PATENT SPECIFICATION

621,133

Application Date: April 11, 1946. *No. 11104/46.*

Complete Specification Left: April 3, 1947.

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

PROVISIONAL SPECIFICATION

A Slide Rule Adapted for English Monetary Calculations

ERRATA

SPECIFICATION No. 621,133.

Page 1, line 39, *for* "goods,'" *read* "goods,"

Page 1, line 76, *for* "3.6198, the minus 3(3)" *read* "$\bar{3}$.6198, the minus 3($\bar{3}$)"

Page 1, line 86, *for* "3.0177" *read* "$\bar{3}$.0177"

Page 2, line 69, *for* "percents. scale" *read* "percents scales"

Page 3, line 112, *for* ".1" *read* "1."

Page 4, line 51, *for* "answer" *read* "answers"

Page 4, line 103, *for* "printing" *read* "pointing"

Page 6, line 11, *for* "placing by" *read* "placing the"

Page 6, line 62, *for* "1000,000" *read* "100,000"

Page 7, line 33, *for* "or 100%)" *read* "(or 100%)"

Page 7, line 94, *for* ".602" *read* ".6021"

THE PATENT OFFICE,
10th September, 1949.

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involving multiplication ... money, proportional amounts, percentages and percentage discounts or percentage advances in price, rates in the pound problems, wage problems, cost of any number of articles, cost of any number of lbs. weight of goods,'' "rates in the pound" problems, and all such calculations, in nearly every case with one movement of the slide only, as will be afterwards demonstrated by actual problems, there being no possibility of error whatsoever, since every money value and every number value has its own separate position on the rule, eliminating the bugbear of "finding the decimal place" which is a serious

the 1 to 10 division), while the decimal portion of the logarithm shows the decimal fraction of the distance along that particular "division." Likewise ¼d. is $£^{1}/_{960} = £0.00104166$. The log. is $\bar{3}$.0177. The characteristic is the same as for a penny, but for ¼d. the position of the mark is seen to be located at .0177 of the distance along the division mentioned. Likewise with all other money values. There is however a much simpler way in which marks of money scales can be determined; having first made the logarithmatic number scale, this scale is moved so that the 240 mark is set to the £1 mark on the

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PROVISIONAL SPECIFICATION

A Slide Rule Adapted for English Monetary Calculations

I, ALBERT WILFRID PARKES, "Welland House," 27, Newlands 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 specific purposes, such as for cost of woven fabrics for instance, there is apparently 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, in which the scales run right through from very low values (say one farthing or less) to high values such as £100, £1,000 or £10,000 for instance, each of these values being marked on a separate part of the scale, and not in the higher reaches of the scale (as is very often done in slide rules), using the same part of the scale to signify 20, 200, 2,000 or 20,000 for instance, the location of the decimal place in this case having to be more or less guessed at, so causing many errors.

The slide rule which is the subject of the present invention however, fulfils all these desirable requirements, and works out nearly all problems in English money involving multiplication and division of money, proportional amounts, percentages and percentage discounts or percentage advances in price, rates in the pound problems, wage problems, cost of any number of articles, cost of any number of lbs. weight of goods," "rates in the pound" problems, and all such calculations, in nearly every case with one movement of the slide only, as will be afterwards demonstrated by actual problems, there being no possibility of error whatsoever, since every money value and every number value has its own separate position on the rule, eliminating the bugbear of "finding the decimal place" which is a serious stumbling block to all users of slide rules involving high numbers.

All the scales used and represented on this slide rule and in the figures shown in the accompanying sheet of drawings,—the money scales, number and percents scales, and "rates in the pound" scales, are of course marked out in proportion to the logarithms of the money values which are shown in pounds, shillings, pence, farthings and in some cases decimal fractions of a penny, and in proportion to the logarithms of the numbers indicated.

The method of arriving at the positions of the marks representing numbers according to the logarithms of those numbers is generally well known by mathematicians, but the marking out of money scales for pounds, shillings, pence and farthings is not quite so obvious so this will be explained in greater detail.

Briefly, the positions of all the marks shown in the money scales of the present slide rule are arrived at by taking the logarithm of its fraction of £1. Thus 1d. is 1/240th of £1, the vulgar fraction being 1/240 or £0.004166. Now the log. of this number is 3.6198, the minus 3 (3) which is the characteristic of the logarithm, only indicates the position of the decimal place (or on a continuous slide rule such as this, indicates the number of "natural divisions" (3) to the left of the 1 to 10 division), while the decimal portion of the logarithm shows the decimal fraction of the distance along that particular "division." Likewise ¼d. is £$^1/_{960}$ = £0.00104166. The log. is 3.0177. The characteristic is the same as for a penny, but for ¼d. the position of the mark is seen to be located at .0177 of the distance along the division mentioned. Likewise with all other money values. There is however a much simpler way in which marks of money scales can be determined; having first made the logarithmatic number scale, this scale is moved so that the 240 mark is set to the £1 mark on the

[Price 2/-]

money scale (there being 240 pence to the pound), when all the pence marks from 1d. to £1 if necessary may be marked off (and incidentally all the shillings such as at numbers 12, 24, 36 etc.), likewise all the farthing positions in the lower value part of the money scales can be found by placing the number 960 to the £1 mark, and marking off all the ¼d. positions required (there being 960 farthings to the pound). The pound scales of course follow the general decimal system of the number scales with the exception of the more widely spaced pound scales, which are subdivided to show suitable shilling marks. Thus in the slide rule shown in Fig. 1, the pound scale from £1 to £2 is marked to show shillings; also where in the number scale it is usually marked 1.5, this is instead marked £1/10/0, and £2/10/0 at the 2.5 position. The £2 to £3 is shown in the figure to be marked for every 2/-, while from £3 to £10 each mark shows a 5/- advance, but other suitable intermediate marks could be used if desired. Onwards, the decimal system of marking is used in Fig. 1, but this it not imperative as in very large rules it might be possible to mark shillings or other intermediate marks much further along the scales. The " rates in the pound " scale shown in Figs. 1 and 4 can then also be marked off easily, directly from the pence and shillings portion of the money scale just mentioned if the slide is moved to the appropriate place, but as this scale has to do with a particular mode of calculation not so commonly used, it is advisable to place this scale at a little higher level than the general number scale, leaving a small space between it and the general money scale as shown in Figs. 1 and 4 to remind the user that this special scale is for " rate in the pound " calculations only. This " rates in the pound " scale is however only for use where the values dealt with happen to be less than £1, as all " rates in the pound " above £1 can be calculated from the ordinary money scales shown on the rule, and the special " rate in the pound " scale can therefore be omitted altogether as in Figs. 2, 3 and 5 if desired, making a more plainly marked rule. A " rate in the pound " scale could be also introduced in the Fig. 5, this scale being placed to the left of the number 1 mark on scale *c*, but this might necessitate a longer rule.

