Dec. 5, 1939. H. F. ATKINS 2,182,331

MILLING MACHINE FOR COPYING OR PROFILING

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Fig. 1

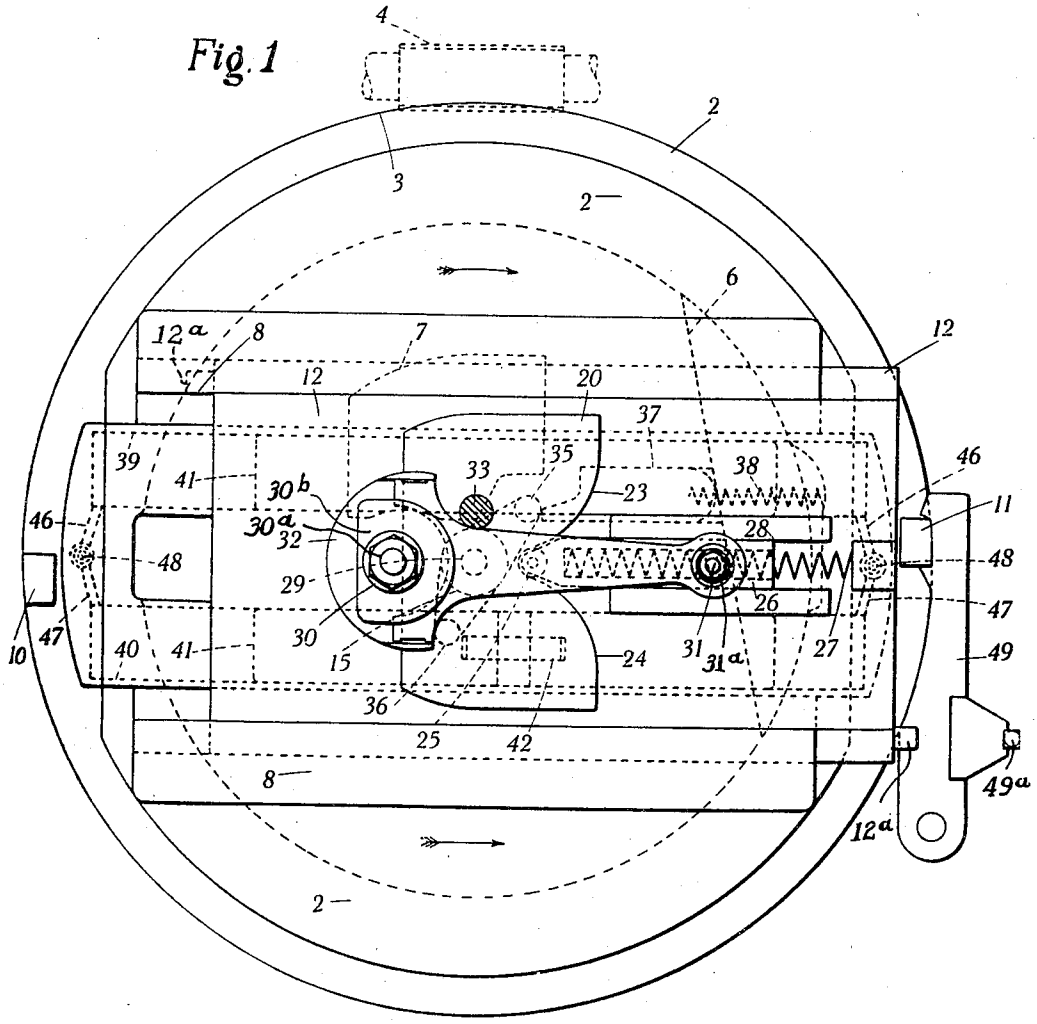


Fig. 2.

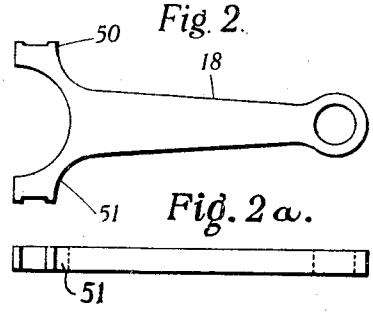


Fig. 2a.

