drop-by-drop method." The latter results in more accurate dosage than the former, and for that reason must be safer and is to be preferred.

Junker's inhaler (Fig. 1272) is considered by many to be an excellent means for the administration of chloroform vapor with controllable accuracy as to strength and quantity. Its use consists in forcing air to the bottom of a bottle partly filled with chloroform through which it bubbles and passes out through a tube which terminates in a face-piece of some kind, a metal tube, or a soft catheter. In ordinary administrations a face-piece is used, while in operations about the mouth and nose the tube or catheter may be passed into one or the other of these orifices and the administration proceed without interfering with the operation. In operations in which a preliminary tracheotomy is performed and the administration of the chloroform conducted through the trachea tube, an apparatus similar to that shown in Fig. 1273 is often employed. The chloroform should be used drop by drop on the flannel top of the conical mask.

With a proper understanding of the physiological action of chloroform and familiarity with the phenomena of anæsthesia (both subjects are considered in the author's article on *Anæsthetics* in Vol. I.), the administration of this agent should be conducted according to the following principles. A reasonable time for the production of complete chloroform anæsthesia varies from three to ten minutes. A very dilute vapor should at first be presented to the patient. The strength of the vapor should be increased gradually, though as rapidly as possible in view of the comfort of the patient. On account of the liability of chloroform to cause inflammation of the skin if it is held in contact with it under circumstances which interfere with its rapid evaporation, it is advisable to protect the nose, cheeks, and chin by an application of vaseline or cold cream to these parts before the administration, or as soon as the patient has lost consciousness. When unconsciousness supervenes the rhythm of the respiration will be liable to great alterations, and it should be remembered that the intake of chloroform will bear a direct relation to the vigor of the respiration, provided the supply of chloroform is a constant factor. When a sufficient depth of anæsthesia has been attained it should be continued as evenly as possible. The addition of chloroform should not be interrupted, but its amount must be lessened to the requirements of the particular case. Operative procedures should not take place while the patient is in the lighter degrees of chloroform narcosis, as dangerous or fatal collapse, probably of reflex origin, has been frequently noted under these circumstances.

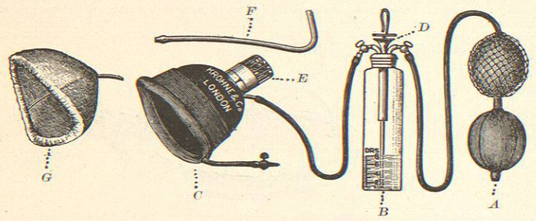

FIG. 1272.—An Improved Junker Apparatus. *A*, Hand bellows; *B*, chloroform bottle graduated to eight drachms; *C*, a hard-rubber face-piece with (*E*) feather valve to indicate respiration; *D*, funnel for addition of chloroform; above this is seen the hook used to attach inhaler to buttonhole; *F*, metal tube for mouth or nose; *G*, flannel-covered mask face-piece.

A. C. E. and similar mixtures should be administered on the same principles as chloroform, though they must be used more freely. It is not advisable to administer these mixtures from a Junker inhaler or by any other means whereby a somewhat large quantity is gradually vaporized by allowing air to pass over or through it, for under these circumstances the unequal rates of volatility of the different ingredients will result in a very different vapor toward the end of the process than that at the beginning. This is well shown by the experiments of

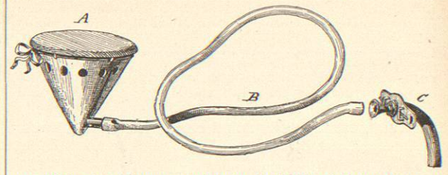

FIG. 1273.—Trendelenburg Apparatus Used with Ordinary Trachea Tube.

