Jan. 9, 1945. D. A. WIELAND 2,366,763

HYDRAULIC SAND FEEDER

Filed April 26, 1943 4 Sheets-Sheet 1

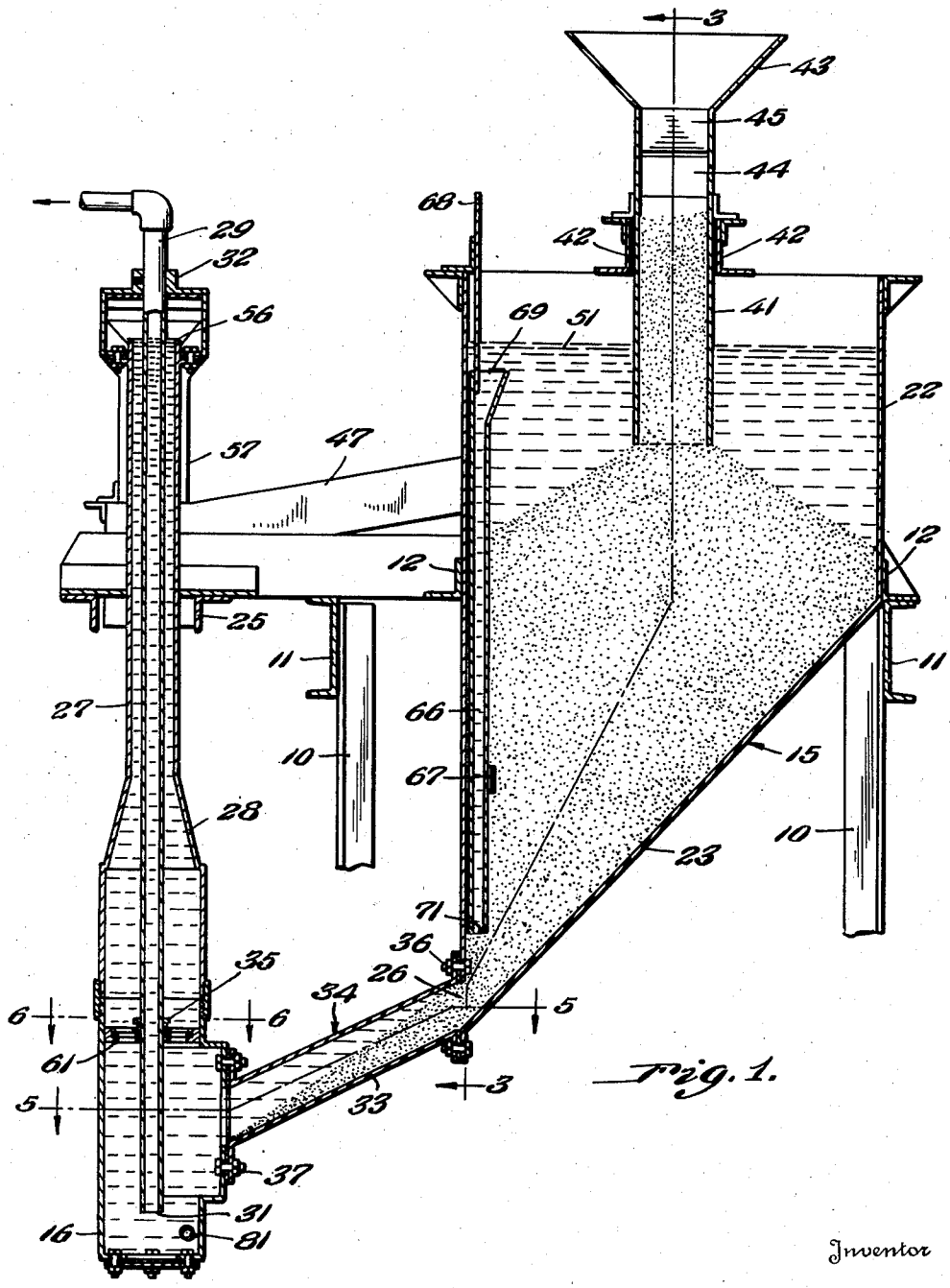


Fig. 1.

