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ENGINE NOISE SIMULATOR

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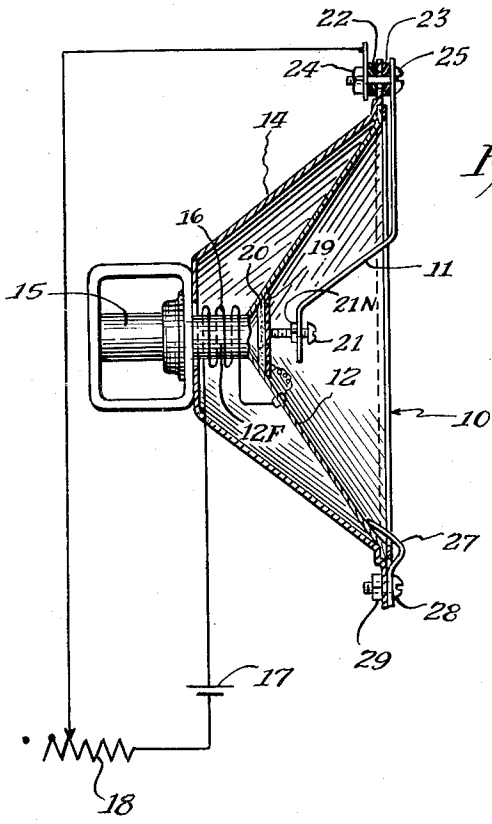
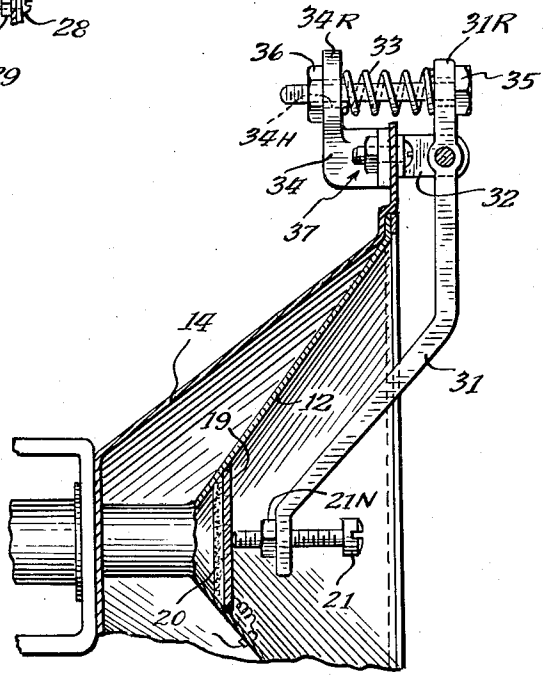


Fig. 1.

Fig. 2



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ENGINE NOISE SIMULATOR

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This invention is concerned with a loud-speaker control circuit arrangement operating at a rate determined by the excursion interval of an interrupter arm that is actuated by the diaphragm of the loud-speaker. This noise-making assembly is remarkably simplified and economical in construction. More particularly, the invention is concerned with an arrangement that is capable of producing sound effects realistically simulating the characteristic noise of a one-cylinder engine or "putt-putt" motor such as is commonly used for motor scooters. It is contemplated that the assembly of this invention may be attached to toy vehicles, and cost and realism are hence of utmost importance.

It is the principal object of the present invention to provide a simple battery-operated electric circuit arrangement that produces a realistic "putt-putt" sound characteristic of a single-cylinder engine.

Still a further object is to provide an arrangement that conveniently accommodates adjustment of the character and rate of the "putt-putt" sound.

Briefly the arrangement, according to this invention, depends upon the use of a resiliently swingable interrupter arm that is biased against the speaker cone or diaphragm to respond to a pulsing movement of the speaker cone and undergo substantially independent resilient swinging excursion movement.

The interval of this independent excursion movement of the interrupter arm substantially determines the "putt-putt" rate of the sound produced by a loud-speaker. To accomplish this, the interrupter arm is arranged, upon movement from normal position, to open the electric circuit that supplies current for pulsing the diaphragm and as the arm returns to its normal position the circuit is closed and builds up another current pulse to again pulse the diaphragm and swing the arm through an excursion movement during which the circuit is again open. Thus, the relatively slow swinging movement of the interrupter arm determines the repetition rate of the pulses which actuate the speaker cone and, hence, determines the characteristic rate of the "putt-putt" sound produced by the speaker. According to the present invention, "putt-putt" rates as low as two or three per second are readily achieved, and rates in this range are required for developing a realistic engine noise.

