Dec. 19, 1939. C. M. HAMBLIN 2,183,561

MECHANICAL FOAM GENERATOR

Filed March 17, 1938 4 Sheets-Sheet 1

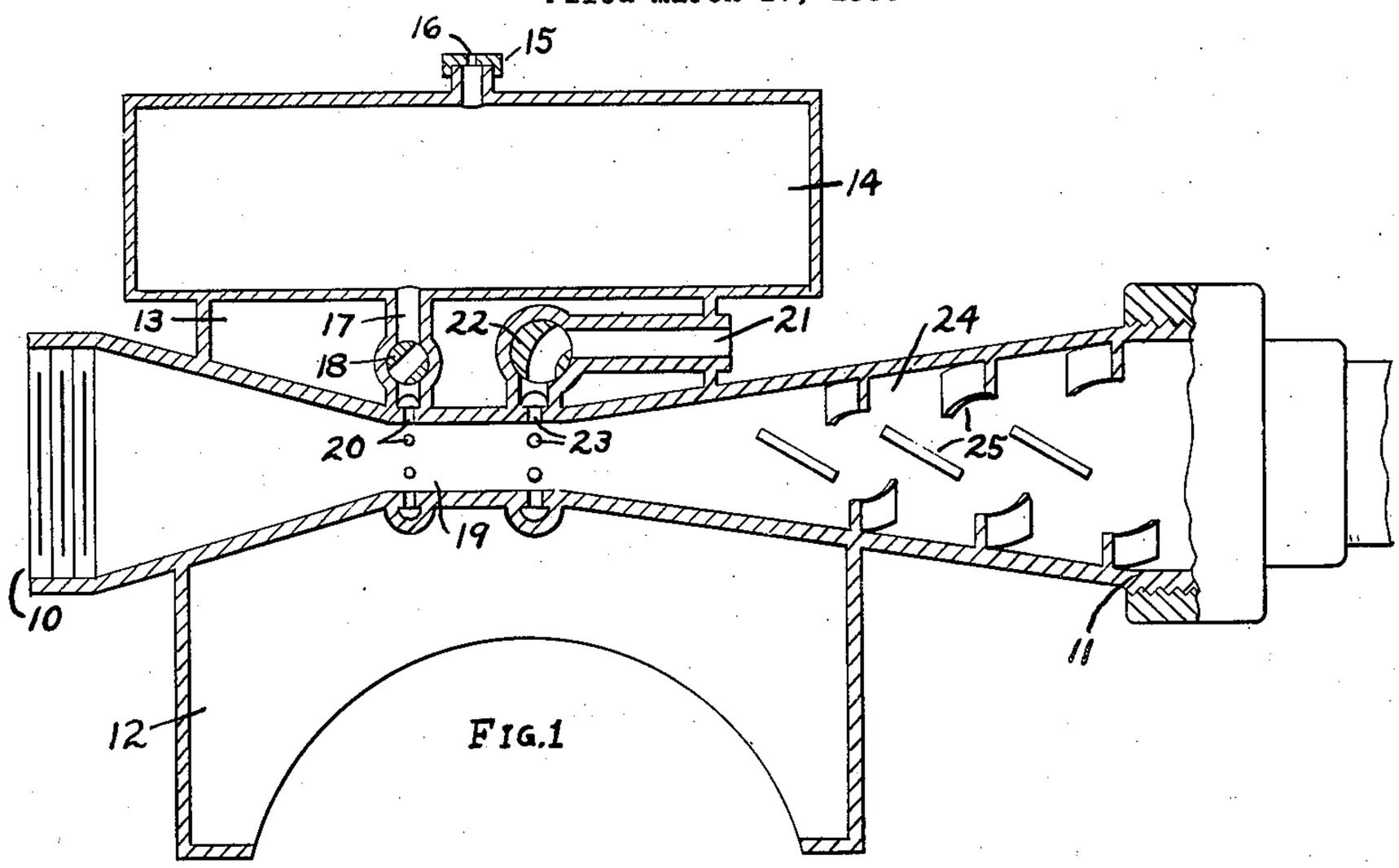

FIG. 1

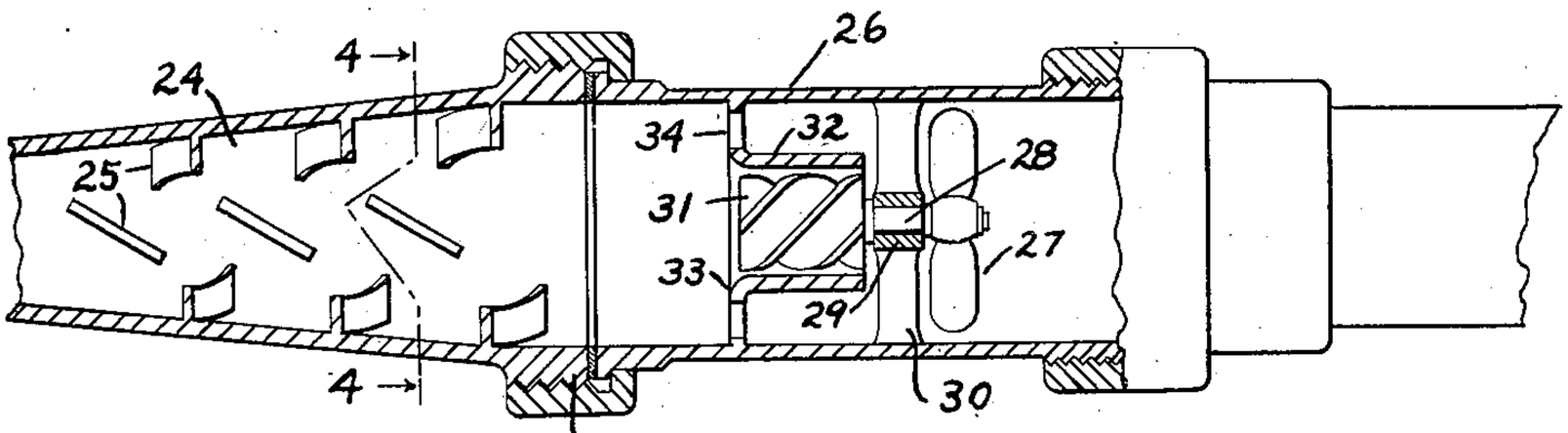

