(No Model.)

4 Sheets—Sheet 1.

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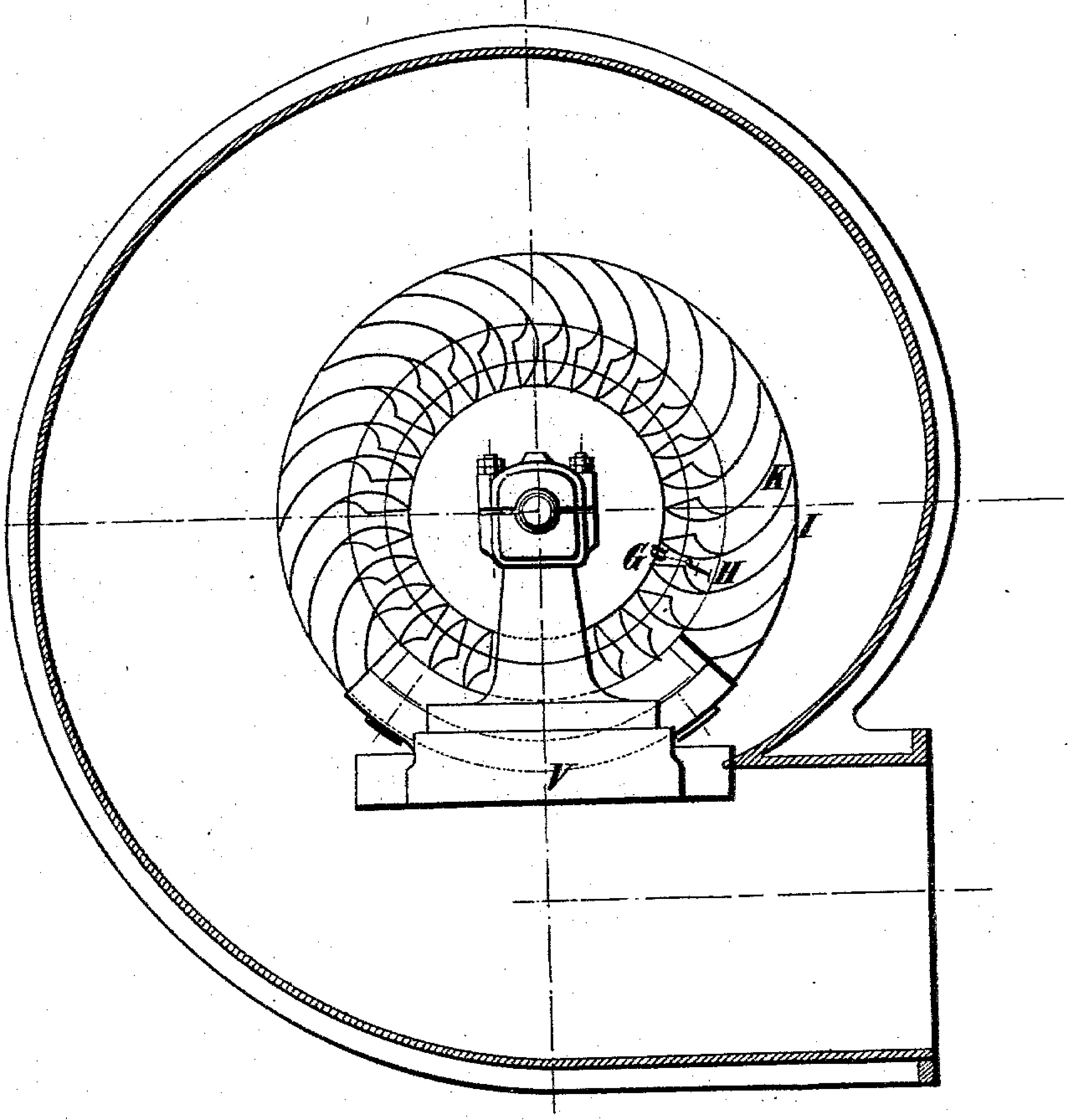
CENTRIFUGAL VENTILATOR.

No. 511,140. Patented Dec. 19, 1893.

