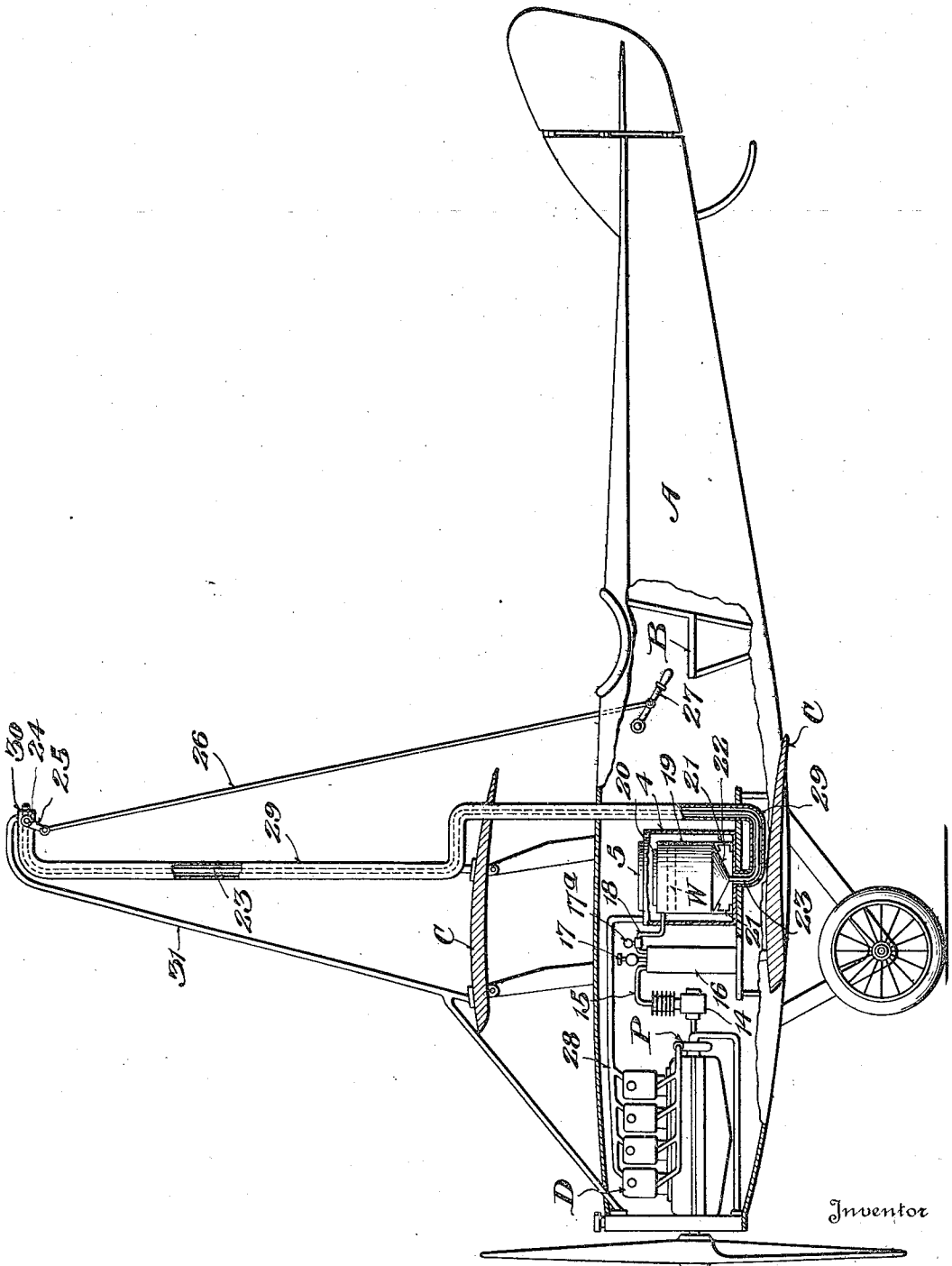
Feb. 17, 1925. 1,526,570

A. R. SMITH

SMOKE PRODUCER

Original Filed July 31. 1923



Inventor

Arthur R. Smith,

By H. Ralph Burton,

Attorney

WITNESS:-

Chas. L. Griesbauer

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UNITED STATES PATENT OFFICE.

ARTHUR R. SMITH, OF CLEVELAND, OHIO.

SMOKE PRODUCER.

