

Oct. 11, 1949.

H. CARSON ET AL
DUPLICATING MACHINE

2,484,553

Filed Oct. 2, 1944

3 Sheets-Sheet 1

Fig. 2

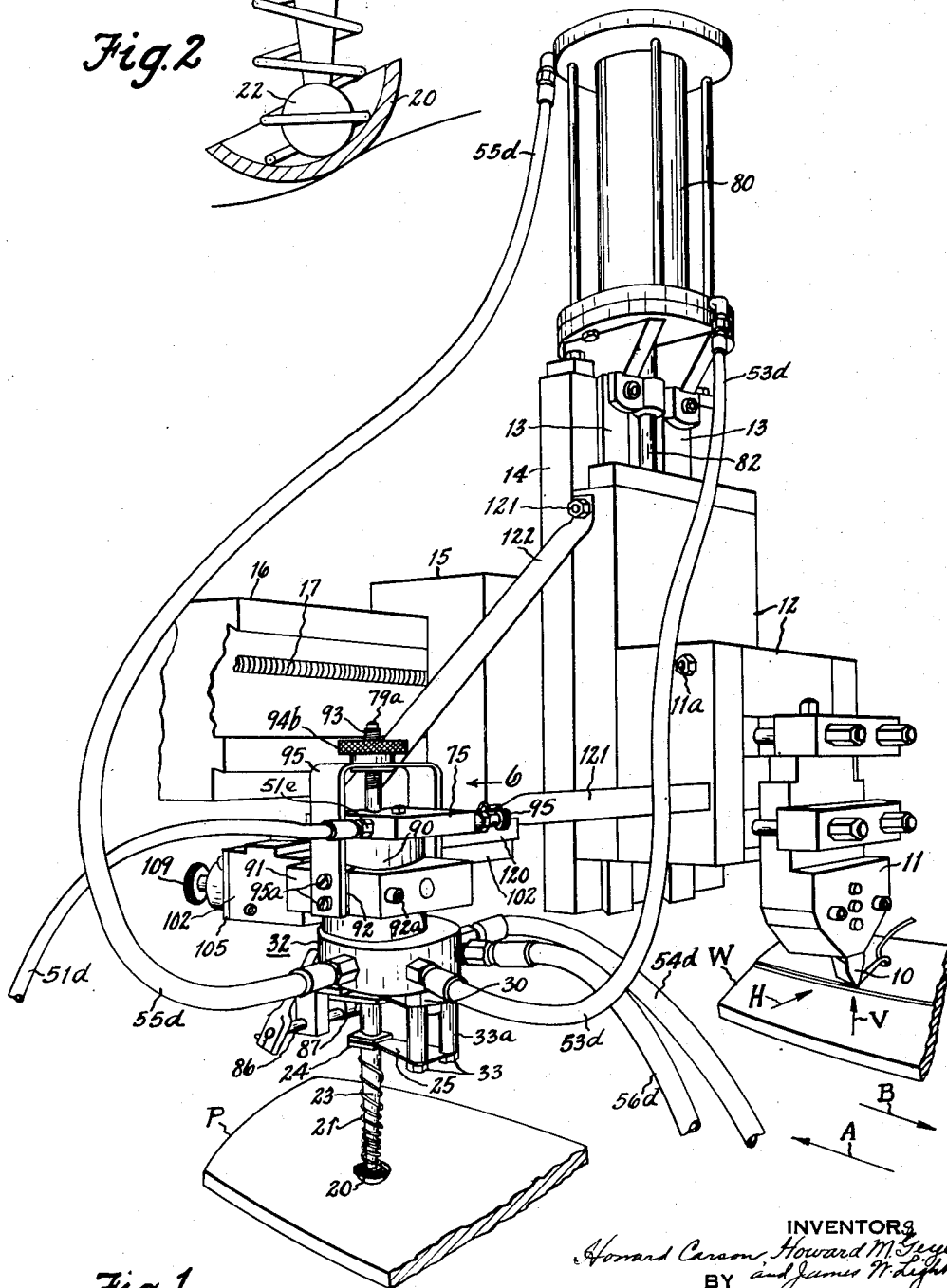
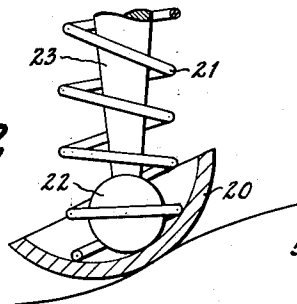


Fig. 1.

INVENTORS
Howard Carson, Howard M. Taylor
BY and James M. Wright
Spencer Hardman & Fisher
their ATTORNEYS

Oct. 11, 1949.