Inventor

Daniel A. Wieland

By William E. Hall

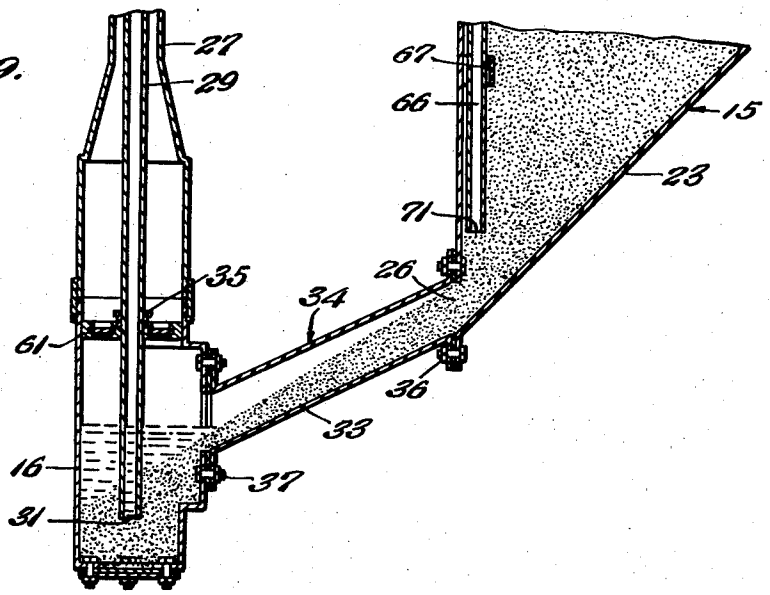
Attorney

Jan. 9, 1945. D. A. WIELAND 2,366,763

HYDRAULIC SAND FEEDER

Filed April 26, 1943 4 Sheets-Sheet 2

Fig. 9.



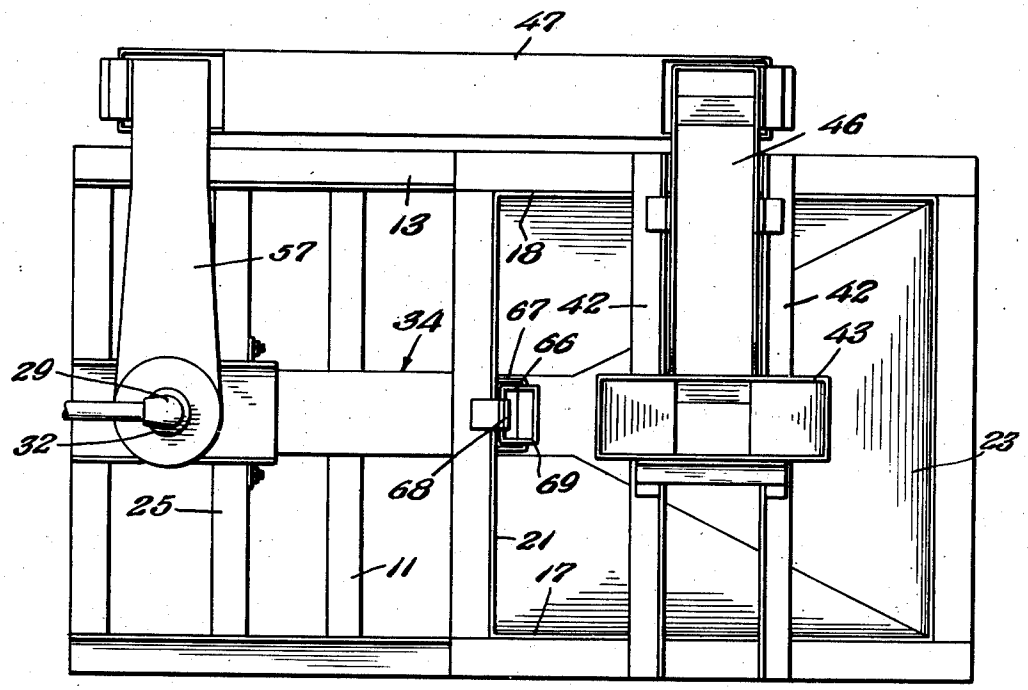


Fig. 2.

Inventor

Daniel A. Wieland

By William A. Hall

Attorney

Jan. 9, 1945. D. A. WIELAND 2,366,763

HYDRAULIC SAND FEEDER

Filed April 26, 1943 4 Sheets-Sheet 3

Fig. 3.

