

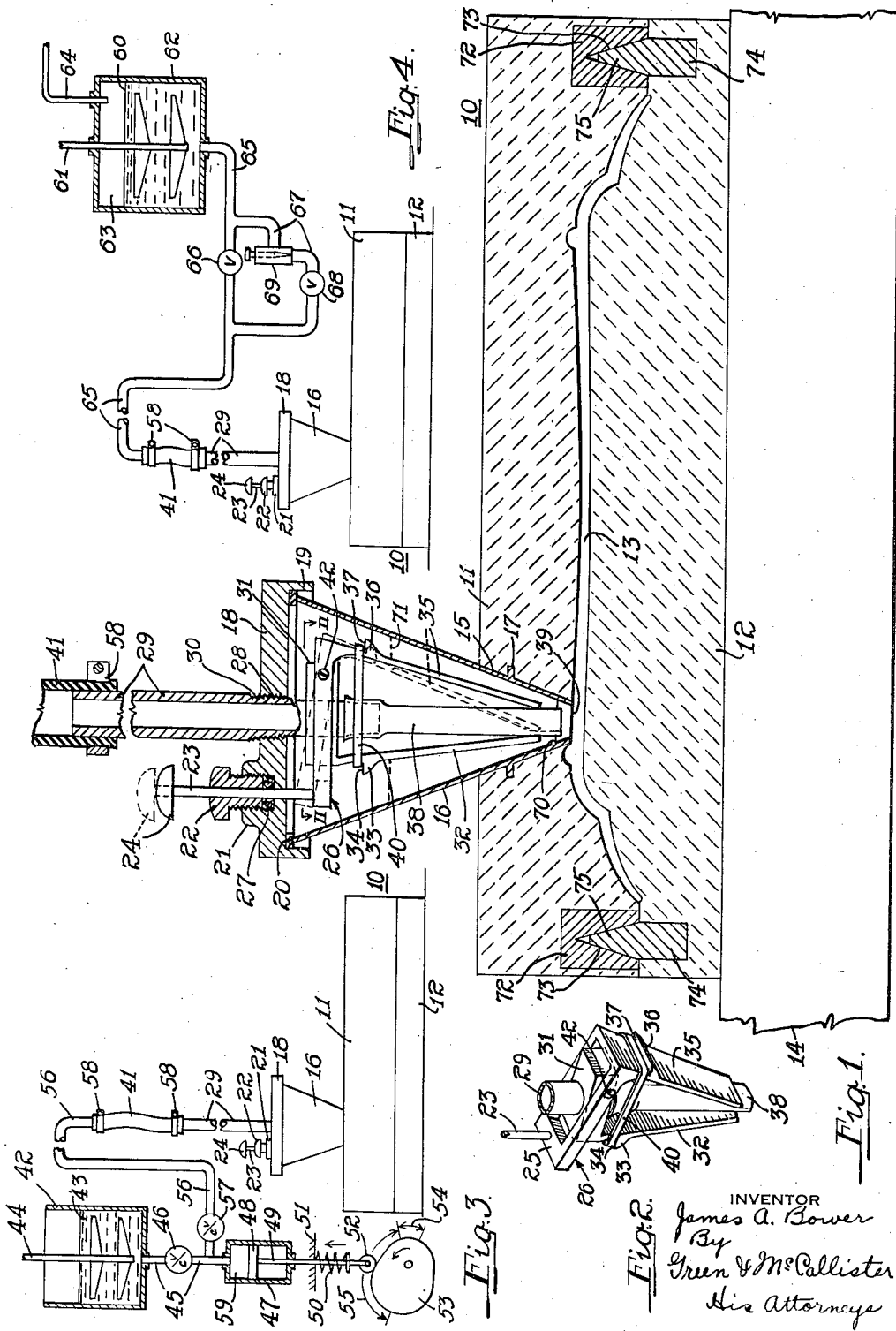
Feb. 17, 1942.