FIG 1



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his attorneys.

THE NATIONAL LITHOGRAPHING COMPANY, WASHINGTON, D. C.

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FIG. 2

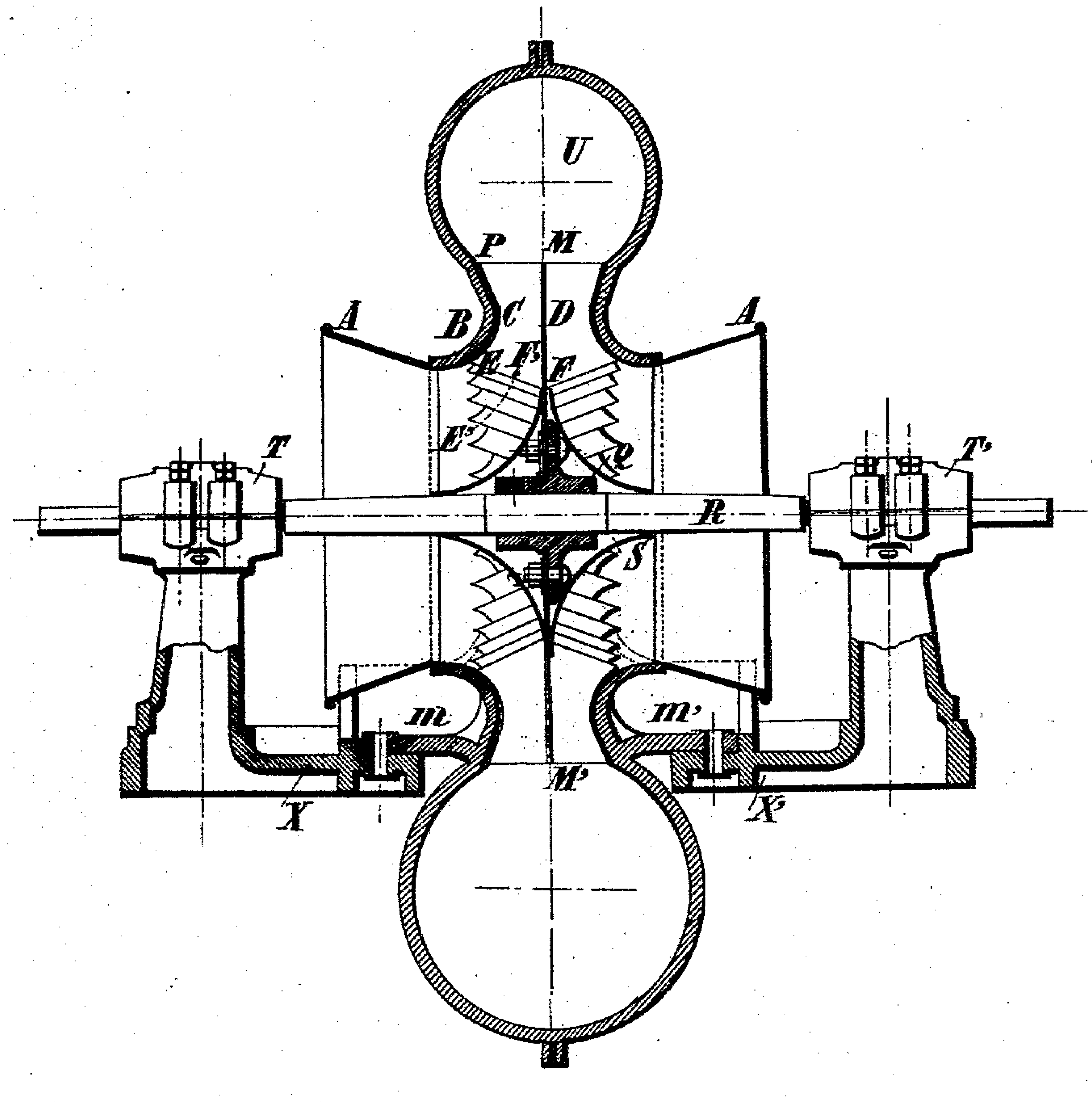

