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TRACER AND TEMPLATE-FOLLOWER APPARATUS

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2 Sheets-Sheet 1

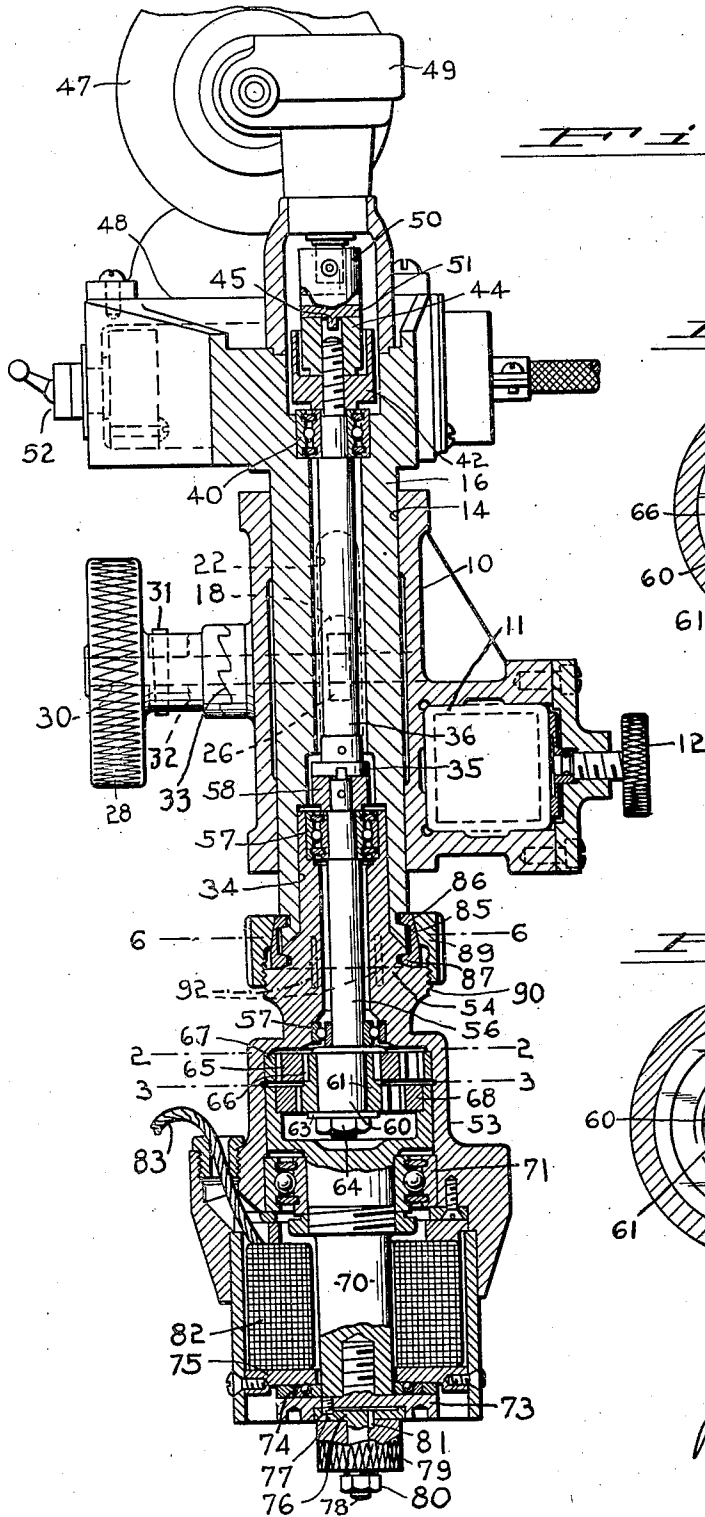


Fig. 1

Fig. 2

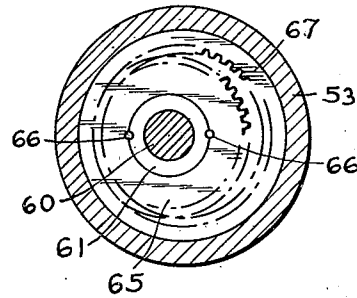
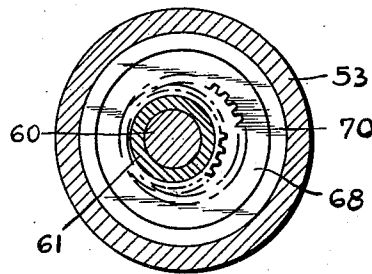