J. A. BOWER

2,273,016

APPARATUS FOR FEEDING CERAMIC SLIP

Filed April 1, 1939



INVENTOR
James A. Bower
By
Green & McCallister
His Attorneys

UNITED STATES PATENT OFFICE

2,273,016

APPARATUS FOR FEEDING CERAMIC SLIP

James A. Bower, Chester, W. Va., assignor to The Taylor, Smith & Taylor Company, a corporation of West Virginia

Application April 1, 1939, Serial No. 265,461

9 Claims. (Cl. 25-29)

The present invention relates to an apparatus for feeding ceramic slip to a mold cavity in which a ceramic article is to be cast, and is particularly designed for carrying out the slow-fast fill described and claimed in my copending application Serial No. 258,746, filed February 27, 1939.

In connection with the filling of liquid slip into a mold cavity where a ceramic casting is to be produced, it is particularly important to avoid the introduction of air either into the slip or into the casting being made. Therefore, any turbulence, splashing or uncontrolled feeding of slip is undesirable since it adversely affects the cast article. Again, even though care be taken in the introduction of liquid slip into a mold cavity, disadvantageous results can readily arise due to a sudden delivery at one time of the entire volume of liquid slip necessary for the casting because this likewise causes undesirable entrapment of air due to splashing, etc. The undesirability of air in the slip and casting and the disadvantages resulting therefrom are more fully and specifically set forth in my aforesaid copending application.

One of the objects of the present invention is to provide apparatus which is simple and inexpensive and which will make possible the efficient accomplishment of the slow-fast fill referred to.

Another object of the invention resides in providing the nonporous funnel by means of which the liquid slip is introduced into the mold cavity with means whereby the liquid slip can be delivered to a predetermined point of the mold cavity, preferably under pressure and always under full control as to rate of delivery and volume delivered.

More specifically, an object of my invention resides in providing the non-porous funnel by means of which liquid slip is fed to a mold cavity, as heretofore mentioned, with an arrangement whereby the liquid slip can be delivered under pressure to the thickest portion of the mold cavity and in such manner that the delivery of the liquid slip, and hence the filling of the mold cavity, is initiated relatively slowly and completed relatively rapidly.

Other and further objects and advantages will be appreciated by those skilled in this art or will be apparent or pointed out hereinafter.

In the accompanying drawing wherein I have illustrated certain embodiments of the present invention and wherein like numerals designate corresponding parts throughout the various views:

Fig. 1 is a vertical sectional view, partly in

elevation, of the molds, funnel and funnel structure by means of which the present objects can be accomplished;

Fig. 2 is a perspective view of the parts in the funnel taken on line II-II of Fig. 1;

Fig. 3 is in part a vertical sectional view and in part an elevational diagrammatic view of one form of effecting the slow-fast fill with the structure of Fig. 1; and

Fig. 4 is a view similar to Fig. 2 of a modified form of slow-fast fill feeding and control means.

Referring first to Figs. 1 and 2, a set of molds of dehumidified plaster of Paris or other suitable absorbent composition, which is designated as a whole by the numeral 10, has its upper and lower molds 11 and 12 so configured as to define between them, when they are assembled, the mold cavity 13 which in the particular form illustrated in Fig. 1 represents a plate but which may be any other item of cast flatware defined by my copending application above identified. The set of molds 10 is preferably conveyed or transferred as may be desired or required on a supporting member or element 14, which may be a conveyor, tray or the like, as will also be apparent from my said copending application.

The upper mold 11 is provided with a frusto-conical opening 15 therethrough within which is disposed the lower end of the nonporous funnel 16 which is preferably made of copper or other suitable metal. This funnel 16 is preferably a permanent part of the upper mold 11 and this is indicated by the fact that the raised ring or annular projection 17 of the funnel is embedded within the material of the upper mold, this arrangement being produced at the time when the mold in question is formed, i. e., the mold 11 is cast around the lower end of the funnel. It will be noted that the funnel terminates flush with the upper edge or surface of mold cavity 13 and that the funnel is so located that it delivers, in the manner hereinafter to be described, the liquid slip to the thickest portion of the mold cavity so that filling thereof takes place in a thick-thin direction. The purpose and advantage of such will likewise be understood from my copending application.

