16mm Motion-Picture Theater Installations Aboard Naval Vessels

By PHILIP M. COWETT

The Navy's shipboard motion-picture installations, involving special location problems calling for equipment of great flexibility, and acoustic problems complicated by high noise levels, are briefly described.

We have presented to this Society at various times the Navy story regarding the problems incurred in the procurement of film of adequate quality to meet the needs aboard ship. We have never, however, described before this Society the theater installations utilizing 16mm equipment aboard Navy vessels located throughout the world. These installations generally break down into categories of ships such as destroyers, aircraft carriers, battleships — each with its own specific problem. The purpose of this paper is to describe some of these installations and set forth the Navy's program at this time with regard to 16mm film and its professional use as a serious entertainment medium.

Following the last world war, a survey was made of the various overseas shore-based activities and ships to determine whether they desired to continue with the use of 35mm film and equipment or convert to the equivalent in 16mm with its obvious advantages with regard to transportation, handling, lack of fire hazard and so forth. This resulted in the report from the various polled activities that 16mm would be very desirable from the standpoint of naval use if equipment could be procured that would match the 35mm equipment characteristics.

Obtaining adequate equipment became a separate project which resulted in the development of two projectors meeting identical performance requisites. As to the equipments themselves, they have been described in the paper presented before the Society by Orr and Cowett in 1951.[1] Very little more need be added as to their performance.

As may be realized, a naval vessel is designed and constructed for one purpose — and that purpose, unfortunately for the motion-picture viewer, is not the showing of motion pictures. Since nothing is allowed to take place aboard ship which will interfere with the prime mission of the ship, our activities must accommodate themselves in any manner possible. One thing, however, becomes readily apparent, and that is the absence

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of acoustic treatment in any part of the ship. Therefore, there is really no best location for the evening show.

The first, or simplest type of installation, is that to be found aboard a destroyer or lesser craft. In this case the particular vessel is assigned a standard portable equipment, comprising a projector, 20-w amplifier, and 25-w loudspeaker. Individual ships sometimes manufacture portable bases for themselves, but none are provided as an allowance item. Figure 1 shows a single equipment (except for the loudspeaker) on board an LST.

Since the distances of throw are varied and limited, and the availability of permanent locations for the projection of film is nonexistent, it is essential that the equipment be easily portable. In good weather the shows are generally projected topside under the stars where high ambient noises are the rule. The projector, mounted on a steel stand, which is generally lashed to the deck, is set up in the most suitable location for the particular vessel, between 50 and 175 ft from the screen which measures approximately 9 ft 6 in. in width. With this vibrating platform as a projection booth preparations for the evening show go on. Vibration is due to the fact that on many types of vessels one of the two propeller shafts of the ship passes almost directly beneath the point where the projector is set up. Interconnection between the various units is established and the show is ready to start.

Of course the portable direct radiator type loudspeaker is mounted as high as possible close to the screen in order that adequate sound coverage may be obtained. There is not much in the way of height around the screen except the screen frame itself, which may or may not be able to support extra weight, since the screen acts as a sail and additional weight could cause it to buckle completely. When the ship is traveling by itself, with no particular time schedule for arriving at any one particular port, or where a ship can make up lost time, the Commanding Officer will normally reduce the speed of the ship to fifteen knots or less or even change course for the duration of the show. This permits a properly lashed down screen to remain in place without too much flapping.

