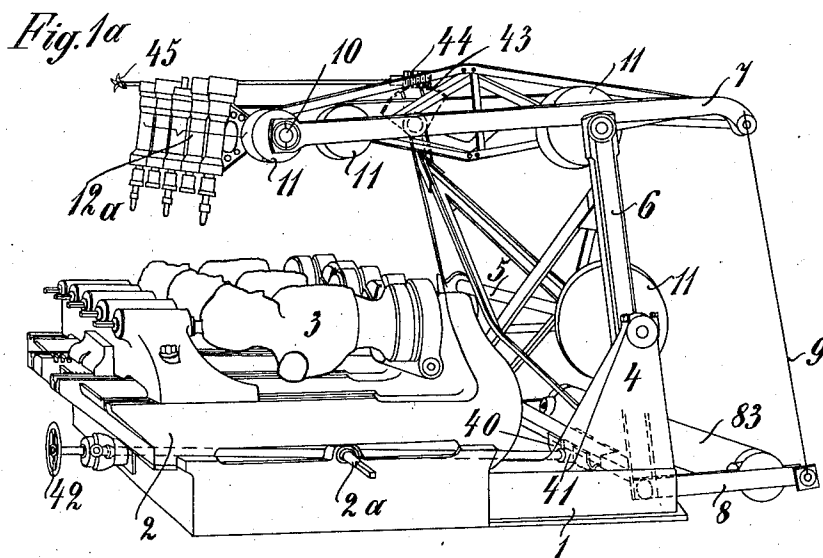
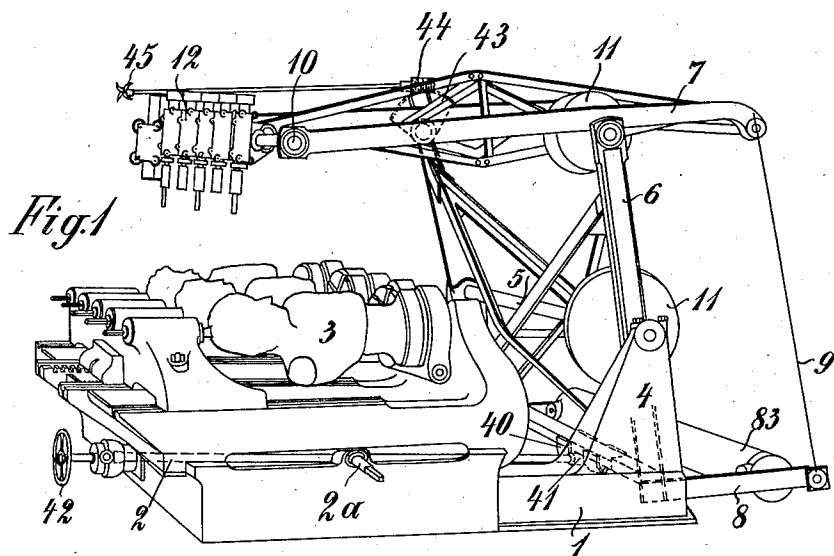


E. PETERS.
STATUARY COPYING MACHINE.
APPLICATION FILED OCT. 22, 1912.

1,058,384.

Patented Apr. 8, 1913.

