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PATENT SPECIFICATION

621,148



Application Date: Aug. 3, 1946.

No. 23190/46.

Complete Specification Left: July 30, 1947.

Complete Specification Accepted: April 5, 1949.

Index at acceptance:—Class 106(i), B5g19.

PROVISIONAL SPECIFICATION

A Slide-Rule Adapted for English Monetary Calculations

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ERRATA

SPECIFICATION No. 621,148.

- Page 1, line 40, for "drawing" read "drawings"
- Page 1, line 90, for "110" read "100"
- Page 2, line 30, for "members" read "numbers"
- Page 5, line 84, for "611,133" read "621,133"
- Page 8, line 106, for "£1" read "£1)"

THE PATENT OFFICE,
10th September, 1949.

25 arranged in such a way that all answers to problems could be read off the scale without the possibility of error arising from faulty estimation of the "position of the decimal place" or exact location of
30 the answer on the scale or scales, in the slide rule described in the present specification, although correct answers are given to all problems, there still remains
35 (in common with most ordinary slide rules) the necessity of estimating the "position of decimal place" or the particular row of scales on which the answer will appear, except in the case shown in
40 Fig. 3 in the accompanying sheet of drawing where the "wide range number and money scales" described in my previous Specification No. 11104/46 (Serial No. 621,133) are included together with the more widely spaced number and
45 money scales described in this present Specification.

ately 0/4d. appear in the one row, continuing in the second row from 6/4d. up to £1, there is no reason however why 75 further accuracy could not be achieved by the use of 3 row marking, where the number scale would be for the first row numbered from 1 to 2.14 approximately, the second row from 2.14 approximately 80 to 4.64 approximately, and the third row from approximately 4.64 to 10, the corresponding money scales say 2/- to £1 for instance would also require to be extended 85 to three rows. Conversely, the lengths of the scales could be contracted so that the number scale from 1 to 10 could occupy half the length of the rule, the other half length being marked from 10 90 to 110, and all money scales made half length to suit; this half length marking and the three-row marking is not however depicted in the drawings.

With reference to the marking out of the scales, all are marked logarithmically, 95 the number and percents scale on the "slide" being marked as in the case of the ordinary "engineers" slide rule, in

In general, the slide rule which is the subject of the present invention has a fixed "stock" at the upper and lower

[Price 2/-]

Price 4s 6d

Price 33s

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PROVISIONAL SPECIFICATION

A Slide-Rule Adapted for English Monetary Calculations

I, ALBERT WILFRID PARKES, "Welland House," 27, Newland's Drive, Blackheath, Nr. Birmingham, of English Nationality, do hereby declare the nature of this invention to be as follows:—

The present invention relates to slide rules for the calculation of English money problems, and while there have been previous slide rules and calculators produced for special purposes such as for cost of woven fabrics for instance, there appears to be no slide rule especially designed for Universal use for all generally required English money problems covering all ranges of values likely to be met with in general practice, from very low values such as one farthing up to high values such as £100 or £1000 for instance (except in the case of my invention detailed in my co-pending application number 11104/46 (Serial No. 621,133) to which reference will be made further on in this specification), but whereas in the Specification named the scales were arranged in such a way that all answers to problems could be read off the scale without the possibility of error arising from faulty estimation of the "position of the decimal place" or exact location of the answer on the scale or scales, in the slide rule described in the present specification, although correct answers are given to all problems, there still remains (in common with most ordinary slide rules) the necessity of estimating the "position of decimal place" or the particular row of scales on which the answer will appear, except in the case shown in Fig. 3 in the accompanying sheet of drawing where the "wide range number and money scales" described in my previous Specification No. 11104/46 (Serial No. 621,133) are included together with the more widely spaced number and money scales described in this present Specification.

In general, the slide rule which is the subject of the present invention has a fixed "stock" at the upper and lower

part of the rule upon which is inscribed various scales representing money values in pounds, shillings, pence, farthings, and in some cases decimals of one penny, while the movable "slide" (which is shown in the drawings as slightly protruding at each end of the rule for convenience) has inscribed thereon all the "number" scales, or "percents" scales, all scales being spread out as much as possible so that finer and more accurate readings can be obtained, and in fact in Fig. 4 is shown double scales to give results with additional accuracy; for instance in Fig. 1, the number and percents scale on the "slide" is marked 1 to 10 in the length of the rule, while in Fig. 4 this same scale is marked from 1 to approximately 3.15 in the one row, and continued from 3.15 to 10 in the second row, the corresponding money scales being also marked in a double row similarly, for instance values from 2/- to approximately 6/4d. appear in the one row, continuing in the second row from 6/4d. up to £1, there is no reason however why further accuracy could not be achieved by the use of 3 row marking, where the number scale would be for the first row numbered from 1 to 2.14 approximately, the second row from 2.14 approximately to 4.64 approximately, and the third row from approximately 4.64 to 10, the corresponding money scales say 2/- to £1 for instance would also require to be extended to three rows. Conversely, the lengths of the scales could be contracted so that the number scale from 1 to 10 could occupy half the length of the rule, the other half length being marked from 10 to 110, and all money scales made half length to suit; this half length marking and the three-row marking is not however depicted in the drawings.

With reference to the marking out of the scales, all are marked logarithmically, the number and percents scale on the "slide" being marked as in the case of the ordinary "engineers" slide rule, in

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Price 33p

proportion to the common logarithms of the numbers represented. Thus number 2 is positioned at .3010 of the distance from 1 to 10, number 3 at .4771 of the distance, or number 7 at .8451 of the distance.

