Oct. 7, 1930. A. B. COSGRAVE 1,777,283

SOUND PRODUCING DEVICE

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Fig. 1.

Fig. 2.

Fig. 3.

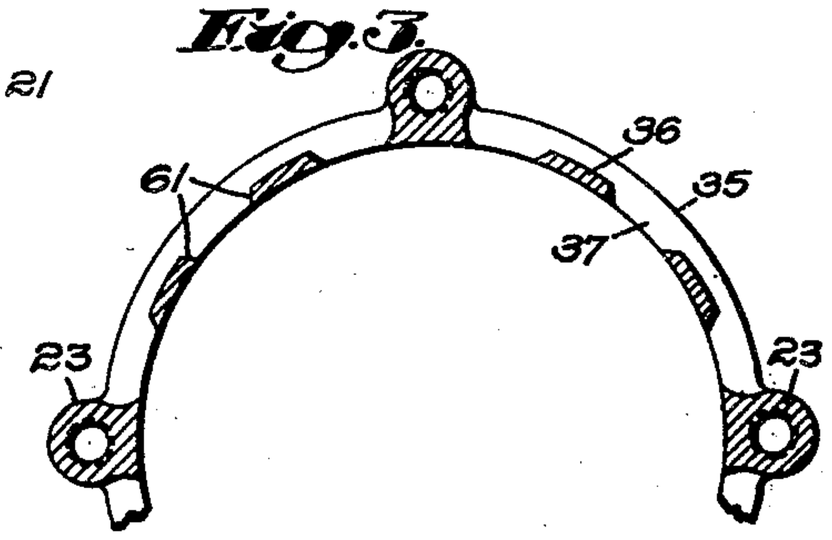

Fig. 4.

