Feb. 7, 1950 R. M. EICHMANN 2,496,781

PANTOGRAPH

Filed Feb. 15, 1946 2 Sheets-Sheet 1

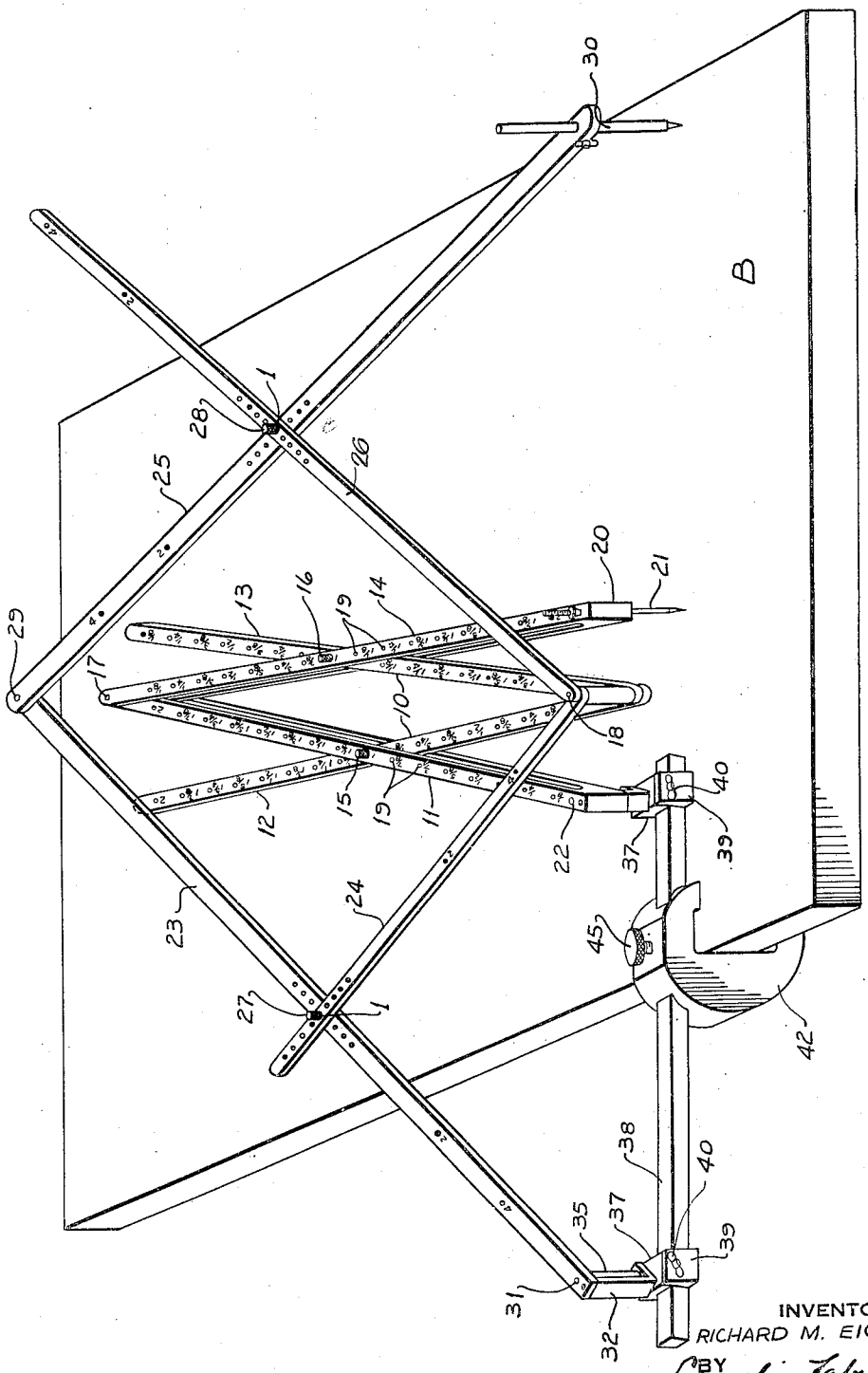


Fig 1

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PANTOGRAPH

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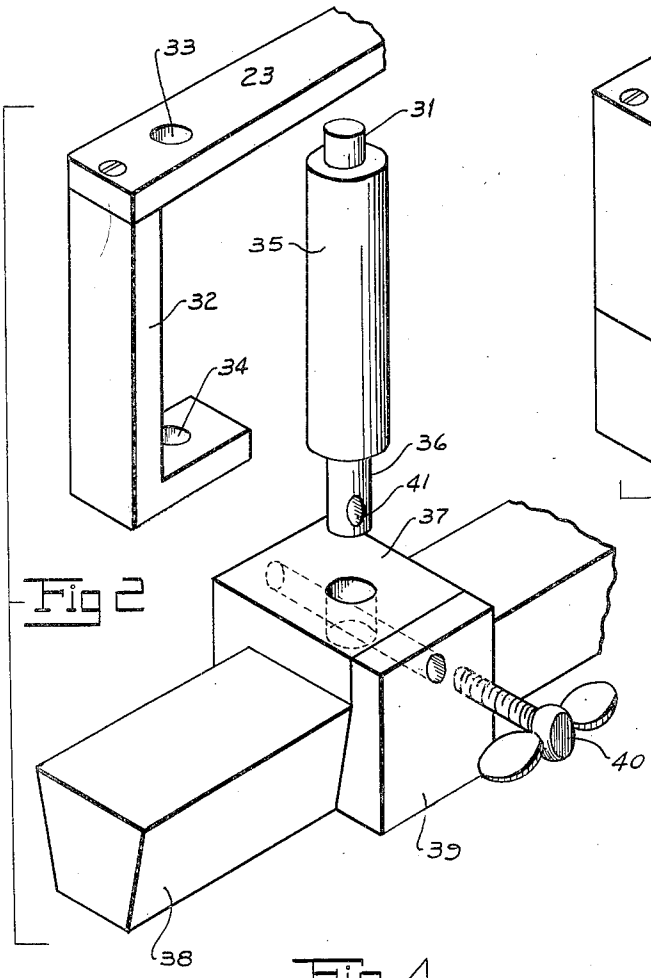


Fig 2

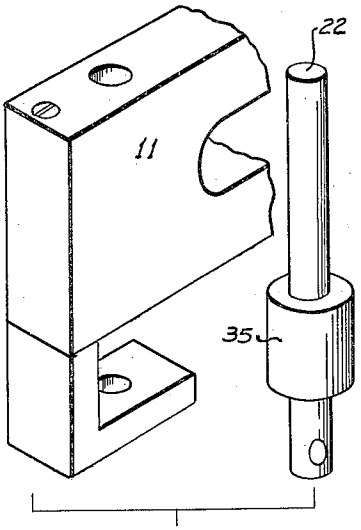


Fig 3

Fig 4

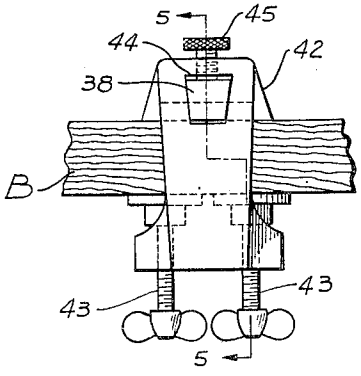
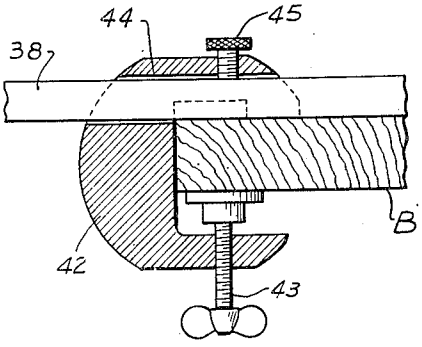


Fig 5



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Patented Feb. 7, 1950 2,496,781

UNITED STATES PATENT OFFICE

2,496,781

PANTOGRAPH

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Application February 15, 1946, Serial No. 647,875

7 Claims. (Cl. 33—25)

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This invention is a duplex pantograph comprising two simple pantographs connected to one another so that the manipulation of one serves to impart movement to the other. These two pantographs are so interconnected with respect to one another as to produce an extremely fine reproductive relation between the tracer and the marker, within an unusually wide range of various adjustments for either enlargement or reduction, as well as reproduction at identical size.