The money scales are also logarithmically marked out but although the principal markings of values £10 to £100 (which row of markings can also be used for the higher values of £100 to £1000, or £1000 to £10,000) follow the same system of marking as the number scales, the scales showing the other money values do not altogether correspond, for instance taking the row £1 to £10, this is marked £1/10/0 at the 1.5 position, or £2/10/0 at the 2.5 position, also in the wider marked scales shown in Fig. 2, which shows a portion of the rule shown in Fig. 1 on a larger scale with as many intermediate marks as can conveniently be inserted, the main positions from £1 to £1/1/0 and so on are further subdivided logarithmically so as to show twelfths of a shilling or pence, so that a value of say £1/0/7 is easily readable. The farthings, pence and shilling values below £1 in value do not however correspond to the direct logarithm value of their members, but are actually marked in proportion to their decimal fractions of £1. For instance 5/- is equivalent to £0.25 and the logarithm of this number (.25) is 1.3979. Neglecting the characteristic portion of the logarithm and reading .3979, the position of the 5/- mark is therefore .3979 of the distance from 1 to 10 which will be found to come opposite to the position of the .25 or 2.5 mark on the number scale when the slide is in the neutral position as in Fig. 1. The 5/- mark will be seen to be in the row of money values from 2/- (£¹/₁₀th) to £1 (Fig. 1), while the lower value money scale 2.4d. or slightly under 2½d. to 2/- (representing £¹/₁₀₀ to £¹/₁₀) will be seen on the lower portion of the "stock," and a still lower value scale from just under ¼d. actually 24d. (being £¹/₁₀₀₀) starts on the row below and reaches 2.4d. (£¹/₁₀₀) at the number 10 position, but with these scales they may be carried a little further than the number 10 position to the 2½d. mark if required, as shown in Figs. 1, 3 and 4, for convenience in reading. In Fig. 1 is also shown a separate row representing decimals of pence, although if desired, as in Fig. 4 the farthings and pence scales can also have the decimals of pence inserted into the same scale. The positions of the pence and farthings marks are also determined according to the logarithms of their decimal equivalents of £1. Thus 3d. = £¹/₃₀ = £.0125, the log being

2.0969, the position for the 3d. mark is therefore .0969 of the distance 1 to 10 (or .01 to .1) or rather less than 1/10th of the distance along the scale shown in Fig. 1. Similarly ¾d. = £1/320 = £.003125, the

logarithm being 3.4949 or, neglecting the characteristic .4949, the mark being placed at .4949 of the distance 1 to 10, or against the position of the 3.125 mark on the number scale. These positions will be easily recognised on the scales in Figs. 1, 3, and 4. A cursor, *a*, may be used with all these rules if desired as shown in the drawings.

The method of using the slide rule follows that of the well known "engineers" rule, that is, in multiplying an amount, place the number 1 (which, in common with number 10, may have an arrow head as shown) against the amount, and against the multiplier will be found the answer on the appropriate scale. Thus if 3 times 5d. is required, move the slide (Fig. 1) so that arrow head 1 points to 5d. and against the multiplier 3, the answer will be shown as 1/3d. A more awkward case is say 6 times 5d. Working as before this would show an answer outside the scale towards the right, the remedy in this case (as with ordinary slide rules) is to place the number 10 arrow to the 5d. instead, reading the answer against number 6 which will be found to be 2/6d.

In case of the division of amounts of money (as with ordinary slide rules) the method is to place the dividing number on the movable slide to the amount to be divided, and the answer will be found at number 1 arrow; thus 1/- divided by 3 is arrived at by placing number 3 to the 1/- mark and the answer 4d. will be found at the number 1 arrow. Again a more difficult case is where the answer comes outside the scale towards the left as in dividing 1/- by 8. In this case place number 8 against 1/- and as arrow number 1 comes outside scale towards the left, the answer is to be found against the number 10 arrow head (as is again the practice in the use of the ordinary engineer's slide rule).

The number scale can also be used for the higher values (being read as from 10 to 100, 100 to 1000, 1000 to 10,000 etc.) and still give correct results. Thus in the problem of finding the 1/9000th part of £150; place number 9 on the slide rule (representing 9000) to £150 (or £15 mark) and as the answer does not come against number 1 arrow as this is off the scale towards the left, read off the answer (4d.) which will be found on the appropriate scale opposite the number 10 arrow.

It will be found that there may be at

first some difficulty in deciding which row of money values should be used in determining the answer until one is familiar with the rule, but as a useful addition to this rule, the special "wide range" number and money scales (such as are described in my co-pending application number 11104/46 (Serial No. 621,133) already referred to) could be used. This arrangement is shown in Fig. 3, and by using this scale first, all answers from $\frac{1}{4}$ d. right up to in this case £1000 can be read off without fear of "decimal place" errors, but as these scales are closely marked the higher values cannot be so accurately estimated as with the wider markings. In practice the combination of the two kinds of scales is particularly desirable as the almost perfect answer is given first on the wide range number and money scales (which to distinguish them could be printed on the rule in a different colour), and the more accurate values are then worked out on the widely spaced scales which are the subject of the present invention. As an example, find 90 times $5\frac{1}{2}$ d. First work out on wide range scales. Place arrow 1 (seen on the wide range number scale Fig. 3) to $5\frac{1}{2}$ d. (seen on the wide range money scale) and against number 90 is the answer which may be read off direct as £2/1/5 as near as possible on the wide range money scale Fig. 3. Testing this on the wider marked scales, place number 10 arrow against $5\frac{1}{2}$ d. and against number 9 will be seen the amount of £2/1/3 which is proved to be the correct answer.

The errors if any would of course be due to the difficulty in gauging the exact positions of the fine lines with the eye as well as slight possible inaccuracies in the marking of the rule, both sources of error being considerably reduced by using the more widely marked scales of the present rule.

