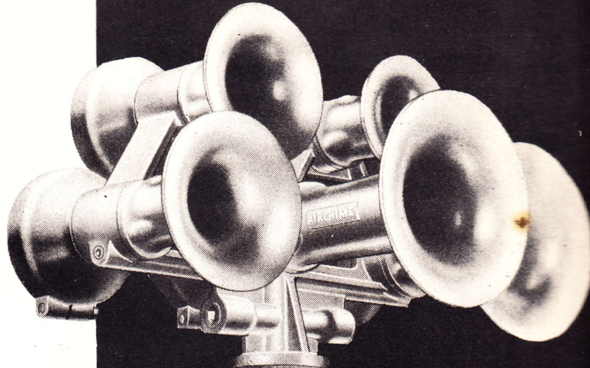
AIRCHIME

The Original "Hexatone" Locomotive Whistle

The "Nathan Airchime" whistle was developed and designed to attain a definite objective—to simulate the sound of a standard steam locomotive chime whistle. Attainment of this objective fulfills an urgent need for an air-blown signaling device which emits a warning recognized and respected by the general public.



This bulletin provides data on the design objectives, construction, performance and installation of the "Nathan Airchime".

Inquiries and requests for further information will receive prompt attention.

DESIGN OBJECTIVES

The "Nathan Airchime" whistle is basically a musical instrument, which, in its most fundamental form (Model MS-1), emits a single tone of a predetermined pitch or frequency. When several of these single tones of various pitches are combined, as in the M-3 and M-5 models, the simultaneous sounding of the various single tones produces a musical chord, or chime effect, similar to that of the steam locomotive whistle. In addition, this whistle can be modulated (or softened) without tonal distortion.

In principle, all the individual tones are produced in the same manner; a circular diaphragm (or reed) is vibrated by compressed air to propagate sound waves, the pitch or frequency of the tone being determined by the size of the bell and the natural period of vibration of the diaphragm. Thus, to produce the desired pitch of the tone is primarily a question of bell size, but to obtain the proper quality or timber of tone by means of a vibrating diaphragm requires a thorough understanding of the acoustics of the flute principle as employed in the steam chime whistle.

The flute type of sound propagation produces a tone relatively pure or free of harmonics other than those inherent overtones which are octaves of the fundamental tone. It is this tonal quality which gives the steam whistle its characteristic sound, and this tonal quality must be built in when designing a different means of propagating sound waves to simulate the steam whistle.

To obtain the proper quality of tone emitted by the "Airchime", the contour of the inside of the resonator, or bell, does not follow an exponential curve, as do the bells of most musical instruments, but follows a specially designed contour which permits resonance to occur at only the fundamental frequency of the vibrating diaphragm and to the frequencies of the first two octave overtones. In addition, all parts of the whistle structure must be sufficiently heavy and rigidly constructed to prevent the introduction of metal harmonics with consequent change of tone quality. To obtain apparent audible balance of intensity between all frequencies of the multiple-tone whistle, the throats of the bells are properly proportioned in size. This proportion must also take into consideration the fact that all tones of a multiple-tone whistle must sound together at a uniform air pressure.

The "Nathan Airchime" meets these design objectives and thereby speaks out with a signal which faithfully reproduces the sound of the steam locomotive chime whistle.

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DESCRIPTION

The "Nathan Airchime" whistle is built in several models, including a single chime (single tone) and various combinations of single tones of different pitches to form the multiple chime (or multiple tone) whistles as illustrated on the opposite page. The single tone (or chime) sounded by any individual bell, whether it be that of the MS-1 or any single tone of a multiple-chime model is produced in the same manner; sound energy of a predetermined pitch (or frequency) is propagated by a diaphragm which is vibrated by compressed air. Therefore, in principle, the physical structure of all individual parts which go to make up an assembly to sound a single tone are identical; the variations are only in the sizes necessary to produce tones of different frequencies. A typical center cross sectional view is shown below and illustrates the major parts which form an assembly (body) to sound a single tone.

