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PEENING NOZZLE

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ABSTRACT OF THE DISCLOSURE

This disclosure is directed to a nozzle for ejecting shot at high velocity for peening operations. The nozzle is fed from a hopper with the input peening shot being all supplied under a like head. The nozzle further is capable of being pivoted so that the uniformity of the head with respect to the feeding chamber will not be affected.

This invention relates to a nozzle and jet construction used particularly with peening apparatus.

Shot peening apparatus is widely used in the cold working process primarily to increase the fatigue life and prevent stress corrosion cracking of metal parts. It is particularly useful with respect to components of heavy weight which cannot be readily transported and of which it is desired to finish and treat the working surfaces. In metal peening operations, steel shot are ejected from jet nozzles under relatively high pressure fluid action thereby to be forced against the component at high velocity and in a relatively constant quantity. In any peening operation, the metal finishing results because the steel shot impinge upon the component at sufficiently high velocity substantially to plastically deform its surface to a depth of a few thousandths of an inch. The net effect is to produce a residual compression strength thereby to give greater resistance to metal fatigue failure. The effect also is to increase to some extent the surface hardness by effectively cold-working the metal.

Some forms of nozzle apparatus have heretofore been used for this purpose. The present invention seeks to provide over prior art an improved form of nozzle and jet construction thereby to control better and more uniformly the quantity of shot projected from the nozzle toward the component to be treated, as well as to stabilize its impacting velocity. Such control provides a more uniform overall surface treatment of the component and tends to insure the component strength being substantially uniform throughout. Peening apparatus usually uses steel balls of size which are determined to a substantial extent by the type of work to be done. Generally, the ball size is in the range between several thousandths of an inch in diameter to about one-quarter inch or, in some instances, even slightly more. The ball hardness may vary but it is preferred that the balls be made exceptionally hard so that they do not lose shape upon impacting the component to be treated and that they be polished so that dust and dirt does not readily adhere. They are usable for recirculation if in a clean and polished state. The projected shot are forced outwardly toward the work through a jet nozzle under fluid pressure. Usually, for convenience, the chosen fluid is air under a pressure which may vary from just slightly above atmospheric to the order of 125 p.s.i.g. or more. Following the shot ejection from the nozzle and impact upon the work, the shot are recollected and recirculated while being subjected to an air blast sufficiently strong to remove such dust as may be collected upon the surface.

In peening operations, in order that the treatment of the component shall be uniform, care is taken to control

the rate at which the peening jet nozzle and the component move relative to each other, thereby to establish the impact period. It is also desirable to control carefully the head at which the peening shot are projected into the mixing chamber or the nozzle and jet. If the head under which the shot are projected into the nozzle and jet is high, the shot already has imparted to it a velocity which may aid in the velocity at which impact is made with one space relation between the supplied fluid and shot but which, under other conditions, may have the reverse effect. If the head at which the shot is fed to the nozzle and jet varies to any substantial extent, both the quantity of shot and the force at which the shot leaves the nozzle jet will be varied. These situations subject the entire operation to an unnecessary variable tending to detract from the quality of the final prepared component.

The present apparatus which forms this invention seeks to overcome the effect of a variable head for the supplied shot through the use of a feed hopper of known depth and configuration through which the shot is passed to a mixing chamber, there to be mingled and mixed with the supply fluid and projected from the nozzle and jet against the component under treatment. The hopper structure is adapted to receive its supply from an inlet tube or pipe which is completely physically separated from the hopper structure per se, thereby to permit the supplied shot to enter the hopper in such a way that the effective head of shot finally mixing with the projecting fluid shall be only that represented by the immediately stored quantity of shot within the hopper and not the shot stored within a long supply line which may be from some considerable height. Further, the hopper, according to the invention, is provided with shot overflow regions between its bottom and top so that in the event the feed of shot exceeds some pre-selected normal rate, the shot will overflow the hopper or pass out from it through the overflow passages, thereby to preclude the effect of a substantial head of shot adapted to be subjected to the projection fluid jet.

The overflow passages from the hopper may be of any desired type but it has been found desirable in order to allow for various positioning of the hoppers to provide slots through which overflow shot may pass. The slots, accordingly, are of a length and width somewhat in excess of the largest size shot that is to be used in the operation. The shot from the hopper fall gravitationally into a mixing chamber into which the fluid under pressure is passed. Within the mixing chamber, the shot that is accumulated therein is projected under the force of the entering fluid jet into an outlet passage which leads to the final nozzle or jet.