In Fig. 4, the double row marking is a further attempt to secure greater accuracy, the principle of this double row marking having been already referred to.

A "wide range" money and number scale is not shown in Fig. 4 but could be included if required, or the rule as shown in Fig. 4 could be used in conjunction with a direct reading money calculating rule as described in my co-pending application number 11104/46 (Serial No. 621,133), the practically perfect answer so found being made more perfect by then working out on the wider marked scales used in the rule which is the subject of the present invention.

A further simple number scale not shown, but similar in all respects to the "number and percents" scales shown in

Figs. 1 to 4 could be ruled on the fixed portion of the rule immediately adjacent to the number and percents scale for the multiplication of ordinary numbers apart from money problems so that ordinary arithmetical problems or calculations in numbers could be also effected, though this refinement is optional.

In Fig. 1 is shown a scale marked for decimals of 1d. as well as for farthings, halfpence, pence etc.

Fig. 4 also has decimals of pence shown which could be continued to lower values by the addition of another row of money values placed below if required.

In every case the actual markings could (on larger rules) be further subdivided to give more accurate readings as shown in Fig. 2, and on a well marked rule it should be quite possible to read to the nearest $\frac{1}{4}$ d. in the scale beginning £1 shown in Fig. 2. All the money problems described in my co-pending application number 11104/46 (Serial No. 621,133) could be worked out on this rule besides ordinary multiplication and division of money, for instance percentages can be worked out by placing the number 1 or 10 representing 100 or 100% to the amount and reading off the answer against the percentage number required. It should be borne in mind that say if 20% is required, the figure 20 does not actually appear to the number scale (although it does in the wide range money scale in Fig. 3), but the answer is seen against the number 2.

Proportional amounts are also given by placing the number of articles to the price of same, when the cost of any other number of these same articles can be read off directly on the appropriate scale. For instance if 1 gross costs £45/11/0 what will 24 articles cost?

Referring to Fig. 4 the number 144 (one gross) shown here as 1.44, is placed as shown against £45/11/0, and against 24 will be seen the answer 15/2d. It will be noticed that against the 1.44 (representing 144) in all the number scales has been placed a dot to facilitate the location of the 1 gross position and in Fig. 4 an imaginary cursor line has been drawn in two places to elucidate the example given. This example shows well the desirability of including the wide range number and money scale shown in Fig. 3, as the working out of the approximate answer on this will enable the user to correctly find the line of scales on which to read off the answer, though continued use of this slide rule would enable the correct scale to be estimated mentally, without the use of the said "wide range" scales.

Wages problems are also easily worked out. If a man earns £5 per week of 48 hours, what are his wages for a job taking 9 hours? Here the number 48 (or 4.8) is set to £5, and against number 9 (9 hours) is given the answer 18/9d. Rates in the pound problems can also be worked out easily by placing the number 10 (representing £1) on the number scale against rate in the pound (say 18/-) then against the rateable value of the house (say £12 per annum) will be found the actual rates to be paid for the year (namely £10/16/0) on the money scale.

It should be noticed in this calculation that the number scale is also used as a money scale the rateable value of £12 (or 1.2) being on the number scale, and on this scale the number 1 or 10 also represents £1, so that in rates in the pound calculations elementary numbers are not used but all are money values. A special "rates in the pound" scale for amounts less than £1 could if desired be marked on the "slide" portion of the rule, this is not shown in the drawings but the principle is explained in my previous specification No. 11104/46 (Serial No. 621,133) though it is seldom necessary to work out rates in the pound problems on such small amounts, and it may therefore be omitted altogether.

Income tax problems can also be worked out in the same way, for instance—what would be the tax on £20 at 6/- in the pound? Set number 1 (representing £1) to 6/-, then against 20 (or 2) on the number scale read off £6 answer on the appropriate money scale. The calculation of price per lb. or price for any number of pounds knowing the price per ton or cwt., is simply a case of working out the proportional amount as explained, the number 2240 (or 2.24) being placed to price per ton, or the number 112 (or 1.12) being placed to price per cwt., when cost can be found against the number of pounds required.

To facilitate the finding of these much-used positions on the rule, special marks such as the dot shown at the gross (144) mark, can be inserted at positions such as 2240, 112, 47 or 48 or at other marks at positions frequently used either in the form of dots, arrows, or fine lines inserted in the scales, or the user himself could insert marks to suit his individual problems.

So far the scales have been represented as being drawn in straight lines on a straight rule, but these same scales could be marked round and round on a circular disc, making a circular calculator, all the money scales being on say the "fixed" part of the circular calculator and the

number, or number and percents scale, being on the "movable" portion of the circular calculator or *vice versa*. Likewise the scales could be marked round and round a cylinder either spirally or in steps, making a cylindrical or drum calculator the number scale being movable relatively to the money scale portion of such a cylindrical calculator.

Whether in the straight form as illustrated in Figs. 1 to 4 or in circular or cylindrical form, the style of the scales and method of working out answers to problems is the same in each case. In the case of circular calculators, the number scale may be nearest the centre, while all the money scales could be at a larger radius, or conversely, the number scale could be at a larger radius than the money scales.

Further to what has been said regarding the method of using the slide rule as shown in Figs. 1 to 4, although in the examples given all answers are shown within the scale markings, there are some cases chiefly in "proportional amount" problems in which the answer comes off the scale either to the left or right, in which case the cursor should be placed at either the number 1 or 10 which appears within the scale markings and then the "slide" is moved so that the number 10 or 1 respectively is under the cursor line, when the answer will then be found to come within the scale markings, thus necessitating two movements of the slide in certain cases. As an illustration using the straight slide rule as marked in Fig. 1, suppose a youth earns £2 per week of 48 hours and it is desired to find wages cost for a job taking 20 hours. Setting 4.8 (48 hours) to £2, we find that number 2 (20 hours) lies outside towards the left and cannot be read directly off. Therefore it is necessary to place cursor line to number 10 then move the number 1 under this cursor line, when number 20 (or 2) will then indicate his wages for this job to be 16/8d.