FIG. 2

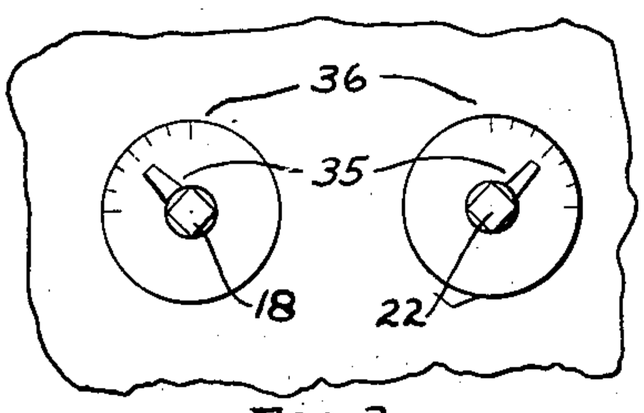

FIG. 3

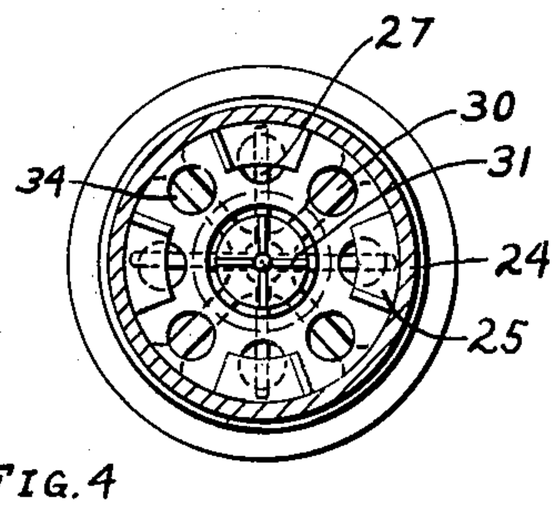

FIG. 4

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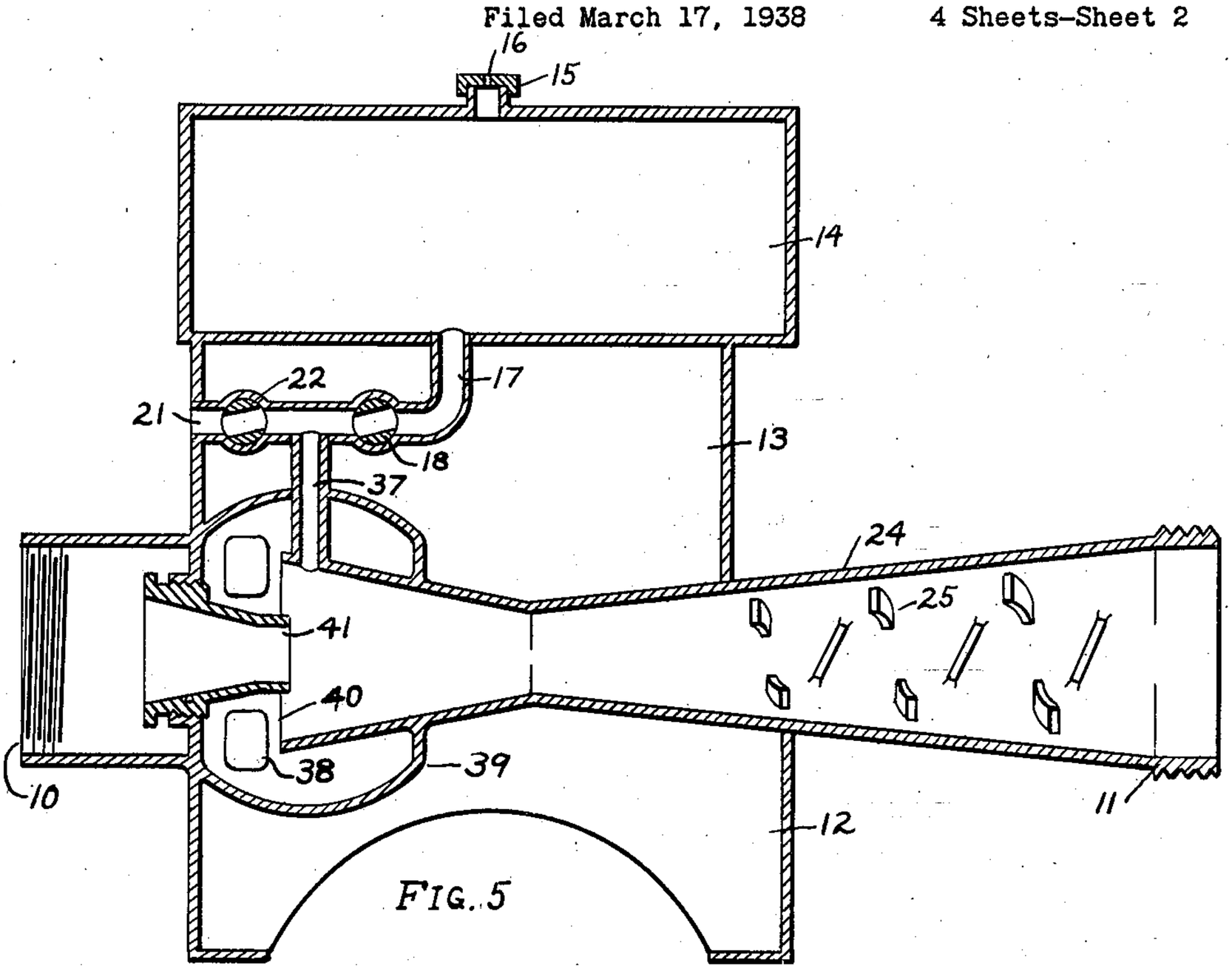

