Jan. 15, 1935. H. W. GILLETT ET AL 1,988,432

NOZZLE

Filed May 17, 1934

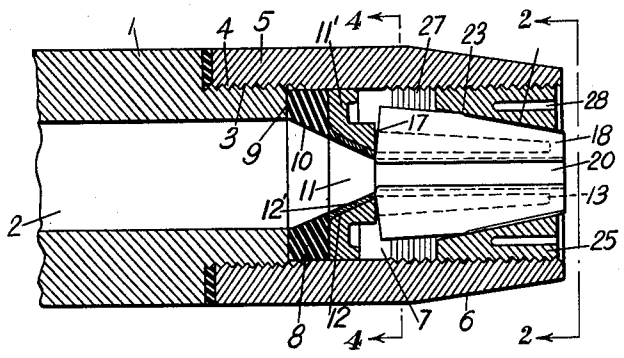

Fig. 1

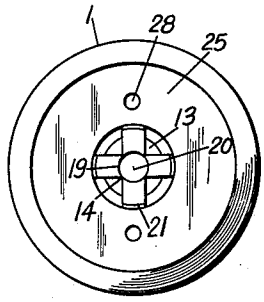

Fig. 2

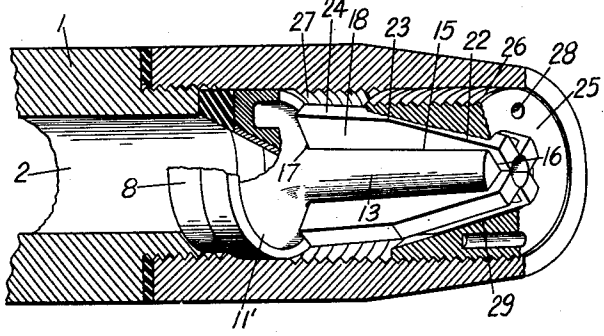

Fig. 3

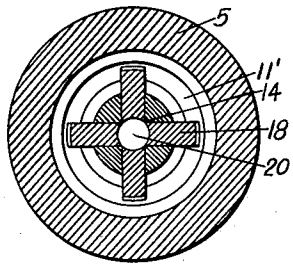

Fig. 4

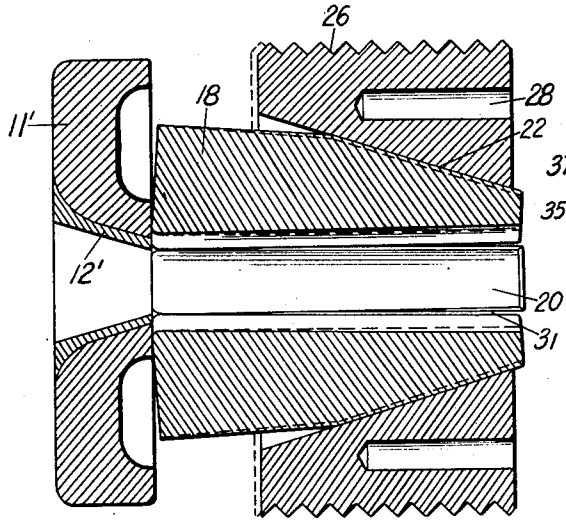

Fig. 5

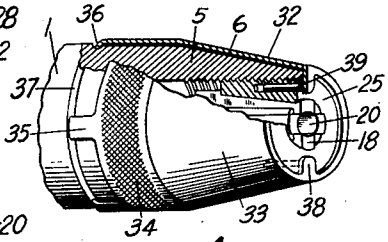

Fig. 6

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NOZZLE

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14 Claims. (Cl. 51—11)

Our invention relates to nozzles. It has to do, more particularly, with nozzles which are particularly adaptable for use in sand-blasting. More specifically, our invention relates to a nozzle which is provided with adjustable means for compensating for wear which occurs when it is used in the sand-blasting operation.

It is a well known fact that nozzles wear very quickly when used in sand-blasting operations. The nozzles are made with an orifice of a predetermined size which will give them the maximum efficiency. Wear caused by the abrading action of the sand passing through the orifice causes the orifice to increase in size and thereby results in a great loss of efficiency. Even though the nozzle may not be completely worn out, the efficiency of the nozzle is greatly reduced after being used a short time. When the nozzle has been worn to such a degree that its efficiency has been decreased to a large extent, it is necessary to replace the nozzle. It will be obvious that, since these prior art nozzles do not last for any great length of time, the cost of replacing these nozzles is considerable. Also, it takes considerable time and a large amount of trouble to replace these nozzles. However, the greatest disadvantage of prior art nozzles resides in the loss of efficiency as the cross-section of the orifice increases, due to wear.