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Fig. 3.

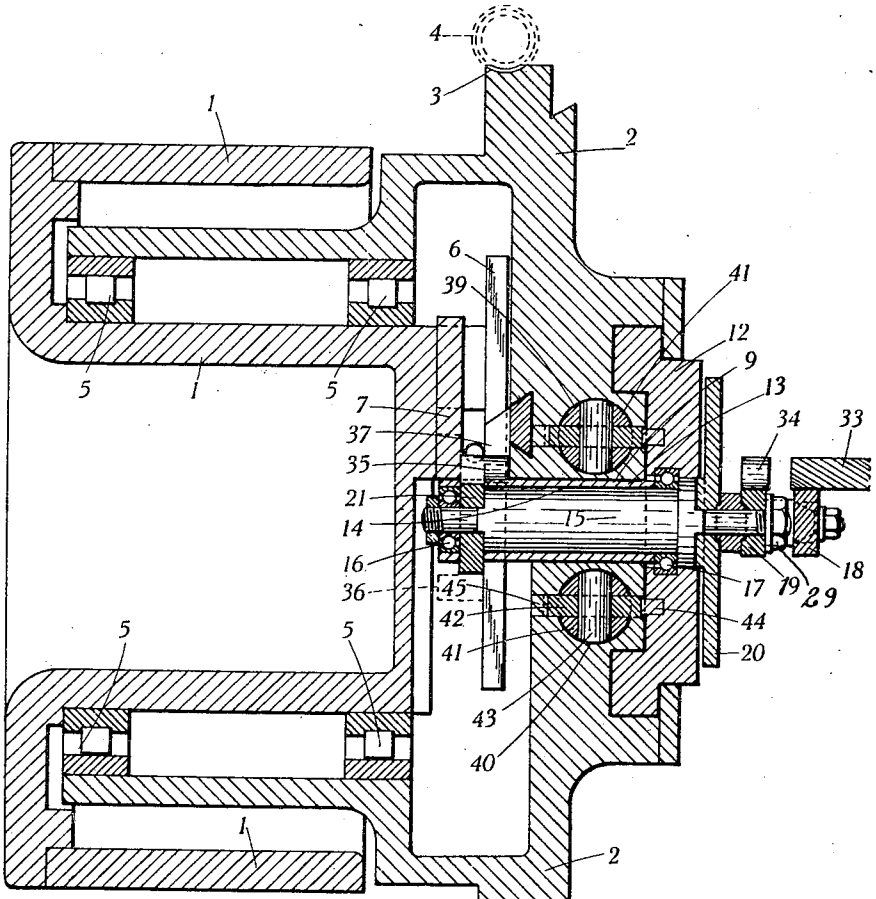


Fig. 7.

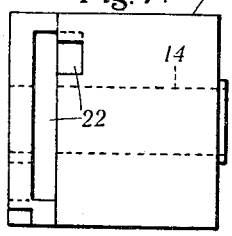


Fig. 8.

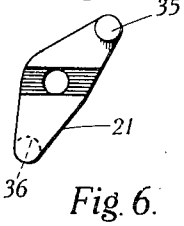


Fig. 4.

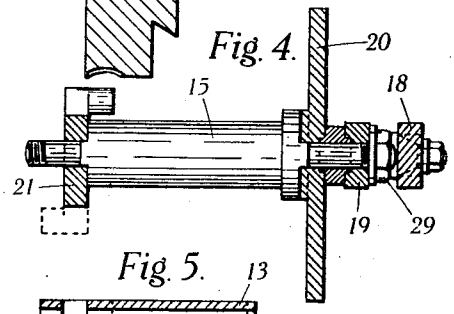


Fig. 6.

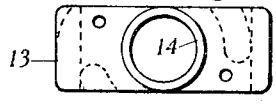
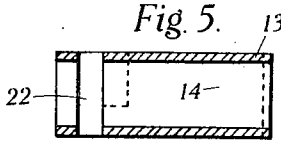


Fig. 5.