The money scales are preferably marked on the fixed portion of the rule or " stock," and preferably start at the left hand end of the bottom scale *d*, Figs. 1 to 4, and continue along to a certain value (£1 in the cases shown, though this value could be 2/- or any other value), at which point the higher values continue onwards on the upper fixed scale *a*, up to the highest values as is shown in Figs. 1 to 4. The matching number and percents. scale are then placed on the " slide " of the rule at *b* and *c*, and are arranged in a peculiar position relatively to the money scales so that like amounts represented on both the money scales *a* and *d*, will point to the same number on both the number scales *b* and *c* (within the limits of the scale markings) at whatever setting of the slide is chosen. In Fig. 1 for instance it will be seen that the number 10 on both upper and lower number scales *b* and *c* points to the £1 mark. This peculiar relative position of the upper and lower money scales relatively to the number scales is essential to secure that all ordinary problems can be arrived at with one movement of the slide only, as it is found that if there is not this relationship this cannot be done. On the other hand there is no fixed position for the top and bottom money scales *a* and *d* as it may be easily imagined that the upper money scale *a*, might be displaced say ¼″ (or several inches for that matter) to the left or right of the position shown, but in order to fulfil the essential condition that the same money values point to the same number values on upper and lower scales, it would be necessary in this case to move the upper number scale *b*, ¼″ to the left or right to correspond, to maintain the peculiar relationship of money and number scales mentioned.

The lower money scale in Fig. 4 is continued on to the end of the rule to £100 in order to fill up the blank space towards the right, but this is unnecessary and would be merely a needless repetition of the money values given on the upper scale *a*, which already shows values of £1 to £100; thus although this could be done, it is much better to leave this blank as in Figs. 1 and 2. The same applies to the first portion of the upper scale *a*, Figs. 1 and 2, where the money values from 2/- to £1 could be inserted but would only cause unnecessary repetition.

It is immaterial whether the money scale starts on one of the lower scales and finishes on one of the upper scales as in Fig. 1, or, conversely, starts on one of the upper scales and finishes on one of the lower scales instead, so long as the appropriate number and percents scales, set in the peculiar relationship to the money scales as already mentioned, are placed to work against the money scales.

In Fig. 5 is shown a useful combination of the money calculating scales C and D, together with useful ordinary number calculating scales F and G which may be used for ordinary number problems, while the top scale E shows squares of numbers and the bottom scale H the cubes of numbers shown on the long number scale F. I make no claim however to originality for the scales E, F, G and H in Fig. 5, which are merely included to show how other useful scales could be used in combination with the number and percents scale C and the money scale D. In Figure 5 the money scale D is continued up to the end of the rule, in this case to £100 just as in the scale shown in Fig. 4, but the higher money values, which in the slide rules shown in Figs. 1 to 4 are shown on the upper scale, are omitted in Fig. 5, in favour of the long number scale F, shown. The method of marking the lower money values in decimals of 1d. as well as showing farthings is also illustrated in Fig. 5. The decimal fractions could be continued to higher values than 1d. if necessary, providing there is sufficient room for them, and with reference to all markings generally, it is obvious that in smaller rules, some of the marks would have to be sacrificed, otherwise they would be too crowded together, while in very large rules further intermediate marks could be introduced in all the money scales to make readings more accurate, while in order to secure much longer scales, the money, number and percents scales could be drawn round a circle making a flat circular disc calculator, or round a cylinder, or spirally round a cylinder several times which would then allow of more intermediate marks to be inserted especially in the higher value scales. Apart from the markings described, there can be certain other useful special marks introduced into the scales such as arrows, lines or dots representing special much-used positions in the scales. For instance, as approximately half or more of the usual calculations made have to deal with the number 1 (in many cases the answer coming against this number) it is advisable to show a bold arrow point here in both scales *b* and *c*. Likewise it is desirable to place a mark at number 144 indicating 1 gross. This is shown as a dot in all number scales in Figs. 1 to 5, as this is a much used number and assists in finding this place easily. A dot is perhaps more desirable than a line here as the latter might be confused with the ordinary marks of the scale. Dots or marks could also be put at various parts of the scale such as at number 112 for cwt. calculations, or at 2,240 for calculations in tons (there being 2,240 lbs. in one ton). A dot could likewise be put at number 47 or 48 for wages calculations, there being usually 47 or 48 hours in the normal working week, but it is suggested that users of the slide rule could insert suitable dots themselves anywhere in the scales to suit the nature of their own calculations. The 100% is also another very desirable mark which is placed at the number 100 on both number scales, as shown in all the figures.

The use of a sliding cursor or hair line to keep the place is optional, as a good many calculations can be made without its use, as in most cases there is no need to move the slide more than once. A cursor is however perhaps desirable.

Having now fully described the marking and arrangement of the money, number and percents, and "rate in the pound" scales on this slide rule, a few typical examples follow, showing the wide use to which this slide rule can be put. The first batch of examples can all be clearly followed from the setting of the slide as shown in Fig. 2, this being the simplest form of the slide rule, no "rate in the pound" scale being shown.

