NATIONAL BROADCASTING COMPANY

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TELEVISION LIGHTING

By

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National Broadcasting Company

Summary—*Lighting a television production presents many problems peculiar to this new field of public entertainment. These problems have necessitated the redesign of lighting equipment and the establishment of a simplified technic for handling the equipment that differs radically from moving picture practice.*

To cope properly with the lighting requirements of the continuous action sequences, characterizing television productions, a system employing inside silvered incandescent lamps in a standardized unit was developed by NBC engineers. Based on multiple standardized group of 1½ kw each, these units are used in both the foundation light and modeling equipment of the television studios in Radio City, thus insuring quantitative as well as qualitative control of lighting by the personnel.

With cameras generally in motion and an average duration of pick-up from one camera a matter of seconds, the problem of modeling in the sets becomes acute. This appears to be satisfactorily solved by the technic now in use wherein the major interest is centered around the close-up camera. Even this solution, however, required new and ingenious equipment to maintain light in the sets and still give floor precedence to the cameras and sound equipment.

While NBC at the present time has appeared to have standardized on the inside silvered lamp, exhaustive tests were carried out in an attempt to utilize more orthodox equipment. Actual tests under production conditions proved, however, that certain requirements of space, weight, and flexibility could not be had without a serious sacrifice of foot-candles on the set, resulting in the present set-up of equipment and personnel that are handling the television lighting assignment in the East.

ALTHOUGH the practical application of lighting to the presentation of television studio programs will admittedly be subject to further improvement, the imminence of a public television service warrants a description of the lighting equipment and operating technic which the National Broadcasting Company has worked out as a result of several years of experimentation in this field.

This description covers primarily the lighting developments since 1935 when the Radio Corporation of America launched an extensive experimental field-test of television. Of considerably greater scope

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than previous tests, it was designed to permit a pre-commercial analysis of the art through a combined appraisal of the laboratory-reared electrical system and a comprehensive survey of the problems introduced by regular production of programs.

Starting with studio lighting equipment similar to that used in moving pictures, we have gradually evolved a reasonably satisfactory solution of our illumination problem that has resulted in a new and interesting layout of equipment applicable to the demands imposed by television studio operation. This was achieved largely through simplification of the equipment and the technic involved in handling it.

To permit both engineer and director to discuss the lighting set-up with a common terminology, and thus facilitate presentations, we also simplified the existing abstract definitions of light into two separate and distinct classifications: namely, foundation and modeling light.

Foundation light, according to our standards, is the non-characteristic flat illumination of a set, irrespective of its origin or amount. It is primarily the light energy necessary to create an electrical picture in the cameras and provide a foundation to which we can add the characteristic or dynamic quality of modeling light.

Modeling light is any illumination that adds to the contrast or delineation of the picture. It may be from overhead, from the floor, or from the back, but according to our definition, it must create some characteristic highlight or shadow, as opposed to the flat illumination function of the foundation lights.

It was, then, the creation of a satisfactory lighting installation for television rather than the adaptation of equipment and technics geared to an older art that paced our developmental work. It may help to follow the reasoning behind our transition from motion picture lighting into the present installation of incandescent sources, if we consider chronologically the television studio work at Radio City during the formative period from 1935 to the fall of 1938.

A rough analysis of the requirements for a satisfactory system seemed to indicate that flexibility and efficiency were the paramount factors to be considered, although glare and radiant heat from the units had to be taken into account. Of necessity, the light produced had to be a high-level diffused illumination in quantities encountered only in the color-film studios. In addition, television required that the operation, upkeep, and maneuvering of this light be of such simplicity that one or two men could satisfactorily handle routine productions. We naturally turned to the standardized fixtures of the moving picture lots for our first tests. In the Radio City studio we installed routine spots and broads. Due to the limitation of a nineteen-foot ceiling, a practical light bridge was out of the question. As a

substitute, the major portion of our lighting equipment was installed on portable stands. Figures 1 and 2 show the arrangement of the apparatus for our first television program from Radio City in 1936.

