E. R. CLARKE.

MEANS FOR DETERMINING THE POSITIONS OF POINTS FROM THEIR COÖRDINATES.

APPLICATION FILED SEPT. 15, 1913.

1,088,207.

Patented Feb. 24, 1914.

8 SHEETS—SHEET 1.

FIG. 1.

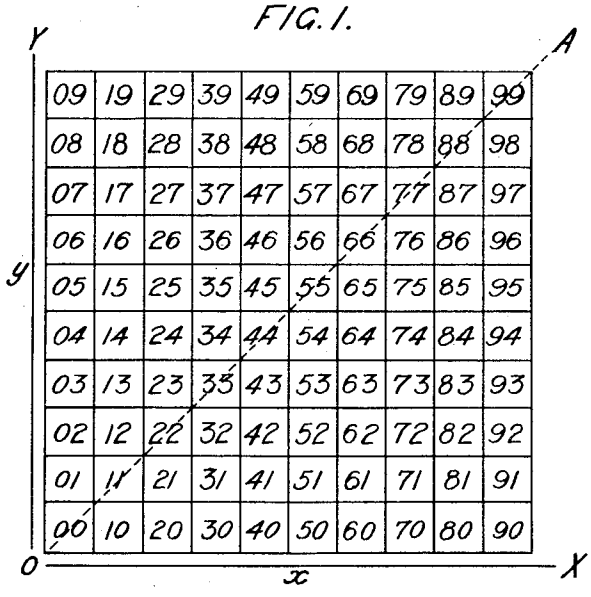
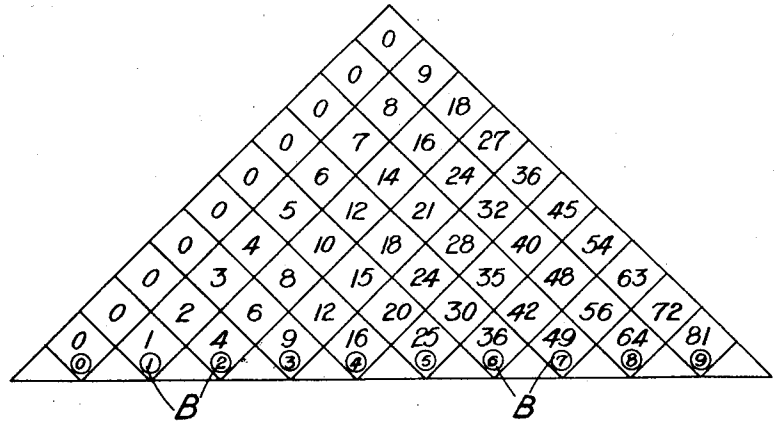


FIG. 4.



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8 SHEETS—SHEET 2.

FIG. 2.

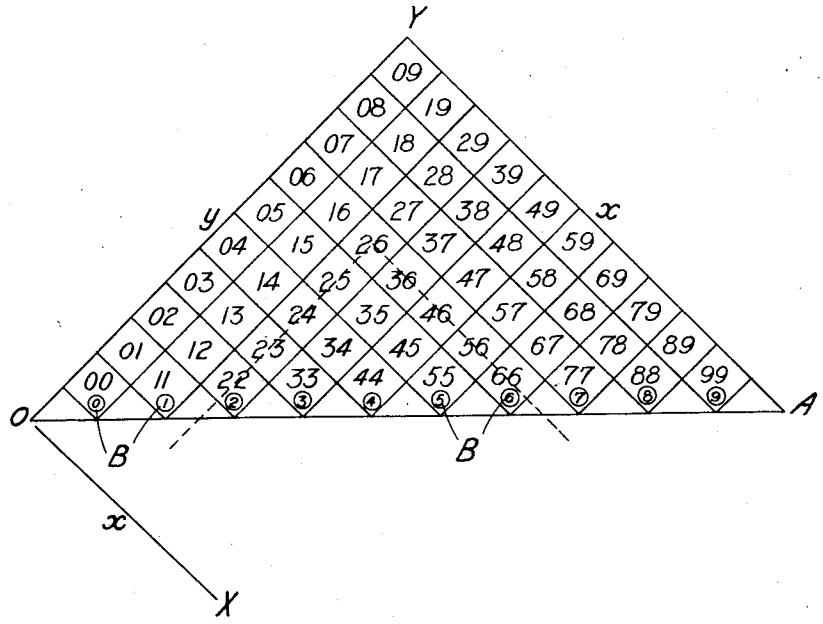
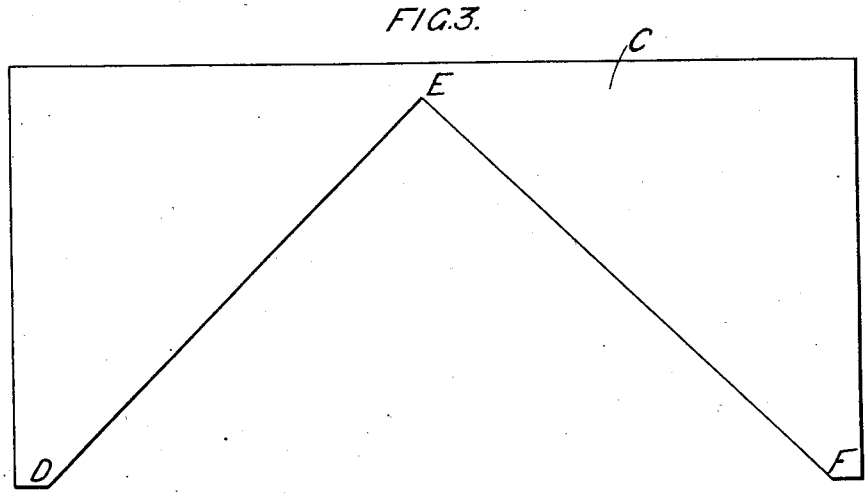


FIG. 3.



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8 SHEETS—SHEET 3.

FIG. 5.

