ability is the great smoothing power of the motor generator set on a.c. line variations, which are present in every theatre supply voltage. Fig. 5 proves this statement graphically. Here, per cent variation in motor supply volts has been plotted against per cent variation in generator output volts, with the stubbornness of the generator in "holding its own" well illustrated. By way of contrast, the dotted line M-N gives the slope that would represent equal per cent change, which still might be tolerable in view of the smoothing effect on transient changes which rotor inertia would have. Efficiencies on late machines run in the order of 65 to 70 per cent from motor input to generator output.

Too much stress can hardly be placed on the desirability and advantage of locating the motor generator set out of the basement and close to the projection room. Modern sets are very quiet and need only a reasonably resilient mounting to overcome transmitted noise; while

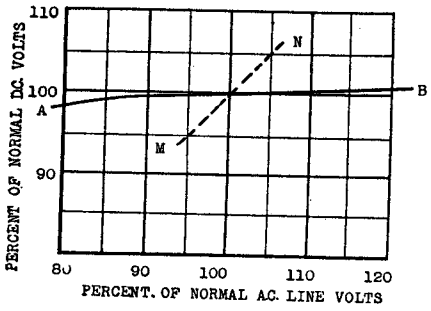


FIGURE 5

most theatre wall construction will satisfactorily insulate noises within the room provided there are no vents connected with the auditorium. Resilient mountings of various types and materials may be used, such as a good grade of soft cork, a coil spring arrangement, or rubber.

The National Electrical Mfg. Assoc. (NEMA), is working out standards of vibration and balance, using blocks of soft rubber. These blocks should be of a section that the weight of the unit will compress the blocks not more than 1/3 or ½ their original thickness. In any event, the set should not be bolted down after being placed on the resilient base, as this will almost cancel the effect of the special mounting.

Since the beginning of d.c. arc lamp projection the generator has been the least thought of and the most neglected of all the equipment involved in putting the picture on the screen, despite its extreme importance in maintaining the continuity of the show. There are examples of generators operating for twenty or twenty-five years and still in daily use. The writer knows of no other unit of projection equipment that could give such service.

MORE DATA ON THE W. E. MIRROPHONIC SPEAKER SYSTEM

By *R. C. MINER*

MEMBER, TECHNICAL STAFF, BELL TELEPHONE LABORATORIES

A SOUND picture reproducting system which gives aural effects approaching the clearness of a visual image in a perfect mirror has been introduced last year under the name of Mirrophonic Sound. One of the outstanding features of this new system is the loudspeakers, named Diphonic because all sounds below 300 cycles per second are fed into one unit while those above 300 are carried by another. This distribution is accomplished by a crossover network.

The high-frequency speakers, of which either one or two may be used, are attached to a horn as shown in Figure 2. Both horn and speaker are commercial adaptations of those used in demonstrating the transmission and reproduction of symphonic music in auditory perspective between Philadelphia and Washington in 1934. The horn consists of fifteen individual cells, each of which tapers exponentially from five-eighths inch square at the small end to eight inches square at the flared opening. The cells are brought so close together at the small end that only a knife edge separates them, and at the large end they are arranged as compactly as the geometry of the arrangement permits. This multicellular construction makes the horn nondirectional.

A horn which has only a single air passage distributes sound uniformly over a wide angle at low frequencies, but concentrates the sound on the axis of the horn as the frequency increases. This condition is undesirable in a theatre since those sitting on or near the axis will hear too great a proportion of high frequencies compared with the low ones, while the reverse will be true for those sitting at the sides. In a multi-cellular horn of good design the various cells radiate sound of all frequencies and distribute it uniformly over a wide angle, thus giving a correct proportioning of all frequencies for all parts of a theatre.

