No. 779,414. PATENTED JAN. 10, 1905.

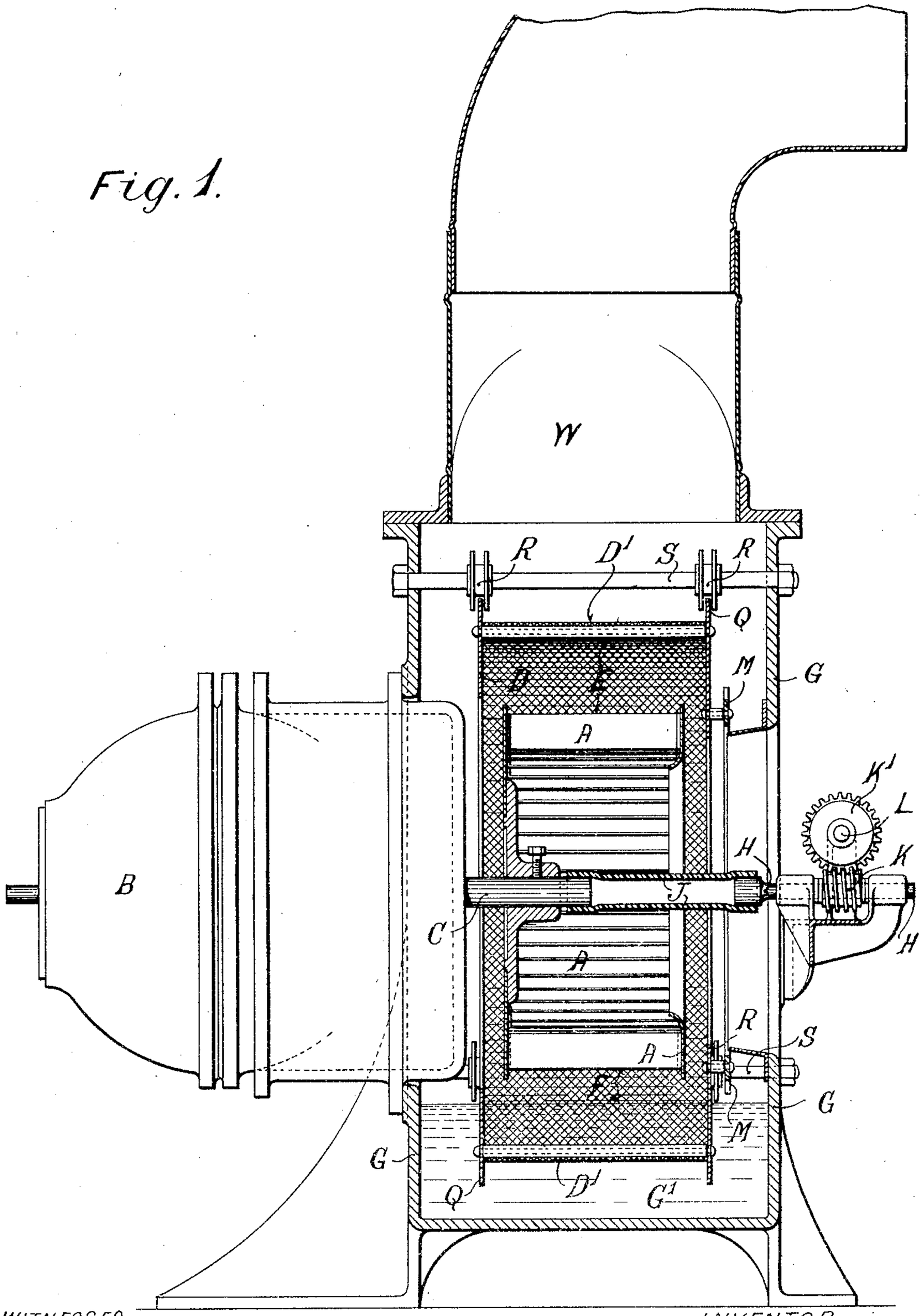
S. C. DAVIDSON.