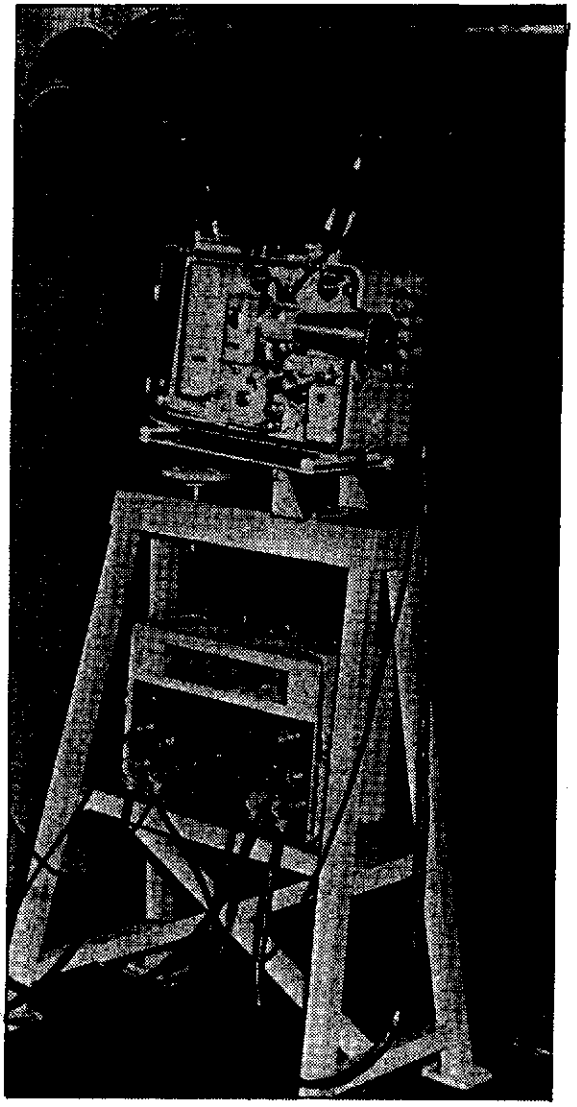


Fig. 1. Portable projector and amplifier.

It has been stated that two projection equipments had been developed—one a 20-w unit and the other a 5-w system.

The 5-w unit is aboard ship for training purposes, since a vessel of destroyer size is not large enough to warrant two projection equipments for entertain-

ment purposes alone. There is, however, a definite advantage in the use of even one 16mm equipment as compared with the 35mm, since we have to change reels only once every 45 or 50 min, whereas with 35mm, reel changing is much more frequent.

The 5-w equipment is designed with changeover facilities as is the 20-w equipment previously mentioned. Since both the 5-w and 20-w equipments have identical characteristics[2] and identical inputs and outputs including plugs and receptacles, the two can be interconnected in such a manner that a dual show may be given, without stopping the projectors for changing reels, and thereby accomplishing instantaneous changeover in the same manner as do professional 35mm equipments. In this instance the outputs of both projectors feed into the 20-w amplifier, and that 20-w amplifier provides exciter supply for both the 5-w and 20-w projection equipments, the 5-w amplifier being isolated.

Aboard larger vessels, such as a battleship or cruiser, a booth installation is involved. As in the previous instance, the high ambient noise still governs, and the same obstacles exist with regard to securing satisfactory sound distribution topside. Cross winds, engine-room blower noises, noise of the ship underway—all act to hinder the intelligibility of sound to a maximum extent. Of course, the effects of the moon on the picture are also noticeable.

Figure 2 shows a typical shipboard booth installation. The booth is mounted generally just abaft the main mast structure. The screen is located topside at the fantail, or stern of the vessel, and in some cases the distance between the only possible location of the projection booth and the only possible location of the screen is in excess of 200 ft. This installation consists of the following components: two projectors operating as a dual system mounted on specially designed projector stands, which include tilt plates, as in 35mm equipments, and mounting places below the projectors for the amplifiers. In addition a monitor loudspeaker, record player, film stowage space, rewind facilities, etc., are also available.

Changeover facilities are provided as in the installation previously described. The two standard Navy 20-w amplifiers are bridged at the front ends through telephone-type jacks. This allows a supply of an effective 40 w of power to the loudspeaker system located below on the main deck. Figure 3 shows the circuits involved in a cruiser installation.

Since the theater areas in ships of this type must be relatively long, as compared to their widths, and because of the various cross winds and miscellaneous noises encountered, it was necessary that a loudspeaker installation be designed especially for this type of ship. There is permanent ship's wiring between the projection booth and the loudspeakers themselves. The loudspeaker installation consists of two horns, or trumpet-type loudspeakers, mounted on the topmost corner sections of the husky screen frame. These horns are tilted to cover approximately the rear portion of the audience. They are parallel connected to one of the 20-w amplifiers in the booth which independently controls the volume and tone control characteristics of the sound from these particular loudspeakers. Portable-type direct radiator loudspeakers, previously mentioned, are mounted about halfway up on either side of the screen frame. These are tilted in the same manner as the horns; however, they cover only the front portion of the audience. They too are separately controlled by their own individual amplifier. The loudspeaker installation can be seen in Fig. 4. With this type of system the Navy endeavors to provide good quality sound, or as good sound as we can achieve under the particular topside conditions.

