Journal of Anesthesia History 5 (2019) 62–63

Contents lists available at ScienceDirect

Journal of Anesthesia History

journal homepage: www.anesthesiahistoryjournal.org

James M. Osgood: An Inventor Behind Sprague's "Self-Watching" Apparatus for G.Q. Colton's Revival of Nitrous-Oxide Anesthesia

Brian L. Hom [a], George S. Bause [a,b,c,*]

[a] Anesthesiology and Perioperative Medicine, Case Western Reserve University School of Medicine, 11100 Euclid Ave, Cleveland, OH, 44106, USA
[b] Oral and Maxillofacial Surgery, Case Western Reserve University School of Dental Medicine, 2124 Cornell Rd, Cleveland, OH, 44106, USA
[c] Honorary Curator and Laureate of the History of Anesthesia, Wood Library-Museum of Anesthesiology, American Society of Anesthesiologists, 1061 American Ln, Schaumburg, IL, 60173-4973, USA

ARTICLE INFO

Article history:
Received 21 May 2019
Accepted 21 June 2019

Keywords:
History of anesthesiology
History of dentistry
Inventions
Massachusetts
New York
Nitrous oxide

ABSTRACT

Inventor J.M. Osgood enabled a fellow Massachusetts inventor, A.W. Sprague, to manufacture heat-regulated nitrous-oxide generators. These generators assisted New Yorker G.Q. Colton in opening exodontia franchises nationwide which revived the use of nitrous-oxide anesthesia.

According to pioneering British dentist-anesthetist Dr. Charles James Fox (1829-1895), the United States Patent No. 44,884, dated November 1, 1864, was the invention of a "poor workman" dentist from Somerville, MA, named Dr. James M. Osgood (1838-1902).[1,2] Osgood may have sprung from an impoverished family background, but his brother had worked in the dental office of the brother-in-law of ether-anesthetic pioneer W.T.G. Morton.[3] Osgood's invention was an automatic regulator that was "operated by the pressure of air, gas, or vapor upon a column of fluid" to regulate heat from the burning jet of a Bunsen burner. The patent rights were purchased by a fellow Baystater, a chemist named Alfred W. Sprague. The apparatus consisted of a retort with a tube that passed into a larger chamber that was partially filled with water, a burner, another tube that passes into a "valve chamber," a tube from the valve chamber that connects to the burner and supplies gas, and another tube connected to an air-filled bulb that regulates the damper. The flame from the burner initiates a distillation process in the retort. The vapor or gas produced in the retort travels through a tube that terminates in a larger chamber below the surface of water. The large vessel becomes a gas holder or "gasometer" that forces water into the fluid valve or valve chamber as it fills with gas. As heat from the burner increases, the volume of gas produced increases, and pressure upon water increases. This forces water into the "fluid valve" chamber. The valve chamber is connected to an inlet pipe that supplies gas for the burner and an outlet pipe that connects to the burner. The valve chamber's height can be adjusted and can be used to regulate the supply of gas that fuels combustion at the burner. The supply of gas is regulated by the pressure of water in the valve chamber. As the column of water in the valve chamber rises toward the opening of outlet valve (h) due to increased volume of gas in the gasometer, the gas supplied to the burner decreases. As the column of water lowers due to decreased heat from the burner, the supply of gas to the burner increases and raises the heat. Another pipe connects from the gasometer that connects to the damper and a bulb filled with air. Pressure from steam/vapor forces water into the pipe, and the weight of water pushing against the air-filled bulb closes the damper. Less heat from the burner causes less vapor to be produced and decreases the pressure from the water column. Decreased pressure from the column allows force from the air bulb to push water back into the pipe and open up the damper.

Figure 1 depicts the front-view (*left*) and side-view (*right*) diagrams from James M. Osgood's patent for "Improved automatic regulator" of combustion in a burner (US Patent No. 44,884; granted Nov.

* Corresponding author at: 5247 Wilson Mills Rd, No. 282, Cleveland, OH 44143-3016.
E-mail addresses: brian.hom2@uhhospitals.org, (B.L. Hom), UJYC@aol.com. (G.S. Bause).

https://doi.org/10.1016/j.janh.2019.06.004
2352-4529/

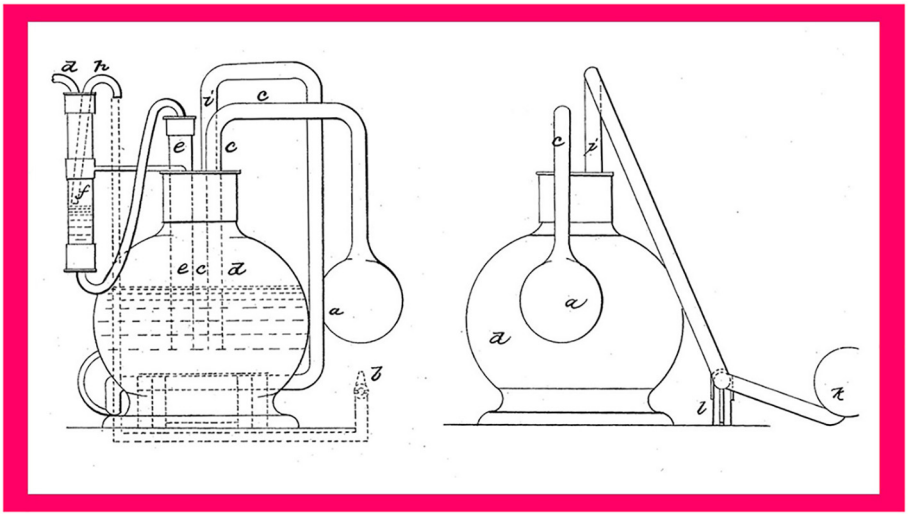

Fig. 1. J.M. Osgood's US Patent 44,484. On November 1, 1864, dentist-inventor James M. Osgood of Somerville, MA, was granted US Patent 44,484 for his "Improved automatic regulator," which was particularly useful for safely heat-regulating the generation of nitrous-oxide gas from ammonium nitrate. Images depicted are front-view (*left*) and side-view (*right*) diagrams from that patent. As improved and manufactured by fellow Baystater Alfred W. Sprague, such "self-watching" apparatus assisted nitrous-oxide pioneer Gardner Q. Colton in setting up his Colton Dental Association of laughing-gas franchises for dental anesthesia. Alphabetical designations of the patent's components are discussed in the main text.

