

July 1, 1969

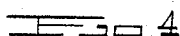
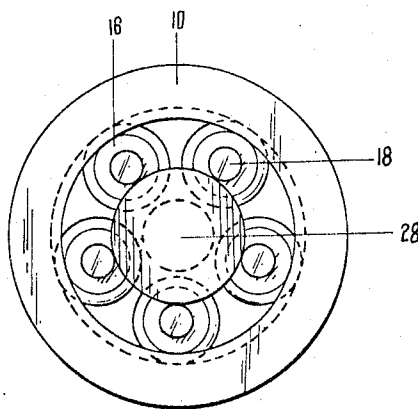
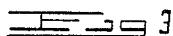
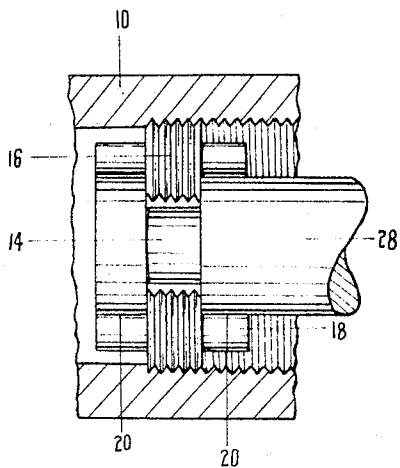
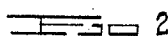
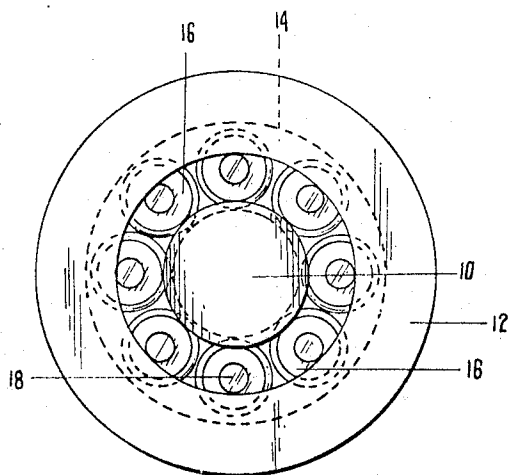
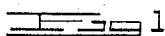
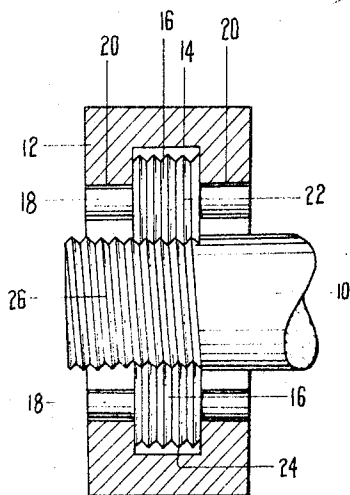
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3,452,567

