M. R. HUTCHISON.

SIGNAL DEVICE AND PROJECTOR THEREFOR.

APPLICATION FILED APR. 6, 1911.

1,149,583.

Patented Aug. 10, 1915.

5 SHEETS—SHEET 1.

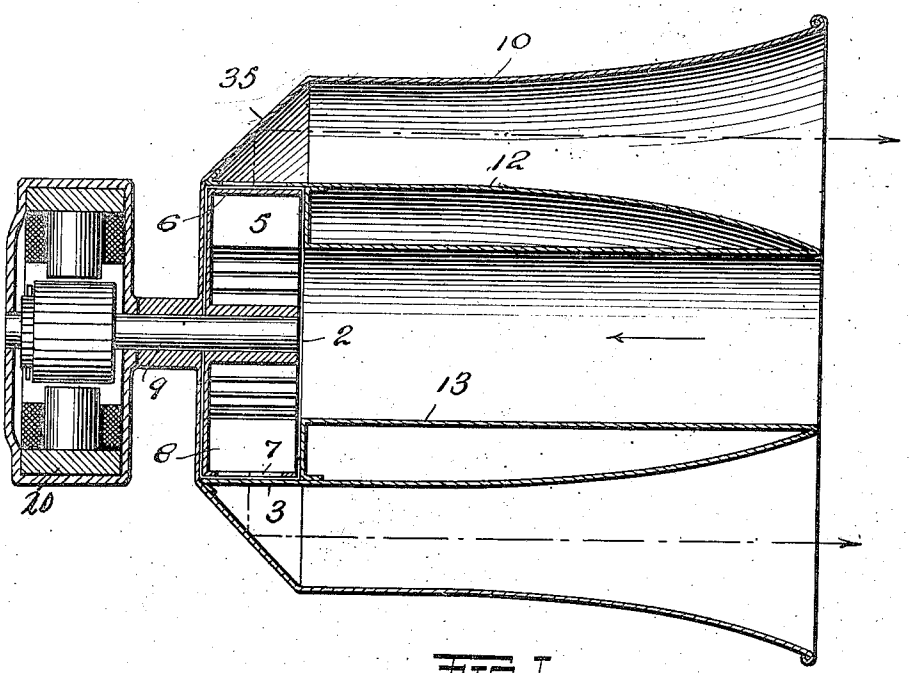


FIG. 1.

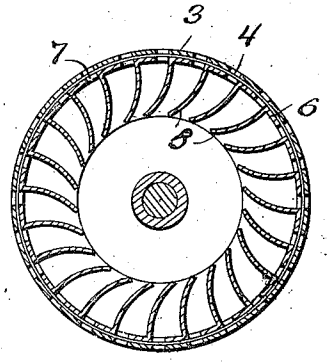


FIG. 2.

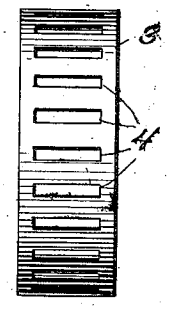


FIG. 3.

Witnesses:
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5 SHEETS—SHEET 2.

FIG. 4.

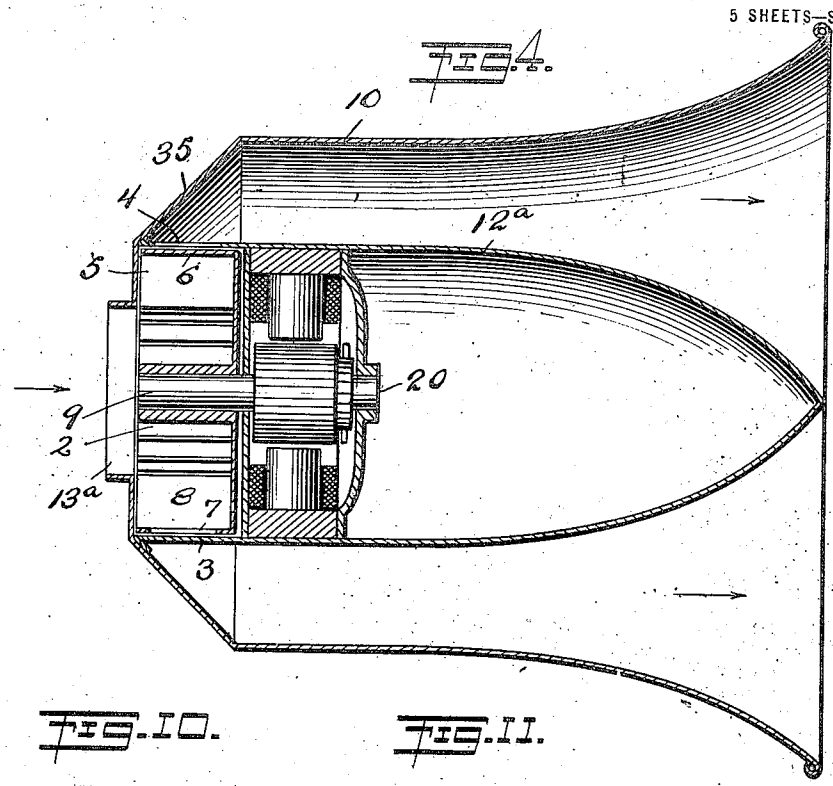


FIG. 10.