Particularly for cases where the component to be treated may have irregular surface configurations, it is frequently desirable to be able to adjust the angle of the hopper relative to the projection nozzle jet. In order that the hopper may not be tipped to an extent such that the supply head therein shall be decreased beyond some preselected minimal value, the combination of the nozzle jet and the feed hopper are supported in any desired fashion to project issuing shot according to a selected path. The nozzles may be single nozzles directing the output shot substantially to a point or the nozzles may be used in multiple in a nested state thereby to provide a greater quantity of flow or to provide for simultaneously subjecting the wider portion of the component surface to simultaneous action. The invention has among its objects those of improving the efficiency of shot projection by jet nozzles as well as that of making more uniform the quantity and velocity of shot projection and the provision of a device for use in peening operations which is relatively simple in its construction and arrangement and which finds wide use in the field for which it is designed. The invention may assume various forms but for the purpose of illustration the accompanying drawings represent one preferred form of structure for carrying out the foregoing aims and objectives.

By the drawings:

FIG. 1 is a generally elevational view of a projection nozzle and hopper assembly particularly to show the adjustable feature thereby to provide for ejecting the shot in controlled paths;

FIG. 2 is a plan view looking out upon the structure shown by FIG. 2 and showing the construction as viewed approximately along the line 2—2 of FIG. 1, in the direction of the arrows;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2 thereby to show the general internal construction of the device depicted by FIG. 1; and

FIG. 4 is a partial end section of the device of FIG. 3 looking at FIG. 3 from the left to right as the figure appears in the drawing and along the path 4—4 shown in FIG. 3.

Now making reference to the drawings, the nozzle, generally shown at 11, is provided with an outer shell section 12 within which there is an extremely tough and hard metal inner tubular member 13 leading to an outlet port 14. The tubular member 13 is made of extremely tough steel, such as a tungsten-carbide, which is sufficiently hard to be substantially immune to damage by the peening operation. This tubular member 13 is fitted within the outer shell 12 and adapted to be secured therein in any desired fashion. As shown particularly by FIG. 3, the inner tubular member 13 has its upper end curved and slightly expanded at 15 to overlap the recessed inner end 16 of the outer shell 12. The internal hard metal tube 13 is centered in the assembly and adapted, as will later be explained, for projecting the ball shot through to the outlet port 14 and then on to the component to be worked upon. In a preferred form of construction, the metal tubular member 13 when rested about the rounded inner shoulder of the outer member 12 has a gasket 20 placed thereover and adapted to fit adjacent to the end tubular wall of a mixing chamber component 21. The mixing chamber component has outer threads 22 extending for a short distance toward its end. The outer sleeve 12 has a shoulder portion 23 over which a clamping nut 24 is adapted to be positioned. The clamping nut is internally threaded and draws the outer sleeve 12 tightly against the gasket 20 and fastens the assembly securely to the threaded end 22 of the mixing chamber element while maintaining the alignment of the hard metal tube 13 substantially centered in the mixing chamber.

The mixing chamber is an elongated tubular section which has an upper opening 25 for entry therein of shot from a hopper 26, later to be further discussed. There is fitted into the end 29 of the mixing chamber 21 a closure plug 30 which fits tightly therein. The closure plug is also metal and is provided with a central opening through which the hollow tubular sleeve 33 is passed to provide a fluid inlet to the mixing chamber. The plug is circumferentially welded to the end wall of the mixing chamber as shown at 51. The sleeve 33 through which the fluid enters is secured to the mixing chamber in a desired location by the set screw 34. This is done in order that the final termination of the sleeve 33 within the mixing chamber 21 may be at a selected point or region whereby shot from the hopper 26 falling through the opening 25 may enter into the mixing chamber at the desired position relative to nozzle through which the inflowing fluid enters. The fluid (under pressure) is supplied to the sleeve 33 from any desired source (not shown) by way of the schematically illustrated tubing 34.

The hopper 26 is usually formed with one substantially vertical wall 35 and a sloping rear wall 36, as well as sloping sides 37 and 38 all leading to an outlet port 39. The shot, schematically represented at 40, are adapted to enter into the hopper 26 from an outlet tube 41 which is separate and disconnected from the hopper. The supply of shot may come from any feed source desired (not shown) to be supplied at any desired rate. The shot falling into the hopper 26 tend to fill the hopper with maximum filling being generally at about the region of the overflow slots 46, 47 and 48 on the two sides and the rear sloping face. If the shot feed from the inlet 41 is very fast, the shot will fill the hopper to the overflow slot which is an indication of the maximum depth. This fill is to occur during the time the shot are passing out through the outlet port 39 and the entry opening 25 into the mixing chamber 21. The fluid inlet sleeve 33 as it enters into the mixing chamber 21 through the closure plug 30 is axially aligned with the axis of the tubular outlet 13 so that fluid entering the mixing chamber is able to leave directly. At the same time, shot 40 entering the mixing chamber through the opening 25 tend to be propelled through the outlet by the force of the incoming fluid and any shot entering beyond the normal amount instantaneously to be moved through to the outlet tend to accumulate in the lower portion of mixing chamber. If the inlet flow is steady and the fluid pressure correctly chosen, the operation provided is a steady outlet flow of shot and pressure fluid.

