PATENT SPECIFICATION 707,740

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COMPLETE SPECIFICATION.

Improvements in or relating to Circular Slide Rules for Making Calculations relating to Speed, Time, and Distance.

I, HAROLD ALEXANDRE BABINGTON BLACKWELL, a British Subject, of Thermetal House, Garston, Liverpool, 19, in the County of Lancaster, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention is for improvements in or relating to circular slide rules for making calculations relating to the movements and performance of vehicles or the like or put another way, calculations relating directly or indirectly to time distance and speed. The invention is particularly applicable to a device which will enable motorists and others interested in such calculations to ascertain quickly and easily :—

(a) Speed, given distance covered or to be covered and time taken or available for covering said distance.

(b) Time, given average speed and distance covered or to be covered.

(c) Distance, given time and average speed.

(d) Index of performance, given qualifying distance and actual distance.

(e) Lap speed, given distance and time.

The latter two calculations are of particular interest to Racing Motorists.

According to the present invention there is provided a device for making calculations apertaining to speed, time and distance, comprising a member or disc having on it in the form of a complete circle a logarithmic scale graduated in speeds (e.g. miles per hour) and concentric therewith and also in the form of a complete circle a logarithmic scale graduated in periods of time (e.g. seconds and/or minutes), a further member or disc rotatably pivoted to said first mentioned member or disc at the centre of said circular scales and having on it in the form of a complete circle and in juxtaposition to said time scale and concentric therewith, a logarithmic scale graduated in distances (e.g. miles or kilometres) and a pointer fixed on said further member or disc for rotation therewith and working over the scale of speeds.

According to a further feature of the present invention there is provided a device for making calculations apertaining to speed, time and distance, comprising a member having on it in the form of a complete circle a logarithmic scale graduated in speeds (e.g. miles per hour) and concentric therewith and also in the form of a complete circle a logarithmic scale graduated in minutes, a disc rotatably pivoted to said member at the centre of said circular scales and having extending completely around its periphery and in juxtaposition to said time scale, a logarithmic scale graduated in distances (e.g. miles or kilometres) and a pointer fixed on said disc for rotation therewith and working over the scale of speeds, said pointer being positioned and the speed scale graduated so that the pointer indicates 60 on said speed scale when the start of the distance scale (e.g. one mile) coincides with the start of the time scale (i.e. one minute) whereby the pointer indicates directly speeds in distances per hour.

The invention will be further described, by way of example, with reference to the accompanying drawings whereon :—

Figure 1 is a front elevation of one form of calculator, according to the invention, designed for making calculations relating to average speed, time and distance ;

Figure 2 is a plan view of Figure 1 ;

Figure 3 is a view of one side of a calculator particularly suitable for use by persons interested in motor or like racing, this side

of the device being used for making calculations relating to lap speed;

Figure 4 is a view of the other side of the calculator shown in Figure 3, this side being used for making calculations relating to the index of performance for a particular car or the like; and

Figure 5 is a plan view of Figures 3 and 4.

The device shown in Figures 1 and 2 comprises a large disc 10 of white celluloid or the like and a smaller disc 11 of similar material. These two discs are connected together concentrically by, for example, a hollow rivet 12 which permits the disc 11 to be rotated relatively to the disc 10. Extending circumferentially right around the periphery of the inner or smaller disc is a logarithmic scale "D" inscribed in miles from 10 to 100. Inscribed on the outer or larger disc 10, so as to circumscribe completely the circumference of the inner disc 11, is a further logarithmic scale "C" inscribed in minutes 10 to 100. These two scales which are adjacent to one another correspond in effect to the "D" and "C" scales of a slide-rule except that, for the purpose of the present invention, they begin with the numeral 10 instead of the numeral 1 as is usual with a slide-rule. Inscribed completely around the outer disc 10 and near the periphery thereof is a further scale "C1" which is a reciprocal scale of the scale "C" inscribed on this disc. The scale "C1" is graduated so as to give average speeds in miles per hour. Mounted on the inner disc 11 for rotation therewith is a transparent pointer of celluloid or like plastic material 13. This pointer may be secured to the disc 11 by means of the rivet 12 and by a further rivet 14.

Conveniently the pointer is of a contrasting colour to the discs. The pointer is arranged to move over and point to the inscriptions on the reciprocal (i.e. average speed) scale "C1" on the larger disc and it is located on the smaller disc in such a position that when the division marked 10 (i.e. the first division) of the "D" scale on said smaller disc is in coincidence with the corresponding division marking on the "C" scale of the larger disc the pointer indicates 60 on the reciprocal scale. It will be appreciated that the first and final division mark on the "C1" scale of the large disc is in radial alignment or coincidence with the first and last division mark on the "C" scale of said disc although as stated said "C1" scale is a reciprocal of the scale "C" i.e. it runs the opposite way around the disc.