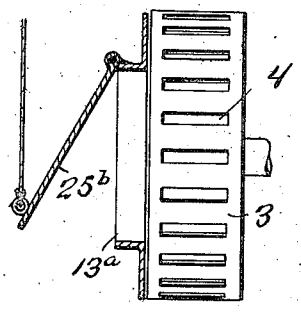
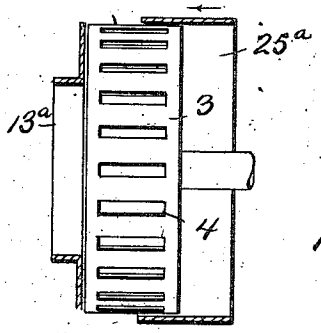


FIG. 11.



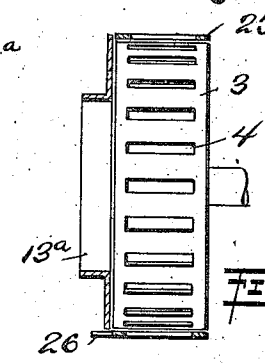
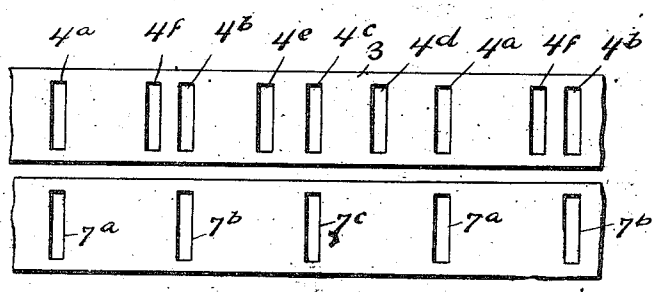


FIG. 12.



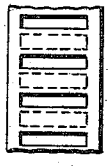


FIG. 13.

FIG. 14.

Witnesses:
G. Robert Thomas
[illegible]

M. R. Hutchison Inventor

By his Attorney
George C. Allen

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SIGNAL DEVICE AND PROJECTOR THEREFOR.

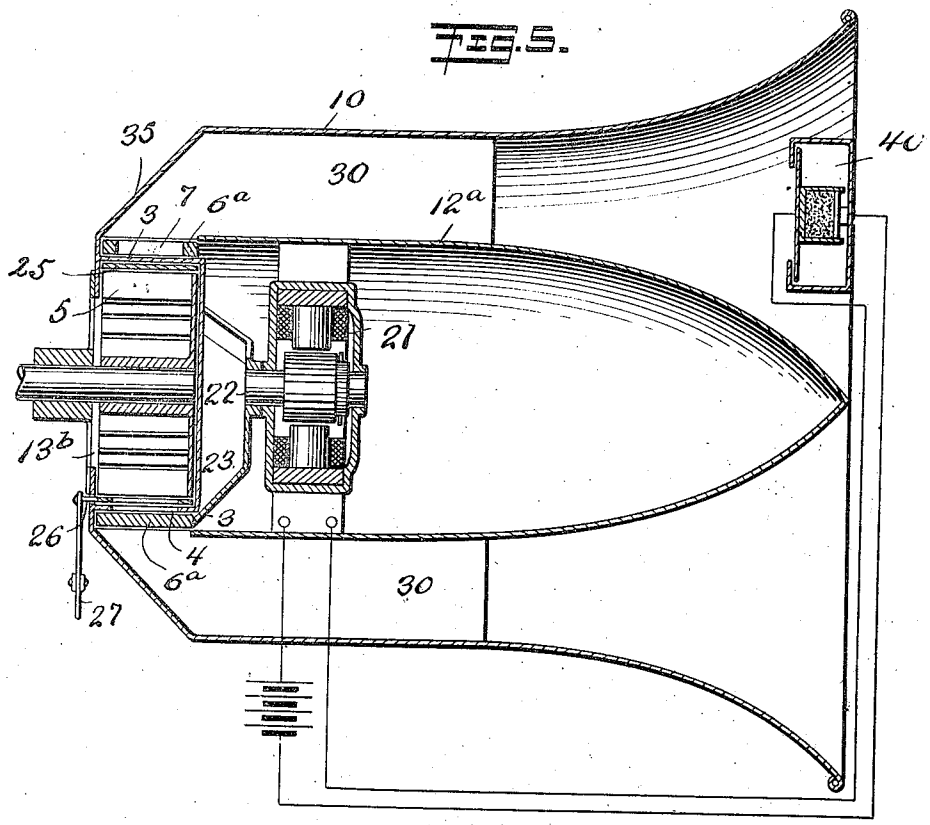
APPLICATION FILED APR. 6, 1911.