The walls of the individual cells of the horn consist of two metal sheets with an intervening layer of felt, all fastened to-

(*Continued on page* 22)

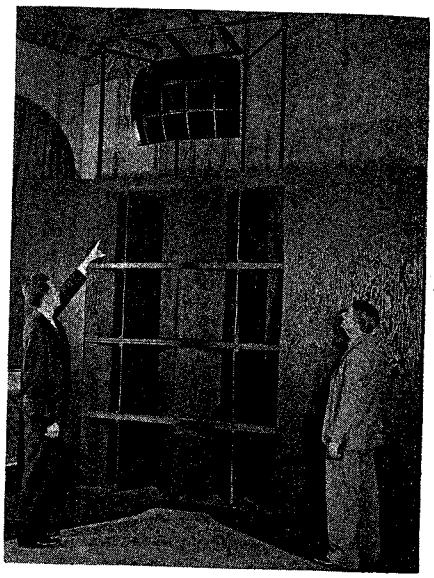


FIGURE 1

The Diphonic speaker comprises two units: one for all sound below 300 cycles, and the other for all sound above that frequency

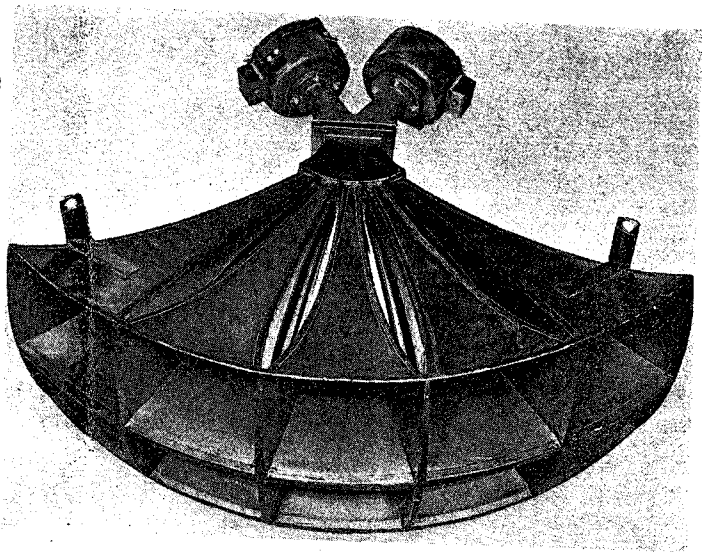


FIGURE 2

The high-frequency speaker has a multicellular horn to distribute sound uniformly throughout the theatre

bitter torture for years by reason of pulmonary ailments?

The Commissioner states that once the show is built-up, no further inspection or revision is necessary. He's wrong; film should be inspected after each showing. He states: work between reels totals only 5 minutes, while the double reel runs 20. Certainly; but what about a man being at the projector during these 5 minutes? While okaying apprentice boys, he alibis his approval of present classifications by citing the difficult B. C. examinations for license. Yet, his apprentice boys couldn't pass any classification! Pointing to Seattle, Coady cites motor rewinds "and only 19 fires in 7 years" there. Doesn't he know that motor rewinds are disapproved by every authority in the industry? Of course, what are 3 fires a year to the Commissioner—as long as he isn't there. He approves "automatic extinguishers." I. P. strongly disapproves such contraptions. So does every other competent observer. These gadgets are unreliable in operation, a definite hindrance to the projection process, and give off noxious fumes that are a menace to health. The Commission disapproves separate rewind rooms. Every projection authority recommends such rooms.

What is Commissioner Coady's score at this point? Answer: zero. We challenge the Commissioner to disprove any of the aforementioned statements. On the basis of the evidence adduced at the hearing, the Coady report is nonsensical in the extreme and utterly unworthy of an impartial body.

The W. E. Mirrophonic Speaker System

(*Continued from page* 20)

gether by a heat-softening cement. This makes a wall with very high damping to mechanical vibration and effectively prevents horn rattles. Assembly of the sixty similar walls into cells and of the fifteen cells and other parts into the completed horn is accomplished entirely by soldering.