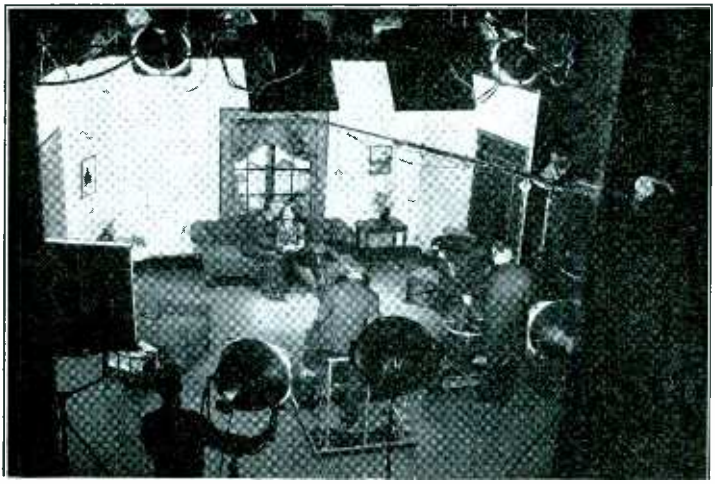

Fig. 1—A stage set-up in the television studio.

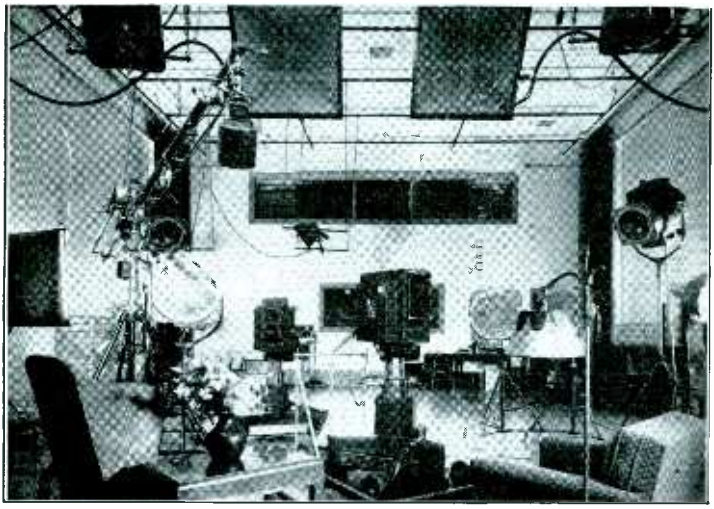

Fig. 2—View of studio showing equipment.

From a quantitative standpoint, we had little to criticize in this installation, but it was immediately apparent that the excessive glare and operational requirements of such a battery of lights precluded their general use in television. An attempt was made to redesign

and redistribute these units, but with little or no success, indicating conclusively that equipment of such power and concentration could not be left unattended throughout a television sequence and that the proper manipulation of this type of illumination required a lighting personnel of considerable magnitude.

Our next step was a gradual conversion from the concentrated type of unit to the more diffused and uniform light produced by scoop reflectors and floor broads. Focusing spots and suns were still maintained in the studio, but their function was limited to modeling rather than producing the foundation illumination. Lack of space for opera-

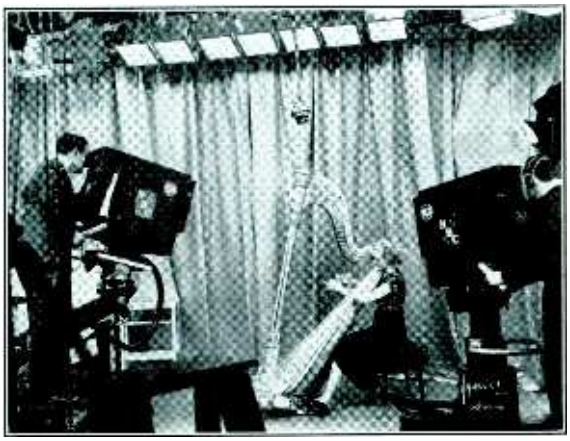

Fig. 3—Illumination by battery of 500-watt units.

tion, weight, and their general inefficiency coupled with unbearable glare on the set soon proved their impracticability even though the unattended light produced by high-efficiency lamps met the requirements of the production staff. During this period, little attempt was made to do more than spill into the sets a predetermined quantity of shadowless light lacking the characteristic modeling that might prove embarrassing in certain sequences. Such a technic reduced the personnel to a minimum, to be sure, but it also produced a television picture in the field that was flat, non-dimensional, and on the whole, highly unsatisfactory from the program standpoint.

