

Sept. 17, 1963

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COPYING MACHINE

3,103,746

Filed Sept. 23, 1957

2 Sheets-Sheet 1

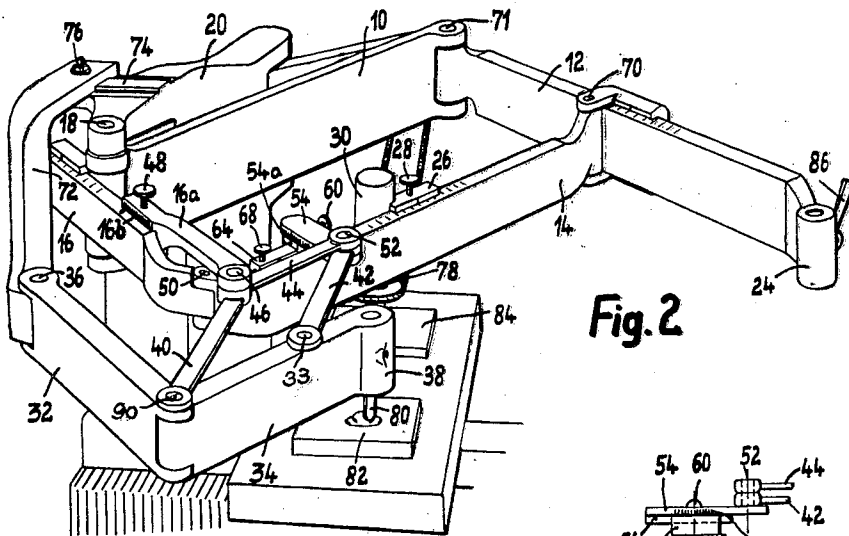


Fig. 2

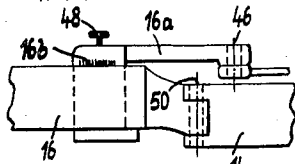


Fig. 3

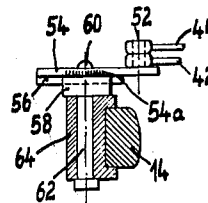


Fig. 4

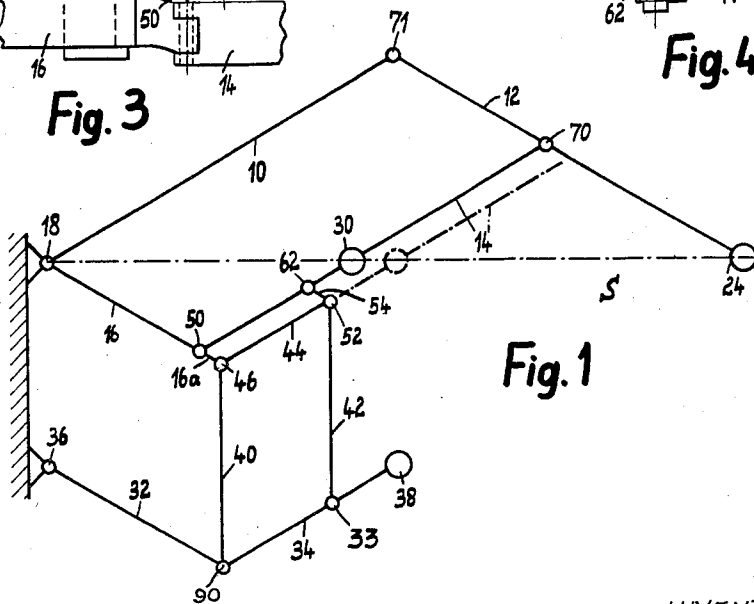
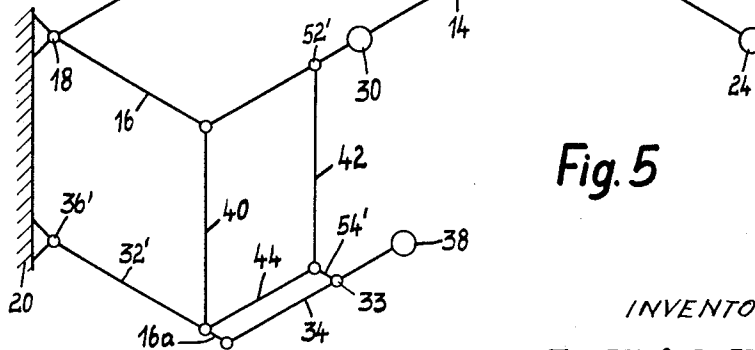
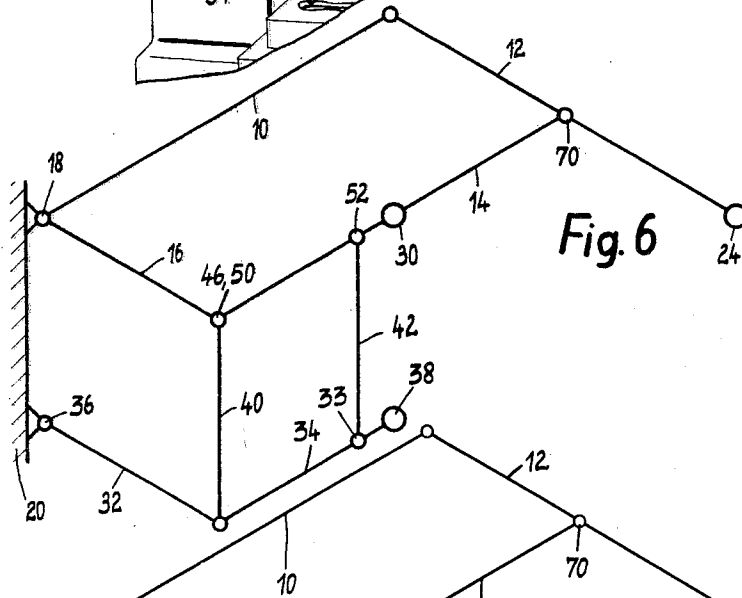
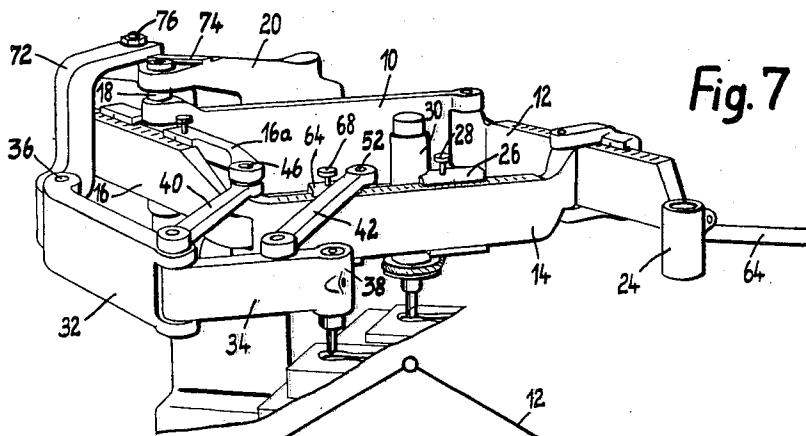


Fig. 1

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2 Sheets-Sheet 2



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3,103,746

COPYING MACHINE

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Filed Sept. 23, 1957, Ser. No. 685,657

Claims priority, application Germany Sept. 28, 1956

13 Claims. (Cl. 33—25)

The present invention relates to a copying machine adapted to assure conformity of the finished work piece with the contours of a model and provided with holders or sockets for a copying pin and at least one work tool and which includes a pantograph, of which one of the links is rigidly connected at a relatively stationary point and another link thereof pivotally secured to the first link carries a socket or holder.

In the known copying machines of this type, the effective length of the pantograph links may be adjusted and therewith the translation of movement between the socket holding the work tool and the copying pin of the pantograph may be adjusted to a predetermined ratio.

In these prior art devices the translation ratio may be adjusted ordinarily within the limits of approximately 1.5:1 and 10:1; however, such known arrangements cannot be adjusted to a ratio of 1:1 or a ratio near the ratio of 1:1, for example, to a ratio of 1.1:1 because the thickness of the material of the links and of the joints does not permit to move the pantograph so close together as would be required for such slight translatory ratios. With a ratio of 1:1, the work tool and the copying pin would coincide. Consequently, with pantograph machines of the prior art, no copying is possible in which the reproduction corresponds in size to that of the model or deviates therefrom only slightly, as is necessary for the manufacture of wooden parts having relatively small shrinkage allowance, as for example, with wooden models.

The present invention has as its primary object to provide an arrangement which obviates these disadvantages of the prior art machines.

