June 10, 1969 M. A. P. CARDON 3,448,544

GRIT BLASTING APPARATUS

Filed Sept. 2, 1966 Sheet 1 of 8

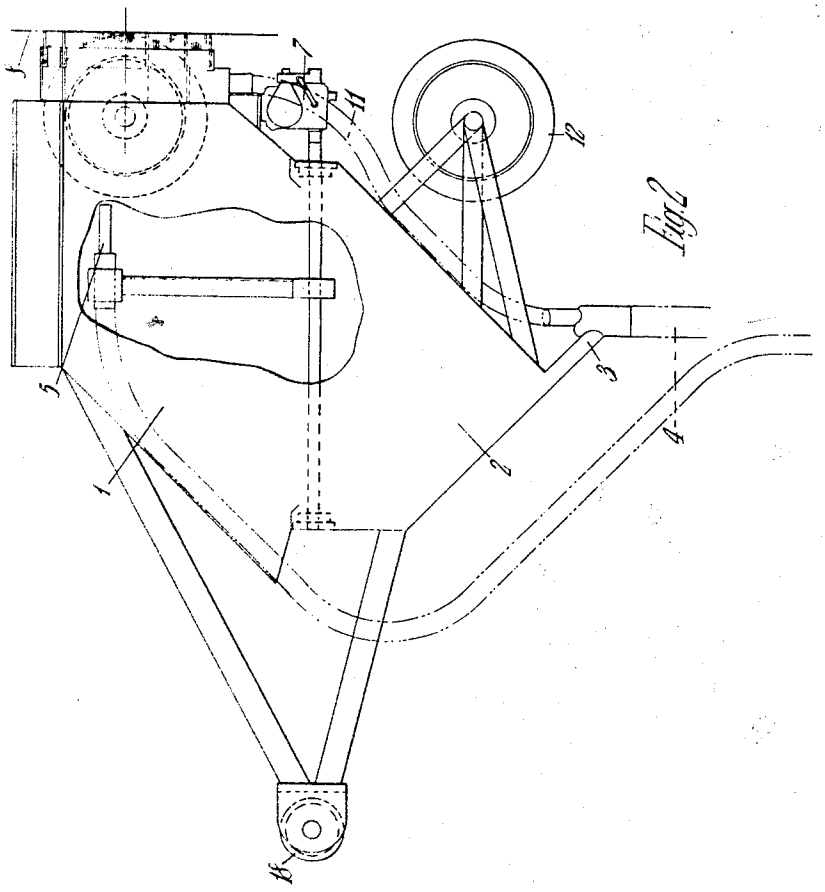


Fig. 2

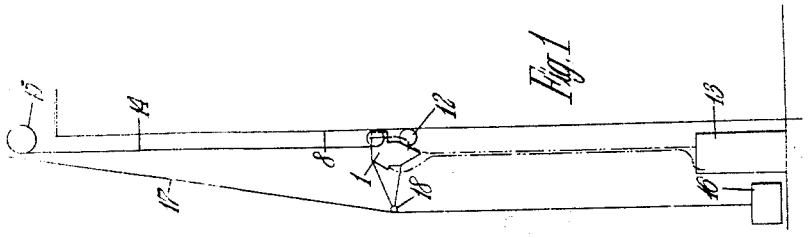


Fig. 1

June 10, 1969 M. A. P. CARDON 3,448,544

GRIT BLASTING APPARATUS

Filed Sept. 2, 1966 Sheet 2 of 8

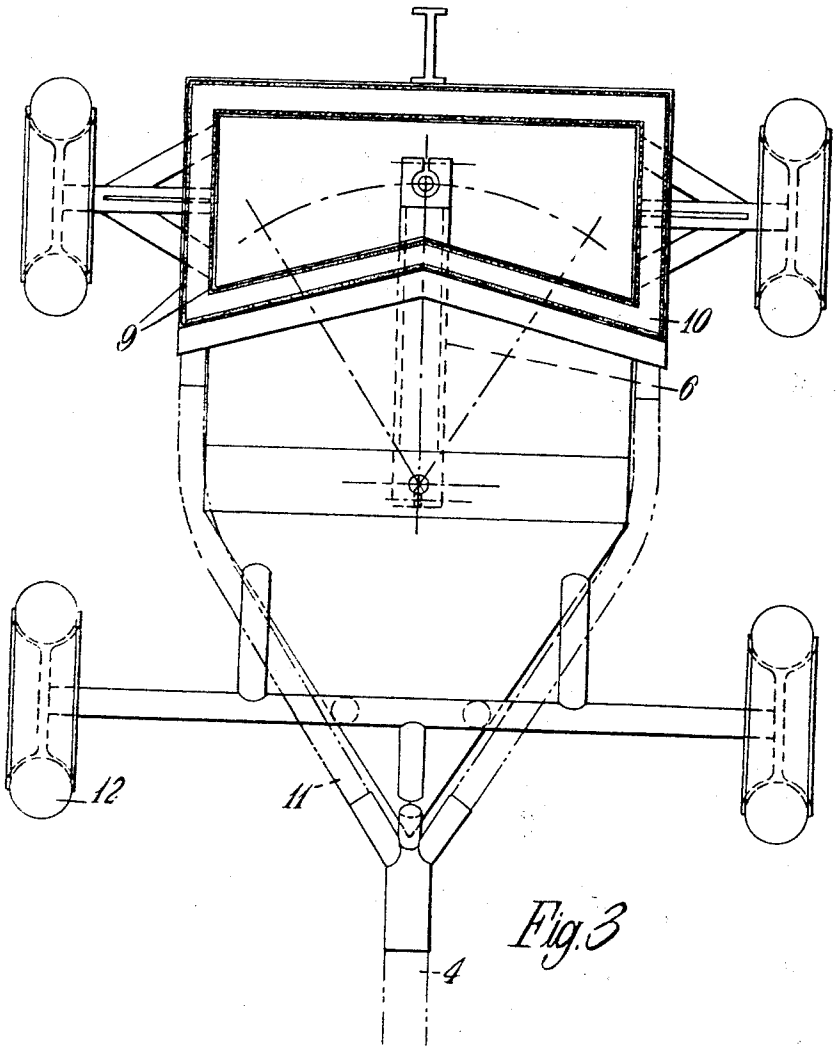


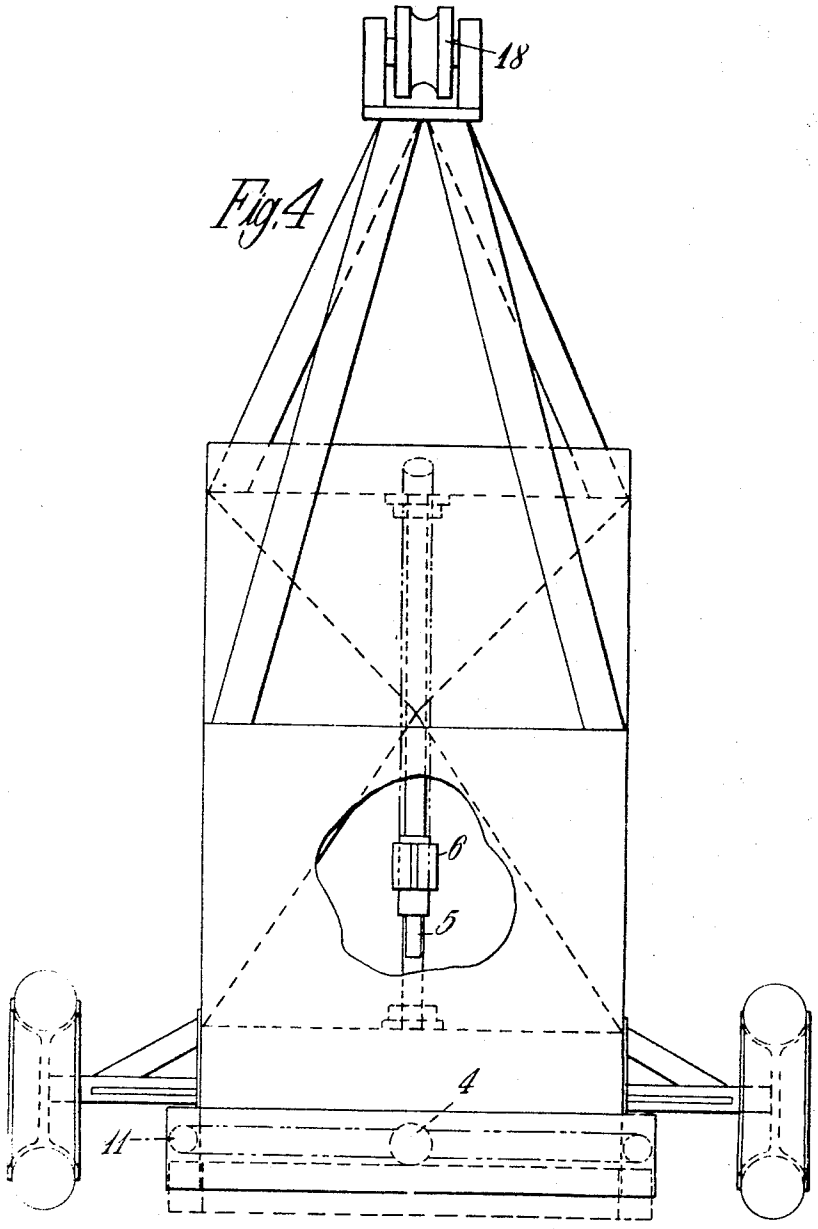
Fig. 3

June 10, 1969 M. A. P. CARDON 3,448,544

GRIT BLASTING APPARATUS

Filed Sept. 2, 1966 Sheet 3 of 8

Fig. 4



June 10, 1969 M. A. P. CARDON 3,448,544

GRIT BLASTING APPARATUS

Filed Sept. 2, 1966 Sheet 4 of 8

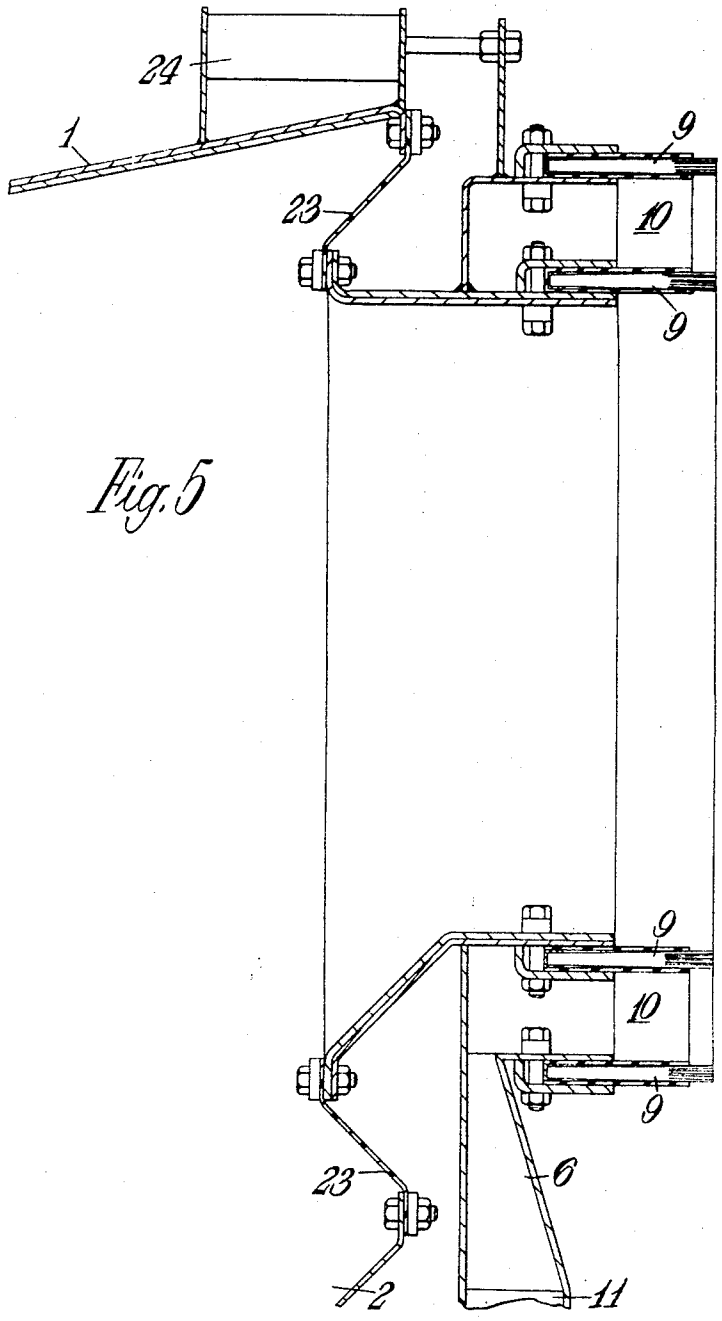


Fig. 5

June 10, 1969 M. A. P. CARDON 3,448,544

GRIT BLASTING APPARATUS