One fundamental feature of the present invention consists in supporting the fulcrums of both pantographs upon a rod or other support adapted to be firmly clamped to a drawing board or the like in such manner that both fulcrums have a fixed anchorage with respect to the board and to each other, while the intermediate elbows of the two pantographs are pivotally connected to one another so that both pantographs have, in effect, a common elbow pivot. For the purpose of concrete definition, one of the pantographs will be hereinafter arbitrarily termed the "primary" pantograph, while the other will be referred to as the "secondary" pantograph.

When primary and secondary pantographs are connected together by a common elbow pivot and with their respective fulcrums anchored in fixed position to a bar and board, as stated, the movement of a tracer, supported at the free end of the primary pantograph, will produce a lesser degree of movement of the elbow of that primary pantograph with corresponding movement of the elbow of the secondary pantograph. But this corresponding lesser movement of the elbow of the secondary pantograph will effect an increase in amplitude of movement of the marker carried at the free end of the latter. Thus, when the duplex pantograph of this invention is employed for enlarging purposes, the primary pantograph will have the function of decreasing the amplitude of movement, while the secondary pantograph will have the function of translating this decreased movement into increased amplitude of the marker which it carries. These two functions are combined to operate conjointly, to produce a reproduction of the same size as the images, or enlarged or decreased reproduction as may be desired.

The advantage of this arrangement is that very fine reproduction is accomplished within large dimensions and through an extremely wide range of ratios between the original image and the reproduction or copy—much more so than has heretofore been possible with any pantograph of which I am aware. Furthermore equality of reproduction may be obtained by this duplex structure. This is impossible of accomplishment with a simple pantograph.

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The several arms of both pantographs carry graduated scales with appropriate associated perforations, whereby each of said pantographs may be set to produce the desired ratio in reproduction as will be hereinafter more fully set forth.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and appended claims, when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate one practical embodiment of the invention, but the construction therein shown is to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is a perspective view showing a duplex pantograph embodying the present invention with the several parts thereof set or adjusted for equality in reproduction.

Figure 2 is a perspective view showing the fulcrum connections for the secondary pantograph, certain parts thereof being dismantled in the interest of clearness.

Figure 3 is a view similar to Figure 2 but showing the fulcrum mounting for the primary pantograph.

Figure 4 is an end view of means for clamping a supporting bar to a drawing board.

Figure 5 is a section on the line 5—5 of Figure 4.

In the accompanying drawings, the primary pantograph is generally designated 10. It embodies arms 11, 12, 13 and 14. The arms 11 and 12 cross one another and are secured together by a removable pin 15 while the arms 13 and 14 similarly cross one another and are secured together by a removable pin 16. The arms 11 and 14 are shown as slotted for substantially their full lengths and the arms 12 and 13 pass through the slots, and the pins 15 and 16 extend through the entire depth of the arms 11 and 14 to facilitate accurate adjustment and smooth operation and to eliminate lost motion and twisting strains. The arms 11 and 14 are secured to one another by a permanent pivot 17, while the arms 12 and 13 are pivoted to one another at the elbow of this pantograph by a pin generally designated by the reference character 18.

All of the arms of the primary pantograph carry graduated scales with associated perforations 19. These scales will be hereinafter more fully described, but suffice it here to point out that the pins 15 and 16 may be shifted along the

scales of the several arms to cooperate with different perforations 19 in order to vary ratios of enlargement or reduction as the case may be.

In the form of the invention shown, the free end 20 of the primary pantograph carries a tracer 21, while the other end of said pantograph is fulcrumed on a pin 22 which constitutes the fixed fulcrum for any particular adjustment.

The secondary pantograph comprises arms 23, 24, 25 and 26. The arms 23 and 24 cross one another and are perforated to be connected by a removable pin 27, while the arms 25 and 26 cross one another and are perforated to be connected by a removable pin 28. The arms 23 and 25 are permanently pivoted to one another on a pin 29, while the free end of the secondary pantograph carries a marker 30. The free end of the arm 23 is pivotally supported on a pin 31 which constitutes a fixed fulcrum for the secondary pantograph when set up in any particular adjustment. The details of the fulcrum mountings of both the primary and secondary pantographs are shown best in Figures 2 and 3 of the drawings wherein the parts are dismantled sufficiently to show their individual structures.