When the show is over the four loud-

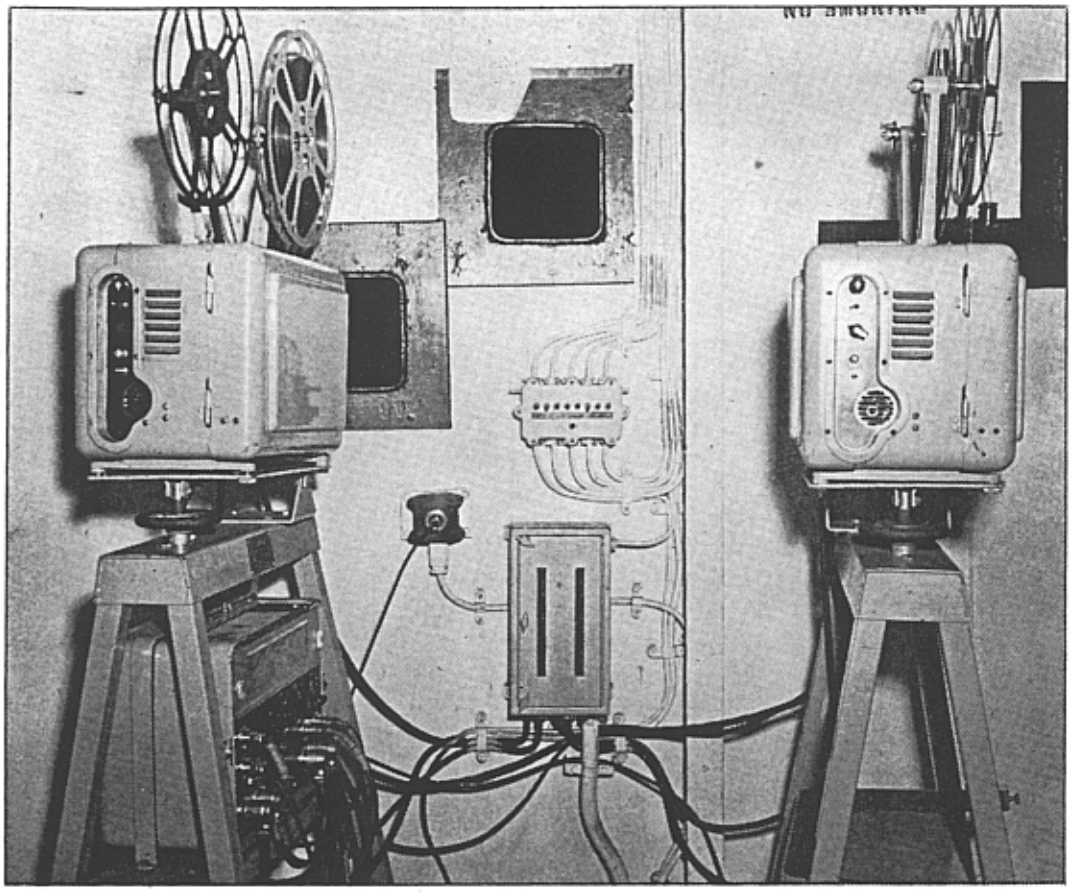


Fig. 2. 16mm shipboard booth installation (*Official Photograph*, **U.S. Navy**).

speakers and the screen with frame are completely dismantled and stowed away in assigned spaces until the following evening. During bad weather, projectors used generally for training purposes, the 5-w unit previously mentioned, or even the 20-w booth equipment can be taken into the wardroom, the crew's mess, or any other interior space and a reasonably good show given.