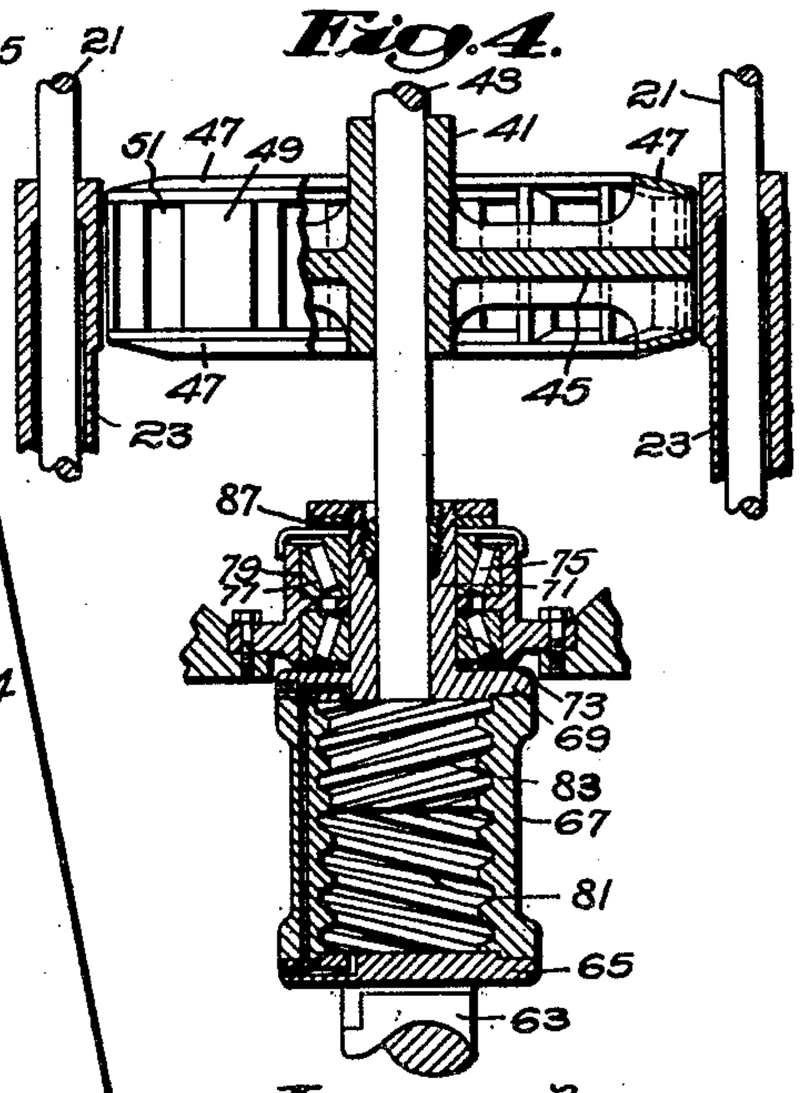

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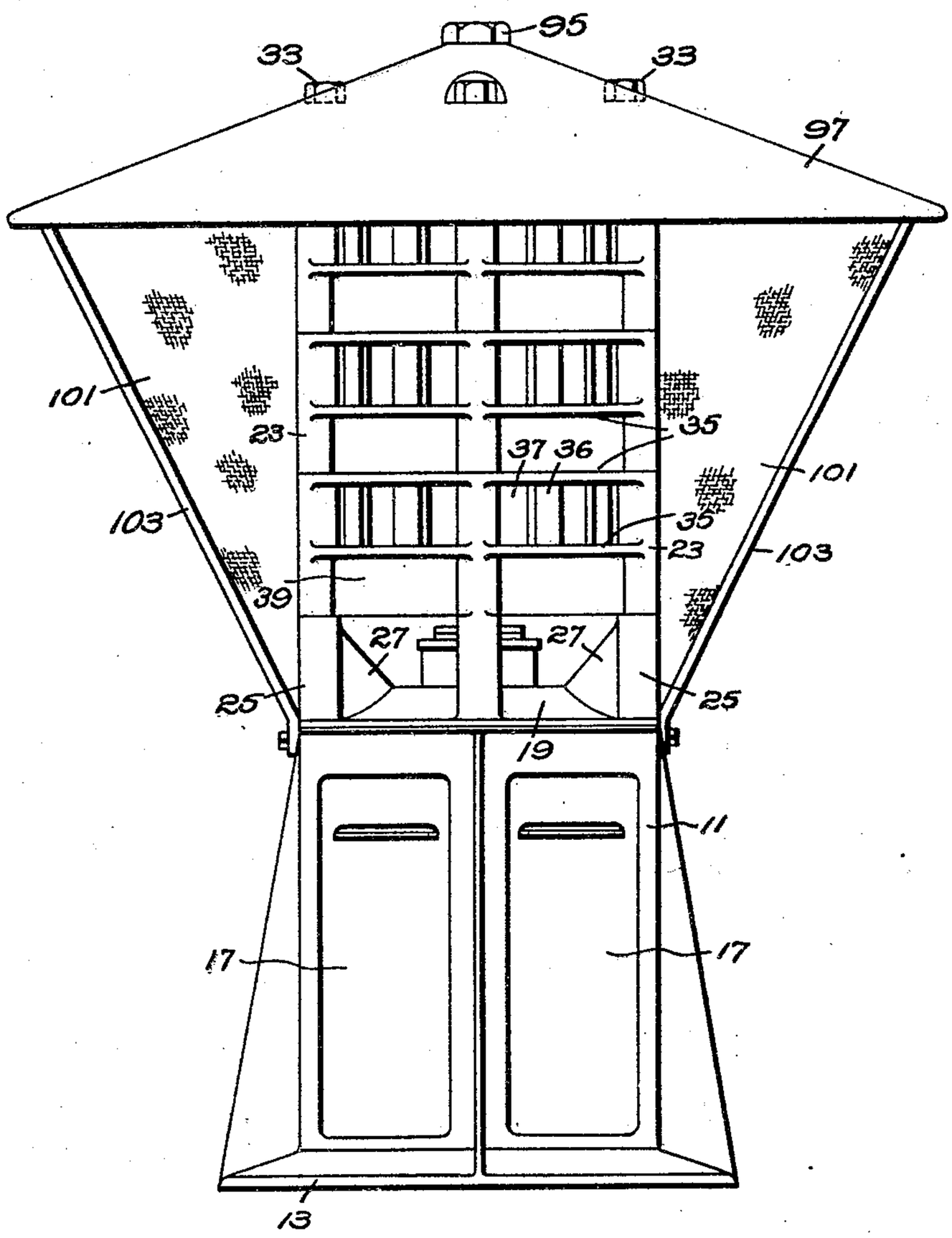
Fig. 5.



