Sept. 16, 1952 C. R. COMPTON 2,610,404

THREE-DIMENSIONAL PANTOGRAPHIC REPRODUCING MACHINE

Filed Sept. 2, 1948 4 Sheets-Sheet 1

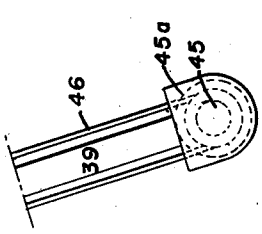


Fig. VIII

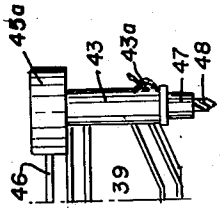


Fig. IX

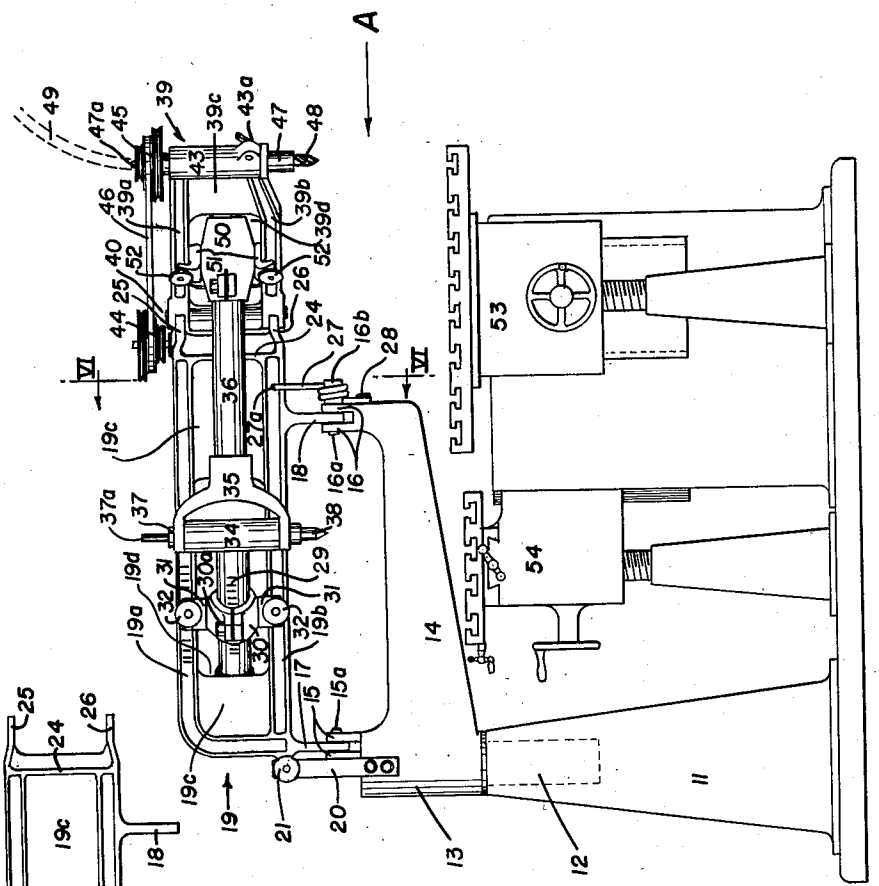


Fig. I

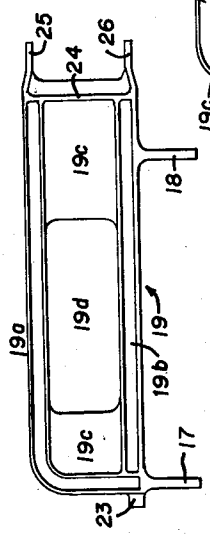


Fig. XI

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THREE-DIMENSIONAL PANTOGRAPHIC REPRODUCING MACHINE

