

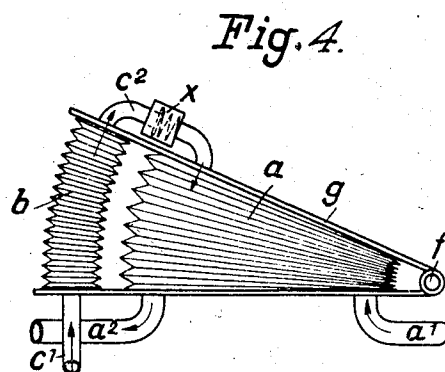
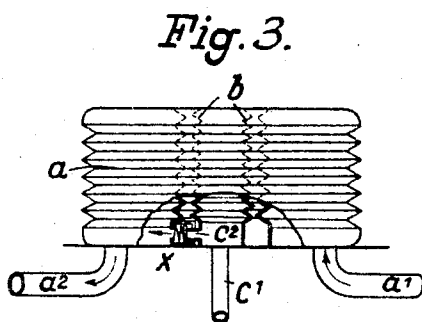
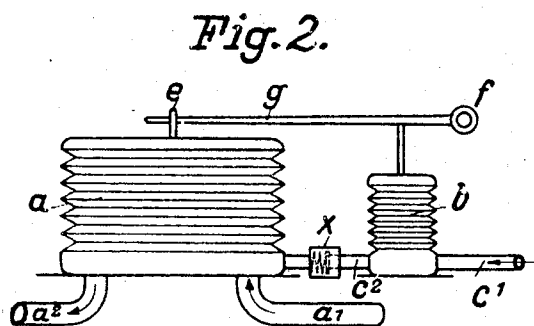
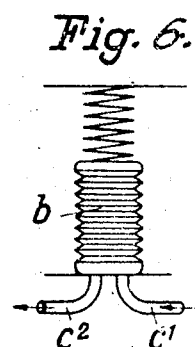
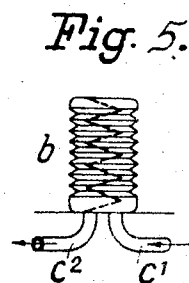
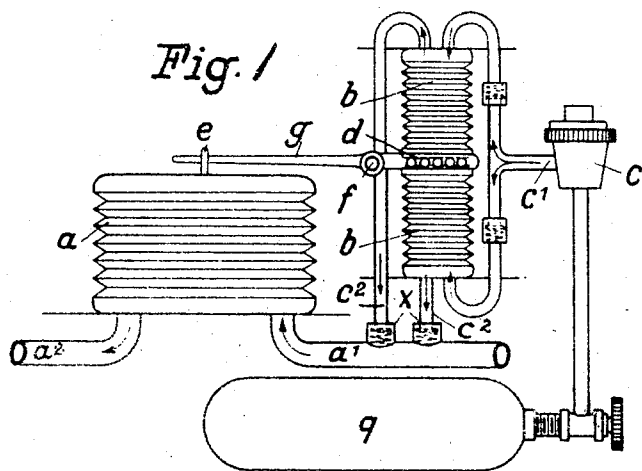
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RESPIRATORY APPLIANCE

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RESPIRATORY APPLIANCE

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49,981. Divided and this application October 9,
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9 Claims. (Cl. 128—202)

This is a division of my co-pending applica-
tion No. 49,981, filed November 15, 1935.

This invention relates to respiratory appli-
ances having circulation of the respiratory air
and automatic lung-controlled oxygen feeding.

In respiratory appliances of this kind, arrange-
ments are known for avoiding excess of nitrogen.
The arrangements aim at the passage of a suf-
ficient quantity of nutritive gas or oxygen whilst
avoiding the constantly uniform nutritive gas
feeding which considerably shortens the dura-
tion of use of the appliance, and which is mostly
provided in addition to the automatic lung-con-
trolled feed.

In order in a respiratory appliance having
automatic lung-feeding, to adapt the supply of
oxygen exactly to the demand at any time, the
respiratory appliance is, in accordance with the
invention, connected to an intermediate con-
tainer of variable volume and maintained con-
tinuously under regulated pressure of the oxygen
so that every movement of the wall of the res-
piratory bellows is mechanically transmitted
and which container is also connected with the
respiration bellows by means of a connecting
member adapted to introduce the oxygen into
the bellows and having a force closure control, so
that on each increase of volume, oxygen passes
from the storage container into the intermediate
container and on each diminution of volume,
oxygen is pressed out of the container into the
respiration bellows. In order not to render more
difficult the movement of the wall of the respira-
tion bellows by means of the pressure of the
oxygen inside of the intermediate container, pres-
sure compensating means may be provided; for
example, a movable bottom or piston which sub-
divides the container, is actuated by lever trans-
mission and has a double contacting action, a
spring member operating in opposition to the
oxygen pressure, or the like.