FIG. 5

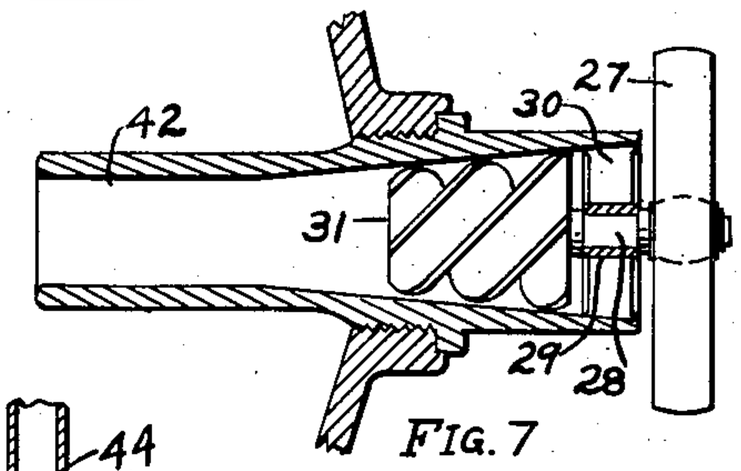

FIG. 7

FIG. 6

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MECHANICAL FOAM GENERATOR

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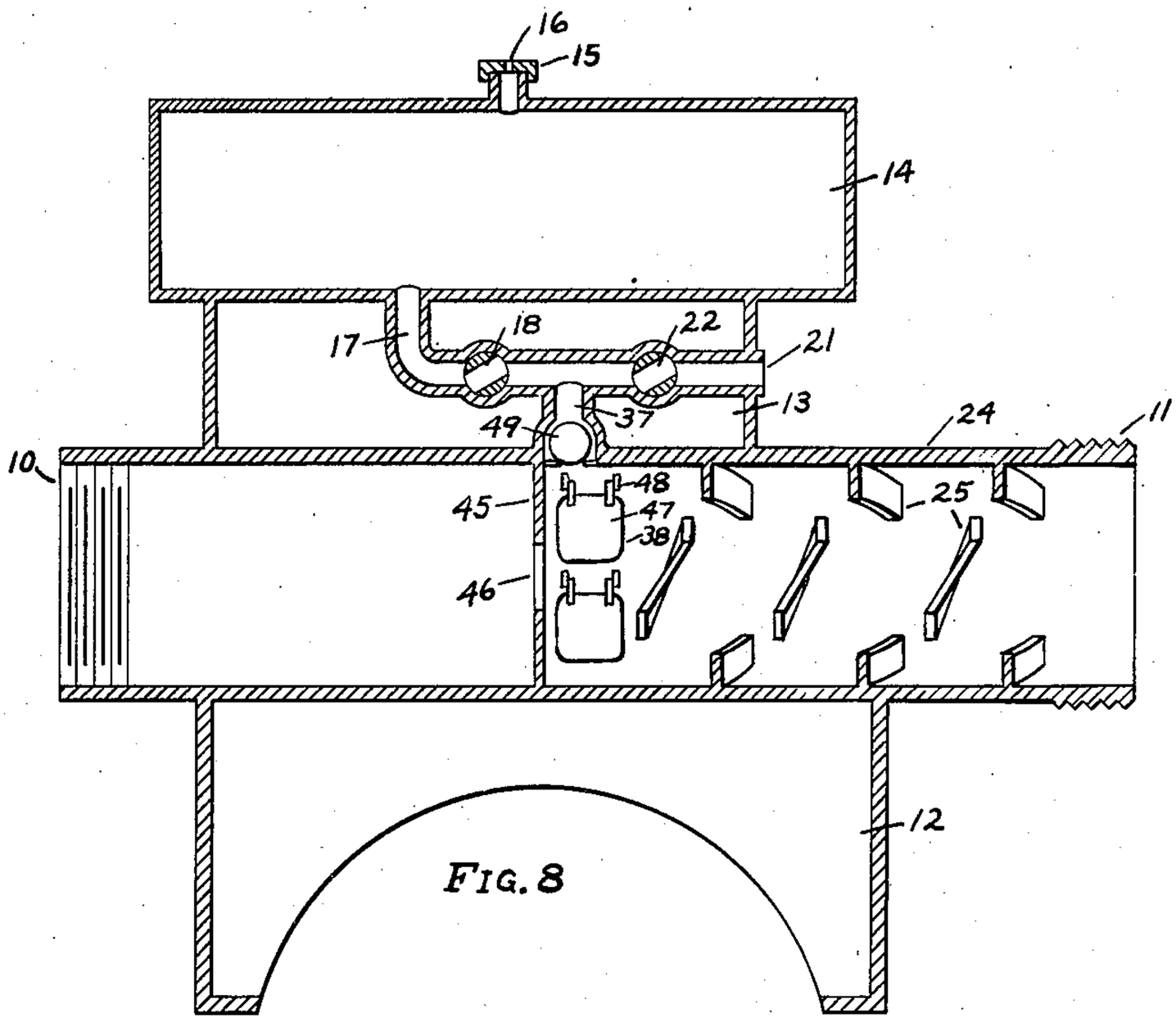

