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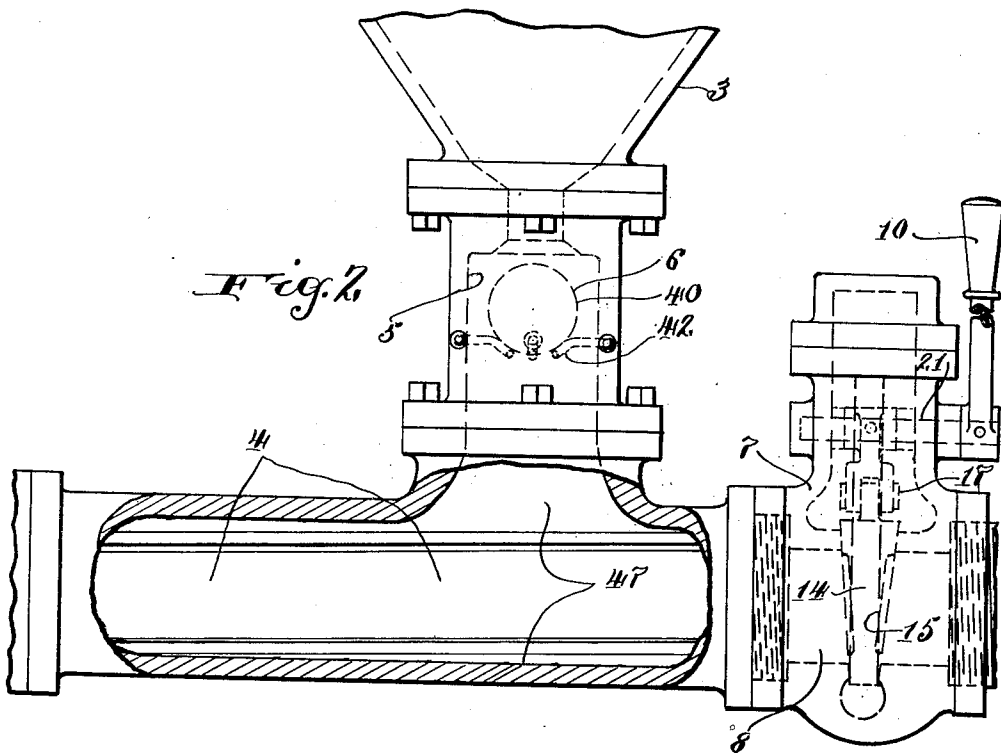
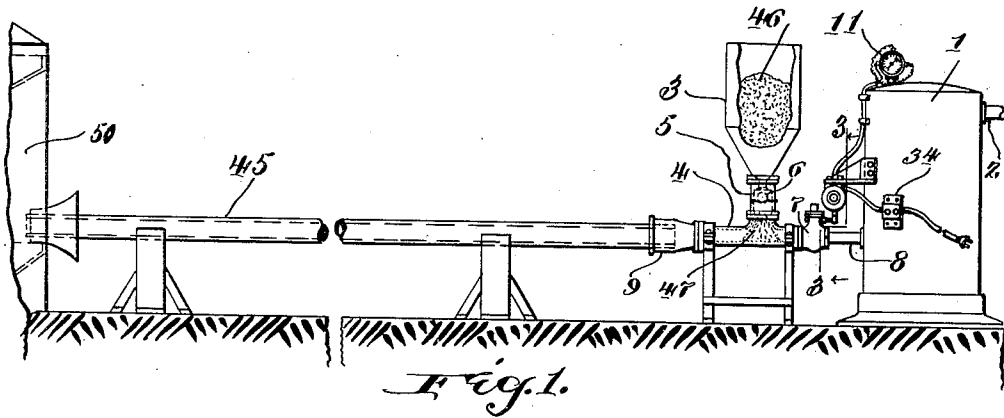
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1,890,164

