The intermittent movement of the projector, as is the case with the camera, when properly interlocked operates at 1440 frames per minute—standard photographing and sound recording speed. Adequate provision is made to adjust the projector and camera movements to the interlocking motor system. The coupling flange on the intermittent movement is so designed that it may be secured to the shaft in any position. It is necessary only to open two clamping screws, rotate either the motor or the intermittent movement shaft while the one or the other is standing, and clamp the flange tightly again after the proper position is attained in synchronism with the camera shutter movement.

As in the case of regular projection room practice, it is necessary to adjust the lamp house to its correct position with relation to the aperture plate of the projector, to see that the special condensing system is in its proper relative position, and that the arc is burning at its proper capacity in order to clear up the entire screen and attain satisfactory and uniformly distributed screen illumination. If a "hot spot" occurs at the center of the screen, it is possible to remove it by mounting a small circular disk cut from fine copper mesh exactly in the center of the light-beam at the proper point in front of the lens. Experiment will definitely determine the distances required with lenses of different focal lengths.

There is, of course, very noticeable flicker upon the screen when using this type of projector, due to the single-bladed shutter that is used, so that it should not be used for normal projection of motion pictures. It is purely for process work, and, naturally, flicker is not noticeable to the synchronized camera under such circumstances. Should it be required to project standard motion pictures with this equipment, the shutter must be removed and the standard two-bladed shutter substituted. The equipment, of course, must be carefully handled, due to its extreme accuracy, and if expert attention is given it, it will give excellent service for an indefinite period of time.

RCA PHOTOPHONE HIGH-FIDELITY SOUND REPRODUCING EQUIPMENT*

J. FRANK, JR.**

In February, 1931, RCA Photophone introduced the first theater sound reproducing equipment operated entirely by alternating current. The rotary stabilizer sound-head attachment was introduced in December, 1932. Consistent development in the past four years in the improvement of reproducing apparatus has made possible the high-fidelity equipment.

Improvements in sound-film recordings during the past year and planned for the near future require reproducer equipments having increased reserve power output for satisfactory results. To meet these requirements a new line of high-fidelity sound reproducing equipment has been introduced. Considerably in-

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* Presented at the Fall, 1935, Meeting at Washington, D. C.

** RCA Manufacturing Co., Camden, N. J.

creased output, equivalent performance at lower cost, greater flexibility, and easier operation are all factors involved. The equipment is designed to reproduce class *A* release prints (certain producers release class *A* and class *B* prints, the former with a reduced recording level permitting extended volume range) satisfactorily in auditoriums of all sizes. The high-fidelity equipment is offered on an outright or conditional sale basis.

High-fidelity equipments are available with either a combined sound projector or with sound-head attachments for mounting with silent projectors. The sound projector is equivalent in performance to the Super Simplex silent projector. All the outstanding features of the high-fidelity sound-head attachment have been incorporated in this projector.

The sound projector and sound-head attachment employ a combined freely

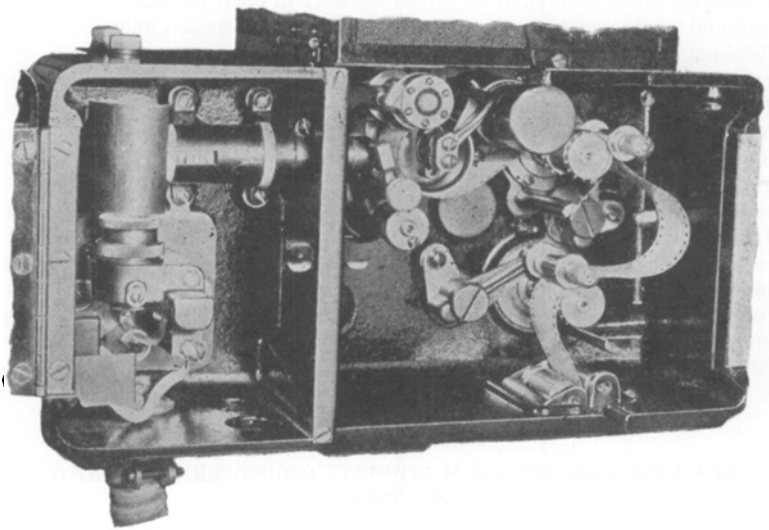

FIG. 1. Operating view of rotary stabilizer sound-head attachment.

revolving gate and rotary stabilizer to maintain constant speed of the film past the scanning light. Driving motors for all forms of power supply are readily interchangeable. The use of precision ball bearings throughout provides a construction that is trouble-free and has very long life.