To obviate the necessity of moving the slide twice in these awkward cases the number scale on the "slide" could be continued on double length, or repeated twice, when all answers of this nature could be read off either against one portion or the other portion of the number scale, or alternatively, all the money scales could be continued on double length or repeated twice leaving the number scale its original length, though both these measures would result in a long awkward rule. To meet the case effectively and without making the rule too cumbersome both number and money scales could be continued half as long

again so that the number scale for instance could start from number 1 and continue further than number 10 to number 31.6 or 32 (which could be marked 3.16 or 3.2) while at the same time the money scales could be continued half as long again either into the higher or lower value regions, and if in the latter case, the original £1 to £10 scale for instance would start considerably below £1 value, approximately at 6/4d. and then continue to £1 and further on up to £10 on the one row. The other rows of money scales would of course be similarly treated. Taking the example given above and placing 4.8 (representing 48 hours) to the £2 mark, then against the number 2 (representing 20 hours work) the answer may be read off the money scale as 16/8d. with only one movement of the slide, and so with other awkward cases. This of course requires the slide rule to be approximately half as long again as the original rule, but might be preferred rather than having to perform two movements of the slide in these cases.

A further useful application for the slide rules shown in Figs. 1 to 4, alike with the circular disc, spiral, or drum calculators based on these scales, is the calculation of percentage discounts or per-

centage advances in price. Two methods of calculation are here open.

The one is to find the percentage of the amount considered as already explained and then separately subtract from the principal amount for percentage discounts, or add to the principal amount for percentage advances. The alternative method of working these problems is to place either the number 1 or number 10 (representing 100 or 100%) to the principal amount, when direct-reading discounts or percentage advances can be read off the scale without further calculation. If, for instance, an article costs £2 plus a 25% advance in price, the number 1 or number 10 (representing 100%) is placed against the £2 mark, when the answer £2/10/0 will be seen against the number 1.25 (or 125) for a 25% advance, or an answer of £1/10/0 for a 25% direct-reading discount against the number 7.5 (or 75), it being quite evident that the answer for a 10% discount for instance would be shown at number 9 (or 90), a 20% discount at number 8 (or 80), or, as in the case above a 25% discount at the number 7.5 (or 75).

Dated the 1st day of August, 1946.
ALBERT W. PARKES.

COMPLETE SPECIFICATION

A Slide-Rule Adapted for English Monetary Calculations

I, ALBERT WILFRID PARKES, of "Welland House," 27, Newlands Drive, Blackheath, near Birmingham, of English Nationality, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to slide rules or calculators for the calculation of English money problems, and while there have been previous slide rules and calculators produced for special purposes such as for cost of woven fabrics for instance, there appears to be no slide rule especially designed for Universal use for all generally required English money problems covering all ranges of values likely to be met with in general practice from very low values such as one farthing up to high values such as £100 or £1000 for instance (except in the case of my invention detailed in my co-pending application number 11104/46 (Serial No. 611,133) to which reference will be made further on in this Specification), but whereas in the Specification named the scales were arranged in such a way that

all answers to problems could be read off the scale or scales without the possibility of error arising from faulty estimation of the "position of the decimal place" or exact location of the answer on the scale or scales, either when made as a straight slide rule or in the form of a circular disc, or cylindrical calculator, in the slide rules or calculators described in the present specification, although correct answers are given to all problems, there still remains (in common with most ordinary slide rules or calculators) the necessity of estimating the "position of the decimal place" or the particular row of scales on which the answer will appear, except in the case shown in Fig. 3 in the sheet of drawings accompanying the Provisional Specification where the "wide range number and money scales" described in my previous Specification No. 11104/46 (Serial No. 621,133) are included together with the more widely spaced number and money scales described in this present Specification.

In general, the slide rule which is the subject of the present invention has a fixed "stock" at the upper and lower

part of the rule (when made in the form of a straight slide rule), upon which are inscribed various scales representing money values in pounds, shillings, pence, 5 farthings, and in some cases decimals of one penny, while the movable "slide" (which is shown in the drawings as slightly protruding at each end of the rule for convenience), has inscribed there- 10 on all the "number or percents" scales, all scales, (whether for money values or for numbers or percents) being spread out as much as possible so that finer and more accurate readings can be obtained, and in 15 fact in Fig. 4 is shown double row scales in the number scale, so that numbers from 1 to approximately 3.15 are shown in one row the whole length of the scale markings, whilst numbers from approximately 20 3.15 to 10 are shown in a second row the whole length of the scale markings, the corresponding money scales being also marked in a double row similarly, for instance values of 2/- to approximately 25 6/4d. appear in one row, continuing in the second row from 6/4d. up to £1; there is no reason however why further accuracy could not be achieved by the use of three-row marking, where the number 30 scale would be for the first row numbered from 1 to 2.14 approximately, the second row from 2.14 approximately to 4.64 approximately, and the third row from approximately 4.64 to 10, the corresponding 35 money scales say 2/- to £1 or £1 to £10 for instance would also require to be extended to three rows.

Conversely, the lengths of the scales could be contracted so that the number 40 scale from 1 to 10 could occupy half the length of the rule, the other half length being marked from 10 to 100, and all money scales would be made half length to suit; this half length marking and the 45 three-row marking is not however depicted in the drawings.

With reference to the marking out of the scales, all are marked logarithmically, the number and percents scale on the 50 "slide" being marked as in the case of the ordinary "engineers" slide rule, in proportion to the common logarithms of the numbers represented.

