30; | 6; | 6; | 13; | 20; | 20; | 20; | 20; | *30; | 6; | 13; | 13; | 13; |
| 20; | *30; | *30; | *30; | *30. | | | | | | | | | | |

In the sixth line:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7; | 14; | 14; | 21; | 21; | *31; | 7; | 7; | 7; | 7; | 14; | *24; | *24; | *24; | *31; |
| 7; | 14; | 14; | 14; | 14; | *24; | *31; | *31; | 7; | 7; | 14; | 21; | 21; | 21; | *24; |
| *31; | 7; | 14; | 14; | 14; | 21; | *31; | *31; | *31; | *31; | 14; | 21; | 21; | 21; | 21; |
| *31; | 7; | 7; | 7; | 7; | 21; | *24; | *31; | *31; | *31; | 7; | 14; | 14; | 14; | 21; |
| *31; | 7; | 7; | 7; | 7; | 14; | 21; | *24; | *24; | *24; | 7; | 14; | 14; | 14; | 14; |
| *24; | *31; | *31; | *31; | 7; | 14; | 21; | 21; | 21; | 21; | *31; | 7; | 7; | 14; | 14; |
| 21; | *31; | *31; | *31; | *31. | | | | | | | | | | |

In the seventh lowermost line:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8; | 15; | 15; | 15; | 22; | 1; | 8; | 8; | 8; | 8; | 15; | *25; | *25; | *25; | *25; |
| 8; | 15; | 15; | 15; | 15; | *25; | 1; | 1; | 1; | 8; | 15; | 22: | 22; | 22; | *25; |
| 1; | 8; | 8; | 15; | 15; | 22; | 1; | 1; | 1; | 1; | 8; | 15; | 22; | 22; | 22; |
| 1; | 8; | 8; | 8; | 8; | 22; | *25; | *25; | 1; | 1; | 8; | 15; | 15; | 15; | 15; |
| *25; | 1; | 8; | 8; | 8; | 15; | 22; | *25; | *25; | *25; | 8; | 15; | 15; | 15; | 15; |
| *25; | 1; | 1; | 1; | 1; | 15; | 22; | 22; | 22; | 22; | 1; | 8; | 8; | 8; | 15; |
| 22; | 1; | 1; | 1; | 1. | | | | | | | | | | |

In nineteen vertical "year" columns **17** positioned immediately beneath the first positions of the nineteen golden numbers, and in six horizontal lines chosen to coincide with the Century Windows **14** of the cover, are recorded a group of two digit numbers representing respectively the tens and units of each year of a century, each pair of digits occupying a space one unit wide and one unit high. The arrangement of these numbers is such that the horizontal rows taken in succession reading downwards and from left to right as shown record the years of a century in numerical sequence, the bottom row containing only five numbers aligned towards the left. Thus the arrangement of these numbers is shown in the following table:

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 |
| 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
| 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 |
| 95 | 96 | 97 | 98 | 99 | | | | | | | | | | | | | | |

In allocating the Julian century numbers to the Century Windows **14** on the cover, this position has been achieved by allocating successive century numbers at intervals of fourteen years as recorded in the "year" columns **17** of the slide visible in the Century Windows **14** when the slide is positioned in the datum position within the cover (in the present example with the ends of the slide and cover exactly corresponding). For convenience, in order to limit the sum obtained by successive additions of fourteen, because the Julian century windows **14** represent a complete nineteen year cycle, nineteen is deducted from the total each time the sum exceeds this figure. Thus the

The calendrial data shown on the slide are so located that, with the slide positioned within the cover according to a fixed datum position, for example when they are positioned so that the ends of the slide and cover exactly correspond, the first vertical column of calendrial data on the slide appears simultaneously in all the left-hand windows on the cover, and the nineteen vertical columns of figures representing the tens and units of each year of a century appear simultaneously in the nineteen Century Windows **14** allocated to the centuries of the Julian calendar. Thus, the horizontal spacing of these windows **14** corresponds to the horizontal spacing of the columns **17** and the particular Julian century is repeated by the number recorder, for example in black, above the appropriate window **14**.

Under this arrangement, the years "01" to "99" in each century (in groups of nineteen years to accord with the nineteen-year cycles of golden numbers, epacts and Easter Sunday dates) are seen to be positioned in relation to the centurial year commencing with "00", which is equivalent to 1 B.C., from which date the cycles of golden numbers, epacts and Easter Sunday dates are assumed to have been calculated.

Since the same golden numbers always recur in cycles of nineteen years, it follows that any two years which are 114 years apart (19×6) will always have the same golden number (e.g. 1454 and 1568 which both have the golden number 11). In other words, the golden numbers (and similarly the epacts and Easter Sunday dates, which also operate on the same nineteen-year cycle) will be the same for all Julian years shown simultaneously by the perpetual Easter calendar, provided that the year figures shown in any Century Window are greater by fourteen than the figures shown in the Century Window for the century immediately preceding in numerical sequence.