In an attempt to overcome these difficulties, it has been customary in the past to make the entire nozzle of wear-resistant material. However, it will be apparent that such a nozzle is very costly, inasmuch as sufficiently wear-resistant materials are quite expensive. Also, even though such nozzles might last a fairly long time, the efficiency thereof is being reduced constantly by wear. It has also been proposed to merely line sand-blast nozzles with a lining of highly wear resistant material such as tungsten carbide and ceramic materials, which lining is designed to be replaced after it has become worn to an undesirable extent. As previously stated, these highly wear-resistant materials are quite expensive. Furthermore, although the liners may be replaced when so far worn as to decrease the efficiency of the nozzle to a point where correction is required, the efficiency of the nozzle constantly decreases, as the wearing action progresses. Also, a considerable amount of time and a large amount of trouble is required in replacing such liners.

One of the objects of our invention is to provide a nozzle which is particularly useful in sand-blasting and which is provided with means for compensating for wear produced by the abrading action of the sand passing therethrough.

Another object of our invention is to provide means whereby it is possible to make the nozzle mainly of material which is only fairly resistant to wear and is less expensive than materials previously used in such nozzles, the nozzle being provided with means for maintaining the efficiency thereof.

A further object of our invention is to provide a nozzle of the type indicated which is provided with means of such a nature that it will compensate for the unequal wear which occurs in sand-blast nozzles while in use and which slowly increases the diameter of the nozzle orifice at the rear end and increases the diameter thereof at the forward or discharge end at a much greater rate.

A still further object of our invention is to provide means by which wear of the nozzle may be compensated for, without interruption in the sand-blasting operation.

In its preferred form, our invention contemplates the provision of a nozzle for use in sand-blasting comprising a plurality of pieces of suitable material which are so disposed relative to each other and are so shaped as to produce an orifice in the nozzle of a desired cross-section. Suitable means is provided for maintaining these various pieces in their proper positions. Also, we provide means which is adjustable whenever desired to properly move the various pieces of material in order to compensate for wear of the nozzle and to maintain the orifice thereof at substantially its original size. This adjustment, which may be readily made from time to time, will maintain the efficiency of the nozzle. It may be of such a type that the adjustments may be made without interruption in the sand-blasting operation. The adjusting means is operative to cause relative movement of the various pieces which make the nozzle in such a manner as to compensate for the unequal wear which occurs in the nozzle during sand-blasting. This unequal wear ordinarily causes the rear end of the nozzle orifice to increase in diameter slowly, while further forward in the nozzle orifice, the wear occurs at a greater rate and, at the extreme forward end of the nozzle, the wear is the greatest. If means were not provided for compensating for this wear, the nozzle orifice would become bell-shaped, with the larger end forward. Thus, it will be apparent that the efficiency of the nozzle would be greatly decreased.

The preferred embodiment of our invention is

shown in the accompanying drawing wherein similar characters of reference designate corresponding parts and wherein:

Figure 1 is a longitudinal section of a sand-blast nozzle made in accordance with the principles of our invention.

Figure 2 is an end view of the nozzle shown in Figure 1 and taken substantially on line 2—2 of Figure 1.

Figure 3 is a perspective view, partly in section, of the nozzles shown in Figures 1 and 2.

Figure 4 is a transverse section taken through the nozzle substantially along line 4—4 of Figure 1.

Figure 5 is an enlarged detail in longitudinal section, illustrating by full lines how the nozzle wears and illustrating in dotted lines how it may be adjusted to compensate for such wear.

Figure 6 is a perspective view, partly broken away, showing the nozzle provided with a member by which the wear-compensating adjustment may be accomplished without interrupting the sand-blasting operation.

From the drawing, it will be apparent that our nozzle comprises a body portion 1 of tubular form, having a bore 2 extending therethrough. This portion 1 is adapted to be connected, at the end not shown, to the hose which carries the sand and air stream to the nozzle, in any well known manner. The outer end of this member 1 is provided with an externally threaded reduced portion 3 which is adapted to receive a correspondingly threaded portion 4 of a sleeve member 5 which serves as the main housing of the nozzle.

