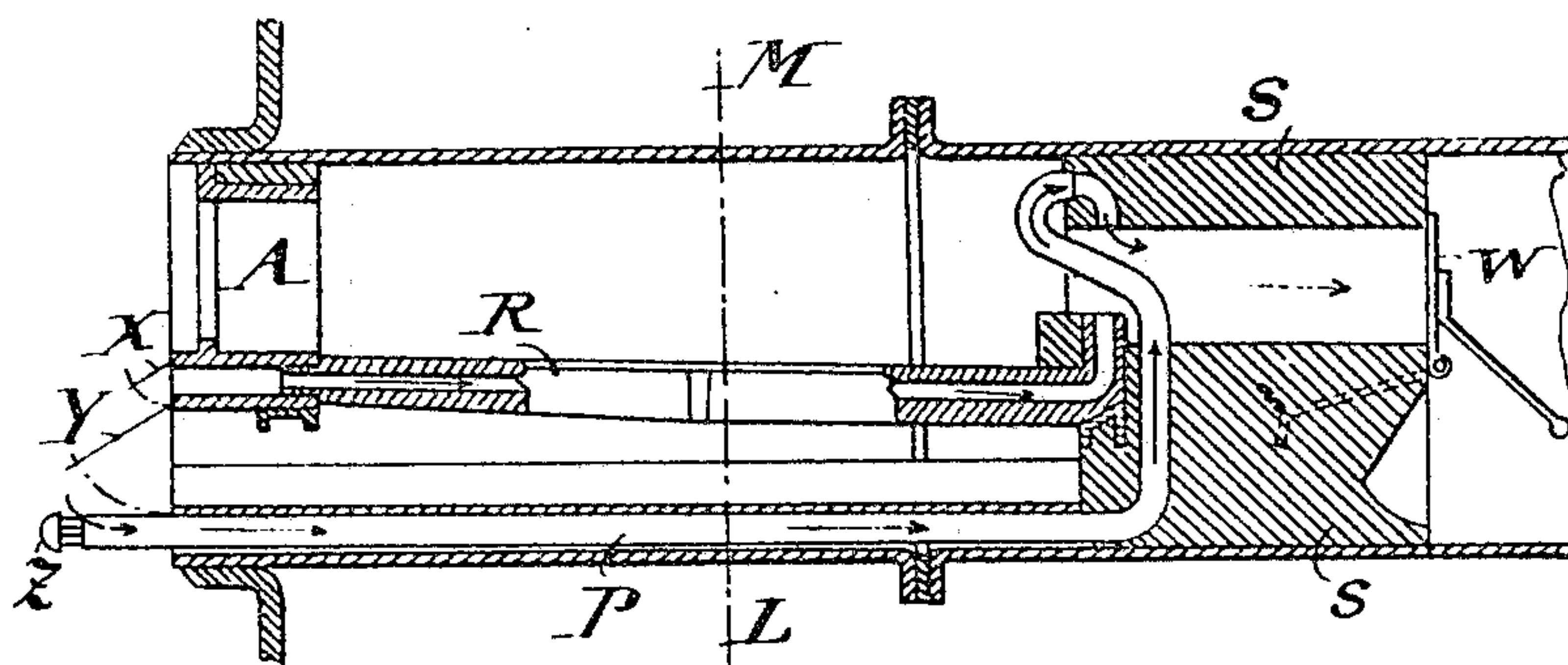


No. 798,898.

PATENTED SEPT. 5, 1905.

