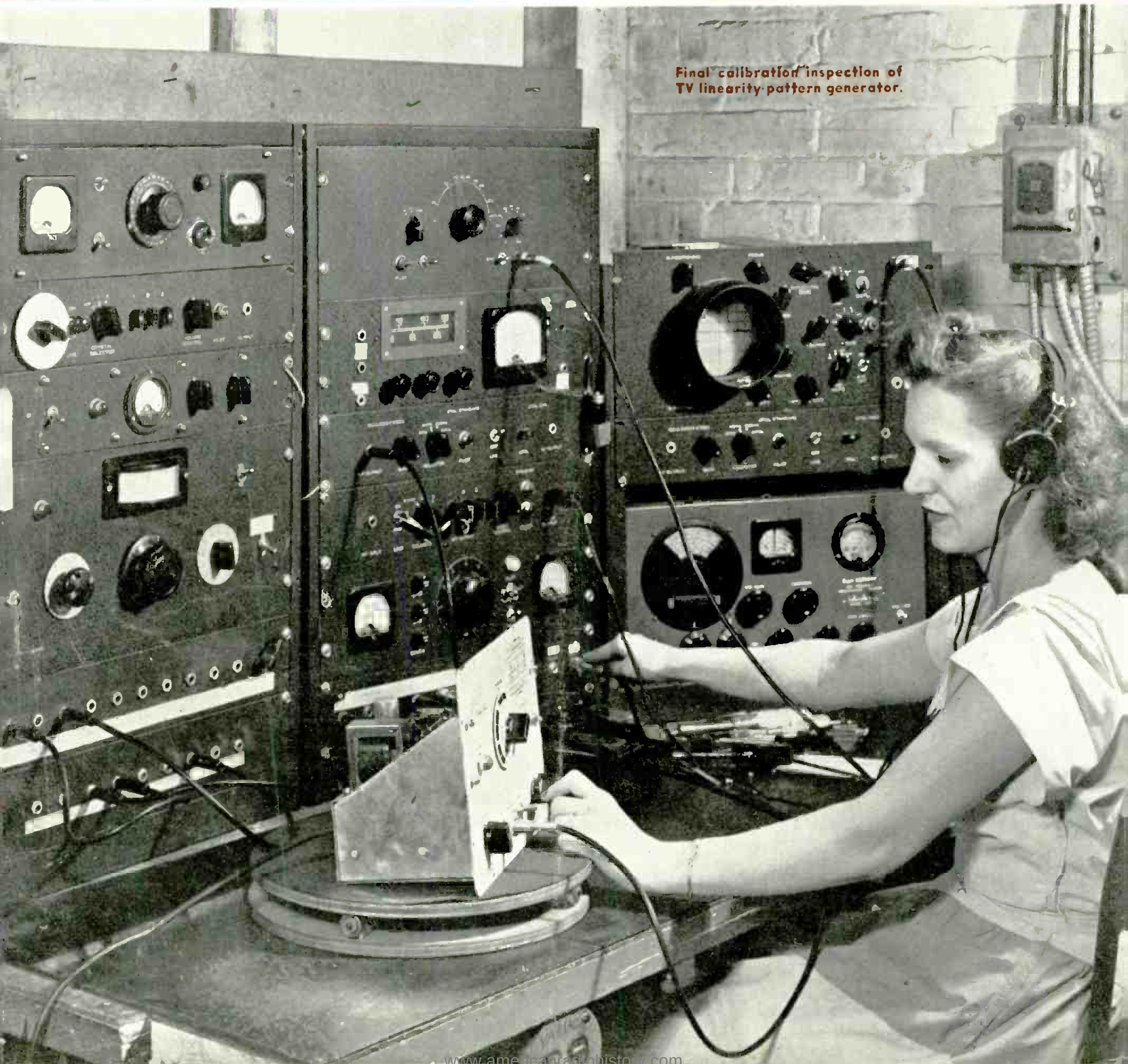
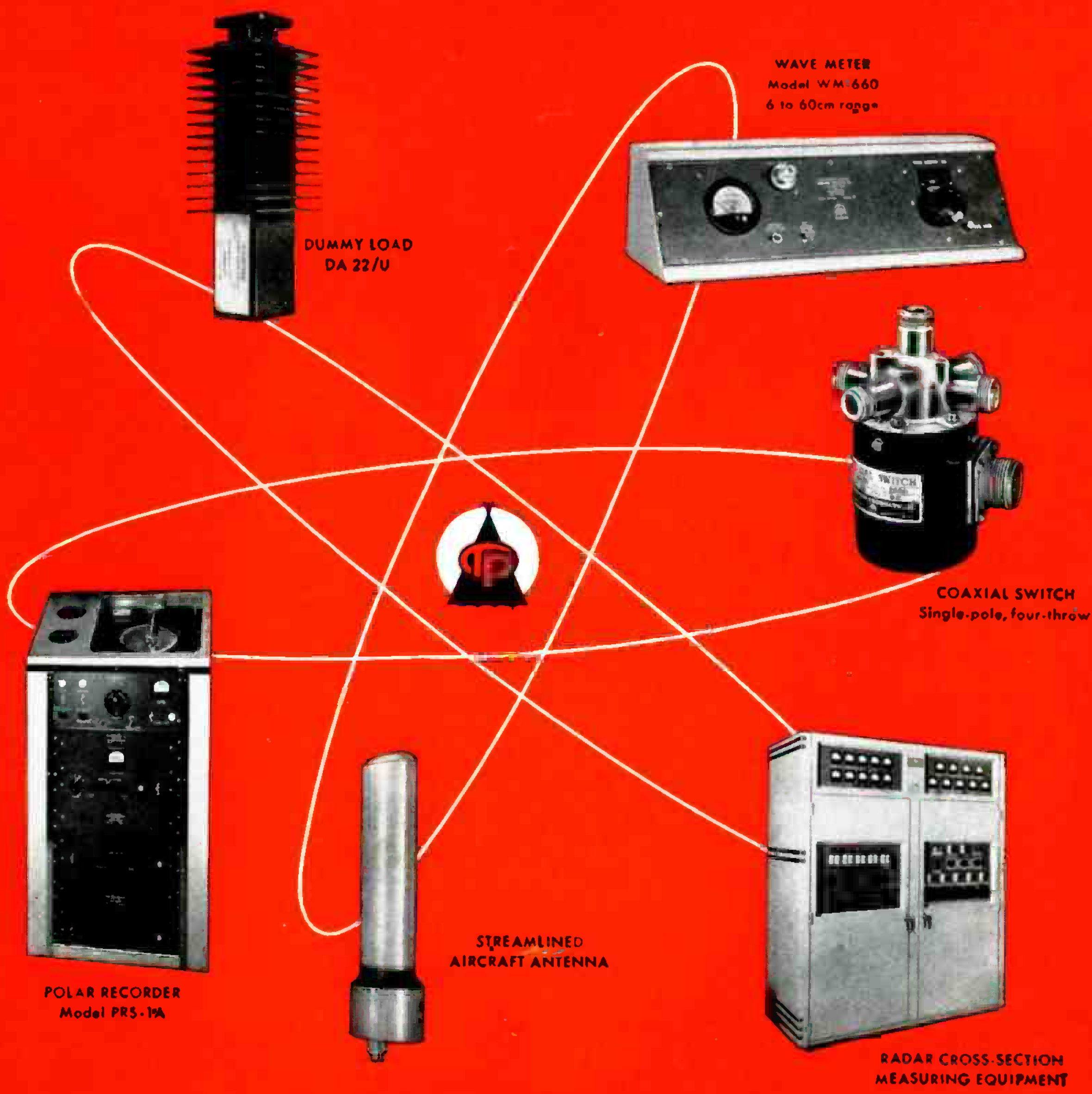
TELE-VISION ENGINEERING

JANUARY, 1952

The News-Engineering Journal of VHF-UHF TV, Radar and Allied Industries



Final calibration inspection of TV linearity-pattern generator.



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Dielectric constant, 1 megacycle	9.2
Loss factor, 1 megacycle	0.014
Dielectric strength, volts/mil	400
Volume resistivity, ohm-cm	1×10^{15}
Arc resistance, seconds	250
Impact strength, Izod, ft.–lb/in. of notch	0.7
Maximum safe operating temperature, °C	350
Maximum safe operating temperature, °F	650
Water absorption % in 24 hours	nil
Coefficient of linear expansion, °C	11×10^{-6}
Tensile strength, psi	6000

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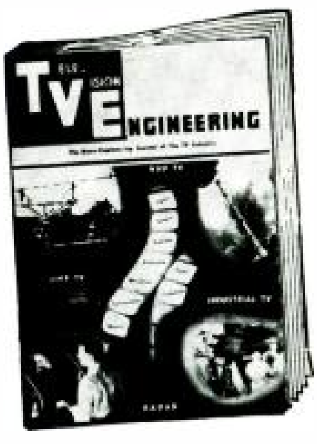
MONTHLY FEATURES

Cover Illustration

Final calibration inspection of a TV linearity pattern generator: *Hickok model 620.*

Editor: LEWIS WINNER



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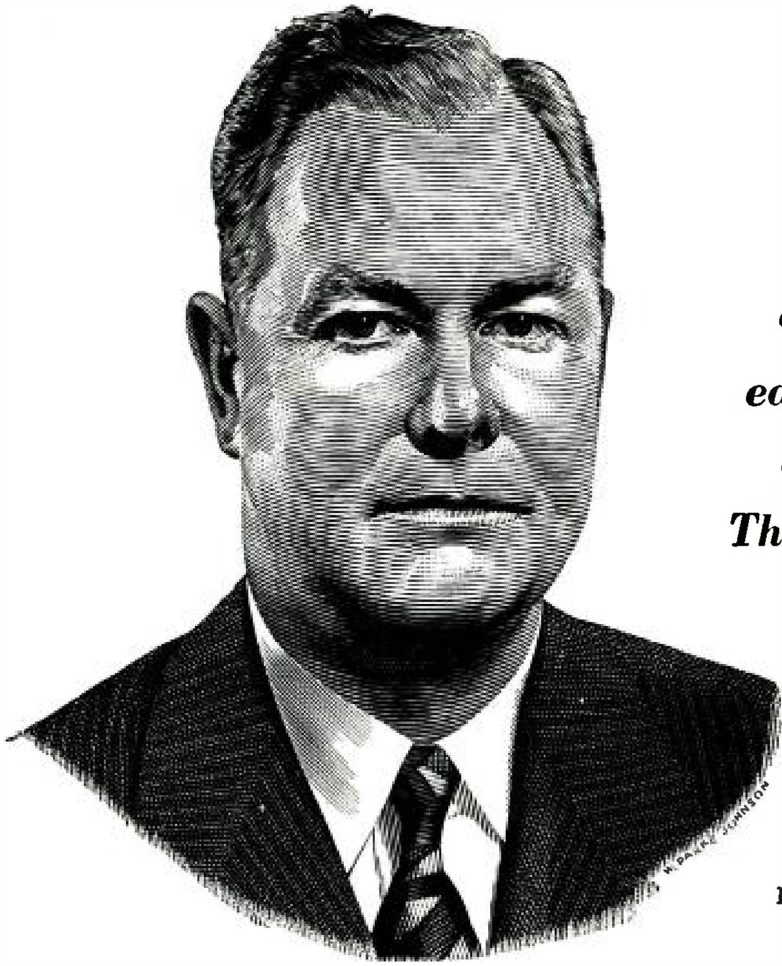

"... Nearly nine out of each ten of our employees are ... participating in The Payroll Savings Plan."

E. J. HANLEY

President, Allegheny Ludlum Steel Corporation

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TELEVISION ENGINEERING

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LEWIS WINNER, Editor

January, 1952

Ultrahighs Scheduled for Stardom in '52—With reams of announcements pouring from the FCC, declaring that not only is the end of the freeze a matter of weeks now, but that the granting of authorizations to *vhf* and *uhf* aspirants is also around the corner, with the early spring set as the date, the new year appears to be off to an exhilarating start. The advent of upstairs TV will inaugrate a bright new era, teaming with possibilities for broadcasters, manufacturers, dealers and Service Men.

Technically, the arrival of channels 14 to 83 will introduce many intriguing factors. Receivers may find themselves equipped with transit-time tubes, crystals in many circuits and vacuum tubes as substitutes for coils and capacitors. Many of the design techniques acquired during the development of radar will undoubtedly find their way into transmitters.

The intensive research and experimental work, carried on during the past 36 months, have driven the ultrahighs out of the labs and established the new bands firmly in the art. Commenting on the significant expansion that the ultrahighs will provide, Doc DuMont said recently that in the 1239 communities scheduled to have TV, 897 will feature ultrahigh stations exclusively: quite a contrast to the limited number of *vhf's* now in operation or possible under the new plan proposed by the Commission. It was also pointed out that since there is less competition for the higher channels at present, the early applications for ultrahigh channels should certainly be acted upon swiftly.

Further evidence that striking *uhf* progress has been made also appeared recently in the announcements of the series of papers that will be offered during the national convention of the IRE: March 3 to 6. Many sessions have scheduled papers on all facets of the new art. During one series of meetings, sponsored by the *professional group on broadcast and TV receivers*, the ultrahighs will receive all of the attention during a pair of symposia. Scheduled to be discussed are hybrid ring mixers, tuners of the turret and continuous type, new triodes for the high bands, amplifiers for ultrahigh distribution systems, practical TV antennas for the high bands and general receiver design. Among those who will describe these developments are: *Walter V. Tyminski* and *Albert E. Hylas* (DuMont); *M. F. Melvin* (Mallory); *H. F. Rieth* (Kingston Products); *Albert Cotsworth, Max Beier, John Bell* and *James White* (Zenith Radio); *A. M. Scandurra* (Kollsman Instrument); *H. W. Chalberg* (G.E.); *E. O. Johnson* and *J. D. Callahan* (RCA Service Co.); *T. Murakami* (RCA Victor); *Ralph A. Verone* (Admiral), and *W. B. Whalley* (Sylvania).

Incidentally, ye editor will also appear during one of the sessions as a moderator of a round-table discussion.

Ultrahighs will also be a featured item during the *Broadcast Day* program of the *professional group on broadcast transmission systems*, at the IRE convention. *John J. Woerner*, of Eitel-McCullough, will describe a high-power ultrahigh klystron and *E. J. McCall* and *T. Paul Tissot*, RCA, wil review a new TV transmitter which includes stages for 1-kw visual and .5-kw aural purposes.

From all indications, it appears as if '52 will be a banner one for the ultrahighs!

A Triumph of Engineering—With the announcement, a short while ago, that the fifth TV broadcaster had gone on the air, via the tower on the tallest office building in the world, the Empire State in New York City, a brilliantly conceived plan became a stirring reality.

Seventeen months of toil, nearly a 100,000 man-hours of time, and an expenditure of several millions of dollars, paved the way for the success of this gigantic installation, without parallel in broadcast history. Thirteen high-power transmitters, including three FM, five TV picture and five TV sound, are now all using one tower, 222 feet high, and some 1700 feet above street level.

In the construction of the tower and the assembly of the elements, difficulties never before encountered were surmounted. Workers erecting the mountain of steel lattice work had to work within an extremely confined area, and continuously battle the elements. The units of the tower had to be designed to fit into an elevator shaft, so that they could be pulled up to the top of the building in elevator cars. Installation adjustments and testing of the elements, a quarter mile above the streets, had to be completed by workers swinging from bosun's chairs, or hanging on the pole with nothing more than snap-on safety belts for support.

Almost a million dollars were spent for the tower alone. In addition, each of the broadcasters had to allocate nearly a half-million dollars apiece for their transmitters and feed lines.

A rousing round of applause is due Doc Kear, who served as consulting engineer, for his resourcefulness and skilfull management of the project. It was he who had to wade through hundreds of pounds of blueprints, attend thousands of meetings, shuttle between New York and Washington and practically live on a rooftop for a year and a half, to be sure that New Yorkers and those in outlying communities would see brighter, clearer pictures, as originally visualized.

Hurrahs of praise are also due to the headmen of the five stations who spent round-the-clock sessions together, so that the plan would be successful, for all concerned. Participating were Frank Mark, ABC; W. B. Lodge, CBS; Rodney Chipp, DuMont; Ray Guy, NBC; and Tom Howard, WPIX.

To these six, and their host of coworkers, we, and we're sure everyone, echo a resounding thank you for a job well done, a job which has originally described as an impossibility. Forever, this will be remembered as a genuine triumph of engineering.—L. W.

TVE-grams . . .

Around the Conference Tables in Washington: With the military streamlining its timetables for gear delivery, civilian agencies striving to adhere to stringent present and future schedules without wrecking the consumer production line, and industry advisory committees counseling both government groups on the precautions which must be taken to cushion the effect of the heavy defense program, many have begun to wonder about the eventual net effect of all these moves.

As reported last month, in some respects, the pinch will not be as severe as might be suspected. There will be inconveniences and reductions in output, but the broad result will not be too damaging on the overall front. Discussing this fact during a recent trade conference in Washington, representatives of the military and civilian agencies said that around about the middle of the year a plateau in military-production requirements will obtain, and unless there are sudden severe changes in world problems, there should be no peaks to worry about. While at present it does not seem that it will be possible to allocate materials on a seasonal basis, it is hoped that during the period in which there are normal rises in demand, or the third and fourth quarters of the year, allocations will not be less than those of the second quarter.

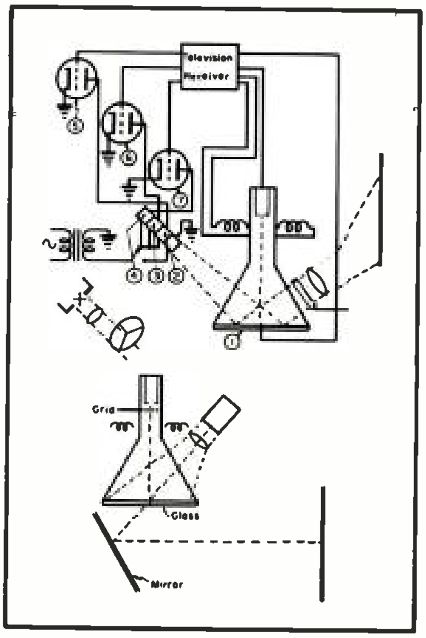
The Nickel Problem: The most critical problem on the scene is the shortage of nickel, it was noted at the meeting. The shortage is affecting tubes more than general parts, because it has been found possible to employ substitutes in the components, while no adequate alternates have been found for tubes. Cobalt has also loomed as a difficulty, although it has not been found to be as severe as originally anticipated. Effective economies for both of these materials have been introduced by speaker manufacturers who have reduced the weights of magnets through redesign techniques. In one instance, a saving of 32 per cent has been affected.

Foreign Component Sources: Should a severe shortage of resistors, selenium rectifiers and fine-enameled resistance wire occur and interfere with the requirements of the armed services and even the consumer front, German and Italian sources may be activated. According to a report on a survey of manufacturing facilities in western Germany and Milano, Italy, there are nearly a dozen manufacturers who would be able to ship quite an assortment of material. Specifically, up to about a half-million selenium rectifiers, using Swedish selenium, could be secured from Germany. The types now being produced over there are of disc and rod structure. Also available from Germany would be deposited-carbon and wire-wound resistors. Sources in Italy were noted as being capable of supplying not only the fixed resistors, but precision wire-wound variable potentiometers and power rheostats. In next month's issue of Television Engineering there will appear an extensive review of this report, with complete details on the physical and electrical characteristics of the components, estimated costs, and exact sources of supply.