Minor, in which 200 c.c. of a mixture of ether and chloroform in molecular proportions were distilled with the following results:

60 c.c. came off, the boiling point ranging from								49°	to 53° C.
40	"	"	"	"	"	"	"	53	" 56
55	"	"	"	"	"	"	"	56	" 59
45	"	"	"	"	"	"	"	59	" 62

Smiles had estimated the percentage of chloroform vapor at different times in the evaporation of a mixture of ether and chloroform in molecular proportions by passing air through it. The results are as follows:

Amount evaporated.	Amount of chloroform in vapor.
10 per cent	14.0 per cent.
20 "	22.5 "
30 "	30 "
40 "	37 "
50 "	44 "
60 "	49 "
70 "	53 "
80 "	57 "
90 "	60 "
100 "	62 "

Mixtures should therefore be administered by the drop-by-drop method, in which event the last drops from the bottle will have the same composition as the first, and each addition of a few drops to the mask is vaporized almost at once, so that there can be no dangerous accumulation of the less volatile chloroform, which is the most active and most dangerous element.

Ether.—There are two distinct methods of administering this agent, the "open" and the "close." In the open method there is little or no attempt to limit the respired air and ether vapor to the inhaler, while the close method is characterized by such limitation, and a bag is provided in order that a certain amount of rebreathing may take place.

The chief advantages of the open method are: that a very simple apparatus or none at all is necessary; that a free supply of oxygen is furnished to the patient if the ether vapor is not presented in so high a degree of concentration as to thus limit the air; that a new and entirely clean inhaler may be furnished for each patient without trouble.

The chief disadvantages of the open method are: that the administration is apt to be prolonged, particularly in the stage of excitement and struggling; that more ether is wasted than is consumed by the patient, and this unused ether changes the air of the operating-room often to a disagreeable degree; that the after-effects are greater, probably owing to a greater degree of saturation of the patient with ether.

The advantages of the close method are: that complete

anæsthesia may be produced rapidly with a comparatively small amount of ether and with comparative comfort to the patient, if a regulating inhaler, such as Clover's or the author's, is employed; that the stage of excitement and struggling is often absent, and when it occurs is usually slight and of short duration; that the ether vapor is warmed by the air from the lungs and is therefore less irritating; that the ether vapor is largely confined to the inhaler and does not impregnate the surrounding air to any extent as compared with the open method; that the patient does not appear to become as saturated with ether as by the open method, the after-effects being less as a rule.

The chief disadvantages of the close method are: that a more or less complicated and cumbersome inhaler is necessary; that this inhaler is kept clean with some difficulty; that more skill is required for the administration.

The best examples of open inhalers are found in the "ether cone" and in the Allis' inhaler. The paper and towel cone has probably been used more extensively, particularly in the United States, for the administration of ether than any other form of inhaler. It can be extemporized at a moment's notice almost anywhere from a towel and newspaper or other suitable material, and furnishes an inhaler so simple, clean, cheap, and effective, if properly used, that it will undoubtedly retain a prominent place in the list of ether inhalers. Paper and towel cones are made in various shapes and sizes, and are constructed on several plans. Usually they are cylindrical, open at one or both ends according to the ideas of the

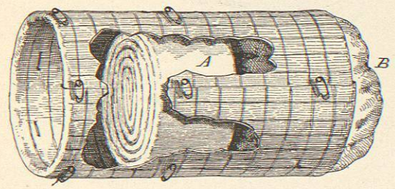

FIG. 1274.—A Paper and Towel Ether Cone. *A*, A loose roll of gauze to receive the ether; *B*, loose gauze to retard escape of ether vapor.

maker. The paper serves to give shape and stiffness and is impervious to air. The towel acts as a cover and furnishes a soft edge for the face. Sponges, cotton, or gauze, may be used to pack the upper end of the cone to receive the ether.

In the writer's opinion the best form of cone may be described as follows: Cuff-shaped, moderately stiff, at least six or eight inches long (in proportion to its diameter), open at both ends, the packing for the reception of the ether to be *fixed* in the centre of the cuff, allowing a considerable space above and below, the packing to be of some loose material offering no appreciable resistance to the passage of air through it, the space above the packing to be filled with a small quantity of loose gauze. Such a cone is illustrated in Fig. 1274. The chief objects attained in such a cone are: that a large air space is provided for the accumulation of ether vapor, the escape of which is retarded by its own weight and by entanglement in the meshes of the loose gauze above the packing; no impediment to respiration as in a cone with one end closed; a considerable space between the face and the packing which receives the ether.

