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H. J. BILLING ET AL

2,396,035

STOPPER

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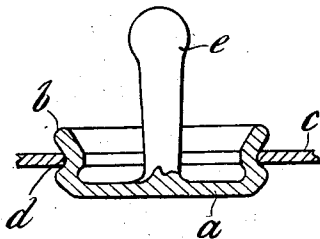


Fig. 1.

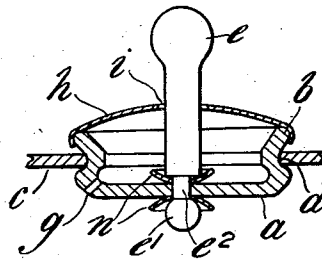


Fig. 3.

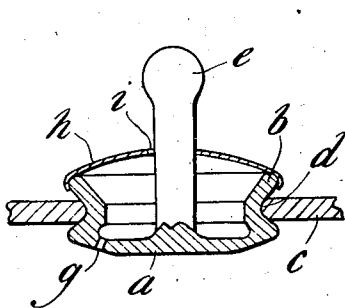


Fig. 2.

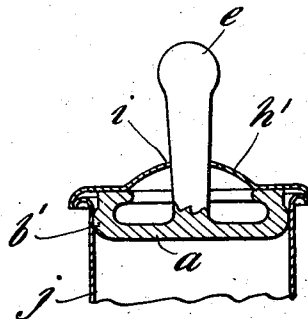


Fig. 4.

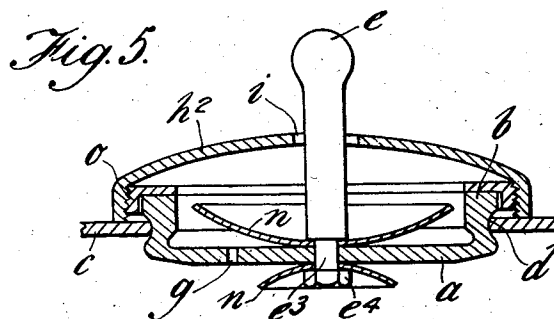


Fig. 5.

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UNITED STATES PATENT OFFICE

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STOPPER

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2 Claims. (Cl. 215—48)

This invention relates to stoppers or bungs for closing the openings in fluid receptacles, and bent and other apertures, and has for its principal object to provide a simple form of stopper or bung which can be readily applied to an opening or withdrawn therefrom by axially applied force but which, when in the applied condition, firmly grips the wall of the opening.

A more specific object of the invention is to provide a stopper or bung which, on the application thereto of a force in a direction to insert the stopper in an opening, is caused to contract laterally to allow the stopper or bung to be inserted into the opening, and which, when the applied pressure ceases, resiliently engages the wall of the opening whereby the stopper is held securely in position closing the opening, the stopper, on the application thereto of a force in a direction to withdraw the stopper from the opening, being again caused to contract to allow the stopper to be withdrawn easily from the opening.

Other objects and advantages of the present invention will be apparent from the following description read in conjunction with the accompanying drawing, in which:

Figure 1 is a central vertical sectional view of one form of stopper in accordance with the invention, and

Figures 2 to 5 are views similar to Figure 1 illustrating respectively four modified forms of the invention.

The various forms of stopper shown in the drawing each comprises a tubular body formed of rubber or other elastic material, a finger piece extending within the tubular body, and flexible means secured both to the tubular body and the finger piece adjacent the inner ends thereof, whereby, when the finger piece is moved axially relatively to the tubular body, the inner portion of the tubular body is caused to contract laterally. Preferably the flexible means is as shown in each of the figures, in the form of a diaphragm which is integral with the tubular body, the diaphragm serving wholly or in part to close or substantially to close the inner end of the tubular body and also serving to urge the tubular body to its uncontracted position.

The diaphragm or other means secured to the tubular body and the finger piece may, in some cases, be the sole means serving to urge the tubular body to its uncontracted position and the present invention also includes a stopper which comprises a tubular body formed of flexible material, a finger piece extending within the tubular body, and elastic means secured both to the tubu-

lar body and the finger piece adjacent the inner ends thereof, whereby, when the finger piece is moved axially relatively to the tubular body, the inner portion of the tubular body is caused to contract laterally and, when pressure on the finger piece is released, the said elastic means urges the tubular body to its uncontracted position.

Referring now more particularly to the drawing, the stopper shown in Figure 1 comprises a tubular body *b*, the inner end of which is closed by a circular disc *a* (herein termed a diaphragm) which may be of desired shape, for example, flat as shown. This diaphragm *a* is made of substantial thickness, so that it is sufficiently strong for its purpose, but it must possess sufficient flexibility to enable it to operate in the manner to be hereinafter described. The tubular body *b* is formed with a circumferential groove *d* adapted to engage the wall of a hole in a sheet metal receptacle (a part of which is indicated at *c*). A stem *e* extends outwardly from the centre of the diaphragm and is shaped to serve as a finger piece. The diaphragm *a*, tubular body *b*, and finger piece *e* are made from rubber or other elastic material, and are formed integrally with each other by a moulding operation. The diameter of the inner and outer end portions of the tubular body *b* is greater than the diameter of the hole to be closed.

In applying the stopper to the hole to be closed, the stopper is pressed against the surface surrounding the hole by force applied axially and inwardly to the finger piece *e*. This has the effect of bending the diaphragm *a* inwardly and causing a corresponding reduction in the diameter of the inner portion of the tubular body *b*. Under the pressure applied to the finger piece *e*, the tubular body *b* then enters the hole until the bottom of the groove *d* is aligned with the wall of the hole, further inward movement of the stopper being prevented by the outer end portion of the tubular body *b* which is not contracted in diameter. On releasing the pressure on the finger piece *e* the diaphragm *a* and the tubular body *b* resume their original condition, the tubular body being thus urged into close contact with the edge of the hole securely holding the stopper in position. To withdraw the stopper a pull is applied to the finger piece *e*. This causes the diaphragm *a* to bend in the outward direction and results in the diameter of the inner part of the stopper again being reduced, enabling the latter to pass out of the hole under the pull exerted on the finger piece *e*. During such operation the groove *d* forms a flexing fulcrum for the portion of the flange *b* of the stopper adjacent the diaphragm.