Projection below deck involves problems of steel bulkheads, decks, overheads, and so forth, which may result in some reverberation. The size of the audience is depended upon to deaden the sound. During inside shows dual operation of the projection equipments is not usually feasible in view of the fact that spaces are too small to hold the entire audience at one time. Therefore, shows are held simultaneously in several different compartments. Each show cannot start at the same time since reels must be passed from one projection area to the other.

A third type of installation would be that on an aircraft carrier, where extremely bad acoustical conditions result in a completely different approach to sound problems. The show, first of all, is presented in one of the hangar areas, normally used for the stowage and repair of aircraft. In some ships such an area is approximately 100 ft in width, 180 ft in length and 18 ft in height. The booth is mounted just below the overhead at one end of the area and projection is toward one of the hangar bay doors on which an 18-ft lace and grommet screen is mounted. A typical motion-picture hangar is shown in Fig. 5.

Projection distances of approximately 170 ft are average in our largest carriers. The projection booth is about the same as that on a battleship or cruiser — about

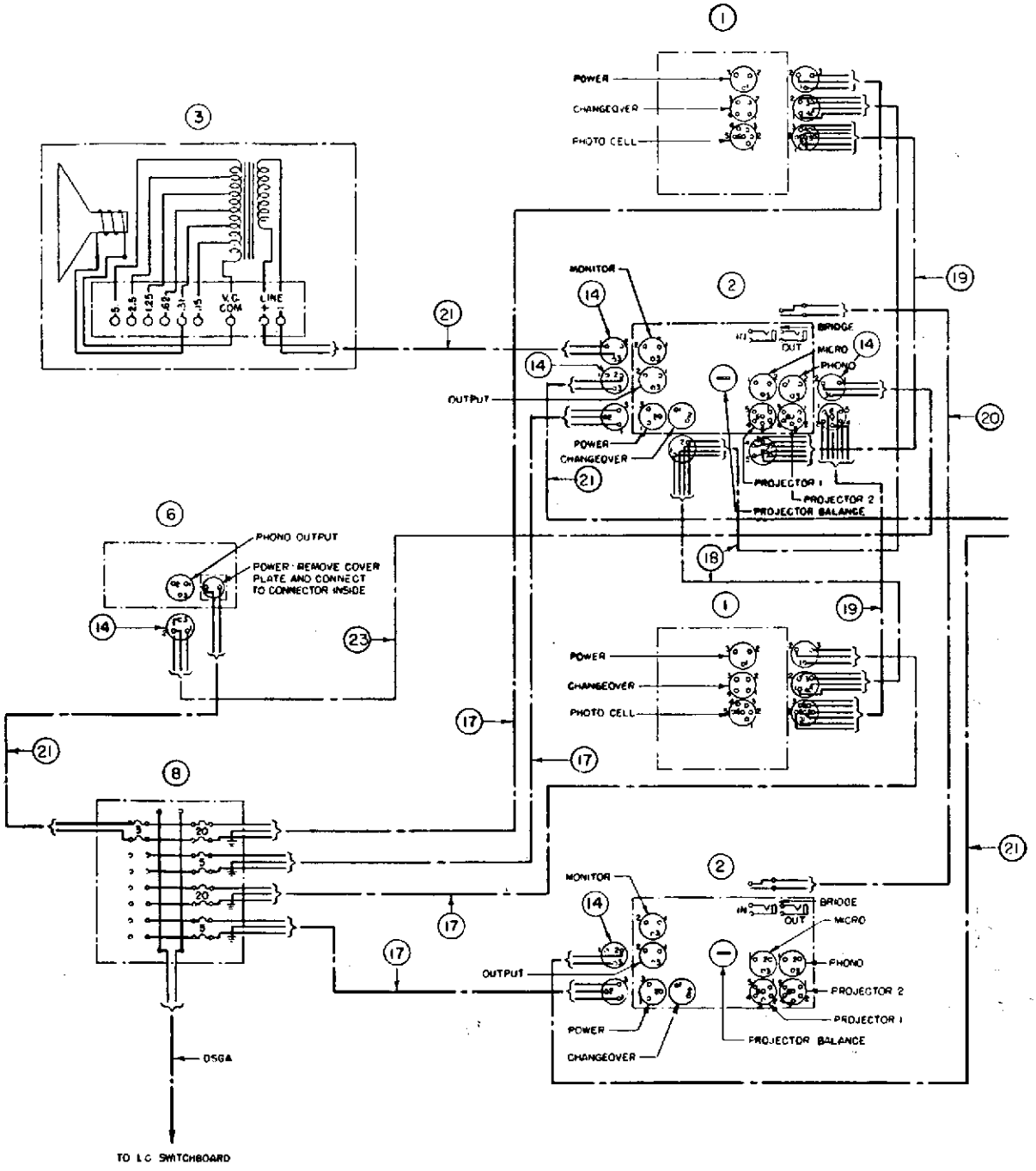
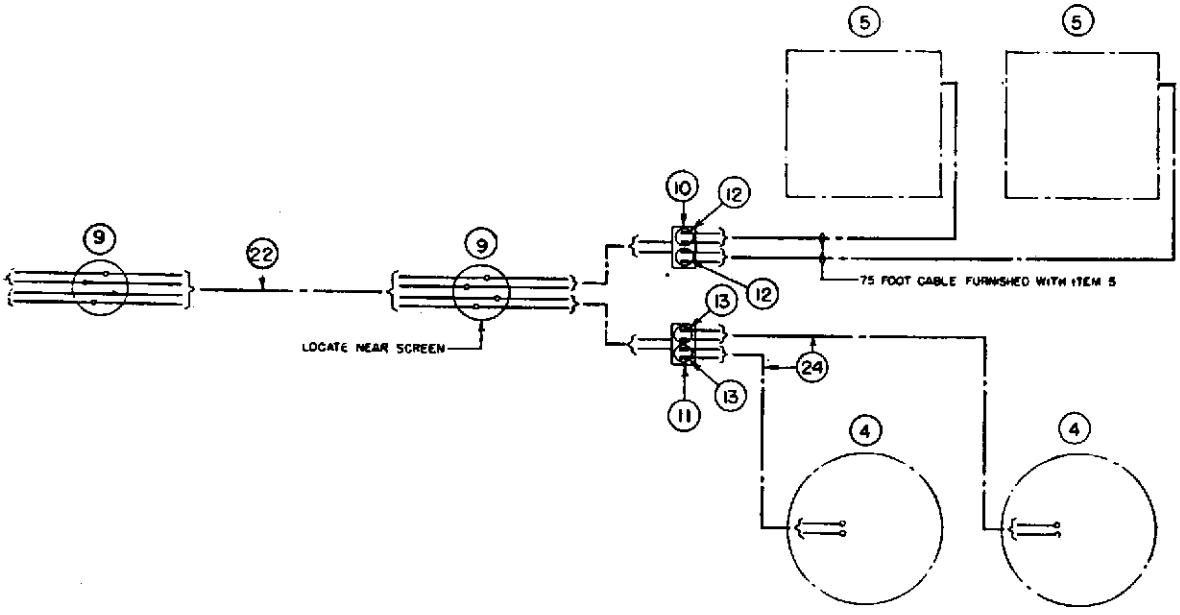


