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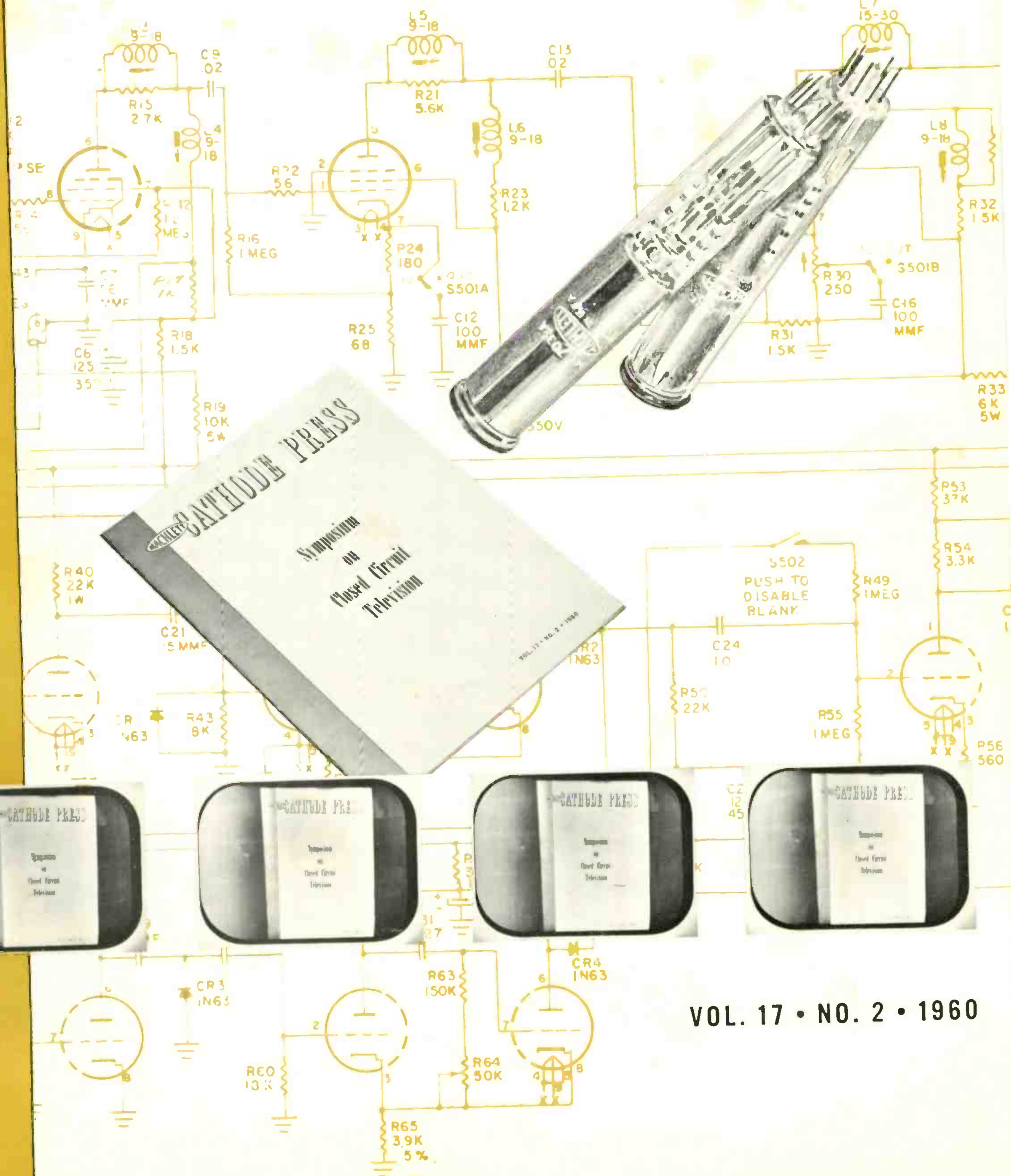

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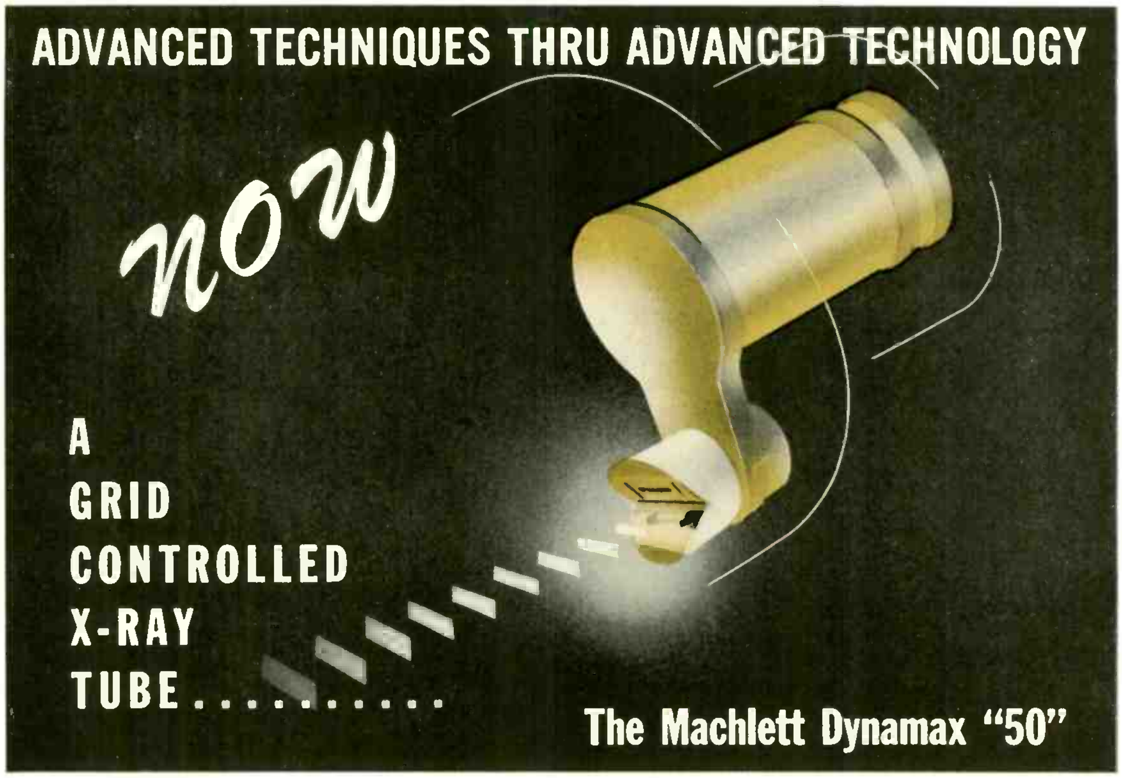

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Springdale, Connecticut

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TODAY THEIR LARGEST MAKER

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Editor, *Alice F. Machlett*

Art, Layout & Design, *Edward J. Bulger*

IN THIS ISSUE

Cathode Press reports developments of interest to the Electronic Industry at large through its coverage of the latest advances in the design, manufacture and use of electron tubes—with specific reference to their use for x-ray, communication and industrial purposes. Particular emphasis is placed on the role of Machlett Laboratories in the development of new electron tube products, improvement in current types and in their application.

