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 [33] **Switzerland**
 [31] **15537/69**

3,092,319 6/1963 Bright..... 235/117
 3,403,851 10/1968 Rechlin 235/117
 3,452,927 7/1969 Bies et al. 235/117

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[54] **MECHANICAL COUNTER**
13 Claims, 12 Drawing Figs.

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235/117
 [51] Int. Cl..... **G06c 15/26**
 [50] Field of Search..... **235/139,**
136, 117 R, 117 A, 1 C, 91 R; 346/98

[56] **References Cited**
UNITED STATES PATENTS
 2,239,460 4/1941 Levy..... 346/98 X
 2,390,444 12/1945 Mefferd..... 235/136
 2,713,971 7/1955 Bud et al..... 235/91

ABSTRACT: A mechanical counter capable of showing values changing continuously and at a high rate of speed, which comprises a series of numbered drums containing e.g. six groups of 10 figures moving angularly in front of a reading window. Each drum after the first has a toothed internal gear, and each drum preceding the last has a pair of circular cams for causing periodic movement of the subsequent drum and then locking it between movement periods. This transfer movement is effected by one of a series of gear means, mounted such that each gear means consists of a first gear continuously engaged with the toothed rim of a given drum, and second and third gears each having a pitch twice that of said first gear and having their teeth alternately aligned with teeth of said first gear, so that the second and third gears are alternately moved and locked by said pair of cams. Each cam has e.g. three arcuate projections, each projection of one cam being opposite an empty space of the other cam.