A. GRÖNBERG.  
SMOKE CONSUMER.  
APPLICATION FILED AUG. 19, 1902.

FIG 1



E FIG 2

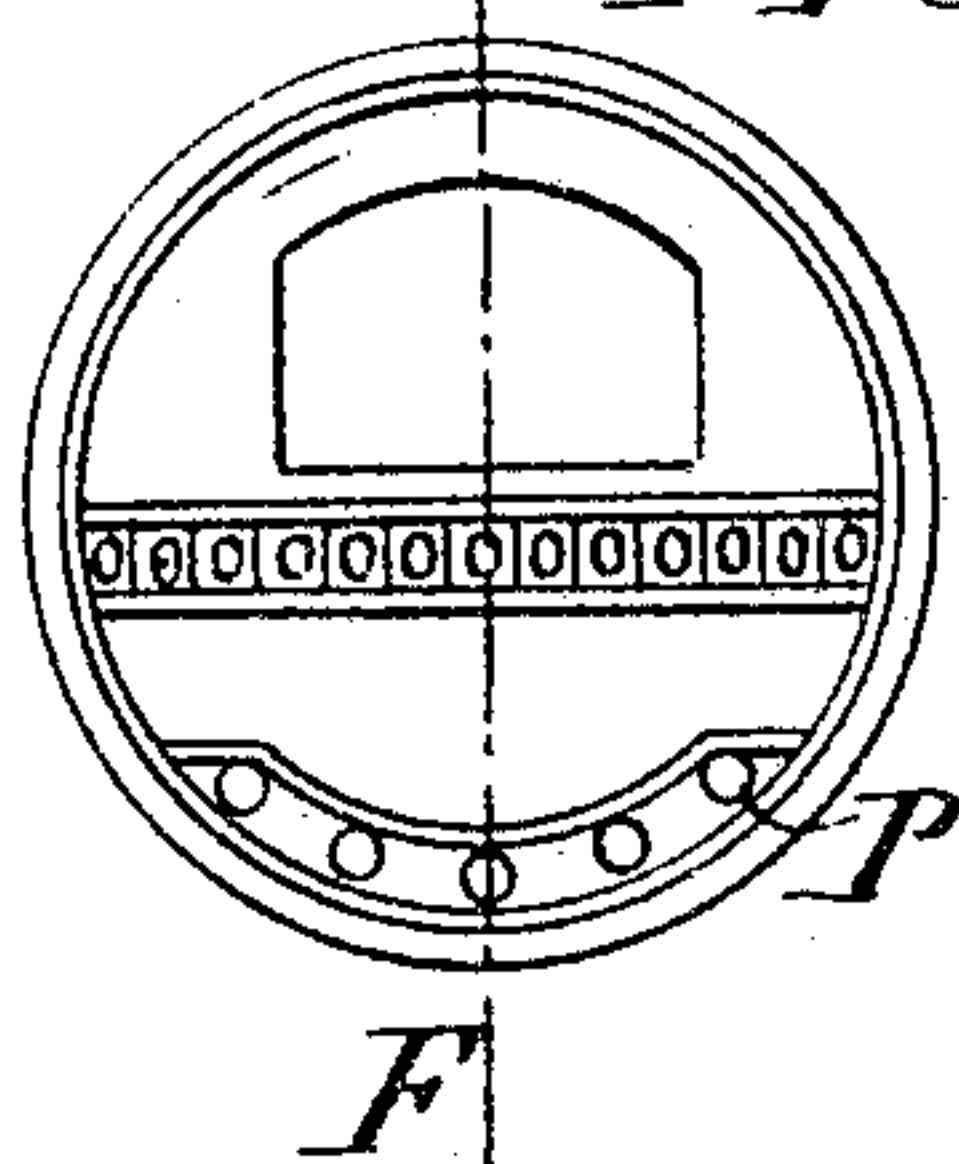