The projector is available with a built-in incandescent lamp house for a 900- or 1000-watt lamp, a 30-ampere low-intensity reflector arc lamp house, or a 45-ampere high-intensity reflector arc lamp house. Power conversion apparatus is also available at additional cost. In addition to the built-in lamp house, other features include a motor, built in for quiet operation, gear drive throughout, 2000-ft. magazines, and a 3- or 5-point pedestal base.

All amplifiers are a-c. operated. Each unit is self-contained, with its own power supply unit. Standard RCA Radiotron tubes are used throughout. Amplifiers are designed for uniform reproduction of 40 to 10,000 cycles per second,

with means for adjusting the response characteristic to compensate for auditorium conditions and poor recordings.

These equipments all employ separate voltage and power amplifier units. From several points of view, this is desirable. The voltage amplifier unit has sufficient power to overdrive the power amplifier, without appreciable distortion from the amplifier unit. If for any reason the power amplifier should fail, operation can be temporarily continued with the voltage amplifier unit alone. If there are, in the future, any marked improvements in the methods of recording, necessitating either extension of the frequency range or the need for increased power output, units can be added to or substituted for the present ones.

The amplifier units are designed for shelf mounting; in a wall cabinet for the smaller equipment, and on standard channel-iron racks for the larger equipment. In the latter case, all the power equipment is mounted upon the rear panel, while the parts comprising the amplifier circuits are mounted upon a hinged shelf protruding in front of the rack. The hinged shelf feature permits easy access to all parts without the necessity of removing the unit from the rack. It also permits easy removal of the amplifier circuit portion alone. Capacitors are sectionalized and separately fused, which means that the failure of any one section will not cause sound "outage," but will merely cause slightly increased hum. The failure of the fuse can easily be determined by the operator. These units also include neon indicator lamps in the plate circuits of the tubes for assistance in determining the cause of failure of operation. Perforated panels are employed in front of amplifier tubes to permit quick inspection.

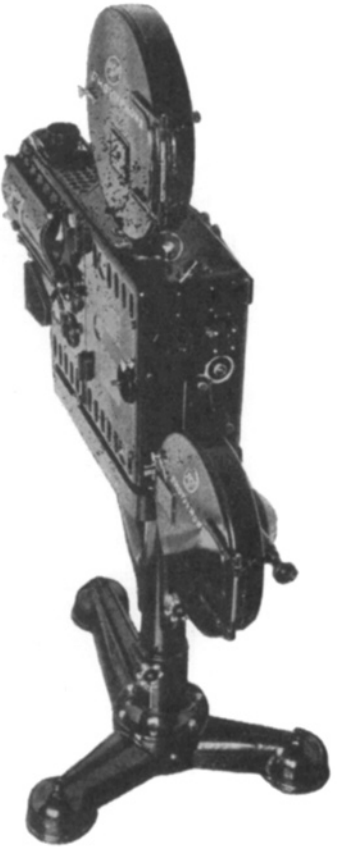

FIG. 2. RCA Photophone sound projector.

The larger equipment employs a low-impedance photocell coupled circuit, permitting locating the amplifier at some distance from the projector. The small equipment employs low-capacity coupling, requiring mounting the amplifier upon the wall between the projectors. Changing over the amplifier input from one projector to the other is accomplished by a switch located upon the front wall at each projector station. With the larger equipment, provision for variable control of the photocell output level is also provided. A remote volume control device is available for the larger equipment at additional cost.

