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APPARATUS FOR INTRODUCING A DEVICE THROUGH A BORE HOLE CASING

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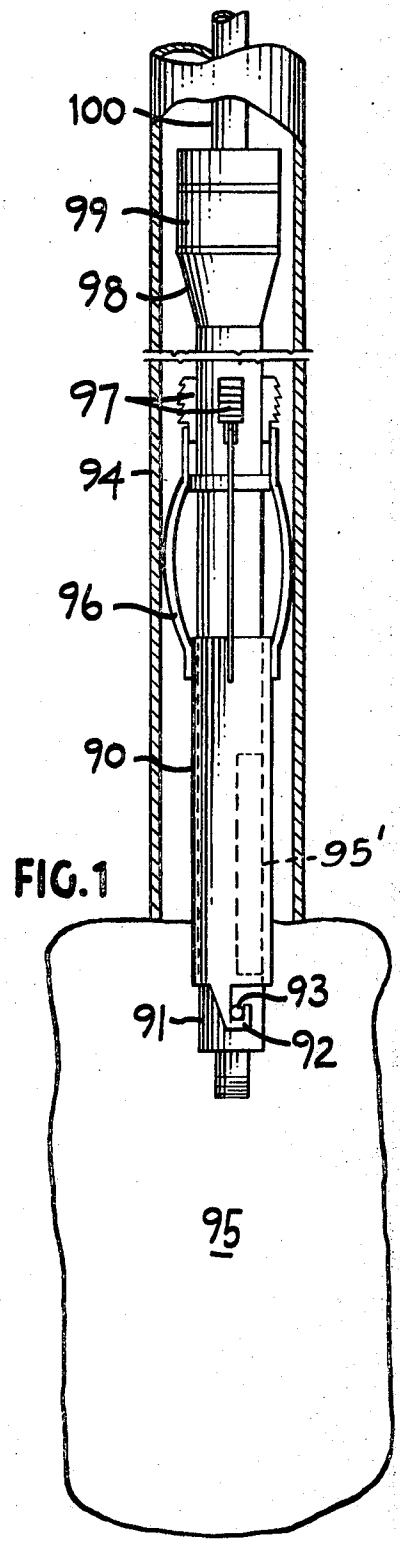


FIG.1

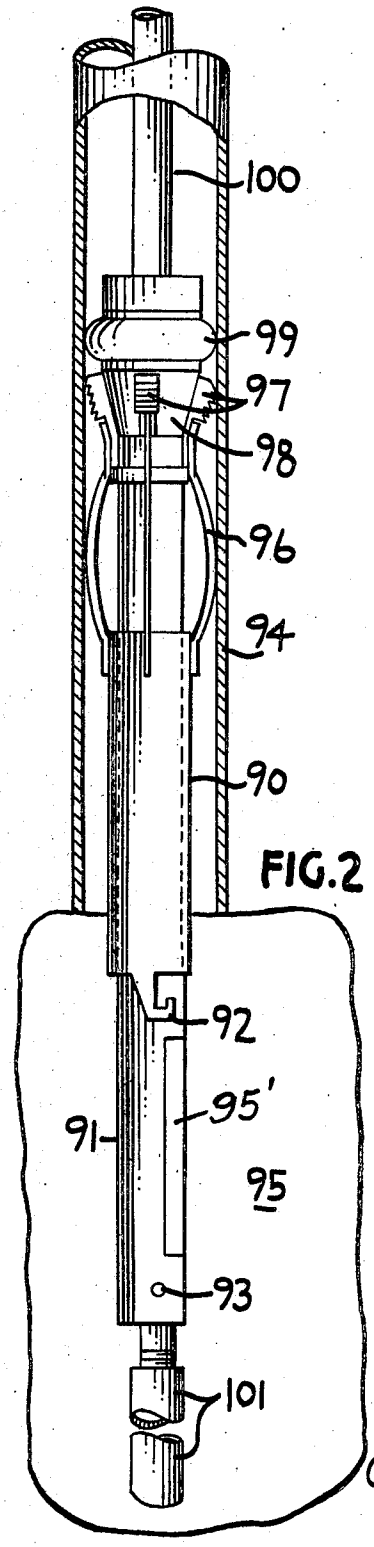


FIG.2

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APPARATUS FOR INTRODUCING A DEVICE THROUGH A BORE HOLE CASING

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Original application Mar. 11, 1966, Ser. No. 533,558, now Patent No. 3,400,980, dated Sept. 10, 1968. Divided and this application May 27, 1968, Ser. No. 732,292
Int. Cl. E21c 37/06
U.S. Cl. 299—5 3 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for introducing devices such as flexible conduits, meters and the like through a bore hole casing to a subterranean cavity as described. The apparatus comprises concentric pipes, one housing the device, the other acting as a protective cover while the pipes are in the bore hole casing. An opening in the inner pipe and construction permitting the pipes to be separated in a vertical direction, allows for the introduction of the device to the cavity when the cavity is reached by both pipes. Means for firmly attaching the outer pipe to the casing are also described.