3 SHEETS-SHEET 1.



Witnesses:
Y. Heck
Richard Magner

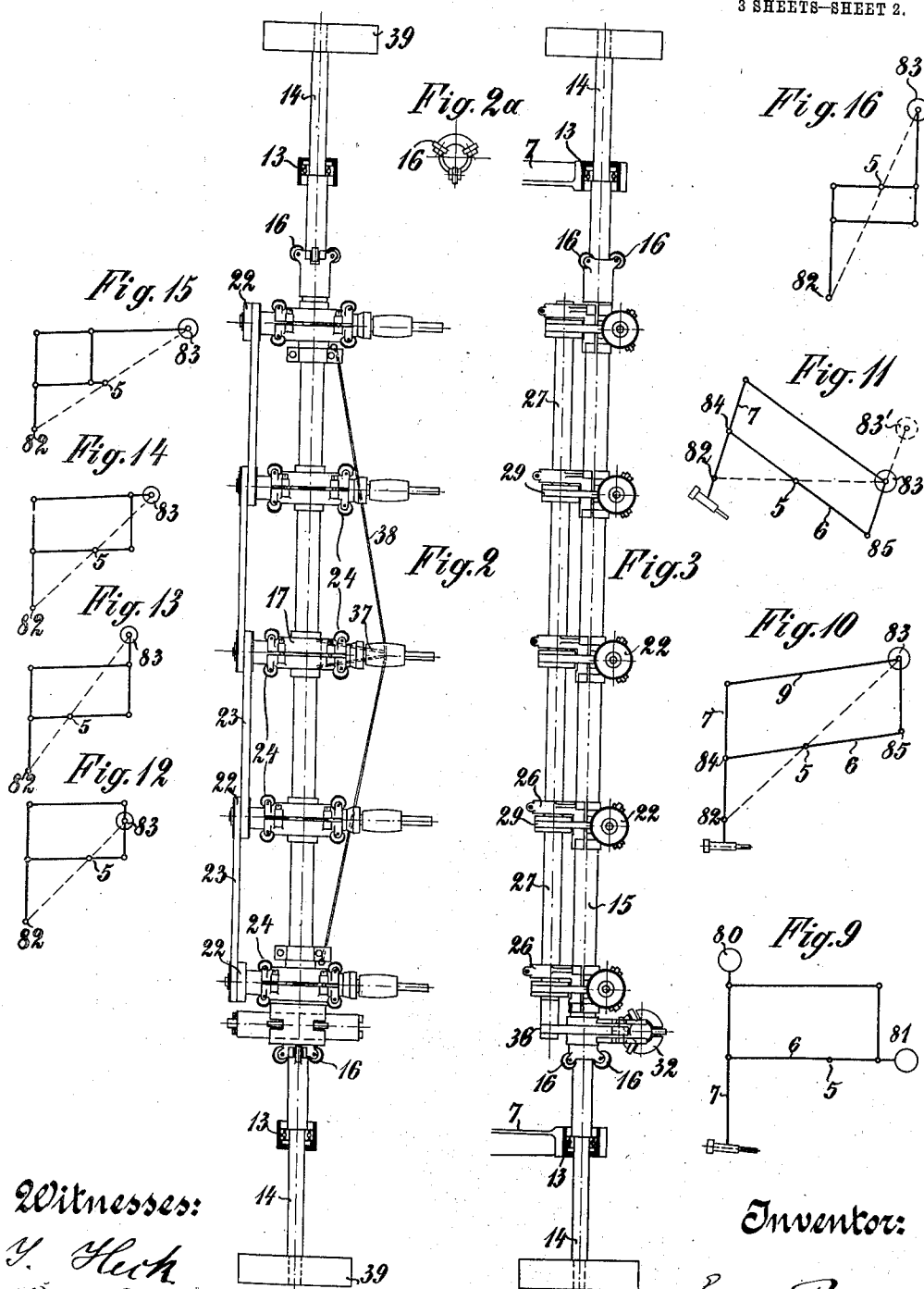
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3 SHEETS—SHEET 2.