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Patented Oct. 7, 1930 1,777,283

UNITED STATES PATENT OFFICE

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SOUND-PRODUCING DEVICE

Application filed April 6, 1929. Serial No. 353,213.

This invention relates to sound producing devices, and more particularly to those of the siren type, the object of the invention being to provide a mechanically simple but powerful and efficient siren capable of producing sharp, intense blasts of sound, especially adapted for the broadcasting of code signals, and so constructed as to be dependably operable under all the severe conditions of weather and other usage to which devices of this character are ordinarily subjected.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:—

Figure 1 is a central, sectional elevation showing the principal working parts of a siren embodying one form of the invention, the rotor being shown in its lowered or non-sounding position;

Fig. 2 is a plan in partial section showing one of the rotor units;

Fig. 3 is a plan in section taken through the apertured, cylindrical body portion of one of the stator units;

Fig. 4 is a fragmentary, sectional elevation showing a rotor unit in the position assumed when the rotor is moved up to its operative position; and

Fig. 5 is a side elevation of the siren shown in Fig. 1 equipped with a protecting hood and screen, the rotor units being omitted to show the stator construction more clearly.

Referring to the drawings and to the embodiment of the invention therein shown for illustrative purposes, the same comprises (Fig. 1) a base 11 adapted to rest on the circular flange 13 and providing an upright, cylindrical closed chamber 14, within which is mounted power actuated driving means, herein comprising the electric motor 15 mounted to rotate about an upright axis. The motor chamber is completely closed so that the working parts therein are protected against the entrance of rain, snow or ice, access to the chamber being had through one or more removable panels 17 (Fig. 5).

The top of the motor chamber is closed by a plate 19 which also constitutes the bottom head or end closure for a cylindrical working chamber concentric with the axis of the motor, which chamber is provided by an upright, sectional stator frame mounted on the four tie rods 21 secured to the base.

Herein the stator frame is shown as composed of a series of stator units (Figs. 1, 3 and 5) provided each with four peripheral lugs 23 which are apertured to receive the tie rods 21 and are assembled thereon in serial relation one above the other and on the plate 19. The latter is also provided with peripheral lugs 25 through which the tie rods pass, the lugs 25 being connected to the plate by the thin reinforcing webs 27. Herein I have shown three stator units, but any number (one or more) of such units may be employed, one of the advantages of the specific construction illustrated being that the capacity of the siren may be varied by varying the number of units and may be increased after installation at any time by the addition of one or more units.

Means in the form of a head or spider is provided for uniting the upper end of the structure. This comprises the hub 29 having four radial arms 30 provided with stiffening webs 31 and terminating in lugs 32 which are also adapted to receive the tie rods 21, the entire structure being clamped in assembled relation by the clamping nuts 33.

Each stator unit (Figs. 1 and 3) comprises a cylindrical shell or body portion having side rings 35 and intermediate spaced peripheral walls 36 providing a circumferential series of sound producing apertures, herein in the form of equally spaced, rectangular openings 37 formed between the side rings 35 and the peripheral walls 36. The cylindrical body portion of each unit is vertically spaced from the body portion of the next adjoining unit by the prolongation of the lugs 23 below the shell or body portion rings 35 to provide intermediate circumferential open spaces 39 (Fig. 5) of substantial area between the end rings of adjacent stator units, obstructed only by the lugs 23, and providing free open passages between the ex-

terior and interior of the working chamber.

