Aug. 25, 1959 J. J. RUTLEDGE 2,900,851

SANDBLASTING NOZZLE AND METHOD OF PRODUCING IT

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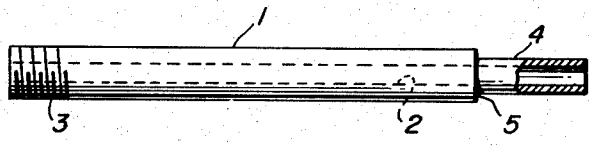


Fig. 1.

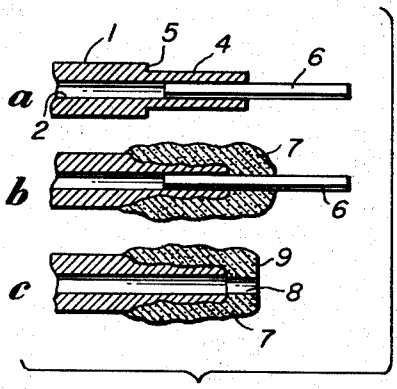


Fig. 2.

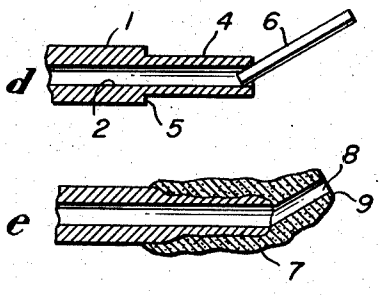


Fig. 3.

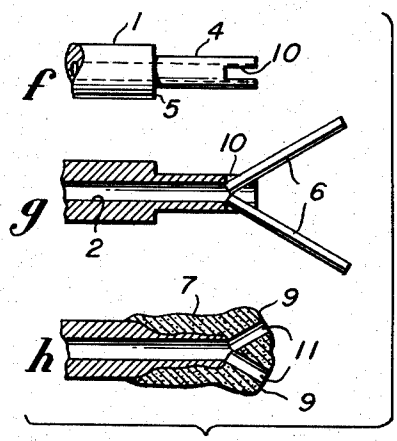


Fig. 4.

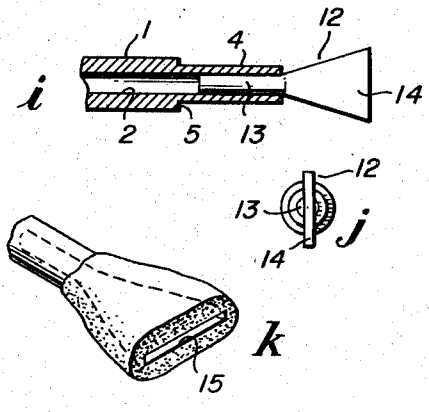


Fig. 5.



Fig. 6.

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SANDBLASTING NOZZLE AND METHOD OF PRODUCING IT

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1 Claim. (Cl. 76—101)

Sandblasting nozzles are widely used in industry for directing particles of sand or other abrasive material entrained in a high pressure air stream against surfaces, usually metallic, to clean and to a certain extent smooth them, the nozzles commercially obtainable comprising a hollow cylinder adapted for connection at one end to a hose carrying the air-sand stream and having a small axial port at the other through which the stream is ejected; they are customarily made of cast iron and mild steel and lined with an abrasion-resistant material. These nozzles are of a diameter which precludes their introduction into narrow spaces such as those between the blades of a turbine, while because of their cylindrical form they are not well adapted for directing the air-sand stream around corners so that for both of these reasons their convenient employment under numerous conditions is restricted or negatived. Hence they are useful only for directing the stream against surfaces in direct view and cannot be used for sandblasting surfaces behind obstructions or otherwise out of line-of-sight.

It is therefore an object of the present invention to provide an improved sandblasting nozzle, as well as a method of making it, not open to these objections in that it may be so constructed as readily to be entered in narrow spaces, or to direct the air-sand stream at an angle to its general direction of travel so as to facilitate its projection around corners and behind obstacles while in certain of its embodiments the nozzle may be formed so as to project a plurality of divergent streams or a flat one having divergent side edges.

Further objects are the provision of an improved sandblasting nozzle which readily can be produced at low cost in accordance with the method of the invention in the usual machine shop.

Other objects and novel features of design, construction and arrangement of the nozzle itself as well as in the method of making it are hereinafter more fully set forth or will be apparent from the following description of five different embodiments of the nozzle as illustrated in the accompanying drawing, the various figures of which are intended not only to facilitate description of such embodiments respectively but the steps incident to their production in accordance with the method of the invention.

