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CONTAINER-EMPTYING CLAMP STAND WITH GAS-FLUIDIZING CAP

Original Filed March 23, 1962

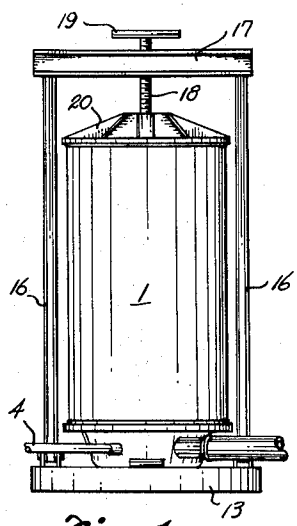


Fig. 1.

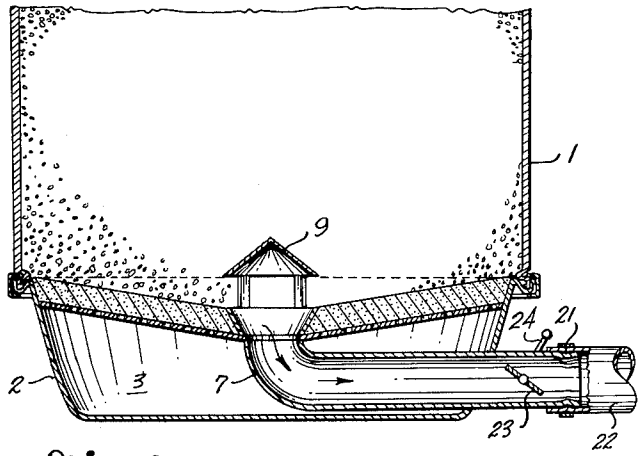


Fig. 2.

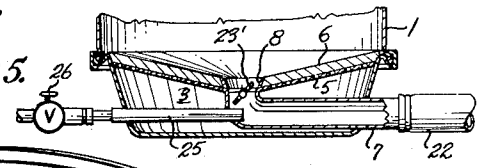


Fig. 5.

Fig. 3.

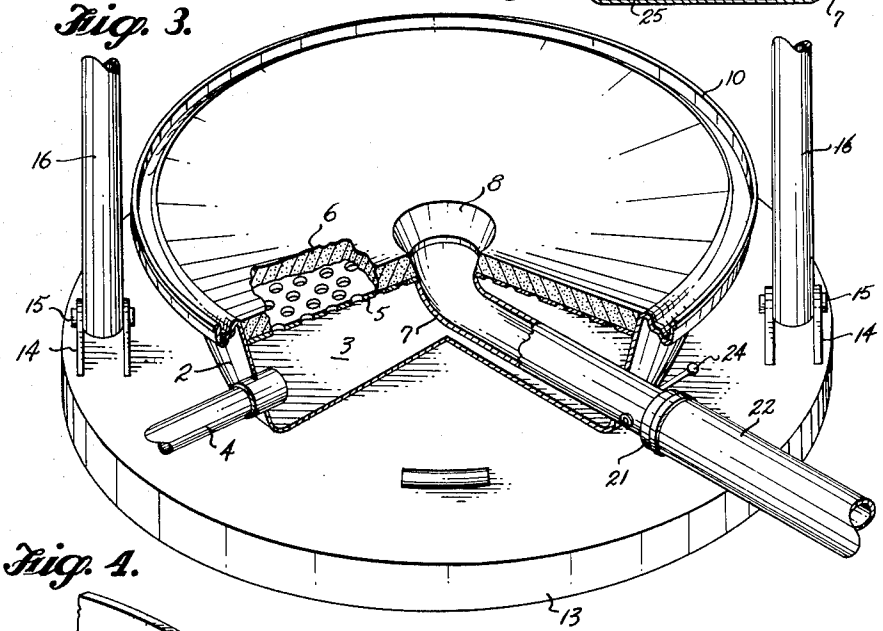
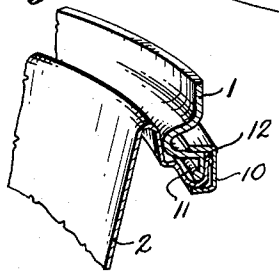


Fig. 4.



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CONTAINER-EMPTYING CLAMP STAND WITH GAS-FLUIDIZING CAP

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Original application Mar. 23, 1962, Ser. No. 181,981. Divided and this application Oct. 8, 1964, Ser. No. 402,585

12 Claims. (Cl. 214—310)

This application is a division of my application Serial No. 181,981, filed March 23, 1962, for Gas-Fluidizing Container-Emptying Cap, now abandoned.