HEAD FOR ROLLING THREADS OR LIKE FORMATIONS

Filed Jan. 30, 1967

Sheet 1 of 4



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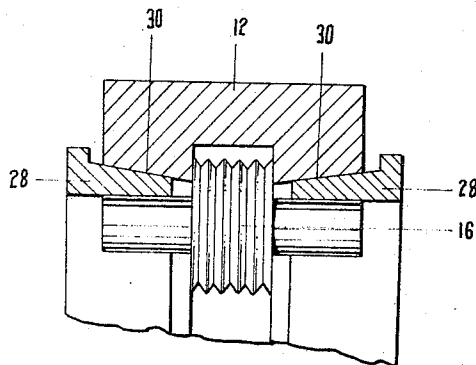
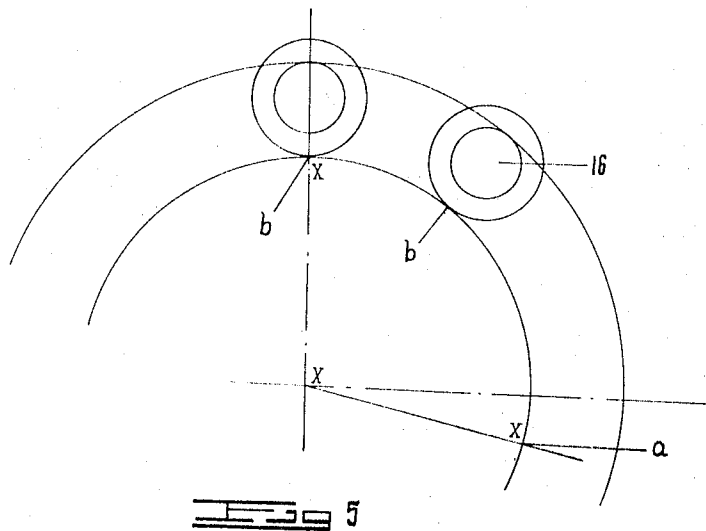
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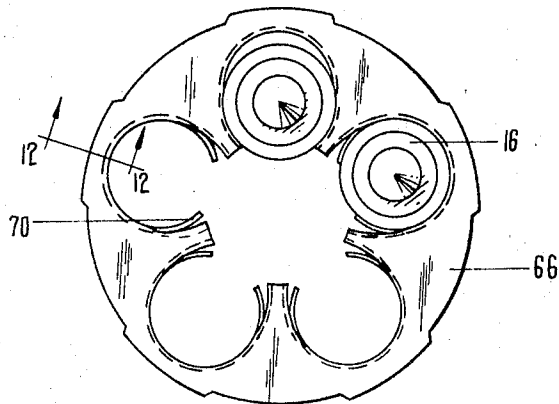
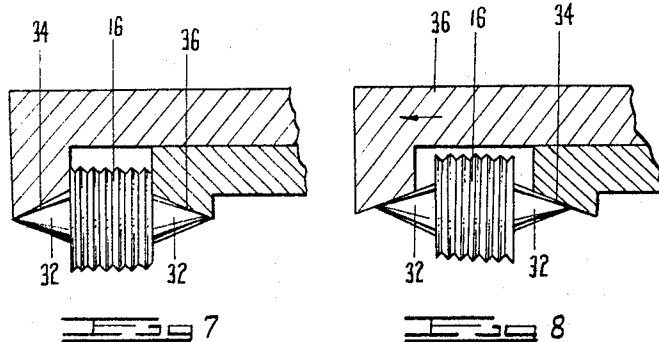


Fig. 11

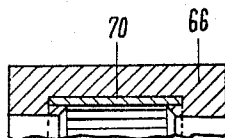


Fig. 12

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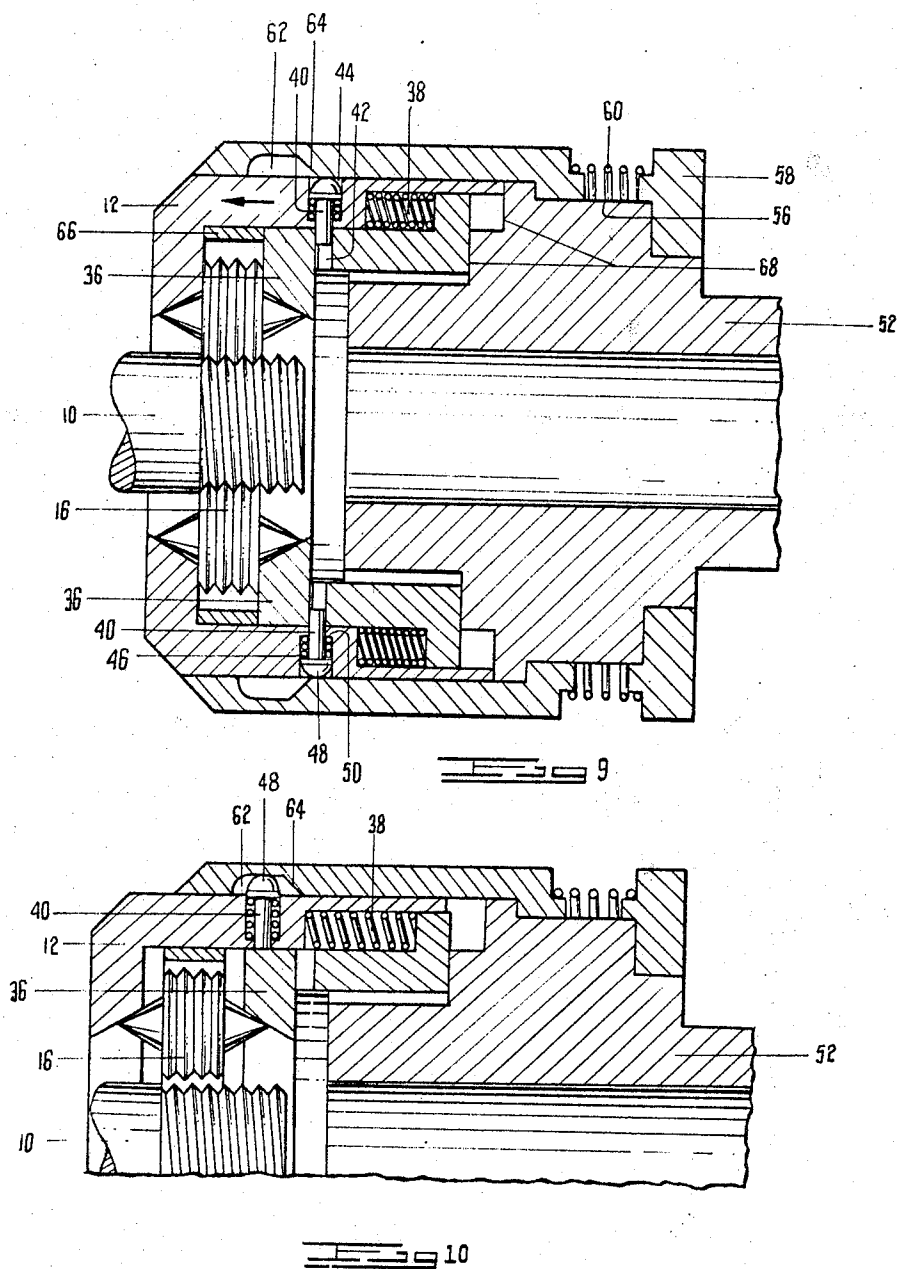
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3,452,567 HEAD FOR ROLLING THREADS OR LIKE FORMATIONS