Fig. 3



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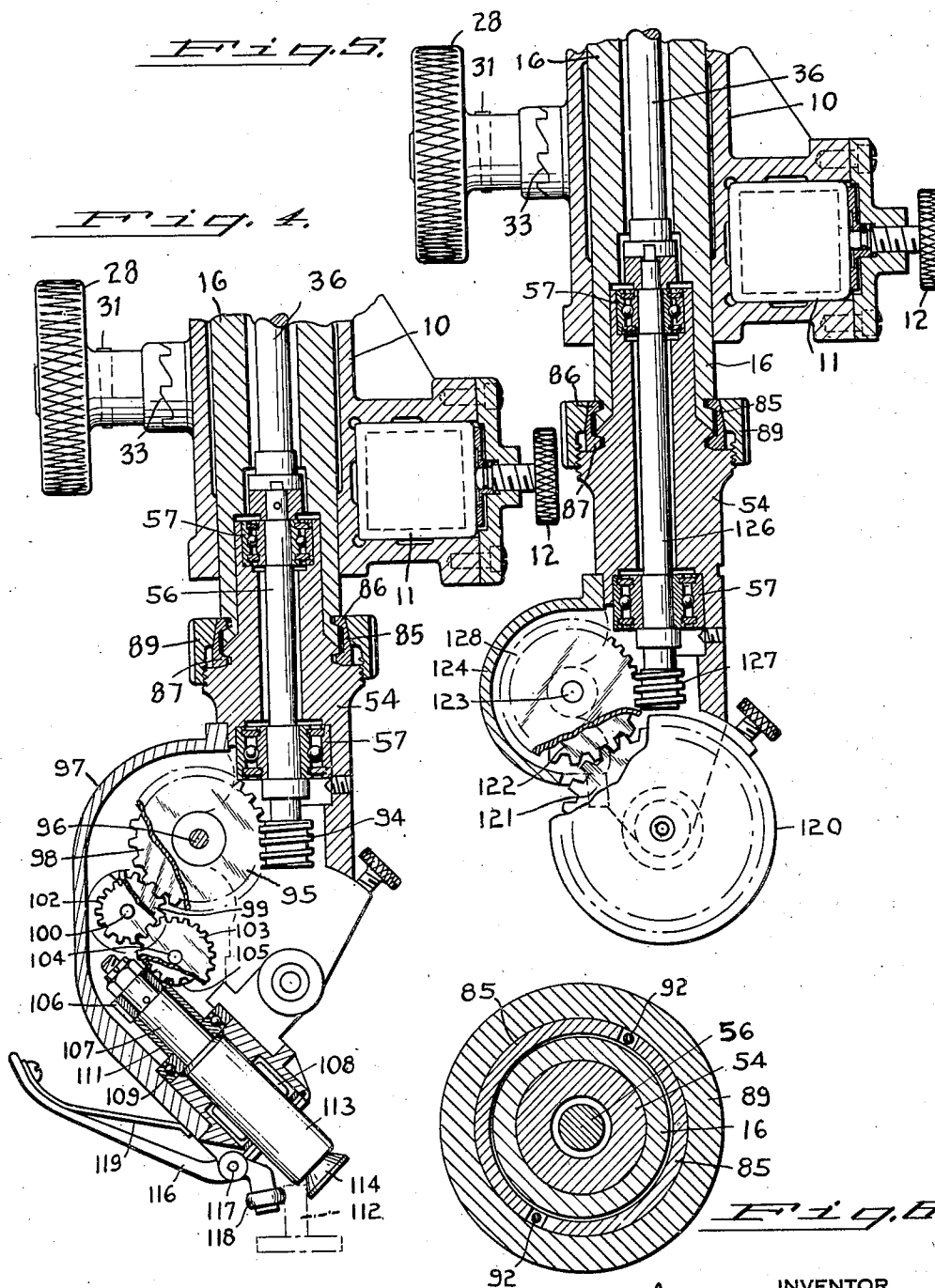
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2 Sheets-Sheet 2



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TRACER AND TEMPLATE-FOLLOWER
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14 Claims. (Cl. 33—23)

This invention relates to apparatus for guiding an instrumentality, more particularly a cutting or welding torch, from the outline of a drawing or pattern.