Cathode Press welcomes suggestions from its readers directed to the more effective presentation of such information to the rapidly expanding Electronics field.

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JUNE 1960

Symposium on Closed-Circuit Television

by ARTHUR F. WEGENER, Manager,
Photosensitive and Special Product Sales,
Machlett Laboratories, Incorporated

The vast potentialities of closed-circuit television are indicated in the tabulation on the next two pages and in the following series of articles prepared by a number of companies in this industry. The variety of single cameras and complete systems available today for remote visual communication meets almost every conceivable requirement.

Available industry statistics indicate that the closed circuit TV industry has grown from one million dollars in 1954 to approximately nine million dollars in 1959, but no information whatsoever is available on the grand total of benefit our economy and people derive from this progress in technology. There exist many well documented case histories of dollars and cents savings, such as "equipment paid for within the first three months of operation," "savings of $10,000.00 reported during the first year of operation," and the like, but it is impossible to put a price tag on the effective net gain in plant efficiency, savings in time and rejected products, freeing of valuable personnel for more productive tasks, decrease of losses due to theft and the proven earnings due to streamlined operations — let alone savings in human misery due to accidents avoided in hazardous operations and crimes averted due to increased surveillance.

A number of estimates have been made regarding the potential future of CCTV — and five year forecasts range anywhere from thirteen million dollars to sixty-four million dollars for new equipment. Some of the companies engaged in this business claim their volume has almost doubled from year to year, while others report modest increases of about 20%. There appears to be a unanimous opinion that CCTV is potentially one of the largest fields in electronics and many companies have joined in an effort to participate in this growth.

As the name "closed-circuit" implies, the picture picked up by the camera is transmitted to the receiver or monitor, not by means of radio waves but through a wire. This eliminates the need for FCC permits and assures complete privacy of communication, as opposed to a television broadcast. Distances of up to several miles can thus be covered without additional equipment. If larger distances are to be covered, special transmission lines — or microwave relays — can be rented from the telephone companies at a reasonable cost.

This fact has given rise to a related industry which makes available complete distribution services covering major cities in the United States for such purposes as business, stockholders and sales meetings, as well as sport events. Companies like Theater Network Television and Teleprompter are able to link audiences throughout the country, thus eliminating the need of wholesale travel by participants over long distances at a considerable cost. For instance, the average "attendance cost" per member can be cut from $300.00 to some $10.00 to $25.00. The volume of this service industry has greatly increased during the past few years and is expected to approach 50 million dollars by 1964. Even entire operas have been transmitted by color television to a number of cities where they were projected on standard screens in existing theaters.

Other companies have specialized in television distribution systems for entire plants, military installations, and others where a number of cameras and display systems are wanted for informational or educational purposes. The Jerrold Electronics Corporation of Philadelphia is an example of this type of company which has also installed a considerable number of community television systems — wired distribution systems — in localities where broadcast television signals cannot be received due to geographical or other limitations.

As may be seen from the following articles, the variety of equipment and applications make a thorough analysis of the individual problem highly desirable in many cases. This can be done either by the equipment manufacturer — or by independent concerns such as the Barkley and Dexter Company which describe their activity in an article on page 26.

The simplest CCTV system is a combination camera and control unit which can be connected to any unused channel on home television receivers. More elaborate systems consist of any number of cameras and monitors and may include a centralized video switching station, remote lens selection and focus control, directional adjustment of the camera and automatic adaptation of the camera to varying light levels. It is, therefore, obvious that a CCTV installation may be as simple or as complex as required — and that the price range varies to the same degree.

Almost all CCTV systems used today include a vidicon tube as a picture pickup device. The considerably more complex and expensive image orthicon systems (as used for live television broadcasts) are used only where light levels are too low and cannot be increased. Besides being less expensive and easier to operate, the vidicon tube is less easily damaged and, unlike the image orthicon, it is not subject to "burn-in" images when it is focused on a scene for a prolonged period.

In the symposium, outstanding producers of closed-circuit television equipment translate a few of the cold statistics on potential applications into actual case histories and show examples of how industries, governments, and educational problems can be solved in terms of equipment which is available on the market today. Machlett Laboratories wish to express their sincere gratitude for the cooperation the editors of "Cathode Press" have received from the authors and their companies.

APPLICATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Advertising	●									●		●	●				●			
Airports	●		●	●	●			●		●	●			●			●			
Airlines	●				●		●			●	●									
Amusement Parks			●	●			●								●				●	
Army Posts	●		●	●	●	●		●		●	●				●		●		●	
Auditoriums							●					●			●			●	●	
Apartment Houses				●												●			●	●
Architects																				
Banks			●	●			●			●	●								●	
Breweries		●		●	●		●		●								●			
Boats						●	●	●						●					●	
Bridges				●				●											●	
Brokers							●			●					●		●			
Bus Terminals				●				●												
Camps	●			●			●			●					●		●			●
Canneries		●			●				●	●	●						●		●	
Carloading					●		●	●			●								●	
Cement Plants		●		●	●	●			●		●									
Centrifugal machinery		●			●	●			●	●										
Chemical plants		●		●	●	●			●	●	●		●						●	
Churches							●								●		●			
City governments			●	●				●		●	●			●			●			
Clinics	●						●				●			●	●					
Clubs														●	●					●
Chain stores	●		●	●			●				●	●	●							
Carnivals			●				●					●			●					
Circuses			●	●				●				●			●				●	
Colleges	●						●			●	●				●		●	●		●
Contractors																				
Consultants																				
Dairy Equipment Manufacturers		●		●	●				●											
Dance Studios	●											●						●		
Department Stores	●			●						●	●	●	●							
Die Makers	●	●					●		●											
Dental Schools	●														●		●			
Distilleries				●					●	●	●									
Docks								●											●	
Drug Manufacturers	●			●					●		●									
Dyers—Industrial							●		●	●										
Electrical Contractors																				
Electric Instrument Manufacturers		●			●	●			●											
Elevator Manufacturers		●			●		●													
Engineers																				
Express Companies			●	●	●			●		●	●								●	
Farm Equipment Manufacturers		●		●	●		●			●	●									
Fibre Products Manufacturers		●			●		●		●	●	●									
Food Processors	●				●				●		●									
Foundries		●			●	●	●		●	●										
Freight			●	●	●			●												
Funeral Directors															●					
Furnace Manufacturers		●				●	●		●											
Garages			●	●			●												●	
Gas Equipment		●		●		●			●		●									
Gas Plants				●		●	●			●	●									
Glass Plants		●		●	●	●			●											
Hardware Manufacturers		●			●		●		●	●										
Hospitals	●						●				●			●					●	
Homes																●				
Hotels											●			●	●	●				●
Hydroelectric Plants				●		●				●	●									

