The Nursing Care of The Patient in The Respirator

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THE NURSING CARE OF THE PATIENT IN THE RESPIRATOR

The type of respirator most commonly used is the cylindrical metal tank equipped with a cot and mattress. One end of the tank has an opening which is surrounded by a metal plate and a soft rubber collar. The patient's body lies on a mattress within the tank and his head rests on a pillow outside the machine. The rubber collar around the neck seals off escaping air.

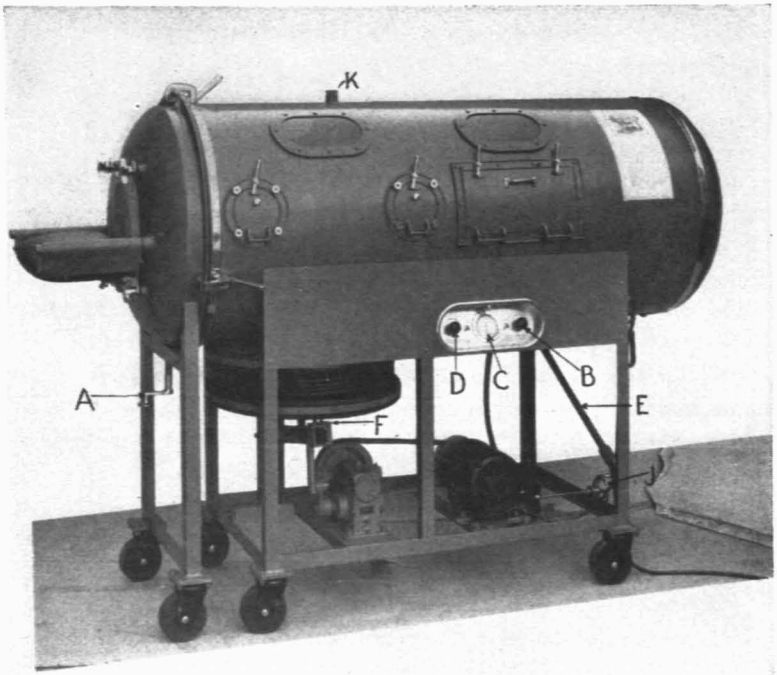
Mechanism of breathing

Normally when an individual inhales, the chest cavity, or thorax, enlarges and air rushes into the lungs through the nose and mouth. The enlargement of the chest cavity is accomplished by the muscles lying between the ribs (intercostals) whose contraction raises the rib cage; and by the diaphragm whose contraction depresses or lowers the floor of the chest. Both of these muscular actions are vitally necessary for normal inhalation. Exhalation is considered by many physiologists to be almost completely passive. It is accomplished largely by the effect of gravity on the elastic walls of the expanded chest, aided by the upward push of the abdominal viscera on the relaxing diaphragm.

If these muscles — the intercostals and diaphragm — were paralyzed there would be no way in which the patient himself could enlarge his rib cage to allow air to flow into the lungs. It is in these cases that the respirator is often necessary to save life.

There are times, however, when the same effect — difficulty of inhalation — may prevail although paralysis is not present. Inability to raise the chest wall has been ascribed to the fact that the large pectoral muscles which cover much of the ventral portion of the ribs are in spasm, that is, clamped down so tightly on the ribs that movement of the chest is impossible. In this type of involvement, continuous hot packs may be used, and the respirator resorted to only long enough to spare the patient exhaustion from the fatigue of trying to breathe against this obstruction.

If the intercostal muscles or diaphragm are in spasm the patient will not be able to exhale satisfactorily. Pressure exerted externally on the chest wall (manually in teaching breathing exercises or through positive atmospheric pressure in the machine) assists in compressing the chest wall. The respirator is not infrequently used for this type of patient, also. However, hot packs to the chest, back, neck, and upper abdomen, combined with such bed positions as will relieve strain on the painful muscles, should be attempted before placing the patient in the machine.



(Courtesy Warren E. Collins, Inc.)

Fig. 1

The handwheel (J) at the end of the motor should be turned clockwise as far as it will go. This permits a respiratory rate of around 14 per minute. Turning in the opposite direction will increase the rate. The knob (B) controls depth of respiration. Turn it clockwise to increase depth, counter-clockwise to decrease it. The gauge (C) shows depth of respiration. The control (D) which is for positive pressure should be completely shut off.

How the respirator works

The Collins respirator (Fig. 1) has a bellows made of tire-tread rubber attached to the under surface of the tank. (Older models may still have the dual installation type of bellows — rubber inside, leather outside.) When the bellows expands to maximum capacity, the air pressure in the tank is lowered. This is "negative" pressure, and will be registered on the gauge of the machine to the left of the zero symbol. As a rule a negative pressure of from 14 to 20 is adequate for pulmonary ventilation. Negative pressure exerts a mild suction or lifting effect on the thorax and abdomen, and air will rush into the lungs from the nose and throat causing the lungs to expand in the manner of normal respiration. This is the stage of inspiration. The patient, aided by the machine, is drawing in a breath at this time and he is taught not to swallow or attempt to speak. When the bellows collapses or folds up, air is being forced back into the machine and the pressure in the tank is raised to about that of outside atmospheric pressure. This is the stage of expiration, and the patient soon learns to talk, to swallow and, when necessary, to cough at this time.

The Emerson machine operates by means of a leather diaphragm. When the diaphragm is concave to the external view (drawn in to the tank) the air in the tank is compressed. This is the stage of expiration. When the diaphragm is convex externally (pushed outward) the air pressure in the machine is lowered and the patient inhales. This is registered as negative pressure on the gauge.