Among the known varieties of such apparatus are tracers in which a traction wheel is guided along the outline of a drawing or print and steered about an axis that passes through the point of traction. Power is applied to the wheel through a vertical drive shaft and worm coaxial with the axis about which the wheel is turned when steering so that the steering has little or no effect on the traction speed.

One form of template-follower that is widely used has a power-driven roller that adheres to a template edge by magnetic attraction as the roller travels along the edge face of the template. Other template-followers have a small diameter roller or "spindle" that is held against the edge face of a template by manual or spring pressure. Some template-followers have friction faces set at such angles that the rollers tend to move against a guiding surface of the template. These various follower devices each have their uses. Some of them can be used for work for which others are not suitable, and among those which can be used for the same work different operators have personal preferences.

It is an object of this invention to provide improved tracer or template-follower apparatus which can be converted from one variety of follower apparatus into another, as for example, from a magnetic template-follower to a wheeled tracer, or angular roller template-follower.

Stated in another way, it is an object of the invention to provide a basic power and supporting unit to which different kinds of follower devices can be connected.

Other objects, features and advantages of the invention will appear or be pointed out as the specification proceeds.

In the accompanying drawings, forming part hereof:

Fig. 1 is a vertical sectional view showing the invention applied to a magnetic template-follower.

Figs. 2 and 3 are enlarged sectional views taken on the lines 2—2 and 3—3, respectively, of Fig. 1.

Figs. 4 and 5 are fragmentary sectional views similar to Fig. 1, but showing different kinds of follower apparatus attached to the basic power and supporting unit of Fig. 1.

Fig. 6 is an enlarged sectional view taken on the line 6—6 of Fig. 1.

The invention is intended for use with various

kinds of universal cutting or welding machines, but is shown in the drawings as equipped with a bracket 10 for clamping it to a front bar 11 of a cutting machine of the folding parallelogram type. The bracket 10 is held in any set position along the bar by a clamping screw 12.

The clamp fitting or bracket 10 has a vertical tubular bearing 14. A sleeve 16 extends through this tubular bearing. A rack 18 is fastened to the sleeve 16 and extends through a slot 22 in the front side of the tubular bearing 14 and serves as a key to prevent turning of the sleeve 16 in the tubular bearing. The rack 18 is shorter than the slot 22, so that the sleeve 16 can move vertically for a limited distance.

A pinion 25 meshes with the rack 18, and this pinion is connected to a hand-wheel 28 by a shaft 30. The hand-wheel 28 is rotated to operate the rack and pinion mechanism to raise and lower the sleeve 16 in the tubular bearing 14.

There is a pin 31 extending from the shaft 30 into slots 32 in the hub of the hand-wheel 28 so that the hand-wheel has a limited movement lengthwise of the shaft but cannot turn independently of the shaft. Teeth 33 on the hub of hand-wheel 28 are moved into and out of engagement with complementary teeth on the bracket 10 by shifting the handwheel 28 one way or the other along the shaft 30. The teeth 33 are designed to hold the hand-wheel 28 and the shaft 30 against rotation when the sleeve 16 is in a raised position and the follower apparatus lifted above the template or pattern table.

The lower end of the sleeve 16 is of enlarged internal diameter to provide a cylindrical bearing or socket 34 into which the upper ends of different kinds of follower apparatus are selectively inserted. The lower end of the sleeve 16 has a frustoconical face that serves as a thrust bearing for the follower apparatus.