SAND BLASTING METHOD AND APPARATUS

Filed April 21, 1931

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

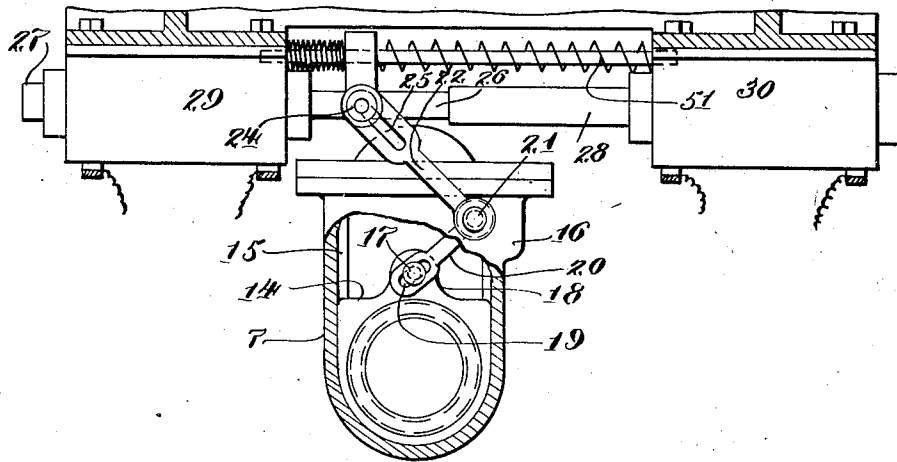


Fig. 3.

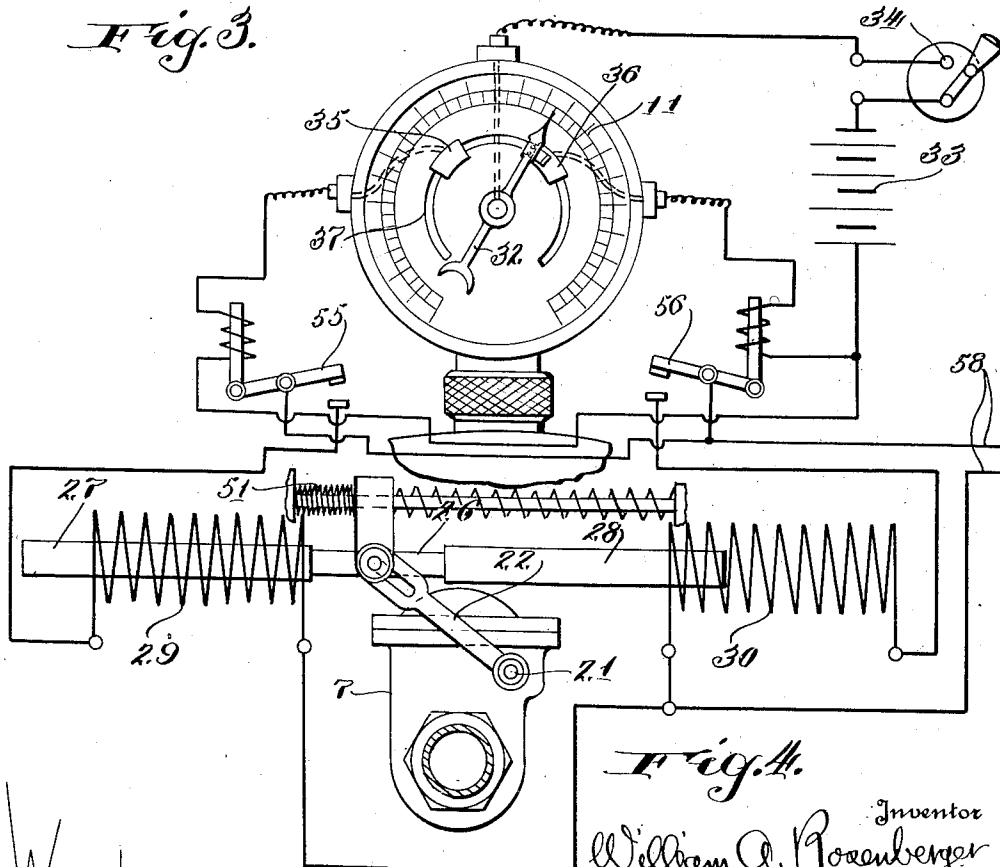


Fig. 4.

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SAND BLASTING METHOD AND APPARATUS

Application filed April 21, 1931. Serial No. 531,659.

The invention relates to the sand blasting or cleaning of the inner surfaces of hollow shapes, the method and apparatus being particularly adapted to the cleaning of the inner surfaces of metal tubes or tubular shapes.