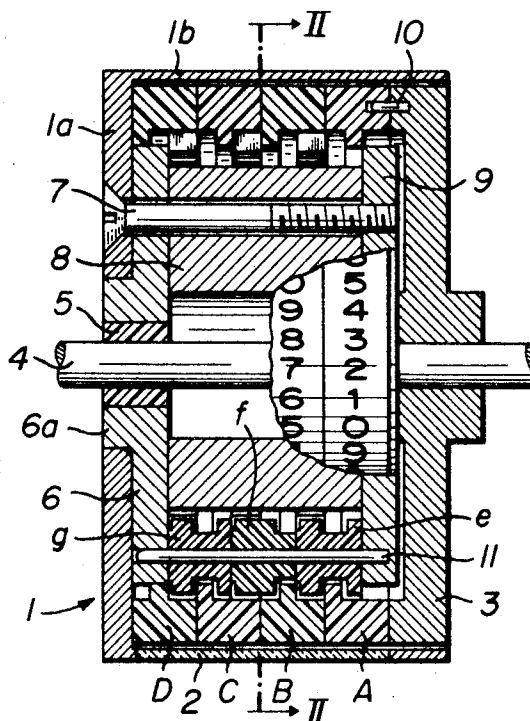


FIG. 1

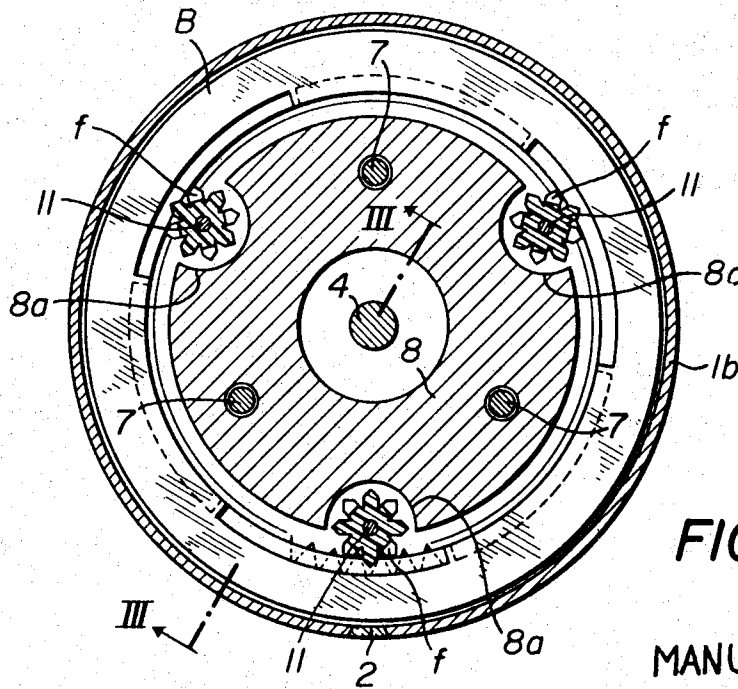
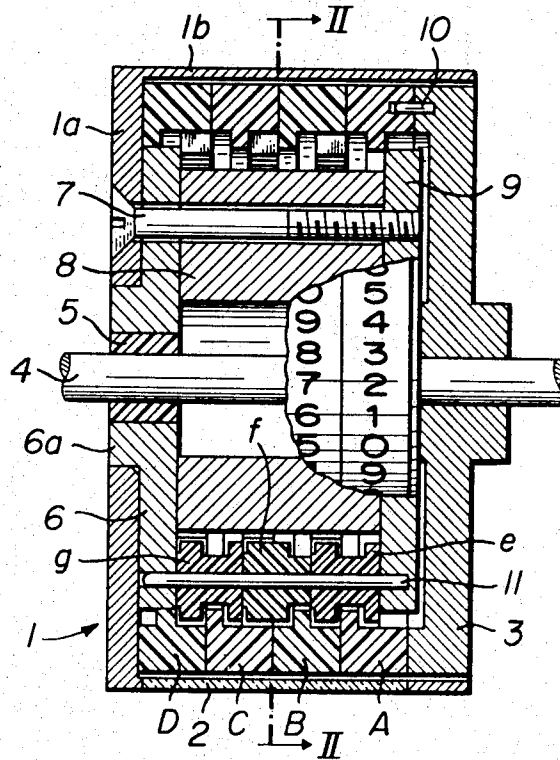


FIG. 2

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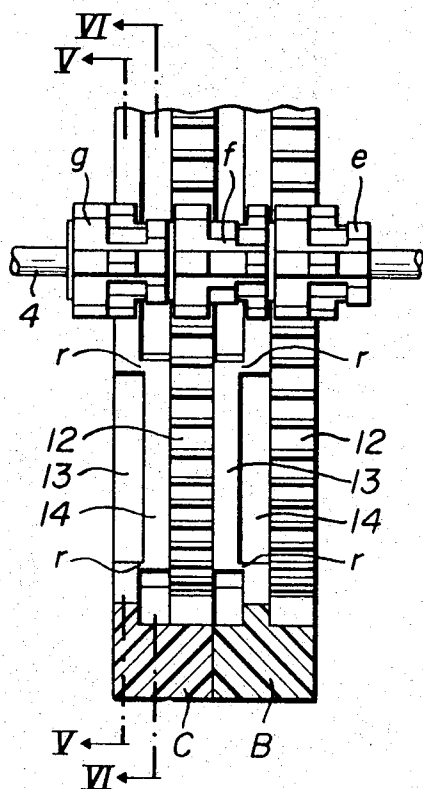