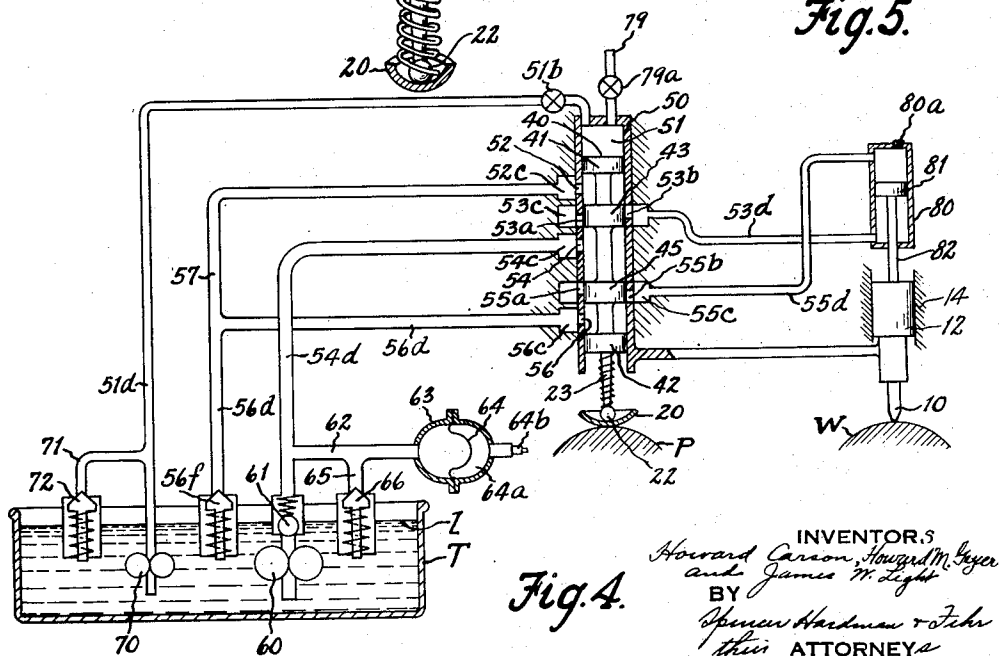
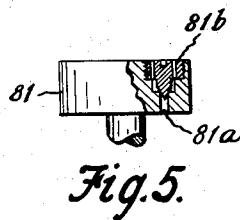
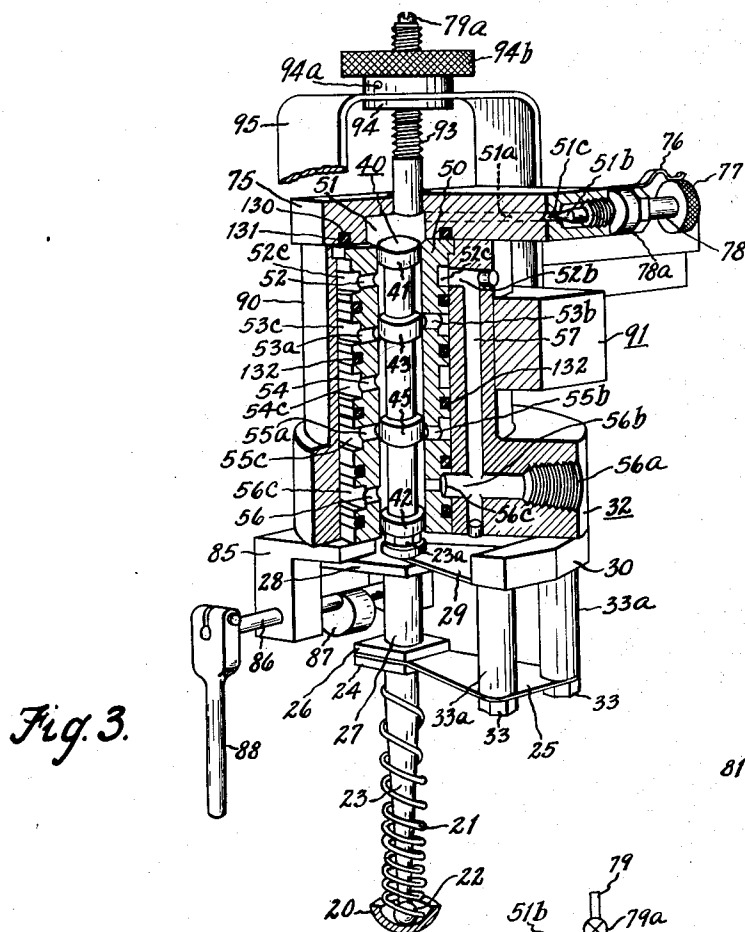
H. CARSON ET AL

2,484,553

DUPLICATING MACHINE

Filed Oct. 2, 1944

3 Sheets-Sheet 2



Oct. 11, 1949.

