Sept. 15, 1925. 1,554,101

A. KREBS ET AL

METAL WORKING MACHINE

Filed Sept. 16, 1924 4 Sheets-Sheet 1

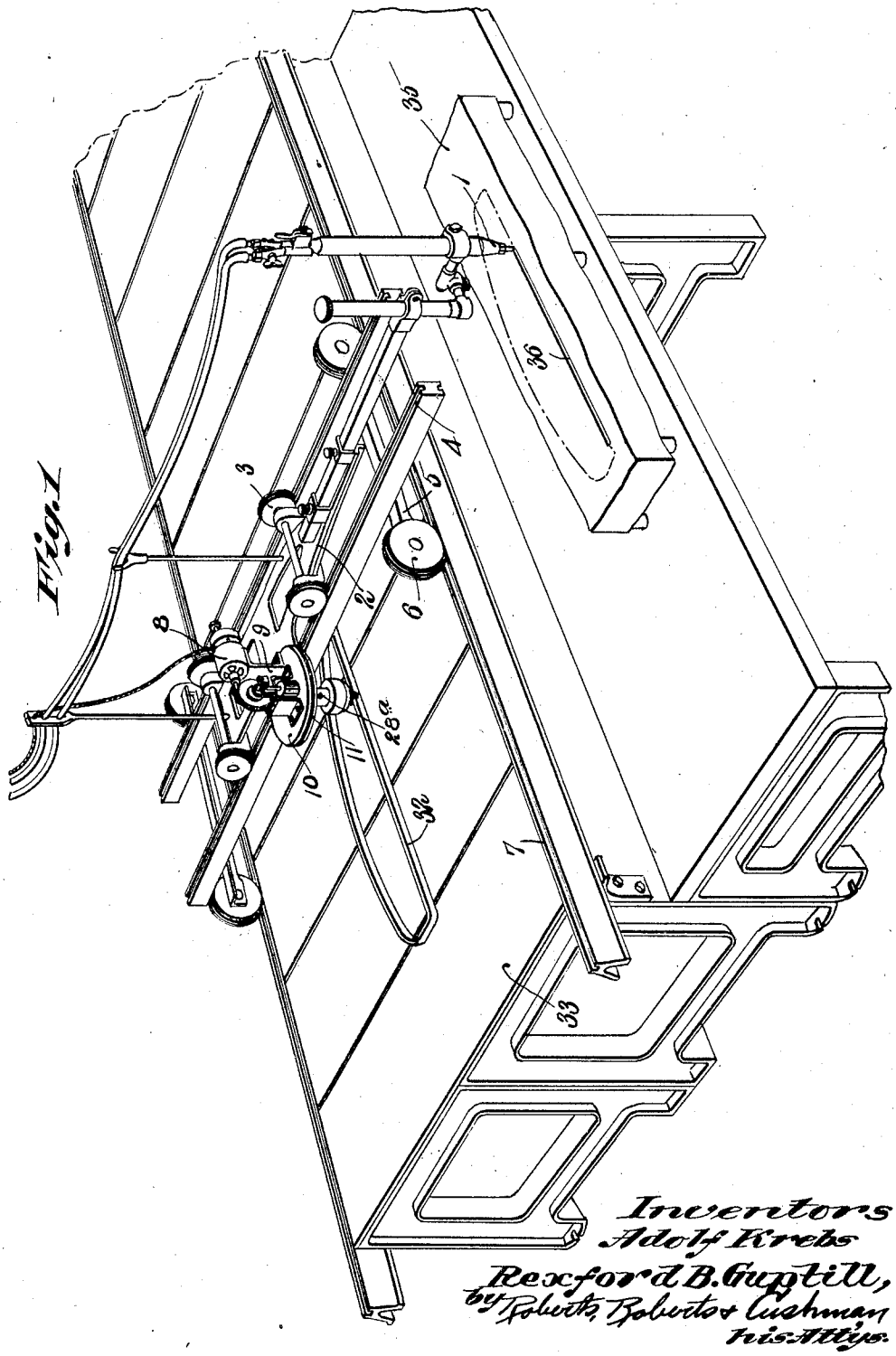

Fig. 1

Inventors
Adolf Krebs
Rexford B. Guptill,
by Roberts, Roberts & Cushman
their Attys.