The following are some examples of how the instrument above described may be used by a motorist:—

EXAMPLE 1.

To find speed.

42 Miles are covered in 70 minutes. What is the average speed? Set 42 on the "D" scale opposite 70 on the "C" scale. The pointer or arrow 13 points to the answer, 36 miles per hour, on the average speed scale "C1".

EXAMPLE 2.

To find time.

A car in a competition must average exactly 28 m.p.h. The distance to be covered is 42 miles. How long will it take?

Set the pointer 13 to 28 on the "C1" scale. The answer 90 minutes may be read on the "C" scale opposite 42 on the "D" scale.

EXAMPLE 3.

To find distance.

A driver has 24 minutes left to complete his run. He is doing exactly 40 m.p.h. How far will he go?

Set the pointer 13 to 40 on the "C1" scale. Opposite 24 on the "C" scale is the answer 16 miles on the "D" scale.

To use the calculator where the number of miles or minutes is less than 10 or greater than 100, the following procedure is adopted:

As previously stated all three scales are calibrated from 10 to 100. This is a convenient form for such scales (which are logarithmic). Let us look at the miles scale and read round from 10 in a clockwise manner: 10, 11, 12, etc., until we reach 100. Now if we continue reading round in a clockwise manner, the next numeral we see is 11; but if we progress *upwards* from 100, this 11 must be read as 110, 12 as 120, etc.

Similarly, if we again start at 10 on the miles scale, but this time read round in an anti-clockwise manner the next numeral we see is 95. But since we are now going from 10 downwards, this must be read as 9.5 and 90 as 9, etc., until we reach 10, which we read as 1.

It will be seen, therefore, that any of the numerals may be read as though they had been divided or multiplied by 10 or multiples of 10. Thus, the numeral 30 could also be read as 0.3, 3, 300, 3000, etc., as the occasion demanded. To make this point quite clear, consider the example which follows.

We know without calculation that at 30 m.p.h. it will take two hours (120 minutes) to cover 60 miles. To set this on the calculator we put the pointer 13 to 30 on the average speed scale "C1" and opposite 60 on the "D" scale we see 12 on the "C" scale. We now know that we must read this as 120 since we are going upwardly from 100.

The embodiment of the invention shown in Figures 3, 4 and 5 comprises a large disc of white celluloid or plastic 15 and two smaller discs 16 and 17 one against each face of the

disc 15. The three discs are connected together by a hollow rivet 18 which allows the discs 16 and 17 to be rotated relatively to the disc 15 and to each other. The disc 16 has a pointer 19 secured to it whilst a pointer 20 is secured to the disc 17. Here again the pointers may be secured to their discs by the rivet 18 and additional rivets 21.

Referring now to Figure 3, the periphery of the disc 16 has a scale " D " calibrated in distances whilst the face of the disc 15 against which the disc 16 works has an inner scale " C " calibrated in minutes and seconds and an outer scale " C1 " in connection with which the pointer 19 works, calibrated in lap speeds.

Turning now to Figure 4, the disc 17 has its periphery calibrated in actual distances to provide a scale " D " whilst the face of the disc 15 against which the disc 17 works has an inner scale, " C," calibrated in qualifying distances and an outer scale " C1," against which the pointer 20 works, giving the index of performance for a vehicle covering an actual distance as given on scale " D " and having allocated to it a minimum or qualifying distance as set off on scale " C ". Some examples will now be given of how the instrument described with reference to Figures 3, 4 and 5 may be used.

Example I. To find a lap speed. A car covers a 3-mile lap in 2 minutes 24 seconds. What is its lap speed ?

Referring to Figure 3, Set 3 on Distance Scale " D " opposite 2 minutes 24 seconds on Time Scale " C ". Pointer 19 will indicate the answer, 75 m.p.h. on Speed Scale " C1 ".

Example II. To find lap time. On a circuit whose lap is 6 miles, a car is averaging 80 m.p.h. What is its lap time ?

Set pointer to 80 on Speed Scale " C1 ". Opposite 6 on Distance Scale " D " read answer 4 minutes 30 seconds on Time Scale " C ".

Example III. To find distance. On a French circuit, a car lapping at 140 k.p.h. returns a lap time of 1 minute 12 seconds. What is the lap length ?

Set pointer 19 to 140 on Speed Scale " C1 ". Opposite 1 minute 12 seconds on Time Scale " C," read answer 2.8 kilometres on Distance Scale " D ".

It will be appreciated that the examples just shown are purely basic ones and it will be useful now to consider some of the more complicated problems which often arise in actual racing practice.

Consider the case of two cars running 1st and 2nd in a race where both cars have one more lap to go. The lap length is 3 miles and the 1st car is averaging 72 m.p.h. As the second car is entering the last lap it is 6 seconds behind the leader. What speed must it do to catch the leader on the winning post ?