APPARATUS FOR COOLING AIR.

APPLICATION FILED APR. 28, 1904.

4 SHEETS—SHEET 1.

Fig. 1.

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Samuel Cleland Davidson,
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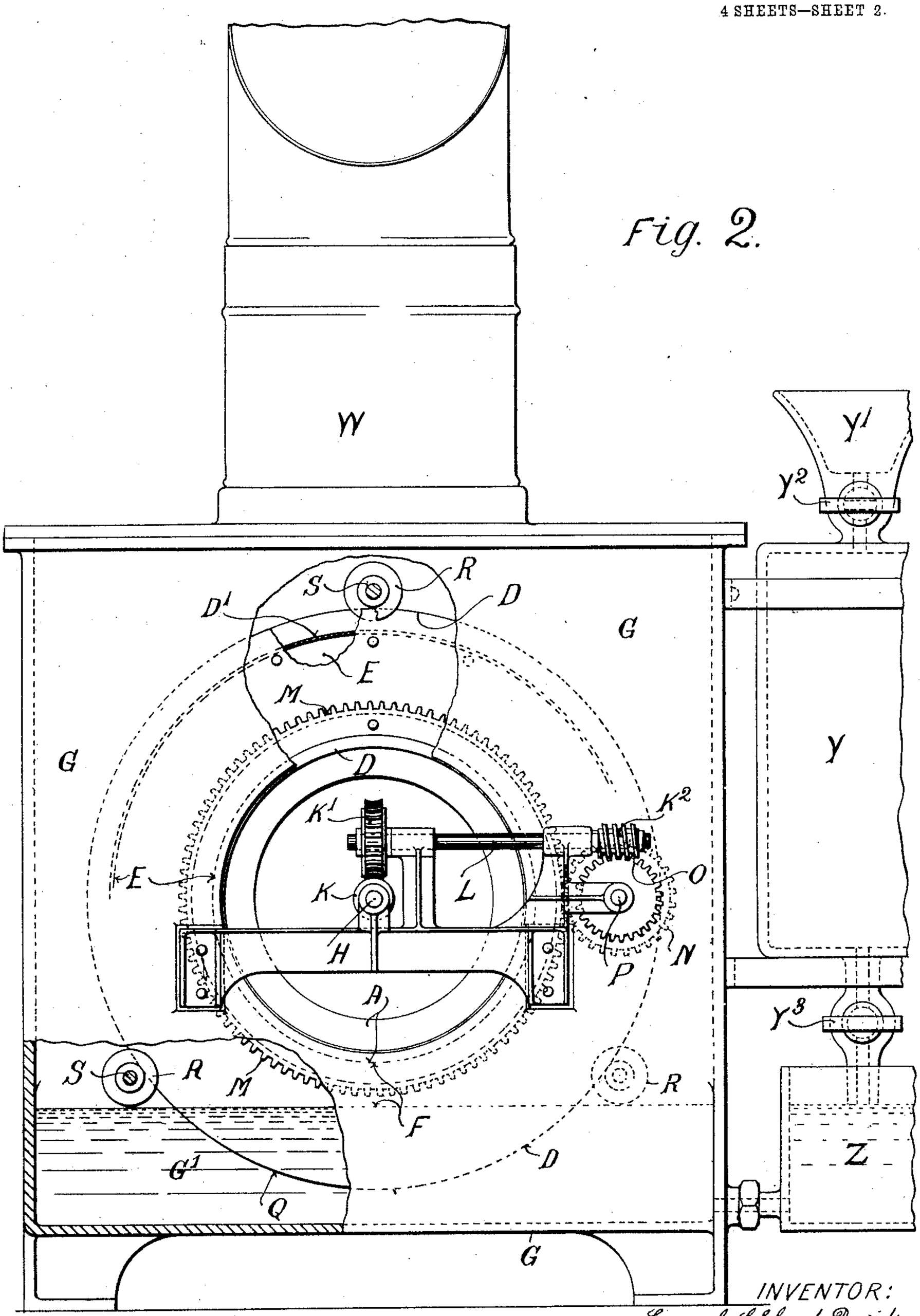
4 SHEETS—SHEET 2.