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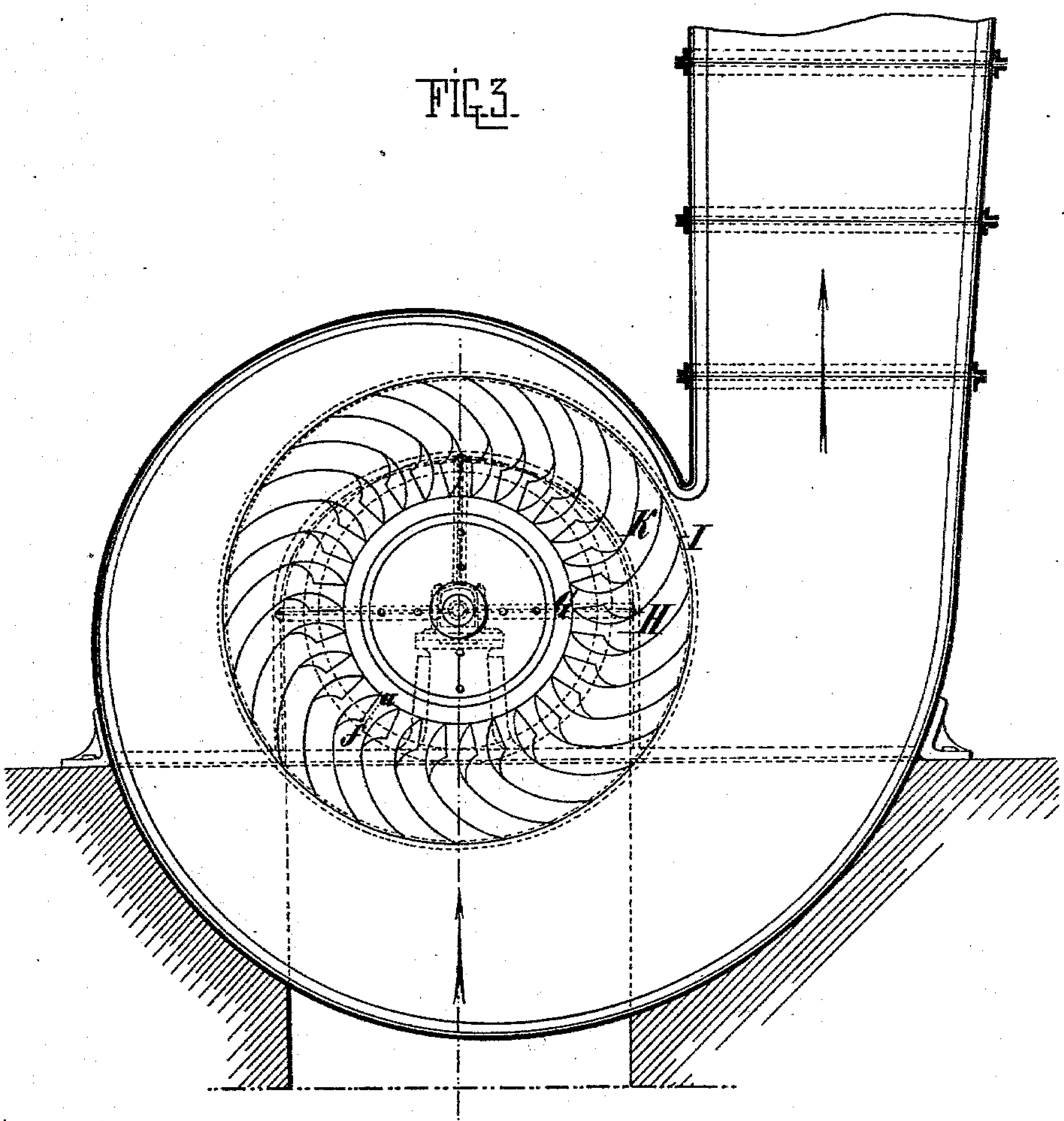
FIG. 3.



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(No Model.)

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CENTRIFUGAL VENTILATOR.