Other objects and advantages of the present invention will become apparent as the description proceeds.

FIG. 1 is a side-sectional view through a speaker assembly that includes an interrupter arm in accordance with this invention, and the electrical supply circuit for the speaker is shown diagrammatically; and

FIG. 2 is an enlarged fragmentary sectional view illustrating an alternative constructional arrangement of the interrupter arm.

Referring now to the drawings and particularly to FIG. 1 thereof, the engine noise simulator embodiment of this disclosure is shown as including a loud-speaker **10** of conventional form that is connected in circuit with a source of steady D.C. voltage, with a current interrupter in the form of a resiliently swingable arm **11** causing the circuit to supply D.C. current pulses to the speaker at a desired rate for producing a characteristic "putt-putt" sound. The interrupter arm normally reacts against the speaker cone or diaphragm **12** and responds to its high-speed excursion to undergo its own low-speed swinging excursion movement, and with this arrangement the excursion interval of the interrupter determines the D.C. pulse rate and, hence, the character of the sound produced.

For purposes of disclosure, the speaker is shown as comprising a generally conical frame **14** having a permanent magnet **15** fixed adjacent the rear or apex of the frame to act in a direction axially thereof. The speaker cone or diaphragm **12** is anchored to the frame at its base end, with the apex of the cone adjacent the permanent magnet and provided with a mounting form **12F** for a voice coil **16**. The polarity of the current through the voice coil determines the direction in which it is moved by the action of the permanent magnet. The speaker cone moves with the voice coil, and when the polarity of the voice coil current is such that the speaker cone kicks toward the interrupter arm **11**, the interrupter arm is thereby pulsed into an independent swinging excursion movement during which it moves free of the speaker cone. A loud-speaker of this general type has been employed in the practice of this invention and is made by the Oxford Electrical Corporation, of Chicago, Illinois, under its Model Designation No. 4AMS, 4" P.M. 3.2 ohm voice coil, and power rating of 3–4 watts.

In the arrangement illustrated herein for purposes of disclosure, one lead of the voice coil is connected in circuit with a six-volt D.C. battery **17** and a twenty-ohm potentiometer **18** of a type preferably having an "on-off" switch and the other lead is connected through a circuit-making contact arrangement that is under the control of the interrupter arm **11** and includes a contact plate **19**, preferably of brass, that is adhesively secured to a felt pad **20** mounted across the apex of the cone, internally thereof, and a contact screw **21** and its mounting nut **21N** that is carried on and resiliently swingable with the interrupter arm. The weight of the contact screw **21** and its nut **21N** is correlated with the stiffness of the interrupter arm, it being heavy enough to develop sufficient momentum in response to actuation by the diaphragm to drive the interrupter arm through a substantial angular excursion. In this arrangement the interrupter arm itself is a current-carrying member, and it is shown in FIG. 1 as a spring-steel leaf or strip mounted in cantilever suspension from the base of the speaker frame **14** with a pair of insulating washers **22** and **23** spacing the mounting nut **24** and screw **25** and the interrupter arm itself from the speaker frame. When current is applied to the voice coil of the speaker, it drives the diaphragm of the speaker through a high-speed excursion to kick the interrupter arm **11** free of the contact plate **20** and break the actuating circuit for the diaphragm until the interrupter arm returns to normal position. The cycle repeats itself and the number of cycles per second, and hence the "putt-putt" rate is limited by the excursion interval of the relatively slow-moving resiliently swingable interrupter arm **11**.

The noise-simulator unit is normally mounted with the face of the diaphragm arranged in a vertical plane; and thus, in normal use, the weight of the contact screw **21** and the nut **21N** does not appreciably affect the neutral position of the interrupter arm **11**. Since in use of this item, there will undoubtedly be situations where its normal vertical position cannot be maintained at all times, it is important that the arm have sufficient stiffness to resist the effects of gravity when the unit is inclined on the order of 5° from its normal position.