Filed Sept. 2, 1948 4 Sheets-Sheet 2

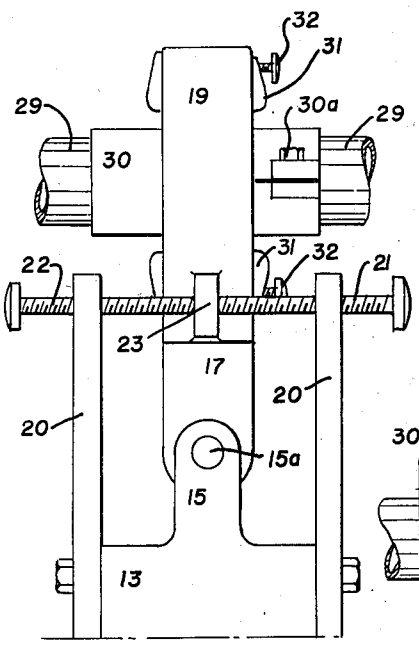


Fig. V

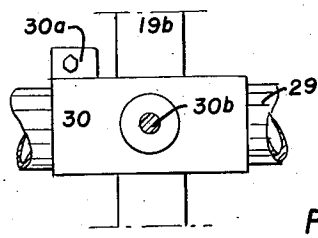


Fig. VII

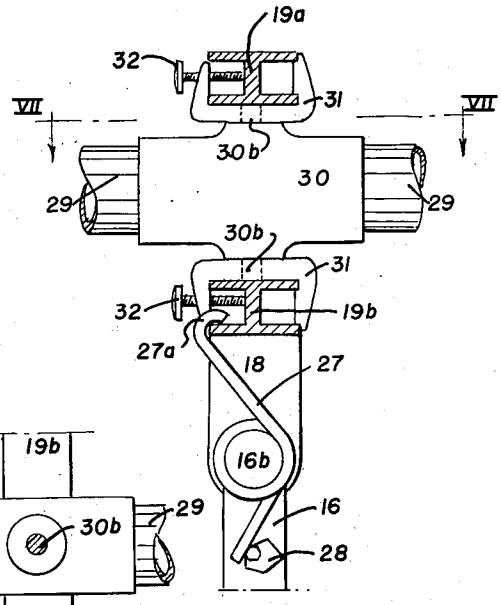


Fig. VI

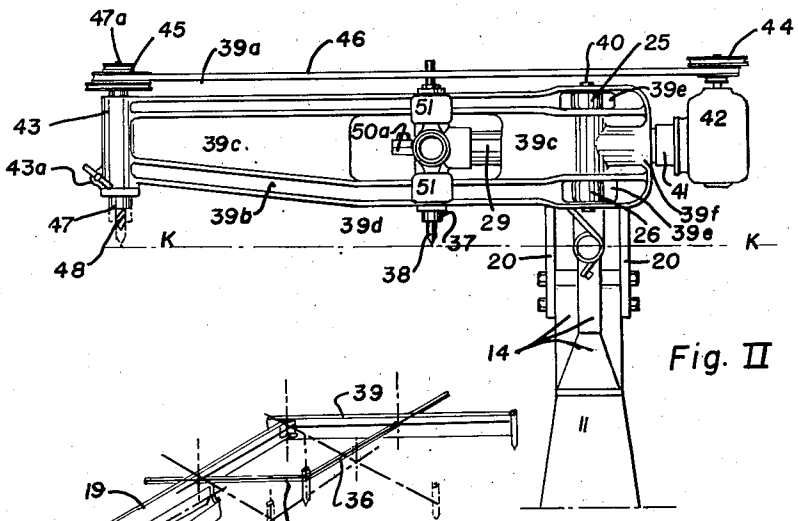


Fig. II

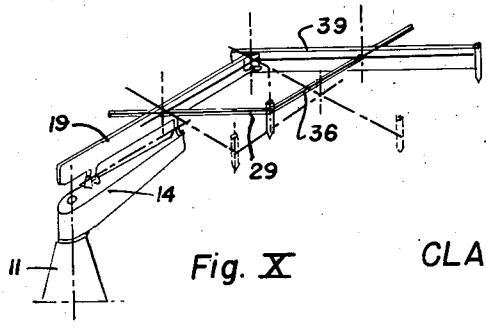


Fig. X

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THREE-DIMENSIONAL PANTOGRAPHIC REPRODUCING MACHINE