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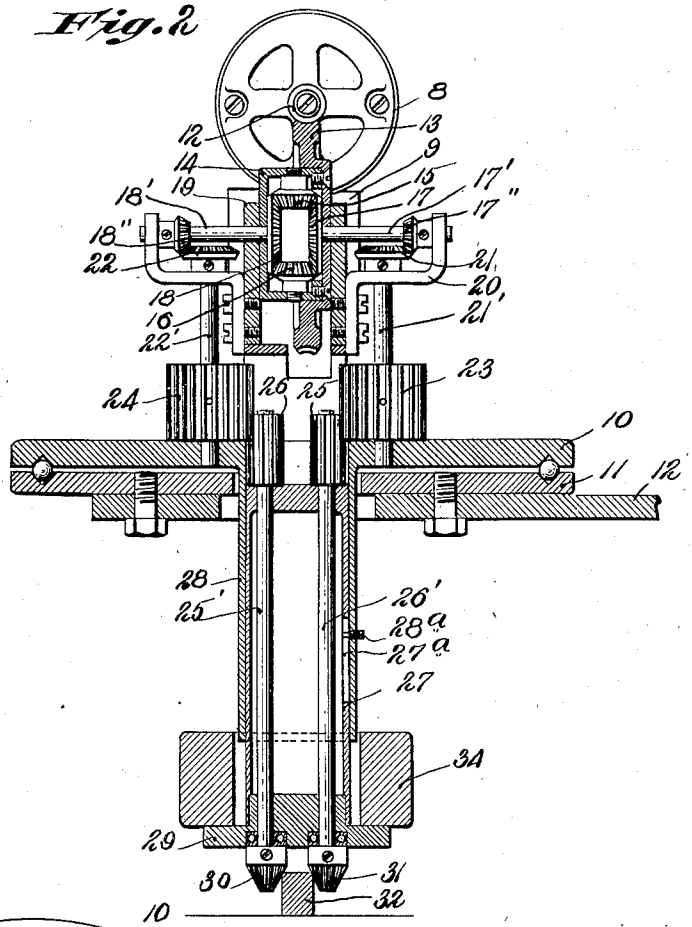
Fig. 2



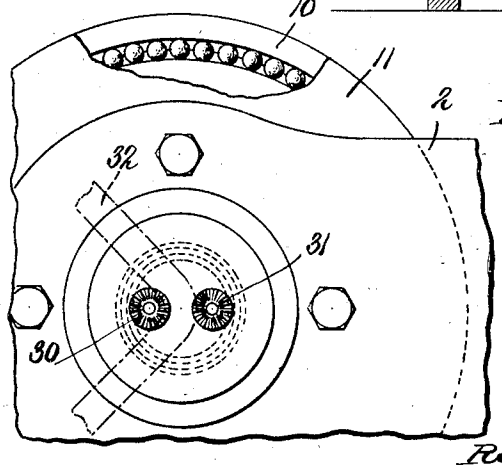


Fig. 3

Inventors:
Adolf Krebs
Rexford B. Gurtill,
by Roberts, Roberts & Cushman
Attys.