A metallic cone is shown in Fig. 1275. It has an inflatable rubber face-piece. Its upper third is partitioned off by a diaphragm of coarse netting, forming a chamber for the packing which receives the ether. It is perfectly simple and is easily kept clean.

The Allis' inhaler shown and described in Fig. 1276 is extensively employed in the United States for the administration of ether, and is an excellent inhaler. It is really a modified cone, over which it possesses no special advantage.

The administration of ether by means of an open inhaler may be conducted in two ways. In one the inhaler

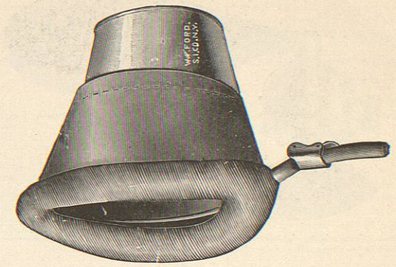

FIG. 1275.—Metallic Cone with Pneumatic Face-Piece.

is charged with several drachms of ether and is gradually brought toward the face as rapidly as the comfort of the patient will admit, more ether in similar quantities being added from time to time. The other plan is to apply the inhaler to the face of the patient without ether, which is to be added gradually, beginning drop by drop and increasing the amount as rapidly as may be agreeable to the patient, and more ether being added in small quantities at frequent intervals throughout the administration. Preference for one or the other of these plans is a matter of personal opinion.

Close Inhalers.—There are many close inhalers for the administration of ether, but Clover's and Ormsby's are the original and most employed types.

In Clover's inhaler the ether chamber revolves upon the shaft of the face-piece. An index pointer attached to the base of the shaft may be seen extending out beneath the bottom of the ether chamber.

When the inhaler is arranged as in Fig. 1277 air breathed back and forth through it will not enter the ether chamber proper, but will pass through the central chimney only, the index pointing to 0 (no ether). Upon rotation of the ether chamber the current of air is permitted to pass over the ether in proportion to the degree of rotation, one-half revolution bringing the index to F

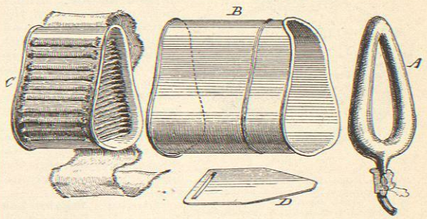

FIG. 1276.—The Allis Inhaler (Improved). *A*, Inflatable rubber face-piece; *B*, metallic cuff; *C*, frame with interwoven bandage to receive the ether; *D*, needle for passing the bandage back and forth.

(full ether), in which position all of the air is made to pass over the ether on its way between the face-piece and the bag. Intermediate positions of rotation allow proportionate amounts of air to pass over the ether, and the figures 1, 2, and 3 to be seen on the side of the chamber indicate that one-fourth, two-fourths, and three-fourths respectively of the air is passing over ether.

The inhaler is used as follows: The ether chamber is charged with from one to two ounces of ether through D, and the index turned to 0. The face-piece is applied

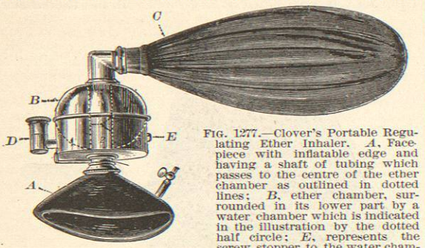

FIG. 1277.—Clover's Portable Regulating Ether Inhaler. *A*, Face-piece with inflatable edge and having a shaft of tubing which passes to the centre of the ether chamber as outlined in dotted lines; *B*, ether chamber, surrounded in its lower part by a water chamber which is indicated in the illustration by the dotted half circle; *E*, represents the screw stopper to the water chamber. The ether chamber is filled through *D*. *C*, Thin rubber bag of about one gallon capacity, detachable from ether chamber.

accurately to the face during several full exhalations so as to distend the bag. The face-piece is now kept applied, and after eight or ten respirations *without* ether, the chamber is gradually rotated from 0 toward F as rapidly as is comfortable to the patient. In from two to four minutes the rotation will usually be accomplished and the patient is in the proper degree of narcosis or nearly so.