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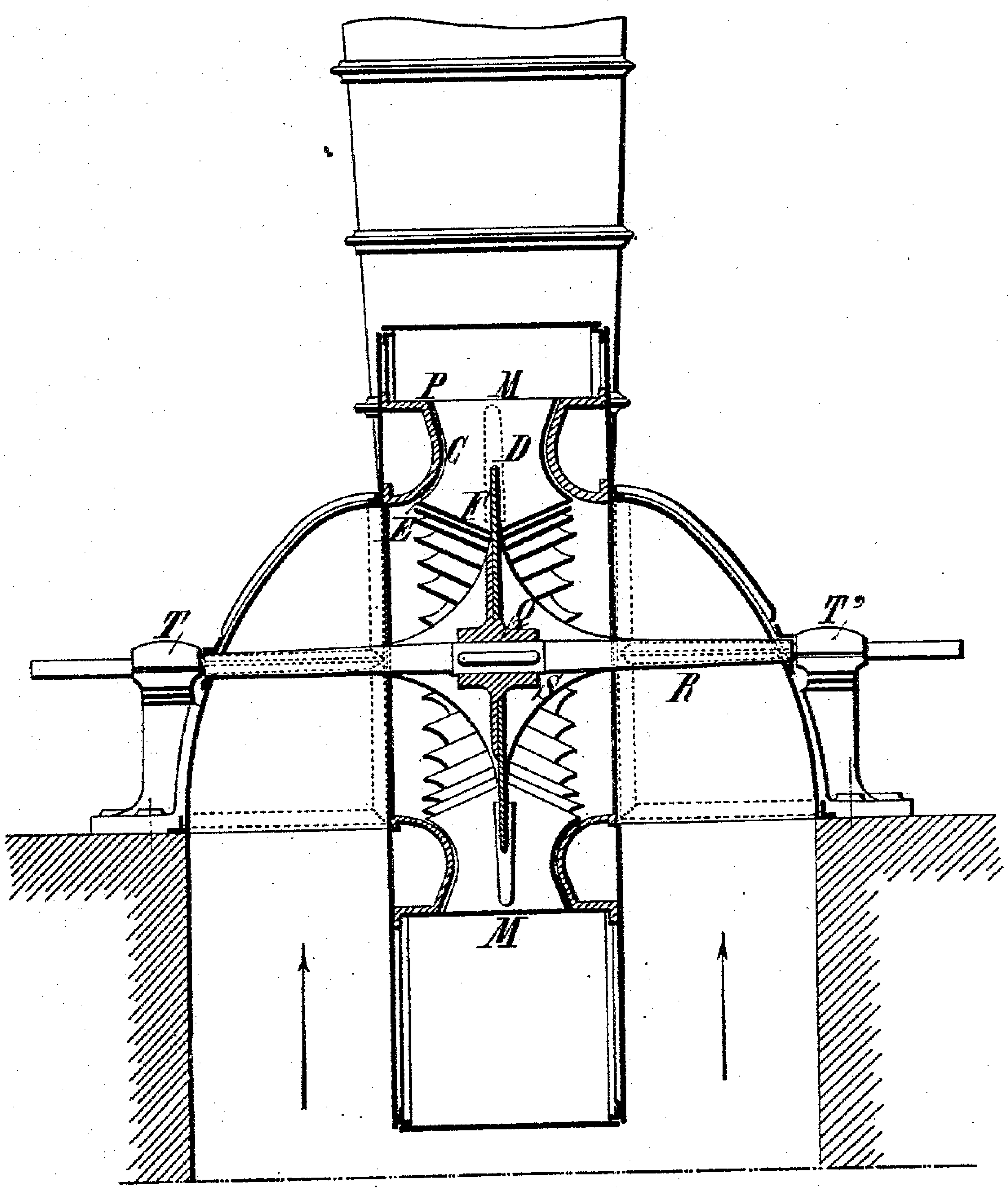
FIG. 4.



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UNITED STATES PATENT OFFICE.

CHARLES GEORGES HERSCHER, OF PARIS, FRANCE, ASSIGNOR TO THE SOCIETY GENESTE, HERSCHER ET CO., OF SAME PLACE.