In the upper portion of the socket 34 there is a tongue and groove coupling member 35 secured to the lower end of a vertical drive shaft 36. The upper end of the vertical shaft 36 turns in a ball-bearing 40 which fits within the upper end of the sleeve 16 and against a shoulder in the sleeve. A hexagonal nut 42 is threaded on the end of the vertical shaft 36 and abuts against the ball-bearing 40.

The hexagonal nut 42 is held in any set position by a lock nut 44 which is substantially cylindrical and fits within a recess in the hexagonal nut 42. The lock nut 44 has a slot 45 in its upper end.

Power is supplied to the vertical shaft 36 by

a motor 47 which is supported on a platform 48. This platform is integral or connected with the upper end of the sleeve 16. The motor drives reduction gearing 49, to which is connected a coupling member 50 in alignment with the vertical shaft 36. The coupling member 50 is connected with the lock nut 44 by an intermediate coupling member 51 to complete the driving connection between the motor 47 and shaft 36.

The motor 47 is stopped and started by a switch 52 in a switch box connected to the platform 48 and sleeve 16. The structure thus far described is the basic power and supporting unit to which the different kinds of follower apparatus can be attached.

The follower apparatus shown in Fig. 1 is a magnetic template-follower and includes a housing 53 with an upper sleeve portion or connector 54 that fits into the socket 34 and is rotatable in the socket 34 as a bearing. A sloping shoulder on the connector 54 bears against the frusto-conical end face at the bottom of the sleeve 16 to limit the telescopic engagement of the connector 54 with the sleeve 16.

A shaft 56 in line with the shaft 36, is supported in ball bearings 57 in the connector 54, and a tongue and groove coupling member 58 fastened to the upper end of the shaft 56 engages the coupling member 35 of the drive shaft 36 and operatably connects the shafts 36 and 56.

A stud 60 connected to, and preferably integral with, the lower end of the shaft 56 is eccentric of the shaft 56 and serves as a bearing for a spur gear 61. The gear 61 is rotatable on the stud 60 but is held against endwise movement by a flange at the upper end of the stud and a washer 63 held on the lower end of the stud by a nut 64.

An upper spur gear 65 fits over the hub of the lower spur gear 61 and has pins 66 which cause these gears 61 and 65 to rotate as a unit. The upper spur gear 65 meshes with an internal gear 67 fixed in the housing 53 as shown in Fig. 2. The lower spur gear 61 engages an internal gear 68, best shown in Fig. 3.

The internal gear 68 is secured in a recess at the upper end of a roller drive shaft 70 which is in line with shafts 36 and 56 and turns in a ball bearing 71 in the housing 53. The spur gears 61 and 65 in association with the internal gears 67 and 68 form an epicyclic train through which rotation of the shaft 56 is transmitted to the roller drive shaft 70 with considerable reduction in speed.

A thrust collar 73 screwed to the lower end of the roller drive shaft 70 contacts with a ball bearing thrust washer 74 that runs against a bottom plate 75 of the housing 53. A roller connector 76 is fastened to the bottom of the thrust collar 73 by screws 77 and has a threaded stem over which fits a knurled template follower roller 79. This roller 79 is held on the stem 78 by a nut 80 and the roller is forced to turn as a unit with the connector 76 by a key 81.

By having the template follower roller 79 detachably connected with its driving shaft, it is possible to replace the roller with others of different diameter. The larger the diameter of the roller face, the greater the lineal speed of the follower along the template. As an illustration of the effect obtained by rollers of different diameter, the follower apparatus of Fig. 1 with a $\frac{3}{8}$ " diameter roller will travel along the edge of a template at a lineal speed of from $\frac{3}{4}$ to $10\frac{3}{4}$ inches per minute depending upon the

adjustment of the motor governor. With the same speed range of the motor and a follower roller of 1" diameter, the lineal speed along a template follower is from 2 to $28\frac{3}{4}$ inches per minute.

The follower roller 79 is magnetized, to cause it to adhere to a steel template, by a solenoid 82 in the lower end of the housing 53. Lead-in wires 83 for the solenoid 82 pass through a special opening in the housing 53.