Thus number 2 is positioned at .3010 of 55 the distance from 1 to 10, the number 3 at .4771 of the distance, or number 7 at .8451 of the distance.

The money scales are also logarithmic- 60 ally marked out but although the principal markings of values £10 to £100 (which row of markings can also be used for the higher values of £100 to £1000, or £1000 to £10,000) follow the same system of marking as the number scales, 65 the scales showing the other money values

do not altogether correspond, for instance taking the row £1 to £10, this is marked £1/10/0 at the 1.5 position, or £2/10/0 at the 2.5 position, also in the wider marked scales shown in Fig. 2, which 70 shows a portion of the rule shown in Fig. 1 on a larger scale with as many intermediate marks as can conveniently be inserted, the main positions from £1 to £1/1/0 and so on are further subdivided 75 logarithmically so as to show twelfths of a shilling or pence, so that a value of say £1/0/7 is easily readable. The farthings, pence and shillings values below £1 in value do not however correspond to the 80 direct logarithm values of their numbers, but are actually marked in proportion to the logarithmic values of their decimal fractions of £1. For instance 5/- is equivalent to £0.25 and the logarithm of 85 this number (.25) is 1.3979.

Neglecting the characteristic portion of the logarithm and reading .3979, the position of the 5/- mark is therefore .3979 of the distance from 1 to 10 which 90 will be found to come opposite to the position of the .25 or 2.5 mark on the number scale when the slide is in the neutral position as in Fig. 1.

The 5/- mark will be seen to be in the 95 row of money values from 2/- ($\frac{\text{£}^2}{10}$) to £1, (Fig. 1) while the lower value money scale 2.4d. or slightly under 2½d. to 2/- (representing $\frac{\text{£}^2}{100}$ to $\frac{\text{£}^2}{10}$) will be seen on the lower portion of the 100 "stock," and a still lower value scale from just under ¼d., actually .24d. (being $\frac{\text{£}^2}{1000}$) starts on the row below and reaches 2.4d. ($\frac{\text{£}^2}{100}$) at the number 10 105 position, but with these scales they may be carried a little further than the number 10 position to the 2½d. mark if required, as shown in Figs. 1, 3 and 4, for convenience in reading same. In Fig. 1 is also shown a separate row representing deci- 110 mals of pence, although if desired, as in Fig. 4, the farthings and pence scales can also have the decimals of pence inserted into the same scale.

The positions of the pence and farthings 115 marks are also determined according to the logarithms of their decimal equivalents of £1. Thus 3d. = $\frac{\text{£}^1}{30} = \text{£}0.0125$, the log. being 2.0969, the position for the 120 3d. mark is therefore .0969 of the distance 1 to 10 (or .01 to .1) or rather less than 1/10th of the distance along the scale shown in Fig. 1.

Similarly ¼d. = $\frac{\text{£}^1}{320} = \text{£}0.003125$, the logarithm being 3.4949 or, neglecting 125 the characteristic .4949, the mark being placed at .4949 of the distance 1 to 10 or against the position of the 3.125 mark on

the number scale.

These positions will be easily recognised on the scales in Figs. 1, 3 and 4. A cursor, *a*, may be used with all these rules if desired as shown in the drawings.

The method of using the slide rule follows that of the well known "engineers" rule, that is, in multiplying an amount, place the number 1 (which in common with number 10, may have an arrow head as shown) against the amount, and against the multiplier will be found the answer on the appropriate scale. Thus if 3 times 5d. is required, move the slide (Fig. 1) so that the arrow head 1 points to 5d. and against the multiplier 3, the answer will be shown to be 1/3d. A more awkward case is say 6 times 5d. Working as before this would show an answer outside the scale towards the right, the remedy in this case (as with ordinary slide rules) is to place the number 10 arrow to the 5d. instead, reading the answer against number 6 which will be found to be 2/6d.

In case of the division of amounts of money (as with ordinary slide rules) the method is to place the dividing number on the movable slide to the amount to be divided and the answer will be found at number 1 arrow; thus 1/- divided by 3 is arrived at by placing number 3 to the 1/- mark and the answer 4d. will be found at the number 1 arrow. Again a more difficult case is where the answer comes outside the scale towards the left as in dividing 1/- by 8. In this case place number 8 against 1/- and as arrow number 1 comes outside scale towards the left, the answer is to be found against the number 10 arrow head (as is again the practice in the use of the ordinary "engineer's" slide rule).

The number scale can also be used for the higher values (being read as from 10 to 100, 100 to 1000, 1000 to 10,000 etc.) and still give correct results. Thus in the problem of finding the 1/9000th part of £150, place number 9 on the slide of the rule (representing 9000) to £150 (or £15 mark) and as the answer does not come against number 1 arrow as this is off the scale towards the left, read off the answer 4d. which will be found on the appropriate scale opposite the number 10 arrow.

It will be found that there may be at first some difficulty in deciding which row of money values should be used in determining the answer until one is familiar with the rule, but as a useful addition to this rule, the special "wide range" number and money scales (such as are described in my co-pending application number 11104/46 (Serial No. 621,133)

already referred to) could be used in conjunction with the other scales. This arrangement is shown in Fig. 3, and by using this scale first, all answers from 1d. right up to in this case £1000 can be read off without fear of "decimal place" errors, but as these scales are closely marked, the higher values cannot be so accurately estimated as with the wider markings. In practice the combination of the two kinds of scales is particularly desirable as the almost perfect answer is given first on the wide range number and money scales (which to distinguish them could be printed on the rule in a different colour), and the more accurate values are then worked out on the widely spaced scales which are the subject of the present invention. As an example, find 90 times 5 1/2d. First work out on wide range scales. Place arrow 1 (seen on the wide range number scale Fig. 3), to 5 1/2d. (seen on the wide range money scale), and against number 90 is the answer which may be read off direct as £2/1/5 as near as possible on the wide range money scale Fig. 3. Testing this on the wider marked scales, place number 10 arrow against 5 1/2d. and against number 9 will be seen the amount of £2/1/3 which is proved to be the correct answer. The errors if any would of course be due to the difficulty in gauging the exact positions of the fine lines with the eye as well as slight possible inaccuracies in the marking of the rule, both sources of error being considerably reduced by using the more widely marked scales of the present rule.