Fig. 2.

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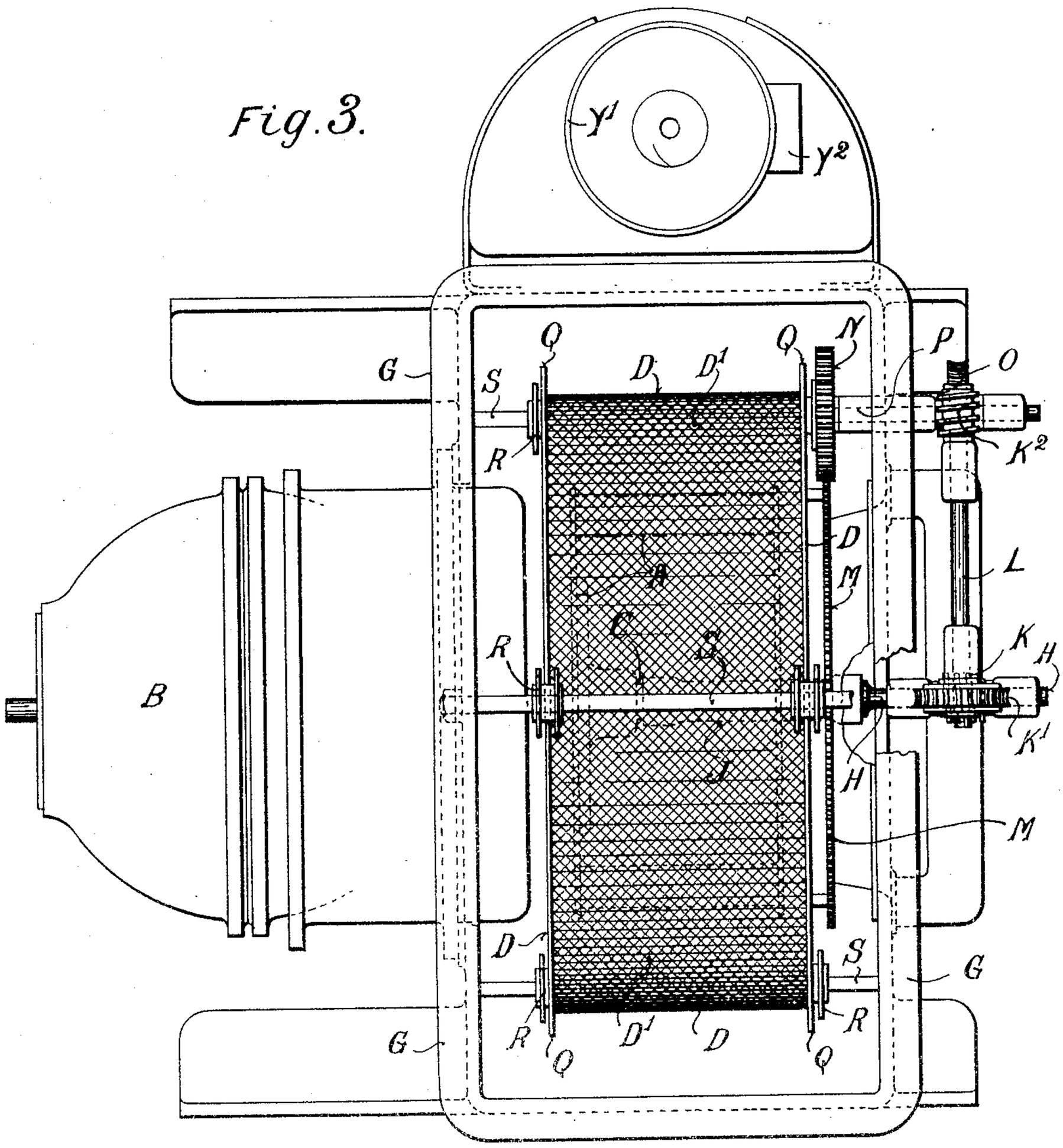
4 SHEETS—SHEET 3.