In accordance with the present invention, links additional to the conventional pantograph links are provided which are connected with each other in the manner of a two-link chain whereby one end of this chain is pivotally secured at a further relatively stationary point and the other end of this chain carries a further socket or holder. The chain member carrying the socket is thereby guided in parallel to the pantograph link also carrying the socket while the pivoted chain member pivotally secured at the further stationary point is guided in parallel to the pivoted pantograph link which is pivoted to its stationary point at one end thereof and which is pivotally connected to the pantograph link carrying the socket or holder at the other end thereof. The parallel guidance for the pivoted chain member thereby takes place by means of a parallelogram system whereas the parallel guidance for the chain member carrying the socket or holder takes place by means of two parallelogram systems having one side each in contact with or touching one another.

A further feature of the present invention consists in the provision of a copying machine which enables changes in the translation ratio by the fact that two links which serve only to guide parallelly the chain member carrying the socket are variably adjustable in the effective length thereof.

According to a still further embodiment in accordance with the present invention, in the case in which only a non-adjustable translation ratio of 1:1 is required, the parallel guidance of the link carrying the holder is real-

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ized, instead of by means of two parallelogram systems, in a more simple manner by a single parallelogram system.

The present invention makes possible that the sockets or holders secured, on the one hand, to the pantograph and, on the other, to the additional link system which are used for holding the work tool and the copying pin, respectively, always have a sufficiently large distance from one another even when the machine is operating at a ratio equal to or near 1:1.

Accordingly, it is an object of the present invention to provide a copying machine of the pantograph type in which the translatory ratio of the movements of the work tool and copying pin may be readily adjusted over a wide range.

It is still another object of the present invention to provide a copying machine of the pantograph type in which ratios of 1.5:1 and less may be obtained.

Still another object of the present invention is to provide a pantograph copying machine which may be readily adapted to produce copies lying within the range of 1:1 to 1.5:1, inclusive.

Still another object of the present invention resides in the provision of a simple and inexpensive attachment which may be readily secured to a conventional pantograph and which enables an extension of the useful range of the device to ratios lower than ordinarily obtainable, namely lower than 1.5:1, and more particularly which enables reproductions at or near a 1:1 ratio.

Still a further object of the present invention resides in the provision of a simple, inexpensive, and reliable attachment consisting of an additional link system for use with a conventional pantograph which readily extends the useful lower limit of the device, as is particularly necessary with wooden models in which only a small shrinkage allowance is used.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, several embodiments in accordance with the present invention, and wherein:

FIGURE 1 is a schematic diagram indicating, in principle, the arrangement of a pantograph and of an additional link system coupled thereto in accordance with the present invention,

FIGURE 2 is a perspective view of a pantograph and additional link system construction in accordance with the present invention according to the schematic showing of FIGURE 1,

FIGURE 3 is a partial detail side view showing one connection between the pantograph and additional link system in accordance with the present invention of the arrangement shown in FIGURE 2,

FIGURE 4 is an axial cross-sectional view through the joint 62, 64 of one of the adjustable connecting link members of FIGURE 2,

FIGURE 5 is a schematic diagram showing, in principle, the arrangement of a modified embodiment of a pantograph and additional link system in accordance with the present invention.

FIGURE 6 is a schematic diagram of still another embodiment of a pantograph and additional link system in accordance with the present invention, and

FIGURE 7 is a perspective view showing the constructional details of the arrangement of FIGURE 6.

Referring now to the drawings wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIGURES 1 through 4, reference numerals 10, 12, 14 and 16 designate the four links of a pantograph which are pivotally

connected with each other. The links 10, 12, 14 and 16 constitute the link system of a conventional pantograph. The vertical pin 18 which connects the links 10 and 16 with each other serves simultaneously as relatively stationary point and, in turn, is supported by a carrier member 20 which may be pivotally arranged, if so desired, about a horizontal axis (not shown) at the machine upright (not shown) in a manner known in itself. However, for purposes of the present invention, pin 18 may be considered as stationary, i.e., relatively fixed in space. A holder 24 is provided at the free end of the link 12. A carriage 26 (FIGURE 2) is adjustably arranged on the link 14 for movement therealong in the longitudinal direction thereof. A clamping screw 28 is used to secure the carriage 26 in the adjusted position. The carriage 26 carries a further holder 30. When using such pantograph for copying purposes, the copying pin is inserted in one of the two holders 24 and 30 and the work tool is inserted into the other of these two holders. By means of an appropriate adjustment of the effective length of the links 12 and 16, i.e., of the distances between joints 70 and 71 and between joints 18 and 50 by sliding the joint 70 along the link 12 and by sliding the link 16 in the guide means associated with the pivot bearing 18, as well as by adjustment of the holder 30 at the link 14 in such a manner that the axes of the joint 18 and of the holders 30 and 24 are located in one plane or along a straight line, i.e., coincide with the dash-and-dot line S, it may be achieved in a known manner that the movements of the point 24 are reproduced or copied with an adjusted translatory ratio by the point 30 and vice versa. So far, only those features of a pantograph have been described which are known in the prior art.