In Fig. 4, the double row marking is a further attempt to secure greater accuracy, the principle of this double row marking having been already referred to.

A "wide range" money and number scale is not shown in Fig. 4 but could be included if required, or the rule as shown in Fig. 4 could be used in conjunction with a separate direct-reading money calculating rule as described in my co-pending application number 11104/46 (Serial No. 621,133), the practically perfect answer so found being made more perfect by then working out on the wider marked scales used in the rule which is the subject of the present invention.

A further simple number scale not shown, but similar in all respects to the "number and percents" scales shown in Figs. 1 to 4 could be ruled on the fixed portion of the rule immediately adjacent to the number and percents scale for the multiplication of ordinary numbers apart from money problems so that ordinary arithmetical problems or calculations in numbers could also be effected, though this refinement is optional.

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In Fig. 1 is shown a scale marked for decimals of ld. as well as for farthings, halfpence, pence etc.

Fig. 4 also has decimals of pence shown which could be continued to lower values by the addition of another row of money values placed below if required.

In every case the actual markings could (on larger rules) be further subdivided to give more accurate readings as shown in Fig. 2, and on a well marked rule it should be quite possible to read to the nearest $\frac{1}{2}$ d. in the scale beginning £1 shown in Fig. 2.

All the money problems described in my co-pending application number 11104/46 (Serial No. 621,133) could be worked out on this rule besides ordinary multiplication and division of money, for instance percentages can be worked out by placing the number 1 or 10 representing 100 or 100% to the amount and reading off the answer against the percentage number required. It should be borne in mind that say if 20% is required, the figure 20 does not actually appear in the number scale (although it does in the wide range number scale in Fig. 3), but the answer is seen against the number 2, which represents 20.

Proportional amounts are also given by placing the number of articles to the price of same, when the cost of any other number of these same articles can be read off directly on the appropriate scale. For instance if 1 gross costs £45/11/0 what will 24 articles cost? Referring to Fig. 4 the number 144 (one gross) shown here as 1.44 is placed as shown against £45/11/0, and against 24 will be seen the answer 15/2d. It will be noticed that against the 1.44 (representing 144) in all the number scales has been placed a dot to facilitate the location of the 1 gross position and in Fig. 4 an imaginary cursor line has been drawn in two places to elucidate the example given. This example shows well the desirability of including the wide range number and money scale shown in Fig. 3, as the working out of the approximate answer on this will enable the user to correctly find the lines of scales on which to read off the answer, though continued use of this slide rule would enable the correct scale to be estimated mentally, without the use of the said "wide range" scales.

Wages problems are also easily worked out. If a man earns £5 per week of 48 hours, what are his wages for a job taking 9 hours? Here the number 48 (or 4.8) is set to £5, and against number 9 (9 hours) is given the answer 18/9d. Rates in the pound problems can also be worked out easily by placing the number 10 (representing

£1) on the number scale against rate in the pound (say 18/-) then against the rateable value of the house (say £12 per annum) will be found the actual rates to be paid for the year namely £10/16/0 on the money scale. It should be noticed in this calculation that the number scale is also used as a money scale, the rateable value of £12 (or 1.2) being on the number scale, and on this scale the number 1 or 10 also represents £1, so that in rates in the pound calculations elementary numbers are not used but all are money values.

A special "rates in the pound" scale of the kind described in my co-pending application number 11104/46 (Serial No. 621,133) for amounts less than £1 could if desired be marked on the "slide" portion of the rule together with the number and percents scale but occupying a separate row or rows. Such a scale is an exact replica of the whole or portion of the money scale or scales, and must read up to, but in no case exceed £1. The £1 mark and other money values on this "rates in the pound" scale or scales exactly correspond to the money values on the money scale or scales as could be tested by sliding the cursor along the rule from end to end when the slide is in the "neutral" position, though it is seldom necessary to work out "rates in the pound" problems for such small amounts, and this special scale may be therefore omitted if not desired.

Income Tax problems can also be worked out in the same way, for instance—what would be the tax on £20 at 6/- in the pound? Set number 1 (representing £1 to 6/-, then against 20 (or 2) on the number scale read off £6 answer on the appropriate money scale. The calculation of price per lb. or price for any number of lbs. knowing the price per ton or per cwt., is simply a case of working out the proportional amount as explained, the number 2240 (or 2.24) being placed to price per ton, or the number 112 (or 1.12) being placed to price per cwt., when cost can be found against the number of lbs. required.

To facilitate the finding of these much-used positions on the rule, special marks such as the dot shown at the gross (144) position, can be inserted at positions such as 2240, 112, 44 or 48 (for wage-hour problems) or at other positions frequently used, either in the form of dots, arrows, or fine lines inserted in the scales, or the user himself could insert marks to suit his individual problems.

So far the scales have been represented as being drawn in straight lines on a straight rule, but these same scales could

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be marked round on a circular disc, making a circular disc calculator, all the money scales being on, say, the "fixed" part of the circular calculator, and the number or number and percents scale being on the movable portion of the circular calculator or *vice versa*.

Similarly, the scales could be marked round a cylinder or cylinders, making a cylindrical or drum calculator, the number scale being movable relatively to the money scale portion of such a cylindrical calculator.