Production-Allocation Ratios in '52: The military have reported that thus far industry has received orders amounting to about ten months of production. There are still to be placed orders which will account for twenty additional months of production, based on the rate of manufacture planned for '52.

A Light That's 1/8 As Bright As The Sun: TV studios are now being flooded with light which has a maximum brightness of 130,000 candles per square inch, or twenty times the brightness of the ordinary tungsten-filament lamps. Originally developed for the military, and recently applied in a commercial package for not only television, but other applications in the motion-picture and photographic world, the light, known as *telcoarc*, operates on a unique principle whereby zirconium metal is constantly renewed from its own products of combustion. It is said that the total light from the new lamp is 20,000 lumens; the zirconium metal is maintained at a temperature of nearly 6500° F. . . . According to the developers of this unusual light source, it can be applied wherever an ordinary arc lamp is used. In addition, it does not offer any toxic fumes nor constitute any fire hazard.

Right: Circuitry of a liquid-face color TV tube, which was the basis of a patent award to Lee Hollingsworth, WKBS prexy. According to the inventor, a group of three-colored lights are triggered on and off in sync with the color camera, casting intense colored lights upon a mercury, oil or other liquid-like surface within the bulbus end of the picture tube. In the drawing, 1 represents a variable-surface reflector, while 2, 3 and 4 are the colored lamps (gaseous-neon type), controlled by triodes 5, 6 and 7.



Below: Dr. Allen B. DuMont receiving testimonial scroll in recognition of his . . . "continuous pioneering and inspiring leadership" . . . from Mayor Morris Pashman of Passaic, N. J., during a dinner commemorating the adoption of the slogan . . . *Passaic, Birthplace of Television.*

Below: T. W. Hohlweck (left) of the New York Fire Insurance Rating Organization, and Charles Singer (right), WOR's assistant chief engineer, observing tests of the automatic carbon dioxide fire-extinguishing system equipment recently installed in the main control room of WOR-TV's new building in New York City. The system, it is said, protects about $600,000 worth of gear in this room.

TVE-grams . . . — Personals

Awards: The IRE has announced the following awards: *Dr. William Shockley*, Bell Telephone Labs . . . the Morris Liebmann Memorial Prize in recognition of his contributions to the creation and development of the transitor. *B. D. Loughlin*, Hazeltine . . . the Vladimir Zworykin Television Prize Award. *H. W. Welch, Jr.*, University of Michigan . . . the Browder J. Thompson Memorial Prize. *Jerome Freedman*, Watson Laboratories . . . the editor's award.

New Posts: *Paul Hines* has been appointed director of engineering for The Workshop Associates. He was formerly head of the antenna group at Raytheon. . . . *Robert E. Lee*, formerly manager of finance, has been named assistant manager of the G. E. picture tube operations. *Randolph M. Duncan* has been named to succeed Lee as manager of finance. . . . *Brig. Gen. Tom C. Rives* (retired) has been appointed manager of the G. E. advanced electronics center at Cornell University. . . . *Ralph R. Shields*, formerly engineer for Sylvania test equipment merchandising, has been appointed merchandising supervisor for the picture tube division. . . . *John A. Wortmann* has been appointed trade-mark attorney for RCA. . . . *Charles H. Griffith*, manager of the radio sales division, has been appointed general sales manager of the International Resistance Co.

John M. Otter, formerly Philco vice president and general sales manager, has been appointed vice president and general manager of the Philco refrigeration division. . . . *Thomas A. Kennally*, former president of the refrigeration division, is now vice president on the executive staff and chairman of the distribution committee, Philco's top level policy committee on distribution planning for all products. . . . *Raymond B. George*, who joined Philco in '36, has been appointed corporate vice president of merchandising. . . . *Frederick D. Ogilby* has been named vice president of the television and radio division in which capacity he will direct all sales activities as well as all product development of the line. . . . *John Kuneau*, while retaining his post as vice president on the executive staff in charge of public relations for Philco, has also been named to serve as chairman of a newly formed merchandising committee for television and radio activities. . . . *James Dale* is now chief TV and radio engineer of Hoffman Radio. . . . *Robert L. Warner* and *Ernest B. Gorin* have been elected vice presidents of RCA. Werner was also elected general attorney, and Gorin, treasurer. . . . *Jack C. Keith* has been elected vice president in charge of sales for Howard W. Sams and Co.

Paul Hines

Douglas Y. Smith

Charles Griffith

James Dale

David S. Rau is now vice president and chief engineer of RCA Communications, Inc. *C. W. Latimer*, formerly vice president in charge of engineering, was appointed vice president and chief technical consultant of RCA Communications. . . . *Admiral Edwin Dorsey Foster* (U.S.N. Ret.) has become vice president and director of planning for the RCA Victor Division. . . . *W. H. Connors Company*, 1590 Eudora Street, Denver, Colorado, has been named sales rep for the Cathode-Ray Tube Division, Allen B. Du Mont Labs, Inc., to cover jobbers in the Denver, Rocky Mountain area. . . . *Maurice P. Fieldman* has become general sales manager of the Halldorson Co. Fieldman was formerly with Standard Transformer Corp. . . . *Paul Baran* has been appointed field engineering rep for the Audio and Video Products Corp., 730 Fifth Avenue, New York 19, N. Y. Baran's experience as an engineer includes work at Raymond Rosen and at Eckert Mauchly. . . . *Douglas Y. Smith* has been promoted to manager of sales operations for the RCA tube department. *Earl M. Wood*, for the past 10 years manager of manufacturing at the tube department's Lancaster, Pa., plant, will succeed Smith as plant manager at Lancaster. . . . *Robert L. Wolff* has been named director of products engineering for Centralab.

George Deters has been named sales manager for the midwest section of Hytron. . . . *W. L. Rothenberger* is now manager of the eastern region of RCA Victor. *R. M. Macrae*, formerly assistant regional manager in New York, has been named manager of a newly formed northeastern region. . . . *Brooks A. Kafka*, formerly supervisor of procedures in the G. E. tube department, has been appointed supervisor of purchasing for the G. E. picture-tube division. . . . *Patrick E. Sullivan* has been appointed assistant manager of the Buffalo tube works of G. E. . . . *Frank H. Edelman*, formerly chief chemist of International Resistance Co., has been appointed technical director of the resistor division of Electronic Devices. . . . *Remhold W. Schmidt* has been named assistant manufacturing manager of the DuMont picture-tube division. *Ellsworth S. Doe* has been named supervisor of mechanical and electrical maintenance at DuMont. . . . *Saul Decker* has been appointed chief television engineer of CBS-Columbia. . . . *Anthony H. Lamb* has been appointed vice president in charge of manufacturing of Weston. . . . *Nat Malamuth* has been appointed manager of the government contract section of Tel-O-Tube Sales Corp.

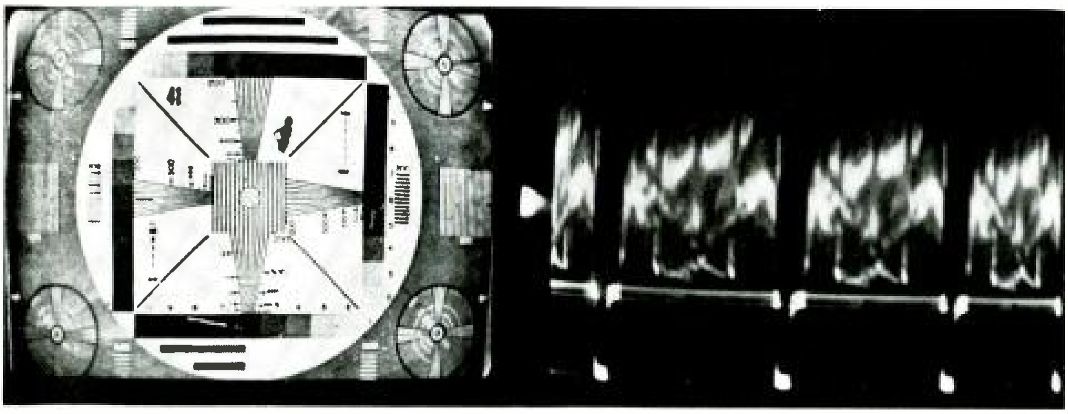
Saul Decker

Robert L. Wolff

Anthony H. Lamb

Detailed Analysis of Advanced Operating Practices, Determined Under Actual Studio Conditions, Which Have Been Found to Contribute to Higher Quality Pictures.

VIDEO Studio



Figures 1 (a) and (b)

Picture tube and 'scope illustrations of target adjustments. View at left indicates that only first six steps may be separated. At right, compression is shown as near the black level; steps seven through ten are not separated.

Today, television audiences are demanding productions of higher quality than ever before. With TV chassis now capable of providing excellent results, and the medium growing largely competitive, many advanced engineering methods used a short time ago are already insufficient. Television engineers are finding it imperative to apply all their knowledge and skill, discard many old procedures and use new methods, more readily acceptable to the art.

Target Setting

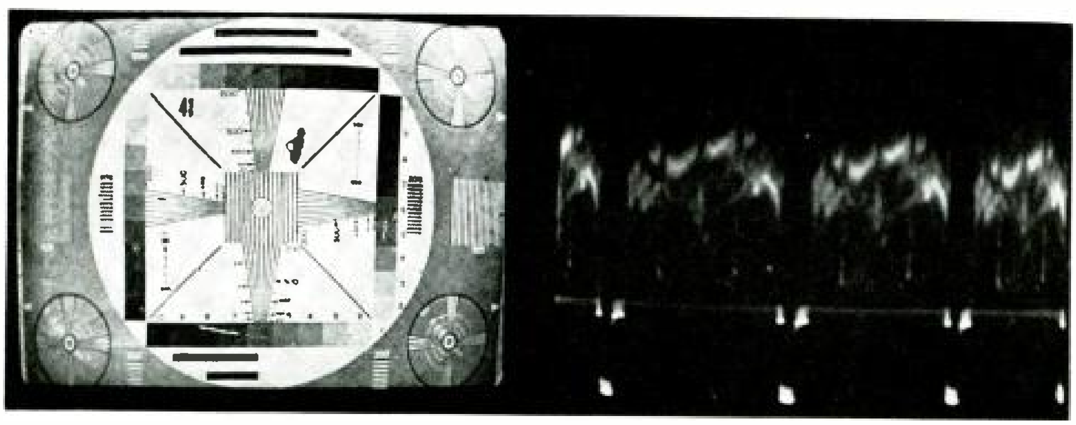
Target setting represents one of the key studio practices which must be considered carefully in preparing for high-fidelity service. There are several methods of arriving at a target setting. Any method from target buttons to full target and bloom can be employed and has been found satisfactory in arriving at a preliminary setting, but not satisfactory for optimum results. To adjust target potential for best signal-to-noise ratio is a commendable approach. However, this results in a broad range of settings, particularly for the new camera control operator. There is one, and only one target setting that can be used to obtain the proper picture matching and quality desired. This singular setting seems to present the greatest obstacle, even among experienced technicians.

Reviewing this condition, let us first consider the need for proper lighting on a set and the application of a color scale that falls within the grey scale range shown on the RTMA resolution chart. In adjusting the target for such a set, the practice would be similar to that used in adjusting for the resolution chart. This does not mean the target can be adjusted on the chart and considered correct for the stage, for their reflectance values may differ. It is the method of adjustment that would be the same. The 'scope must be studied when making target adjustments. It will provide more detailed information at a critical point than the picture tube. This critical point may be illustrated by use of studio *tp*. Starting from the point of cut-off, the target potential should be raised until the first six steps of the grey scale may be defined or separated from one another.

The last four steps will still be black on the picture tube, and, as displayed on the 'scope, will be compressed or laying down on the black level determined by pedestal: Figure 1*a* and *b*.

Now, the target setting should be advanced until the last two steps on the scale are just separated by an amount equal to those other steps. This point is the optimum target potential; Figure 2*a* and *b*.

It will be noticed that the inverted *V* pattern is near the black level. The apex is approximately step *five*, and actually continues upward to form an V pattern, the upper portion of which is mostly obscured due to the prominence of white on the *tp*. At this point, the greatest concern is black; thus, it is possible to disregard the display above step *five*, as shown on the 'scope. The target can be advanced still further. It



Figures 2 (a) and (b)

Views of optimum target potential, with view at left illustrating all steps separated. 'Scope view shows inverted V pattern; apex is approximately step five.

Techniques by C. DAN PARMELEE

Master Control, CBS-TV

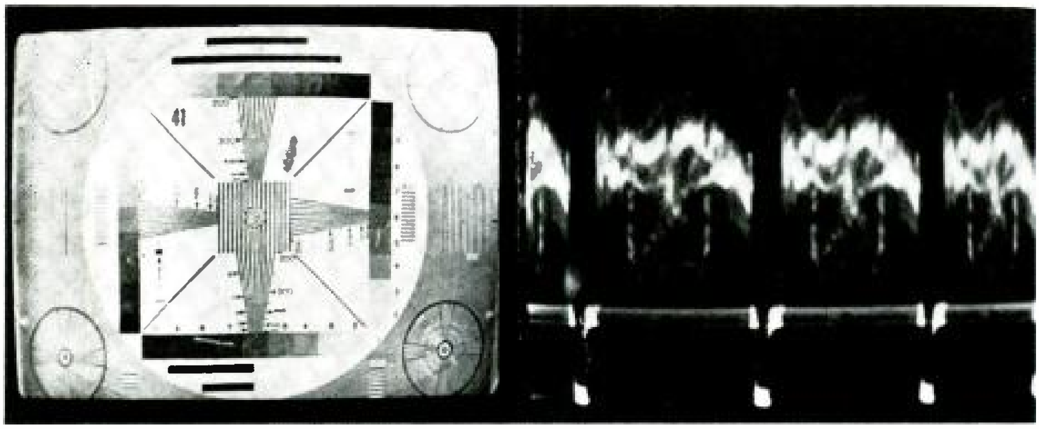


Figure 3 (a) and (b)

Reproductions which illustrate results when optimum setting has been passed. View at left discloses the wash-out and milky appearance which prevails, while at right we see the resultant large step between steps nine and ten, and absence of blacks.

will be now noticed that step *ten*, or the blackest portion of the *tp*, actually *lift out* of black and enter a grey region. Here the optimum setting has been passed; Figure 3*a* and *b*. If this optimum setting has been exceeded, there will appear a definite change in the set-up, with a change in video level. If this condition is avoided, it will simplify the problem of maintaining proper blanking level and minimize extremely black corners.

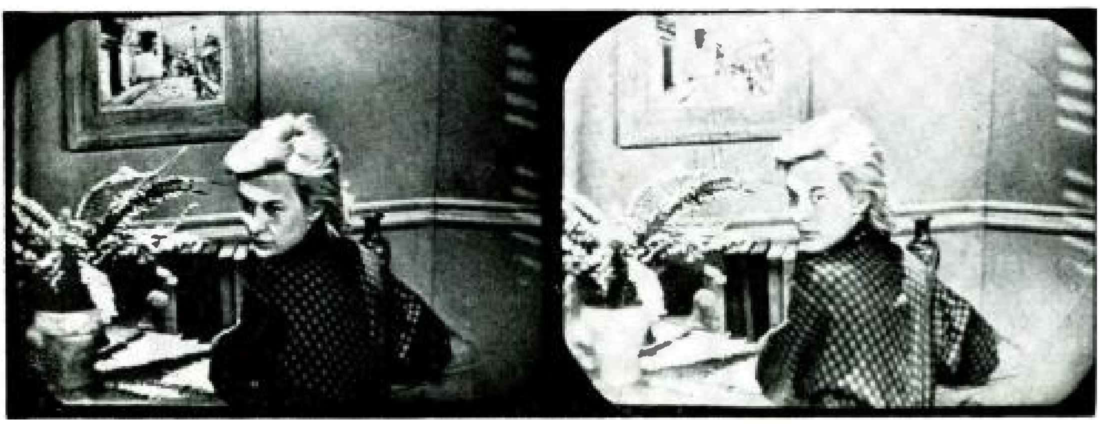
From the foregoing, it will be apparent that target potential is particularly linked to black and grey scale rendition. Proper picture matching can be readily accomplished by the proper use of the target control. The whites can be disregarded when making these adjustments. The beam bias control should be used to push out the spikes and the 'scope watched while doing so. Here again, there will be found more detailed information. It now becomes necessary to reset or at least check the beam with every change in target potential, the beam not being advanced any further than necessary to bring the whites up to thin pointed spikes.

This method of target control has been found to be most satisfactory under all conditions. It may be desirable to operate the target lower than normal in some instances, particularly on low key sets. This is permissible and often necessary. It is important, though, that the target is not operated beyond its optimum potential; Figures 4*a* and *b*, 5*a* and *b*.

A three-dimensional effect, while going through beam (*orth*) focus, is characteristic of a high-target potential. Also, black spots at random points and white following black give evidence of misadjustment. Poor overall resolution and severe loss of definition in the whiter portion of the scale will be most evident.

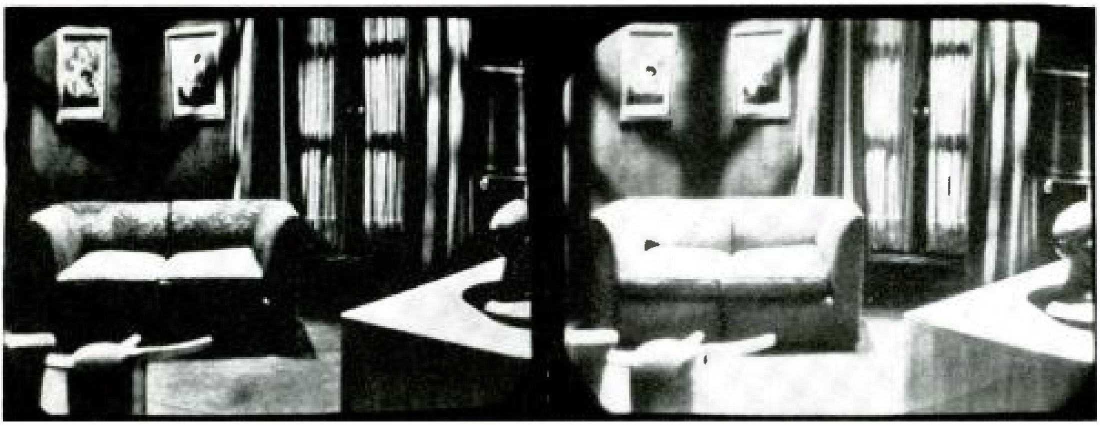
Lens Openings

There are varied opinions regarding lens openings. Lenses are frequently overlooked and in some cases considered unimportant. Unlike film camera operators, television cameramen do not set their own lens stops. The camera-control operator should make these adjustments, since they fall directly into his line of responsibility for picture quality. Moreover, he is more qualified to make these adjustments, being familiar with image-orthicon operation. Many cameramen insist on slower lens speeds, stating that this provision affords depth of field, thereby simplifying focus during movement. Few realize that this method introduces a sacrifice in overall picture definition. Lenses employed in image-orthicon cameras must not be set arbitrarily. Their speeds must



Figures 4 (a) and (b)

Reproductions resulting when target is low (left) and high (right). Left hand view illustrates detail of set achieved, and the effect of model and back lighting. View at right reveals complete lack of detail of set, model and back lighting having been desrtoyed.