Thus by reference to Figure 2, it will be noted that the free end of the arm 23 carries a bracket 32 and this bracket, as well as the arm 23, is provided with alined or coaxial perforations or bearings 33 and 34, axially spaced apart. The fulcrum pin 31 of the secondary pantograph is formed as an upper reduced end of a stud 35 which has a cylindrical portion equal in height to the spacing between the bearings 33 and 34. The pin 31 extends into the bearing 33 and, from the cylindrical part 35, a second coaxial pin 36 extends downwardly through the bearing 34 and is adapted to be received within a block 37 forming part of a carrier adapted to be adjustably mounted on a rigid bar 38. I find it desirable to make this bar of substantially keystone shape with the wider portion at the top.

The block 37 is substantially L-shaped so as to bear against one side and the top surface of said bar, while the plate 39 bears against the opposite side of the bar and is attached to the block 37 by means of a thumb screw 40. This thumb screw works idly through the plate 39, passes through a hole 41 in the pin 36 and threads into a tapped hole in the block 37. Thus this thumb screw 40 serves not only to secure the stud to the block 37, but also serves to tightly clamp the carrier to the bar in any desired position of adjustment longitudinally of the later. Notwithstanding this tight clamping engagement, however, the arm 23 of the secondary pantograph is free to oscillate about the axis of the stud, which provides a relatively deep bearing for this articulatory movement. This deep bearing serves to support the arm 23 throughout its entire length, as well as the attached end of the arm 25, so that the outer ends of these arms will not contract with the board B and will be properly supported even though these ends extend beyond the confines of the drafting board B on which the device is mounted.

The mounting for the fulcrum pin 22 of the primary pantograph is shown in Figure 3. It is the same in all respects to the structure shown in Figure 2 save only that the cylindrical part 35 is of less axial length and the pin 22 is longer than the pin 31. These differences in dimensions provide for proper relation between the two pantographs so that the cooperating arms of both of them will lie in contiguous, substantially parallel planes.

The supporting bar 38, by which the fulcrums of the two pantographs are supported, is adapted to be rigidly secured to the drafting board B or other table on which the reproduction is adapted to be carried out. The rigid attachment of this bar to such a board or table may be accomplished in various ways, but a very satisfactory means is shown in Figures 1, 4 and 5, as embodying a C-clamp 42 of special construction. This C-clamp is shaped to embrace the margin of the board B and to be firmly secured thereto by two thumb screws 43. These collectively serve to form a three point support between the clamp and the board B and affix said clamp to the board with great rigidity. The head of the C-clamp is provided with a straight-through passage 44 through which the bar 38 is adapted to loosely extend, but said bar may be anchored in any desired position by means of a set screw 45 which is threaded into the head of the clamp and projects into the passage 44. The purpose of clearance between the bar 38 and the passage 44 is to permit of longitudinal adjustment of the bar within said passage, so as to locate the fulcrums and hence both pantographs in optimum positions on the board with respect to the work to be done. For certain reproduction the setting of the bar shown in Figure 1 will be highly efficient. In some other cases the bar 38 might be well adjusted to the right or left with respect to the clamp 42. In Figure 1 the fulcrums of both pantographs are positioned on opposite sides of the clamp though for some reproductions, both fulcrums may be positioned on the same side of the clamp. This adjustment of fulcrums can be readily obtained by loosening the clamping screws 40 to release the carriers 37, which may then be shifted or adjusted as desired and thereupon locked in place by again tightening the clamping screws 40.

Reference has hereinbefore been made to the graduation or indexing of the several arms of the two pantographs, with corresponding perforations to permit of adjustment for reproduction at different ratios. In the illustrative showing of the drawings, the arms of the primary pantograph are indexed with graduations progressing in increments of ⅛" from ⅛ to 2, while the arms of the secondary pantograph carry main index points 1, 2 and 4. If the arms of the secondary pantograph are adjusted so that the pivot pins 27 and 28 pass through holes corresponding to the graduations indicated 1, and the pivot pins 15 and 16 of the primary pantograph are likewise passed through holes correspondingly indicated, the image will be of the same size, i. e., inch for inch with no reduction or enlargement. Now if the pins 27 and 28 are left in the perforations 1 of the arms of the secondary pantograph, it is possible, by varying the adjustment of the primary pantograph, to change the enlargement or reduction ratio from ⅛ to 2, although it would be necessary in doing this to reset the fulcrums 22 and 31 on the supporting bar 38 in order to maintain the most efficient relation between the image and the original.