Filed Sept. 2, 1966 Sheet 5 of 8

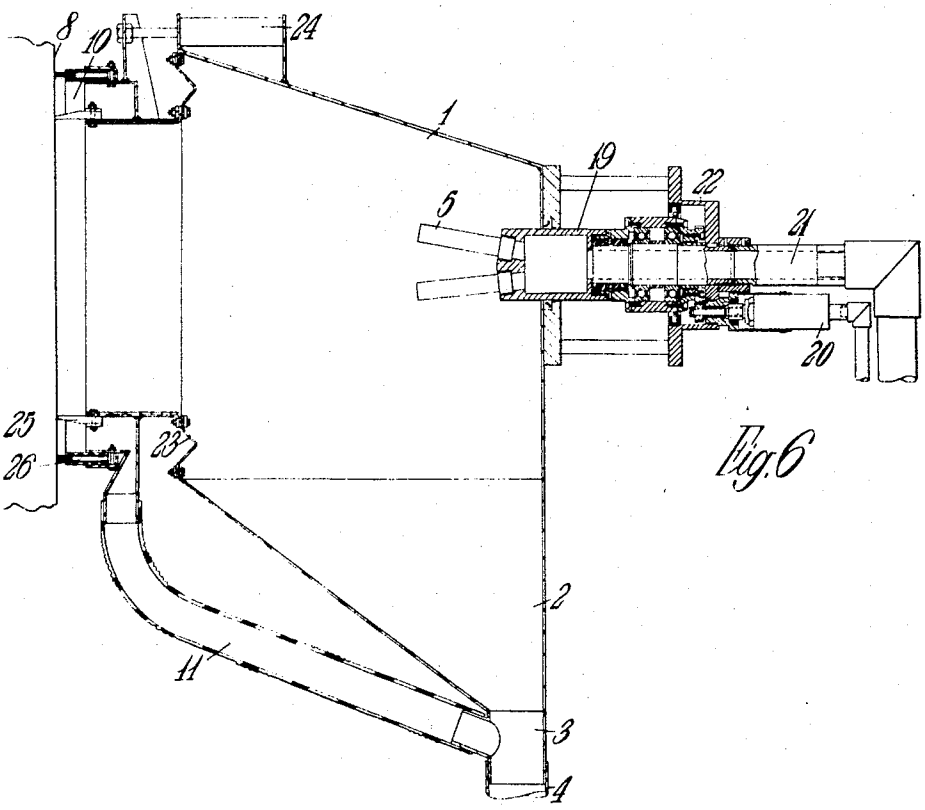


Fig. 6

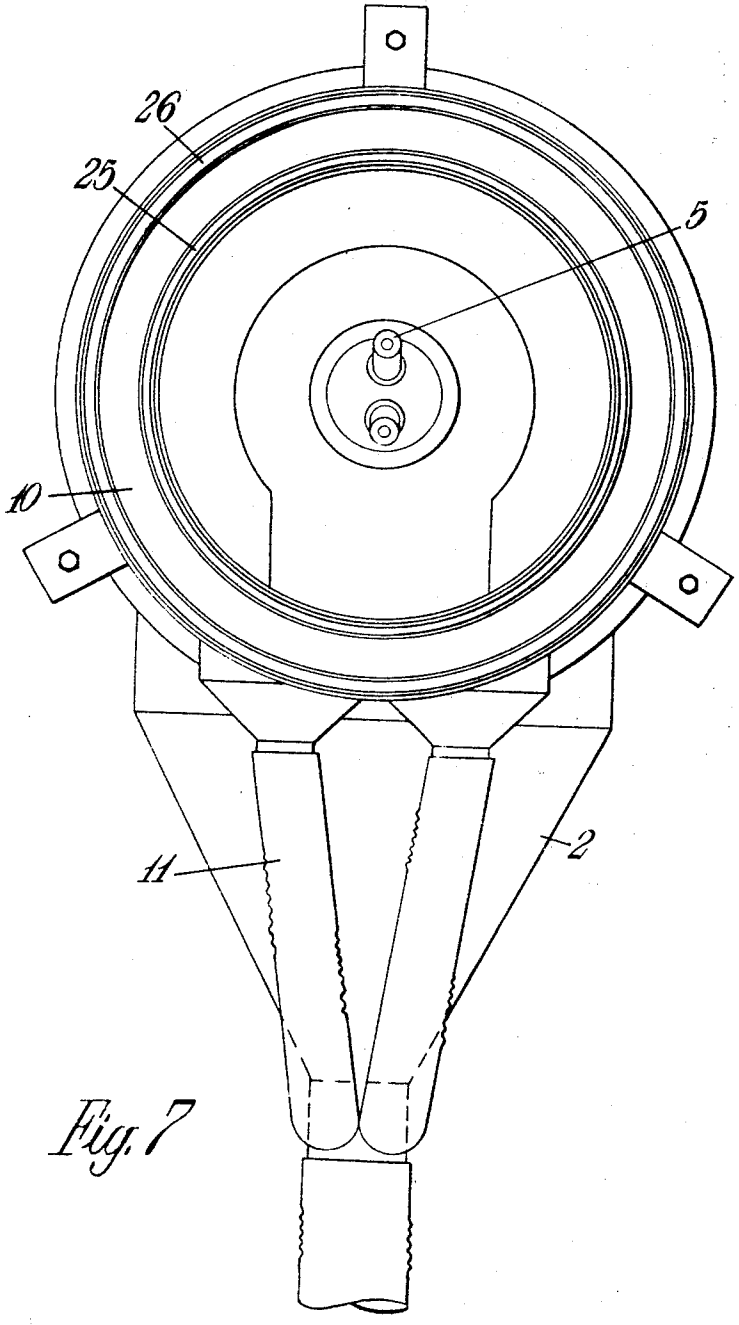


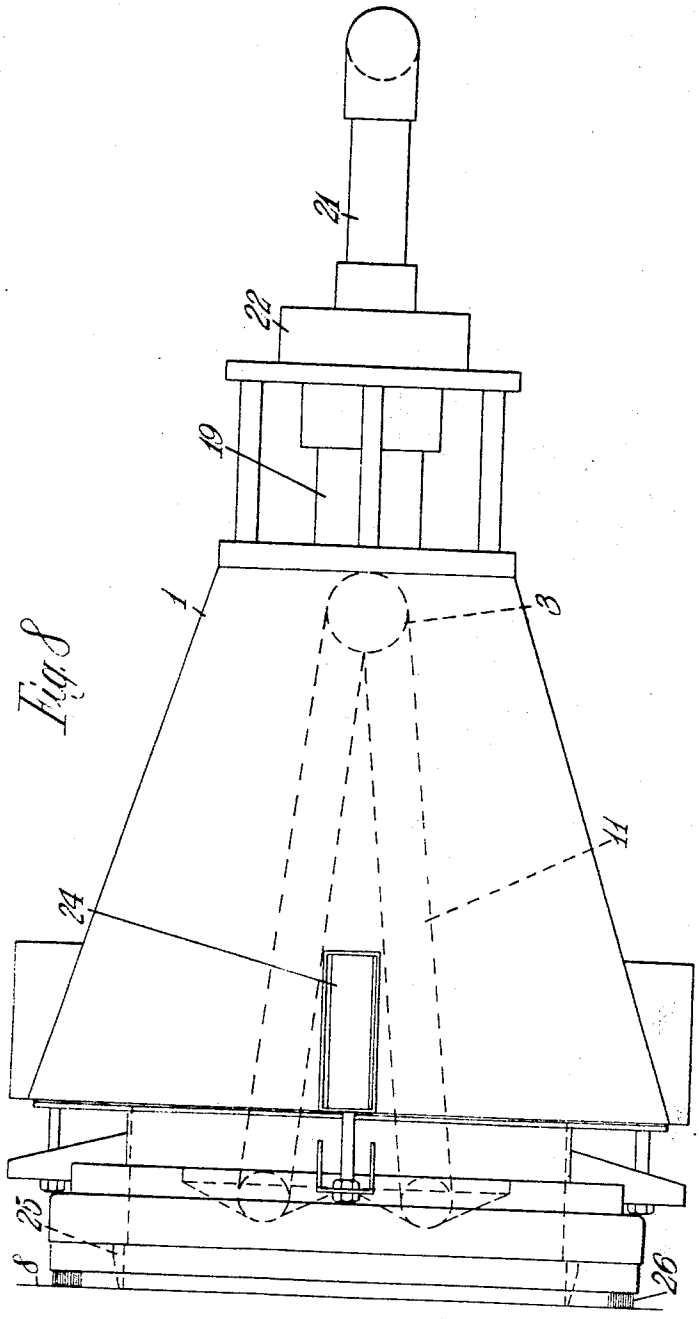
Fig. 7

June 10, 1969 M. A. P. CARDON 3,448,544

GRIT BLASTING APPARATUS

Filed Sept. 2, 1966 Sheet 7 of 8

Fig 8



GRIT BLASTING APPARATUS

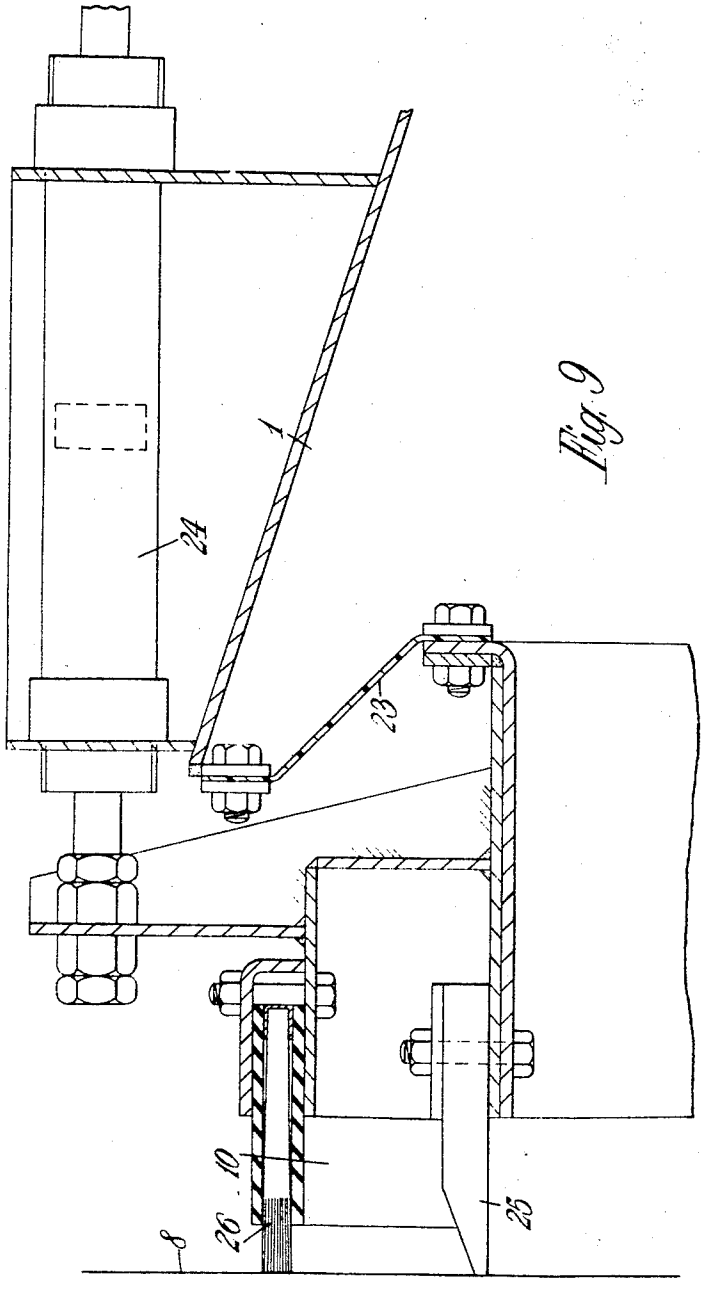


Fig. 9

United States Patent Office 3,448,544
Patented June 10, 1969

3,448,544

GRIT BLASTING APPARATUS

Michael Alexandre Pierre Cardon, Montrouge, France, assignor to Vacu-Blast Company, Inc., Belmont, Calif., a corporation of California

Filed Sept. 2, 1966, Ser. No. 577,001
Int. Cl. B24c 3/00
U.S. Cl. 51—8 11 Claims

ABSTRACT OF THE DISCLOSURE