The fastening means for connecting the follower apparatus with the basic power and supporting unit includes a coupler 85 with inwardly extending annular rims 86 and 87 at its upper and lower ends respectively. The rim 86 fits into a circumferential groove in the lower portion of the sleeve 16 and the rim 87 extends into a similar groove in the connector 54.

The coupler 85 is made in two semi-circular parts so that it can be removed from the grooves in the sleeve 16 and connector 54 when new follower apparatus is to be fastened to the basic supporting unit. The semi-circular parts of the coupler 85 are held together by a clamping nut 89 that screws on threads 90 on the outside of the connector 54. The nut 89 has an inclined face that bears against a tapered surface on the outside of the coupler 85.

The semi-circular parts of the coupler 85 are slightly less than 180 degrees so that there is some clearance between their ends when they are assembled in the grooves of the sleeve 16 and connector 54. This clearance is shown in Fig. 6. Two pins 92 extend upward from the connector 54 between the ends of the semi-circular parts of the coupler 85.

The pins 92 cause the coupler 85 to turn as a unit with the connector 54 and prevent any movement of the coupler 85 with respect to the nut 89 when the connector 54 turns during the ordinary steering movements of the follower apparatus.

When the nut 89 is screwed down tight, it clamps the rims 86 and 87 of the coupler against the tapered side walls of the grooves into which these rims extend and thereby fastens the sleeve 16 and connector 54 rigidly together so that the housing 53 cannot turn. If the nut 89 is not screwed down tight against the coupler 85, the rim 86 is a running fit in the groove in sleeve 16 and the housing 53 can rotate freely about the axis of the shaft 56 as a center.

With some tracer apparatus it is necessary for the assembly that includes the follower wheel or roller to be free to turn with respect to the upper supporting structure. Since the coupler 85 does not interfere with such turning movement, when the nut 89 is not screwed down tight, it is suitable for use with follower apparatus that must be left free to turn with respect to the basic supporting unit.

With the magnetic template follower shown in Fig. 1, however, the housing 53 in which the internal gear 68 is fixed must be prevented from turning. When this follower apparatus is connected to the basic supporting unit, the nut 89 is screwed down tight.

Figs. 4 and 5 show the lower end of the same basic supporting unit with different kinds of template follower apparatus attached to it in place of the magnetic roller apparatus of Fig. 1. Parts of the follower apparatus of Figs. 4 and 5 that correspond to parts of the magnetic roller apparatus of Fig. 1 are indicated by the same

reference characters.

In the apparatus of Fig. 4 the shaft 56 extends downward beyond the lower ball bearing 57 and there is a worm 94 secured to the end of the shaft 56. The worm 94 drives a worm wheel 95 on a shaft 96 that is journaled in a housing 97 at the lower end of the connector 54. A spur gear 98 secured to the same shaft as the worm wheel 94 drives a spur gear 99 on a countershaft 100.

A second spur gear 102 on the countershaft 100 drives a spur gear 103 that is secured on a shaft 104 supported by the housing 97. A spiral gear 105 on the shaft 104 drives a spiral gear 106 fastened to the top of a roller shaft 107 that turns in a roller bearing 108. A second bearing for the shaft 107 is a ball bearing 109 and this ball bearing serves as a thrust bearing for end thrust from either direction. A shoulder on the shaft 107 transmits upward thrust to the ball bearing 109, and a bushing 111 between the gear 106 and the ball bearing 109 transmits downward thrust to the ball bearing to prevent the roller shaft from sliding downward when the apparatus is lifted out of contact with a template 112.

The lower end of the shaft 107 extends beyond the end of the housing 97 and comprises a template follower roller 113 that rests on the top face of the template 112. A guide roller 114 is connected to the bottom face of the roller 113 and has a frusto-conical face that bears against a side of the template.

A lever 116 connected with the housing 97 by a fulcrum pivot 117 carries two wheels 118 that bear against the side of the template opposite the guide roller 114. A leaf spring 119 urges the upper end of the lever 116 away from the housing 97 and holds the wheels 118 against the template with a yielding force.

