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APPARATUS FOR THE RECOVERY OF SOLVENTS

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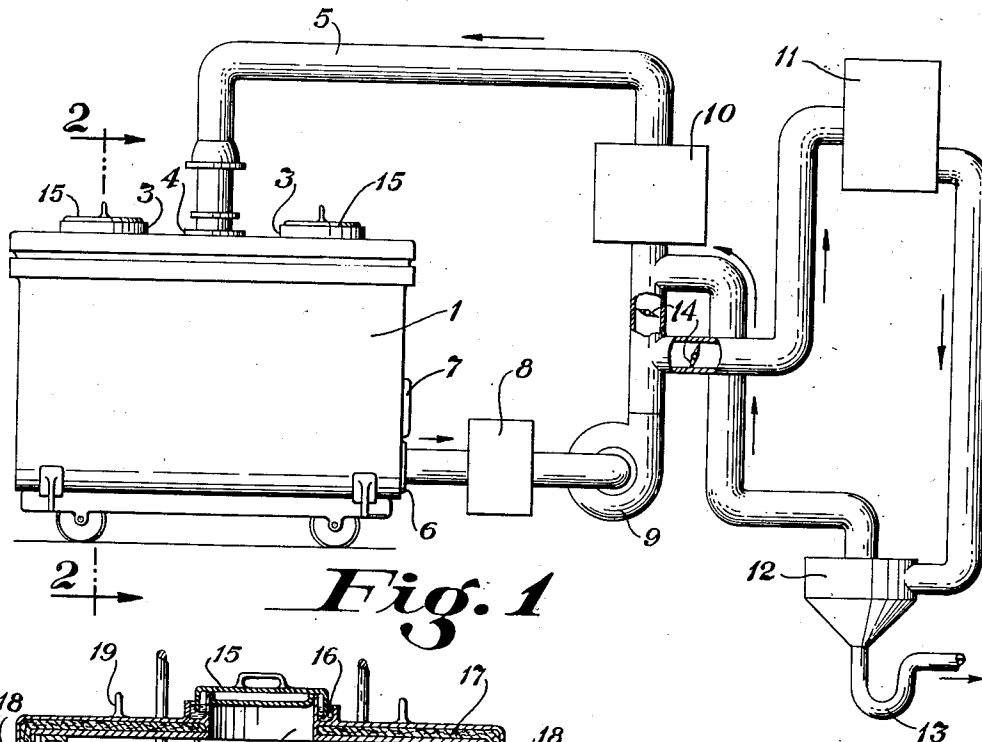


Fig. 1

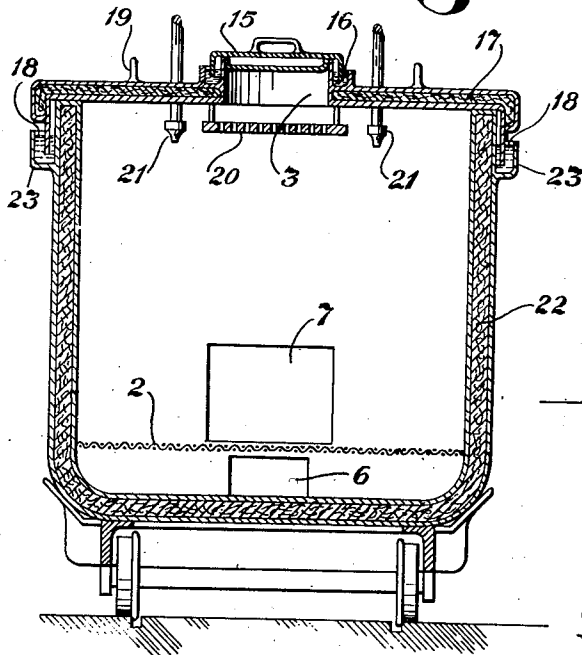


Fig. 2

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APPARATUS FOR THE RECOVERY OF SOLVENT

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Original application May 14, 1941, Serial No. 393,340, now Patent No. 2,349,249, dated May 23, 1944. Divided and this application December 11, 1942, Serial No. 468,684

2 Claims. (Cl. 34—60)

This invention pertains to the recovery of solvent from smokeless powder, particularly with respect to an improved apparatus for the recovery of said solvent.

This application is a division of U. S. application Serial No. 393,340, filed May 14, 1941.

The object of the present invention is an assembly adapted to the efficient removal of solvent while permitting the production of a substantially uniform powder. Another object is an apparatus adapted to facilitate control of the solvent vapor content of the drying medium during the solvent recovery treatment. A further object is a solvent recovery assembly adapted to the regulated removal of solvent from smokeless powder by controlling the solvent vapor content of the drying medium and the temperature of said drying medium as well as that of the powder being treated. A still further object is an apparatus capable of use for all the steps involved in the finishing of powder, that is to say, solvent recovery, water drying, and air drying. Other objects will become apparent as the invention is described in detail hereinafter.