However, as pointed out hereinabove, by reason of the physical thickness of the various link members and appertaining parts thereof of such known pantographs, the lowest ratio which is obtainable with such devices of the prior art is usually 1.5:1. Smaller ratios, however, are impossible by reason of the fact that the necessary coincidence between the tracing pin and the work tool cannot be obtained.

The present invention is predicated on the recognition that the limitations mentioned hereinabove and imposed on the prior art devices for the reasons stated hereinabove seriously hamper the full utilization of the pantographs of the prior art. Accordingly, the present invention proposes to provide an additional link system which is additional to the conventional pantograph link system so far described to extend the useful range of ratios to a 1:1 ratio.

The additional link system in accordance with the present invention includes two additional link members 32 and 34 which are pivotally connected with each other. The link member 32 is further pivotally connected with the relatively stationary carrier 20 by means of pivot bearing 36 at support member 72, while support member 72 is rigidly connected with the carrier 20 so that pivot bearing 36 constitutes another stationary or fixed point and the relative position of the pivot pins 18 and 36 remains constant with respect to each other, and particularly the distance therebetween always remains the same. Furthermore, the additional link system in accordance with the present invention includes three guide link members 40, 42 and 44 which form together with the aforementioned link 34 a parallelogram system. The distance between the pivot pins 90 and 46 of the guide member 40 as well as between the pivot pins 33 and 52 of the guide member 42 is equal to the distance between the pivot pins 18 and 36. The free end of the link member 34 is constructed as holder 38 for receiving the copying pin or work tool. The two additional link members 32 and 34 thereby effectively constitute a two-link chain member having two links pivotally connected with each other at one end thereof and having a holder at the other

end of one of the two chain links while the other end of the other chain link is pivotally connected to a relatively stationary point.

The connection between the additional link system in accordance with the present invention and the conventional pantograph is established by two connecting link members 16a and 54 forming also part of the additional link system in accordance with the present invention. More particularly, the connecting link member 16a represents an extension of the pantograph link member 16 and is slidably mounted thereon in a carriage-like manner so that the joint 46 located at the end of the connecting link member 16a lies in a single plane with the joints 18 and 50 of the pantograph link 16 parallel to the swiveling axes of said joints. Consequently, the pivot axes of joints 18, 50 and 46 of FIGURE 1 are disposed in alignment with each other along a straight line. The extension or connecting link member 16a is constructed at one end thereof in the form of a carriage, as shown in FIGURE 3 which slides along appropriate guide means provided at the pantograph link member 16 and which may be secured at the link member 16 in the desired position by means of a clamping screw 48.

By displacing the extension link member 16a along the part 16, the distance between the axes 46 and 50 and therewith the effective length of the connecting link member 16a may be adjusted by the use of a small scale 16b provided on the link member 16a in any suitable manner.

Furthermore, the extension link member 16a may be so adjusted on the pantograph link member 16 that the aforementioned distance between axes 46 and 50 may be reduced to zero whereby the pivot bearing 46 is then located directly above the pivot bearing 50, i.e., the axis of the pivot bearings 46 and 50 are thereby coaxial with each other. The inner end joint 46 of the connecting link member 16a simultaneously constitutes the pivot bearing between the guide member 40 and guide member 44.

The second connecting link member 54 is pivotally connected at the other pantograph member 14 so as to be rotatable thereto and adjustable in the effective length thereof. The effective length of the connecting link member 54 is adjustable by the fact that a slide 58 is adjustably arranged at the end thereof in appropriate guide means 56 thereof (FIGURE 4). The slide 58 may be adjustably secured at the connecting link member 54 in the desired position by means of the clamping screw 60. The slide 58 is rotatable about a pivot pin 62 (FIGURE 4) which is secured at the pantograph link member 14 by means of a clamp or shackle 64. The connecting points 50, 62 and 70 are thereby in alignment with each other, i.e., are disposed in a straight line. For purposes of adjusting the effective length of the connecting link member 54, i.e., for purposes of adjusting the distance of the bearing pivots 62 and 52 by the displacement of the connecting link member 54, serves a scale 54a provided at the link member 54.

