June 24, 1941. J. C. BATCHELOR ET AL 2,247,111

ACOUSTICAL PROJECTILE

Filed July 10, 1937

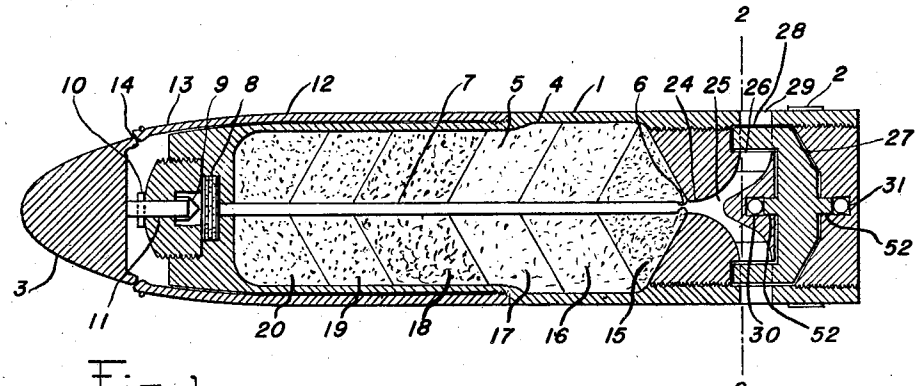

Fig. 1

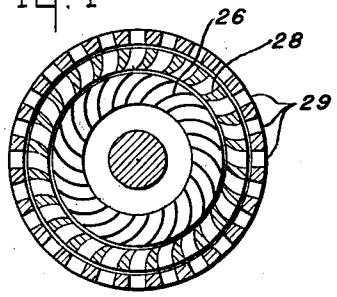

Fig. 2

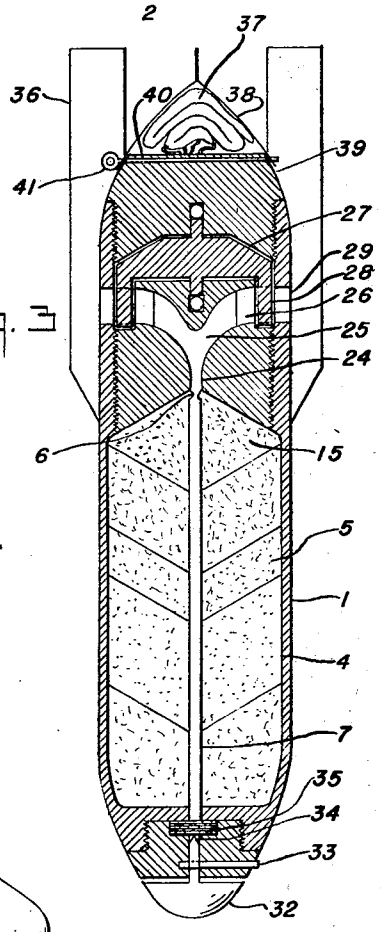

Fig. 3

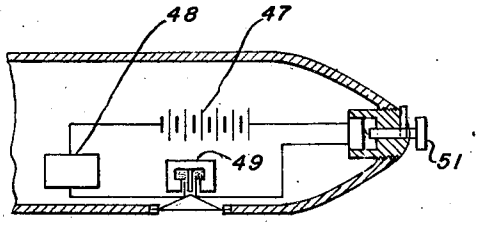

Fig. 5

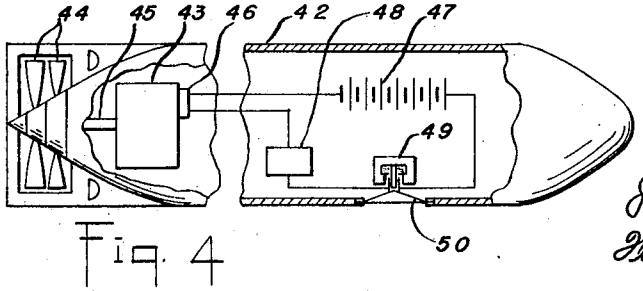

Fig. 4

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ACOUSTICAL PROJECTILE

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5 Claims. (Cl. 102—26)

Our invention relates to methods of and apparatus for producing sound waves at a point remote from a control point, which sound waves have a desired psychological, physiological, destructive or other effect upon their auditors, or instruments or other objects upon which they are incident.