The foregoing objects are attained by means of the assembly shown in the accompanying drawing which illustrates preferred embodiments of the invention. Figure 1 denotes a schematic plan of the various elements composing the assembly. Figure 2 refers to a cross-sectional view of the solvent recovery car along the line 2—2. Similar numerals refer to similar parts throughout the drawings.

Referring to Figure 1, the numeral 1 denotes an insulated powder container, said container preferably being constructed of welded metal and mounted on a chassis, so that facile transfer of the powder, together with its contents, can be effected whenever it is deemed desirable. Preferably, the inner part of the container is constructed of stainless steel, because this material permits the construction of inner surfaces which are smooth, and to which particles cannot cling. The outer surfaces of the car may be constructed of galvanized metal. Insulation may be effected by means of a number of well-known insulating materials. Glass wool has proved to be very attractive for this purpose. This insulated, welded metal container is provided with a screen, 2, said screen being adapted to support or retain the powder being treated while permitting passage of the treating medium therethrough. The powder is introduced into the container by means of the openings 3, said openings being provided with lids which may be positioned readily and which in

addition are designed to be made air- or gas-tight by means of the liquid seal (shown in Fig. 2). The drying medium is introduced into the car through opening 4. At this juncture, the line 5 is joined to the car and the jointure also made gas-tight by means of a liquid seal. After the powder has been treated it is removed from the container merely by opening up the hinged section 7 and shoveling it therefrom, or by tilting the car somewhat and permitting the powder to flow through said opening.

The direction of flow of the drying medium is indicated. It may be seen that the direction of flow of the gas is downwardly into the car, said flow being distributed uniformly throughout the bulk of the powder in the container by means also shown in Fig. 2, the flow of the gas continuing on through the screen and exiting from underneath the screen, where it passes to the filter, 8. The piping between the filter and car is connected to said car by means of a removable vapor-tight member, 6. The filter serves the purpose of removing any finely divided solid particles which may pass through the screen and which otherwise might cause damage to the assembly. Although various filtering media may be employed, we prefer to use glass wool, because this material has proved to be particularly efficacious and thus can be employed more advantageously than various types of paper or cloth. The desirable high rate of circulation is attained by means of the blower, 9, said blower being of the type deemed safe for use with explosive gas mixtures. As shown, the gases passing through the filter enter the blower and pass therethrough. After leaving the blower, the drying medium is separated into predetermined portions, one portion being passed directly to the heater 10, whereas the remainder is passed through the condenser, 11, and thence through the cyclone separator, 12. Separation or division of the gas from the blower is effected by means of the valves or dampers, 14, these being manipulated to attain any desired ratio. During its passage through the condenser, the temperature of this part of the drying medium is cooled sufficiently to cause condensation of at least part of the solvent vapors present. Further cooling is effected when the already cooled gases are passed into the cooled cyclone separator. This latter element is particularly effective with respect to the separation of entrained solvent droplets. The solvent condensed passes down through the line 13, which is designed to prevent escape of gases, and then passes to storage. The residual gases exit from

the top of the separator and pass into the line at a point immediately before the heater, 10, and behind the valve, 14. The passage of part of the gases through the condenser, of course, lowers the temperature of this portion of the gases and causes condensation of some of the solvent vapors present. The cooled gases of lower solvent content are then joined with the gases coming directly from the blower and the resultant mixture is passed into the heater where a predetermined temperature is maintained, this increase in temperature having the effect of raising the solvent-carrying capacity of the gases. From the heater, the gases pass to the top of the powder container, and the circulation described above is repeated.

The details of construction of the powder car are shown in Fig. 2, wherein the numeral 17 refers to the cover of the car. Said cover is preferably composed of two metallic layers, with a layer of insulating material therebetween. This cover merely rests over the insulated side walls, 22, of the car, and forms a vapor-tight union therewith by means of the liquid seal, 18, which is formed by cooperation of the lip of the cover with the curved member, 23. It will be noted that the liquid seal is entirely outside the car. This feature is advantageous because it prevents the introduction of water into the system as a result of evaporation of some of the water in the seal. No permanent connections or fastenings between the cover and the side walls of the car are employed, the weight of the cover being sufficient per se to maintain a closed system. Thus, if accidental ignition of the powder or gases occurs, the cover is displaced so that the possibility of high pressure being created within the system is greatly reduced. Consequently, accidental ignition of the contents is usually characterized only by burning, rather than by explosion or detonation. The members, 19, are employed for removal of the cover.

The cover is provided with quick opening lids, 15, which are made vapor- or gas-tight by means of the liquid seal, 16. Beneath the cover 17 in the region below opening 4 is the baffle 20. This member is provided with a multiplicity of perforations, and serves as a means for distributing the incoming gas over the entire bed of powder being treated, so that said gas may diffuse through the entire powder bed. Water-sprays, 21, are provided for wetting down the powder at the end of the solvent recovery treatment, in case it is desired to remove the powder at the end of said treatment.