Figures 5 (a) and (b)

Another pair of reproductions illustrating results secured when target is low (left) and high (right). At low target, picture is realistic, with striking detail on set and sofa apparent. In low-target view, set and sofa details are missing, and the whites are saturated.

be carefully and individually determined on the set having lowest reflectance value. In some cases this may be the darkest set; however, lens openings must not be determined on a set having practically no base light.

In the past, the knee of the curve has been referred to as a clue to satisfactory operation. In Figure 8 there appears a plot illustrating that lens speeds can be determined with reference to the *heel* or the cut-off portion of the curve. Under ideal lighting conditions (where contrast ratios do not exceed 20-to-1) either the knee or the heel may be used. However, such conditions seldom exist. Therefore, if apertures are adjusted so that spikes or highlights do not pass the knee of the curve, chances are that the average level or portions thereof will be well into or below the heel of the curve, with a resultant loss of picture definition and black compression.

The simplest and most accurate method of determining proper *f* stop is by one operation: observing the viewfinder, thereby enabling the technician to coordinate two senses at one time. The lens should be stopped to a point just before the *average* level enters the heel or cutoff portion of the curve. The lens aperture may then be rocked about the heel until this point is clearly seen.

It will be noted that the *average level* has been stressed. Since the average level is the predominating level, occupying perhaps 40 per cent of the straight portion of the output curve, it contains large percentages of essential video information. An additional ten per cent lies below this level in the dark grey or black region, and another twenty per cent above the average level in the white region. The remaining 30 per cent is occupied by highlights. Specular reflections can be allowed to exceed the knee of the curve, since they contain no information essential to the medium. Thus, it is obvious why it is necessary that the lenses must be operated *just open* from the heel, to contain all of the essential information within the straight portion of the output curve.

Figure 6

Interesting reproduction illustrating eyelight, skin tone and picture definition.

Under normal studio conditions, where base light is usually 25 *f/c* to 100 *f/c* the 50-mm lens will generally give best results between *f* 4.0 and *f* 5.6, and the 135-mm lens between *f* 5.6 and *f* 8. Many question this one stop difference between the 50 and the 135-mm lens. There are two reasonable factors involved. First, the 50-mm wide-angle lens has a greater depth of field than the 135-mm lens, given the same *f* stop when compared at equal short distances. This greater depth of field contributes to an apparent greater contrast in video. With the long lens one *f* stop slower, the likelihood of more effective picture matching is evident. Secondly, due to limitations of the medium, wide-angle shots do not compare in definition with closeups. The apparent contrast of a wide-angle lens being greater, black compression will occur earlier, resulting in poor definition between near greys. Hence, the one stop difference will offer definition of a wide-angle scene more comparable to that of a close-up.

Lighting

Many television directors, producers and lighting supervisors have attempted to adopt lighting techniques featured in Hollywood and on Broadway stages. While these techniques are sometimes successful, they have been found to be lacking in many respects on the TV set.

To the video operator, lighting is of prime concern. It is ever important that he be aware of the misuse of existing facilities. While it is not the responsibility of the video operator to light a set, it is important that close cooperation with the lighting supervisor pre-

Figures 7 (a) and (b)

'Scope views illustrating results which can be detected when multi-focus and shading controls are continuously supervised. In both instances, the cro was at one-half line frequency; reproduction at left indicates good horizontal shading, while view at right reveals poor horizontal shading.

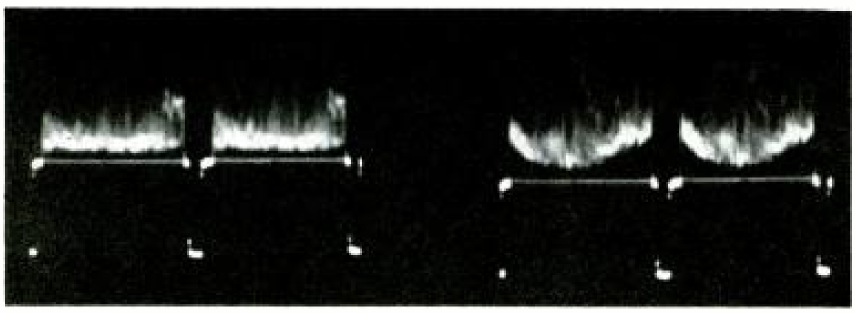
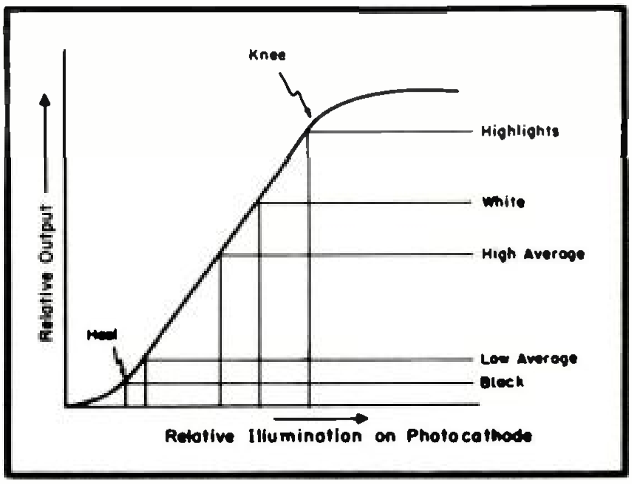


Figure 8 (right)

Plot illustrating how lens speeds can be determined by referring to heel or cutoff portion of curve.



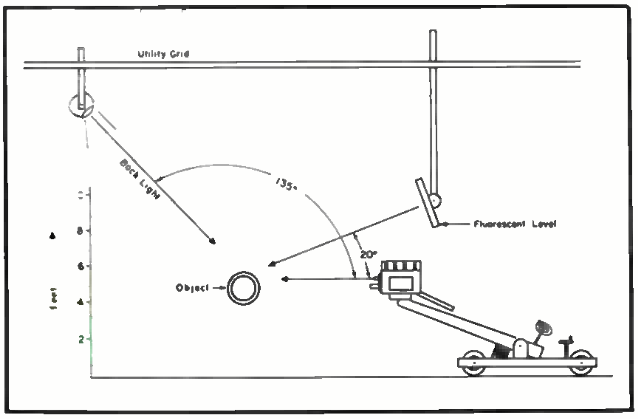


Figure 9 (left)

A basic-lighting arrangement. Fluorescent pans should be no higher than 8' from studio floor to form an angle not greater than 20° between light source, subject and camera lens.

vails. This point cannot be overemphasized, and any lighting supervisor stands to gain equally as much as the video operator in prestige and satisfaction.

Base Light

The use of fluorescent lights as a base-light source has been popular in most dramatic presentations, since they cover large areas and cast no microphone or boom shadows.

Obviously, it is most desirable to have a base-light source at camera level and directly in front of the cast. This would be practical, were it not necessary for cameras and microphone booms to be moving about. It is impractical to restrict movement of technical equipment to accomplish perfect base light. The best compromise is to raise the fluorescent pans, so that equipment may be moved conveniently beneath them. This compromise has been cited to emphasize the need for a low angle of base light. The pans should be no higher than eight feet from the studio floor to form an angle not greater than 20° between light source, subject and camera lens.

The video operator may frequently be annoyed by overlighting, since this condition is seldom correctable by reducing target potential or changing *f* stops. Quite often, directors and producers will request additional base light to fill in dark eyes not realizing that the set may already be overlit. The most logical correction appears in the changing of base-light angle and not intensity. The optical-contrast range is affected by base light and should be held to within 20 to 1. If a set is overlit, backing, live subjects and other objects may be reflecting large percentages of base light. On many sets particularly dramatic, there are areas where little or no light is reflected, such as shaded areas behind props and dark shadows beneath, or to one side of picture frames, door and window casings, etc. The optical contrast of such a set may well exceed the straight portion of the output curve. If, as in this situation, the base light is reduced, the contrast range in lighting will be correspondingly reduced, and a more correct approach toward perfect lighting will have been accomplished.

Under Lighting Problems

Under lighting is equally troublesome, for a point may be reached where noisy pictures are unavoidable. If the situation demands low key lighting, it is not advisable to *reach for a volt*, but maintain sufficient level to convey the required information. Spikes from back lighting may conveniently produce a one-volt level on wide-angle shots, where on a closeup they may not exist. Of course, a one-volt level on closeups will defeat the purpose of low key lighting altogether.

A small amount of incandescent light added to fluorescent base light will provide eye light and improve skin tones and picture definition. It is particularly complimentary where low key situations call for closeups. When incandescent light is added to base light, its incident angle should nearly equal that of the fluorescent base light. Care must be taken to avoid destroying effects lighting. Intensity may best be determined by observing a picture monitor; however, incandescent light intensity should not exceed fluorescent base light intensity; Figure 6.

Back Lighting

Back lighting provides separation between foreground material and backing, adds depth and enhances general appearance. Its source should be low and to the rear, to form an angle not less than 135° between back light source, subject and camera lens. Back-to-front light ratios of 1½:1 should not be exceeded.

Some low key stages, however, may require back-to-front light ratios as high as 4:1 to obtain the desired effect. Quite often, in an effort to simulate night effects, base light only is reduced. It is imperative that back light should be reduced to proportions within reasonable value and proper back-to-front light ratios maintained.

The use of frosts to diffuse back light is not recommended unless the set is designed to provide action close to the backing, where low rear-angle lighting is not possible. A diffused back light then becomes necessary to avoid bright noses, dark eyes and reduce multiple ground shadows.

Black Velour

Black velour is often employed where an infinite black backing is desired. If it can be realized, such a backing provides a very complimentary composition, particularly on portrait shots. Generally, the product will result in either saturated skin tones or a milky background. It must be remembered that black velour, regardless of its shade, has some reflectance value. By nature, it reflects larger percentages of diffused light than straight incandescent light. Its reflectance value, when used with fluorescent base light, is generally sufficient to destroy its own purpose. Fluorescent and diffused light sources should be avoided, since focusing is not possible, and the spread of light is exceedingly difficult to control. The use of straight incandescent light is suggested where focusing is easily accomplished. Dimmers should be used where

(Continued on page 31)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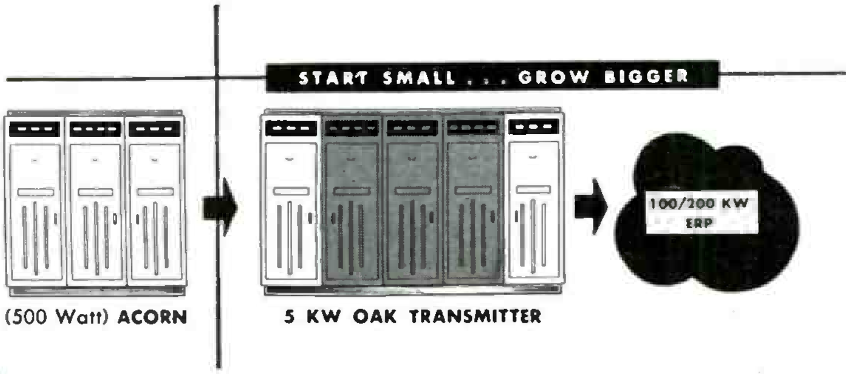


TELEVISION TRANSMITTER DIVISION,
ALLEN B. DU MONT LABORATORIES, INC.
Clifton, New Jersey

Optimum Signal

Revealing Discussion of Study of General Problems Encountered in Measurement of Distance by Echo Time with Examination Revolving About Specific Application to Depth Sounding, Where the Geometry of the Target is so Simple Problems Can be Treated Analytically. Method of Approach Can be Readily Extended to Radar.

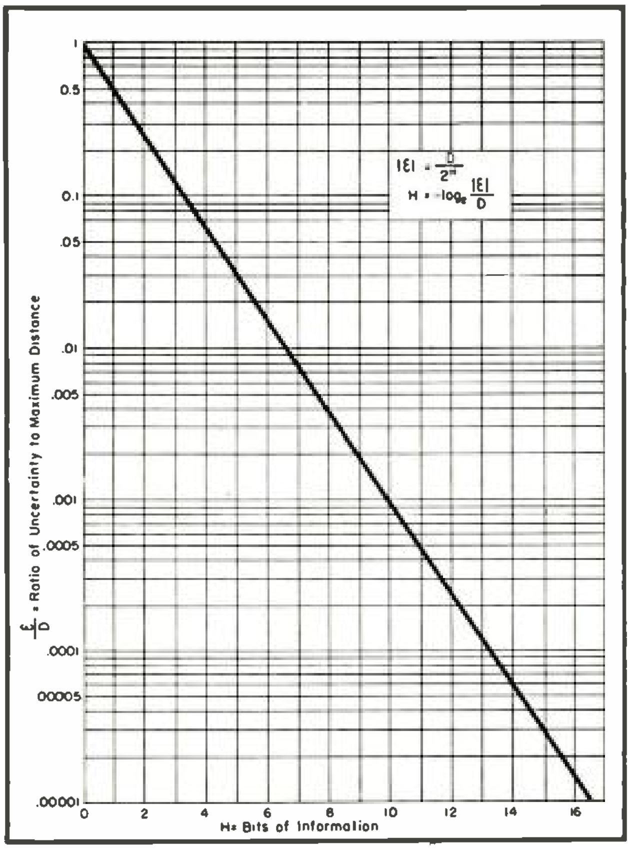
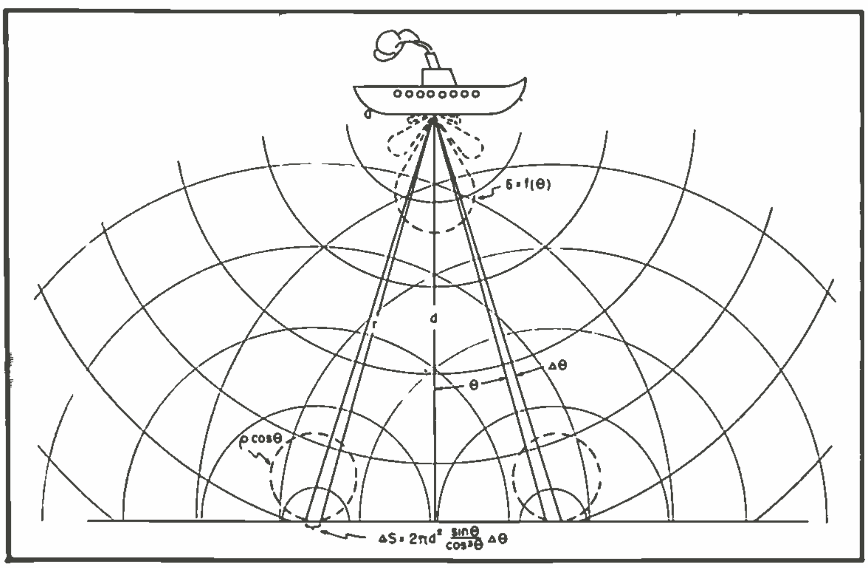


Figure 1

Relation between the precision of measurement and the number of information units involved.

Figure 2

Geometry of echo depth sounding.



In echo ranging by radar or sonar the precision of distance measurement corresponds uniquely to the amount of information received. There is always some limiting distance, D, beyond which a detectable target cannot exist. It is no information to say the range is less than D, because the contrary would be ridiculous. But if we can say the range is more or less than half of D we have one bit of information. If the range lies in some particular quarter of D, then two bits of information are available. The range is determined within an error

$$|\epsilon| = \frac{D}{2^H} \qquad (1)$$

where H is the number of bits of information. In Figure 1 the error or uncertainty has been plotted as a function of H. This reveals that satisfactory accuracy requires very few information units. A precision of one part in a thousand requires only five bits of information, a small amount indeed when compared with the communication of language. It is roughly equivalent to the information in a single letter of the alphabet. Furthermore, the rate of information is also small in echo ranging. The target range cannot change fast, and the rate of change is fairly slow. It is not necessary to repeat the measurement at very frequent intervals.

From the viewpoint of information alone, the measurement of distance should be easy, providing the medium is suitable for propagation of the waves. Unfortunately, however, the medium does not cooperate. It imposes a limit on the intensity of the radiated signal, and it adds clutter or reverberation and various other kinds of noise to the returning echoes. These adverse influences reduce the probability of performing the measurement correctly. The measurement must be repeated many times to place confidence in the result. In the language of information theory more bits of information must

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**From a paper presented at the annual '51 National Electronics Conference in Chicago.*

Characteristics for Distance Measurement By Echoes

by LAURENCE BATCHELDER

Submarine Signal Division
Raytheon Manufacturing Company

be transmitted to receive the few we require. In effect, the curve of Figure 1 must be moved to the right to overcome noise.

Echo ranging differs from most forms of communication in one important way. Other systems send a message from a transmitter to a remote receiver. The receiver never knows what message to expect. In echo ranging, however, the transmitter and receiver are side by side. The message is some form of modulation, usually by a single wave train, repeated at regular intervals. The medium and the reflecting target distort the message, but the distortion is predictable to a large degree. The receiver, therefore, knows quite precisely what kind of echo to expect. Its only task is to determine *when* it gets there. The system designer is blessed with a freedom he could not have with ordinary communications. He is not forced to accept whatever message a customer might prescribe. He can choose his own message, and make it as simple as he likes. On the other hand, he must pay close attention to time delays and keep them within close tolerances. What kind of signal should he use for echo distance measurement? That depends on the circumstances. When we pick a messenger for a trip we consider how hard the going will be, and how precise an answer we want brought back.

Echo Depth Sounding Example

Echo depth sounding has been selected as an example, because its problems are comparatively easy to analyze. Its two basic requirements are common to all forms of echo ranging:

(1) Sufficient signal must be transmitted to enable the echo to be detected through ambient noise.

(2) The character of the signal must permit the requisite precision in depth measurement.

Fortunately, in depth sounding these two requirements do not conflict. The sound is not greatly attenuated in shallow water, and extreme precision is not needed in the deep.

One can say intuitively that accuracy requires the wave train to have a rectangular envelope. A yardstick with a rounded end would not be very useful. Of course, with practical circuits a truly rectangular envelope can never be attained. But, let us overlook such

(Continued on page 34)

Figure 3

Value of the definite integral in equation (5) as a function of normalized time, for the case d = −0.01 bel. The directivity is that of a circular piston with beam widths as noted.

