The Standardized 16mm JAN Projector

By GEORGE W. REUTELL, JR.

The standardized 16mm JAN Sound Projector was established by the Projection Equipment Committee under Standardization Working Group 402-40E of F.S.C. Group 67. The transition from three different projectors used by the Army, Navy and Air Force to a single projector was accompanied by design improvements for the new projector. Available conversions and accessories for this standardized projector are also described.

THE Defense Cataloging and Standardization Act, Public Law 436, which was enacted by the 82d Congress and affirmed by the 84th Congress in Public Law 1028, authorized the Department of Defense Photographic Standardization Plans and resulted in the organization of the Projection Equipment Committee in February 1957. All of the Services were represented on this committee, of which Philip M. Cowett of the Bureau of Ships was chairman. Details of the Plans have been covered by Mr. Cowett in a previous paper (*Jour. SMPTE, 66:* 535–537, Sept. 1957).

The Committee Assignment

The equipment to be examined by the Project Equipment Committee for the purpose of standardizing, improving and making it more economical was the 16mm JAN Sound Projector used by all three Services. The three different types of the same basic projector design that were being used had considerable differences in features, finishes and applicable specifications. The differences between these projectors were reviewed along with proposed improvements and applicable specifications. This work resulted in an improved standard projector which, when combined with available conversions and accessories, provided the Services with equipment suitable for small classrooms as well as large auditoriums, reproducing either optical or magnetic sound. The machine could also be adapted for television use and to record magnetic sound.

History of JAN Projector Specifications

The specification for the JAN Projector was written by the ASA War Standards Committee on Photography and Cinematography Z52, Subcommittee "D" in September 1943. This specification was the basis for Signal Corps Specification MIL-P-14103, U.S. Navy Specification 18P12 and the Joint Army-Navy Specification JAN-P-49. Cooperation between the Services during the initial development of the projector resulted in a common basic design with modifications to suit the special requirements of each of the three Services. The significant differences in the three types of projectors that existed prior to standardization were as follows:

(1) The Signal Corps projector was designated Type AQ-2A(2); the Air Force, Type AQ-2A(1); and the Navy, Type AQ-2(1).

(2) The color of the entire case of the Navy and Air Force projectors was gray, while the Signal Corps projector case was olive drab with black hardware.

(3) The Navy specified single-branded 6AQ5 amplifier tubes, the Signal Corps double-branded and the Air Force triple-branded.

(4) The Air Force and the Signal Corps projector nameplates were reverse-etched aluminum and the Navy, direct-etched monel.

(5) The rotary main switch for the Signal Corps and Air Force projectors was a good commercial grade, whereas the Navy used a switch developed especially for the Navy.

(6) The power plug for the Air Force and Signal Corps projectors was a modified commercial grade, and that for the Navy projector was a type covered by a Military Specification.

(7) The Air Force did not require that slip-over covers for the projector be supplied, whereas the Navy specified a gray plastic cover with a glass-fiber lining and the Signal Corps an olive drab duck cover with a sponge-rubber lining.

(8) An hour counter was supplied on each projector for the Air Force and Signal Corps only.

(9) The basic mechanism for converting to complete change-over facilities was included only on the Navy projectors.

(10) The Signal Corps and Air Force projector wiring was fused on one side of the line, whereas the Navy projector wiring was fused on both sides of the line.

(11) In general, different specifications were specified by the three Services covering such items as the projector itself, finishes, lenses and lubricants.

These three projectors, then, were the units analyzed part for part by the committee, along with a number of design improvements, the details of which will be covered later in this paper.

Problems and Procedure of Committee

This committee had a somewhat tedious job owing to the rather large number of parts involved and the complex specifications covering the equipment. The changes that had resulted in greater differences in these projectors over a period of years, when it was not necessary for the Services to standardize their requirements, had to be resolved. The resolved changes, along with those solicited from industry, were submitted to Bell & Howell with the request that a prototype model be made.

Since technical responsibility for this projector was assigned to the U.S. Navy, Bureau of Ships, testing of the prototype model was performed at the Brooklyn Naval Testing Laboratories. From the information thus obtained, and the detail changes made in the projector and accessory equipment, the applicable specification was then rewritten as MIL-P-49C, which is expected to be released during 1959.

The cooperative spirit of this committee was apparent in that agreement on the Standardized JAN was reached within one year after its inception. This accomplishment is an example that should be recognized in relation to the standardization possibilities that do exist if the responsible parties are given the proper authority.

The Standardized JAN

The differences between projectors were resolved as follows:

(1) The type designation of the projector was changed to AQ-2A(3).