A grit blasting apparatus comprising an enclosure with an open side adapted to contact around it the workpiece to be treated, and means within the enclosure for projecting a stream of abrasive through the said open side onto the workpiece. A sealing means is provided around the boundary of the open side comprising two or more flexible seals with space between them to which a subatmospheric recovery pressure is applied to remove abrasive material and debris particles that pass through the inner seal.

The invention relates to grit blasting apparatus of the kind in which granular material is projected at high velocity against a surface to be treated, such as, for removing rust, dirt, paint, or other deposits from, for example, the sides of ships, and in particular to an apparatus of the kind provided with means for recovering the abrasive material together with the deposits removed from said surface.

Previously apparatus for this purpose has consisted of a box-like hood or enclosure with one side open, which encloses the impinging stream of abrasive material, and contacts the surface under treatment around the edges of the open side. In one known form of construction a single rubber or similar flexible impervious seal is provided around the edge of the open side and reliance is placed upon the vacuum provided inside the enclosure, by the recovery air flow, to cause the enclosure to adhere to the surface being treated. This form of construction cannot be moved over the work surface while blasting is taking place due to the adhesion against the workpiece. It has to be repositioned after each area bounded by the open side of the enclosure has been cleaned, thus resulting in lost time of operation.

In another known form of blasting enclosure, for example, as shown in United States Patent No. 2,455,514 the seal around the blast enclosure takes the form of a flexible air pervious partition which, while preventing the escape of abrasive and debris from the enclosure by permitting the entry of high velocity air flow sufficient to prevent egress from the enclosure, completely prevents spillage. While this method permits the blast enclosure to be moved over the work surface while the blasting operation is being carried out, the size of such an enclosure is limited by the volume of air which must pass through the air pervious seal to give the air velocity necessary. For practical considerations the volume of the recovery air flow is maintained as small as possible which, in turn, necessitates a small area of the seal around the enclosure and this restricts the enclosure size. Furthermore, as the seal is close to the stream of abrasive it is a disadvantage that the wear of the enclosure from the abrasive action is considerable. A further disadvantage is that, in order to utilize to the full the nozzle

output, the complete enclosure must be moved at very high speed over the work surface.

