May 11, 1965 A. S. ARWINE 3,182,915

HIGH PRESSURE REFRACTORY GUN

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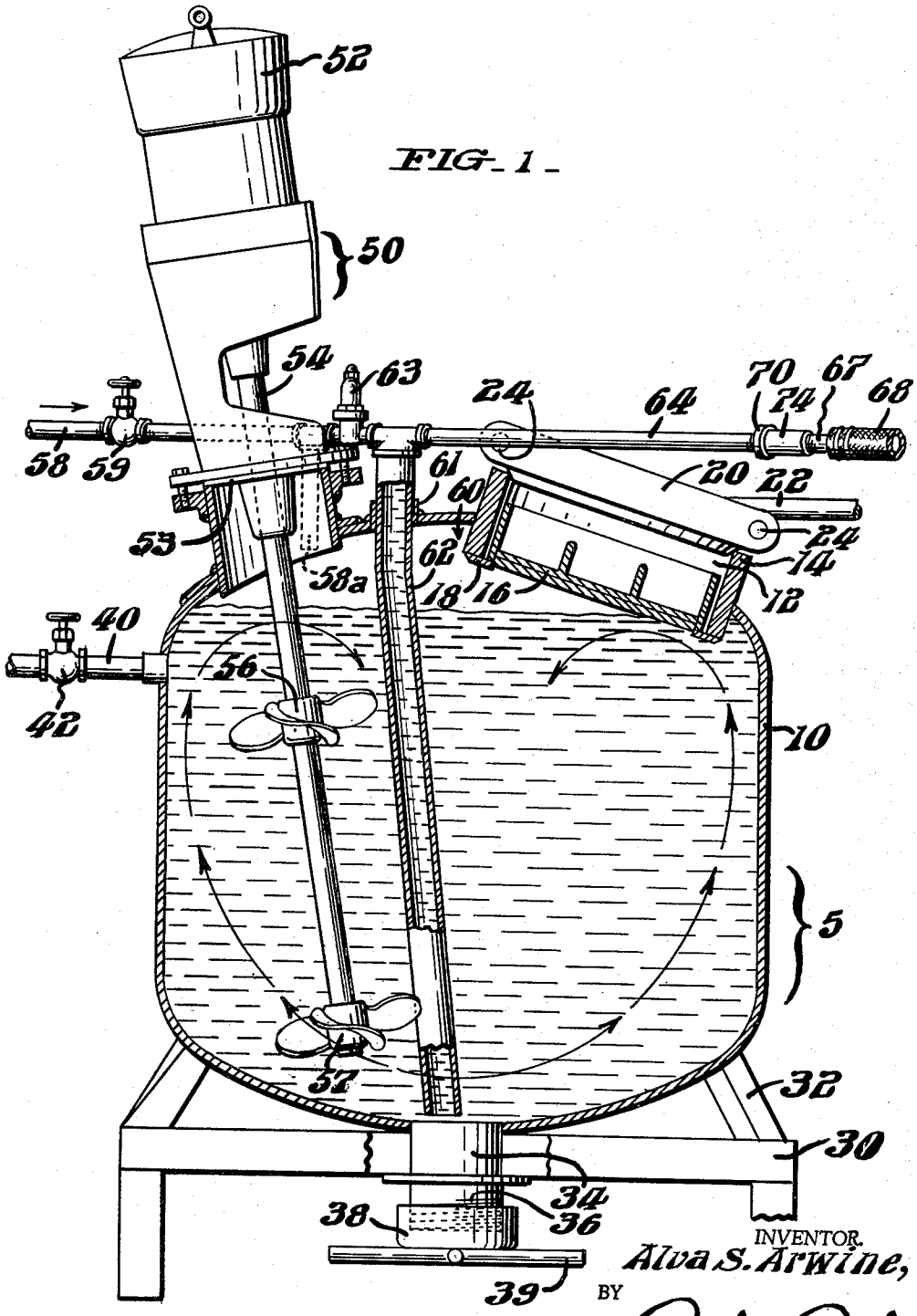
FIG. 1