FIG. 8

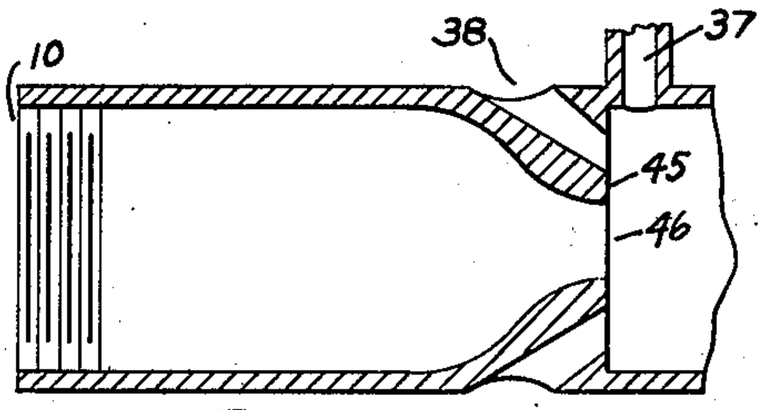

FIG. 9

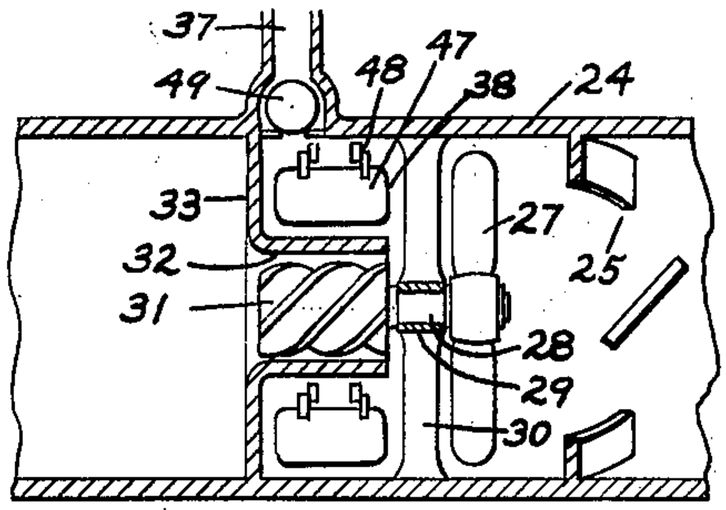

FIG. 10

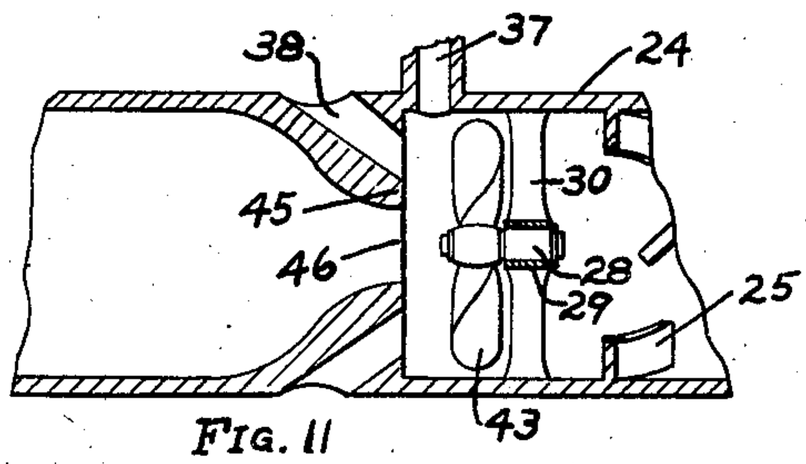

FIG. 11