The high-frequency speaker is shown in cross-section in Figure 3. The moving element consists of a diaphragm made of thin aluminum alloy to which is attached a cylindrical coil of many turns of aluminum ribbon wound on edge and held together by thin layers of varnish between adjacent turns.

To deliver the required amount of sound energy to the horn, the diameter of the diaphragm has to be considerably greater than the wave-length of the highest frequencies which it reproduces. If the diaphragm were coupled directly to the throat of a horn, the output at the higher frequencies would be greatly decreased because the phase of the sound coming from various parts of the diaphragm would differ. To eliminate these differences sound is taken from the diaphragm through several concentric annular passages so that the distance from any portion of the diaphragm to one of the passages is small compared with the wave-length of any sound transmitted.

The magnetic field for the air-gap of the high-frequency speaker is provided by a field coil wound for 24 volts, the voltage which is generally used with theatre equipment. Safety features such as a cover over the field terminals and various factors for convenience in installation and ruggedness which have been built into this speaker contribute materially to its satisfactory operation in the field.

The low-frequency speaker of the Diphonic system is also an improvement over those used previously in theatres. The driving element consists of four dynamic speakers of the cone type connected in a vertical row to a shallow cavity which flares out to a flat baffle. An approximately square post is mounted in the cavity directly in front of the speaker units so that the surfaces of the post form angles of about forty-five degrees with the plane of the baffle. Two thin vertical vanes are mounted in the cavity between the post and the sides of the cavity to aid in the proper distribution of the higher frequencies radiated by the loud speaker.

The construction of the parts which form the cavity and baffle is so rugged that it prevents the possibility of extraneous sound being radiated by mechanical vibration. The advantages of this loudspeaker are good distribution of its higher frequencies, improved efficiency, and elimination of resonance effects which tend to distort the quality of the sound by unnaturally prolonging certain tones.

The entire loudspeaker can be installed easily and dismantled quickly if required. It occupies a minimum of space on the stage and has small depth—an important consideration because some of the older theatres have very shallow stages. With its greater capacity for sound volume and improved distribution of all frequencies over the entire theatre the Diphonic loudspeaker is a notable improvement in sound equipment.

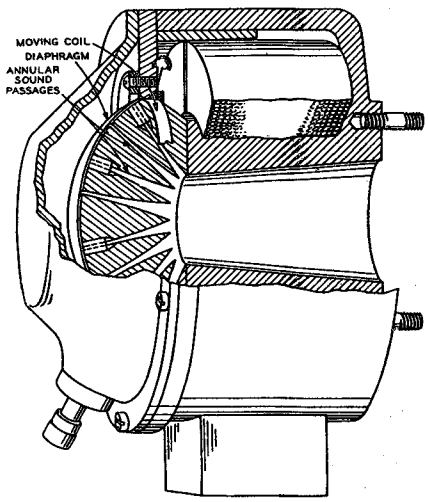


FIGURE 3

Sound radiated by the diaphragm of the h. f. units is conducted through annular passages to prevent interference effects

EXECUTIVE PROMOTIONS AT INTERNATIONAL PROJECTOR CORP.

Herbert Griffin (center) vice-president, announced promotion of A. E. Meyer (right) to General Sales Manager. Meyer, who served as Export Manager for many years, is succeeded by John Brozek (left).

less. The right-hand thread was stripped entirely; the other had no more than one turn left. These bolts were made up with unnecessary force and were hardly holding at all. A complete bind-up was averted only by the single turn still remaining in the left-hand hole.

Slightly larger bolts were obtained, the sound head casting was drilled out and re-tapped, a new and straight shaft was substituted, and the projector head was loosened in place and realigned. Some small damage had evidently been done to the projector, as some of the noise of operation and a small portion of the flutter still remained. Inasmuch as the head is slated for factory overhaul in the near future, further effort at clearing up these difficulties was deferred.