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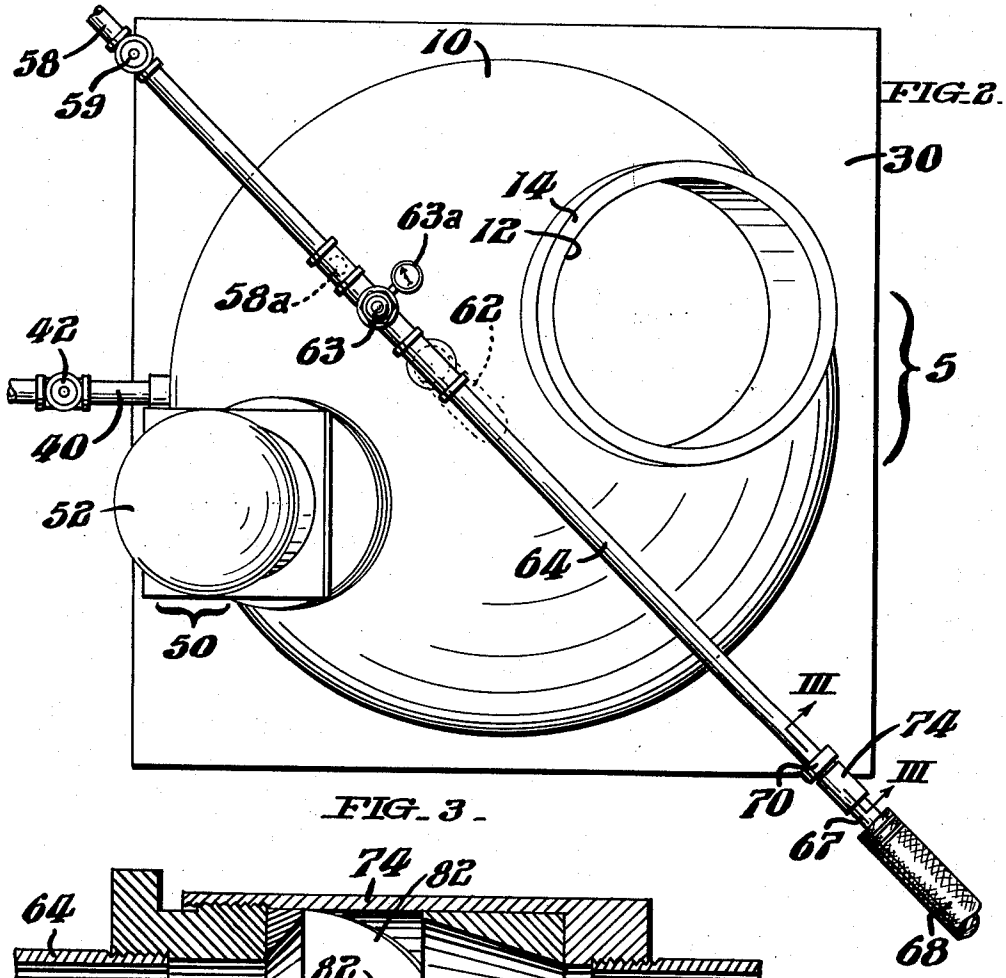


FIG. 2.

FIG. 3.

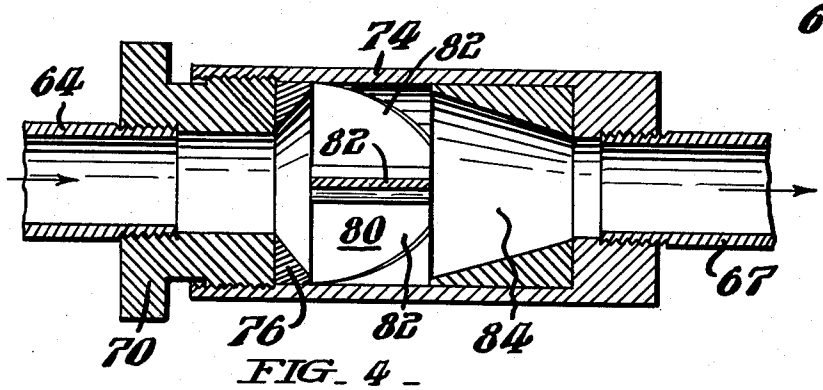
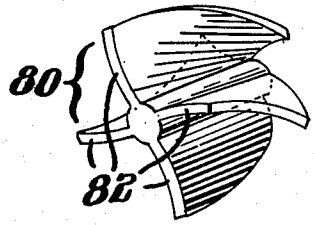


FIG. 4.



