

June 20, 1944.

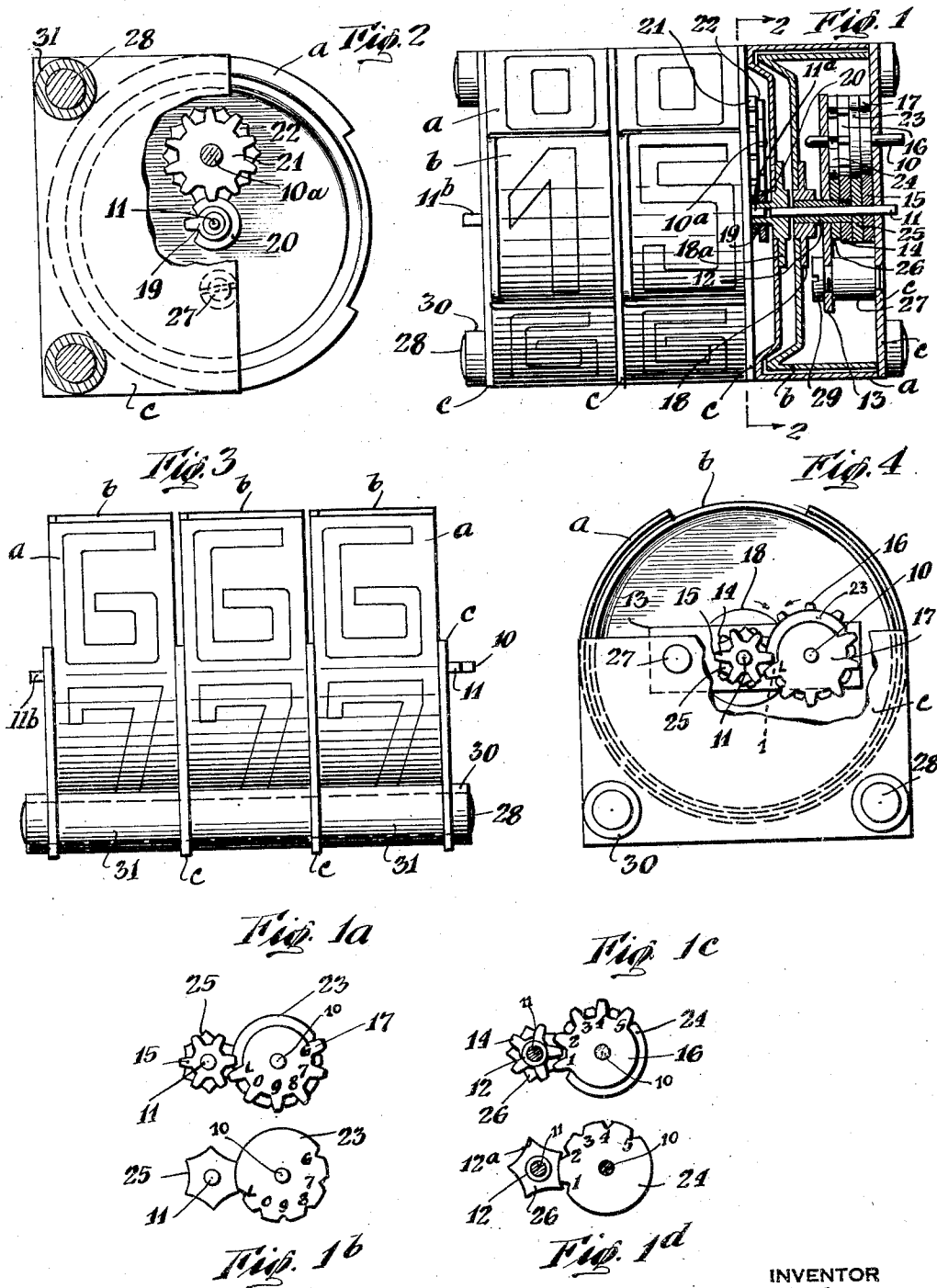
A. HOLZNER

2,351,814

CYCLOMETER CLOCK

Filed Oct. 30, 1939

3 Sheets-Sheet 1



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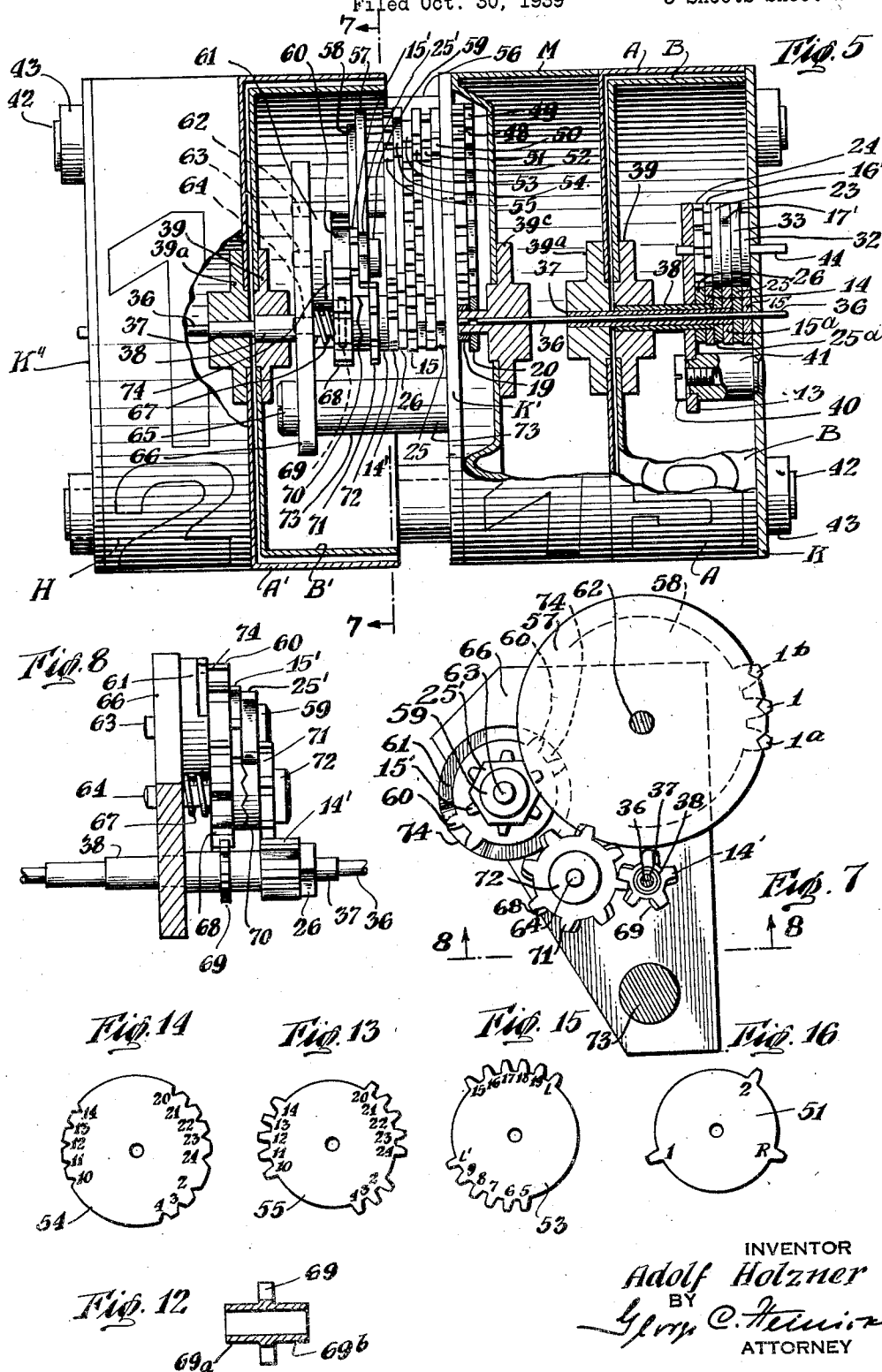
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3 Sheets-Sheet 2