The link member 54 may also be adjusted in such a manner that the effective length thereof, i.e. therewith the distance between the axes of the pivots 52 and 62 may be reduced to zero.

The bracket 64 is so secured at the pantograph link member 14 that the distance of the pivot bearings 50 and 62 is equal to the distance of the pivot pins 46 and 52 of the additional link system. By reason of the aforementioned adjusted equal effective length of the connecting link members 16a and 54 is thereby achieved that the additional and connecting link members 32, 16a, and 54 form a parallel system additional to the pantograph link members 16 and 12 and that also the additional link members 34 and 44 form a parallel system additional to the pantograph link members 10 and 14, whereas the guide link members 40 and 42 are parallel to the line

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connecting the relatively stationary pivot bearings 18 and 36.

The constructional details of the embodiment in accordance with the present invention are clearly visible from FIGURES 2, 3 and 4 of the drawing. The additional link system is thereby constructed as a detachable additional aggregate which is attached to the copying machine only when needed. For that purpose, the stationary point 36 of the additional link system which is constructed as a pivot pin is supported at a detachable support member 72. The support member 72 is emplaced during use of the link system upon an appropriate guide means 74 provided on the pantograph carrier 20 and is secured in the adjusted position by tightening the clamping screw 76. The stationary point 36 of the additional link system is thereby rigidly connected with the stationary point 18 of the pantograph. For purposes of completing the assembly, it remains only to establish the connection of the remaining link members of the additional link system with the pantograph. This is accomplished by inserting or emplacing the carriage 16a into the guide means extending along the pantograph link member 16, whereupon it is aligned and is then secured by means of a clamping screw 48 in the desired position, and by securing link member 54 at the pantograph link member 14 by means of clamp or bracket 64.

If the machine is intended to carry out a reproduction of the work at a ratio of 1:1, then the distances between the points 50 and 46 as well as between the points 62 and 52 are adjusted to zero, i.e., the pantograph link member 14 is disposed exactly below the link member 44 by adjusting the effective length of the links 12 and 16 and the location of the carriage 26 in such a way that link members 12, 16, 32 are parallel and the distance between holder 30 and joint 50 is equal to the distance between holder 38 and the joint between the link members 32 and 34. The position of the link member 14 and the holder 30 is shown in dot-and-dash lines in FIGURE 1.

The work tool spindle 78, for example, is inserted into the holder 30 and the copying pin 80, for example, is inserted into the holder 38. If now the pantograph is moved in the plane thereof by the operator, then the link system is moved in unison therewith. The additional link members 32 and 34 thereby carry out a movement which proceeds parallel to the movement of the pantograph link members 16 and 14. In this manner is achieved that the copying pin 80 and work tool 78 which are inserted in the points 30 and 38 carry out movements which are parallel to each other. Consequently, a reproduction of the work piece 84 from a model 82 at a ratio of 1:1 may be realized.

If, in another case, not a 1:1 reproduction is to be made but the work is to be machined at a ratio different from 1:1, for instance, if a slightly increased or decreased reproduction of the model is to be made, for example, a reproduction at a ratio of 1.1:1, as is oftentimes the case in connection with the manufacture of a wooden part having a shrinkage allowance, then the pantograph and the additional link system is to be adjusted into the position thereof shown in FIGURE 1 in full lines. The link members 16a and 54 are adjusted to the effective length thereof corresponding to the desired translation ratio by the aid of scales 16b and 54a and are securely clamped in such position, while the socket or holder 30 is correspondingly adjusted on the link member 14. If, now the pantograph system is moved, then by the use of the additional link system in accordance with the present invention, it is possible that the translation ratio of movement between the points 30 and 38, corresponding to the particular adjustment, is different by a predetermined amount from the ratio of 1:1, for example, at the ratio of 1.1:1.

The scales 16b and 54a may thereby indicate directly

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the corresponding ratio or also directly the percentage value of shrinkage so that the adjustment may be made readily and in a simple manner depending on the type or use of the machine. The parts of the additional link system are thereby so dimensioned that with the use of this additional link system a translatory ratio within the range of 1:1 up to approximately 1.5:1 is obtainable.