FIG. 3

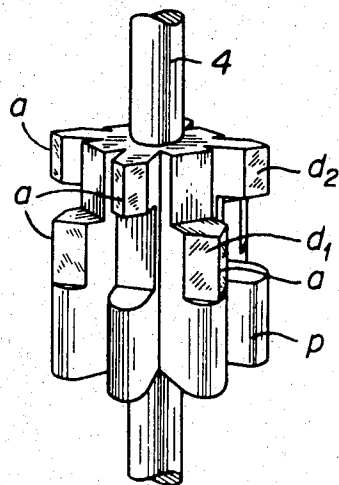


FIG. 4

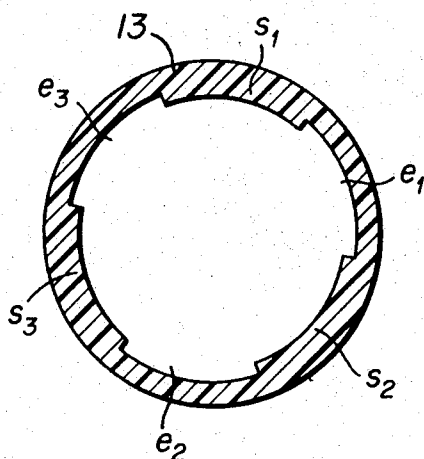


FIG. 5

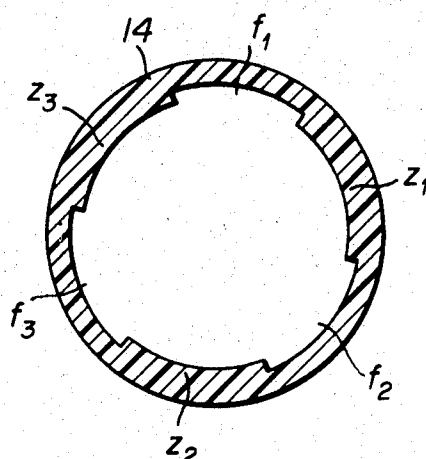


FIG. 6

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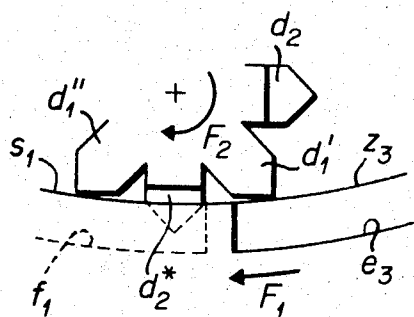


FIG. 7

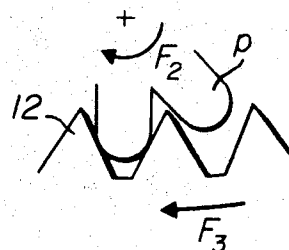


FIG. 8

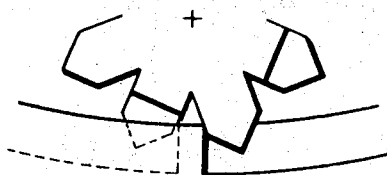


FIG. 7A

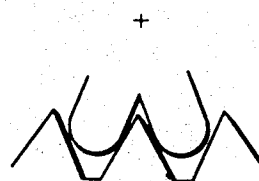


FIG. 8A

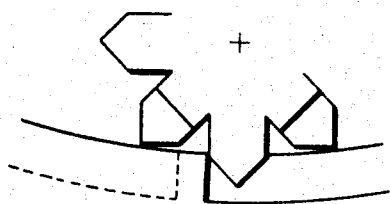


FIG. 7B

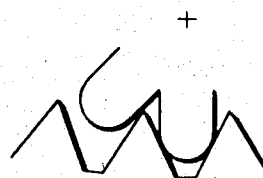


FIG. 8B

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MECHANICAL COUNTER

The present invention is a mechanical tens-transfer counter, in the general nature of a conventional odometer. In the illustrated embodiment, four ringlike drums disposed along a common horizontal axis bear numerical indicia for displaying a four-digit number through a window in the housing. A rotatable shaft projecting axially from the housing is connected to the drums by suitable gearing so that the indicia are caused to display a desired multiple of the number of revolutions through which the shaft has traveled.

For the number to be displayed as a conventional decimal value, it is necessary for the "tens" drum to be rotated one increment to display the next figure each time the "units" drum has rotated through 10 such increments. Although conventional electric or gas meters with separate dials for each figure accomplish this by simply providing a 10 to 1 ratio continuous step down gearing between units and tens dials, this produces the possibility of confusion in an odometer-type display. In that event, when the units value is above about 7, the tens value displayed appears to be the approaching figure rather than the preceding tens value, which should be.

Odometer displays, accordingly, conventionally provide means for holding constant the tens value displayed while the units display ranges from 0 to 9. Then only as the units value goes from 9 to 0, the tens value is caused to increment as well.