Mounted within the working chamber of the stator and arranged in coaxial relation thereto is a rotor capable not only of a rotary movement but a movement in an axial direction as well. This comprises one or more substantially similar rotor sections or units, each unit comprising (Figs. 1, 2 and 4) a central hub 41, non-rotatably secured to an upright driving shaft 43, is provided with the arms 45 which carry a circumferential rim composed of the side rings 47 and the intermediate peripheral walls 49, the latter being cut away to provide a circumferential series of spaced apertures 51 which are here (though not necessarily) rectangular in shape, equally spaced, and of the same shape, size and number as the openings 37 in the stator unit. Each rotor unit is also provided with centrifugal-pressure-creating blades 53 which are herein radially arranged between the side rings 47 and extend inwardly, leaving an open central space 55 through which the air is admitted to pass to the blades when the rotor is driven. Herein one such blade is provided at one edge of each rectangular aperture 51, so that there is provided a series of apertured pockets or chambers 57 between the blades and the said rings 47 so that when the rotor is revolved at a rapid rate, the air is drawn into the pockets and delivered through the apertures 51 under a substantial pressure.

The number of rotor units corresponds to the number of stator units employed and the hubs of adjoining rotor units abut against each other and are of such dimensions axially and the spacing between the rotor units is such that when the rotor is operatively positioned the circumferential series of apertures in each rotor unit is brought into alignment or registration with the circumferential series of apertures in the body portion of the corresponding stator unit. The hub of the uppermost rotor unit is prolonged downwardly only and that of the lowermost unit is prolonged upwardly only, while that of the one or more intermediate units is prolonged both upwardly and downwardly to provide the desired spacing, but otherwise the rotor units may be substantially alike in construction. The capacity of the rotor may be varied to meet variations in the capacity of the stator by varying the number of rotor units employed.

The apertured rim of each rotor section is adapted to be brought (see Fig. 4) by movement axially of the rotor (as hereinafter described) into close operative aligned relation to the apertured wall of the corresponding stator section. and, when rotated in such relationship, the air pressure created within the rotor chambers 57 is rapidly and alternately released and cut off by the successive registration and non-registration of the rotor apertures 51 and the stator openings 37, the siren being caused thereby to produce a sharp, intense, sound blast in the manner well understood by those skilled in the art. On the other hand, when the rotor is shifted to bring its several series of apertures into registration with the circumferential open spaces 39 (Fig. 5) of the stator unit (the position represented in Fig. 1), the air pressure is exhausted from the chambers 57 directly through such unobstructed, circumferential openings, thus terminating the blast of significant sound.

The edges 59 of the openings 37 in the stator unit and the edges 61 of the apertures 51 of the rotor unit are preferably beveled, as shown, to increase the sharpness of the air cut-off which the rotation of the rotor effects.

When the siren is required to produce a sound blast, the rotor is rotated and also given a movement to shift its position axially with relation to the stator and to bring each rotor unit into operative relationship to the cylindrical, apertured shell portion of the stator, or to the position represented in Fig. 4. To terminate the sound blast, the shaft 43 is again shifted axially so as to position the rotor unit where the apertures 51 will discharge into the open spaces 39, as indicated in Fig. 1.

To provide for the axial movement of the rotor, as well as its rotation, a driving connection is provided between the motor 15 and the rotor shaft 43 which comprises the coupling 63 (Fig. 1) secured to the upper end of the motor shaft and adapted to rotate the rotor shaft through the bottom head 65 of a cylindrical driving member or sleeve 67, the coupling being preferably connected to the head by interengaging teeth or such other clutch or like connection as to be axially free and, in connection with the hereinafter described thrust bearing, prevent the thrust arising from axial movement of the rotor from being transmitted to the motor shaft.

The upper end of the sleeve 67 is closed by a head 69 having the bearing hub 71 upwardly prolonged to provide internally a lower bearing for the shaft 43 in which the latter is movable, both rotatably and longitudinally, and to provide externally a seat for the conical bearing races 73 of a journal bearing for the sleeve. The latter comprises the bearing rolls 75, the outer conical races 77 and the stationary bearing supporting ring 79, the latter clamped to the plate 19. This provides a journal bearing for the driving sleeve in which the latter is held in an axially fixed position but which, due to the axial inclination of the bearing rollers, is qualified to resist any upward or downward thrust which may be transmitted through the sleeve.