This sleeve 5 is mainly of cylindrical form but preferably has its outer end tapered, as indicated at 6. It has a cylindrical chamber 7 formed therein which is substantially larger in diameter than the bore 2 formed in the body portion 1 of the nozzle. In the rear end of the chamber 7, a collar 8, which is preferably made of hard rubber, fiber, or the like, is disposed. This collar member 8 is adapted to be pressed tightly against the extreme forward end 9 of the member 1. The collar member is tapered on its inner periphery, as indicated at 10, so that the flared opening extending therethrough is greater in diameter at its rear than at its forward end.

A member 11' is provided within the chamber 7. This member is of the form shown and, as will later appear, is adapted to hold a plurality of plate members which cooperate with each other to form the nozzle bore. The collar member 8 is held in position by an annular enlargement 11 which is formed on the inner end of the member 11'. The member 11' is preferably made of metal, although it might be made of other material. The annular enlargement 11 is of such a diameter that it fits snugly within the sleeve 5, but permits the member 11' to be moved longitudinally in the chamber 7 formed in the housing. The annular enlargement 11 has a bore 12 extending therethrough. This bore is flared so that its rear end is greater in diameter than its forward end.

The wear produced by the sand stream will not be very great on the wall of the bore 12 within the annular enlargement 11 of the member 11'. However, if desired, a funnel-shaped insert 12' of wear-resistant material may be provided within the bore 12. Instead of having the insert 12', which may be welded or brazed in position within the bore, the annular enlargement 11 may be made completely of wear-resistant material. Further, instead of insert 12' being integral with the annular enlargement 11, it may be made separately therefrom and held in place in a suitable manner. It may then be replaced when worn and, therefore, need not, necessarily, be made of highly wear-resistant material. The inner surface of the insert 12' serves as a continuation of the tapered wall of the rubber collar insert 8.

The member 11' is slotted for the greater portion of its length to form a plurality of guide members 13 which are preferably integrally formed with the annular enlargement 11. However, these guide members may be welded or otherwise secured to the member 11. It will be apparent from the drawing that we have provided four of these members 13, although any suitable number may be provided. These members 13 extend forwardly of the annular enlargement 11 and terminate adjacent the outer end of the sleeve member 5. As indicated in Figure 4, each of these members 13 is substantially segment-shaped in cross-section, having a sharp inner edge 14. All of the members 13 are spaced from each other, as shown. It will be clear from the dotted lines in Figure 1 that the inner sharp edges 14 of the various members 13 are all substantially parallel with each other throughout their length. Between the various guide members 13, longitudinally extending slots 15 are formed. The walls of these slots are substantially parallel with each other throughout their length. The extreme forward ends of these slots are open, as indicated at 16, but the rear ends are closed, as indicated at 17.

Each longitudinally extending slot 15 is adapted to receive a plate member 18. These plate members are placed in the slots between the various guide members 13 and are loosely disposed therein. The inner edges of these plate members 18 are curved as at 19 so that, when all of these plate members 18 are properly positioned between the guide members, they form a nozzle orifice 20 of suitable cross-section which, in the form shown, is circular in outline. However, if desired, the inner edges of these plates may be of other shape so as to produce an orifice of another shape.

It will be apparent from the drawing that, when the plates 18 are properly positioned, the adjacent edges of the adjacent plates contact with each other throughout their length and cover the tips 14 of the members 13. These plates 18 are comparatively thick from their inner edges to their outer edges so that they may be used for a considerable length of time, as will be more clearly apparent hereinafter. When the plate members 18 are in the positions indicated in Figure 4, the orifice 20 is formed, as stated, and this orifice extends from the extreme forward ends of plate members 18 rearwardly until it communicates with the bore 12 in the annular enlargement 11. As shown in Figure 1, this bore 20 will be of uniform diameter throughout its length. However, the plate members may be so formed as to produce an initially tapering bore, or one of varying taper, if desired, so that any selected bore may be had.

The outer edges of the plates 18 are as indicated at 21. The slightly curved outer edges of the plates 18 are, also, inclined rearwardly and outwardly for substantially half of their lengths, as indicated at 22, for a purpose which will be described more in detail. The inclination terminates at a point 23 and from this point, rearwardly, the outer edges are substantially parallel with the inner edges thereof.