Thus the characteristic resiliency and flexibility of the swingable interrupter arm **11** are selected in accordance with the "putt-putt" rate which it is desired to achieve. The contact screw **21** is made adjustable to facilitate initial setting up of the apparatus and to allow a range of adjustment of the "putt-putt" sound. Similarly, the potentiometer **18** may be adjusted to various positions to cut in more or less resistance. The lower the resistance in the circuit, the faster is the build-up time of the current pulse

and, hence, the faster is the "putt-putt" rate, though it will be appreciated that the characteristics of the interrupter arm fix the upper limit of the "putt-putt" rate.

When the current pulses in the voice coil are strong, there is a tendency for the resilient arm **11** to bounce to some extent, and this bouncing tendency can upset the uniformity of the pulse intervals. This can be substantially eliminated by means of a damper arm **27** that is fastened to the frame **14** of the speaker by a screw **28** and nut **29**. The damper arm **27** is in the form of a substantially rigid strip of metal or other suitable material that is mounted to exert a slight pressure directly against the cone or diaphragm **12**, and this prevents free vibration of the cone and minimizes the tendency for the interrupter arm **11** to bounce. There results a better regulated pulse interval and a more distinct and controllable "putt-putt" sound at both "low" and "high" speeds.

The enlarged fragmentary view of FIG. 2 shows an alternative embodiment of the interrupter arm of this invention and in this instance, the arm **31** is rigid and is pivotally mounted on a bracket **32** with its free end carrying an adjustable contact screw **21** that is biased into engagement with a contact plate **19** mounted at the apex of the speaker cone. The biasing is provided by a coil spring **33** that reacts between a bracket **34** and a rearward extension **31R** of the interrupter arm. The spring **33** is mounted in telescoping relation over the shank of a bolt **35** that extends through the rear extension **31R** and a rear extension **34R** of the bracket **34** to engage a suitable retaining nut **36**. The brackets **32** and **34** may be of insulating material or the mounting fasteners shown generally at **37** for these brackets and the brackets themselves may be insulated from the frame **14** of the speaker. The bolt hole **34H** in bracket **34** is enlarged to provide lateral clearance for accommodating swinging movement of the bolt **36** as it follows the interrupter arm **31**. The action of the embodiment of FIG. 2 is similar to that of FIG. 1: each time the diaphragm **12** is pulsed towards the interrupter arm **31**, the interrupter arm will undergo independent resilient swinging movement, during which separation of the contact screw **21** and the contact plate **19** opens the actuating circuit for the speaker diaphragm.

While the disclosed arrangements wherein the circuit-making contacts are carried by the diaphrgam and interrupter arm are preferred, it will be apparent that one or both of the circuit-making contacts could be mounted from the frame of the speaker and still be controlled by the excursion movement of the interrupter arm as it responds to the pulsing action of the diaphragm. Where the contacts are mounted from the frame, the interrupter arm need not be a current-carrying member. Such variations are contemplated within the broader scope of this invention.

The applicant is aware of the U.S. patents to Santino, 2,645,768, and McGonigle, 1,023,215. It is to be noted that the structures shown in these U.S. patents produce high-pitched "beep-like" sounds as determined by the excursion intervals of the speaker diaphragm, whereas the sound characteristics of the present device are in a much lower frequency realm, they being determined by the excursion interval of the interrupter member.

I claim:

1. An engine noise simulator for producing a characteristic "putt-putt" sound and comprising a frame, a diaphragm mounted on said frame for pulsing movement relative thereto, magnet means on said frame, a driving coil on said diaphragm to produce flux for reaction with said magnet means to generate pulsing movement of said diaphragm, means including an interrupter member mounted on said frame and having a normal position wherein it reacts against one side of the diaphragm and is responsive to pulsing movement of the diaphragm theretoward to undergo independent resilient swinging excursion movement, said member having a swinging frequency on the order of a few cycles per second, and an electric circuit for pulsing said diaphragm and connected to said voice coil for supplying current of a polarity adapted to pulse said coil and diaphragm towards said member to initiate independent resilient swinging excursion movement said circuit including circuit-making contact means engageable by said member and held closed thereby only when said member is in its normal position such that the excursion interval of said member substantially determines the "putt-putt" rate.