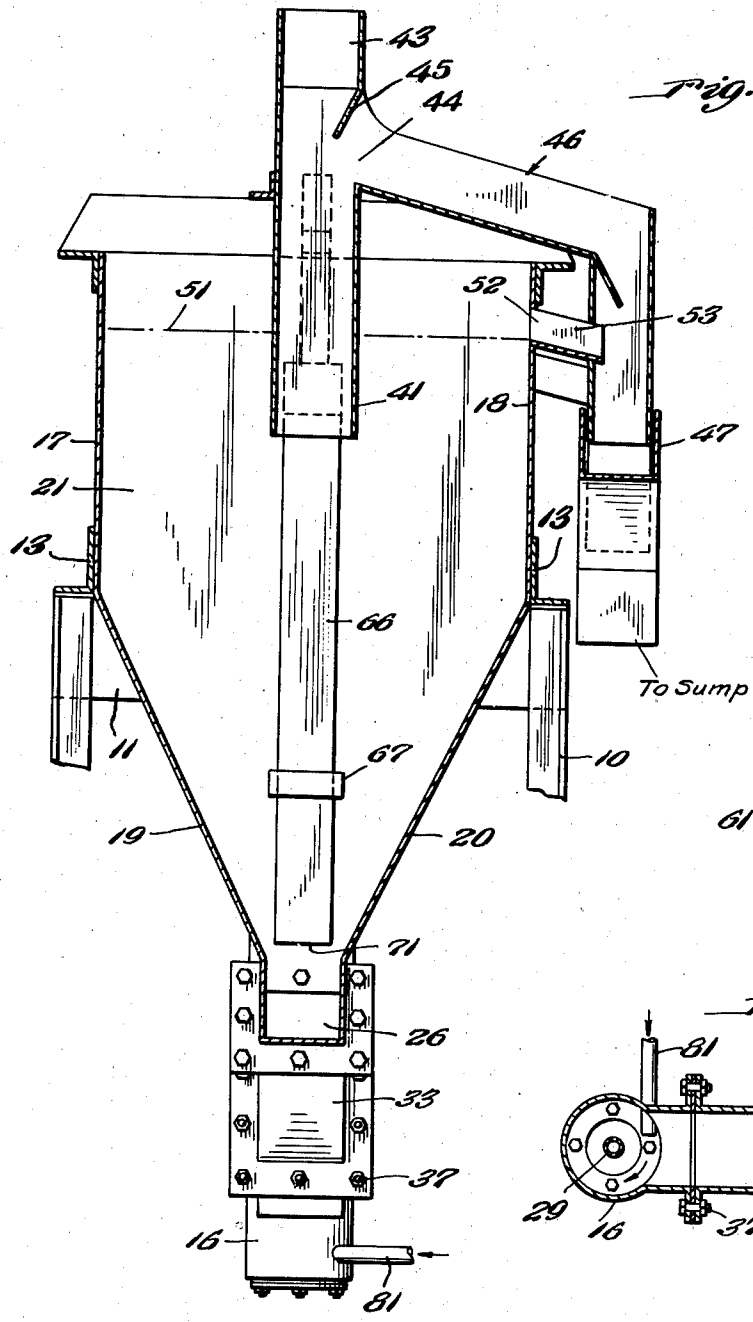


Fig. 6.

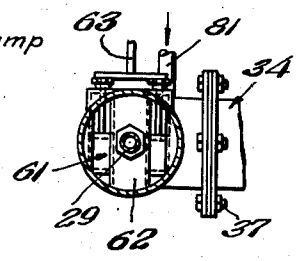


Fig. 5.

Inventor

Daniel A. Wieland

By William B. Hall

Attorney

Jan. 9, 1945. D. A. WIELAND 2,366,763

HYDRAULIC SAND FEEDER

Filed April 26, 1943 4 Sheets-Sheet 4

Fig. 4.