To cause the rotation of the driving sleeve

67 to move the rotor axially, the sleeve is provided with internal threads 81 of relatively sharp pitch which inter-engage with corresponding external threads of a head or piston-like enlargement 83 fixedly secured to the lower end of the rotor shaft, the length of the internal chamber formed by the sleeve being sufficiently great to permit a substantial longitudinal movement of the externally threaded head 83 when the sleeve is rotated with relation to the rotor shaft.

When the sleeve is turned in the proper direction to impart a lifting movement to the threaded enlargement 83, the latter is caused to move toward the upper end of the chamber contained within the sleeve until the upper face of the threaded head comes in seating contact with the lower face of the top closure 69 for the sleeve, whereupon, the head being incapable of further movement in an axial direction, a driving connection is established and the rotor becomes for the time being rotatably fixed with relation to the driving sleeve and assumes the rotary movement of the latter.

While the parts are relatively positioned as just described, if the power is cut off from the motor or its speed is otherwise reduced by any substantial amount, the driving torque transmitted through the threaded sleeve is relieved, but the momentum of the rotor shaft and the parts fixed thereon tends to so maintain their speed of rotation as to effect movement thereof relative to the motor shaft such that, due to the rotation of the threaded head moving with the rotors being more rapid than that of the sleeve moving with the motor shaft, and to the action of other forces as hereinafter more fully explained, the head will be caused to move quickly from the top to the bottom of the cylinder, bringing the lower face of the head into seating contact with the bottom head 65, thereby bringing the rotor units opposite the open spaces 39.

The travel permitted the threaded enlargement 83 within the threaded sleeve between the upper head 69 and the lower head 65 thereof is substantially equal to the distance required to move the rotor axially from a position of operative or sound producing relationship to the apertured cylindrical walls of the stator (or that shown in Fig. 4) to a position of inoperative or sound suppressing relationship (or that shown in Fig. 1).

In order to cushion the axial movement of the rotor, the internally threaded sleeve is herein also caused to function as a dash-pot, and the sleeve and the upper and lower heads thereof are provided with registering passages which provide a by-pass 85 from one end of the cylindrical chamber to the opposite end, there being maintained within the chamber a small quantity of oil which with the air trapped within the chamber becomes effective near the end of either the upward or downward movement of the threaded head to cushion the shock of the final seating thereof. To prevent any leakage of oil from the cylinder, the bearing hub 71 of the sleeve is provided with a suitable packing gland 87.

The upper end of the rotor shaft 43 is journaled in a bearing presented by the hub 29 of the upper head or spider. When the rotor rises into its operative position, the end of the shaft moves into and through the bearing hub 29, there being provided a compression spring 91 abutting against the end of the shaft and enclosed within the protecting sleeve 93, the lower end of which is threaded into the hub. The opposite end of the spring seats in a recess presented by the opposed end of a screw 95, the latter being threaded into the upper end of the sleeve and the head of the screw being utilized to clamp and hold the flattened apex of the conical cap or hood 97. This spring 91 supplements the action of gravity in promptly starting and rapidly accomplishing the downward movement of the shaft 43 and the rotor unit carried thereby whenever there is relaxation of the driving torque transmitted from the motor through the sleeve.

It will be observed that the spider is so formed as to freely admit air to the central portion of the rotor adjacent thereto, both radially between the arms 30 and the webs 31 thereof, and transversely to said arms from the space between the top of said spider and the cap 97. The walls of the plate 19 are outwardly inclined, and herein concaved and outwardly flared, to provide such arrangement of deflecting walls as will facilitate admission of air to the central portion of the lower surface of the adjacent rotor, and the peripheral lugs 32 are upwardly prolonged to add to the circumferential open space at the bottom of the stator assembly.

The illustrative embodiment of the invention has provision for moving the rotor longitudinally while maintaining the stator longitudinally fixed, but the required relative movement between the stator and the rotor may be had by other structural arrangements, all within the scope of this invention, as by lengthwise movement of the stator while maintaining the rotor fixed, or by lengthwise movement in part of both rotor and stator.