A separate tube rectifier for supplying power to the loud speakers is furnished in a wall-mounting cabinet for location in the rheostat room. This unit furnishes d-c. excitation to a maximum of five speaker units upon the stage as well as current for the exciter lamps. In the smallest equipment, a-c. exciter lamps are used and speaker field excitation is derived from the amplifier circuit. For operation by direct current, rotary converters and starters can be supplied.

Loud Speaker Equipment.—The loud speakers are of the directional baffle type, with dynamic cone reproducing units. For the larger equipment a combination of straight baffle loud speakers for reproducing a range of 125 to 10,000 cycles per second and a folded baffle loud speaker for reproducing frequencies of 40 to 125 cycles per second are furnished. The straight baffle loud speakers employ a 6-inch dynamic cone unit. For large auditoriums, three or six are used, depending upon the size and shape of the auditorium. The low-frequency folded baffle loud speaker employs two 8-inch dynamic cone units. This combination of loud speakers has an over-all depth of only 26 inches, and can be flown with the picture screen or mounted in a cage on a monorail.

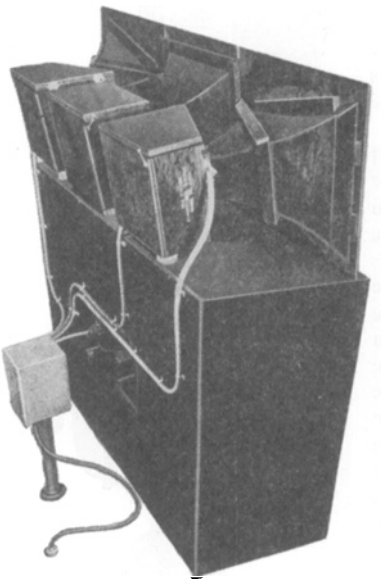

FIG. 3. Triplet and low-frequency loud speaker combination.

The high efficiency and directional characteristics of the loud speakers make it possible to cover the auditorium uniformly, with minimum reflection from walls and ceiling. An electric circuit cutting off the response of the low-frequency loud speaker below the range of the fundamental voice frequencies assures satisfactory intelligibility.

A compound directional baffle loud speaker, employing a single 6-inch dynamic cone unit, with an over-all depth of 21 inches is used with the medium-size equipment. Extended-range reproduction is attainable with this single loud speaker, which employs a straight horn for reproducing the high frequencies and an exponential horn for the low frequencies.

A straight directional baffle loud speaker, employing a single 6-inch dynamic cone unit, having an over-all length of 37 inches, is furnished with the smallest equipment. A short metal directional baffle loud speaker, employing a permanent field dynamic cone unit with a separate volume control, is furnished for monitoring purposes in the projection room.

Portable Sound Equipment.—This consists of one or two portable sound projectors, a portable amplifier, and a portable loud speaker. The single projector equipment consists of three cases, one each for the projector, amplifier, and loud speaker. The double projector equipment consists of five cases, one each for two projectors, amplifier, loud speaker, and second upper magazine.

Portable Sound Projector.—The portable sound projector is available with either an incandescent lamp house for a 900- or 1000-watt Mazda lamp, or with a 15-ampere, low-intensity reflector arc lamp. An a-c. exciter lamp is employed. Projectors are regularly furnished with a standard series *1* Bausch & Lomb 5-inch projection lens. Portable projector stands are available at additional cost. The