More specifically, our invention relates to methods of and apparatus for producing sounds at a distance from a control point for the purpose of communication, signalling or, such as in the case of warfare and the like, for the purpose of having deleterious effects on the morale of opposing troops, and for other purposes.

One object of our invention is to provide a projectile or other automobile vehicle not requiring the presence of a local operator, which we include in the scope of the word projectile, adapted to be set in motion from a given point and, at a predetermined time, either during its motion, upon its arrival at its destination or both, to produce, for a predetermined and relatively protracted period, sound waves of either a pure or complex character having pronounced psychological, physiological or other effects in order to accomplish the required mission of the projectile or vehicle.

In accordance with our invention, we have provided a projectile adapted to be set in motion toward an objective which is at a point remote from the origin of the projectile, and having incorporated in itself a sound generating device, a source of power for operating that sound generating device and means for releasing the power from the power source and communicating it to the sound generating device at such time as the emission of sound from the projectile is required.

A specific embodiment of our invention may take the form, for example, of an artillery projectile adapted to be fired from a conventional artillery piece and further adapted, after a predetermined time, to produce, for a protracted period, pure or complex sound waves of pronounced psychological effect which may be, for example, a deleterious effect on the morale of the troops against whom the projectile is used.

In another form, our invention may be an aerial bomb projectile adapted to be dropped by aircraft or the like and provided, in a manner similar to the above described artillery projectile, with sound generating means adapted to be rendered operative at a predetermined time at or after the departure of the bomb from the carrying vehicle. The projectile, when desired, is provided with fall-arresting means such as, for example, a parachute adapted to maintain the projectile in a substantially suspended condition in the atmosphere when it is desired that the sound be radiated from such a point.

In still another form, our invention may become a naval torpedo projectile adapted to produce and radiate sounds either into the water or the air, the former being, for example, for the purpose of disabling hydrophonic receiving equipment by superimposing waves of high intensity over other waves being received by the hydrophone, and the latter being for the purpose, for example, of harassing personnel within the range of the radiated sound. A second characteristic of this aspect of our invention is the ability to produce sounds of a character which effectively prevent the possibility of their being excluded from hydrophonic receiving equipment, so that the disabling of that equipment is rendered complete. A further characteristic of one form of this aspect of our invention is the ability to produce sounds of a particular character which are undistinguishable from the sounds produced by another instrumentality, which latter sounds it is desired to conceal, the sounds produced by the projectile being preferably of an intensity greater than those produced by that instrumentality with the result that the illusion of the existence of that instrumentality at a point where it does not in fact exist may be created.

Certain further purposes, objects and modes of application of our invention will appear in the description which follows, and still further applications of the methods and apparatus herein disclosed will become immediately evident to those skilled in the art.

In order to describe certain embodiments of our invention more fully, attention is directed to the accompanying drawing in which Figure 1 represents a longitudinal sectional view of an artillery projectile constructed in accordance with our invention; Figure 2 is a cross-sectional view of the embodiment shown in Figure 1 taken on the line 2—2; Figure 3 is a longitudinal sectional view of an aerial bomb projectile constructed in accordance with our invention; Figure 4 is a partially sectional view of a naval torpedo projectile of our invention; and Figure 5 is a partially sectional view of a modified form of the torpedo projectile shown in Figure 4.

Referring to Figure 1, a shell casing 1 of any suitable type is provided having the rotating band 2 and the contact fuse 3. A cavity 4 is provided containing the powder charge 5 adapted to

be fired at the point 6 by a flame projected along the tube 7 from the explosive material 8 when struck by a firing pin 9 upon contact of the fuse 3 with a solid object. The safety pin 10 is provided through the staff 11 of the firing pin 9 to prevent accidental ignition of the shell by casual impact of the fuse 3 against a solid object. Sufficient force is required against the fuse 3 to shear the pin 10, thereby permitting the firing pin 9 to strike the explosive material 8.