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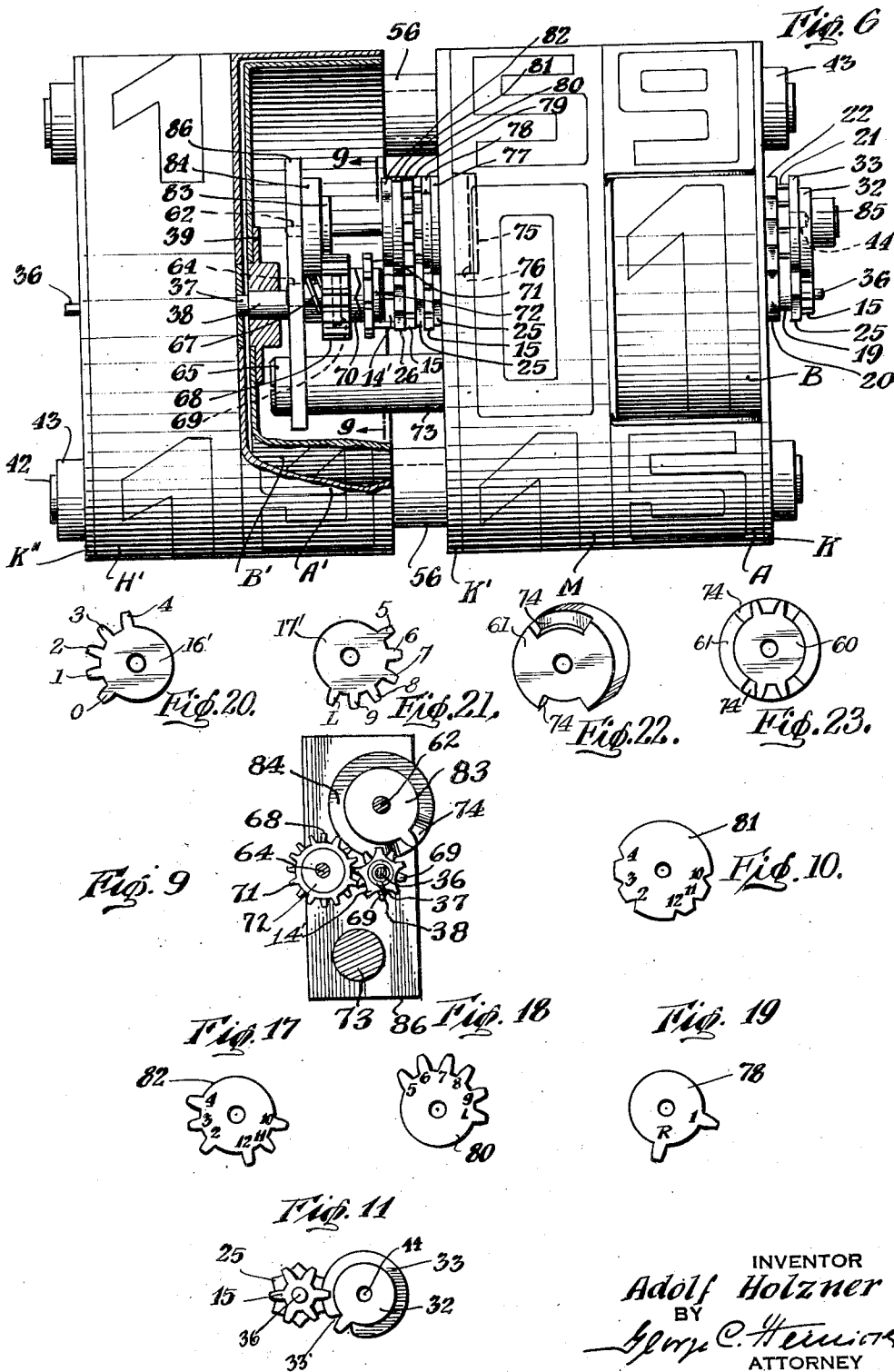
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,351,814

CYCLOMETER CLOCK

Adolf Holzner, Merrick, N. Y.

Application October 30, 1939, Serial No. 301,971

25 Claims. (Cl. 58—125)

This invention relates to improvements in numeral clocks, principally such making use of counters as they are for instance disclosed in my Patent No. 2,117,168, issued May 10, 1938, in which a small transfer mechanism is employed to operate comparatively large number wheels, so that a counter is produced which has decided advantages over the existing counters. Moreover I obtain numbers which are larger than the numbers on the known counters, while the space taken up by the device is not any larger than the space required for the known counters. By such a construction I obtain a decided reduction in the dimensions of the device patented to me under No. 2,097,065 and No. 2,180,590 in which in practical use, it is desirable to follow the counting operation from a considerable distance, so that it was necessary to make the patented device comparatively large, and this I avoid by my present invention so that I obtain the same result without undue enlargement of the device.

It is the principal object of this invention to provide a counter displaying large numbers on automatically operated direct reading clocks or the like, by arranging the numeral sequence 0 1 2 3 4 5 6 7 8 9 on two drums for the purpose of presenting numerals which have twice the size of the numerals on the customary counters and numeral clocks, whereby the size of the individual numbers is always approximately equal to the radius of the drum. The numerals 0 1 2 3 4 5 6 7 8 9 on the two drums are distributed in the following manner: One of the drums is an inside and the other an outside drum. The inside drum has on its circumference five equally divided fields, and the outside drum, being naturally larger than the inside drum, has six equally divided fields; one of the fields is cut out and therefore appears as an opening, and in the five remaining fields the numerals 6 7 8 9 and 0 appear and are as large as it is possible to make them in these fields. Because the inside drum is only a trifle smaller than the outside drum, and its circumference is divided into five fields only, larger numerals could be placed on this wheel. However it must be borne in mind that the numerals on the inside drum should not be any larger than the size of the opening in the outside drum, as otherwise the entire numerals 1 2 3 4 5 on the fields of the inner drum could not appear in the opening of the outside drum.

The distribution of the numerals about the wheels can be done in any suitable way, as will later more fully be explained, and the above described distribution is given as an example only. But as long as the numerals 0 to 9 are always distributed on the two wheels, it will contribute to the achievement of the desired result, i. e. to obtain comparatively large numerals with a comparatively small and compact mechanism. The

mechanism actuates the nested number wheels to display the consecutive numbers from 0 to 9 inclusive in an uninterrupted cycle and in successive order, one number at a time, the same as in the well known counters in which the numbers from 0 to 9 inclusive are distributed on one wheel.

One of the primary objects of my invention is to provide a counter with a series of pairwise arranged nested number wheels with a transfer mechanism from one pair of nested number wheels to the adjoining pair of nested number wheels to actuate the nested wheels as above referred to, to display the numbers from 0 to 9 inclusive in uninterrupted successive and uniform cycles. Another object of this invention is the provision of a direct reading clock in which the operating mechanism for the number wheels is comparatively small and operates comparatively large number wheels on drums surrounding the mechanism while using a minimum of operating force.

Still another object of my invention is the provision of a 12 and a 24 hour cyclometer clock. The 24 hour cyclometer clock indicating method is in use in many European countries. According to my invention both, the 12 and the 24 hour clock have two sets of number wheels, one set for counting the minutes and the other set for counting the hours; each set having three number wheels, one of the three number wheels being for the counting of the decadal minute and hour denominations. Furthermore, each set has two nested number wheels for counting the cardinal minute and hour denominations. The two nested number wheels display the numbers from 0 to 9 inclusive (one number follows the other displayed number with no interruption up to the number 9, and then follows the number 0, and after the disappearance of the number 0, appears the number 1, and the entire uninterrupted cycle is again repeated). The operation is the same as required for a counter, as above stated, and as it is explained in this application with reference to a counter with nested number wheels.

Furthermore, at the moment at which the number 0 appears on the two nested number wheels of either set (one for the hour and one for the minute cardinal denomination), a transfer takes place to the adjoining decadal number wheels (one for the hour, and one for the minute decadal denomination). The transfer mechanism operates in the manner as explained in this application including a counter transfer mechanism having a series of pairwise arranged, nested number wheels. However, the set of number wheels for counting the hours in the 12 hour clock has in addition to the display of the numbers from 0 to 9 inclusive in uninterrupted successive cycles and the transfer mechanism, an auxiliary mechanism which constitutes means to present the 1

hour indication after the 12 hour indication (so that the 2 of the cardinal group is replaced by the 1, and the 1 of the decadal group is replaced by an empty space), whereby the set of number wheels in the 24 hour clock has for counting the hours in addition to the display of the numbers from 0 to 9 inclusive in uninterrupted cycles in successive order, and to the transfer mechanism, an auxiliary mechanism which constitutes means to present the 1 hour indication after the 24 hour indication (so that the 4 of the cardinal group is replaced by the 1, and the 2 of the decadal group is replaced by an empty space).

A numeral clock according to my invention would be a decisive factor in introducing such counters in the clocks at railroad stations or other public places and buildings, as a comparatively small mechanism can operate large number drums with the use of a minimum of power, so that the manufacturing expenses can be kept comparatively low, as it is not necessary to enlarge the operating mechanism in proportion to the size of the number drums or wheels. My invention will also be of great advantage when employed with clocks of small size as for instance with those used on desks or writing tables on account of the small dimensions of the operating mechanism, and may be equally well used with mile counters on automobiles, and all such apparatus where counters are used.

These and other objects and advantages of my invention will become more fully known as the description thereof proceeds and will then be more specifically defined in the appended claims.

In the accompanying drawings forming a material part of this disclosure:

Fig. 1 is a front elevation, partly in section of a counter constructed according to my invention having three pair of number drums.

Figs. 1a, 1b, 1c and 1d are detail views of the various gears, mutilated gears, gap discs and co-operating ratchet discs used in the construction of my counter.

Fig. 2 is a view of the counter, Figure 1, seen in the direction of arrows 2—2 of Figure 1.

Fig. 3 is a bottom view of Fig. 1.

Fig. 4 is an end view illustrating part of the inner mechanism with the end plate broken away.

Fig. 5 is a front elevation, partly in section of a modified form of my counter intended for use with clocks having a 24 hour dial.

Fig. 6 is a front elevation, partly in section, illustrating the use of my counter with a clock having a 12 hour dial.

Fig. 7 is an inner view of the elements shown in Figure 5 seen in the direction of arrows 7—7 of Figure 5.

Fig. 8 is a view seen in the direction of arrows 8—8 of Figure 7.

Fig. 9 is an inner view of the elements shown in Figure 6, and seen in the direction of the arrows 9—9 of Figure 6.

Figs. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and 23 are detail views of various parts of gears, mutilated gears, gap discs and co-operating ratchet discs or locking discs used in the counter clock.