More than normal atmospheric pressure is called "positive" pressure, and is seldom required in the treatment of patients with poliomyelitis. Therefore the needle on the pressure gauge as a general thing should not make an ex-

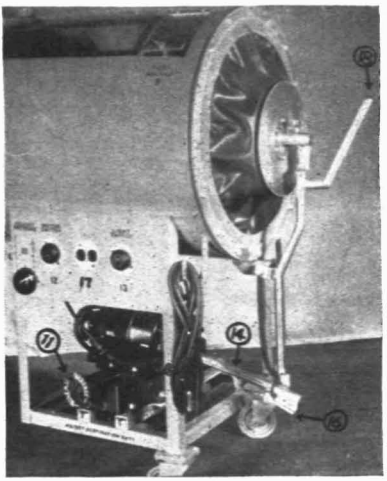


Fig. 2
The Emerson Respirator

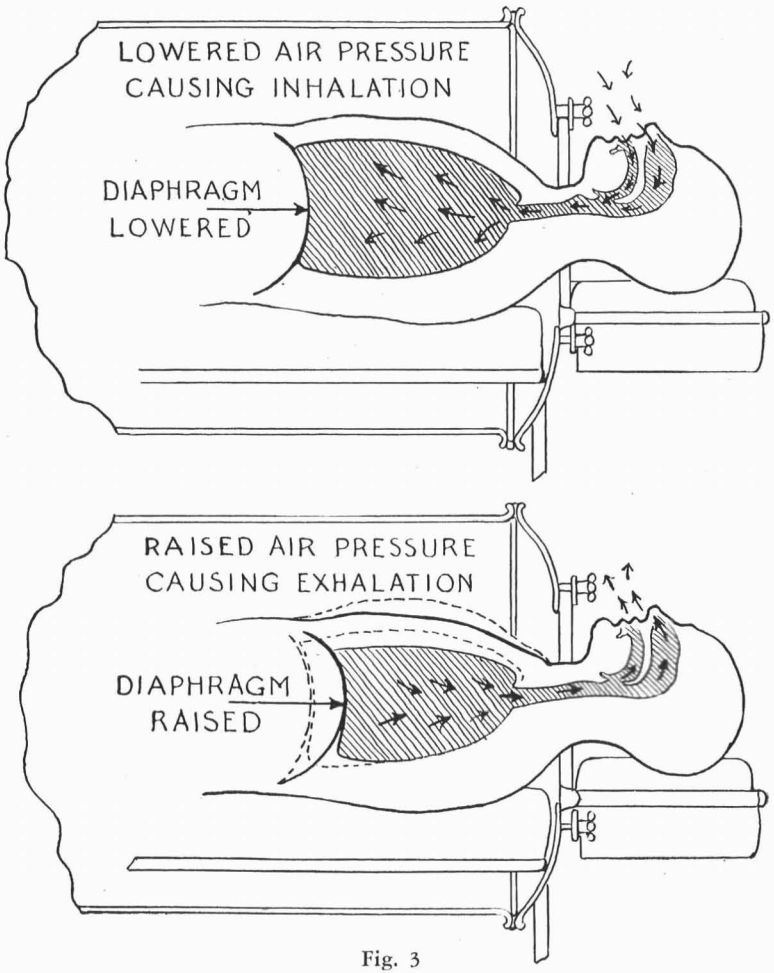


Fig. 3

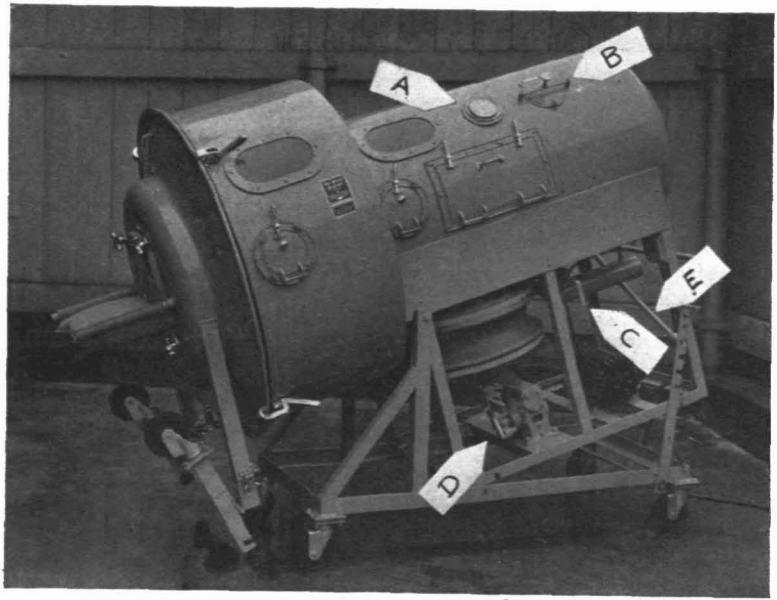
cursion to the right of the zero symbol. (Diagrams showing mechanism of breathing. Fig. 3)

Depth of respiration

The *mechanism* for controlling pressure varies with different respirator models. The pressure *gauge* which indicates the amount of pressure within the tank is located in different places on the various machines.

It resembles a clock in appearance, is covered with glass, and has a needle-like indicator. (Fig. 1, C.) In the machine pictured in figure 1, depth of respiration is controlled by use of a knob which is located in a central control panel. By turning the knob clockwise it is possible to increase the depth of respiration; while turning it counterclockwise decreases the depth of respiration. The control valve (Fig. 1, D) is left completely turned off, as this controls positive pressure which is seldom used.

In the orthopedic respirator pictured (Fig. 4), control of pressure is managed through use of a lever. (Fig. 4, C.) Even a minute amount of change in the position of this lever accomplishes considerable change in pressure. It is a delicately adjusted mechanism and should be treated as such. The positive pressure is controlled by the valve (Fig. 4, B). The screw cock here should be completely free to avoid positive pressure.