Original application filed July 31, 1923, Serial No. 654,887. Divided and this application filed February 26, 1924. Serial No. 695,355.

To all whom it may concern:

Be it known that I, ARTHUR R. SMITH, a citizen of the United States, and resident of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Smoke Producers, of which the following is a specification.

The invention pertains to production of smoke and the discharge of smoke and smoke-producing material. It relates particularly to discharge of smoke or smoke-producing material from heavier-than-air craft in sky writing, but it also relates to production of smoke in other places and for other purposes.

It is an object of the invention to provide means, easily controlled by the operator, that efficiently will treat smoke-producing material and discharge it into the atmosphere.

Another object of the invention is to provide means for employing heat from the propelling-engine of an aircraft to bring smoke-producing material to such temperature as will permit its conveyance to the place of discharge into the atmosphere.

The present application more particularly relates to a form of apparatus in which hot liquid from the engine is used for that purpose, as disclosed by my co-pending application Ser. No. 654,887, filed July 31, 1923, of which this application is a division, and to a process that involves employment of hot liquid for heating purposes.

When considered in connection with the description herein, the characteristics of the invention are apparent from the accompanying drawing, forming part hereof, wherein an adaptation of the invention to an airplane is disclosed, for purposes of illustration.

Although the disclosures herein exemplify what now is considered to be a preferable embodiment of the invention, it is to be understood that it is not the intention to be limited necessarily thereto in interpretation of the claims, as modifications and adaptations within the limits of the claims can be made without departing from the nature of the invention.

The figure of the drawing is a side elevation, partly in section, and with parts broken away.

In the drawing, A designates the fuselage of an airplane of conventional form, B an operator's seat therein, C the sustention-planes, and D the propelling-engine, the parts being shown to some extent diagrammatically and only to the degree necessary for exemplification of the invention.

A casing 4, preferably of cylindrical form, and having a removable cover 5, is installed in the fuselage, and in the adaptation shown in position between the engine and the operator's seat. The casing contains the heating-chamber of the apparatus.

An air-pump 14, actuated in any suitable manner, as by the propelling-engine, forces air through a pipe 15 to a storage-tank 16 having a relief-valve 17 and thence through a pipe 18 to the upper portion of a casing 19 inside of the casing 4. Instead of using an air-pump, the storage-tank may be charged with air at sufficient pressure before the machine leaves the ground, in which event a pressure-reducing valve 17^a is located in pipe 18.

The inner casing 19 embraces a chamber in which the smoke-producing material is treated as hereinafter explained, the casing preferably is of cylindrical form, and it is smaller than, and has its side wall separated from, the side wall of the casing 4. The casing 19 has a removable or liftable cover 20, it is supported on the bottom of the casing 4 by legs 21, and it has an inverted-cone-shaped bottom 22 positioned somewhat above the bottom of the heating-chamber. The arrangement is such that hot fluid in the outer casing may entirely surround the inner casing.

A pipe 28 leads from the jackets of the engine-cylinders to the interior of the casing 4, a pipe 29 leads from the bottom of that casing downwardly and thence upwardly to a point above the upper sustention-plane and it has a rearwardly-deflected terminal portion 30 at its upper end, and a return-pipe 31 leads therefrom to the engine-radiator.

A pipe 23 leads downwardly from a lower point of the bottom 22 of the inner casing into the pipe 29, and thence it continues inside of that pipe to its upper or outer end, where it extends through the wall of, and projects from, the rearwardly-deflected terminal portion 30. The pipe 23 is smaller than the pipe 29 through which it extends, so that hot fluid may move through the latter pipe and around the former.

The heating system comprising the pipes 23, 28, and 29, the outer casing 4, and the inner casing 19 is a part of the cooling system of the propelling-engine, in which system there is the usual pump P connected by pipes with the cylinder-jackets and radiator.

When the apparatus is in operation, or is maintained in readiness for operation, the inner casing 19 contains material that evolves smoke when heat or air or both are applied thereto, or that produces smoke effect when discharged into the atmosphere; the inner chamber and the pipe 23, which carries smoke material therefrom to the place of discharge above the sustention-plane, are maintained at all times during operation of the apparatus in a heated condition by the circulation of fluid of the engine-cooling system; and by means of the air-pump or of a precharged storage-tank and the pipes leading therefrom to the inner chamber sufficient air pressure above atmospheric is maintained in that chamber to cause immediate discharge of material therefrom through the pipe 23 upon the opening of a valve 24 at or near the discharge end of that pipe. That valve is operable by an arm 25 connected by a member 26 with a hand-lever 27 within reach of the occupant of the seat B.