Fig. 3.

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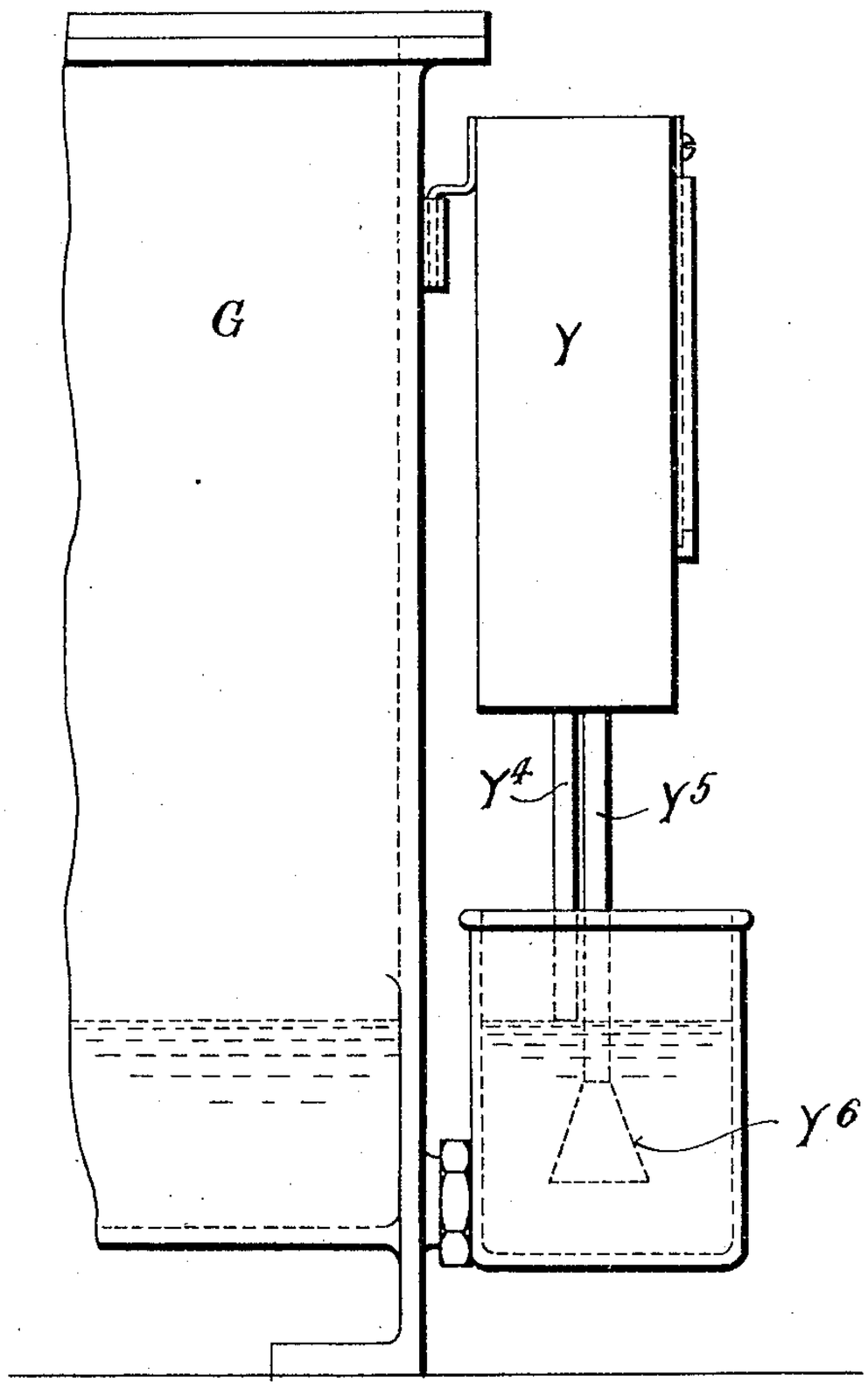
4 SHEETS—SHEET 4.