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3,182,915

HIGH PRESSURE REFRACTORY GUN

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2 Claims. (Cl. 239—142)

This invention relates to a high pressure refractory gun and, more particularly, to a high pressure mixing and spraying apparatus for dispensing a mix, containing liquid and finely divided solid particles, around the inside surfaces of a high temperature furnace.

It is an object of this invention to provide a high speed mixing apparatus wherein finely divided but relatively heavy particles of metallic ore can be uniformly mixed within a liquid, usually water, and then the mixture sprayed through a conduit around the interior surfaces of a high temperature furnace.

It is another object of this invention to provide a means within the conduit itself so that the particles remain diffused in the conveying fluid even though the material is conveyed a considerable distance from the primary mixing apparatus.

It is another object of this invention to provide an apparatus having the advantages described above which is substantially portable so that it can be placed in any position outside a large furnace while operating, and the refractory material sprayed within.

These and other objects together with the attendant advantages are described herein and in the attached drawings, wherein:

FIG. 1 is a sectional view taken in side elevation of one form of the apparatus of this invention;

FIG. 2 is a top view of the apparatus shown in FIG. 1;

FIG. 3 is a sectional view of the conduit mixer taken as indicated by the lines and arrows III—III in FIG. 2; and

FIG. 4 is a perspective view of the mixer shown in FIG. 3.

Referring first to FIG. 1 of the drawings wherein one specific embodiment of the refractory gun of this invention is disclosed, the primary diffusing apparatus is designated by the number **5**. This apparatus comprises a pressurized mixing tank **10**, equipped with an enlarged inlet opening **12** which is surrounded by a collar **14** through which the refractory particles are charged into the tank. A circular sealing insert **16**, making the inlet substantially water tight and pressure tight, rests upon an annular flange **18** attached to the bottom of inlet collar **14**. The inlet door **20** is equipped with a handle **22** to facilitate the loading operation and two locking bars **24** secure the door after the tank is loaded. The tank itself rests upon platform **30** and is held in the upright position by a plurality of supports **32**. A drain pipe **34** joins the tank at its lowest point and is equipped with threads **36** so that drain cap **38** can be threaded thereon with the use of handle **39**. A vent pipe **40** joins the tank at the upper left side as shown in FIG. 1, also shown in FIG. 2, with a valve **42** for releasing pressure from the tank whenever it is desired to open the door **20**.

The material customarily sprayed on the inner surfaces of refractories and high temperature furnaces so as to contain and reflect the heat as far as possible, consists of finely divided particles of chrome ore and magnesite ore, or the like, which are of such size as to readily pass through a 60 mesh screen with approximately 50% of the particles passing through a 100 mesh screen. This material may be charged in its dry state through the tank inlet **12** and liquid, usually water and liquid binders, is also fed through inlet **12**.

A high speed mixer **50** consisting of an electric drive motor **52**, a connected drive shaft **54** and a plurality of propellers **56**, **57** positioned above and within the tank as shown in FIG. 1 and partly in FIG. 2. The shaft **54** extends through a packing gland **53** sealing the tank against the escape of water and high pressure air. Propellers **56** and **57** are preferably positioned approximately 20 inches apart so that an optimum mixing action is achieved at the bottom of the tank but it is pointed out that one propeller can also be used effectively. It is particularly important to achieve strong mixing action at the bottom of the tank as the particles are relatively heavy and tend to settle rapidly out of the suspension along the bottom surfaces of the tank. The propellers **56**, **57** have a plurality of blades similarly pitched and arranged so that when they are rotated at high speed the suspension flows in the tank substantially in the direction of the arrows shown in FIG. 1. The axis of shaft **54** is positioned approximately 10 degrees away from the vertical position so that the flow of material will be as the arrows of FIG. 1 indicate. Because of the pitch of the shaft, the position of the propellers, and the high speed at which they are driven, a strong turbulence is created adjacent the bottom of the tank and the particles are swept around the tank and mechanically diffused into the suspension. A vortex is thereby created at the surface of the suspension and strong currents are directed to all parts of the tank.

Extending through the top of the tank and surrounded by packing gland **61** is a tube **62** which is connected to an outlet conduit **64** on top of the tank and which has an open end deep within the tank. Tube **62** can preferably have a diameter of approximately two inches and the open end preferably is positioned about one-half inch from the tank bottom. Tube **62**, at least that portion immersed in the suspension, is positioned at an angle of approximately 6 degrees away from the vertical position so as to facilitate the flow of material from the propellers and the bottom of the tank. It is most important that the lower propeller **57** be located immediately adjacent to the bottom opening of pipe **62**, substantially as shown.

