

# United States Patent

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[54] APPARATUS FOR FORMING THORN-LIKE PROJECTIONS

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156/6; 117/47 R, 49, 50; 83/1, 4, 5, 6, 11;

204/200, 203, 207, 209, 215, 217, 226, DIG.

10; 29/527.4, 78

[56]

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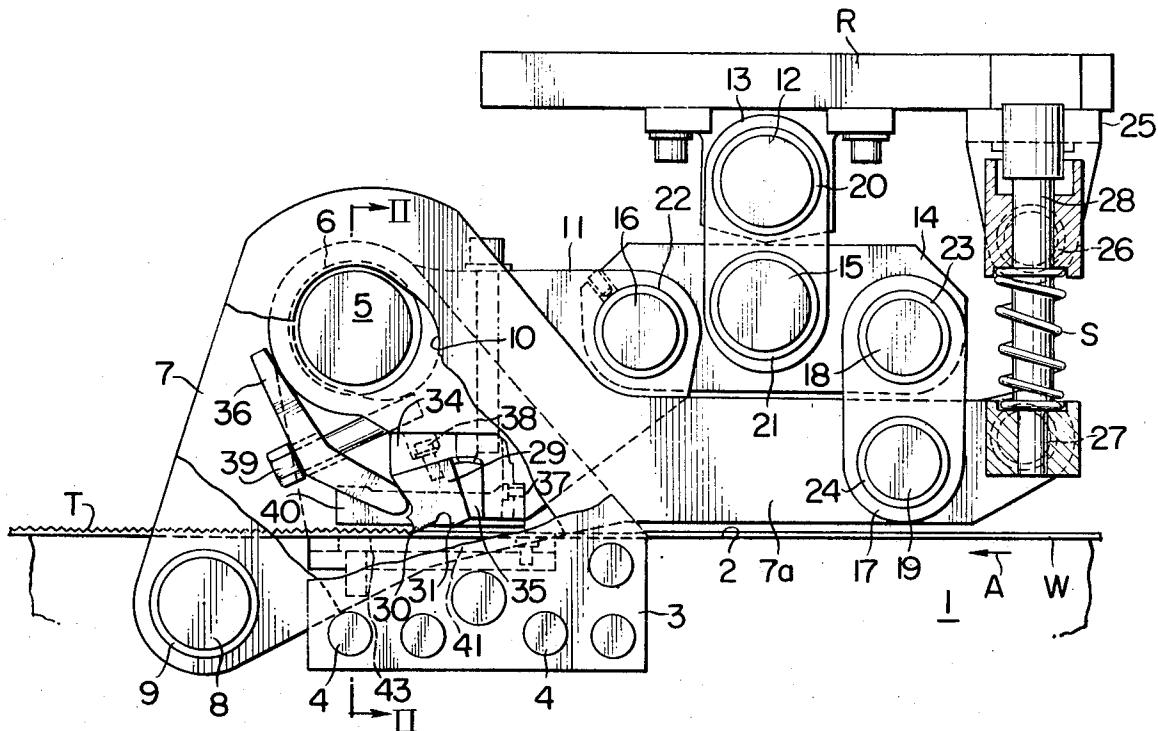
Attorney, Agent, or Firm—Fleit & Jacobson

[57]

ABSTRACT

An apparatus for forming thorn-like projections on a workpiece surface wherein biting cutters are mounted on a swingable surface and brought into biting engagement with said surface upon each swinging movement of the arm. The projection formed workpiece surface may be thereafter used for casting another metal thereon.