The funnel 16 is provided with a closure 18 which in the particular example shown is in the form of a comparatively thick metal disc having a depending annular flange 19. The upper end of the funnel lies within the flange and is sealed with respect to the bottom of the closure 18 by means of the annular gasket or washer 20 which is of rubber, fibre or other suitable non-

metallic material capable of providing an air-tight seal. The closure 18 is also provided with an upwardly projecting cylindrical boss 21 within which the bored plug 22 is threadedly engaged. Through the bore of such plug extends the shank 23 of the actuator 24, the said shank extending entirely through the closure and terminating in the funnel in contact with one end 25 of the yoke-like member 26. Actuator 24 is adapted to be lowered manually (or automatically) and in order to provide an air-tight joint a suitable packing material 27 is disposed between the plug 22 and the bottom of the boss 21 to form, in effect, a stuffing-box.

The closure 18 is provided with a central threaded aperture 28 within which is adapted to be threadedly received the conduit or delivery member 29 which has a threaded section 30. This conduit while normally retained assembled with the closure, as shown, may be removed and replaced by appropriate directional rotation thereof. The portion of the conduit below the closure is of reduced external diameter and disposed thereon is the block-like member 31. Depending from one end of such block-like member is the plate-like member 32, the outer surface of which is provided with a projection 33, the upper surface of which provides a shoulder 34. Depending from that end of the member 26 which is opposite the end of the block-like member 31 from which the plate-like member 32 depends, the member 26 itself is provided with a similar plate-like member designated as 35, the external surface of which is provided with a projection 36 providing a shoulder 37 similar to the corresponding members described in connection with the other plate-like member.

The lower end of conduit 29 is provided with a rubber tube 38, of readily collapsible nature, the bottom of which terminates at or adjacent the bottom of the funnel and centrally with respect to the small opening 39 of such funnel. A rubber holding member 40, in this case a strong rubber or gum band, surrounds the plate-like members as shown, is prevented from slipping by the said projections and rests upon the said shoulders. Member 40 acts normally to urge the plate-like member 35 to the dotted line position shown in Fig. 1. In its dotted line position this plate-like member collapses a portion of the rubber tube 38 with the result that the delivery of liquid slip is prevented. In other words, the structure just recited is equivalent to a valve which is capable of operating within the closed funnel under the control of an external member which extends into operative relation therewith. The upper end of conduit 29 is connected to a suitable hose or the like 41.

It will be understood that movement of member 35 from dotted to full line position (Fig. 1) is effected by depressing actuator 24 from dotted to full line position, such movement causing member 26 to fulcrum about the eccentrically mounted screw or the like 42. The dotted line positions are the positions which the parts normally assume when filling is not taking place and under which conditions the rubber tube 38 is collapsed and closed so that liquid slip cannot be delivered therefrom. Removal of the depressing force on actuator 24, however, results in the parts assuming their dotted line positions, this taking place under the contractile influence of member 40.

In Fig. 3 I have illustrated an arrangement which is capable of effecting the slow-fast fill here involved, and in this figure the numeral 42

indicates an open tank in which there is a supply of liquid slip 43 of desired viscosity, specific gravity and composition. This supply of slip is preferably maintained in an agitated condition by means of the agitator diagrammatically indicated at 44. The bottom of the tank 42 is provided with a pipe 45 which is provided with a check valve 46, the lower end of the pipe connecting into the top of the cylinder 47 in which the piston 48 operates. The piston is provided with a rod or stem 49, the lower portion of which is provided with a helical spring 50 one end of which is suitably secured to the rod 49 and the other end of which bears against a suitable supporting surface 51 through which the said stem operates. The lower end of the stem is provided with a rotatable cam follower 52 which is adapted to follow the profile of the eccentrically mounted cam 53. This cam is so shaped that it moves piston 48 in cylinder 47 relatively slowly at the beginning of the upward stroke while the cam profile is turning the amount indicated by the distance arrow 54. Throughout the remainder of the half profile of the cam (indicated by the distance arrow 55) the piston is actuated relatively rapidly. That is to say, the initial displacement of piston 48 is slow and the balance of the displacement on the upward stroke is rapid. The down or suction stroke is, of course, just the opposite and therefore most of the succeeding charge of slip is withdrawn rapidly from the tank.