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Fig. 4

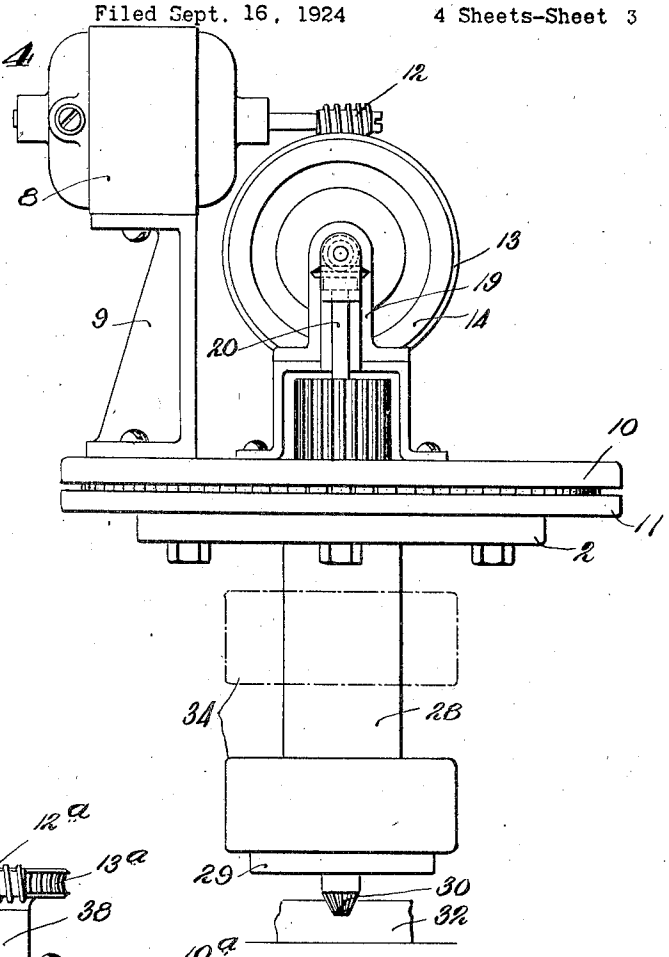


Fig. 5

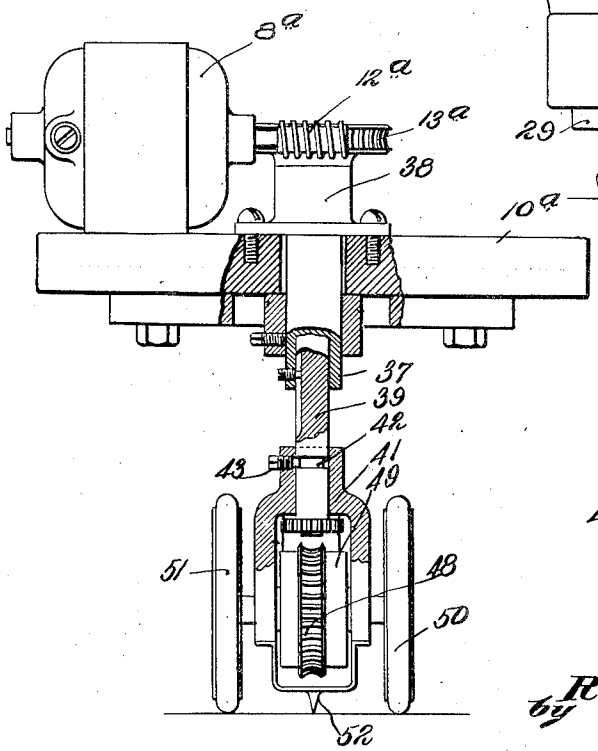
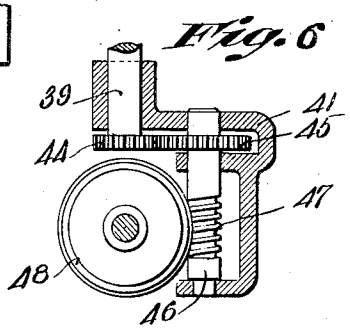


Fig. 6



Inventors
Adolf Krebs,
Rexford B. Guptill,
by
his Attys.