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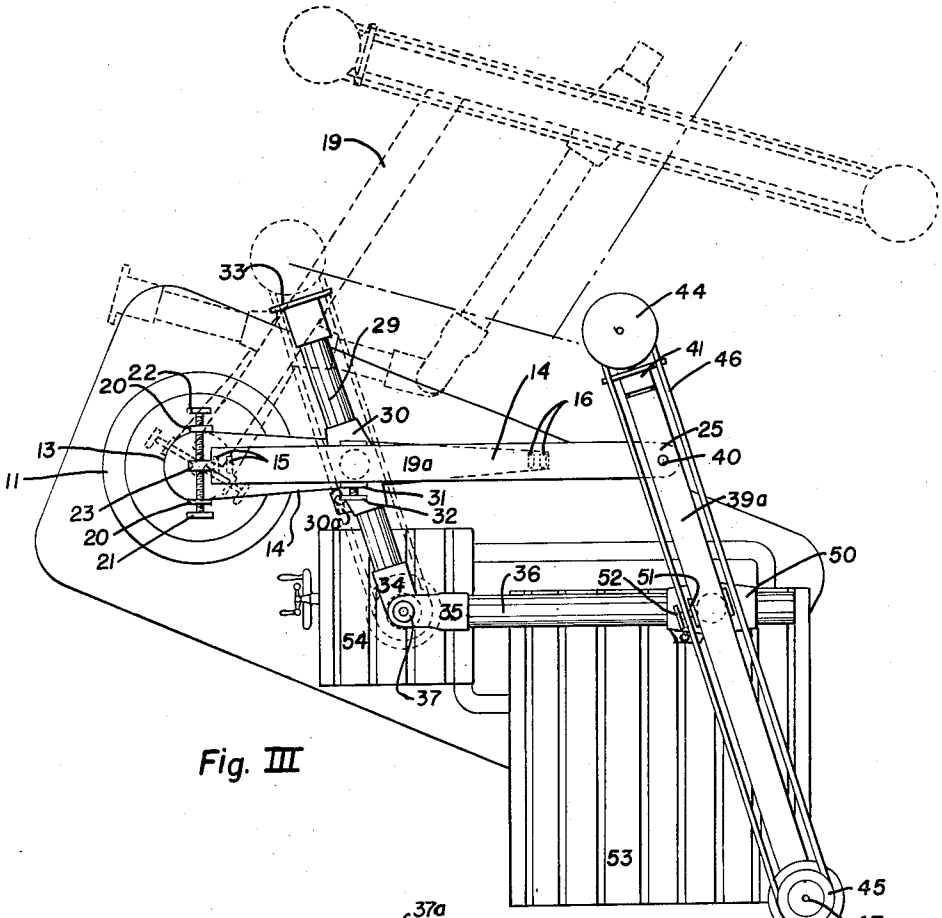


Fig. III

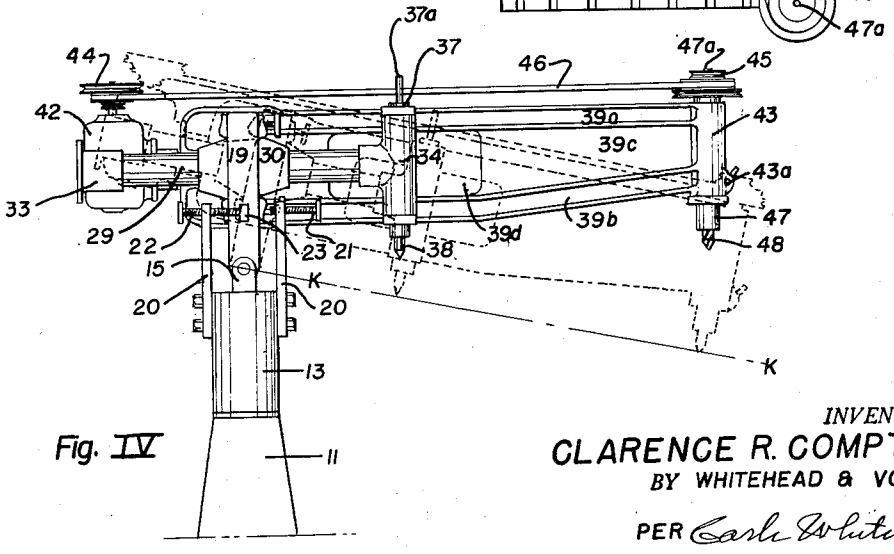


Fig. IV

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THREE-DIMENSIONAL PANTOGRAPHIC REPRODUCING MACHINE

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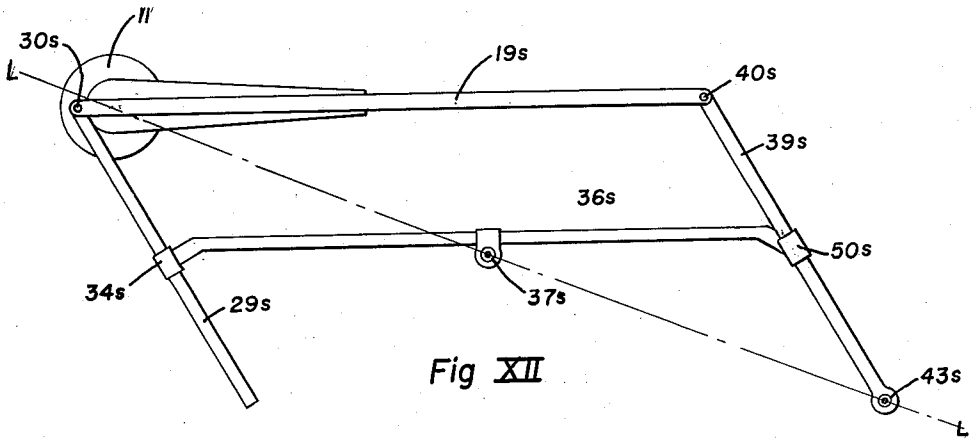