Lead-covered cable of the common type mentioned previously proved to be the cause of a comparatively simple case of sound outage in an installation some two or three years old. Whether the cable itself was older, having been held over from a previous installation, seemed probable from its appearance. In the common form of these cables, as everyone knows, the solid No. 19 wires are surrounded by rubber insulation, which in turn is surrounded by the lead sheath. The projection room walls in this theatre were sheet-rock mounted on angle-iron. The amplifier was bolted between two of the angle-iron struts.

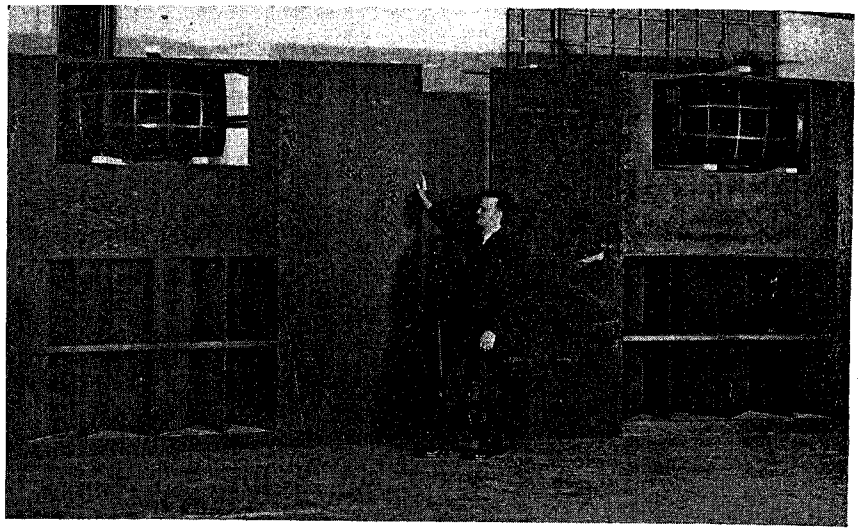
Sound outage occurred suddenly and was apparently cured by the random replacement of a tube in the amplifier. An hour later sound went out again, and installing still another tube in the same socket failed to help. Click test for sound applied to the other projector was not heard, eliminating the projectors from further consideration. The amplifier was then checked more intelligently by the simple process of flipping a finger-nail against the first tube. The resultant sound was heard in the monitor, eliminating the amplifier and the speakers, and confining the trouble to the amplifier input, fader output, or the cable between the two.

The tube that had been removed from the amplifier an hour earlier was then reinstalled, and the finger-nail test repeated. The same ringing sound was heard, indicating that the tube was not defective, but that there was some open or short circuit in the amplifier itself which had been adjusted temporarily by the slight jarring of replacing a tube in apparatus mounted on a shaky wall. One projectionist turned to the nearest projector and applied a click test for sound continuously, while the other man struck the wall repeatedly with his fist. Under these conditions the sound of the click test was heard now and then, confirming the suspicion of trouble at the amplifier input.

Inspection there showed that the lead sheath has been stripped back during installation about ten inches from the ends of the wires. Ten inches of rubber-covered No. 19 were exposed, and the rubber had cracked through age or other cause, leaving gaps of exposed copper as much as 1/16 inch long. Apparently one of these gaps had grounded or shorted the input circuit; at any rate, the click tests were heard continuously as soon as the projectionist pulled the wires toward him to examine them. Had the amplifier been more solidly mounted these wires probably would not have shifted position, and the same cracks in the rubber might have done no harm at all. Rubber and friction tape constituted a permanent cure.

A flagrant case of poor trouble work concerns repeated occurrences of line frequency hum which was traced to a modernized amplifier still using the older type, "bayonet" sockets. The hum disappeared when the tubes were taken out and their prongs cleaned with Carbona. On its second appearance the same trouble was eliminated by taking out the tubes, cleaning them as before, and also cleaning the socket prongs *with* the eraser on the back of a pencil. On the third occasion neither remedy sufficed until new tubes were installed.