(Courtesy Warren E. Collins, Inc.)

Fig. 4

Orthopedic, tilting-rotating model respirator. Note that pressure gauge (A) and positive pressure control (B) are located on the tank. Pressure is controlled through lever (C). (D) Lever bars and handwheel for attaching handle for manual operation. (E) Handle.

Rate of respiration

Most respirators are so constructed that they may be operated at several speeds, usually varying from 14 to 36 respiratory excursions a minute. Some models have a handwheel near the motor which controls the rate of respiration (Fig. 1, J). On other models, where only two or three rates are possible, it is necessary to adjust the rate of respiration by turning off the motor and transferring the belt to the required grooves on the motor and gear box pulleys. Instructions for doing this are explicitly recorded on the machines which require this type of adjustment.

A respiratory rate of from 14 to 18 a minute is usually desirable unless the patient has some type of respiratory infection or obstruction in the trachea. Care must be taken to synchronize the rhythm and depth of the machine's operation to the patient's own voluntary efforts. Frequently after the patient has been put in the machine the rate of his respiration becomes more normal and the rate of the machine may be decreased. As a general rule little good is obtained by operating the machine at an increasingly higher rate or pressure in an effort to overcome the apparent inability of the patient to cooperate with the machine. But Dr. James L. Wilson states that use of the alae nasi or of accessory muscles of respiration *may* indicate a need for increasing rate or depth of respiration, as these signify inadequate expansion of the thorax. Such increase of rate or depth must be carefully estimated and not used in a hit-or-miss fashion. In these cases it is wise to make an investigation to ascertain if mucus or a foreign body in the respiratory passage is interfering with the rate of breathing.

Care of the machine

The respirator deserves good care. It should be stored in an easily-accessible spot for quick moving. The casters should be tested frequently to see that moving the machine can be accomplished without difficulty.

The tank should be kept clean with soap and water and an occasional airing. Care should be taken, however, not to get water into the bellows chamber or into the control valve tubing. Alcohol should never be used to clean the tank or windows.

The bellows should be fully opened when the respirator is not in use.

In the collapsed stage, considerable deterioration may take place at the folds. Otherwise the bellows needs no special attention. The diaphragm of the Emerson machine should be wiped with neat's foot oil once yearly, but no other oil should be allowed to come in contact with it or deterioration may occur.

Once a year the respirator should be checked by an expert. A new sealing gasket should be cemented into the head of the machine at this time. This is an important item and should not be overlooked. This gasket is vitally necessary to insure an airtight tank.

Manufacturers of respirators issue specific directions for the care of their machines. *These instructions should be placed in the hands of the hospital engineer who must assume responsibility for supervising the operation and care of the machine at all times.*

Rubber collar and port cuffs must be inspected frequently. This is particularly true where sponge rubber is the material in use for this purpose. Constant contact with the metal of the machine tends to rot the rubber. In some hospitals it is the custom to remove the collar and keep it inside the machine on the cot when it is not in use since collar-openings vary in diameter and must be changed according to the size of the patient who will be using the machine. Because of war-time shortages it is recommended that all rubber parts be removed from the machine, properly labeled, and stored at a low temperature in a refrigerator. If this is not done screws holding the cuffs to the ports should be loosened to lessen deterioration of the rubber from pressure when the machine is not in use. It must *never* be forgotten that the rubber cuffs and collar *must* be in good condition or it will not be possible to secure sufficient vacuum inside the machine. In an emergency this can be a matter of the greatest seriousness. An extra set of collars and cuffs should always be available.

Nursing care will be greatly facilitated if special linen is available to use as drawsheets. A full-size sheet, folded in the middle, lengthwise, and applied to the cot in double thickness, may be used for the undersheet. A small, light rubber sheet, 18 to 24 inches in width, which can be tucked under the mattress, is used for the buttocks. The fabric drawsheet for covering the rubber can be made of old sheeting — 20 to 28 inches in width and only long enough to tuck securely under the mattress. The ordinary drawsheet is usually too bulky for this purpose; it is

harder to change inside the machine, and it occasionally is the cause of excessive pressure on the patient's back. A folded drawsheet or narrow, firm pillow used under the lumbar spine often affords considerable relief for the patient's back.

The patient's skin must be protected from the rubber collar. Sheet wadding is used routinely in some hospitals, and chamois has been found useful in some instances. However, washable materials such as old diapers or linen have definite advantages because of the frequent changes which can be made without waste.

Indications for use of the machine

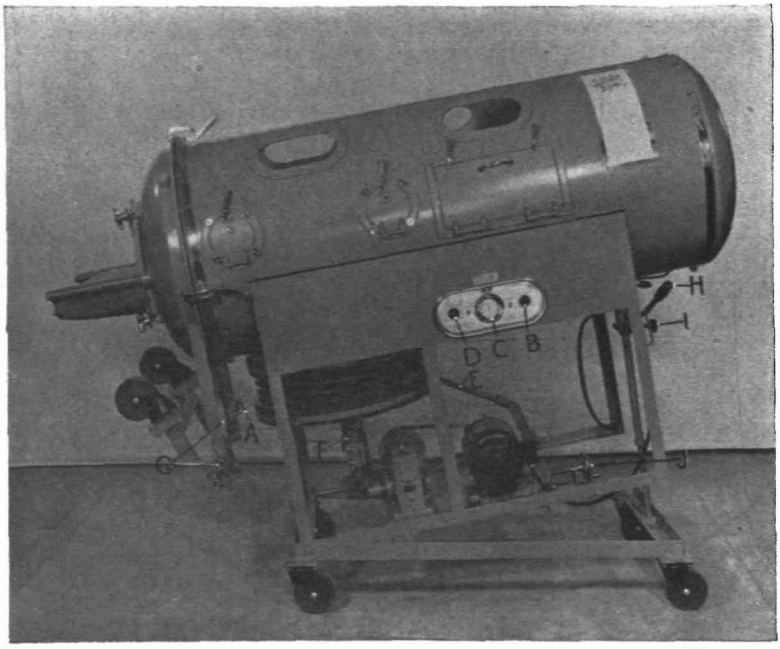
Indications for use of the respirator are set down in Dr. James L. Wilson's pamphlet, "The Use of the Respirator in Poliomyelitis." The decision to place the patient in the machine must be made by the doctor, but the nurse should recognize early symptoms of approaching respiratory embarrassment so that she may report the condition to the doctor *before* symptoms of exhaustion appear. This means before cyanosis or overt dyspnea are in evidence.