Average patients will not require a rotation beyond two and one-half or three, at which point the index may be kept till a proper degree of narcosis is reached. During this rotation the face-piece should be kept closely applied and no fresh air admitted unless too marked cyanosis appears; some duskiness is to be expected. When the signs indicate the proper degree of anæsthesia, or before that time, if the cyanosis becomes too great, a number of respirations of pure air should be given by removing the inhaler from the face. After maintaining a proper anæsthesia for several minutes with the index at 2½, 3, or F, it may be moved to a point between 1 and 2, at which the desired level of narcosis is found to be maintained, and from this time on a number of respirations of fresh air must be admitted by removing the inhaler from the face from two to four times a minute. Under these circumstances the normal color should soon return. More ether must be added from time to time as necessary. In cold weather and for unusually vigorous subjects it is advisable to fill the water chamber, which surrounds the ether chamber, with *warm* water through the tap E before the administration.

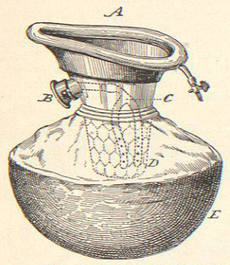

FIG. 1278.—The Ormsby Ether Inhaler. A, Face-piece with inflatable rubber edge (detachable); *B*, tap for admission of air and addition of ether, which passes to the cage *D* through the tube *C*; *E*, the rubber bag which permits re-breathing.

Ormsby's inhaler has been variously modified, and with slight changes is known by several different names as Parkinson's, Davis', etc. It is really nothing more than a metallic cone with a tightly fitting face-piece, a bag to allow re-breathing, and an air tap to admit fresh air. Connected with this tap is a small funnel and tube for the purpose of adding ether to the packing. This arrangement for adding ether is not practicable and is rarely used. It is better omitted as it interferes with packing the cage and with the admission of air through the tap.

To use Ormsby's inhaler the cage D is packed moderately full of sponge or gauze; if a sponge is used it should be wrung out of warm water. Half an ounce of ether is now added to the packing, and the inhaler is brought into position on the face as rapidly as the strength of the vapor will permit, the air tap B being wide open and the patient encouraged to breathe deeply. When the face-piece is in position the air tap should be gradually closed and the inhaler kept applied to the face till anæsthesia is complete. This is often accomplished without further addition of ether. The air tap should now be opened fully or half-way and the administration continued, ether being added several drachms at a time at moderate intervals or smaller amounts more frequently.

The ether inhaler shown in Fig. 1279, and in sectional view in Fig. 1280, is one the author has devised with the

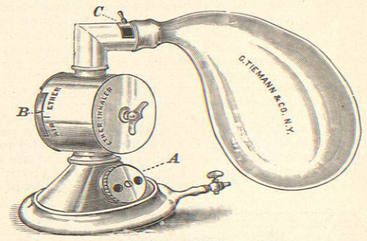

FIG. 1279.—Bennett's Ether Inhaler.

idea of combining in one instrument a number of the advantages of several, and of furnishing, in as small a compass as possible, a means by which the air supply and the ether supply might be under perfect control. The inhaler may be described as follows:

It consists of three parts—the face-piece, the ether chamber, and the bag. The face-piece is cone-shaped; its base is oval and is notched at the nasal end. The apex is open and is threaded to screw into place on the ether chamber. It is of metal, and its free edge is provided with an inflatable rubber cushion, which may be removed at will. On the side of the face-piece is an air tap, *A*, which may be opened or closed to any degree. When fully open, this tap has a large capacity—a desirable feature in a bag inhaler.*

The face-piece is made in three sizes—small, medium, and large. The medium size will be found suitable for all ordinary cases, but small children and large men require special sizes.