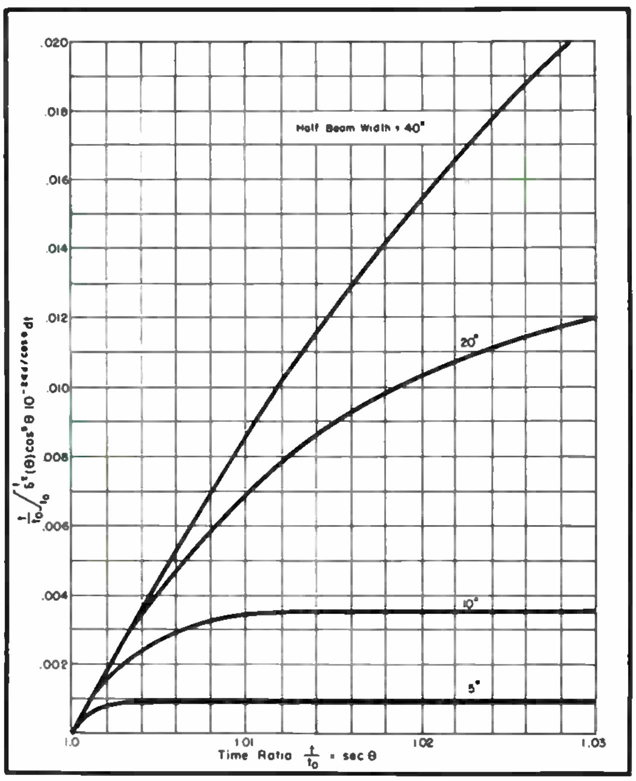
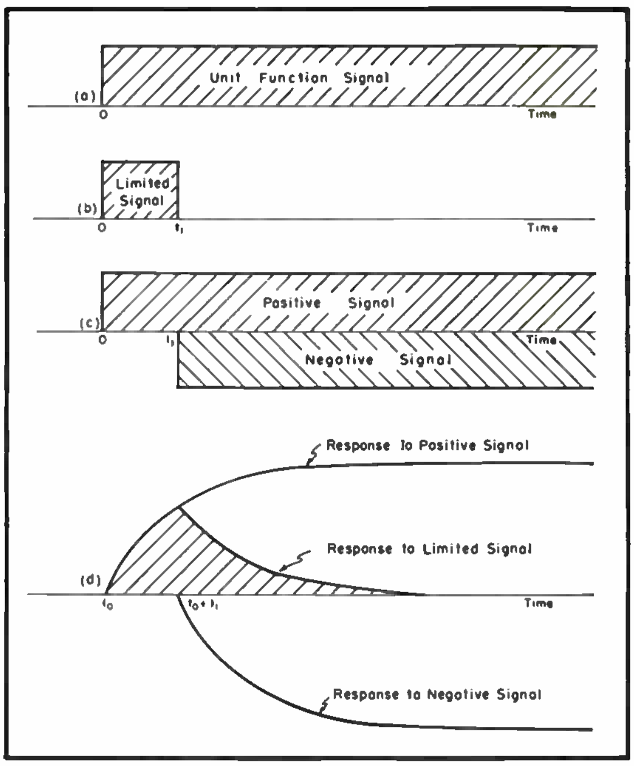


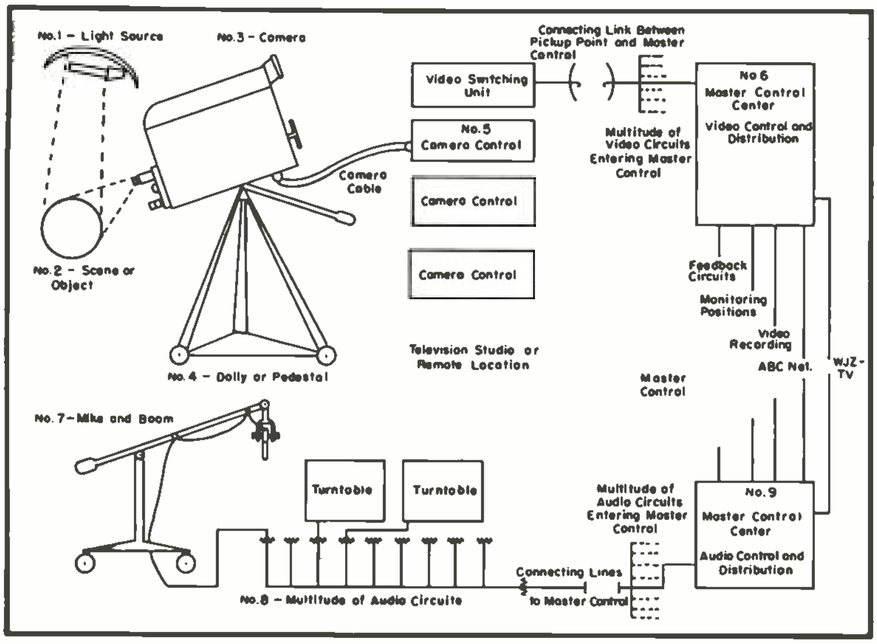
Figure 4

Composition of the transmitted signal and the resulting echo response.



Organization of

(Below)
TYPICAL TV SYSTEM layout at a station.



The system of television is complicated, so complicated that the problem of operating the equipment on a commercial basis requires serious consideration. As a first basic rule of *operations*, it may be stated that *the closest possible cooperation between all persons involved is the prime requisite!* The number of persons required to *stage* a television show is tremendous. The personnel requirements (not including *behind-the-scene* persons) looks almost like a telephone directory!

They include: *(1)* Producer, *(2)* actors, including orchestra et al. *(3)* program director, *(4)* assistant program director, *(5)* technical director, *(6)* camera control engineer (1 per 2 cameras), *(7)* camera man (1 per camera), *(8)* light direction engineer, *(9)* audio *boom* man, *(10)* camera dolly man, *(11)* audio-control engineer, *(12)* master-control supervisor, *(13)* master-control operating personnel, *(14)* transmitter engineering staff, *(15)* floor director (stage crew director), *(16)* video recording personnel, *(17)* electrician, *(18)* stage hands and *(19)* projectionist.

Behind the scene operations include: *(1)* Maintenance of television equipment, *(2)* art department, *(3)* carpentry, *(4)* scenic painters, *(5)* film-service department, *(6)* script writers, *(7)* sound effects, *(8)* music arranging and research or clearance, and *(9)* continuity research (clearance).

It is important to note that each individual on this *team* plays a vital part in the rendition of high-quality television productions. Actors must be flexible with respect to the special requirements imposed on television; experience in radio, stage, or moving pictures is helpful, but by no means a criteria that great effort is not required in television. True, many techniques have been borrowed from the foregoing industries, but in the art of TV they are combined into a fast moving sequence of production that has all the spontaneity of radio, plus the scintillating appeal of the stage with always the background thought that there can be *no retakes*.

In general, the producer develops the format of the production and releases the details to the program and technical directors.

The program director (*PD*) and the technical director (*TD*) are the two persons who are directly responsible for the overall quality of the show; therefore the greatest possible amount of cooperation must exist between these two persons, each recognizing in the other his experience and background in his respective post.

The program director must have a firm understanding of the basic motif of the production, he must be able to get the most out of the actors, he must be capable of giving directions to those with whom he works in a concise and accurate manner, and he must be able to cope with emergencies. He must also have an appreciation of photographic composition and be capable of planning, in advance, the proper lenses and camera angles to produce the effect desired. This director must have a keen sense of pace and timing. He must also have a sense of the *dramatic:* recognize situations with respect to movement, pathos, tragedy, comedy, and to inject in his direction the *mood feeling* required. In general, it may be said that the program director should have an acute realization of artistic values and in addition have a personality which tends toward the extrovert. Further, he must be willing and capable of recognizing the limitations of the television system.

The technical director must be equally a specialist in his understanding of the technical aspects of the production; he should have an understanding of the over-all television system from camera to receiver, and he must have the full cooperation and respect of those with whom he works to get the *best* possible pictures. He must understand the problems involved in the use of different types of image orthicon camera tubes, and the manner in which lighting sources affect the apparent transformation of color to an equivalent grey tone or brightness. He must be in a position to advise the production department on the effect of different types of makeup and scenic coloring. He must not only know the effects of different light sources on the particular camera tubes and the effect that will be produced by various colors, but the quantity of light required for base lighting and the amount further required for producing highlighting effects. He must be familiar with basic lens details with respect to distances and area of field. In addition, he must be equipped (in background) to recognize, analyze and localize faults in the camera equipment, and even to anticipate difficulty based on experience. He must be capable of recognizing good photographic composition. The *TD* is the person responsible for the entire technical excellence of a particular production. It is his responsibility to delegate duties in a manner such that the most efficient technical product may be attained. The *TD* must have a basic understanding of all production problems to evaluate better the problems concerned with the *show*. It is also the *TD's* responsibility to maintain a spirit of cooperation and decorum between his crew and all other persons involved which will result in a most harmonious operation.

Where special effects are advantageous, the *PD* and *TD* must mutually discuss the problem and decide upon a course of action; the *TD* should arrange the technical details such as camera position, lens stops, light positions and intensities, colors, filters, etc., etc. The

SYSTEM TV

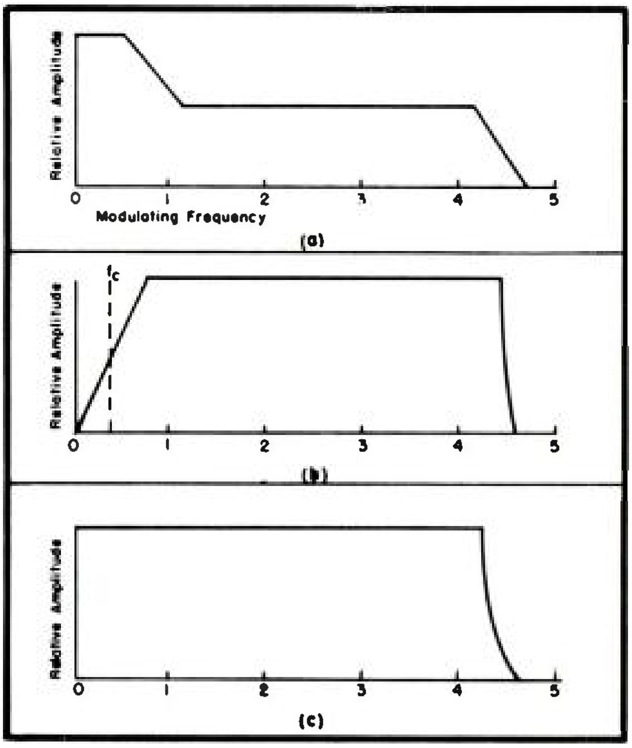
by G. E. HAMILTON

Eastern Division TV Engineer
American Broadcasting Company, Inc.

Part I of Two-Installment Discussion . . . Analysis of Responsibilities of Personnel in Typical Station, Which Includes the Program and Technical Directors, Camera-Control Engineer, Camera Man, Light-Direction Engineer, Audio Boom Man, Camera Dolly Man, Floor Director and Master Control Operating Staff.

(Below)

TV SINGLE-SIDEBAND transmission elements resulting in a linear frequency-response characteristic. In (a) appears the ideal video frequency response of a TV transmitter. The plot in (b) illustrates the ideal rf-if frequency response of the receiver. In (c) appears the ideal video-response characteristic of the overall TV system.



effect should then be studied by both individuals and agreed upon mutually as to satisfaction or non-satisfaction. Due to the technological complexity of the system it is imperative that a spirit of cooperation exist at all times. There should be a desire on the part of both directors to develop new and unusual effects which may be experimented with, to add variety to the overall production. At no time should either person adopt the position that *it won't work—maybe it will!*

The *floor manager* assumes the responsibility of keeping the entire show on a smooth running basis; he directs the placement of scenery and light sequence, camera position, actor position, et al. He must be capable of handling emergencies and taking direction from both the *PD* and *TD*, as the case may dictate.

The *video-control* engineer must have a basic understanding of the TV system and especially must he be familiar with the equipment directly associated with the production; namely, he must understand the camera and camera-control circuit functioning, the purpose of individual circuits, and the effects introduced due to failure of any of the components. Further, he must have a general understanding of associated equipment such as sync generators, generator locks, wave-forming gear, stabilizing amplifiers, distribution amplifiers, all types of monitors, power supplies, etc.

In addition, he must be capable of using measuring equipment for the determination of video signal levels, *dc* voltage measurements, *dc* current measurements, termination measurements, etc. In general, it is the responsibility of the video-control engineer (unless otherwise directed by the technical director) to assume all responsibility for equipment operating according to basic standards as adopted by the organization. He must be capable of obtaining the best possible pictures under the conditions at hand; they are infrequently ideal. He must anticipate requirements.

He is directly responsible to the technical director, and works directly with the camera men to coordinate the functioning of the camera with its camera control unit. He also works directly with his signal termination (master control or other) to establish the correct operating standards.

The camera man is, of necessity, required to know basic television systems' philosophy, plus specific detailed information concerning the camera operation (not necessary theoretical). He works directly with the video control engineer, following detailed instructions concerning camera alignment and adjustment. It is further his direct responsibility to keep the camera in focus, and to set his lens stops according to requirements prescribed by the production; the lens stops having been determined during rehearsal. Since the camera man deals directly with the artists, it is essential that his personality be most pleasant and *non-argumentive;* he must also be neat in appearance. Basically, he must also have an excellent sense of pix composition; have the alertness of mind and memory to keep one step ahead of the director, have *team* spirit to work closely with other cameraman, and be physically well coordinated.

The dolly operator assumes the responsibility of having the camera in the right position at the right time; it is further his function to keep the various cables in an orderly fashion, so that a minimum time is required for camera movement and, in case of equipment failure, making it necessary to substitute camera positions. The position of the dolly operator must not be underestimated, since a failure in this function may completely ruin an otherwise satisfactory production.

The *light-direction engineer*, or other person so designated by the technical director, is responsible for directing personnel on the handling and placement of lighting equipment. It is his responsibility to work in accordance with the requirements of production.

(*Continued on page* 31)

Important news for all owners of 5-kw TV transmitters

25/20-KW

RCA High-Power TV Amplifier

TT-25AL delivers 25 kw, Channels 2 to 6. TT-20AH delivers 20 kw, Channels 7 to 13. Each is shipped with matching aural amplifier, power supplies, and auxiliary equip-

Building Block amplifiers for VHF

- **An economical method for raising power to maximum provided by FCC**
- **Saves about 50% as compared to cost of a complete transmitter of same power—protects original investment**
- **Requires a minimum of extra floor space**

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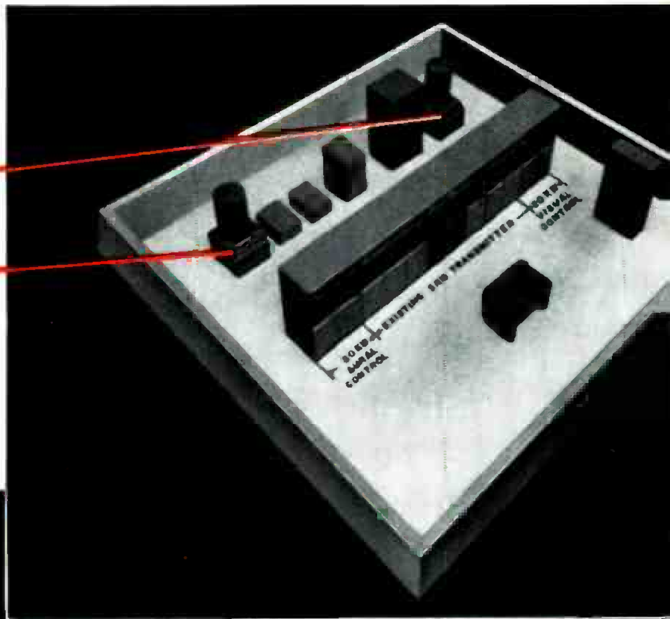
For complete details, call your RCA Sales Representative.

Typical 25-kw conversion—one of many different arrangements showing how RCA high-power amplifiers can be added to a "5 kw" set-up.

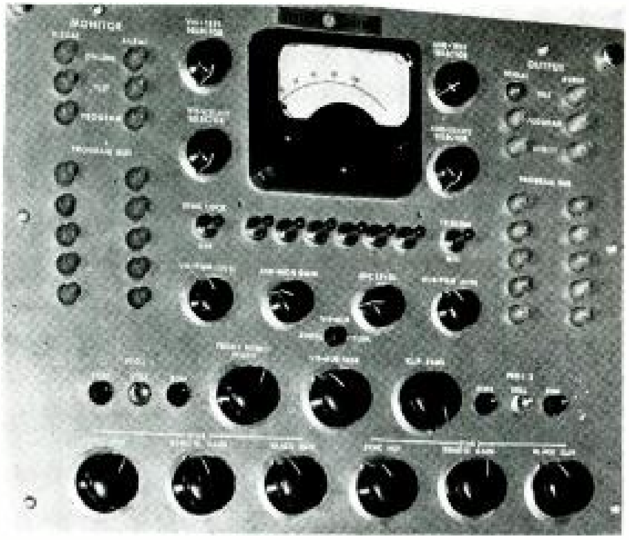


RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT **CAMDEN, N.J.**

TV Audio Facilities

by W. W. DEAN

Broadcast Studio Engineering
Electronics Division, General Electric



(Above)

MASTER-control panel[1], which features a row of controls for monitor selection, vu meter selection and range, master and sub-master gain control and monitor volume control.

(Right)

SHELF for plug-in equipment[2] which mounts trays to accommodate up to six preamps, four program-monitor amplifiers, two power supplies, or combinations thereof in seven inches of rack space.

In the early days of TV, video received the major share of attention and sound was often neglected. It was common to assign the more capable personnel to video operation and more or less let the audio take care of itself. However, there has been a complete turnabout and currently more emphasis is being placed on audio. Perhaps those in TV are beginning to agree with the motion-picture folks that good sound can be of substantial help to a weak show, and poor sound can spoil an otherwise good show by its unpleasant distractions. After all, TV like the movies is a blending of the talents of sight and sound. With the best of both, maximum enjoyment can be achieved.

The improvements are the result of more attention to details and not necessarily to any major new developments. Such factors as microphone placement, more attention to proper control-room operation and carefully-planned installation and maintenance of equipment have all been found to account for a share of the trend to better audio in TV.

The Studio Console

A most important link in the TV audio chain is the studio control console. TV control consoles must have both *more* and yet *simpler* facilities than radio consoles, since operators should be able to control more microphones with *less effort*. He has to switch to turntables, projector sound, networks and remote lines with a *minimum of confusion*. The TV audio operator must not only manipulate his way through more complicated shows, but he must also blend his talents with other participants in the production of a show. He is subject to instructions from both the producer and video technical director. He must be in communication with the studio microphone boom operators, projection room and other sources of audio program material. His console must have more of the basic facilities and less of the frills that have crept into some AM and FM consoles.

In large studios, the TV console is required to provide for grouping of inputs through sub-controls. It is also likely to have to use the console for echo and sound-effects filters. To effect greater realism perspective and dialogue equalizers are often needed. To simplify operation, colored or color lighted controls are employed; they can signify particular functions or grouping.

Circuit-patching panels have been found useful; however, they are located away from the control panel since patching during the program, with its possibility of errors, is undesirable. These jack fields do facilitate special setups or emergency equipment substitutions. Jacks may be of the two-circuit tip and sleeve type or the three-circuit type with tip, ring and sleeve construction, depending on the user's preference. Normalled through-connections are widely used in either case.

[1]G.E. TC-22-A. [2]G.E. FA-23-A.