The present invention relates to a stand for clamping a container to facilitate emptying of it and a cap associated with the stand to be applied to the container by which gas is supplied to fluidize granular material or powder in the container so that it can be emptied through a discharge aperture in the cap. Such container-emptying cap is attachable to a container at a destination in place of its usual lid.

It is a principal object of this invention to provide a stand for holding a container securely while it is being emptied by the aid of a cap on the container which will expedite emptying of granular material or powder from the container without the necessity of providing any other opening in the container. Such caps can be provided in several sizes to fit different standard containers, so that such a fluidizing cap can readily replace a conventional lid.

It is a further object to provide container-handling mechanism which will enable a gas-fluidizing cap to be applied to a container and thereafter enable the container to be positioned easily with the cap beneath the container for supporting the contents of the container.

It is also an object to provide a gas-fluidizing cap of a single size which can be applied to containers of various sizes, shapes and types, such as metal, wood or cardboard drums. Moreover, the cap may be of a size to cover the entire end of a container.

Another object of the present invention is to provide securing mechanism for an attachable gas-fluidizing cap which will enable such a cap to be secured quickly and easily to the end of, or an opening in, a container so that the complete emptying operation can be accomplished very expeditiously. Control valves can be provided for controlling the rate at which material is discharged from the container by use of the gas-fluidizing cap.

It is also an object to provide a gas-fluidizing cap of the type mentioned which will be very effective in effecting fluidization of granular material or flour in a container, which will not be contaminated or clogged readily by such material and which can be cleaned easily when necessary.

The foregoing objects can be accomplished by an attachable gas-fluidizing cap composed of a pan having in it spaced from its bottom a porous partition and a discharge duct which opens toward the top of the pan. Preferably such partition is inclined toward the discharge opening, the partition preferably being dished with the discharge opening in its central portion and the discharge duct being connected to the lower portion of the pan. A plenum chamber is formed between the partition and the bottom of the pan and a fluidizing gas supply pipe is connected to the plenum chamber for supplying gas under pressure which will permeate the partition to fluidize the material in the container above it. The lip of the cap may have in it a groove to fit an end or opening in the container, both to locate the cap in proper

position relative to the container and to provide a seal between the cap and the container, and the cap can be secured in such position by a clamping band. The cap can also be secured to the container by additional clamping mechanism which may be applied to the container while the opening in the container to which the cap is applied is in upwardly opening position, and after the cap has been secured in place the container can be inverted to locate the cap at the bottom of the container.

FIGURE 1 is an elevation of a container-dumping stand and container to which the container-emptying cap is fitted. FIGURE 2 is a vertical section through the lower portion of the container and cap shown in FIGURE 1. FIGURE 3 is a top perspective of the bottom portion of the container-emptying stand and the cap on it with parts of the cap broken away. FIGURE 4 is a detail top perspective of a portion of the cap rim and container lip secured together by a clamping band.

FIGURE 5 is a vertical section through a modified container-emptying cap and the adjacent portion of the container.

Provision has been made heretofore to fluidize granular or powdered material in special containers for the purpose of emptying such material from the container, but no equipment has been provided to enable this process of material handling to be utilized for emptying material from containers of conventional type. Moreover, the fluidizing equipment has been constructed as an integral part of the container so that it was necessary to employ the fluidizing procedure in every instance in which material was removed from the container. The present invention provides a gas-fluidizing container-emptying cap attachable to containers of various standard types without modification of such containers. Alternatively, such a container-emptying cap can be secured detachably to various types of containers, or can be mounted permanently on containers with minimum modification of them being required.

A typical application for such a container-emptying cap is a conventional small, cylindrical drum made of metal, plywood, or paperboard, one entire end of which may be closed by a lid. The container-emptying cap of the present invention can be of a size, shape and construction to be substituted for the lid of such a container when it is desired to empty it. In FIGURE 1 such a container **1** is shown as having attached to it a gas-fluidizing container-emptying cap of the present invention and mounted in a container-dumping stand which may be employed conveniently in the container-emptying operation.

Details of construction of the container-emptying cap are shown in FIGURES 2, 3 and 4. The cap is composed of a pan **2** of sheet material, such as plastic or noncorrodible metal, for example, aluminum alloy or stainless steel. A partition is spaced from the bottom of the pan to form a plenum chamber **3** to which gas under pressure is supplied by a gas supply pipe **4**. The partition is gas permeable, being composed of a perforate plate **5** supporting a porous mat **6** which preferably is of cellular urethane material or fabricated from bonded fine rubber particles, the cells of which are interconnected to enable gas to pass through the mat and emanate substantially uniformly from its surface.