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MILLING MACHINE FOR COPYING OR PROFILING

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Fig. 9

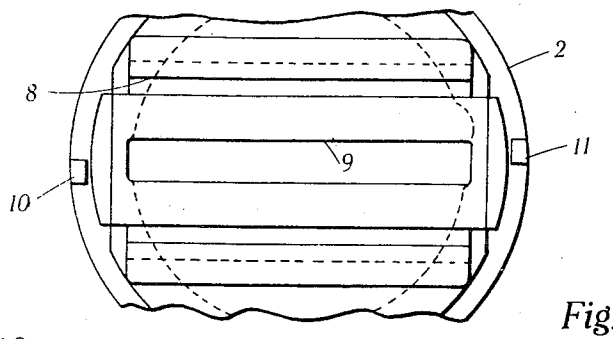


Fig. 10.

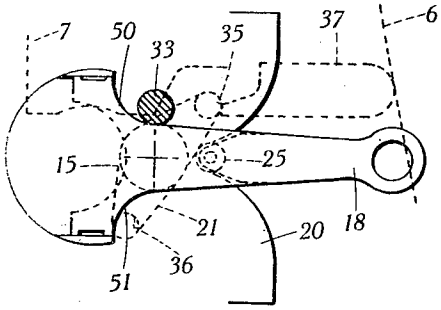
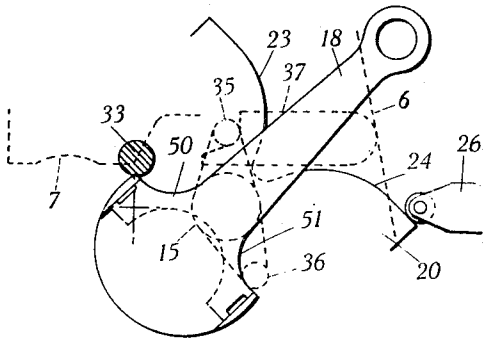


Fig. 11.



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Fig. 12.

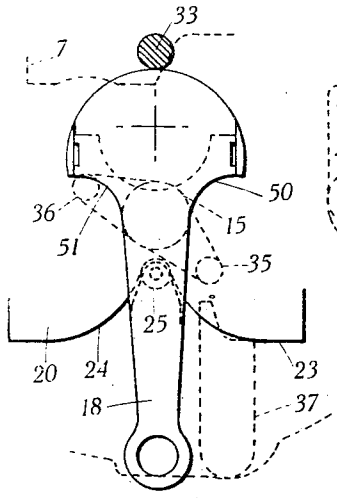


Fig. 13.

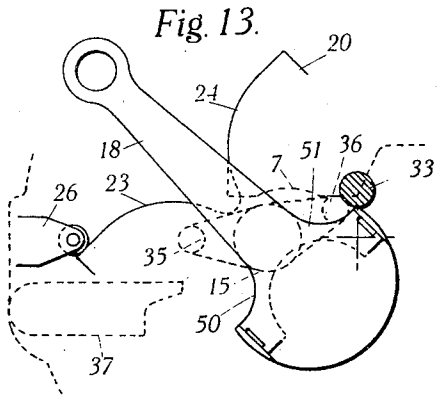


Fig. 14.