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MECHANICAL FOAM GENERATOR

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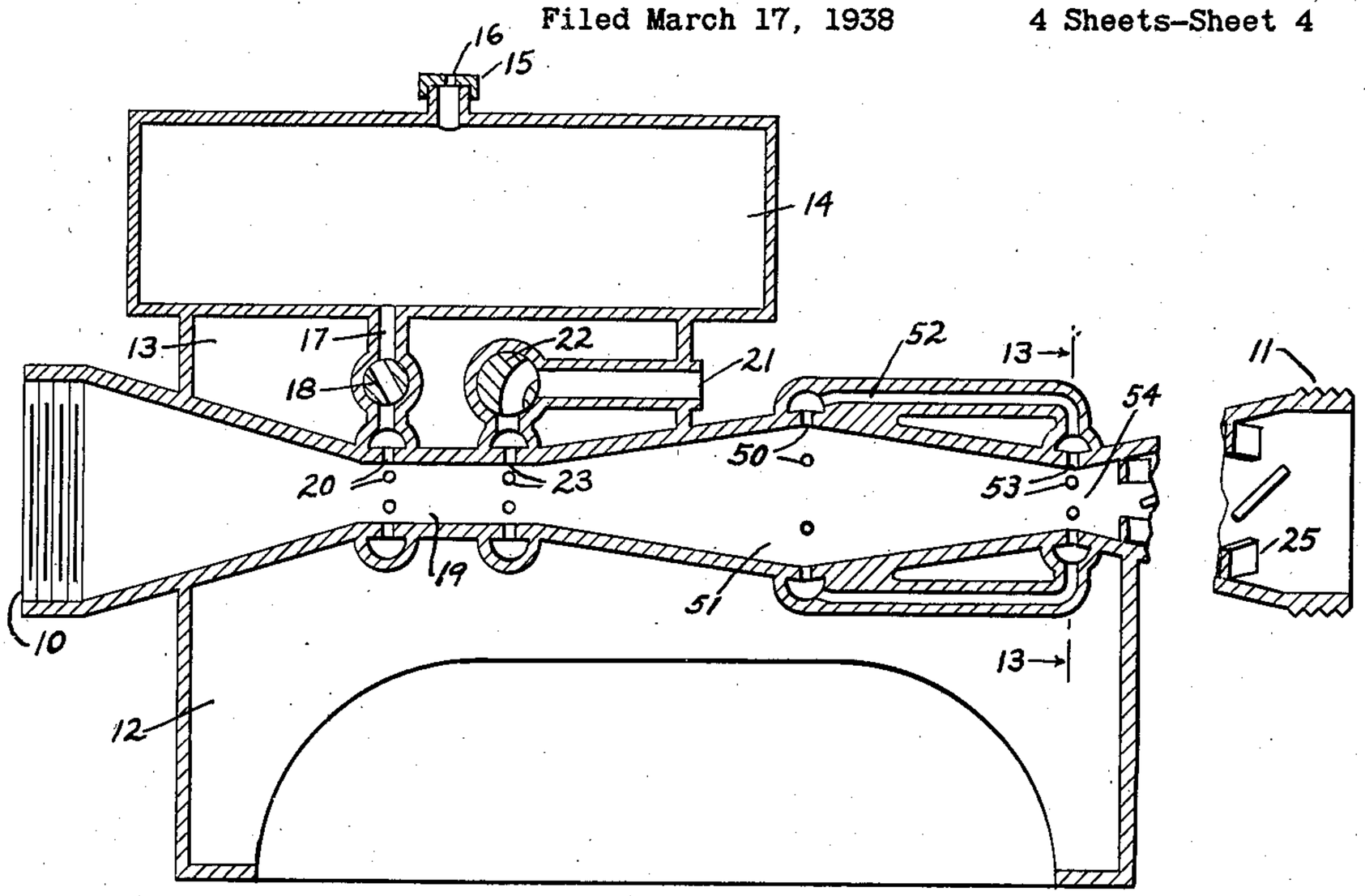