The ether chamber, shown in the "sectional view," consists of two cylindrical metallic boxes, one fitting ac-

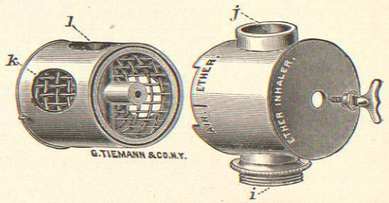

FIG. 1280.—Bennett's Ether Inhaler; Sectional View.

curately within the other. The inner box presents four openings in its sides, two of which, *k* and opposite, are

* In this respect the Ormsby apparatus is usually inadequate, the tap being too small, and in Clover's there is no air tap.

of large size; the other two, *l* and opposite, are smaller and are connected by a tube which passes through the centre of the box. This part of the ether chamber is provided with a cage of coarse wire netting, to hold the gauze which receives the ether. The cage is somewhat smaller than the box it occupies, the intervening space allowing the respired air to circulate freely around the gauze rather than through it, thus offering little or no resistance to respiration. The cage also prevents the gauze packing from protruding through the openings *k* and opposite, and thus interfering with the rotation of the inner chamber. On the closed end of the inner box is placed a revolving disc, presenting a small circular opening at one point near its periphery; this opening is surmounted by a short funnel-shaped chimney, and may be brought opposite any one of three openings in the end of the box. By this arrangement it is possible, when the patient's head is turned on the side, to pour ether upon the gauze without removing the inhaler from the face—a matter of great practical advantage under certain circumstances.* The outer box presents two large and opposite openings in its sides, and each of these is surmounted by a chimney, one of which is threaded to receive the face-piece, the other being smooth and bevelled to receive the bag. On one side of the free edge of this box is a slot, which, in connection with a pin and pointer on the inner chamber, limits the rotation of the latter and indicates whether "air" or "ether" is being breathed. When the two parts of the ether chamber have been put together, they are held in place by the thumb screw shown in the drawing, and this serves the further purpose of a handle for revolving the inner cylinder.

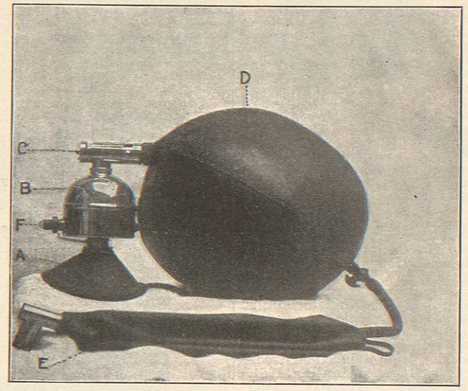

FIG. 1281.—The Clover-Hewitt "Gas and Ether" Inhaler. A, Face-piece with inflatable edge; *B*, ether chamber of Clover inhaler (improved); *C*, valve chamber of Hewitt's gas apparatus; *D*, gas bag of Hewitt's gas inhaler; *E*, ether bag of Clover's inhaler; *F*, rubber stopper with hollow glass dome, by which ether may be seen.

By referring to the sectional view of the ether chamber, it will be seen that a tube traverses the centre of the inner cylinder, its upper opening being marked *l*. Now if the two parts are put together in the positions they occupy in the cut, it is evident that the openings of the tube *l* will correspond with those marked *i* and *j* of the outer cylinder; and if breathing should take place through the inhaler so arranged, the air would pass directly through the tube *l* without entering the ether space proper. In this position it will also be noticed that the index pointer, seen directly below *k* in the "sectional view," occupies the lower end of the slot on the outer cylinder, indicating "air." If the inner cylinder is now rotated so that the index traverses toward "ether," it will come to a transverse line between "air" and "ether," and in this position the openings of the tube *l* are just beginning to pass out of the openings *i* and *j*, and the openings *k* and opposite are beginning to enter the openings *i* and *j*. Breathing through the inhaler in this position allows a very small percentage of air to pass through the ether space; further rotation increases this percentage, till finally the tube *l* has passed completely away from the openings *i* and *j*, and full ether is on, the index pointer being at the upper limit. In this way the ether may be turned on as slowly as desired, and any strength of ether vapor may be administered at will throughout the narcosis.

The ether bag is of large size, its capacity exceeding the most exaggerated respiration. It is attached to an elbow of metal tubing, by which it is connected with the upper chimney of the ether chamber when in use. In this elbow, near the attachment of the bag, is a large air tap, *C*, which may be opened to any degree.

