The shape of the external horn is not necessarily conical, nor is it entirely arbitrary. It is determined by the use to which the horn is to be put, to its length, aperture, and small end diameter, to the distance to the sound source, to the extent it is desired to make use of the horn as a sound resonator, and to the pitch and quality of the sound to be amplified or condensed.

Figure 2 shows both horns, H and S of the same shape. This is not always the most efficient design. The shape of the outer horn having been decided upon, the inner horns are so shaped as to condense the maximum amount of energy at the small end. They are supported by radial strips of sheet metal placed with the plane of the strips parallel with the common axis of the horns, in order to give minimum interference to the passage of sound waves through the system.

The writer is still experimenting with multiple horns of different designs, in order to determine the one having the maximum efficiency. An account of this work, with data, will be published later.

LOCOMOTIVE WHISTLE EXPERIMENTS.

Arthur L. Foley, Indiana University.

A study of the amount of steam, and consequently the amount of coal, required to blow an ordinary locomotive whistle, the probable average time per day the whistle is blown, and the total number of locomotives in use, convinces me that we "pay dearly for the whistle". Is it not possible to reduce the cost and the coal waste?

In the first place, it would seem that the position of the whistle is bad. It is almost always behind the smoke stack, and frequently behind or at the side of the steam dome, bell or sand box. Sound shadows are not pronounced like light shadows. Nevertheless sound shadows actually exist. The intensity of the sound along the track in front of a locomotive is certainly somewhat lessened by placing the whistle behind the smoke stack or other objects. But it is much further reduced by the hot gases coming from the smoke stack, which act like a dispersing cylindrical lens. Moreover, the currents of hot air about the walls of the smoke stack and rising from the boiler are both absorbing and dissipating for sound energy. That such conditions are undesirable can not be questioned. The question concerns the magnitude of their effect. Is the reduction in the intensity of the sound along the track sufficient to warrant placing the whistle in front of the locomotive smoke stack, as is the case with the headlight?

A second question. Can one devise a sound reflector that will increase the sound intensity along the track where it is needed and decrease it in other directions where it is not only not needed, but is usually a nuisance?

It has been argued that sound waves are relatively so long that a reflector of ordinary size would have little or no effect. Certainly we should not expect results anything comparable to what we have in

the case of the headlight reflector. But it is wrong to expect nothing. Whenever one places his hand to his ear in order to hear better, he makes use of a reflector many times smaller than the whistle reflector would be, yet the hand gives results. So does a megaphone.

In order to settle the question raised above the writer arranged to measure the intensity of sound in various directions and at various distances from a locomotive blowing a whistle. The Monon Railroad Company kindly placed at my disposal one of their mogul engines, with engineer, fireman, and men to operate the turn table on which the locomotive stood. Instead of moving my point of observation to measure the sound intensity in various directions, I set up my apparatus at the side of the track at the desired distance from the locomotive, and measured the sound intensity as the locomotive was turned on the table. This method has many advantages over one in which the observer changes his points of observation, one of which is that the sound is always traveling over the same surface contour in the same direction with respect to wind, etc. The writer expected to make measurements —first without a reflector, to determine the effect of the position of the whistle, then with a reflector to determine its efficiency. The experiments begun late in the fall, were interrupted by a notice from a family living near the railroad roundhouse that, owing to sickness, the noise would not be tolerated. I hope to continue and complete the experiments in the spring. I shall defer publishing data until the experiment has been completed.

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