Set pointer 19 to 72 on Speed Scale " C1 ". Opposite 3 on Distance Scale " D " read 2 minutes 30 seconds on Time Scale " C ". This is the leader's lap time. In order to catch the leader, Car No. 2 must gain 6 seconds, i.e. he must do his last lap in 2 minutes 24 seconds. Therefore set 2 minutes 24 seconds on Time Scale " C " opposite 3 on Distance Scale " D ". The pointer will show his required speed, 75 m.p.h.

Another type of problem might be as follows :—

Two cars in a race whose lap length is 2.5 miles are averaging respectively 79 and 86 m.p.h. How many seconds per lap is the faster car gaining ?

Set pointer 19 to 79 on Speed Scale " C1," and opposite 2.5 on Distance Scale " D," read 1 minute 54 seconds on Time Scale " C ". This, of course, is the slower car's lap time. Now set pointer 19 to 86 on Speed Scale " C1," and opposite 2.5 on Distance Scale " D " read 1 minute 45 seconds on Time Scale " C ". This is the faster car's lap time. Therefore the faster car is gaining 9 seconds per lap.

It may have been noticed in the examples shown that the pointer 19 has in one case been on that portion of the Speed Scale " C1 " where part of a second circle of numbers is engraved over the main numbers (i.e. 110, 120, 130, 140 over the main numbers 11, 12, 13, 14), and to those who are unfamiliar with logarithmic scales (which are the type used in this Calculator) it will be advisable to consider such scales in general.

They are normally calibrated from 1—10 or from 10—1000, and the action of performing one complete revolution on the scale multiplies the number started from by 10. Thus if we start at 10 and make an ascending circuit of the scale (10, 11, 12, etc.), we eventually come back to our starting point. Now, of course, we read the number 100 engraved over our starting number 10. It will be clear then that if we now wish to read speeds in excess of 100 (that is, if we wish to make a second ascending circuit), we must read the top row of figures. These have not been continued beyond 140 since that speed is not likely to be exceeded as an average.

The same reasoning applies if we wish to read speeds less than 10 m.p.h. (even though no actual numbers below 10 are included in the engravings on the scale). Just as we have seen that making an ascending circuit of the scale multiplies by 10, so a descending circuit divides by 10. Thus if we start at 10 and commence such a descending circuit, we must mentally divide the engraved numbers by 10, so that 95 becomes 9.5, 90 becomes 9, etc.

This will be clearly understood by considering the following examples :—

Suppose that a car covers 2 miles in 1 minute. Its speed is obviously 120 m.p.h. Now if we set 2 miles against 1 minute on the scales " D " and " C," the pointer will indicate the line marked both 12 and 120 in Scale " C1 ". But since the speed is in excess of 100, we are, in effect, on our second ascending circuit and must therefore read the top figure. Now take the case of a car which covers 1 mile in 7.5 minutes. Here its speed is clearly less than 10 m.p.h. (which is 1 mile in 6 minutes). We are therefore on our second descending circuit and must divide the indicated number by 10. On setting 1 mile against 7.5 minutes on the " D " and " C " scales, the pointer will indicate 80 on the " C1 " scale. This, divided by 10 gives the correct answer 8 m.p.h. Exactly the same thing applies to the Distance Scale " D," the numbers of which may be multiplied or divided by 10 or multiples of 10 as special occasions demand.

On the Time Scale however there is one important difference. Minutes and seconds have been included in the calibrations and, if advantage is to be taken of this, the range 1—10 must be adhered to. If, however, times of less than 1 minute or greater than 10 minutes are to be set on the scale it is only necessary to ignore the seconds figures and to use only those representing minutes. Then the treatment is exactly the same as on the Distance Scale " D ". If, for example, it is desired to set 15 minutes, use the line marked 1 minute 30 seconds (which is 1.5 minutes multiplied by 10). Also if say, half a minute is the required setting, use the line marked 5, since half is 0.5 and thus we have merely to divide the indicated minute number by 10.

On the other side of the instrument (see Figure 4) is a calculator for use in the index of performance method of determining the placing of cars in a race. Briefly, in this method each class of car, determined by engine size, is given a minimum or qualifying distance (d) to cover. The distance " D " actually covered by the car is divided by the qualifying distance and the result is known as the Index of Performance. In most cases the distance actually covered is less than the qualifying distance and the Index figure is therefore less than 1 and is usually expressed as a decimal, e.g. .7, .8, .9, etc.

In some cases however the qualifying distance is exceeded when, of course, the Index figure is greater than 1.

To find the Index figure it is only necessary to set the actual distance (D) covered on the " D " scale against the qualifying distance (d) on the " C " scale. The pointer will then indicate the Index of Performance on the " C1 " scale. If the actual distance covered is equal to or greater than the qualifying distance, the top row of figures should be read for the Index.

As on the other side of the instrument, the " D," " C " and " C1 " scales are logarithmic and therefore the numbers on the " D " and " C " scales can be multiplied or divided by 10 or multiples of 10 as has already been described.