FIG 3

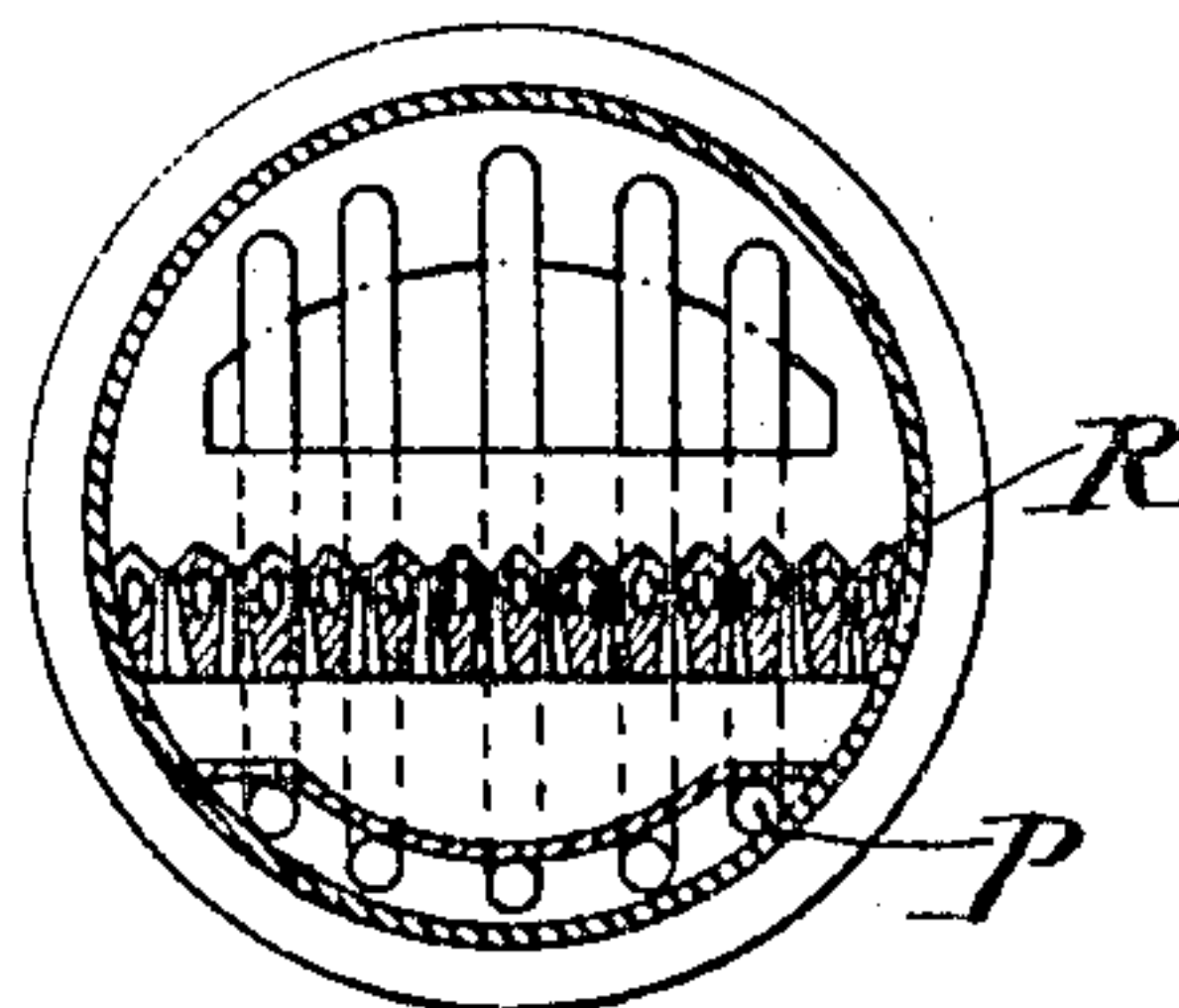


FIG 4

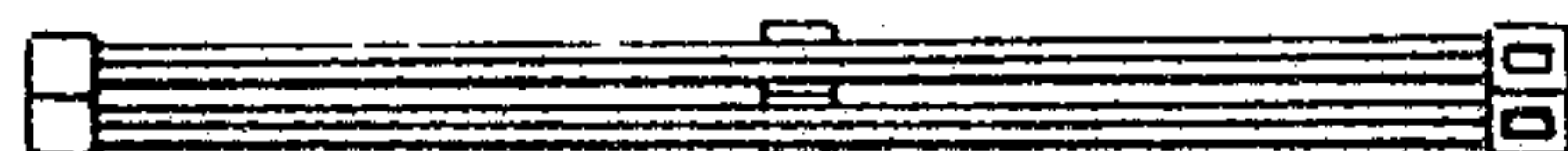