The problems are set out for clearness in question and answer form, and are numbered (1), (2), (3), etc. (1) Find 1/24,000th of £1,000.—Set cursor *i*, Fig. 2, to the amount (£1,000) and move the slide so that the number 24,000 also coincides with the hair line of the cursor and the £1,000. The answer is shown at the number 1 arrow point as being 10d. It will be noticed that the number 1 on scale *b* is "off the scale" altogether, but this makes no difference as, due to the peculiar relationship of the scales as mentioned, the number 1 on the lower scale will point to the answer instead. This is true in all such cases, and if an answer cannot be got on upper scale it will be shown on the bottom one instead, and *vice-versa*. (2) What is 1/72nd part of £3?—Set 72 to £3 (either using or not using cursor) and against arrow 1 is the answer which is again 10d. (3) If 15 articles cost 12/6d. find cost of one.—Set 15 (scale *c*, Fig. 2) to 12/6 (scale *d*) and answer 10d. appears opposite arrow 1. (4) If one gross of articles cost £6, what is the price of one article?—Set the 144 dot (one gross) to the £6 mark, and answer at number 1 is 10d.; again in this problem if cost of 7 articles at £6 per gross was required, the same setting is made—place 144 dot to £6 but the answer is given against the number 7 as 5/10d., likewise the cost of 40 articles is shown to be £1/13/4 on scale *a*.

Thus proportional amounts can be easily obtained without fear of error. It should be remarked that as the specification drawings were marked out and drawn by hand, some of the results shown may not be strictly accurate, but with machine-marked scales, greater accuracy could be obtained. (5) At a price of 10/- per dozen what will 42 cost?—Set the number 12 (one dozen) to 10/- when the answer is given opposite number 42 as £1/15/0 on scale *a*. Labour costs and wages problems can also be easily effected as follows:—

(6) Taking a 48 hour week, if a youth earns £2 per week how much per hour does this represent?—Set 48 to £2 as shown and against arrow number 1 will be seen the answer 10d. per hour. Likewise if he worked 6 hours on a job, this would cost 5/- as shown against the number 6 (6 hours).

Percentage calculations are also simplified, for instance—(7) Find 6% of £4/3/4, —Set number 100 (or 100%) against £4/3/4 and against 6 (6%) will be found 5/- as answer, while 1% would be 10d. Further, direct reading discounts on amounts can be read off with one movement of the slide only, thus (8). If a discount of 10% is allowed off £4/3/4 what is the answer?—Set 100 (or 100%) against £4/3/4 as in Fig. 2, when the answer is £3/15/0, will be seen against the 90 (or 90%) mark, it being readily understood that if 10% be taken from 100% this leaves 90% of the original amount. An alternative method of working out this problem would be to first find 10% which can be read off the rule as set as 8/4 and subtract this from £4/3/4 which likewise gives £3/15/0 as answer. Likewise a 15% discount would be read off at number 85, or a 20% direct reading discount would be read off at 80% mark.

Similarly percentage advances in price can be directly read off by placing 100% mark against the amount £4/3/4 (as in Fig. 2) and if a 50% advance in price is required, the answer is read off opposite the 150 mark giving £6/5/0. Here also an alternative method is possible if the 50% value is first read off which is shown to be £2/1/8, and adding this to the £4/3/4 gives the same answer £6/5/0.

Further problems will now be worked out with the slides set as in Figs. 3 and 4. In Fig. 3 the slide is shown moved a considerable distance towards the left presenting answer of a low value down to ¾d. as shown. Thus if 4,800 articles cost £15, one article costs ¾d., or again if 1 gross of articles (indicated by the 144 dot) costs 9/-, one article cost ¾d., or 1 dozen articles (12) costs 9d. etc., as will be readily seen from Fig. 3). Also if 1 ton costs £7, 40 lbs. is shown to cost 2/6, which result is got by placing 2,240 (there being 2,240 lbs. to the ton) to £7 mark, and answer is read off as 2/6 against the number of pounds required (40). Again, if certain material costs ¾d. per lb., what would 1 cwt. cost at the same rate?—Set number 1 against ¾d., and against 112 (there being 112 lbs. in 1 cwt.) is the answer 7/- per cwt. In the case of Fig. 4, the slide is set considerably towards the right, dealing with somewhat high values, so that here if one article costs £70, 60 such articles will cost £4,200 and so on, or if a business yields a profit of £3,640 per annum, what is the average profit per week?—Set 52 (there being 52 weeks in a year) to £3,640 and for 1 week the profit is read off as £70.

Referring now to the calculation of "rates in the pound," such as is used in Income Tax problems where Income Tax is at say 6/- in the pound, or in Rates of a house at say 18/- in the pound, or interest at say 1/- in the £1 etc., these problems can easily be worked out on this slide rule. The method is to place the number 1 arrow (on scale *c*, Fig. 2) to the "rate in the pound" on scale *d* (which in this case is set for 10d. in the £ in fig. 2) and against the amount on scale *c* is shown the answer on scale *d*. Thus in Fig. 2, if the rate in the pound is 10d. what is the rate for £2? The answer is seen against the number 2 which is 1/8d. The same rate for £6 would be 5/-, or the same rate for £240 would come to £10 at 10d. in the pound. Thus all rates in the pound problems could be worked out where the amount considered is larger than £1, but where it is less than £1, the special "rates in the pound" scale shown in Figs. 1 and 4 on scale *c* has to be used.

For instance in Fig. 1, the "rate in the pound" is set as 2/- in the pound (arrow 1 printing to the 2/- on money scale *d*). Here the same method is used for amounts over £1, where it is shown that for an amount of £300 say, £30 is the rate, but for an amount less than £1 it is necessary to use the special "rate in the pound" scale which is set towards the left of the number scale on scale *c*. An illustration of this is given in Fig. 1 on scale *c* where the rate in the pound being 2/-, this rate for an amount of 1/3d. is shown to be 1½d., or for an amount of 10d. the rate is seen to give a value of 1d.