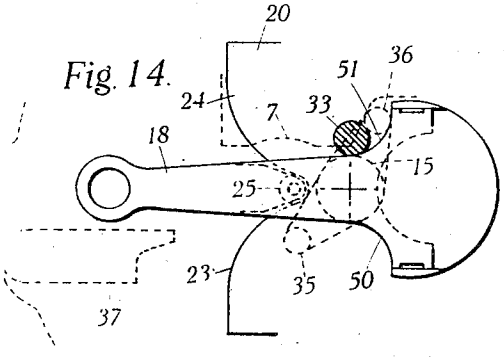
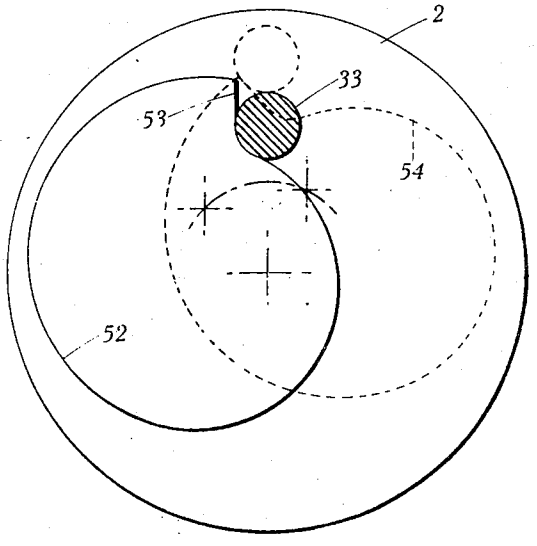


Fig. 15.



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Patented Dec. 5, 1939 2,182,331

UNITED STATES PATENT OFFICE

2,182,331

MILLING MACHINE FOR COPYING OR PROFILING

Harry Frederick Atkins, Old Fletton, Peterborough, England

Application September 21, 1938, Serial No. 230,912
In Great Britain August 11, 1937

6 Claims. (Cl. 90—13.7)

The invention provides the hereinafter described and claimed improvements in a profile milling or like machine of the kind in which a pattern of the shape desired of the article to be machined and the work, on the one hand, and a stylus adapted to be guided by the pattern and the milling cutter on the other hand, are coupled to effect the desired operation on the work from linear, circular, or combined linear and circular movements of a carrier upon which the "pattern" and work are rigidly mounted as one piece, such machine being automatic in its action except for hand starting or stopping, and hand application and removal of work.

In particular the invention relates to such a machine in which the "pattern" and the work are rigidly mounted as one piece upon a slide diametrically applied to the face of a carrier-head which is supported for intermittent half revolution upon a stationary frame of the machine, the automatic operation of such machine being that while the carrier-head is held from revolution, that is to say, is held stationary, the slide traverses, and vice versa. The milling cutter and the stylus are carried by a common vertically swingable arm to rise and fall together while the stylus contacts the pattern and the cutter, which is revolved independently of all other movements, operates against the work.

In previous machines of the aforesaid kind, profile milling is limited to contours having angles which such a stylus can effectually negotiate as, for example, angles between 180° and 130° inclusive.

The invention provides a profile milling or like machine of the kind in which any angle within 180°, and which is reasonably machinable by a milling cutter, can be effectually negotiated under automatic control.

The invention provides a machine of the kind, distinctive by the "pattern" and work being arranged to make automatically independent swivelling movements in addition to the automatic movements of the carrier on which they are mounted.

More particularly the invention provides a machine wherein the carrier is a slide diametrically arranged upon an intermittently revoluble carrier-head. In this arrangement the work and "pattern" are carried upon a swivelling fulcrum-peg attached to the slide, and the swivelling movements are automatically arranged for in co-operation with the automatic relative movements of the slide and carrier-head.

The fulcrum-peg has applied to it a cam-plate which is acted upon by a plunger to restore the work and "pattern" back from swivelled position to a predetermined normal position relative to the slide.

Conveniently the fulcrum-peg has applied to it at its forward end the work, the "pattern", and the cam-plate, and at its rearward end a rockable lever, the latter to co-operate with abutments on the carrier-head and stationary frame for swivelling the peg.

Hydraulic means are preferably applied to the carrier-head for traversing the slide, and the movement of the pistons is arranged to increase the traverse of the slide relative to the travel of the pistons.

A machine embodying the essential features of the invention in a desirable form is illustratively exemplified in the accompanying drawings, in which:

Fig. 1 is a front elevation looking at the face of the carrier-head.

Fig. 2 and Fig. 2*a* are a plan and an edge view, respectively, of the piece of work to be profiled.

Fig. 3 is a sectional elevation at right-angles to Fig. 1.

Fig. 4 is a view of the assembled fulcrum-peg, rockable lever, cam-plate and "pattern".