Fig. 5 shows a tracer with a traction wheel 120 for following the outline of a drawing, print, or similar pattern. The traction wheel 120 is connected with a gear 121 that is driven by a smaller gear 122 on a countershaft 123 journaled in a housing 124 at the lower end of the connector 54. A shaft 126, corresponding to the shaft 56 of Figs. 1 and 4, has a worm 127 at its lower end. A worm wheel 128 on the shaft 123 transmits motion of the worm to the gear 122.

The point of traction of the wheel 120 is in line with the axis of the shaft 126 so that the traction wheel can be steered without affecting its speed of travel. With this follower apparatus attached to the basic supporting unit the nut 89 is left in a position that will permit the connector 54 to turn freely with respect to the sleeve 16 when the tracer is being steered along a curved course. When straight line cuts are to be made, however, the nut 89 can be screwed down tight to hold the tracer mechanism against turning.

The preferred embodiment and some modifications of the invention have been described, but other modifications and changes can be made and some features of the invention can be used without others.

I claim:

1. A template-follower unit for connection with a movable frame of a universal cutting or welding machine, said follower comprising a template-follower roller that contacts with the edge of a template, a housing with bearings supporting the rollers, a drive shaft, and motion-transmitting connections between the drive shaft and roller including an epicyclic gear train that drives the roller at a speed slower than the drive shaft speed, one gear of said train being connected with

the drive shaft and another gear of said train being fixed in the housing.

2. A template-follower including a roller that travels along the edge of a template, a motor, two shafts extending in the same direction as the roller axis and one of which is connected directly to the roller and the other of which is connected with the motor, and epicyclic speed reducing gearing between said shafts.

3. A template-follower including a roller for contact with the guiding edge of a template, a motor, a driving shaft connected with the motor, and a driven shaft connected with the roller, said follower including also an upper section in which the driving shaft is supported, a lower section having a portion that telescopically engages the lower end of the upper section, a bearing in the lower section for the driven shaft, gearing in the lower section for transmitting motion from the driving shaft to the driven shaft, at least a portion of said gearing being supported by the lower section and reacting against the lower section in transmitting motion to the driven shaft, and releasable fastening means connecting the sections together and preventing rotation of the lower section relative to the upper section.

4. Tracer or template-follower apparatus comprising a bracket for connecting the apparatus with a cutting or welding machine, a sleeve in the bracket, a connector for attaching a follower assembly with the sleeve, said connector being constructed and arranged to telescope with the sleeve, and means below the bracket and accessible from outside of said connector for detachably holding the connector in a definite position on said sleeve.

5. Tracer or template-follower apparatus comprising a supporting unit, a bracket for connecting said unit with the frame of a cutting or welding machine, a bearing surface at the lower portion of the supporting unit for receiving a connector to attach a follower device to the supporting unit, and limit means on the supporting unit for determining the position of such a connector when associated with said supporting unit, said supporting unit being grooved below the bracket to receive a detachable holding device accessible from outside of said connector for retaining the connector on said bearing surface.

6. The combination with a tracer or template-follower equipment having a bracket for connection with the frame of a cutting or welding machine, a sleeve supported by the bracket, and a power driving connection at the lower end of the sleeve, of a follower device including a rotatable element, a housing in which said element is supported, a connector secured to the housing and that fits said sleeve for attaching the follower device with the holder, driving means for engaging the power driving connection at the lower end of said sleeve, and means below the bracket and accessible from outside of said connector for detachably holding the connector in a definite position on said sleeve.

7. A template-follower comprising a bracket for connection with the frame of a universal cutting or welding machine, a sleeve vertically slidable in the bracket as a bearing and having a lower portion extending below the bracket, a motor supported by the upper end of the sleeve, a drive shaft operatably connected with the motor and extending downward through the sleeve, a bearing for the drive shaft, a connector telescoped into the lower end of the sleeve, a housing on the lower end of said connector, a driven

shaft supported by a bearing in the housing, a solenoid surrounding a portion of the shaft, a template-follower roller at the lower end of the driven shaft, an eccentric stud at the lower end of the drive shaft, an internal gear connected to the housing, another internal gear at the upper end of the driven shaft, and an epicyclic gearing assembly associated with the internal gears and including a connecting hub rotatably supported on the stud at the lower end of the drive shaft.