By way of further example, if the secondary pantograph is adjusted so that the pins 27 and 28 pass through the points indicated 2, then by setting the primary pantograph at points 1 or 2, the enlargement can be made twice to four times the size. Similarly by setting at points 4 in the secondary pantograph, it is possible to obtain enlargements of from four to eight times by

changing the adjustment of the primary pantograph.

It will be noted from Figure 1, that the arms of the secondary pantograph contain relatively fine graduations or short scale perforations adjacent the graduations 1. These are to permit of slight variations in ratio which individual users may desire. These small graduation scales may, if desired, also be associated with each of the graduations 2 and 4 on all of the arms of the secondary pantograph if desired and they make it possible to work through blind points between the large graduations with small increments of change in ratio.

The graduations or scales to which I have referred and which have been shown in the drawings have been found to be highly satisfactory for most purposes, but I wish it understood that they may be varied without departing from this invention.

It will be apparent from the foregoing detailed description that the duplex pantograph of this invention embodies, generally speaking, two pantographs connected to one another at their elbows with their fulcrums relatively fixed for any particular ratio adjustment upon a rigid bar which is, in turn, rigidly mounted on a firm support on which the reproduction is carried out. This reproduction may manifestly be in the nature of either enlargement or reduction, depending upon which of the parts 21 and 31 is the tracer and which the marker. When reference is made to the marker, it will be understood that this may be a pencil or pen or an engraving or any other type of tool by means of which it is desired that the reproduction be made. In any event, the two pantographs are permanently attached to one another and constitute, in effect, a unitary working device, all parts of which are interlocked to produce a unitary result. The long bearings to which I have referred serve to effectually support the device for efficient operation, so that the arms will not drag upon the drawing board nor will the fact that the arms or joints thereof may project beyond the board, interfere with the proper functioning of the device. These long bearings also minimize friction, lost motion and wear which would result in imperfect or faulty reproduction.

In the accompanying drawings and in the preferred form of this invention, the two pantographs are interconnected with one another at the pin 18 which constitutes the common pivot for one elbow of each pantograph. Each of the pantographs which enters into this construction is of the lazy tongs type in that each comprises two pairs of crossed arms pivoted to one another at their point of crossing and with each pair of crossed arms pivoted to one another to form the elbows of the particular pantograph formed by each two crossed pair of arms. One of these elbows of each pantograph is, as stated, secured to the corresponding elbow of the other pantograph, so that the primary and secondary pantographs, as I prefer to call them, have a common elbow pivot 18. Each of these pivots has a fulcrum pivot (22 and 31) at the free end of one of the arms, while the other end of said arms is terminally connected (17 and 29) to another arm, the other end of which carries a stylus (21 and 30), all as clearly shown in the drawings.

The invention as stated is primarily directed to a duplex pantograph. There are, however, numerous features embodied in the present structure which will be highly utilitarian in a single

or simple pantograph. For example, if the primary and secondary pantographs are separated at the pivot 18 and one removed, so that the other might be used as a simple pantograph, very appreciable advantage would be had in the use of the clamp 42 and bar 38 as a mounting for the remaining pantograph. It would provide a very efficient support for the fulcrum of this pantograph and would permit adjustment of the same laterally of the board B.

Furthermore, in many cases a distinct advantage would result in the use of a simple pantograph by mounting its fulcrum directly on a clamp, such as the clamp 42, so as to be rigid therewith and to provide for a rigid mounting of such fulcrum on the board in a manner to permit the clamp to be adjusted longitudinally of the edge of the board and clamped rigidly in any position desired thereon.

Another feature of the invention useful in simple pantographs is the employment of the slotted arm construction shown in the primary pantograph wherein the arms 12 and 13 pass through slots in the arms 11 and 14.