The use of the ether inhaler may be briefly described as follows: The wire cage is packed firmly with dry gauze, upon which one-half ounce or more of ether is poured; the index is now turned to "air," the taps *A* and *C* are closed, several expirations are caught to distend the bag, and the face-piece is then kept applied; the index is now turned to the line between "air" and "ether" and is moved forward slowly toward the latter, an occasional breath of air being given by removing the face-piece. Complete anæsthesia is present in from two to five minutes in average patients. The administration now consists chiefly in the regulation of two factors—the ether supply and the air supply.

The ether supply: In continuing the administration, it is best to allow the index to remain at full ether and to pour from one-half to one drachm of ether upon the gauze every two or three minutes as necessary. This may be done (1) through the face-piece, (2) through the chimney, or (3) through the revolving disc on the end of the ether chamber; (1) is preferable in usual cases; (2) or (3) is of great advantage when it is inconvenient to remove the inhaler from the face.

The air supply: During the induction of anæsthesia enough air should be given to prevent more than slight cyanosis. In maintaining anæsthesia it is rarely necessary to exclude air to the extent of causing any cyanosis, and the air supply is to be regulated in accordance with the following facts: The tap *C* being closed, if *A* is opened slightly the patient will receive little air and much ether; if fully opened, he will receive much air and little ether. The tap *A* being closed, if *C* is opened slightly the patient will receive little air and much ether; if fully opened, he will receive much air and much ether.

The quantity of ether necessary in usual cases will average about four ounces for the first hour and about two ounces for the second hour.

Ether Preceded by Nitrous Oxide.—For this excellent succession of anæsthetics we are indebted to Clover, who called attention to it in 1876, and of which Buxton has recently stated, "It is the best method of producing general anæsthesia." The advantages of this succession of anæsthetics may be briefly stated as follows: Great comfort to the patient in being spared all knowledge of the

* In operations about the head or neck it is often desirable to cover the inhaler and the hand and arm of the anæsthetist with a sterile towel. Under these circumstances it is inconvenient to disarrange this every time it is necessary to add ether, and it was for this class of cases in particular that the arrangement was added. When this plan of adding ether is to be used, the inhaler should be so applied to the face that the revolving disc is uppermost.

administration of the ether. Great saving of time, complete ether anæsthesia being accomplished in from two to four minutes in average patients. Complete absence of struggling and of the usual phenomena of the stage of excitement.

There are two plans of conducting this form of anæsthesia. In one, nitrous oxide is administered to complete

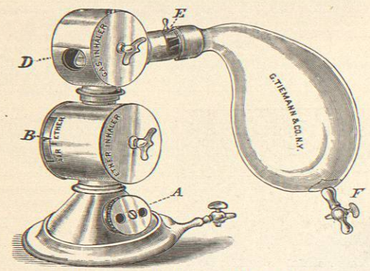

FIG. 1282.—Bennett's "Gas and Ether" Inhaler.

anæsthesia, when the gas is stopped and strong ether abruptly substituted and rapidly pushed. This was Clover's original method, but through the advocacy of the plan by Mr. Woodhouse Braine, it has been called his method. Mr. Braine changed from nitrous oxide by an ordinary apparatus to ether in an Ormsby inhaler.

In the other plan, also devised by Clover, a gradual transition from gas to ether takes place, and to do this Clover perfected an excellent inhaler which, however, was large and impracticable for general use. Hewitt, by combining his own nitrous-oxide inhaler with Clover's portable regulating ether inhaler, has produced an excellent "gas and ether" inhaler which is shown in Fig. 1281. A single bag full of gas is sufficient. The gas inhaler fits into the place of the usual bag of the Clover inhaler. Gas is administered through the charged ether inhaler, the index of which points to 0 (no ether). When two-thirds or three-fourths of the gas has been breathed through valves, the latter are thrown out of action by closing the tap at C, whereupon rebreathing of gas takes place. At this time ether is turned on gradually so that both gas and ether are administered. This is continued till signs of complete gas anæsthesia appear, when the tap cutting off the gas and admitting air is turned so as to do this. After a few respirations of air and ether the tap is again closed and gas and ether are rebreathed. Ether anæsthesia is soon deep enough to discontinue the gas, and this is done by removing the gas inhaler and substituting the ether bag. Ether is now continued as usual.

The author's inhalers for gas and for ether are made to combine in the same way as the Clover-Hewitt apparatus, and act on the same plan (see Fig. 1282).