It is unlikely however that distances less than 100 miles (or kilometres) will be required. But those greater than 1,000 may be needed in some races. To assist in rapid setting, a second circuit of numbers has been engraved on the scales up to 3,000 which should cover any range likely to be required.

The following examples will show the general method of operation of the Index of Performance Calculator :—

Example I. To find Index of Performance. The qualifying distance for a certain car is 550 miles. Actual distance covered is 495 miles. What is the Index of performance ?

Set 495 on " D " scale against 550 on " C " scale. The pointer 20 indicates the answer 0.9 on the " C1 " scale.

Example II. To find Distance Covered. The Index of Performance of a certain car is 0.8. The qualifying distance is 1,500 miles. What is the actual distance covered ?

Set pointer 20 to 0.8 on Index scale " C1 ". Opposite 1,500 on " C " scale read answer 1,200 on " D " scale.

Example III. To find Qualifying Distance. By covering 525 kilometres a car's Index figure is 1.05. What was the qualifying distance ?

Set pointer 20 to 1.05 (top row of figures) on " C1 " scale. Opposite 525 on " D " scale read answer 500 on " C " scale.

The method of calculating Index of Performance is based on the Le Mans formula D/d where " D " is the actual distance covered, and " d " is the qualifying distance.

In certain races, however, " d " represents qualifying speed and " D " actual speed. In this case the Index is generally given as a percentage.

This change of values for " D " and " d " does not alter the operation of the calculator and, provided that the engraved numbers of the Distance scales are divided by 10, they may be regarded as Speed scales. The Index Figure is, of course, converted to percentage by merely multiplying by 100.

For example, suppose that the qualifying speed of a car is 80 m.p.h. and the actual speed averaged is 72 m.p.h. These speeds are set by using the numbers 800 and 720 on the " C " (d) and " D " scales. The pointer 20 will indicate the Index 0.9 which, multiplied by 100 gives the correct answer, 90%.

One final example will now be given to show how both sides of the Calculator may be used in the same problem.

In a 12-hour race, a certain car must have a final Index figure of at least 0.9 in order to win. The length of a lap is 2 miles and the qualifying distance for its class is 990 miles.

For the first 8 hours the car has averaged 75 m.p.h. but the driver has managed to reduce his lap time by 6 seconds. Assuming he maintains this increased speed, will his final Index figure equal or exceed the required 0.9 ?

The car has done 8 hours at 75 m.p.h. which is equivalent to 600 miles. Now set the pointer 19 to 75 on Speed scale " C1," and opposite 2 on Distance scale " D " read 1 minute 36 seconds on Time scale " C ". This is, of course, the car's lap time at 75 m.p.h. This lap time has now been reduced by 6 seconds (to 1 minute 30 seconds) so set 1 minute 30 seconds on scale " C " against 2 on Distance scale " D " and read the new lap speed 80 as indicated by the pointer 19 on scale " C1 ". Thus we have the remaining 4 hours which, at 80 m.p.h. will give 320 miles. So the car has now done 600+320 which = 920 miles. Now turn the calculator over and set 920 on " D " scale against 990 on " C " (d) scale. The pointer 20 will indicate the Index to be 0.93 (approx.) on the " C1 " (D/d) scale. The car will therefore win the race.

The specific examples above described may be modified by, for example, providing the " C " and " C1 " scales on the smaller disc and the " D " scale and pointer, which will project inwardly, on the larger disc.

What I claim is :—

1. A device for making calculations apertaining to speed, time and distance, comprising a member or disc having on it in the form of a complete circle a logarithmic scale graduated in speeds (e.g. miles per hour) and concentric therewith and also in the form of a complete circle a logarithmic scale graduated in periods of time (e.g. seconds and/or minutes), a further member or disc rotatably pivoted to said first mentioned member or disc at the centre of said circular scales and having on it in the form of a complete circle and in juxtaposition to said time scale and concentric therewith, a logarithmic scale graduated in distances (e.g. miles or kilometres) and a pointer fixed on said further member or disc for rotation therewith and working over the scale of speeds.

2. A device for making calculations apertaining to speed, time and distance, comprising a member having on it in the form of a complete circle a logarithmic scale graduated in speeds (e.g. miles per hour) and concentric therewith and also in the form of a complete circle a logarithmic scale graduated in minutes, a disc rotatably pivoted to said member at the centre of said circular scales and having extending completely around its periphery and in juxtaposition to said time scale, a logarithmic scale graduated in distances (e.g. miles or kilometres) and a pointer fixed on said disc for rotation therewith and working over the scale of speeds, said pointer being positioned and the speed scale graduated so that the pointer indicates 60 on said speed scale when the start of the distance scale (e.g. one mile) coincides with the start of the time scale (i.e. one minute) whereby the pointer indicates directly speeds in distances per hour.