Fig XII

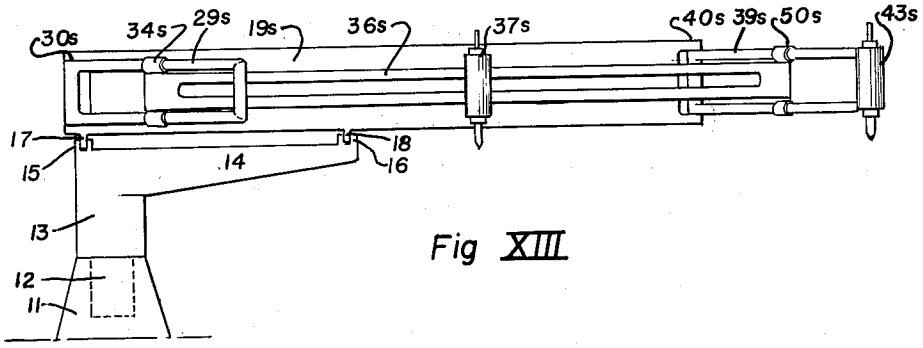


Fig XIII

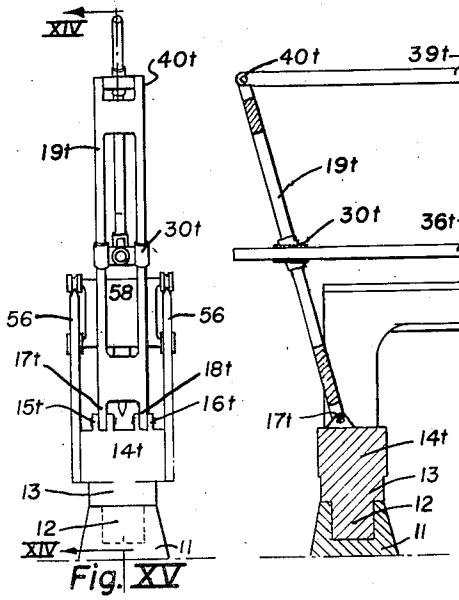


Fig. XV

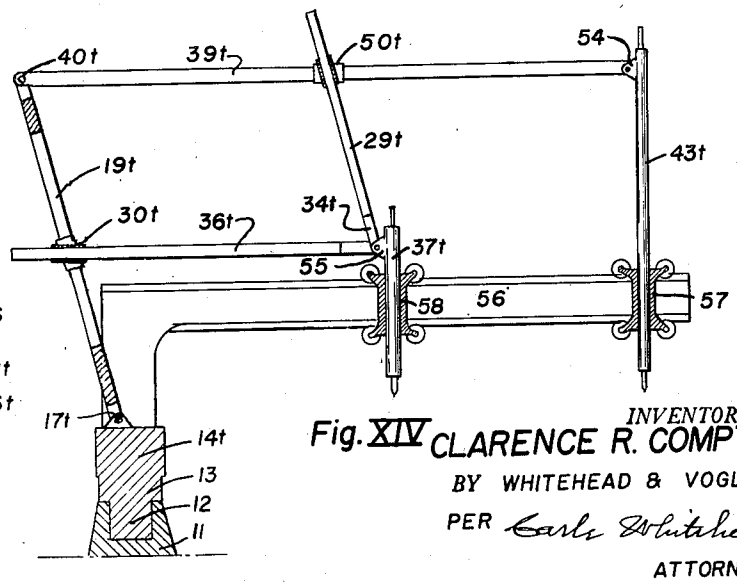


Fig. XIV

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UNITED STATES PATENT OFFICE

2,610,404

THREE-DIMENSIONAL PANTOGRAPHIC REPRODUCING MACHINE

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Application September 2, 1948, Serial No. 47,387

3 Claims. (Cl. 33—23)

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This invention relates to machines for reproducing, in selectively varied proportions, a large variety of articles, including among many others such articles as dies, molds, engravings and the like, and especially to machines of that class which operate in three dimensions using a pantographic action.

An object of the invention is to provide a device of the class described which shall be adapted by pivotal mounting for swinging horizontally throughout a circle and which shall be hingedly mounted upon said pivotal mounting in such manner as to provide a raising and lowering of the tools attached to the pantograph in varied proportional heights and depths.