The present invention provides a counter which functions satisfactorily at high rates of revolution, such that under similar use prior art devices would generate undesirable noise and suffer excessive wear. One way this is accomplished in the present invention is to lower the rate of rotation of the indicia-bearing drums by providing several, e.g. six, sets of indicia on each drum. Here, each drum rotates at one-sixth the rate at which it would have to travel if a single set of digits (0 to 9) were on its face. Of course, this makes positioning of the drum more critical, as an increment is only 6° rather than 36° .

To provide the required accurate positioning of each drum, means are provided for transferring increments from a lower order drum to a higher order one in a very precise manner. The higher order (e.g. tens) drum carries an internal gear with a multiplicity of teeth cut into its inner circumference. The lower order (e.g. units) drum carries along its inner circumference a pair of internal cams which have complementary elevations and depressions. Each elevation on each cam extends one-sixth of the circumference in the preferred embodiment and is followed by a corresponding depression extending for a similar distance, and so on around the inside of each cam.

Associated with each drum and its pair of cams is a pair of star, or Maltese cross, gears which are fixed to each other out of phase. These gears are disposed so that the tooth of one gear fits into the depression of one of the cams of the drum and the cut or shortened portion of the other gear rides on the protrusion of the complementary cam. As the drum is rotated, the cams will pass the gears without changing their position until the depressed portion of the one cam gives way to an elevated portion. At this point, the tooth of the first gear will be kicked out of the cam depression in which it had been riding, and at the same time a tooth of the second gear will rotate into the depression of the second cam which will have moved into position near the gear, replacing the protrusion of the second gear will rotate into the depression of the second cam which will have moved into position near the gear, replacing the protrusion of the second cam previously there. This describes a single "kickover" of the pair of star gears.

As the pair of star gears are fixed to a first gear which continuously meshes with the internal gear of the next higher order drum, the higher order drum is thus caused to move one increment each time the star wheel assembly kicks over.

It is to be noted that the pair of star gears have not resumed the starting position after only a single kickover, since a tooth of the second gear is in a depression of the second cam at the end of the operation just described. It will be apparent that as the drum continues to rotate, a protrusion of the second cam will force the tooth of the second gear out of the depression in

a manner entirely analogous to that previously recited and that the second kickover will result in a tooth of the first star gear again being within a depressed portion of the first cam. The effect of the complementary sets of cam surfaces and star gears is not unlike walking; that is, the teeth of the star gears appear to "walk" around the inside of the drum as the drum rotates in operation.

A further advantage may be obtained by providing additional sets of identical transfer wheels, disposed about the internal circumference of the drums. That helps to balance the application of rotational moment to each higher order drum as it is moved by providing impetus from several evenly spaced points. By so doing, the load on any given transfer wheel is reduced proportionally, through sharing with corresponding elements, and wear is thus further reduced.

In general, the numbering on each drum may contain n same groups of m figures, arranged one after the other. Each cam of each pair of cams will thus have $xn/2$ arcuate projections, where x is a small integer. The star gear teeth are arranged, one in the plane of the first cam, and the other in that of the second cam, so that they each have a tooth pitch equal to $2k/x$ times the pitch π of the corresponding gear, that one of the series of teeth is placed at an angle in relation to the other of k/x times the pitch π of the gear and finally that the external diameter of each star gear is such that, for a given angular position of the gear means to which they are associated, two adjacent teeth of one star gear come in contact at their ends with a projection of the corresponding cam, the tooth of the other star gear which is contained between the said adjacent two teeth being engaged in the hollow of the other cam facing this projection.

PREFERRED EMBODIMENT

The drawings represent one example of an embodiment of this invention, in which

FIG. 1 is an axial section;

FIG. 2 is one view in section along the line II—II of FIG. 1;

FIG. 3 is an explanatory section of certain components of one portion of the counter visible in FIG. 2, along the line III—III of this Figure;

FIG. 4 is an enlarged perspective view of a driving gear of the counter;

FIG. 5 and 6 are sections along the line V—V and VI—VI respectively of one of the drums visible in FIG. 3;

FIGS. 7, 7A, 7B, 8, 8A, and 8B are enlarged diagrammatic views showing the angular progression of one numbered drum of the invention.