Patients with weakness of the arms and shoulders should be watched carefully for the onset of respiratory symptoms. The patient's efforts to speak may be significant. Speech may be interrupted or monosyllabic, and the patient cannot usually count to ten without taking a breath. Wakefulness, restlessness, and increasing anxiety are significant and often indicate approaching paralysis of the muscles of respiration. Increase in the rate of breathing combined with shallowness and a definite limitation of movement in the chest wall may be observed. Use of auxiliary muscles such as the sternocleidomastoids to lift the rib cage, and dilatation of the nostrils are danger signals which mean that treatment must be swift and intensive.

It must always be borne in mind that spasm of the pectoral muscles may cause the same set of symptoms. In these cases, hot foments may bring about swifter relief than the use of the respirator. The physician will be able to distinguish between the types of involvement and to institute the proper treatment.

Frequently bulbar complications may occur with paralysis of the muscles of respiration, making the choice of treatment a most difficult one. Mucus and dysphagia may further complicate the picture. In any

case it is well to have a suction apparatus and equipment for administering nasal oxygen on hand. Many of the newer machines are equipped so they may be tilted and thus provide postural drainage for the patient who is troubled with mucus. (Fig. 5.)



(Courtesy Warren E. Collins, Inc.)

Fig. 5

Directions for tilting machine:
Unscrew 2 handwheels (G) on the sides of front legs. Grasp crosspiece between the two front casters and lift it up and attach to hook. Then operate hydraulic lift handle (H) as pump until tank is tilted desired amount. To lower, open release valve (I). Close this valve after lowering, otherwise lift will not operate.

Preparation of the patient for the experience

A severely involved patient, gasping and cyanotic, is a desperate emergency to handle in any circumstance. The respirator in these cases is purely a life saving device and the all-important necessity is speed. The less severely afflicted patient who is conscious should be carefully prepared for the experience of being placed in the respirator. The ten-

dency at present is to use the machine on less severely involved patients in whom it is suspected exhaustion and apprehension may increase even though the pathological involvement does not. The patient should be told that the respirator, in his case, is used solely to provide him with rest and a chance to get through the most taxing period of his illness without depleting his strength. He should understand that it is a temporary measure and will be dispensed with as soon as the acute stage of the disease is passed.

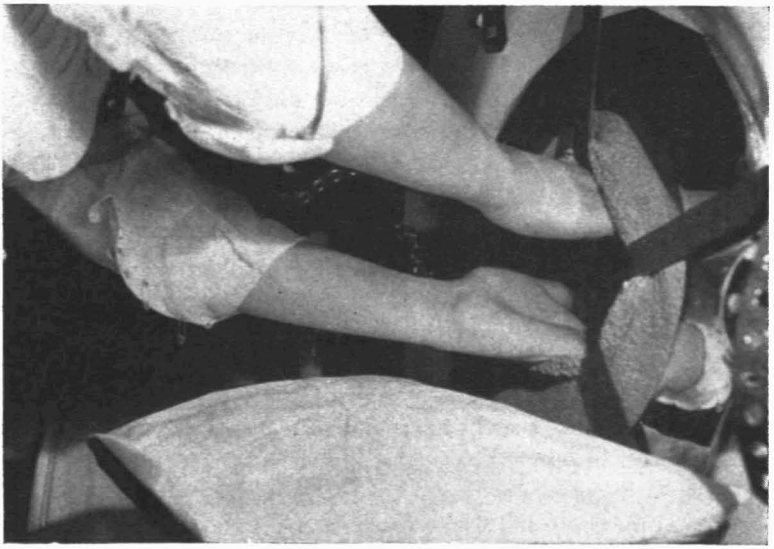
If he is told what is expected of him and why his cooperation is so urgently needed, difficulties of placing him in the tank will be greatly reduced.

To place the patient in the machine

At least four, and sometimes five, people should be on hand to place an adult in the respirator. The neckpiece is prepared in one of two ways: In the Collins machine the four handwheels which control the collar are loosened one at a time, and the rubber collar is pulled out at that point as far as it will go. Each handwheel is tightened before the next one is loosened. It is necessary to be very careful in handling sponge rubber collars not to tear them with the fingernails. In the Emerson machine the collar straps are tightened and attached in their respective pins until the opening is large enough for the patient's head. (Fig. 6.) A silk hairnet or cap of stockinette may be kept in the machine to place on women patients' hair before pulling the head through the machine, a feature which makes the procedure more comfortable for the patient.