An outlet duct **7** is connected to the partition in which the discharge opening **8** communicating with such outlet duct is provided. In the cap shown in FIGURES 2 and 3 the pan **2** and the partition within it are circular and the outlet duct is located in the center of the partition. Such partition is dished so that the fluidizing surface slopes slightly toward the discharge opening to facilitate flow of the fluidized material to such opening. If desired, a baffle **9** shown in FIGURE 2 may be mounted in spaced rela-

tionship above the discharge opening to support the column of material directly above such opening and prevent material being packed in the opening.

The cap can be secured on the container **1** in various ways. In the particular instance illustrated it is assumed that the gas-fluidizing cap will be attached to the container **1** in place of the conventional lid which normally closes the entire end of the drum shown. The rim **10** of the pan is shaped to form a groove of a size and shape to receive the lip of the container wall. Such engagement between the pan and the container will establish proper registry of the cap with the container opening and will prevent the cap from sliding sidewise relative to the opening. The container lip may be bent to provide a seat for the lid, as shown best in FIGURE 4, and the groove **11** in the rim of the pan **2** should be shaped to receive the lip of the container in a manner such as shown in FIGURE 4, for example. When the cap has thus been fitted to the lip of the container, such lip and the rim of the pan **2** can be secured together by a clamping band **12** of channel cross section, which will embrace the container lip and pan rim in the manner shown in FIGURE 4 and this band can be contracted circumferentially and its ends secured to bind it in place.

The container-dumping stand shown in FIGURE 1 and partially in FIGURE 3 includes a base **13** from the upper side of which project lugs **14** receiving pivot pins **15** by which the legs **16** of a container-clamping bail are pivotally secured. A crossbar **17** connects the opposite ends of legs **16** to which the crossbar is rigidly secured. Through the central portion of the crossbar is a threaded aperture through which the clamping screw **18** extends. This screw can be turned by the handle **19** to move the screw lengthwise for pressing the pressure plate **20** against the bottom of the drum **1**.

As shown in FIGURES 1 and 3 the gas-fluidizing cap rests on the base and the gas supply pipe **4** and material discharge duct **7** are connected to the pan **2** at an angle of less than 180 degrees, so that the cap can be placed on the base between the diametrically opposite lugs **14** without interfering with such lugs. The portion **7** of the outlet duct carried by the cap need extend only from the discharge opening **8** through the wall of the pan **2**, at which location it can be connected by a coupling **21** to a conveyor pipe **22** of either flexible or rigid type extending to a location at which it is desired to deposit the contents of the container. The flow of material through the outlet duct and conveyor pipe can be controlled by a butterfly valve **23** swingable to a desired regulating position by the handle **24** connected to the valve shaft.

To apply the gas-fluidizing cap to the drum **1** of FIGURE 1 and mount the drum in the container-dumping stand the lid will first be removed from the drum while it is supported on its bottom. Next, the cap in inverted position is placed on the drum full of material with the lip of the drum lodged in the groove **11** of the cap. The cap is then secured to the drum by the clamping band **12**. To facilitate handling, the conveyor pipe **22** should not be connected to the outlet duct at this time and the valve **23** should be in closed position so as to prevent any accidental discharge of material from the drum through the outlet duct.

When the gas-fluidizing cap is thus secured on the drum it is upended with the pan **2** placed on the base **13** of the stand, while the bail is in its lowered position. Next, the bail is swung upward about pivots **15** into the position shown in FIGURE 1 with the screw **18** retracted sufficiently so that the clamping plate **20** will clear the bottom of the drum. The handle **19** may then be turned to move screw **18** downward until the clamping plate **20** is pressed firmly against the bottom of the drum to hold the drum and cap against the base **13** and prevent separation of the drum and cap during the material-discharging operation even if considerable pressure is built up within the drum by such operation. The stand will, of course, be much more stable than would be the drum alone supported on the gas-fluidizing cap.

In order to accomplish the container-emptying operation the conveying pipe **22** is connected by the coupling **21** to the outlet duct **7** and air or other suitable gas under pressure is supplied by the gas supply pipe **4** to the plenum chamber **3** for permeating the partition **5, 6** to fluidize the material in the drum. If the valve **23** is now opened by swinging handle **24** the fluidized material will flow out of the drum through the discharge opening **8** and into the conveying pipe **22**. The rate of material discharge can be regulated both by controlling the amount of fluidizing gas supplied by the pipe **4** and by adjusting the position of the control valve **23** in the outlet duct. Even the slight slope of the upper surface of the cap's partition shown in FIGURE 2 will be sufficient to cause all of the material in the drum to be emptied from it through the discharge opening **8** because of the fluidizing action of the gas supplied to the material in the container through the partition **5, 6** of the cap.