Witnesses:
Y. Fleck
Richard Wagner

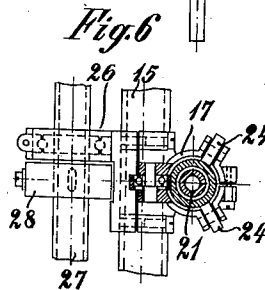
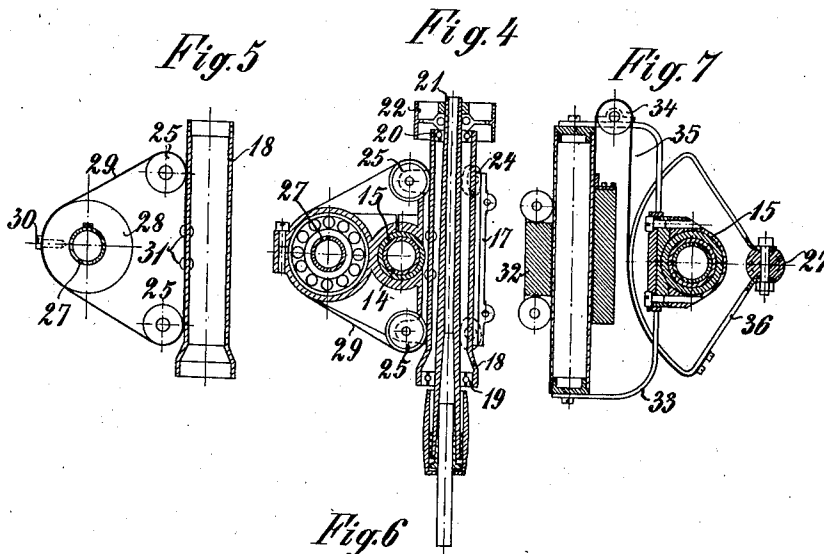
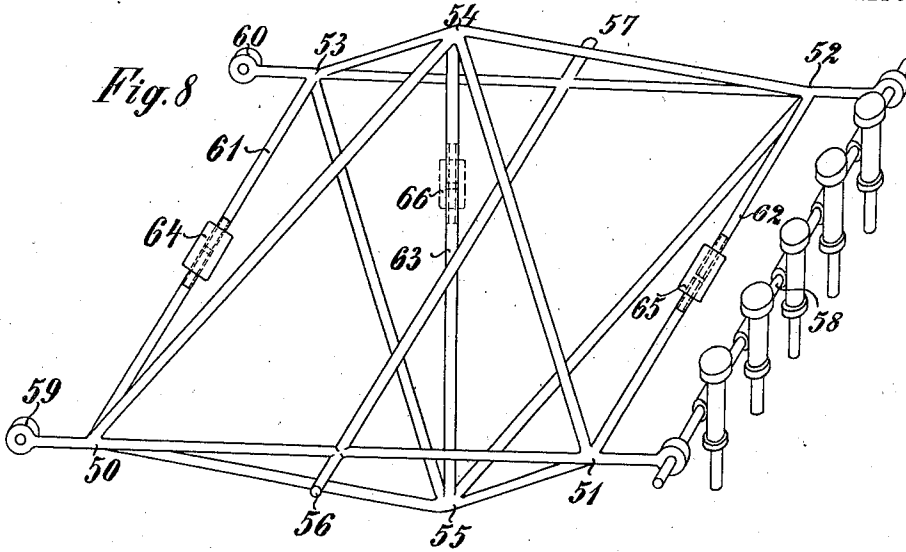
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3 SHEETS-SHEET 3.



Witnesses:
Y. Heck
Richard Wagner

Inventor:
E. Peters

UNITED STATES PATENT OFFICE.

ERNST PETERS, OF BERLIN-KARLSHORST, GERMANY.

STATUARY-COPYING MACHINE.

1,058,384.

Specification of Letters Patent.

Patented Apr. 8, 1913.

Application filed October 22, 1912. Serial No. 727,240.

To all whom it may concern:

Be it known that I, ERNST PETERS, a citizen of Germany, residing at Berlin-Karls-horst, Germany, have invented new and useful Improvements in Statuary-Copying Machines, of which the following is a specification.

My invention relates to a statuary copying machine of that type in which the set of tools, comprising mechanically driven tools and feeler, is mounted to rock in one of two frames pivotally connected together. This frame carrying the set of tools will hereinafter be termed the "tool frame". The other frame, hereinafter termed the "supporting frame", rocks about two pivots journaled in stationary bearings. All three axes of the combined tool and supporting frames constituting one "transmission frame", the axis of oscillation of the set of tools and the two axes about which the frames oscillate, are parallel to one another. The set of tools comprises several tools, *e. g.* milling tools, and a feeler having parallel axes. The axis about which the set of tools rocks is parallel with the plane passing through the axes of the tools. This arrangement enables the tools to work every point in a plane and to undercut the work-pieces at places in the plane. In known machines of this type, when guiding the tools for working the work-pieces, the entire mass of the transmission frame and the mass of the various weights used for balancing the frame and the set of tools had always to be driven with it. When the transmission frame is constructed in the usual manner the arrangement of several balancing weights in statuary copying machines enables only clumsy working and simultaneously causes inaccuracies in workmanship, because the transmission frame cannot be made sufficiently rigid and free to oscillate, particularly for continuous working, or the rigid frame and the usual arrangements of weights are too unwieldy or cumbersome when constructed in known manner. In another type of machine the tool frame is made elastic as a jointed parallelogram, for the purpose of being able to make undercuts, the same running at right angles to the plane of oscillation of the fixedly mounted frame. Both in this flexible construction of frame and also in the rigid construction of

the transmission frame known heretofore only relatively small motive forces for maintaining fairly proper working of the machine could, however, be transmitted to the mechanically driven set of tools. In the known machines, therefore, the work-pieces could be mechanically worked according to the model either only relatively coarsely or imperfectly, and then had to be removed from the machine in order to be subsequently worked up by hand in the case of delicate models, thereby generally entailing very tedious and expensive work, or such machines worked properly only at first when there was no play at all in their joints.