Julian century numbers are allocated to the windows **14** as follows:

| Julian century: | Above the windows **14** in which appears the year— |
|---|---|
| 00 | 00 |
| 01 | 14 (00 plus 14). |
| 02 | 09 (14 plus 14 less 19). |
| 03 | 04 (09 plus 14 less 19). |
| 04 | 18 (04 plus 14). |
| 05 | 13 (18 plus 14 less 19). |
| 06 | 08 (13 plus 14 less 19). |
| 07 | 03 (08 plus 14 less 19). |
| 08 | 17 (03 plus 14). |
| 09 | 12 (17 plus 14 less 19). |
| 10 | 07 (12 plus 14 less 19). |
| 11 | 02 (07 plus 14 less 19). |
| 12 | 16 (02 plus 14). |
| 13 | 11 (16 plus 14 less 19). |
| 14 | 06 (11 plus 14 less 19). |
| 15 | 01 (06 plus 14 less 19). |
| 16 | 15 (01 plus 14). |
| 17 | 10 (15 plus 14 less 19). |
| 18 | 05 (10 plus 14 less 19). |
| 19 | 00 (05 plus 14 less 19). |

The Gregorian centuries have been similarly allocated, but moved one, two, three or four units to the left, depending upon whether the first, second, third or fourth Gregorian epact cycle applies. Thus new windows **14** are provided for the Gregorian centuries, and the century allocation is provided, for example, in red or other contrasting colour for ready distinction, as follows

Gregorian century 15 displaced by one unit to the left from the window **14** in which appears year 01

Gregorian century 16 displaced by one unit to the left from the window **14** in which appears year 15

Gregorian century 17 displaced by two units to the left from the window 14 in which appears year 10
Gregorian century 18 displaced by two units to the left from the window 14 in which appears year 05
Gregorian century 19 displaced by three units to the left from the window 14 in which appears year 00.

It is to be noted that as the Julian century windows **14** represent the nineteen year cycle, a movement of three units to the left of the window **14** in which year 00 appears is equivalent to the movement of two units to the right of the window **14** in which the year 18 appears, and for convenience this movement is adopted in FIG. 2.

Gregorian century 20 displaced by three units to the left of the window **14** in which appears year 14 (00 plus 14)
Gregorian century 21 displaced by three units to the left of the window **14** in which appears year 09 (14 plus 14 less 19)
Gregorian century 22 displaced by four units to the left of the window **14** in which appears year 04 (09 plus 14 less 19)

It is now required only to provide a means of exhibiting the Sunday letter of any selected year under either the Julian or Gregorian calendar. As already explained, the Sunday letter is determined by the position of the first Sunday in any year in relation to the day of the week upon which January 1 falls in that year (with special allowance having to be made for leap years). Obviously, therefore, the determination of the Sunday letter must be based upon a recurrent cycle of 28 years (with special allowance having to be made for centurial years that are not leap years). As previously described in connection with the perpetual calendar of FIG. 1, the same cycle provides the means for determining the key for any selected year. As is also described, a set of seven different letters may be employed to form the keys as shown in FIG. 2 instead of the digits used for this purpose in FIG. 1. By choosing the order in which these letters are allocated to correspond to the seven days of the week as described, it is arranged that the key letter of any particular year will, in fact, also be the Sunday letter used to determine the Easter Day of that year.

The effect of all the foregoing arrangements is such that, to find the date of Easter Sunday for any selected year of the Christian era, according to either the Julian or Gregorian calendars during their respective periods of operation, it is necessary only to:

(a) use the perpetual calendar as described earlier to ascertain the key (which in this case will also be the Sunday letter) of the selected year;
(b) adjust the slide so that the figures representing the tens and units of the selected year appear in the appropriate Century Window **14** of the Easter calendar appendage.

The golden number and epact of the selected year are now exhibited in the windows **11** and **12** respectively and the date of Easter Sunday is also exhibited in the Easter Sunday Window **13** against the previously ascertained Sunday letters of the selected year, the colour in which the date is recorded distinguishing, as previously described, between March and April dates respectively.