Fig. 5 is a section of a bearing block for the fulcrum-peg.

Fig. 6 is a front view of Fig. 5.

Fig. 7 is a plan of Fig. 5.

Fig. 8 is a side view of the rockable lever separately.

Fig. 9 is a front elevation of the carrier-head only, on a reduced scale.

Figs. 10–14 are diagrams illustrating the independent swivelling movements of the "pattern" and work, and of the essential parts used for these movements.

Fig. 15 is a diagrammatic front elevation showing the invention applied to a revoluble carrier-head without a slide.

With reference to Figs. 1–14, upon a stationary frame 1 is revolubly mounted a carrier-head 2, whose periphery is formed at 3 as a worm wheel to be engaged by a worm 4 which is suitably driven to revolve said carrier-head intermittently a half revolution. Said carrier-head 2 is supported upon the frame 1 by the roller bearings 5. Except for revolution said carrier-head is immovable. Abutments 6 and 7 are fixed upon the stationary frame 1, for use as hereinafter described.

The front of the carrier-head is formed with a diametric slide-way 8, and also with a diametric

slot 9 at the centre line of the slide-way, while each side said slide-way said carried-head 2 is provided with boundary lugs 10 and 11, shown in Fig. 9.

A diametric slide 12 is applied to the slide-way 8 to revolve with the carrier-head 2, but to traverse independently thereof while said carrier-head is held stationary. This slide 12 has rigidly connected to it a bearing block 13 where in is provided a clearance hole 14 for a revoluble fulcrum-peg 15, said block being accommodated in the diametric slot 9 of the carrier-head, and extending from the slide 12 rearwardly, and always moving with said slide. Said block is conveniently fixed to the slide by screw pins applied through the slide at the front to engage the block on either side of the clearance hole 14, so that said block is unsupported except by the slide 12.

The fulcrum-peg 15 is anti-frictionally mounted within its clearance hole 14 by the ball bearings 16 and 17, and carries rigidly on its front end the work 18, the "pattern" 19, and, a cam-plate 20 and, on its rear, a rockable lever 21, the block being cut away at 22 to accommodate the lever.

When the slide 12 traverses, the fulcrum-peg 15 is carried with it, but said fulcrum-peg can swivel within the bearing block during said traverse, and also during a part revolution of the carrier-head 2 while the slide is stationary, as will be hereinafter more fully explained, but always the work 18, "pattern" 19, cam-plate 20 and rockable lever 21 take part in said swivelling movement.

The cam-plate 20, clearly shown in Figs. 1 and 4, and in the diagrams Figs. 10–14, is rigidly mounted on the fulcrum-peg 15, and has two active surfaces 23 and 24 one thereof on each side of the centre line of the slide, a roller 25 carried by a plunger 26 operating against said surfaces for the purpose of normally centralising the position of the "pattern" and work relative to the centre line of the slide, said plunger being urged into operation by a strong spring 27, and being guided in its movement by a guide-way 28, arranged centrally of the slide.

The "pattern" 19 is rigidly clamped onto the forward extension of the fulcrum-peg 15 by a clamping nut 29, (omitted from Fig. 1 for the sake of clarity), and the work is rigidly clamped to the pattern by means of screw pegs 30 and 31 projecting from the face of the pattern 19 and nuts 30*a* and 31*a* screwed onto said pegs, where necessary with interposition of a clamping plate 30*b*. The pattern 19 has a circular idle part 32 which acts to lift the milling cutter 33 off the work, when the stylus 34 is guided by said circular part, as will be hereinafter explained.

The rockable lever 21 fixed to the inner end of the fulcrum-peg 15 has reversed stud ends 35, 36, the end 35 to operate against a movable stop abutment 37 slidably mounted upon the slide 12, to co-act with the abutment 6, and to be operated upon by a spring 38, as will be hereinafter described, and the end 36 to co-act with the fixed abutment 7, as will also be hereinafter explained, these abutments serving for the forced rocking of the lever 21 and consequently of the fulcrum-peg 15 and the parts it carries.