A pressure regulator **63** and gauge **63***a* are located between air pipe **58** and conduit **64** so that a predetermined amount of compressed air passes through the regulator **63** and acts to speed the flow of the liquid material along conduit **64**.

As shown in FIG. 2, in addition to FIG. 1, outlet **64** subsequently connects with the discharge nozzle **68**. Conduit **64** is a continuous length of tubing having connected pipe **58**, regulated by valve **59**, feeding compressed air through the extension pipe **58***a* into the unfilled top portion **60** of the tank and against the surface of the suspension. Compressed air having a pressure of substantially 100 p.s.i. is sufficient to force the liquid suspension up tube **62** and out conduit **64**.

Referring now to FIGS. 3 and 4, the apparatus for mixing the particles a second time and within the conduit itself, a distance from the main mixing tank, is shown in greater detail. Conduit **64**, shown to the left of FIG. 3, is threaded into a reducing element **70** which in turn is threaded into a sleeve **74** which is attached, at the opposite end, by threads to an outlet pipe **67**. The pipe **67** is attached, as shown in FIGS. 1 and 2, to a flexible spraying hose or nozzle **68** which is directed by hand. A cone shaped element **76** allows the flow of liquid material to disperse somewhat before it passes into the helical mixer **80**. This mixer, as shown in greater detail in FIG. 4, has a plurality of curved or helical blades **82** and is mounted stationary within the sleeve **74** so that the axis of the mixer coincides with the longitudinal axis of conduit **64**. A receiving chamber **84** condenses the flow once again before it is discharged through outlet pipe **67**. When the

aqueous suspension strikes the blades of the helical mixer **80**, the metallic particles are violently deflected within the conveying liquid and the compressed air so that the water, air and particles are again thoroughly mixed together before they are ejected out of the nozzle **68**. The purpose of the helical mixer is to prevent or retard the premature settling out and separation of these particles within the conveying liquid and compressed air stream.

This embodiment of the high pressure refractory gun of this invention operates substantially as follows. The main mixing apparatus **5** is positioned outside an opening which extends through the furnace. A quantity of chrome or magnesite ore particles, for example, is deposited through opening **12** and then insert **16** and door **20** are locked in closed position. Liquid is fed into the tank through opening **12**, usually until it fills the tank to a level somewhat above the upper propeller blade **56**, as shown in FIG. 1. The high speed mixer is started and the propellers cause the diffusion of the particles and a turbulence at or near the bottom opening of tube **62** so that the suspension flows up the tube. Compressed air meanwhile, flows into the unfilled and emptying portions **60** of the tank, forcing the suspension up tube **62**. Compressed air also passes through the regulator **63** and adds to the velocity of the stream passing out conduit **64**. The suspension encounters the conduit mixer **80** whereby the refractory particles are again diffused by deflection in the stream. An operator controls and directs the flow of the suspension out of the nozzle.

It is understood that only one specific embodiment of the invention is described herein but that other forms and modifications thereof can be made. For example, the high speed mixing means can have additional propellers and arranged different in respect to the outlet tube. Further, the conduit mixer can have revolving parts rather than that shown. These and other modifications are well within the spirit of the invention as defined by the appended claims.

Having thus described my invention, I claim:

1. A high pressure refractory gun comprising, in combination, a mixing tank for holding a suspension of finely divided metallic ore refractory particles; a tank discharge tube extending angularly downwardly and inwardly toward, and having its open lower end substantially at, the bottom center of the tank, said tube having its upper end spaced away from the vertical center axis of said tank; a propeller shaft extending angularly downwardly and inwardly toward, and having its lower end near to, the lower end of said tank discharge tube; a propeller mounted at said lower end of said shaft; a spray-directing nozzle remote from said tank; a conduit of substantial length connecting to said spray-directing nozzle; junction means connecting a source of compressed air to the top of said tank, connected to said discharge tube and also to said conduit, for maintaining air under pressure on the surface of the suspension within the tank thereby to tend to force such suspension through said tank discharge tube and out through said conduit.

2. A gun as claimed in claim 1 characterized by the provision of mixing means within said conduit near said nozzle, said mixing means including a cone-shaped expander chamber, followed by a helical mixing propeller and a condensing chamber.

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