For calculation of rates on property, say if the rates were at 18/- in the pound, move the slide till the number 1 arrow on scale *c* points to 18/- on scale *d*, when, if the rateable value of the property is say £40 per annum, the rates for the year will be found to be £37/10/0, the number 40 on scale *b* pointing to £37/10/0 on money scale *a*. This example is not shown, but if a tracing of scales *b* and *c* be moved along the scales *a* and *d*, this can be easily proved. This problem can be worked out on the simple slide rules shown in Figs. 2 and 5, as the special "rates in the pound" scale is not here required, the values dealt with being greater than £1.

In Fig. 5 is shown the combination of money calculating scales C and D, with other useful scales. The hair line of the cursor being set to 125 on the "cubes" scale H gives the cube root direct on long scale F, as 5. Also setting hair line to 25 on the "squares" scale E, the square root is given direct on long scale F. Figure 5 also illustrates the use of the "decimal fractions of 1d." marks where 1/1,000th of £1 is shown to be .24d. on money scale D against the number 1 arrow point on scale C.

Dated this ninth day of April, 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, Nr. 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 and calculators for the calculation of English money problems, and while there have been previous slide rules or calculators produced for special specific purposes such as for cost of woven fabrics for instance, there is apparently 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 in which the money scales run right through from very low values (say one penny, halfpenny or farthing or less) to high values such as £100, £1,000 or £10,000 for instance, each of these values being marked on a separate part of the scale, and not in the higher reaches of the scale (as is very often done in slide rules) using the same part of the scale to signify 20, 200, 2,000 or 20,000 for instance, the location of the decimal place in this case having to be more or less guessed, so causing many errors.

The slide rule which is the subject of the present invention however, works out nearly all problems in English money involving multiplication and division of money, proportional amounts, percentages, percentage discounts or percentage advances in price, rate in the pound problems, wage problems, cost of any number of articles, cost of any number of lbs., cwts., or tons of goods and all such calculations, with one movement of the slide only, as can be easily demonstrated by the actual problems set out in the Specification, there being no possibility of error, since every money value and every number value has its own separate position on the rule or calculator, eliminating the bugbear of "finding the decimal place" which is a serious stumbling-block to the use of slide rules in general, where high numbers are involved.

The essential features of the invention are well portrayed in the sheet of drawings accompanying the Provisional Specification, where Fig. 5 shows the said money scale D, marked from the very low value of one tenth of a penny reaching in one straight line to the comparatively high value of £100, the related number and percents scale C, Fig. 5, starting at number 1 (which may have an arrow head marked thereon) also continuing in one straight line up to in this case 100,000. Thus on this rule it would be possible to calculate the cost of as many as 100,000 articles, for instance as set in Fig. 5, it shows that if the price of one article is .24 pence, 100,000 such articles would cost £100, also with the same setting of the slide, 100 such articles would cost 2/-, or cost of 144 articles is given as 2/10½d. (actually 2/10.56d.). A dot may also be marked on the rule as shown in Fig. 5 and also in Figs. 1, 2, 3 and 4 to easily locate this much-used number (144), likewise other useful locating marks or dots could be introduced for other much-used numbers such as at 112 for cwts., 2,240 for tons or 44 or 47 for working hours per week for wage problems etc.

Similarly, if in Fig. 5 the slide be moved along so that the number 1 arrow be placed to .2d., then 100,000 articles would be shown to be £83/6/8d., or 144 would be shown to be 2/4¾d. (actually 2/4.8d.) at the 144 dot. So with any other values, for instance if number 1 arrow be moved to 6d. mark, then against number 20 on the number scale C will be seen the answer 10/- on the money scale D, Fig. 5.

The cost of any other number of articles at 6d. each can also be read directly off on the lower money scale D with the same setting of the slide up to a total value on this rule of £100.

Conversely, a second function of the rule can be demonstrated from the position of the slide as set in Fig. 5, that is, the division of money. Thus if 150 articles cost 3/- what will one article cost? To the 3/- mark on money scale D, Fig. 5, set the number 150 (as shown in Fig. 5), the number 1 arrow then points to .24d. which is the cost of one, or with the same setting of the slide the cost of say 50 such articles will be 1/- as shown in Fig. 5, this latter calculation illustrating the determination of proportional amounts of money.

Percentages can also be worked out simply by placing by number 100 (also marked 100%) to the amount, and the answer is then read off against the percentage required.

Direct reading discounts or direct reading price advances can be easily determined by setting the 100% mark to the original amount, when an advance of say 25% can be read off directly at the 125 (or 125%) mark, or a discount of 25% would be read off at the 75 mark, (75% being 25% less than the 100%).

Wage-hour problems are a special case of proportional amounts of money, and these are easy to work out, for instance if a man's wage is £5/10/0 per week of 44 hours, what is his rate of wages per hour? In this case the number 44 is placed against £5/10/0 mark and the number 1 arrow points to 2/6d. being his rate per hour, also with the same setting 20 hours work shown against the number 20 will be £2/10/0.

In the slide rule shown in Fig. 5 other useful auxiliary scales E, F, G and H are included on the same rule for the calculation of numbers, F and G scales being for multiplication and division of ordinary numbers as in the ordinary well known engineer's slide rule together with scale E giving squares of the numbers on scale F and also scale H giving cubes of the numbers shown on scale F. The use of the hair line of the cursor *i* is necessary to estimate these numbers. Such auxiliary scales do not form part of the present invention however, but are introduced into Fig. 5 to illustrate how these scales may be used if required on the same slide rule as the money and number calculating scales C and D.