It will be realized that the complete assembly of a perpetual calendar with the Easter calendar attached as an appendage has been described in the opened-out form shown in FIG. 2. It will be clear that this composite calendar may take other forms as previously described in connection with the perpetual calendar alone. For example, if the Easter calendar part is made to have the same physical dimensions as the perpetual calendar part then clearly these two parts may be formed as the front and back respectively of a simple structure in which the cover encloses the slide, the slide having the perpetual calendar information recorded on one face and the Easter calendar information recorded on the other face. The complete instrument may also be formed by a cover enclosing a square-section slide, thus having four faces. In this case, for example two adjacent faces may be used to contain the perpetual calendar part, this part being divided along dotted lines **19** shown in FIG. 1, while the Easter calendar part is divided along dotted lines **20** shown in FIG. 2, and occupies the two remaining faces. In this case, of course, in order to permit the interchange of information accurately between the two faces of the Easter calendar, each of these faces should carry the golden number and exact information. To this end additional golden number windows **21** and epact windows **22** would be provided in the cover as indicated by broken outlines (FIG. 2) and corresponding lines of data **23** and **24** respectively would be provided on the slide, the lines **23** and **24** duplicating the information carried by the lines **15** and **16** respectively. Under these conditions each face of the cover may be associated with a separate slide instead of the common square-section slide.

As described with reference to the perpetual calendar part alone, it will also be clear that the composite calendar may be in the form of a circular cover and slide relatively rotatable about a central pivot, or, for example, in the form of a cylindrical slide rotatable within a cylindrical cover about a common axis. The two parts of the composite calendar may, in either case, be arranged to operate effectively independently. Thus, in the circular form three discs of differing sizes may be employed; two discs, an upper and a lower, may be used to form the perpetual calendar, while the upper disc of this calendar forms the lower disc of a pair forming the Easter calendar. In much the same way, in the cylindrical form a common cover may be associated with a separate pair of inner cylinders, or a common inner cylinder may be used with separate outer cylinders.

It will also be appreciated that all the tables for either the perpetual or composite calendars may be printed on one, or both, sides of a single sheet and a sliding cursor with suitable indicator markings used to show the appropriate calendar.

Because the Easter calendar is an appendage to the perpetual calendar, the two calendars in any of the forms noted above, for example, may be provided separately, so that the Easter calendar is then to be regarded as a separate device for extending the usefulness of the perpetual calendar which itself forms a separate but complete instrument. Alternatively, for example, a common cover in the slide rule form may be provided with a pair of independent slides, one for each part of the composite calendar.

The blank spaces on the cover, and/or the slide, may be used for the printing of additional material, such as instructions in the use of the calendar device, linear measuring scales, conversion tables, and the like.

I claim:

1. A perpetual calendar for indicating dates according to the Julian and Gregorian systems including first and second members moveable relative to one another along a predtermined axis, the first member having a plurality of columns spaced at unit intervals along said axis of movement and carrying indications of all the years of a century in solar cyclic order, a complete solar cycle containing 28 years, the year indications of a complete cycle being indicated in order and occuping 34 unit intervals, the individual years of the cycle being indicated in sub-groups of four, each year of the sub-group occupying one unit interval and there being one unit interval between successive sub-groups; the first member also carrying in a direction parallel to said axis of movement day indications spaced at unit intervals in continuous regular cyclic order of days in a week; the second member having seven century indexing positions arranged to co-operate with the year indications of said first member, the century indexing positions being regularly spaced apart parallel to said axis of movement by a distance equal to one

more than an integral multiple, including one, of seven unit intervals, each century indexing position being arranged to indicate a single one of the year indications in dependence upon relative displacement of the members along said axis, the second member also having first century indications arranged in regular order in a seven century Julian cycle, the seven centuries of each Julian cycle being arranged in order respectively in association with the century indexing positions, one indication associated with each position, the association of the Julian century indications with the indexing positions corresponding respectively each to a different centurial terminal day, each different one of the indexing positions corresponding respectively with each of the different days of the week, and having second century indications arranged in regular order in a four-century Gregorian cycle, the four centuries of each single Gregorian cycle being arranged respectively in association with those four of the seven indexing positions corresponding to the respective centurial terminal days of the Gregorian centuries; the second member further carrying calendar blocks, each block including a display of dates in a month arranged in seven columns at unit intervals, the columns respectively being associated with the different days of a week and being positioned on the second member to co-operate with the day indications of the first member; the order of the year and day indications on said first member and of the century indications on said second member all progressing in order of elapsed time in the same direction on both members and the dispositions of the century indexing positions with respect to the year indications and the calendar blocks with respect to the day indications respectively between the members being arranged such that relative movement of the members to a displaced position in which a selected year indication is aligned with a selected century indexing position brings the appropriate annual terminal day indication into alignment with that column of the calendar block containing the terminal date of a year, the remaining columns of the calendar then being associated with the correct day indications for the selected year.

**2.** A perpetual calendar for indicating dates according to the Julian and Gregorian systems as claimed in claim **1**, in which said second member overlies said first member and in which said century indexing positions are century windows each one unit interval in extent in the direction of the axis of movement, the century windows overlying the year indications of said first member to permit the year indications to be viewed through the century windows.