A suitable means of "registering" the money and number scales on such circular or cylindrical calculators such as a hair line scratched upon transparent celluloid or a pointer to move over the scales may be used, taking the place of the usual "cursor" used in the straight calculating slide rules, but the exact method of doing this forms no part of the present invention and "registering" may be done in any suitable manner.

Whether in the straight form illustrated in Figs. 1 to 4 or in circular or cylindrical form, the style of the scales and general method of working out answers to problems is the same in each case. In the case of circular calculators the number scale may be nearest the centre, while all the money scales could be at a larger radius, or conversely, the number scale could be at a larger radius than the money scales, or could be sandwiched between the rows of the money scales which might be conveniently done by printing the number scales on a transparent medium such as a rotating celluloid disc or an annular ring slide inserted between the rows of money scales, or by other means.

Further to what has been said regarding the method of using the slide rule as shown in Figs. 1 to 4, although in the examples given all the answers are shown within the scale markings, there are some cases chiefly in "proportional amount" problems in which the answer comes off the scale either to the left or right, in which case the cursor should be placed at either the number 1 or 10 whichever appears within the scale markings and then the "slide" is moved so that the number 10 or 1 respectively is under the cursor line, when the answer will then be found to come within the scale markings, thus necessitating two movements of the slide in certain cases. As an illustration using the straight slide rule as marked in Fig. 1, suppose a youth earns £2 per week of 48 hours and it is desired to find wages cost for a job taking 20 hours. Setting 4.8 (48 hrs.) to £2, we find that number 2 (20 hrs.) lies outside the scale towards the

left and cannot be read directly off. Therefore it is necessary to place cursor line to number 10 then move number 1 under this cursor line, when number 20 (or 2) will then indicate his wages for this job to be 16/8d.

To obviate the necessity of moving the slide twice in these awkward cases, the number scale on the "slide" could be continued on double length, or be repeated twice, when all the answers of this nature could be read off either against one portion or the other portion of the number scale.

A further useful application for the slide rules shown in Figs. 1 to 4, alike with the circular disc, or drum calculators based on these scales, is the calculation of percentage discounts or percentage advances in price. Two methods of calculation are here open. The one is to find the percentage of the amount considered as already explained and then separately subtract from the principal amount for percentage discounts, or add to the principal amount for percentage advances. The alternative method of working these problems is to place either the number 1 or number 10 (representing 100 or 100%) to the principal amount, when direct-reading discounts or percentage advances can be read off the scale without further calculation. If, for instance, an article costs £2 plus a 25% advance in price, the number 1 or number 10 (representing 100%) is placed against the £2 mark, when the answer £2/10/0 will be seen against the number 1.25 (or 125) for a 25% advance, or an answer of £1/10/0 for a 25% direct-reading discount against the number 7.5 (or 75), it being quite evident that the answer for a 10% discount for instance would be shown at number 9 (or 90), a 20% discount at number 8 (or 80), or, as in the case above a 25% discount at the number 7.5 (or 75).

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

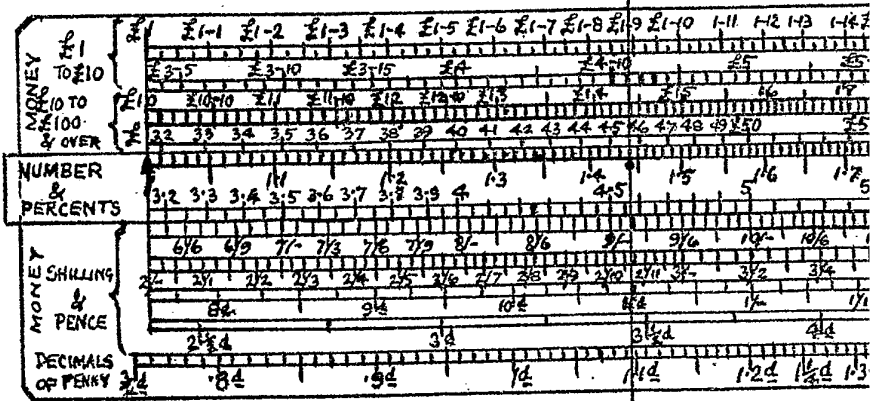
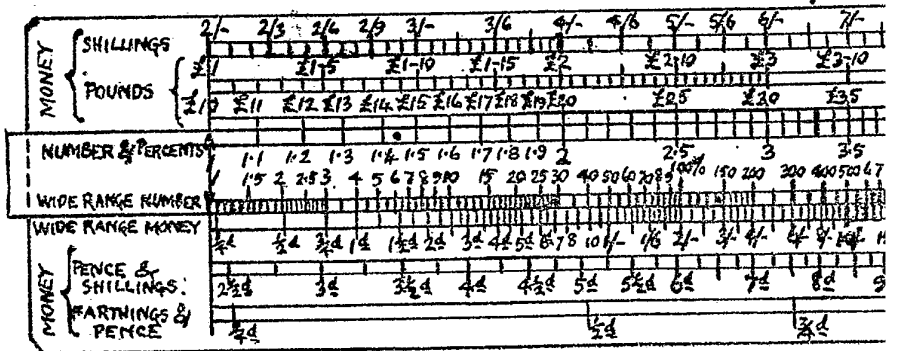
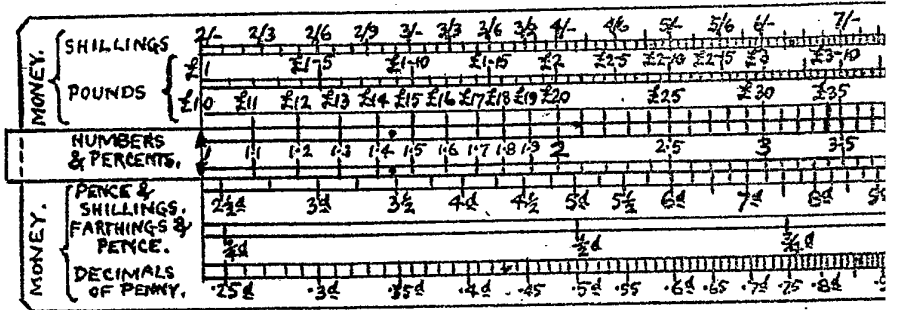
1. A slide-rule or calculator for problems involving English monetary units comprising two relatively movable members, one member bearing a scale or scales of numbers and percentages arranged logarithmically, and the second member having a logarithmic scale of monetary values subdivided into three or more parts across the width of the member and extending from end to end to form a scale with widely spaced markings to secure greater accuracy, such scales enabling the solution of English money problems in pounds, shillings, pence, farthings and in