Intercommunications

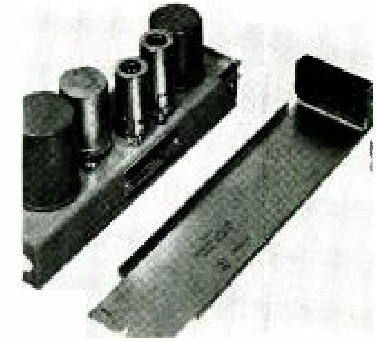
Some form of contact must be available between almost all personnel in the TV studio. An intercom system, to permit convenient direction of a large show, often surpasses in number of components and system complexity the entire program audio layout.

During rehearsal of a TV show regular studio talkback speakers are used. However, all studio personnel who must receive direction during the show are equipped with headsets, which serve three purposes: (1) Keep talkback out of program; (2) permit transmission of many messages at the same time to different people on the floor; and (3) permit reception of program cues as desired.

In addition, many headsets are equipped with microphones for communication back into the control room. In one instance, it is necessary to have communication between camera, camera rack and control desk during maintenance periods. Two-way communication must also be used in remote TV pickups between camera locations and the mobile studio truck.

In large studios wireless systems have been found effective permitting contact to production personnel on the floor. Such systems can also be used to cue

Report on TV Studio Audio Discloses that Facilities, Heretofore Neglected and the Butt of Sharp Criticism, Now Accepted as a Vital Factor in Picture-Sound Transmission, With Labs and Manufacturers Striving to Produce Equipment That Will Assure Quality Results.



PLUG-IN PREAMP[3] which uses 5879 low-noise miniature tubes. It has an output level of +18 dbm, with less than ½% distortion, and a noise level of better than —120 dbm. It may be equipped with bridging volume control and meter connection.

actors where memory fails. These are usually high or low-frequency transmitters with miniature receivers carried by studio personnel. and supersonic systems employing miniature earpiece receivers.

A mixture of standard broadcast program equipment. public-address components, and telephone parts are employed in intercom setups. They are at once intercom, interphone, talkback and cue. all tying in the activities of a large number of people. each with an important job to do. to keep the show moving.

In the Studio

TV studios use both fixed and movable microphones. It is common practice to permit microphones to be seen on variety type shows. However. on dramatic shows the microphones are generally mounted on booms which are moved about so that they are in the sound range but just out of the picture. Hidden mikes are sometimes used. but are not favored because the motion of the actors causes severe level changes.

Sound pickup in TV has been found to be more of a problem than in the movies, since TV does not afford an opportunity to take the picture at one time and dub in sound under more ideal conditions.

In TV the microphones have been much the same as those used in broadcast stations, except that their location and mounting are different. The old familiar ribbon bidirectional mikes and the cardioids are still used, but the modern small slimline mikes used on stands or as hand mikes are becoming increasingly popular. Smaller, lighter mikes with relatively high-output level are receiving more and more attention in research and production.

The high-output requirement has placed a severe strain on preamps. forcing a change in the modern high-output level types. The point has been reached where it is possible, in a high-intensity sound field. to read mike output directly on a *vu* meter and get a respectable loud-speaker level out of a miniature 40-db gain preamp. At the other end of the range, it is still necessary to deal with —80 *vu* output from some microphones under soft-speaking conditions: thus it is necessary to design preamps for a very low noise level. only a few db above the thermal agitation threshhold of —132 db.

Special Effects

The special audio effects in television consist of echo chambers. special filters. recorded effects. and studio-produced sound effects. Echo chambers are mainly reverberant rooms equipped with speaker and microphone. controlled from the studio console. Lately, magnetic-tape echo machines have been used with some success.

Filters are generally combined adjustable highpass-lowpass types. although some feature peaking and rejecting circuits. For about every distortion of sound desired by producers there is a filter combination. The filters can be pre-set or adjusted during the show. Bypass circuits to effect the proper balance between filtered and normal sound are used.

It is frequently more convenient to record the desired effects in advance and then weave them into the show. Conventional broadcast turntable equipment can be used for this service. as well as to provide musical background.

Some studios have an interconnection between camera switcher and audio console to provide special audio effects when a certain camera is selected. This system has possibilities. but has not yet been widely adopted.

Master Control

The TV master-control rooms fall into two broad classifications: *(1)* Those of small or moderate-sized stations where some program production is carried on and output switching plays a minor or at least straightforward part, and *(2)* those of large stations or networks where output switching. or dispatching. plays a very important and complex role.

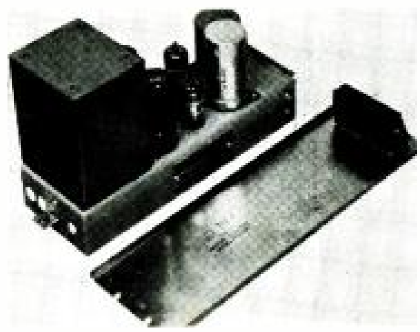
To fit the need of modest stations. where conservation of space and manpower is important. the audio and video switching should be combined on a single control panel and they should be separately switchable. With one recently-designed unit of this type.* one man can perform most of the necessary control and switching functions in a small TV master control room.

The *panel* provides switching of five aural and visual inputs to either of two outputs. Full aural and visual monitoring of all these circuits are also afforded. A level control for a local mike is included: the mike thus may be switched to announce position or to a bank of intercom selector switches. The panel also features two sets of projector controls. which may be used with synchrolite projectors. One combined audio-video fader with the video clip-fade section routed to an associated stabilizing amplifier is also included. There is also a separate video clip-fade potentiometer control. with a second stabilizing amplifier. In addition, a separate audio attenuator is provided for control of audio program bus level.

In the large master-control rooms where output switching is of major importance. the program origination and output switching function must be entirely separated. Often. the input con-

(*Continued on page 32*)

PROGRAM-MONITOR AMPLIFIER[4] which as a program amplifier, provides up to 1 watt with less than ½% distortion. As a monitoring amplifier it provides 8 watts at 1% and 15 watts at 3% distortion over the 50 to 15,000 cps range. Its output stage may be equipped with a variety of tubes including 6V6s, 6L6s, and 5881s. Its gain may be set to 56 or 71 db.



[3]G.E. BA-1-F. [4]G.E. BA-12-C. *G.E. TC-22-A.

POWER-INCREASE

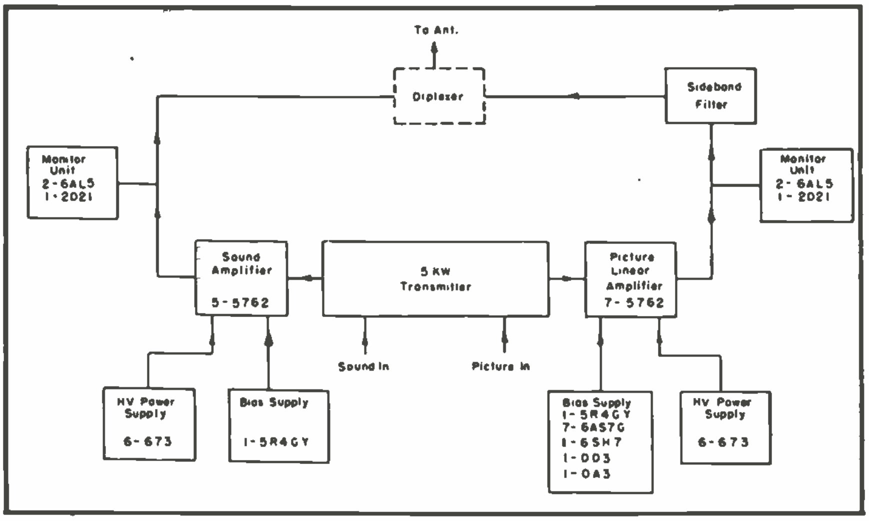


Figure 1 (right)
Block diagram of conversion equipment* as used with 5-kw transmitter.

Figure 2 (above)
External view of low band amplifier for channels 2 to 6.

In the light of the *erp* increases granted recently by the FCC to operating TV stations *power conversion* has assumed a new importance in the industry. For the TV station on-the-air, which began life on a small scale, it has become possible to raise its effective radiated power through conversions, rather than through a completely new installation.

Using conversion units[1] with a 5-kw transmitter as a driver, it is possible for a station to multiply its transmitter power 4 or 5 times, depending upon whether the channel in use is low band or high band. Thus, a transmitter with a 20-kw output, used in conjunction with a 6-bay antenna and an average length of line could give an *erp* of at least 100 kw. With a 12-bay antenna, the *erp* would become at least 200 kw.

The advantages of higher power are obvious. The station gets increased coverage with its signal, plus better signal-to-noise ratio in the picture. More effective use of indoor antennas is possible in the reception area, and there is less receiver oscillation interference.

A block diagram of the conversion system appears in Figure 1. The internal circuits of the 5-kw driver are not changed. The video and audio signals are fed to the driver and the modulation occurs in this unit. The *rf* output from the visual driver is fed to a class *B* linear amplifier. The aural amplifier is similar to the visual amplifier except that it may be operated class *C*, since the sound carrier is frequency modulated.

The power and control equipment for the amplifiers are housed in four cabinets which match the cabinet of the base transmitter. These cabinets may be placed either in line with the transmitter or at right angles.

The *rf* circuits are housed in two cylindrical cabinets illustrated in Fig-

[1]RCA TT-25AL and TT-20AH conversion equipments are high-power amplifiers for use with 5-kw television transmitters. The TT-25AL operates on channels 2 through 6 and will provide up to 25-kw peak visual power and 12.5-kw aural power. The TT-20AH operates on channels 7 through 13 and will supply up to 20-kw peak visual power and 10 kw aural power. These equipments, designed primarily to operate with the RCA TT-5A television transmitter, can be furnished for use with other 5-kw television transmitters meeting FCC and RTMA specifications.

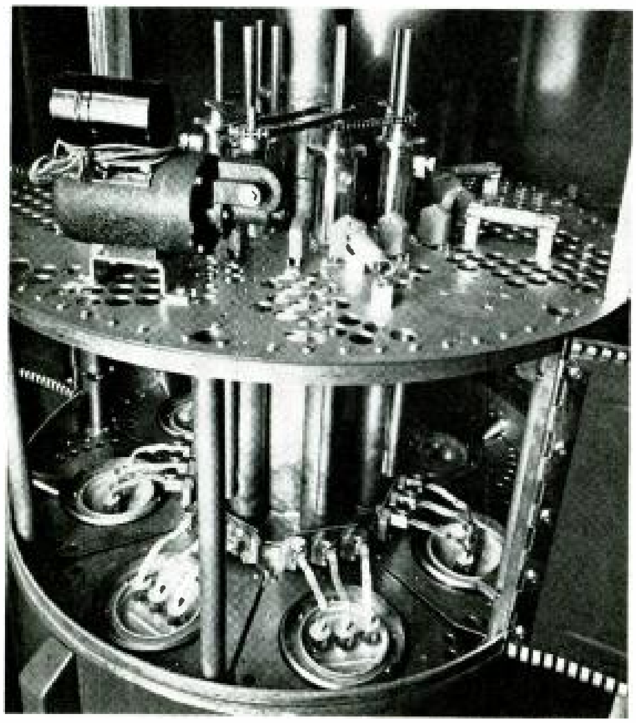
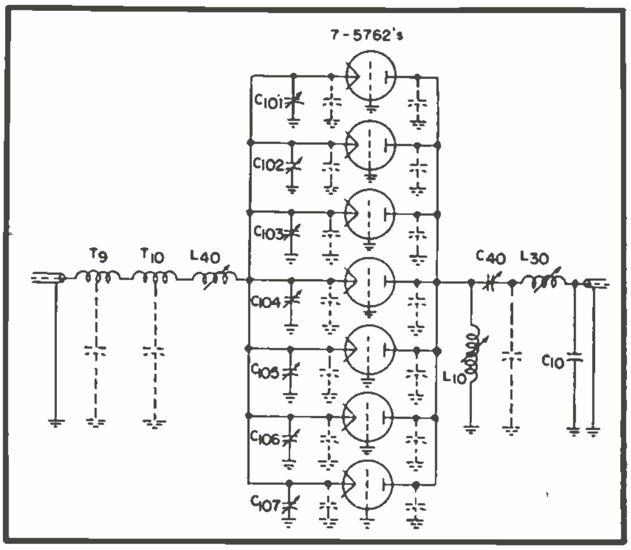


Figure 3
Closeup of 20-kw amplifier showing cluster of seven air-cooled 5762 triodes.

Figure 4
Simplified equivalent circuit of the low-band amplifier.



CONVVERSIONS

by F. E. TALMAGE

Broadcast Transmitter Engineering
Engineering Products Department
RCA Victor Division, RCA

How to Modify Operating 5-Kw VHF Stations to Secure Up to 200-Kw ERP Outputs.

ure 2. The units for the visual and for the aural amplifier are mechanically almost identical.

The lower rectangular section of the amplifier unit houses the blower, filament transformers, meters and tuning controls while the upper cylindrical section contains the tubes and *rf* circuits. Air for cooling the tubes is drawn in through two filters on the sides of the bottom section and is expelled out the top of the unit. Access to the tubes is obtained through four hinged doors near the top of the unit. A reflectometer and monitor circuits are contained in a separate unit which may be inserted in any convenient place in the output line.

Circuit Description

The visual *rf* amplifiers for both the low-band and the high-band equipments each employ seven 5762 air-cooled tubes[2] operating in parallel in a grounded grid circuit. The tubes are placed in a circle as shown in Figure 3. The aural amplifier also contains seven 5762 tubes in an almost identical circuit; however, the filaments of two of the seven tubes may be turned off if desired, leaving only five operating tubes. The general appearance of the low and high band units are similar, but the internal circuits necessarily differ in several important respects.

Low-Band Amplifier

The plate tank circuit, as indicated in Figures 4 and 5, is tuned by L_{10}. As will be noted in the cut-away view, this inductance is a coax tank formed by the outer shell and an inner cylinder, and varied by a shorting bar located below the tubes. The shorting bar is motor driven and controlled from the front panel. The output transmission line is brought up through the center of the tank and coupled to the plate circuit through a variable capacitor, C_{40}. This capacitor is also motor driven and controlled from the front panel. What is equivalent to a second tuned circuit is formed by inserting a shunt capacitor, C_{10}, in the output transmission line approximately one-quarter wave from C_{40}. This secondary circuit is tuned by sliding the C_{10} capacitor along the line. The inductance, L_{30}, shown in the equivalent circuit is actually the first quarter wave of the output transmission line. By a suitable selection of the value of the C_{10} capacitor and proper adjustment of the coupling capacitor, C_{40}, a broadband flat-topped circuit can be obtained, as illustrated in Figure 6. The optimum circuit has been found to be 8½ to 10 mc wide between half power points and almost flat over the 6-mc channel.

The input or cathode circuit is also essentially a coax tank circuit, tuned by a shorting bar shown near the center of Figure 5, just above the tube level. In the equivalent circuit this is shown as

[2]RCA.
*RCA TT-25AL/TT-20AH. **RCA TT-25AL.

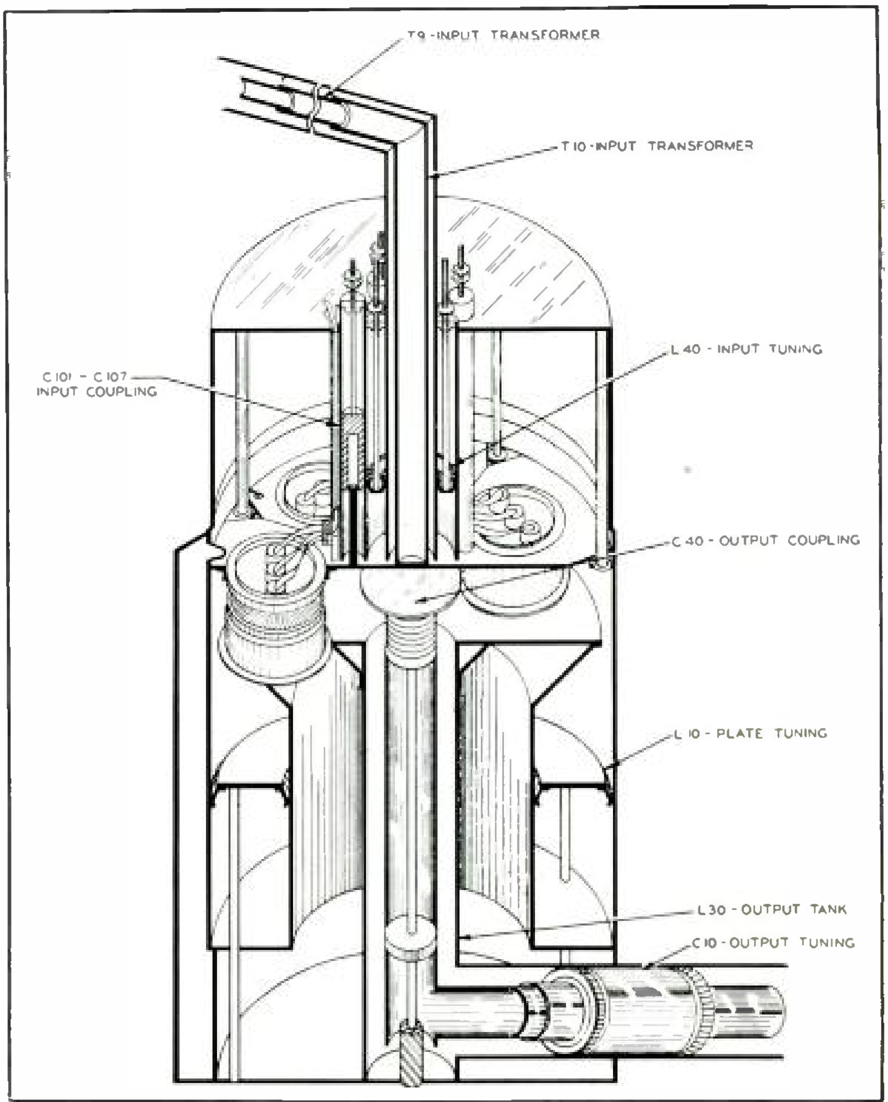


Fig. 5
Cutaway view of low-band amplifier showing rf circuits.**

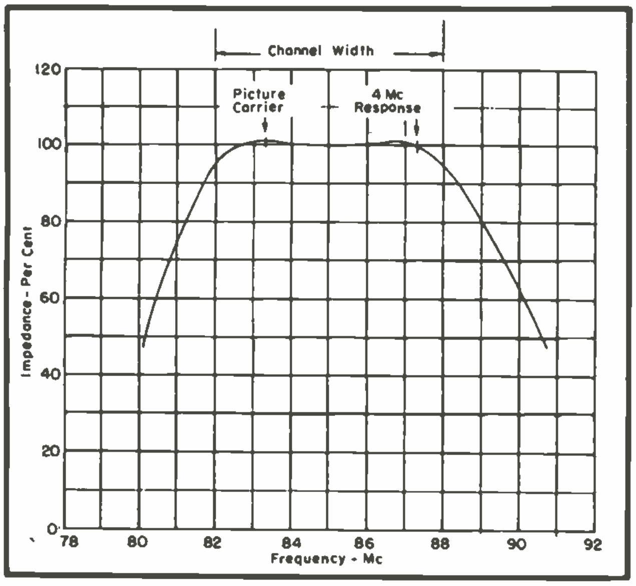


Figure 6

Curve showing typical response of low-band amplifier output circuit for channel 6.