FIG. 12

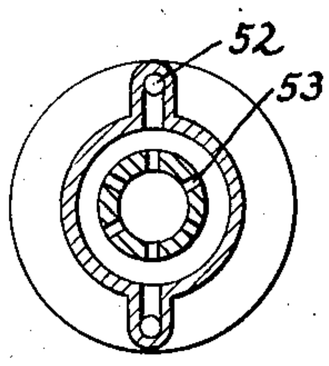

FIG. 13

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Patented Dec. 19, 1939 2,183,561

UNITED STATES PATENT OFFICE

2,183,561

MECHANICAL FOAM GENERATOR

Clyde M. Hamblin, Washington, D. C.

Application March 17, 1938, Serial No. 196,411

6 Claims. (Cl. 261—76)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to improvements in means for mechanical generation of foam for extinguishing fires.

It is a principal object of this invention to provide means for mechanically mixing water with a foaming agent such as saponine, "Tutogen", such as shown in U. S. Patent No. 2,088,085, or similar liquid and air or inert gas such as CO_2 or nitrogen to produce a foam as used for extinguishing fires.

Another object of this invention is to reduce the cost and weight and the space occupied by stowage of foam ingredients and avoid the size and weight of generating equipment necessary for the chemical generation of foam which is the generally accepted method in this country.

In accomplishing these objects there are provided the improved forms of construction shown diagrammatically by the accompanying drawings, wherein,

Fig. 1 is a sectional view of a foam generator of the Venturi tube type of construction.

Fig. 2 is a sectional view of a generator attachment.

Fig. 3 shows the fluid valve stems and indicators.

Fig. 4 is a cross-sectional view taken at 4—4 on Fig. 2.

Fig. 5 is a sectional view of a foam generator of the ejector or eductor type of construction.

Fig. 6 is a sectional view of a modified form of ejector or eductor type of foam generator in which a propeller wheel is actuated by the flow of the fluid to beat the mixture to a foam.

Fig. 7 is a sectional view of a modified form of discharge nozzle of Fig. 6.

Fig. 8 is a sectional view of a foam generator of the orifice type construction.

Fig. 9 is a sectional view of a modified form of orifice for the generator shown on Fig. 8.

Fig. 10 is a sectional view of a portion of a modified form of orifice type foam generator.

Fig. 11 is a sectional view of a portion of another modified form of orifice type foam generator.

Fig. 12 is a modified form of foam generator of the Venturi tube type having reentrant passages to aid in generating the foam, and

Fig. 13 is a cross-section of view on line 13—13 of Fig. 12.

Throughout the description like numbers designate like parts in the various figures.

Referring more in detail to the several drawings:

There is shown in Fig. 1 a Venturi tube having an inlet 10 for connecting to a water supply pipe or hose and an outlet 11 for connecting to a pipe or hose for discharging the foam. The Venturi tube is supported by a base 12. Above the Venturi tube and supported by web 13 is a reservoir 14 for containing the foaming agent. At the top of the reservoir is a filling cap 15 with a vent hole 16. At the bottom of the reservoir is a tube 17, fitted with a valve or other adjusting means 18 and connecting to the throat 19 of the Venturi tube by means of holes 20 for admitting the foaming agent. Another tube 21 fitted with valve or other adjusting means 22 and also connecting to the throat 19 of the Venturi tube by means of holes 23, is provided for admitting air or inert gas.

The operation depends upon the well known principle that the change of velocity of flow through a Venturi tube causes a reduced pressure at the throat or point of least sectional area. This reduced pressure in throat 19 is utilized to induce a flow of foaming agent through tube 17 and a flow of air or inert gas through tube 21. The proper proportions of foaming agent and air or inert gas to give suitable foam are regulated by adjusting the valves 18 and 22, respectively, by means of the handles 35 and indicator scales 36. The adjusting means may also be fixed orifices of predetermined size instead of valves. When air at atmospheric pressure is used the tube 21 and holes 23 must be of sufficient size or additional openings provided so that the volume of air admitted will be several times the volume of water passing through the generator.