1, 1864).[1] A distillation reaction occurs in the retort (a) as the burner (b) heats the retort from below. The gas produced in (a) travels through tube (c) into a larger vessel (d) that is partially filled with water. Tube (c) ends below the surface of the water. A separate tube (e) placed below the water surface in vessel (d) connects to a "fluid valve" or "valve chamber" (f). The fluid valve (f) functions to regulate gas supply to the burner (b) and can be adjusted based on height. The gas supply for the burner enters through (g), mislabeled as a second (d) in the front view. The fluid valve chamber (f) has an outlet pipe (h) that connects to the burner (b). As the burner produces more heat, more gas is produced in the retort and expands the volume in vessel (d). The increased gas volume forces water into the fluid valve chamber and raises the fluid column. As the fluid column rises toward the outlet pipe (h), the gas supply for the burner decreases. Conversely, as the heat from the burner decreases, the gas volume in (d) decreases, causing the fluid column to fall in height and allow more fuel to flow to the burner, which raises the heat. If vessel (d) represents a boiler, the column of water forced by pressure of steam into pipe (i) against air in bulb (k) can regulate a furnace damper (l). The damper is closed by the weight of water forced by pressure into bulb (k). As the pressure decreases and air in the bulb forces water back into pipe (i), the damper will open and return to its normal position.

Using Osgood's patented regulator to properly heat solid ammonium nitrate can generate nearly pure nitrous oxide; however, unregulated heating of the same solid can produce impure gas and even explosions. Because nitrous oxide is flammable, that gas itself poses a fire hazard. Prior to this invention, flasks were "constantly broken and much impure [nitrous-oxide] gas" was produced.[1] The regulator allowed busy dentists to turn their backs on the potentially explosive "baking" of ammonium nitrate and helped them generate nitrous oxide with few or no noxious byproducts. This device was a significant development for the disciplines of anesthesia and dentistry in the mid-1860s because it allowed quality nitrous-oxide gas to be produced due to better regulation of heat from the burner.[4] As a result, dentists could administer safer and more satisfactory anesthesia and analgesia for completion of painful dental procedures.

"Sprague's Self-Watching Nitrous Oxide Apparatus" became a favorite generator of laughing gas for American dentists by the late 1860s. Proud of manufacturing heat-regulated nitrous-oxide generators for the Manhattan-based Colton Dental Association, Sprague advertised that the celebrated "Dr. G. Q. Colton…ordered six No. 1 [Sprague] Machines for his Dental association—a seventh for the Paris Exposition, and an eighth for the Dentiste Royal of Belgium."[4,5] Colton is credited with reviving use of nitrous-oxide anesthesia in America and Europe in 1862 and 1867, respectively. British dental pioneer Fox was similarly impressed by Sprague's devices, raving by 1869 that "If you order one of Sprague's apparatus with his regulator you will have, in my opinion, the very best apparatus that has yet been contrived for making the gas. It is the only one I have found after every trial to act with uniform comfort and regularity, and with it I can easily make 100 gallons of good gas in an hour."[6] Over the next 5 years, the US Patent Office would also grant Sprague and Osgood a patent on automatic regulators for the draft of stoves and furnaces[7] and for heating homes.[8,9]

Funding

There were no funding sources for this historical investigation.

Declaration of Competing Interests

Neither author has any intellectual, ethical, or financial conflicts of interest.

References

1. Osgood JM, inventor. Improved automatic regulator. US Patent 44484, November 1, 1864.
2. Fox CJ. On the manufacture of nitrous oxide. *Br J Dent Sci* 1868;11(147):490-497.
3. Bause GS. The patent trail from etherist W.T.G. Morton to laughing-gas pioneer G.Q. Colton. *Anesthesiology* 2019;130(1):8, https://doi.org/10.1097/ALN.0000000000002541.
4. Bause GS. The 2016 Lewis H. Wright memorial lecture: America's doctor anaesthetists (1862-1936)—turning a tide of asphyxiating waves. *J Anesth Hist* 2017;3(1):12-18, https://doi.org/10.1016/j.janh.2016.12.001.
5. *Sprague's self-watching nitrous oxide and oxygen apparatusAm J Dent Sci* [Jan] 1868;1(9). advertisement.
6. Fox CJ. *On Nitrous Oxide*. London, UK: JE Adelard; 1869.
7. Sprague AW, Osgood JM, Inventors. Improvement in automatic draft-regulators for stoves and furnaces. US patent 137632, April 8, 1873.
8. Sprague AW, Osgood JM, inventors. Improvement in automatic heat-regulators for houses. US patent 150200, April 28, 1874.
9. Bause GS. From baking up nitrous oxide to making the home thermostat: the heat regulators of Alfred W. Sprague. *Anesthesiology* 2016;125(5):888, https://doi.org/10.1097/ALN.0000000000001395.