In the form of our invention shown in this figure, we have provided, about the forward portion of the shell casing 1, a secondary casing 12 of relatively thin material adapted to be spread open and split at the region 13 when the fuse 3 strikes a solid object with sufficient force to drive the terminal ring 14 of the fuse 3 into the region 13 of the casing 12. Upon partial opening of the casing 12, the entrance of earth or the like into the casing 12 as the shell continues to penetrate the earth will still further force open the casing 12 and will at the same time arrest the progress of the projectile into the earth by the expansion of the casing 12. Thus, we have provided means effective to minimize the shock of impact of the projectile and to maintain a substantial portion of the back part of the projectile above the surface of the earth when the projectile comes to rest. It will be recognized that, even though the projectile may come to rest at a point materially beneath the surface of the earth, a sufficient pit will have been dug about the projectile by the spades formed by the split casing 12 to enable sounds to be radiated effectively from the projectile.

The powder charge 5 consists, in the embodiment shown, of a plurality of discrete sections adapted to be burned successively from the point 6 where the burning is initiated, starting with the section 15 and burning through the sections numbered consecutively from 16 to 20, inclusive. The sections are preferably of various degrees of density in order that the speed of burning will be different for different successive sections, with the result that the gases of combustion are yielded at various rates to produce a variable power output from the burning mixture. The speed of burning of the material may be adjusted by known methods to any appropriate value, and, in a preferred form of our invention, we prefer to extend the total burning time of the entire powder charge 5 to a period of at least several minutes. This value may be varied, however, over wide limits to conform with the requirements of the tactical situation in which the projectile is to be used.

In certain instances, we have found it desirable to use as the burning charge 5 a material which produces, upon burning, certain appropriate noxious or toxic gases or vapors so that approach to the projectile while in operation is effectively prevented. Thus, means may be incorporated when desired to ensure the complete utilization of the potential noise-making ability of the projectile with relatively complete immunity from interference by personnel against whom the projectile is being used. It will be recognized, of course, that any appropriate means may be used to generate and yield gas during the burning of the actuating charge in any projectile produced in accordance with our invention, and the charge 5 will not necessarily be of a gas-yielding type when other gas yielding means are included.

Adjacent the point 6 at which the combustion of the charge is initiated is located the throat 24 of the nozzle 25 through which the gas from the combustion is allowed to expand. The stationary blades 26 of a turbine, which includes the rotor 27 having the movable blades 28, form a continuation of the nozzle 25 and impart to the gas a large component of outwardly radial velocity and a relatively small component of tangential velocity whereupon the gas impinges the movable blades 28 to which is imparted the tangential component of the velocity of the gas. The gas is then permitted to emerge periodically from the ports 29. The gas emerging from the ports 29 has velocity variations with respect to time such that the pressure on the atmosphere adjacent the ports 29 rises at a substantially constant rate to a maximum, whereupon it falls, also at a substantially constant rate, to a minimum, with the result that complex sound waves are generated in the region of the ports 29 and radiated into the surrounding atmosphere.

It will be recognized that the form of the ports 29 need not always be the forms herein shown, but various shapes may be provided for the generation of any desired acoustical wave form.

The direction of the tangential velocity component imparted to the gas by the stationary blades 26 is preferably in a direction corresponding to the direction of relative motion which will result between the casing 1 and the rotor 27 with respect to the casing 1 when the latter is set into rotation about its longitudinal axis by the action upon the rotating band 2 of the rifling of the tube of the piece by which the projectile is fired. Thus, we have introduced a further assurance that the rotor 27 will be effectively started by the gas from the combustion of the charge 5. It will be recognized that any slow rotation of the rotor 27 with respect to the casing 1 will operate to insure the provision of a direct exit path for the gas at some time when the spaces between the stationary blades 26, those between the movable blades 28 and the ports 29 will be in complete registration to permit radial discharge of the gas.

The rotor 27 is carried in the sleeve bearings 32 which permit relatively free rotation of the rotor 27, and the ball bearings 30 and 31 are provided to receive the axial thrust of the rotor.