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5 SHEETS—SHEET 3.

FIG. 5.



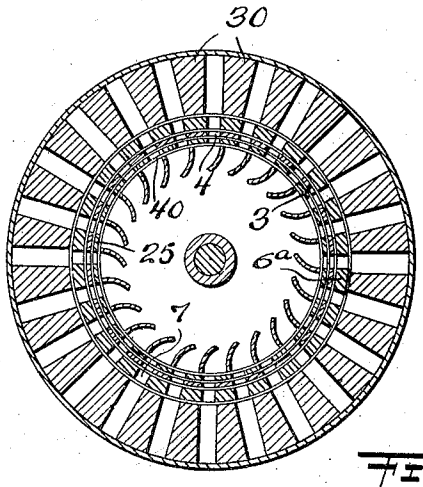
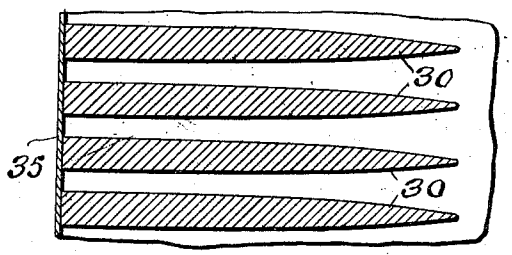


FIG. 6.

FIG. 7.



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SIGNAL DEVICE AND PROJECTOR THEREFOR.

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1,149,583.

Patented Aug. 10, 1915.

5 SHEETS—SHEET 4.

FIG. 8.

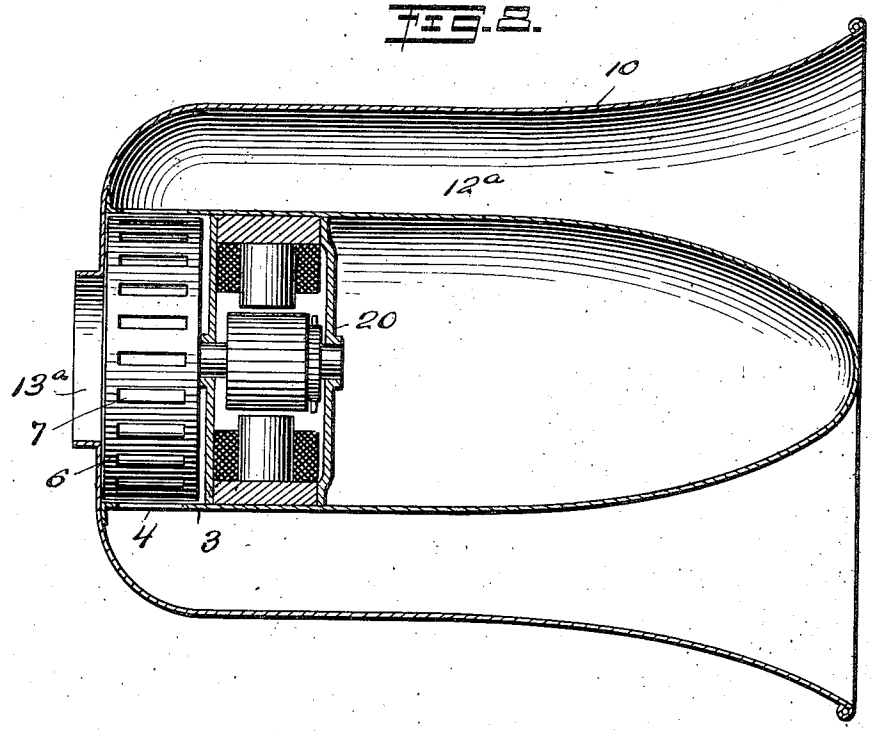
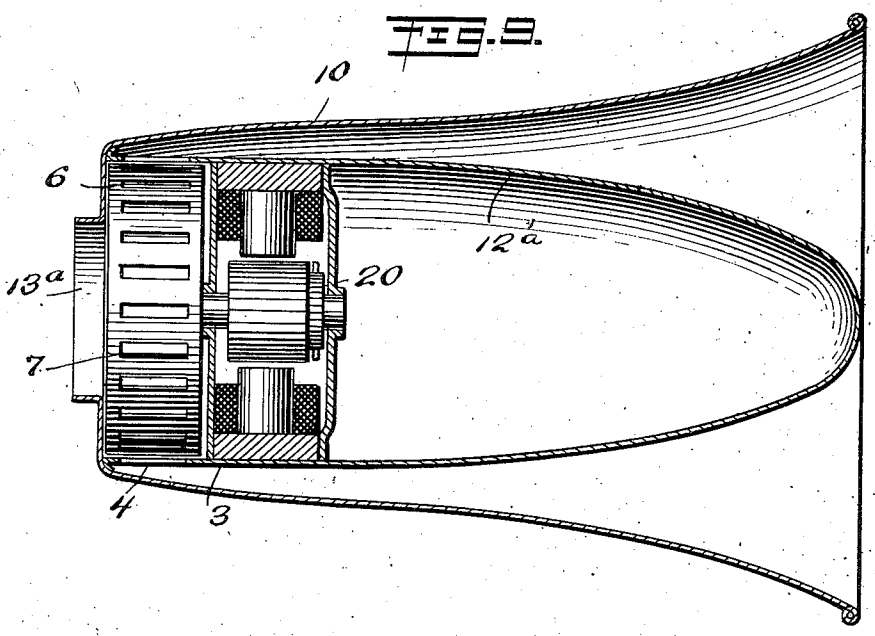