H. CARSON ET AL
DUPLICATING MACHINE

2,484,553

Filed Oct. 2, 1944

3 Sheets-Sheet 3

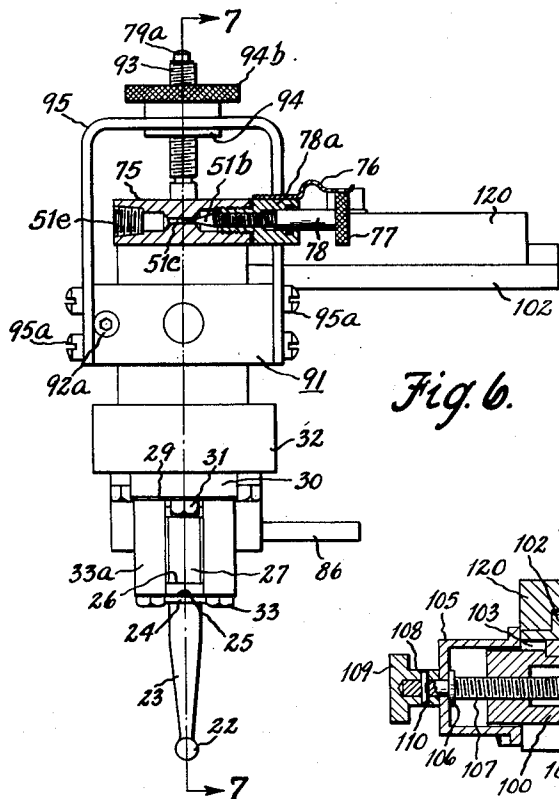


Fig. 6.

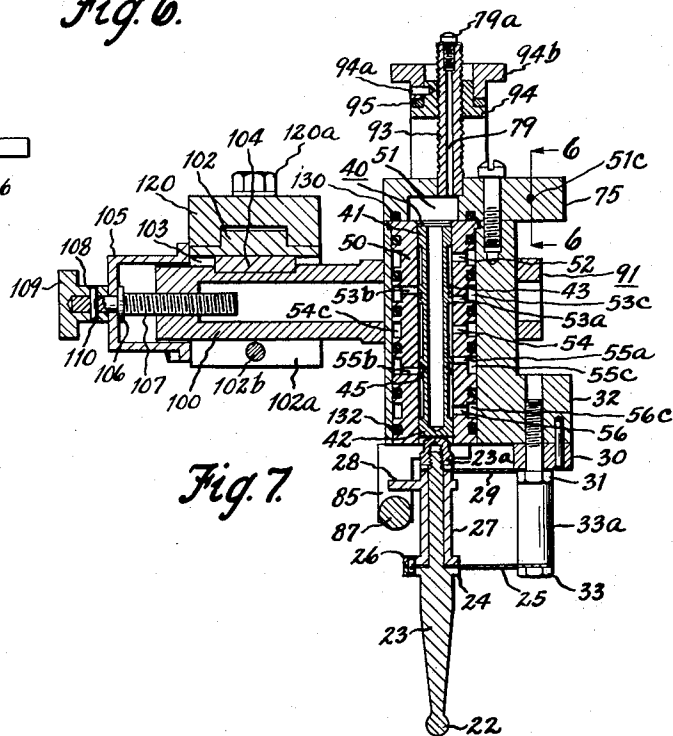


Fig. 7.

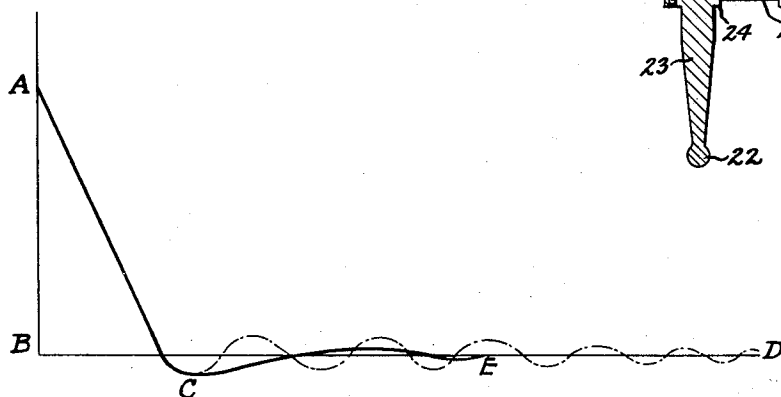


Fig. 8.