The guide members 13 may be made entirely of material that is highly wear-resistant, or only

the tips 14 thereof may have wear-resistant material applied thereto by brazing, welding, "hard-facing" or by other methods. The only portion of these members 13 which will wear will be the tips 14 when they are exposed to the sand stream, due to wear of the inner edges of plates 18, as will be described later. However, most of the time, these tips will be covered as it is possible to readily adjust the plate members 18 radially inwardly, in a manner to be described, to maintain the orifice 20 of its original cross-sectional area. The plate members 18 may be made of cheap, moderately-resistant materials, such as high-carbon steel, white cast-iron or similar materials. However, if desired, the inner edges of these plates 18 may be faced with some wear-resistant metal which may be applied thereto by brazing, welding, "hard-facing" or other methods.

As previously stated, the plate members 18 are loosely mounted in the slots 15. Thus, these plate members 18 may be adjusted inwardly and may also be tilted so that the forward ends will move further inwardly than the rear ends. The inner ends of plate members 18 rest on the bearing surfaces formed at the closed ends 17 of the slots 15. When proper adjustment is made, as will be described later, the plate members 18 will be moved bodily inwardly, which will cause the rear ends thereof to slide on the said bearing surfaces and the plates will simultaneously be tilted so that their rear ends will rock on the said bearing surfaces.

The means for adjusting the plate members radially inwardly to maintain the cross-sectional area of the orifice 20, will now be described. This means comprises an externally threaded collar member 25 which fits around the outer edges of the plate members 18. This collar member has a cylindrical outer surface 26 and the threads thereon extend throughout its length. This threaded surface 26 is adapted to cooperate with the threaded inner surface 27 of the sleeve 5. The threaded surface 27 of the sleeve 5 extends from the extreme forward end thereof almost to the extreme rear end thereof. It will be apparent that, by turning collar member 25 in the proper direction, it may be moved longitudinally within the sleeve 5. The forward end of the collar 25 is provided with a plurality of openings 28, which may extend thereon a considerable distance and are adapted to receive a suitable wrench which may be used in rotating the collar. The inner surface of collar member 25 gradually tapers so that its forward edge is much thicker than its rear edge. Consequently, the opening extending through the collar is of less cross-section at its forward end than at its rear end. The angle of taper of the inner surface of collar member 25 is substantially the same as the angle of taper of the portion 22 of the outer edge of each of the plate members 18. The curvature of the inner surface of collar member 25 is substantially the same as the curvature 21 of the outer edges of plate members 18.

It will be apparent that, in assembling our nozzle, the sleeve member 5 may first be threaded into position on the member 1. Then, the rubber collar member 8 will be positioned against the shoulder 9. The member 11' with the guide members 13 thereon, and the plate members 18 in position between such guide members, may then be placed in the housing until the annular enlargement 11 thereon abuts the rubber collar 8. Then, the collar member 25 is screwed into the housing in surrounding relation to the plate members 18. The collar member 25 will hold the various plate members 18 in their proper positions relative to each other between the guide members 13, in such a manner that the discharge orifice 20 is formed, as described. This collar member 25 is of such a length that the rear end thereof will never contact with the outer edge of the annular enlargement 11, even if the plates 18 are worn to such an extent that they must be removed.

As previously stated, the sand which is forced through the nozzle produces an abrading action which causes wear on the walls of the discharge orifice thereof. The wear produced by the sand stream will not be very great on the walls of bore 12, extending through the annular enlargement 11 of member 11'. The greatest amount of wear will be in the orifice 20 formed by the plates 18. It is well known that the sand stream going through the orifice of a nozzle causes the rear end of a discharge orifice to increase in diameter slowly and causes the diameter of the orifice to increase at a greater rate at points further towards the forward end and the greater wear will be at the extreme forward end. Consequently, after the nozzle is used for a time, the orifice will be of substantially bell-like shape with the larger end forward. Thus, the efficiency of the nozzle would be greatly reduced.

With our nozzle, however, means is provided for compensating for this wear and for taking care of the unequal amount of wear from the rear end to the forward end of the nozzle orifice. In Figure 5, we have shown, more or less diagrammatically, how our nozzle might wear after being used for a time. The forward portions of the plates 18 will be worn away more than the rear portions. In time, this will produce substantially V-shaped spaces 31 between the adjacent edges of adjacent plates 18. The narrower portions of these V-shaped spaces will be towards the rear ends of the plates 18. When the plates 18 are worn in this manner, the tips 14 of members 13 will be exposed to the sand stream. However, since the tips are made of highly wear-resistant material, or the members 13 are made entirely of highly wear-resistant material, they will not wear as quickly as the plates 18.