In my improved statuary copying machine comprising a perfectly rigid tool frame it is possible to work two, four and more work-pieces simultaneously according to one given model, and with a degree of accuracy unobtained heretofore, by means of the mechanically driven set of tools for the preliminary work, and employing larger mechanical forces than heretofore, while by employing a separate, mechanically or manually driven set of tools for the delicate work it is possible to reproduce all the details of the model in all the work-pieces simultaneously, without the work-pieces and model being removed at all from the machine, almost or entirely without retouching by hand. These improvements which are exceedingly important for mechanical sculpture or for copying statuary are obtained according to the invention, firstly, by making the tool frame specially adapted for mechanical preliminary work by constructing the framework in the general form of a rhomboid, which is preferably suitably stiffened by ties, has relatively little weight, and does not warp, bend or become otherwise deformed even when transmitting larger mechanical forces than those used heretofore; secondly, by an ingenious arrangement of one single counterweight for balancing both the transmission frame itself and also the mechanically driven set of tools, readier movability of the transmission frame and a diminished load on the same being obtained; and, thirdly, by the improved construction of frame which enables a separate set of tools to be used for the delicate or retouching work of the work-

pieces without removing the same from the machine, because my rigid frame enables work-pieces to be worked delicately in common in a certain, exact and steady manner such as has not been known heretofore for the delicate finishing work in statuary copying machines.

The set of tools for delicate work is able to move in various ways, as compared with the set of tools for the preliminary work, relatively to the common bearing for the two sets of tools in the rigid frame, so that when this set of tools is employed for the delicate work the tool and supporting frames can be fixed rigidly relatively to its axis of oscillation and only be displaced when the set of tools for the delicate work has completely worked the surface passed over by it and is to be adjusted for a new surface.

The holding device for the work-pieces and for the model is formed as a slide which can be shifted laterally by means of an endless screw. This arrangement of the slide is necessary in order to be able to make undercuts not located in the plane of oscillation of the transmission frames by means of the mechanically driven set of tools.

The invention is illustrated in the accompanying drawings, wherein:—

Figures 1 and 1^a are general views in perspective showing the copying machine, Fig. 1 showing the set of tools for the delicate work, and Fig. 1^a showing the mechanically driven set of tools for the rough or preliminary work; Figs. 2 and 3 are elevation and top plan view, respectively, showing the arrangement of the set of tools for the detail work; Fig. 2^a is a detached detail view. Figs. 4 to 7 are detail views, enlarged, showing details of this arrangement; Fig. 8 is a perspective view showing the construction and arrangement of the tool frame; Fig. 9 is a diagram showing a known balancing device, and Figs. 10 to 16 are diagrams showing my improved balancing device in various positions.

The copying machine shown in Figs. 1 and 1^a comprises a work-piece slide 2 mounted in known manner on a bed-plate 1; this slide 2 can be shifted laterally by means of an endless screw 2^a; the work-pieces 3 and the model are suitably mounted on the slide and can be moved uniformly one with another by means of devices not comprised in the present invention. The bed-plate 1 has at each side a bearing bracket 4, in which is journaled a shaft 5 about which the transmission frame can rock. This frame forms a parallelogram having the pivotally connected sides 6, 7, 8 and 9, of which the sides 6 and 7 subjected to compression and bending strain are formed of two rigid frames 6, 7, each of which is stiffened by frame-work having substantially the outline of a rhomboid. The tool frame 7 is

lengthened and carries at its one end a shaft 10. On this shaft, adapted to be driven by a belt from the pulley 11, is mounted in known manner a set of tools 12^a, shown in Fig. 1^a, comprising the feeler and a milling or other tool for the mechanical rough or preliminary work. When the work-pieces have been preliminarily worked by means of this set of tools, this set is substituted by a set of tools 12, the details of which are shown in Figs. 2 to 7.

The set of tools 12 for the delicate work will hereinafter be termed the "scraping device" as these tools principally exercise a scraping action. It has at least three possibilities of movement corresponding to the three principal directions in space. Preferably, each tool can rotate about its longitudinal axis in addition.

The side members of the frame 7 are provided at their front ends with bearings 13 in which the shaft 14 is journaled, as shown in Figs. 2 and 3. A carriage 15, 16 is movable on this shaft; this carriage is formed of a tube or sleeve 15 which surrounds the shaft 14 with play and carries at each end three rollers 16 by means of which it can readily move to and fro on the shaft 14. This tube or sleeve 15 carries casings 17 in which the sleeves 18 of the spindles of the tools can move longitudinally. Guide rolls 24 and 25 insure the sleeves 18 moving readily. The tool spindles 21 are located in the sleeves 18 and are revoluble about their longitudinal axes in ball-bearings 19 and 20. Belt-pulleys 22, connected together by steel bands 23, are keyed on the top ends of these spindles, so that all the spindles always rotate axially in the same manner.