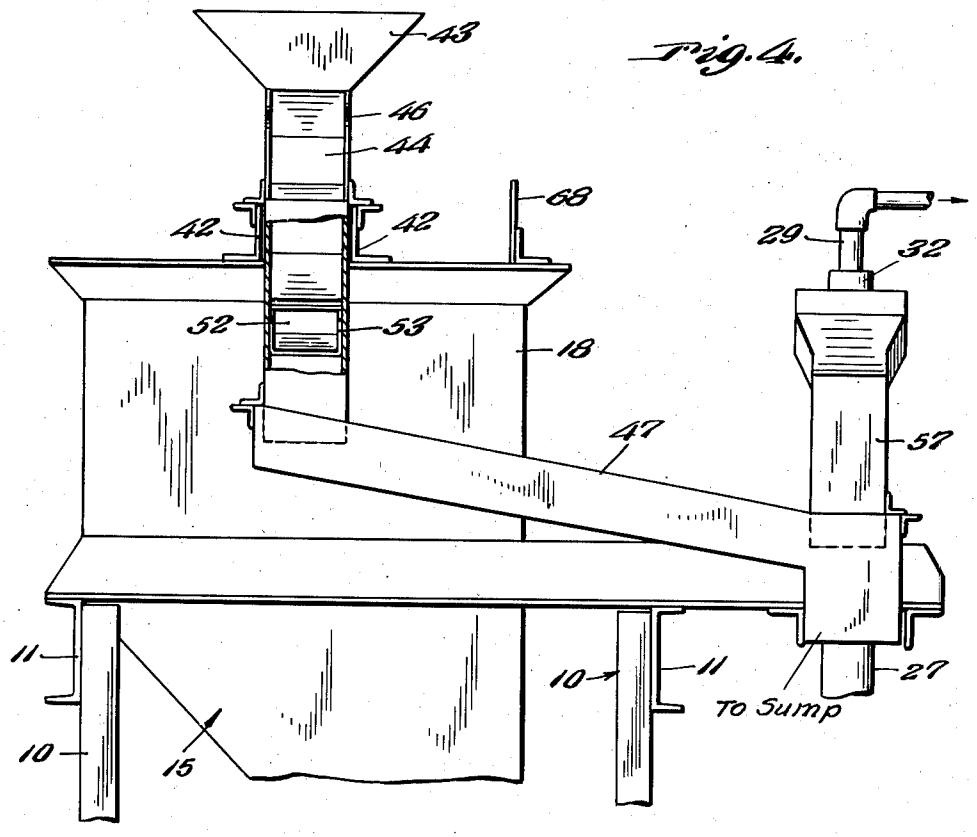


Fig. 7.

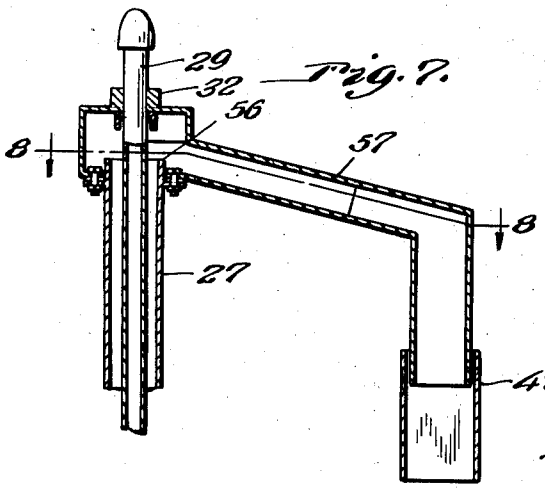
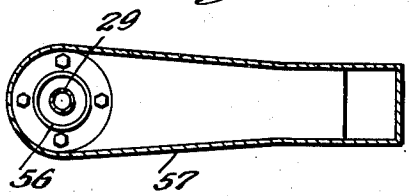


Fig. 8.



Inventor

Daniel A. Wieland

William S. Hall

By

Attorney

Patented Jan. 9, 1945 2,366,763

UNITED STATES PATENT OFFICE

2,366,763

HYDRAULIC SAND FEEDER

Daniel A. Wieland, Hagerstown, Md., assignor to Pangborn Corporation, Hagerstown, Md., a corporation of Maryland

Application April 26, 1943, Serial No. 484,647

10 Claims. (Cl. 51—12)

The present invention relates to apparatus for feeding a mixture of sand and water to a hydraulic blast gun wherein the sand particles are carried forward by means of a high velocity jet of liquid, such as water. The invention more specifically pertains to apparatus for supplying wet sand in such a fluid condition that the mixture or slurry may be introduced into the hydraulic blast gun.

A hydraulic blasting arrangement includes a gun having a nozzle therein through which a stream of liquid such as water is forced at high velocity. This water jet is employed to carry an abrasive medium into engagement with an article or the surface to be abraded. The abrasive is necessarily made wet by the water jet and the expended water and abrasive is collected in a pit or sump for reuse. In view of the fact that the abrasive is wet, and since molding sand is removed from some of the articles being cleaned, sand is usually employed as the abrasive medium. The wet sand recovered for reuse in the blasting operation presents a problem in the handling thereof in that this sand cannot be readily supplied to the blast gun. In other words, the wet sand readily cakes or packs and must be maintained in a somewhat fluid state if it is to be drawn into the hydraulic blast gun by an injector action created within the gun.

Accordingly it is an object of the invention to provide means for automatically flushing sand from a storage bin or hopper and simultaneously mixing the sand with the flushing liquid.

Another object of the invention resides in providing a current of water moving downwardly by gravity adjacent a supply of wet sand so as to move the sand to a position adjacent a pipe or tube through which the slurry is drawn into the hydraulic blast gun.