The counter represented in the drawing has a casing 1 including a circular wall 1a and a cylindrical lining 1b continuous with this wall, in which is cut a reading window 2, the opening of which is closed by a rotating plate 3 joined to a driving axle 4 of the counter which pivots in a mounting 5 made of synthetic antifriction material which has a support 6 formed by circular plate with a cylindrical extension located in a central opening cut in the wall 1a.

The support 6 is fixed on the wall 1a of the casing by means of three screws 7 arranged equidistantly from each other around the axle 4, passing through the support 6 and a ringlike crosspiece 8 and fixed by screwing the end into a circular screw-hole plate 9.

Between the plate 3 and the wall 1a of the casing are four drums A, B, C, D, the external surface of each of which has six groups of 10 figures from 0 to 9, arranged one after the other in each group and from group to group as shown by the portions of the drums A and B visible in FIG. 1 of the drawing.

The drum A is joined to the plate 3 by pins such as 10 and thus turns with the latter.

The drums A, B and C have an unfixed position with regard to the possible axis of rotation, only the drum D having a set position by direct contact with the end of the plate of the support 6.

The lateral surface of the ringlike crosspiece 8 has three semicircular channels 8a angularly equidistant from each other in the opening of which are three axles 11, each with three gears *e, f, g* mounted loosely, the function of which will be shown later. The axles 11 are arranged angularly in equidistant position and are parallel; they are fixed, at the left end, in the appropriate openings of the support 6 and, at the right end, in corresponding seats of the screw-hole plate 9.

As can be seen in FIGS. 3, 5 and 6, the drums B and C are actually composed of a ringlike piece of which one-half of the internal rim has a series of teeth 12, 60 teeth in the example illustrated that is, a number of teeth equal to the number of figures on the numbered drum but which can, in variant form, be a multiple of this number, or equal to $k \cdot m \cdot n$, if *m* is the number of groups of *n* figures and *k* the multiplicity factor, *k* being equal to 1, 2, 3, ... etc.

In the second half of the internal rim each drum B and C has two cams 13 and 14, ringlike in structure, the profile of which is seen in FIG. 5, for cam 13 and in FIG. 6 for cam 14.

Each cam 13 and 14 has three projections s_1, s_2, s_3 for cam 13 and z_1, z_2, z_3 for cam 14 and three empty spaces e_1, e_2, e_3 for cam 13 and f_1, f_2, f_3 for cam 14 of angular length slightly below that of the projections. In addition, the bottom of these spaces and the arc of the projections have a rounded profile of which the center of curvature coincides with the center of curvature of the external surface of the drum.

As seen in the drawing, each projection of one of the cams is opposite to an empty space of the other and vice versa. Thus, the projections s_1, s_2, s_3 of the cam 13 face the respective empty spaces f_1, f_2, f_3 of the cam 14, whereas the projections z_1, z_2, z_3 of the latter are respectively opposite the empty spaces e_1, e_2 , and e_3 of the cam 13. It should be noted in addition that each projection of one of the cams is linked, at each end, to the adjacent projections of the other cam by an intermediate strengthening component *r* (FIG. 3).

In the application shown, the total number of projections of each drum is equal to the number *n* of groups of *m* figures appearing on the external surface of the drum; in this instance the number is thus six.

As a variation, the number of projections may be equal to a multiple of *n*. In general, the number of projections of the two cams of each drum might be equal to xn , where $x=1, 2$, etc.

In the application represented in FIG. 1, the four drums, A, B, C and D are of identical structure, all having a series of teeth 12 and cams 13 and 14. It should be noted that for the drum A, the teeth are not necessary, and are not of any use, as this drum rests by means of this series of teeth on the external surface of the plate 9 previously noted. As a variation, the drum A could be made without the teeth 12 and have instead a support ring of diameter corresponding to the internal diameter of these teeth.

Similarly, the part of the drum D composed of the cams 13 and 14 is not indispensable and is masked by the plate 16 on the surface of which this drum rests by means of the projections of the said cams.