CENTRIFUGAL VENTILATOR.

SPECIFICATION forming part of Letters Patent No. 511,140, dated December 19, 1893.

Application filed May 18, 1893. Serial No. 474,663. (No model.) Patented in France August 20, 1892, No. 223,848, and in England March 30, 1893, No. 6,758.

To all whom it may concern:

Be it known that I, CHARLES GEORGES HERSCHER, a citizen of the Republic of France, and a resident of Paris, in said Republic, have invented certain new and useful Improvements in Centrifugal Ventilators, which are fully described in the following specification, and for which I have obtained Letters Patent in France, No. 223,848, dated August 20, 1892, and in Great Britain, No. 6,758, dated March 30, 1893.

This invention relates to a new kind of centrifugal ventilator in which the organs are so disposed as to obtain the maximum yield in pressure and work. To accomplish this result it is sought in the present invention to eliminate the causes of loss of charge, of eddies, and of shocks during the flow of the air from the inlet of the apparatus to the extremity of the receiving chamber and in particular to avoid, first, contraction of the stream of fluid (the *vena contracta* of physicists) at the inlet of the ventilator; second, loss of charge due to the turn between the ventilator inlet and the entrance portions of the channels formed by and between the vanes or floats; third, contraction (*vena contracta*) at the entrance portions of the said channels; fourth, eddies at the beginning of the vanes or floats at the ventilator inlet; fifth, loss of pressure in the passage of the fluid through the channels formed by and between the vanes or floats; sixth, defective guiding of the fluid in said channels; seventh, incomplete utilization of the impelling velocity at the extremities of the vanes or floats; eighth, unequal distribution of the fluid in the receiving chamber at the ends of the vanes or floats; ninth, shocks of the fluid passing from the channels into the receiving chamber; tenth, friction and shock encountered by the fluid during its passage through the receiving chamber. The dispositions whereby these disadvantages can be avoided in what is considered the best mode, are represented by way of illustration in the accompanying drawings which form part of this specification, and in which—

Figure 1, is a vertical section of a blowing ventilator constructed in accordance with the invention. Fig. 2, is a transverse section of the same apparatus. Fig. 3, is a section parallel to the plane of the wheel of an aspirating and blowing ventilator, also constructed in accordance with the invention; and Fig. 4 is a transverse section of such aspirator and ventilator.

The apparatus will be considered as a whole, and an analysis be given in detail of the dispositions adopted severally to remedy the different losses of pressure, eddies and shocks enumerated above.

1. *Means of avoiding the contraction (vena contracta) of the stream at the ventilator inlet.*—Contraction at the inlet of the ventilator results in a diminution of pressure corresponding to the square of the difference of the velocities of the air in respectively the contracted section and the entrances of the movable channels between the vanes or floats. To avoid the effect of such contraction it suffices that the velocity with which the fluid is animated in its passage through the ventilator inlet be not diminished. To effect this, a flaring mouth A, Fig. 2, is placed at the ventilator inlet, so that the flow takes place, not as through an orifice in a thin wall, nor even as through a cylindrical pipe, but like that obtained through a pipe of suitable converging conical form.

2. *Diminution of the loss of charge due to the turn between the ventilator inlet and the entrances of the channels between the vanes or floats.*—The air enters the ventilator inlet in the direction perpendicular to that in which it escapes into the receiving chamber. From this change in direction results a loss of pressure which can be avoided by giving a minimum value to the ratio of the cross section of the stream to the radius of curvature of the middle of such stream. Figs. 2 and 4 show the radius of curvature which results from the convexity of the wall at the ventilator inlet.

3. *Reduction of contraction (vena contracta) at the entrances of the movable channels.*—The ventilators which have heretofore given the best results have been those in which it has been sought to give to the fluid a relatively constant velocity from the entrances to the ends of the channels. The

stream which is thus produced in a passage of constant section is similar to that obtained in discharging the fluid from a reservoir under pressure through a cylindrical pipe, in which as is known there is produced a contraction of the stream at the entrance. It is to avoid this that in the new or improved ventilator the channels are made to decrease in section from the entrances E F to about their middle C D, so that the stream produced fills the channel (Fig. 2).