A further object of the invention pertains to the provision of an inclined plate over which the wet sand is moved by a current of water, so that upon interruption of the water current, the movement of wet sand to the hydraulic blast gun will be interrupted by reason of the inclination of the plate.

A more specific object of the invention relates to the provision of a storage bin or hopper within which a quantity of sand and water is stored, including a substantially vertical pipe for directing a current of water into engagement with the sand particles adjacent an outlet of the storage bin, so as to prevent blocking of the outlet orifice and for moving the wet sand to a position to be drawn into a hydraulic blast gun.

A still further object of the invention pertains to the feature of removing water from the top of the sand storage bin and permitting such water to move downwardly whereby the falling water provides means for creating turbulence in the wet sand adjacent the discharge orifice of the storage bin whereby blocking of the discharge orifice is prevented.

Another and further object of the invention pertains to means for skimming water from above the sand in the storage bin and directing such water into engagement with the sand particles adjacent the discharge outlet of the sand bin, including means for adjusting the point at which the water is directed into engagement with the sand particles adjacent the discharge outlet.

Another object of the invention resides in providing a feed pipe for water with the lower end thereof adjacent a discharge outlet for wet sand from a storage bin, whereby a layer of water flushes the wet sand from the storage bin over an inclined plate and into a well from which the sand slurry may be drawn into the hydraulic blast gun.

Other objects and features of the invention will be more apparent upon consideration of the accompanying drawings and the following detailed description, wherein an exemplary embodiment of the invention is disclosed.

In the drawings

Figure 1 is a sectional view taken in side elevation illustrating sand mixing and feeding apparatus embodying the invention.

Fig. 2 is a top plan view of the apparatus illustrated in Fig. 1.

Fig. 3 is a sectional view of the hydraulic sand feeding apparatus taken on the line 3—3 of Fig. 1.

Fig. 4 is a side elevational view of part of the sand feeding apparatus and illustrating details thereof in section.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 1.

Fig. 6 is a sectional view of the stand pipe taken on the line 6—6 of Fig. 1.

Fig. 7 is a vertical sectional view of the upper end of the stand pipe and illustrating a conduit arrangement for returning sand and water to a sump.

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 7.

Fig. 9 is a sectional view of the lower end of the storage bin and the well illustrating the

condition of the wet sand during the blasting operation.

Referring to the drawings, there is shown at 10 a plurality of posts or standards which support a number of cross beams 11 to provide a frame for the various elements of the sand feeding apparatus hereinafter described. The beams 11 may be suitably joined to the post 10 as by welding so as to form a rugged framework for supporting other beams on which a main sand storage bin indicated generally at 15 is mounted. The sand storage bin and auxiliary elements are suitably supported on the framework in any conventional or desirable manner, such as by welding of these parts to the beams forming the framework.

The main sand storage bin 15 may be of any suitable cross-sectional shape, and in the illustrated embodiment, takes the form of a rectangular shaped hopper formed of side walls 17 and 18, and a substantially vertical front wall 21. The rear wall of the sand storage bin is formed of a vertical wall portion 22 and an inclined flat wall member 23, as shown particularly in Fig. 1. The lower portions of the side walls 17 and 18 are also inclined as shown at 19 and 20, respectively in Fig. 3. The bin 15 is mounted on angle iron members 13 which rest on the cross beams 11 and extend longitudinally of the apparatus. The hopper 15 is further reinforced and supported by angle irons 12, which are supported by the members 13. The inclined plate 23 forming a part of the rear wall of the sand bin and forming in part a bottom therefor is inclined with respect to the horizontal at a rather steep angle, and preferably greater than the angle of repose of the wet sand. The sand storage bin is provided with a discharge opening 26 in the lower portion thereof, as shown in Figs. 1 and 3.

In carrying out the invention, one of the principal objects is to provide means for moving sand from the storage bin 15 through the discharge opening 26, and in such a fluid condition for being readily drawn into a conventional type of hydraulic blast gun for propelling the wet sand particles towards the articles to be blasted or abraded. An exemplary embodiment for carrying out such objects of the invention includes a receptacle or well 16 which is positioned below the discharge opening or orifice 26 of the sand bin. The well or receptacle 16 may be formed of a pipe 27 suitably supported on cross beams 25 forming part of the framework. The pipe 27 may be formed of any suitable cross-section and in the embodiment illustrated it is cylindrical and extends substantially vertically upward and terminates in a plane corresponding substantially to the top of the sand bin 15, and the purpose of this stand pipe 27 will be more clearly understood as the present disclosure proceeds. The stand pipe 27 may be reduced in cross-section at the upper end thereof as indicated at 28 in the drawings.