As a variation, the drum D could be made without the cams 13 and 14 and have instead a support ring of diameter corresponding to twice the radius of curvature of the profile of the arc of the different projections.

As will be seen, the calculator described functions without the teeth 12 for the drum A and cams 13 and 14 for drum D.

As described, the drum A is driven directly by the plate 3 to which it is joined whereas the movement of each drum B, C and D is controlled, by the drum designed to count the next lower decimal numbers.

In the mechanical counter pictured, the drum A counts units; the drum B, tens; the drum C, hundreds; and the drum D, thousands.

The control of each drum B, C and D by the preceding drum is accomplished by means of substantially identical gear means *e, f* and *g* previously noted and shown in FIG. 4.

Each gear means *e, f, g* has a first gear *p*, the teeth of which have a pitch identical to that of the teeth 12 of the drums B

and D. In the application represented, the gear *p* of the component has eight teeth.

Each gear means *e, f, g* has in addition two star gears d_1 and d_2 the pitch of the teeth of which is equal to twice the pitch of the teeth of the gear *p*, that is to twice the pitch of the teeth 12 of each drum. Each star gear d_1 or d_2 thus has four teeth.

In general, it can be shown that for a counter each drum of which has cams with a total of xn projections and of which the series of teeth 12 has a number of teeth equal to $k \cdot m \cdot n$, the pitch of the adjacent teeth d_1 of star gears and d_2 must be equal to $2(k/x)$ times the pitch π of this series of teeth 12 or $p=2 \cdot (k/x)$.

As seen in FIGS. 1 and 3, each gearing must thus cooperate at the same time with two adjacent drums, that is by the gear *p*, with the toothed rim 12 of a given drum and by the teeth d_1 and d_2 , with the two cams 13 and 14 of the adjacent drum, of next lower decimal place. Towards this end, the diameters of the part of the gearing constituting the gear *p* and those of the teeth of star gears d_1 and d_2 as well as the position of each axle 11 with relation to the pivotal center of the drums are chosen such that the gear *p* of each gear means is constantly engaged with the toothed rim 12 of a drum and that the teeth of the star gears d_1 and d_2 occupy with regard to the two cams 13 and 14, with which they must cooperate, the position shown for example, in FIG. 7.

It can be seen in FIG. 7, that if one tooth d_2^* of the star gear d_2 is engaged in one empty space of the cam 14, the adjacent teeth d_1' and d_1'' of the star gear d_1 , situated on both sides of the tooth d_2^* , have their apices arranged on a circle of radius corresponding to the radius of curvature of the arc of the projections of the cam 13, which signifies obviously that the teeth d_1' and d_1'' will come in contact with the projections of this cam in the course of angular displacement of the latter, in direction F_1 for example (FIG. 7).

FIG. 7 shows the position of the star gears d_1 and d_2 of one gear means and the projections s_1 and z_3 , and of the empty spaces f_1 and e_3 of the cams 13 and 14 at the moment when the projection z_3 of the cam 14 meets the tooth d_2^* of the star gear d_2 . It can be seen in particular that the tooth d_1'' of the star gear d_1 is thus resting on the projection s_1 of the cam 13 whereas the tooth d_1' is already over the adjacent empty space e_3 .

FIG. 8 shows the corresponding position of the gear *p*, associated with star gears d_1 and d_2 shown on FIG. 7, and of one portion of the toothed rim 12 with which this gear *p* engages and belonging to the following drum.

When the drum with the cams 13 and 14 moves at an angle in direction F_1 (FIG. 7), the projection z_3 pushes the tooth d_2^* and moves the star gear d_2 in direction F_2 which makes the tooth d_1' of the star gear d_1 penetrate into the empty space f_3 of the cam 13 and correspondingly advance the gear *p* and thus the toothed rim 12 of the next drum, in direction F_3 identical to F_1 .

This movement stops at the time that the gear means has turned to such a degree that the tooth d_2 occupies with regard to the projection z_3 the position illustrated in FIG. 7B, a position shifted angularly by one tooth pitch with regard to the position in FIG. 7A. It can be noted on FIG. 7B that the gear means is then engaged in an empty space e_3 of the cam 13 by tooth d_1' and that it rests at the same time on the projection z_3 of cam 14 by the next tooth of the star gear d_2 .