*Fig. 4.*

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No. 779,414. Patented January 10, 1905.

# UNITED STATES PATENT OFFICE.

SAMUEL CLELAND DAVIDSON, OF BELFAST, IRELAND.

## APPARATUS FOR COOLING AIR.

SPECIFICATION forming part of Letters Patent No. 779,414, dated January 10, 1905.

Application filed April 28, 1904. Serial No. 205,435.

*To all whom it may concern:*

Be it known that I, SAMUEL CLELAND DAVIDSON, a subject of the King of Great Britain and Ireland, and a resident of Belfast, Ireland, have invented certain new and useful Improvements in or Relating to Apparatus for Cooling Air, of which the following is a specification.

This invention relates to apparatus for cooling air of that type where the air to be cooled is passed through damp foraminous material, whereby it causes evaporation of the moisture contained in the foraminous material, which evaporation extracts an equivalent of heat from the air, and consequently cools it to this extent.

According to this invention I provide a fan mounted and rotating within a drum or casing covered with foraminous wetted material through which the air to be cooled is forced by the fan within. The fan and the drum of foraminous material (hereinafter called the "foraminous" drum) are both rotated, the drum rotating at a much lower speed than the fan, and it is or may be driven from the fan-spindle through the medium of a connection of flexible material disposed between the fan-spindle and the driving-spindle of the foraminous drum, the ends of which spindles are in alinement, the said flexible material serving to minimize loss of power and lessen the necessity for accurate fitting of the said spindles the one in regard to the other. For the purpose of maintaining the foraminous material in a suitably moist state the foraminous drum rotates with its lower portion dipping into a bath of water, which water is maintained at such a level within the drum that it causes a contraction in the even continuity of the cylindrical space between the drum and the fan within, thereby preventing the circumferential rotation of the air in such cylindrical space under the action of the fan and causing the fan to effectually discharge the air through the foraminous material of the drum.

I will describe one form of my invention in reference to the accompanying drawings, wherein—

Figure 1 is a cross-sectional elevation; Fig. 2, a side elevation looking on inlet-opening to center of fan. Fig. 3 is a plan with top cover of the inclosing or tank casing removed. Fig. 4 shows in side elevation an alternative construction of water-reservoir and feeding device.

Referring now to Figs. 1, 2, and 3, A is a fan of the type I preferably employ, which fan rotates inside an inclosing casing G, (hereinafter called the "tank-chamber,") which is so constructed that its base acts as a water-tank G′. Around the fan A and concentric therewith is a drum-like cylinder D, forming the foraminous-drum. The circumference of this drum is constructed as an open framing, around which is stretched and attached any suitable material D′ of a foraminous nature, and of sufficiently open structure to permit the passage of air through same. The foraminous drum D is of sufficiently larger diameter than the circumference of the fan A to provide a cylindrical space E between the circumference of the fan and that of the forminous material $d'$, forming the outer circumference of the drum $d$. The lower part of the foraminous drum D dips down into the water contained in the tank G′ and revolves through it slowly, whereby the whole surface of the foraminous drum is continuously kept moist, and the circumference of the fan A revolves sufficiently clear of the surface of the water not to touch same. Where the foraminous drum D dips into the water the cylindrical space E between the fan and the inner surface of the drum is contracted, as at F, owing to the surface of the water in the tank G′ forming a chord to the immersed portion of the circumference of the drum D, which contraction prevents the air discharged from the fan rotating freely around the cylindrical space E between the fan and the foraminous drum, whereby pressure is set up in the air within the said cylindrical space, which pressure forces it through the foraminous material into the air-space between the drum and the inner sides of the tank-chamber G′. The air in passing through said foraminous material at a high velocity comes into intimate contact with the moisture held therein, and in addition to the evapora-