TV APPLICATIONS

APPLICATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Insurance Companies	•									•	•									
Ironworks		•			•	•			•											
Jewelry Manufacturers		•	•				•		•	•										
Jewelry Schools	•										•		•							
Jails			•				•													
Knitting Machine Manufacturers		•		•					•											
Laboratories	•					•			•	•	•									
Laundry Machine Manufacturers		•		•	•					•	•									
Leather Goods Manufacturers		•			•				•	•										
Libraries							•				•									
Lubricant Manufacturers				•	•	•			•											
Lumber Mills				•	•		•													
Machine Shops		•			•				•											
Machine Tool Manufacturers		•		•	•	•				•										
Mining				•	•	•	•													
Milling Operations	•	•				•	•													
Metal Fabricators		•			•	•														
Mortgage Companies	•										•									
Naval Installations	•		•	•		•	•				•			•	•					•
Night Clubs												•			•					
Needle Trades	•	•								•										
Nursing Homes			•																•	
Oilfield Equipment Manufacturers		•		•	•	•			•											
Optical Schools	•									•										
Packing				•	•				•											
Paint Manufacturers				•	•				•		•									
Paper Mills		•			•															
Pharmaceutical Manufacturers		•		•	•				•	•	•									
Photographers—Commercial	•											•						•		
Plastic Manufacturers		•		•		•			•											
Police Departments			•				•	•											•	
Prisons			•				•				•								•	
Power Plants				•		•	•				•									
Post Offices			•																	
Radio Stations	•											•						•		
Race Tracks															•					
Railroads							•	•						•					•	
Refineries		•		•		•			•		•								•	
Schools—General	•						•				•				•				•	
Shipyards					•		•	•											•	
Shoe Manufacturers		•			•				•											
Steel Mills		•		•	•	•		•	•		•								•	
Textile Manufacturers		•			•				•											
Tobacco Manufacturers					•		•		•											
Toll Bridges			•					•												
TV Stations																		•		
Universities	•									•	•							•		•
Warehouses				•				•			•								•	
Water Plants				•			•		•											
Wind Tunnels						•	•													
Woolen Mills		•		•	•				•	•										

APPLICATION CODE

A Training
B Production Control
C Surveillance
D Property Protection
E Material Handling
F Dangerous Viewing
G Remote Observation
H Traffic Control
I Process Control
J Work Coordination
K Centralized record viewing
L Merchandising
M Display
N Silent paging
O Accommodation of Overflow crowds
P Protection—Homes and Apartment Houses
Q Information
R TV and stage rehearsals
S General action monitoring
T Community Antenaplex

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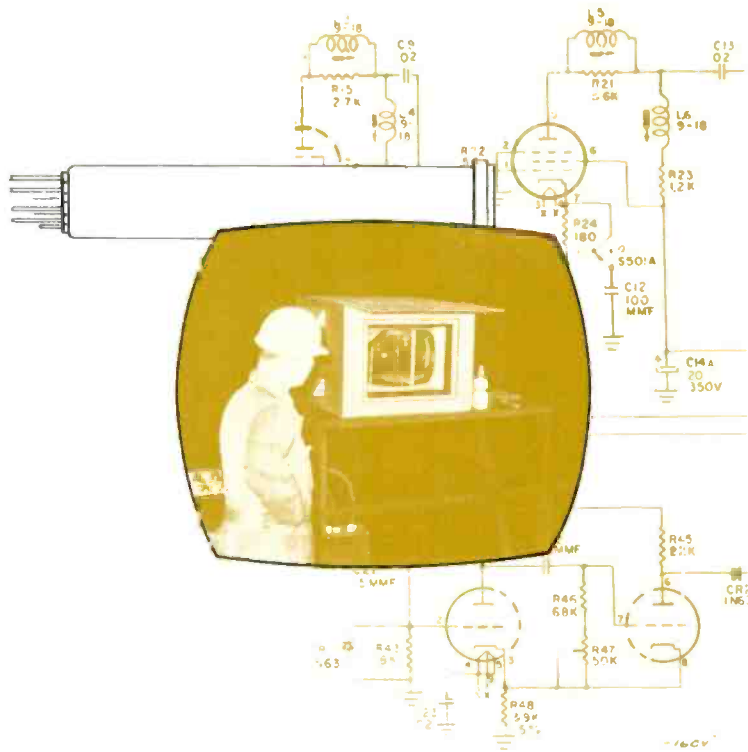
The "Observer" in Industry

by JOSEPH KERNER, Sales Manager, Blonder-Tongue



JOSEPH KERNER

Joseph Kerner has held the position of Sales Manager for Blonder-Tongue for nine years. In his capacity he directs not only the sale of B-T TV Camera Division, but also the sale of all other Blonder-Tongue products. Mr. Kerner is active in a number of industry trade associations and is presently first Vice-President of PACE.

Since the entry of the B-T "Observer" closed-circuit TV system into the field, the company has pioneered the application of industrial television in a number of fields. Among the novel applications of this novel medium of making an operation either more efficient, safer, faster, more accurate and above all, less expensive, are the following installations:

Brunswick Pulp and Paper Company, Georgia affiliate of Mead Corp. and Scott Paper Company.

This new, modern 3 million dollar plant now uses five B-T "Observer" cameras encased in protective environment-proof housings. Three cameras view the pulp discharge from the washers, one peers down on the vat side of one washer, and the fifth camera watches the pulp feed from the conveyor onto the distributing conveyor chute.

At a central control room, five monitors allow a single worker to observe all points at will while heretofore five men were required to stand at these sections.

Reports Brunswick, "The units installed are fulfilling the requirements very well."

Moral: closed circuit TV can save industry much money in time and labor.

Details of this installation are shown in Figures 1 and 2.

Another paper mill taking advantage of another application of this new medium of visual communication is **Ketchikan Pulp Mill** where the "Observer" camera system monitors huge storage bins, as shown in Figure 3.

Sharon Steel Company in Sharon, Pennsylvania utilizes B-T cameras to control quality at key-rolling and handling operations in its new slabbing and blooming mill at Farrell, Pennsylvania. This application of monitoring furnace and rolling mill operations required special protective housings which were custom made by Modern Sound Company, Pittsburgh distributor of B-T.