FIG. 9.



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SIGNAL DEVICE AND PROJECTOR THEREFOR.

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1,149,583.

Patented Aug. 10, 1915.

5 SHEETS—SHEET 5.

FIG. 15.

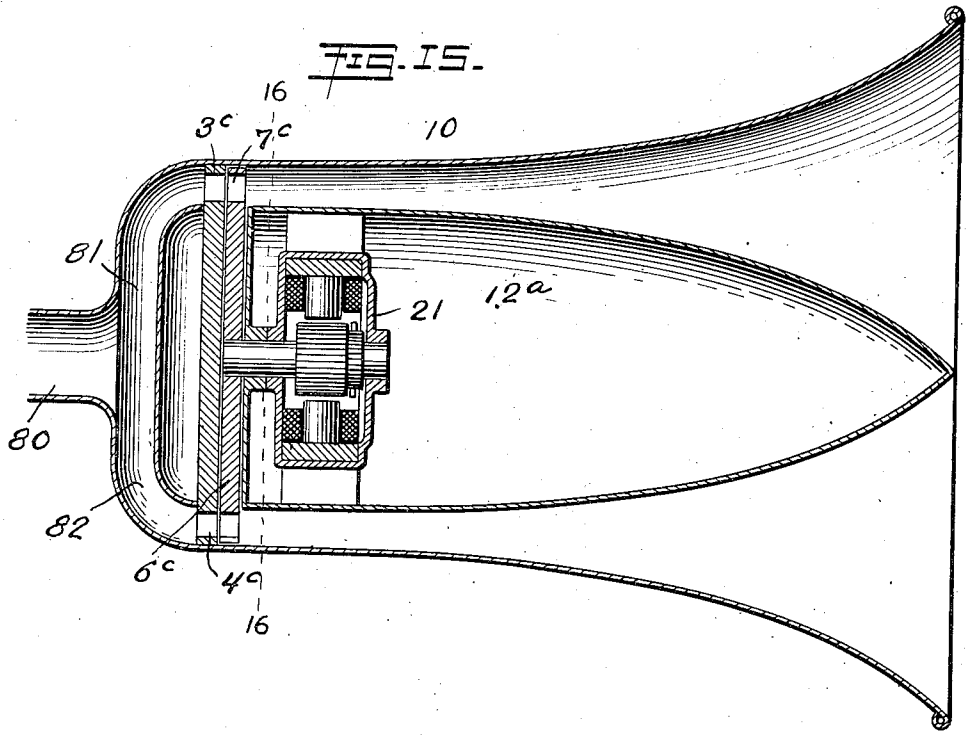
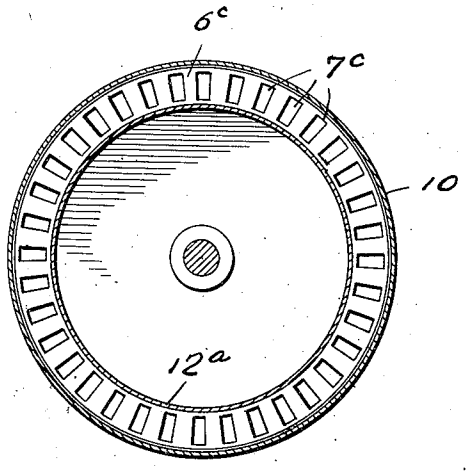


FIG. 16.



Witnesses:
G. Robert Thomas
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Inventor Miller Reese Hutchison

By His Attorney
George C. Blair

UNITED STATES PATENT OFFICE.

MILLER REESE HUTCHISON, OF SUMMIT, NEW JERSEY, ASSIGNOR TO LOVELL-McCONNELL MANUFACTURING COMPANY, A CORPORATION OF DELAWARE.

SIGNAL DEVICE AND PROJECTOR THEREFOR.