Fig. 3. Cruiser installation electrical wiring layout.



List of Material—Quantities for One Ship

Item No.	*Name*	*Qty.*	*Item No.*	*Name*	*Qty.*
1	Projector	2	15	Blkhd. mtg. bracket for sound reprod.	1
2	Amplifier	2	16	Studs for mtg. item nos. 3 and 15	8
3	Loudspeaker, monitor	1	17	Power cable assembly	4
4	Loudspeaker, horn type	2	18	Changeover cable assembly	1
5	Loudspeaker	2	19	Photoelect. cell cable assembly	2
6	Sound reproducer	1	20	Amplifier bridging cable assembly	1
7	Projector mounting base	2	21	TTHFWA 1½ cable, lengths as required	4
8	Distribution box	1	22	TTHFWA 3 cable, length as required	1
9	Branch box	2	23	Cable, shielded, 2 cond., length as required	1
10	Receptacle, double, W.T.	1	24	Cable, DCOP-2, length 75 ft	2
11	Jack box, W.T., telephone	1	25	Mtg. bracket for type IC/QDM loudspeaker	2
12	Plug, receptacle, SBM	2			
13	Plug, telephone	2			
14	Plug, three connection	5			

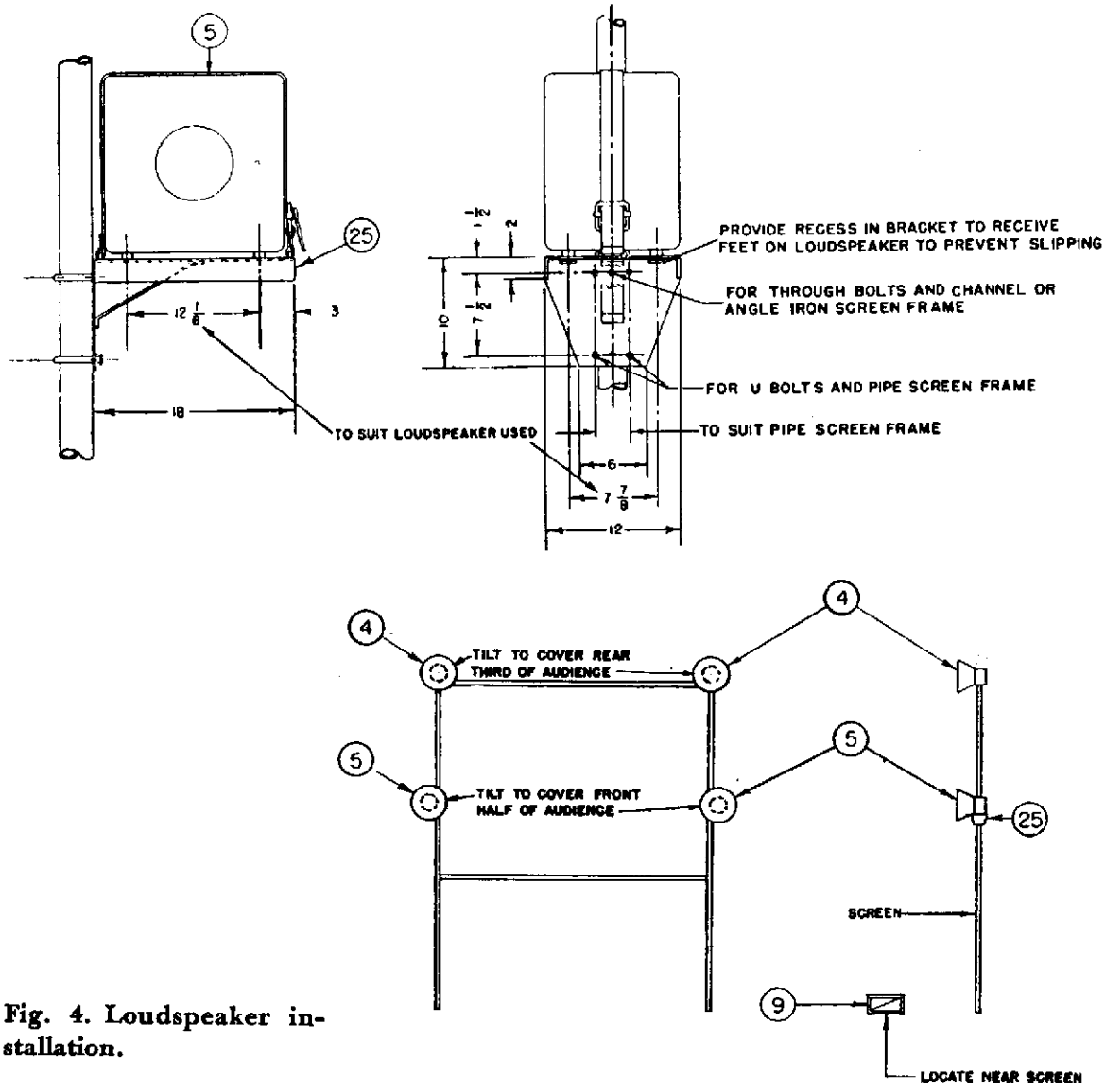


Fig. 4. Loudspeaker installation.