Since movement of the stem *e* relatively to the tubular body *b* can be sufficiently great to cause the tubular body at the groove *d* to contract, the diameter of the groove at the bottom thereof in the unapplied condition of the stopper may be slightly greater than the diameter of the opening into which the stopper is to be inserted so that when the stopper is inserted into the opening and pressure on the stem *e* is released, the tubular body at the groove *d*, under the resiliency of the tubular body and the diaphragm, will be strongly urged against the wall of the openings.

The stopper may be provided with one or more vent holes as indicated at *g* in Figures 2 and 3. In this case it may be required to prevent or minimize access of dirt from the outer atmosphere to the vent hole or holes. To meet this requirement we may attach a metal or other cover plate *h* to the outer edge of the tubular body *b* as shown in Figures 2 and 3, the cover plate having a central hole *i* through which the finger piece *e* can pass.

Figure 4 illustrates a form of the invention suitable for closing a receptacle neck *j* having an outwardly projecting circumferential lip. In this form of the invention, a metal cap *h*¹ adapted to cover the outer end of the neck *j* is bonded to the outer end of the tubular body *b*¹, this cap being formed at its centre with a hole *i* through which the finger piece *e* passes.

Instead of being formed integrally with the diaphragm *a*, the finger piece *e* may be made separately therefrom and may be made of metal or any other rigid material and be secured to the diaphragm in any convenient manner. Thus, as shown in Figure 3, the finger piece *e* may be formed with a spherical inner end *e*¹, and with a reduced portion *e*² adjacent to this end. In this case the diaphragm *a* is formed with a central hole through which the spherical inner end *e*¹ of the finger piece *e* can be forced, and which is adapted to receive snugly the reduced portion *e*² of the finger piece. To prevent accidental disengagement of the finger piece *e* from the diaphragm *a* split metal washers *n* may be arranged as shown between the faces of the diaphragm and the shoulders on the finger piece formed by the reduced portion *e*², these washers having a larger diameter than the said shoulders, and being of concavo-convex form to facilitate bending of the diaphragm.

In the modification shown in Figure 5 the finger piece *e* is made of metal and is formed at its inner end with a reduced portion *e*³ which passes through a hole of corresponding diameter in the centre of the diaphragm *a*, the latter being secured between the shoulder at the outer end of the reduced portion and a nut *e*⁴ on the inner end of the said portion. Also mounted on the reduced portion *e*³ of the finger piece *e* are a pair of concavo-convex washers *n*, one of these discs being situated between the outer face of the diaphragm *a* and the above mentioned shoulder on the finger piece, and the other of the discs being situated between the inner face of the diaphragm and the nut *e*⁴. These discs *n* are sufficiently large to prevent accidental disengagement of the finger piece *e* from the diaphragm. Bonded to the outer end of the tubular body *b* is a metal ring *o*, and in screw thread engagement

with this ring is a metal cover plate *h*² having a central hole *i* through which the finger piece *e* passes. The diaphragm *a* is formed with one or more vent holes *g*, and access of dirt to the vent hole or holes from the hole *i* in the cover plate *h*² is obstructed by the washer *n* at the outer side of the diaphragm, this washer being of larger diameter than that at the inner side of the diaphragm. In the form of stopper shown in Figure 5, the cover plate *h*² limits inward movement of the stopper when applied to an opening and, if desired, the outer end portion of the tubular body may have the same or substantially the same external diameter as the intermediate portion.

Stoppers according to this invention, which is not limited to the specific examples described and illustrated, may be put to a wide variety of uses, and may be adapted to meet different requirements.

We claim:

1. A stopper adapted to close an opening in a wall comprising a diaphragm of elastic material, a peripheral flange of substantially the same thickness as the diaphragm extending therefrom at one side, said flange having a free edge portion at the side thereof remote from the diaphragm, a finger piece extending from one side of the diaphragm in the same direction as said flange, the free edge portion of said flange being adapted to overlie one face of the wall surrounding the opening and form a stop when the stopper is inserted into the opening, said flange having an annular, inwardly-extending groove intermediate its ends located beyond the diaphragm in the direction of the free edge of the flange, the portion of the flange adjacent the diaphragm being adapted to overlie the other face of the wall surrounding the opening when the stopper is inserted therein, said groove forming a flexing fulcrum for the portion of the flange adjacent the diaphragm when the finger piece is moved longitudinally.

2. A stopper adapted to close an opening in a wall comprising a diaphragm of elastic material, a peripheral flange of substantially the same thickness as the diaphragm extending therefrom at one side, said flange having a free edge portion at the side thereof remote from the diaphragm, a finger piece extending from one side of the diaphragm in the same direction as said flange, the free edge portion of said flange being adapted to overlie one face of the wall surrounding the opening and form a stop when the stopper is inserted into the opening, said flange having an annular, inwardly-extending groove intermediate its ends located beyond the diaphragm in the direction of the free edge of the flange, the portion of the flange adjacent the diaphragm being adapted to overlie the other face of the wall surrounding the opening when the stopper is inserted therein, said groove forming a flexing fulcrum for the portion of the flange adjacent the diaphragm when the finger piece is moved longitudinally, and a cover piece secured to the free edge portion of said flange and having an opening through which said finger piece extends.

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