When the trouble appeared for the fourth time (in as many weeks) the back of the amplifier was opened and the sockets inspected. Scrapes and abrasions were seen all over the backs of the socket prongs. The side edges of some of them were actually "chewed up." Unquestionably the same sockets had caused hum in the past, and someone tried to improve contact with a screwdriver! There can be no permanent remedy now other than new sockets.



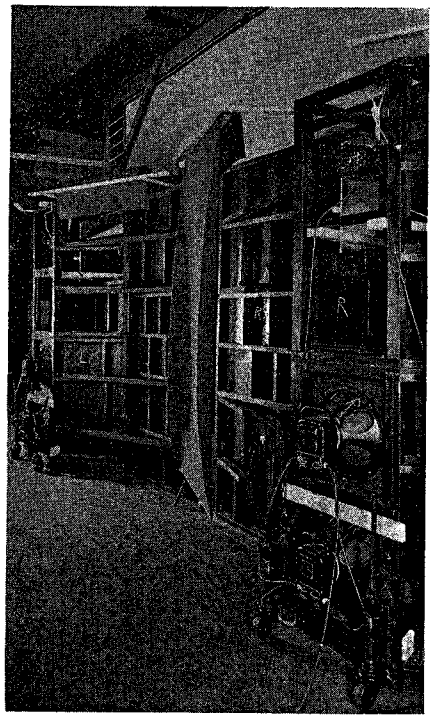
Front view of the two loudspeaker systems used for Stereophonic reproduction. This is an experimental setup and differs from the regular theatre installation in which the two h. f. multi-cellular horn units would be placed further above the l. f. units than is shown here.

NOTES ON ERPI'S STEREOPHONIC SOUND PICTURE SYSTEM

RECENT demonstrations by Erpi of its Stereophonic, or "three-dimensional," sound recording and reproduction system, having been confined almost exclusively to the Metropolitan New York City area, have elicited numerous inquiries from the field as to its nature and potentialities. This brief presentation, including the accompanying illustrations, is an attempt to convey such information regarding this new system as has been made available to date.

The Stereophonic system is an attempt to "localize" the sound, that is, to have the dialogue and sound effects emanate directly from the point of origin on the motion picture screen. In such a demonstration, a ping pong game is shown on the screen and the sound of the bouncing ball follows the exact path of the ball itself. So accurate was the "sound path" of the ball as it traveled from one side of the net to the other, it was easily possible to close the eyes and tell at any instant which side of the net the ball happened to hit. At one point of the game, the player missed the ball and it bounced off the table and disappeared behind the player. The *sound* of the bouncing ball likewise went to the floor and appeared to recede beyond the line of vision on the screen.

"In present-day sound pictures we obtain only an illusion of sound coming



Behind-the-screen view of experimental Stereophonic theatre speaker system. Two complete speaker systems are usually seen. Above is not a finished theatre job

from the point of origin on the screen," said Mr. J. P. Maxfield, of Erpi, who figured prominently in the development of this new system. "Actually, it comes from a fixed point behind the centre of the screen with no direction or space-relationship. If, for instance, we see someone playing a piano on the screen, our ears and our eyes tell us that the sound of the piano is coming from the *keyboard* of the piano because we see the pianist strike the keys. There is no effect of sound motion on the screen. Stereophonic recording and reproduction provides this sound motion or direction.