A pipe 56 leads from the pipe 45, is provided with a check valve 57 therein, and has its free end provided with the flexible section 41, previously referred to, which may be of rubber hose or other flexible nonmetallic material. One end of section 41 is secured to pipe 56 by means of a hose clamp 58, and the other end of the flexible section is similarly connected to the upper end of the conduit 29.

The check valve 46 permits liquid slip to flow only in a downward direction and the check valve 57 permits liquid slip to flow only toward the funnel. Thus, the chamber 59 between the piston and the end of the cylinder is charged with liquid slip by gravity or by the suction action created by the piston during its downward movement, or both, and then upon upward movement of the piston 48 the charge of slip is first relatively slowly forced through pipe 56 and then relatively rapidly pumped for the balance of the charge, the chamber 59 being of such dimensions that it holds the required or desired amount of slip.

In Fig. 4 another arrangement has been illustrated for producing a slow-fast fill of mold cavity 13. However, in Fig. 4 the supply of liquid slip 60, which is maintained under agitation by means of a suitable agitator such as that diagrammatically illustrated at 61, is confined within a closed tank 62 in such manner that there is an air chamber 63 between the top of the liquid slip and the top of the tank. By means of the pipe 64 air under pressure can be introduced into said air chamber and the pressure is maintained at such a value as will enable the liquid slip to be discharged in such manner as to meet the requirements of the present invention.

The pipe 65 leading from the bottom of tank 62 is provided with a valve 66 of a type which is herein termed a "quick opening valve," indicating that it can be fully opened almost instantaneously at the desired or appropriate time. Pipe 65 leads to the flexible section 41 which is

clamped at one end to the said pipe 65 and at the other end to the conduit 29, precisely as in Fig. 3. The pipe 65 is provided with a by-pass line 67 which has a quick opening valve 68 of the same character as that previously referred to at 66, and on the inlet side of the valve 68 a needle valve 69 is located which is permanently set or adjusted in such manner as to admit a relatively small flow of liquid slip to the funnel 16 with insufficient velocity or force to cause splashing, turbulence, etc. in the funnel, as above pointed out, and thus in such manner as to prevent the entrapment or the entrainment of air in the slip. The amount and rate of flow of slip passing through the needle valve is the slow part of the slow-fast fill and corresponds to the flow of slip created by the initial portion of the upward stroke of piston 48 in the structure of Fig. 3.

In connection with the operation of the system of Fig. 4, the valve 68 is opened simultaneously with the depression of the actuator 24, and thus at the same time that the rubber tube 38 is opened. Valve 66 remains closed at this time. Due to the preadjusted needle valve 69 and to the presence of air under pressure in the chamber 63, liquid slip flows through pipe 65, through by-pass 67, through flexible section 41 and through pipe 29 down into the rubber tube 38 from which it is delivered directly into the thickest portion of the mold cavity 13, and this slow initial feed continues substantially only until liquid slip rises to the level in the funnel indicated by the line 70. This occurs almost immediately, i. e., within a very few seconds. When the liquid slip reaches the level of the line 70, and hence seals off the bottom of the rubber tube from the air or atmosphere within the funnel, the valve 66 is opened, and thus liquid slip from that time on is fed or delivered relatively rapidly, and this rapid feed continues until the liquid slip level rises to the line indicated by the numeral 71. The exact height of this line depends upon the air pressure in the chamber 63, the size of the funnel, etc., and it will be understood that the level will rise in the funnel until the pressure in the reduced unoccupied air space in the funnel becomes equal to that in the storage tank chamber. When the two pressures reach equilibrium the feed of slip ceases. Thus, by controlling or predetermining the pressure in the chamber 63 of the storage tank and/or the size of the funnel I can precisely determine the amount of liquid slip which is fed into the funnel so as to produce ultimately a ceramic casting which represents a minimum waste or excess of liquid slip. The same mode of operation applies, of course, to Fig. 3.