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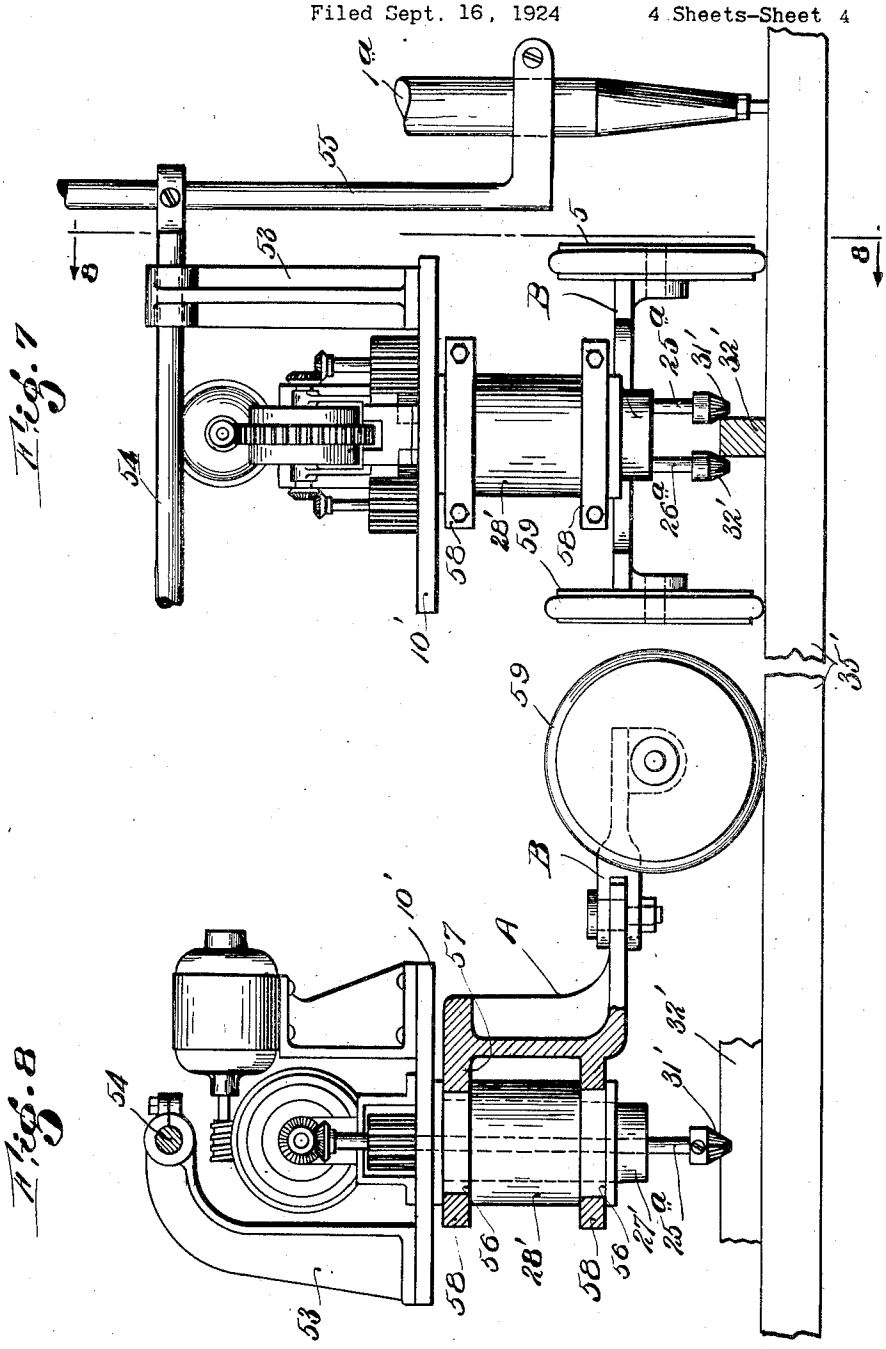

Inventors
Adolf Krebs,
Rexford B. Cuptill,
by Roberts, Roberts & Cushman
Attys.

Patented Sept. 15, 1925. 1,554,101

UNITED STATES PATENT OFFICE.

ADOLF KREBS, OF BOSTON, AND REXFORD B. GUPTILL, OF CAMBRIDGE, MASSACHUSETTS; SAID GUPTILL ASSIGNOR TO SAID KREBS.

METAL-WORKING MACHINE.

Application filed September 16, 1924. Serial No. 737,986.

To all whom it may concern:

Be it known that we, ADOLF KREBS and REXFORD B. GUPTILL, citizens of Germany and the United States of America, respectively, and residents of Boston and Cambridge, in the counties of Suffolk and Middlesex, respectively, and State of Massachusetts, have invented new and useful Improvements in Metal-Working Machines, of which the following is a specification.

This invention relates to machines for automatically moving and controlling the movements of an operative instrumentality in a predetermined manner with respect to work material, particularly a thermal instrumentality, such as a blow-torch moved by a template follower automatically propelled along a template by a motor or other source of power.

In machines of this character employing a blow-torch as the cutting element, one outstanding source of criticism of their operation has been their failure to transcribe sharply varying curves or angles of the template with sufficient accuracy upon the metal being cut, so that the finished shape in many instances fails to conform as closely as desired to the template or pattern. Such inaccuracy in operation has been occasioned in most cases from one of two general causes: first, the employment of a template following roll or other guide element of so large a size that it is unable accurately to follow the contour of the template, especially if such contour includes sharp turns, curves, or re-entrant angles; and second from the practice of transmitting movement of the template following element to the cutting instrumentality by the use of links or lever arms, such arrangements even though carefully constructed, exhibiting a certain degree of lost motion.