The assembly described in the foregoing is employed for the recovery of solvent from smokeless powder in the following manner. Freshly grained or green smokeless powder is loaded into the car at a locus which is at an appreciable distance from the place where the solvent recovery process is to be effected. During the loading operation, the major portion of the solvent vapors evolved may be condensed by passing them in contact with cooling coils. After the charge of the green powder has been introduced into the car, the various openings of the car are closed and then it is moved from the graining area to the solvent recovery area by means of a dinghy or other suitable engine provided for hauling such cars when they are superimposed on a chassis as described hereinbefore. This portable feature of the car is important because of the fact that it avoids concentration of large quantities of smokeless powder

and explosive gas mixtures. The loaded car is then placed in proper position in the solvent recovery area and attachment of the line 5 in the proper position is made. The lids, 15, have already been clamped in a tight position and the water seal has been made. Likewise, attachment at the base of the car is made for the exit of the drying medium therefrom. The temperature of the heater and condenser has already been regulated so that when the operation is started, the air in the powder container is purged therefrom via the cyclone separator and then exact regulation of the air flow is made.

The period of operation for the recovery of solvent is continued until potentially all of the solvent, in most cases ether and alcohol, which can be volatilized readily under the conditions obtaining, is removed. The present arrangement permits facile control of the temperature of the drying medium as well as its solvent carrying capacity. This is due to the fact that the temperature and solvent content of the gases entering the car can be controlled accurately without difficulty. These conditions may be varied so that practically any set of factors considered desirable during the various stages of the operation can be obtained. The length of time of treatment will vary according to the size of the powder grains, their composition, the conditions obtaining during treatment, etc.

The foregoing apparatus is particularly useful for the efficient removal of volatile solvent from newly made grains of smokeless powder because it permits control of the solvent vapor content of the medium surrounding the powder and the temperature of this medium as well as that of the powder. As a result, the rate of removal of the solvent can be controlled so that when subjected to the treatment, the dimensions of the grain will change uniformly, and controlled shrinkage will be achieved when the solvent is removed therefrom. In addition, it is adapted for use in processes involving what may be considered a high rate of circulation of the drying medium, this feature being particularly advantageous in view of the fact that a high flow of the drying medium is conducive to the production of a uniform lot of powder. In other words, variations in solvent composition of the powder are reduced to a minimum.

It will be understood that the utility of the present assembly is not limited to the recovery of solvent from freshly-granulated or green smokeless powder. Instead, it may also be employed for the steps employed in the finishing of smokeless powders. These steps usually include preliminary air drying, water drying, and a final air drying treatment. The water-drying step involves steeping the powder in water at an elevated temperature, and is employed in order to reduce the volatile solvent in the powder to a satisfactory residual solvent content. After this has been accomplished, the powder is accorded final air drying, during which step the excess moisture in the powder is removed.

Thus, if the powder is to be accorded a preliminary air drying, it is necessary only to disconnect the pipe at the base of the powder car, employing the resulting opening for introduction of air, and closing the valve into the condenser so that this unit as well as the separator is cut out of the system. As a result, air at room temperature comes into the piping, passes through the filter, blower, and heater, and then the warm air passes downwardly into the car

and through the powder bed, the moist air leaving the car at the exit resulting when the piping was disconnected. For the water-drying step, it is necessary only to provide an inlet and outlet for hot water of the desired temperature, and to plug the opening at the base of the car. Final air drying of the powder may be effected in the manner described above for the preliminary air drying treatment.

It will be understood that the assembly described herein is not limited to the use of one powder car. Instead two or more cars may be attached in parallel to the system, it being essential only that the various parts of the assembly be designed to yield the desired flow and temperature conditions. In such cases it is possible to recover simultaneously the solvent from a plurality of batches of powder while preventing the concentration of an unduly large quantity of powder in one zone. This may be accomplished by simply providing a fire wall between the cars.

The process disclosed herein is claimed in co-pending application Serial No. 257,840, filed February 23, 1939, and issued as U. S. Patent No. 2,280,803 and the apparatus in Serial No. 393,340, filed May 14, 1941 and issued as U. S. Patent No. 2,349,249.

It will be apparent to those skilled in the smokeless powder art that the foregoing description permits of variations, without departing from the spirit or scope thereof. We intend, therefore, to be limited only in accordance with the following claims.

We claim:

1. A transferable, insulated container adapted for use in the recovery of solvent from smokeless powder, said container comprising an unsecured, removable cover in sealed relationship with the walls thereof, at least one unsecured but vapor-tight lid in said cover, an adit for the introduction of the drying medium into the container, said adit being located in the cover, a screen for supporting a bed of powder within the container, means for distributing said drying medium over the entire bed of powder, an aperture toward the base of said container for the exit of said drying medium, and means for removing the powder from the container at the completion of the treatment.

2. A transferable, insulated container adapted for use in the recovery of solvent from smokeless powder, said container comprising an unsecured, removable cover in sealed relationship with the walls thereof, at least one unsecured but vapor-tight lid in said cover, an adit for the introduction of the drying medium into the container, said adit being located in the cover, a screen for supporting a bed of powder within the container, means for distributing said drying medium over the entire bed of powder, an aperture toward the base of said container for the exit of said drying medium, means for removing the powder from the container at the completion of the treatment, and means for introducing water in the form of sprays into said container.

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