As shown in Figure 1, a counter has three pairs of number drums *a* and *b*. The drum *b* of the first pair at the left hand side displays the numeral 1 constituting the hundred group of characters, the next adjoining group to the right, the second pair, shows the numeral 5 representing the decadal group, and the third pair of drums

at the right, is supposed to show a 1 of the cardinal group or lowest number group, as the mechanism is shown in section, so that with this numeral 1, a three grouped number, i. e. 151 can be read off. As shown in the portion in section in Figure 1, an end plate *c* has riveted thereto one end of a bolt 27, to the other end of which a plate 13 is secured by means of a screw 29. A spindle 11 is passed through plates 13 and *c*, and the spindle 11 carries a bushing 12 freely rotating thereon which also freely rotates in the plate 13, and spindle 11 also rotates freely in plate *c*. Another spindle 10 freely rotates in plates 13 and *c* above the spindle 11. The spindle 11 carries secured thereto a flange 18a, which besides is freely rotating on the spindle 11a of the adjoining pair of number wheels of the decadal group of numbers. The flange 18a carries secured thereto the number drum *a* and the bushing 12 has secured thereto a flange 18 to which is secured the inner drum *b* of the pair of drums. The number drum *b* carries on its outer periphery equally spaced numerals 1 2 3 4 and 5, and the number drum *a* has the equally distanced numbers 6 7 8 9 0, and an opening of the same size as the numbers, so that the numbers on drum *b* can be read through this opening. This is effected in the following manner: Spindle 11 carries a gear 15 having six teeth and a ratchet cam disc 25 with six cam faces (Figs. 1, 1a and 1b) so positioned that each tooth of the gear 15 is located accurately in the center of one of the cam faces on the disc 25 said gear 15, and the ratchet cam disc 25 being secured to spindle 11. The spindle 10 carries secured thereto a mutilated gear 17 (Fig. 1a) having six teeth coming periodically into engagement with the gear 15 which, as stated above, is fixed to shaft or spindle 11. The spindle 10 carries secured thereto also a ratchet disc 23 having six notches designated L 0 9 8 7 6 (Fig. 1b) which are accurately aligned with the teeth of the gear 17 similarly designated L 0 9 8 7 6 (Fig. 1a). The bushing 12 carries secured thereto a gear 14 having five teeth and a ratchet cam disc 26 with five cam faces which is also secured to bushing 12 (Fig. 1c), and the cam faces are so positioned and held that the teeth of the gear 14 are accurately in alignment with the cam faces of ratchet cam 26. The spindle 10 has secured thereto a mutilated gear 16 having five teeth coming periodically into mesh with the gear 14. A ratchet disc 24 (Fig. 1d) having five notches is secured to spindle 10, and these notches are designated 1 2 3 4 5 (Fig. 1d) and are accurately aligned with the teeth 1 2 3 4 5 of the gear 16 (Fig. 1c).

The mutilated gears 16 and 17 (with their respective ratchet discs 24 and 23) must be arranged on spindle 10 in a distinct relative position to one another, so that the tooth L of the gear 17 and the tooth 1 of the gear 16 are aligned, as shown in Figure 4, in which for the sake of clearness I have omitted all the numeral indexes shown on the mutilated gears 16 and 17 in Figures 1a and 1c, except, as stated before, reference characters L and 1. The plate *c* in this Figure 4 is partly broken away in order to clearly show the relative positions of the gears 14 and 15, and mutilated gears 16 and 17. As shown, one tooth of the gear 15, and one tooth of the gear 14 are accurately on a center line passing through both spindles 10 and 11, and as these gears 14 and 15 have an unequal number of teeth, all other teeth will be out of alignment.

The operation of the drums *a* and *b* proceeds as follows: At a one tenth revolution of the spindle 10 always a new number appears, and as mentioned above, number 1 appears on drum *b* of the lowest pair of drums just as the numeral 1 is visible in Figure 1 representing the hundred group.

At the next one tenth revolution of the spindle 10 (in Figure 4 counter-clockwise), and in Figure 1 (towards below), (and these directions shall be referred to in the following as the same at each one tenth revolution of the spindle 10), the tooth 2 of the gear 16 meshes with gear 14 and turns the same for one tooth, i. e. for a one fifth revolution, as the gear 14 has five teeth so that the numeral 2 on the drum *b* appears behind the opening in drum *a*. After this operation, the tooth 3 of the gear 16 is placed before a tooth of gear 14 where formerly stood tooth 2, and upon the next one tenth revolution of spindle 10 tooth 3 of gear 16 will come to mesh with gear 14 and the drum *b* will expose number 3, because, as mentioned above, gear 14 and flange 18 are stationary on bushing 12 and drum *b* is secured to flange 18. As shown, the teeth on gears 16 and 17 are accurately numbered in the same succession of numbers, to present after engagement with their respective gears 14 and 15 the same numbers on drums *a* and *b*.

It will now be clear that after the following one tenth revolution of spindle 10, the 4 and then the 5 will appear on drum *b* behind the opening in drum *a* and after another one tenth revolution of spindle 10, tooth 6 of gear 17 which is fixed to shaft 10 will mesh with gear 15 and the number 6 of number drum *a* will appear at the top of the drum *b* where formerly the opening was located. This movement of the drum *a* is effected because the gear 15 and flange 18a are stationary on the spindle 11, and drum *a* is also secured to flange 18a. Upon further one tenth revolutions of spindle 10, the 7 and then the 8 and thereafter the 9 and then the 0 will appear on drum *a*, and at the moment at which the 0 appears, the drum *a* of the decadal group will show the number 6. This operation is effected because the gear 19 which has one tooth only, came into mesh with gear 21. This gear 21 and the ratchet cam 22 are stationary on spindle 10a of the decadal group of the drum pair. Gear 19 is thus secured with the ratchet disc 20 on flange 18a and the mechanism of the decadal group of number drums operates in the same manner as described above with respect to the operation of the drum for the lowest number group, and thus a specific description concerning the appearance of the number 6 of the decadal group drum *a* will not be necessary. The purpose of the arrangement of the ratchet discs 20, 23 and 24 will hereafter more fully be explained: At the next one tenth revolution of the spindle 10, the 0 on drum *a* disappears and the opening in drum *a* appears again, and at the same moment the number 1 on drum *b* becomes visible through the opening in drum *a*. This is effected because the tooth L of the gear 17 has turned the gear 15 for one tooth and this causes the drum *a* to rotate, and its opening appears and at the same moment tooth 1 of gear 16 has turned the gear 14 for one tooth so that now again the 1 has to appear on drum *b*. With further one tenth revolutions of the spindle 10 the entire cycle of movements described above is repeated and every time the 0 appears on drum *a*, a transfer to the decadal drum pair is effected,

and so on, until on the drum *a* of the tenth or decadal group the 0 appears, and at this moment a transfer to the hundred group drum pair is effected, and it will be clear that if it is desired to have a number with six or eight numerals appear, it will only be necessary to add a corresponding number of number drum pairs which are held together in the following manner: Each pair of drums has to have a plate *c* with a bolt 27 riveted thereto, while a screw 29 holds plate 13 to *c*, and thus the entire gear mechanism and the drums *a* and *b* are held by plate *c*. All of the plates *c* have two openings or holes through each of which passes a spindle 28, the distances of all holes being accurately located in all of the plates *c*. Bushings 31 having accurately calculated lengths are placed upon the spindles 28 always between two of the plates *c* (Figure 3), and the spindle 11b of each pair of drums projects from the plate *c* as for instance spindle 11a of the decadal pair of drums, Figure 1. On spindle 11a of the decadal number drums rests the flange 18a of one of the pair of drums of the lowest number group freely rotating and in this manner the banding of the plates *c* is effected with the already mounted pair of drums *a* and *b* and the mechanism co-operating therewith and it is therefore immaterial how many plates *c* are mounted, only with the last pair of drums, as for instance the pair of the hundred group, Figure 1, an exception must be made by making the spindle 11b longer and extending it through the last plate *c*. It will be clear that the more pairs of drums are used, the longer the spindles 28 must be made. At both ends of each spindle 28 a threaded portion is provided and nuts 30 thereon hold all the pairs of drums together.

I use the above mentioned ratchet cams 22, 25 and 26 and ratchet discs 20, 23 and 24 because even if the mechanism would work without the same, it would be necessary to provide a flat spring secured to bolt 27 and a loop of this spring would have to be entered into one of the gaps in the teeth of gear 15 which would hold the gear in position; however, care should be taken by suitable means that always one tooth only is moved, and still better, such a spring may be arranged to press on gear 14, or a similar spring may press on gear 21. However, such an arrangement of springs is not very suitable, as in the first place these springs deteriorate easily, and secondly more operating force will be required in order to overcome the spring tension. Thus, in order to avoid the use of such springs, I have made use of the ratchet cams and ratchet discs which operate in the following manner:

As shown in Figures 1c and 1d, the periphery of the ratchet disc 24 slides along a cam face of the ratchet cam 26 and the cam 26 has no opportunity to turn by itself, while the depressions or notches 1 2 3 4 5 of the ratchet disc 24 will allow an intentional turning of the cam 26 as the points 12a of the cam 26 are received in the recesses or depressions of the disc 24 at the moment at which one tooth of the gear 16 meshes with a gear tooth of gear 14. A further explanation of Figures 1a and 1b will be unnecessary because the disc 23 and cam 25 with their respective gears 17 and 15 operate on the same principle because at the moment at which one tooth of the gear 17 meshes with one tooth of the gear 15, the notches 6 7 8 9 0 L of the ratchet disc 23 will allow an intentional turning of cam 25, and this is also the case with disc 20 and cam 22 in Figure 2 with their respective gears 19 and 21,

because at the moment at which the one tooth of the gear 19 meshes with the gear 21, the notch of disc 20 will allow a turning of cam 22. As already above explained, the ratchet cams 22 and 25 with their respective gears 21 and 15 are secured to their respective spindles, and ratchet cam 26 and gear 14 are fixed to the bushing 12, and also are secured the ratchet discs 20, 23 and 24 with their respective gears 19, 17 and 16 to their respective spindles.