tion which it effects it also mechanically disengages and projects some of the moisture outward as a mist-like spray, which striking against the inner sides of the tank-chamber G keeps same wetted, so that they form additional evaporating-surfaces for the air to pass over after coming through the foraminous material around the drum itself, which surfaces may be further increased by ribbing the inner surfaces of the sides of tank-chamber G or by hanging in front of said sides wire gauze, netting, or other foraminous material. The last-mentioned modification is not illustrated. The air escapes from said tank-casing through a short vertical pipe W at a reduced temperature equivalent to the amount of evaporation it has effected. The said foraminous drum D is rotated by means of a worm and worm-wheel gear-train driven by the fan-spindle C, and the terminal wheel of said gear-train consists of a toothed pinion N, which engages a toothed wheel M, concentrically mounted upon and of less diameter than the foraminous drum D, which drum is provided with projecting rims Q Q, on which it revolves and which are carried and guided in grooved pulleys R R upon spindles S S, passing through the said tank-chamber G and supported from the walls thereof. This gear-train is so arranged as to give the foraminous drum D only about two revolutions per minute or other such slow speed as may be deemed desirable. The gear-train, as shown in the drawings, consists of a worm K on the primary or driving spindle H. L is a second worm-spindle, carrying the worm-wheel K′ and also another worm, $K^2$, the latter driving another worm-wheel, O, which is mounted on the same spindle P as the before-mentioned pinion N, which drives the toothed wheel M on the foraminous drum D.

The spindle C, on which the fan A is mounted, is preferably an extension of the spindle of an electric motor B, and as it is of much importance when the apparatus is of smallest sizes and very small motors are employed that there shall be no waste of power in transmitting motion from the end of the motor and fan-spindle C to that of the first spindle H of the gear-train, owing to the existence of any slight inaccuracy of fitting whereby the spindles might not be exactly in true alinement with one another, and as the power required for driving the gear-train is very minute I employ a flexible connection J between said two spindles C and H, which consists merely of an india-rubber tube fitting tightly upon the adjacent ends of each spindle. If necessary, a small quantity of rubber solution may be applied to the ends of the spindles before the ends of said rubber tube J are stretched over them, forming an amply strong connection for the purposes required.

It is to be understood that other forms of flexible connection may be employed; but the above is specially simple and useful for the purpose.

In order to keep the water at a uniform height within the tank-casing G, a ball-cock may be employed in the tank of the largest sizes of the apparatus; but for the medium sizes I may employ a water-supply reservoir, such as shown at Y, supplying the water to the tank-base G′ on the bird-fountain principle or on the principle of the tallow-cups used on steam-engine cylinders. The said reservoir may have a funnel Y′ on the top and a tap $Y^2$ on the intermediate connecting-pipe and a pipe $Y^3$, with a tap in it leading from the base of the reservoir into an open-topped cup or basin Z, on the outer side of the tank-casing G′ and so connected with the tank-base G′ that the water-level in the tank corresponds with that in the cup Z and is openly visible therein. The lower end of the base-pipe $Y^3$ from the reservoir Y should merely dip into the water in the cup Z and terminate just at the level at which it is desired to maintain the water-level in the tank. When filling the reservoir, the tap on the base-pipe $Y^3$ is closed and that between the funnel Y′ and the reservoir open, and when the reservoir is filled the funnel-tap is closed and that on the base-pipe opened, whereupon if the water in the cup and tank has fallen below the proper level the lower end of the base-pipe $Y^3$ will be uncovered and air will pass up into the reservoir, which will allow water to fall therefrom into the cup until the water-level in the tank G′ and cup Z is raised to the required point and the end of the reservoir base-pipe $Y^3$ is covered, which by preventing any more air ascending into the reservoir prevents any more water coming out of it until the water-level in the cup again descends sufficiently to uncover the end of the pipe $Y^3$ and let a further quantity of air up again into the reservoir through the pipe. For the smallest sizes of the apparatus, however, I preferably make said reservoir Y of the form shown in Fig. 4, where said reservoir is closed entirely on top and has two base-pipes $Y^4$ $Y^5$ led into the bottom end, one of which, $Y^5$, is somewhat longer than the other. In this form to fill the reservoir Y it is unhooked from the side of the tank-chamber G and turned upside down, and said longer pipe $Y^5$ is sufficiently bell-mouthed, as at $Y^6$, to facilitate pouring of water into the reservoir therethrough. The reservoir therefore is easily filled as the air escapes through the short second pipe $Y^4$. When full, the reservoir is inverted and placed in position with both base-pipes $Y^4$ $Y^5$ immersed in the water in the tank-cup. The end of the short pipe $Y^4$ regulates the water-level in the tank; for so soon as the level falls below same air passes up into the reservoir through the short pipe $Y^4$ and an equivalent volume of water flows down the long pipe $Y^5$ until the water-level in the cup rises sufficiently to water-seal the end of the short