- some cases decimals of one penny, involving multiplication or division of money, wage-hour problems, cost of lbs., cwts., tons or other weights or quantities of materials, price of any number of articles in units, dozens, grosses or other numbers, rates in the pound problems, percentages of money, direct-reading discounts or direct-reading percentage advances in price, or other problems as described in the Specification.
2. A slide-rule or calculator as in Claim 1, wherein there is provided a cursor, hair line or pointer or the like to locate the answers on those scales not immediately adjacent to the number scale.
3. A slide-rule or calculator as in Claims 1 or 2, but where the money values are set on the movable slide and the number and percents scales are set on the fixed part of the slide-rule or calculator instead of *vice-versa*.
4. A slide-rule or calculator as claimed in Claims 1, 2 or 3, provided with a "rates in the pound" scale for amounts less than £1, as described in the Specification.
5. A slide-rule or calculator as claimed in Claims 1, 2, 3 or 4 having an additional scale of numbers for the multiplication or division of ordinary numbers.
6. A slide-rule or calculator as claimed in any of the preceding claims, having "wide range" number and money scales as shown in Fig. 3.
7. A slide-rule or calculator of circular form in which the number and money scales according to any of the preceding claims are disposed round a disc.
8. A slide-rule or calculator of cylindrical form in which the number and money scales according to any of the preceding claims are disposed round a cylinder.
9. A slide-rule or calculator as claimed in any of the preceding claims having marks in any of the number scales, such as a mark or dot at 1.44 or 144 signifying a gross, or at 1.12 or 112 for cwts., or at 2.24 representing 2240 lbs. in a ton, or arrow heads placed at numbers 1, 10 or 100 as indicated in the specification and drawings.
10. A slide-rule or calculator provided with scales as shown in the drawings Figs. 1 to 4, or as particularly described in the Specification whether for straight slide-rules or calculators, or for disc or cylindrical calculators, for the working out of English money problems in the manner described in the Specification.

Dated the 29th day of July, 1947.

ALBERT W. PARKES.

[This Drawing is a reproduction of the Original on a reduced scale.]



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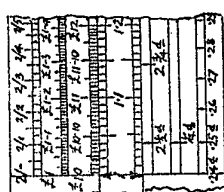


Fig. 2.

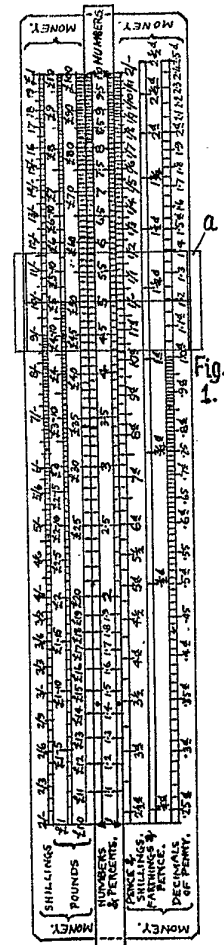


Fig. 3.

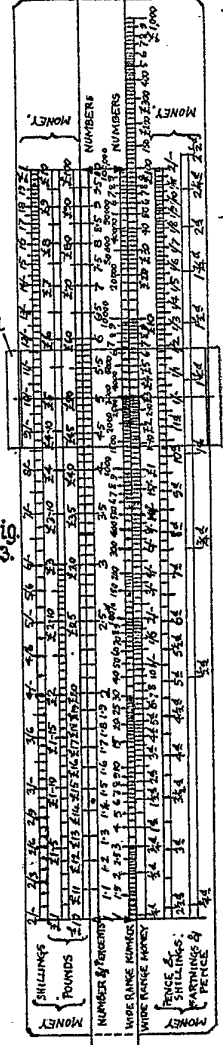
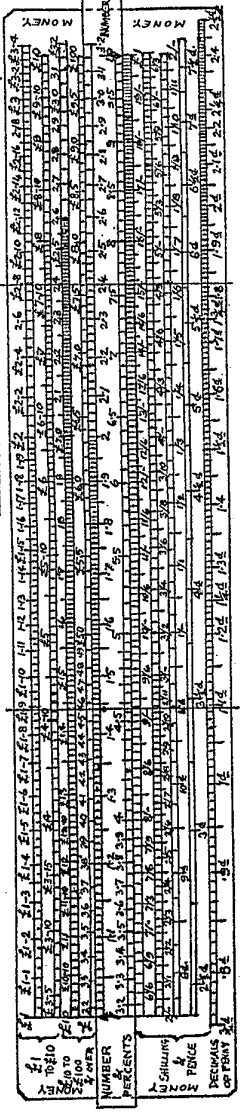


Fig. 4.



[This Drawing is a reproduction of the Original on a reduced scale.]