Hereby I might explain that hereinafter in the description of the 12 hour and 24 hour clock the same ratchet discs and cams are used.

In Figure 5 I have shown a clock with a 24 hour dial and the above description of my counter will open a way for a better understanding of the counter mechanism in this form of my invention since the basic idea developed above will find its application to this form of the invention also. In Fig. 5 the mechanism for the 24 hour clock is surrounded by the following number drums and their respective numerals thereon in the following manner: Drums A and B are intended for the counting of the lowest minute denominations; B is an inside drum and has the numerals 0 1 2 3 4 distributed around its circumference, and A is the outside drum and has the numerals 5 6 7 8 9 distributed around its circumference, and has an opening of the same size as the numerals. Drum M is intended for the display of the decadal minute denominations, and has the numbers 0 1 2 3 4 5 distributed about its circumference. Drums A' and B' are intended for the counting of the lowest hour denomination, and are provided with the same numerals as drums A and B for the lowest minute indications. Drum H is for the designation of the decadal hour indication and has twice the numerals 1 and 2, and an empty space of the same size as the numerals distributed around the drum.

Referring now to the mechanism of the 24 hour clock: Beginning with the drums MA and B at the right in Fig. 5:

The bushing 37 as shown in Figure 5 has a flange 39a secured thereto, and to this flange the drum A is secured while the bushing 38 has also a flange, designated 39 secured thereto, to which is secured the drum B. The pair of drums A and B denotes the lowest number unit of the minute group. The bushings 37 and 38 are superposed and freely rotating on the spindle 36 which has secured thereto a flange 39c to which is attached a drum M which denotes the decadal number of minutes. The spindle 36 and the bushings 37 and 38 are mounted on plate K to which is riveted a bolt 41 to which is secured a plate 13 by means of a screw 40. In the plate 13 the outer bushing 38 is arranged for free rotation, just as spindle 36 in plate K.

A spindle 44 above spindle 36 passes through plates 13 and K and carries the gears 16' and 17', and the ratchet discs 23 and 24 secured thereto, and these gears 16' and 17' are identical with the gears 16 and 17 explained in the description of the counter, Figure 1, and the ratchet discs 23 and 24 are identical with those explained in the description of the counter, Figure 1, and it will therefore be understood that the operation as described with respect to counter Figure 1 is here repeated, and the gears 16' and 17' will mesh with their respective gears 14 and 15a; gear 14 and ratchet cam 26 are secured to bushing 38 and gear 15a and cam 25a are secured to bushing 37. Spindle 44 has also secured thereto another gear 32 having one tooth only 75

and a ratchet disc 33. The tooth of gear 32 is aligned with a notch 33' of the ratchet disc 33 (Fig. 11). The tooth of gear 32 and the notch of the ratchet disc 33 are engaged respectively with another gear 15 and another ratchet cam 25 which are secured to spindle 36 and said other gear 15 and said other cam 25 similar to the previously mentioned gear 15 and cam 25 are provided with the same reference characters as in Fig. 1 as they are evidently like elements. The gear 32 and with it the ratchet disc 33 are secured to spindle 44 in such a position that when the spindle 44 performs the last of the one tenth revolutions, and assuming that after the first one tenth revolution a 1 appears on one of the drums AB, and immediately after the ninth of the one tenth revolutions the 9 appears on one of the drums of the pair of drums AB, and with the last or tenth revolution, when the 0 on one drum of the pair of drums A and B appears then at the same moment the one tooth of the gear 32 will mesh with the gear 15 on spindle 36, which as mentioned above has six teeth, and the decadal drum M will then present another number as it has on its periphery the numbers 0 1 2 3 4 5 as shown in Figure 6.

This Figure 6 illustrates the number wheels for a clock having a 12 hour dial as will hereafter be described. However, the drums A and B, as well as drum M, and the mechanism co-operating therewith is the same as shown in section in Figure 5 with respect to drums MAB. The pair of drums for the lowest number unit, A and B, are different from the pair of drums a and b of the counter, Figure 1. As the drum A in Figure 5, has no further transfer means to the adjoining pair of drums as shown in Figure 1 with respect to the drum a for the lowest number unit group to the decadal pair of drums, which is effected by the one tooth of gear 19 in Figure 1, this operation is performed in the construction Figure 5 by means of the tooth of gear 32. On drum B starting at the place where on drum b the number 1 is displayed (Fig. 1), the 0 takes the place of the 1 and then the numerals 1 2 3 follow, and at the end in place of the number 5, a 4 is present. Thus on drum B, Figure 6, the numbers 0 1 2 3 4 are presented in succession while the numbers 5 6 7 8 9 are presented on drum A, so that the following difference exists between the drums A and a: The number on drum A above the opening in drum A is 9 (Figure 6), and underneath the opening the number is 5. In contradistinction thereto the drum a in Figure 1 shows the number 0 above the opening and underneath the opening the number 6 is placed, so that in Figure 6 the numerals appear in the following manner: The 1 on drum B can be seen through the opening in drum A, and thereafter as the next numbers, the numerals 2 3 4, whereafter the 5 appears on drum A, and then numerals 6 7 8 9. The operation and the sequence of appearance of these numerals 0 1 2 3 4 on drum B and 5 6 7 8 9 on drum A is as follows: It is similar to the operation of drums a and b of the counter illustrated in Figs. 1 to 4. The mutilated gears 16' and 17' (with their respective ratchet discs 24 and 23) must be arranged on spindle 44 in a distinct relative position to one another, so that the tooth L of the gear 17' and the tooth O of the gear 16' are aligned. As shown the teeth of the gears 16' and 17' are accurately numbered in the same succession of numbers to present after engagement with their respective gears 14 and 15a the same numbers on drums A and B.

At the next one tenth revolution of the spindle 44, the tooth 2 of the gear 16' meshes with gear 14 and turns the same for one tooth, i. e. for one fifth revolution as the gear 14 has five teeth, so that the numeral 2 on the drum B appears behind the opening in drum A, because gear 14 is secured to bushing 38, and so is also flange 39 secured to bushing 38, and drum B is attached to flange 39, and upon the next one tenth revolution of spindle 44, tooth 3, and thereafter tooth 4 of gear 16' will come to mesh with gear 14 and drum B will expose the numbers 3 and 4. After the following one tenth revolution of spindle 44 the tooth 5 of gear 17' will mesh with gear 15a and turn the same for one tooth, i. e. for one sixth revolution, as the gear 15a has six teeth and is secured on bushing 37 and the number 5 of drum A will appear at the top of the drum B where formerly the opening was located. This movement of the drum A is effected because the gear 15a and flange 39a are fixed on bushing 37, and drum A is attached to flange 39a. Upon further one tenth revolutions of spindle 44, the tooth 6, and then the teeth 7 and 8, and thereafter the tooth 9 of gear 17' will mesh with gear 15a on bushing 37 and drum A will present the numbers 6 7 8 and 9. At the next one tenth revolution of spindle 44, the 9 disappears and the opening in drum A appears again, at the same moment the 0 on drum B becomes visible through the opening in drum A. This is effected because the tooth L of gear 17' has turned the gear 15a on bushing 37 for one tooth and at the same moment tooth 0 of the gear 16' has turned the gear 14 on bushing 38 also for one tooth, and also at the same moment, when the 0 on drum B appears, the numeral 1 will be visible on drum M, and this operation is repeated so that every time the 0 appears on drum B, another number will appear and can be read from drum M so that if 59 minutes are displayed when drum M presents the 5 and drum A the 9, with the next operation the 60th minute is reached and the 0 appears on drum M and the 0 on drum B, while at the same moment a transfer is effected to the lowest number unit on the hour drum pair A' and B' in the following manner: In Figure 5, representing the mechanism for a clock having a 24 hour dial, the flange 39c to which the drum M is secured, carries on a lateral extension thereof a gear 19 secured thereto having one tooth and a ratchet disc 20 secured thereto so that just before each appearance of the 0 on drum M the tooth of the gear 19 meshes with gear 48, and turns the same for one tooth, the operation proceeding in the same manner as previously described with respect to Figure 2 with the sole exception that in the present instance the one tooth of gear 19 meshes with gear 48 having twenty-four teeth. Gear 48 and a ratchet cam disc 49 are secured to spindle 62. Flange 39c is provided with a bore having secured therein a spindle 36 of the minute counter wheels M, A, B, part of the bore also acting as a bearing to rotatably receive spindle 36 of the hour counter wheels H, A', B' which extends through plates K'' and K'. As previously mentioned, the mechanism of the lowest unit for the minute counter drums A and B, and the decadal minute drum M in the clock with the 12 hour dial, Figure 6, is the same as that in Figure 5 with the exception that the one tooth of gear 19 with the ratchet disc 20 belonging thereto does not mesh with a gear 48 with twenty-four teeth, as in Figure 5, but with a gear 76 (Fig. 6) hav-

ing twelve teeth. Gear 76 and ratchet cam 75 are secured to spindle 62 in Fig. 6.