Objects of the invention are to provide an improved apparatus for accurately and reliably cutting, welding or carrying out other operations along a path corresponding to a given pattern or template and to arrange the apparatus so that it is adapted to use an extremely simple form of template readily constructable from cheap and easily obtainable material such as cardboard, fiber, wood, or other easily workable material, the arrangement being such that the template is not required to support any additional weight; and to provide means for driving the template followers at substantially a constant average speed so that the cutting element is moved reliably and accurately to accord to the shape of the template.

Three concrete embodiments of the invention are illustrated on the accompanying drawings, in which:

Fig. 1 is a perspective view of a torch cuting machine;

Fig. 2 is a vertical section showing the mechanism for operating the template follower;

Fig. 3 is a bottom view of the follower;

Fig. 4 is a side elevation of the template follower operating mechanism;

Fig. 5 is an elevation partly in section of a modified form adapted for tracing drawings;

Fig. 6 is an elevation showing the driving connection for the mechanism shown in Fig. 5;

Fig. 7 is a front elevation of further modification; and

Fig. 8 is a section on the line 8—8 of Fig. 7.

In the particular form of the invention illustrated in Figs. 1 to 4, a blow-torch is mounted for universal movement in a horizontal plane. Template followers are mounted in a vertical position on the support for the blow-torch and are connected to be driven by a motor, the followers fitting over and rotating along the edge of the template. Mechanism permits the followers to move around curves and irregularities in the contour of the template without change of speed, so that the average speed of the followers is not varied, but kept constant at all times regardless of the number of sharp turns, curves or re-entrant angles in the template.

Referring to Figs. 1 to 4, the blow-torch or other instrumentality 1 arranged to project a cutting blast vertically downward is supported from a carriage 2 mounted on wheels 3, supported in tracks 4 for restricting the movement of the carriage 2 to linear movement with respect to a carriage 5 on which the tracks are mounted. Carriage 5 is provided with wheels 6 supported on horizontal tracks 7 which restrict the carriage to linear movement transverse to that of the carriage 2.

Motor 8 is supported on an upright bracket 9 secured to a platform or turntable 10

which is rotatably mounted in antifriction bearings on a plate 11 bolted to the carriage 2. Rotated by the motor 8 is a worm 12 meshing with gear 13 which is secured by screws to the casing 14. Within the casing 14 is a differential comprising bevel pinions 15 and 16 carried by the casing meshing with opposed bevel gears 17 and 18 which are fast to shaft 17′ and 18′ respectively carrying bevel pinions 17″ and 18″. Shafts 17′ and 18′ are journaled in brackets 19 and arms 20 secured to the bracket 9 which bracket support the outer ends of the shafts. Meshing with the pinions 17″ and 18″ are pinions 21 and 22 respectively fast to vertical shafts 21′ and 22′, the upper ends of which are journaled in the bracket arms 20 and the lower ends are journaled in the platform 10. Fast to the shafts 21′ and 22′ are gears 23 and 24 respectively meshing with gears 25 and 26 respectively secured to the template follower shafts 25′ and 26′. Supporting the shafts 25′ and 26′ is a slide 27 which is axially movable in an extension 28 integral with the platform 10, the lower ends of the shafts being mounted in antifriction bearings in a head 29 fitting within the slide 27. Relative rotative movement between the slide 27 and extension 28 is prevented by a screw 28^a in the extension 28 which extends into an elongate slot 27^a in the slides 27.

Fast to the ends of the template follower shaft 25′ and 26′ are template follower members 30 and 31 respectively, frusto-conical in form and having axial ridges or otherwise provided with frictional surfaces for engagement with vertical edges of the strip 32 constituting the template or pattern. The template 32 of relatively soft metal, cardboard, fiber, wood or other easily worked material rests upon the table 33, or if desired may be clamped in position although this is not required owing to the smoothness of operation of the mechanism. The template follower members 30 and 31 are held in contact with the template by a weight 34 bearing against the head 29 and adapted to slide on the extension 28 to permit the members to be moved axially away from the template.