1,149,583. Specification of Letters Patent. Patented Aug. 10, 1915.

Application filed April 6, 1911. Serial No. 619,267.

To all whom it may concern:

Be it known that I, MILLER REESE HUTCHISON, a citizen of the United States, and resident of Summit, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Signal Devices and Projectors Therefor, of which the following is a specification.

This invention relates to improvements in sound producing instruments operating on the principle of a siren, particularly such as are adapted for alarms or signals on automobiles, motor boats, and other vehicles, or for factories, fire alarms, fog signals, etc. The invention was devised, primarily, with reference to sirens of the type in which the required initial air pressure is produced by a high-speed fan or centrifugal blower, and in which the relatively movable cut off openings, which produce the air puffs and sound waves characteristic of the siren, are circularly arranged on a circle or on a cylinder of considerable circumference. In one of the well known devices of this sort, sometimes used on automobiles, the relatively movable members are cylindrical and the puff producing passages are radially directed; while in certain cases only one of the cylindrical apertured members is movable, and is secured to and carried by the fan itself.

According to my invention, I provide a siren with an annular projector or amplifier adapted to direct the sound waves forwardly. This is particularly applicable to sirens of the type in which the outgoing puffs of air are allowed to escape radially, though it is equally applicable to any siren construction in which the openings referred to are circularly or annularly arranged so that the puffs escape at the face of the device instead of at the periphery. In any such case, the inner annular wall of my projector tends to prevent dissipation and distortion of the sound waves in the dead space within the circle formed by the innermost portions of the outlet openings. A further refinement of this feature consists in filling in the dead spaces between the adjacent outlet openings on the exit side, so that each outgoing puff of air, and the acoustic wave generated thereby, is propagated and directed through a smoothly expanding passage until they gradually merge and are harmoniously projected, preferably forwardly rather than radially. This improvement may be applied to sirens in which the air inlet to the fan or centrifugal blower is forwardly directed, but in such case the location of the air intake inside the annulus of the sound outlet, though giving added air pressure, in case of a rapidly moving vehicle, is objectionable, insomuch as the sound waves have to be elastically propagated across and against the indrawn current of air. Moreover, each sound wave, as it leaves the projector, being annular, is less unitary and definite and is more distorted than is desirable. Hence I prefer to carry the inner walls of the projector to a point, so that the annular sound wave, upon leaving the projector, has a more clean-cut and definite wave front extending across the entire area inclosed by the outermost walls of the projector. This arrangement involves entire separation of the functions of air inlet and sound projector, and in practice, I prefer to arrange the air inlet on the rear side of the fan; that is, on the side opposite that from which the sound is projected.

One of the main faults of the siren, as an automobile signal, has been that its note was smooth and musical, instead of having the compelling quality desirable for a warning signal. I find that I can largely obviate this defect by making the apertures, in the relatively rotatable members, short in the direction of movement and elongated in a transverse direction; so that with the same pressure, and with the same volume of air in each puff, the escape and cut-off is much sharper than where the openings are square or elongated in the direction of movement. Moreover, by spacing the apertures apart a distance materially greater than the width thereof, I am enabled to obtain a good accumulation of pressure between puffs, so that a louder, sharper, air wave is produced.

In automobile sirens, it has been customary to arrange one of the sets of the relatively movable cut-off passages in a cylindrically stationary member, and the other registering set in a rotary member inside the latter. The latter rotating member may be called the rotor, and the stationary member the stator. The rotor, as commonly constructed, is a combination of centrifugal fan and an annular cut-off member, mounted on the periphery of the fan and provided with apertures which alternately coincide and blank with the apertures in the stator.

This construction imposes serious limitations on the signal, because, at high speeds, the centrifugal action on the comparatively light rotor construction tends to cause the rotor to scrape against the stator, providing the fit of the rotor and stator are sufficiently close to insure against leakage of air between these members. Thus, if high speeds, with a consequent high note, are desired, choice must be made between risk of interference of moving surfaces, with consequent limitation of speed, on the one hand, and detrimental leakage, with consequent loss in loudness, on the other hand. I find that this difficulty may be obviated by separating the fan and the rotary cut-off, so that the fan may rotate as a fan alone, without the necessity of a close peripheral fit between the same and the stator. The rotary cut-off may now be driven by the same means as the fan, or by separate means, preferably the latter, as a much more effective control can be had in this way. The best arrangement is one in which the stator, or member containing the stationary openings, is interposed between the fan, on the inside, and rotary cut-off, on the outside.

