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P. O. Box 12, Old Chelsea Sta.,
New York 11, N. Y.

No Coded Signals

H. S. MORRIS*

A discussion of the advantages of voice sound systems over the rapidly obsolescent bell or whistle signals so generally used heretofore in industrial installations.

THE REQUIREMENT "No Coded Signals" is beginning to appear in important bid specifications. This is of significance to us on two scores.

First, it announces recognition by industrial planners that the various forms of coded signal systems commonly used in the past for warning purposes, and to give routine directions to large or scattered groups of persons, are no longer capable of coping effectively with the rapidly growing variety of situations which must be anticipated in modern industrial and everyday civil life.

Second, to us who make our livelihood in audio, this accelerating trend towards discarding coded signals as unsatisfactory tools for mass directions may well open the largest of all fields for Voice Sound Systems. Since a prime mover in this shift is the need for a reliable way to communicate detailed and changeable instructions to large numbers of persons in the event of enemy air attack, this application of Voice Systems embraces every conceivable place where people may gather in numbers—not only industrial plants, but office buildings, hotels, department stores, apartment houses and whole communities.

By coded signals we mean simple signal systems, usually audible systems, that can be coded to emit combinations of long- and short-duration sounds to communicate different meanings. Widely used devices for this purpose are sirens, bells, whistles, buzzers, gongs, air horns and howlers.

One of the first signal systems used early in our civilization was the church

* *Altec Lansing Corporation, 161 6th Ave., New York 13, N. Y.*

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bell. There was a time when this simple signal served all needs adequately for warnings and to assemble the populace in unusual situations. The bell was well located high in the church tower, its tone was powerful and carried well enough to blanket the usual-sized community and to penetrate the small industrial activities and crafts of the day. A form of coding existed when it was rung at times other than for religious purposes, and in this respect it served as an alarm to bring people running from their homes and shops to learn the nature of good or bad news—of portending disaster of fire, flood, or enemy attack.

With the "steam age" came the steam whistle which even today remains one of the most powerful of all signals. The steam whistle was capable of transmitting coded signals, so combinations of blasts were soon composed and used as a valuable assistance to direct growing industrial organizations to call employees to work, for quitting signals, to time routine operations, and to sound warnings of emergency nature.

The advent of public electricity developed a variety of signaling devices, and for the first time, signals became available that could be actuated readily at remote locations and in infinite numbers. The facility offered by electrical signal networks opened many opportunities to promote efficiency in sprawling industrial units and commercial operations. Complicated coding was often resorted to in an effort to provide a many-function service to meet ever-growing needs—to time work periods, to page executives, to coordinate widely located operations, to supervise processes, to call watchmen, to summon repair and clean-up crews. In addition, the same over-worked signaling system was supposed to serve for all-important warning purposes, should any kind of emergency occur.

It was inevitable that these simple

signal systems would become overloaded to the point where their usefulness was jeopardized. This point was hastened by the continued growth of more complicated industrial and commercial organizations, with attendant problems of efficiently directing hundreds or even thousands of employees or the public, together with management's greater safety responsibilities in the face of multiplied hazards to life from dangerous processes within the plant and threats from without. Both of these problems continued to become more extreme with technological development.

While it is true that sirens, bells, and whistles are effective in commanding attention, their real value stops right there. The number of instructions they can deliver without confusion is very limited. The successful completion of instructions depends upon the listener being previously instructed on the code, that he remembers the code, and that he correctly interprets the code even under conditions of great mental stress.

One serious fault is the danger of regular employees becoming so accustomed to hearing signaling systems used all day long for routine directions that, like the boy who cried "Wolf" too often, they may disregard that once-in-a-million case when the system is used as an emergency warning.

Another serious limitation is that all possible situations have to be anticipated in advance and associated codes pre-specified. When the meaning of a signal is once defined, it is impossible to change it quickly to convey other instructions to cope with an unforeseen or opposite emergency situation. Take, for example, the tragic case of the school building in which one-half of the top floor pupils were carefully drilled to use one stairway and the other half another stairway whenever the fire bell sounded. One day the fire alarm went off in earnest. Teacher quickly marshalled well-drilled charges down their respective stairways.