A pipe or tube for supplying a sand and water mixture to the hydraulic blast gun (not shown) depends into the well or receptacle 16, and this pipe is indicated at 29 in the drawings. The pipe 29 preferably extends vertically upward through the stand pipe 27, and it is also adjustable vertically to vary the position of the lower end 31 with respect to the bottom of the well 16. Thus the pipe 29 may be slidably mounted in a bushing shown generally at 32 and a water-tight bushing 35. The upper end of the pipe 29 is preferably higher than the normal position of the blast gun so that the sand and water mixture therein may drain towards the hydraulic blast gun and back into the well 16 when the blasting operation is interrupted.

The invention includes an encased open connection between the main sand bin 15 and the well 16, and an important feature of the invention pertains to the arrangement of the lower wall of such connecting means. In the embodiment illustrated, a conduit having flat side walls provides such a connection and the lower wall 33 thereof is inclined to the horizontal at an angle somewhat less than the angle of repose of wet sand. The angle of repose of sand particles is approximately thirty-three degrees, and the bottom plate or lower wall 33 is thus preferably inclined from the horizontal at a somewhat lesser angle than the angle of repose of wet sand. The conduit member, as indicated generally at 34, may be suitably connected at one end to the main sand bin by means of bolt and flange assemblies shown at 36, and may likewise be detachably connected to the receptacle 16 by means of bolt and nut assemblies 37. While the cross-sectional shape of this tubular conduit is shown and described as being formed of flat side walls, it is to be understood that other cross-sectional shapes may be employed without departing from the scope of the invention as long as the lower wall thereof is inclined at an angle less than the angle of repose of the wet abrasive.

A spout 41 is provided for introducing sand and water into the main storage bin 15. This spout 41 may be supported in any suitable manner such as two transverse angle irons 42 which form part of the framework. The upper end of the spout 41 is provided with a funnel 43. While this spout and funnel are shown as being rectangular in cross section, other shapes may be employed without departing from the spirit and scope of the invention. In carrying out a blasting operation with sand and water wherein the sand particles are propelled forwardly by water under pressure, and issuing at high velocity from the gun, the sand particles and water are recovered and after removal of the fine sand particles, and the heavy or large particles, the mixture of sand and water is introduced into the funnel 43, and this mixture of sand and water moves downwardly in the spout 41. During the blasting operation the mixture of sand and water continues to enter the bin or hopper 15, and some of the sand particles adhering to castings and the sand core will add sand to the system, so that a source of supply is thus provided which is in excess of the sand propelled by the blast gun. The sand entering the main bin through the spout 41 will fill the bin 15, as shown in Fig. 1, and the lower end of the spout will become blocked when the angle of repose of the wet sand particles after settling in the bin 15 is at sufficient height to prevent drainage of the sand particles from the spout 41.

For the purpose of removing the surplus sand from the supply system, the spout 41 is provided with a lateral opening 44, as shown particularly in Fig. 3. Thus when the sand particles settling in the main bin 15 from the spout 41 fill these parts to the level of the opening 44, the surplus sand escapes through the opening 44 and a conduit 46 extending therefrom as shown in Fig. 3. This wet sand is returned to a sump (not shown) by means of the conduit 46 and a further conduit 47, as shown in Fig. 4. The spout 41 is also provided with a baffle 45 for prevent-

ing inadvertent escape of sand and water through the opening 44.

The sand as hereinabove pointed out settles to the bottom of the bin or hopper 15, as indicated by the stippled portion of Fig. 1, and substantially clear water or liquid free of sand particles accumulates above the surface of the sand in the bin 15. During the blasting operation, additional water is supplied to the system so as to flush all the sand removed from the casting into the pit or sump, and at all times there is a surplus of water in the system. The water in the main bin 15 is, however, maintained at a level indicated approximately at 51 by the provision of an outlet orifice 52 in the wall 18 of the sand bin. This outlet orifice 52 is provided with a small chute 53 for conveying the surplus water into the conduit system 46 and 47 whereby the excess water is also returned to the sump.

The upper end 56 of the stand pipe 27 terminates on a level corresponding substantially to the height of the opening 52, so that the upper end of the stand pipe is at the same level as the water accumulated above the sand in the bin 15. The upper end 56 of the stand pipe is open, and also in open communication with a transverse conduit 57 whereby sand and water may be forced upwardly through the stand pipe 27 and discharged over the upper end thereof into the conduit 57 so that this fluid material may be returned to the sump. Thus when no blasting is being carried on, and when no further sand and water are being added to the hopper or bin 15, the sand and water will assume the position and condition shown in Fig. 1 wherein the stand pipe 27 will be filled with water to the level of the upper end 56, and the bin 15 will include accumulated water therein at the level 51 corresponding to the level of the upper end 56 of the stand pipe 27.