The object of the present invention is to overcome the disadvantages above referred to and to construct an enclosure of a size within which a nozzle or nozzles can be moved to reduce the amount of movement required of the apparatus as a whole, and to arrange seals around the edge of the enclosure in such manner that, while utilizing only a small recovery air flow to convey the abrasive and debris from the enclosure, spillage of abrasive is prevented.

The invention consists in grit blasting apparatus comprising an enclosure with an open side adapted to contact around it the workpiece to be treated, and means within the enclosure for projecting a stream of abrasive through the said open side onto the workpiece, characterized in that there is provided sealing means around the boundary of the open side comprising two or more flexible seals with space between them to which a subatmospheric recovery pressure is applied, at least the outermost seal of which is pervious.

The invention is primarily designed for use in a closed circuit abrasive blasting machine although it may be used with an ordinary blasting machine and a separate dust-collecting system in order to prevent the escape of abrasive and debris from the enclosure. Typical uses for the equipment are, for the cleaning of ships, hulls either in a drydock or afloat, and the cleaning of sides of storage tanks and the like.

The accompanying drawings show, by way of example only, two embodiments of the invention in which,

FIGURE 1 is a diagrammatic section through the side of a ship showing the equipment in position,

FIGURE 2 is a side view of one embodiment of the invention in part elevation, part section,

FIGURE 3 is a front elevation of the embodiment of FIGURE 2,

FIGURE 4 is a plan view of the embodiment of FIGURE 2,

FIGURE 5 is a section through the open side of the embodiment of FIGURE 3 showing a modified form of construction,

FIGURE 6 is a section through a second form of embodiment of the invention,

FIGURE 7 is a front elevation of the embodiment of FIGURE 6,

FIGURE 8 is a plan view of the embodiment of FIGURE 6, while

FIGURE 9 is a part section through the sealing means of the embodiment of FIGURE 6.

The equipment consists of an enclosure **1**, with one side open, beneath which is fitted a hopper **2**, the outlet **3** of which is connected by means of a hose **4**, to a source of vacuum, normally through an abrasive reclaimer unit. Inside the enclosure a blast nozzle **5**, is connected to a source of compressed air and abrasive from the blasting machine **13**, and is mounted on a drive shaft **6**, powered by a pneumatic cylinder **7**, or similar means, which causes the nozzle to reciprocate and thus direct abrasive through the open side of the enclosure on to the workpiece being cleaned **8**. Alternatively, two or more nozzles may be mounted on a rotating holder as described hereinafter in relation to the embodiments of FIGURES 6–9.

Around the edge of the open side is fitted a double row seal **9**, consisting for example of a flexible air pervious

material such as crimped nylon brush, and which makes contact against the work surface to prevent the abrasive or debris escaping.

It has been found previously that by using a single brush seal with an enclosure of large size, and with a recovery air flow sufficient merely to convey the abrasive and debris from the enclosure, the air velocity passing through the single brush seal is not sufficient to prevent the escape of abrasive and debris. By using two rows of brushes in accordance with the invention, although most of the abrasive blasted inside the enclosure ricochets directly back into the enclosure and is collected from the takeoff hopper, some abrasive passes through the inner seal into the annulus **10**, between the two brush seals. From this annulus, therefore, a separate hose or series of hoses **11** is taken to the same source of vacuum as the hose from the enclosure hopper, and arranged so that a separate controlled air flow is drawn from the annular space between the two brushes.

It has been found with such an arrangement that only a relatively small air flow through this secondary hose **11**, is needed to scavenge the annulus between the two brushes of any abrasive which may have passed the inner seal. The distribution of the air flow from the enclosure and the annulus can be controlled by means of valves or restricter orifices in the various hoses to achieve the desired effect.

While the enclosure is fitted with wheels **12**, in order to guide it over the work surface, the twin brush seal assembly can be mounted resiliently in the open side of the enclosure and be spring loaded in order to form an effective seal against variations in contour of the work surface. Such an arrangement is shown in the modified form of construction of FIGURE 5 where a rubber bellows **23** forms the flexible seal between the enclosure and the double row seal. Three or more spring loaded cylinders **24** then maintain the seal under pressure against the workpiece. In a similar manner to that shown in FIGURES 1–4 the inner and outer seals may take the form of brushes **9** with space **10** between, the debris and abrasive being recovered by way of the long slots **6** in the bottom of the opening leading to the pipes **11**.