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Int. Cl. B21d 3/00, 3/02

U.S. Cl. 72—78

11 Claims

ABSTRACT OF THE DISCLOSURE

Threads or like formations are rolled externally into a rod, or internally into a tube, by means of suitably profiled rollers located around a body having a circumferential groove into which the rollers extend, the rollers having integral axles which roll on lands to each side of the groove. The axles may be tapered and the lands complementally shaped, and retraction of the rollers to release the workpiece may be effected by moving the lands apart to allow the rollers to be displaced radially.

This invention relates to heads for rolling threads or like formations into a cylindrical surface of a workpiece. The head includes a series of circumferentially profiled rollers located around its axis and which, by rotation relatively to a bar or other workpiece, roll the required formations into the bar.

In a known thread-rolling head, the rollers are eccentrically mounted on shafts which are supported in bearings provided by a cover plate, to resist the considerable radial forces imposed on the rollers as the thread is formed. These forces are of such magnitude that the component parts of the head—the rollers, the shafts and the bearings—must necessarily be massive and bulky. For instance, a well-known thread-rolling head which is designed to accept bars of two inch diameter has an outer diameter of 12" and a weight of nearly 200 lbs. Obviously, the size and weight of this head are a nuisance, and the massive construction makes the head costly. There are the further disadvantages, in known heads, that the rolling of right- and left-hand threads requires changing of parts; that thin-walled workpieces cannot be tackled because the large contact area between the rollers and the workpiece would cause collapse; and that the speed of formation of the thread, although usually greater than the rate of thread-cutting, is still lower than that possible when ceramic or hard-metal tools are used.

For these reasons, thread-rolling, though manifestly superior in most cases to thread-cutting, has not prospered in the market as it deserves to have done.

The object of the present invention is to provide a thread-rolling machine which minimises or avoids the disadvantages of known heads.

The invention provides in essence a head for rolling threads or like formations into a cylindrical surface of a workpiece, the head comprising a body on which there are formed an annular groove and annular lands flanking the groove and coaxial with it, the body being adapted to be positioned relatively to the workpiece with the axis of the workpiece surface coincident with the axis of the groove and lands on the body, and the body spaced away from the workpiece surface; a series of at least three rollers that are adapted to bear on the workpiece surface and are profiled to impose the required formations on it, each roller having an axle projecting to each side of it, the rollers being spaced around and projecting into the groove with the axles in rolling contact with the lands; means sup-

porting the rollers in position on the body, and means to rotate the body relatively to the workpiece to cause the rollers to roll around the workpiece surface and profile it, and simultaneously roll relatively around the groove on the body.