In the said drawing:

Fig. 1 is a side elevation of a pipe nipple or tube utilized in the production of each of the aforesaid embodiments of the nozzle;

Fig. 2 is a composite view with its figures in longitudinal section illustrating a nozzle adapted to project a single axial air-sand stream and in auxiliary views steps incident to its production;

Fig. 3 is a generally similar view illustrating a nozzle designed to project an air-sand stream at an angle to its general direction of flow with a single auxiliary view showing one step in its method of production;

Fig. 4 is a generally similar view illustrating a nozzle

adapted to discharge angularly divergent streams with two auxiliary views showing steps in its production;

Fig. 5 comprises a perspective view of a nozzle adapted to discharge a single flattened but divergent stream with two auxiliary views showing steps in its production, and

Fig. 6 is a longitudinal section illustrating a nozzle constructed in accordance with the invention adapted to discharge a stream at an angle greater than 90° from the general direction of axial flow.

As the initial step in the production of all the aforesaid nozzles a mild steel tube or pipe **1** of desired length and preferably relatively heavy wall having an axial bore **2** of suitable diameter, for example ¼", and usually externally threaded as at **3** adjacent its rear end to facilitate coupling to the hose with which the nozzle is to be associated, is first reduced in diameter by turning or otherwise at its opposite end **4** to leave a wall of about 1/16" thickness, for an appropriate distance such as 1⅛" from the extermity of the tube and terminating at a shoulder **5**; the tube then appears substantially as shown in Fig. 1.

In producing a nozzle such as shown in Fig. 2 the tube is then clamped by any appropriate means so as to hold it steady and a preferably cylindrical element such as a rod **6** of carbon, although other materials may be utilized as hereinafter noted, is inserted in the bore of the reduced end **4** to extend therein for a relatively considerable distance, preferably at least one-half the length of the reduced portion, the rod being of a diameter to form a fairly snug fit in the tube bore so that no material clearance is left between it and the wall thereof; no clearance is therefore indicated in the drawing although it is not essential that the element be a tight fit in the bore. The parts then appear as at *a* (Fig. 2).

The reduced end of the tube is next heated with a welding torch or other appropriate means until it reaches a temperature just below that at which it becomes appreciably soft and tungsten carbide or other highly abrasion-resistant material is then built up progressively about said reduced end as well as about that portion of element **6** closely adjacent its extremity and preferably for a short distance about the body of the tube rearwardly of shoulder **5** until the maximum outside diameter of the generally cylindrical body of tungsten carbide **7** is slightly greater than that of the body of the tube, all substantially as shown at *b*. After completion of the building-up step just described, which is of course performed by ordinary welding procedure and with a suitable welding rod, the carbon element **6** is withdrawn after the parts have become sufficiently cool, an operation which readily can be performed since tungsten carbide does not adhere to carbon, and to impart an appropriate finish the extremity **9** of the built-up portion finally forming the nozzle tip may be faced off normal to the axis of the bore, thus completing the production of the nozzle as shown at *c*. Of course if desired the relatively rough and irregular periphery of the built-up portion may likewise be ground to coincidence with the exterior of the tube and under some circumstances the end facing be omitted since neither operation materially enhances the utility of the nozzle and both increase its cost of production, particularly since the tungsten carbide is so hard it is extremely detrimental to grinding wheels.

While various tungsten carbide "alloys," if they may be so termed, or other material susceptible by progressive deposition under heat of being formed into an extremely hard abrasion-resistant mass can be utilized in the production of the nozzle, I prefer to employ a welding rod of the character disclosed in U.S. Patent 1,803,875

marketed by the Stoody Company, Whittier, California, under the trademark "Borod" which consists essentially of a mild steel tube containing particles of tungsten carbide as more fully disclosed in said patent. Further, in place of a rod-like element of carbon, elements of other composition, such as copper, to which melted tungsten carbide will not adhere may be employed but normally are not so desirable as a carbon one due to their greater tendency to expand under heat and so "freeze" within the tube, thus rendering their removal therefrom more difficult than that of a carbon element.

Mention has been made of the heating of the reduced end of the tube close to its melting point before application of the tungsten carbide thereto, such heating enabling the latter to penetrate and alloy with the thin steel wall and enhance its subsequent resistance to abrasion, but care must be taken that this heating be not sufficient to induce collapse of the wall either before or during the building-up of the tungsten carbide about it which, should it occur, would restrict or even close the bore inwardly of the element.

A nozzle produced in the manner just described may be used in sandblasting operations and the like in a manner similar to that of the customary commercial nozzles presently available in the market. Since it can be constructed to present a relatively small external diameter it can be introduced into spaces too narrow to enable entry of ordinary commercial nozzles, a matter of great advantage in numerous industrial operations such, for example, as the cleaning of turbine blades as heretofore mentioned. Moreover, since the length of the tube employed in the production of the nozzle is a matter of choice one up to several feet in length may be utilized if desired which frequently facilitates application of the sandblast at a point remote from an operative.