Another object of my invention is, to provide means whereby any motor-operated instrument, having a "wailing" or rising and falling sound, may be improved, by synchronizing the normal pitch or frequency of the note with the natural or resonant pitch of the projector. This has the further advantage of giving a maximum output of sound for a given power expended. This governing of the normal frequency of the note may be accomplished, either by causing a disproportionate increase of work done, or decrease of power to the motor, for all speeds beyond the resonant frequency. I prefer the expedient of cutting down the power of the motor, and in the case of an electric motor, I employ automatic controlling means, governed by the loudness of the sound waves of the resonant air column of the projector, and operating to cut down the current supply to the motor, when the speed tends to exceed the speed at which the note produced is the resonant note of projector. Such means may be widely varied. An illustrative embodiment is one in which a suitable carbon transmitter or microphone is employed, which allows less current to pass when the amplitude of vibration of its diaphragm decreases. With such an arrangement, any tendency of the motor to speed up beyond the resonant frequency, is checked by decrease of current flow, thus checking increase of the speed of the motor or other driving means, and holding the note approximately in resonance with the air column of the projector.

Other features of the invention relate to means for deflecting the radially moving puffs of air longitudinally of the projector, and means for throttling the siren, as by throttling the inlet, or by throttling the passage of the air puffs from the apertures into the resonator.

Having thus generally described my invention, I shall now proceed to describe certain specific embodiments thereof, reference being had to the accompanying drawing, in which:—

Figure 1 is a longitudinal section through a siren signal, the driving motor being conventionally illustrated. Fig. 2 is a transverse section through the fan and the relatively rotatable cut-off members. Fig. 3 is a side view of one of the cut-off members. Fig. 4 is a view similar to Fig. 1 showing a form of siren signal in which the intake and projector are disposed at opposite sides. Fig. 5 is a view somewhat similar to Fig. 4 but showing a form of siren with independent fan and cut-off. Fig. 6 is a cross-section through the base of the projector shown in Fig. 5 and the parts therein. Fig. 7 is a detail enlarged interior view of a portion of the projector showing filler strips occupying the dead spaces therein. Figs. 8 and 9 are longitudinal sections through similar signals showing varied forms of projector. Figs. 10, 11, 12, and 13 are detail views showing different forms of throttle. Fig. 14 is a view of portions of the lengths of the peripheries of the relatively rotatable cut-off members, showing a special arrangement of openings. Fig. 15 is a longitudinal section showing a modification in which the puffs of air escape forwardly through the face of the device instead of radially; and Fig. 16 is a cross-section on the line 15—15 of Fig. 15.

The signal shown in Fig. 1 comprises a siren, in which the relatively movable members consist of a rotary member 2 and a stationary encircling member 3, provided in its periphery with apertures 4. In this case, the rotary member includes a centrifugal fan 5 and an annular cut-off 6 fixed at the ends of the fan blades 8 and provided with a series of apertures 7 corresponding to the series of apertures in the stationary member. The action of such an assemblage is well understood. The shaft 9 of the rotary member will be mounted in suitable bearings and may be driven by any suitable means, such as an electric motor 20.

The siren proper is inclosed by a projector, adapted to direct the sound parallel to the axis of rotation, and this projector is distinct from the inlet to the siren. The construction of the projector may be considerably varied, but the air column thereof is preferably annular. It may consist of an outer horn 10 and an inner wall 12, with the annular air column between them. The siren is inclosed within the base of the an-

nular projector, and the stationary member 3 may form part of the inner wall thereof. The length of this projector is such that the annular air column thereof is resonant to a note of the frequency which will be produced when the rotor is running at normal speed. The cross-section of the annular air column is proportioned in accordance with the combined volume of the puffs which the siren is capable of emitting at each opening of the apertures, and it increases in cross-section toward the front, to allow for the expansion following the compression due to the entering puffs. To this end, the outer wall of the horn 10 diverges in a forward direction, whereas the inner wall of the horn 12 converges in the same direction.

In Fig. 1, the air inlet for the siren is arranged within the inner horn 12, so that the entering air and the projected sound waves travel in opposite directions. The passage thus formed for the entering air may be cylindrically defined by a wall 13 and is ample in cross-section, as is also the opening in the front of the fan. The space between walls 12 and 13 is closed by an annular wall close to and parallel with the front edges of the blades of the fan.

The apertures 4 and 7 in the rotor and in the stationary member respectively, are preferably similar, and are constructed so as to produce more abrupt puffs of air, thereby generating sharper and more intense sound waves than is customary in sirens. To this end, as shown in Figs. 3 and 14, they are made narrrow in the direction of movement of the relatively rotatable members, and correspondingly long transversely to such direction; moreover, they are spaced apart at distances materially greater than their width. This form and arrangement of apertures is preferably employed in all the forms of the invention.