INVENTORS
Howard Carson, Howard M. Geyer
and James W. Light
BY
Spencer Hardman & Fisher
ATTORNEYS

UNITED STATES PATENT OFFICE

2,484,553

DUPLICATING MACHINE

Howard Carson, Howard M. Geyer, and James W. Light, Dayton, Ohio, assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application October 2, 1944, Serial No. 556,702

8 Claims. (Cl. 90—24.3)

1

This invention relates to the art of planing metal, and more particularly to a duplicating mechanism by which a surface of a pattern is automatically reproduced on a workpiece by a metal planer. The type of duplicating mechanism to which the present invention relates comprises an hydraulic servomotor for positioning the planer tool holder and means for controlling the servo-motor comprising a ported member movable with the workholder and a valve cooperating with the member and connected with a pattern follower member. When the duplicator is used with a planer having a horizontal movable bed, the pattern and the workpiece are mounted side by side on the planer bed, the pattern being engaged by the follower and the workpiece by the tool. As the planer bed moves the workpiece against the tool, the follower moves vertically according to the contour of the pattern and effects vertical movement of the tool holder equal to and in the same direction as the vertical movement of the follower.

It is an object of the invention to provide a duplicator for a metal working machine, such as a planer, which is of durable and economical construction and which is sensitive and stable in operation.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a perspective view of the duplicating mechanism.

Fig. 2 is a fragmentary view showing the manner in which the valve controller follows a pattern having a relatively steep slope.

Fig. 3 is a perspective view partly in section of the ported valve member and enclosed valve for controlling the servo motor of the duplicating mechanism.

Fig. 4 is an hydraulic diagram.

Fig. 5 is an enlarged view showing the valve in section assembled in the piston.

Fig. 6 is a front view of the controller looking in the direction of the arrow 6 of Fig. 1, the part in section being on line 6—6 of Fig. 7.

Fig. 7 is a sectional view on line 7—7 of Fig. 6.

Fig. 8 is a diagram which denotes stability of operation of the mechanism.

Referring to Fig. 1, P denotes the pattern and W the workpiece, these members being mounted on the horizontally reciprocating bed (not shown) of a metal working planer which causes the parts

2

P and W to move in the direction of the arrow A for cutting and in the return direction indicated by arrow B. As the planer bed moves in the direction of the arrow A, the workpiece W moves against a cutting tool 10 mounted in a holder 11 which is pivotally connected at 11a with a support 12 which is guided by ways 13 provided by a plate 14 which is carried by a slide 15. By a screw and nut mechanism (not shown) the plate 14 may be adjusted vertically relative to the slide 15. The slide 15 is supported for horizontal movement on a bar 16 which is supported by the frame of the planer. During motion of the bed in the direction of the arrow A, the slide 15 remains fixed; and, during movement of the planer in the direction of the arrow B, the slide 15 is caused to move a predetermined distance to the right in order to locate the tool 10 in position for a new cut. The feeding of the block 15 is effected in a well known manner, such as by means of a nut and screw mechanism, the screw being indicated by the numeral 17.

It will be understood that the planer controls the horizontal movement of the tool 10 in a horizontal direction as represented by the arrow H (Fig. 1), while the vertical movements of the tool as indicated by the arrow V are controlled by the pattern P which is engaged by a follower 20 which is a segment of a hollow sphere. The follower 20 is urged by a tension spring 21 attached thereto against a ball 22 (Figs. 2 and 3) provided by the end of a rod 23 extending downwardly from a flange 24 (Fig. 7) which, together with a leaf spring 25, is fastened to a flange 26 integral with sleeve 27 having a lug 28. The rod 23 extends through the sleeve 27 and receives a nut 23a which clamps to the sleeve 27 a leaf spring 29, which, together with a bracket 30 is secured by screws 31 to a valve housing 32. The screws 33 pass through spring 25 and spacer sleeves 33a and are threaded into housing 32. Sleeves 33a determine the distance between the fixed ends of the leaf springs 25 and 29.

A valve 40 is urged downwardly by fluid-pressure means, to be described, against the nut 23a. Valve 40 is slidable within a ported valve guide 50 located within the housing 32. The valve 40 is provided with flanges 41 and 42 engaging the guide 50 near the upper and lower ends thereof and with valve lands 43 and 45 which respectively control ports 53a, 53b and 55a, 55b of the guide 50. The ports 53a, 53b communicate with an annular channel or groove 53c which, by passages (not shown) in the housing 32 and by a hose 53d (Fig. 1), is connected with the lower end

3

of a cylinder 80 as shown diagrammatically in Fig. 4. The ports 55a, 55b communicate with a groove 55c which by passages (not shown) provided in the housing 32 and by a hose 55d, is connected with the upper end of the cylinder 80. Cylinder 80 receives a piston 81 (Fig. 4) connected by rod 82 with the tool holder support 12 (Fig. 1).