The foaming agent and air or inert gas are mixed with the water to form foam by making the diverging angle of the discharge nozzle or pipe 24 of such degree as to cause turbulent flow. The mixing may be increased by providing in the discharge nozzle or pipe inwardly projecting fins or baffles 25 arranged in staggered relation to increase turbulence of flow and improve the generation of foam. This modification may be adapted to all types of foam generators described herein.

In Fig. 2 is shown a foam generator attachment added to the generator shown in Fig. 1, and this attachment consists of a casing or tube 26 adapted to be coupled to the discharge nozzle or pipe 24. The tube 26 is provided with a mechanical beater having a paddle wheel 27 mounted on shaft 28 which is housed in bearing 29 supported by radial arms 30 and driven by a screw type impeller 31 located within a tubular exten-

sion 32 from an orifice plate 33, and actuated by the flow of the mixture of water, foaming agent and air or inert gas. Additional guide means or bearing is provided if desired by making impeller 31 an easy turning fit in tubular extension 32. Holes 34 are provided as necessary in plate 33 to avoid excessive resistance to flow. If desired, holes 34 may be omitted and holes provided in casing 26 on the discharge side of plate 33, as in Fig. 10, to admit additional air if required to improve the quality of the foam. The above attachment may be added to any type of generator described herein.

In the ejector or eductor type generator shown in Fig. 5 the foaming agent entering through tube 17 and air or inert gas entering through tube 21 are premixed in tube 37 to aerate the foaming agent before it enters the water stream. The larger quantities of air for mixing with the water stream to aid in the production of foam is drawn by induction through holes 38 in ejector or eductor housing 39 and discharge nozzle inlet 40, due to the high velocity of water through auxiliary nozzle 41.

In the modified form of ejector or eductor type generator shown in Fig. 6, the mixture of water, foaming agent and air or inert gas is beaten to a foam by the propeller wheel 43 mounted on shaft 28 housed in bearing 29 by radial arms 30 and actuated by the flow of water, foaming agent and air or inert gas through discharge nozzle 42. In this generator air or inert gas under pressure may be admitted to the mixture of water and foaming agent through tube 44 instead of obtaining the air by induction through openings 38 in ejector or eductor housing 39.

In Fig. 7 a beater having a paddle wheel 27 actuated by screw type impeller 31, as in Fig. 2, is provided in discharge nozzle 42 instead of the propeller type beater 43.

In the generator shown in Fig. 8, a plate 45 having an orifice 46 is substituted for the Venturi throat 19 shown in Fig. 1 and the auxiliary ejector or eductor nozzle 41 shown in Figures 5 and 6. The mixing of water, foaming agent and air in this generator is produced by the turbulence due to the abrupt slowing down of the water stream after passing through orifice 46, and the mixing is aided by the inwardly projecting fins or baffles 25, as in the case of previously described generators. The openings 38 for admission of air are located close to the downstream side of orifice plate 45 so as to be within the area of low pressure caused by the jet of water at high velocity through orifice 46. In this generator check valves 47 hinged at 48 are provided for air inlet openings 38 and check valve 49 is provided in inlet tube 37 to prevent escape of liquid through these openings in event of stoppage of the discharge hose. These check valves also permit a pressure to be built up which will tend to clear the stoppage. Instead of a single check valve 49 in tube 37 separate check valves may be provided in tubes 17 and 21.

Check valves described above may be adapted to the air openings and tubes for admitting the foaming agent and air or inert gas in any of the generators described herein.

In Fig. 9 the orifice plate 45 is modified by having the upstream side streamlined to reduce the resistance to flow. In this figure the air inlets 38 are provided through plate 45, but they may be provided through casing 24 on the downstream side of the orifice plate, as in Fig. 8.

In Fig. 10 is shown a modification of the orifice plate type of generator in which a paddle wheel 27 driven by screw type impeller 31 actuated by the flow of water through tubular extension 32 in plate 33 is used to beat the mixture of water, foaming agent and air or inert gas to foam.

In this, as in Fig. 8, openings 38 with check valves 47 are shown for admission of air at atmospheric pressure, and check valve 49 is shown to prevent back flow through tube 37.

Fig. 11 is a modification of the orifice type generator shown in Fig. 9, in which a propeller 43 actuated by the jet of water through orifice 46 is used to beat the mixture of water, foaming agent and air or inert gas to foam.

In Fig. 12 is shown a modification of the Venturi type generator in which the mixing of water, foaming agent and air or inert gas to generate foam is aided by circulating a portion of the liquid mixture through pressure discharge openings 50 at enlargement 51, tubes 52 and induction inlet openings 53 at throat of venturi 54.