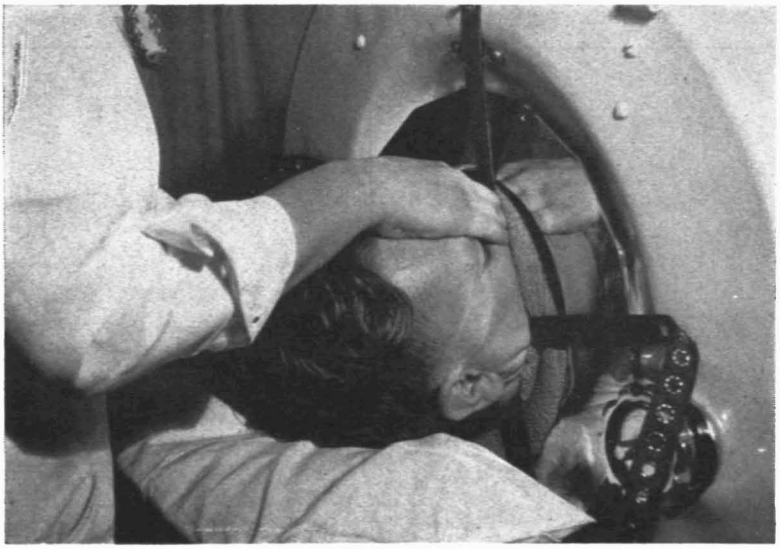
Unfasten the clamps at the head of the machine and pull out stretcher and mattress to its full length. Cot and mattress should always be as low as possible before patient is put in machine. Inspect the rubber gasket around the head of the machine. If it is loose at any point, call the engineer at once. Negative pressure cannot be secured inside the machine if this is faulty.

The patient, clad in the minimum of easily-removable clothing, is carefully lifted to the mattress of the machine. His head is turned slightly to one side, and his chin is kept down. This frequently is an uncomfortable position for a patient who has spasm in his posterior neck muscles. To avoid unnecessary pain, the patient's body should be *lifted* from the cot as the head is pulled through the opening. One nurse stands at the



(Courtesy Clay-Adams Co., Inc.)

Fig. 6
Position of nurse's hands to pull patient's head through collar.

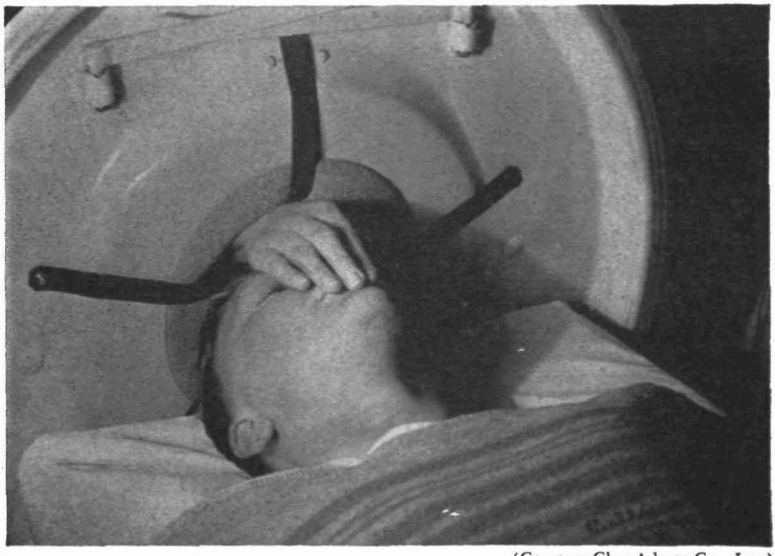


(Courtesy Clay-Adams Co., Inc.)

Fig. 7
Nurse's hand protects patient's nose as head is pulled through machine.

head of the respirator, inserting her hands in the collar lengthwise, and spreading the collar further with the backs of her hands as she does so. (Fig. 6.) This nurse grasps the occiput with her lower hand and covers the face and nose of the patient with the upper hand momentarily as she gently pulls the head through the opening. (Fig. 7.) (Fig. 8.) The crew of nurses or attendants at the other end of the respirator lifts the patient's body toward the head of the machine. There must be no dragging or pushing. Only practice makes this kind of teamwork possible.

If the case is a grave emergency, the machine must be closed at once, all clamps secured, and the mechanism turned on immediately. Two things are essential, however, in spite of the necessity for speed. The patient's arms must be protected securely by crossing them on his chest as the machine is closed, and such covering as is placed in the machine with him must be watched to see that it does not hang down in the tank. Jamming of the apparatus may occur if this is allowed to happen. The mattress of the cot should always touch the upper end of the tank, otherwise the patient will have considerable strain and discomfort under his inadequately-supported neck and shoulders.



(Courtesy Clay-Adams Co., Inc.)

Fig. 8

Nurse's hand protects patient's nose as head is pulled through machine.

The rubber collar is now released so that it touches the neck all around. This is done by use of the hand screws in the Collins machine or, in the Emerson respirator, by letting out the leather straps. The anterior straps are released last, great care being taken to prevent excess pressure on the anterior surface of the neck. The collar should just touch the throat during inspiration. In small children who tend to be frightened this is an exceedingly important point.

The necessity for having the patient's shoulders in contact with the head-end of the tank cannot be over-emphasized. If this is not done, the rubber collar will be immediately under the patient's chin where it will be a source of great annoyance. The proper place for the collar is as near the clavicles as possible. The patient's head can be centered in the collar by raising or lowering the head-end of the cot by means of the screw or handle provided for this purpose directly under the front of the machine.

As has been stated, a negative pressure of from 14 to 20 is usually sufficient. However, some authorities prefer to begin with much less negative pressure, particularly where the patient himself is still able to breathe with a fair degree of comfort. As he becomes accustomed to the machine, the pressure is increased just enough to secure adequate pulmonary ventilation with minimal effort on the part of the patient. It is not wise to increase the pressure where cyanosis seems to persist, or where cooperation seems incomplete. If inability of the patient to cooperate with the machine is manifest, the likelihood of foreign bodies or mucus in the trachea should be borne in mind. Suction or oxygen may be indicated rather than an increase of pressure. Excessive negative pressure is uncomfortable for the patient and emphysema has been found to develop in both superficial and deep tissues after prolonged periods of such hyperventilation.