The fact is generally accepted and recognized by those skilled in the sand blasting art that, while small tubes of a diameter closely approaching that of the sand blasting nozzle can be cleaned without great difficulty by attaching one end of the tube to the nozzle and passing a continuous stream of air and abrasive through the tube, the amount of compressed air used under these circumstances being governed by the size of the nozzle, the air pressure and the diameter and length of the tube; the sand blasting of relatively large tubes in this way or at least on an economical basis has not been found possible. The difficulty in cleaning the inside of these larger tubes by sand blasting seems to be due to the loss of velocity of the air and abrasive within the tube so that the velocity through the tube of such diameters is insufficient for cleaning the inner surface. The experiments which have been made in this connection relate to tubes of a diameter thirty to fifty percent larger than that of the nozzle, and to larger diameters in connection with which the invention has been developed. While these are the sizes that will be principally discussed in connection with the description and claims, it will be understood that the invention is capable of much more general application.

When the blast is discharged from the nozzle through a relatively large tube, the velocity is the rate of flow divided by the cross section. The loss of velocity of air and abrasive when a tube of considerably larger diameter than the nozzle is affixed to the nozzle for the purpose of cleaning the inside of the tube is such that the velocity of the abrasive is not sufficient for effective cleaning so that the cleaning operation can not be accomplished economically in this way. It is also of interest that the attempt to blast or clean such tubes under these circumstances leaves an unblasted length of two inches or more at the inlet end. A further difficulty results from the deposit of abrasive within the tube

due to the comparatively low velocity of the air and abrasive and the loss of energy of the abrasive caused by impacting of the particles against the walls of the tube. This deposit forms a protective layer which prevents or greatly retards the blasting or cleaning action.

By means of the present invention the previously existing difficulties in connection with the sand blasting of the inner surfaces of tubes have been overcome and means has been devised whereby a maximum velocity of the air and abrasive flow is obtained irrespective of the size of the tubes or pipes to be cleaned.

The loss of economy, being due to the necessity under the former practice for supplying sufficient compressed air to maintain a continuous blast through the relatively large tubes at a velocity sufficient for sand blasting purposes, the difficulty has been overcome by the inventive conception that the introduction of abrasive and the operation of the blast can be performed intermittently, and preferably alternately giving the desired results in the way of an efficient and complete cleaning of the interior surfaces with a relatively small consumption of compressed air and abrasive.

To this end in applicant's preferred apparatus an explosion or blast chamber is so arranged in connection with a supply of air under pressure and an abrasive tank with a quick operating air valve as a gate valve or the like in the air passage leading to the blast chamber, that the air blast can be released intermittently at the will of the operator or by automatic control at suitable intervals so that the air blast is projected at high velocity through the blast chamber or explosion chamber, and is then almost immediately discontinued before the air pressure back of the blast is dropped below a predetermined minimum. The term air is used for convenience as any other fluids may be utilized within the scope of the invention.

Between the blasts the abrasive is caused to accumulate in the blast chamber or explosion chamber, being preferably cut off in any suitable manner either automatically or otherwise to prevent back flow through the abrasive supply. The explosion chamber is

also preferably provided at the end opposite to the air valve with a suitable connection for engaging the various sizes of tubes to be treated, the same being referred to as an adapter.

In the performance of the method of the invention, the tube to be blasted is connected to the explosion chamber by means of the adapter or in any suitable manner on the opposite side thereof from the air valve. The tank, is at the same time duly supplied with abrasive. The air reservoir or receiver which is located adjacent the explosion chamber to afford a supply of air under pressure immediately available, without too great a pressure drop, for the purposes of blasting, is connected to the air main or any suitable supply of air under pressure, or a sufficient supply of air or other fluid capable of being utilized in this way is connected to the explosion chamber by way of the quick operating valve. The quick operating valve adjacent the explosion chamber is then opened for a moment and closed almost immediately or when the pressure gauge shows a certain predetermined drop. The valve is then caused or permitted to remain closed until the pressure in the air tank or receiver is built up to normal and the abrasive flow, which was cut off during the air blast, is supplied to the chamber. The air valve is then reopened and the process is continued passing a series of short quick jets or blasts of air and abrasive through the tube until the blasting or cleaning of the tube has been accomplished to the desired degree of perfection.