3. A calculating device as claimed in Claim 1 or Claim 2 wherein the disc is pivotally connected to the member at its centre by a rivet-like pivotal connecting device and wherein the pointer is loosely secured in position under the disc by said pivotal connecting device and is also secured rigidly to the disc, for rotation therewith by a rivet.

4. A calculating device as claimed in any of the preceding claims and further comprising, on the reverse side of the member, a further disc rotatably secured to said member at its centre and having extending right around its periphery a logarithmic scale of actual distances (D), the member having on its said reverse side an inner logarithmic scale in the form of a complete circle concentric with and in juxtaposition to said disc and graduated in qualifying distances (d) and also having in the form of a complete circle and concentric with the disc an outer logarithmic scale graduated in index of performance figures $\frac{(D)}{(d)}$ and a pointer fixed on the disc for rotation therewith and working over said scale of index of performance figures.

5. A calculating device substantially as herein described with reference to Figures 1 and 2, or Figures 3, 4 and 5 of the accompanying drawings.

Dated this 4th day of December, 1951.

E. R. ROYSTON & CO.
Chartered Patent Agents,
Tower Building,
Water Street, Liverpool, 3.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Circular Slide Rules for Making Calculations relating to Speed, Time, and Distance.

I, HAROLD ALEXANDRE BABINGTON BLACKWELL, a British Subject, of Thermetal House, Garston, Liverpool, 19, in the County of Lancaster, do hereby declare this invention to be described in the following statement :—

This invention is for improvements in or relating to devices for making calculations relating to time, distance and speed. The invention is more particularly concerned with a device which will enable the following calculations to be made quickly and easily :—

(a) To find speed, given distance covered or to be covered and time taken or available for covering said distance ;

(b) To find time, given average speed and distance covered or to be covered ;

(c) To find distance, given time and average speed.

A device of the character concerned is of great value to motorists.

According to the present invention there is provided a device for calculating relationships between speed, time and distance, comprising two relatively movable parts having co-operating logarithmic scales representing respectively distance and time in minutes, one of said parts having a further scale, representing average speed in units of distance per hour, which is a reciprocal logarithmic scale of the other scale on said disc and the other part having a pointer adapted to work over and point to the inscriptions on said reciprocal scale and located so that it indicates 60 on said scale when the other two scales are in numerical coincidence.

More specifically the present invention provides a device for calculating relationships between speed time and distance comprising an outer disc and an inner disc secured together concentrically so that the inner disc can be rotated relatively to the outer disc, a logarithmic scale of distances around the periphery of the inner disc, a co-operating logarithmic time scale in minutes on the outer disc adjacent the peripheral edge of the inner disc, a further logarithmic scale of average speeds on the outer disc said further scale being a reciprocal scale of the time scale on said disc, and a pointer on the inner disc adapted to be moved therewith over the average speed scale on the outer disc, so as to point to the inscriptions on said average speed scale, said pointer being positioned so that it indicates 60 when the time and distance scales are in radial numerical coincidence.

One specific embodiment of the invention will now be described by way of example, as applied to an instrument or device particularly useful to motorists and adapted to give data regarding distance, time and average speed.

The device comprises a large disc and a small disc secured together concentrically, by, for example, a hollow rivet. Extending circumferentially right around the periphery of the inner or smaller disc is a logarithmic scale inscribed in miles from 10 to 100. Inscribed on the outer or larger disc, so as to circumscribe completely the circumference of the inner disc, is a further logarithmic scale inscribed in minutes from 10 to 100. These two scales correspond, in effect, to the D and C scales of a slide rule except that, for the purpose of the present invention, they begin with the numeral 10 instead of the numeral 1 as is usual with a slide rule. Inscribed completely around the outer disc and near the periphery thereof is a further scale which is a reciprocal scale of the other scale inscribed on this disc. This scale gives average speeds in miles per hour. The legends "miles," "minutes" and "average speed" are appropriately inscribed on the scales as well as appropriate numerals to facilitate rapid reading of the scales. Mounted on the inner disc, for rotation therewith, is a transparent pointer which may be secured in position by means of the rivet by which the discs are secured together and by a further rivet. Conveniently this pointer is of a contrasting colour to the discs and the latter and the pointer are preferably made from celluloid or some similar fairly rigid sheet material. The pointer is arranged to move over and point to the inscriptions on the reciprocal (i.e. average speed) scale on the larger disc and it is located on the smaller disc in such a position that when the division marked 10 (i.e. the first division) of the scale on said smaller disc is in coincidence with the corresponding division marking on the inner scale of the larger disc the pointer indicates 60 on the reciprocal scale. It will be appreciated that the first and final division mark on the outer scale of the large disc is in radial alignment or coincidence with the first and last division mark on the inner scale of said disc although as stated said outer scale is a reciprocal of an inner scale, i.e. it runs the opposite way around the disc.