8 ft wide by 10 ft deep by 7 ft high. It contains a rewind table, a little stowage space, record player, and so forth.

The loudspeaker system is, however, completely different from any of the other systems used. Instead of the portable loudspeakers, a number of 12-in. loudspeakers in one-cubic-foot enclosures are mounted to the overhead and spaced approximately on 9-ft centers. Carriers of the *Midway* class have approximately 36 loudspeakers mounted to the overhead (Fig. 6). They are each tilted 20° toward the audience in order to minimize the reverberation which might be caused by the sound bouncing on the steel deck between rows of seats. As can be seen by the loudspeaker arrangement, space is allowed for a passageway in the middle of the audience. All loudspeakers are terminated in a switch control panel in the booth so that the quantity of loudspeakers on at any one time may be adjusted to the size of the audience. Advantage is taken of the sound deadening capacity of the audience and more loudspeakers are therefore connected as the crowd grows. This is a real advantage and allows maximum intelligibility from sound to be obtained. The loudspeaker system is powered by a

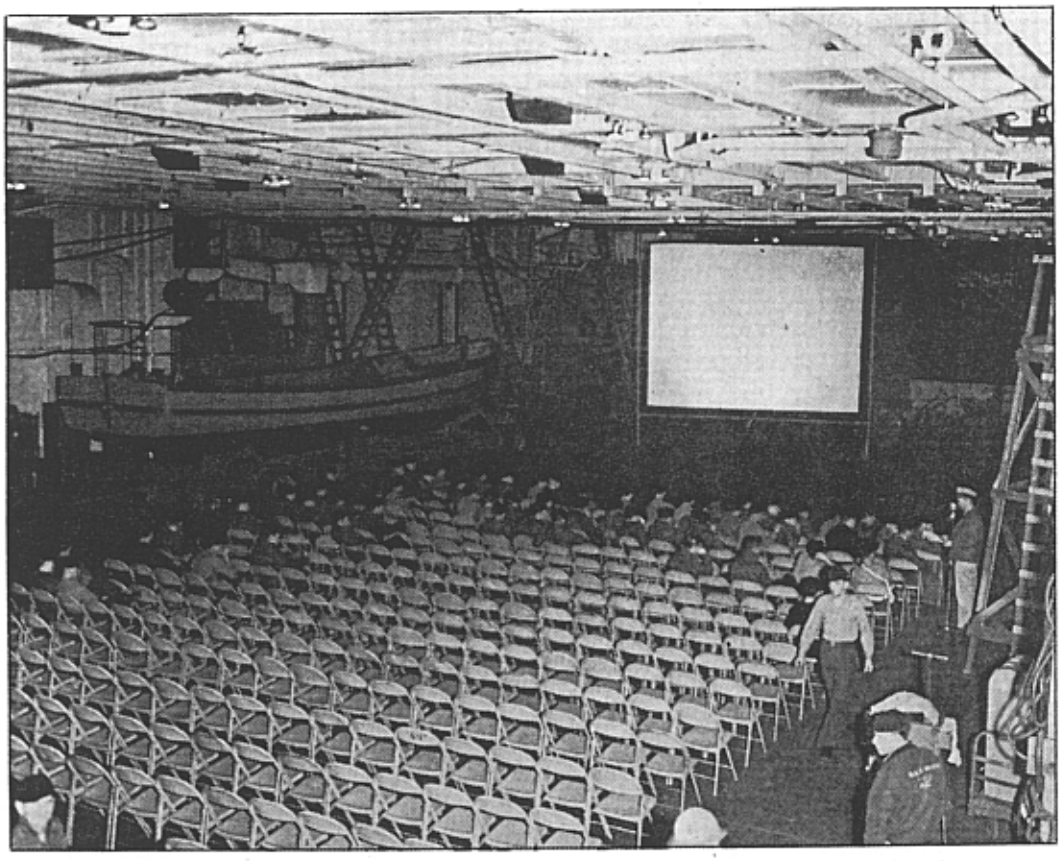


Fig. 5. Motion-picture hangar area, U.S.S. Oriskany (CVA34) (*Official Photograph*, **U.S. Navy**).

