G. P. E. STOLLE,
METHOD FOR PRODUCING ARTIFICIAL RESPIRATION.
APPLICATION FILED DEC. 19, 1914.

1,358,893.
PATENTED NOV. 16, 1920.
2 SHEETS-SHEET 2.

Fig. 2.
To all whom it may concern:

Be it known that I, GEORG PAUL EUGEN STOLLE, engineer, a subject of the German Emperor, and residing at Kiel, Germany, 5 Bluecherstrasse 1, have invented certain new and useful Improvements in Methods for Producing Artificial Respiration, of which the following is a specification.

The present invention is a division of my application No. 796,460 filed October 21st 1913 and relates to a method of producing artificial respiration. Several forms of construction of apparatus are known for this purpose and they can be conveniently divided into five groups, as follows:

1. Apparatus in which respiration is produced by moving the arms and simultaneously expanding and contracting the chest.

2. Apparatus by means of which the entire abdominal part of the person under treatment is rhythmically expanded or contracted.

3. Apparatus which rhythmically forces oxygen into the lungs.

4. Apparatus which forces oxygen into the lungs, the contents of the lungs being withdrawn after each supply by means of a hand operated pump.

5. Apparatus by means of which air rich in oxygen is forced into the lungs the contents of which are withdrawn after each supply, the rhythm of exhaust and supply depending directly upon the more or less rapidly obtained increase or reduction of pressure in the exhaust or supply pipe or in the lungs.

The invention is a development of the last class of apparatus referred to above. The apparatus of this class suffer from considerable disadvantages owing to the fact they are dependent for their working on the cooperation of the lung spaces and the reversal from the supply to the exhaust effect and vice versa only takes place when a certain increase or reduction of pressure in the lung spaces is obtained.

If the lungs of a person being treated by means of the above apparatus do not work to the standard degree, the rhythm is extraordinarily and unnaturally accelerated as its rapidity depends upon the time taken to obtain a reduction or increase of the pressure in the lung spaces. When this acceleration of the rhythm takes place, overstrain-
the movements of the piston unites with the respiration gas proper. The control mechanism conducts the respiration gas alternately into an exhaust chamber or compartment and a supply chamber or compartment; these chambers or compartments can be provided with a plurality of connections so that a number of persons can be treated at the same time while employing a single apparatus. The control mechanism regulates the respiratory period and it is therefore only necessary to provide, for each person to be treated, a separate set of exhaust and supply nozzles and connecting pipes and a separate mask in which safety valves are arranged, these valves being differently adjusted for different persons.

In order to increase the regularity of the reversal from exhaust to supply and vice versa and to improve the operation of the apparatus as a whole, provision may be made to insure that in its end positions, or in one of them, the valve is held by a resilient member so that the reversal takes place in overcoming an opposing force constituted by this member and is, therefore, correspondingly accelerated.

In the accompanying drawings:

Figures 1 and 2 illustrate an apparatus, embodying my invention, in two similar longitudinal vertical sections, showing the two characteristic positions of the control mechanism.

In the construction illustrated in Figs. 1 and 2, 1 is a chamber into which two supply nozzles 2, 3 open; these nipples serve for connection with a bottle or other reservoir containing the respiration gas, the nipple 2 being provided with a screw 30 for regulating the supply of gas. Inside the chamber 1 a cylinder 4 is fixed, and in this cylinder a piston 6 provided with a piston rod 5 is displaceable upward and downward. On the front end of the piston rod is provided a tappet 7 which, in proximity to each of its end positions, actuates two tappets 9 and 10 arranged on a movable slide valve 8 provided with a longitudinal bore 14.

The slide valve 8 is guided in a casing 11 connected with the cylinder 4, and also in a bush 12, which is fixed in a chamber 13. The chamber 13 is united to the chamber 1, and is divided into two compartments by the bush 12. In addition to its longitudinal bore 14, the slide valve 8 carries a series of ports cooperating with ports in the wall of the cylinder 4 and also with passages leading from the interior of the guide bush 12 into the two halves of the chamber 13. The three ports 15, 16 and 17 in the valve cooperate with the cylinder 4, in the ports 15 and 16 permitting of passage from the longitudinal bore 14 to the ports 18 and 19 and consequently to the interior of the cylinder 4 alternately when the valve 8 moves upward and downward, while the annular port or passage 17 serves to permit fresh gas to pass by way of a pipe 20 fitted to the socket 2 into the space above or below the piston 6 according to the position of the valve 8. The ports 21 and 22 on the lower part of the slide valve 8 cooperate with the passages 23 and 24 provided in the guide bush 12. According to the position of the slide valve, the ports 21 and 22 register with the passages 23 and 24 respectively. The passage 22 leads to the half of the chamber 13 which is marked 25 and which, in the construction illustrated, serves as an exhaust compartment, while the passage 24 leads to the other half 26, which serves as a supply compartment. The compartments 25 and 26 are provided with connections 27 and 28, adapted to be closed and enabling a number of persons to be treated. In the example here illustrated, it is assumed that only one pair of connections is utilized. Two flexible conduits 29, 30, proceed to the patient 38 from the two connections 27, 28, with the interposition of the two nozzles 31, 32, and corresponding pipes 33, 34, the device 37 being a mask provided with exhaust and delivery safety valves 35, 36. At their lower end the pipes are connected by way of the nozzles 31 and 32 with a common chamber 40. The pipe 33 opens into the atmosphere while the pipe 34 is fitted to the mask proper 37.