Although the whole of the seal periphery may be air pervious in the form of a brush as previously described, some advantage results from the use of a solid but flexible seal such as rubber for selected parts of the seal periphery. For example, if the sides and top of the inner seal and the sides of the outer seal, are made of rubber, this at once reduces the area of the remaining brush seal and increases the velocity of air passing therethrough. Any abrasive which may pass the inner seal is scavenged by the air entering either the top or bottom of the outer seal.

In the construction shown in FIGURES 6–9 the use is made of a flexible but solid rubber inner seal **25**, in conjunction with an air pervious outer brush seal **26**. Such an arrangement retains almost all the abrasive within the inner seal. At the same time almost all the recovery flow is drawn through the outer seal **26** by way of the annulus **10**. The result of such an arrangement is reduced wear of the inner seal and improved scavenging of abrasive from the seal annulus.

FIGURE 9 shows the displacement inwards of the seal and support against the action of the cylinder **24**.

In the second embodiment two nozzles **5** are rotated on a holder **19**, powered by an air motor or similar means **20**. The connection from the stationary abrasive supply tube **21** to the nozzle holder is made through a gear box seal assembly **22**. Because in this construction the nozzles are rotated, it is most convenient to make the seal around the open side of the enclosure of a circular form as may be seen from the front elevation of FIGURE 7. The distance from the nozzle to the workpiece can be varied as can its angle of blast on the workpiece and the speed of rotation as desired.

In one method of operation the enclosure is moved over the work surface, for example a ship's side, by being suspended from a cable or beam or by being supported at the end of a mobile hydraulic arm or similar piece of equipment.

In the arrangement shown in FIGURE 1, the enclosure is suspended by means of a cable **14**, and is moved in a vertical direction by means of a winch **15**, while the nozzle of the first embodiment reciprocates horizontally within the enclosure, or the second embodiment rotates. In order to maintain the enclosure, and thus the brush seal squarely against the shipside, one method is to attach weight **16**, to a second fixed cable **17**, passing over a pulley **18**, mounted on the rear of the enclosure. Many alternative methods may be adopted, however, to achieve this effect, such as by mounting the enclosure on rails positioned vertically or horizontally along the workpiece, and attached at intervals to the workpiece by means of vacuum pads or permanent or electromagnets.

This same principle can, of course, be adopted for cleaning plates from the under side, such as on ships in dry dock. In such cases the takeoff hopper from the enclosure is normally mounted on the side opposite to the open side, the whole equipment being supported from the deck bottom and held against the work surface by means of hydraulic or pneumatic cylinders or springs. The same principle of double sealing around the edge of the enclosure is adopted in order to scavenge any abrasive which may pass the inner seal and thus prevent it escaping from the outer seal.

It is to be understood that the above description is by way of example only, and that details for carrying the invention into effect may be varied without departing from the scope of the invention.

What I claim is:

1. Abrasive blasting apparatus comprising in combination an enclosure with an open side adapted to contact around it a workpiece to be treated, and means within the enclosure for projecting a stream of abrasive through the said open side onto the workpiece, sealing means around the boundary of the open side comprising: two or more flexible seals forming a space between them, and means for applying a subatmospheric recovery pressure to said space for removing any material which penetrates outwardly through the innermost seal.

2. Abrasive blasting apparatus as claimed in claim **1** in which there are two seals both of which are pervious.

3. Abrasive blasting apparatus as claimed in claim **1** in which there are two seals, one pervious and one impervious.

4. Abrasive blasting apparatus as claimed in claim **1** in which the pervious seal is in the form of a brush.

5. Abasive blasting apparatus as claimed in claim **4** in which the pervious seal is a crimped nylon brush.

6. Abrasive blasting apparatus as claimed in claim **1** in which the open side of the enclosure is circular and the sealing means is circular and the space between is an annular groove.

7. Abrasive blasting apparatus as claimed in claim **1** in which the sealing means is resiliently mounted upon the enclosure.

8. Abrasive blasting apparatus as claimed in claim **1** provided with connectors for connection to an abrasive recovery system from the bottom of the enclosure and the said space between the seals separately controlled to adjust the respective air flows.

9. Abrasive blasting apparatus as claimed in claim **1** in which the means for projecting a stream of abrasive through the said open side of the enclosure is a compressed air operated blast nozzle means which is caused to reciprocate.

10. Abrasive blasting apparatus as claimed in claim **1** in which the means for projecting a stream of abrasive through the said open side of the enclosure is a compressed

air operated blast nozzle means which is caused to rotate about an axis nonaxial with the axis of the nozzle.

11. Abrasive blasting apparatus as claimed in claim **1** provided with attachment means for a suspension cable for suspending it at the face of the workpiece are being held against it.

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LESTER M. SWINGLE, *Primary Examiner.*