The following are some examples of how

the instrument above described may be used by a motorist.

EXAMPLE 1.

To find speed.

42 Miles are covered in 70 minutes. What is the average speed ? Set 42 on the miles scale opposite 70 on the minutes scale. The pointer or arrow points to the answer 36 on the average speed scale.

EXAMPLE 2.

To find time.

A car in a competition must average exactly 28 m.p.h. The distance to be covered is 42 miles. How long will it take ? Set the pointer to 28 on average speed scale. The answer 90 minutes may be read on the minutes scale opposite 42 on the miles scale.

EXAMPLE 3.

To find distance.

A driver has 24 minutes left to complete his run. He is doing exactly 40 m.p.h. How far will he go ?

Set the pointer to 40 on the average speed scale. Opposite 24 on the minutes scale is the answer 16 miles on the miles scale.

To use the calculator where the number of miles or minutes is less than 10 or greater than 100, the following procedure is adopted : As previously stated all three scales are calibrated from 10 to 100. This is a convenient form for such scales (which are logarithmic). Let us look at the miles scale and start reading round from 10 in a clockwise manner : 10, 12, 13, etc., until we reach 100. Now if we continue reading round in a clockwise manner, the next number we see is 11 ; but if we progress *upwards* from 100, this 11 must be read as 110, 12 as 120, etc.

Similarly, if we again start at 10 on the miles scale, but this time read round in an anti-clockwise manner the next number we see is 95. But since we are now going from 10 *downwards*, this must be read as 9.5 and 90 as 9, etc., until we reach 10, which we read as 1.

It will, therefore, be seen that any of the numbers may be read as though they had been divided or multiplied by 10 or multiples of 10. Thus, the number 30 could also be read, as 0.3, 3, 300, 3000, etc., as the occasion demanded. To make this point quite clear, consider the example which follows.

We know without calculation that at 30 m.p.h. it will take 2 hours (120 minutes) to cover 60 miles. To set this on the calculator we put the pointer to 30 on the average speed scale and opposite 60 on the miles scale we see 12 on the minutes scale.

We now know that we must read this as 120 since we are going upwardly from 100.

Dated this 22nd day of December, 1950.

E. R. ROYSTON & CO.,
Chartered Patent Agents,
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Water Street, Liverpool.

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from which copies may be obtained.

707,740 COMPLETE SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1

FIG. 1.

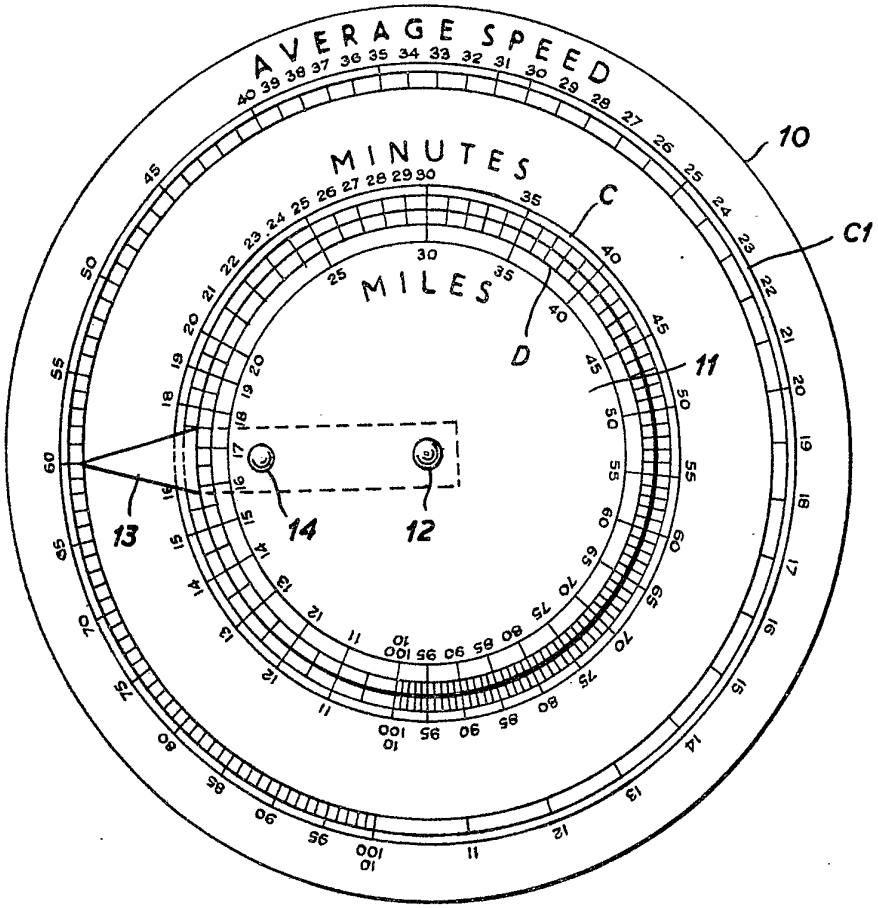


FIG. 2.