The operation of this apparatus is as follows:

In the position of the several parts illustrated in Fig. 1, the respiration gas passes through the nipple 2, the pipe 20, the annular port 17 of the slide valve 8, and the port 18 of the cylinder 4, into the space beneath the piston 6, which is at once caused to rise. Respiration gas also flows through the socket 5, the longitudinal bore 14 in 110 the slide valve 8, and the passages 21 and 22 into the exhaust compartment 25 of the chamber 13 and then through the conduit 29 into the supply nozzle 31 and finally into the atmosphere, and, owing to the injector-like action of the nozzle 31, exerts an exhaust effect upon the lungs of the patient and expels their contents into the atmosphere through the pipe 34 and 35. In the longitudinal bore 14 of the slide valve 8, 120 the gas flowing from the nipple 3 down the longitudinal bore 14 of the valve unites with the gas located above the piston 6 in the cylinder 4 which, under the influence of the upward movement of the piston, is forced 125 through the ports 19 and 16 into the bore.

In the course of the upward movement of the piston, the tappet 7 on the piston rod strikes against the tappet 9 on the slide valve and in overcoming the opposing force 130
constituted by the resilient roller 41 causes the said valve to move quickly upward so that it passes into the position shown in Fig. 2 with considerable acceleration; the piston 5 6 has then also reached its upper end position. In this position of the parts, the annular port 17 while still remaining in communication with the pipe 20 enters into communication with the port 19 in the cylinder wall while the lower port 18 registers with the port 15. In the upward movement of the slide valve 8 the passage ways at its lower end have also become modified, inasmuch as the port 22 now registers with the passage 24 leading to supply compartment 26 of the chamber 13, while access to the exhaust compartment 25 is cut off. The reversal is therefore complete, and the fresh gas is now conducted from the socket 2 22 through the pipe 20, and the ports 17 and 19, into the space above the piston 6, and also from the socket 3 through the longitudinal bore 14, the port 22 and the passage 24, into the supply compartment 26 from which the gas flows through the conduit 30 into the supply nozzle 32, and thence, while simultaneously sucking fresh air through the pipe 33, into the pipe 34 from which it reaches the lungs through the natural respiratory passages.

Under the influence of the gas situated above the piston 6, the latter is again caused to descend. Meanwhile the gas situated below the piston is expelled through the ports 18 and 15 and mixes with the respiration gas flowing through the socket 3 and proceeding along the longitudinal bore 14. As the piston continues to move downward with its tappet 7, it again strikes the tappet 10 on the slide valve 8 and after overcoming the resistance opposed by the resilient roller 41 causes the valve to descend also with considerable acceleration and thereby causes the parts to resume the position illustrated in Fig. 1, whereupon the operation just described is repeated. The number of reversals in a unit of time can be regulated by adjusting the throttling screw 39.

In order to prevent excessive pressure or exhaust effect from being exerted upon the lungs, the safety valves 35 and 36 are provided; when a given degree of pressure or of exhaust is exceeded, these valves automatically establish communication with the outer air.

In the illustrated form of the invention the supply or exhaust effect is a maximum at the beginning and gradually decreases thus producing an effect similar to natural respiration. In Fig. 1 the control mechanism is in the position in which the maximum exhaust effect takes place, the working gas which enters through the supply nipple 2 being admitted to the cylinder 4 below the piston 6 while the working gas in the cylinder above the piston passes through the ports 19 and 16 and enters the longitudinal bore 14 of the slide valve 8 where it unites with the respiration gas which enters through the supply-nipple 3. By means of the increase of pressure thus obtained an increased exhaust effect is produced and this effect gradually decreases as the increase pressure brought about by the working gas exhausting from the cylinder 4 diminishes. When the piston 6 reaches the end of its stroke the exhaust effect is due to the pressure of the gas entering through the supply nipple 2 only. When the reversal takes place the same effect is produced, that is to say, the pressure of the gas supplied to the patient gradually decreases.

In this way, an artificial respiration is obtained which agrees entirely with natural respiration, thereby insuring the success of the reviving action.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. A method of producing artificial respiration which comprises causing a flow of respiration gas, positively utilizing a portion thereof independently of lung pressure to effect the reversal of direction of flow and thereafter delivering a portion of it to the respiration passage and automatically relieving excessive or inferior pressure.

2. A method of producing artificial respiration which comprises causing a flow of respiration gas in a plurality of respiration units, and positively utilizing a portion of the respiration gas independently of lung pressure, to effect a reversal of direction of flow in all of said units simultaneously and exhausting a part of such portion of the respiration gas into the respiration units.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE PAUL EUGEN STOLLE.

Witnesses:

HERMANN SCHÜTT,
C. WILHELM KRÜTZFELDT.