A valve 61 is provided in the enlarged lower portion of the stand pipe 27. This valve may be of any type and in the example shown in the drawings includes a disc 62 provided with several openings which may be closed by slidable plates. These slidable plates may be actuated by a handle 63.

When it is desired to initiate the blasting operation, the hydraulic blast gun is supplied with water under high pressure, and this water jet creates an injector action within the sand hose to the gun, and a depressed pressure condition within the pipe 29, so that water is drawn from the well 16. Before the blasing operation is started the valve 61 is closed so that the water within the stand pipe 27 below the valve 61 is drawn into the pipe 29 by the injector action of the hydraulic gun. When the well 16 is partly evacuated of water, it is necessahy to add some sand thereto which may be drawn through the pipe 29 to the hydraulic blast gun. A fundamental feature of the invasion pertains to providing means for moving sand in a fluid condition from the bin 15 into the well 16. An exemplary embodiment of means for carrying out such objectives takes the form of a pipe 66 extending vertically of the sand bin from a position adjacent the discharge opening 26, and terminating at its upper end below the water level 51. This pipe 66 is mounted so as to be adjusted vertically to thereby vary the point at which the water may be applied to the sand particles in the main bin adjacent the discharge opening 26. The pipe 66 may therefore be slidably mounted in suitable supports 67 and moved by means of a handle 68 which extends above the upper end of the storage bin.

Thus, when the water in the well 16 is partly evacuated as shown in Fig. 9 water from a position above the upper end 69 of the pipe 66 will flow downwardly therein by gravity and this water issuing from the lower end 71 of the pipe 66 will create considerable turbulence in the wet sand adjacent the discharge opening 26, and move or flush sand particles as a layer over the sand lying in the blocked condition at its angle of repose on the inclined wall 33, and this flow of water will flush additional sand particles into the well 16 and in a sufficient fluid condition for being drawn therefrom by the depressed pressure condition in the pipe 29. The invention thus provides means for flushing wet sand particles from the main bin 15 and at the same time mixing such particles with sufficient water to provide a sand slurry adapted to be drawn by an injector action into a hydraulic blast gun.

When the injector action of the hydraulic blast gun ceases, the water and sand entering the well 16 will assume a position approximately as indicated in the stippling of Fig. 1, and the water will fill the well 16 to the point of the valve 61. When no further blasting is to be done for a considerable period, it is advisable to remove the sand from the well 16 in order to prevent packing thereof adjacent the lower end 31 of the suction pipe 29. For this purpose, a water admission pipe 81 is provided for introducing water under pressure into the well 16 and preferably in a tangential direction. Then the valve 61 may be opened and the sand and water in the well or receptacle 16 will be forced upwardly and flow over the upper end 56 of the stand pipe 27 into the conduit 57 whereby the sand is moved into the sump. The water will thus remain to fill the stand pipe 27, and no further pressure differential will remain between the level 51 and the upper end 56 of the stand pipe 27, so that no current of water will flow in the pipe 66. The sand will thus block the discharge orifice 26 since the angle of repose of this abrasive will assume the condition shown in Fig. 1, whereby the discharge orifice 26 will be blocked and the objectionable feature of this sand moving into the well 16 will thereby be avoided.

When it is desired to continue the blasting operation, the valve 61 is closed, and when sufficient water is drawn from the well 16, water will again flow downwardly in the pipe 66 to flush a fresh supply of sand into the well or receptacle 16 whereby the gun will be provided with an adequate and continuous supply of sand slurry to carry out the blasting operation.

While the invention has been described with reference to specific structural details, it will be understood that various modifications in shape and arrangement of the various parts may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. Apparatus for feeding a mixture of sand and water to a hydraulic blast gun comprising, a bin adapted to receive sand and water whereby the sand particles settle in the lower portion of the bin to provide liquid free of sand particles in the upper portion of the bin, said bin having a discharge opening therein below the normal level of said sand particles, said bin having an outlet orifice therein above the settled sand through

which water may escape from the bin to provide a water level within the bin above the settled sand, a pipe extending downwardly from a point below said outlet orifice and from a point above the settled sand to a point adjacent said discharge opening whereby the water flowing downwardly in said pipe flushes sand through said discharge opening.