The respiration bellows is in general larger
than the intermediate container connected to it.
The ratio of the dimensions taken in connection
with the position of the parts with regard to
one another is so chosen that the quantity of
respiration air in the bellows has a certain
amount of oxygen, for example, about 4-10%
added to it. The intermediate container is during
the employment of the appliance, in continuous
direct connection with the reducing valve of the
oxygen container, which may be, for example,
adjusted to a pressure of 100 mm. water column.
If, during the inspiration, the volume of the
respiration bellows decreases, then with the cor-

responding diminution of the intermediate con-
tainer, the oxygen located therein must pass over
through the connection provided into the respira-
tion bellows, inasmuch as the reducing valve
prevents a return of the oxygen into the oxygen
container. In order that the oxygen from the
intermediate container be unable to pass over
from the intermediate container into the respira-
tion bellows continuously but only when its volume
is decreased, a valve controlled by force closure
is inserted in the connecting conduit which valve
is closed under greater pressure than exists in
the intermediate container. If, for example, the
oxygen pressure in the intermediate container
amounts to 100 mm. water column, then a coun-
ter pressure on the valve in the connecting con-
duit of about 120 mm. will suffice for closing it.

For the respiration bellows in appliances ac-
cording to the present invention, bellows of con-
certina-like type having a fixed lower wall and a
movable but rigid upper wall, are particularly
suitable. Bellows of this kind have a volume
and a variation of volume which can be easily
determined—which fact is important in connec-
tion with the present appliance for the reason
that the oxygen supply is dependent on the varia-
tion of volume of the respiration bellows. Further-
more these bellows render possible easy trans-
mission of the movement of their walls. If the
transmission of the movement is effected by
means of a one or two-armed lever, then the
power necessary for the alteration of volume can
be diminished by the alteration of the point of
connection of the intermediate container with
the short lever arm. This power is also in any
case less on account of the smaller volume of the
intermediate container as compared with the
respiration bellows. The oxygen pressure existing
in the intermediate container facilitates the ex-
pansion of the respiration bellows and thereby
diminishes the resistance of the wall of the bellows
during the expiration. If, as is provided for, the
oxygen pressure in the intermediate container is
eliminated by means of a compensating arrange-
ment, then the alteration of volume of the inter-
mediate container does not cause any overload
during the movement of the walls of the respira-
tion bellows. The force for opening the valve
in the connecting conduit can be completely elimi-
nated by the transmission ratio of the long lever
arm to the short one.

The advantage of the intermediate container
as a measuring device resides, as compared with
the known arrangements, in the fact that the
conducting path for the respiration air remains

entirely free and independent. The oxygen no longer flows, as in the case in all the hitherto known appliances, on the release of the valve automatically controlled by the lungs, into the interior of the whole appliance at the pressure of the pressure-reducing valve or directly at the whole pressure of the oxygen container, but, by the direct connection of the reducing valve with the intermediate container, the supply of oxygen is in the first place limited to the capacity of the latter and the quantity of oxygen passing out of the intermediate container into the conducting path is limited to the particular amount which is determined by the alteration of volume of the respiration bellows.

In order that the invention may be fully understood, some embodiments thereof will now be described by way of example by reference to the accompanying drawing in which the figures of the drawing are restricted to that part of a respiration appliance which is necessary for the comprehension of the invention. The drawing shows in:

Fig. 1, the mechanical and pneumatic connection of the respiration bellows with an intermediate container subdivided by means of a movable bottom, and the always open connection of the latter with the reducing valve of the oxygen container,

Figs. 2-4, the same connection with a single-space intermediate container with various means for the transmission of the movement,

Fig. 5, a tension spring in the interior of the intermediate container, and

Fig. 6, a compression spring above the intermediate container acting as a compensation for the oxygen pressure.