The housing consists of a cast aluminum base and heavy gauge aluminum cover, with a rain shield over the plate glass window. Included are a windshield wiper, heater, blower air filter and thermostat. This housing may be adapted for use in hazardous areas by eliminating the blower and filter, sealing off the openings, and inserting gasket seals around the edges between the camera housing and the base. A compressor outside the hazardous area would feed a stream of pressure into the enclosure through a 1/4" tube. A pressure gauge and switch would be used to disable all electrical circuits in case the intake system fails; and a relief valve outside the enclosure would permit escape of air above the normal pressure. This accomplishes cooling of the camera within the explosion-proof housing. One system enables the operator to control loading and unloading of the conveyor carrying ingots from the soaking pits to the rolling mill. Another system provides a close-up of the ingot approaching the shear.

This added control point was not available prior to installation of the system, which is shown in Figure 4.

Union Carbide Chemical Company, in its South Charleston, West Virginia plant, has a two camera B-T chain to enable the operator in the control room to watch other operators in process areas which may be subject to hazard. These men take samples of materials from pumps and tanks within the structure. Both cameras, one at ground level and one at 60 foot elevation, are installed in special vapor-proof housings.

Brand, Grumet and Seigel, Incorporated, stockbrokers. The Board Room of this company is equipped with two "Observer" CCTV cameras which are focused on the ticker tape of the New York and American Stock Exchange. The quotations are then televised and transmitted to TV sets in all the private offices of the brokers, where both customers and their account executives can see up-to-the-minute prices on their stocks. The lay-out of this system is shown in Fig. 5, where an inset shows one of the monitoring stations.

Figure 1 — Pulp discharge from washer at Brunswick Pulp & Paper Co.

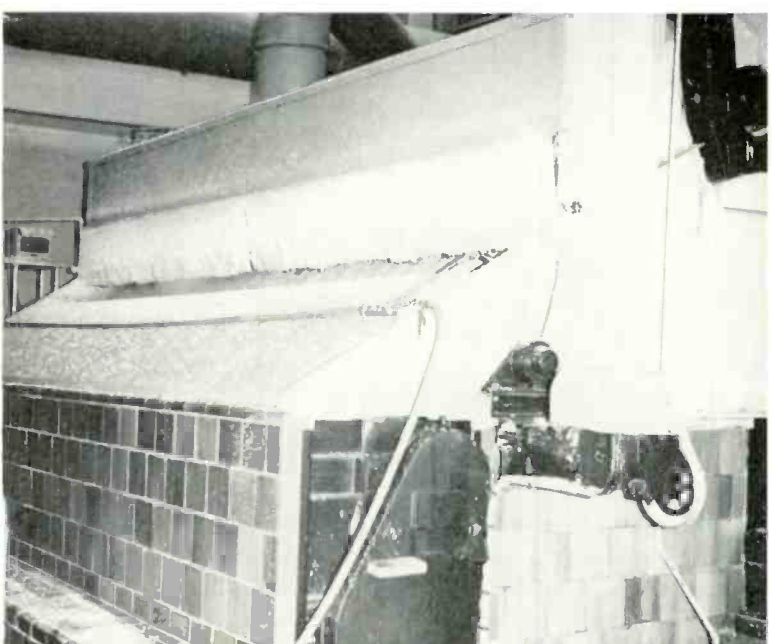
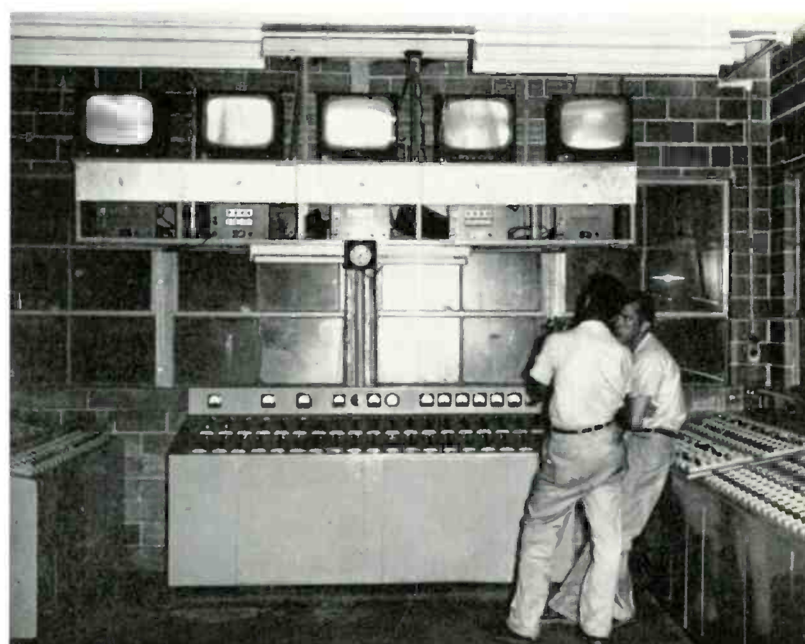


Figure 2 — Central control room, Brunswick Pulp & Paper Co.



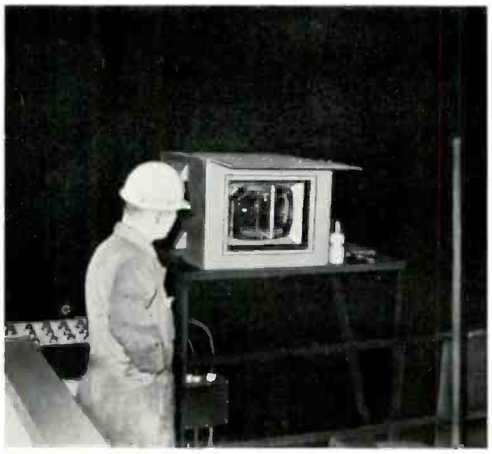


Figure 3 — Monitoring of storage bins at Ketchikan Pulp Mill.

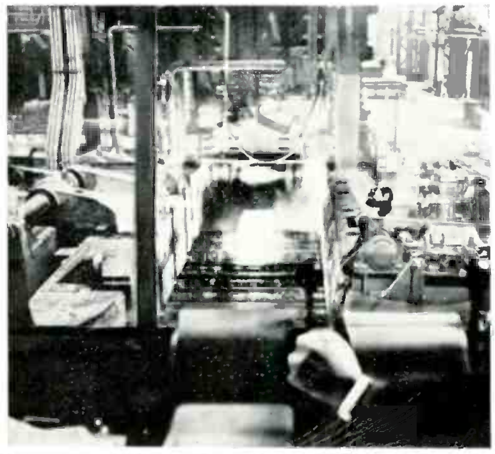


Figure 4 — Viewing of rolling mill operation at Sharon Steel Company.