Chloroform, A. C. E., ethyl chloride, and ethyl bromide have each been administered before ether with agreeable results, though they are neither as safe nor as pleasant as nitrous oxide for this purpose.

Nitrous Oxide.—There are several different plans of administering this agent—pure, mixed with air, or mixed with oxygen. Nitrous oxide is a true anæsthetic and does not depend upon asphyxia for its narcotizing effect. Administered in a pure state the resulting anæsthesia is *complicated* by asphyxia depending upon deprivation of oxygen. Given in combination with small percentages of air, complete anæsthesia may be induced with marked lessening or absence of asphyxia. In combination with oxygen, complete anæsthesia results without asphyxia. In order to administer nitrous oxide in its pure state it is necessary to employ an apparatus in which, through the action of valves, the inspirations are made to be taken from the gas reservoir and the expirations made to pass out into the surrounding air.

Before gas was supplied in the present portable form a gasometer was an essential part of a nitrous-oxide apparatus, but with the advent of the small cylinders containing liquefied gas and with the perfection of the accurately fitting face-pieces of the present time, the gasometer became unnecessary, though it is still extensively used, especially in dental offices. White's complete gas apparatus with gasometer is shown in Fig. 1283.

The author's gas inhaler (Figs. 1286 and 1287) consists of three parts—the face-piece, the valve chamber, and the gas bag. The face-piece is identical with that of the ether inhaler.

The valve chamber consists of two cylindrical metallic boxes, one fitting accurately within the other. The inner box contains a T of tubing, the longer or cross part of which traverses the centre of the chamber and is joined in the middle by the shorter or stem part of the T. The three ends of this T open upon the outer surface of the sides of the box. The longer of these tubes contains the valves mounted upon a skeleton tube, which may be removed at will. The valves themselves consist of thin rubber flaps, fastened at one end over fenestrated diaphragms set in an inclined position in the skeleton tube. Each rubber flap is reinforced by a thin piece of aluminum cemented

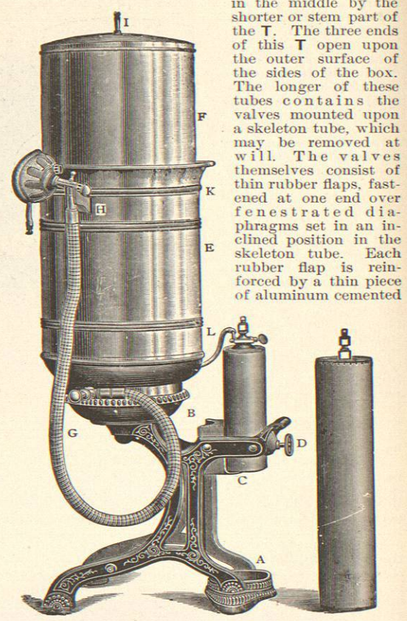

FIG. 1283.—The White Nitrous Oxide Apparatus with Gasometer. Showing end-valve cylinders containing 100 gallons and 450 gallons of liquefied nitrous oxide.

to its surface. This keeps the rubber flat and prevents it being forced through the opening which it guards, during violent respiration.* On each side of the opening of the short or stem part of the T above described is placed a similar opening communicating with the general box cavity.

* These valves may be replaced when necessary by cutting pieces of rubber bandage into proper shape and cementing the aluminum forms to them.

The outer box presents three openings through its sides, two of which are provided with chimneys. One of the latter has a thread cut upon it for the screwing on of the face-piece. The other is slightly bevelled for the twisting on of the gas bag.

The boxes are held together by a thumb-screw, which also serves

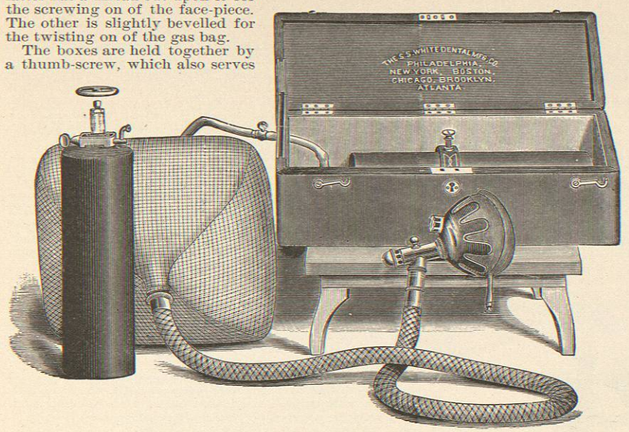

FIG. 1284.—White's Portable Nitrous Oxide Apparatus. Showing cylinder with yoke and wheel key.

as a handle for rotating the inner chamber, the rotation being limited by a slot on the outer box and a pin on the inner.