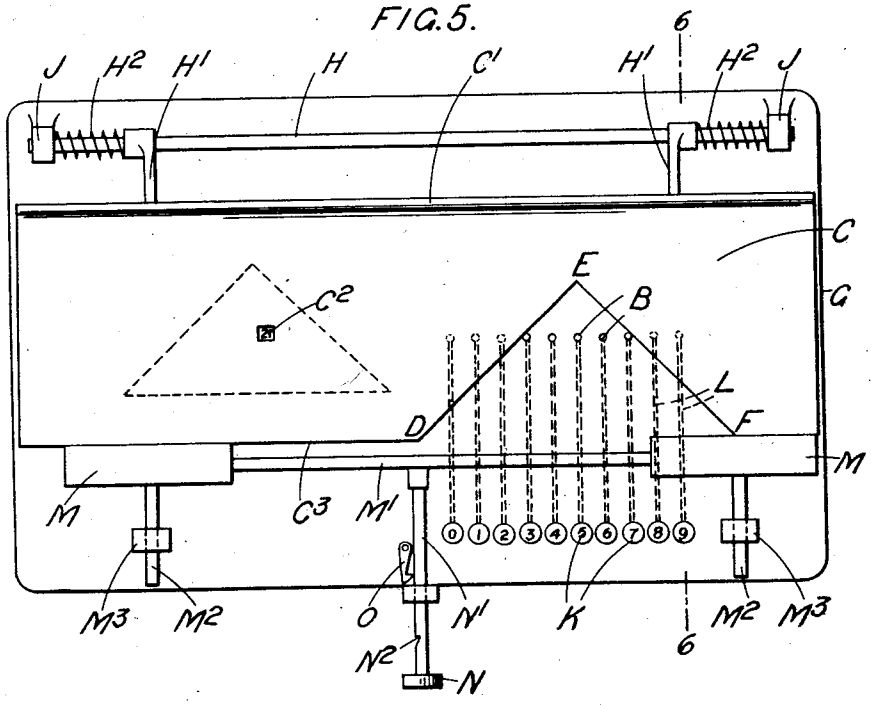
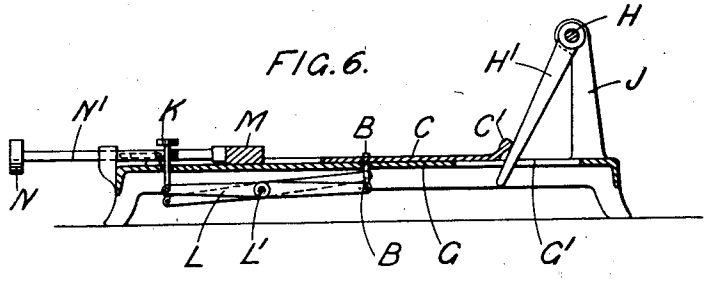


FIG. 6.



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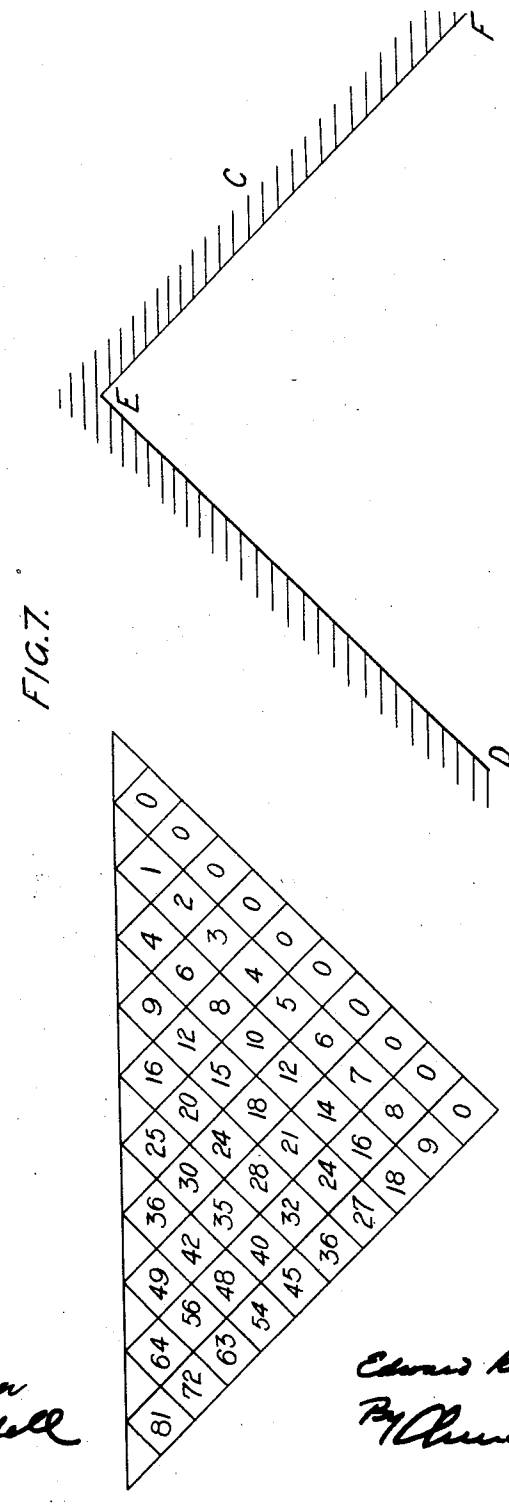
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8 SHEETS—SHEET 4.

FIG. 7.



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8 SHEETS—SHEET 5.