Our next experimental step toward a television lighting system came with the installation of a battery of 500-watt units (Figure 3), each equipped with separate reflector and lens systems. These lights were positioned on a gridiron over a single set in such a manner that they would produce a cube of uniform, nondirectional illumination that, it was hoped, would approximate the character and modeling

obtained under high-intensity diffused light. Needless to say, the resultant picture showed the effect of flat front lighting. Again the spots and suns were brought out from the storeroom and put into operation as modeling units in an attempt to create above this pedestal of 1500 foot-candles the highlights and shades that had been destroyed by the basic arrangement of the foundation-light installation. Because this system of multi-unit lighting was the first radical departure from orthodox lighting practice and the forerunner of our present studio equipment, it might be well to go into more detail concerning its advantages and shortcomings.

Fig. 4—The single-six mounting.

Coupled with the failure of this installation to produce the required quality of light were several equally important deficiencies: namely, lack of flexibility, excess weight, and great heat radiation. By reason of the bulk of the single unit alone it was necessary to select a certain area to be illuminated, a limitation that required the program group to parade their subjects within the confines of a limited stage. This placed a definite limitation on the efforts of this program group. The weight of the installation closely approached the safe load limit of our acoustical ceiling, making impossible the addition of further equipment above the set to reinforce the existing light or to create special light effects. The unit inefficiency of each lamp, lens, and exterior reflector created an ambient heat problem that severely taxed the air-conditioning service to this particular studio. These deficiencies made the adoption of this system inadvisable but did indicate the direction of our next step.

Photometric tests, conducted in the studio, have already indicated that the new inside silvered spotlight would deliver into an area more light per watt than the lens, lamp, and reflector assembly or the standard incandescent bulb and exterior scoop. This new bulb was light in weight and of relatively small envelope size in the wattage required. It remained to design a fixture that would permit simple adjustment in elevation and direction to satisfy the requirements of the multi-set productions proposed by the program staff. Figure 4 shows such a mounting, known as the "single six." It incorporates

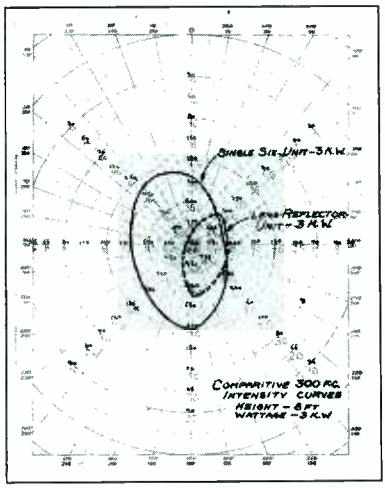

Fig. 5—Light distribution curves of single-six unit and lens reflector unit.

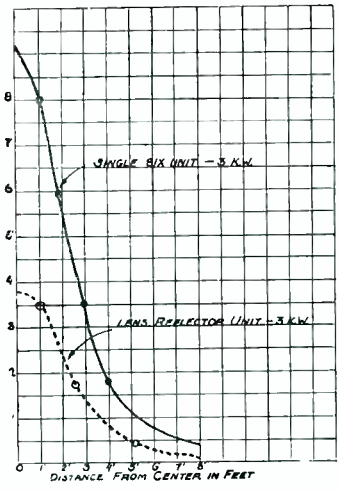

Fig. 6—Photometric distribution of the beam about the center-line.

six 500-watt spotlights on a framework of thin-walled steel tubing, so arranged that the center-to-center distance between lights is ten inches. This insures that the light-beams interlock at a distance of eight feet from the fixture and that the light arriving on the set is relatively free from spots and secondary shadows. The total weight of the fixture, equipped with spots, is slightly less than 19 pounds and lamped for three kilowatts produces an index of 18,000 units, compared with an index of 7650 units registered by an equivalent grouping of lens, lamp, and reflector units. Roughly, this amounts to an increase in usable light per watt consumed of approximately 240 per cent. The distribution of these two test fixtures is best demonstrated by referring to polar coördinate curves projected on an area of approximately 200 square-feet from a height of eight feet. In Figure 5 the 300-foot-candle intensity curve for the "single six"

is indicated by the solid line; that of the competitive fixture is shown dotted. Areas within these limits serve to indicate relative efficiencies, as the wattage, arrangement, and length of throw were held constant in obtaining the data. Figure 6, with the solid line again indicating the "single six," gives a general idea of the photometric distribution of the beam about the center line.