It is therefore clear that the work 18 is detachably clamped to the "former" 19, and the latter firmly and rigidly clamped to the fulcrum-peg 15, as also are the cam-plate 20 and the rockable lever 21, and that the oscillations of the fulcrum-peg are caused upon the traverse of the slide 12 and the intermittent rotation of the carrier-head 2, by cooperation of the rockable lever 21 with the abutments 6 and 7 of the stationary frame 1 and with the movable abutment 37, all of which will be hereinafter further made clear.

Within the carrier-head 2 at the back of the slide 12 are arranged two hydraulic cylinders 39 and 40 having complementary double-acting pistons 41, said cylinders being parallel with the slide 12, and disposed one each side of its centre line. Each piston is provided with a toothed pinion 42 mounted to revolve upon a diametric pin 43 disposed intermediate of the piston ends, each pinion gearing with opposed racks 44 and 45 carried, respectively, on the slide 12 and the carrier-head 2, the pinion and rack gearing being such that the slide 12 is traversed at a ratio of two to one to the movements of the pistons 41.

At each of their ends the two hydraulic cylinders communicate by ducts 46 and 47 with a liquid passage 48 controlled by valve action for both inlet and exhaust of a pressure liquid by the intermittent revolution of the carrier-head 2.

A pivoted catch 49, mounted upon the frame 1, normally holds the carrier-head 2 from revolving by engagement with one of the boundary lugs 10, 11, said catch being automatically moved out of action upon completion of the traverse of the slide 12 by one of the two pegs 12*a* on the slide 12 pushing against the stud 49*a* on the catch 49, after which the carrier-head 2 automatically revolves a half revolution from the worm drive until the other lug is automatically engaged by the catch.

The slide 12 always traverses in the same direction, being turned round by the part-revolution of the carrier-head.

The driving gear for the worm 4 can be a friction gear, instantly started and stopped by the release and engagement of the catch 49 in respect of the lugs 10, 11.

The work shown in Fig. 2, is a connecting rod for an internal combustion engine, and the machine is mainly concerned with the automatic machining of the shoulders 50 and 51 which are approximately at an angle of 90° to the traverse of the slide 12.

The position of the parts as shown in Figs. 1 and 2 and in the diagram Fig. 10 is near the finish of a traverse of the slide 12, while the carrier-head 2 is held from revolution, up to the commencement of the machining of the curved right-angled shoulder 50 of the work, the one stud 35 of the rockable lever 21 being brought into touch with the abutment 37 on the carrier-head 2. The completion of the traverse causes the abutment 37, which is for the time being backed up by the fixed abutment 6, to rock said lever 21 and thereby forcibly swivel the work 18 and "pattern" 19 to enable the shoulder 50 to be inclined for easy machining, as clearly shown by Fig. 11, this swivelling also forcibly moving the cam-plate 20 so that the plunger action is operative on one of the curved rises of said cam-plate.

The work 18 is now to be moved to bring the other shoulder 51 to the cutter 33, and this is done by a half revolution of the carrier-head 2 without traverse of the slide 12, and while the cutter is idle and the stylus 34 is riding over the idle circular surface 32 at the one end of the "pattern" 19, the carrier-head 2 having been

automatically released to permit its drive to operate, during which movement the plunger **26** operates upon the cam-plate to bring the work **18** again onto the centre line of the slide **12**, as represented in Fig. 12, this being effected during a quarter revolution of the carrier-head **2**.

The remaining portion of the idle movement from Fig. 12 to Fig. 13 takes place during the remaining quarter revolution of the carrier-head **2**, and by a swivelling of the work in consequence of the other stud end of the rockable lever **21** contacting the fixed abutment **7**, while the slide is stationary, so that in relation to the cutter **33** the work **18** has now been moved about three quarters of a circle, to enable said cutter to operate upon the other shoulder **51** of the work, accomplished by a combined traverse of the slide and the centralising action of the plunger while the carrier-head is held from revolution, this position being shown in Fig. 14, after which the slide **12** makes a simple traverse to the other end of the work, which end is then machined by a simple half rotation of the carrier-head while the slide is stationary, a further traverse of the slide while the carrier is held from rotation completing the circle of operation back to the positions Figs. 1 and 10.