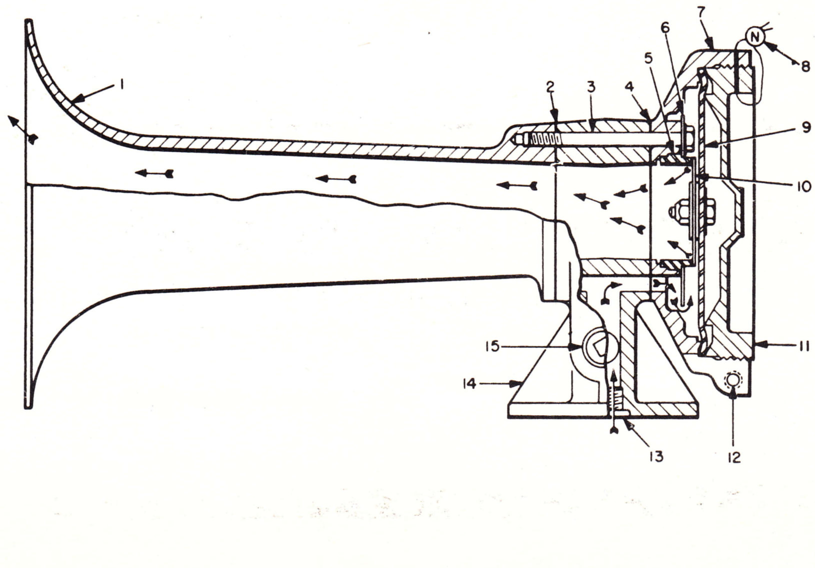
The body is composed principally of four major parts or assemblies: the bell (1), base (14), diaphragm head assembly (7), and the diaphragm assembly (9). The base provides a mounting flange for the entire whistle assembly and serves essentially as a manifold for the various bells and diaphragm head assemblies. Obviously, therefore, the shape and size of the base varies in accordance with the model of the whistle, that is, with the number of bells.

The bell and diaphragm head assembly are secured to opposite faces of the base by three bolts (3) which also hold the diffuser ring (6) in place. The ring in turn secures the circular clapper seat (5) in a recess in the diaphragm head (7). To prevent leakage of air, gaskets (2) and (4) separate the bell and the diaphragm head assemblies from the base. The diaphragm assembly, composed of phosphor bronze diaphragm discs (9), a clapper disc (10), and spacers—all held together by a nut and bolt, is secured in the diaphragm head by the adjusting cap (11). This cap screws into the diaphragm head, tightening the diaphragm against a circular land in the diaphragm head. This tensions the diaphragm discs, the adjusting cap being tightened sufficiently to bring the clapper disc down against the clapper seat and produce vibration of the diaphragm at its natural period or frequency of vibration at a predetermined minimum air pressure. After the positioning the adjusting cap to maintain proper tension on the diaphragm, the clamp screw (12) through the split bracket at the bottom of the diaphragm head is tightened, locking the adjusting cap in position. Finally, to prevent change of adjustment, the diaphragm head and adjusting cap are drilled, lockwired, and sealed.

An air inlet port in the bottom of the mounting flange, as well as two alternate ports on opposite sides of the stanchion above the mounting flange, provide connections for the air supply line. When the whistle valve in the air supply line is opened, air flows into the inlet port, (see arrows) through an integral passage in the base and diaphragm head and into the forward (or bell side) chamber formed between the face of the base and the diaphragm assembly. Here the pressure builds up until it is sufficient to overcome the tension of the diaphragm and push the clapper disc of the diaphragm assembly away from the clapper seat. This permits air to escape through the bell, momentarily lowering the pressure on the bell side of the diaphragm, permitting the clapper disc to again close against the clapper seat. At this instant, the cycle starts over again; pressure builds up, the diaphragm tension is overcome, the clapper disc is raised off the seat, pressure in the chamber is released, and the clapper disc again returns to the seat. This action is equivalent to the chattering of a check valve, the diaphragm being so designed that vibration occurs at the natural period of vibration of the diaphragm or at the frequency necessary to produce a tone of the desired pitch.

Therefore, the vibrating diaphragm of the "Nathan Airchime" whistle, along with its specially designed bell, produces a sound which is similar to a single tone of a steam whistle employing the flute type of sound propagation. And further, when the tones of several vibrating diaphragms of predetermined pitches are combined, the resultant musical chord, acoustically simulates the sound of the steam chime whistle.