(2) The color of the case and painted castings is gray.

(3) Amplifier tubes are single-branded, which is the less costly type.

(4) The nameplate is etched monel, which is required by the Navy because of the extreme corrosive conditions encountered on shipboard.

(5) The main switch is the improved type developed by the Navy.

(6) The power plug is the bladed type, covered by a Military Specification, which is more suitable for the rugged usage encountered.

(7) The projector slip-over cover is gray duck with a sponge-rubber lining.

Presented on May 4, 1959, at the Society's Convention in Miami Beach, by George W. Reutell, Jr., Bell & Howell Co., 7100 McCormick Rd., Chicago 45.
(This paper was received on April 20, 1959.)

(8) An hour counter is included on each projector to facilitate maintenance.

(9) Basic parts for conversion to change-over were not included in this projector.

(10) The projector wiring is fused on both sides of the line to provide maximum safety.

(11) Applicable specifications were standardized in MIL-P-49C.

The improvements incorporated in the standardized JAN Projector were as follows:

(1) *Lubrication.* All bearings were changed to an improved oil-impregnated, powdered-metal bearing, and the shuttle is oiled by a recirculating system capable of running for 1000 hr without re-oiling. Formerly, the shuttle and the bearings were lubricated through a system of oil lines; oil had to be added by the operator every 100 hr.

(2) *Reel-arm drive belts.* The reel-arm drive belts were changed to neoprene-impregnated fabric capable of 500 hr of operation. These belts replace stainless-steel spring belts which averaged between 40 and 70 hr of operation and frequently failed as the projector was being operated, necessitating an interruption in showing of the film.

(3) *Drive clutch.* The take-up and rewind drive clutches were changed to a spring-loaded ball to ensure positive drive. Formerly, these balls were actuated by centrifugal force.

(4) *Photocell.* The photocell was changed to a germanium diode. This new cell has a distortion of less than 3%; a much higher percentage was encountered with the lead sulfide cell formerly used. Its sensitivity variation is less than ±3 db, whereas that of the lead sulfide cell can run as high as ±20 db. Another advantage of this photocell is that the polarizing voltage can vary up to 100% either side of nominal without affecting the output level.

This new cell, along with the necessary amplifier wiring changes, greatly improved the sound performance by reducing second harmonic distortion and simplifying amplifier adjustment initially as well as in the field. The initial cost of the germanium diode is higher, but it is expected that subsequent production runs and reduced projector manufacturing costs will eventually make it comparable to, or lower than, the PbS cell in cost.

(5) *Drive-motor resistor.* The drive-motor resistor was changed from 150 to 100 ohms to reduce radiated noise and increase brush life.

(6) *Projector legs.* The projector legs were changed to heat-treated steel in place of cast aluminum to reduce failure due to severe handling and meet the drop test requirements of MIL-P-49C.

(7) *Magnetic conversion.* Facilities for conversion to magnetic-optical reproduce

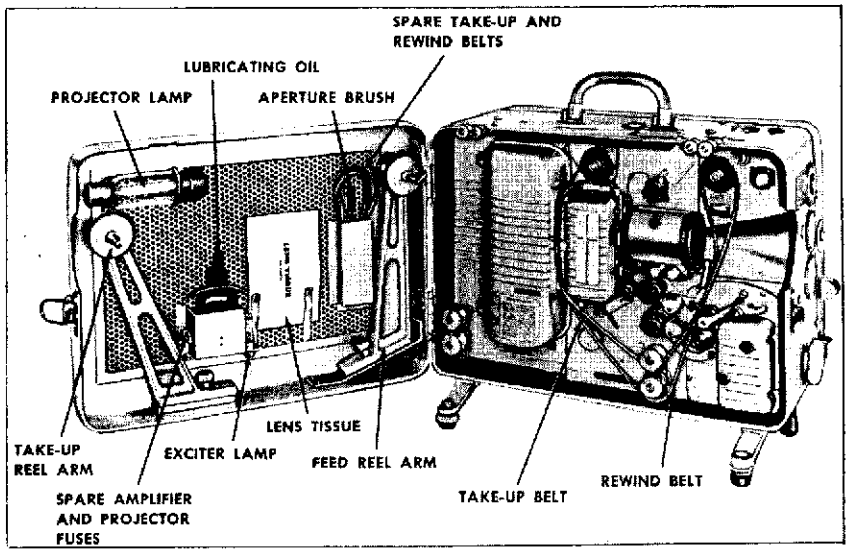

Fig. 1. Front view of the standardized JAN Projector with the door open.

were incorporated in the amplifier design. With this change, conversion is made merely by replacing the sound-head assembly.