Every time the air valve is opened, there takes place a sudden rush of air through the explosion chamber carrying with it the accumulated abrasive which is expelled, at the end of the tube being cleaned, with great force. Experiments previously conducted by the inventor show that smooth steel tubing thus treated requires from five to ten shots or blasts for thorough uniform blasting as to the inner surface.

In the accompanying drawings I have illustrated a sand blasting apparatus of the explosion or intermittent type, the same being an embodiment of my invention insofar as it relates to the apparatus and being capable of operation in the performance of the method of the invention, the apparatus being controlled for this purpose either automatically or by hand.

In the drawings:

Figure 1 is an elevation of the apparatus in the operation of cleaning the inside of a tube in accordance with the method of the invention including an automatic device for operating the air valve.

Figure 2 is an elevation of the apparatus on an enlarged scale, a portion of the explosion chamber being broken away to show the

inside of the chamber. The apparatus in accordance with this view is adapted to hand operation.

Figure 3 is an elevation of the air valve and the solenoids for operating the same, taken on the line 3—3 in Figure 1 and looking to the left.

Figure 4 is a circuit diagram showing the air valve in external elevation, the view of the valve being taken from the line 3—3 in Figure 1.

Referring to the drawings by numerals, each of which is used to indicate the same or similar parts in the different figures, the apparatus, Figure 1, comprises an air receiver 1, connected at 2 to an air main or supply of air under pressure, a storage tank 3 for abrasive and explosion chamber 4 connected to the bottom of the storage tank by an upright passage 5 in which is mounted a check valve 6. On one side of the explosion chamber is the quick operating air valve 7 controlling an air passage 8 leading from the receiver 1 to the explosion chamber 4 and on the other side of the explosion chamber which is shown in the form of a tubular member, is the work connection or tube adapter 9. The abrasive passage 5 enters the explosion or blast chamber 4 laterally and preferably from the top side as shown. The apparatus also includes an air pressure gauge 11 shown as mounted on the air receiver 1, and suitably connected thereto to indicate the pressure therein. This air gauge may also be utilized as an element of the automatic operating means serving to make and break the electric circuit in the operation of the air valve in response to changes of pressure as hereinafter described.

A similar apparatus is shown fragmentarily in Figure 2 in front elevation which corresponds to Figure 1.

In the illustration, Figure 2, the air valve 7, which is shown in detail in dotted lines, is controlled and operated by a hand lever 10. In Figures 1, 3 and 4, on the other hand, I have illustrated more or less diagrammatically an automatic device for operating the air valve 7 periodically in response to the changes of pressure in the receiver and substantially in accordance with the requirements for producing the desired result most efficiently.

Referring more particularly to the details of the apparatus, the air valve 7 is shown as comprising a gate valve member 14 mounted to slide vertically and transversely to the air passage 8, in ways 15 formed for this purpose in the valve fitting 16. This gate valve member is shown as provided with a transverse stud or pin 17 seated in an upwardly projecting lug 18 on the upper side of the valve member near the center. This pin is engaged by slot 19 in the transverse arm 20 of a bell crank lever pivoted at 21 in the valve fitting or casing and having an upper arm 22 substantially at right angles to the arm 20.

This arm 22 is connected at its upper end by means of a pin 24 and slot 25 to a sliding shaft 26 carried by the cores 27 and 28 of two solenoids 29, 30, arranged in alignment transverse to the air passage 8 and substantially over the valve fitting or casing 16. 51 is a spring cushioning device to break the shock to the apparatus incident to the quick operation of the solenoids.

For the purposes of the automatic operation of the air valve 7, the pointer or hand 32 of the air pressure gauge 11 is shown as connected to one terminal of an electric battery 33 in any suitable manner as by way of a control switch 34. The gauge is also provided with electric contacts 35, 36 in the path of the hand or indicator 32 to be engaged thereby at certain predetermined maximum and minimum pressures. These terminals or contacts 35, 36 may, if desired, be supported for adjustment in a circular arcuate slot 37 whereby the maximum and minimum points of contact may be determined in accordance with the will of the operator, or they may be permanently located as desired.

These contact points or terminals 35, 36 are connected to magnetic switches 55, 56, respectively, each of which controls a corresponding solenoid 29, 30. These solenoids are in turn connected to an outside source of current at 58.