In Fig. 5 the money scale D is set in one single row from lowest to highest values alongside its related number scale (C), but the money calculating rules shown in Figs. 1, 2, 3 and 4 show a means whereby the money and number scales can be spread out so as to give higher values or wider spaced markings and to easily give values from as low as ¼d. up to £10,000, and number values up to as high as 1000,000 for instance, by starting the money scale D, (Figs. 1, 2, 3 and 4) on the lower fixed scale up to a certain value (£1 in Figs. 1, 2 and 3) and continuing from that same value, £1, up to the highest value £10,000 on the upper fixed scale. The related number scales (showing the number of articles etc.) start at number 1 on both the lower and upper parts of the movable slide (see scales C and *b*, Figs. 1, 2, 3 and 4), and can continue up to the highest value possible on their respective scales, the upper and lower money scales being set in a certain peculiar position with respect to the related number scales, such that same numbers on the upper and lower number scales *b* and *c*, point to the same money values on the upper and lower money scales *a* and *d*. Thus in Fig. 1 the slide is shown set so that number 10 on scale *b* points to £1 on scale *a*, the number 10 on scale *c* pointing also to £1 on scale *d*, while in Fig. 3 the number 320 on both upper and lower scales *b* and *c* are set at the £1 marks on scales *a* and *d*, also in Fig. 4, number 1 on both scales *b* and *c* points to £70, the scale *d* in Fig. 4 in this case being continued past the £1 mark up to £100 to the end of the rule, likewise the upper money scales *a*, Figs. 1, 2, 3 and 4 could be continued backwards below the value of £1 down to 2/- or less if desired which is however unnecessary as values below £1 are already indicated on the lower money scale *d*, Figs. 1, 2, 3 and 4, against the appropriate number value.

Furthermore the "break" between the lower and upper money scales need not necessarily be at the £1 mark. For instance the lower money scale could be marked up to the value of 2/- (or any other value), continuing on the upper scale, from any location whatever on that scale from 2/- (or such other value) up to the highest values, but the related number scales *b* and *c* on the slide should still be set, so that same numbers will be found against the 2/- mark (in this case) on both upper and lower pairs of scales.

The advantage of this peculiar relative position of the upper and lower scales is not at once obvious until actual examples are worked out on the rule; thus in Fig. 3, if 3,200 articles cost £10 what will 600 cost, also what will 200 articles cost? The first answer to be seen against number 600 is £1/17/6 but the number 200 on scale *b* comes outside the scale here, but the answer 12/6d. can be however read off on the lower pair of scales *c* and *d*, the actual answer being on the money scale *d*, also the cost of one article against the number 1 arrow on scale *c* is ¾d. as shown on money scale *d*. This would not be possible, without setting the slide twice, unless the peculiar relative position of the scales mentioned is maintained.

Conversely, if 44 articles cost 2/9d.

(with slide set as in Fig. 3, what will 300 cost, and what will 4,000 cost? The first answer can be read off as 18/9d. (see Fig. 3) but the 4,000 comes on upper scale *b* and shows the answer £12/10/0 without having to alter the slide setting.

Fig. 3 also shows that at 9/- per gross (see gross dot), one article would cost ¾d., or 8000 articles would cost £25/0/0.

Percentages are also well demonstrated in Fig. 3, for instance what is 4% of 6/3d? Place number 100 (or 100%) against 6/3d. (as in Fig. 3) then against number 4 read 3d. An example of direct-reading price advances can also be shown with the same setting of the slide. What is the new price of a 6/3d. article if the price is raised 20%? Set 100 (or 100%) to 6/3d. (see Fig. 3), then the new price will be seen against number 120 (or 120%) as 7/6d. Likewise direct-reading discounts can be readily estimated. In the above case if a discount of 20% is allowed the 6/3d. becomes 5/- by reading the answer against number 80 (or 80%) since 100% less 20% equals 80%. Likewise a 30% direct-reading discount would be read off at the 70% mark and so on. Another way of getting answers to discount problems is to subtract the discount as read from the slide rule, from the value under consideration, separately. Thus in the above problem set 100 or 100%) to 6/3d. when a discount of 20% shows 1/3 (see Fig. 3) which when subtracted from 6/3 gives the same answer as before, namely, 5/-.

Numerous other examples such as cost of lbs. weight knowing price per cwt., ton, etc., and also estimation of cost of labour for any number of hours work done. and a selection of other problems are given in the Provisional Specification which need not be repeated here.

A " rates in the pound " scale could be added as in scale *c* Figs. 1 and 4 if desired for working out " rates in the pound " problems on amounts under the value of £1. Thus for a rate of 14/- in the pound if the slide in Fig. 1 be moved so that 14/- on the rates in the pound scale *c* is set to the £1 mark on scale *d*, the answers are read off on the rates in the pound scale *c* against the principal amount on scale *d*. In the above case 10/- is shown to be reduced to 7/- at a rate of 14/- in the pound as the 10/- on scale *d* will then point to 7/- on the rate in the £ scale. For " rates in the pound " above £1 value however, a special rates in the pound scale is not necessary, as a plain scale as shown in Fig. 2 can be used. In Fig. 2 the slide happens to be set to a rate of 10d. in the pound (the number 1 in scale *c* here representing £1), therefore for £10 the rate is read off the money scale *d* as 8/4, or for £30 the rate is read directly off money scale *a* as £1/5/0.

The exact markings of the money and number scales vary according to whether the rules are of small size or of much larger size, and in the latter case it may be readily understood that many intermediate marks can be introduced especially in the upper reaches of the scales which could not be done in small miniature rules.

All marks representing either numbers or money values are set out on the scales according to the common logarithms of the numbers, or in the case of money values the common logarithms of the decimal fractions of £1 represented.

A table of logarithms will be found to give all number positions from 1 to 10 if the log. number be multiplied by the actual length of the scale from 1 to 10. For instance if the latter was chosen as 10 inches, then number 1 would be marked at the beginning of the scale at .0000 inches from the start of the scale, number 2 with log. number as .3010 which when multiplied by 10 would equal 3.010 inches along the scale, number 4 with log. number .602 would be at 6.021 inches along the scale and so on with all numbers up to 10. Beyond 10, say number 20 for instance, the log. number is again .3010 (neglecting the characteristic of the logarithm), but in this case it comes in the section of the scale 10 to 100 at 3.010 inches past the number 10 mark, or at 13.010 inches from the start of the scale, while the 200 mark would likewise come at 3.010 inches past the 100 mark or 23.010 inches from the start of the scale.

This presumes the distance from 1 to 10, 10 to 100. 100 to 1,000 etc., to be chosen as 10 inches, but if less than 10 inches all the distances given would of course be proportionally reduced. The number scales *b* and *c*, also used as percentage scales, are all marked on this plan.