But, unfortunately, one stairway led directly into the blazing fire area on a lower floor, and many of the children were trapped. It was not possible to modify the pre-defined alarm signal to direct the entire floor to use the safe stairway.

There is also the uncontrollable psychological reaction of undrilled people to the wail of the siren, the clang of the alarm bell, and the startling staccato of frenzied whistle blasts when these signal devices are restricted to emergency warnings. In American life these sounds mean danger. Coming with sudden unexpectedness, they shock the heart with apprehension. The first reaction is to drop everything and run—unorganized—anywhere. Even when their use is restricted to disaster signals, and all are well-informed of their meaning, they breed fright and terror, particularly where masses in enclosed areas are involved. Nothing can be more serious in factories, office buildings, apartment houses, and other structures housing many persons and having a limited number of elevators and exits.

The great uncorrectable weakness of these signals lies in the uncertainty which follows their use and their inability to follow through with detail instructions that everyone can understand and follow with confidence. This weakness, more than any other, is making coded signals unacceptable in the new tense Defense Era that has been ushered in by the Atomic Age.

The Logical Solution

To survive in this new era, we are going to have to rely upon many coordinated precautions. There seems to be only one way to achieve this vital coordination at the civilian level—local communication networks of loudspeaking electronic systems that can sound the standard alert signals and then follow through with detailed *spoken* instructions which will calm human fears and direct orderly teamwork under any emergency situation.

Consider the many situations which may have to be dealt with in a medium-sized plant or office building in case of enemy air attack, and how a Voice Sound System throughout the premises would be the Defense Coordinating Officer's most valuable tool for minimizing danger to human lives and company property.

Here are some of the directions the Defense Coordinator—acting as a master dispatcher—must get over quickly, clearly, and in a manner to inspire confidence:

1. Sound the standard alert signal to gain attention. Then follow through with a vocal explanation to assure that everyone, including visitors, understands the significance of the signal. By being able to give a spoken explanation, it is less necessary for drills on costly company time.
2. Call upon workers to shut down their machines, unplug soldering irons, turn off chemical processes, and so on, before leaving their posts, to prevent possible fires or other damage while unattended.

Only at-the-moment voice instructions can assure this being done.

3. Direct people, including undrilled visitors, to different safety shelters; and then possibly re-direct them, later, to other shelters because of the development of close-by danger. Simple signals could never do this.

4. Caution employees and the public to move in an orderly manner to their designated shelters so as to restrain hysteria or stampede. Recently there has been released a 16-mm film entitled "Target U.S.A." designed to instruct plant employees how to act under conditions of an enemy air attack. The film portrays the sounding of the air raid alarm and the wild rush to designated shelters. It shows developing panic as people madly scramble through bottle-neck doors and corridors, but only the commentator in the film is able to caution the rushing mob to "take it easy." How simple it would be if the Defense Coordinator, with the facilities of a Voice Sound System, could do this very thing.

5. It will be easier to confine people in shelters for a prolonged time if the Defense Coordinator can cut in on shelter loudspeakers periodically and reassure the occupants. If this is not done, uncertainty may breed panic. The situation is no different than that on a man-o'-war in battle, when the battle announce system is used every few minutes to acquaint those below deck how the fight is going. Knowledge that the rocking blast on the port side was close but not damaging makes it a hundred times easier to stick to their posts.

6. Call rescue workers from one part of the premises to another to administer to first-aid cases resulting from either attack or hysteria. The need for more stretchers or more smelling salts can be communicated only by spoken directions.

7. Direct trained and equipped crews direct to points of need, such as to turn off broken water, chemical, or electrical mains or to prevent other equipment hazards that might develop while unsupervised.

8. Instruct the Wardens to vary ventilating controls throughout the premises in the case of radiological, chemical, or biological attack, or to provide isolation of highly combustible materials in case of fire or explosive attacks.