In order to produce a uniform lifting motion of all the tool spindles of the set of tools 12 for the delicate or finishing work, the device which will now be described is mounted on the sleeves 18. Bearings 26, in which a shaft 27 is journaled, are provided on the rear of the casings 17. This shaft 27 carries pulleys 28 about which the steel bands 29 are passed and attached at 30. These steel bands run over the guide rollers 25 and are attached at 31 to the sleeves 18 of the tool spindles. The longitudinal movement of the sleeve 18 of the tool spindle carrying the feeler is imparted by the shaft 27 to all the others. In order to equalize the weight of the tools tending to rotate the shaft 27 I provide a counterweight 32 (Fig. 7) which slides with guide rollers on a bracket 33 attached to the carriage 15, 16, and is connected by a steel band 35, guided over a roller 34, with a segment 36 fast on the shaft 27. The movement of the entire set of tools 12 about the axle 14 is equalized by constructive arrangements. A tensioning device 37, 38 serves for preventing the carriage 15 of the set of tools 12 being bent, 13

while the shaft 14 is prevented from being bent by counterweights 39 provided on its ends projecting beyond the bearings 13.

When the described arrangement of tools 3 is being used for finishing work, the supporting frame 6 is fixed and only moved when a new surface is to be worked. The following device, shown in Fig. 1, is used for fixing the supporting frame. The supporting frame 6 rocking about the axle 5 carries at its lower end a nut 40 which is rotatable about two pivots. A threaded spindle 41, mounted to rock in the bed-plate 1, able to be rotated by means of the hand-wheel 42, engages in this nut. The top of the frame 6 carries at one side a toothed segment 43 gearing with a worm 44 journaled in the frame 7. A hand-wheel 45 is provided for moving the worm. The fixing device 20 can be disconnected while the one set of tools is doing preliminary work, so that the supporting frame can then rock about its axes.

In order to prevent the shaft 10 twisting 25 both during the preliminary work with the mechanically driven set of tools and also, particularly, during delicate work by means of the scraping device 12, the frames forming the sides 6 and 7 of the parallelogram 30 are stiffened in an improved manner, as mentioned above. The mode of stiffening is diagrammatically shown in Fig. 8. Each of the frames consists of rods, tubes, angle-irons or figured iron or the like, so assembled that each frame has the general outline of a rhomboid which, in the construction shown, comprises two, four-sided pyramids having their bases placed one on the other. 35 The points 50, 51, 52 and 53 correspond to the corners at the bases of the pyramids, while the points 54 and 55 are the apexes. The sides 50, 51 and 52, 53 of the frames carry the pivots 56 and 57, about which the entire frame rocks. The apexes 54 and 55 40 of the pyramids are connected by a rod 63. The sides 50, 51 and 52, 53 are lengthened both ways beyond the corners of the pyramids and carry the axle 10 between them at one side; in the frame 7 (Fig. 1) this 45 axle 10 carries the set of tools. The forces which counterbalance the weight of the supporting frame and the set of tools are applied to the extensions 59 and 60.

Ties 61 and 62, provided with rod-strainers 64 and 65, respectively, are arranged between the points 50, 53, and 51, 52, respectively, for stiffening the frames. When tightening these ties all the rods forming the pyramids are compressed and all the 60 frame-work rods as well as the rod 63 connecting the apexes of the pyramids are tensioned. Also, the stiffening could be effected by shortening only the rod 63 by means of a rod-strainer.

65 By tensioning the members of the frame

the frame is protected from trembling. The members of the frame constantly subjected to tensile, compressive or bending strains damp the oscillations of the frame which are produced by the varying resistance of the tools, or by free forces of masses (acceleration pressures) resulting during the operation of the tools. 70

The device for balancing the weight of the frame and tools is so arranged that all the 75 weights are completely counterbalanced in every position of the frame by one single weight. In similar machines two separate weights were employed heretofore; Fig. 9 shows diagrammatically how they were arranged. 80 The movement due to the weight of the tool and of the frame 7 acting about the center of rotation of the latter was balanced by a weight 80, while for balancing the movement due to the total weight acting 85 about the axle 5 a weight 81 mounted on the frame 6 was used.