For the foregoing reasons the invention is to be understood as including these features, as well as the broad concept of the duplex pantograph mounted on the board in the manner hereinbefore described.

The foregoing detailed description sets forth the invention in its preferred practical form, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. An assembly of the character described comprising: a clamp adapted to rigidly engage a drawing board or the like and provided with a passage, a rigid bar adjustable longitudinally through said passage while the clamp is in rigid engagement with said board, a thumb screw for securing the bar in adjusted position, a pair of carriers mounted on the bar for adjustment longitudinally of the bar and having means for locking them in selected positions thereon, a fulcrum on each carrier, and a pantograph secured to each fulcrum, each pantograph having an elbow and said pantographs being connected to one another by one common elbow pivot for both of them.

2. A duplex pantograph comprising: two lazy tongs pantographs each having two pairs of crossed arms pivoted to one another at their points of crossing with the arms of both pairs of each pantograph hinged together at their ends to form the elbows of that pantograph, a common pivot securing together one elbow of one of said pantographs to the corresponding elbow of the other pantograph, a rigid fulcrum bar, and a fulcrum pivot securing the free end of one arm of each of said pantographs to the fulcrum bar in spaced relation to the corresponding fulcrum pivot of the other pantograph.

3. A duplex pantograph comprising: two lazy tongs pantographs each having two pairs of crossed arms pivoted to one another at their points of crossing with the arms of both pairs of each pantograph hinged together at their ends to form the elbows of that pantograph, a common pivot securing together one elbow of one of said pantographs to the corresponding elbow of the other pantograph, a rigid fulcrum bar, and a fulcrum pivot securing the free end of one arm of each of said pantographs to the fulcrum bar

in spaced relation to the corresponding fulcrum pivot of the other pantograph, said fulcrum pivots being adjustable longitudinally of said bar to vary the distance between them at the will of the operator.

4. A duplex pantograph comprising: a primary four arm lazy tongs pantograph with its fulcrum at the free end of one arm, and its stylus at the free end of the arm which is terminally jointed thereto and having an elbow at the terminal joint of the other two arms, a secondary four arm lazy tongs pantograph with its fulcrum at the free end of one arm and its stylus at the free end of the arm which is terminally jointed thereto and having an elbow at the terminal joint of the other two arms, a common pivot connecting said elbows of both the primary and secondary pantographs, and a rigid bar carrying the fulcrums of both of said pantographs in spaced relation to one another.

5. A duplex pantograph comprising: a primary four arm lazy tongs pantograph with its fulcrum at the free end of one arm, and its stylus at the free end of the arm which is terminally jointed thereto and having an elbow at the terminal joint of the other two arms, a secondary four arm lazy tongs pantograph with its fulcrum at the free end of one arm and its stylus at the free end of the arm which is terminally jointed thereto and having an elbow at the terminal joint of the other two arms, a common pivot connecting said elbows of both the primary and secondary pantographs, and a rigid bar carrying the fulcrums of both of said pantographs in spaced relation to one another, said fulcrum being adjustable longitudinally of said rigid bar to vary the distance between them at the will of the operator.

6. A duplex pantograph comprising: a primary four arm lazy tongs pantograph with its fulcrum at the free end of one arm, and its stylus at the free end of the arm which is terminally jointed thereto and having an elbow at the terminal joint of the other two arms, a secondary four arm lazy tongs pantograph with its fulcrum at the free end of one arm and its stylus at the free end of the arm which is terminally jointed thereto and having an elbow at the terminal joint of the other two arms, a common pivot connecting said elbows of both the primary and secondary pantographs, a rigid bar carrying the fulcrums of both of said pantographs in spaced relation to one another, said fulcrums being adjustable longitudinally of said rigid bar to vary the distance between them at the will of the operator, and a clamp longitudinally adjustable with respect to said bar for rigidly clamping said bar to a table or other support.

7. In an assembly of the character described, a clamp adapted to be rigidly clamped to a drawing board, said clamp being provided therein with an opening, a rigid bar extending through said opening and longitudinally adjustable therein, a set screw for securing the bar rigidly to the clamp, and a pantograph with its fulcrum rigidly supported on the bar.

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