Furthermore, while the internally threaded member is utilized as the driving member and the externally threaded member as the driven member of the driving connection, various alternative arrangements may be adopted, all within the scope of the invention, as by causing the externally threaded member to function as the driving member and the internally threaded member as the driven member.

The operation of the described form of siren is as follows:

On the closure of the motor circuit, the motor is rotated and quickly accelerates. This imparts a rapid rotation to the internally threaded sleeve 67 causing the threaded head 83 to rise rapidly in the cylindrical chamber until the head seats against the upper closure head 69 of the cylinder, at the same time raising the rotor into operative sound producing position with the apertured rotor members in registration with the apertured, cylindrical shells of the stator. Due to the inertia of the rotor and the consequent lag of the threaded member 83 behind the sleeve, on the initial rotary movement of the latter, the lifting of the stator into its sound creating position is accomplished almost instantaneously. As soon as the threaded head seats against the end closure of the cylinder, it becomes locked or rotatably fixed with relation to the sleeve and assumes the same rotary movement as the sleeve, producing a sharp, intense, sound blast which is continued so long as the motor is driven under power at the established speed.

Preferably a relatively small amount of oil only is utilized in the dash-pot chamber so that the initial rise of the threaded member 83 is unopposed, the air in the upper end of the chamber passing through the by-pass to the lower end thereof. The chamber is provided, however, with a sufficient amount of oil to supplement the confined air in trapping or cushioning the final seating movement of the head against the face of the end closure 69, so that the driving connection is established without undue shock.

If power is suddenly cut off from the motor, or if its normal speed is suddenly reduced by any substantial amount, as by lowering the applied voltage or by any other means, the driving torque through the threaded cylinder is relieved and the rotor and threaded head 83 over-run the sleeve, causing a reverse relative rotation to take place between the sleeve and the rotor shaft. This causes the threaded head to move quickly down from the top to the bottom of the cylinder until its descent is stopped by being brought into seating contact with the lower end closure head 65 thereof, thus shifting the rotor into its non-sounding or blast terminating position, where the rotor units are free to discharge the compressed air through the open, circumferential spaces at the sides of the apertured, cylindrical shell-members of the stator.

The final downward movement of the rotor is similarly cushioned by the confined air finally supplemented by the oil previously forced to the bottom of the dash-pot cylinder through the by-pass 85 at the conclusion of the preceding upward movement of the head. The engagement of the threaded head 83 with the bottom head 65 of the sleeve again effects a driving connection between the rotor and the sleeve so that the rotor, sleeve and motor armature rotate together, with the rotor in its lowered position, until speed conditions are established such that the driving sleeve again over-runs the threaded member 83. The thrust which accompanies the stoppage of the upward and downward movements of the rotor is taken up by the thrust bearing in which the driving sleeve is journaled and, due to the axially free coupling 63, cannot affect the motor shaft or motor bearings.

The engaging threads of the cylinder and head are relatively steep so that the upward and downward movement of the rotor is effected rapidly, within say but one turn of relative rotation between driving sleeve and the head. It follows that the sound blast may be initiated almost instantly by starting up the motor circuit, or sharply cut off almost instantly by checking the motor speed. This will ordinarily be most conveniently accomplished by merely opening and closing the motor circuit, but for the transmission of successive blasts separated by relatively short intervals, it will suffice merely to abruptly raise and lower the speed of the motor by means of any suitable speed controlling means.

This permits the transmission of short, sharp, distinct code signals, with clear distinction between digits, numbers and rounds, for it permits the creation of a succession of short, sharp blasts separated by intervals of silence, readily controllable as to duration, as by successively closing and opening the motor circuit.

Since the time required for the motor to come to rest after its circuit is opened is relatively long as compared to the longest time interval required between successive blasts of the usual code signal, it is unnecessary to bring the motor up to speed from a condition of rest between each blast, but the motor and the driving sleeve 67 may rotate continuously during the successive closings and openings of the motor circuit and therefore during the entire period covering the transmission of the code signal, provided that the speed is suitably varied to effect operative and inoperative positionings of the rotor, and such variations may be kept within reasonably small limits.

