Jan. 23, 1951 S. S. GARRETT 2,539,189

APPARATUS FOR ANATOMICAL USE OF GAS

Filed April 18, 1947

Fig. 1.

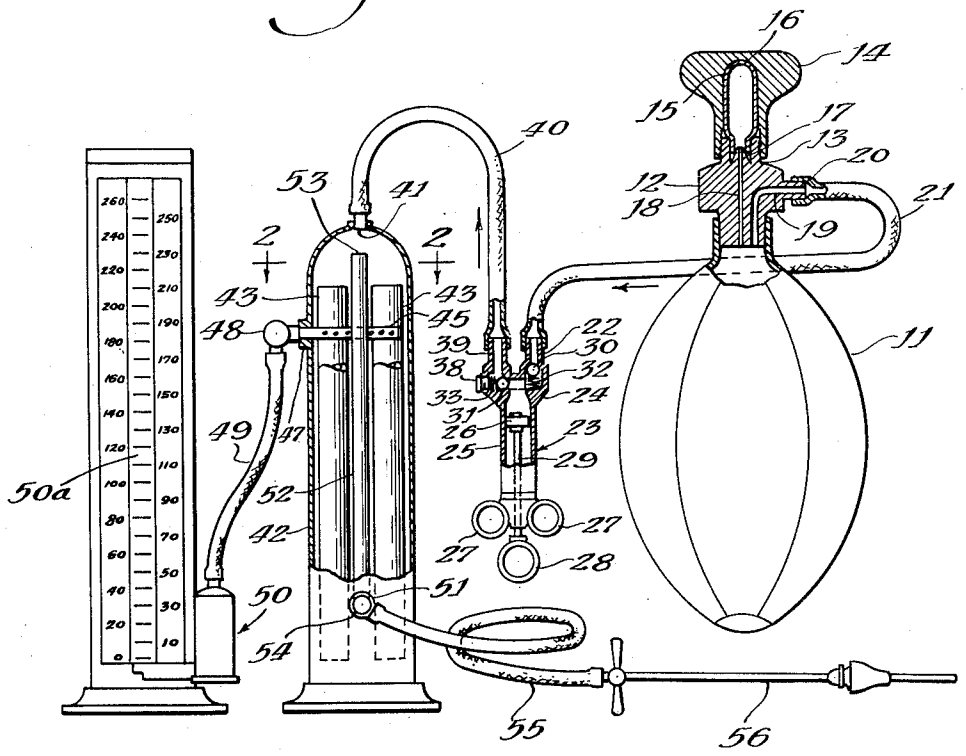


Fig. 2.

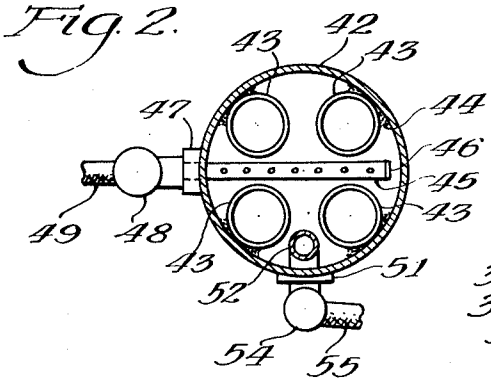
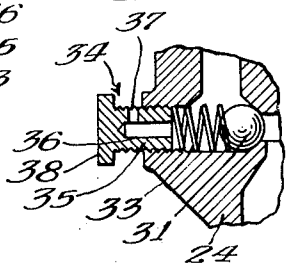


Fig. 3.



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APPARATUS FOR ANATOMICAL USE OF GAS

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10 Claims. (Cl. 128—184)

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This invention relates to improvements in apparatus and methods for introducing gas into the human body and more particularly to an improved apparatus and method for using gas in testing for and treatment of female sterility.

It is known that many women are unable to conceive because they have a blockage of the Fallopian tubes which convey the ovum to the uterus.

It has been previously proposed to introduce gas under pressure into the cervix and then determine by X-rays whether the gas has passed into the abdominal cavity by way of the uterus and the tubes. Attempts have been made to use this technique both as a test to determine whether the tubes were closed by mucus, adhesions or some other obstruction and to open them if they were found to be closed.

The methods and apparatus used for this purpose prior to my invention, however, have been crude and subject to rather serious objections, particularly from the standpoint of safety in use. While there have been variations in the devices employed, all of them, so far as I am aware, have used gas from a high pressure source, such as the usual tank of carbon dioxide, without adequate means of reducing the pressure or controlling and measuring the flow. Gas under the pressure at which it is stored in such tanks is difficult to control and its use for the purpose above stated is therefore dangerous unless proper safeguards are employed.