Another object of this invention is to provide a device of the type last above described which shall be adapted to raise and lower the tools attached to the pantograph in planes perpendicular to the axis of the said hinged mounting.

Yet another object of this invention is to provide in a machine of the class described, a pantograph having its supporting element mounted by a horizontally axised hinge to a vertically axised pivotal support.

Another object of this invention is to provide in a machine of the class described, a pantograph having its supporting element mounted on a vertically axised pivot, said supporting element having incorporated therein a horizontally axised hinge.

With the foregoing and other objects in view, all of which shall more fully hereinafter appear, the invention comprises certain novel constructions, arrangements and combinations of parts as shall now be described and as defined in the appended claims and illustrated, in preferred embodiment, in the accompanying drawings, in which

Figure I is a front elevation of a pantographic machine constructed according to the present invention.

Figure II is a side elevation of the machine illustrated at Fig. I looking in the direction of the arrow A at Fig. I.

Figure III is a plan of the same machine and indicating, in dotted lines, certain movements or change of position of the pantograph and associated parts.

Figure IV is a side elevation of the machine illustrated at Fig. I and looking in the direction of the arrow 4 at Fig. I.

Figure V is a fragmentary view, on enlarged scale, of the top of the rotatable hub and certain parts associated therewith and immediately

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thereabove, looking in the same direction as at Fig. IV.

Figure VI is a fragmentary sectional view, on enlarged scale, taken on line VI—VI of Fig. I.

Figure VII is a fragmentary sectional view, taken on line VII—VII of Fig. VI.

Figure VIII is a fragmentary plan of the extreme right portion of the machines shown at Fig. I but illustrating a cover guard positioned over the pulley.

Figure IX is a front elevation of the fragment illustrated at Fig. VIII.

Figure X is a diagrammatic view illustrating the principle of construction and operation of the machine.

Figure XI is a detail view of the base member of the pantograph.

Figure XII is a diagrammatic plan view of a modified embodiment of the present invention.

Figure XIII is a diagrammatic elevation view of the structure shown at Fig. XII.

Figure XIV is a diagrammatic view in side elevation of a still further modified embodiment of the invention, being partly in section on line XIV—XIV, Fig. XV.

Figure XV is a diagrammatic end elevation of the embodiment illustrated at Fig. XIV.

The entire machine, including the prime mover, furnishing the operative power, is mounted on any suitable standard 11 by means of pivot 12, rotatably mounted in the standard and surmounted by hub 13. In the Figs. I to XI embodiment a supporting arm 14 projects from the hub and is provided with the upstanding pairs of ears 15 and 16 between which are pivotally mounted, by means of co-axial pins 15*a* and 16*a*, lugs 17 and 18 depending from the pantograph base 19. The base 19, which both carries, and forms the pivot arm of, the pantograph, is hingedly carried by and above the arm 14 so that the entire pantograph structure may be swung in a horizontal plane by swinging the arm 14 and the pantograph structure itself may be inclined or tilted out of such horizontal plane by tipping the base 19 on the hinges 15—16—17—18, all as hereinafter described.

The means for permitting and limiting the degree of inclination of the base 19, illustrated, on enlarged scale, at Fig. V, comprise standards 20, uprising from hub 13 and carrying threaded pins 21 and 22 in their upper ends, the points of the pins normally abutting opposite sides of lug 23 carried on and projecting from the rear of base 19 whereby the retraction of one pin permits the base to be tipped toward the retracted pin,

while the other pin limits the movement of the base in the opposite direction. It will be seen that the pins 21 and 22 may be respectively retracted and advanced and kept in abutting position against opposite sides of lug 23 whereby the base may be inclined to and locked, by the pins, in any desired inclination or one pin may be retracted to the desired limit of inclination of base 19 without advancing the other pin whereby the base, and its carried pantograph, may be inclined or straightened to any desired degree between the points of the two pins.

The base 19 comprises upper and lower I beams 19a and 19b, the upper beam 19a being bent down to connect with the rear end of beam 19b and likewise to form the portion which carries the lug 23. There is preferably provided a web 19c connecting the beams 19a and 19b which web is provided with a cut-out 19d for the purpose later described. The forward ends of beams 19a and 19b are connected by strengthening rib 24 and the beams are projected forwardly beyond the rib 24 into and forming upper and lower lugs 25 and 26 between which a portion of the pantograph is pivotally mounted as later described.

In order to cushion and counterbalance the swinging of the base 19 on the hinges 15—16—17—18 between the points of pins 21 and 22, whenever said points are separated, whereby to permit such movement of lug 23 between the points, I provide spring 27 coiled around stub 16b which is preferably an enlarged extension of pin 16a, the upper end of the spring being hooked over a flange of beam 19b as at 27a and the lower end of the spring being seated against a cam member 28 adapted to be rotated and thereby increase or diminish the tension of the spring.