A more startling effect may be secured by irregularly spacing the apertures, as in Fig. 14, wherein are shown portions of the peripheries of the relatively movable cut-off members in which this feature is embodied, it being assumed that the development of the respective peripheries would show regular repetitions of the spacing shown in this view. In this arrangement, coincidence of one set of apertures 4^a, 4^b, 4^c, with apertures 7^a, 7^b, 7^c, produce a dominant or fundamental note, but when 7^b coincides with 4^f, another puff takes place, and immediately after 7^c coincides with 4^e giving another puff. These and similar intermediate puffs are superposed on the dominant or fundamental note. The spaces could be so arranged that the intermediate puffs can be harmonics of the fundamental, or vice versa; but this effect is sometimes too harmonious and for warning purposes the best results will probably be attainable by irregularly distributing the openings, so that a harsher or more ragged sound is produced.

The arrangement of projector and air-intake, described in connection with Fig. 1, permits of producing and directing sound in a very efficient manner; but owing to the proximity of the mouth of the projector to the stream of air entering the intake, there is a tendency to distortion and attenuation of the sound waves, due to the draft across the mouth of the projector and to the dead space thus presented at the center of the annularly propagated sound waves. In Fig. 4, I show how this difficulty may be avoided, by closing in the air passage, preferably by shaping the inner walls of the projector so that they converge to a point. This permits the annular sound waves to be projected more effectively. This arrangement is of particular value when the intake, 13^a, is placed at the rear of the device, at the opposite side from the forwardly extending projector. In such case, it is better protected from rain, dirt, flying stones etc., and can be made short, as shown, so as to afford less obstruction to the air supply. The separation of the intake and projector has a further material advantage, in that it permits me to close the inner wall 12^a of the projector, at the front, thereby forming an inclosed chamber or casing, in which a motor 20 for driving the fan and rotatable apertured member may be installed. Thus, an extremely compact device may be obtained.

In Fig. 5, I have shown a still further development of the invention, in which the air-forcing means and the rotary cut-off member are separated, and preferably separately driven. Here the fan 5 does not have the annular cut-off fixed to its periphery, but operates to force the air against the stationary cut-off member 3. The rotary cut-off 6^a is rotatably mounted on the outside of the stationary member, being provided with suitable air passages as before. This permits of mounting the rotary cut-off on a shaft which carries practically no load and the fan may be driven at high or constant speed. The fan shaft may be connected to any suitable source of power, and the rotary cut-off may be driven relatively much slower by a motor 21 inside the inverted horn, through suitable connections such as a shaft 22 and a spider 23. It will be clear that, owing to the separation of the air-forcing means and the rotary cut-off, the fan may be dispensed with and the compressed air or other fluid supplied from any suitable source. This view shows also how the device may be throttled and the sound controlled while the rotary parts continue to run at speed. Such arrangement may be utilized for turning on or off or modulating the ordinary warning note or for sending code messages, or for

other purposes. The throttling means may be widely varied. The particular construction here shown is a sleeve 25, concentric with and inside the member 3, the sleeve having apertures 40 exactly conforming in size, shape and arrangement to the openings in the latter. The sleeve may be provided with any suitable operating means for turning it through a small arc, as an example of which I have shown a projection 26 extending through a short slot in the base of the horn and an arm or link 27 for engaging therewith. As will be readily understood, when the openings 40 in the sleeve coincide with the apertures 4 in the stator, the sound is not affected; but as the sleeve is turned to cover the openings more and more, the sound will decrease until it is cut off entirely, though the rotary cut-off and fan continue to run. In Fig. 12, I have illustrated the same form of rotatable throttling sleeve mounted to turn on the outside of the stationary cut-off member. This arrangement will be particularly applicable to those forms in which the rotary cut-off is inside the stationary member and is carried by the fan. Fig. 11 shows another form of device for throttling the puffs of air, the same consisting of a solid endwise slidable sleeve 25^a. Fig. 10 illustrates a throttle adapted to act on the incoming air, the same being shown for purposes of illustration as in the hinged shutter 25^b coöperating with the intake.

In Fig. 4, I have illustrated a very carefully designed fan construction for siren purposes. The blades 8 are deep in an axial direction and short radially, permitting of a very ample intake 13^b without sacrifice in the capacity of the fan. Moreover, the fan blades 8 are curved, and in practice the curvature will be such as to produce the most efficient air-forcing action.

Figs. 6 and 7 likewise illustrate an embodiment of means for preventing lateral eddying of the puffs of air in the annular projector, at the region of the openings by which the air enters the projectors. This is accomplished, in the particular construction illustrated, by means of fillers 30, arranged in a circular series, so as to fill the portions of the interior of the projector, between the air openings in the stationary member of the cut off. The result of this provision is, the puffs of air, on entering the projector, are barred from spreading sidewise, the only movement possible being in a forward direction. The spaces between these fillers should be proportioned, so that the fillers may taper and the air passages diverge and finally merge into the annular interior of the projector.

In all the forms of the invention so far discussed I have shown the projector as being provided with an annular deflecting surface 35, preferably arranged at a 45° angle, for impingement of the waves or puffs from the openings of the relatively rotatable cut off members, and to direct them longitudinally of the projector. Instead of being straight in cross-section, this annular surface may be curved, as shown in Fig. 8. Or, instead of being comparatively wide at the base, the interior of the projector may be narrow, as shown in Fig. 9, the inner and outer walls of the projector forming a comparatively acute angle.