White phosphorous has been found in the practice of the invention to be among the substances suitable for use in the apparatus for attainment of the results desired. That substance in the commercial form usually is in sticks or cakes. It melts under water at about 111 degrees F. When discharged into the atmosphere in melted condition, it ignites spontaneously and produces dense smoke. When that substance is used as the smoke-producing material, it preferably is covered with a layer of water in the casing 19, as indicated at W, to prevent preignition in that place under the influence of air or heat or both.

The inner casing 19 being charged with a smoke-producing material—say white phosphorous for example—the casing and its contents are heated by the liquid of the engine-cooling system, which surrounds the casing. It has been found in practice that the liquid of that system gives a sufficient temperature to melt white phosphorous.

As the material in casing 19 melts, it is forced upwardly through the pipe 23 by pressure of air maintained in the casing when the valve 24 is open. Air pressure in the inner casing is maintained automatically by relief-valve 17 or by pressure-reducing valve 17ª at a degree not exceeding that predetermined as suitable; and, assuming that the air-pump constantly operates or that the storage-tank remains charged, that pressure is maintained at all times.

The hot fluid of the engine-cooling system maintains the smoke material at sufficient temperature for the desired result until it reaches the place of discharge. In the case of white phosphorous, for example, it is kept in melted condition until discharge. It is desirable not only to discharge that substance in melted condition, but also at such temperature above the melting point to which it may be brought safely in order to counteract the low temperature of the atmosphere at high altitudes, which otherwise might prevent ignition on discharge. The apparatus is capable of bringing the material to that temperature.

When the operator wishes to have streams of smoke formed in the air, he opens valve 24 to the extent necessary to permit emission of the required amount of smoke material. In the case of white phosphorous, the material at the temperature it is emitted ignites upon contact with the atmosphere and produces dense smoke. When it is intended to trail the smoke in such manner as to form signs, characters, letters, words, etc., the airplane is maneuvered to produce the desired forms.

Another substance that may be used advantageously in the apparatus for production of smoke is red phosphorous powder, which is placed in the inner chamber and forced by the air therein under pressure to the discharge end of pipe 23, where it ignites and produces dense smoke.

The apparatus also is adapted to the burning of a smoke-producing material in the inner chamber, wherein the air under pressure furnishes the necessary amount of oxygen for combustion and at the same time by down draft causes passage of produced smoke through the pipe 23 to the point of discharge. If the combustible is one that is liable to overheat the inner casing, the engine-cooling water surrounding that casing will operate to keep that casing at safe temperature.

An important feature of the invention is the discharge of smoke, or of material that will produce smoke on contact with the atmosphere, into a strata of air that is not disturbed or not liable to be disturbed, by the propeller sustention-planes, and other parts of the machine in flight.

One of the ways this may be done is disclosed by the drawing, wherein the circulating-water pipe 29 and the smoke-material pipe 23 therein extend upwardly to a point considerably above the upper sustention-plane into atmosphere that is undisturbed by the advancing machine. Smoke or smoke material thus discharged is less apt to be disturbed than when, as is of common practice, it is discharged at the tail of the machine or at other places in the slip steams or in the back wash from the propeller. It will be seen, therefore, that characters,

words, etc., formed by maneuver of a machine equipped with this apparatus retain their integrity and visibility for a longer period than when smoke or smoke material is discharged into machine-disturbed air.

Although the invention is described herein with particular reference to the production of smoke in sky writing, the apparatus also is adapted to the production of smoke for screening and other purposes.

The term "smoke material" is used hereinafter to indicate either smoke produced in the apparatus or material that produces smoke on discharge from the apparatus into the atmosphere.

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

1. A smoke apparatus comprising a receptacle arranged to contain smoke-producing material, means whereby hot liquid is applied to the exterior of said receptacle, and a pipe leading from said receptacle and arranged to discharge smoke material.

2. The combination, with an engine and a cooling system therefor, of a smoke apparatus comprising a receptacle arranged to contain smoke-producing material, means whereby fluid of said cooling system is applied to the exterior of said receptacle, and a pipe leading from said receptacle and arranged to discharge smoke material.

3. A smoke apparatus comprising a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle, means whereby hot liquid is supplied to the interior of said casing, and a pipe leading from said receptacle and arranged to discharge smoke material.