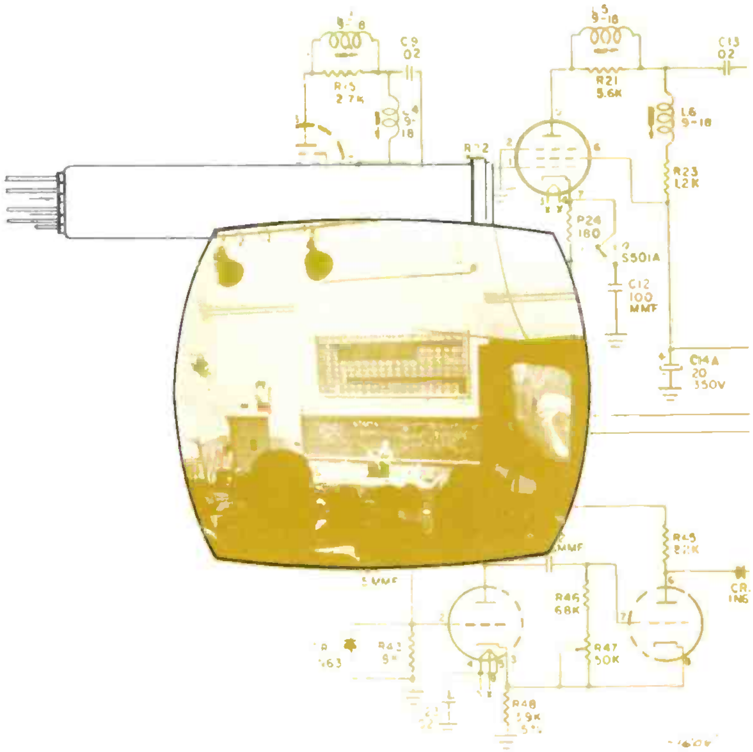
Figure 5 — CCTV system of Brand, Grumet and Siegel, Incorporated.

Figure 6 — "Observer" camera in use at Harry Levit, Jewelers.

Harry Levit, Jewelers, uses an "Observer" system for a different kind of application: To sell his customers on the skill and efficiency of his craftsmen. The Levit jewelry store in Houston, Texas is equipped with a monitor, located in a prominent place to enable customers to watch Levit technicians and watch repairmen manipulate delicate parts which finally mesh together in a balanced movement. They observe experts polish diamonds, twist, bend, and weld gold and silver to form fine jewelry, giving new life to old, worn jewelry. Their fine work and clean shop instills a new kind of confidence in Levit's clientele.

The Sun Valley Steam Plant of the Los Angeles Department of Water and Power is utilizing ten cameras at various locations to coordinate flame control work. The new setup enables one operator to watch several furnace flames simultaneously in order to make adjustments for proper and most efficient combustion. Hollywood Sound, B-T distributor, has installed automatic light compensators to maintain constant, high definition, picture quality regardless of light intensity variations of over 150 to 1.

This system not only increases the efficiency of plant operators but also saves fuel for the generating station. Previously considerable unburned fuel escaped from the furnaces because it was impossible to look into the units to check flame quality.



Television in Education

by

by J. W. ALINSKY, Chief Engineer,
Dage Television Division,
Thompson-Ramo-Wooldridge, Inc.

J. W. ALINSKY

Joseph W. Alinsky, Chief Engineer of Dage Television Division, Thompson-Ramo-Wooldridge, Inc., has been in the electronics field since 1936. He entered the television field in 1939 as a development engineer for American Television Laboratories.

He joined Valparaiso Technical Institute as head of the Service Department in 1941, became Director of the Television Engineering Department in 1945. In 1949 he was elected Vice-President of Valparaiso Technical Institute.

In 1953 he joined Dage Television Division, as chief engineer, the position he holds today.

He majored in physics and mathematics at Valparaiso University and in Electronic Engineering at V.T.I. He holds a B.S. degree in Electronic Engineering.

Psychological studies have indicated that knowledge is obtained through our various senses in the following approximate proportions:

Sight	80%
Sound	15%
Touch, taste, smell	5%

It is not unusual then, that television should prove of great interest to the modern educator. With both visual and aural correspondence between the teacher and student extended without a theoretical limit, the power of the excellent teacher can be tremendously enhanced. Although the sound motion picture also serves as an excellent educational aid, it does not contain the magic of television's immediacy and "presence."

Television, as an educational tool or medium, has been praised and damned by educators. However, the preponderance of opinion is well on the side of acceptance.

Most of the difference in opinion concerning educational television is derived from a lack of understanding about the goals of the various programs in effect. As a matter of fact, the term "educational television" may broadly define any application of television involving an educational function. Problems arise when the term is loosely used to define a specific application. This application, while ideally suited to one situation, may be totally wrong for another. The teacher who may object to loss of personal contact with the student, thus may categorize educational television as unsatisfactory, while he is in real need for a means to increase the number of students who may view a microscope slide before the specimen expires! In too many instances, the educator has rejected the techniques of television because he did not agree with the purpose of content of the program.

Lewis Carroll very succinctly described the situation in his "Through the Looking Glass"; "When I use a word," . . . Humpty Dumpty said . . . "it means just what I choose it to mean . . . neither more nor less." "The question is," said Alice, "whether you can make your words mean so many different things."

The problem then, is not to make educational television mean so many different things. This paper will attempt to delineate some of the more important areas of television as applied to the educational process.

Broadcast Television

It is in the area of broadcast television that the greatest philosophical differences may be seen in the employment of television as an educational medium.

In United States' broadcasting, two types of station operation are licensed by the Federal Communication Commission: commercial broadcast and noncommercial educational broadcast. The essential difference in these licenses is that the Educational Broadcast license does not permit the sales of program time or the inclusion of advertising beyond that of a credit line. Of course, this does not restrict educational institutions from holding a commercial type license. Such stations as WWL-TV and WBAY-TV are commercial type stations owned by Loyola University, New Orelans, Louisiana and St. Norbert College, Green Bay, Wisconsin respectively.

The first educational institution owned TV station was WOI-TV at Iowa State College which has been in operation since 1950. Not until 1952 did the FCC establish the category of non-commercial TV station licensing.

There are two distinct areas of educational programming found in broadcasting:

(a) "General"

(b) "Instructional"

An example of "general" programs are the public service features and cultural type programs such as "Meet the Press."

"Instructional" or classroom type programs, are usually characterized by the option of obtaining scholastic credits from a participating school. At one time such programming was solely the province of the educational broadcast station, but today programs such as "Continental Classroom," offering college credit courses in physics and chemistry, have been instituted as a public service feature by commercial stations.