pipe $Y^4$ and prevent any more air ascending into the reservoir, which stops any further outflow of water from it.

The use of an automatic means for limiting the quantity of water admitted to the tank enables me to make the machines of quite small size with very high evaporating power, notwithstanding the fact that with such machines the water-level necessarily falls quite rapidly. With my improved apparatus the water is admitted only so fast as it is evaporated. Consequently there is no need of any means for drawing off the water from the tank.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In apparatus for cooling air, the combination with a drum the circumference of which consists of wetted foraminous material, of a fan mounted within said drum rotating independently of said drum and forcing air through the wetted foraminous material thereon.

2. In apparatus for cooling air, the combination of a rotary drum the circumference of which consists of wetted foraminous material, a fan-shaft, a fan mounted on said shaft within said foraminous drum and forcing air through the wetted foraminous material thereof, a driving connection between the rotary drum and the fan-shaft, and gearing for reducing the speed of the rotating drum.

3. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air through the wetted foraminous material thereof, a shaft carrying said fan, a shaft for driving the drum and disposed in alinement with the fan-shaft, a flexible coupling joining the adjacent ends of the fan-shaft and the drum-driving shaft, and speed-reducing gear between the driving-shaft and the drum.

4. In apparatus for cooling air, the combination of a drum, the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air through the wetted foraminous material thereof, a shaft carrying said fan, a shaft for driving the drum and disposed in alinement with the fan-shaft, and an elastic sleeve coupling the adjacent ends of the fan-shaft and the primary spindle of the drum-driving mechanism, and speed-reducing gear between the driving-spindle and the drum.

5. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing said drum and fan and having an inlet to the eye of the fan for admitting air thereto, and an outlet-opening for efflux of the cooled air therefrom, means for driving the fan, means for driving the drum from the fan-driving shaft at a reduced speed, a tank in the base of said tank-chamber and containing water into which the foraminous material constituting the circumference of the drum dips.

6. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing said drum and fan and having an inlet to the eye of the fan for admitting air thereto, and an outlet-opening for efflux of the air therefrom, a tank in the base of said tank-chamber containing water into which the foraminous material of the drum dips as the drum rotates, means for driving the fan, means for driving the drum from the fan-shaft at a reduced speed, projecting rims upon the drum, grooved wheels disposed around the drum so as to support and guide the same by the projecting rims thereon, spindles carrying said wheels and mounted in the tank-chamber.

7. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing the said drum and fan and having an inlet to the eye of the fan for admitting air thereto and an outlet-opening for efflux of the air therefrom, a tank in the base of said tank-chamber containing water into which the foraminous material upon the drum dips as the drum rotates, means operating on the bird-fountain principle for feeding and maintaining a constant level of water in said tank, means for driving the fan, means for driving the drum from the fan-driving shaft at a reduced speed.