The mechanical arrangement for flexibility consists of a universal clamp for attaching the supporting arm to a gridiron, with rotational freedom possible at the fixture itself. A single adjusting screw allows

Fig. 7—The double-three unit.

the operator to set the bank for any desired angle or direction of throw with the framework arranged either horizontally or in a vertical position relative to the studio floor.

The first of the standardized installations consisted of eighteen of these "single-six" units mounted on the gridiron in such a manner that they could quickly and easily be brought into play on any acting area selected by the production group. As a space-conserving measure a few of these long units were reassembled in two rows of three (Figure 7), designated as "double threes." In certain sets where the light-concentration was high and space at a minimum, this arrangement was found to be more satisfactory from an operational standpoint. This type of construction was later mounted on portable stands for use as floor broads.

The "single three" (Figure 8), one-half of the "single six," was next brought into use for reinforcing light, background flooding, and as a general-purpose strip-light of minimum dimensions.

By standardizing the construction of our unit assembly we were assured of uniform spectral characteristics and distribution from each fixture rather than a spotty heterogeneous mixture of several types of light requiring careful blending on the set. A common standard of light-producing unit also allowed us to familiarize ourselves with

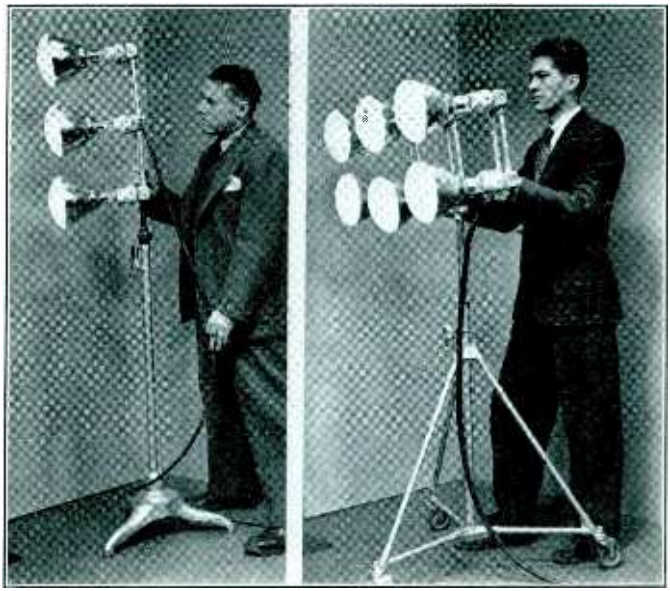

Fig. 8 *(Left)*—The single-three unit.
Fig. 9 *(Right)*—The floor broad.

the operation of the fixture and, by simple addition or subtraction, to meet the studio's quantitative light problems.

Shortly after completing the foundation-light installation we turned to the more complex problem of supplying the characteristic, or modeling, light from the floor. Here again, several problems confronted us, resulting in a partial redesign of the standardized mounting.

The floor broad (Figure 9) is identical with the overhead array except that it is mounted on a portable floor stand. Two of these units are used normally as reinforcing lights from stage right and left to create a rough modeling angle or to temper the shadows on the backdrops. In all cases, however, it was required that the operation of

these lights should give floor precedence to camera movement. They are, therefore, brought into play and taken out frequently during the course of a single sequence. The diffused characteristic of this light permits such an unorthodox procedure to be satisfactorily carried out without leaving an apparent hole in the set illumination.