Positive pressure is unpleasant and the patient will usually complain of it if he is conscious. It is not in common use, although Dr. Wilson states that occasionally it is of value in helping the patient to exhale more forcefully when abdominal muscles are paralyzed and coughing is impossible. It may in this way help the patient to bring up phlegm and mucus, but it should not be used without medical direction.

Skilled hands, self-control, and poise on the part of the nurse are necessary to minimize the patient's nervousness. These attributes will best be assured if the nurse and her assistants know exactly what they are doing.

Practice alone makes this possible, but it is not necessary to wait until there is a patient in the respirator in order to learn more about its operation. A classroom situation, where a student acts as a patient, is ideal for improving skill in respirator care. All nurses who periodically care for patients in the respirator should themselves undergo the experience. They will thereby be more cognizant of the patient's problems and discomforts. Remember that synchronization between the patient's own breathing efforts and the rhythmic action of the machine is indispensable. Nurses should note extra efforts to inhale which do not coincide with the action of the respirator. Mucus or vomitus may be occluding the glottis, and suction rather than a change of rate or depth of respiration may be indicated. Suction is only used as the patient exhales.

Daily care of the patient in the respirator

It is usually possible to remove the patient from the tank for short intervals during which time the bath, change of linen, and care of the back may be accomplished. The head, of course, is not removed from the collar, so that it is possible to return the patient to the tank and start the mechanism speedily in case of emergency. Where care is given in this manner, good teamwork is essential, and since everyone must work at high speed each task must be assigned before the machine is opened so that no confusion occurs. A crew of four people working together with good teamwork may give adequate care to an adult patient in a little over two minutes. Sometimes a preceding period of hyperventilation (25 to 30 cm. of negative pressure) may enable the patient to remain out of the machine for a longer period than he would be able to tolerate otherwise.

If the patient cannot do without the aid of the machine even for short intervals, bath and nursing care are given through the arm ports. The rubber cuffs surrounding the ports seal off escaping air by their contact with the nurse s arms. The patient will usually not be disturbed by the slight change of air pressure in the tank if only two ports are opened at one time. However, when two nurses work at the same time, and four portholes are therefore kept open for a considerable period, it may be necessary to increase the negative pressure briefly in order to compensate for leakage around the cuffs. If this is not done the patient is frequently exhausted at the end of the bath. Both the pressure gauge and the patient's face should be watched closely. Pressure should always be ad-

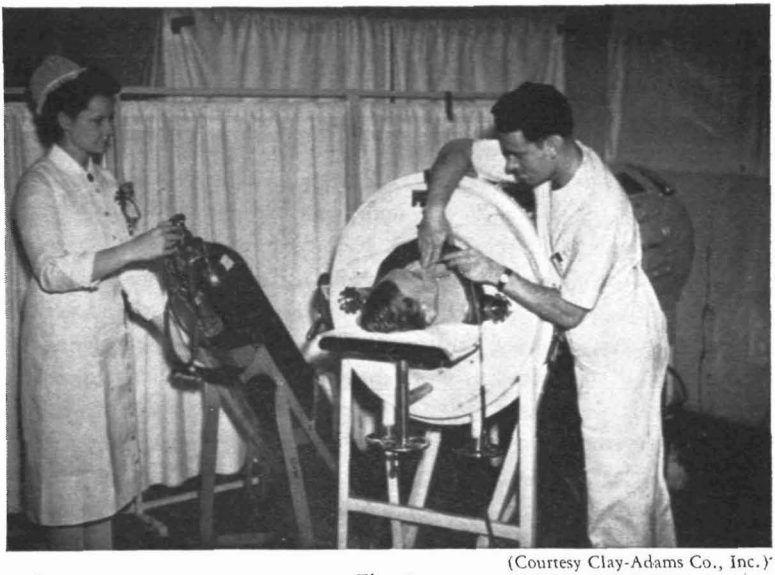
justed back to the customary level when nursing care is completed and the ports closed.

On the whole, it is quicker and less tiring for the patient to be cared for by two nurses or a nurse and an attendant, working on either side of the machine simultaneously. The arm reach inside the respirator of any nurse is of necessity very limited, and by handing equipment back and forth between them, two nurses can give more adequate care than one nurse working alone, and much time can be saved.

When two work together, a small bath basin which can be reached by both nurses is placed between the patient's legs. All equipment for the bath and change of linen is placed in the machine before the procedure is begun by way of the large bedpan port. This port should be opened and closed with the greatest possible speed and should be timed to follow an inhalation. When the anterior portion of the body has been bathed a third person, preferably an orderly, is summoned before turning the adult patient for his back care and change of linen. The trio works together deftly and very swiftly during the next steps. One nurse assists the patient to turn his head as the body inside the machine is turned by the orderly. The bath basin is placed *outside* the machine on a high stool near the ports through which the nurse giving back care intends to work. The orderly reaches across the patient and grasps the opposite shoulder and hip, gently turning the patient toward him. This enables the nurse on the other side of the machine to give a thorough rub to the patient's back, shoulders, buttocks, and heels. She then loosens the soiled drawsheet and tucks a clean one under the mattress on her side, fan-folding it as far under the patient's back as it will go. The patient is then returned to his back where he is allowed to rest a moment before the next step is undertaken. The nurse who is watching the head sees to it that it is always turned with the body in order that no twisting or torsion occurs. The process is now repeated on the other side so that the entire back is well cared for. The undersheet is tightened but is not changed every day. Change is made only when necessary. It is usually possible to release the patient from the machine for 30 seconds to do this. The sheet, folded in half, length-wise, is changed from the bottom as attendants lift the patient's body. It can be done inside the machine in the same fashion, but it is something of an ordeal for the adult patient. When changing the undersheet, care should be taken to see that it is

tucked in carefully at the top of the mattress and that no wrinkles remain under the shoulders. Frequently patients in respirators have more pain at this point than in any other section of the body. Before leaving the patient, the attending nurse should assure herself that the mattress is touching the upper end of the tank.