(8) *Amplifier wiring.* Besides being changed to accommodate the new photocell, the design was changed from a semi-fixed bias to a self-bias system to extend output tube life. The "B" supply filter was also changed to reduce the hum modulation in the exciter supply, thereby improving the signal-to-noise ratio by approximately 10 db.

(9) *Spares.* Provisions were made to store a complete set of running spares within the projector. A set of reel-arm drive belts, exciter lamp, projector lamp, amplifier and projector fuse are stored on the projector door and a set of amplifier tubes, behind the removable amplifier panel.

(10) *Lens.* The rear condenser lens retainer was revised to facilitate removal for cleaning.

(11) *Tube shield.* A more efficient Nel type of heat-dissipating tube shield, developed by the Navy, was used to reduce the running temperature of the 6AQ5 tubes; tube temperatures were reduced from 220 to 185 C. This change, along with amplifier wiring changes, greatly extended tube life, as was evident from the results of the tests of the prototype unit. This unit ran in excess of 1000 hr without changing a tube and with no appreciable change in sound performance.

(12) *Exciter lamp socket.* An improved socket design was used to provide a more positive and safer construction.

(13) *Projector circuitry.* The complete projector circuitry was revised to reduce radio interference and radiated and conduced noise and to eliminate the necessity for shielding.

(14) *Hardening of parts.* The shuttle-spring mounting bracket and the intermediate drive-gear stud were heat-treated to reduce wear.

(15) *Speaker receptacle.* The external loudspeaker receptacle was changed to an improved type.

(16) *Sound shaft.* The sound-shaft bearings were changed from an unshielded type to a smaller, standard shielded type, and the method of spring loading was revised to a more positive design. This resulted in a more economical design and shielded the bearing against the harmful effects of dust or other foreign matter.

(17) *Motor brush removal.* A hole was added to the bottom of the projector case to facilitate replacement of the motor brush.

This completes the description of the changes made to effect standardization and to improve projector performance. The details for each of these changes were developed by the members of the committee and/or the Bell & Howell Company along with a number of other changes which were not adopted for various reasons. In the design and development of these changes, consideration had to be given to the available and proposed conversions and accessory equipment, to maintain standardization and flexibility. The standardized projector is shown in Figs. 1, 2 and 3.

Conversions Available

Facilities for picture and sound change-over when two projectors are used can be incorporated in the standardized projector to allow the showing of a film without interruption. Two projectors are connected with an interconnecting cable. Change-over is obtained by activating a pushbutton switch which operates a solenoid on each projector to lower a douser cutting off the light on one unit and simultaneously to raise the

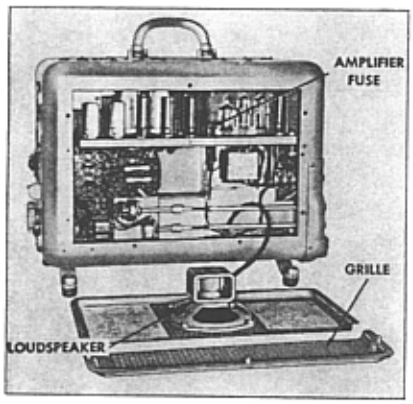

Fig. 2. Back view of the standardized projector with the grill and speaker panel removed.

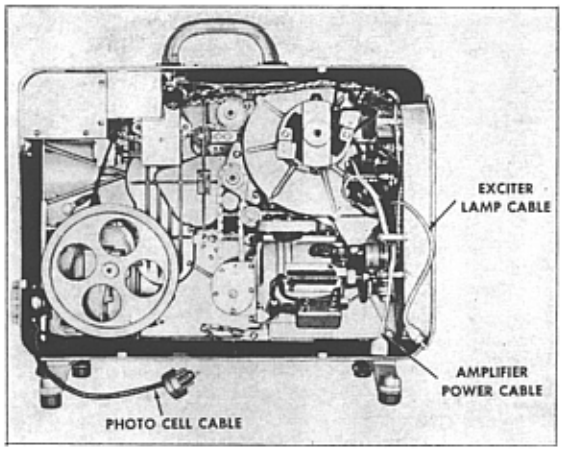

Fig. 3. Back view of the standardized projector with the amplifier removed.

douser on the second unit. At the same time the exciter lamp on the unit being cut out is turned *off* while that on the other unit is turned *on*. This projector, used extensively by the Navy, designated Type AQ-3(2), is identical to the standardized projector except that the necessary change-over parts are added.

Conversion to magnetic-optical reproduce is accomplished by merely replacing the soundhead assembly.