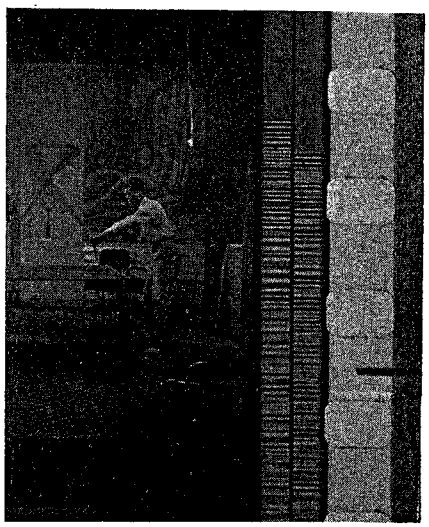
"The reel of Stereophonic recordings demonstrate this effect. In one sequence a woman plays a short piano selection, and the notes of the piano actually come from the strings behind the keyboard, and the *distance* between the bass and treble strings is easily discerned. In another scene a large symphony orchestra plays. The location of the choirs or individual musicians in the orchestra is easily discerned by the sound coming directly from each instrument.

"A short skit is also presented which opens with a darkened screen. A clock is heard striking and the audience involuntarily looks to the right of the screen to see it. A telephone rings and the audience looks to the opposite side to see it. When the lights come up revealing a living room set, the clock and telephone are in the exact positions in which the audience had looked.

Two Channels and Double Track

"In ordinary sound pictures of today, sound is picked up with one microphone amplifier channel and recorded on only one sound track. The condition is actually similar to hearing with only one ear. In the Stereophonic system, sound is picked up by two channels and *the output of each is recorded on a separate sound track on the film.* In other words, there are two separate sound tracks on the film each of which is a recording of just one channel. In reproducing the two sound tracks in the theatre, the output of each track is fed to a separate set of loud-speakers at the sides of the screen. The effect on the listener is that he is actually enjoying 'two-ear hearing' (binaural) instead of 'one-ear hearing.'

"How soon Stereophonic recording will be incorporated in regular production is a matter that rests with the production companies. Ultimate naturalness in talking pictures will be accomplished only when color, stereoscopic photography, and stereophonic recording are combined and presented together in the motion picture."



Note double track of Stereophonic recording. (Note: Position of track is the engraver's idea, not ours.—Ed.)

Comparative Operating Costs of Low-Intensity SRA and Suprex Carbons

(Power data was computed on the basis of source of average efficiency)

TRIM	Arc Amps.	Arc Volts	Inches Consumed per Hr.	Aver. Stub. Inches	Aver. Carbon Life Hours	* Net Price per Carbon	*Carbon Cost per Hour	POWER DATA: Arc Watts	Effic. Line to Arc	Line Watts	Power Cost per Hour @ 2¢	Power Cost per Hour @ 4¢	Total Arc Cost per Hour @ 2¢	Total Arc Cost per Hour @ 4¢	Approx. Lumens on Screen	Relative Amount Screen Light
SRA																
12mm. x 8"	32	55	2.76	1¾	2.26	$.049	$.0217									
8mm. x 8"			2.45	1¼	2.75	.056	.0203									
							.0420	1760	48%	3670	$ .0734	$ .1468	$.1154	$ .1888	2300	100
"SUPREX"																
6mm. x 12"	40	34	9.99	2⅜	.95	.1086	.1144									
5mm. x 9"			4.58	2⅜	1.42	.042	.0296									
							.1440	1360	60%	2265	.0453	.0906	.1893	.2346	3100	135
7mm. x 12"	45	34	8.8	2⅜	1.08	.112	.1036									
6mm. x 9"			3.7	2⅜	1.76	.063	.0358									
							.1394	1530	60%	2525	.0505	.101	.1899	.2404	4500	195
8mm. x 12"	60	33	8.0	2⅜	1.19	.119	.100									
6.5mm. x 9"			4.2	2⅜	1.55	.0644	.042									
							.142	1980	60%	3300	.066	.132	.208	.274	5300	230
8mm. x 12"	65	37	11.07	2⅜	.86	.119	.1385									
7mm. x 9"			3.66	2⅜	1.77	.0666	.0377									
							.1762	2405	60%	4000	.080	.160	.256	.336	6200	270