Other modifications and changes in the proportions and arrangements of the parts may be made by those skilled in the art without departing from the nature of the invention, within the scope of what is hereinafter claimed.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. An apparatus for the production of fire extinguishing foam comprising a tube having an entrance end and an exit end, a conduit for quenching liquid connected to the entrance end of the tube, a foam promoting agent reservoir, said reservoir being connected to discharge into said tube, said tube having means for gas to enter therein, means in said tube to produce a turbulent mixture of the gas, foam producing agent and quenching liquid, said turbulent mixture producing means comprising a plurality of disconnected staggered vanes extending inwardly from the outlet side of said tube, a restricted passage, a worm screw in said passage, a spider, a bearing in said spider, a shaft journaled in said bearing, said worm screw being mounted on said shaft at one end thereof and extending into said restricted passage, and a mixing wheel of a substantially greater diameter than said worm screw mounted at the other end of said shaft within said tube to beat the turbulent mixture into a foam.

2. An apparatus for the production of fire extinguishing foam comprising a tube having an entrance end, a restricted passage and an exit end, a conduit for quenching liquid connected to the entrance end of the tube, a foam promoting agent reservoir, said reservoir being connected to discharge into said tube, said tube having means for gas to enter therein, means in said tube to produce a turbulent mixture of the gas, foam producing agent and quenching liquid, said turbulent mixture producing means comprising a plurality of disconnected staggered vanes extending inwardly from the outlet side of said tube, a worm screw in said passage, a spider, a bearing in said spider, a shaft journaled in said bearing, said worm screw being mounted on said shaft at one end thereof, and a mixing wheel of a substantially greater diameter than said worm screw mounted at the other end of said shaft within said tube to beat the turbulent mixture into a foam, said means for permitting gas to enter said tube

comprising gas inlet openings in said tube on the outlet side of said restricted passage.

3. An apparatus for the production of fire extinguishing foam comprising a tube having an entrance end, a restricted passage and an exit end, a conduit for quenching liquid connected to the entrance end of the tube, a foam promoting agent reservoir, said reservoir being connected to discharge into said tube, said tube having means for gas to enter therein, means in said tube to produce a turbulent mixture of the gas, foam producing agent and quenching liquid, said turbulent mixture producing means comprising a plurality of disconnected staggered vanes extending inwardly from the outlet side of said tube, a worm screw in said passage, a spider, a bearing in said spider, a shaft journaled in said bearing, said worm screw being mounted on said shaft at one end thereof, a mixing wheel of a substantially greater diameter than said worm screw mounted at the other end of said shaft within said tube to beat the turbulent mixture into a foam, said means for permitting gas to enter said tube comprising gas inlet openings in said tube on the outlet side of said restricted passage, and flap check valves preventing escape of back pressure through said gas inlet opening.

4. An apparatus for the production of fire extinguishing foam comprising a tube having an entrance end, a restricted passage and an exit end, a conduit for quenching liquid connected to the entrance end of the tube, a foam promoting agent reservoir, one way check valved means connecting said reservoir to discharge into said tube, said tube having means for gas to enter therein, means in said tube to produce a turbulent mixture of the gas, foam producing agent and quenching liquid, said means for permitting gas to enter said tube comprising gas inlet openings in said tube on the outlet side of said restricted passage, and flap check valves preventing escape of back pressure through said gas inlet openings.

5. An apparatus for the production of fire extinguishing foam comprising a tube having an entrance end, a restricted passage and an exit end, a conduit for quenching liquid connected to the entrance end of the tube, a foam promoting agent reservoir, one way check valved means connecting said reservoir to discharge into said tube, said tube having means for gas to enter therein, means in said tube to produce a turbulent mixture of the gas, foam producing agent and quenching liquid, said turbulent mixture producing means comprising a plurality of disconnected staggered vanes extending inwardly from the outlet side of said tube, said means for permitting gas to enter said tube comprising gas inlet openings in said tube on the outlet side of said restricted passage, and flap check valves preventing escape of back pressure through said gas inlet openings.

6. An apparatus for the production of fire extinguishing foam comprising a tube having an entrance end and an exit end, a conduit for quenching liquid connected to the entrance end of the tube, a foam promoting agent reservoir, said reservoir being connected to discharge into said tube, said tube having means for gas to enter therein, means in said tube to produce a turbulent mixture of the gas, foam producing agent and quenching liquid, a restricted passage, a worm screw in said passage, a spider, a bearing in said spider, a shaft journaled in said bearing, said worm screw being mounted on said shaft at one end thereof, and a mixing wheel of a substantially greater diameter than said worm screw mounted at the other end of said shaft within said tube to beat the turbulent mixture into a foam.

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