In operating the machine, the template follower members 30 and 31 are moved into engagement with the opposite edges of the template strip 32, the weight 34 holding the members in position. Motor 8, acting through the series of gears described causes rotation of the follower members 30 and 31 in the same direction. The template followers are thus automatically moved by rolling along the edges of the template, thereby propelling the carriage 2 and torch 1 synchronously in accordance with the contour of the template, the followers being adapted to turn together owing to the rotatable connection between the platform 10 and plate 11. In moving in and out of angles and curves in the template, such as indicated in Fig. 3 the gears comprising the differential function to maintain the average speed of the followers substantially contstant, because the average speed of the two follower members is kept constant although the speed of one or the other is permitted to increase or diminish with respect to the other. In this manner the torch is moved continuously at the same speed irrespective of the number and magnitude of the irregularities on the surface of the template. The material 35 being worked upon is accordingly cut along the path 36 indicated by the full line, the dotted line in continuation of line 36 representing the path to be cut by the torch upon further movement of the followers along the template. Thus the block of metal or other material 35 is cut accurately to conform to the pattern of the template 17 without adjustment or manipulation by the operator other than positioning the follower members and energizing the motor.

In order to stop the propulsion of the template followers 30 and 31 and the torch 1, it is only necessary to displace the shafts 25′ and 26′ slightly from the edge of the template by raising the slide 27 thus instantly stopping further travel of carriage 2 and the torch by directly applied manual control. To start again it is merely necessary to reestablish contact between the follower members and template.

In the embodiment of the invention illustrated in Figs. 5 and 6, motor 8^a is supported directly on the platform 10^a and is provided with the rotor worm 12^a meshing with the gear 13^a carried by a shaft 37 rotatable in a bearing 38. Extending into and rotatable with the shaft 37 is a shaft 39 which is splined thereto for longitudinal adjustment. The end of the shaft 39 extends into a housing 41 and has a annular groove 42 receiving the end of a screw 43 to permit relative rotative movement between the shaft and housing. Fixed to the end of the shaft 39 is a pinion 44 meshing with gear 45 fast to shaft 46 which is provided with a worm 47. The worm 47 meshes with a gear 48 fixed to the differential housing 49 constructed to drive wheels 50 and 51 having rubber tires journaled in the housing 41. This machine is also universally mounted after the manner above described for synchronously moving the blow-torch.

In operation of this machine, a blue print or working drawing is placed on a support and a pointer 52 fast to the housing 41, is guided manually over the lines on the print, the blow-torch being accordingly moved as above described. It is merely necessary for the operator to grasp the casing 41 or other suitable part to guide the pointer, the wheels

50 and 51 being driven through the connections described. As in the above described form, the differential in the housing 49 serves to insure an even and uninterrupted movement of the blow-torch regardless of the turns or angles described by the pointer.

Under some conditions it is desirable to support the template directly on the material to be worked upon, thus to eliminate the tracks for the carriage, and, as in the first form described the driven template followers propel the carriage along, the carriage functioning to maintain the followers in planes at substantially right angles to the horizontal plane of the template. For this purpose, the driving mechanism is similarly mounted on a platform 10′ having an integral tubular extension 28′ within which fits sleeve 27′ supporting the driven follower shafts 25ª and 26ª to which are fixed template followers 31′ and 32′ arranged for rolling contact with the opposite edges of the template 32′, the above mechanism being substantially the same as above described. Also mounted on the platform 10′ is a bracket 53 supporting a horizontal rod 54 to which is attached a vertical rod 55 for supporting in a vertical position the blow-torch 1ª clamped thereto.

Formed in the extension 28′ are annular grooves 56 around which fit brackets 57 forming an integral part of the section A of the machine carriage, the brackets being held in place by semi-cylindrical straps 58 bolted thereto. Extending rearwardly of the carriage section A and pivoted thereto to swing in substantially a horizontal plane is the carriage section B to which are journaled a pair of wheels 59, which may be provided with rubber tires to prevent slipping. It will be observed that the motor is mounted rearwardly on the platform 10′ so that the center of gravity is in rear of the vertical axis of the machine. In this manner the machine tends to tilt to the rear in order that the wheels 57 may aid in supporting the weight and liability of the machine tilting forwardly is prevented.

It will be apparent that in this form the template 32′ is placed directly upon the material 35′ being worked upon and the followers 31′ and 32′ propel the carriage in accordance with the contour of the template, the blow-torch being synchronously moved along the material. This machine otherwise operates in the same manner as that shown in Figs. 1 to 4.