In marking out the money scales however, the decimal equivalent of £1 has to be got for each money value before the position of the mark can be determined, except the marks representing £1 £10, £100, £1,000, etc., also £$^{1}/_{10}$ or 2/-, £$^{1}/_{100}$ or 2.4d., or £$^{1}/_{1,000}$ or .24d. which have to be set the same distance apart on the rule as the 1 to 10, 10 to 100, 100 to 1,000 on the number scale it has to work with, which in the above example was 10 inches apart. The other money values have to be then inserted between these main markings positioned according to the log. numbers of their decimals of £1. For example 5/- equals £.25 the logarithm of which is found to be .3937 (neglecting the characteristic) which on a

10 inch scale means that the mark comes at 3.937 inches to the right of the 2/- mark. Likewise £2/10/0 changed to decimals of £1 equals £2.5 the log. of which again is .3937 (neglecting characteristic) and on a 10 inch scale the mark would therefore be 3.937 inches further on than the £1 mark.

Again the 6d. mark which amount is £$^1/_{40}$ or £.025 the log. of which is again .3937 (neglecting characteristic) would be placed at 3.937 inches from the position representing 2.4d. (if marked) or 6.063 inches back from the position of the 2/- mark (which figure is got by subtracting 3.937 inches from 10 inches.

The position of farthings marks are also determined by their decimal fractions of £1, for instance ¾d. = $^1/_{320}$ or £.003125 the log. number being .4949 or 4.949 inches to the right of mark representing .24d. (if marked) or 5.051 inches back from mark representing 2.4d. or, (if this is not marked on scale) 15.051 inches back from the 2/- mark. There is however a very easy method of marking all money positions after the number scales have been marked out.

The marks for the upper values £10 to £100, £100 to £1,000, £1,000 to £10,000 etc. correspond exactly to the numbers 10 to 100, 100 to 1000 etc. on the number scale if the slide is moved along to the appropriate position. The lower money values however are marked out for shillings, pence and farthings and in addition in some cases in decimals of 1*d*. This easy method is to move the slide *b* and *c* along until the number 240 on scale *c* points exactly to the £1 mark, when all the pence and shilling positions up to £1 are shown, there being 240 pence to the pound. Thus the 1d. mark comes opposite number 1, 2d. mark opposite number 2, 6d. mark opposite number 6, 1/- mark opposite number 12, 1/3 mark opposite number 15 (15d.), 2/- mark opposite number 24, 6/- mark opposite 72, 10/- mark opposite 120, 15/- mark opposite 180, 15/3 mark opposite 183 etc. Even the pence and shilling marks above the value of £1 can be marked with the same setting of the slide, such as £1/0/10d. or 250*d* found opposite number 250, £1/10/3 or 363d. opposite number 363, £1/8/0 opposite number 336 etc.

Similarly, all farthing positions are easily determined by placing number 960 to the £1 mark (there being 960 farthings in one pound), when all farthings from ¼d. upwards can be marked, thus ¼d. is against number 1, ½d. against number 2, ¾d. against number 3, 1d. against number 4, 1¼d. against number 5, 1½d. against number 6, 1¾d. against number 7 and so on until the lines become too crowded for farthings to be marked, after which, marks may be made at each halfpenny, and later at each 1d., later at each 2d., and later at each 3d. and so on according to the space available for the markings.

In the Figs. 1 to 4 all the numbers are represented on the movable slide *b* and *c*, while all the money values are represented on the fixed stock or body of the rule *a* and *d*, and this is indeed the best arrangement, though the scales could be changed in position so that all the money values were on the movable slide while all the number values were on the fixed stock, and answers could be got in the same manner as before, but this arrangement would be less favoured by general users of the slide rule. Also in Fig. 5, scales C and D could be altered in position if desired so as to give money scale on scale C and number scale on D instead, without prejudice to the results to be obtained. Also in Fig. 5 the number and money scales C and D could equally well have been placed on the upper part of the rule in place of the scales F and G, the latter scales being then placed on the lower part of the rule instead. So also with rules as in Figs. 1, 2, 3 and 4 the low values could start on the upper scales, being continued up to the higher values on the lower scales if desired. A cursor *i* may be added to any of the rules as shown if desired to keep the place while setting the rule.

The number and money scales as represented in Fig. 5 may also be marked out round a disc or round and round a disc either spirally or in steps to form a circular disc calculator, or may be marked round a drum or cylinder, or spirally round and round a cylinder enabling a very long money scale to be accommodated in a small space. In one construction of this the money values could be printed or marked spirally round and round on the cylinder, while the movable scale of number values could be marked round and round spirally on a transparent medium such as a thin celluloid tubular sleeve surrounding the cylinder, or *vice versa*, the number scale being marked on the cylinder and the money values marked on the celluloid tube or sleeve. Upon the number 1 being placed to the cost of one article the cost of any number of articles could be read off on the cylinder, being visible through the transparent sleeve. Any of the problems already described could thus be worked out with equal ease on such a cylindrical calculator, the results being much more accurate due to the much longer scales which could thus be used.

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 English monetary calculations in which either a single or double row number scale logarithmically set out slides or moves relatively to a single or double row money scale marked in English money values also logarithmically set out wherein the English money scale covers a range of from 2½d. or under, to £10 or over, suitable for working out problems in English money involving simple 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 units, rates in the pound problems, and other problems as described in the Specification, the use of a cursor or hairline being optional.

2. A slide-rule or calculator as in Claim 1, but where the money values are set out on the movable slide and the number or percents scales are set on the fixed part of the slide-rule or calculator, instead of *vice-versa*.

3. A slide-rule or calculator according to Claim 1, for English monetary calculations in which, when double row marking be adopted, the same number values on both upper and lower rows point to similar money values on both upper and lower money scales, facilitating the direct reading of all answers over the whole range of the rule with only one setting of the slide.

4. A slide-rule or calculator as claimed in Claim 1, provided with a "rates in the pound" scale.

5. A slide-rule or calculator as claimed in Claim 1, provided with additional logarithmic number scales F and G, Fig. 5, for the purpose of ordinary number calculations, with or without the addition of a scale of squares E, or of cubes H, as illustrated in Fig. 5.