FIG 5

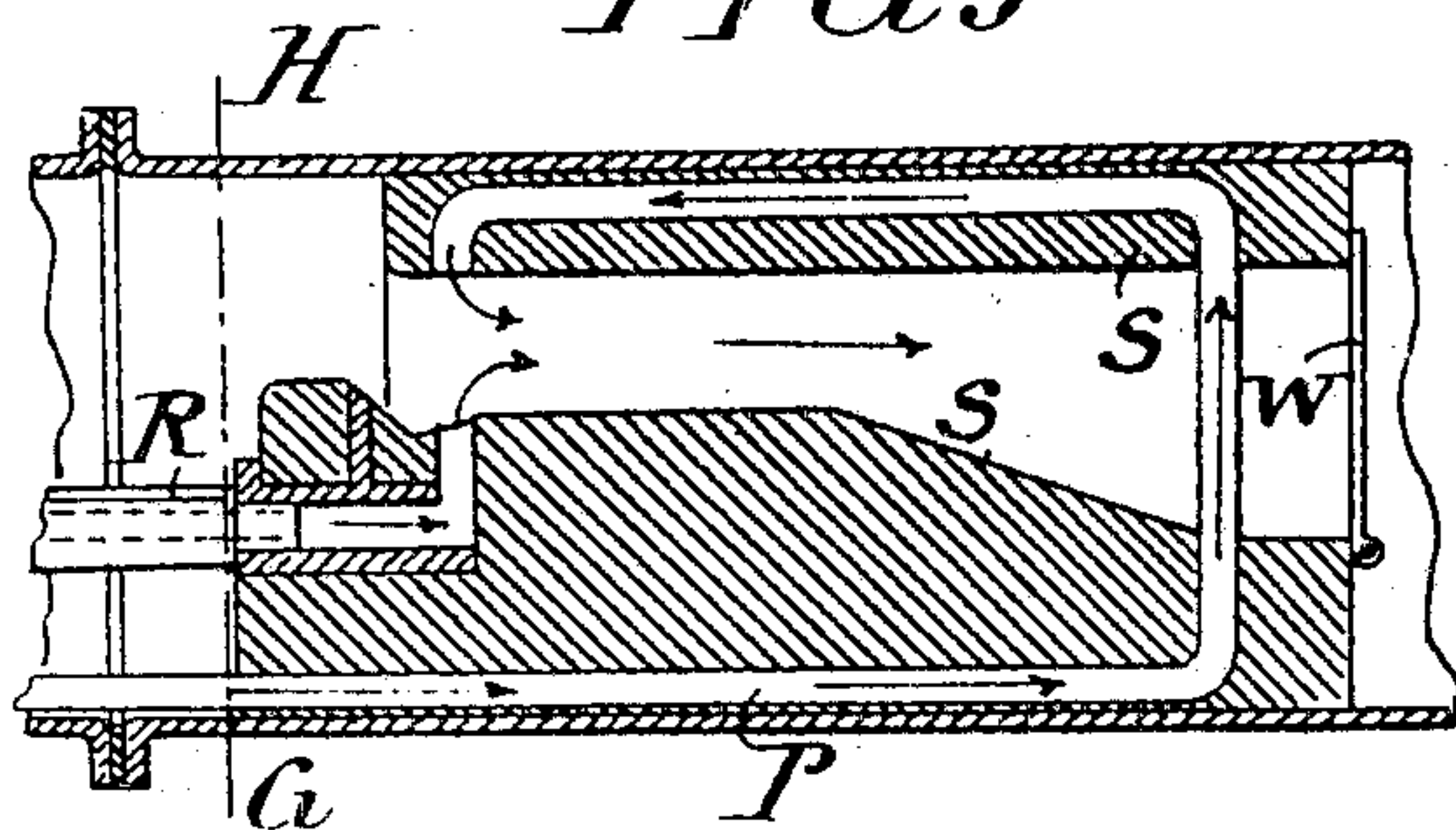
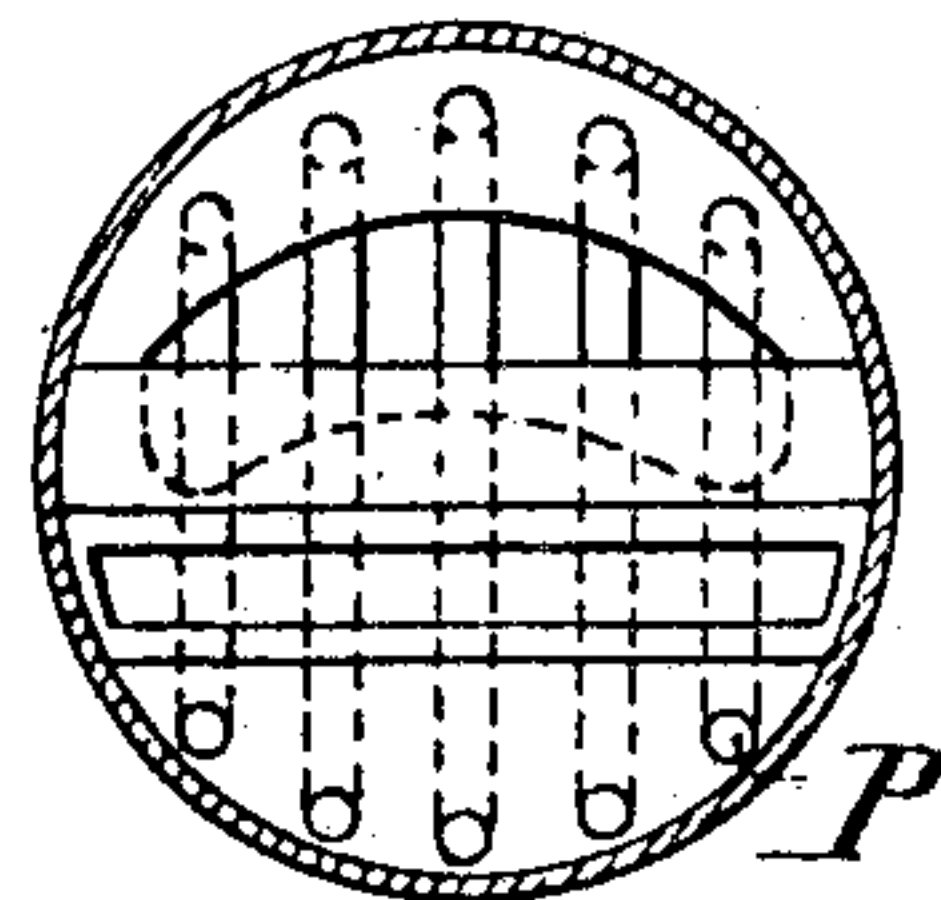