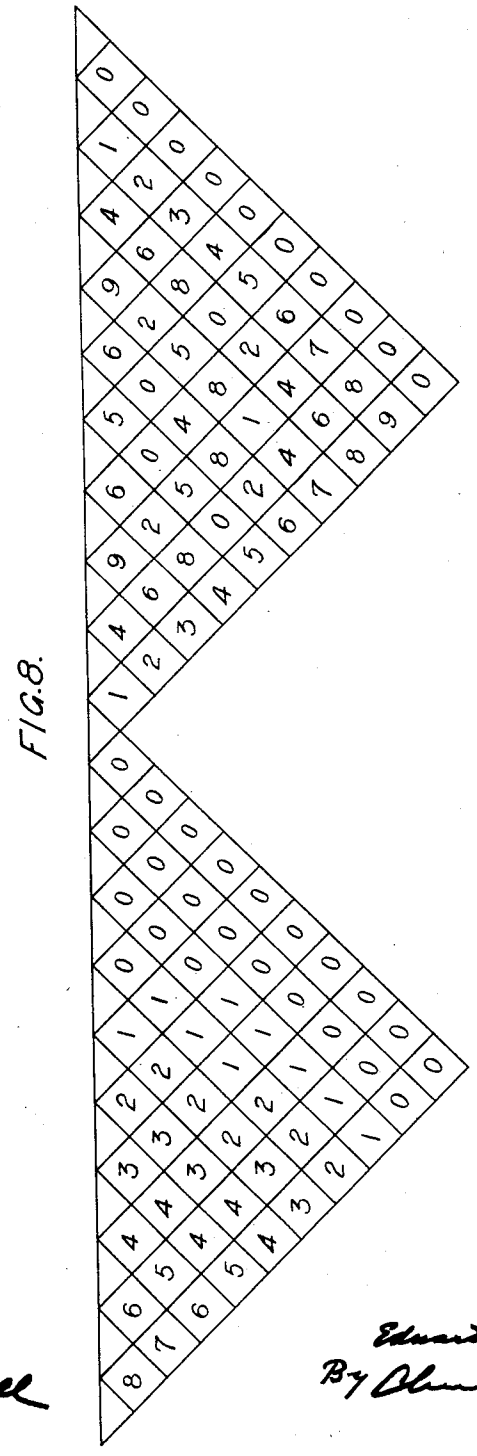


FIG. 8.

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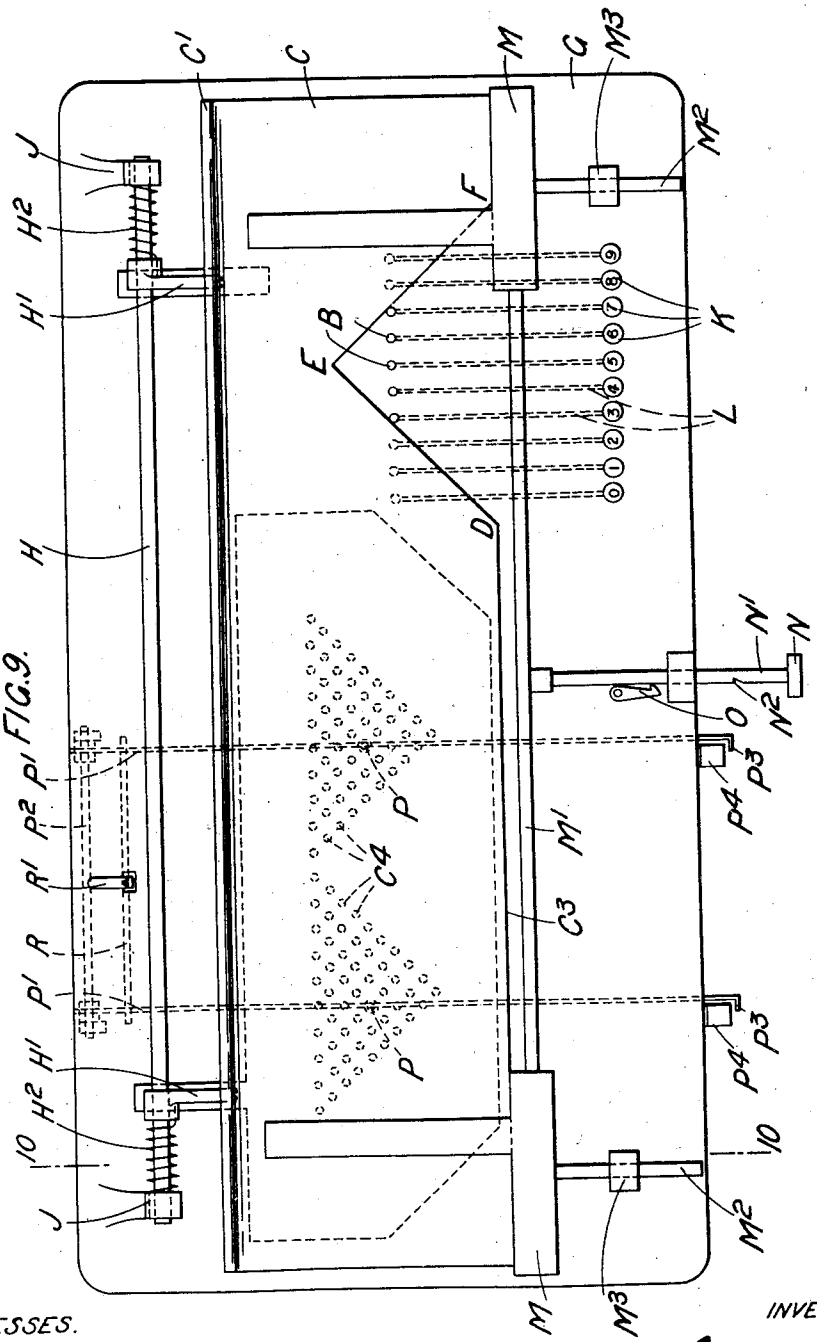
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APPLICATION FILED SEPT. 15, 1913.

1,088,207.

Patented Feb. 24, 1914.

8 SHEETS—SHEET 6.



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MEANS FOR DETERMINING THE POSITIONS OF POINTS FROM THEIR COÖRDINATES.

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8 SHEETS—SHEET 7.

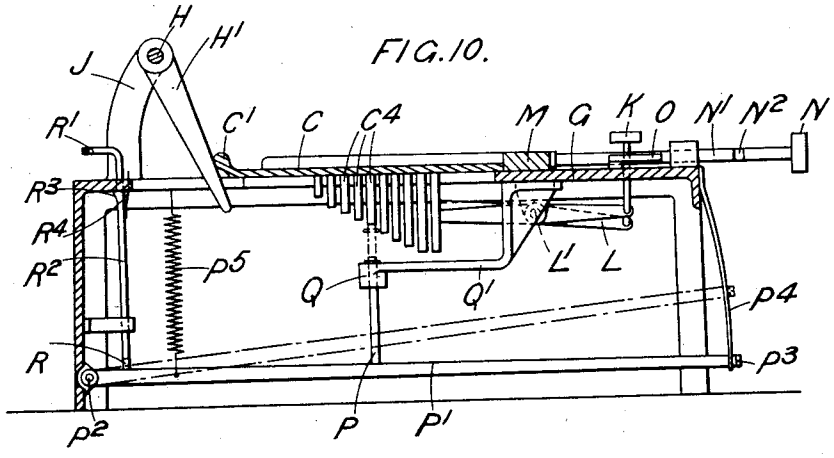


FIG. 10.