If the workpiece is to be externally threaded, the body is hollow, with the groove in its inner wall, so that the rollers define between them a space for the workpiece which is advanced into the space to be engaged by the rollers, and to have a thread rolled into its external surface. On the other hand, if the workpiece is hollow and is to be threaded internally, the body is solid and the groove is circumferential.

For screwthreading, the rollers may be permitted to tilt somewhat, tending to follow the helix angle of the thread provided they do so together. Once the workpiece has been engaged and the thread started, the head automatically takes up the feed of the workpiece, rendering external feeding unnecessary.

The invention will be further described in connection with the attached drawings, in which:

FIGURE 1 is a fragmentary side view, partly sectioned, of an external screwthreading head or die,

FIGURE 2 is an end view of the die of FIGURE 1,

FIGURE 3 is a fragmentary side view of an internal screwthreading die,

FIGURE 4 is an end view of the die of FIGURE 3,

FIGURE 5 is a diagrammatic sketch illustrating a "gearing" effect in the die of FIGURES 3 and 4,

FIGURE 6 is a fragmentary view, partly in section, of an internal screwthreading die, using an adjustable lining sleeve,

FIGURE 7 is a similar view of a die with conical axles,

FIGURE 8 is a similar view of the die of FIGURE 7 in retracted condition,

FIGURE 9 is a longitudinal section of a complete die head,

FIGURE 10 is a fragmentary view of the machine of FIGURE 9 in the retracted position,

FIGURE 11 shows a cage such as that used in the machine of FIGURE 9, and

FIGURE 12 is a section along the line 12—12 of FIGURE 11.

The principle on which the machine of the invention is based is apparent from FIGURES 1 and 2, and FIGURES 3 and 4, which show the rolling of an external and an internal thread respectively.

In FIGURES 1 and 2, a thread-rolling head or die consists of a hollow body 12, internally grooved at 14. The groove accommodates a series of rollers 16, each mounted on an axle 18 that rolls on annular lands 20 flanking the groove 14. The rollers are profiled with a series of grooves 22, that are parallel to themselves, and perpendicular to the axis, leaving a series of parallel V-shaped teeth 24. The workpiece 10 to be externally screw-threaded is offered axially to the die, and is rotated relatively to the die, or both die and workpiece may be rotated, but in opposite directions. The teeth 24 of the die form a screw-thread 26 on the workpiece, right- or left-hand, depending on the directions of relative rotation of the die and the workpiece. After the die has started the thread, relative rotation of the die and the workpiece ensures that the workpiece advances automatically through the die at the correct rate of axial feed.

In FIGURES 3 and 4, the workpiece 10 is tubular. The die has a solid body 28 with an annular groove 14. The rollers 16 project into the groove, and their axles 18 roll on the lands 20. The operation of the die is the same as that of FIGURES 1 and 2.

The geometry is such that the workpiece can rotate at a high angular speed relatively to the die but yet ad-

vance relatively slowly in the axial direction through it, the rate of thread formation being correspondingly slow. This "gearing" effect is shown in FIGURE 5, which illustrated a semi-schematic section through a solid workpiece in a die. The center of the sectioned workpiece is shown at 0; the arc 21 is the periphery of the workpiece, on which a roller 16 acts. The axles of the roller, shown by the circle 25, roll on the lands 23 through a lesser angle ϕ , to a position shown at 16'. The workpiece will have been threaded, in this process, over an arc of its surface 21 subtended by the angle $(\theta - \phi)$. Its axial advance through the die will have been correspondingly limited.

If a point X on the periphery of the workpiece is initially in contact with a point b on the surface 27 of the roller 16, and if the workpiece is then rotated as shown by the arrow through an angle θ , the axis of the roller 16 will have rolled on the lands 23 through a lesser angle ϕ , to a position shown at 16'. The workpiece will have been threaded, in this process, over an arc of its surface 21 subtended by the angle $(\theta - \phi)$. Its axial advance through the die will have been correspondingly limited.

In a conventional die, one rotation of the workpiece results in thread formation around the full circumference of the workpiece, and axial advance of the workpiece by the amount of the thread pitch. In the die of the invention, however, the "gearing" effect means that the workpiece may make several revolutions before the thread advances once fully around its circumference, and before the workpiece need be advanced the distance of the pitch through the die. This effect has important advantages where the die of the invention is used in conjunction with a lathe. In normal practice, the lathe speed for cutting a workpiece is considerably greater than a desirable speed for threading the workpiece, so that it is necessary to have a clutch and reduction gearing mechanism which are brought into operation between the cutting and threading operations. Since this mechanism can be eliminated with the die of the invention, an important saving in equipment can be made.