Accordingly, I have devised the present apparatus and method by which gas to be ultimately introduced into a body cavity is discharged from its original high pressure container, stored at low pressure, and portions thereof subsequently measured and compressed as desired for admission into the cavity, the principal object of my invention being to provide a simple, inexpensive, and reliable apparatus for more safely and accurately controlling the gas pressure and measuring the amount of the flow than has been heretofore possible by the use of earlier constructions.

A further object of my invention is to provide in such an apparatus simple means for conditioning the temperature of said gas after its initial expansion and subsequent compression whereby pressure changes due to temperature changes will be avoided and the operator will thus not be misled as to the true open or closed condition of the body passage being examined or treated.

While the invention is herein described with particular reference to treatment for female human sterility, it is to be understood that it is also adapted for introducing gas for therapeutic purposes into other cavities of the human body than the uterus and could be used to treat animals such, for example, as race horses as well as human beings.

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Other objects and advantages of the invention will be apparent from the following description of a preferred embodiment thereof adopted for uterotubal insufflation, taken in connection with the accompanying drawing in which:

Fig. 1 is a schematic illustration of the apparatus showing certain of the parts thereof in partial cross-section;

Fig. 2 is a cross-sectional view of a container taken on line 2—2 in Fig. 1; and

Fig. 3 is an enlarged fragmentary cross-sectional view of a part of a pump showing in detail the construction of a pressure release valve.

Referring in detail to said drawing, a variable capacity gas reservoir 11, which may be constructed of rubber or like material, is attached by cement or otherwise to the base of a head 12. A hollow externally threaded nipple 13 on the upper portion of said head is adapted to receive an internally threaded member 14 having a cavity 15 therein for holding a small high pressure gas cylinder 16. Within the nipple 13 is a stylet 17 for puncturing said cylinder, and from the center thereof is a passage 18 extending downwardly through the head and opening into said reservoir. A second passage 19 in said head 12 has one of its openings within said reservoir and another opening in the center of a nipple 20 on a side of said head adapted to receive an end of a rubber tube 21. If so desired, the nipple 20 may contain a screen or filter (not shown) for preventing the passage of foreign material into said tube.

The tube 21 leads from the nipple 20 to another nipple 22 on a hand-pump shown generally at 23. Said pump is of a type well known to the art, having a base 24, a cylinder 25, a piston 26, stationary finger rings 27 and a movable finger ring 28 by which a piston rod 29, upon which said piston is mounted, can be moved reciprocally. The pump also contains in said base an intake ball check valve 30 and an outlet ball check valve 31, each of which is normally held in a closed position by springs 32 and 33 respectively. The spring 33 may rest against a pressure relief valve shown generally at 34 (Fig. 3) comprising a stem 35 threaded into said base and having therein gas passages 36 and 37. Said

stem may have a knurled head 38 thereon for facilitating the turning of the same.

Upon an outlet nipple 39 on said pump base is another rubber tube 40 which leads to an inlet 41 in the top of a cylindrical container 42 which may be of metal construction and of substantially greater volumetric capacity than that of said pump. A plurality of metal heat absorbing members 43, shown in the drawing to be tubular in design, may be suspended within said container in any suitable manner, as, for example, by soldering the same to the side walls of the container as at 44. A perforated metal tube 45, having a closed end 46, may be mounted horizontally within the upper portion of said container to pass through a wall thereof, as at a reinforced portion 47, and adjoin a right-angle nipple 48 to the latter of which may be attached a rubber tube 49 leading to a pressure indicating device such as a standard manometer, shown generally at 50, having a graduated scale 50a thereon. At another reinforced portion 51 of the wall of said container a vertical stand-pipe 52, having an open end 53 in the upper interior of the container, may be mounted to pass through said wall to another nipple 54 to which may be attached a rubber tube 55 leading to a cannula 56 of any well known design.

To prepare the above-described apparatus for purposes of injecting gas into body cavities for analytic or therapeutic reason, the high pressure gas cylinder containing carbon dioxide, for example, is placed in the cavity 15 of the member 14 and the latter is screwed down on the nipple 13 until the stylet 17 ruptures said cylinder and allows the contents thereof to escape through the passage 18 into the reservoir 11, causing the latter to expand and retain the gas at approximately atmospheric pressure. At such a pressure said gas may, of course, readily be controlled and measured, and one of the greatest advantages of the apparatus is thus apparent.