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8 SHEETS—SHEET 8.

FIG. 11.

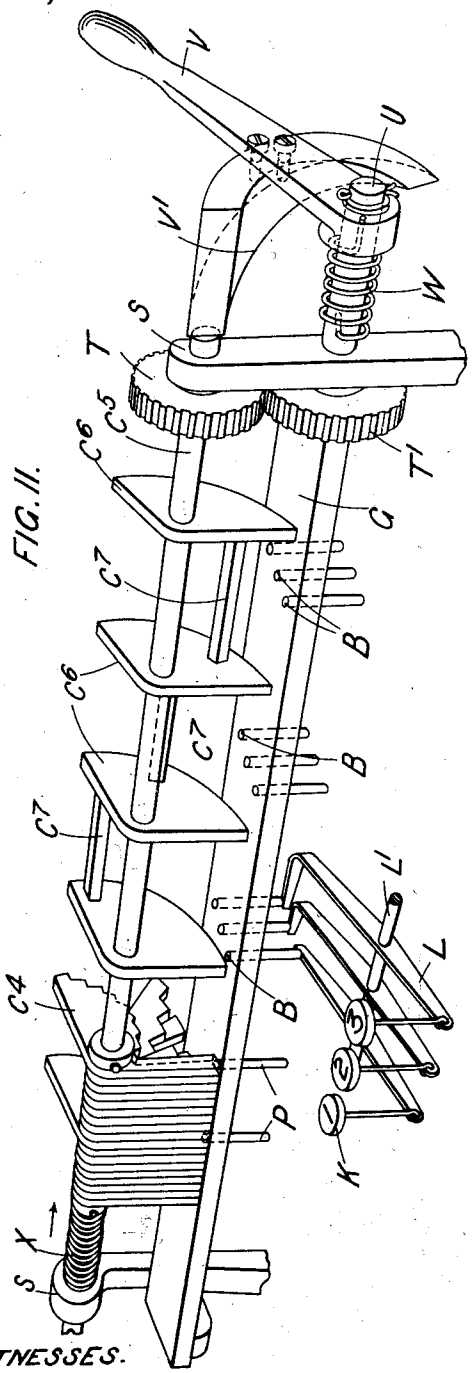


FIG. 13.

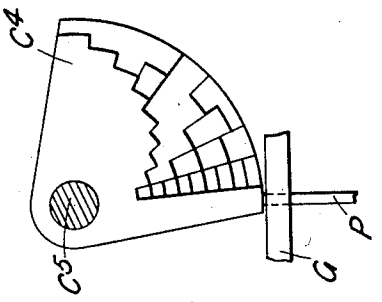
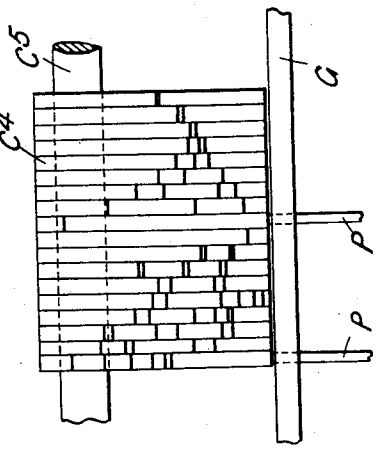


FIG. 12.



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UNITED STATES PATENT OFFICE.

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MEANS FOR DETERMINING THE POSITIONS OF POINTS FROM THEIR COÖRDINATES.

1,088,207. Specification of Letters Patent. Patented Feb. 24, 1914.

Application filed September 15, 1913. Serial No. 789,956.

To all whom it may concern:

Be it known that I, EDWARD RUSSELL CLARKE, a subject of the King of England, and residing at London, in England, have invented a certain new and useful Means for Determining the Positions of Points from their Coördinates, of which the following is a specification.

This invention relates to an improved means for determining the positions of points from their coördinates applicable also for use in effecting multiplication, in type casting machinery and the like.

According to this invention the position of a point is determined by coördinating a member in directions x and y by means of a single row of stops or their equivalent in conjunction with a member which is controlled so that it can move parallel to itself and is provided with guides or the like which are respectively parallel to the directions x and y and are adapted to embrace or engage any one or pair of stops selected from the single row. It is possible by this invention to position a body either at a point which may be designated xy or a point which may be designated yx. The two directions may make any angle with one another but in most cases they will be at right angles and it is with reference to coördination at right angles by means of a single movable member and where the xy position is identical with the yx position that the invention will be more particularly described.

In the accompanying drawings, Figure 1 is an illustration of positions ascertained by coördination in directions at right angles and illustrative of the evolution of the present invention. Fig. 2 shows the positions in Fig. 1 which can be obtained according to the present invention. Fig. 3 illustrates in plan a plate constructed in accordance with this invention for use with the table of positions illustrated in Fig. 2. Fig. 4 illustrates a product table for use with the device illustrated in Fig. 3. Fig. 5 is a plan of a simple form of calculating machine whereby multiplication can be performed in accordance with this invention. Fig. 6 is a sectional end view of the apparatus shown in Fig. 5 the section being taken on the line 6—6 in that figure. Fig. 7 illustrates a modification in the disposition of the product table. Fig. 8 shows another form of product table. Fig. 9 is a plan of a modification of a calculating machine of the type illustrated in Fig. 5. Fig. 10 is a sectional end elevation of the same on the line 10—10 of Fig. 9. Fig. 11 is a perspective view of a further modification of a calculating machine operating in accordance with this invention. Fig. 12 is an elevation of the product members employed in the machine shown in Fig. 11 the view being taken from the rear of the machine. Fig. 13 is an end elevation of these product members.

In this invention the desired position is ascertained by coördinating a member in directions designated x and y so that the xy position is identical with the yx position this coördination being effected by means of a single row of stops or their equivalent any one or a pair of which can be selected and caused to engage or be embraced by a pair of guides or the like which are respectively parallel to the directions x and y and are disposed on the member to be coordinated which is so controlled that it can move parallel to itself. One or more representations of the values or products corresponding to the position ascertainable and one or more corresponding devices for ascertaining or showing these position values or products are so disposed as to be relatively movable as and in conformity with the movements of the member with relation to the stop or stops set up.