This is a division of applicants' copending application Ser. No. 533,558, filed Mar. 11, 1966 and now Patent No. 3,400,980.

This invention relates to placing down hole mechanisms in a subterranean cavity. It more specifically relates to novel apparatus for inserting down hole mechanisms through a cased bore hole to a subterranean cavity and methods for the use thereof.

Very often in subterranean operations, notably in solution mining, it is desired to place a variety of mechanisms ranging from simple pipe extensions to complicated gadgetry in a subterranean cavity. The only access to such a cavity may be through one or more cased bore holes of limited diameter. In solution mining of salts, e.g., NaCl, KCl, trona, or similar extractable materials, the casings employed are rarely in excess of 12 inches internal diameter. More often, the casings employed are between about 4 and about 10 inches in diameter. In typical solution mining operations where a cased bore hole is disposed through subterranean formations to communicate with a cavity located, e.g., less than 1,000 to 5,000 or more feet beneath the surface of the earth, 7 inch casings are commonly employed. Pushing down hole mechanisms through this limited access is hazardous to the equipment. The difficult and hazardous nature of the operation severely limits the type of equipment which can be disposed in a bore hole. Typically only very rugged mechanisms of a simple nature have been inserted through a long casing to a a subterranean cavity. The present invention provides simple yet effective means for introducing delicate and/or complicated down hole mechanisms to a subterranean cavity.

Particularly useful adaptations of the claimed apparatus are those employed to deliver delicate solvent carrying devices to a subterranean cavity. In a typical solution mining operation, a cased bore hole is provided through the earth to an extractable deposit. One or more tubes are then disposed through the bore hole to communicate with the deposit. These tubes provide additional conduits for fluid flow. Typically, solvent is introduced to the deposit through the annulus between the centrally disposed tubing and the casing of the bore hole to contact the extractable deposit. Solution laden with extracted minerals is then withdrawn from the deposit to the surface of the

earth through the centrally disposed conduit thereby forming a cavity in the extractable deposit.

At first, when the cavity is small, a solution mining system is normally quite uneconomical. As the cavity size is increased, the economics of the operation significantly improve. The efficiency and productivity of a solution mining cavity may often be greatly improved by developing the cavity in selected directions to produce a cavity of a desired shape. The desired shape of a cavity depends largely on the configuration and mineral composition of the mineable and adjacent deposits.

Economics, productivity, and efficiency of a solution mining operation also generally improve when the injection point at which solvent is introduced to the cavity is separated by a substantial distance from the effluent point at which solution is withdrawn from the cavity. This separation results in an improved flow pattern in the cavity. Lateral separation of the injection and withdrawal points is particularly beneficial. Such lateral separation is most conveniently obtained by providing in the cavity horizontal extensions of the injection and/or withdrawal conduits.

It is often desirable to develop a plurality of cavities until they communicate with each other. The internal piping or tubing can then be removed from the bore holes communicating with the respective cavities. One such bore hole can then function as the solvent input conduit while the laterally separated bore hole functions as the effluent withdrawal conduit. It is usually desirable to accomplish this connection of separated bore holes as quickly as possible. Connection of separated bore holes is greatly facilitated by preferentially extracting the deposit at the base of a bore hole towards a separated bore hole. Extraction in a selected direction is encouraged by providing in the cavity lateral extensions to the supply conduit or conduits oriented in the desired direction.

Copending application Ser. No. 533,489, filed Mar. 11, 1966, teaches the introduction of flexible conduits to a solution mining cavity. The tube is oriented and extended in the earth to provide a lateral extension of the casing from which it originates. Commonly assigned, copending application Ser. No. 533,518, filed Mar. 11, 1966, teaches the introduction of telescoping rigid conduits to a cavity. The nested tubes are oriented and extended to provide lateral extensions of the injection and/or withdrawal casings. The conduits disclosed in the aforementioned copending applications are subject to damage as they are introduced down a bore hole. The apparatus of the present invention provides protective carrying means for these delicate extendable conduits. The claimed apparatus is also useful to protectively introduce other delicate devices besides solvent delivery systems such as flow diverters, photographic equipment, electronic gear, sample retrieval devices, etc.

The invention will be more readily understood with reference to the accompanying drawings of which FIGURES 1 and 2 illustrate an embodiment of the claimed device in which the hatch is covered by an outer concentric pipe section.

It is recognized that a casing may not always be disposed in a strictly vertical orientation in practice. Often a bore hole is provided to a subterranean deposit in a direction with both a vertical and a significant horizontal component. The direction of the bore hole is often altered from time to time between the earth's surface and the subterranean terminus of the bore hole. The overall vertical component is normally much greater than the overall horizontal component, however. Hence, in the instant disclosure, the invention is described with referece to vertical bore holes. The solvent supply or other devices introduced down a bore hole in the apparatus of this

invention and subsequently reoriented are accordingly described as being in an "upright" or "vertical" position. The invention includes within its scope embodiments in which such devices are disposed in a horizontal or some other direction, provided the axis of the carrier is approximately parallel to the axis of the bore hole.