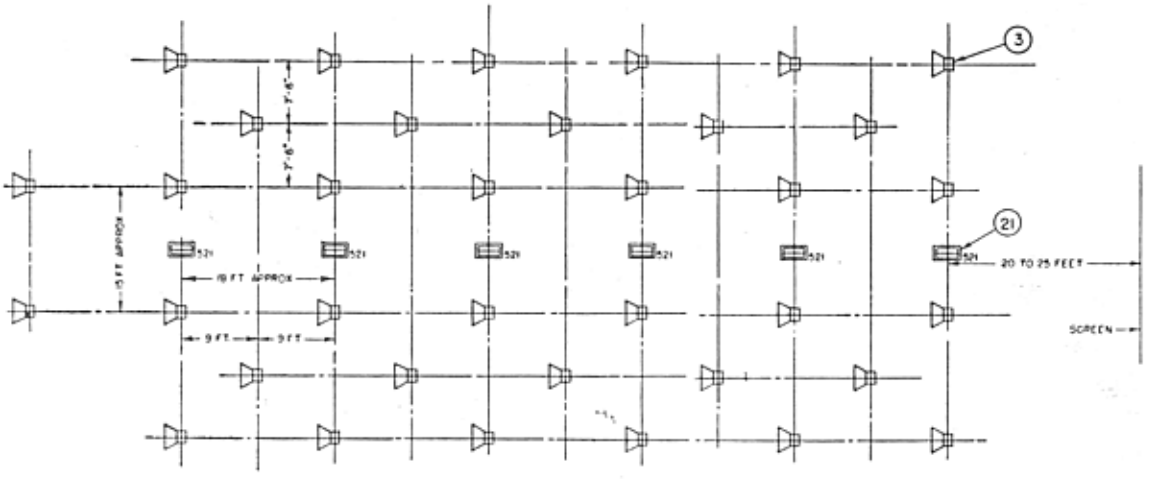


Fig. 6. Overhead loudspeaker layout for U.S.S. Midway class aircraft carrier.

constant voltage of approximately 100 v. Each loudspeaker enclosure contains a transformer which permits the sound output from any one particular loudspeaker to be adjusted depending upon the noise level of the area in which the loudspeaker is located. This, therefore, permits an even sound distribution to reach the entire audience regardless of the noise level surrounding any one person. It is obvious, however, that high ambient noises of 80 to 90 db, and

reflections and reverberations in the projection area provide serious obstacles to the hearing of highly intelligible sound.

This situation, however, is not unlike that in many industrial areas where loudspeakers are used for public announcing involving coverage over a wide area of enclosed space. Experiments are continually being made to solve the acoustic problems involved. Various types of loudspeakers and loudspeaker systems are being tested in order to procure a more satisfactory final result.

A perfect theater can never result from the efforts made in this direction since the spaces allocated for motion pictures on ships have to fill their primary combat functions first, and can be adapted only secondarily for motion pictures. This, then, means that sound deadening material must be held to a minimum. Inflammable materials are absolutely out, no matter how good their acoustical properties may be.

Only one 20-w amplifier is used to cover the hangar area and to feed the booth monitor loudspeaker. From Fig. 7 it will be seen that both projectors can be fed to one or the other of the amplifiers. Two projectors feeding into one amplifier can be instantaneously shifted to the input of the stand-by amplifier in the event of the failure of the working amplifier. Should other peculiar conditions arise, each projector may feed into its own amplifier with both amplifiers individually feeding into the same overhead loudspeaker system. The switches which accomplish this change are identified by the numeral 9 in the center of the figure. In this manner we have attempted to provide a system of maximum flexibility because the conditions of use are subject to change without notice, depending almost entirely upon the number of persons attending the show; that is to say, of the amount of acoustic or sound absorption material present in the hangar bay area. This, of course, would be in addition to the change of film itself.

References

1. Lowell O. Orr and Philip M. Cowett, "Desirable characteristics of 16mm entertainment film for naval use," *Jour. SMPTE, 58:* 245–258, Mar. 1952.
2. "Tentative recommendations for 16mm review rooms and reproducing equipment," *Jour. SMPTE, 56:* 116–122, Jan. 1951.