In order to compensate for this wear, it is merely necessary to rotate the collar member 25 so that it will move further rearwardly in the sleeve 5. Such movement of the collar member 25 causes the inner tapered surface 29 thereof to slide rearwardly on the tapered portions 22 of the outer edges of the plate members 18. This, in turn, will cause simultaneous radially inward movement of the plates 18 until the adjacent edges of the plates contact and the tips 14 of the guide members 13 will be covered by the plates. This will also cause the orifice 20 to be restored to substantially its original size. Because of the fact that the outer edges of plates 18 are not provided with a continuous taper 22 from their extreme forward ends to their extreme rear ends, but are provided with substantially straight portions 24, the forward portions of plates 18 may be moved inwardly further than the rear portions thereof. The forward ends of plates 18 will be caused to move inwardly, even after the rear ends of the plates are in contact. In other wards, the plate members 18 will not only be moved bodily radially inwardly, but the plates will also be tilted to cause the forward ends to swing in further than the rear ends.

Thus, the unequal wear from rear end to for-

ward end of the orifice is taken care of. The manner in which the plate members 18 are adjusted is illustrated by the dotted lines in Figure 5. It will be seen that the collar member 25 may be adjusted from time to time to maintain the orifice 20 of approximately its original cross-sectional area from its rear end to its forward end.

The collar member 25 not only keeps the edges of the plate members 18 in contact with each other, but also keeps the rear ends of these plates 18 in contact with the closed rear ends of slots 15. Furthermore, the collar member 25 also maintains the member 11 in position and compresses the collar between member 11 and the shoulder 9.

After the plates 18 have been worn too much, they may be removed and replaced. This will be done by removing member 11 with the plate members 18 carried between the guide members 13 thereon. Then, the worn plates 18 may be removed and be replaced by new plates.

In Figure 6, we have illustrated a structure whereby it is possible to adjust the nozzle member to compensate for wear without interrupting the said-blasting operation.

To accomplish this, we have provided a spanner wrench 32 of the form illustrated. This wrench comprises a hollow frusto-conical portion 33 which surrounds the tapered portion 6 of the sleeve 5 and a hollow substantially cylindrical portion 34 which surrounds the cylindrical outer surface of the sleeve 5. This portion 34 may be knurled, if desired, so that the wrench member may be rotated easily.

The portion 34 has rearwardly projecting flexible lug members 35 having depending portions 36 at their rear extremities adapted to cooperate with an annular groove 37, formed in the outer surface of sleeve 5, to keep the wrench 32 in place on the nozzle member. It will be apparent that the wrench 32 may be readily rotated on the nozzle member.

The forward end of the wrench 32 is open and is provided with a plurality of lugs 38 which project radially inwardly a short distance from the periphery thereof. Each of these lug members 38 has a pin 39 extending rearwardly therefrom and which is adapted to cooperate with one of the openings 28 in the collar 25. These pins may be of such a length that when the collar member 25 is in its original position within the sleeve 5, the inner ends of the pins will contact with the inner ends of the openings 28. The openings 28 and the pins 39 are of such a length that when the collar member 25 is in its rearwardmost position within housing 5, the pins will still extend into the openings.

It will be apparent that when the nozzle is assembled, the wrench member may be positioned in surrounding relation thereto with the portion 36 of lugs 35 extending into groove 37 and with pins 39 extending into openings 28. Rotation of wrench 32 will be permitted and, when this is rotated in the proper direction, the collar member will be moved inwardly. Consequently, by turning wrench 32 from time to time, the efficiency of the nozzle may be maintained. Since the outer end of wrench 32 is open, it will not interfere with the sand stream emerging from the nozzle.

With this structure, it is possible to make the necessary adjustments to compensate for wear without interrupting the sand-blasting operation. The wrench may be left in position at all times during the sand-blasting operation. It is only necessary to remove it when it becomes necessary to remove collar 25 in order to replace plates 18.

To remove the wrench 32 from the nozzle, it is merely necessary to pull it forwardly relative to the nozzle until the projections 36 emerge from the groove 37. Then, it may be easily slipped from the nozzle. If it is desired to completely remove the collar member 25 from the housing, the wrench 32 may be rotated, while projections 36 are in groove 37, until the ends of pins 39 contact with the closed ends of openings 28. Then, it will be necessary to cause the projections 36 to slip out of the groove 37 and the wrench 32 may then be rotated and moved forwardly along the sleeve 5 until the collar 25 is completely removed therefrom.