4. *Suppression of eddies at the beginning of the vanes or floats at the ventilator inlet.*—These eddies are avoided by given to the different points of the edge E F of each vane or float, normal to the curve E′ F′ representing the direction of the current at the middle of the stream at the entrance to each channel, an inclination corresponding with the impelling velocity at each of these points so that the fluid enters over the whole depth of the vane or float without shock. To this end the part G H of the vane or float (the latter mounted on a central disk M M′) is given a form corresponding with the surface of an oblique cone of circular section whose generatrix, which has its path at H, Fig. 1, is perpendicular to the plane of the wheel. Besides the angle of the cone is so chosen that each of the points receives the fluid under a variable angle decreasing in proportion to its distance from the center of the wheel. As moreover, the vane or float at its part H I is bent to conform to a cylindrical surface normal to the disk supporting the vanes or floats, it results that the entire vane or float is capable of development on a plane, which capacity contributes to the simplicity of its construction. It is not intended to limit the invention to the combination of a cylindrical surface with a conical curvature of the vane or float, but it extends to surfaces capable of development of a plane in general aside from the employment of simple cylindrical curvature.

5. *Diminution of the losses of pressure of the air during its passage through the channels formed by the vanes or floats.*—This result is obtained on the one hand by so shaping the channels that the current at the middle of the stream in each channel has a path of a great radius of curvature which becomes greater toward the exit, or end of the channel, and upon the other hand by limiting the section of the channels formed by the vanes or floats to the smallest perimeter, a result obtained by proportioning the height and width of the channels.

6. *Guiding of the fluid in the channels and at their exit portions.*—The curvature given to the vanes or floats of a wheel has the effect of compressing the air in the movable channels. It hence results that the friction being greater at the surface of the vane or float than at the center of a channel, the fluid under the action of centrifugal force flows with unequal velocity, and that a part escapes at the end of the float or vane without having acquired the absolute velocity which it is desired to give it. To overcome this difficulty it is necessary on the one hand that the length of the channel be proportioned to its width so that the streams of fluid cannot escape without being deflected longitudinally of the floats or vanes and on the other hand that the end portions of the channels have also a sufficient length for securing the delivery of the fluid at the angle desired. This has been effected in the new and improved ventilator by the disposition given to the vanes or floats. The vanes or floats have in fact a suitable length (Figs. 1 and 3) and are sufficiently prolonged from the point of inflection K for the guidance of the fluid to the ends of the channels to be completely assured.

7 and 8. *Means employed for better utilizing the velocity of rotation at the ends of the vanes or floats and for delivering the fluid without eddies in the receiving chamber.*—These results are obtained by giving to each vane or float counting from about the middle of its length, heights which successively increase from the middle C D to the end M P. This special form given to the vane or float (see Figs. 2 and 4) permits the impelling velocity with which the vanes or floats are animated to be communicated not only to the current at the middle of the stream in each channel but to a number of parallel portions of said stream, whence it results that for a given volume delivered, a larger number of particles are impressed with the impelling velocity of the wheel. The progressive increase in height given to the vane or float in the part C D P M moreover, allows the fluid to be delivered both to the center and the periphery of the receiving chamber, which delivery tends to avoid eddies therein and to equalize the velocity of flow. On the other hand as the sections of the channels increase progressively from C D to M P, it results in accordance with what was said before in section 3 on the form of channels with converging walls at the entering portions thereof that one of the characteristics of the new and improved ventilator is to have converging-diverging curvilinear channels, obtained by giving to each vane or float successively decreasing and increasing heights, the said converging - diverging channels permitting a stream which fills the section to be obtained throughout the length and in which consequently all eddies are avoided.