In this way either solenoid may be separately energized by closing either contact at the gauge. Contact 35 is closed at minimum pressure and 36 at maximum pressure. When contact 35 is engaged by the pointer 32, the switch 35 is closed and energizes the solenoid 29, closing the valve 7. When contact 36 is engaged by the pointer, the switch 56 is closed energizing the solenoid 30 and opening the valve 7.

The illustration, Figures 1 and 2, includes check valve 6 in the vertical passage 5 leading downwardly from the abrasive storage tank 3 to the explosion chamber 4. This check valve which under certain circumstances might not be regarded as necessary to the successful operation of the apparatus, is shown in the form of a ball valve opening downwardly and supported in its lower position by a stop 42.

Figure 2 shows the explosion chamber 4 which is preferably tubular or cylindrical as rifled, to give a swirling or rotary motion of the air causing the abrasive to be thrown radially outwards due to centrifugal force with the result that it comes into contact with the inner walls of the tube to be cleaned. This rifling may, however, be omitted and the details of the apparatus may be widely varied without departure from the principle of the invention. The rifling is believed to give better results.

In the operation, as already suggested in the preamble, a tube 45 is suitably held in

alignment with the explosion chamber 4, which is preferably horizontal, having the abrasive passage 5 entering the same transversely from above. The connection of the explosion chamber to the tube is most easily effected by means of the adapter 9 which has a tapering or bell shaped nozzle admitting the end of the tube therein. The abrasive tank or reservoir 3 is supplied with abrasive and air is admitted to the receiver 1. Under these circumstances the weight of the abrasive 46 opens the valve 40 and the abrasive flows downwardly into the explosion chamber 4 into the line of the air blast. The abrasive thus admitted accumulates at 47 in the explosion chamber and in the path of the air blast as outlined in Figure 1.

The receiver 1 being suitably supplied with air under pressure as already suggested, the air valve 7 may be opened intermittently at the will of the operator and closed immediately or when the pressure gauge shows a certain predetermined pressure drop. The valve 7 is then caused to remain closed until the pressure in the receiver 1 is again built up to line pressure by the admission of air from the line. The valve is then again opened and the operation repeated five to ten times or until the inside of the tube being treated is sufficiently cleaned or blasted.

When the valve 7 is thus suddenly opened, a rush of air through the explosion chamber takes place carrying with it the accumulated abrasive 47 which is thus expelled with great force at the end of the tube 45 being treated. Experiments with this method and apparatus show that smooth steel tubing requires about five to ten shots in this manner.

If the apparatus is to be operated automatically, the switch 34 is closed and the pressure being registered by the swinging of the indicator 32 to the right or clockwise in Figure 3, the attainment of any predetermined or line pressure will bring this hand or indicating pointer 32 in contact with the terminal or contact member 36. Under these circumstances the solenoid 30 will be energized, drawing the core 28 to the right in Figures 3 and 4, raising the gate valve member 14 and opening the valve 7 to permit a rush of air from the receiver 1 through the explosion chamber 4 as already described, carrying the abrasive with high velocity from the chamber and through the tube 45, eliminating any possibility of accumulation of abrasive therein. The abrasive may be caught in a suitable abrasive receiving and separating chamber, indicated at 50.

When the pressure in the receiver 1 has dropped to a predetermined point, the hand or indicating pointer at 32 swings to the left in Figure 4 and comes in contact with the terminal 35, energizing the left hand solenoid 29 and closing the valve 7 whereupon this valve remains in closed position until the

pressure in the receiver 1 is built up to the predetermined line pressure when the valve is again opened by the operation of solenoid 30 and core 26, repeating the explosion and projection of the abrasive through the tube. This operation is repeated as already outlined in the description of the process for five to ten shots or more until the blasting of the inside of the tube or other hollow work has been completed to the desired extent.

While I have referred to compressed air as the most convenient medium for propelling the abrasive, it will be understood that other fluids, as steam and even water, under pressure, may be used. Compressible fluids, as gases or liquids propelled by air or similar resilient pressure, are most conveniently available for this purpose. The term air, as used in the specification and claims, is intended to include any fluid element adapted to propel abrasive.