As already mentioned hereinabove, by the use of the conventional pantograph system by itself, i.e., with the additional link system removed or disassembled, a translation of the movement within the range of 1.5:1 up to 10:1 may be attained. Thus, by the use of the conventional pantograph alone and by the use of the additional link system with the pantograph, copies may be made by the use of the same machine within the range of ratios of 1:1 up to 10:1. Consequently, practically all copying jobs which may occur in practice can be carried out by the use of a machine in accordance with the present invention.

During practical use of such copying machines, the handle 86 arranged at the holder 24 is grasped by the operator and the pantograph and additional link systems are moved thereby. As a result of the large translation between the points 24 and 30, it is possible that the movement of the copying pin and of the work tool along the model and the work piece may be effected with the least possible use of force. Consequently, the actuation and operation of the machine is considerably facilitated.

It is quite obvious that the purchase of the additional link system which consists only of relatively few simple parts does not involve considerable additional costs. Furthermore, the connection at the pantograph system may be realized very easily and rapidly because the guide means already present at the pantograph system are used for that purpose. As shown in the drawing, the arrangement is also made advantageously in such a manner that the points which serve for the accommodation of the copying pin and/or the work tool do not coincide with the pivot points or connecting points between the two systems. As a result thereof, the joints may be made very simple, on the one hand, and the sockets or holders for the copying pin and/or work tool, on the other, may be constructed very sturdily.

In the embodiment according to FIGURE 5, parts corresponding to those of the embodiment according to FIGURES 1 through 4 are designated by corresponding reference numerals. The pantograph link system 10, 12, 14 and 16 is the same in both embodiments. However, in the embodiment according to FIGURE 5, the link member 32' in contrast to the corresponding link member 32 of FIGURE 1, does not have a constant effective length but is adjustable in the guide means thereof at the bearing pin 36' exactly in the same manner as the parallel pantograph link member 16 of FIGURE 1 in the guide means thereof at the bearing 18. The effective lengths of the links 32' and 16 may thereby be made the same. A further difference of the embodiment according to FIGURE 5 consists therein that the connecting link member 16'a which is adjustable in the effective length thereof does not constitute an extension of the pantograph link member 16 but an extension of the link member 32'. Furthermore, the other connecting link member 54' which is adjustable in the effective length thereof is not arranged at the pantograph link member 14 as in the embodiment according to FIGURES 1 through 4 but at the pivot pin between the additional link members 44 and 42. Otherwise the embodiment according to FIGURE 5 is identical with that of FIGURE 1 and the same copying tasks may be realized in a similar manner as with the embodiment according to FIGURE 1.

In the embodiment according to FIGURE 6 the adjustable members 16a and 54 as well as the link member 44 are missing. The parallel guidance of the two-link chain members 34 and 32 takes place exclusively over the additional link members 40 and 42. By reason of the parallel-

ogram guidance 18—36—16—40—32 and 40—14—42—34, the socket or holder 38 carries out or undergoes the same movements in magnitude and direction as the socket 30 so that a translatory ratio of 1:1 takes place. Also, in this embodiment is obtained the advantage that the work tool and copying pin possess a sufficiently large distance from one another. This particularly simple embodiment is intended for a non-adjustable reproduction ratio of 1:1. FIGURE 7 shows the actual constructional embodiment of FIGURE 6 in perspective. In contrast to FIGURE 2, the link member 54 is missing, and the pivot pin 52 is secured directly on the clamp or bracket 64. Furthermore, the link member 16a is always so secured to the pantograph link member 16 that the joint 46 lies directly above the pantograph joint 50.

While I have shown three embodiments in accordance with the present invention, it is understood that the same is not limited thereto but that these embodiments were only given herein for purposes of illustration. Other possible applications within the scope of the present invention are possible. For example, copying pins and work tools may be inserted into the sockets 24, 30 and 38 in any appropriate sequence whereby simultaneously several work pieces may be machined at reproduction ratios different from one another.

Furthermore, it is possible by the arrangement of additional link members at the additional link system or at the pantograph to increase the number of holders or sockets. For example, if two further bearing pivots are arranged at the center of each of the link members 40 and 42 of the embodiment according to FIGURE 1, and if these two further bearing pivots are connected with each other by a still further link member extending beyond the bearing pivot at the link 42 by the distance 33—38, then a further socket or holder may be arranged at the end point of the projecting link member which corresponds to the socket 38 and which carries out the same movements as the socket 38. Two work tools may be then inserted into the socket 38 and into the additional socket and two work pieces may thereby be simultaneously machined.