When the drum has thus been emptied the conveyor pipe **22** can be disconnected from the outlet duct **7**, the supply of gas under pressure through the pipe **4** can be shut off and such pipe may or may not be disconnected from the gas-fluidizing cap as desired. The handle **19** of screw **18** may then be turned in the retracting direction to disengage the clamping plate **20** from the base of the drum **1** and retract it sufficiently to enable the plate to clear the bottom of the drum when the bail is swung downward again. The drum may then be righted by tipping it off the base **13** while the cap remains secured to the drum. Next, the clamping band **12** is loosened and removed from the assembly so that the cap can be lifted off the drum and stored or applied to another drum or other container.

While the gas supplied to the material in the drum **1** during an emptying operation will fluidize such material so that it will flow through the conveyor pipe **22** for a considerable distance without further assistance, it may be desirable to make provision for conveying the material through such pipe over a greater distance. In that instance supplemental gas can be supplied to the conveyor pipe **22** after the material has been discharged from the container. In FIGURE 5 a pipe **25** is illustrated for the purpose of supplying gas under pressure to the elbow of the outlet duct **7**, in addition to pipe **4** shown in FIGURE 3 for supplying gas under pressure to the plenum chamber **3** for fluidizing the material in the container. Pipe **25** may be a pipe branching from pipe **4**, or pipe **4** may be a branch of pipe **25**, but the flow of gas through these pipes should be controllable independently. For this purpose a valve **26** is shown diagrammatically in pipe **25**.

If the velocity of the gas discharged from pipe **25** connected to the elbow of the outlet duct **7** is sufficiently high, such pipe serves as an injector which assists in withdrawing material from the container **1** through the discharge opening **8**. For such an installation it is undesirable to have the control valve in the outlet duct at the discharge side of the pipe **25** and consequently the valve **23′** is shown as being located in the discharge opening, or immediately below it, and ahead of the pipe **25** in the direction of material movement from the container. Except for the provision of the pipe **25** to supply supplemental gas under pressure to the outlet duct **7** and conveyor pipe **22**, the construction and operation of the apparatus shown in FIGURE 5 is the same as that described in connection with FIGURES 1 to 4, inclusive.

I claim as my invention:

1. A gas-fluidizing container cap comprising a pan having a bottom, a peripheral wall with one edge encircling said bottom and an open side opposite said bottom, a gas-permeable partition in said pan spaced from the bottom of said pan for defining a chamber therebetween, means connected to the periphery of said pan

for supplying gas under pressure to such chamber, an outlet conduit projecting from the peripheral wall of said pan at a location between the bottom of said pan and its open side for receiving material from the container fluidized by gas emanating from said partition, a valve in said outlet conduit adjustable to vary the flow of such material through said outlet conduit, and a baffle partially covering the opening from the open side of said pan into said outlet conduit.

2. Container-emptying apparatus comprising a container having an opening, a gas-fluidizing container cap including a pan having a bottom and a peripheral wall having one edge encircling said bottom and said wall extending upwardly from said bottom to an open side which closes said container opening, a gas-permeable partition in said pan spaced from said pan bottom to define a chamber, means connected to said peripheral wall for supplying gas under pressure to such chamber, an outlet conduit extending from said peripheral wall at a location between said pan bottom and said gas-permeable partition for receiving from said container material fluidized by gas emanating from said gas-permeable partition, a base, and a frame supported by said base and holding said container for maintaining said cap in position supported by said base when said cap is closing said container opening.

3. The container-emptying apparatus defined in claim 2, in which the frame includes a bail having a crossbar straddling a portion of the container remote from the base, and pivot means mounting said bail on said base for swinging between a container-holding position in which said bail holds the container for maintaining the cap supported by the base and a container-released position in which the container is freed from holding engagement by the frame.

4. The container-emptying apparatus defined in claim 2, in which the outlet conduit has an opening communicating through the open side of the pan with the interior of the container, and a baffle partially obstructing the communication between the interior of the container and the outlet conduit opening.

5. Container-emptying apparatus comprising a container having an opening, a gas-fluidizing container cap including a pan the open side of which closes said container opening, a gas-permeable partition in said pan having a perforated plate and a mat of resilient porous material carried by said plate which are spaced from the bottom of said pan to define a chamber, means for supplying gas under pressure to said chamber, an outlet conduit extending from the periphery of said pan receiving from the container material fluidizing by gas emanating from said gas-permeable partition and a control valve in said outlet conduit operable to vary the flow of material therethrough, a base, and a frame supported by said base and holding said container for maintaining said cap in position supported by said base when said cap is closing said container opening.