The base 19 constitutes the pivot arm of the pantograph which is attached to the fixed pivot 12 through the hub 13. Another limb of the pantograph, the minor work arm 29, is pivotally attached to the base 19 in the cut-out 19d by doubly adjustable sliding mountings 30 and 31. The arm 29 is mounted in sleeve 30 which has a normal sliding fit on arm 29, but is split and provided with lugs and a tightening bolt, all as generally indicated at 30a, for clamping the sleeve to the arm at any desired point, thereby adjusting the effective length of the minor work arm 29. The sleeve 30 is pivotally mounted to clamps 31, which are slidable, respectively, along beams 19a and 19b and clampable thereto by thumb screws 32, the pivotal mounting of the sleeve in the clamps being indicated at 30b, Fig. VII. It follows that the position of the pivot 30b may be adjusted along the base 19 longitudinally of said base.

The beam 19a and the minor work arm 29 are preferably scaled as indicated on the drawing to facilitate exact adjustments. As one object of this invention is to provide a pantograph in which power-driven engraving or cutting tools may be attached to either the minor or major working head, there is located a motor mount 33 at the rear end of the minor working arm 29 to permit attachment of a power source, or prime mover, which will be movable in conjunction with the movements of the minor working head, but stationary with respect to the minor working head itself.

The minor working head consists of a housing 34 attached to the front end of shaft 29, and a yoke 35 attached to the coordinating arm 36 of the pantograph. This housing and yoke are pivotally interconnected by spindle shaft 37 in

such a manner that the axis of the shaft 37 is perpendicular to the axis of the arms 29 and 36, and perpendicular to the tilt axis formed by the pins 15a and 16a, and parallel to the axis of the pivot 30b. However, it is to be noted that the axis of the shaft 37 is not parallel to the axis of the fixed pivot 12 whenever the pantograph is tilted about the axis formed by pins 15a and 16a, but will be inclined from the axis of pivot 12 to the same degree that the pantograph is tilted. Since this spindle shaft is rotatable in the working head formed by housing 34 and yoke 35, an extension 37a is provided to connect pulleys or gears to effect rotation of the shaft. In the lower end of the shaft 37 there is provided a hole or collet for the purpose of mounting tools rotatable with shaft 37 or for providing a work guide pointer 38 as shown.

The major working arm 39 is pivotally attached to the base 19 on lugs 25 and 26 by pin 40, the axis of pin 40 being parallel with the axis of the shaft 37 and the pivot 30b. The construction of the arm 39 is similar to that of the base 19, consisting of two beams 39a and 39b, and of a web 39c. A cut-out 39d is provided to accommodate the mountings of the coordinating arm 36, described above, for the purpose later described. Cut-outs 39e are also provided in the beams 39a and 39b to accommodate lugs 25 and 26 to which the arm 39 is attached.

The flanges of the beams 39a and 39b are joined and the web is reinforced at 39f to form motor mount 41 to which motor 42 may be attached. As shown, this motor provides rotatable power to the major working head 43 by means of pulleys 44 and 45 and belt 46. A hood 45a covers pulley 45.

The major working head consists of a housing 43 attached to the beams 39a and 39b and the web 39c, forming a single unit. Inside this housing there is a spindle shaft 47 with axis parallel to the spindle shaft 37. As may be seen from the drawings, rotation of this spindle shaft 47 may be accomplished through the pulley on the extension 47a. In the lower end of the shaft 47 there is provided a hole or collet for the purpose of mounting tool 48 rotatable with shaft 47 as shown.

With the belt and pulley construction shown in the drawing and above described, it is obvious that the motor must be in fixed relation to the working head as shown, and described. However, it will also be obvious that when the power required is small enough to permit the efficient use of flexible connections, as flexible shaft 49, such flexible shaft may be connected with spindles 37a and 47a and may lead from a motor which need not be in fixed relation with the working head. It is also obvious that by intermediate pulleys and belts, the motor may be placed in various positions other than those shown, and still maintain a constant operative relationship to the working head.

The distal portion of the coordinating arm 36 is pivotally attached to the major working arm 39 by doubly adjustable sliding sleeves and clamps 50—51 which are identical in structure and function with the mountings 30—32, arm 36 being mounted and having a normal sliding fit in sleeve 50. The sleeve 50 is pivotally mounted in clamps 51 which are slidable along beams 39a and 39b and clampable thereto by thumb screws 52.