Moreover, instead of the socket 38 and the additional socket described hereinabove in the preceding paragraph, a further bearing pivot each may be substituted therefor, and these last-mentioned two bearing pivots may be connected by means of an additional connecting link member which is thereby guided parallel to itself and carries out the same movements as the joint 38. Several work tools may be arranged at the last-mentioned connecting link member all of which carry out the same movement as point 38 and all of which may serve for simultaneously machining a corresponding number of work pieces.

A similar modification of the link arrangement, as described hereinabove in connection with the arrangement of FIGURE 1 is also possible for the arrangement of FIGURE 5, whereby, however, the additional or projecting link member which connects the link members 40 and 42 extends beyond the bearing place at the link member 42 only by the distance 52—30. An additional socket may then be arranged at the end of the projecting link member which corresponds to the pantograph socket 30 and which carries out the same movements as the pantograph socket 30. By substituting pivot bearings for the socket 30 and for the aforementioned additional socket and by connecting these two pivot bearings by a link member carrying several sockets, it is also possible in that case to multiply the number of sockets or holders for use with the copying device.

In the embodiments described in connection with FIGURES 1 to 4, 5 and 6 and 7, the stationary bearings 18 and 36 are always arranged at the carrier 20 which is rotatable about a horizontal axis. As a result of this arrangement, the copying devices of these embodiments permit three-dimensional reproductions. However, in many cases, for example during machining of a plane surface, a carrier 20 rotatable about a horizontal axis is

not necessary but it suffices if the joints 18 and 36 are constructed as stationary bearings arranged at a part of frame member which is relatively fixed in space.

While I have shown and described several embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of many changes and modifications within the spirit of the present invention, and I intend to cover all such changes and modifications as encompassed by the appended claims.

I claim:

1. A copying machine for translation of movements between a copying tool and a work tool of the ratio of nearly equal to 1:1 having at least one relatively fixed part, comprising a pantograph system including a plurality of link members, one of said pantograph link members having holder means for one of said tools adjustably supported thereon, means including another of said pantograph link members for pivotally securing said pantograph system to a said relatively fixed part, a parallelogram system including an additional link member provided with holder means for the other one of said tools, additional link means pivotally connecting said parallelogram system to a said fixed part, and parallel connecting link members for connecting said parallelogram system with said one pantograph link member, said parallel connecting link members being adjustable in their lengths, one of said parallel connecting link members constituting a rigid extension of said another pantograph link member, the translation ratio of said machine being dependent on the effective length of said parallel connecting link members and the position of the first-mentioned holder means on said one pantograph link member.

2. A copying machine for translation of movements between a copying tool and a work tool of a ratio of nearly equal to 1:1 having at least one relatively fixed part, comprising a pantograph system including a plurality of link members, one of said pantograph link members being provided with holder means for one of said tools, said holder means being adjustable along the length of said one pantograph link member, means for pivotally securing said pantograph system to a said relatively fixed part including another of said pantograph link members, a parallelogram system including an additional link member provided with holder means for the other one of said tools, additional link means pivotally connecting said parallelogram system to a said relatively fixed part, two parallel connecting link members connecting said parallelogram system with said one pantograph link member, an additional one of said pantograph link members being parallel to said another pantograph link member, and adjusting means for changing the position of each end of said one link member of the pantograph system with respect to the respective one of said additional pantograph link member and said another pantograph link member to vary the effective length of said two parallel connecting link members, the translation ratio being dependent on the effective length of said parallel connecting link members and the position of the first-mentioned holder means on said one pantograph link member.

3. A copying machine for translation of movements between a copying tool and a work tool of a ratio of nearly equal to 1:1 having at least one relatively fixed part, comprising a pantograph system including a plurality of link members, one of said pantograph link members being provided with holder means for one of said tools, said holder means being adjustable along the length of said one pantograph link member, means for pivotally securing another one of said pantograph link members at a said relatively fixed part, a parallelogram system including an additional link member provided with holder means for the other one of said tools, additional link means for pivotally connecting said parallelogram system to one of said fixed parts, parallel connecting link members for connecting said parallelogram system with said one pantograph link member, means for adjusting the

effective length of said parallel connecting link members, and graduation means for indicating the adjustment thereof, said adjusting means providing an overlapping arrangement of said parallel connecting link members relative to the parts of said pantograph system, whereby the effective length of each of said parallel connecting link members may be adjusted to zero, the translation ratio being dependent on the effective length of said parallel connecting link members and the position of the first-mentioned holder means on said one pantograph link member.