Enemas may be given, either by elevating the common type of irrigating can and bringing the tubing down through the small opening, (Fig. 1, K) in the top of the machine provided for this purpose; or a small enema may be given with a funnel and rectal tube inside the tank. Catheterization is difficult in the respirator on female patients, although it is occasionally necessary. Every effort should be made to remove the patient from the machine for this purpose. Satisfactory catheterization may be performed on a male patient in the respirator if the operator wears a pair of sterile gloves over scrubbed hands. The gloves may be removed inside the machine without contaminating the hands after they have passed through the ports; or, sterile towels may be used to cover the gloves as the nurse puts her hands through the ports.



(Courtesy Clay-Adams Co., Inc.)

Fig. 9
Nasal catheter for oxygen administration.

Meticulous care must be taken to prevent the nostrils from becoming sore or irritated when a nasal catheter is in use for suction or oxygen administration (Fig. 9). The catheter should be lubricated, but excess oil must be carefully eliminated.

The Kenny techniques and the respirator

If hot foments are being used concurrently with the respirator and the patient cannot be out of the machine, the moist blanket wrapped in a piece of waterproof material is slipped quickly through the bedpan port. A second nurse with her hands through the arm ports applies the packs quickly to the chest and shoulders, tucking them under the axillae, around the upper arm, and under the neck as far as they will go. Waterproof material may be placed over these packs, but the dry outer pack is omitted. Very little success has been obtained in trying to pack the back or posterior neck muscles of these patients. Occasionally thighs and legs are packed with the same "lay-on" type of foment.

Body alignment is given careful attention. The feet are supported by a small box or pillow, and outward rotation at the hips is prevented by a long sandbag or trochanter roll. A rolled towel is kept under the knees. Except in the orthopedic type of respirator little can be done in regard to the position of the upper arm. Passive motion for the shoulder joint should therefore be given when the patient is out of the machine for bath or morning care. The forearm can be positioned in the machine by the use of small pillows, with the elbow in the neutral position, the wrist in dorsiflexion, and the fingers slightly relaxed over a ball or thickly rolled bandage. Early, painless, passive motion should be instituted in all possible joints while the patient is in the respirator in order to minimize stiffness of joints and contractures of soft tissues.

There is variation of opinion among doctors in regard to the teaching of breathing to patients in respirators. Attempts have been made to remove patients from the machine for short intervals of instruction and practice in breathing so that complete alienation of the function will not occur. The patient is taught to breathe in through the nose while the doctor or nurse places both hands on the rib cage and asks the patient to fill out the chest at that spot. The patient is then told to breathe out through the nose, pull the ribs together and tighten the abdominal muscles.

However, many doctors are pessimistic about the whole process of reeducation in breathing for patients as long as they are relatively dependent on the machine. These doctors point out that the very nature of the respirator works against the system of treatment outlined by Miss Kenny inasmuch as "alienation" is bound to occur if the patient's breathing is taken care of by the machine without any effort on his part. They feel that by reducing negative pressure and allowing the patient to put forth increasingly more effort to do his own breathing in the machine they accomplish satisfactory results without attempts at actual breathing exercises. Prolonged dependence on the machine in either case is considered inadvisable.

Changing the patient's position

Provision for rotating the cot and mattress from side to side is available in some machines. Before attempting this rotation the machine must be in the horizontal position — not tilted. The front legs are hooked up off the floor and clamps at the head are loosened slightly. The head disk is then rotated to the side. This rotation turns the cot with the patient's body to a semi-side-lying position. The head must, of course, be turned at the same time. The clamps to the head disk are then fastened again. Where mechanism for rotating is not provided in the machine the patient may be turned on his side manually. Some hospitals have developed "teams" for this work composed of hospital personnel or of volunteers. These "teams" call at scheduled times to perform the necessary turning of such patients.

Frequent alteration of position is essential for several reasons. The danger of hypostatic pneumonia is, of course, always present. Less well recognized is the threat of renal calculosis which so frequently complicates the progress of long-term respirator cases. And, as is always the case with completely recumbent patients, the skin tends to break down over bony prominences. Heels, scapulae, and sacrum must be given particular care; the skin of the neck and occiput, too, will need regular attention. Frequent shampoos are helpful in preventing pressure areas on the occiput, and the neck must be washed gently, massaged, and powdered twice daily. In any use of talcum near the patient's face, care must be taken to prevent aspiration of the powder.

All people coming in contact with individuals in respirators should

wear masks. These patients must be protected at all costs from upper respiratory infection. Such infections are a threat to the life of *any* patient with involvement of chest muscles, but with respirator patients even a mild cold may bring about a fatal pneumonia.

Fluid intake should be generous and both intake and output should be recorded. Frequent urinalyses are often ordered, and the specimens should be inspected for signs of occult blood. However, the first indication of the formation of renal stones may appear with a complaint of discomfort or pain in one of the lower quadrants.