Reverting now to the explanation of the counter HA' and B' for the clock with the 24 hour dial, in Figure 5: Plate K' has a bolt 73 riveted thereto and the plate 66 is secured thereto by means of a screw 65. On spindle 36 a bushing 37 is freely rotatable on which another bushing 38 freely rotates which also rotates freely in plate 66, just as previously described with respect to the mechanism of drums AB and M, and also here the bushing 37 carries secured thereto a flange 39a and on this flange the drum A' is secured and on bushing 38 a flange 39 is secured and again on this flange 39 the drum B' is secured. Drum H is secured to its spindle 36 by means of a flange (not shown) similar to flange 39c which supports drum M. On spindle 36, bushing 37 and bushing 38, the above mentioned gears and cams are provided and as previously described with respect to the mechanism of the minute counting drums AB and M, some of the elements used in the mechanism of these drums are again used for the mechanism co-operating with drums HA' and B', as they are identical in size and shape and therefore bear the same reference characters: In the mechanism for the hour drums HA' and B' in Fig. 5, and H'A' and B' in Fig. 6 spindle 36 carries secured thereto ratchet cam 25 and gear 15, and bushing 37 carries secured thereto also a ratchet cam 25a and a gear 15a; however, on bushing 38 a gear 14' and a ratchet cam 26 are freely rotating and yet gear 14' and ratchet cam 26 are secured to one another, and gear 14' has 5 teeth, similar to gear 14 in Fig. 1, but is wider. The bushing 38 however carries another gear 69 which is readily seen in Figures 8 and 12, and is secured thereto. This gear 69 is made in one piece with the distancing means 69a and 69b which serve the following purpose: The means 69b is intended to hold the gear 14' in position so that it cannot slide laterally towards the gear 69, and means 69a is intended to prevent a lateral displacement of the bushing 38 through the plate 66, or in Figure 6 through the plate 86 and therefore, flange 39 which is secured to bushing 38 will be prevented from touching the flange 39a which is secured on bushing 37 and causing friction therewith. The mechanism and its parts so far described in Figure 5 is the identical for drums A'B' and H' in Figure 6. As shown in Figures 5 and 7, a spindle 64 is secured to plate 66 in the same way in Figure 6 a spindle 64 is secured to plate 86 and on both spindles 64 are two gears 68 and 71 freely rotating and both gears having eight teeth. The gear 71 carries secured thereto at the left hand side a coupling member with eight lateral teeth 70, and also the gear 68 has at its right hand side a coupling member secured thereto having eight lateral teeth 70, and both coupling members are in engagement so that gears 68 and 71 are coupled and are held coupled by means of a helical spring 67 on spindle 64. A cam 61 on a spindle 63 in Figures 5 and 8, and a cam 84 on spindle 62 in Figures 6 and 9 as later on will be more fully described serve the purpose for locking the two gears 68 and 71 with their coupling members, and only by the depression 74 of cam 61 and 84, gear 68 has a chance to be disengaged from gear 71 in a longitudinal direction on spindle 64.

A ring 72 (Figs. 7 and 9) is pressed to spindle 64 so that the gears 68 and 71 cannot be displaced in a longitudinal direction. Figure 7 is

a sectional view of the parts in Figure 5 and Figure 9 a similar view of the illustration in Figure 6. In both Figures 7 and 9, the gears 68, 71, 69 and 14' are in a predetermined position so that one tooth of gear 14' on the bushing 38 is just located on a center line passing through both spindles 64 and 62 respectively (Figs. 7 and 9). Gear 71 is in mesh with the wider gear 14', and thus the above described position of the gear 14' will allow gear 71 to take up an angular position predetermined by the gear 14' only, and no other position (see Fig. 7), and gear 68 (which is on the same spindle 64 as gear 71) has one tooth on the center line passing through the spindles 64 and 62 (Fig. 7) so that a perfect engagement of gear 68 on spindle 62 is assured which will later be more fully described. The above explanation will make it clear why gears 68 and 71 which both have eight teeth cannot have their teeth in alignment. Inasmuch as gear 69 is in mesh with gear 68, and wider gear 14' is in mesh with gear 71 it will be clear that the teeth of the gears 68 and 14' which have an equal number of teeth, cannot be in alignment as shown in Figure 7. The same explanation holds good also for the illustration in Figure 9 with the exception, that in this figure one tooth of the gear 68 must be on the center line of spindles 64 and 62 so that a perfect engagement of gear 68 on spindle 62 is assured as will be explained later on. The gear 55 meshes with gear 14' (Fig. 5), and gear 52 meshes with gear 14' (Fig. 6), and in both instances the drum B' is rotated. This rotation is effected because gear 14' is freely rotating on bushing 38, as previously mentioned, and meshes with gear 71 on spindle 64, and inasmuch as gear 68 is coupled to gear 71, gear 68 will experience an identical rotation, which rotation is transferred to gear 69 because gears 68 and 69 are in mesh and gear 69 is secured to the bushing 38 and thus the drum B' will be rotated as mentioned above, and as stated before, flange 39 is also secured to bushing 38, and drum B' is attached to said flange 39. The position of the drums HA'B' in Figure 5 before the start of this movement is so that on drum H the number 1 appears. Drums A' and B' shown in section in Figure 5, show the same position as drums A and B in Figure 6 as the numeral 1 appears through the opening of drum A, and therefore in Figure 5 the drums H and B' will disclose numeral 11.

The spindle 62 in Figures 5 and 7 carries secured thereto the mutilated gears 58, 55, 53 and 51, and the ratchet discs 57, 54, 52 and 50. The gear 55 Figure 13, gear 53, Figure 15, gear 51, Figure 16 and 58, Figure 7 have all different numbers of teeth and these teeth are numbered in the same manner and with the same numbers as will appear on drums HA' and B' upon the engagement with the respective gears, and the gears 55, 53 and 51 are secured on spindle 62 in the following relative positions: Tooth 10 of gear 55 is in alignment with tooth L' of gear 53 and with tooth 1 of gear 51 with the result, that tooth 20 of the gear 55 is also in alignment with tooth L of gear 53 and tooth 2 of gear 51. The arrangement of tooth R on gear 51 will be explained later on. Each of the gears has a ratchet disc as for instance gear 55 has a ratchet disc 54 (Fig. 14), and the notches are, as previously explained, in alignment with the teeth. The gear 53 has a ratchet disc 52 and gear 51 a ratchet disc 50 Figure 5. 75

Gear 58 has a ratchet disc 57 (Figs. 5 and 7). As mentioned above, at each new hour indication, the tooth of gear 19 engages gear 48 which has twenty-four teeth and rotates the same and imparts to the spindle 62 a one-twenty-fourth rotation towards below Figure 5, and counter-clockwise in Figure 7 and this rotation of spindle 62 causes to operate the mechanism for the hour indicating drums HA' and B' in a manner as will be described in the following: As stated above, before the start of the operation, as the numeral 11 appears on drums H and B', the next rotation of spindle 62 will bring the tooth 12 of gear 55 into mesh with gear 14' and this operation causes gear 14' to rotate so that the numeral 2 appears on drum B' because gear 14' is loose on bushing 38 as stated above, and meshes with gear 71 which is coupled to gear 68, and gears 71 and 68 are both freely rotating on shaft 64; gear 68 is in mesh with gear 69 which gear is secured to bushing 38, and as flange 39 is also secured to bushing 38, and drum B' is attached to flange 39 drum B' has to participate in the rotation of gear 14' so that numeral 12 can be read on drums H and B'. On the drums A' and B' the numbers appear in the same manner as previously explained with respect to the lowest number unit on drums A and B, so that upon further rotation of the spindle 62, tooth 13 and then 14 of gear 55 engage gear 14' on bushing 38 and with the following rotation of spindle 62 the tooth 15 of gear 53 will engage gear 15a on bushing 37 and the numeral 5 will appear on drum A' because gear 15a and flange 39a are secured to bushing 37 and drum A' is also attached to flange 39a and the numeral 15 can be read off drums H and A'. This operation proceeds until the number 19 appears, the 1 on drum H and the 9 on drum A'. Upon the following rotation of the spindle 62, the tooth 20 of gear 55 meshes with gear 14' so that the numeral 0 will appear on drum B' and at the same moment tooth L of gear 53 engages gear 15a on bushing 37 so that the opening in drum A' appears through which the 0 on drum B' can be seen, and tooth 2 of gear 51 brings the 2 on drum H in appearance, as this tooth 2 of gear 51 comes into engagement with the gear 15 on spindle 36 and the number 2 on drum H appears, as stated above, because the gear 15 and the flange 39c are both secured to spindle 36, and the drum H is attached to flange 39c. Thus the number 20 can be read off, on drum H the 2 and the 0 on drum B'. Upon further rotation, the teeth 21 22 23 of the gear 55 come to mesh with gear 14' on bushing 38 and the numbers 1 2 and 3 appear on drum B' and the numbers 21, 22 and 23 can be read off consecutively, as the number 2 remains stationary on drum H.