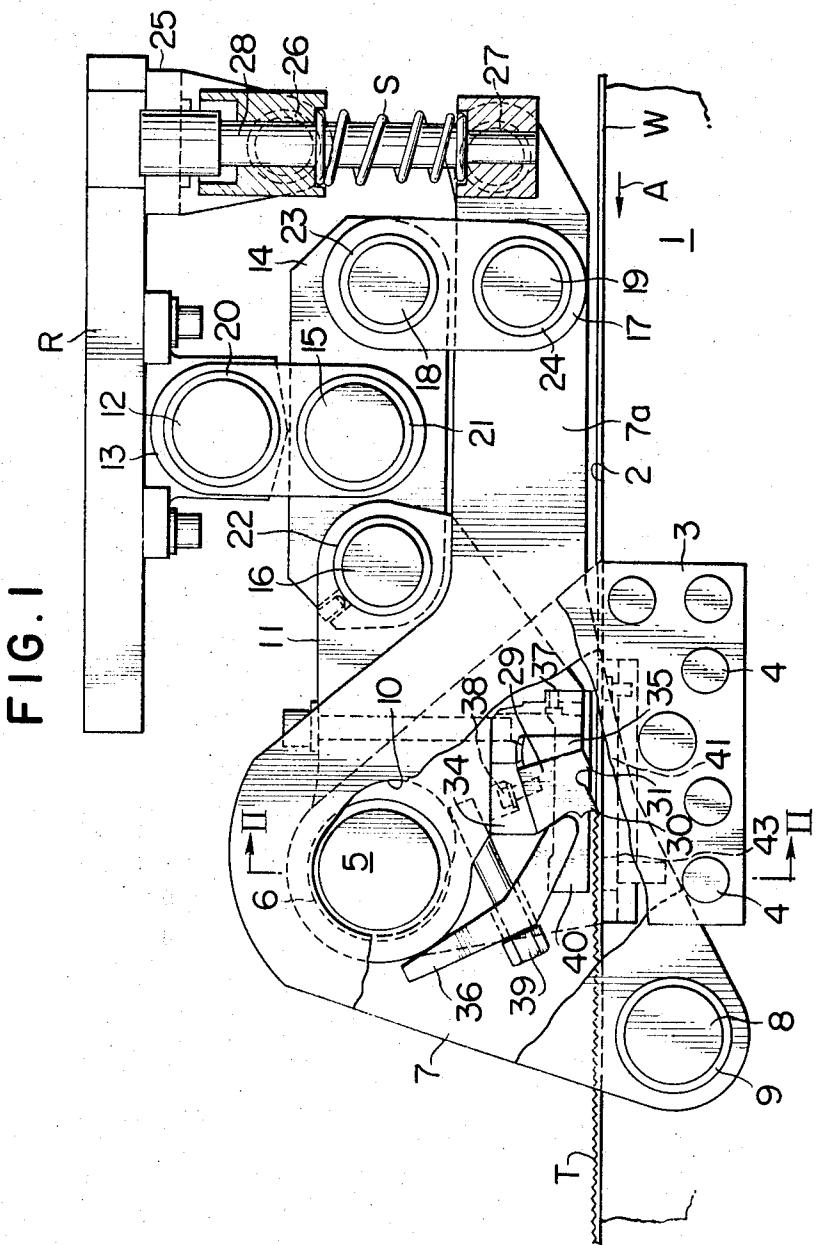
8 Claims, 7 Drawing Figures



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FIG. 2

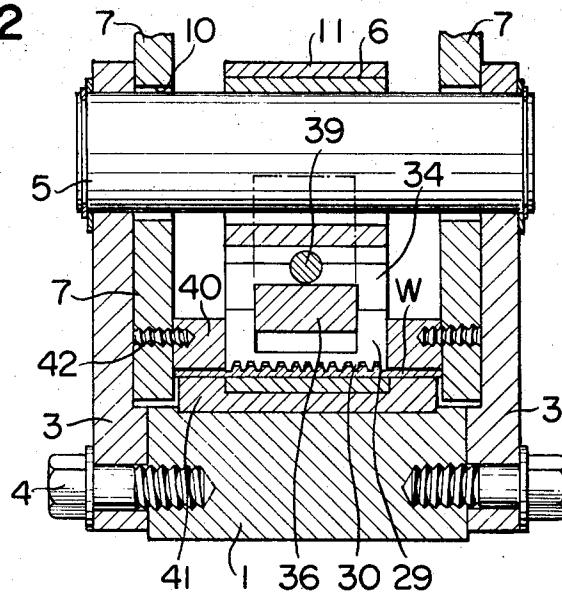


FIG. 3

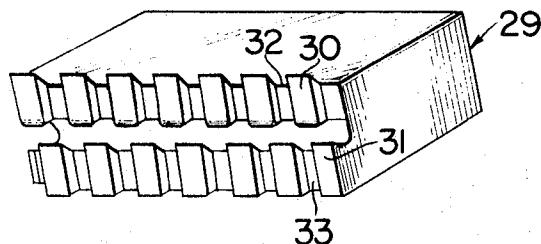


FIG. 4

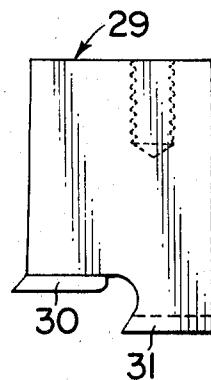
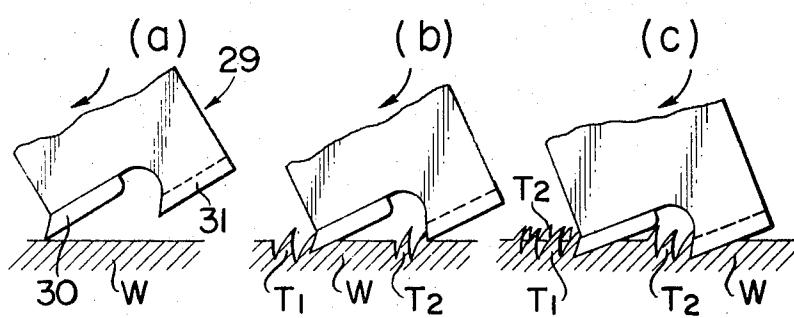


FIG. 5



## APPARATUS FOR FORMING THORN-LIKE PROJECTIONS

The present invention relates to an apparatus for forming a thorny surface and more particularly to an apparatus for forming thorn-like projections on a metal surface.

In an application where chromium is to be plated on an aluminum alloy surface, there has been proposed first to cast aluminum on one side of a metal plate such as a steel plate to form an integral part therewith and then form a chromium plated layer on the other side of the metal plate. In order to secure satisfactory bonding between the metal plate and the casted aluminum alloy, it has already been proposed to provide a plurality of thorn-like projections on the side of the metal plate on which the aluminum alloy is casted.

Conventionally, such projections have been provided by spring-biased biting means. A rotatable cam is provided for moving the biting means against the influence of the spring-bias force apart from the metal surface and, as the cam is rotated, the biting means is cyclically allowed to bite into the metal surface. In this apparatus, however, since the biting means is brought into biting engagement under the spring-bias force, it is often damaged and moreover when the biting edges are worn it becomes no longer possible to form desired thorn-like projections uniformly throughout the metal surface.

The present invention, therefore, has an object to eliminate the aforementioned problems of known apparatus.

Another object of the present invention is to provide an apparatus for forming thorn-like projections on a workpiece surface, which is durable and can effectively form uniform projections.