4. The combination, with an engine and a cooling system therefor, of a smoke apparatus comprising a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle, means whereby fluid of said cooling system is supplied to the interior of said casing, and a pipe leading from said receptacle and arranged to discharge smoke material.

5. The combination, with an engine and a cooling system therefor, of a smoke apparatus comprising a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle and connected with said cooling system, means whereby fluid of said cooling system is caused to circulate through said casing, and a pipe leading from said receptacle and arranged to discharge smoke material.

6. A smoke apparatus comprising a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle, a pipe extending outwardly from said casing, means whereby hot liquid is supplied to the interior of said casing and pipe, and a smoke-material pipe leading from said receptacle through said casing-pipe and arranged to discharge into the atmosphere at its outer end.

7. The combination, with an engine and a cooling system therefor, of a smoke apparatus comprising a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle, a pipe extending outwardly from said casing, means whereby fluid of said cooling system is caused to flow through said casing and pipe, and a smoke-material pipe leading from said receptacle through said casing-pipe and arranged to discharge into the atmosphere.

8. The combination, with an engine and a cooling system therefor, of a smoke apparatus comprising a closed receptacle arranged to contain smoke-producing material, means whereby fluid pressure above atmospheric is maintained in said receptacle, a casing surrounding said receptacle, means whereby fluid of said cooling system is supplied to the interior of said casing, and a pipe leading from said receptacle and arranged to discharge smoke material.

9. In an aircraft, a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle, a pipe extending from said casing outwardly from said aircraft, a smoke-material pipe leading from said receptacle through said casing-pipe and arranged to discharge at the outer end of the latter, and means whereby hot liquid is caused to flow through said casing and pipe leading therefrom.

10. The combination, with an engine and a cooling system therefor, of a smoke apparatus comprising a receptacle arranged to contain smoke-producing material, a casing surrounding said receptacle and connected with said cooling system, a pipe extending outwardly from said casing, a pipe connecting the outer portion of said casing-pipe with said cooling system, and a smoke-material pipe leading from said receptacle through said casing-pipe and arranged to discharge into the atmosphere.

11. A smoke apparatus comprising a heat-convecting element, means whereby cooling fluid of an engine is brought into contact with said element, and means whereby smoke material is placed in proximity to said element and heated thereby.

12. A smoke apparatus comprising a heat-convecting element, means whereby hot liquid is conveyed from an engine into contact with said element, and means whereby smoke material is placed in proximity to said element and heated thereby.

13. In a smoke apparatus, a pipe for conveying smoke material, a pipe surrounding said smoke-material pipe, and means whereby hot liquid is moved through said surrounding pipe.

14. The combination, with an engine hav-

ing a cooling system, of a smoke apparatus comprising a pipe for conveying smoke material, a tubular member surrounding said pipe, and means whereby fluid of said cooling system is conveyed to said tubular member.

15. A process of emitting smoke material from a vehicle propelled by an internal-combustion engine that includes the conveying of hot fluid of the cooling system of said engine against the exterior of a container of said material, and discharging smoke material thereby heated into the atmosphere.

16. A process of emitting smoke material from a vehicle propelled by an internal-combustion engine that includes subjection of white phosphorous material to fluid pressure in a container, melting said material by applying hot fluid of the cooling system of said engine to the exterior of said container, and permitting discharge of said melted material into the atmosphere.

17. A process of emitting smoke material from a vehicle propelled by an internal-combustion engine that includes subjection of smoke material to fluid pressure in a container, discharging smoke material through a pipe leading from said container, and bringing hot fluid of the cooling system of said engine into contact with the exterior of said receptacle and pipe.

18. A process of emitting smoke material from a vehicle propelled by an internal-combustion engine that includes directing hot fluid of the cooling system of said engine into contact with a heat-convecting element, bringing smoke material into contact with said heat-convecting element, and permitting discharge of said material into the atmosphere.

19. A process of emitting smoke material from a vehicle propelled by an internal-combustion engine that includes directing hot liquid heated by said engine into contact with a heat-convecting element, bringing smoke material into contact with said heat-convecting element, and permitting discharge of said material into the atmosphere.

20. A process of emitting smoke material from a vehicle propelled by an internal-combustion engine that includes the conveying of liquid heated by said engine against the exterior of a container of said material, and discharging smoke material thereby heated into the atmosphere.

In testimony whereof, I affix my signature.

ARTHUR R. SMITH.