With the gas confined in said reservoir, as above explained, it is allowed to stand until the heat of the room has raised its temperature to approximately that of the room. The stem 35 of the pressure relief valve 34 is screwed into the pump base 24 and the pump operated by hand to cause part of the gas in the reservoir to be moved through the tubes 21 and 40 into the container 42 to displace the air therein, said air being forced to the top of said container, by the heavier carbon dioxide, and out through the stand-pipe 52, the tube 55, and the cannula 56.

When all of the air has been displaced from said container the apparatus is properly prepared for use. When the device is used for uterotubal insufflation, for example, the cannula is inserted in the cervix of the womb and the pump is slowly operated to build up gas pressure within the container 42, a similar pressure being created, of course, within the womb. Said pressure will be accurately indicated on the graduated scale 50a of the manometer 50, the perforated tube 45 being provided to prevent any foreign matter from entering said manometer. It will be understood that, since the volumetric capacity of said container is great as compared to that of the pump, each stroke of the pump will cause only a slight increase in the pressure within said container and within the body cavity, and said pressure may thus be very accurately controlled.

By counting the number of pump strokes the volume of gas admitted to the container may be measured accurately. By building up said pressure and by watching the rate of fall of the same, as well as by computing the volume of gas which has entered the body, it may be determined whether the Fallopian tubes, for example, are open. If the same are found to be closed, the pressure may be raised as desired to clear them of their obstructions. An increased rate of fall in the pressure in the container 42 will indicate when the opening has been accomplished. The heat absorbing members 43 will remove the heat of compression from said gas immediately upon its introduction into the container 42, thus avoiding subsequent cooling of the gas within the container and avoiding misleading decreases in pressure which would otherwise occur as a result thereof. Upon the opening of the Fallopian tubes or when the valve 34 is opened, the gas confined in the container will expand as gas escapes into said Fallopian tubes or from the valve 34. As this expansion of gas within the container occurs, said gas absorbs heat from the members 43 and cooling of the contents of the container (which would ordinarily take place as a result of the expansion) is avoided. It will thus be evident that the members 43 act as heat reservoirs or compensators and serve to maintain the temperature of the contents of the container substantially at a constant under all conditions, thereby preventing misleading decreases in pressure following introduction of the gas into the container and as it leaves the same.

When the examination or treatment is at an end, the pressure within container 42 and the body cavity may be released by unscrewing the pressure release valve stem 35 until the passage 37 is exposed to allow an escape of the gas. If so desired, another valve (not shown) may be appropriately incorporated in the head 12 to provide a means for releasing the contents of the reservoir 11.

It will be observed that none of the parts of my apparatus are subjected to high gas pressures and that there are no complicated parts which are subject to failure. Under no circumstances could the malfunction of any of the parts cause the patient to be exposed to damaging gas pressures.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, for it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention as defined in the claims in this application.

I claim:

1. Apparatus for introducing gas into a body cavity, comprising: a variable capacity reservoir for confining said gas at low pressure; a rigid container of fixed volume; a pump for compressing, measuring, and transferring portions of said gas from said reservoir to said container as desired, said container having a volumetric capacity many times greater than that of said pump whereby each stroke of the pump will cause only a slight increase of the pressure in said container; a pressure indicator for measuring said compression; and, a cannula for introducing said gas from said container into said body cavity.

2. Apparatus for introducing gas into a body cavity, comprising: a variable capacity reservoir for confining said gas at low pressure; a rigid container of fixed volume; a pump for compressing, measuring, and transferring portions of said gas from said reservoir to said container as de-

sired, said container having a volumetric capacity many times greater than that of said pump whereby each stroke of the pump will cause only a slight increase of the pressure in said container; one or more heat-absorbing members in said container having an extensive heat-absorbing surface for removing the heat of compression from said compressed gas; a pressure indicator for measuring said compression; and, a cannula for introducing said gas from said container into said body cavity.

3. Apparatus for introducing gas into a body cavity, comprising: a variable capacity reservoir for confining said gas at low pressure; a pump; a passage between said reservoir and said pump through which said gas may be conducted from the former to the latter for compression and measurement; a container having a fixed cubic volume, said volume being many times greater than that of said pump whereby each stroke of the pump will cause only a slight increase of the pressure in said container; a second passage for directing said gas in its compressed state into said container; one or more heat-absorbing members in said container having an extensive heat-absorbing surface for removing the heat of compression from said compressed gas comprising a metallic mass exposed thereto; a pressure indicator for measuring said compression; a cannula; and, a conduit for conducting said gas from said container to said cannula whereby said gas may be introduced into said body cavity.