Due to the sharpness of successive blasts, and the rapidity with which successive blasts, separated by distinct but short time intervals, may be made to follow each other through relatively small variations in motor speed, code transmission may be carried on at a very rapid rate.

The described construction, it will be observed, provides unusually large air admission openings for supplying air to the rotor

when the latter is rotated in its operative position, such openings comprising not only the circumferential spaces 39 adjacent the stator rings, but also the open, circumferential spaces above and below the top and above the bottom plates of the working chamber. This amply large air intake materially assists in increasing the volume and intensity of the sound blast.

The construction of the stator and the rotor in sectional form not only permits the apparatus to be built up to provide sirens of varying capacity through the use of similar standardized units, but also permits the utilization of a relatively short axial movement of the rotor in shifting the latter from inoperative to operative position, irrespective of the number of sections employed or the capacity of the siren.

The illustrated form of siren is so constructed as to be substantially unaffected by exposure to the weather and to other severe conditions of usage. The motor and its driving connections to the rotor are encased within the base 11, fully protected against the entrance of rain, sleet or snow. The upright construction of the stator not only increases the carrying power of the siren and provides for the transmission of the sound equally in all horizontal directions, but also permits the provision of efficient weather protection.

The top of the working chamber is closed by the conical cap or hood 97, preventing the entrance of rain, sleet or snow except through the sides and at the lower end of the chamber. This hood is secured to the top of the siren by the central screw 95 and the nuts 33, which latter seat in suitable depressions in the top of the hood. The latter extends out from the sides of the stator for a substantial distance, and serves as a protecting deflector for rain, sleet and snow. As an additional protection, there is also provided a screen 101 enclosing the space around the stator frame between the edges of the weather hood 97 and the base 11, the screen being supported by the rods 103 extending from the edges of the hood to the base, the upper ends of which rods are supported by said hood 97 and the lower ends thereof extend in close proximity to said base 11. This screen assists in preventing the entrance of any large foreign material, such as leaves or the like, into the working chamber, and any sheet, snow or rain entering the chamber must enter at the side or the lower end. There it tends to gravitate to the bottom into the large open space immediately above the base where it will not interfere with the rotor and where the inclined walls of the plate 19 tend to deflect it outside of the working chamber. Furthermore, when the siren is started into operation, the rising and rotating movement of the rotor, tends to clear away by its grinding action any adhesions of ice or other foreign material within the working chamber or on the rotor which might interfere with its rotary movement.

While I have herein shown and described for illustrative purposes one specific embodiment of the invention, it is to be understood that the details herein shown are illustrative only, that many of the features herein described may be embodied in sound producing devices of widely different types, and that extensive deviations from and modifications of the form and relative arrangement of parts and other constructional features may be had, all without departing from the spirit of the invention.

I claim:

1. A siren having a stator, a rotor, driving means, means actuated by the driving means for shifting the relative position axially of the rotor and stator, the same comprising interengaging, relatively movable members, one presenting an internally threaded dash-pot cylinder having closed ends and the other an externally threaded dash-pot piston, one of said members being movable axially with relation to the other on relative rotation thereof, said cylinder having a restricted passage connecting the opposite ends of said cylinder about said piston, and means for establishing a driving connection between the rotor and driving means through said axial movement and through the engagement of said piston with an end of said cylinder.

2. A siren having a stator, a rotor, driving means, means actuated by the driving means for shifting the relative position axially of the rotor and stator, the same comprising interengaging, relatively movable members so interrelated as to form a dash pot to cushion such axial movement, one presenting an internally threaded dash-pot cylinder and the other an externally threaded dash-pot piston, one of said members being movable axially with relation to the other on relative rotation thereof, and means for establishing a driving connection between the rotor and the driving means through said axial movement and through the engagement of said piston with an end of said cylinder.

3. A siren having a stator member, a rotor member, driving means, means actuated by the driving means for shifting the relative position axially with the rotor and stator members, and means to cushion the axial movement of the shifted member.