The valve guide 50 provides cylinder drain ports 52 and 56 communicating respectively with grooves 52c and 56c which, as shown in Fig. 4, are connected together by horizontal passages 52b and 56b and by vertical passage 57 with an opening 56a which is connected by hose 56d with valve seat 56c closed by a check valve 56f and communicating with the tank T containing the hydraulic pressure fluid, the level of which is indicated at 1. Valve 56f maintains 15 to 20 lbs. per square inch on the discharge line 56d.

In Fig. 4, a pump 60 forces liquid under high pressure past a check valve 61 through a hose 54d connected with a groove 54c of valve guide 50 which is connected by ports 54 with the central bore of the guide 50. The pump 60 is connected by pipe 62 with an accumulator 63 having a diaphragm 64; and pipe 62 is connected with the tank T by a branch pipe 65, the outlet of which is controlled by a spring-loaded valve 66. Valve 66 maintains 700-800 lbs. per square inch pressure in pipes 62 and 54d. The chamber 64a is filled with air or nitrogen at 300 lbs. per square inch pressure through a tube closed by a tire-valve 64b.

A low pressure pump 70 is connected with a by-pass 71 controlled by valve 72, loaded for 15-20 lbs. per square inch pressure, and with a hose 51d (Figs. 1 and 4) connected by pipe fitting 51e with a passage 51c provided by a block 75 attached to the housing 32. Communication between passage 51c and a passage 51a is controlled by a needle valve 51b on the end of a screw 78 threaded through a bushing 78a threaded into the block 75. Screw 78 has a knurled head 77 frictionally engaged by a spring 76 fixed to block 75. Passage 51a connects with a central recess 51 in block 75, said recess being closed by the flange 41 of the valve 40, said flange functioning as a piston to receive the low pressure fluid in the cylinder 51.

It is important that air be excluded from the hydraulic system. During filling with pressure oil, a plug 80a (Fig. 4) in cylinder 80 is removed. By means of a screw-driver passed down through the unplugged hole, a valve 81b in piston 81 is turned to open a port 81a through the piston (Fig. 4). The recess 51 is provided with a vent passage 79 controlled by an air bleed valve 79a which is open while this recess is being filled with pressure oil. After the system is filled to overflowing, valve 81b is closed, plug 80a is applied, and valve 79a is closed. As shown in Fig. 7, a rod 93 provides the vent passage 79 and a plug 79a provides the valve for closing it.

The valve guide 50 is retained within the housing 32 by the plate 75 which is attached to the upper end of the housing and by a bracket 85 attached to the lower end of the housing. The bracket 85 supports a shaft 86 carrying an eccentric cam 87 for engagement with the lug 28 of sleeve 27 when the shaft is rotated by moving a lever 88 connected with the shaft 86 upwardly for the purpose of moving the valve upwardly from the position shown in Figs. 3, 4 and 7 to such position as to place port 53a in communication with port 54 so that the lower end of the cylinder 80 will receive pressure fluid while the

4

upper end is connected with drain in order that the tool 10 will be retracted from the work W. In other words, when the lever 88 is rotated 180° from the position shown, the piston 81 operates to retract the tool 10 from the work W. When the cam 87 does not engage the lug 28, and when there is no pressure in the system, the springs 25, 29 normally hold the valve 40 about .010 inch above neutral position. Leakage between the recess 51 (Fig. 3) and the groove 52c is prevented by packing ring 130 located in a groove 131 provided by the plate 75. The leakage between the several grooves 52a, 53a, 54a, 55a and 56a and between the groove 55a and the lower end of the housing 32 is prevented by other packing rings 132 received by grooves provided by the valve guide 50.

The valve housing 32 is provided with a cylindrical portion 90 eccentric with the valve 40; and this cylindrical portion is received within the cylindrical bore of a block 91 which is split at 92 so that the bracket 91 may serve as a clamp which can be tightened around the cylindrical portion 90 of housing 32 by the tightening of a screw 92a, thereby securing the housing 32 to the block 91 in a desired position of vertical adjustment relative thereto. In order to provide for this vertical adjustment, there is attached to the plate 75 the threaded rod 93 extending through a nut 94 (Fig. 6) connected by pin 94a with a knurled ring 94b. Nut 94 and ring 94b are spaced vertically by the yoke of a bracket 95 shaped like an inverted U and attached by screws 95a to the block 91. The plate 75 fits between the vertical arms of the bracket 95 so that rotation thereof is prevented while turning the nut 94, by means of the knurled ring 94b, in order to raise or lower the rod 93 and the valve housing 32 while the block 91 is unclamped from the housing 32 by loosening the screw 92a. After the housing 32 has been adjusted vertically relative to the block 91, the screw 92a is tightened.