I have thus described specifically and in detail the method of sand blasting tubes and other hollow shapes according to the invention and an apparatus by means of which this method may be performed, which apparatus is also a feature of the invention, the description being specific and in detail in order that the invention and the manner of operation, applying and using the same may be fully understood, however the specific terms herein are used descriptively rather than in a limiting sense, the scope of the invention being defined in the claims.

What I claim as new and desire to secure by Letters Patent is:

1. An apparatus for blasting the inside of long tubular objects with abrasive comprising an air receiver of suitable proportions, a quick acting control valve, an explosion chamber connected to the receiver through the control valve, means for supplying compressed air to the receiver, means for introducing abrasive into the explosion chamber permitting it to accumulate therein when the air is shut off, means for preventing backflow through the abrasive supply and means for connecting a tubular object to the explosion chamber.

2. The method of sand blasting particularly adapted to the treatment of the inner surfaces of tubular objects and the like which consists of projecting abrasive through the tubular work against the said surfaces by means of intermittent blasts of air under pressure.

3. The method of sand blasting particularly adapted to the treatment of the inner surfaces of tubular objects and the like which consists of projecting abrasive into, to and through said tubular work and against the said surfaces by means of intermittent blasts of fluid under pressure, the abrasive being introduced into the path of the fluid between the blasts, whereby a relatively large flow of

abrasive and fluid at a high and substantially uniform speed is maintained for successive short periods.

4. A method of sand blasting particularly adapted to treatment of the inner surfaces of tubular and similar work which consists in releasing at predetermined intervals successive blasts of air under pressure and introducing into the air blast successive charges of abrasive through the said tubular work, projecting the abrasive and directing said intermittent blasts of air and abrasive against a surface to be treated and imparting a swirling motion to the air and to the abrasive whereby a centrifugal tendency is imparted to the abrasive, projecting it against said surface.

5. A sand blasting apparatus comprising an explosion chamber, means for introducing blasts of air into the chamber at intervals, means for introducing successive charges of abrasive into the path of the air between the blasts and means for directing the successive blasts of air and abrasive into contact with the work and means for imparting a swirling motion to the air.

6. In a sand blasting apparatus an explosion chamber, a receiver for air under pressure, means for connecting the receiver to a supply of air under pressure, means connecting the receiver to the explosion chamber, a quick acting valve between the mixer and the receiver, means for introducing abrasive into the path of the air in the explosion chamber, and means for operating the air valve at intervals to produce a succession of air blasts through the mixing chamber.

7. In a sand blasting apparatus an explosion chamber, a receiver for fluid under pressure, means for connecting the receiver to a supply of fluid under pressure, means connecting the receiver to the explosion chamber, a quick acting valve between the chamber and the receiver, means for accumulating successive charges of abrasive in the path of the fluid in the explosion chamber, and means for operating the fluid valve to produce a succession of air blasts through the explosion chamber, said means being controllable in accordance with the rise and fall of pressure in the receiver.

8. In a sand blasting apparatus an explosion chamber, a receiver for air under pressure, means for connecting the receiver to a supply of air under pressure, means connecting the receiver to the explosion chamber, a quick acting valve between the mixer and the receiver, means for introducing abrasive into the path of the air in the explosion chamber, a check valve for preventing backflow, and means for operating the air valve at intervals to produce a succession of air blasts through the mixing chamber, said means being controlled in accordance with the rise and fall of pressure in the receiver, to con-

5 trol the pressure in the receiver, causing it to be lowered to a predetermined minimum pressure after each opening of the valve before it is closed, and permitting the pressure to be raised after closing to the predetermined maximum prior to each operation of the valve in opening.

10 9. The combination in a sand blasting apparatus of an explosion chamber, means for introducing air under pressure at one end and means for directing the blast against the work at the other end, means for introducing successive charges of abrasive into the chamber, including an abrasive supply pas-
15 sage and a check valve controlling the same, an air valve controlling the introduction of air, a receiver for air and means for controlling the air valve to open it at a predetermined maximum pressure in the receiving
20 chamber and close it at a predetermined minimum pressure in the receiver, the opening and closing being accomplished continually to produce a succession of air blasts in and through the explosion chamber, alternat-
25 ing with the feeding of abrasive thereto.

Signed by me at Hagerstown, Maryland,
this 14th day of April, 1931.

WILLIAM A. ROSENBERGER.

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