In Fig. 3 is shown another embodiment of my nozzle which is capable of directing the air-sand stream at an angle to the main bore and, as shown at *d*, in the production of a nozzle of this character the element **6** instead of being entered axially in the bore after the end of the tube has been reduced in diameter as already described is inserted therein at an angle to the axis of the latter and maintained in that position by any appropriate means while the tungsten carbide **7** is being built up about the reduced end of the tube and the element, with the result that after extraction of the latter the nozzle presents the appearance shown at *e* in which its extremity is illustrated as faced off at **9** in a plane normal to the axis of the angular portion of its bore.

Such a nozzle is often of great utility in directing the air-sand blast into out-of-the-way places, around corners and behind intervening objects, and it will of course be appreciated that the angular diversion of the stream with respect to the axis of the bore of the tube is controlled by the angular disposition of element **6** preparatory to building-up the tungsten carbide about the reduced end of the tube and about the element. Hence by varying this angularity the nozzle may be formed to project the stream at any desired angularity within a relatively considerable arc with respect to said axis to thereby adapt it for a particular service. If the angularity desired is at 90 degrees or more from the direction of axial flow, a transverse bore is made in one side of the reduced portion of the tube close to the outer end and the element **6** is inserted in this bore at the desired angle. The end is then built up with tungsten carbide as previously described and finally the element is removed and the nozzle trimmed. Such nozzles typified in Fig. 6 are particularly useful in sandblasting difficultly accessible surfaces facing away from the operator such as the inward surfaces of turbine shroud rings.

The embodiment shown in Fig. 4 is effective to divide the main air-sand stream and project it in two divergent ones as will be apparent from an inspection of the axial section of the finished nozzle shown at *h*. In its production, after appropriate reduction of end **4** of tube **1**, a diametrically extending slot **10** is cut in its extremity and two carbon or other elements **6**, **6** then inserted in this slot at their inner extremities in the manner generally shown at *g* preparatory to thereafter building up the tungsten carbide **7** about both of them and the reduced end of the tube substantially as already described, with the result that after removal of the elements divergent passages **11** extend from the main bore to the tip of the nozzle which of course may be faced off adjacent the mouths of the passages either normal to their respective axes or otherwise. In operation, therefore, two separate divergent air-sand streams are projected from the passages to impinge at separated points on the article being sandblasted.

Finally in Fig. 5 there is shown in fragmentary perspective still another embodiment of my nozzle which is operative to project a flaring air-sand stream relatively thin in transverse dimension in comparison with its width. In the production of this nozzle, shown at *k*, there is inserted in the bore of the reduced end of the tube an element **12** of carbon or other suitable material having a preferably cylindrical stem **13** of diameter appropriate to fit fairly snugly in the bore and an outwardly oppositely flared relatively thin portion **14**, as shown at *i* and *j*, with the result that after the tungsten carbide is built up about said reduced end and about the flared portion **14** of the element so as to fully enclose both of its faces and side edges and the element then removed, a cavity of the general shape indicated at **15** conforming to the shape of said flared portion is left in the extremity of the nozzle and is effective to correspondingly flatten and diverge the air-sand stream as it passes therefrom. Nozzles adapted to discharge such streams are desirable for certain classes of work as where large areas are to be blasted in a minimum of time. After 4 to 8 hours of use, the orifices of the nozzle become eroded to a funnel shape, which causes undesirable spreading of the stream of sand. This condition is readily remedied and the nozzle rebuilt substantially like new by inserting element **6**, reheating the nozzle to a temperature at which the matrix of the abrasion-resistant material becomes sufficiently pliable, reshaping the tip to conform tightly about the element, and finally driving out the latter. If desired, instead of merely reshaping the material of the tip, more tungsten carbide may be added. This wearing away and rebuilding of the nozzle may be continued indefinitely.

Should the tube **1** become perforated by the stream of sand, the damaged part can be cut out and the tip or nozzle welded to the intact portion of the tube or to a new tube of any desired length.

The several nozzles heretofore described are but exemplary of many types which may be constructed by the method of my invention either for general sandblasting operations or for particular service under unusual conditions, and in consequence I do not thereby desire to restrict myself specifically to the said embodiments or exactly to the manner of their production herein described, as various changes and modifications can be made in the nozzles themselves and in the performance of the method comprehended by the invention without departing from the spirit and scope of the latter as defined by the appended claim.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

The method of making a composite sandblasting nozzle which comprises the steps of reducing the extremity of a ferrous tube to a diameter less than that of its body, inserting in the bore of the reduced portion an element approximating said bore in diameter and of length sufficient to project beyond the end face of the reduced

portion, progressively depositing a matrix of hot substantially fluid ferrous material containing particles of tungsten carbide about and in welded relation to said reduced portion, said face and the projecting part of the element adjacent thereto and, after the material has cooled, removing the element.

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