**3.** A perpetual calendar for indicating dates according to the Julian and Gregorian systems as claimed in claim **2**, in which said calendar blocks of said second member have columnar windows respectively lying within the columns, the columnar windows being positioned to overly the day indications of said first member to permit the day indications to be viewed through the columnar windows.

**4.** A perpetual calendar for indicating dates according to the Julian and Gregorian systems including a composite structure having first and second members as claimed in claim **1**, further including a third member relatively moveable along a further predetermined axis with respect to the second member, the third member carrying second indications of all the years of a century in lunar cycles each of nineteen years, said second year indications being arranged in order in nineteen columns respectively, each column occupying one unit and the columns being regularly spaced at intervals of five units in the direction of relative movement; the third member also carrying date indications arranged in columns spaced at unit intervals in the direction of relative movement, there being five columns of date indications for each column of year indications, each column of date indications consisting of a group of seven consecutive dates, each of the five columns of date indications for a single year indication representing a different group of dates respectively according to each of five epact cycles; the second member further carrying nineteen Julian century indexing positions, each position spanning one unit interval, the positions being regularly spaced at intervals of five units in the direction of relative movement, and also carrying Gregorian century indexing positions each spanning one unit interval, all the century indexing positions being disposed to co-operate with said second year indications, the Gregorian century indexing positions for Gregorian centuries correspondingly membered to Julian centuries being displaced respectively from the indexing positions of those corresponding Julian centuries and the Gregorian century indexing positions for other Gregorian centuries being displaced respectively from positions notionally occupied by corresponding centuries in a notionally extended Julian series, said displacement being in the opposite direction to the direction of elapsed time in which the said second year indications are arranged and being one, two, three or four unit intervals in extent respectively in dependence upon the application of a first, second, third or fourth epact cycle to each particular Gregorian century; the second member also carrying Julian and Gregorian century numbering indications associated respectively with the century indexing positions, the Julian century indications being associated therewith respectively by the allocation of the number of each succeeding Julian century to each fourteen—occuring one of the regularly spaced Julian indexing positions during a repetitive recycling of all the Julian century indexing positions in order, and the Gregorian century indications being allocated to the displaced century indexing positions according to the numbering of corresponding Julian century indexing positions from which they are respectively displaced; the second member also carrying a date indexing position extending over one unit interval disposed to cooperate with the columns of date indications of the third member and seven key indicia arranged respectively one for each of the seven dates of a column, the key indicia having day significance in regular order of days of the week in order of elapsed time opposite to the order of the consecutive dates of a column, the dispositions of the century indexing positions with respect to the second year indications and the date indexing position with respect to the date indications respectively between the second and third members being arranged such that relative movement of the members to a displaced position in which the selected year indicated is aligned with the selected century brings the date indexing position into alignment with that selected column of date indications including the Easter Day for the selected year, and the key indicia are arranged so that indicium having significance corresponding to the said terminal day of the same year selected by relative displacement of said first and second members indicates that one of the date indications of the selected column which is a Sunday.

**5.** A perpetual calendar as claimed in claim 4 in which the key indicia are dominical letters A through F arranged in alphabetical order in the order of the consecutive dates of a column and in which the first member carries a sequence of dominical letters spaced at one unit intervals in the direction of relative motion the letters being arranged in continuous cyclic order, the alphabetic order of the letters being in the opposite direction to the order in which the days of the week are arranged in said day indications on said first member and in which the second member carries a dominical letter indexing position cooperatng with the dominical letter sequence, the relative dispositions of the sequence and the dominical letter indexing position being such that the indexing position indicates the terminal dominical letter of a year selected by relative displacement of said first and second members.

**6.** A perpetual calendar as claimed in claim **4** in which said second member overlies said third member and in which the century indexing positions and the date indexing position in the second member are windows, each window being one unit interval in extent in the direction of relative movement and respectively positioned to overly the second year indications and the columns of date indications.

**7.** A perpetual calendar as claimed in claim **5** in which said second member overlies said third member and in which the century indexing positions, the date indexing position and the dominical letter indexing positions are all windows in the second member, each window being one unit interval in extent in the direction of relative movement and respectively positioned to overly the second year indications, the columns of date indications and the sequence of dominical letters respectively.

**8.** A perpetual calendar as claimed in claim **7** in which said third member further carries a sequence of golden numbers, each number occupying one unit interval in the direction of movement, the sequence containing the numerals 1 through 19 in order, each successive numeral being repeated in five adjacent unit intervals throughout the sequence, and said third member also carries a sequence of epact numbers arranged to correspond to the golden number sequence at unit intervals, five epact numbers being associated with each of the five adjacent intervals for each golden number according to the allocation of epact cycles to the golden numbers under the Gregorian system, and in which said second member has windows one unit interval in extent positioned to overly the sequences of the golden numbers and epact numbers respectively to permit the golden number and epact number of a selected year to be viewed.




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