9. Route de-contamination crews from point to point to clean up hazardous conditions and report on their safety.

10. And last, to call on wardens and emergency crews to report back and assure that safety exists before the All Clear signal is sounded and employees or public are allowed to return to their normal activities.

Sirens, whistles, horns, bells, gongs and buzzers—even when ably supplemented by telephone and message runners—cannot do this man-sized job. They are as puny as voice tubes.

Up-to-Date Requirements

A loudspeaking electronic system capable of transmitting the standard Alerts, plus Voice and Music, is required in every good-sized building to discharge the safety responsibilities of this new Atomic Age. Sound Systems designed to perform this special service have been dubbed "Survival Sound Systems"—not a warning system, not a disaster system, but a system designed for Survival.

In addition to being built to life-saving specifications, such a system also can

serve day-in-and-day-out the purpose of an ordinary sound system, as an efficiency tool of limitless application in routine industrial and commercial operations.

Design Needs

The requirements of a Survival Sound System are much more demanding than those of an ordinary sound system. Its serious purpose allows little leeway for compromises in performance or price. The audio engineer planning such a system should bear the following uppermost in mind:

1. Major emphasis on speech intelligibility. Particular instructions may be issued only once; 20 per cent of the personnel may be hard of hearing, but every syllable must be instantly understood as it may mean life or death. It cannot be chanced that anyone will misunderstand instructions and run directly into the arms of disaster instead of running the other way. The best quality of equipment only will suffice—quality as relates to reliability as well as reproduction. No junk, typical of many systems for paging or music distribution use where it matters little if listeners understand only 50 or 60 per cent of the words pronounced.

2. Loudspeakers must be installed liberally, with horn types used in locations of high noise level. In addition to usual locations, speakers must also be installed in toilets, washrooms, warehouses, loading platforms, corridors, elevators, basement storage areas, and parking lots.

3. Switching provisions should be provided so that loudspeakers can be controlled by zones. It should be possible to talk to people confined in shelters separate from plant-wide direction of emergency crews. Likewise, if the Defense Coordinating Dispatcher knows that the first-aid crew is operating in Zone A, it should be unnecessary to call to all other zones to re-direct the crew to a need in another location.

4. Since many of the above speaker locations will not be utilized in routine day-to-day use of the sound systems, priority circuits must be provided whereby all speakers can be actuated and any special speech equalization cut in, in cases of emergency.

5. Microphone inputs must be provided at the Building Defense Control Center, plus inputs on each separate floor and in each building, as well as in important areas of large enclosures from which it might conceivably be desirable to direct defense activities.

6. Consideration should be given to providing emergency speaker circuits for carrying on, should one of the main circuits be damaged. This might be accomplished by wiring all circuits as loops so that input can be provided from either end.

7. An auxiliary power supply must be provided for use should the standard power mains become inoperative. Gas-driven generators appear most appropriate. The size of auxiliary power plant to operate a Survival Sound System will often be only a fraction of the size of power plant that would be required to operate other types of signaling systems.

Modifying Present Systems

Existing sound systems can profitably be resurveyed and brought up-to-date to meet these Survival System standards.

Nuclei now exist in many forms which can be built up readily to provide Survival Sound System service. For instance, the addition of microphones, plus loudspeakers in shelters and other working areas of existing wired-music systems in restaurants, hotels, and offices would convert these to valuable warning and direction systems. The same applies to the already existing high-quality sound systems in motion picture theatres.

The trend towards discarding simple signals within buildings is only part of the "No Coded Signals" story. The same arguments that favor loudspeaking electronic systems within enclosures apply with equal force to outdoor warning systems for general public use.

Siren, whistle, and horn air-raid warnings only alarm, confuse, and incite panic. Their weakness lies in the uncertainty which follows their initial sounding. They cannot follow through with explicit instructions; they cannot reassure; they cannot tell the populace what to do should an unanticipated emergency occur requiring action other than that for which people have been drilled. These systems are costly to install, and, being mechanical, are relatively troublesome and unreliable. To provide them with an emergency power supply is impracticable.