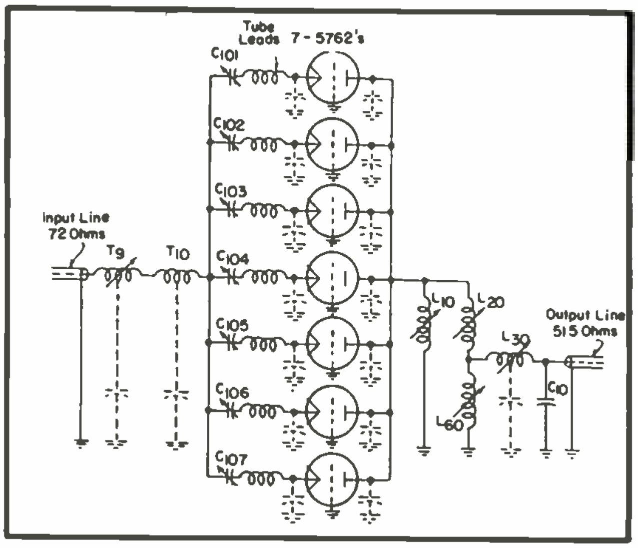


Figure 7

Equivalent circuit of high-band amplifier for channels 7 to 13.

a variable inductance (L_{60}). Because of the high input capacity of seven tubes in parallel, this tank is actually much less than a quarter of a wavelength long. A large part of the inductance is formed in the tube and by the tube leads. The input line is fed through the center of the cathode tank and is connected in series with the input circuit at a low impedance point. To match this impedance to the 72-ohm line from the driver, two quarter-wave transformer sections (T_9 and T_{10}) are employed. In the cut-away view these are shown built into a 3⅛″ input line by using the proper size center conductors for the quarter-wave sections.

To allow for a variation in the tube input capacity and for variation in feed-through power, a means for making some adjustment to the input coupling must be provided. In the low-band amplifier this has been accomplished by adding shunt capacitors, C_{101} and C_{107}. These capacitors actually take the form of seven coax capacitors. To vary the capacity a *mycalex* cylinder, which has a dielectric constant of approximately 6, is inserted between the center and outer tubes. There are seven of these cylinders, mechanically ganged together and driven by a tuning motor. Since the tube leads form a portion of the tank inductance these capacitors are not actually in parallel with the tube input but are part way down the tank circuit, where it has been found that they serve as a coupling adjustment and have little effect on the resonant frequency of the circuit.

A cut-away view of the high-band amplifier is shown in Figure 8; the sim-

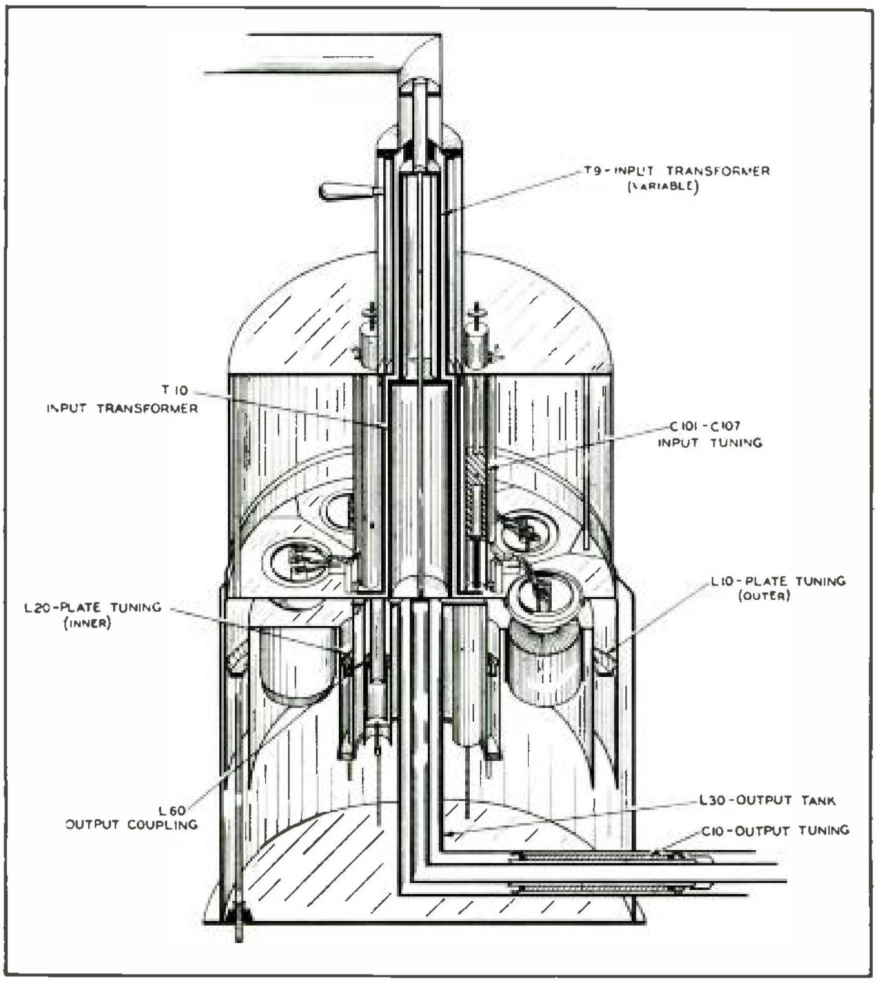


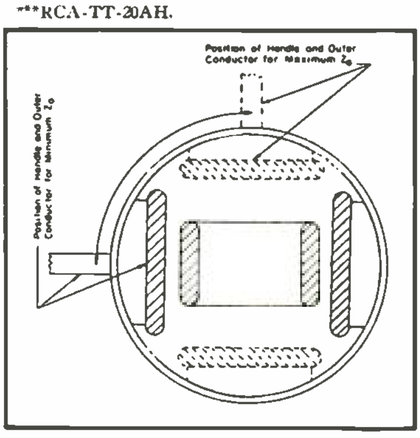
Figure 8

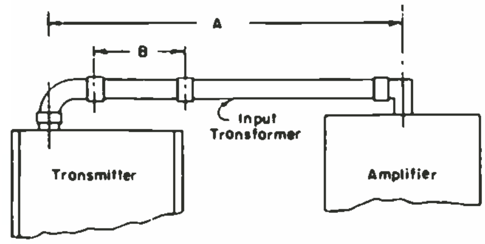
Cutaway view showing rf circuits of high-band amplifier.

Figure 9

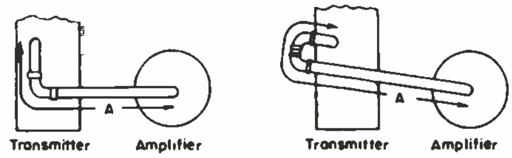
Cross-sectional view of the variable-Z transformer used in the high-band amplifier.***

***RCA-TT-20AH.





Channel No.	A (inches)	B (inches)	¼ wavelength
2	121	25	103⅝
3	101	5	93¾
4	175	77	85⅝
5	141	45	74¼
6	125	29	69⅜



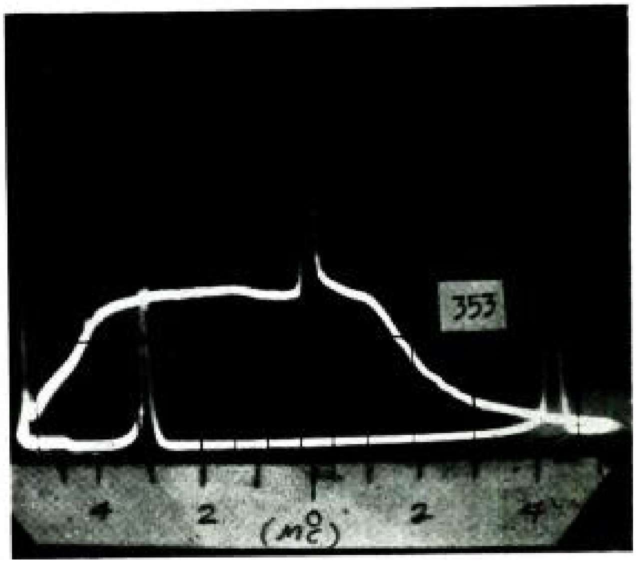


Figure 10 (left)

Table and drawings illustrating length of line between driver and 25-kw amplifier, and several ways of running the line to obtain the correct length.

Figure 11 (above)

Overall frequency response of the low-band amplifier, including the driver of the 5-kw transmitter. Measurements were made on channel 2 with side-band response analyzer.

plified equivalent circuit appears in Figure 7. The general appearance of this unit is similar to the low band unit, but the circuit actually differs in several important details. Because the operating frequency is much higher, it would be impractical to use a simple quarter-wave concentric line tank similar to that used in the low band amplifier, since there would be little or no tank circuit left outside of the tubes themselves. To overcome this, two coax tank circuits are employed. One of these tanks is inside the other, as shown in Figure 8. These function as inductances in parallel and thus raise the effective resonant frequency. In the equivalent cir-unit these inductances are L_{10} and L_{20}. The output is coupled to the inner of these plate tank circuits across a shunt inductance, L_{30}. To preserve the circuit symmetry this inductance is actually made up of seven small adjustahle shorted transmission lines, connected in parallel and located on a circle just inside the inner plate tank. Like the low-band unit, the secondary or output circuit is formed by inserting a shunt capacitor, C_{10}, in the output transmission line and is tuned by sliding this capacitor along the line. Because the two circuits are coupled at a low impedance point, this capacitor is located approximately one-half wavelength along the line. This secondary circuit, coupled to the plate circuit, by means of a mutual reactance, L_{40}, forms the necessary elements of an over-coupled broadband circuit, whose response is equivalent to that shown in Figure 6 for channel 6.

The cathode circuit, like the plate circuit, cannot be a conventional quarter-wave tank, because the first low impedance point will occur on the tube straps. To compensate for this extra inductance of the straps, seven coax capacitors (C_{101} to C_{107}) have been connected in series with the tube leads, instead of in shunt as was the case in the low-band amplifier. These capacitors are variable and when mechanically ganged together serve as the input tuning control. This cathode circuit is matched to the 72-ohm input by two quarter-wave transformer sections in series. To provide for an input coupling adjustment one of the transformers (T_9) is constructed so as to have a variable characteristic impedance as the outer shell is rotated through 90°.

Power and Control Equipment

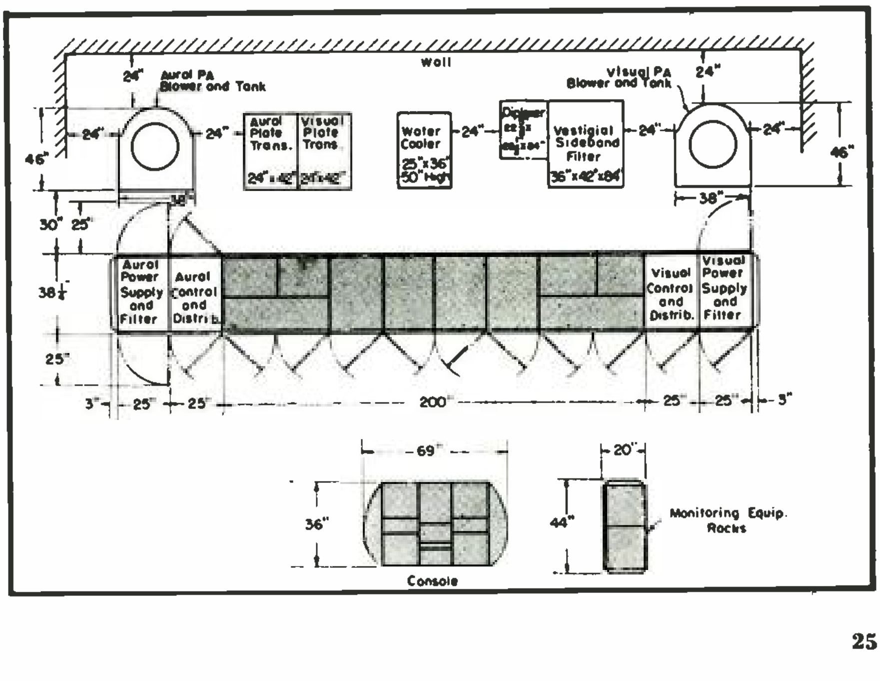
The control equipment is of conventional design. An instantaneous trip

(*Continued on page* 33)

Mycalex 400 and Mycalex K-10 (compression molded grades), Mycalex 410 and Mycalex 410X (injection molded grades), glass-bonded mica insulation, are products of the Mycalex Corporation of America, 30 Rockefeller Plaza, New York 20, New York.

Figure 12

FLOOR PLAN showing straight-line arrangement of low and high-band amplifiers.



RADAR Target Measurements‡

by RALPH G. PETERS

Part II* . . . Transmitter-Receiver Characteristics Calibration Procedures . . . Potentialities of System.

Reviewing the target radar transmitter, in the initial installment last month,* it was noted that a 2K39 kylstron, used withina Pound system of frequency stabilization, was adopted.

Basically the system features the use of the imaginary component of the reflection coefficient of a standard cavity as an error signal to control the klystron frequency. A further degree of stabilization was obtained by operating the 2K39 in an oil bath maintained at a controlled temperature (140° ± 1° F). It was found necessary to operate the bath continuously to avoid the difficulties of *hysteresis* in the klystron operation, i.e., with constant voltages, the oscillator would not return to the same frequency when the temperature was cycled from 140° *F* to room temperature, and then back to 140° *F*. By a careful selection of oscillator tubes, a power output of 400 milliwatts was found to be obtainable over the entire 2K39 frequency range of 7,500 to 10,300 mc.

Measurements with the system indicated that a 3-kc deviation of the oscillator frequency would just produce a detectable unbalance of the hybrid junction. The drifts of balance which occur at the present time were found to be due to the effects of temperature on the impedances of various parts of the equipment associated with the oscillator, rather than to the drift in the oscillator frequency.

Receiver

In the receiver, there was included a crystal mixer with a 723/AB klystron local oscillator, with a bandwidth of 2 mc, a sensitivity equal to 125 db below one milliwatt, and a dynamic range equal to about 60 db.

In lieu of an *afc* system, it was decided to superimpose a 6.3-volt *ac* voltage upon the repeller voltage of the local oscillator so that the oscillator could sweep through the correct frequency 120 times per second. Thus, the output of the second detector is a pulse signal having a repetition rate of 120 cps and a shape corresponding to the bandpass characteristic of the receiver.

Continuing an analysis of the receiver, the report said that the second detector is followed by video amplifiers and an integration network, the combination of which produces a *dc* voltage which, in turn, is fed to the control grids of the first two stages of the *if* amplifier for automatic gain control. The integration network is followed by a *dc* amplifier and a 1-ma meter, to monitor the receiver output.

A second output from the second detector is fed to a 'scope** (also used as a monitor) and finally to the input of a radiation pattern recorder,*** to plot the receiver output.

The target rotation rate of 0.83 rpm was found to be slow enough so that the time constants in the receiver produce no error.

Target Support

The target support was noted as the most difficult requirement of the entire project. Three specifications were set up:

1) The supports and rotation mechanism had to give a return far below the minimum required from the target for an actual measurement.

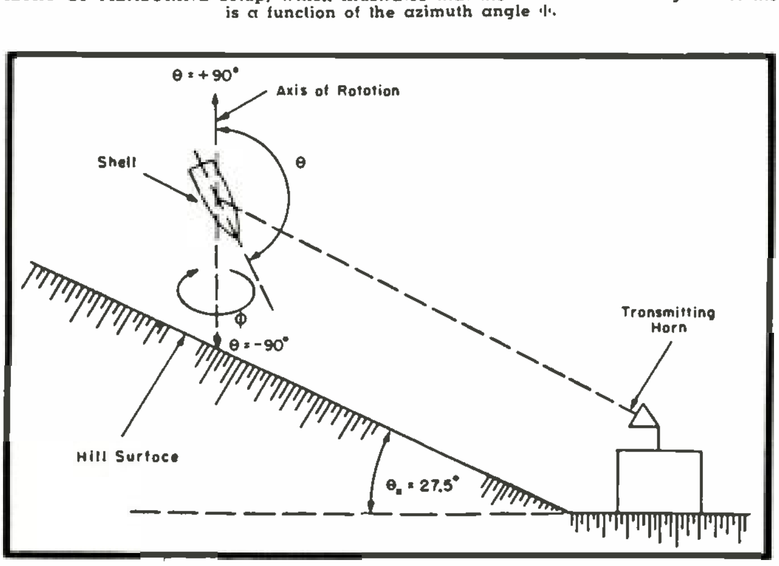
2) The target had to be supported rigidly and in such a manner that its aspect to the antenna would be known accurately and could be changed readily.

3) The target rotation rate should be uniform.

The field of the antenna was explored with a small horn so that the upright support pipes could be placed at nulls of the antenna pattern. The metal pipes, which are 4" in diameter, were so placed that they were illuminated by a power density of 22 db below the power density at the target. In addition, they were covered with electromagnetic absorbing material which further reduced the return by at least 15 db.

The antenna was pointed up a hill (at an angle of 27.5° to the horizontal). This feature was found to be advantageous for two reasons: (*1*) When transmitting up the hill, a free space background could be obtained beyond the hill crest (about 300' from the antenna). This reduced the possibilities of reflections from trees and other moving objects which often are found over normal level terrain. (*2*) The return from the support pipes and strings was found to be considerably reduced since at no time were the support strings or

GEOMETRY OF MEASURING setup, which illustrates that the true elevation angle θ of the shell is a function of the azimuth angle Φ.



‡Based on Naval Research Lab Report 3800; work on the problem is continuing.
*Television Engineering, December, 1951.
**DuMont type 241. ***AN/ARH-1.

pipes normal to the antenna direction.

There was one disadvantage of this arrangement: the true elevation angle θ of the shell became a function of the azimuth angle ρ.

It was noted that the tuning stubs allow a long-time balance of the hybrid junction even in the presence of return from undesired (background) targets, if the return from the background targets remains constant. Once, however, the hybrid junction has been balanced against the return from the background, the report added, the insertion of a model target into the field of the antenna (and its consequent rotation) will, in general, change the illumination of the background, and destroy the balance of the hybrid junction against the background. The result is that the total unbalance of the hybrid junction is the sum of the unbalance caused by the target itself, and the unbalance created by changing the illumination of the background. Accordingly, it was pointed out, the error introduced by background will be directly proportional to its return. The target echo will beat with the undesired return as the target is rotated and, unless the magnitude of the desired return greatly exceeds the undesired return, measurements will be inaccurate. Describing a check which can be made on these factors the report declared that a sphere can be rotated off center and the return plotted.[1] With small off-center displacements, the sphere will be illuminated equally by the antenna pattern throughout its rotation and should give a constant return. Any deviation from a constant return is a measure of the undesired return. The return will vary by about ±0.6 db.

Calibration

The system must be calibrated in order that the radial deflections of the polar recorder may be transformed into radar area. Such calibration can be completed by the use of spheres whose diameters range from 5" to 12".

After the polar plots of the target are taken, several spheres, whose radar areas are comparable with that of the model, are introduced into the field and their patterns taken. The transmitter is then shut off and a signal from the signal generator is fed through the directional coupler via a secondary-standard *rf* attenuator, and the relative readings of the attenuator to produce discrete steps of deflection of the recorder are noted. This information will allow construction of a plot of radar area versus deflection for the range of radar area in which the spheres lie.