I will now further describe the elements on spindle 63: Spindle 63 is secured to plate 60, Figures 5, 7 and 8 and carries a lateral disc 61 which has on opposite sides a recess or lateral depression 74. Furthermore, a gear 60 with two groups of two teeth each diagonally opposite to one another is provided on spindle 63. The gear 60 has thus four teeth which are provided by cutting off four teeth of the twelve original teeth on each side so that altogether eight teeth have been cut off and it will be therefore understood that if a gear 15' which has six teeth (similar to the gear 15 in Fig. 1) and which is secured to gear 60 rotates for one tooth, and performs a one sixth rotation, the gear 60 will ro-

tate for two teeth. The teeth of the gear 60 are in alignment with the recesses or depressions 74 of the lateral disc 61, and so all elements on spindle 63 are secured to one another while freely rotating thereon. These elements include the disc 61, mutilated gear 60, gear 15' and ratchet cam 25', said ratchet cam 25' serving the same purpose as the similar ratchet cam 25 mentioned in the description of the counter in Figs. 1 to 4. Cam 25' will hold gear 15' in position as the periphery of the ratchet disc 57 slides along a cam face of ratchet cam 25', just as previously explained during the description of Figs. 1a and 1b where ratchet disc 23 slides along the cam face of ratchet cam 25. A ring 59 is pressed onto the spindle 63 in order to hold these elements thereon. These elements on spindle 63 and also on spindle 64 are designed for the purpose when in operation of presenting the hour 1 after the hour 24, when the numeral 2 is seen on the decadal drum H and the 4 on the cardinal drum B' and the operation of this mechanism will now hereafter be more fully explained: When the numeral 2 disappears on drum H and an empty space appears on said drum, and on drum B' the 4 disappears and the 1 appears, the drum B' which has the numbers 0 1 2 3 4 must execute a two fifths rotation, as after the numeral 4 the number 0 and then the desired number 1 appears. Thus, with the following rotation of spindle 62, tooth 24 of gear 55 meshes with gear 14' and the number 24 may be read off. However, at the same moment the tooth 1b of the gear 58 has engaged gear 15' on spindle 63 and has thereby brought the lower two teeth of the gear 60 in position before a tooth of gear 68 on spindle 64 so that they are ready for the following operation. Upon the following rotation of spindle 62, gear 14' will remain stationary as no tooth is present between tooth 24 and tooth 2 on gear 55 (Fig. 13) and in the same manner gear 14' is held in position by the ratchet cam 26 which cannot turn as the ratchet disc 54, Figure 14, has no depression or notch between the depressions 24 and 2 (Fig. 14) and therefore the periphery of the ratchet disc 54 between notches 24 and 2 slides along a cam face of ratchet cam 26, just as previously explained during the description of counter, Fig. 1, ratchet disc 24 slides along the cam face of the ratchet cam 26 (and as stated above gear 14' and cam 26 are secured to one another), so that also gear 71 with its coupling is stopped because gears 71 and 14' are in mesh. At this moment the tooth 1 of the gear 58 meshes with gear 15', and the two lower teeth of gear 60 rotate gear 68 for two teeth while the recess 74 of the lateral ratchet disc 61 allows an uncoupling of the gear 68 from gear 71 as it is longitudinally displaced on spindle 64 and thereby compresses cylinder spring 67 and again couples with gear 71 during the expansion of the spring after the rotation of gear 68 for two teeth. The timing and setting of the elements is so devised that when the two gears 68 and 71 are coupled, always one tooth of the gear 68 is located just before the lateral face of disc 61, as seen in Figure 7.

The gear 68 therefore has no chance to be uncoupled from the gear 71, unless one of the recesses 74 of disc 61 is in a position behind a tooth of gear 68. This will be the case when disc 61 is rotating, and for the purpose of a smooth operation of the disengagement of gear 68 from gear 71 the width of the recess 74 has

to begin at least the size of a tooth thickness of a tooth of gear 68 at the left of the left tooth of the two lower teeth of gear 60 as seen in dotted lines in Figure 7. The width of the recess 74 must extend a size of a tooth thickness after the right tooth of the two lower teeth of gear 60, and it will be understood that the same description is also good for the upper teeth and the upper recess 74 of disc 61, Figure 7. By this operation appears on drum B' the number 1 and at the same time on drum H an empty space, as simultaneously tooth R of the gear 51 has engaged gear 15' on spindle 36 while upon the following rotation of spindle 62 the tooth 2 of gear 55 engages gear 14' so that the number 2 appears on drum B' and at the same time also tooth 1a of gear 58 (Fig. 7) meshes with gear 15' on spindle 63 and the two teeth of gear 60, which heretofore were below, are now thereby rotated up to a position out of mesh with gear 68 while the teeth which were formerly up are now below. The lateral face of the disc 61 as well as the spring 67 prevent the gear 68 from displacement in longitudinal direction. Upon the further rotation of spindle 62 tooth 3 and then tooth 4 of the gear 55 bring first the numeral 3 and then the numeral 4 of drum B' in appearance, and then the drum A' with its numbers 5 6 7 8 9 as the teeth 5 6 7 8 9 on gear 53 engage gear 15a on bushing 37 while upon the further rotation the tooth L' engages gear 15a on bushing 37 and advances the drum A' and the opening in drum A' appears, while at the same moment the tooth 10 of gear 55 engages gear 14' and the 0 will appear on drum B' through the opening in drum A', and in the same way at the same moment the tooth 1 of the gear 51 engages gear 15 on spindle 36 and the numeral 1 will appear on drum H because on drum H are the following numbers in evenly distributed six fields, at first the numeral 1, then the numeral 2, and the third field is left blank, while in the fourth field another number 1 and in the fifth field another number 2 appear, and the sixth field is also left blank. Upon the next rotation of spindle 62 the tooth 11 (Fig. 13) engages gear 14' and on drum B' the numeral 1 will appear and consequently the number 11 can be read on drums H and B', and thus we have arrived at the number 11 with which we have started the description of the counting mechanism for drums HA' and B'.

Again reverting to the description of a clock having a 12 hour dial: As mentioned above, in Fig. 6 the drums MA and B counting the minutes of the 12 hour clock are provided with the same numerals as drums MA and B for the 24 hour clock, Fig. 5, and also drums A' and B' in Fig. 6 are provided with the same numerals for the 12 hour clock which numerals indicate the lowest hour denomination, the same as drums A' and B' for the 24 hour clock in Fig. 5. However, drum H' for the 12 hour clock is different from drum H of the 24 hour clock; drum H' indicates the decadal hour denomination and has three times the numeral 1 and three empty spaces distributed around the drum, so that every number 1 is followed by one empty space. As shown in Figure 6, to spindle 62 are secured the gap gears 78, 80, 82, 83 and ratchet discs 77, 79, 81, 84. The gears 78, 80, 82, 83, Figures 9, 17, 18 and 19, all have a different number of teeth and these teeth are numbered with the same numbers as upon the engagement with the respective gears will appear on drums H', A' and B', and these

gears are secured in their relative positions as follows: tooth 10 of the gear 82 is in alignment with the tooth L of the gear 80 and with tooth 1 of gear 78, and the alignment and the purpose of arranging the one tooth on gear 83 and tooth R on gear 78 (Fig. 19) will be explained hereinafter. Each gear has a ratchet disc as for instance gear 82 has a ratchet disc 81, Figures 6 and 10, and the depressions or notches are again as explained heretofore, aligned with the teeth of gear 82 and gear 80 has a ratchet disc 79, and gear 78 a ratchet disc 77, Figure 6. As mentioned above, at each hour indication the one tooth of gear 18 engages gear 76 which is secured to spindle 62, Figure 6, and which has 12 teeth so that with each engagement of the gear 18 another hour number will appear as follows: In Figure 6 suppose through the opening in drum A' the number 3 on drum B' is visible, while on drum H' a vacant space appears so that the hour 3 can be read off. Upon the further rotation of spindle 62 the tooth 4 of gear 82 engages gear 14' and the number 4 appears on drum B'.

With the next movement of spindle 62, tooth 5, and then teeth 6 7 8 9 of gear 80 engage with gear 15a on the bushing 37 and the corresponding numbers appear on drum A' while upon the next rotation of spindle 62 the tooth 10 of gear 82 engages gear 14' and the 0 will appear on drum B'. At the same moment the tooth L of the gear 80 engages gear 15a on bushing 37 and through the opening in drum A' the 0 on drum B' will be seen, and again, at the same moment tooth 1 of gear 78 engages gear 15 on spindle 36 and the number 1 will appear on drum H'. Thus the hour 10 can be read off. The drum H' has at its periphery six equally distributed fields or spaces and in each second of these fields a number 1 is provided so that three empty fields and three fields with the numeral 1 are present and these fields are as large as the numerals. Upon the next rotation of spindle 62 the tooth 11 of gear 82 will engage gear 14' and the number 1 will appear on drum B' so that the number 11 can be read on the counter. Upon the next rotation of spindle 62 the tooth 12 of gear 82 will engage gear 14' and the number 2 appears on drum B' and the hour 12 can be read off, on drum H' the 1 and on drum B' the 2, while upon the following rotation of spindle 62 the hour 1 will appear in the following manner: the same as in the clock having a 24 hour dial, after the indication of the hour 24, the hour 1 is indicated, also on the clock having a 12 hour dial, the number 1 appears after the 12 because the numeral 1 on the decadal drum H' disappears and an empty space appears, while at the same moment the numeral 2 on drum B' disappears and the numeral 1 appears. This happens because the gear 14' will remain stationary as no tooth is present between the tooth 12 and the tooth 2 of gear 82 (Fig. 17), and gear 14' is stopped by the ratchet cam disc 26. This disc cannot turn because the ratchet disc 81, Figure 10, has no depression or notch between the depressions 12 and 2 and therefore the periphery of the ratchet disc 81, between the notches 12 and 2 slides along the cam face of ratchet cam 26, just as previously explained with respect to Fig. 1, ratchet disc 24 slides along the cam face of the cam 26. Thus gear 71 is stopped also, and at this moment the one tooth of the gear 83 engages gear 88 which turns clockwise in Figure 9, so that gear 88 turns

counter-clockwise. In this manner drum B' will turn in a direction opposite to the one explained above, the normal one, and number 1 will appear on drum B', while at the same moment the drum H' will be turned and an empty field will appear as the tooth R of the gear 78 engages gear 15 on spindle 36. After this operation, as it is known from the description of the clock having a 24 hour dial, the cylinder spring 67 and also the lateral face of the disc 84 will hold both gears 68 and 71 coupled, while the depression 74 of disc 84, upon the engagement of the one tooth of the gear 83 did allow gear 68 to be uncoupled from gear 71, the same as with the clock having a 24 hour dial. Upon the further rotation of spindle 62, the tooth 2 of gear 82 engages gear 14' and the number 2 will appear on drum B', and at the continued rotation, the tooth 3 of the gear 82 will make the number 3 appear on drum B', and so we have again reached the beginning of the operation on the 12 hour dial clock. The mounting and assembling of the elements of the 12 hour and the 24 hour clock is effected in the same manner as explained in the description of the counter shown in Figure 1, as two spindles 42 are passed through plates K, K' and K'', Figures 5 and 6. On these spindles 42 bushings 56 are arranged between the plates K and K' and between plates K' and K'' while the whole is kept together by means of nuts 43.