Means for displacing the rollers radially, either to allow quick release of the workpiece or to allow adjustment for wear, is preferably provided. Fine adjustment can be achieved by means of axially movable sleeves such as that shown at 28 in FIGURE 6, which provide the lands on which the axles of the rollers 16 roll. The sleeves 28 are wedge-shaped, and the inner face 30 of the body 12 is complementary to them. For slight wear, of the order of thousandths of an inch, the elasticity of the liner sleeve allows it to be moved axially the required distance.

Another arrangement, designed for quick release and gripping to allow smooth interchange of workpieces is shown in FIGURES 7 and 8. The rollers 16 have tapered or conical axles 32 that run on complementally shaped lands 34. The body of the die is divided, and while one of the lands is fixed, the other is part of a movable sleeve 36 that, as it is moved axially, causes the rollers to move radially inwardly or radially outwardly relative to the workpiece. Of course, it is important that the rollers are biased into contact with the lands 34 and held at all times in correct space relationship with each other by means such as a cage (not illustrated in FIGURES 7 and 8).

In FIGURES 9 and 10, a machine such as that partially illustrated in FIGURES 7 and 8, is shown with an opening means to allow a workpiece to be rapidly removed or inserted. The body is again divided into two parts 12 and 36 that are axially movable, as in FIGURES 7 and 8. Rollers 16 with tapered axles are provided. The parts 12 and 36 are urged apart by means of a compression spring or springs 38, and are constrained against relative axial movement by a headed detent pin 40 that is contained in a bore 44 in the part 12 and penetrates into a registering bore 42 in the part 36. The pin is biased outwardly by a compression spring 46 that fits over the shank of the pin between the bull-nosed head 48 and a shoulder 50 in the bore in the part 12.

A backing member 52, coaxial with the part 12, is engaged slidably in the cavity of the part 36 and backs the rear faces of the parts 12 and 36. An annular casing 54 surrounds the part 12 and portion 56 of the backing member 52. The rear end of the casing terminates ahead of a flange 58 at the rear end of the backing member 52, and a compression spring or springs 60 is or are located between the rear end of the backing member 52 and the forward face of the flange 58.

Towards its forward end, the casing 54 is formed with an annular groove 62, the rear face 64 of which is sloped. As will be explained, the casing 54 functions in effect as a latch movable between a position in which it holds the pin 40 in place, and a position in which the pin is able to retract under its biasing spring 46.

In use, the workpiece 10 is offered to the die and moved relatively into its cavity, while the die is in the "closed" condition shown in FIGURE 9. When the rollers 16 start to "bite," further advance of the workpiece relatively into the die must be accompanied by relative rotation to form the length of screw-threading desired on the workpiece. When the length of screw-threading has been nearly formed, the backing member 52 and workpiece are held against further relative advance, but relative rotating is not prevented, while parts 12 and 36 continue to advance. The casing 54 is brought to a halt by engagement of rebates 57 and 59 on the backing member and casing, so that the body parts 12 and 34 advance relatively to the casing, until the pin 40 reaches the groove 62 when the spring 46 causes the pin to be retracted into the groove. As soon as the penetration is sufficient for the pin to clear the part 36, the springs 38 take over and the part 36 is abruptly moved rearwardly onto the backing member 52. The rollers 16 are thus freed for retraction radially to clear the screw-threading formed in the workpiece as seen in FIGURE 10. Their radially outward movement is governed by any suitable means, which, in the embodiment being described consists of a cage 66 (FIGURE 11) which not only holds the several rollers spaced apart around the circumference of the die, but biases the rollers outwardly by means of leaf springs 70 as shown in FIGURE 11. In FIGURE 11, two rollers are shown, one in the closed and the other in the open position. In FIGURE 12, a means of holding the leaf spring 70 in position on the cage 66 is shown. The cage is formed with a groove into which the spring 70 is fitted, lugs 71 holding it firmly in place. The lugs 71 are absent in the central zone of the cage to allow the springs 70 to act effectively on the rollers 16.