Referring by way of example to Fig. 1 the coördinate x has any value from 0 to 9 and the coördinate y has any value from 0 to 9 but it is to be clearly understood that there is no limit to the number of values which can be assigned to each of these coordinates. Let OX and OY be the axes of the coördinates. It will be seen that there are a hundred positions namely: 00, 01, 02, 03, . . . up to 09; 10, 11, 12, 13, . . . up to 19; 20, 21, 22, 23, . . . up to 29, and so on up to 90, 91, 92, 93, . . . up to 99. If now a diagonal line OA be drawn through the positions 00, 11, 22, 33 . . . it will be seen that there is a certain symmetry with regard to the positions in Fig. 1 which lie on either side of this diagonal line. The xy positions on one side of the diagonal OA repeat themselves as yx positions on the other side of the

diagonal, these xy and yx positions being symmetrical with regard to the diagonal. The coördination obtained by the present invention only gives positions situated on the diagonal or on one side of it so that an xy position is the same as a yx position or to take an example from Fig. 1 the 26 position is the same as the 62 position since the 26 and 62 positions are symmetrical with reference to the diagonal OA. In Fig. 2 are shown only those positions that can be obtained by the present method, that is to say all the positions on one side of the diagonal OA. A row of stops, pins or equivalent B are arranged on or about the diagonal OA one of these stops B being disposed in the neighborhood of each of the diagonal positions 00, 11, 22 . . . as shown in Fig. 2, these stops being designated the 0, 1, 2, 3, . . . 9 stops.

The body which is to be coördinated may for example be taken to be a flat plate such as C Fig. 3, which is controlled by suitable means so that it is free to move in a plane over the surface on which are set out the positions as shown in Fig. 2, but the body is controlled so that it can only move parallel to itself. The body C which may be of any convenient shape, is provided with an angular opening DEF. The sides DE and EF inclosing this opening are respectively parallel to the directions y and x in which the body is to be coördinated and consequently the angle DEF is equal to the angle OYA which, in the case under consideration, is a right angle. If now any two of the stops B are set out as for example the stops 2 and 6 and the body C be moved always through positions parallel to itself over Fig. 2 until the side ED of the opening is in contact with the 2 stop and the side EF is in contact with the 6 stop the body C will be brought to rest with the sides ED, EF as indicated by dotted lines in Fig. 2. It will then be found that the vertex E is over the 26 position. Similarly if another pair of stops are set out as for instance stops 3 and 9 the vertex E will indicate the 39 position. If only one stop is set out such for example as the 4 stop the body C will indicate at the vertex E the 44 position the single stop being in contact with and embraced by both the sides ED and EF. Thus by the interaction of a single row of stops and suitable guides such as ED, EF carried by a body such as C which is controlled so that it can move parallel to itself and in a plane it is possible to obtain the various positions in that plane corresponding to the coördinates of such stop or stops as may be set up.

The invention may be applied with advantage to machines for performing the process of multiplication. Thus for example values can be assigned to the positions designated in Fig. 2 these values being the products of the coördinates which are set forth in the manner shown in Fig. 4 and since the product xy is the same as the product yx it is a great advantage that the positions on the other side of the diagonal OA are neglected owing to the fact that it is only necessary to employ one half of the multiplication table. If the product table shown in Fig. 4 be used in place of the position table indicated in Fig. 2 and a body such as C as shown in Fig. 3 be used in the manner described in conjunction with the product table Fig. 4 together with a single row of stops B it will be found that when the body C has been positioned as a result of setting up any one or any pair of stops the desired product will be indicated by the vertex E.

Figs. 5 and 6 illustrate a simple apparatus for putting the present invention into practice and enabling multiplication to be performed. This apparatus comprises a suitable base G with a plane upper surface on which rests the movable member C. A rock shaft H mounted in bearings on brackets J carries two arms H′ which project downward through slots or openings G′ in the base plate G. The arms H′ bear against the rounded edge C′ of the plate C. Coiled springs H^2 on the shaft H tend to rotate this shaft so that the arms H′ constantly push the plate C over the plane surface G maintaining the plate C parallel in its movements. The plate C however is free to slide longitudinally across the arms H′. A series of stops B is disposed in a straight line in a series of openings in the plate G. Each stop is controlled by a key K through a lever L pivoted at L′ the arrangement being such that when a key is depressed a stop B will be set or thrown up so that it will project from the plane surface G into the path of the movable plate C. Suitable means not illustrated in the drawings may be provided to insure that each stop B when set out will remain so until its function has been performed when the stop can be withdrawn and the key raised in readiness for the next operation. The plate C is provided with an angular opening DEF the sides of which form guides or the like adapted to come in contact with or embrace any one or pair of stops B which may be set up. In a suitable position in the plate C is formed a window C^2 through which can be viewed any number in a product or multiplication table which is placed or inscribed beneath the plate C on the base G the product table being in this case that which is shown in Fig. 4. The plate C is so formed, disposed and movable with reference to the product table that the sides DE, EF, bounding the angular opening in the plate C, are always respectively parallel to the axes of the coördinates of the product table. The fore-edge C^3 of the plate C is parallel to the rear edge C′. This fore-

edge C^3 bears against suitably formed push blocks M mounted on a rod M′ and guided by pins M^2 which pass through guides M^3 mounted on the base G. A push key N on a rod N′ projecting from the rod M′ enables the plate C to be returned to its initial or zero position through the push blocks M which press the plate C back against the action of the springs which normally impel the plate C forward through the arms H′. A catch O conveniently spring-controlled engages a notch N^2 in the rod N′ when the key N has been pushed right back and the plate C is in its zero position.

The method of employing the apparatus is as follows: Assuming that it is desired to ascertain the product of 3×7 the keys K corresponding to these numbers are depressed and the 3 and 7 stops B are set up. The catch O is now withdrawn thus releasing the plate C which is pushed forward by the springs until the sides DE and EF of the angular opening bear against the stops B that have been set up. The product 21 can now be read through the window C^2. The key N is next pushed in when the plate C is restored to its position in readiness for the next operation to be performed. If the square of a number is to be ascertained a single key corresponding to that number say 6 is depressed and the 6 stop set up. When the plate C is released it will come to rest with the 6 stop in the angle DEF and the product 36 will appear at the window C^2. From this will appear one important feature in the apparatus namely that a single row of stops enables the product of two separate numbers to be ascertained and by the depression of a single key and the throwing up of a single stop only it is possible to ascertain the square of a number.