2. In an engine noise simulator for producing a characteristic "putt-putt" sound, the combination with a speaker assembly that includes a frame, a diaphragm mounted on said frame, a permanent magnet mounted on said frame adjacent said diaphragm, and a voice coil mounted on said diaphragm adjacent said magnet and responsive to current flow therethrough to pulse said diaphragm; of means including an interrupter member mounted on said frame and having a normal position wherein it reacts against one side of the diaphrgam and is responsive to pulsing movement of the diaphragm theretoward to undergo independent resilient swinging excursion movement, said member having a swinging frequency on the order of a few cycles per second, and an electric circuit connected to supply current to said voice coil of a polarity adapted to pulse said diaphragm toward said member to initiate independent resilient swinging excursion movement, said circuit including circuit-making contact means engageable by said member and held closed thereby only when said member is in its normal position such that the excursion interval of said member substantially determines the "putt-putt" rate.

3. The arrangement of claim 2 wherein said contact means comprises a first contact mounted on said diaphragm on the side thereof adjacent said member and a second contact provided on said member and resiliently held against said first contact by said member to determine the normal position of said member, with the interrupting member being connected in current-carrying relation in said circuit.

4. In an engine noise simulator, the combination with a frame, a permanent magnet secured to the frame, a speaker cone having a base anchored to the frame and having an apex adjacent the permanent magnet, a voice coil secured to the cone adjacent the cone apex and movable away from the permanent magnet upon passage of a current of predetermined polarity through the voice coil, and an electric supply circuit connected to the voice coil for energizing it with a current of said predetermined polarity; of means for interrupting said circuit at a low rate to produce a characteristic "putt-putt" sound and comprising a contact mounted on and movable with the speaker cone, and an interrupter member mounted on the frame and carrying a cooperating contact and having a swinging frequency on the order of a few cycles per second, said member having a normal position wherein it reacts against the diaphragm to hold the contacts closed, said member being responsive to pulsing movement of the diaphragm theretoward to undergo resilient swinging excursion movement during which it holds said contacts open, with the excursion interval of said member substantially determining the "putt-putt" rate.

5. The arrangement of claim 4 wherein said interrupter member is in the form of a strip of resiliently flexible material mounted as a cantilever suspension from the frame of said speaker, with the free end of the member resiliently reacting against the cone.

6. The arrangement of claim 4 wherein said interrupter member is in the form of a rigid arm pivotally mounted from the frame to swing towards and away from the cone and spring means resiliently bias the interrupter member into reaction against the cone.

7. Apparatus for producing pulsating current at a low repetition rate and comprising a frame, a diaphragm mounted on said frame for pulsing movement relative thereto, a permanent magnet mounted on said frame, a

driving coil mounted on said diaphragm adjacent said magnet and responsive to current flow therethrough for moving said diaphragm in a direction determined by the polarity of the current, means including an interrupter member mounted on said frame and having a normal position wherein it reacts against one side of the diaphragm and is responsive to pulsing movement of the diaphragm theretoward to undergo independent resilient swinging excursion movement at a frequency on the order of a few cycles per second, and an electric circuit having a constant voltage source of D.C. current connected to supply current to said coil of a polarity adapted to pulse said diaphragm toward said member, said circuit including circuit-making contact means engageable by said member and held closed thereby only when said member is in its normal position such that the apparatus produces pulsating current at a repetition rate substantially determined by the excursion interval of said member.

8. The arrangement of claim 7 wherein a relatively rigid damper arm is mounted on the frame to engage against said one side of the diaphragm and minimize free vibration of the diaphragm.

9. An engine noise simulator for producing a characteristic "putt-putt" sound and comprising a speaker assembly including a frame, a vibratile diaphragm mounted on said frame for pulsing movement relative thereto, a permanent magnet mounted on said frame adjacent said diaphragm and a driving coil mounted on said diaphragm adjacent said magnet and responsive to

current flow therethrough to pulse said diaphragm, an elongated interrupter member having a mounting point adjacent one end, mounting means for attaching the mounting point of the interrupter member to said frame to dispose the interrupter member in normal position wherein its other end reacts against one side of the diaphragm and is responsive to pulsing movement of the diaphragm theretoward to undergo independent resilient swinging excursion movement about said mounting point, said interrupter member having a frequency on the order of a few cycles per second and an electric circuit for pulsing said diaphragm, said circuit being connected to said driving coil to supply current of a polarity tending to pulse said diaphragm towards said interrupter member for initiating one cycle of independent resilient swinging excursion movement, said circuit including circuit-making contact means engageable by said interrupter member and held closed thereby only when said interrupter member is in its normal position such that the excursion interval of said member substantially determines the "putt-putt" rate.

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