The form of the invention shown in the diagram Fig. 15 is one wherein the revoluble carrier-head **2** is without a slide and has continuous slow revolution. The work is a cam-shaped piece **52** having a right-angle shoulder **53**, against which the milling cutter, and similarly the stylus of the "former" will not normally operate, as indicated by the work **52** in full lines, during revolution of said carrier-head, but which by simultaneously automatically swivelling the work, in accordance with the invention, to the position indicated in dotted lines **54**, said cutter will automatically operate on said shoulder during the revolution of the carrier-head.

The carrier for the work and "former" may be a slide, the invention being carried out in connection therewith, for the purpose.

Having now described my invention, what I claim and desire to secure by Letters Patent is:

1. In a profile milling machine, the combination of a movable carrier, means for automatically moving said carrier, a fulcrum peg on said carrier adapted for swivelling, means for automatically swivelling said peg independently of the carrier, a pattern rigidly mounted on the fulcrum peg, means for supporting the work on and coupling it to the pattern to move as one piece therewith, a movable stylus to follow the contour of the pattern, and a cutter coupled to the stylus and adapted to operate on the work.

2. In a profile milling machine, the combination of a revoluble carrier-head, means for intermittently revolving said carrier-head, a slide diametrically arranged for traverse on said carrier-head, means for automatically traversing said slide, a fulcrum peg mounted rotatably on said slide, means for automatically swivelling said peg on the slide with respect to the carrier-head and slide, a pattern rigidly mounted on the fulcrum peg, means for supporting the work on and coupling it to the pattern to move as one-piece therewith, a movable stylus to follow the contour of the pattern, and a cutter coupled to the stylus and adapted to operate on the work.

3. In a profile milling machine, the combination of a revoluble carrier-head, means for intermittently revolving said carrier-head, a slide diametrically arranged for traverse on said carrier-head, means for automatically traversing said slide, a fulcrum peg mounted rotatably on said slide, means for automatically swivelling said peg with respect to the carrier head and slide, a pattern rigidly mounted on the fulcrum peg, means for supporting the work on and coupling it to the pattern to move as one-piece therewith, a cam-plate rigidly mounted on the fulcrum peg, a plunger mounted on the slide for cooperation with said cam-plate to normally hold said fulcrum peg in a predetermined angular position relative to said slide and to restore it to said predetermined position when it has been swivelled, a movable stylus to follow the contour of the pattern, and a cutter coupled to the stylus and adapted to operate on the work.

4. In a profile milling machine, the combination of a revoluble carrier-head, means for intermittently revolving said carrier-head, a slide diametrically arranged for traverse on said carrier-head, means for automatically traversing said slide, a fulcrum peg mounted rotatably on said slide, a lever mounted rigidly at the rear end of said fulcrum peg, abutments on the carrier-head and stationary frame with which the rockable lever co-acts to swivel said peg upon movements of said carrier-head and slide, a pattern rigidly mounted on the forward end of the fulcrum peg, means for supporting the work on and coupling it to the pattern to move as one-piece therewith, a cam-plate rigidly mounted on the forward end of the fulcrum peg, a plunger mounted on the slide for cooperation with said cam-plate to normally hold said fulcrum peg in a predetermined angular position relative to the slide and to restore it to said predetermined position when it has been swivelled, a movable stylus to follow the contour of the pattern, and a cutter coupled to the stylus and adapted to operate on the work.

5. In a profile milling machine, as claimed in claim 4, a bearing block including bearings for the fulcrum peg and being rigidly attached at one end thereof to the slide to engage a transverse slot provided in the carrier head.

6. In a profile milling machine, as claimed in claim 2, a hydraulic cylinder mounted on said carrier-head, a double-acting piston disposed in said cylinder, and a rack and pinion gear connecting said piston with said slide to increase the traverse of said slide with respect to the traverse of the piston.

HARRY FREDERICK ATKINS.