The 12 hour number clock according to my invention is operated in the following manner: The spindle 44, Figure 6, carries a gear 21 having ten teeth and a ratchet cam 22, like in Figure 2, while another gear 32 with one tooth and having a ratchet disc 33 like in Figure 11, is secured to a bushing 35 which is loose on spindle 44. On spindle 36 gear 15 like in Figure 11 and a gear 19 like in Figure 2, together with the ratchet discs 29 and 25 are all secured to one another while being loose on spindle 36 so that when bushing 35 is coupled to an electromotor which is built in the well known manner in electric clocks which rotate uniformly by making for instance six revolutions per minute, the tooth of gear 32 will engage gear 15 as for instance shown in Figure 11, after each revolution, so that after six revolutions the gear 15 will make one turn while at the same moment the tooth of gear 19 will engage gear 21 exactly as shown in Figure 2, so that the spindle 44 will make one-tenth revolution. However I do not wish to restrict myself to a special starting and operating mechanism for my number clock, as I may make use of any of the many known motors, so for instance I may use a spring motor which in every minute may turn the spindle 44 for one-tenth revolution.

In building a counter as disclosed in Figures 1 to 4, where a transfer operation takes place from one set of wheels to the adjoining set of wheels, care must be taken to distribute the numerals in a certain way about the wheels. The outside wheel has a finger disc secured thereto to transfer the rotary movement of one pair of wheels to the adjoining pair of wheels, therefore, the outside wheel must always be in rotation when the zero appears on one pair of the wheels while at this moment the finger disc has to be timed so, that a transfer to the adjoining pair of wheels takes place, while the distribution of the numerals is possible in many ways as for instance the numerals 1 2 3 4 5 on the inside wheel could be 2 3 4 5 6 or 3 4 5 6 7 or 4 5 6 7 8 or 5 6 7 8 9 and relatively the numerals 6 7 8 9 0 on the outside wheels could be 7 8 9 0 1 or 8 9 0 1 2 or 9 0 1 2 3 or 0 1 2 3 4 and also numerals 0 1 2 3 4 could be

on the inside wheel and 5 6 7 8 9 on the outside wheel as for instance seen in Figs. 5 and 6 of the 24 hour and 12 hour clock on wheels A and B, and in such case the finger disc would have to be timed so that when the opening on the outside wheel appears and the 0 on the inside wheel could be seen through the opening at the moment the finger disc transfers the operation to the adjoining pair of wheels. If however, a counter is built without the specifically described transfer mechanism, the numerals could be distributed in any desired way about the wheels so for instance 8 9 0 1 2 on the inside wheel and 3 4 5 6 7 on the outside wheel; in other words as long as there is always one half of the numerals on one wheel and the other half on the other wheel.

As explained in the description of counter in Figs. 1 to 4, the numerals from 0 to 9 are distributed on the circumference of the two wheels *a* and *b*, the wheel *a* has one opening through which the numerals from the wheel *b* can be seen. However, the numerals could also be distributed on the side or face of the wheels *a* and *b* and the overlapping cylindric tubes cut away which then would appear as a front or rear dial. The front dial, which would be wheel *a* would have to have an opening on its face and through said opening the numerals from the rear dial which would be wheel *b* could be seen. Such a construction would clearly come within the spirit of my invention, but such a construction would clearly not result in such a compactly assembled mechanism obtained by placing the numerals on the circumferences of wheels *a* and *b* as described.

From the above description it will be clear to anybody skilled in the art, that the means for compactly and separately holding the elements of each set of number wheels together in order to prevent the elements from a longitudinal movement present a construction enabling the assembling of as many compact and completely assembled sets with one another as desired and described, and such a construction can also be made use of with a counter having number wheels of the old known type in which the numbers from 0 to 9 inclusive are distributed on one wheel, as for instance in applicant's Score register Patent No. 2,180,590.

In the cyclometer clock the arrangement of the operating mechanism is separate from the number wheels, as the spindle and the bushings are for transmitting the operation of the mechanism to the number wheels surrounding the mechanism, which is referred to in my Patent No. 2,117,168 for a Counter with telescoped number wheels. This construction makes it possible to provide a comparatively small operating mechanism for comparatively large number wheels while using a minimum of operating force and can also be used in any of the known numeral clocks where the numerals for the hour denomination are on one wheel and the numerals for the cardinal and decadal minute denomination are each on another wheel. It will also be clear that other arrangements may be employed, so for instance in the 12 and 24 hour clock, instead of displaying the cardinal hour denomination on two nested wheels, they could also be displayed on one wheel only, however then there could not be obtained by far such a large or high numeral, as I presently obtain with my above described construction.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A counter comprising a set of nested number wheels, said set having an inner and an outer number wheel for the purpose of presenting large numerals, the numerals 0 to 9 inclusive distributed on the two wheels, as to present the numerals 1 2 3 4 5 on the inside wheel, and the numerals 6 7 8 9 0 on the outside wheel, said outside wheel having an opening of the same size as these numerals, and a means for displaying one numeral at a time.

2. A counter comprising two number wheels, one nested in the other with the numbers 0 1 2 3 4 5 6 7 8 9 so distributed on the wheels that the inner of the number wheels bears on its circumference equally distributed the numbers 1 2 3 4 5 and the outer of the number wheels the numbers 6 7 8 9 0 also equally distributed on its circumference while having an opening of the same size as the numbers through which the numbers on the inner number wheel can be read while the outside wheel remains stationary.

3. A counter comprising a set of nested number wheels, said set having an inner and an outer number wheel and having the numerals from 0 to 9 inclusive distributed on the two wheels as described and said outer number wheel having an opening, and a means to let one number on the inside wheel appear at a time through the opening in the outside wheel while it remains stationary.

4. A counter comprising a set of nested number wheels, said set having an inner and an outer number wheel and having the numerals from 0 to 9 distributed on the two wheels as described, and a means to let one number at a time appear on the outside wheel while the inside wheel remains stationary.

5. A counter comprising a set of nested number wheels, said set having an inner and an outer number wheel and having the numerals from 0 to 9 distributed on the two wheels, said inner wheel having the numerals 1 2 3 4 5 equally distributed around the wheel, and said outer wheel having the numerals 6 7 8 9 0 distributed around the wheel, and having an opening of the same size as the numerals, and a means for simultaneously operating the inside and the outside wheels at the moment when the number 1 appears on the inside wheel so that the opening of the outside wheel is so positioned that said number 1 can be read through this opening.

6. In a counter transfer mechanism as described a series of pairwise arranged nested number wheels, for the purpose of presenting large numerals, each pair of number wheels having an inner and an outer number wheel, a spindle to which said outer wheel is secured, and a bushing to which said inner wheel is secured, said bushing freely rotating on said spindle, said inner wheel executing $\frac{1}{5}$ rotation at each operation of the wheel, and said outer wheel executing $\frac{1}{5}$ rotation at each operation of the wheel, and a finger disc secured to said outer wheel for transferring the operation of one pair of number wheels to the adjoining pair of number wheels.

7. In a counter as described, a set of number wheels, having two number wheels, one nested in the other, for the purpose of presenting large numbers, a separate operating mechanism for said number wheels, a frame including a front and a rear plate, a spindle journaled in and passing through the front and rear plate of the set, a bushing on said spindle journaled in the rear plate and extending through the same, one of said nested number wheels secured to said bush-

ing, and the other of said number wheels secured to said spindle.

8. A counter including a transfer mechanism and comprising a plurality of sets of nested number wheels, pairwise arranged, and having the numbers 0 1 2 3 4 5 6 7 8 9 evenly distributed on the two wheels of each pair, a means for holding compactly and separately the elements of each set of number wheels together, said holding means preventing displacement against longitudinal movement, said holding means constructed to connect as many compact assembled number wheel sets to one another as desired.

9. A counter transfer mechanism for a series of pairwise arranged number drums, each pair having an outer and an inner number drum and having the numerals from 0 to 9 inclusive distributed on the inner and outer drum as described, said outer drum equipped with a finger disc for transferring the rotary movement of one set of number drums to the other adjoining set of number drums alternately to impart to the inner drum a full revolution and then to impart a full revolution to the outer drum.