6. A slide-rule or calculator as claimed in Claims 1, 2 and 4, wherein the number and money scales are disposed round, or round and round a disc either spirally or in steps forming a circular or disc calculator.

7. A slide-rule or calculator as claimed in claims 1, 2 and 4, wherein the number and money scales are laid out round a cylinder or drum, or spirally round and round a drum or cylinder, forming a cylindrical calculator.

8. In slide-rules or calculators as claimed in Claims 1 to 7 for calculation of English money problems, special locating marks made on the number scales to facilitate the working out of problems, such as an arrow head at number 1, a dot at the gross mark, or a mark or dot at useful numbers such as 112 for cwts., 2,240 for tons, or 44 or 47 for wage-hour problems.

9. The slide-rules or calculators for calculation of English money problems as particularly described in the Specification including those illustrated in Figs. 1 to 5 of the drawings.

Dated the 2nd day of April, 1947.

ALBERT W. PARKES,

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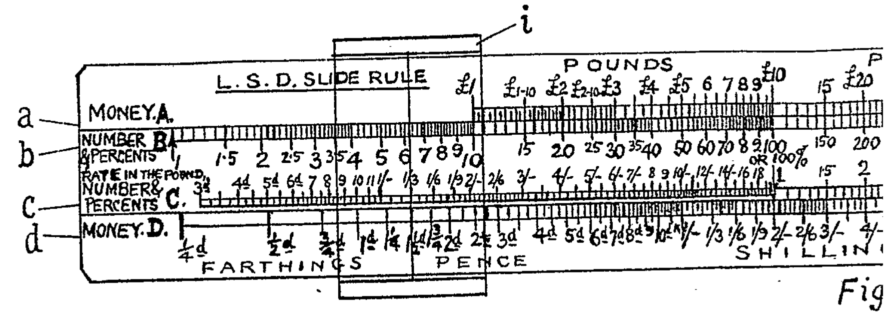
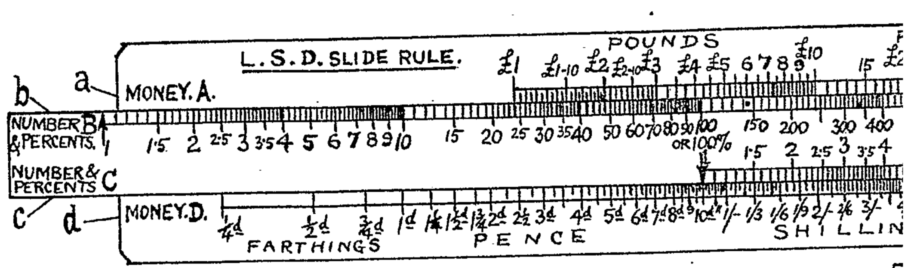


Fig



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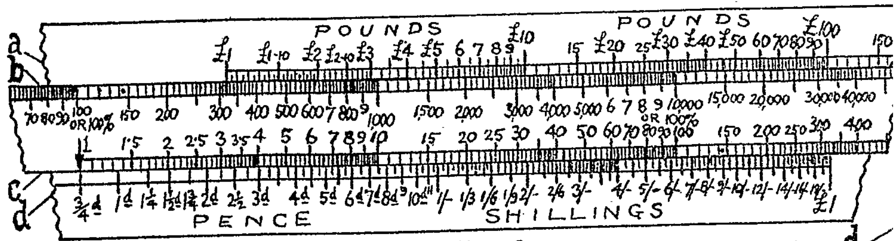

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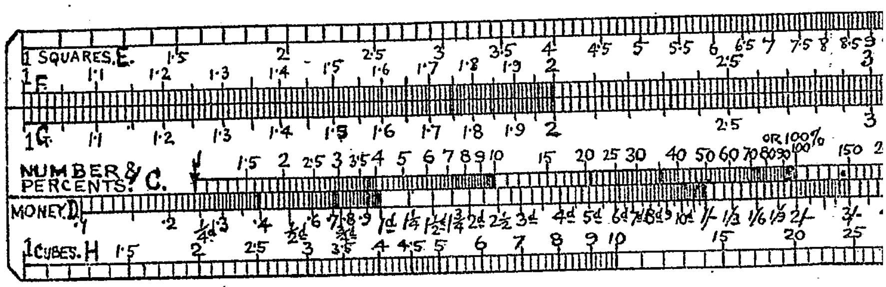

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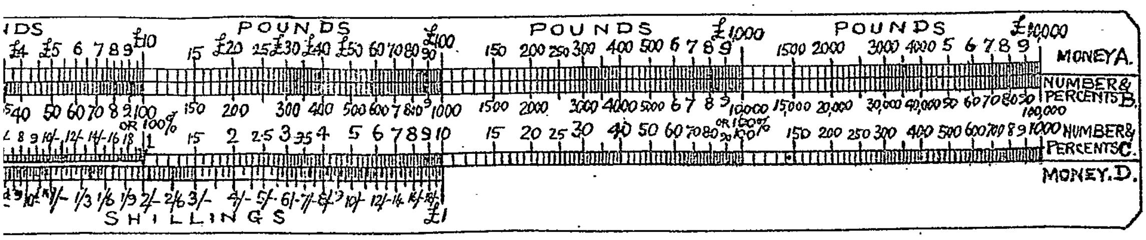


Fig. 1.