FIGURES 1 and 2 illustrate an embodiment in which the carrying apparatus of this invention comprises essentially two concentric pipes. The outer pipe **90** is held in relation to the inner pipe **91** by means such as a J hook **92** and lug **93**. Referring to FIGURE 1, the inner pipe carries the mechanism to be introduced down down the bore hole casing **94**. The outer pipe serves as a shield or cover to protect the apparatus stored in the inner pipe as it is introduced down a casing **94**. When the unit reaches the bottom of the casing, the inside pipe is raised slightly and turned to cause lug **93** to come out of J hook **92**. The inner or carrier pipe may then be dropped or pushed down through the outer pipe as shown in FIGURE 2 exposing or releasing the internals via opening **95'** to the cavity **95** communicating with casing **94**. Means such as bow springs **96** suspend the outer pipe in the casing to hold the outer pipe in position as the inner pipe is moved independently.

As the inner pipe **91** is pushed down through the outer pipe **90**, slips **97** ride up on mandrel **98** and bite into the casing wall to anchor the outer pipe even more firmly into position. The thus firmly anchored outer pipe offers sufficient resistance to the downward movement of the expandable packer **99** to cause it to expand to contact the casing wall (FIGURE 2). The expanded packer provides a complete seal of the annulus between the inner pipe **91** and the casing **94**. Fluids introduced through this annulus are thus directed through the carrier to the apparatus, e.g., flexible tubes or telescoping tubes, contained therein. As in other embodiments, internal tubing **100** is conveniently disposed through the assembly to provide a second fluidizing conduit if desired. An extension **101** of the tubing is sometimes employed to locate the terminus of this second fluid-carrying conduit at a predetermined elevation in the cavity.

The apparatus of the present invention is provided through a bore hole by any convenient means. Often tubing passes through the carrier and is attached thereto. The apparatus is then pushed through the casing by the tubing. In other embodiments, the carrier is attached to liner and the liner is suspended from the casing by packing means. By "liner" is meant a conduit which is disposed inside a casing but extends only a portion of the length of the casing, typically from the cavity only a few feet up the casing. "Tubing" refers to similar conduits which extend from the earth's surface down through the casing. Liners are set in a casing by well known techniques on tubing strings or by means of wire lines.

The hatches of the claimed apparatus are openings of any convenient size and shape. There may be one or a plurality of such hatches in a given apparatus. A hatch may be covered with a door for added protection. The door, typically a removable section of the carrier, may be mechanically biased by means provided for that purpose. Alternatively, the doors may be removed in response to electrical or magnetic impulses or any other suitable means. Opening of the hatches is usually correlated with emergence of the apparatus from a casing into a cavity. It is within contemplation that the opening

of the hatch be correlated with some other reference point, e.g., when the carrier strikes the bottom of the cavity or reaches a pre-determined pressure or temperature environment in the cavity.

Orientation means are often included in association with the carrier assemblies of this invention. Means within contemplation include simple hinge means adjusted to stop or lock in a predetermined position as the down hole device falls from the carrier. More sophisticated means may be employed when it is desired to adjust from time to time the orientation of the device with respect to horizontal or with respect to the points of the compass. Such means will readily suggest themselves to the skilled art and the invention is not limited in scope to the specific means illustrated in the drawings.

The dimensions of the claimed apparatus are restricted only by the height of the cavity and the diameter of the bore hole casing through which it is emplaced in the cavity. Thus, the outer diameter of the carrier need be only very slightly smaller than the internal diameter of the casing. The total height of the carrier may be even greater than the height of the cavity provided the top of the hatch is below the bottom of the casing when the carrier touches the bottom of the cavity. In a cavity 50 feet high, for example, a carrier nearly 50 feet long may be conveniently employed. If it is desired to relocate the down hole mechanism near the top of the cavity after it has been released near the bottom of the cavity, the carrier need merely be partially withdrawn up the bore hole.

What we claim is:

1. Apparatus for protectively introducing a device through a bore hole casing to a subterranean cavity comprising a container formed by two concentric pipes, the inner of said two concentric pipes being constructed to house said device and provided with an opening suitable for introducing said device into said cavity, the outer of said concentric pipes forming a cover for said opening, means associated with said concentric pipes to separate them from each other in a vertical direction to thereby expose the opening of said inner pipe and provide casing for said device from said inner pipe to said opening and means operably associated with said inner pipe to provide for firmly attaching the outer pipe to the wall of the bore hole casing when the inner pipe is moved away from the concentric outer pipe in a vertical direction.

2. The apparatus of claim **1** wherein said device is selected from the group consisting of solvent supply systems, flexible conduits, fluid flow diverters, electronic measuring devices, sample retrieval devices and photographic equipment.

3. The apparatus of claim **1** wherein the device includes a telescoping rigid conduit.

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U.S. Cl. X.R.

299—17; 166—117