[1] *Present Status of Model Measurements from Missiles*, Ohio State University Research Foundation, Report No. 235-1; September, 1946.

GLYCERINE in TV

by MILTON A. LESSER

Concluding Installment Covering Use of Glycerine as Wire Insulation, Binder for Split Mica and Bonding of Rubber to Metal Bases.

ALKYD RESINS, with its high content of glycerine are extensively used in TV manufacture.

Alkyds, for instance, are important components of insulation for wire. Their ability to impart resistance, toughness and flexibility to insulated coatings for conductors is widely recognized. As with other coatings, the alkyds are sometimes combined with other resins to obtain desired characteristics. In one insulated wire coating, featuring high-dielectric strength, there appears melamine-formaldehyde resin, ethyl cellulose and castor oil-modified glyceryl phthalate resin.

Outer coatings or layers on cables may also utilize alkyd resins, especially where specific properties are required. In one instance, an alkyd has been used in formulating an outer semi-conducting coating for high tension electric cables. In another, a modified glyceryl sebacate resin has been employed in the composition of a flexible, highly heat-resistant coating.

Plasticized ester gums are also used in insulation. They can replace asphalt saturants and stearin pitch employed for weatherproofing fibrous coating on conductors and are said to be particularly advantageous when used as undercoatings for colored lacquers, because no black color shows through when the lacquer coating becomes damaged.

The superior adhesive characteristics of alkyd resin coatings also account for their usefulness as binding agents. For example, the alkyds have long been used as binders for flake, powder and split mica to produce insulation of high dielectric strength. In addition to their use with mica, alkyds have been incorporated in fast air-drying adhesives for assembling parts and coils. Alkyd binders have proved effective for attaching bases to large tubes, and in a recent development, a glyceryl phthalate resin has served as an intermediate layer to permit a synthetic rubber to be bonded to metal bases.

Although the glyceryl phthalate resins have not been extensively employed in making molded articles for TV parts, several recent patents indicate that this field of application may be an expanding one in the near future. One describes a number of heat-curable compositions, containing alkyds and glycerine-sebacic acid condensates, which are suitable for molding, extruding, calendering and other forming operations. The resulting shaped articles are generally insoluble in organic solvents, nonreactive, tough, essentially infusible and of limited thermoplasticity. Another patent suggests that glycerine may be used in the production of alkyd type casting and adhesive resin materials of superior water resistance and electrical properties.

Bibliography

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BACK FROM THE KOREAN FRONT

Morris E. Patneaude (right), first electronics field engineer to be assigned by the RCA Service Company to duty in Korea, being greeted by C. M. Odnrizzi, operating vice president of the RCA Victor Division, on his return to Camden, N. J., headquarters from the fighting front. Patneaude spent more than a year in Korea, installing and servicing radar equipment and instructing military personnel in its operation.

TV Parts & Accessory Review

Button Capacitors for UHF

BUTTON CERAMIC CAPACITORS, for *vhf* and *uhf* applications, with tiny disc capacitor elements buried in a recess in the head of a garden-variety threaded fastener, have been announced.

Button units are said to offer minimum ground inductance of a fixed value, allowing higher circuit gains to be used; shielding of the capacitor element by the outer metal shell; and a short and radially uniform bypass path to ground and lug terminals at tube socket height to provide tie points for multiple connections while maintaining short, uniform lead lengths.

Units are rated at 500 volts *dc* in values up to 1000 mmfd, depending on characteristics. Four thread variations are available: self-tapping 6-32 thread, standard 6-32 thread with non-removable lock washer, and self-tapping and standard 10-32 threads.—*Types 505-C, 506-C, 507-C, 508-C; Sprague Electric Co., North Adams, Mass.*

Sprague Electric Screw-Mounting Button Capacitors.

Remote Thermal Switch

A THERMAL SWITCH for remote on-off control of auxiliary electrical circuits is now available.

Switch is claimed to feature fast self recycling, pure silver-to-silver contact, and mechanical stability. Maximum load is 50 watts; actuating load minimum, 100 watts at 117 v; actuating load maximum, 500 watts at 117 v. *Model SW-T-1; The LaPointe Plascomold Corp., Windsor Locks, Conn.*

Disk Ceramic Capacitors

A THIN DISK CERAMIC CAPACITOR with a high *K* ceramic body is now being produced. Dimensions are .156" maximum thickness and .594" maximum diameter.

Now in mass production are .005 mfd 500 *v* units: Working volts, 500 volts *dc*; test voltage, 1300 volts *dc*; leakage resistance, over 7500 megohms; power factor, less than 2.5%.—*J.Cap; Jeffers Electronics, Inc., Speer Carbon Co., Saint Mary's, Penn.*

Jeffers Disk Ceramic Capacitor.

Selenium Rectifiers for Instruments

SELENIUM RECTIFIERS for instruments, fabricated with a plate-stabilizing process which is said to permit matching of the characteristics of individual cells to provide uniformity within and between units, has been produced.

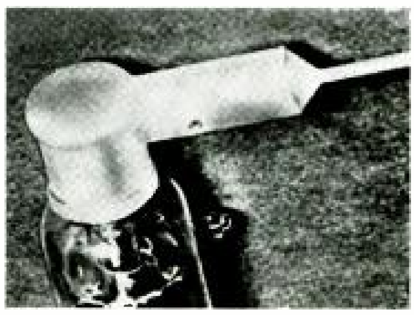
Rectifiers are available as half-wave, center-tap, doubler, ¾-bridge and bridge types. Individual cells are rated at 10 *v ac* input and 5 *ma dc* output, but can be had in input ratings up to 26 *v ac* and output current ratings up to 10 *ma dc*.—*Minisel; Electronic Devices, Inc., Precision Rectifier Division, 423 12th St., Brooklyn, N. Y.*

Minisel Rectifier.

Molded Resistor Tube Cap Connector

A HALF-WATT RESISTOR of any resistance, integrally molded as a part of a tube cap connector, has been announced.

Made to fit ¼" and 23/64" diameter tube caps, the resistor is snubbed and spot welded right to the grid cap, then to the lead. Grid cap insulation, resistor insulation and wire insulation are molded into one unit. Clip has two curved surfaces that fit almost entirely around the grid cap. Elimination of sharp edges and multiple fingers is said to reduce corona effect.—*90 ISRL; Alden Products Co., 117 N. Main St., Brockton, Mass.*



Alden Tube Cap Connector.

Coax RF DPDT Switch

A DOUBLE-POLE-DOUBLE-THROW COAX RF SWITCH to replace the use of two single-pole-double-throw switches has been produced. Switch is motor operated instead of solenoid. Straight end connections are said to eliminate the use of lossy angle connectors.

RF performance characteristics: frequency range up to 11,000 mc; *vswr* less than 1.3 to 1; insertion loss less than .5 db throughout operating range; attenuation between unused connectors 55 db average; power-handling capabilities equal to improved-type N connectors; and motor driven actuator rating 21-28 *vdc*.—*1460-22; Transco Products, Inc., 12210 Nebraska Ave., Los Angeles 25, Calif.*

Instruments

Double Pulse Generator

A DOUBLE PULSE GENERATOR that is said to produce either single or double pulses such that the amplitude and width of each pulse is continuous and variable, has been inbeen introduced.

Unit is capable of producing either positive or negative pulses. Amplitude of negative pulse is variable from 200 *v* maximum into a 1000-ohm load, and 10 *v* maximum into a 50-ohm load. Amplitude of positive pulse is also variable from 50 *v* maximum into a 1000-ohm load and 2.5 *v* maximum into a 50-ohm load. Separation of pulse pairs is variable from 0-10 microseconds. Rise time is said to be .035 microsecond, and decay time less than .15 microsecond. Pulse width is variable from .1 to 1.8 microseconds.—*Model 903; Berkley Scientific Corp., 2200 Wright Ave., Richmond, Calif.*

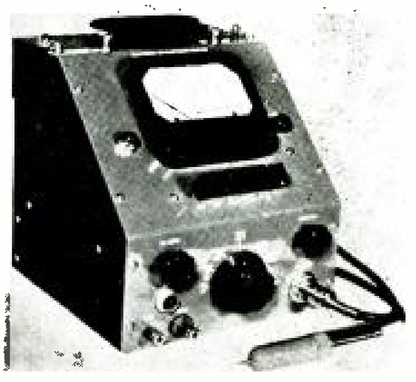
Berkley Double Pulse Generator.

High Frequency VTVM

A HIGH-FREQUENCY VTVM that features a frequency range of 60 cycles to 700 mc has been introduced.

Voltage ranges are *dc*—1, 3, 10, 30, 100, 300, 1000, and *ac*—1, 3, 10, 30, 100, 300. Resistance range has center-scale values of 10, 100, 1000, 10,000, 100,000, 1,000,000 ohms and 10 megohms. Readings from .1 ohm to 1000 megohms are possible. Power level has one scale reading from - 10 db to ± 10 db, calibrated from the 3 volt scale at 600 ohms.

DC voltage has an input resistance that is claimed to be constant at 43 megohms, ± 2% on all ranges; *ac* voltage at 60 cycles has an input impedance represented by a 7-megohm resistance shunted by a capacitance of 1.3 mmfd.—*Model 161-A; Electronic Measurements Co., Red Bank, N. J.*



Electronic Measurements HF VTVM.

Production Aids

Shaft-Position Indicator with Digital Output

A SHAFT-POSITION INDICATING SYSTEM which is said to detect the angular position of a rotating shaft and convert the resulting indications to a digital representation has been developed.

Device consists of an electromechanical locator unit which couples to the reference shaft and an electronic converter unit. Utilizes a magnetic recording mechanism to indicate on command (and as often as twenty times per second) the position of a reference shaft. Accurate to ±0.09°. Measurements may be routed to remote location and displayed as visual indications in digital form, transferred to magnetic tape, punched tape, or punched cards for future analysis, or used to perform desired control functions.—*Shaft-Monitor; Engineering Research Associates, Inc., Dept. A, 1902 W. Minnehaha Avenue, St. Paul W4, Minnesota.*

Gang Channel

A MULTIPLE LOCK-NUT FASTENER, containing spring steel lightweight lock-nut as inserts, has been developed.

Made of 24 ST alclad aluminum alloy to Army and Navy Air Force specifications, the channel portion features a double-vertical wall, providing high *push out* resistance, plus maximum rigidity.

The inserts used are steel high-temperature self-locking nuts.

Made presently in sizes ranging from 8-32 through ¼"-28 size. — *The Kaynar Manufacturing Co., Inc., Kaylock Division, Engineering Dept. C-50, 820 E. 16th St., Los Angeles, Calif.*

TV Jumper Cord

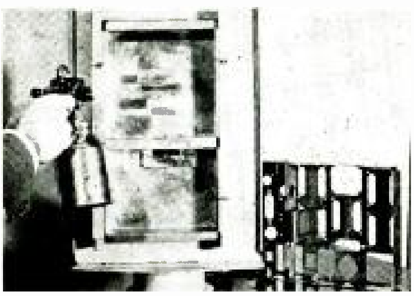
A TV JUMPER CORD, which serves as a connector between the two parts of the interlock after the back has been removed from a TV set, automatically disconnecting the power, is now available.

Cord is a six-foot length of 18-gage parallel cord with an all-rubber female connector molded on one end and a miniature male connector substituted for the conventional plug on the other.—*Available from G. E. tube distributors.*

Code-Marking Stencils

CUSTOM CODE-MARKING STENCILS that are said to make it possible to spray both sides of a chassis in a single operation, and eliminate the necessity of handling a wet stencil, through the use of holders, have been announced.

Stencil can be fitted over any part, regardless of size or shape.—*Jas. H. Matthews and Co., 3801 Forbes St., Pittsburgh 13, Pa.*



Matthews Code-Marking Stencil.

Tungsten Machining Technique

A TECHNIQUE for drilling, grinding, turning, milling, threading and tapping tungsten metal, using ordinary metal working machines, has been developed.

Technique is said to permit the machining of tungsten metal to tolerances comparable to those normally achieved with steel or brass. It is claimed that tungsten tubing has been fabricated with an outer diameter of .066" ± .0005 and an inner diameter of .060 ± .001. An 0-80 tungsten screw 11/16" long has been made with a .025" hole drilled through its entire length.

Method is used in manufacturing tungsten L-cathodes. — *Philips Laboratories, Inc., 100 East 42nd St., New York 17, N. Y.*

Tang Break-Off Tools

AUTOMATIC TANG BREAK-OFF TOOLS, for the removal of inserting tangs of helical-wire thread inserts, is now available. Operating on the principle of a spring-loaded center-punch, these tools are said to remove tangs without disturbing the inserts.

Fourteen standard models permit tang-removal operations at production rates on thread inserts: 6-32 to ½-13 sizes in the National Coarse thread series to lengths of 1, 1½, and 2 diameters; and 10-32 to ½-20 sizes in the National Fine thread series to the same lengths.

Thread inserts provide female receiving threads in aluminum, brass, bronze, copper, magnesium, plastics, iron, steel, zinc and wood. — *Heli-Coil Corp., Danbury, Conn.*

Shielded Isolating Transformer

A SHIELDED ISOLATING TRANSFORMER that is claimed to provide a voltage supply source independent of any line interference or disturbance on the primary side, has been developed.

Secondary winding is enclosed in a copper electrostatic shield; metallic shielded secondary cables are integrally attached to the copper shield.

Ratings from ½ to 15 *kva*, 120 or 240-volts primary, 120-volts secondary.—*Acme Electric Corp., Cuba, N. Y.*

Portable Sliding-Drawer Oven

A PORTABLE OVEN, with eight sliding drawers that are said to permit baking of different materials at the same time or at intervals, has been announced.

Weighing 118 pounds, oven provides a thermostatic temperature control up to 325° *F*, forced circulation by fan, and an adjustable damper for control of volume of air circulation. Drawers are 2" high x 11½" wide and 23" deep.—*Model TD; Grieve-Hendry Co., Inc., 1011 N. Paulina St., Chicago 22, Ill.*

Stainless Steel Coating

A STAINLESS STEEL COATING for metal surfaces, that is said to dry to handle within 30 to 60 minutes, has been produced. Applied with brush or spray gun.

Coating is claimed to protect against rust, acids and other types of deterioration, and is said to be noninflammable, odorless, tasteless when dry, and will take fungus treatments.—*Steelcote Manufacturing Co., St. Louis, Mo.*

Broadcast News

Volume Level Indicator

A VOLUME LEVEL INDICATOR, with components mounted to withstand shock and the rough usage given portables, is now available. Unit is self-contained, requiring no batteries or external power supply.

Indicating meter is a copper-oxide type. Adjustment is such that the pointer is said to indicate 99% normal deflection at zero *vu* in approximately 0.3 second. Overswing is not more than 1 to 1½%. Meter scale is calibrated in *vu* and per cent.

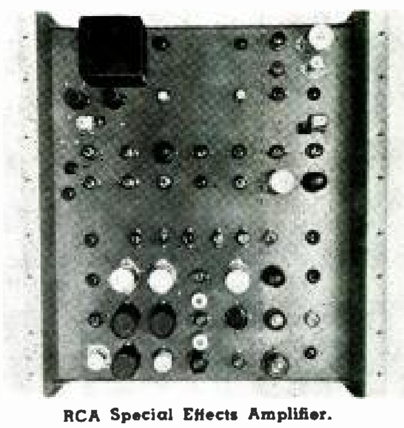
Two meter controls are provided; a small decade with screw driver adjustment for zero level setting of the meter pointer, and a constant impedance *T* type network for extending the range of the instrument in steps of 2 db. These controls make it possible for all *vu* meters in one installation to be adjusted to the same scale reading when desired. Indicator is 11" x 6" x 6¼".—*Series 911; Daven Co., 191 Central Ave., Newark 4, N. J.*

Daven Volume Level Indicator.

Special Effects Amplifier

A SPECIAL EFFECTS AMPLIFIER, that can accomplish fades, dissolves, superpositions, wipes, insertions, and other dramatic picture combinations at microsecond speed, has been announced.

System consists of a single rack-mounted unit which accepts the two video signals to be mixed, together with a masking signal, and delivers the desired composite signal. Relationship between the two video signals is controlled by the masking signal, which may be delivered by a TV camera of any type (field, studio, film, or flying spot) or by a generator of synthetic signals. Masking signal is used to operate two electronic switching circuits in the channels carrying the two picture signals to be mixed. When the masking source scans black, one picture signal is transmitted, and when it scans white, the other signal is transmitted.—*TA-15A; RCA Victor Division, RCA, Camden, N. J.*



RCA Special Effects Amplifier.

Industry Literature

Allen B. DuMont Labs., Instrument Division, 1000 Main Ave., Clifton, N. J., has issued Vol. 12, No. 1, of the *Oscillographer*, which includes material on RTMA screen phosphors, special picture tubes, polaroid-land process as applied to photorecording, amplitude and transient response curve evaluation.

General Electric Co., Schenectady 5, N. Y., has released a 4-page bulletin, *GEA-5660*, on electronic contour follower systems for machining irregularly shaped parts. Publication covers 1-, 2- and 3-dimension tracer control systems for use on lathes, boring mills, milling machines, drilling machines, etc.

Stupakoff Ceramic and Manufacturing Co., Latrobe, Pa., has published a 52-page catalog, *951*, describing steatite products such as tubing, coil forms, standoffs, strains, asemblies, appliance parts, bushings.

Distillation Products Industries, Eastman Kodak Co., Rochester 3, N. Y., has issued a data sheet which describes and charts the characteristics of type *mcf* diffusion pumps that can be used for evacuation of electronic tubes and other devices requiring an ultimate pressure of less than 10^{-5} mm Hg. Sheet provides information on forevacuum, fractionation, speed, baffles, and installation of pumps.

Advance Electric and Relay Co., 2435 N. Naomi St., Burbank, Calif., has published a catalog describing a line of standard and special relays. Included are circuit controls, radio and high frequency, keying, midget, coax, and hermetically sealed and special purpose types.

Standard Transformer Corp., Chicago, Ill., has released an output transformer chart, *375*, which lists 129 of the most frequently used output transformers and the tubes with which they should be used.

Ferroxcube Corp. of America, Saugerties, N. Y., has issued a bulletin, *FC-5101-A*, on nickel-free ferrite cores for coils and transformers. Includes performance curves for the 3C series of cores, which it is said can be substituted for cores in horizontal TV deflection yokes and horizontal output transformers.

National Bureau of Standards has published a supplement to the '50 *Screw-Thread Standards Handbook H28*, which describes a number of changes in American screw-thread standards adopted since '44. Supplement is available from Government Printing Office, Washington 25, D. C., at 50 cents.

Chicago Telephone Supply Corp., Elkhart, Ind., has released a data sheet, *155*, detailing performance characteristics of high-temperature variable resistors. Data covers wattage, voltage rating, humidity characteristics, leakage resistance, temperature coefficient, rotational life and voltage coefficient.

Iliffe and Sons, Ltd., Dorset House, Stamford St., London 1, England, has published a book, *Advance Theory of Waveguides*, by L. Lewin. Book describes various methods that have been found successful in treating types of problems arising in work on waveguides.