4. Apparatus for introducing gas into a body cavity, comprising: a variable capacity reservoir for confining said gas at low pressure; a pump; a passage between said reservoir and said pump through which said gas may be conducted from the former to the latter for compression and measurement; a container having a fixed cubic volume, said volume being many times greater than that of said pump whereby each stroke of the pump will cause only a slight increase of the pressure in said container; a second passage for directing said gas in its compressed state into said container; a pressure indicator in association with said container for measuring the pressure therein; a cannula; and, a conduit for conducting said gas from said container to said cannula whereby said gas may be introduced into said body cavity.

5. Apparatus for introducing gas into a body cavity, comprising: a variable capacity reservoir for confining said gas at low pressure; a pump; a passage between said reservoir and said pump through which said gas may be conducted from the former to the latter for compression and measurement; a container having a fixed cubic volume, said volume being many times greater than that of said pump whereby each stroke of the pump will cause only a slight increase of the pressure in said container; a second passage for directing said gas in its compressed state into said container; a pressure indicator for measuring said compression; a perforated member for preventing foreign material from entering said indicator with said gas; a cannula; and, a conduit for conducting said gas from said container to said cannula whereby said gas may be introduced into said body cavity.

6. Apparatus for introducing gas into a body cavity, comprising: a variable capacity reservoir for confining said gas at low pressure; a pump; a passage between said reservoir and said pump through which said gas may be conducted from the former to the latter for compression and measurement; a container having a fixed cubic volume, said volume being many times greater than that of said pump whereby each stroke of the pump will cause only a slight increase of the pressure in said container; a second passage for directing said gas in its compressed state into said container; one or more heat-absorbing members in said container having an extensive heat-absorbing surface for removing the heat of compression from said compressed gas; a pressure indicator in association with said container for measuring the pressure therein; a perforated member for preventing foreign material from entering said indicator with said gas; a valve for releasing said pressure from said container; a cannula; and, a conduit for conducting said gas from the upper portion of the interior of said container to said cannula whereby said gas may be introduced into said body cavity.

7. Apparatus for introducing gas into a body cavity, comprising: a source of gas under pressure; a low pressure reservoir communicably connected with said source and in which the gas, upon being admitted thereto from said source, may expand to substantially atmospheric pressure; a pump for compressing portions of said gas to desired pressure; a container for receiving said compressed portions; a standpipe in said container serving as a conduit for removing air from the container as gas under pressure is introduced into the latter and serving thereafter as an outlet conduit for such gas as the same is being introduced into such body cavity; and a cannula communicably connected with said standpipe for introducing the compressed gas into said body cavity.

8. Apparatus for introducing gas into a body cavity, comprising: a source of gas under pressure; a variable volume low pressure reservoir communicably connected with said source and in which the gas, upon being admitted thereto from said source, may expand to substantially atmospheric pressure; a pump for compressing portions of said gas to desired pressure; a container for receiving said compressed portions; a standpipe in said container serving as a conduit for removing air from the container as gas under pressure is introduced into the latter and serving thereafter as an outlet for such gas as the same is being introduced into such body cavity; and a cannula communicably connected with said standpipe for introducing the compressed gas into said body cavity.

9. A tubal insufflator, comprising: a flexible bag arranged to receive gas from a high pressure source and store it under relatively low pressure; a conduit leading from said bag; a manually operable metering pump arranged to receive gas from said conduit; a rigid-walled gas chamber of fixed volumetric capacity many times greater than that of said pump communicably connected with the latter and into which gas is directed in small increments by successive operations of the pump; metallic heat-stabilizing tubes positioned in said chamber and having extensive surfaces exposed to the gas therein; a pressure indicator communicably connected with said chamber; and a tube leading from said chamber and having an intra-uterine cannula at the end thereof.

10. A tubal insufflator, comprising: a flexible bag arranged to receive gas from a high pressure source and store it under relatively low pressure; a conduit leading from said bag; a manually operable metering pump arranged to receive gas from said conduit; a rigid-walled gas chamber of fixed volumetric capacity many times greater

than that of said pump communicably connected with the latter and into which gas is directed in small increments by successive operations of the pump; metallic heat-stabilizing tubes positioned in said chamber and having extensive surfaces exposed to the gas therein; a pressure indicator communicably connected with said chamber; a standpipe in said chamber open to the interior of the chamber near the top of the latter; and a tube communicably connected with said standpipe and taking off from said chamber near the bottom thereof, said tube having an intra-uterine cannula at the end thereof.

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