It follows that if the cams 13 and 14 continue to move in direction F_1 , the teeth d_2 will then be in contact with the projection z_3 by two of these teeth.

What has just been stated with regard to only one gear and one portion of the cams 13 and 14 of a drum is obviously true for all the gear means and for all the cams.

In particular, each gear means is blocked angularly be contact with the projections of one cam while the projections of the other cam do not control the angular displacement in direct F_2 (FIGS. 7, 7A, 7B) so that the drum controlled by this gear is blocked angularly while it is not moved (position shown in FIG. 8 and 8B, for example).

The two cams 13 and 14 of each drum and the two star gears d_1 and d_2 of the gear means cooperating with these cams thus act alternately to control the locking of the next drum and to control the advance of this drum.

In addition, considering the multiplicity of projections of each cam and gear means e , f and g which the counter contains, each tooth of a star gear is used only once for one advance of the next drum equivalent to two tooth pitches, and because there are three series of gears, with only one-third of the expenditure which would be required if there were only one projection per cam and only one series of gears.

It follows that the drums of the calculator and the driving gears e , f and g can be made of synthetic resin without fear of premature breaking.

In addition, the angular displacement which each drum of the calculator described must make in order to change readings by 1,000 units per second will be one-sixth that of the traditional counter, the drums of which have only one group of figures from 0 to 9, for example, on the surface.

In this latter case, the first drum would have to turn, as described above, at a rate of 100 r.p.s., or 6,000 r.p.m. With the drum described in this invention, this rate can be reduced to 16% r.p.s. or 1,000 r.p.m., the star wheel teeth d_1 or d_2 of the gear means e each being used only 500 times per minute. In the case of a counter the drums of which would be numbered only from 0 to 9 and in which the advance of each drum would have to be by one figure for a complete turn of the preceding drum, the teeth d_1 or d_2 of a gear having the same function as the gear e of the computer described would be used 3,000 times per minute, or six times more.

It should be noted that, by the arrangement chosen, the assembly of the drums A to D of the counter described is particularly simple as they are centered by means of the three series of gears e , f , g which are constantly in contact by at least one tooth of the series d_1 and d_2 with one of cams 13 and 14, alternately, of the drums driving these gears.

Finally, the rotation of these drums being accomplished by mutual contact of pieces made of synthetic material and the number and intensity of shocks intervening between the projections of the cams and the gears being particularly small, the counter described functions relatively quietly, in spite of the very high speed with which it can change readings.

In fact, and in general, the number of series of gears of a counter of this type depends closely on the total number xn of projections of both cans of each drum, or on the number $xn/2$ of projections of each cam.

The number of gear series can be equal to $xn/2$ or a submultiple of $xn/2$ always having a minimum value of 3, as the centering of the drums described above can be accomplished only by support of these drums on at least three points.

Having thus described the invention, what it is desired to claim and thereby secure by Letters Patent is:

1. A mechanical counter capable of continuously counting rotation results at a high rate of speed comprising a housing, a driven shaft received within said housing, a succession of different order counter drums mounted adjacent one another for individual rotation on a common axis and including at least a units and tens drum mounted for rotation with said shaft, the remaining drums each kinematically independent of the preceding drum, said drums being supported in said housing by at least three series of gear means, each drum having a plurality of a series of figures on the outside periphery thereof, each drum except for said units drum having a gear surface with the number of teeth of said gear corresponding to a multiple of the number of figures on the periphery thereof, each said drum except for the last drum in succession also having cam means, each series of gear means having one gear means mounted so as to be in engagement with the cam means of the driving drum and the gear surface of the driven drum, the configuration of the cam means and gear means being such that a given amount of rotation of a first said driving drum means results in a fraction of that amount of rotation in a second driven drum equal to one divided by the number of figures in each of said series.

2. A mechanical counter as in claim 1, further including a window means in said housing through which said figures on said drums can be read.