It will be evident that an outstanding characteristic of the invention consists in the provision of a differential for insuring the even and regular movement of the drivers so that at all times the average speed of the drivers is constant. This is advantageous because there is no liability of the blow-torch stopping at intervals which would tend seriously to impair efficient results. Another particularly advantageous feature of the invention consists in mounting both the motor and transmission in such a manner that the template followers can move freely, and readily follow any change of direction without side thrust which would be the case if the mechanism was mounted on an immovable base or rigidly mounted with respect to the carriage. If, for instance, the motor was not mounted on a plate movable with respect to the carriage the thrust or turning movement of the motor would be directly transmitted to the carriage itself with the result that the template followers and therefore the cutter or torch would have a tendency to turn about a vertical axis instead of following the template without such skewing tendency.

From the above it will be observed that in each of the forms described there is a follower which is supported in substantially a vertical position and guided along a predetermined path, viz the slide 27 in the first form, the pointer 52 in the second form, and the sleeve 27′ in the third form. Furthermore the follower in each form is propelled along a predetermined path by a pair of drivers differentially connected together and which are located upon opposite sides of the vertical axis of the follower, viz in the first and third forms the template follower 30 and 31, and 31′ and 32′ respectively, and in the second form the drive wheels 50 and 51.

We claim:

1. In a machine of the class described, a cutting tool, means for supporting said tool for universal movement in a plane, follower members supported from said means, means for positively rotating said follower members thereby to propel said support, and means for maintaining the average speed of said members constant.

2. In a machine of the class described, a cutting tool, means for supporting said tool for universal movement in a plane, follower members supported from said means, means for rotating said follower members thereby to propel said support, and a differential associated with said last means for maintaining the speed of said tool uniform.

3. In a machine of the class described, a thermal cutting tool, means for supporting said tool for universal movement in a plane, a pair of follower members supported from said means, means for rotating said follower members thereby to propel said support, and a differential associated with said last means for maintaining the average speed of said members substantially constant.

4. In a machine of the class described, a thermal cutting tool, means for supporting said tool for universal movement in a plane, template follower elements supported from said means, means for positively rotating

said elements on an axis normal to said plane, and means for maintaining the average speed of said elements constant.

5. In a machine of the class described, template follower elements, means for supporting said elements for rotation on a vertical axis, means for holding the ends of said elements in engagement with a template, and means for positively rotating said elements at a substantially constant average speed, thereby to propel said elements and support in accordance with the contour of the template.

6. In a machine of the class described, template follower elements, means for supporting said elements for rotation on a vertical axis, said elements being arranged to engage opposite edges of a template, and means for positively rotating said elements at substantially a constant average speed, thereby to propel said elements and support in accordance with the contour of the template at a uniform rate of speed.

7. In a machine of the class described, a template in the form of a continuous strip, template followers engaging opposite sides of said strip, means for supporting said elements for rotation on a vertical axis, and means for positively rotating said elements at a substantially constant average speed thereby to propel said elements in accordance with the contour of the template.

8. In a machine of the class described, a template having an upstanding edge, template followers in rolling contact with the opposite sides of said edge, means for supporting said followers for universal movement in a plane, and means for positively rotating said followers.

9. In a machine of the class described, a template having an upstanding edge, template followers in rolling contact with the opposite sides of said edge, means for supporting said followers for universal movement in a plane, and means for positively rotating said followers, including mechanism for maintaining the average speed thereof substantially constant.

10. In a machine of the class described, a thermal cutting tool, means for supporting said tool for universal movement in a plane, a template having an edge to be followed, template followers in rolling contact with the opposite sides of said edge respectively, and means for conjointly rotating said followers thereby to propel the support and elements in accordance with the contour of the template.

11. In a machine of the class described, a thermal cutting tool, means for supporting said tool for universal movement in a plane, a template having an edge to be followed, template followers in rolling contact with the opposite sides of said edge respectively, and means for conjointly rotating said followers thereby to propel the support and elements in accordance with the contour of the template, said means including mechanism for maintaining the average speed of said elements substantially constant.

12. In a machine of the class described, a thermal cutting tool, means for supporting said tool for universal movement in a plane, a template having an edge to be followed, template followers in rolling contact with opposite sides of said edge, means for mounting said followers on said supporting means for rotation as a unit relative to said supporting means, and means for conjointly rotating said followers, said means including a differential associated with said last means.