FIG 6



WITNESSES :

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Walton Harrison

INVENTOR  
Axel Grönberg  
BY  
Munn & Co.  
ATTORNEYS.



# UNITED STATES PATENT OFFICE.

AXEL GRÖNBERG, OF WASA, RUSSIA.

## SMOKE-CONSUMER.

No. 798,898.

Specification of Letters Patent.

Patented Sept. 5, 1905.

Application filed August 19, 1902. Serial No. 120,202.

*To all whom it may concern:*

Be it known that I, AXEL GRÖNBERG, a subject of the Czar of Russia, and a resident of Wasa, in the Grand Duchy of Finland, Russia, have invented a new and Improved Smoke-Consumer, of which the following is a full, clear, and exact description.

This invention relates to an arrangement to effect the burning of smoke and saving of fuel and can be applied to boilers of any construction, but is described here as being applied to a boiler with interior furnace.

I will describe a smoke-consumer embodying my invention and then point out the novel features in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 represents a vertical section of a furnace equipped with my improved smoke-consumer. Fig. 2 is a front elevation of the same. Fig. 3 is a section of the same upon the line M L of Fig. 1. Fig. 4 represents two grates seen from above. Fig. 5 shows a modification of the invention, and Fig. 6 is a section of the modified form along the line G H of Fig. 5.

The invention consists of a combination of the grate R, the tubes P in the lower part of the furnace, and a fireproof vault S. The grate R consists of hollow grate-bars, the upper edges of which are arranged so as to form a serrated surface and the rear ends of which are bent upwardly, as shown in Fig. 1. The tubes P, the shapes and numbers of which are suited according to the size of the furnace and its heating-surface, are likewise bent upward, so that they may be surrounded by the flames and the gases, and after having been led through the fireproof vault S (see Fig. 1) they come out into the furnace. That part of the tubes which is exposed to the influence of the flames is made of a fireproof material. The fireproof vault S has the double purpose of causing a concentration of the escaping gases as well as the hot air, and, secondly, to prevent the same from being cooled. The invention further requires four special arrangements of dampers  $\alpha$  Y Z W, Fig. 1, of which  $\alpha$ , Y, and Z are intended to regulate the supply of air to the grates, to the space between the same, and to the tubes P. The fourth damper W, which is situated in the back part of the vault, is intended to regulate the entrance of cold air to the furnace

when the doors of the same are being opened and should before this is done be partly closed.