4. A copying machine according to claim 3, wherein said parallelogram system together with said parallel link members constitute a readily detachable assembly.

5. A copying machine with a relatively fixed part and provided with holder means for a copying pin and at least one work tool, comprising a pantograph having a normal range of operating ratios within certain limits including a plurality of link members, means for pivotally securing one of said pantograph link members at said relatively fixed part, means for pivotally connecting another one of said pantograph link members to said one pantograph link member, said another pantograph link member having adjustably supported thereon one of said holder means, two-link chain means including two additional link members, means for pivotally connecting one of said additional link members to said relatively fixed part, and means for pivotally connecting the other of said additional link members to said one additional link member, said other additional link member including another one of said holder means, and means operatively connecting said two-link chain means to said pantograph to extend the lower limit of operative ratios usable with said machine including means for guiding said one additional link member and said one pantograph link member in parallel and for guiding said other additional link member and said another pantograph link member in parallel to provide a geometrically similar reproduction of two sets of pivotally connected link members between said relatively fixed part and two corresponding holder means respectively, said guiding means including two parallelograms having a common guide link member and being formed in part by at least a portion of each of said other additional link member and said another pantograph link member, said copying machine being adapted to provide a translation of movement equal to or nearly equal to a ratio of 1:1.

6. A copying machine as defined in claim 5 wherein one of said two parallelograms having a common link member includes a connecting link member which forms an extension of said one pantograph link member and is connected to said common link member.

7. A copying machine as defined in claim 6, wherein said one parallelogram further includes a second connecting link member parallel to said first mentioned connecting link member, said second connecting link member being pivotally connected to said another pantograph link member and to said common link member, and further including means for adjusting the effective length of said two parallel connecting link members, said effective length being the distance from said another pantograph link member to said common link member, the operative ratio of said copying machine being dependent on the effective length of said parallel connecting link members and the position of the first-mentioned of said holder means on said another pantograph link member.

8. A copying machine as defined in claim 5, wherein one of said two parallelograms having a common link member includes a connecting link member which forms an extension of said one additional link member of said two-link chain means and is connected to said common link member.

9. A copying machine as defined in claim 8, wherein said one parallelogram further includes a second connecting link member parallel to said first-mentioned connecting link member, said second connecting link member being connected to said common link member and said other additional link member, and further including means for adjusting the effective length of said two parallel connecting link members, said effective length being the distance between said other additional link member and said common link member, the operative ratio of said copying machine being dependent on the effective length of said parallel connecting link members and the positions of the first-mentioned of said holder means on said another pantograph link member.

10. A copying machine according to claim 5, wherein said another holder means provided on said other additional link member is located a distance apart from the nearest adjacent pivot means of said other additional link member.

11. A copying machine according to claim 5, wherein one of said two parallelograms includes two connecting link members connected to said other additional link member, the connection between each of said two connecting link members and said other additional link member being adjustable for varying the effective length of said connecting link members, the translation ratio being dependent on the effective length of said connecting link members and the position of the first-mentioned holder means on said another pantograph link member.

12. A copying machine according to claim 5, wherein one of said two parallelograms includes two connecting link members connected to said another pantograph link member, the connection between each of said two connecting link members and said another pantograph link member being adjustable for varying the effective length of said connecting link members, the translation ratio being dependent on the effective length of said connecting link members and the position of the first-mentioned holder means on said another pantograph link member.

13. A copying machine for translation of movements between a copying tool and a work tool of a ratio of nearly equal to 1:1 having at least one relatively fixed part, comprising a pantograph system including a plurality of link members, holder means for one of said tools secured to one of said pantograph link members, means for adjusting the position of said holder means along the length of said one pantograph link member, means for pivotally securing said pantograph system to a relatively fixed part including another of said pantograph link members, said another pantograph link member being pivotally connected to said one pantograph link member, a parallelogram system including an additional link member provided with holder means for the other one of said tools, second additional link means for pivotally connecting said parallelogram system to one of said relatively fixed parts, parallel connecting link members for connecting said parallelogram system with said one pantograph link member, and means for adjusting the effective lengths of said parallel connecting link members, said effective length being the distance between said one pantograph link member and said parallelogram system, the translation ratio being dependent on the effective length of said parallel connecting link members and the position of the first-mentioned holder means on said one pantograph link member.

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