8. In apparatus for cooling air, the combination of a drum the circumference of which consists of foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing said drum and fan and having an inlet to the eye of the fan for admitting air thereto, and an outlet-opening for efflux of air therefrom, a tank in the base of said tank-chamber containing water into which the foraminous material of the drum dips as the drum rotates, means operating on the bird-fountain principle for feeding and maintaining a constant level of water in said tank, means for driving the drum from the fan-spindle at a reduced speed, projecting rims upon the drum, grooved wheels disposed around the drum so as to support and guide the same by said projecting rims, spindles carrying said wheels and mounted in the tank-casing.

9. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum, rotating independently of said drum and forcing air through the wetted foraminous material thereof, means for rotating the said fan and said drum, a tank containing water into which the foraminous material constituting the circumference of the

drum dips, and means operating on the bird-fountain principle for feeding and maintaining a constant level of water in said tank.

10. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air through the wetted foraminous material thereof, a shaft carrying said fan, a gear-train for driving said drum the primary spindle of which is disposed in alinement with the fan-shaft, an elastic sleeve coupling the adjacent ends of the fan-shaft and the drum-driving spindle, speed-reducing gear between the driving-spindle and the drum, a tank containing water into which the foraminous material constituting the circumference of the drum dips, means operating on the bird-fountain principle for feeding and maintaining a constant level of water in said tank.

11. The combination with apparatus for cooling air wherein a drum covered with wetted foraminous material around its circumference is rotated and dips into a tank of water, and a fan inclosed within and rotating independently of the said drum forces air through the wetted foraminous material thereof, of an open cup in connection with the tank, a reservoir detachably fitted to the apparatus above said cup, two pipes of unequal length depending from said reservoir into the liquid in said cup, the shorter pipe terminating at or about the level of liquid to be maintained in the cup and tank, a funnel at the end of the longer pipe for filling said reservoir when detached and inverted.

12. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing said drum and fan and having an inlet to the eye of the fan for admitting air thereto and an outlet for the efflux of cooled air therefrom, a shaft carrying and driving said fan, a gear-train for driving the drum the primary spindle of which is disposed in alinement with the fan-shaft, a flexible or an elastic sleeve coupling the adjacent ends of the fan-shaft and said primary spindle of the drum-driving speed-reducing gear between the driving-shaft and the drum, a tank in the base of said tank-chamber and containing water into which the foraminous material constituting the circumference of the drum dips.

13. In apparatus for cooling air the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing said drum and fan and having an inlet to the eye of the fan for admitting air thereto, and an outlet-opening for efflux of air therefrom, a tank in the base of said tank-chamber containing water into which the foraminous material of the drum dips as the drum rotates, a shaft carrying and driving said fan, a gear-train for driving the drum the primary spindle of which is disposed in alinement with the fan-shaft, a flexible or an elastic sleeve coupling the adjacent ends of the fan-shaft and said primary spindle of the drum-driving speed-reducing gear between the driving-shaft and the drum, projecting rims upon the drum, grooved wheels disposed around the drum so as to support and guide the same, spindles carrying said pulleys or wheels and mounted in the tank-casing.

14. In apparatus for cooling air, the combination of a drum the circumference of which consists of wetted foraminous material, a fan mounted within said drum and forcing air therethrough, a tank-chamber inclosing the said drum and fan and having an inlet to the eye of the fan for admitting air thereto and an outlet-opening for efflux of air therefrom, a tank in the base of said tank-chamber containing water into which the foraminous material upon the drum dips as the drum rotates, means operating on the bird-fountain principle for feeding and maintaining a constant level of water in said tank, a shaft carrying and driving said fan, a gear-train for driving the drum and the primary spindle of which is disposed in alinement with the fan-shaft, a flexible or an elastic sleeve coupling the adjacent ends of the fan-shaft and the drum-driving shaft, speed-reducing gear between the driving-shaft and the drum.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

SAMUEL CLELAND DAVIDSON.

Witnesses:
HARFORD HUGH MONTGOMERY,
JOHN BODEL.