As mentioned before, it is preferable that the system of grates be made serrated in order to insure an equal distribution over the whole system of grates of the air entering between the grates.

When the boilers are fired, the following is the operation: The fuel is introduced in the usual way through the doors A and spread on the grate R. The smoke developed by the fire will be ignited and entirely consumed, so that no part of it is allowed to escape into the exterior air. This is effected by the currents of air passing through the grate R and the tubes P, which are heated to the utmost possible degree. It is easily understood how the air entering through the damper  $\alpha$  into the grates is heated by the burning fuel placed on the grates and that the same process of heating is taking place with the air in the tubes P when passing the vertical part of the tubes which is surrounded by the gases. Now when these two currents of heated air, one flowing downward and the other upward, meet in the furnace and are merged together the smoke almost instantaneously will catch fire and be entirely consumed, the result of which is not only a fire free from all smoke, but also effecting a considerable saving of fuel.

Fig. 5 shows a modification of the invention intended for furnaces of less diameter, in which the vertically-rising neck of the grate would not reach a sufficient height, and is meant to prevent the coals, if carelessly thrown in, from falling upon the opening of the grates and stopping the same. To prevent this, the fire-bridge is constructed at a higher elevation. At the same time the vertical part of the tubes is placed a little farther backward; so that several more tubes may be put in, if required, and a greater or longer portion of the same is being exposed to the flames and the current of air thus being heated. The vertical part of these tubes should for the purpose of gaining space be made of an elliptical shape.

Special modifications concerning the shape of the grate, the bending of the grate and the tubes P, &c., can of course be made without changing or diminishing the effect of the arrangements.

As concerns the application of this invention to furnaces for steamers of modern construction with retrogressing tubes, the idea does not in this case necessitate any altera-



tion, the heated air being introduced through the fire-bridge, where the smoke is ignited and the smokeless gases pass through the tubes.

5 When boilers with exterior furnaces or tube-boilers are employed, a special stove must be erected before the boilers into which the grates, tubes, &c., have to be placed and the firing is done, the heated air being introduced  
10 at a proper place that allows the smoke to be ignited shortly before the gases touch the fire-surface of the boiler.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

15 1. A smoke-consumer, comprising a grate having a series of hollow grate-bars capable of serving as hot-air conduits, a passage-way disposed adjacent to said grate, and a series of air-tubes disposed below said grate and adjacent to the path of the ashes falling there-  
20 from, said grate-bars being bent upward and provided with terminals extending into the bottom of said passage-way, said air-tubes being bent upward and extended across said  
25 passage-way, and provided with terminals extending downwardly and into the top thereof, said terminals being disposed substantially in alinement with said terminals of said grate-bars for the purpose of effecting the thorough  
30 commingling of the air and the gases of combustion.

2. In a smoke-consumer, a grate comprising a series of hollow grate-bars capable of serving as hot-air conduits, said grate-bars  
35 being bent upward at their respective rear ends and provided with terminals each disposed at an angle to the path of the flames,

and a series of air-tubes each having a portion disposed below said grate-bars for the purpose of absorbing heat from falling ashes, and also having a portion bent upwardly and across the path of the flames, said portion being also bent downwardly and provided with terminals disposed at an angle to said path of said flames, said terminals of said grate-bars being disposed substantially in alinement with said terminals of said air-tubes for the purpose of effecting a thorough commingling of the air and gases of combustion.

3. In a smoke-consumer, a grate comprising a series of hollow grate-bars serving as hot-air conduits, said grate-bars being bent upward at their respective rear ends and provided with terminals crossing the general path of the flame, and a series of air-tubes each having a portion disposed below said grate-bars for the purpose of absorbing heat from falling ashes, and also having portions bent upwardly and across the path of the flames, said portions being also bent downwardly and provided with terminals disposed in alinement with the terminals of said grate-bars, said terminals of said air-tubes and of said grate-bars being disposed respectively upon opposite sides of the general path of the flame for the purpose of discharging hot air therein from different directions.

In witness whereof I have hereunto set my seal.

AXEL GRÖNBERG. [L. s.]

Witnesses:

GUSTAV SCHÜTT, [L. s.]

NAT. SILVANUS. [L. s.]