Fig. 5 shows one embodiment of means for holding the siren to resonance. This means includes a suitable carbon microphonic resistance 40, which may be of the telephone transmitter type capable of carrying considerable current, said resistance being interposed in the supply circuit, or a controlling circuit for the motor which drives the rotary cut off. The microphonic resistance includes a body made up of loose particles which body may transmit an electric current at all times but may transmit it with less resistance when the particles are in vibration. This microphonic resistance is exposed to the action of the sound waves produced by the instrument, and the diaphragm which holds the particles in place is vibrated by the sound waves and by its vibrations agitates the particles so that their resistance changes in response to the sound vibrations. Thus when the note produced by the siren is in synchronism with the resonator, the amplitude of vibration given the diaphragm of the transmitter will be a maximum, and the amount of current permitted to pass will also be a maximum; but that when the speed tends to exceed that required for resonance, the diminution of sound, through decreasing resonance, will result in less diaphragm vibration, thus increasing the resistance and keeping down the speed of the motor and the rotating parts, so that the note of the siren will be maintained approximately at resonance. This action may be made more pronounced by tuning the vibratory diaphragm so that it will respond to the resonant frequency and vibrate more violently to a note of that frequency than to much louder notes of other frequencies. Numerous other forms of automatic means susceptible to the sound vibrations from the resonator may be employed for the purpose.

I claim:

1. A siren signaling device, comprising relatively rotatable inner and outer members, one of said members having openings and the other of said members adapted to open and close said openings as said members are relatively driven, and annular sound-projecting means communicating with said openings and having inner and outer walls, the inner walls being closed upon each other at the front.

2. A siren signaling device, comprising

relatively rotatable apert ıred cut-off members, and an annular projector communicating with the outlet side of said members and having outer and inner walls, the latter converging substantially to a point.

3. A siren signaling device, comprising relatively rotatable cut-off members, one of said members having openings and the other of said members being adapted to open and close said openings as said members are relatively rotated, sound-projecting means communicating with said openings and having inner and outer walls inclosing a hollow air column between them, and driving means within the inner walls.

4. A siren signaling device, comprising relatively rotatable members, one of said members having openings and the other of said members being adapted to open and close said openings as said members are relatively rotated, a driving motor, and sound-projecting means surrounding said motor and inclosing a hollow air-column with which said openings establish communication.

5. A siren signaling device, comprising relatively rotatable cut-off members, means for relatively driving said members at high speed, a centrifugal fan separate from said members and having an ample air inlet, and an annular projector distinct from said inlet and communicating with the outlet side of said members.

6. In a siren signaling device, a projector, a member having a circular series of openings delivering to said projector, rotatable means for opening and closing said openings, means for driving said means, and means for preventing transverse eddying in the projector at the region of the openings.

7. In a siren signaling device, a member having a circular series of openings, rotatable means for opening and closing said openings and means for driving said means, an annular projector arranged to communicate at the inner side of its basal portion with said openings, and an annular series of fillers occupying the dead spaces in the basal portion of the projector.

8. In a siren signaling device, an annular projector, a member having openings delivering to the inner part of the base of the projector, rotary cut-off means for opening and closing said openings, and an annular series of fillers in the basal portion of the projector alternating with said openings.

9. In a siren signaling device, an annular projector, a member having openings delivering to the inner part of the base of the projector, rotary means for opening and closing said openings, and a circular series of fillers in the basal portion of the projector barring the entering puffs of air against lateral spreading, the spaces between said fillers flaring forwardly and merging with the annular chamber of the forward part of the projector.

10. In a siren signaling device, a fan, a stator adjacent the fan and provided with an annular series of openings, and a cut-off rotor on the other side of the stator and adapted to blank and uncover said openings.

11. In a siren signaling device, an apertured member, a fan for forcing air to pass therethrough, and a separately driven rotary cut-off member.

12. In a siren signaling device, a fan for producing the initial air pressure, and separately driven relatively rotating apertured cut-off means.

13. In a siren signaling device, a siren, a resonator, a rotary electric motor for driving the siren, and means susceptible to the sound vibrations for controlling the speed of the motor.

14. In a siren signaling device, relatively rotatable members, one of said members having openings and the other of said members adapted to blank and open said openings, a resonator arranged to communicate with said openings, and means controlled by the vibrating air-column for preventing said member materially exceeding the speed which produces a note synchronous with the resonator.

Signed at New York city, in the county of New York, and State of New York, this 18th day of March, A. D. 1911.

MILLER REESE HUTCHISON.

Witnesses:
IRVING M. OBRIEGHT,
GEORGE C. DEAN.