13. In a machine of the class described, a template having an edge to be followed, template followers in rolling contact with opposite sides of said edge, a support for said followers, a carriage, means for rotatably mounting said support on the carriage, means for rotating said followers, and a differential associated with said last means for maintaining the average speed of said followers substantially constant.

14. A metal cutting machine comprising a carriage, an instrument mounted on the carriage, a motor associated with the carriage, two drive rollers connected with the motor for propelling the carriage, and a differential interposed between the drive rollers and the motor.

15. A metal cutting machine comprising a carriage, an instrument mounted on the carriage for universal movement in a plane, a motor associated with the carriage, two drive rollers connected with the motor for propelling the carriage, and a differential interposed between the drive rollers and the motor.

16. A metal cutting machine comprising a carriage, an instrument mounted on the carriage for universal movement in a plane, a motor associated with the carriage, two drive rollers supported for rotation on a vertical axis and connected with the motor for propelling the carriage, and a differential interposed between the drive rollers and the motor.

17. A metal cutting machine comprising a carriage, an instrument mounted on the carriage for universal movement in a plane, a motor associated with the carriage, two drive rollers supported for rotation on a vertical axis and connected with the motor for propelling the carriage, the rollers being arranged for rolling contact with opposite edges of a template, and a differential interposed between the drive rollers and the motor.

18. A metal cutting machine comprising a follower to be propelled along a predetermined path, a support for said follower, a

pair of drivers to propel said follower, a motor for rotating said drivers, and a differential interposed between said drivers and motor.

19. A metal cutting machine comprising a vertically disposed follower to be propelled along a predetermined path, a support for said follower, a pair of drivers to propel said follower, a motor for rotating said drivers, and a differential interposed between said drivers and motor.

20. A metal cutting machine comprising a vertically disposed follower to be propelled along a predetermined path, a support for said follower, a pair of drivers on opposite sides of the vertical axis of the follower to propel said follower, a motor for rotating said drivers, and a differential interposed between said drivers and motor.

21. A metal cutting machine comprising a follower supported for universal movement in a plane, a pair of drivers on opposite sides of the follower to propel said follower along a predetermined path, a motor for rotating said drivers, and a differential interposed between said drivers and motor.

22. In a machine of the class described a cutting tool, means for supporting said tool for universal movement in a plane, follower members supported from said means, means for positively rotating said follower members to propel said support evenly, and means for maintaining the average speed of said members constant, said rotating means being arranged to propel said support without tendency to deflect said follower members from their course.

23. A metal cutting machine comprising a carriage, an instrument mounted on the carriage for universal movement in a plane, a support rotatably mounted with respect to said carriage, a motor carried by said support, two drive rollers supported for rotation on vertical axes and connected with the motor for propelling the carriage, and a differential interposed between the drive rollers and the motor.

24. A metal cutting machine comprising a carriage, an instrument mounted on the carriage for universal movement in a plane, a support rotatably mounted with respect to said carriage, a motor carried by said support, two drive rollers supported for rotation on vertical axes and connected with the motor for propelling the carriage, said motor being mounted on said carriage for rotation about a vertical axis between said axes whereby to avoid tendency for the motor to deflect the rollers from their course, and a differential interposed between the drive rollers and the motor.

25. In a machine of the class described, a carriage mounted for universal movement in a plane, a cutting tool mounted on said carriage and movable therewith, follower elements mounted on said carriage, means for positively rotating said follower elements, said means being mounted on a support rotatable with respect to said carriage whereby the turning moment of said rotating means causes no relative movement between the follower elements and the support.

26. In a machine of the class described, a carriage mounted for universal movement in a plane, a cutting tool mounted on said carriage and movable therewith, template follower elements mounted on said carriage, driving means for positively rotating said follower elements mounted on said carriage, anti-frictional bearings between said driving means and carriage whereby the thrust from the driving means will not tend to prevent the carriage and cutting tool from accurately following the course prescribed by the follower elements.

27. A metal cutting machine comprising a carriage, an instrument mounted on the carriage for universal movement in a plane, a support mounted on said carriage and rotatable in anti-frictional bearings with respect thereto, a motor carried by said support, and template followers driven by said motor to propel the carriage and impart a corresponding movement to the instrument mounted thereon.

Signed by us at Boston Mass. this fourth day of September 1924.

ADOLF KREBS.
REXFORD B. GUPTILL.