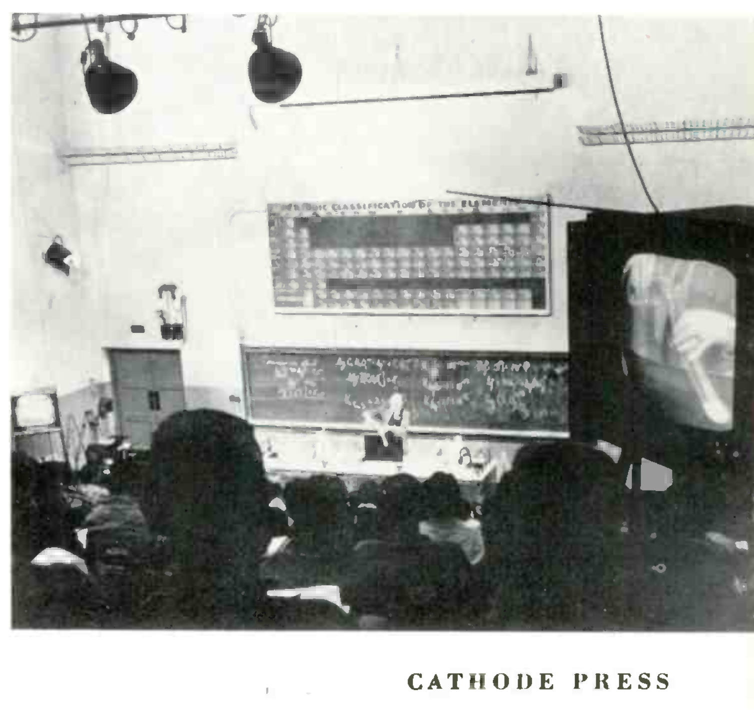
Similarly, many pure noncommercial or educational stations carry programs of a more or less entertainment value such as travelogues, music appreciation and popular science lectures in addition to their instructional programs.

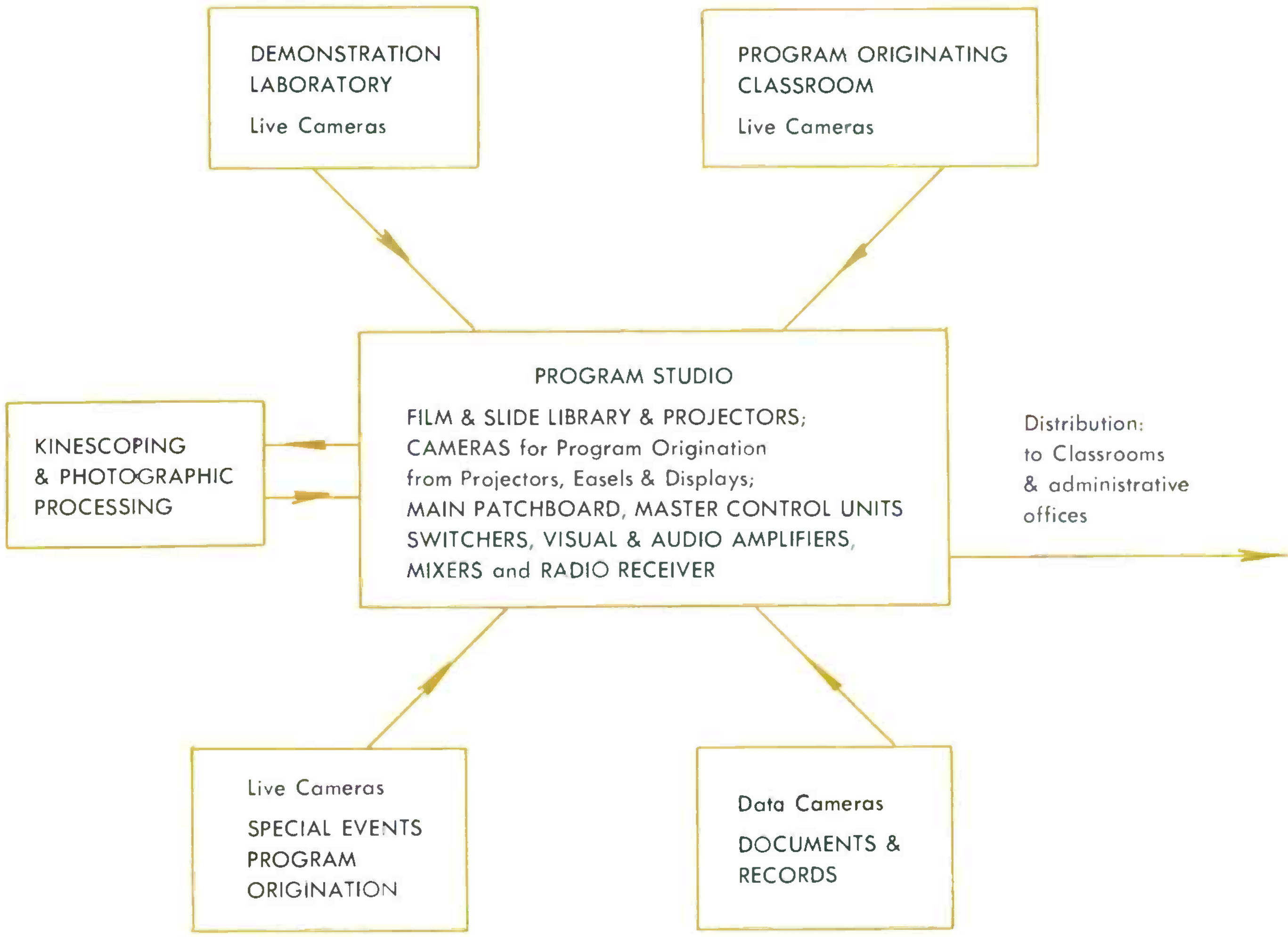
Perhaps the most important contribution broadcast television makes to education is the stimulus which a large potential audience can give to encourage and justify the greatest minds in the country to spend the time in preparation of thorough and detailed lectures and demonstrations. Such preparation would not be justified for a class of 30 to 50 students.

Figure 1 — With television, every student gets a better view of delicate adjustments than is possible even in direct demonstrations to small groups.

Block diagram of interrelated elements that may be included in Davits-Dage-Audio-Visual Integrated Television System.

Figure 2 — Large lecture halls can be used effectively when each student can see and hear as well as from a front-row seat.





Thus, one of the most important aspects of TV is the contribution it can make to improve the quality of instructors. Many educators compare the impact of television as being second only to the invention of printing as a communications medium.

Point-to-Point TV

One of the point-to-point (closed circuit) applications of television is that it endeavors to solve an enrollment problem which is causing deep concern to school managements. The present projections of capital plant facilities and operating costs do not supply adequate answers to the educational demands of the future.

Such experimental installations as the Washington County Closed Circuit Television project at Hagerstown, Maryland, where an entire county school system is completely interconnected via television, make possible the presentation of special classes which are normally beyond the training scope of the regular teacher. Such classes requiring advanced training of the teacher are music, art, science and others. In addition, the materials, display and equipment normally required for a superior presentation are thus made available to the entire school system.

On a more local basis, excellent use of TV techniques is being made by Pennsylvania State University where the many courses are extended throughout the campus via television. In these courses, the entire instruction is presented to the student through television.