8. Follower equipment for a cutting or welding machine including a basic supporting unit with driving mechanism and a bracket for connecting said unit with a cutting or welding machine frame, follower apparatus at the lower end of the supporting unit, motion transmitting means in the follower apparatus operatably connected with the driving mechanism of the supporting unit, and means for holding the follower apparatus detachably connected with the supporting unit, said means including a threaded member that is adjustable to clamp the follower apparatus securely to the supporting unit or leave the follower apparatus free to turn on the supporting unit.

9. Follower equipment for a cutting or welding machine including a basic supporting unit and follower apparatus, one of which fits within the other as a bearing, and coupler means for holding the supporting unit and follower apparatus in assembled relation, said coupler means being movable into position to clamp the follower apparatus and supporting unit against relative movement, and movable into another position to release the follower apparatus and supporting unit for relative movement at said bearing.

10. The combination with a basic driving and supporting unit, of follower apparatus detachably connected with said supporting unit by a coupler that includes arcuate parts with rims, one of which extends into a circumferential groove in the lower end of the supporting unit, and another of which extends into a similar groove in the upper end of the follower apparatus, and a member that holds said arcuate parts in contact with the grooved ends of the supporting unit and follower apparatus.

11. The combination of a driving and supporting unit and a follower apparatus, one of which elements fits within the other as a bearing, and means holding said elements in assembled relation, said means including a plurality of arcuate coupler parts, each with two inwardly extending rims, one of which extends into a circumferential groove in the lower end of the supporting unit and the other of which extends into a similar groove in the upper end of the follower apparatus, a nut that threads over one of the elements and that holds the arcuate coupler parts in said circumferential grooves, and means on the element on which the nut threads for causing the coupler parts to turn with that element.

12. Follower equipment including in combination a basic driving and supporting unit with a bracket for connecting it with a frame of a cut-

ting or welding machine, a sleeve, a motor, and driving connections including a shaft extending downward through the sleeve, and follower apparatus with an upper connector portion that fits into the lower end of the sleeve as a bearing, motion transmitting connections in the follower apparatus including a shaft that extends upward through the connector portion of the follower apparatus for connection with the downwardly extending shaft in the sleeve, and means for holding the follower apparatus and the supporting unit in assembled relation including two arcuate coupler pieces slightly less than 180 degrees in length with parallel inwardly extending tapered rims that fit into complementary circumferential grooves in the supporting unit and follower apparatus, a nut that extends around the coupler pieces and fits over threads on the follower apparatus, said nut having an inside face in contact with the outside faces of the coupler and constructed and arranged to hold the coupler pieces in light contact with the sides of the grooves when said nut is in one position, but to clamp the coupler pieces against the sides of the grooves as the nut is screwed further down on the threads.

13. A template follower comprising a roller rotatable about a sloping axis, a guide roller connected with the first roller in position to contact with a side of the template when the first roller is running on the top face of the template, means for contacting with the other side of the template to hold the guide roller against the template, motion transmitting mechanism for driving the rollers, a supporting unit with a bracket for connecting with a frame of a cutting or welding machine, cylindrical bearings at the upper and lower ends of the follower apparatus and supporting unit respectively, one of said bearings fitting within the other, detachable coupler means on the outside of the template-follower for holding the supporting unit and the follower apparatus in assembled relation, driving mechanism on the supporting unit, and a coupling between said driving mechanism and the motion transmitting mechanism of the follower apparatus.

14. A tracer comprising a traction wheel, mechanism for transmitting motion to the traction wheel including a driven shaft with its axis of rotation in line with the point of traction of said wheel, bearings and a housing forming with the wheel and motion transmitting mechanism a complete assembly which can be connected and disconnected from a basic driving and supporting unit that comprises the upper portion of the tracer, driving means on said basic unit including a motor and a drive shaft in line with the driven shaft of the traction wheel assembly, a coupling between the shafts, and detachable means surrounding portions of both the traction wheel assembly and the driving and supporting unit for connecting said assembly and said unit.

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