It will be appreciated by those skilled in this art that the total amount of liquid slip which is fed is equal to the volumetric capacity of the mold cavity 13 plus an allowance for shrinkage due to absorption of moisture by the molds plus an exceedingly small excess which constitutes a pour spot which must be ultimately removed, as is shown in and as will be understood from my aforesaid copending application. Thus, by varying the air pressure in storage tank 63 for different molds or mold cavities or articles to be made, the slow-fast fill can be accomplished under various conditions and is thus applicable to the production of many different articles of cast ceramic ware.

It will be understood further that suitable means is provided for ensuring accurate registration of the upper and lower mold parts 11 and 12, and, while the means for registration may take

various specific forms, many of which are well known in the mold-makers' art, I prefer to provide the upper mold with the two brass or other metallic cylindrical members 72, each of which is provided with an inverted conical recess 73 and the lower mold with a plurality of cylindrical pins 74 embedded cylindrical end downward in the mold 12 and having a truncated cone end 75 projecting above the mold and adapted to be received within the inverted cone recesses above mentioned. This registration means makes possible both a rapid assembly of the mold parts and an assembly which cannot result in relative displacement or misalignment of the mold parts due to the shape of the projecting pins and recesses. It is, however, to be understood that I am not limited to the use of the particular registration means shown.

The foregoing description is intended as illustrative and not as limitative and I intend that the same shall be subject to various modifications, substitutions, additions and omissions without departing from the spirit and scope hereof which is rather that set forth by the appended claims. While the apparatus herein described and claimed is particularly intended and adapted for use in connection with my new procedure for making cast flatware, it may nevertheless be employed wherever the principles hereof find application. While the feeding arrangements described involve some manual intervention, i. e., require an operator, it is within the purview of my invention to make the same entirely automatic, in which event the various valves will be electrically actuated and preferably in a timed relationship, depending upon the rate at which molds are to be filled. As each set of molds with its funnel approaches the point where slip is fed, the funnel closure 18 with all the associated parts attached thereto is placed over the funnel, filling is effected, and after filling is completed the closure 18 with all its associated parts is again removed so that the set of molds may travel on as required unencumbered by any accoutrements except the funnel itself. Also, while I have shown the section 41 secured by hose clamps, it will be clear that other suitable arrangements can be resorted to equally well.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Apparatus for accomplishing a slow-fast fill of a mold cavity in which a ceramic article is to be cast which comprises a funnel embedded in one of the molds defining said mold cavity, a top closure for said funnel, a conduit passing through said closure and terminating in a rubber tube which is adapted to deliver liquid slip adjacent the bottom of the funnel, means within the funnel for collapsing the rubber tube to prevent discharge of slip, and means extending through the closure and operable from without the funnel for rendering said previous means ineffective.

2. Apparatus for accomplishing a slow-fast fill of a mold cavity in which a ceramic article is to be cast which comprises a funnel embedded within one of the molds which defines said mold cavity, a flanged disc-like top closure for said funnel, an actuator extending through said closure and provided with a stuffing-box-like arrangement, a metal conduit passing through said closure and adapted to be threadedly engaged therewith, a rubber tube on the lower end of the conduit and terminating adjacent the bottom

of said funnel, a block-like member engaging said conduit and through which said conduit extends, a yoke-like member eccentrically fulcrumed to said block-like member, a plate-like member depending from said block-like member, a plate-like member depending from said block-like member, a plate-like member depending from said block-like member, means for normally urging the second plate-like member toward the first plate-like member to collapse and shut off the rubber tube which extends therebetween, and means for delivering liquid slip to the mold cavity from the lower end of said rubber tube first slowly and then rapidly.

3. Apparatus for accomplishing a slow-fast fill of a mold cavity in which a ceramic article is to be cast which comprises a funnel embedded within one of the molds which defines said mold cavity, a flanged disc-like top closure for said funnel, an actuator extending through said closure and provided with a stuffing-box-like arrangement, a metal conduit passing through said closure and adapted to be threadedly engaged therewith, a rubber tube on the lower end of the conduit and terminating adjacent the bottom of said funnel, a block-like member engaging said conduit and through which said conduit extends, a yoke-like member eccentrically fulcrumed to said block-like member, a plate-like member depending from said block-like member, a plate-like member depending from said block-like member, a plate-like member depending from said block-like member and converging downwardly with respect to the first plate-like member, means for normally urging the second plate-like member toward the first plate-like member to collapse and shut off the rubber tube which extends therebetween, and means for delivering liquid slip to the mold cavity from the lower end of said rubber tube first slowly and then rapidly, each of said plate-like members being provided with an external projection forming a pair of shoulders to prevent downward slippage of said first means.