According to my invention I use one single counterweight 83 (Fig. 10) so arranged that a line connecting the common 90 center of gravity 82 of the frame 7 and tools with the center of rotation 5 passes through the center of gravity of the counterweight. In this case the leverage of the center of gravity 82 is always proportional to that of 95 the center of gravity 83, as the triangles 82, 5, 84, and 83, 5, 85 are similar in every position of the parts, and thus the projections of the distances 82—5 and 83—5 on the horizontal are always proportional to 100 one another, and in the position shown in Fig. 11, for example, simultaneously equal zero. If the center of gravity of the counterweight did not fall in the line 82—5, thus have approximately the position 83' in Fig. 105 11, there would be no equilibrium for all positions of the parts, as the part 83—83' of the leverage of the counterweight would not vary proportionally with the above-mentioned leverage. The side 9 of the parallelogram is subjected to tension only and 110 can therefore consist of stretched wires.

It is not necessary for the counterweight 83 to be located in a corner of the parallelogram as represented in Figs. 10 and 11. 115 As shown in Figs. 12 and 16 it may be connected in any desired manner with the parallelogram, only the line 82—5 must always pass through its center of gravity. Also, the axle 5 may be located outside the parallelogram (Fig. 15), or on that side thereof 120 nearest the counterweight (Fig. 16).

I claim:—

1. In a statuary copying machine, the combination with a bed-plate having bearings, of a supporting frame mounted to rock in said bearings, a tool frame pivotally connected with the supporting frame, and a set of mechanically driven tools and a feeler mounted to rock in the tool frame, 130

the axis of oscillation of the tools being parallel with the plane passing through the axes of the tools, the supporting frame and the tool frame each having the contour of a rhomboid.

2. In a statuary copying machine, the combination with a bed-plate having bearings, of a supporting frame mounted to rock in said bearings, a tool frame pivotally connected with the supporting frame, and a set of mechanically driven tools and a feeler mounted to rock in the tool frame, the axis of oscillation of the tools being parallel with the plane passing through the axes of the tools, the supporting frame and the tool frame being each formed of rods arranged in the base of two pyramids placed base to base.

3. In a statuary copying machine, the combination with a bed-plate having bearings, of a supporting frame mounted to rock in said bearings, a tool frame pivotally connected with the supporting frame, and a set of mechanically driven tools and a feeler mounted to rock in the tool frame, the axis of oscillation of the tools being parallel with the plane passing through the axes of the tools, the supporting frame and the tool frame being each formed of rods arranged in the form of two pyramids placed base to base, some of the rods in each frame being divided and connected by rod-strainers.

4. In a statuary copying machine, the combination with a bed-plate having bearings, of a supporting frame mounted to rock in said bearings, a tool frame pivotally connected with the supporting frame, and a set of mechanically driven tools and a feeler mounted to rock in the tool frame, the axis of oscillation of the tools being parallel with the plane passing through the axes of the tools, the supporting frame and the tool frame being each formed as a cubical framework; one single counterweight on the said frames for balancing both the tool frame

itself and also the set of tools mounted therein, the said counterweight being guided by a jointed parallelogram whose sides are formed by the two frames and two links parallel to the two planes of the frames, the counterweight being arranged on one of said links.

5. In a statuary copying machine, the combination with a bed-plate having bearings, of a supporting frame mounted to rock in said bearings, a tool frame pivotally connected with the supporting frame, an axle journaled in the tool frame, a carriage movable along said axle, casings mounted on the carriage, tool spindles rotatable and longitudinally displaceable in the casings, means for lifting and rotating the spindles conjointly, and means for fixing the frames, the axis of oscillation of the tools being parallel with the plane passing through the axes of the tools, the supporting frame and the tool frame each having substantially the contour of a rhomboid.

6. In a statuary copying machine, the combination with a bed-plate having bearings, of a supporting frame mounted to rock in said bearings, a tool frame pivotally connected with the supporting frame, and a set of mechanically driven tools and a feeler mounted to rock in the tool frame, the axis of oscillation of the tools being parallel with the plane passing through the axes of the tools, the supporting frame and the tool frame being each formed of rods arranged as square pyramids having their bases one on the other, one single counterweight on only one of the said frames for balancing both the tool frame and also the set of tools mounted thereon.

In testimony whereof I affix my signature in presence of two witnesses.

ERNST PETERS.

Witnesses:

OSKAR ARENDT,
HENRY HASPER.