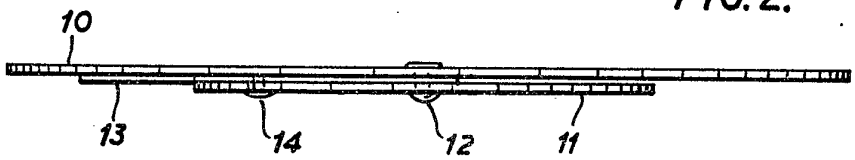
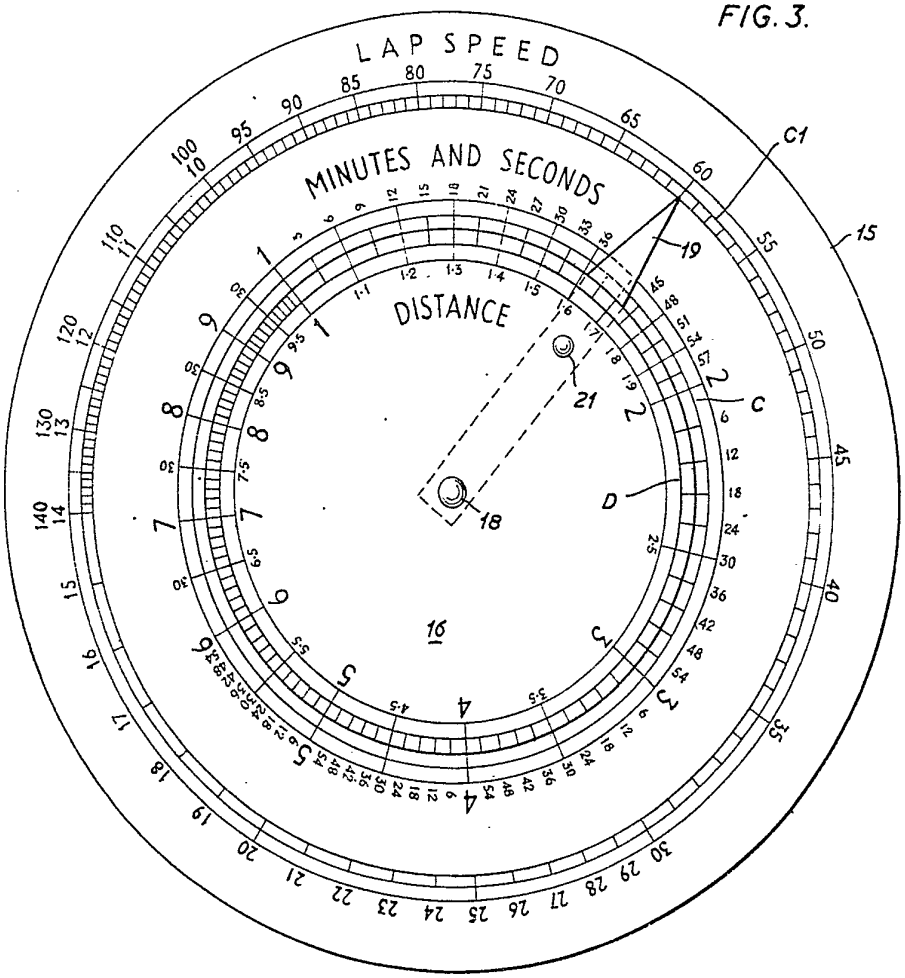


FIG. 3.



707,740 COMPLETE SPECIFICATION
2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

'G. 3.

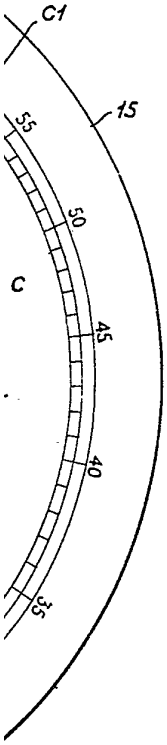


FIG. 4.