According to the present invention, the above and other objects can be achieved by an apparatus for forming thorn-like projections on a surface of a workpiece, said apparatus comprising a stationary frame having a work supporting platform, first swingable arm means having one end pivotably supported on said frame, said first arm means having surface means confronting to said platform, second swingable arm means pivotably supported on said frame and having biting cutter means provided on lower side thereof, means for biasing said second arm means upwardly with respect to said first arm means, vertically movable actuating means disposed above said first and second arm means, and linkage means for transferring downward movement of the actuating means to said first and second arm means whereby when the actuating means is moved downwardly the surface means of the first arm means is brought into holding engagement with a workpiece on said platform and thereafter upon further downward movement of the actuating means said second arm means is swung to bring the biting cutter means into biting engagement with the workpiece. In a preferred mode, a pair of first swingable arms are disposed at the opposite sides of the frame and a second swingable arm is provided between said first arms. The linkage means may comprise a vertical link having a lower end pivotably connected to said first arm at a position remote from the pivotably supported end of the first arm, a horizontal link connected at one end with the upper end of the vertical link and the other end with said second arm, and a third link extending be-

tween the actuating means and the intermediate portion of the horizontal link. Preferably, the biting cutter means comprises a plurality of biting edges which are disposed in two rows, the edges in one of the rows being longer than those in the other row. Further, the two rows of biting edges are preferably arranged in a staggered relationship with each other. The apparatus of the present invention is particularly suitable for forming thorn-like projections on a metal surface but it may be used for other kinds of workpieces.

The above and other objects and features of the present invention will become apparent from the following descriptions of preferred embodiments taking reference to the accompanying drawings, in which:

FIG. 1 is a side view of a thorn-like projection forming apparatus in accordance with one embodiment of the present invention;

FIG. 2 is a sectional view taken substantially along the line II-II in FIG. 1;

FIG. 3 is a perspective view of biting cutter used in the apparatus shown in FIG. 1;

FIG. 4 is a side view of the biting cutter shown in FIG. 3; and

FIG. 5(a), (b) and (c) show the biting action of the cutter.

Referring now to the drawings, particularly to FIGS. 1 and 2, there is shown an apparatus including a frame 1 which has a workpiece holding platform 2 on which a workpiece W such as a steel sheet is advanced in the direction shown by an arrow A. A pair of brackets 3 are disposed at the opposite sides of the frame 1 and secured thereto by means of a plurality of bolts 4. The brackets 3 support a transversely extending shaft 5 on which a swingable arm 11 is rotatably mounted through a bearing 6. A pair of swingable arms 7 are mounted one on each side of the frame with one end pivotably supported by a shaft 8 through a bearing 9. Each of the arms 7 has a slot 10 which allows the shaft 5 to pass there-through, and extends over the platform 2 to define an extension 7a.

Above the platform 2, there is provided a vertically movable actuating member R which may be a movable element of a pressing machine (not shown). A link 13 is connected at its upper end with the actuating member R through a pin 12 and bearing 20 and at its lower end with intermediate portion of a horizontal link 14 through a pin 15 and a bearing 21. The horizontal link 14 has one end connected with the free end of the swingable arm 11 through a pin 16 and a bearing 22, and the other end with the upper end of a vertical link 17 through a pin 18 and a bearing 23. The other end of the vertical link 17 is connected to the swingable arm 7 at its extension 7a.

The actuating member R carries a bracket 25 which has a bearing 26 mounted thereon for slidably receiving a vertical guide rod 28 and permitting pivotal movement of the rod 28 in the plane of the sheet of drawing. The guide rod 28 has a lower end carried on the swingable arm 7 at its free end through a bearing 27 which allows pivotal movement of the rod 28 in the plane of the sheet of drawing. A compression spring S is disposed between the bearings 26 and 27 so as to force the bearings 26 and 27 apart from each other whereby the free end of the swingable arm 11 normally biased upwardly.

At the lower side of the arm 11, there is mounted by means of bolts 38, a biting cutter 29 including two rows

of biting edges 30 and 31 which are respectively separated by grooves 32 and 33. As shown in FIG. 3, the biting edges 30 and 31 are arranged in staggered relationship with each other. Further, in order to securely hold the cutter 29 in place, a holding member 36 is mounted on the arm 11 by means of a bolt 39. From FIGS. 1 and 4, it will be seen that the distances from the center of swinging movement of the arm 11 and the biting edges 30 and 31 are different from each other. The arms 7 carries at its lower side a depressing plate 40 which is mounted thereon by a plurality of pins 42 at a position confronting to said platform 1, and the platform 1 is provided with a platen 41 which cooperates with the plate 40.