1—Bell
2—Gasket
3—Bolt
4—Gasket
5—Clapper Seat
6—Diffuser Ring
7—Diaphragm Head
8—Seal
9—Diaphragm
10—Clapper Disc
11—Adjusting Cap
12—Clamp Screw
13—Air Inlet Port
14—Base
15—Alternate Air Inlet Port



CONSTRUCTION FEATURES

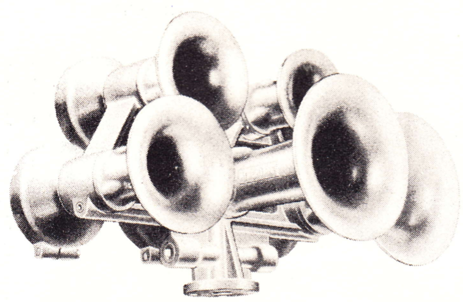
- Simple, rugged construction. Major parts are heavy cast aluminum.
- All parts sufficiently ribbed and reinforced to give high strength and prevent vibration with introduction of "metal harmonics" in tone of whistle.
- Laminated diaphragms have high resistance to flexure and therefore long life.
- Diaphragms tensioned below elastic limit for longer life.
- Thickness of diaphragms scientifically determined so that diaphragms vibrate only at natural frequency.
- Diaphragm itself does not touch seat, preventing work hardening.
- Sizes of diaphragms and bells properly proportioned to produce a balance between intensity of sound of various tones in the musical chord and also for simultaneous sounding at the same air pressure.

PERFORMANCE

The signal produced by the "Nathan Airchime" whistle is basically musical in character, whether it be the single tone of the MS-1 model or the combination of several tones to form a musical chord, as in the multiple tone models. The sound is pleasing yet penetrating and simulates the signal of the steam chime whistle so that it can not be confused with the sound of a ship's whistle, a truck or fog horn.

The "Nathan Airchime" whistle is designed to produce its full intensity of sound at an air pressure of 100 psi., and at this pressure has a decibel rating equivalent to or greater than a similar type of steam chime whistle operating on 200 psi pressure of steam. The range or coverage of the "Airchime" signal is approximately uniform in all directions, and not only forward. Coverage to the rear (depending upon topographical surroundings) is usually greater than with steam whistles. Where greater signal intensity to the rear is desired, the M-3R1 model, with the No. 1 bell reversed, can be employed.

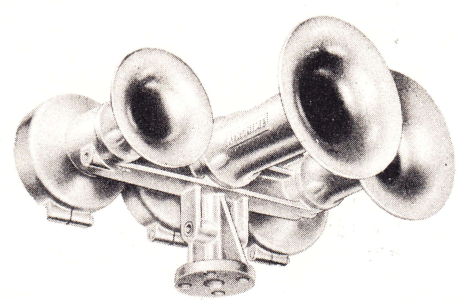
The intensity of the "Nathan Airchime" signal can be modulated for terminal and suburban use.



M-5

Combines five separate tones to produce a penetrating, musical, A major 7th chord. Distinctive and powerful for all types of road service, passenger or freight.

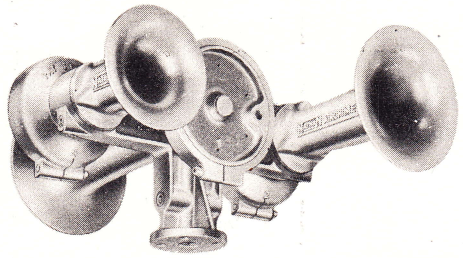
Operating Pressure.......20 to 130 psi
Weight ....35 lbs.



M-3

Signal is a musical major triad (A major). Less euphoneous sound than M-5 but sufficient range and quality for general switcher service.

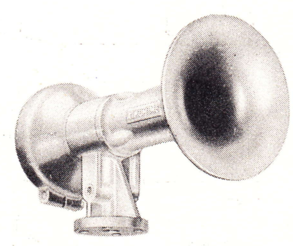
Operating Pressure.......20 to 130 psi
Weight ....28 lbs.



M-3R1

Same as M-3 except that Bell No. 1 is pointing to the rear to give better rear signal coverage for yard and switcher service.

Operating Pressure.......20 to 130 psi
Weight ....28 lbs.