9. *Diminution of shock of the fluid flowing from the channels into the receiving chamber.*—The essential condition for avoiding the shock of the streams from the channels and that flowing in the receiving chamber is to give the same direction to both streams. It is necessary then that the direction of the fluid at the ends of the channels should not be opposed to that of the stream in the receiving chamber, as is the case in ventilators in which the vanes or floats are inclined in

the opposite direction to their rotation, but that they should be as nearly as possible parallel. The curvature of the vanes or floats in a ventilator with eccentric or concentric receiving chamber ought to be in the direction of the rotation of the wheel. This has been done in the new or improved apparatus by diminishing still more, as compared with ventilators in use with a flow of relatively constant velocity, the angle of the final portion of the vane or float to the tangent at the exterior circumference of the wheel.

10. *Reducing the friction in the receiving chamber.*—This friction may be due to two different causes, namely, to a perimeter having an extent of surface excessively great as compared with the section which it circumscribes, or to the approach of the wall of the receiving chamber on which the fluid from the channels is projected, too near the wheel. The double difficulty has been overcome in the new or improved apparatus by giving to the receiving chambers of blowers or aspirators of small diameters a circular section, which presents as is known the minimum of perimeter for a given section, and to the receiving chambers of blowing or aspirating and blowing apparatus of large diameters, such as the mine ventilators shown in Figs. 3 and 4, a form as near square as may be, so disposed as to remove from the vanes or floats the wall whose presence tends to give rise to the shocks.

Description of apparatus.—The wheel comprises a circular disk of sheet steel M M′ fixed to a hub Q keyed on the arbor of rotation R. On this disk are fixed say twenty-four to thirty more or less, vanes or floats of sheet steel. These vanes or floats each of simple curvature and conforming each to the fraction of a developable surface, conical or cylindro-conical for example, are bent forward near the crown in the manner to cut this at an angle of from forty to thirty degrees. The wheel is provided at its center with a sort of conical deflector S of spun brass or copper, fixed at its apex on the arbor of the wheel and at its base on the disk at the beginning of the vanes or floats. The wheel is mounted on the arbor of rotation R, which rests on two standards T T′ placed symmetrically on opposite sides of the wheel and it turns in an envelope U forming the receiving chamber. The position of the wheel with reference to the receiving chamber is such that its exterior circumference is tangent to the inner plane of the receiving chamber without overpassing the same at any point. The arbor R of the ventilator wheel diminishes in cross section from the point of its attachment to the wheel, to its extremities in a manner to present a solid of equal resistance to torsion and flection. It can be driven by symmetrically placed pulleys, which arrangement has the advantage of reducing the section of the arbor in the bearing and of thus uniting, in a construction rationally balanced and avoiding all false load, the minimum of friction of the parts in contact. Each inlet of the ventilator is formed by a sort of hollow converging guide A on the cheeks of the ventilator. In the mine ventilator of which the rectangular pipe is surrounded by a diffuser, the eduction orifice can take any direction about the aspiration shells fastened to the cheeks of the ventilator. It suffices simply to change the position of the bolts which fasten these pieces together. In the blowing ventilator in like manner any direction can be given the eduction pipe.

The envelope of the ventilator is provided to the end with ears *m m′*, which may be in any position about the ventilator inlet. The lower parts of these ears in contact with the soles X X′ of the standards present circular forms so that their adjustment in the said soles centers and fixes as well the direction and distance of the standards with reference to the arbor of the ventilator.

I claim as my invention or discovery—

1. A ventilator having between the vanes or floats channels with converging-diverging walls, substantially as described.

2. A ventilator having inwardly extending cheeks and vanes or floats increasing in height from the middle toward the channel entrances and exits corresponding with the cheeks, substantially as described.

3. A ventilator having vanes of developable form, the portion nearest the exit of the fluid being part of a cylindrical surface and that nearest the entrance being part of the surface of an oblique cone, the edge of the vane having an inclination at its different points varying with their distance from the center of the wheel, substantially as described.

4. A ventilator having vanes or floats bent to conform in part to a cylindrical surface and in part to the surface of an oblique cone, said vanes diminishing in height from the entrance inward and then increasing to the point of exit, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHARLES GEORGES HERSCHER.

Witnesses:

JEAN VICTOR BARTAMEY,
DAVID T. S. FULLER.