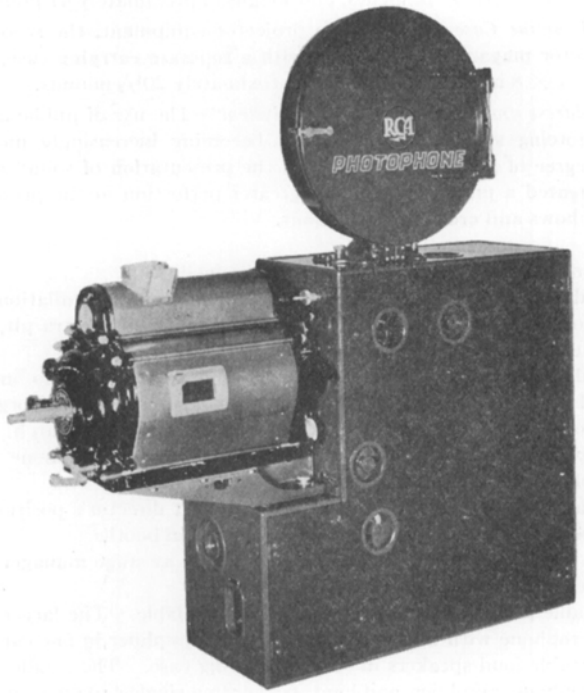

FIG. 4. RCA Photophone portable projector with 15-ampere arc lamp.

over-all dimensions of the projector are $43^1/_2 \times 13 \times 44$ inches; weight, approximately 106 or 129 pounds.

Portable Amplifier.—The portable amplifier consists of a voltage amplifier unit and power amplifier unit neatly mounted in a carrying case in such a manner that all controls are readily accessible. Two receptacles are provided for the output of each projector. A jack is provided for a close-talking microphone or a phonograph.

The amplifier units are similar to those furnished with the *PG-90* equipment. A tone control is included, for modifying the response. A 10-ft. power cable is furnished. The complete assembly of amplifier in case measures $18 \times 19 \times 11$ inches, and weighs approximately 52 pounds.

Portable Loud Speaker.—The portable loud speaker consists of an 8-inch dynamic cone speaker unit mounted in a carrying case of such construction that it acts also as a baffle. Included in the case is a wooden reel which carries 100 feet of loud speaker cable, and provision is made also for carrying one 2000-ft. upper projector magazine. The completed unit is of very rigid construction, and capable of handling the power output of the amplifier adequately. The unit in the case measures 20 × 19 × 12 inches, and weighs approximately 47 pounds.

Upper Magazine Case.—For double projector equipment, the second 2000-ft. upper projector magazine is furnished with a separate carrying case, measuring $17^{3}/_{4} \times 18^{1}/_{16} \times 8$ inches, and weighs approximately $20^{1}/_{2}$ pounds.

Public Address and Sound Reënforcing System.—The use of public address and sound reënforcing systems in theaters is becoming increasingly more gereral. The high degree of perfection attained in the presentation of sound motion pictures has created a public demand for greater perfection in the presentation of both stage shows and orchestral selections.

RCA sound systems provide all the following facilities:

(*a*) Sound reënforcement of stage program, involving installation of microphones in footlight trough, upon the stage, and in the orchestra pit, with loud speakers at the side of the proscenium arch.

(*b*) Sound reënforcement of vaudeville performance or vocal solo, involving installation of one or two microphones upon the stage or upon the organ console near the soloist, with loud speakers at the side of the proscenium arch.

(*c*) Public address system for announcements, with microphone located in manager's office, loud speaker in auditorium.

(*d*) Rehearsal address system, with microphone at director's position and permanent or portable loud speaker upon the stage and in booths.

(*e*) Stage manager's call system, with microphone at stage manager's position, and loud speakers in dressing rooms.

Two portable public address equipments are available. The larger includes a velocity microphone with desk stand and suitable amplifier in one carrying case, and two portable loud speakers in second carrying case. The smaller includes a carbon microphone, amplifier, and loud speaker in a single carrying case.

RCA Sonotone.—This equipment is available with either bone-conduction or air-conduction instruments, connected to double-jack boxes mounted beneath the arms of the seats in the auditorium. A separate amplifier, placed across the output of an RCA amplifier, or connected to a magnetic microphone hung in front of the loud speakers upon the stage, is employed.

RCA Trans-Lux.—Arrangements have been made with the Trans-Lux Daylight Picture Screen Corporation for marketing their patented device which provides for rear projection equipment in conjunction with RCA Photophone equipment.