Resetting of the die to close it for insertion of a fresh workpiece is effected by pulling the casing 54 rearwardly towards the flange 58 against the resistance of the springs 60. The head 48 of the pin 40, being caught up in the groove 62 of the casing 54, moves rearwardly with the casing 54, and carries the body part 12 with it against the resistance of the springs 38. This motion reduces the space between the lands on the parts 12 and 36, and moves the rollers 16 radially inwardly in the die. Rearward motion halts when the rear end 55 of the body part 12 abuts against a flange 53 on the backing member 52. In this position, the holes 42 and 44 are in register. The front end of the body part 12 is then held by the operator against forward movement under the action of the springs 38, and the casing 54 is released to return forwardly under the action of the springs 60. As it does so, the inclined surface 64 of the groove 62 runs over the head 48 of the pin and depresses the pin into the hole 42 to lock the parts 12 and 14 together.

While the part 12 has moved rearwardly, the rollers 16 have of course moved radially in the die to their closed position.

Splines or the like are provided to prevent relative rotational movement of the body parts 12 and 36.

One of the major advantages of the head of the invention is that the rollers are not journalled in fixed bearings,

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but roll freely on lands in the head. By making the roller axles relatively long and supporting them along a substantial part of their length on the lands, large pressures can be transmitted to the workpiece over the length of the roller without generating excessive stresses in the body. These features allow the head to be comparatively small and light, and simple to construct and service. At the same time it can impose large pressures on the workpiece, allowing formations such as threads to be rolled into even comparatively tough steels.

Another advantage, at least in relation to heads used in conjunction with a lathe, is the "gearing" effect described earlier.

Although the invention has been described above in particular relation to screwthreading, other operations may be performed by it, and formations other than threads imposed on the workpiece, by changing the rollers. End operations such as knurling, burnishing, sizing, forming and "peeling" and steadying on a bar fall well within the scope of the invention, which is intended to be defined only by the appended claims.

I claim:

1. A head for rolling threads or like formations into a cylindrical surface of a workpiece, the head comprising a body on which there are formed an annular groove and annular lands flanking the groove and coaxial with it, the body being adapted to be positioned relatively to the workpiece with the axis of the workpiece surface coincident with the axis of the groove and lands on the body, and the body spaced away from the workpiece surface; a series of at least three rollers that are adapted to bear on the workpiece surface and are profiled to impose the required formations on it, each roller having an axle projecting to each side of it, the rollers being spaced around and projecting into the groove with the axles in rolling contact with the lands; means supporting the rollers in position on the body, and means to rotate the body relatively to the workpiece to cause the rollers to roll around the workpiece surface and profile it, and simultaneously roll relatively around the groove on the body.

2. The head of claim 1, including means to displace the rollers radially relatively to the workpiece.

3. The head of claim 2 in which the lands comprise adjustable tapered lining sleeves seated on tapered surfaces of the body.

4. The head of claim 1 in which the roller axles and the lands on the body are plain cylindrical.

5. The head of claim 1 in which the roller axles are tapered and the lands on the body are complementally tapered.

6. The head of claim 5 in which the body is divided to

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allow the lands to be moved relatively to each other along their axis, thereby to displace the rollers radially relatively to the workpiece; and including means to move the lands relatively to each other.

7. The head of claim 6 including compression spring means urging the lands apart, and displaceable means to limit the distance apart of the lands.

8. The head of claim 7 in which the body comprises a first and a second part slidable relatively to each other in the direction of the groove axis, a land for the roller axles being formed on each of the body parts, the body parts having holes adapted to register in a selected relative position of the parts; a pin adapted to extend through the registering holes to hold the body parts against relative movement, biasing means to urge the pin to a position in which it is retracted from the hole in at least one of the body parts; and including a latch mounted for movement between a closed position in which it holds the pin in engagement with the body parts, and an open position in which it permits the biasing means to retract the pin from the hole in at least one of the body parts to allow relative movement of the body parts.

9. The head of claim 1 in which the means to support the rollers in position comprises a cage which holds the rollers spaced apart around the groove on the body but allows the rollers limited radial movement.

10. The head of claim 9 in which the cage includes spring means biasing the rollers radially away from the workpiece surface.

11. The head of claim 1 including means to advance the head relatively to the workpiece in the direction of the common axis of the workpiece surface and the groove and lands on the body.

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RICHARD J. HERBST, *Primary Examiner*.

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