Referring now to Figure 3, it may be seen that we have introduced certain modifications in the projectile shown in Figure 1, particularly in that the projectile is adapted to be used as an aerial bomb and a different type of arresting mechanism is used to prevent damage to the projectile upon impact with the earth. The casing 1 is provided having the powder charge 5 in the cavity 4 and a contact fuse 32 is provided having the safety pin 33 and the firing pin 34 adapted, upon impact of the fuse 32 with a solid object, to strike the explosive material 35 which projects a flame along the tube 7 to the point 6 in the section 15 of the powder charge 5 to ignite that charge. The contact fuse 32 may, when required, be replaced by a time or combination fuse to initiate the production of sound at any required time.

The throat 24 is provided, through which expansion of the gas of combustion is permitted into the nozzle 25 from which it is permitted to expand further through the stationary blades 26 and to pass the movable blades 28 on the rotor 27 and emerge from the ports 29 to produce sounds in a manner more fully described in reference to Figure 1.

The stabilizing blades 36 are further provided to maintain the proper direction of flight of the

bomb projectile in its fall from the carrying vehicle, and still further, a parachute 37 is disposed in the cap 38 which is attached to the portion 39 of the casing 1 by the pin 40 provided with the ring 41 adapted to be attached by any suitable cord to the launching mechanism from which the bomb is dropped. In this manner, the pin 40 is withdrawn from its position in the portion 39 at the time the projectile is launched and the cap 38 is thereby permitted to uncover the parachute 37 which, after a reasonable time, will open and present sufficient resistance to passage of the projectile through the air to prevent undue shock upon the internal mechanism upon impact with the earth. It will be recognized, of course, that the retracting force of the parachute 37 must not be sufficient to prevent the operation of the contact fuse 32 upon impact with the earth if such a fuse is used. Conversely, in the event that this type of arresting means is used in the presence of a time fuse and it is desired that the sound be radiated from a point above the ground, any desired degree of retracting force may be given to the parachute to ensure the retention of the parachute above the earth for the required time.

It should be further recognized that the parachute means in this embodiment may be replaced by the spade arresting means of Figure 1 should conditions indicate the desirability of such substitution. It will be further recognized that in all forms of our invention, any appropriate type of fuse and arresting mechanism may equally well be used to replace the contact fuse 3 and the spade brake 12 as shown in the embodiment of Figure 1.

In Figure 4, we have shown a modified form of our invention in which we have used a different type of sound generating apparatus and have installed that apparatus in a projectile adapted to be transmitted through water. A casing 42 is provided in the general form of a torpedo having driving means comprising a motor and a power source, and indicated generally by the block 43, adapted to drive the propellers 44 through the power transmitting means 45. Suitable stabilizers, rudders and other control apparatus may be provided in accordance with any form of the known or future art to ensure the arrival of the projectile at its required destination.

In one form of this embodiment of our invention wherein it is desired to have the sound generating means rendered operative at the moment of arrival of the projectile at its destination, we have provided switching means 46 in connection with the motor and power source 43 and adapted to be closed at the time when the motor is rendered inoperative, in a manner such that the sound producing mechanism is simultaneously rendered operative.

In the embodiment shown in Figure 4, the sound producing mechanism comprises a source of power such as the battery 47 connected through the switch means 46 with the interruptor 48 which may be of any known type adapted to alternately and successively interrupt and close the circuit at any desired speed such as, for example, 2800 interruptions per second, and further connected in series with the sound generating means 49 including the diaphragm 50 adapted to establish direct contact with the water beneath the projectile so that sounds may be emitted directly into the water. In a preferred form of our invention, we utilize as the interruptor 48, a variable frequency interruptor which may be of a motor driven type and adapted to vary the frequency of interruption over a relatively wide range so that the frequency of the sound emitted by the diaphragm 50 into the adjacent water is changing continuously and in accordance with a random schedule in order to preclude the possibility of electrical or other filters being used to exclude sounds coming from the projectile from sound receiving means which it is desired to disable by our apparatus.