Block 91 has a cylindrical portion 100 (Fig. 7) slidable through a horizontal bore in a block 102 having a key-way 103 receiving a key 104 attached to part 100. To block 102 is attached a bracket 105 which spaces a flange 106 of a screw 107 from the hub 108 of a knurled head 109 attached to screw 107 by a pin 110. Screw 107 passes loosely through the yoke of bracket 105 and threadedly engages the part 100 of block 91. By turning the screw head 109 the block 91 and the follower 20 (Fig. 1) can be adjusted horizontally in the direction of arrows A or B. When the adjustment is made, the block 102, which is split at 102a, can be clamped around the part 100 of block 91 by tightening a screw 102b.

The block 102 is adjustable horizontally (at right angles to directions A or B) relative to a bracket 120 and is secured thereto in the required position of adjustment by the tightening of a screw 120a. Bracket 120 is secured to tool holder support 12 by members 121 and 122. Therefore the tool and the valve housing 32 and the valve guide 50 move as a unit.

The system consists essentially of a source of hydraulic power (the pump 60) a four-way valve (valve 40 and guide 50) and a servo-motor (piston 81 and cylinder 80) for transforming the hydraulic power into linear motion. When tracer 20 is raised by the pattern P traversing it, the valve 40 moves up relative to guide 50. Ports 53a and 53b are opened, and oil flows from pump 60 to the bottom of cylinder 80. At the same time, the top of cylinder 80 is connected through ports

5

55a and 55b and 56 and by pipe 54d and drain valve 56f with tank T. With valve 40 so located, the pressure in the bottom of cylinder 80 forces piston 81 upwardly. Since the valve guide 50 is connected to the piston 81, through support 12 and rod 82, the guide 50 moves up with the piston 81 and ports 53a, 53b and 55a, 55b become closed by lands 43, 45 of valve 40. This results in a new equilibrium position of the piston 81 corresponding to the new position of the valve 40.

Since the lowering of valve 40, as the pattern P traverses it, will result in the lowering of the piston 81 by the reverse of the action described in the preceding paragraph, it is apparent that the piston 81 will continually follow the vertical movements of the valve 40 as the follower 20 is traversed by the pattern P. As the forces that can be exerted by hydraulic pressure on the piston 81 are very great compared to that necessary to deflect the valve 40 from its equilibrium position, it is apparent that a relatively large amount of power amplification is obtained. It is of great advantage to be able to exert relatively large forces upon the tool holder to raise and lower it and to hold it fixed, while the tracer 20 is exerting relatively light pressure upon the pattern P.

In order to obtain the greatest possible accuracy of duplication between the master pattern and the work, it is essential that the four-way valve (valve 40, guide 50) be very sensitive to deflections of the valve 40. That is, for very slight deflections of the valve 40, there should be a considerable change in pressure on the end of piston 81 in order that motion of piston 81 start to bring the valve guide 50 to a position of equilibrium. It has been found that the most sensitive type of four-way valve is one which has negative overlap between the lands of the valve and the ports of the valve guide. To obtain this negative overlap, it is necessary that the valve lands be slightly shorter than the total port width of the valve guide. Therefore land 43 is slightly less in width than the distance between the lowest portion of port 53a and the highest portion of port 53b and land 45 is slightly less in width than the distance between the lowest portion of port 55b and the highest portion of port 55a. This arrangement results in a slight bleeding of the oil from pump 60 to the sides of the piston 81 and a slight bleed from both these sides to drain. This use of negative overlap results in a pressure on both sides of the piston 81 equal to about one-half the supply pressure from the pump 60 when the system is in equilibrium. Slight deflections of the valve 40 will result in pressure decrease on one side of piston 81 and pressure increase on the other side and, consequently a movement of the valve guide 50 to bring its ports into a position of equilibrium relative to valve 40 when the pressures on both sides of the piston 81 will be equal again.