Many Civil Defense officials are dissatisfied with the siren, even as an alarm device because of the possibility of confusing siren-generated Attack Warning Signals with other established emergency services. Sirens have been used for years by police, ambulances, volunteer fire departments, and penal institutions. Since all sirens sound substantially the same, disastrous mis-cues are possible.

An all-electronic public Warning System could easily sound an endless variety of distinctive non-confusing signals and at the same time offer the answer to other deficiencies of the siren. However, it appears unlikely that entirely practical electronic systems can be offered until engineering study resolves some of the well-known vagaries of transmitting sound and intelligible speech over large outdoor areas.

Under conditions of good transmission, outdoor sound can be heard many miles, while under other normally-to-be-expected weather conditions the range of the same sound may be reduced to a fraction of a mile. Building obstructions cause garbling due to reflections and dead areas due to acoustic shadows. In concentrated areas of people and traffic activity, the ambient noise which must be pierced is high and variable. These adverse factors are most troublesome in congested downtown business areas where buildings are tall, streets narrow and canyon-like, and traffic heavy.

It seems probable that such business areas can be covered reliably only by relatively low-level systems consisting of many loudspeakers at frequent locations. Two low-power horn-type speakers pointing in opposite directions at each street intersection could do the job of blanking each block with the stand-

ard alert signals, even through the heaviest traffic noises, and should understanding of subsequent voice instructions be difficult, people could quickly approach the nearest speaker, which never would be further away than a few hundred feet. If efficient speakers are used, a centrally located, remotely controlled 1-kw amplifier could feed speakers enough to checker-board an area of 100 street intersections. This would be sufficient to cover the business sections of most cities, and the number of units required for the largest cities would be within reason.

High-Level Systems

So much for low level systems. It is the high level system consisting of a few high power loudspeaking units at widely spaced locations that seems to have the most glamour appeal to municipal authorities, possibly because it mimics the existing siren practice.

The high level system poses two big engineering questions: First, can it communicate intelligible speech reliably over appreciable outdoor areas, even in residential sections? And second, can existing electronic equipment economically reproduce the required acoustic levels?

There seems to be a plausible answer to the first question. It is proposed that intelligence should be possible under adverse conditions if the message is limited to phrases of only two or three words, and these discreet phrases repeated over and over many times. For instance, it might be desirable to follow the standard warning signal with information to prepare for a fire bomb attack. The word "fire" could be repeated over and over again many times. If it should be expedient to instruct the populace of an entire area to evacuate in a certain direction, the words "Go North" could be repeated over and over again until it was reasonably certain that all people outdoors understood.

The second question, of whether present-day electronic systems can put out adequate acoustic power, is another matter, particularly in view of the fact that Civil Defense officials are continually crying for louder and louder signals. It appears probable that electronic systems can be put together with presently available equipment which will provide as strong a signal as a 2- or possibly 5-h.p. electric siren, although at an unfavorable cost ratio of two or three to one. Such systems might have a reasonably reliable radius of a quarter or maybe half a mile. Electronic systems to compete with high pressure air horns, high pressure steam sirens, and high horsepower gasoline-driven air sirens are entirely out of the question.

Conclusions

In closing, it is important to reiterate the seriousness of our immediate National Defense task and to cite two specific examples where audio can make important contributions.

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A printed instruction card on what to do in case of an enemy attack is put out by the American Hotel Association and was observed in a room in one of the country's most recently built modern hotels. This instruction card is headed "SIRENS, HORNS OR WHISTLES," and then follows with the instructions:

1. Step outside of your room and close the door.
2. Immediately sit or lie near corridor wall.
3. *Await instructions.*

Await instructions from whom? From bell-hops or possibly chamber-maids? Isn't this a pitiful direction for a public hotel which may house as many as several thousand transient visitors—men, women, and children?

Another instruction card put out by a County Civil Defense and signed by the director states: "The Red Signal is a sustained warbling wail on fire sirens, or intermittent blasts by fire horns or whistles, lasting about two or three minutes. This means an air raid within eight minutes. *If this is the normal fire alarm in your community, regard it as an air raid signal only if you hear similar signals at the same time from neighboring areas.*"

Need I say more?

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