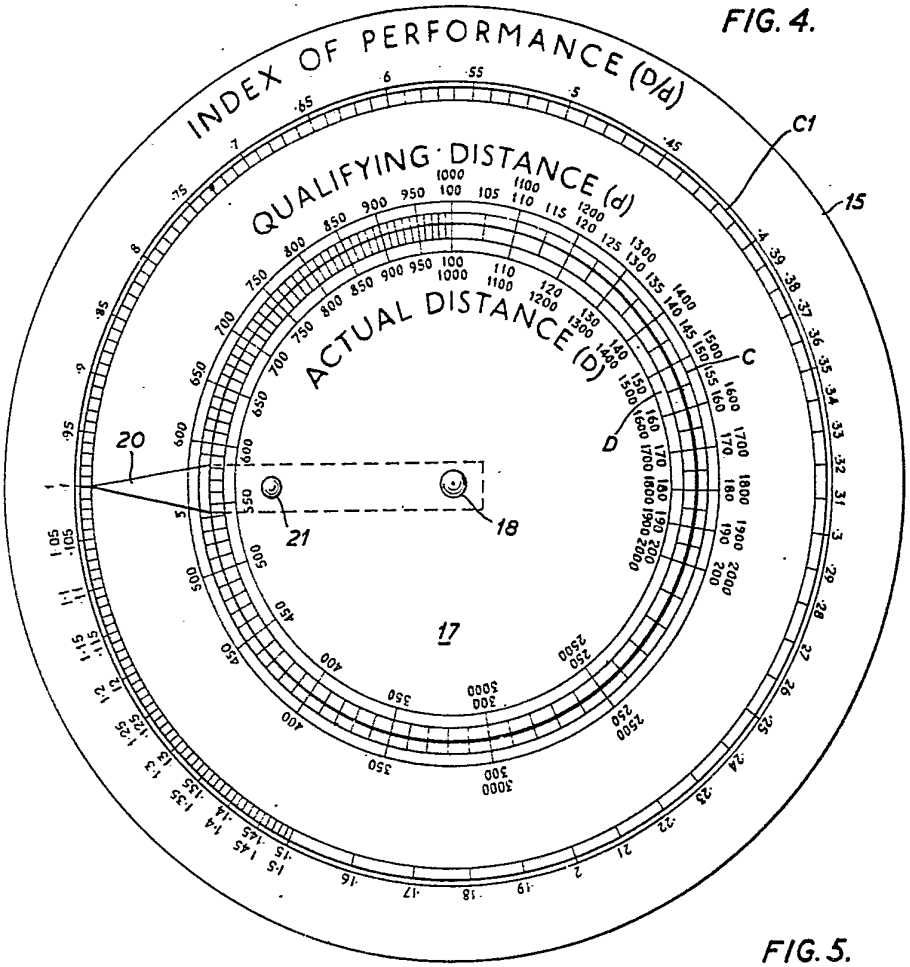
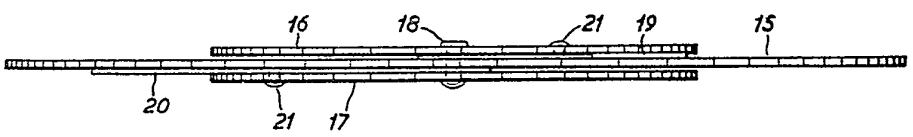


FIG. 5.



707,740 COMPLETE SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEET 2

FIG. 3.

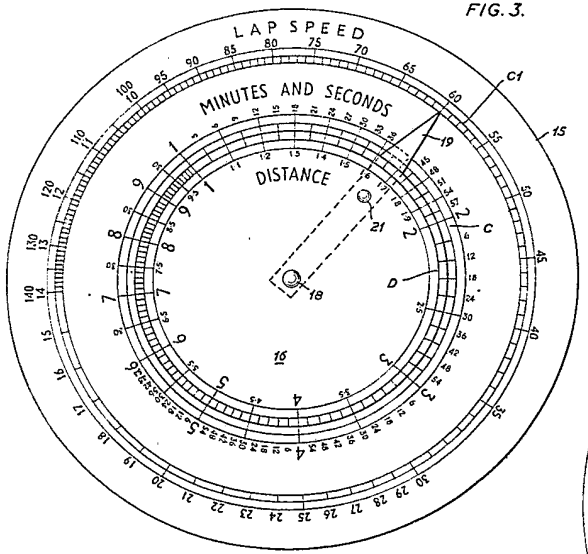


FIG. 4.

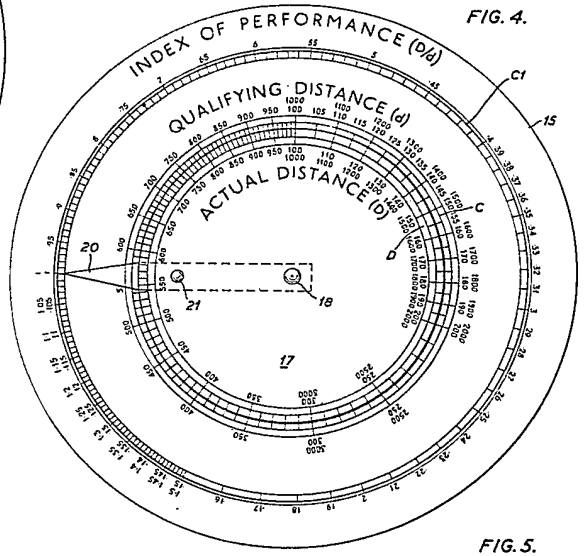


FIG. 5.