10. In a counter as described comprising two number wheels, one nested in the other for the purpose of presenting large numbers, said number wheels operated for rotary movement to display the numbers on the wheels one at a time, and means for operating the outer number wheel to execute a one-sixth and the inner number wheel a one-fifth rotation.

11. In a counter, a pair of numbers wheels, comprising an outer and an inner number wheel and having the numerals from 0 to 9 inclusive distributed on the inner and outer wheel as described, a spindle to which said outer number wheel is secured, and a bushing to which said inner number wheel is secured, said bushing rotating on said spindle, a gear having six teeth secured to said spindle, another gear having five teeth secured to said bushing, and a shaft parallel and above the number wheel spindle, two mutilated gears on said shaft, one of said mutilated gears having six teeth periodically meshing with the gear on said number wheel spindle, and the other mutilated gear having five teeth and periodically meshing with the gear on said bushing, said mutilated gears providing a means for operating said pair of number wheels one at a time.

12. In a counter transfer mechanism as described, a series of pairwise arranged nested number wheels, an outer and an inner number wheel and having the numerals from 0 to 9 inclusive distributed on the inner and outer wheel, a spindle to which said outer number wheel is secured, a shaft above the number wheel spindle, a gear having ten teeth secured to said shaft, and a finger disc secured to the spindle of the outer number wheel, said transfer effected by the engagement of the said finger disc of one pair of number wheels with the gear having ten teeth of the adjoining pair of number wheels.

13. In a counter having two number wheels, one nested in the other and both having the numbers 0 1 2 3 4 5 6 7 8 9 distributed on the two wheels as described, and a locking mechanism for the number wheels to keep the wheels in alignment and in their relative positions.

14. In a counter for presenting large numerals and of the character described, a set of nested number wheels, said set including an inner and an outer number wheel and a front and rear plate, a post secured to the front plate, said rear plate secured to the post, a number wheel spindle pass-

ing through the front and rear plate, a bushing on said spindle journaled in and extending through said rear plate, another shaft above the said number wheel spindle and located in the front and rear plate, means on said shaft to rotate the two number wheels as described, the inner number wheel secured to the bushing and the outer number wheel to said spindle, both number wheels surrounding the operating mechanism, the front and rear plate for limiting the movement of the two number wheels and the mechanism connected therewith in a longitudinal direction.

15. In a counter comprising a pair of number wheels, said pair bearing the numbers 0 1 2 3 4 5 6 7 8 9 distributed on two wheels as described, a spindle to which one of the number wheels is secured and a bushing to which the other number wheel is secured, a shaft above the number wheel spindle, and two mutilated gears secured to said shaft so as to have some of their teeth in opposite directions while one tooth of one gear is aligned with one tooth of the other gear facing in the same direction.

16. A counter as described for a 12 hour clock comprising two sets of operatively connected number wheels, each of the sets having three number wheels, one of the sets counting the minutes, and another counting the hours, whereby each set has two number wheels for the counting of the lowest minute and hour denominations, one of the wheels being an inside wheel and the other an outside wheel, said inside number wheel having the numerals 0 1 2 3 4 equally distributed around its circumference, and said outside number wheel having the numerals 5 6 7 8 9 equally distributed around its circumference and an opening of the same size as the numbers, and the third number wheel for the display of the decadal minute denomination and having the numbers 0 1 2 3 4 5 distributed about its circumference, and for the designation of the decadal hour indication a number wheel having three times the numbers 1 and three empty spaces equally distributed around the number wheel so that every number 1 is followed by one empty space.

17. A counter as described for a 24 hour clock comprising two sets of operatively connected number wheels, each of the sets having three number wheels, one of the sets counting the minutes and another counting the hours, whereby each set has two number wheels for the counting of the lowest minute and hour denominations, one of the wheels being an inside wheel and the other an outside wheel, said inside number wheel having the numerals 0 1 2 3 4 equally distributed around its circumference, and said outside number wheel having the numerals 5 6 7 8 9 equally distributed around its circumference and an opening of the same size as the numbers, and the third number wheel for the display of the decadal minute denomination having the numbers 0 1 2 3 4 5 distributed about its circumference, and for the designation of the decadal hour indication a number wheel having twice the number 1 and 2 and an empty space of the same size as the number distributed around the number wheel.

18. A counter as described for a 12 hour clock comprising two number wheels for counting the lower hour numbers including an inside wheel having the numbers 0 1 2 3 4 equally distributed on the circumference thereof and an outer number wheel having the numbers 5 6 7 8 9 distributed

about its circumference and having an opening therein of the same size as the numbers, and a third number wheel for indicating the decadal hour numbers having three times the number 1 and three empty spaces equally distributed about its circumference so that after every number 1 follows an empty space, a means for making the one hour indication appear after the 12 hour indication so that upon the decadal number wheel an empty space appears and at the same moment the 1 appears on the inside number wheel.

19. A counter as described for a 24 hour clock comprising two number wheels for counting the lower hour numbers including an inside wheel having the numbers 0 1 2 3 4 equally distributed on the circumference thereof and an outer number wheel having the numbers 5 6 7 8 9 distributed about its circumference and having an opening therein of the same size as the numbers, and a third number wheel for indicating the decadal hour numbers having twice the number 1 and 2 and an empty space distributed around the circumference, and a means to let the 1 hour indication appear after the 24 hour indication, so that upon the decadal number wheel an empty space appears and at the same moment the number 1 appears on the inside number wheel.

20. A counter for a 12 and 24 hour clock comprising two sets of operatively connected number wheels, each set having three number wheels, one set for counting the minutes and another set for counting the hours, whereby each set has two number wheels for counting the lowest minute and hour denominations, an inside and an outside number wheel for each set, and each set having a third number wheel for counting the decadal numbers of the minutes and of the hours, the inside and the outside wheel of each set for counting the lowest minute and hour denominations having the numbers 0 1 2 3 4 5 6 7 8 9 so distributed that the inside number wheel bears the numbers 0 1 2 3 4 and the outside number wheel the numbers 5 6 7 8 9 and having an opening of the same size as the numbers, a means for letting one number on the inside number wheel appear at a time through the opening in the outside wheel when the same remains stationary, and a means to let one number at a time appear on the outside wheel while the inside wheel remains stationary, and a means for simultaneously operating the inside wheel and the outside wheel at the moment when the number 0 appears on the inside wheel, said opening in the outside wheel being so positioned as to allow the reading of the number 0 through said opening.

21. In a counter for a 12 and 24 hour clock as described, two sets of number wheels, each of the sets having three number wheels, one of the sets counting the minutes, and the other set counting the hours, each set having two number wheels, one nested in the other, for counting the lower minute and hour denomination, one wheel being inside and one outside, and each set having a third number wheel for counting the decadal numbers of the minutes and of the hours, a front and a rear plate for each set, a post secured to the front plate, said rear plate secured to said post, a spindle passing through the front and rear plate, two bushings on said spindle also extending through the rear plate, one being an inner and the other an outer bushing, the outer bushing

journalled in said rear plate, the inner number wheel secured to the outer bushing and the outer number wheel secured to the inner bushing, and the third number wheel secured to the spindle, said spindle and the bushings representing means for transmitting the operation of the rotary movement to the number wheels, an operating shaft above the spindle parallel thereto, said operating shaft located in the front and rear plate, and means on said shaft cooperating with means on the spindle and bushing to rotate the number wheels as described.

22. In a counter transfer mechanism as described, a series of pairwise arranged nested number wheels, said series comprising an outer and an inner number wheel and having the numerals 0 1 2 3 4 5 6 7 8 9 distributed on the outer and inner number wheel, a frame having a front and a rear plate, a number wheel spindle passing through and beyond the front and rear plate, a flange having a boring, half of said boring taken up by the spindle, said flange secured to said spindle, a bushing on said spindle journalled in and extending through said rear plate, another flange secured to the bushing, the inner number wheel secured to the flange on the bushing, the outer number wheel secured to the flange on the spindle, and the other half of the boring of the flange on the spindle of one pair of wheels freely rotating and journalled on the spindle extending through the front plate of the adjoining pair of wheels.

23. A counter comprising a set of nested number wheels, said set having an inner and an outer number wheel for the purpose of presenting large numerals, the numerals 0 to 9 inclusive distributed on the two wheels, said outer number wheel having an opening of the same size as these numerals, and a means for displaying one numeral at a time.

24. In a counter, an outer and an inner number wheel having the numerals from 0 to 9 inclusive distributed on said outer and inner wheel, a spindle to which said outer number wheel is secured, and a bushing to which said inner number wheel is secured, said bushing rotating on said spindle, a gear secured to said spindle, another gear secured to said bushing, and a shaft parallel and above the number wheel spindle, two mutilated gears on said shaft, one of said mutilated gears periodically meshing with the gear on said number wheel spindle, and the other mutilated gear periodically meshing with the gear on said bushing, said mutilated gears providing a means for operating said pair of number wheels, one at a time.

25. A counter as described comprising a set of nested number wheels, said set having an inner and an outer number wheel for the purpose of presenting large numerals, the numerals 0 to 9 inclusive distributed on the two wheels as to present one half of the numerals on the inside wheel and the other half on the outside wheel, said outside wheel having an opening of the same size as these numerals, and a means for actuating said wheels to display the numerals in uninterrupted successive cycles one numeral at a time, said set of nested number wheels surrounding said actuating means.

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