For use in certain applications of our invention, we have found particular utility to lie in an apparatus of this general type having an interruptor 48 which is capable of producing a particular type of complex wave which is substantially identical with the type of wave emitted by some other device, such as a ship, submarine or aircraft, the projectile in this instance being so constructed as to permit its being sent to a point relatively remote from the ship or other device having the characteristic sound, at which point the projectile is permitted to generate and radiate its own characteristic sounds. In this instance, the latter sound will preferably be of an intensity substantially greater than the sound generated by the ship or the like, with the result that the illusion may be created that the ship is at a point where it in fact does not exist.

It will be recognized that the embodiment shown in Figure 4 may be operated in a position in which the diaphragm 50 is on the upper surface of the projectile and sufficient buoyancy may be provided to ensure that the upper portion will be exposed to the atmosphere in a manner such that sounds from the diaphragm 50 may be radiated directly into the atmosphere for any desired tactical purpose.

A further modification of the embodiment shown in Figure 4 is shown in Figure 5 in which we have provided a contact operated switch 51 adapted, upon impact with any solid object, to close the circuit which includes the battery 47, the interruptor 48 and the sound generating means 49 so that the sound generating means 49 is rendered operative upon such operation of the switch 51. This embodiment may be used, for example, as a training weapon to make possible the direct acoustical observation of the successful arrival of the projectile at its designated target.

From the foregoing description it will be evident that, in its broader aspect, our invention cannot be construed as lying only in the specific methods or means of producing sounds from projectiles, but more broadly it lies in the concept of using, for example, harassing sounds in military and naval operations, and it will be recognized that broadly different means are possible within the spirit of the invention of producing such sounds at the required points by the use of projectiles of various types designed to meet the exigencies of the tactical situation. For example, in the broader aspect, we do not wish to be limited to any particular source of energy for the sound producing means. We have shown in certain embodiments a relatively slow burning explosive mixture adapted to yield explosive gases which, upon expansion, actuate a sound producing mechanism. In other embodiments, we have shown electrical means for generating sounds and the choice between the shown means or modifications thereof lies entirely in the consideration of the tactical employment of our projectiles.

Moreover, although we have shown a preferred type of device for producing sounds from a source of power using expansive gases, we do not wish to be precluded, should the tactics of the situation require it, from the use of whistles and horns of various types provided they are actuated by a self-contained source of power which is capable of utilization independent of the motion of the projectile. Still further, it will be understood that our invention may be made capable of producing any type of disturbance which follows the laws of acoustics, and is not limited merely to disturbances which are audible to the human ear.

We claim:

1. A projectile comprising a housing provided with at least one port wherethrough gas may emerge therefrom, a source of gas under pressure within said housing, and control means for alternately and successively opening and closing said port to permit periodic release of said gas from said housing to produce periodic acoustical waves adjacent said projectile.

2. A projectile comprising a housing provided with at least one port wherethrough gas may emerge therefrom, a source of gas under pressure within said housing, means for conducting said gas to said port, and control means for alternately and successively opening said port at a substantially constant rate and then closing said port at a substantially constant rate to produce uniformly rising and falling gas pressure external to and adjacent said port.

3. A projectile comprising a housing provided with at least one port wherethrough gas may emerge therefrom, a charge within said housing adapted when burned to yield gas under pressure at a plurality of different substantially constant rates for successively different intervals, and control means for alternately and successively opening and closing said port to permit said gas to emerge from said housing in a succession of discrete impulses during each of said intervals to produce periodic acoustical waves.

4. A projectile comprising a housing, a source of energy within said housing, means for translating energy from said source into pressure impulses external to said housing, means for conducting said energy to said translating means, and variable control means so arranged and constructed as to periodically interrupt the delivery of said energy to said translating means in accordance with a predetermined periodic complex schedule to produce recurrent complex pressure waves.

5. A projectile comprising a housing, a source of energy within said housing, means for translating energy from said source into pressure impulses external to said housing, means for conducting said energy to said translating means, and variable control means so arranged and constructed as to periodically restrain the delivery of said energy to said translating means in accordance with a predetermined schedule corresponding to the waves emitted from a vehicle from the group including a ship, a submarine and an aircraft, whereby said pressure impulses are modulated into sounds imitative of said vehicle.

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