A motor mount 41 is provided at the rear end of the arm 39 to which motor 42 may be attached to provide rotatable power to the major

working head 43 by means of the pulleys 44 and 45 and the belt 46. At the working head 43 there is a spindle shaft 47. This shaft is similar to shaft 37, serving a similar purpose. The pulley 45 is shown attached to the extension of the spindle 47 by the extension 47*a*, which is similar to the extension 37*a* so pulley 45 may be set interchangeably upon either extension.

In the operation of a three dimensional pantograph whereby contours and patterns are duplicated to various scales, it is necessary that the points of the cutting tool 48 and the pointer 38 be in a plane which passes through the axis of the pins 15*a* and 16*a* as shown by the line K in Figures II and IV. Since the cutting tool 48 will not necessarily lie in this plane when set in the machine, there is an adjusting ratchet provided at 43*a* whereby the spindle and its tool 48 may be moved axially to effect an adjustment of the cutting tool. Such adjusting ratchet will not be described further since it may be of conventional construction.

In operation of a machine of the nature described, vertically adjustable tables 53 and 54 are provided for the model and work, table 54 being horizontally adjustable as well as vertically. The work and the model are placed on the respective tables according to whether the operation is to be an enlargement or reduction. These tables may be of any approved design and form no part of the present invention.

With the work and the models placed upon the tables and adjusted to the desired position and the tables adjusted to desired relative positions, the tools may be moved horizontally by swinging the pantograph on the pivot 12 and by the movement of the pantograph itself. For a wide range of work this horizontal movement may be accomplished throughout a 360 degree movement of the pantograph.

By thus swinging about pivot 12 the tools may be used for operation at any point within a complete circle, thus making possible operation by the single machine on a number of different tables similar to 53 and 54 positioned circularly about standard 11. Vertical adjustment of the tools, to attain three dimensional action, is obtained by tilting the pantograph about hinges 15—16—17—18.

In the embodiment illustrated in Figs. XII and XIII, the standard 11, pivot 12 and hub 13, are identical with those already described. In this embodiment the parts 14 to 18 are identical in function and substantially identical in structure with those in the first-described embodiment. Other associated elements, previously described, which may be appropriately incorporated in this embodiment, are not included in the diagrammatic illustration because unnecessary for complete illustration of the differences in embodiment. The material differences of this embodiment from that previously described are fully illustrated at Figs. XII and XIII.

A pantograph for reproduction on a single plane, attained by movements of the various coordinating and working arms, requires three fixed hinges, and two adjustable hinges for making adjustments of scale; said hinges may be arranged in various interrelationships, and any pantograph having such requirements may be incorporated in a machine embodying this invention.

On hinges 15—18 there is mounted pivot arm 19*s*, to the ends of which there are attached working arms 29*s* and 39*s* by fixed hinges 30*s* and

40*s*, the working arms being connected by coordinating arm 36*s* slidably clamped to the working arms at 34*s* and 50*s*, the arm 36*s* being pivotally connected with clamps 34*s* and 50*s*. The minor working head 37*s* is slidably connected with coordinating bar 36*s*, while the major working head 43*s* is positioned at the end of arm 39*s*. With this construction, the minor working head 37*s*, when properly adjusted on arm 36*s* for the work in hand, will be in the line L—L from the center of pivot 12 to the center of major working head 43*s*. This embodiment differs from that previously described in that 30*s* is a fixed hinge, while the corresponding element 30 of the previous embodiment, is a doubly slidable connection; hinge 34*s* is a slidable pivotable connection, whereas 34 is a fixed hinge; hinge 50*s* is a slidable pivotable connection, whereas 50 is a doubly slidable pivotable connection; the minor working head 37*s* is slidably mounted on coordinating arm 36*s*, whereas in the previous embodiment the minor working head is centrally positioned in the fixed hinge 34. Nevertheless, the operation and accomplishment of this later embodiment are the same as those of the Fig. I—XI embodiment.