It will be understood that the apparatus described and illustrated in Figs. 5 and 6 is merely given as an example of a simple means for carrying out the present invention and various details in this machine may be added or varied from the apparatus as illustrated.

In place of the product table being mounted on the base G and fixed relatively to the row of stops B this product table may be disposed on the movable member C, and some window or equivalent indicator arranged over the product table and in a fixed position relatively to the stops B. In this case it is necessary to reverse the relative angular dispositions of the product table and the opening DEF the arrangement then being as shown in Fig. 7. Further in place of the whole of each product number being disposed in a single table these products may be split up into two or more tables respectively carrying in their proper relative positions the units, tens, hundreds and so on. Such a split product table is shown in Fig. 8 where the units are shown on the right hand portion of the table while the tens appear in the left hand portion.

Instead of setting forth the position or multiplication table as a series of numbers the position values or products may be represented by a series of depressions or projections of varying depths, heights or lengths. In this case supposing depressions are used the depth of any one depression is in proportion to the product number which it represents. By employing a finger or the like as a means of ascertaining the value of the position the extent of the depression representing the value or product determined may be felt and the desired result thereby ascertained and if necessary shown or otherwise utilized in some convenient manner.

Figs. 9 and 10 illustrate a modification of the machine shown in Figs. 5 and 6 in which in place of the series of numbers representing the position values these values are in the form of a tabulated series of product members of various dimensions. In this form of the apparatus it will be also noted that the positions of the tabulated values and the indicator are reversed that is to say whereas in the construction shown in Figs. 5 and 6 the tabulated values are fixed relatively to the stops while the indicator, which in that case is the window or opening C^2, is carried by the movable member C, in the modified construction the indicator is fixed relatively to the stops B while the table of values is disposed on the movable member C.

Referring to Figs. 9 and 10 it will be seen that on the underside of the movable plate C there are mounted a series of downwardly directed pins C^4 each pin having a length which corresponds to the value to be assigned to a certain position which can be determined by setting up any one or pair of stops B. In other words where multiplication is being performed each pin C^4 has a length corresponding to a certain product. For convenience in graduating the pins C^4 the product table is split into two parts one table representing units and the other tens as shown and described with reference to Fig. 8. Further in this arrangement the vertex of the product table is directed oppositely to the vertex of the angle DEF in the plate C as described in connection with Fig. 7.

In order to ascertain the actual value represented by the length of any pin C^4, after the plate C has been positioned, a feeler or finger P is employed. This comprises as illustrated in Fig. 10, a rod which can slide vertically through a sleeve Q carried on a bracket Q′ mounted on the underside of the plate G. The pin or feeler P which in effect constitutes an indicator is positioned relatively to the stops B in the same way as the indicator window C^2 in the construction

shown in Fig. 5 is positioned relatively to the vertex E of the angle in the plate C. Thus after two stops B for example have been set up and the plate C has been positioned there will be presented over the feeler P a rod C^4 whose length corresponds to the product of the figures represented by the stops B which have been set up, and the length of this rod can be measured by the upward movement of the feeler P. There is a feeler pin P for each of the series of rods C^4 constituting the two tables of values indicated in dotted lines in Fig. 9. The feeler P may be operated so as to measure the length of the position rod C^4 in various ways and the product thus ascertained by the feeler P may be utilized or presented as a visible number by different mechanisms. A simple and convenient construction however is that illustrated in Figs. 9 and 10 where the lower end of each feeler pin P rests on the upper side of a lever P′ pivoted at P^2 and carrying at its free end a pointer P^3. On a quadrantal plate P^4 are set forth numbers corresponding to the values assigned to the different lengths of the rods C^4. Each lever P′ tends to be drawn upwardly by a spring P^5 but both levers P′ together with their feeler pin P can be moved downwardly and retained in their lowest or zero positions by means of a rod R which lies across the upper sides of the levers P′ and can be moved downward by pressing on a thumb piece R′ disposed on the end of an upright member or arm R^2. When the rod R is pressed downward through the thumb piece R′ it is retained in its depressed position by means of a tooth R^3 which projects laterally from the vertical arm R^2 and will engage the edge of the plate G at the opening in this plate through which the arm R^2 passes. A spring R^4 tends to push the arm R^2 in a direction such as to cause the tooth R^3 to thus engage the plate G and hold the rod depressed. By pushing the thumb piece or key R′ toward the front of the machine the tooth R^3 will be disengaged and the rod R released with the result that the levers P′ will rise to the extent permitted by the feelers P as they feel the lengths of the rods C^4 presented to them. Each pointer P^3 will thus move until it stops over or opposite the member corresponding to the value of the positioned rod C^4 the length of which has been felt. This machine is operated in much the same way as that illustrated in Figs. 5 and 6. One or a pair of keys are depressed thus setting up a stop or stops B and then the plate C is positioned in the manner already described. The thumb piece R′ is then manipulated so as to release the rod R and free the feelers P and their levers P′ when the product will be ascertained and indicated on the scales P^4 by the pointers P^3.

The moving member need not necessarily be uniplanar but may take a cylindrical form capable of moving axially and also of rotating. In this case the multiplication or position value table will consist of a series of radial heights and depths of the necessary extent and in the required positions. It will be appreciated that the surface of the cylindrical member constrained in this way does in effect move parallel to itself. An apparatus constructed on these modified lines is illustrated in Figs. 11, 12 and 13. Here the movable member comprises a shaft C^5 on which is disposed a series of segmental plates C^6 connected by bars C^7. The shaft C^5 is mounted in bearings S in which it is capable of rotating and also moving longitudinally. The periphery of each segmental plate C^6 is a portion of a cylinder and all the segmental plates C^6 are truly parallel to each other and are positioned on the shaft C^5 at right angles to the axis of that shaft. The connecting bars C^7 are parallel to the axis of the shaft C^5 and all situated at the same radial distance from the shaft C^5. The row of stops B is divided into three parallel rows in each of which are three stops. The splitting up of the row of stops is purely for the sake of convenience in construction as it is exactly equivalent to a single row of stops which however would have to be arranged so as to be projected radially inward toward the center of the shaft C^5 through the face of the plate G which would then in effect have to be a portion of a hollow cylinder. The arrangement of segmental plates C^6 and bars C^7 is again for convenience of construction and is in effect equivalent to a hollow cylinder in the wall of which has been cut an angle similar to the angle DEF in the movable member C as previously illustrated and described. Such a single angle would coöperate with a continuous row of stops B but as this row of stops has been split up as shown the angle also is split up the various constituent portions of the angle being comprised by the segmental plates C^6 and the bars C^7.