MS-1

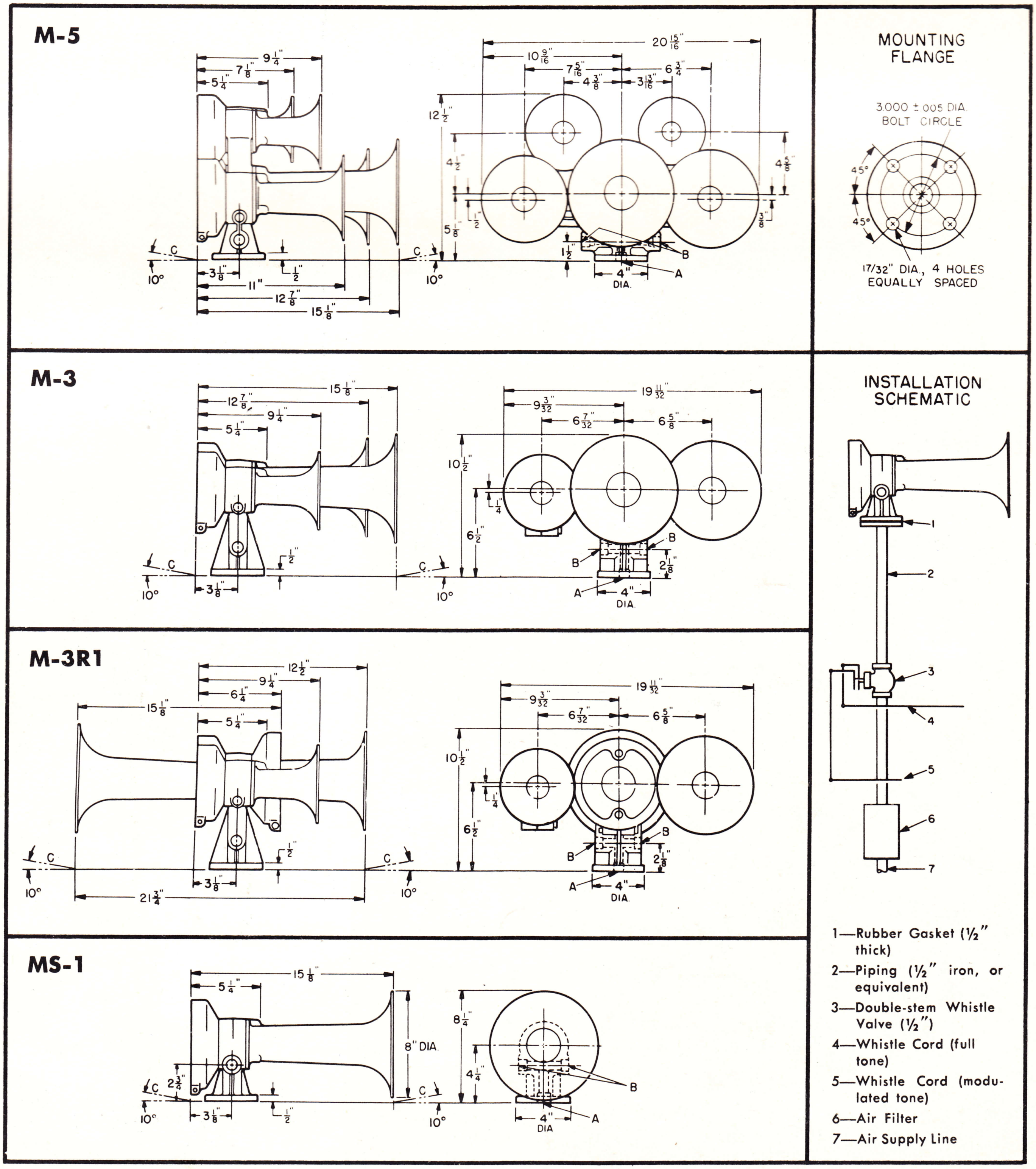
Sounds a single deep tone (C#) sufficient for general signal service.

Operating Pressure.......20 to 130 psi
Weight ....11 lbs.

U. S. AND FOREIGN PATENTS PENDING

INSTALLATION

The "Nathan Airchime" whistle is simple to install. The mounting flange (see outline drawing below) is designed to fit conventional mounting pads for air signalling devices. When mounting the whistle, install a ½-inch thick rubber gasket between the flange and the pad. The air supply line can be connected to the air inlet port (A) or to either of the alternate ports (B) shown in the outline drawings below. The air supply line should be ½-inch iron or equivalent. For modulated tone the minimum recommended air pressure, measured at the base of the whistle while blowing, is 20 psi. For maximum loudness the pressure, measured at the base of the whistle while blowing, should be 90 to 100 psi. The Nathan double-stem whistle valve provides in one unit the means for selecting either loud or modulated tone. For maximum loudness to the front or rear, all obstructions should be below the 10-degree obstruction line (C).



A—Recommended Air Inlet Port (½" Nat'l pipe thd.) B—Alternate Air Inlet Port C—Obstruction Line

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