Gries Reproducer Corp., 780 East 133 St., New York 54, New York, have published a bulletin with details on zinc alloy wing nuts, which are cast in one piece of nonferous zinc alloy. Bulletin provides a chart of dimensions, sizes and other pertinent data.

Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J. have produced a bulletin, *440*, describing a line of 400-cycle motor generator sets which are used in labs and factories and in industrial operations for testing electronic equipment and operating high frequency motors, and radar equipment.

Video Techniques

(*Continued from page 11*)

intensity can be maintained within camera-performance limits.

Multi-Focus and Shading

Where a ten per cent setup is required, it is not simple to produce a real rich black. However, by proper manipulation of the multi-focus and shading controls, this result becomes quite feasible. It is not dangerous to sacrifice a small amount of video gain to maintain a good flat black base. Every operator should become accustomed to riding continually multi-focus and shading controls while on the air. There is nothing to lose and a great deal to gain in picture quality: Figure 7*a* and *b* (page 10).

Credits

The author is grateful to his colleagues at CBS for their assistance in the preparation of this article: Emanual Kaufman and John Lincoln, *photography;* Greg Harney and Hank Alexander, *lighting;* and Robert Brown, *technical assistance.*

System TV

(*Continued from page 17*)

programming and engineering as required to produce technically satisfactory pictures. He should have a complete understanding of lighting parameters; namely, lighting fixtures, lighting intensities, color temperatures, lighting angles and in general, the knowledge required for producing the effects desired in the production. He must further have a basic understanding of photographic technology. He must be capable of making light measurements and analyzing these data in terms of the TV system requirements, and also serve as liaison between production, programming and engineering. He is directly responsible to the technical director.

The *audio engineer* works with the *TD* and the studio *boom* man in an effort to produce *life-like* sound throughout the entire production. It is further the function of the audio engineer to *mix* all microphones and turntables into a common output, maintaining correct balance and levels at all times. Since the general policy of *no visible microphones* exists in TV, frequent application of hidden microphone technique is required. Final responsibility, however, falls on the *TD* for the quality of overall audio during a production.

The *mike boom operator* is charged with the responsibility of having the

(*Continued on page 32*)

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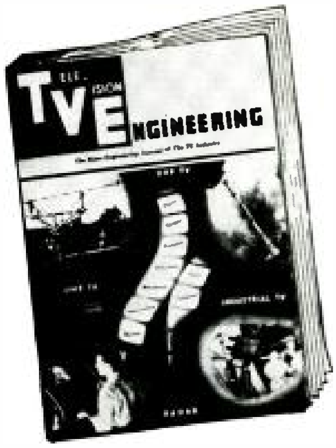

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System TV

(*Continued from page 31*)

mike in the right place at the right time. This *link* in the audio chain is a most important function, since failure in timing or sequence may render an otherwise perfect production unsatisfactory. The mike boom operator must know the characteristics of his microphone, boom, and carriage. He must be cautious of front and back boom position at all times so as to avoid damage to equipment or personnel by fast untimely action. He must be cognizant of mike placement as a criteria of picture composition and sound pickup, i.e., solo, group, dancing, speech, music, etc. This operator works directly with the audio control engineer.

The scenic specialists require a well-rounded understanding of stage techniques, plus a basic understanding of the limitations of the orthicon camera tube with respect to transformation of colors to the grey shades of black and white. These personnel must be familiar with design and construction details required for all types of scenic composition, including background projection techniques. They must be aware of the effects produced by different lighting techniques, and the camera position with respect to angle and perspective.

TV Audio

(*Continued from page 21*)

trols are grouped together to form a sub-control facility. This affords handling of film controls, incoming remotes and local announcements. In addition, the sub-control facility can be provided with switches that will superimpose it across any of the outgoing channels. This feature has been found useful for making tie-in or flash news announcements.

Master control output switching panels for TV should feature video and audio outputs for each channel side by side. The operate push-buttons for video and audio should be capable of parallel operation so that combined switches can be made in the simplest possible manner. Some networks combine all video and audio output switching, thus eliminating dual controls.

Grouping of operate push-buttons has been found to simplify switching of a large number of output channels. Extension of operate controls, together with status lamps, into the studio is customary. Master control can then delegate switching to the point of program origination.

[***To Be Continued***]

Power-Increase Conversions

(Continued from page 25)

relay is connected in the cathode return circuit of each of the seven power amplifier tubes. In addition, a total *dc* current relay has been provided and *ac* relays have been inserted in the primary leads of a high voltage plate transformer. The overload system has an automatic reset feature. After an overload occurs the plate voltage will be removed momentarily, then automatically returned twice. If the overload persists for the third time the plate voltage will remain off. All circuits, such as the filament bus, the blower and the bias supply, are protected by breakers with built-in overload trip coils. The control equipment for the aural transmitter is identical to that for the visual transmitter and the two are arranged so that the two carriers may be turned on and off independently.

Except for the bias supply and slight differences in the high voltage filter, the power equipment for the aural and visual equipments are identical. The high voltage rectifiers for each employs six 673 mercury-vapor rectifier tubes in a three-phase full-wave circuit, with a balance coil. The bias for the aural amplifier is essentially obtained from grid leaks with just enough fixed bias to protect the tubes when there is no drive.

In installation, the amplifiers can be located at the ends or at right angles to the transmitter. The important thing to keep in mind during installation is that the length of transmission line between the driver and the amplifier should be kept as short as possible. Distances between the output of the driver and the center line of the amplifier of 15′ or less should be satisfactory. If the distance is much greater than this, it will be difficult to obtain the required bandwidth. The line cannot be too long because the amplifier input circuit is essentially a single tuned circuit and can terminate the line exactly at only one frequency. To provide for a line of indefinite length, it would have to have a standing-wave ratio of better than 1.1 to 1 over the 6-mc channel. This would mean that the bandwidth of the terminating circuit would be 60 mc between half power points. On channel 2 this is equivalent to having a *Q* of *1*, which is obviously an impractical condition. It is necessary, therefore, that the input circuit of the amplifier must be a part of the driver output circuit. On the low channels it is not only important that the length of line be kept short, but that the effective length of line should be in approximate multiples of ½ wavelength.

Echoes

(*Continued from page 15*)

practical matters for the moment and think only of the ideal. Suppose it would be possible to transmit a sound wave which starts suddenly at a constant amplitude.

Character of the Echo

The geometry of depth sounding is illustrated in Figure 2. Sound is transmitted downwards in some sort of a beam, with an intensity proportional to the directivity function $\delta(\theta)$. This is a function of the angle θ from the axis. For simplicity, it is assumed that the ship is on an even keel, so that the axis of the beam is vertical. Usually the beam pattern is broad enough so that roll and pitch do not greatly affect the results. Traveling with a velocity, c, the sound goes down a distance, d, to the sea bottom, and returns as an echo. At a time

$$t_o = \frac{2d}{c} \qquad (2)$$

after the transmission began, the echo starts to appear from the point immediately beneath the ship. The first sound to strike the bottom covers only an infinitesimal area which returns an infinitesimally small amount of energy in the echo. Later on, the transmitted sound has spread over a wider area of the bottom and the energy of the echo has increased.

Let us consider an annular zone ΔS of the bottom lying between cones of angles θ and $\theta+\Delta\theta$. The contribution of this zone to the available power of the echo may be shown to be

$$\Delta w = W_o \rho \frac{A_c^2}{\lambda^2} \cdot \frac{\delta^2(\theta)\cos^2\theta}{r^4} 10^{-2\alpha r} \Delta S \qquad (3)$$

Where: W_o = total power transmitted
ρ = reflection factor of the sea bottom
A_c = capture area of transducer
λ = wavelength of the sound
$\delta(\theta)$ = directivity function of transducer
α = attenuation coefficient of sea water

In the derivation of *(3)* the normal intensity of sound on the bottom is considered proportional to cos θ. The bottom is supposed to be uniformly rough, so reflection is diffuse, with a cosine distribution about the normal according to Lambert's law. Much of the incident sound undergoes specular reflection, and is lost to us because it goes back up in a diverging cone. However, this loss can be accounted for by a suitable numerical value of ρ. It is also assumed that the directivity function, and consequently the capture area, are the same for transmitting and receiving. The sound is diminished, both going and coming, by the inverse square of the distance r, and it suffers an attenuation of $2\alpha r$ bels.

Both r and ΔS may be expressed in terms of d and θ, by reference to Figure 2. The angle θ increases monotonically with time according to the relation

$$\frac{t}{t_o} = \sec\theta \qquad (4)$$

The echo power, w, at any time, t, is the resultant of contributions from all the sea bottom within a cone of angle θ.

$$w = 2\pi W_o \rho \frac{A_c^2}{\lambda^2 d^2} \frac{1}{t_o} \int_{t_o}^{t} \delta^2(\theta)\cos^2\theta \, 10^{-2\alpha d/\cos\theta} dt \qquad (5)$$

Since this expression is the basis of the discussion, it is worthwhile to examine its behavior in some detail. Usually $\delta(\theta)$ is of such a form that *(5)* cannot be integrated analytically, but the definite integral converges rapidly enough for numerical evaluation.

To investigate the behavior of the definite integral, it is only necessary to assign appropriate values to the parameters and labor through the arithmetic. In moderately shallow water the logarithmic term is such a weak function of θ that it does not make much difference how we choose it. Let us take $\alpha d = 0.01$ bel, for which $10^{-2\alpha d} = 0.95$. This is realistic for, say, 100 fathoms of water with operation at a carrier frequency of 25 kc. It could equally represent deeper water at a lower frequency, or vice versa. The directivity function, on the other hand, is such a strong function of θ that it is worthwhile to consider several choices. Let us arbitrarily select typical beam patterns 10°, 20°, 40°, and 80° wide, at the —10 db level. With these choices, calculated curves of the definite integral are shown in Figure 3. The

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origin represents the time t_0, when the echo begins to arrive. Normalized time ratios are used as abscissae for the sake of generality. All the curves start with the same initial slope of 10^{2ad} and each one flattens off when the angle θ approaches the limit of the sound beam.

Echo Response

The curves of Figure 3 illustrate the echo response to the unit function signal shown at a in Figure 4. Of course, it would never be necessary to send out all this signal, for it is pointless to continue the transmission very long. Actually, there would be transmitted a limited signal from $t = 0$ to $t = t_1$, as in Figure 4*b*. The response to this limited signal can be easily computed, following what has already been done. The limited signal may be considered to consist of the two components illustrated in Figure 4*c*. Obviously, their sum is equal to the signal of Figure 4*b*. The response to the positive component has already been computed in Figure 3. The response to the negative one is just the same but reversed in sign and displaced in time, as illustrated in Figure 4*d*. The algebraic sum of these two responses is the response to the limited signal.

[***To Be Continued***]

ADVERTISERS IN THIS ISSUE

TELEVISION ENGINEERING

JANUARY, 1952

Briefly Speaking . . .

TV's PROGRESS in '52, which it has been predicted will be towering, with all fronts, including broadcasting, reaping rich benefits, will be highlighted by the advent of the ultrahighs, with the educators playing a key role in stimulating interest. Not only does it appear as if at least 200 or more stations will be authorized for educational use, but many millions of dollars will be appropriated by foundations to aid the cause. According to Don McNicol, the Ford Foundation, which in '51 supplied over one-million dollars, is expected to continue to lend a substantial financial hand. . . . A study of TV programs in the Los Angeles area by the National Association of Educational Broadcasters has revealed that films are being used for the bulk of programs. . . . Rear Admiral R. M. Watts, Jr., U.S.N., director of production policy, office of Naval Material, Washington, addressed members of the Radar-Radio Industries of Chicago, Inc., recently at a luncheon meeting of the group held at the Hotel Blackstone. . . . RCA plants in New Jersey were hosts recently to 25 postgraduate students from the U. S. Naval Academy at Annapolis, who are making a tour of the nation's electronics industry. Tour is part of a 3-year study of EE by the midshipmen. . . . A facilities exchange committee has been formed within the Los Angeles Council of WCEMA, and chairmaned by R. G. Leitner, chief development engineer of Packard-Bell Co. . . . A 15-minute 16-mm sound motion picture, that is said to provide a graphic demonstration of the ability of high-speed motion picture cameras to magnify time, has been announced by the Eastman Kodak Co. . . . A factory building at 1521 East Grand Ave., El Segundo, Calif., has been purchased by International Rectifier Corp. Plant at 6809 S. Victoria Ave., Los Angeles, wil be maintained for research and development. . . . DuMont telecasting equipment has been shipped to Circuito CMQ S.A., Havana, Cuba, for use in a chain of TV stations to extend the island of Cuba. . . . A 2-volume edition of August Hund's *Short-Wave Radiation Phenomena* has been published by the McGraw-Hill Book Co. First section of this work covers the fundamental concepts and relations of currents and electromagnetic fields. Section two treats space electromagnetic fields, considering both elementary electric and magnetic dipoles from a comparative viewpoint. The third section analyzes fundamental methods applicable to magnetic theory. The fourth presents many useful formulas connected with wave propagation and its characteristics. Priced at $20.00.

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R-770	24 VDC	150	1A 10 Amps	1.45
R-368	8/12 VDC	200	1B	1.40
R-771	24 VDC	200	1A/10 Amps	1.45
R-603	18/24 VDC	400	2A	1.55
R-575	24 VDC	500	2C	2.40
R-764	48 VDC	1000	1C&2A	2.00
R-417	5.5 ma	5800	2C	2.50
R-563	60/120 VDC	7500	1A	2/3.10
R-213	5 8 VAC 60 Cy.	....	2A	2.50
R-801	115 VAC	..	NONE	1.45
R-589	12 VDC	125	2A	1.30
R-113	12 VDC	150	4A	1.55
R-689	12/24 VDC	255	1C	1.55
R-799	24 VDC	500	NONE	1.00
R-115	24 VDC	500	1C	1.70
R-110	24/32 VDC	3500	1C	2/3.45
R-121	150 VDC	5000	2A&1C	2.05
R-122	150 VDC	5000	2C/Octal Base	2.50
R-634	150/250 VDC	6000	1A&1B	2.45
R-369	8/12 VDC	150	2A, 2B	1.60
R-908	6 VDC	15	4A @ 4 Amps	1.50
R-800	12 VDC	150	2C&1A	1.55
R-537	12/24 VDC	150	2C&1B	2.00
R-750	24 VDC	400	1A	1.60
R-367	10/16 VDC	195	2C	2.50
R-335	20/30 VDC	700	2A, 1C	2.00
R-366	30/120 VDC	4850	1C	2.50

STANDARD TELEPHONE RELAYS

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	UNIT PRICE
R-806	115 VAC	900	1A	$2.05
R-161	6 VDC	10	2B&1A	1.10
R-873	6 VDC	12	3C-3A MICALEX	3.00
R-305	12 VDC	50	2A Split Cerm.	1.35
R-360	24 VDC	200	1C	1.50
R-484	24 VDC	200	2A, 1C	1.35
R-337	24 48 VDC	1200	1A, 2B Split	2.65
R-101	24 VDC	1300	2A	2.50
R-868	30/162 VDC	3300	1C	1.90
R-365	52/162 VDC	3300	4C	3.95
R-518	85 125 VDC	6500	1C	3.60
R-918	52 228 VDC	6500	1C	3.60
R-852	52 228 VDC	6500	1C, 1A	3.00
R-341	75 228 VDC	6500	4C @ 4 Amps	3.65
R-633	180 350 VDC	10.000	1C @ 5 Amps	2.90
R-344	72 300 VDC	11,300	3A, 1B	2.45
R-332	100 350 VDC	40.000	2A	3.50
R-664	110 VAC	...	2B&1A OCT.SOCKET	2.45
R-667	6 VDC	.75	1B 10AMP. 1A/3AMP.	1.45
R-632	6 VDC	12	5A&1C	3.25
R-154	6 12 VDC	200	1A	1.50
R-517	12 VDC	250	2A	1.50
R-116	85 VDC	3000	1B	3.05
R-631	100 125 VDC	3300	2A	1.90
R-545	110/250 VDC	7000	1C	2.40
R-124	300 VDC	12,000	1A	1.55
R-511	24 VDC	200	W MICRO N.O.	3.05
R-160	6 VDC	12	3C&3A	3.00
R-851	52 228 VDC	6500	1C, 1A	3.00
R-591	6 VDC	40	1B&1C	1.35
R-155	12 VDC	100	4A&4B	1.45
R-520	200 300 VDC	14.000	2C	3.45
R-159	6 VDC	50	2A	1.35
R-158	6 VDC	50	4A Cerm.	1.85
R-381	6 8 VDC	100	1A Split	2.50
R-382	6/12 VDC	200	1B Split	2.50
R-153	12 VDC	200	1C&1A	1.55
R-304	12 VDC	200	4A Split Cerm.	2.50
R-383	6/12 VDC	500	1A Split	2.50
R-385	6/12 VDC	500	1B Split	2.50
R-384	6/12 VDC	500	3A Split	3.00
R-576	12 VDC	200	2A	2.50
R-316	24 VDC	200	1C	1.50

OTHER RELAY TYPES IN STOCK

- **Keying Relays**
- **Rotary Relays**
- **Contactors**
- **Midget Relays**
- **Voltage Regulators**
- **Differential Relays**
- **Sealed Relays**
- **Special Relays**

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1912 1952

is the theme of the 1952 IRE National Convention and Radio Engineering Show, marking the progress of IRE's first forty years' service.

— *What this Annual Event Means* —

To the Member and Visitor:

The Conference and Show provide a refresher course on the progress and pace of the science and engineering application of radio in television, broadcasting, electronics and defense.

In no other way can one feel the pulse-beat of a great industry as easily, and learn as much as in the four days of this meeting. From theory in the technical papers, to practice in engineering demonstrations of the exhibits, this is the modern, fast way to keep up-to-date.

So convinced of this is our industry that last March 5,082 different firms sent their engineers and executives to this conference. 15,258 attended sessions of their choice. Of the 22,919 who registered, all but ¼ of 1% visited the exhibits. 7,924 were IRE Members. This means that nearly 30% of the total membership of this engineering society attended its annual national convention.

Skillfully grouped technical papers map the advances in every field of radio, from guided missiles to television, and from communications to industrial electronics. This year, more than 200 papers will be presented, using five lecture halls—giving engineers an equivalent coverage of five conferences in one.

△

To the Radio Industry:

What is the significance to an industry when 277 exhibitors meet in one place for four days to show their technical products to engineers? It means that IRE has produced through its meeting an economically sound market-place.

These exhibitors are the top 15% of the manufacturers supplying the field, who produce 90% of the products engineers buy! Is it any wonder that the audience comes to such a concentration of equipment, component and instrument exhibits? Think of the time saved!

Here is the record:

1947—177 firms met 12,013 visitors
1948—180 firms met 14,459 visitors
1949—225 firms met 15,710 visitors
1950—253 firms met 17,689 visitors
1951—277 firms met 22,919 visitors
(More than 300 firms in 1952)

When the manufacturer's engineer meets the buyer's engineer, problems are solved and sales are made. In a technical industry, only the engineer can "set the specs" and he is the man usually too busy to see a salesman. But at the Radio Engineering Show, he comes to see what's new.

△

Audience at Technical Papers Session

Main Floor Exhibits—1951

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March 3-6, 1952

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