The standardized projector can also be converted to optical reproduce-magnetic reproduce and record. These conversions, available in kit form, can be accomplished in the field.

A special model of this same basic projector is utilized by TV stations. This model has facilities for reproducing optical or magnetic sound-tracks and is mounted on a pedestal which contains the switching panel and remote-control power supply, as shown in Fig. 4.

Accessory Equipment

Accessory equipment available includes a 16-ohm external loudspeaker, a booster amplifier and a mixer. These units are all matched and mounted in an individual case. If desired, the cases can be removed to mount the amplifier and mixer in a relay cabinet.

The booster amplifier is capable of 40-w output with a total harmonic distortion of less than 1%. It has an 8-ohm output to accommodate the external loudspeaker as well as a tap on the output transformer to accommodate a 70.7-v sound-distribution system. Means for bridging are also provided for increasing the power output to the desired amount. Frequency response is $\pm\frac{1}{2}$ db from 20 to 50,000 cycles/sec.

A three-channel mixer has also been developed for use with the booster amplifier. This mixer meets or exceeds broadcast performance requirements. Distortion is less than $\frac{1}{10}$ of 1% and the frequency response is $\pm\frac{1}{2}$ db from 20 to 50,000 cycles/sec.

It is apparent that this standardized JAN Projector, along with available conversion accessories, has an extremely wide application. With the ever-increasing use of training and entertainment film under conditions ranging from a small classroom to a large auditorium, and in any environment ranging from the tropics to the poles, this flexibility is mandatory from the standpoint of having the right equipment for the conditions encountered as well as having maintenance facilities and spare parts available at a minimum cost.

Standardization in Process

With the advent of the standardized JAN Projector, a most important initial step has been taken that will enable complete standardization and improvement of this projector and accessory equipment to realize the greatest possible cost savings. Standardization of the ordering, stocking and distribution of spares, detail drawings and technical manuals has been initiated but is not yet completed. Presently, each Service separately selects, orders and stocks the spares required. This also increases the cost of these spares in that the quantities are relatively small. The advantages of standardizing would certainly reflect a cost saving as well as facilitate maintenance throughout the wide areas in which this equipment is used.

Each of the Services currently requires a set of a different type of reproducible drawings and prints. The Navy uses the manufacturers' drawings, whereas the Signal Corps and Air Force require drawings to meet special requirements. In addition, a technical manual must be furnished with each projector. An entirely different manual is used by each of the Services.

Separate committees have been established for the purpose of standardizing drawings and technical manuals. The intent of the Defense Department standardization plans and the work accomplished by the Projection Equipment Committee have established the basic requirements for complete standardization of this equipment.

Discussion

George Lewin (*Army Pictorial Center*): What about the spectral response of this new cell? It must be different, because I understand you get less distortion now with certain types of dye track.

Malcolm Townsley (*Bell & Howell Co.*): The germanium diode does have a different spectral response from the lead sulfide cell which was formerly used. The changing of the distortion characteristic, however, does not seem to be because of the spectral response change but because of the electrical characteristics of the photocell and the circuit in which it operates.

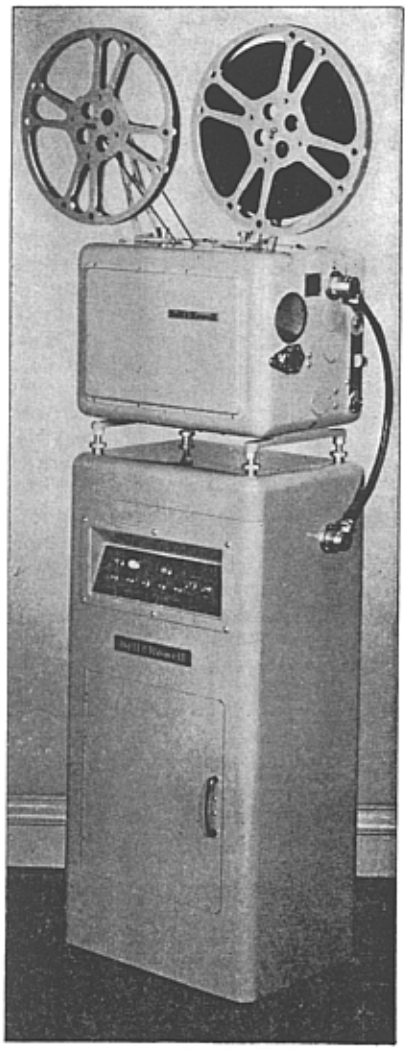

Fig. 4. The JAN Projector model used by TV stations.