The gas bag is of pure rubber, and has a capacity of about two gallons when just full, but will distend to several times this capacity without bursting.* It is attached to a short metal tube, the free end of which is ground to fit the smooth chimney of the valve chamber. In this tube is placed a large air tap, shown at *E* in Fig. 1286, which may be opened or closed by a lever. Working in connection with this air tap is a cut-off, placed between the air tap and the bag, and so arranged that when the air tap is fully open the gas is completely cut off and

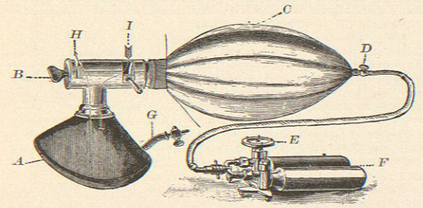

FIG. 1285.—Hewitt's Nitrous Oxide Inhaler. *A*, Rubber face-piece with inflatable edge (through tube *G*); *B*, valve chamber—action of valves indicated by arrows at *H* and *I*; *C*, gas bag of about two gallons capacity; *D*, stopcock for disconnecting a full bag from tube; *E* and *F*, side-valve cylinders with foot-key.

confined to the bag. When the air tap is closed the bag is opened into the tube. At the opposite end of the gas bag is a hard-rubber stopcock, through which the gas is admitted to the bag. By referring to the sectional view of the gas inhaler, it is apparent that if the two boxes are pushed together in the positions they occupy in the cut, the face-piece screwed on at *a*, and the inhaler breathed through, during inspiration the valve at *d* will close so that the air must enter through the chimney *c*, pass through the valve at the opening *h*, and down through the opening *f* into the face-piece. During expiration the valve at *h* will close and the air must pass into the T and out through *d* and *b*, which are now together. The inhaler is used in this position in the ordinary administration of nitrous oxide. By revolving the inner box so that *d* is depressed and *h* elevated to the limit allowed by the pin and slot above referred to, the opening *b* will be closed and *e* and *g* will come together with *a* and *c* respectively. Breathing now takes place through the box cavity, the valves are out of action, and both inspiration and expiration pass through the opening *c*. This position is used for a short time during the administration of "gas and ether."

The object of placing the bag close to the face-piece in Hewitt's and the author's inhalers is to avoid the resist-

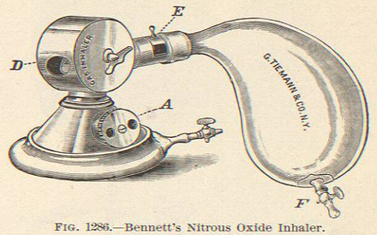

FIG. 1286.—Bennett's Nitrous Oxide Inhaler.

ance to respiration which is occasionally noticed in breathing through a long tube. This resistance causes a feeling

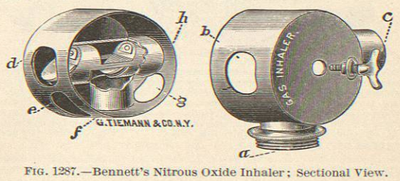

FIG. 1287.—Bennett's Nitrous Oxide Inhaler; Sectional View.

of suffocation in some patients. Gas bags are made of pure rubber or rubber cloth. The former are to be preferred for several reasons. They are less bulky, can be

* A very practical point in view of the fact that such over-distention is common from inability or failure to turn off the gas in time, or from unexpected rushes of gas from the cylinder. Under these circumstances bags made from non-elastic material must burst, and this is a matter of alarm from the loud report, failure of the narcosis from inability to proceed, and expense from having to replace the bag.