3. A mechanical counter as in claim 1, wherein the gear surface of each drum is located on the internal annular surface of said drum and said three series of gear means are equally arcuately spaced within said housing so as to support said drums for rotation thereon, each gear means supporting a portion of two adjacent drums.

4. A mechanical counter as in claim 3, wherein said cam means are also located on the internal annular surface of each said drum and are adjacent said internal gear surface.

5. A mechanical counter as in claim 4, wherein each said cam means consists of two circular cam rings, each ring having a number of projections equal to one-half of a multiple of the number of series of figures on the external surface of each drum, each projection having a rounded profile coaxial to the pivotal axis of the drum, said projections being separated from each other by a distance equal to their arcuate length, the arcuate length being equal for all said projections, each ring's projections being staggered so that no project is positioned adjacent another in the other ring, and said rings being fixedly secured to each other and to the corresponding drum.

6. A mechanical counter as in claim 5, wherein each said series of gear means is mounted for rotation on a common axis fixed to said housing.

7. A mechanical counter as in claim 6, wherein each gear means consists of a first gear whose teeth have a pitch equal to the pitch of the teeth of the internal gear surface of said drum, said first gear being adapted to engage said internal gear to drive said drum, and further consists of second and third gears with teeth having a pitch twice the pitch of the internal gear surface teeth of said drums, the teeth of said second gear being aligned with alternate teeth of said first gear and the teeth of said third gear aligned with the other alternate teeth of said first gear, said first, second and third gears being fixedly secured to each other, the teeth of said second and their gears being adapted to engage the projections of said internal cam rings on the driving drum.

8. A mechanical counter as in claim 7, wherein said gear teeth on said second and third gears are star gears out of phase with each other, so that when, for a given angular position of either of said two gears, two adjacent teeth of one gear are in engagement with said rounded profile on the projections on one of said cam rings, the tooth of the other gear is in the space between two of said projections on said other cam ring.

9. A mechanical counter as in claim 8, wherein all of the components of said calculator are made of a plastic material.

10. A mechanical counter capable of continuously calculating revolutions of a shaft at a high rate of speed, said counter comprising a housing, a shaft received in said housing and adapted to be driven, a succession of different order counter drums having six series of the numbers 0 through 9 on the external periphery thereof, three series of gear means mounted in said housing for rotation about a common axis and supported by said three series of gear means, said drums including at least a units drum, a tens drum, a hundreds drum and a thousands drum, said units drum being coupled to said shaft for rotation therewith, the other drums not being operatively coupled to said shaft, each drum beginning with said tens drum having a surface with a gear thereon and engaged with said gear means, each gear having 60 teeth thereon, each said drum with the exception of said last drum having cam means, each gear means in each series supporting two drums by engaging the cam means of one drum and the gear surface of an adjacent drum, each cam means and each gear means being so configured that 10 revolutions of a driving drum results in 1 revolution of the driven drum.

11. A mechanical counter as in claim 10, wherein the gear on each drum is on a portion of the internal annular surface of each drum, adjacent said gear surface, each said cam means comprising two circular rings mounted adjacent each other inside said drum, each ring having three projections which have an arcuate profile coaxial with the axes of said drums, the ar-

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cuate length of said projections being the same and equal to the arcuate spacing between said projections, the projections of one ring being adjacent the spaces on the adjacent ring.

12. A mechanical counter as in claim 11, wherein each gear means consists of three gears, the first gear having eight teeth whose pitch is equal to the pitch of the internal gear teeth, said first gear being adapted to engage said internal gear to drive a drum, and further consists of second and third gears each having four teeth thereon with a pitch twice the pitch of the internal gear surface, the four teeth on said second and third gears

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being staggered and adapted to engage the projections on said cam rings of a driving drum, said first, second and third gears being integral.

13. A mechanical counter as in claim 12, wherein said second and third gears are star gears out of phase with each other, so that when two adjacent teeth of one gear are in engagement with the arcuate profile of the projections on one of said cam the the adjacent tooth of the other gear is in the space between two of said projections on said other cam ring.

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