6. Container-emptying apparatus comprising a container having an opening, a gas-fluidizing container cap including a pan the open side of which closes said container opening, a gas-permeable partition in said pan having a perforated plate and a mat of resilient porous material carried by said plate which are spaced from the bottom of said pan to define a chamber, means for supplying gas under pressure to said chamber and an outlet conduit extending from the periphery of said pan receiving from the container material fluidized by gas emanating from said gas-permeable partition, a base, and a frame supported by said base and holding said container for maintaining said cap in position supported by said base when said cap is closing said container opening.

7. Container-emptying apparatus comprising a container having an opening with a flange encircling said opening, a gas-fluidizing container cap closing said container opening and having a circumferential groove receiving said container flange, a clamping ring securing together said gas-fluidizing container cap and said container with said container flange fitted in the cap groove, a base, and a frame supported by said base and holding said container for maintaining said cap in position supported by said base when said cap is closing said container opening.

8. Container-emptying apparatus comprising a container having an opening, a gas-fluidizing container cap including a pan having a bottom, a peripheral wall with one edge encircling said bottom and an open side opposite said bottom closing said container opening, a gas-permeable partition in said pan spaced from the bottom of said pan for defining a chamber therebetween, means connected to the periphery of said pan for supplying gas under pressure to such chamber, an outlet conduit projecting from the peripheral wall of said pan at a location between the bottom of said pan and its open side for receiving material from the container fluidized by gas emanating from said partition, a valve in said outlet conduit adjustable to vary the flow of such material through said outlet conduit, a baffle partially covering the opening from the open side of said pan into said outlet conduit, a base, and a frame supported by said base and holding said container for maintaining said cap in position supported by said base when said cap is closing said container opening.

9. Container-emptying apparatus comprising a container having an opening, a gas-fluidizing container cap including a pan having a bottom, a peripheral wall with one edge encircling said bottom and an open side opposite said bottom closing said container opening, a gas-permeable partition in said pan spaced from the bottom of said pan for defining a chamber therebetween, means connected to the periphery of said pan for supplying gas under pressure to such chamber, an outlet conduit projecting from the peripheral wall of said pan at a location between the bottom of said pan and its open side for receiving material from the container fluidized by gas emanating from said partition, a baffle partially covering the opening from the open side of said pan into said outlet conduit, a base, and a frame supported by said base and holding said container for maintaining said cap in position supported by said base when said cap is closing said container opening.

10. A gas-fluidizing container cap comprising a pan having a bottom, a peripheral wall with one edge encircling said bottom and an open side opposite said bottom, a gas-permeable partition in said pan spaced from the bottom of said pan for defining a chamber therebetween, means connected to the periphery of said pan for supplying gas under pressure to such chamber, an outlet conduit connected to the central portion of the gas-permeable partition and projecting from the peripheral wall of said pan at a location between the bottom of said pan and its open side for receiving material from the container fluidized by gas emanating from said partition, said partition being dished so as to slope toward the opening to said outlet conduit, a valve in said outlet conduit adjustable to vary the flow of such material through said outlet conduit, and a baffle located above and spaced from the opening to said outlet conduit and partially covering such opening from the open side of said pan into said outlet conduit for flow of fluidized material under said baffle and into said conduit.

11. A gas-fluidizing container cap comprising a pan having a bottom and a peripheral wall having one edge encircling said bottom and said wall extending upwardly from said bottom to an open side opposite said bottom adapted to be attached to an opening in a container, a gas-permeable partition in said pan spaced from said pan bottom for defining a chamber therebetween, means connected to said peripheral wall for supplying gas under pressure to such chamber, and an outlet conduit projecting from said peripheral wall at a location between said pan bottom and said gas-permeable partition for receiv-

ing material from the container fluidized by gas emanating from said partition.

12. A gas-fluidizing container cap comprising a pan having a bottom, a peripheral wall with one edge encircling said bottom and an open side opposite said bottom, a gas-permeable partition in said pan spaced from the bottom of said pan for defining a chamber therebetween, means connected to the periphery of said pan for supplying gas under pressure to such chamber, an outlet conduit connected to the central portion of the gas-permeable partition and projecting from the peripheral wall of said pan at a location between the bottom of said pan and its open side for receiving material from the container fluidized by gas emanating from said partition, said partition being dished so as to slope toward the opening to said outlet conduit, and a baffle located above and spaced from the opening to said outlet conduit and partially covering such opening from the open side of said pan into said outlet conduit for flow of fluidized material under said baffle and into said conduit.

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