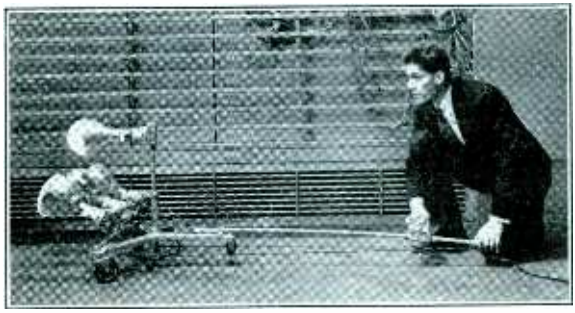

Fig. 10—Portable foot light.

Our modeling equipment is completed by the addition of two other units, the portable foot light (Figure 10) and the hand light (Figure 11). This floor light, working with and ahead of the close-up camera, is maneuvered to highlight the subject properly from this camera angle. Such a technic decrees that the intimate close-ups which pro-

Fig. 11—The hand light.

duce the best delineation of halftone value shall benefit by the best lighting. It is impossible, of course, to light each shot of each camera from the optimum angle in a studio where we find the duration of pick-up from a single camera sometimes a matter of seconds. We have, therefore, made it a practice to work toward the camera that best displays our wares, after making sure that the foundation lighting over the set is so arranged as to supply satisfactory illumination for the other cameras.

The hand light (Figure 11) is used to reinforce floor light in such sequences where a single camera shot can be safely modeled to the contrast limit. It is normally used on the wide-angle close-up camera and can be fitted with either a spotlight for contrast highlights or a diffusing lamp for the more subtle modeling.

We do not attempt to approach the contrasts common on the stage and in motion pictures. In television we are confronted with a highly compressed contrast range that permits modeling, to be sure, but also holds as a penalty for exaggeration a wash-out or a complete black. It is therefore necessary that we work well within these limits, since the review and criticism of our lighting technic is by the audience in the field rather than by a cutting-room jury. This, however, has not restricted the use of modeling light; the trend, on the other hand, being toward the greater contrast that the electrical system will accept, in preference to the flat non-dimensional pictures of past years. Experience gained by operation and observation appears to be the only rule in the use of these modeling fixtures even though we have endeavored to take guesswork out of the equipment.

Our failure to mention back-lighting does not mean that we have overlooked the possibilities of this type of illumination. In the studio sets we have yet to arrive at a reasonable system of back-lighting that will answer all the requirements of flexibility, weight, and operation. It is true that we now are using, in our main studios, an advanced type of remotely controlled ceiling light that appears to solve the problem, but since our findings to date are not conclusive, we felt that discussion of this system should be held for the future.

We make use of one other type of light that merits consideration. This equipment is known as the "portrait table," used as the name implies: in cases where the picture is primarily a portrait. Four lights are arranged at the outer rim of the announcing desk on flexible goosenecks adjustable as to height, angle, and throw. By substitution of various types of bulbs and variations of the wattage, detailed modeling of the face can be effected with a minimum of difficulty. This equipment also has portable back-lighting, which again is controllable, making the work shot of this table the television equivalent of a studio portrait.

This enumeration completes the catalog of our lighting technic and equipment in the National Broadcasting Company television studios. We have tested all reasonable systems of light production and are still carrying on these investigations. Lately we have been interested in vapor-lamps as a possible adjunct to the system, but the complications inherent in a three-phase power-supply and a water-

cooling system would appear to make further consideration of present models impracticable.

There have been many statements and many more conjectures as to the light used in television studios. We quote pertinent figures based on our last six-month period of operation. Our average set illumination was in the neighborhood of 1200 foot-candles of incident light. Our average modeling ratio was 2 to 1, while the average light load was slightly more than 50 kw of 110-volt d-c. Our lowest foundation lighting level was 800 foot-candles, a play in which the contrast throughout the set was carried to the upper limit of the Iconoscope. The highest foot-candle reading recorded was slightly less than 2500 foot-candles, a continuity where, obviously, little modeling was attempted.

In our work of the past three years, we feel that we have established a substantial foundation in television studio lighting on which we hope to base an even simpler system. If we appear to have standardized certain assemblies and particular light-sources, this does not mean that our development work has ceased. It continues with renewed vigor as we see our experiments bearing fruit.

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