It is desirable at times that the jet be turned to one direction or another thereby particularly for the purpose of nesting a plurality of nozzle jets in a group. For this purpose, the outlet passage 39 from the hopper is preferably formed as a generally cylindrical member feeding into a collecting cup 49 which connects into the inlet opening 25. To provide a structure so that the hopper itself may be generally maintained in a reasonably level position, the inlet cup may be suitably hinged to the lower end of the hopper at its outlet port 39 thereby to permit the nozzle as a whole to be turned through a limited angle as represented in phantom by FIG. 1. In some instances, the structure can be formed without the adjustment of the hopper but, where changes are to be made in the relative positioning of the final tilt of the nozzle jet, as compared to the hopper, economy frequently dictates a relative shift between the hopper position and the mixing chamber while maintaining substantially a constant velocity flow of shot into the mixing chamber through the connection of the collecting cup 49 to the mixing chamber.

Various modifications in the disclosed structure may be made without departing from either the spirit or the scope of the invention as herein set forth and claimed.

Having now described the invention what is claimed is:

1. A nozzle for ejecting shot at high velocity comprising:

a mixing chamber,

a hopper adapted to be supplied with shot over a relatively long vertical distance to maintain a pre-established substantially constant shot level and thereby a known pressure head,

a tubular inlet member adapted to have a fluid supply under pressure connected thereto,

a feed throat element leading from the hopper and terminating within the mixing chamber and constituting an inlet thereto for gravitationally feeding shot from the hopper to the mixing chamber wherein the said shot are adapted to be accelerated to a substantially constant high known velocity established by the pressure head from the hopper and the pressure of a supplied inlet fluid for ejection from the tubular outlet member,

a tubular outlet member having its inner end terminate at the mixing chamber in substantial alignment with the inlet member, and

an outlet nozzle connecting into the mixing chamber in axial alignment with the fluid supply and having an internal lining of a hardness substantially impervious to the action of the ejected shot.

2. The nozzle structure claimed in claim 1 comprising, in addition,

means to provide angular adjustment between the hopper and the feed throat to control thereby the average volume of shot contained within the hopper.

3. The nozzle and hopper structure claimed in claim 2 comprising, in addition,

an overflow opening in the hopper thereby to limit the shot volume within the hopper and thereby the constant head.

4. The nozzle claimed in claim 1 wherein the feed throat from the hopper to the mixing chamber terminates behind the forward end of the tubular inlet member in the mixing chamber.

5. The nozzle and hopper structure claimed in claim 4 comprising, in addition,

means to adjust the hopper angularly to maintain it substantially upright independently of the angle of tilt of the tubular outlet.

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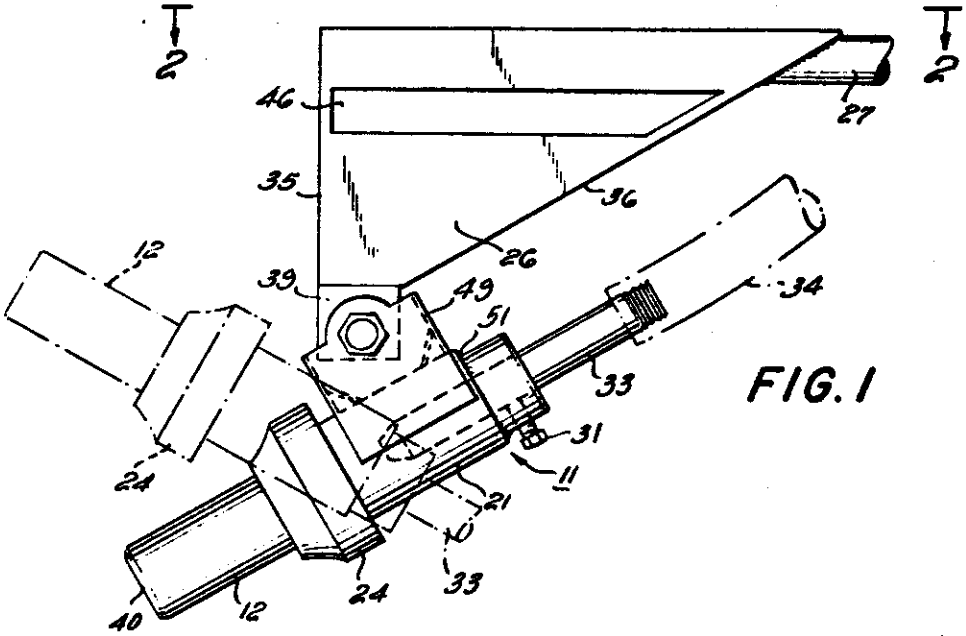