On the movable member are mounted the tabulated products the relationship being as in the construction shown in Figs. 9 and 10, but in the construction shown in Fig. 11 the product members are formed with their measures of length or depth disposed radially about the shaft C^5. These product members C^4 as will be seen from Fig. 11 and from Figs. 12 and 13 where they are shown on an enlarged scale, are each composed of a plate notched to a radial extent corresponding to the value which each product member represents. The product members are in two groups corresponding to the split product table shown in Fig. 8 and to the two groups of pins in the construction

shown in Fig. 9. The value of a positioned product member in each group is ascertained by a feeler pin P which can be released and arranged to indicate the numerical value of the product by mechanism such as that described in connection with the apparatus illustrated in Figs. 9 and 10.

The stops B are set up by the depression of keys K on levers L and the positioning of the movable member, that is to say its rotation and longitudinal movement, may be effected in various ways. Fig. 11 illustrates by way of example one way of bringing about this positioning. Mounted on and toward one end of the shaft C^5 by means of a feather and keyway or some similar device is a toothed wheel T which by some convenient means is held against axial movement but is free to rotate with the shaft C^5 while allowing the latter to slide axially with relation thereto. Below or in some suitable position with relation to the toothed wheel T and gearing therewith is a second toothed wheel T′ conveniently of the same diameter as the wheel T. The toothed wheel T′ is mounted on a short shaft U carried in suitable bearings. On this shaft U is loosely mounted a lever arm V the boss of which is connected to the shaft U by a coiled spring W which is of such strength or stiffness that normally movement of the lever V will cause the rotation of the shaft U but if resistance is offered to the rotation of the shaft U the lever V can still be moved about the shaft U as about a pivot without damage to the mechanism. At one side of the lever V is mounted a cam V′ against the face of which is pressed the end of the shaft C^5 by the action of a coiled spring X conveniently disposed around the shaft C^5 toward its opposite end. It will be seen that if the lever arm V is pulled toward the front of the machine the shaft C^5 will be rotated. At the same time owing to the movement of the cam V′ the shaft C^5 will be allowed to slide axially and thus the movable member comprised by the shaft C^5, the segmental plates C^6 and the bars C^7 will be positioned.

In operating the machine after a stop or pair of stops B have been set up, the lever V is pulled when the shaft C^5 will be rotated until one or other of the bars C^7 comes in contact with one of the stops that has been set up. The shaft C^5 will at the same time have moved axially bringing one or other of the segmental plates C^6 in contact with the other stop B that has been set up. If a bar C^7 during the rotation of the shaft C^5 comes in contact with a stop B before a plate C^6 has moved sufficiently far axially to come in contact with the other stop B which has been set up, then owing to the manner in which the lever V is mounted on the shaft U it will still be possible to continue moving the lever V and thus permit continued axial movement of the shaft C until this axial movement is checked by the second stop which has been set up. Conversely if when positioning the movable member a segmental plate C^6 meets and is checked in its axial movement by a set up stop B before the rotary movement is checked, this rotary movement can still be continued until the positioning of the movable member has been completed.

It will be apparent that as the shaft C is rotated and moved axially into the position determined by the stop or stops that have been set up, so will the product members C^4 be rotated and moved axially until those product members corresponding to the product determined have been positioned and presented to their respective feeler pins P.

It is not necessary that the movable member should always be constrained to move parallel to itself provided that when the opening DEF comes in contact with the stops the parallel position is then assumed. It will then be found that the two stops B form the base of a triangle the sides of which are formed by the angular opening DEF and in all cases these triangles will be similar to one another as they contain the same vertical angle DEF and the corresponding sides are parallel to one another.

It will be appreciated that several multiplying devices or units such as described may be combined in one machine with suitable mechanism for collecting and adding the motions of the feelers so that the results may be set forth in a convenient form. In this manner complicated multiplication can be effected.

In applying the invention to certain other purposes the movable member with its guides is duplicated or two separate sets or pairs of guides are suitably mounted on the member the angle inclosed by one pair of guides being oppositely directed or disposed with relation to the angle inclosed by the other pair of guides. Positions may then be ascertained by moving the member or members positively or negatively that is to say in opposite directions. Thus with two pairs of guides each adapted to deal with positions on one side of a diagonal which diagonal is represented for example by a row of ten stops it will be possible to ascertain any one of a hundred positions of which half would be found by positive movement of the movable member and the other half by negative movement thereof.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a member so controlled that it can move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable

member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides and means for imparting movement to the member as set forth.

2. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a member so controlled that it can move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, means for imparting movement to the member and means for indicating any position when determined as set forth.

3. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a tabulated series of values associated with the positions determinable and means for indicating the value associated with any position when determined as set forth.

4. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position and means for feeling and indicating the dimensional value of any product member as set forth.

5. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position, means for feeling the dimensional value of any product member and means for translating a dimensional value when ascertained by feeling into a numerical value as set forth.

6. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a tabulated series of values and means for indicating the corresponding value when any position has been determined, one of these, that is the tabulated series of values or the indicating means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable member as set forth.

7. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position, and means for ascertaining and indicating the dimensional value of any product member, one of these two devices, that is the series of product members or the ascertaining and indicating means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable member as set forth.

8. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a series of product members of various dimensions constituting a tabulated

series of values each of which corresponds to the value associated with an ascertainable position, means for feeling the dimensional value of any product member, one of these two devices, that is the series of product members or the feeling means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable member, and means for translating a dimensional value when ascertained by feeling into a numerical value as set forth.

9. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, means for moving each stop into the path of the guides, a tabulated series of values associated with the positions determinable, means for indicating the value associated with any position when determined and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

10. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected to the stops and by means of which each stop can be moved into the path of the guides, a tabulated series of values associated with the positions determinable and means for indicating the value associated with any position when determined as set forth.

11. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected to the stops and by means of which each stop can be moved into the path of the guides, a tabulated series of values associated with the positions determinable, means for indicating the value associated with any position when determined and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

12. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected to the stops and by means of which each stop can be moved into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position, means for feeling the dimensional value of any product member, means for translating a dimensional value when ascertained by feeling into a numerical value and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

13. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected to the stops and by means of which each stop can be moved into the path of the guides, a tabulated series of values, means for indicating the corresponding value when any position has been determined, one of these, that is the tabulated series of values or the indicating means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable member and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

14. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected

to the stops and by means of which each stop can be moved into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position, means for feeling the dimensional value of any product member, one of these two devices that is the series of product members or the feeling means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable member, means for translating a dimensional value when ascertained by feeling into a numerical value, and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

15. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops a base plate having holes for the stops, a plate movable over the base plate, means for moving this plate, means for controlling such movement so that the plate can only move parallel to itself, an angle cut in the movable plate the edges of the plate inclosing this angle constituting guides respectively parallel to the directions x and y and adapted to engage any one or pair of stops selected from the single row and projecting from the base plate, a series of keys operatively connected to the stops and by means of which each stop can be moved through the base plate into the path of the guides, a tabulated series of values, means for indicating the corresponding value when any position has been determined, one of these, that is the tabulated series of values or the indicating means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable plate, and means for returning the selected stops and for resetting in a zero position the movable plate after it has been positioned as set forth.

16. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a base plate having holes for the stops, a plate movable over the base plate, means for moving this plate, means for controlling such movement so that the plate can only move parallel to itself, an angle cut in the movable plate the edges of the plate inclosing this angle constituting guides respectively parallel to the directions x and y and adapted to engage any one or pair of stops selected from the single row and projecting from the base plate, a series of keys operatively connected to the stops and by means of which each stop can be moved through the base plate into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position, means for feeling the dimensional value of any product member, one of these two devices, that is the series of product members or the feeling means, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable plate, means for translating a dimensional value when ascertained by feeling into a numerical value, and means for returning the selected stops and for resetting in a zero position the movable plate after it has been positioned as set forth.

17. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a base plate having holes for the stops, a plate movable over the base plate, means for moving this plate, means for controlling such movement so that the plate can only move parallel to itself, an angle cut in the movable plate the edges of the plate inclosing this angle constituting guides respectively parallel to the directions x and y and adapted to engage any one or pair of stops selected from the single row and projecting from the base plate, a series of keys operatively connected to the stops and by means of which each stop can be moved through the base plate into the path of the guides, a series of pins of various lengths grouped so as to constitute a tabulated series of products corresponding to the positions determinable, means for ascertaining the dimensional value of any pin in the tabulated series, one of these, that is the groups of pins or the means for ascertaining their value, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable plate, and means for returning the selected stops and for resetting in a zero position the movable plate after it has been positioned as set forth.

18. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a base plate having holes for the stops, a plate movable over the base plate, means for moving this plate, means for controlling such movement so that the plate can only move parallel to itself, an angle cut in the movable plate the edges of the plate inclosing this angle constituting guides respectively parallel to the directions x and y and adapted to engage any one or pair of stops selected from the single row and projecting from the base plate, a series of keys operatively connected to the stops and by means of which each stop can be moved through the base plate into the path of the guides, a series of pins of various lengths grouped so as to constitute

a tabulated series of products the length of each pin corresponding to the value associated with an ascertainable position, a pin movable axially for feeling the length of any product pin in a group, means for controlling the operation of a feeler pin, one of these two devices that is the groups of product pins or the feeler pins, being fixed in definite relation to the row of stops while the other is movable as and synchronously with the movable plate, means operated by a feeler pin for translating the dimensional value of a product pin when ascertained by feeling into a numerical value, and means for returning the selected stops and for resetting in a zero position the movable plate after it has been positioned as set forth.

19. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected to the stops and by means of which each stop can be moved into the path of the guides, a tabulated series of values mounted on the movable member, means for indicating the corresponding value when any position has been determined such indicated means being fixed in definite relation to the row of stops, and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

20. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a movable member, means for moving this member, means for controlling such movement so that the member can only move parallel to itself, guides respectively parallel to the directions x and y mounted on the movable member and adapted to engage any one or pair of stops selected from the single row, a series of keys operatively connected to the stops and by means of which each stop can be moved into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position such series of product members being mounted on the movable member, means for feeling the dimensional value of any product member such feeling means being fixed in definite relation to the row of stops, means for translating the dimensional value of a product member when ascertained by feeling into a numerical value, and means for returning the selected stops and for resetting in a zero position the movable member after it has been positioned as set forth.

21. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a base plate having holes for the stops, a plate movable over the base plate, means for moving this plate, means for controlling such movement so that the plate can only move parallel to itself, an angle cut in the movable plate the edges of the plate inclosing this angle constituting guides respectively parallel to the directions x and y and adapted to engage any one or pair of stops selected from the single row and projecting from the base plate, a series of keys operatively connected to the stops and by means of which each stop can be moved through the base plate into the path of the guides, a series of product members of various dimensions constituting a tabulated series of values each of which corresponds to the value associated with an ascertainable position such series of product members being mounted on the movable plate, means for feeling the dimensional value of any product member such feeling means being carried by the base plate in definite relation to the row of stops, means for translating the dimensional value of a product member when ascertained by feeling into a numerical value, and means for returning the selected stops and for resetting in a zero position the movable plate after it has been positioned as set forth.

22. In an apparatus for determining positions from their coördinates x and y the combination of a single row of stops, a base plate having holes for the stops, a plate movable over the base plate, means for moving this plate, means for controlling such movement so that the plate can only move parallel to itself, an angle cut in the movable plate the edges of the plate inclosing this angle constituting guides respectively parallel to the directions x and y and adapted to engage any one or pair of stops selected from the single row and projecting from the base plate, a series of keys operatively connected to the stops and by means of which each stop can be moved through the base plate into the path of the guides, a series of pins of various lengths grouped so as to constitute a tabulated series of products the length of each pin corresponding to the value associated with an ascertainable position such series of pins being mounted on the movable plate, a pin movable axially for feeling the length of any product pin in a group such feeler pin being carried by the base plate in definite relation to the row of stops, means for controlling the operation of each feeler pin, means operated by a

feeler pin for translating the dimensional value of a product pin when ascertained by feeling into a numerical value, and means for returning the selected stops and for resetting in a zero position the movable plate after it has been positioned the feeler pins and the indicating mechanism connected therewith as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD RUSSELL CLARKE.

Witnesses:

PERCY GEORGE GATTER,

WALTER J. SKERTEN.