In operation, when the actuating member R is moved downwardly, the arms 7 is swung about the shafts 8 downwardly until the depressing plate 40 engages with the workpiece W on the platen 41 so as to securely hold the workpiece therebetween. As the actuating member R is further moved downwardly, the horizontal link 14 is swung counterclockwise and thus the arm 11 is swung clockwise. Thus, as shown in FIG. 5(a), the biting edges 30 are brought into biting engagement with the workpiece W to produce thornlike projections T<sub>1</sub>. Upon further movement of the actuating member, the biting edges 31 come into biting engagement with the workpiece W as shown in FIG. 5 to produce thorn-like projections T<sub>2</sub>. Thereafter, the actuating member R is moved upwardly, the workpiece W is advanced, and the operation cycle is repeated. It is to be noted that according to the illustrated structure, the projections T<sub>1</sub> may be directed in somewhat different directions from the projections. Further, in the illustrated arrangement, since the biting edges 30 and 31 are disposed in staggered relationship, the thorn-like projections T<sub>1</sub> and T<sub>2</sub> are also formed in similar positional relationship. This will provide an advantage in that, when the workpiece W is a metal plate on which another metal is casted, uniform bonding strength can be assured between the workpiece and the casted metal in all directions along the workpiece surface.

According to the arrangement of the present invention, the biting thrust of the biting edges is substantially proportional to the holding effect applied by the depressing member to the workpiece so that the biting cutter can be used without trouble even when the biting edges are worn to some extent.

The invention has thus been shown and described with reference to a specific embodiment, however, it should be noted that the invention is not limited to the details of the illustrated embodiment but changes and modifications may be made without departing from the scope of the appended claims.

We claim:

1. An apparatus for forming thorn-like projections on

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a surface of a workpiece, said apparatus comprising a stationary frame having a work supporting platform, first swingable arm means having one end pivotably supported on said frame, said first arm means having a surface means confronting to said platform, second swingable arm means pivotably supported on said frame and having biting cutter means provided on lower side thereof, means for biasing said second arm means upwardly with respect to said first arm means, vertically movable actuating means disposed above said first and second arm means, and linkage means for transferring downward movement of the actuating means to said first and second arm means whereby when the actuating means is moved downwardly the surface means of the first arm means is brought into holding engagement with a workpiece on said platform and thereafter upon further downward movement of the actuating means said second arm means is swung to bring the biting cutter means into biting engagement with the workpiece.

2. Apparatus in accordance with claim 1 in which said first arm means includes a pair of first swingable arms disposed one at each side of the frame and said second swingable arm means includes a second arm disposed between said pair of first arms.

3. An apparatus in accordance with claim 2 in which a plate member is carried by said first arms to provide said surface means.

4. An apparatus in accordance with claim 3 in which a platen member is provided on the platform for cooperation with said plate member on the first arms.

5. Apparatus in accordance with claim 1 in which said linkage means comprises a vertical link having a lower end pivotably connected to said first arm means at a position remote from said one end thereof, a horizontal link connected at one end with upper end of the vertical link and the other end with said second arm means, and a third link extending between the actuating means and an intermediate portion of the horizontal link.

6. Apparatus in accordance with claim 5 in which said biasing means includes a compression spring extending between said first arm means and said actuating means.

7. Apparatus in accordance with claim 1 in which said biting cutter means comprises a plurality of biting edges which are disposed in two rows, the edges in one of the rows being disposed far from the center of swinging movement of said second arm means than those in the other row so that the edges in the rows are brought into biting engagement in sequence.

8. Apparatus in accordance with claim 7 in which said two rows of biting edges are arranged in a staggered relationship with each other.

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