FIG. 1

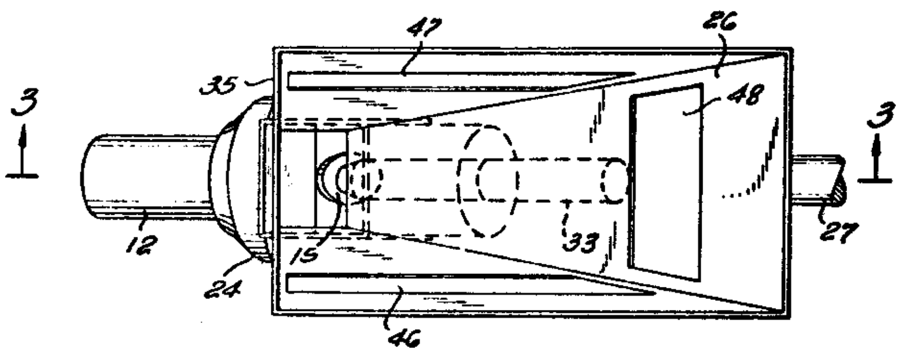

FIG. 2

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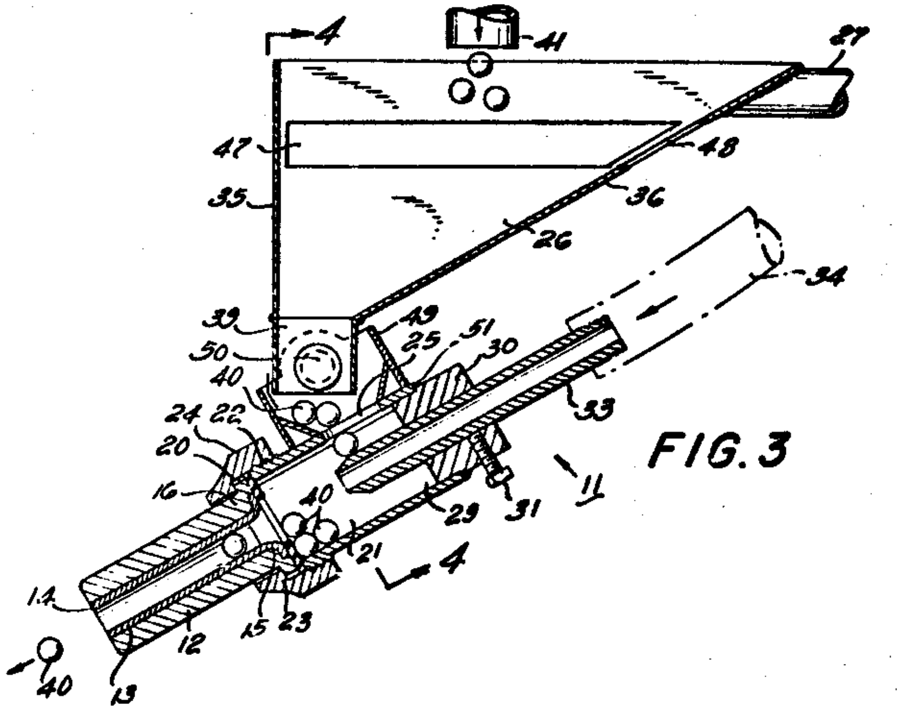

FIG. 3

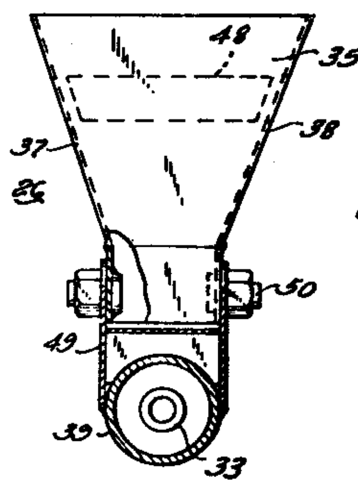

FIG. 4

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