According to Fig. 1, the intermediate container *b* is provided with a pressure compensating means consisting of a movable intermediate bottom *d*, which is connected with the two stationary boundary walls after the manner of a concertina. Into each of the two boundary walls, a branch of the conduit *c*¹ to the reducing valve *c* opens, so that both halves of the container *b* are under the same oxygen pressure. By means of the two-armed lever *g* adapted to swing on the stationary fulcrum *f*, the movement of the wall of the respiration bellows *a* is transmitted to the movable intermediate bottom *d* of the container *b*. During this movement, the intermediate bottom *d* presses the oxygen alternately out of the lower and upper container half *b* through the conduits *c*² which are likewise connected to the two boundary walls of the container, the oxygen passing either directly or indirectly into the respiration bellows *a*. As a consequence of the fact that the bottom *d* is operated upon by the oxygen on both sides, the pressure in the intermediate container above and below the bottom *d* is compensated. For the movement of the bottom *d*, only the power required for opening the valve *x* in the connecting conduit *c*² is consequently necessary. If, for example, the oxygen pressure in the intermediate container amounts to 100 mm. and the load of the valve *x* to about 20 mm. more, then there is opposed to the transmission of movement of the respiration bellows to the intermediate container only the small pressure of 20 mm., which, however, is almost entirely eliminated by the arrangement of the intermediate bottom *d* on the short lever arm. The magnitude of the movement of the intermediate bottom *d* and consequently the alteration of volume of the container *b*, can be adjusted by providing on the short arm of the lever *g* a number of bores,

wherein a variable positioning of the bottom *d* is rendered possible. In this embodiment, in consequence of the subdivision of the intermediate container *b*, the oxygen therefrom is pressed into the respiration bellows, not only when the latter contracts, but also when it expands.

In the embodiment shown in Fig. 2, the transmission of motion from the respiration bellows *a* to the intermediate container *b* is effected by means of the one-armed lever *g* fulcrumed at *f*, the point of application of the respiration bellows *a* being on the long lever arm, and the point of application of the intermediate container *b* being on the short arm. In this case, the conduit *c*¹ leads from the intermediate container *b* to the reducing valve *c*, and the conduit *c*² with the valve *x* leads to the respiration bellows *a*.

In Figure 3, the intermediate container *b* is arranged in the middle of the respiration bellows *a*. Both of these are retained in position so as to be movable by means of the common top wall. From the reducing valve *c* the conduit *c*¹ leads into the intermediate container *b* which is connected with the respiration bellows *a* by means of the connection *c*² which is controlled by force closure.

In the embodiment shown in Figure 4, the respiration bellows *a* is located after the manner of a wedge between two walls connected by a hinge *f*, the upwardly directed wall *g* being adapted to swing and, owing to this capacity for swinging, produced by the alteration of volume of the respiration bellows *a* effecting the alteration of volume of the intermediate container *b*. The container *b*, which is adapted to be arranged at any desired place between the two walls, is, in this case, illustrated as being located on the long lever arm. The intermediate container *b* is also connected by means of the conduit *c*¹ with the reducing valve *c* and by means of the conduit *c*² which is controlled by force closure with the respiration bellows *a*.

For compensating for the oxygen pressure, there is provided, according to Figure 5, a tension spring arranged inside the intermediate container *b*, which spring, acting against the oxygen pressure, tends constantly to draw the movable top wall of the container downwards, whilst in the construction shown in Fig. 6, there is arranged above this movable top wall a compression spring supported at its other end. If the power demand for compressing the intermediate container *b* exceeds the permissible load on the lungs, which for example, may be the case in the embodiments illustrated in Figs. 3 and 4, a compensating means of this kind for the pressure is desirable. In an arrangement such as is shown in Figure 2, wherein the operating power for the intermediate container is applied to the short lever arm, a pressure compensating means is not necessary.

With the intermediate container *b* the variability of its volume is illustrated on the drawing by means of an intermediate bottom moved after the manner of a concertina, or by a similarly moved top wall. The same object can be obtained by means of a bellows of another kind, or a stationary hollow cylinder having a piston moved within it by the action of the respiration bellows.

The position of the respiration bellows with the quantity meter regulating the oxygen supply is the same as is general with circulation appliances for the respiration bellows, for example, between the air purifying chamber and the inspiring pipe.

I claim:

1. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of: a respiratory bellows, a source of oxygen supply, and an intermediate variable volume container in communication with said oxygen supply source and said respiratory bellows in such manner as to allow of passage of oxygen from said source to said container and from said container to said bellows, and said container being constantly positively operatively connected to the wall of said bellows such that every variation in volume of said bellows produces a proportional variation in volume of said intermediate container, every volume increase of said container causing oxygen to pass from said source of supply to said intermediate container and every volume diminution thereof causing oxygen to be forced from said container into said bellows in an amount which is a constant uniform percentage of the air respired.

2. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of: a respiratory bellows, a source of oxygen supply; an intermediate variable volume container in communication with said oxygen supply source and said respiratory bellows in such manner as to allow of passage of oxygen from said source to said container and from said container to said bellows; and a lever connected at one end to said container and constantly responsively connected at the other end to said bellows for positively operatively connecting said container to the wall of said bellows such that every variation in volume of said bellows produces a proportional variation in volume of said container, every volume increase of said container causing oxygen to pass from said source of supply to said intermediate container and every volume diminution thereof causing oxygen to be forced from said container into said bellows in an amount which is a constant uniform percentage of the air respired.

3. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of: a respiratory bellows, a source of oxygen supply, an intermediate variable volume container communicating with said oxygen supply source and said respiratory bellows in such manner as to allow of passage of oxygen from said source to said container and from said container to said bellows and said container being constantly positively operatively connected to the wall of said bellows such that every variation in volume of said bellows produces a proportional variation in volume of said intermediate container, every volume increase of said container causing oxygen to pass from said source of supply to said intermediate container and every volume diminution thereof causing oxygen to be forced from said container into said bellows in an amount which is a constant uniform percentage of the air respired, and force closure means for preventing passage of oxygen from said container to said bellows except during movement of the latter.

4. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of: a respiratory bellows, a source of oxygen supply, an intermediate variable volume container, conduits connecting said container respectively to said oxygen supply source and to said respiratory bellows in such manner as to allow of passage of oxygen from said source to

said container and from said container to said bellows, and said container being constantly positively operatively connected to the wall of said bellows such that every variation in volume of said bellows causes a proportional volume variation of said intermediate container, every volume increase of said container causing oxygen to pass from said source of supply to said intermediate container and every volume diminution thereof causing oxygen to be forced from said container into said bellows in an amount which is a constant uniform percentage of the air respired, and a valve disposed in the conduit connecting said container to said bellows, said valve being held normally closed under the action of a force, such as a spring, greater than the pressure of the oxygen in said container.

5. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of: a respiratory bellows; a source of oxygen supply; an intermediate variable volume container communicating with said oxygen supply source and said respiratory bellows in such manner as to allow of passage of oxygen from said source to said container and from said container to said bellows; and a lever connected at one end to said container and at the other end to said bellows positively operatively connecting said container to the wall of said bellows such that every variation in volume of said bellows causes a volume variation of said container, every volume increase of said container causing oxygen to pass from said source of supply to said intermediate container and every volume diminution thereof causing oxygen to be forced from said container into said bellows in an amount which is a constant uniform percentage of the air respired, and the point of engagement of said lever with said container being variable for the purpose of controlling the variation of volume of said container.

6. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of a respiratory bellows; a source of oxygen supply; an intermediate container of variable volume communicating with the respiratory bellows and the oxygen supply source; and a movable bottom subdividing said container, said bottom being operatively connected to the wall of said bellows such that every wall movement of said bellows is transmitted to said bottom whereby each expansion and contraction of said bellows causes alternately the evacuation of one side and the simultaneous filling of the other side of said container.

7. In a lung controlled respiratory appliance having automatic oxygen supply, the combination of: a respiratory bellows; a source of oxygen supply; an intermediate variable volume container communicating with said oxygen supply source and said respiratory bellows in such manner as to allow of passage of oxygen from said source to said container and from said container to said bellows; and said container being positively operatively connected to the wall of said bellows; and a tension spring disposed within said container, said spring normally tending to contract said container, the arrangement being such that every wall movement of said bellows causes a volume variation of said container whereby on every volume increase oxygen passes from said source of supply to said intermediate container and on every volume diminution oxygen is forced from said container into said bellows, the pressure of the oxygen in said container being compensated by said spring.

8. In a lung controlled respiratory appliance

having automatic oxygen supply, the combination of: a respiratory bellows; a source of oxygen supply; an intermediate variable volume container communicating with said oxygen supply source
5 and said respiratory bellows in such manner as to allow of passage of oxygen from said source to said container and from said container to said bellows; and said container being constantly positively operatively connected to the wall of said
10 bellows; and a compression spring arranged above and connected to the top of said container, the arrangement being such that every variation in volume of said bellows causes a volume variation of said container every volume increase of said
15 container causing oxygen to pass from said source of supply to said intermediate container and every volume diminution thereof causing oxygen to be forced from said container into said bellows in an amount which is a constant uniform percentage
20 of the air respired and the pressure of the oxy-

gen in said container being compensated by said spring.

9. A lung controlled respiratory appliance having automatic oxygen supply including the combination of: a source of oxygen supply; a respiratory bellows connected to said oxygen supply; a
5 variable volume container communicating with said supply and said bellows and through which said oxygen passes; a movable partition member subdividing said container, the container on both
10 sides of said movable member being connected to said oxygen supply and to said bellows; and a lever operatively connected to said bellows and to said container for the purpose of transmitting the
15 movement of said bellows to said intermediate container, whereby each expansion and contraction of said bellows causes alternately the evacuation of one side and the simultaneous filling of the other side of said container.

CARL VON HOFF. 20