2. Apparatus for feeding wet set and water to a hydraulic blast gun comprising, a bin for receiving sand and water whereby sand particles settle in the water to provide a layer of water above the sand, said bin having a discharge opening in the lower portion thereof, a pipe extending downwardly from a point above the upper surface of the sand in the bin and from a point below the normal level of the water in the bin to a point adjacent said discharge opening whereby water is discharged from the pipe to flush sand through said discharge opening, and means for adjusting the position of the discharge end of the pipe in relation to the discharge opening.

3. Apparatus for mixing water with sand and for feeding the mixture to a hydraulic blast gun comprising, a bin having a discharge opening in the lower portion thereof, means for guiding sand and water into the upper portion of the bin whereby the sand settles in the bin to provide a layer of liquid over the sand, a substantially vertical pipe within the bin extending from a point immediately above the sand to a position adjacent the discharge opening, and means supporting said pipe for movement vertically in the bin.

4. Apparatus for supplying a sand slurry to a hydraulic blast gun comprising, a bin for receiving sand and water whereby the sand particles settle in the bin to provide water above the sand, said bin having a discharge opening in the lower portion thereof, means for skimming water from a point above the sand particles and guiding the skimmed water downwardly into engagement with the sand particles adjacent said discharge opening, a receptacle positioned below said discharge opening, means providing a conduit connection between the discharge opening and said receptacle including a lower wall inclined with respect to the horizontal at an angle smaller than the angle of repose of the sand over which the sand from the bin is flushed by the water skimmed from the top of the bin.

5. In apparatus for supplying sand to a hydraulic blast gun, a sand hopper having a discharge opening below the normal sand level therein, a receptacle, a conduit connecting said receptacle to said hopper whereby sand may move from the hopper through said opening into said conduit, the lower wall portion of said conduit sloping downwardly from said discharge opening at such an angle that wet sand lying at its angle of repose thereon will tend to block said discharge opening, and means for supplying water to the sand adjacent said discharge opening to flush sand into said receptacle.

6. In apparatus for supplying sand to a hydraulic blast gun, a sand hopper having a discharge opening below the normal sand level therein, a receptacle, a conduit connecting said receptacle to said hopper whereby sand may move from the hopper through said opening into said conduit, the lower wall portion of said conduit sloping downwardly from said discharge opening at such an angle that wet sand lying at its angle of repose thereon will tend to block said discharge opening, means for supplying water to the sand adjacent said discharge opening to flush sand into said receptacle, and a pipe depending into said receptacle for drawing sand and water therefrom.

7. In apparatus for supplying sand to a hydraulic blast gun, a sand hopper having a discharge opening below the normal sand level therein, a receptacle, a conduit connecting said receptacle to said hopper whereby sand may move from the hopper through said opening into said conduit, the lower wall portion of said conduit sloping downwardly from said discharge opening at such an angle that wet sand lying at its angle of repose thereon will tend to block said discharge opening, means for supplying water to the sand adjacent said discharge opening to flush sand into said receptacle, a pipe depending into said receptacle for drawing sand and water therefrom, and means for admitting water under pressure to said receptacle to remove sand packed therein.

8. In apparatus for supplying sand to a hydraulic blast gun, a sand hopper having a discharge opening below the normal sand level therein, a receptacle, a conduit connecting said receptacle to said hopper whereby sand may move from the hopper through said opening into said conduit, the lower wall portion of said conduit sloping downwardly from said discharge opening at such an angle that wet sand lying at its angle of repose thereon will tend to block said discharge opening, means for supplying water to the sand adjacent said discharge opening to flush sand into said receptacle, a pipe depending into said receptacle for drawing sand and water therefrom, and a pipe terminating tangentially in said receptacle for directing water under pressure into the receptacle to flush sand therefrom.

9. Apparatus for supplying granular abrasive and liquid to a blast gun comprising, a bin having a discharge opening in a lower portion thereof, means for guiding abrasive and liquid into said bin and preventing the abrasive particles from filling the bin whereby the abrasive particles settle in the bin to provide a quantity of liquid within the bin above the abrasive particles, and means skimming said liquid from a point above the settled abrasive particles and guiding the skimmed liquid downwardly into the presence of the abrasive particles adjacent said discharge opening.

10. In apparatus for feeding a mixture of granular abrasive and liquid to a blast gun, a bin for receiving wet abrasive particles, said bin having a discharge opening in a lower portion thereof, a supply of liquid maintained above said discharge opening, and conduit means in open communication with said liquid supply terminating adjacent said discharge opening whereby the liquid moves through the conduit means into the presence of the abrasive particles adjacent the discharge opening under pressure developed by the head of liquid and the weight of the liquid above said discharge opening.

DANIEL A. WIELAND.