The embodiment illustrated in Figs. XIV and XV is mounted on standard 11, by pivot 12 and hub 13, the same as in the previously described embodiments. A preferably enlarged top 14*t* of hub 13 carries ears 15*t* and 16*t* forming a part of the pivot arm 19*t* and pivotally connected thereto by the pinned lugs 17*t* and 18*t*. The arms 19*t*, 29*t*, 36*t* and 39*t*, respectively, function the same as the arms 19, 29, 36 and 39 of the first-described embodiment, and they are respectively connected by doubly slidable and pivotal hinges 30*t* and 50*t* and by fixed hinges 34*t* and 40*t* respectively functioning in identical manner with and of substantially the same structure as hinges 30 and 50 and 34 and 40 in the first-described embodiment. In the latter embodiment as may be seen in the drawings, the pantograph is set and moves in a vertical plane which requires a somewhat different mounting for the working heads. The major working head 43*t* and the minor working head 37*t* are pivotally mounted respectively at the ends of arms 39*t* and 36*t* by pinned lugs 54 and 55 respectively. In this embodiment it is preferable to hold the working heads in a vertical position, and for this purpose there is provided a double guide arm 56 rigidly connected with the hub 13. On this double guide arm there are provided roller carriages 57 and 58 adapted to roll along the arms responsive to the pantographic movement of the working heads. The body of each carriage comprises a sleeve in which the respective working heads have a vertical sliding fit, whereby the working heads may be moved longitudinally along the guide arms by the pantographic action or may be raised and lowered through the carriages by the tilting of the pantograph on hinges 17*t* and 18*t*, but the carriages will always hold the working heads in vertical position.

The only differences between this embodiment and those previously described, are those necessary to translate the essential movements from a horizontally mounted pantograph to a vertically mounted pantograph, and these differences are, in substance, that hinges 15—18 are positioned along the side of pivot arm 19 and 19*s* in the embodiments previously described, but are incorporated as hinges 15*t* to 18*t* in the end of the pivot arm 19*t* in the present embodiment; the working

heads 37*t* and 43*t* are pivotally suspended from the ends of the respective arms and held in the plane of the pantograph instead of, as in the previous embodiments, being positioned through the ends of the arms in a plane at right angles to the plane of the pantograph. There is a further preferable difference that in the present embodiment means may be and are provided for holding the working heads vertical during all operations.

While I have illustrated and herein described many details of construction, alternatives or equivalents will occur to those skilled in the art and I am not to be limited in my protection to the details illustrated or described.

I claim:

1. A pantographic reproduction machine including, in combination, a standard, a supporting arm pivotally mounted on said standard, projecting laterally therefrom and adapted to rotate in a full circle thereabout on a vertical axis, a two dimensional pantograph having its pivot arm carried above said supporting arm by hinge means comprising lugs upstanding on said supporting arm and lugs depending from said pivot arm hingedly attached to said supporting arm lugs, the hinge means having an axis perpendicular to and intersecting the vertical pivot axis, tool and tracing means on said pantograph having their respective operating and guiding points depending from the pantograph frame and thereby adapted for movement in a plane offset from a plane medial to the arms of the pantograph and intersecting said perpendicular pivot axis at its intersection with said hinge axis, whereby tiltable movements of the pantograph about said hinge axis are accompanied by rotation of said plane of the points about said hinge axis, the guiding points being so aligned that a line therethrough and projected will intersect the point of intersection of said vertical-pivot and hinge-means axes in all positions of said points, whereby said operating and guiding points provide for reproduction, on a different scale, by the operating point of a three dimensional model traced by the guiding point.

2. A pantographic reproduction machine including, in combination, a standard, a supporting arm pivotally mounted on said standard and projecting laterally therefrom and adapted to rotate in a full circle thereabout on a vertical axis, a two dimensional pantograph having its pivot arm carried above said supporting arm by hinge means having an axis perpendicular to and intersecting the vertical pivot axis, tool and tracing means on said pantograph having their respective operating and guiding points adapted for movement in a plane which intersects and is tiltable about said hinge-means axis and with said operating and guiding points so aligned that a line therethrough and projected will intersect the point of intersection of said vertical-pivot and hinge-means axes in all positions, whereby said operating and guiding points provide three dimensional pantographic operation, opposing standards upstanding from the supporting arm, opposing adjusting screws in said standards and a lug outstanding from the pivot arm and projecting between said adjusting screws to limit tiltable movements of the pantograph.

3. A pantographic reproduction machine including, in combination, a standard, a supporting arm pivotally mounted upon said standard, projecting laterally therefrom and adapted to rotate in a full circle thereabout on a vertical axis, a two dimensional pantograph having its pivot arm carried above said supporting arm by hinge means having an axis perpendicular to and intersecting said vertical pivot axis, tool and tracing means on said pantograph having their respective operating and guiding points adapted for movement in a plane which intersects and is tiltable about said hinge-means axis and with said operating and guiding points so aligned that a line projecting therethrough will always intersect the point of intersection of said vertical pivot and hinge-means axes, whereby said guiding point may follow a three dimensional model and said operating point may reproduce said model on a different scale, said hinge-means comprising lugs depending from the pantograph pivotally connected to lugs upstanding the supporting arms, and wherein said operating and guiding points are laterally offset from the plane medial to the pantograph arms to provide operative clearance between said points and the pantograph.

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