4. Apparatus for accomplishing a slow-fast fill of a mold cavity in which a ceramic article is to be cast which comprises a funnel embedded in one of the molds which defines the mold cavity, a top closure for said funnel, a partly rigid metallic and partly yielding nonmetallic conduit extending through said closure and terminating adjacent the bottom of said funnel, means for predeterminedly collapsing and opening the yieldable nonmetallic portion of said conduit, and means for delivering liquid slip into said mold cavity from said yieldable nonmetallic conduit portion first at a relatively slow rate and then at a relatively rapid rate.

5. Apparatus for accomplishing a slow-fast fill of a mold cavity in which a ceramic article is to be cast which comprises a funnel embedded in one of the molds which defines the mold cavity, a top closure for said funnel, a partly rigid metallic and partly yielding nonmetallic conduit extending through said closure and terminating adjacent the bottom of said funnel, means for predeterminedly collapsing and opening the yieldable nonmetallic portion of said conduit, and means for delivering liquid slip into said mold cavity from said yieldable nonmetallic conduit portion first at a relatively slow rate and then at relatively rapid rate, said first means being dis-

posed partially within said funnel and partially outside the same and the former part being actuated by the latter part.

6. Apparatus for accomplishing a slow-fast fill of a mold cavity in which a ceramic article is to be cast which comprises a funnel embedded in one of the molds which defines the mold cavity, a top closure for said funnel, a partly rigid metallic and partly yielding nonmetallic conduit extending through said closure and terminating adjacent the bottom of said funnel, means for predeterminedly collapsing and opening the yieldable nonmetallic portion of said conduit, and means for delivering liquid slip into said mold cavity from said yieldable nonmetallic conduit portion first at a relatively slow rate and then at a relatively rapid rate, said first means including two plate-like members one of which is adapted to advance toward and retract from the other in such manner as to shut off and open the said yieldable nonmetallic conduit section, an element which normally maintains the plate-like members in conduit closing position, and means extending through said funnel closure and adapted to effect opening of said closed conduit section.

7. Apparatus for slip-casting a ceramic article comprising a mold having a cavity, means for introducing slip into said cavity, means for initially supplying slip to said introducing means at a relatively slow rate for a predetermined period of time less than that necessary to fill the cavity, means for thereafter supplying slip to said introducing means at a faster rate than the said initial rate, the supply and introducing means being so constructed and arranged that the slip supplied at the faster rate is out of contact with the atmosphere during its passage through the introducing means and at the point of entry into the cavity.

8. Apparatus for slip-casting a ceramic flatware article comprising a mold having a cavity of the shape and size, with due allowance for shrinkage, of such flatware article and of non-uniform thickness characteristics, means for introducing slip into said cavity adjacent the thickest portion thereof, means for initially supplying slip to said introducing means at a relatively slow rate for a predetermined period of time less than that necessary to fill the cavity, means for thereafter supplying slip to said introducing means at a faster rate than the said initial rate, the supply and introducing means being so constructed and arranged that the slip supplied at the faster rate is out of contact with the atmosphere during its passage through the introducing means and at the point of entry into the cavity.

9. Apparatus for slip-casting a ceramic article comprising a mold having a cavity, means for introducing slip into said cavity, means for initially supplying slip to said introducing means at a relatively slow rate and in an amount less than that necessary to fill the cavity, means for thereafter supplying slip to said introducing means at a faster rate than the said initial rate and at super-atmospheric pressure, the supply and introducing means being so constructed and arranged that the slip supplied at the faster rate is out of contact with the atmosphere during its passage through the introducing means and at the point of entry into the cavity.

JAMES A. BOWER.