We may also provide automatic means for adjusting the nozzle member to compensate for wear. For example, automatic means may be provided for turning the wrench 32 from time to time to compensate for wear. The turning means for turning the wrench member could be caused to operate upon variations in air velocity, caused by wear of the nozzle.

It will be apparent from the description above that we have provided a nozzle member which is particularly adaptable to sand-blasting and which has many desirable features. The nozzle may be adjusted from time to time to compensate for wear and this adjustment may be made in such a manner that the unequal amount of wear occurring from the rear end to the forward end of the nozzle may be taken care of. The nozzle may be adjusted from time to time and, even without interrupting the sand-blasting operation to maintain the orifice of approximately its original size throughout its length. Consequently, the efficiency of the nozzle member may be maintained at all times. Furthermore, the adjustable plate members which form the orifice need not be made of highly-resistant materials which are expensive, since these plate members may be adjusted from time to time in a very easy manner. Many other advantages will be readily apparent.

Having thus described our invention, what we claim is:

1. A nozzle member having an orifice therein with the walls thereof composed of rigid material and adjustable means for compensating for wear on the walls of said orifice.

2. A nozzle member for use in sand-blasting having an orifice formed therein with the walls thereof composed of rigid material, and adjustable means for compensating for wear on the walls of said orifice, said adjustable means being of such a nature as to take care of unequal wear throughout the length of said orifice.

3. A nozzle member for sand-blasting having an orifice therein of a predetermined cross-section with the walls thereof composed of rigid material and means for maintaining said orifice of substantially its original cross-section.

4. A nozzle member for sand-blasting having an orifice therein of a predetermined cross-section throughout its length with the walls thereof composed of rigid material and adjustable means for maintaining said orifice of substantially its original cross-section throughout its length.

5. A nozzle member for sand-blasting having an orifice therein of a predetermined cross-section with the walls thereof composed of rigid material, and means for adjusting the walls of said orifice to compensate for wear.

6. A nozzle member for sand-blasting, said nozzle member including a plurality of members of such a shape and so disposed relative to each

other as to form an orifice, and means for adjusting said members relative to each other to compensate for wear.

7. A nozzle member for sand-blasting including a plurality of members of such a shape and so disposed relative to each other as to form an orifice of a selected cross-section, said members extending longitudinally of the orifice and having their edges in contact with each other, and means for moving said members inwardly to maintain the said edges in contact and to compensate for wear.

8. A nozzle member for sand-blasting including a plurality of longitudinally extending members of such a shape and so disposed relative to each other as to form an orifice of a selected cross-section, said members having their adjacent edges contacting with each other throughout their lengths, and means for maintaining said edges in contact with each other.

9. A nozzle member for sand-blasting including a plurality of longitudinally extending members of such a shape and so disposed relative to each other as to form an orifice of a selected cross-section, said members having their adjacent edges contacting with each other throughout their length, and means for moving said members inwardly and simultaneously tilting said members to maintain the said edges in contact with each other.

10. A nozzle member for sand-blasting comprising a member having a plurality of guide members thereon, a plurality of longitudinally extending plate members disposed between said guide members, the inner edges of said plate members being so shaped and so disposed relative to each other as to form an orifice of a selected cross-section, and adjustable means for moving said plate members inwardly to compensate for wear, said adjustable means being of such a type that one end of said plate members may be moved inwardly a greater distance than the other end of said plate members.

11. A nozzle member having an orifice therein, with the walls thereof composed of rigid material, adjustable means for compensating for wear on the walls of said orifice, and means for operating said adjusting means without interrupting flow through said orifice.

12. A nozzle member for sand-blasting having an orifice therein with the walls thereof composed of rigid material, adjustable means for compensating for wear of the walls of said orifice caused by flow of the sand stream through said orifice, and means for operating said adjusting means without interrupting the sand-blasting operation.

13. A nozzle member for sand-blasting having an orifice therein with the walls thereof composed of rigid material, adjustable means for compensating for wear of the walls of said orifice caused by flow of the sand stream through said orifice, and means on the outside of said nozzle member and adapted to be operated to cause operation of said adjusting means without interrupting the sand-blasting operation.

14. A nozzle member for sand-blasting, said nozzle member including a plurality of members of such shape and so disposed relative to each other as to form an orifice, means for adjusting said members relative to each other to compensate for wear, and means for operating said adjusting means without interrupting the sand-blasting operation.

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