It has been found that the use of a sensitive four-way valve, such as described, results in instability of control. To be able to use a sensitive valve and yet retain stability, the valve 40 is urged toward the pattern by hydraulic pressure supplied by pump 70 at 15 to 20 lbs. per square inch upon the piston portion 41 of valve 40 which closes the recess or cylinder 51 in the housing cover plate 75. A total pressure of five pounds on the tracer 20 has been found satisfactory. If too little, the tracer will not follow the pattern closely; and, if too great, the pattern, if made of wood, will be unduly worn. The rate of flow of fluid into or out of the cylinder 51 through passage 51a is con-

6

trolled by needle valve 51b which is adjusted to give the correct amount of damping effect or retardation of the rate of movement of valve 40 relative to valve guide 50. Stability is increased by increasing the damping effect. The response of the tracer 20 to the elevations and depressions in the moving pattern P is retarded somewhat but the response is still fast enough for normal duplicating operations such as for shaping an airplane propeller blade. For proper functioning of the stability producing means, all air must be excluded from the space between the piston 41 and the valve 51b, that is, in the cylinder 51 and passage 51a. Therefore the vent 79 must be tightly closed after being filled with oil.

The test of stability is by what is known the step function: In Fig. 8, the horizontal represents time and the vertical represents deflection. A—B represents a sudden drop of the follower 20. A—C represents the drop of the tool 10 by piston 81 and also the drop of the valve guide 50. Without stability control, the tool will vibrate vigorously as indicated by the dot-dash wavy line C—D which represents vibrations at 10 to 15 cycles per second which continued for some time. With stability control as provided by hydraulic damping in the manner described, vibration of the tool is promptly damped as indicated by full line C—E which shows that stability is attained in a small fraction of a second after the drop A to B. If the apparatus can pass the "step function" stability test by producing the damping effect of line C—E, the apparatus performs satisfactory duplication.

The springs 25 and 29 which support the tracer or follower 20 provide a rigid support preventing movement of the follower 20 in all directions except the vertical without introducing friction. Hence, only a small force in opposition to these springs is required to move the follower 20 in the direction of movement of the valve 40.

The hydraulic loading of the valve 40 provides a safety feature which prevents the digging of the tool into the work in case of failure of the pumps to supply pressure fluid. The pumps 60 and 70 may be driven for example by electric motors. In case of cessation of electrical power, the pumps will stop. The pressure in cylinder 51 upon valve piston 41 will cease. Springs 25 and 29 lift the valve 40 about .010 inch above equilibrium position which is sufficient to block ports 55a and 55b from pressure in pipe 54d and to connect 54d with the lower side of piston 81. The tool is raised from the work by virtue of hydraulic pressure created by the air or gas pressure of 300 lbs. per square inch stored in the accumulator chamber 64a acting against diaphragm 64, said pressure being retained by check valve 61 and by spring closed valve 66 which can open only at pressure of 700 lbs. to 800 lbs. per square inch or greater. The capacity of the accumulator is sufficient to give time for stopping the planer and to provide some other means for the support of the tool above the work.

It is desirable to be able to duplicate from a relatively soft wooden master pattern such as one made of mahogany or other wood which retains its shape. For accurate duplication, the follower or tracer 20 should have an effective radius equal to the radius of the plane of the cutting edge of the tool 10 which, for example, may be only .125 inch. If the tracer were only the ball 22 (Figs. 2 and 3) having this radius, a wooden pattern would become grooved quickly and rendered unfit for use because the unit pres-

sure applied to the wood would be high. This unit pressure can be reduced to a value such that grooving the pattern becomes practically negligible by using a tracer 20 in the form of a spherical cup of about one-half inch radius. The cup 20 is .030 inch thick and the radius of the ball 22 is .095, thus making the effective radius of the tracer .125 inch which is equal to the radius of the plane of the cutting edge of the tool 10.

As the radius of the cutting tool 10 in the direction of work motion (arrow A in Fig. 1) is very small (practically a sharp point) some error is introduced in duplicating, especially when the tracer engages a relatively steep slope of the pattern as indicated in Fig. 2, due to the fact that the tracer has a definite radius. With the "ball and cup" tracer, this error is considerably reduced from that which would occur if a roller type tracer were used.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo for positioning the tool-holder and comprising piston and cylinder members, one being stationary and the other being connected with the tool-holder, a valve for controlling the admission of pressure fluid to the servo cylinder, said valve comprising a ported valve guide attached to the tool-holder and a port-controlling valve actuated by the tracer, fluid pressure operated means for urging the tracer against the model and means for limiting the rate of fluid pressure circulation with respect to said means in order to limit the rate of relative movement between the valve and the valve guide in order to dampen vibration of the tool-holder.

2. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo for positioning the tool-holder and comprising piston and cylinder members, one being stationary and the other being connected with the tool-holder, a valve for controlling the admission of pressure fluid to the servo cylinder, said valve comprising a ported valve guide attached to the tool-holder and a port-controlling valve actuated by the tracer, fluid pressure operated means for urging the valve against the tracer and the tracer against the model and comprising a piston connected with the valve and a cooperating cylinder provided by the valve guide, and means for restricting the flow of pressure fluid between the cylinder and a pressure fluid source in order to limit the rate of relative movement between the valve and the valve guide in order to dampen vibration of the tool-holder.

3. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo for positioning the tool-holder and comprising piston and cylinder members, one being stationary and the other being connected with the tool-holder, a valve for controlling the admission of pressure fluid to the servo cylinder, said valve comprising a ported valve guide attached to the tool-holder and a port-controlling valve actuated by the tracer, fluid pressure operated means for urging the

tracer against the model, and spring means opposed thereby and acting, upon cessation of fluid pressure upon said means, to move the tracer away from the model and to position the valve for effecting, through the hydraulic servo, a movement of the tool-holder away from the work.

4. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo for positioning the tool-holder and comprising piston and cylinder members, one being stationary and the other being connected with the tool-holder, a valve for controlling the admission of pressure fluid to the servo cylinder, said valve comprising a ported valve guide attached to the tool-holder and a port-controlling valve actuated by the tracer, fluid pressure operated means for urging the tracer against the model, spring means opposed thereby and acting, upon cessation of fluid pressure upon said means, to move the tracer away from the model and to position the valve for effecting, through the hydraulic servo, a movement of the tool-holder away from the work, a source of fluid pressure for operating the hydraulic servo and a pressure fluid accumulator charged by the fluid pressure source and acting, upon cessation of operation of said fluid pressure source, to supply pressure fluid to the hydraulic servo in order that the tool-holder will be moved away from the work.

5. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo comprising a cylinder and a piston connected with the tool-holder, a high pressure fluid source, a four-way valve for connecting one end of the cylinder with the source and the other end with drain or vice versa, said valve comprising a tubular, ported valve guide attached to the tool-holder and a valve actuated by the tracer and having lands controlling the ports of the valve guide, a low pressure fluid source, and means operated thereby for urging the tracer against the model, said means including a cylinder provided by the valve guide and a piston provided by the valve.

6. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo comprising a cylinder and a piston connected with the tool-holder, a high pressure fluid source, a four-way valve for connecting one end of the cylinder with the source and the other end with drain or vice versa, said valve comprising a tubular, ported valve guide attached to the tool-holder and a valve actuated by the tracer and having lands controlling the ports of the valve guide, a low pressure fluid source, means operated thereby for urging the tracer against the model, said means including a cylinder provided by the valve guide and a piston provided by the valve, and a spring device opposed by the last named means and acting upon the tracer, upon cessation of the low pressure source, to move the valve into position for causing the hydraulic servo to move the tool-holder away from the work.

7. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo comprising a cylinder and a piston connected with the tool-holder, a high pressure fluid source, a four-way

9

valve for connecting one end of the cylinder with the source and the other end with drain or vice versa, said valve comprising a tubular, ported valve guide attached to the tool-holder and a valve actuated by the tracer and having lands controlling the ports of the valve guide, the arrangement of the ports and lands being such that, in the equilibrium position of the valve, the high pressure fluid source is connected with both ends of the cylinder and with drain, the work-holder being held fixed, a low pressure source, and means operated thereby for urging the tracer against the model, said means including a cylinder provided by the valve guide and a piston provided by the valve, and means for limiting the rate of movement of the low pressure fluid with respect to said last named cylinder in order to limit the rate of relative movement between the valve and valve guide thereby to dampen vibrations of the work-holder.

8. A duplicating mechanism comprising a tracer for engaging a model to be duplicated, a tool-holder for supporting a tool which operates upon the work, an hydraulic servo comprising a cylinder and a piston connected with the tool-holder, a high pressure fluid source, a four-way valve for connecting one end of the cylinder with the source and the other end with drain or vice versa, said valve comprising a tubular, ported

10

valve guide attached to the tool-holder and a valve actuated by the tracer and having lands controlling the ports of the valve guide, the arrangement of the ports and lands being such that, in the equilibrium position of the valve, the high pressure fluid source is connected with both ends of the cylinder and with drain, the work-holder being held fixed, means for urging the tracer toward the model and means for limiting the rate of relative movement between the valve and valve guide thereby dampening vibrations of the work-holder.

HOWARD CARSON.
HOWARD M. GEYER.
JAMES W. LIGHT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,046,013	Bingel et al.	June 30, 1936
2,101,712	Johansen	Dec. 7, 1937
2,154,718	Bannon	Apr. 18, 1939
Re. 21,544	Richard	Aug. 27, 1940
2,349,171	Jackson	May 16, 1944
2,376,405	Turschan et al.	May 22, 1945