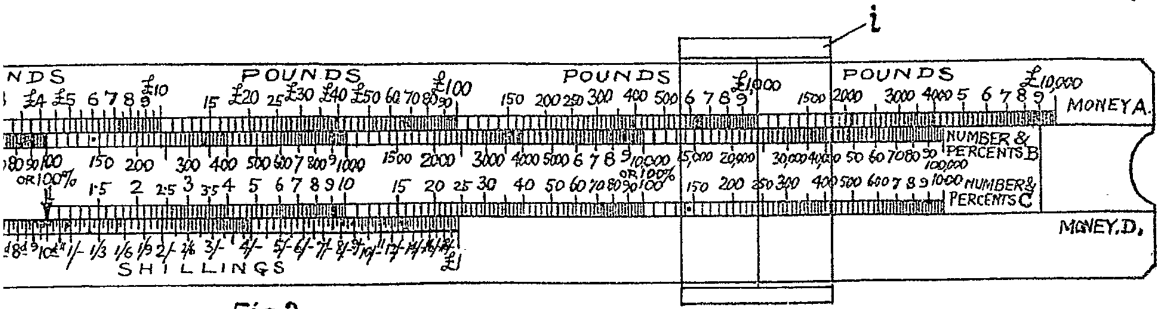
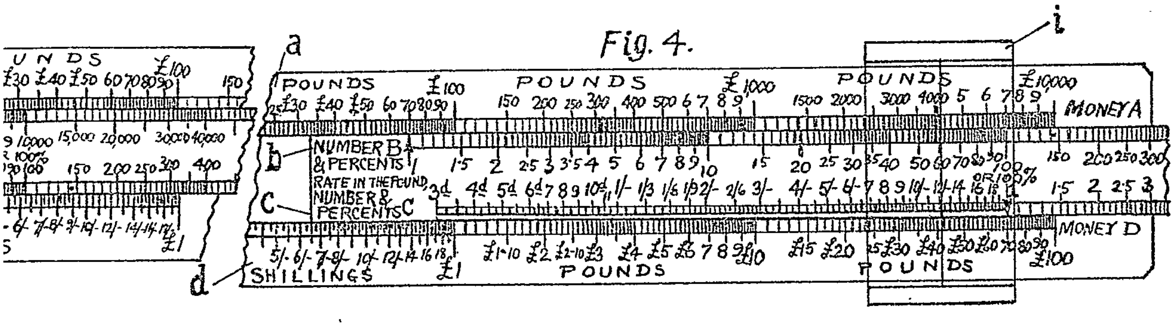


Fig. 2.

Fig. 4.



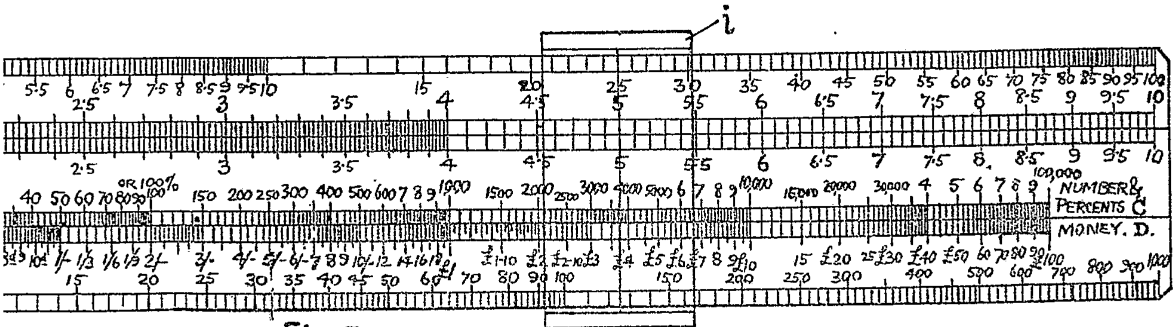
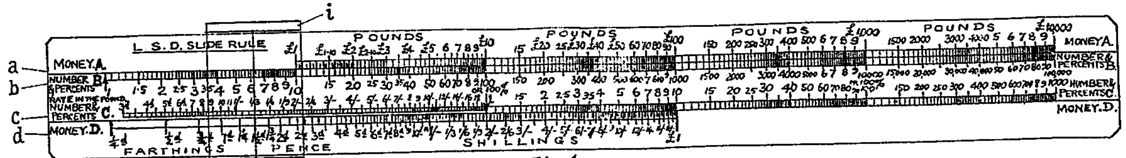


Fig. 5.



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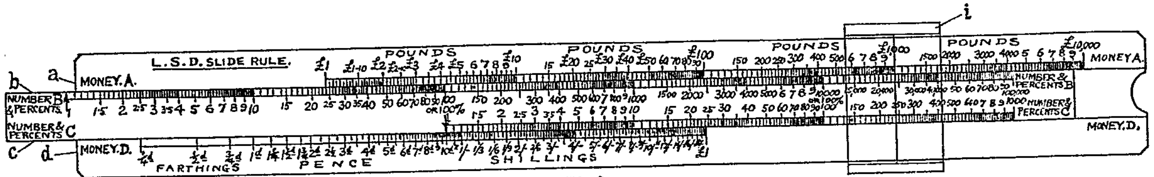


Fig. 2.

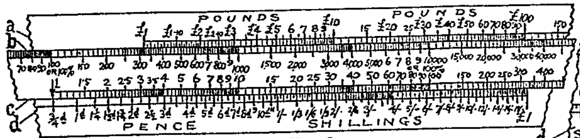
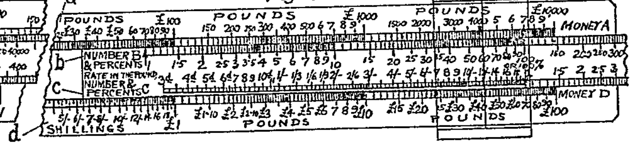


Fig. 3.

Fig. 4.



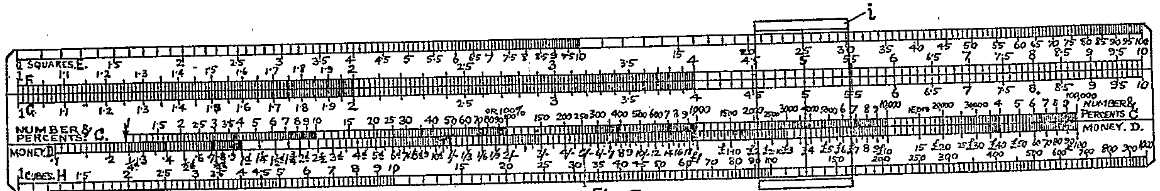


Fig. 5.

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