4. A siren having a stator, a rotor, driving means, means actuated by the driving means for shifting the rotor axially with relation to the stator, the same comprising an internally threaded sleeve connected to be turned by the driving means and an interengaging, externally threaded member connected to turn with the rotor and having a limited axial movement with relation to the

internally threaded member on relative rotation thereof, said members being adapted to establish a driving connection between the driving means and the rotor on the completion of said axial movement, a journal bearing for said sleeve in which the same is axially fixed, and an axially free coupling between the sleeve and the driving means.

5. A siren having a rotor and a stator relatively movable in an axial direction, driving means, a driving coupling connected to the driving means but having an axially free connection thereto, and a thrust bearing for said coupling.

6. A siren having a base, a motor mounted on the base, a stator mounted above the motor comprising a plurality of like but separate sectional units, each presenting a cylindrical wall portion provided with a circumferential series of spaced apertures, the cylindrical wall portion of each unit being spaced from that of the next adjoining unit to provide a relatively unobstructed, intermediate, circumferential opening, means for assembling said units serially in co-axial relation to provide an upright working chamber having alternate sound producing and sound eliminating sections, upper and lower closures for the ends of said chamber, there being provided relatively unobstructed, circumferential openings adjacent said closures, a rotor positioned within said chamber rotatable about an upright axis and comprising a plurality of separate but similar bladed, pressure-creating, rotor members, having each a circumferential rim provided with a circumferential series of spaced apertures, an upright rotor shaft connected to be driven by the motor, said rotor members being assembled serially on said shaft and spaced to conform to the spacing of the cylindrical wall portions of said stator units, and means for moving said rotor axially to bring the apertures of each rotor member into registration with either the sound producing apertures of one of the stator units or with an adjoining sound eliminating, circumferential opening.

7. A sectional siren having driving means, a frame presenting a cylindrical working chamber having a plurality of like but separate sectional units, each presenting a cylindrical wall portion having a circumferential series of sound producing apertures, the wall portion of each unit being spaced from the wall portion of the next adjoining unit to provide a relatively unobstructed, intermediate, circumferential opening, means for assembling said sectional units serially in co-axial relation, a rotor mounted to turn within said chamber and comprising a plurality of separate, similar rotor units, and means for coupling said rotor units serially in co-axial relation to each other and spaced to conform to the spacing of the cylindrical wall portion of said stator units.

8. A sectional siren having a stator comprising a plurality of like but separate sectional units, each presenting a cylindrical wall having a circumferential series of sound producing apertures, means for assembling said units serially in axially spaced and co-axial relation to provide a working chamber, a rotor within said chamber comprising a plurality of like but separate rotor units, means for assembling said rotor units serially in co-axial relation to each other in spaced relation to conform to the spacing of said apertured, cylindrical wall portions, and means for driving the rotor.

9. A siren having a stator composed of a plurality of similar but separate sectional units assembled in spaced coaxial relation, and a rotor cooperatively related to the stator comprising a plurality of similar but separate rotor units also assembled in correspondingly spaced co-axial relation.

10. A siren having a base provided with an enclosed compartment, a motor within said compartment, a frame mounted on the base presenting an upright cylindrical working chamber, a rotor rotatable within said chamber, a bottom closure for the chamber having outwardly inclined walls, the chamber presenting circumferential walls having a circumferential series of sound producing apertures and having a relatively unobstructed opening between said bottom closure and said circumferential walls.

11. A siren having a casing presenting a cylindrical working chamber having cylindrical walls provided with a circumferential series of sound producing apertures, a bottom closure for said casing presenting to the lower end of said chamber outwardly inclined walls, and a rotor within said chamber.

12. A siren having a rotor, a cylindrical working chamber within which said rotor is rotatable, end closures for said chamber, said chamber having relatively unobstructed circumferential openings at opposite ends adjacent said end closures, and an intermediate circumferential wall portion having a circumferential series of sound producing apertures.

In witness whereof, I hereunto subscribe my name, this 14th day of January, 1929.

AUSTIN B. COSGRAVE.