When nasal feeding is necessary this should preferably be done by the physician. The danger of introduction of fluid into the lung is so serious that it would seem advisable for nurses not to take the responsibility for such a procedure. If, however, no physician is available the nurse must take great precautions to assure herself that the tube is in the stomach before introducing fluid. This may be done by aspirating stomach contents with a syringe, or the end of the tube may be placed in a bowl of water during the exhalation phase of the breathing cycle and observed carefully for air bubbles. If air bubbles occur the tube must be withdrawn immediately.

Hand operation

All hospital ward personnel, professional and non-professional, should know how to change the respirator from electric to hand operation. The accompanying illustrations show two methods by which this is done.

1. The Emerson Respirator. (Fig. 2.) Push down lever (16) at lower end of rocking beam, so that rod (14) slides freely in sleeve. Stand close to foot of machine, hold handle (18) with both hands and sway alternately backward and forward. It will generally be found best to close valve (10) when operating machine by hand.

2. The Collins Respirator. (Fig. 4.) The handle (E) for manual operation is usually located underneath the foot-end of the machine and is fastened with a thumb nut which may be unscrewed. The respirator bellows is operated by means of two lever bars (D) which are connected at the forward end by a box-shaped clamp and handwheel. When the clamp is loosened and pulled forward to the stop-pin on the longer of the two levers these are disconnected and the handle for manual operation can then be inserted into the box clamp and the handwheel tightened.

Hand operation is not an easy assignment and the person performing it will need frequent relief periods. An alarm bell operated by a separate battery is indispensable. It should be planned so the bell will ring loudly in case the motor of the machine fails or the current is shut off or if, for some reason, a port window or door opens and pressure is lost in the tank. The patient is thus assured immediate attention if the machine fails him. The ears of nurses working nearby soon become attuned to the peculiar type of sound made by the respirator when it is in operation, and they should recognize any sudden alteration in rhythm which may mean the machine is operating at less than optimal efficiency.

Weaning the patient from the machine

Every effort should be put forth to prevent complete dependence on the respirator. In developing independence the moderately involved patient may be helped by a gradual decrease of negative pressure before he is actually taken out of the machine. This will provide a test of his endurance and ability to perform his own respiratory function unaided. These trials should be carefully observed and recorded by the nurse. Occasionally the trial may be made as the patient sleeps, but if badly involved, his confidence is sometimes sacrificed by this type of experiment.

The severely involved patient who has been confined to the respirator for a longer period may be treated in the same fashion. This situation, however, is not quite so simple. The long-term respirator patient may be expected to have periods of apprehension and panic when he is actually taken out of the machine, even though he has been able to lie in it with the current turned completely off quite comfortably.

The attitude of the nurse in combating this nervousness is all important. She must be confident, reassuring and sympathetic in order to establish the desired sense of security which such a patient absolutely must have in order to fight his way back to complete independence of the machine. An increase of time spent each day out of the machine must be worked for.

The problem of diversional therapy for the long-term respirator patient is one which cannot be overlooked. Much ingenuity has been demonstrated by nurses who have cared for these patients. Frequently the occupational therapist is of great assistance to the nurse in figuring out a

means of providing entertainment or diversion. Every respirator patient should have a mirror attached to his machine to enlarge his range of vision. (Fig. 10.) A glass shelf attached above his head at a suitable distance provides a rest for books, newspapers, or magazines. Pages must of necessity be turned by attendants. Phonograph music is good entertainment for these patients; also chess and checker games for which the patients call out the moves. Respirator patients are often considered in the light of a "cooperative enterprise" in hospitals, and adult ambulatory patients frequently donate a portion of their time each day for reading and playing games with them.

Fig. 10

The commercial respirator never seems to have quite enough ports or windows for the nurse caring for the full-grown patient. Hospital engineers and carpenters have been very ingenius in adding to these to provide space for more adequate care. (Fig. 11.)

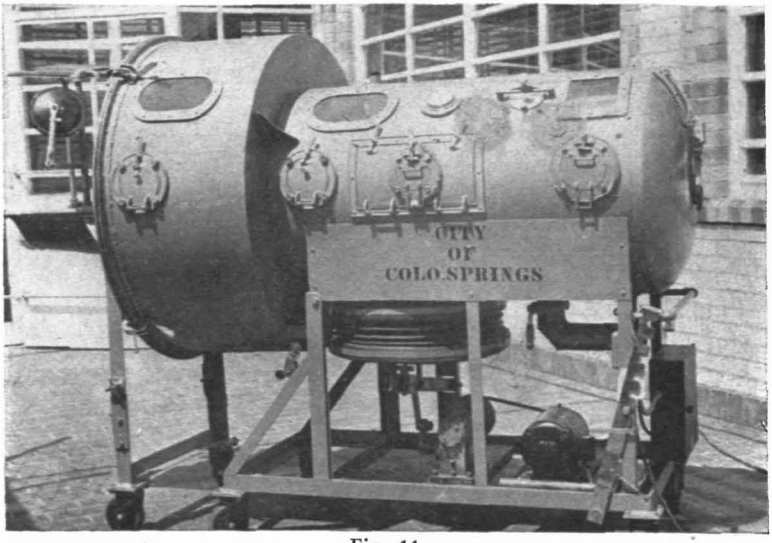


Fig. 11

Showing additional parts and windows added by hospital engineer. (From "The Patient in the Respirator — Some Suggestions for Nursing Care," by Hulda Helling. American Journal of Nursing.)

During epidemic seasons when a considerable number of respirator patients are hospitalized in the community, graduate nurses should be encouraged to return to the hospital for a few days to acquaint themselves with the care of patients in these machines. Ideally, all nurses should know these techniques before graduation from the school of nursing, but unfortunately opportunity is sometimes lacking. Generous use should be made of the educational opportunity when it *is* available.

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