Institutional Promotion

Many of the colleges and universities holding broadcast licenses employ the TV station as an excellent public relations medium. The stature and prestige of the institution is considerably enhanced by the presentation of timely program content to the general public. Farm and Home, public health programs and popular science features provide a real service to the area viewer.

The Audio-Visual Aid

As an audio-visual device, television has a unique place in education. The innumerable demonstrations required, which are on scale too small to be observed by more than a few students at a time, may now be presented to an entire class simultaneously to any desired magnification of detail. This is particularly emphasized in microscope observations and in the field of medical and surgical training. Where, previously, only a few medical students could observe an operation in detail, now by means of color

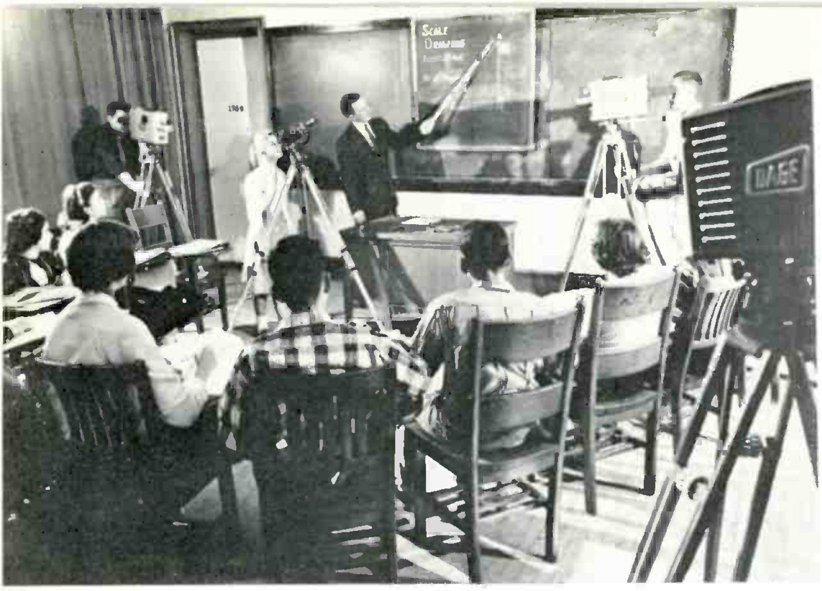


Figure 3 — Laboratory demonstrations under controlled conditions can be shown to several classes, or transcribed for later use.

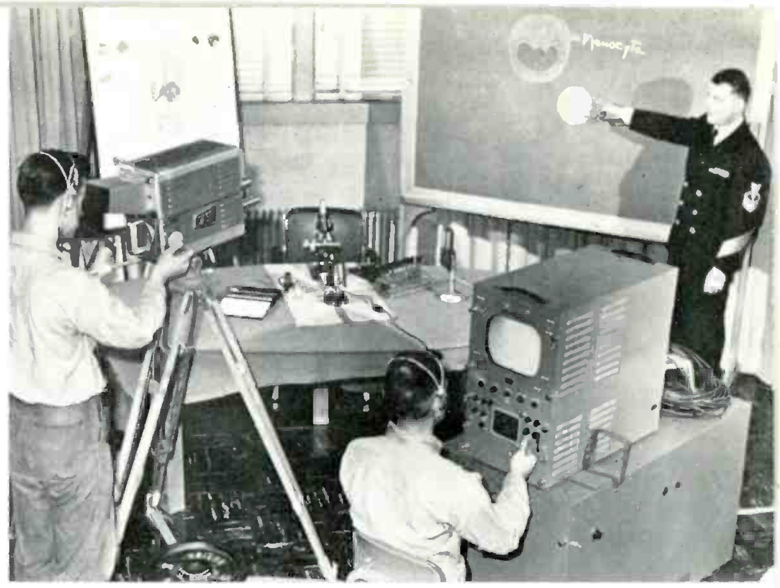


Figure 4 — A single demonstration can be used for several separate discussion groups. Student participation in camera operation adds interest and a feeling of immediacy.

Figure 5 — Techniques of medicine, dentistry and veterinary medicine can be demonstrated more effectively by television than with the audience in the operating room.

television any number may view the operation, oft times in greater detail than was possible by direct view.

The possibility of bringing elaborate demonstration setups from a remote laboratory directly to the classroom provides a powerful training tool.

Broadcast Careers and Communications Research

Another application of educational television is the teaching *about* television instead of *by* television. Many universities have television installations duplicating typical broadcast studio facilities for the purpose of training for broadcast careers.

In other schools, TV is used by dramatics departments as a check on student performances. For critical self-analysis, video recording is added to the usual studio equipment.

As an experimental aid to study of all visual-audio educational tools, TV has become a very important adjunct to communication research programs.

The Laboratory Research Tool

The value of TV as a laboratory instrument apart from its use as a training device, has been utilized in many ways. Many installations have been made for unobtrusive observation of psychiatric patients, for studies in behavior problems and evaluation of teacher-trainees. Where observation of any human activity is required without intrusion by the viewer, the TV camera is indispensable.

Similarly, the ability to observe many different remote test stations at the same time or from one central point is easily accomplished by multiple camera installations.

Central Communications Systems

As a last illustration of an educational use of television, the integration of all communications requirements in one system is illustrated on page 11. The audio-visual integrated television system provides for the use of one central point to originate all communications and audio-visual activities for transmission to one or more classrooms or offices over closed circuit television. The complete facility provides five main functions:

1. Film and slide program origination from one point.
2. Special events facilities, such as lectures, plays, student registration activities, etc.
3. Lab and classroom demonstration facilities.
4. Documents, library and records viewing.
5. Photographic processing and kinescoping or tape facilities.

One of the most important influences in the stimulation of increased activity in the application of television to educational systems was the introduction of low cost television systems. These low cost systems were made possible by the development of the vidicon pickup tube. Previous television pickup tubes, while technically providing excellent picture quality, did not provide the following advantages of the vidicon:

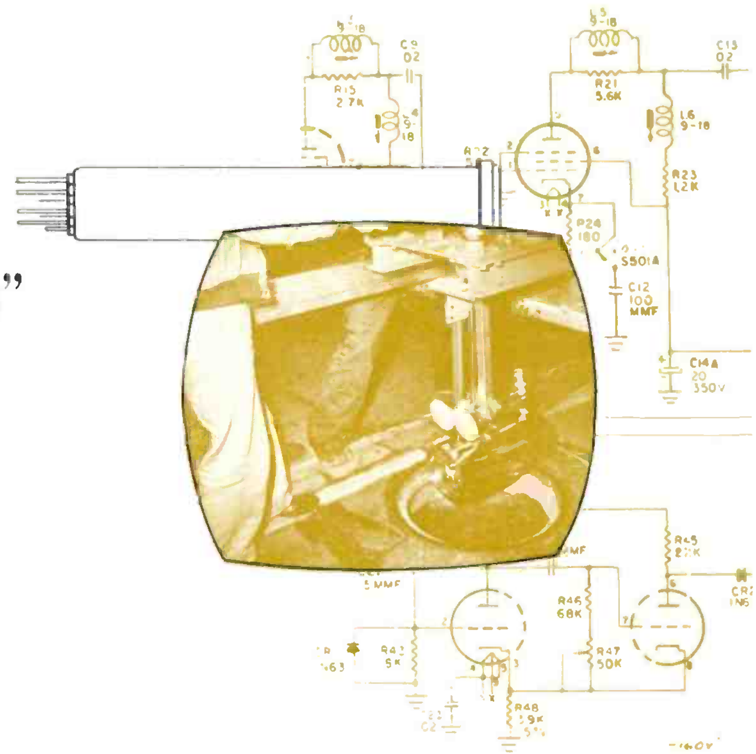
(a) Low initial and operating cost.
(b) High reliability.
(c) Long life.
(d) Simplicity of structure and operation.
(e) Small size.

The vidicon tube enabled the electronic industry to introduce television at a price level which was substantially less than the cost of a classroom. The simplicity of operation and general ruggedness of operation has great appeal to the nontechnical user. It is interesting that the introduction of simple cameras soon led to the requirement and use of more sophisticated equipment designed specifically for the educator. The Dage ETS System pictured is an illustration of packaging fulfilling the specific requirements of the educator.

As was stated in the beginning of this writing, our purpose was not to define educational television, but to delineate its structure. The examples chosen are not necessarily the author's expression of the best examples, but primarily to show typical examples of each area of applicator.

The future educator will certainly provide new techniques which will render our present methods obsolete. The paramount thought to be borne in mind is that television must not be considered as a philosophy of education but rather as a worthy technique and tool. Until the "gadgets" of television are divorced from the pure technique of utilizing TV as an aid to the educational process, some confusion will continue to slow its growth — that growth, however, is inevitable. The power of such a basic communication medium is unquestionable.

Figures 6a, 6b — Examples of equipment installations for a central communication facility.



Closed Circuit Television For Things "Worth Looking Into"

by JAMES G. GELDER,
Marketing Manager,
Electronics Division,
Diamond Power Specialty Corp.,
Lancaster, Ohio

JAMES G. GELDER

James G. Gelder received a B.S. degree from Oklahoma State University in 1950, after a six year interruption for service in the U. S. Navy. He joined Diamond Power Specialty Corporation in July 1958 as Marketing Manager. In this position Mr. Gelder is responsible for all sales, service, and application engineering activities of Diamond's Electronics Division. Prior to joining Diamond Power, Mr. Gelder had been Sales Manager — Process Control Systems for Philco Corporation's Government and Industrial Division. Mr. Gelder is on the Advisory Board of the American Institute of Management and is a member of the Institute of Radio Engineers and of the American Management Association, Inc. He also is a "Life Loyal Member" of Alpha Kappa Psi, a professional business administration fraternity.

Diamond Power began building and marketing closed-circuit television systems in 1946. Until then the Diamond corporation had been completely absorbed in the design and manufacture of power plant boiler cleaning systems, and boiler water level gauges.

Diamond went into the television field because there was no positive way to see water level gauges hundreds of feet away from the Power Station control room without depending upon mirrors — whose line of sight may easily be interrupted. (And which have many other limitations.)

In 1946 television was a highly unconventional and skeptically received answer to problems of remote observation or surveillance. In 1959 the trade press was filled with applications for television that were neither economically feasible nor technically practical just twelve short years ago.

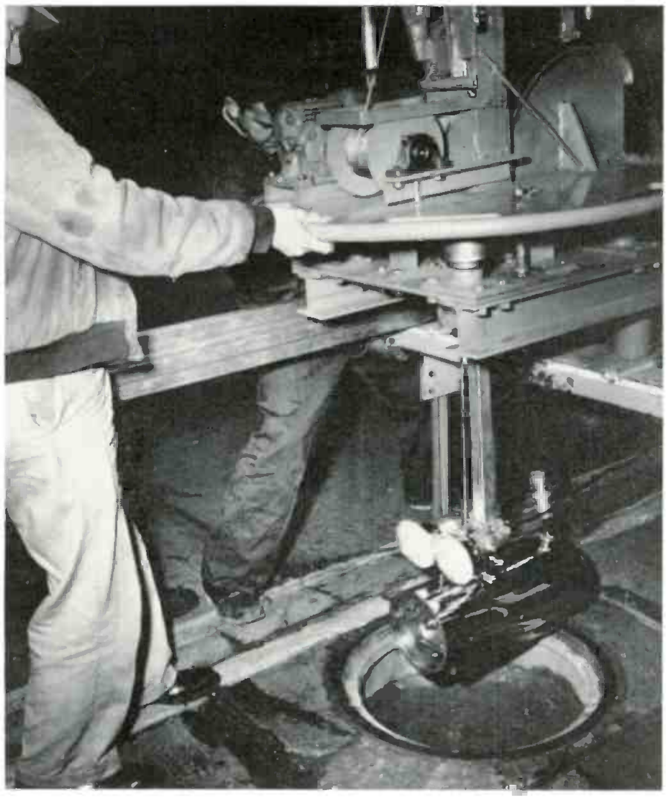
Now television is an accepted "tool" of industry. It is a conventional answer that is economically feasible — technically practical and in more than one instance indispensable. Anything "worth looking into" can be accomplished with closed-circuit television if the job is tackled with ingenuity backed by engineering skill. Here are a few examples from the Diamond Scrapbook.

Cincinnati, Ohio Televises Its Sewers

Prior to television, men had to go underground to make the necessary inspections; often travelling down rope ladders to depths of 75 feet. Safety precautions, necessary at all times, only made the job bulkier, more difficult, and more time consuming. Could closed-circuit television do the job? The answer is an emphatic yes! The Cincinnati system is installed in a one ton cargo trailer; carries its own gasoline driven 2,000-watt power plant which provides 115 volts, 60-cycle, single-phase, with a full load capacity of 17.4 amps at 3,600 rpm.

Figure 1 — City of Cincinnati, Ohio Diamond Television System is completely portable. It is mounted on a surplus Army one ton cargo trailer. Shown in operation here, monitor screen shroud cuts down reflections on view screen.

Figure 2 — City of Cincinnati, Ohio Diamond Television System camera, ready to go underground on a sewer inspection job. Camera housing is sufficiently watertight to withstand occasional deliberate duckings in order to inspect interceptor outlets.



The television camera is a standard Diamond Model 500 unit which uses a vidicon pickup tube. The camera has a special housing of chrome plated tubing, eight inches in diameter and 18¼ inches long. Length of the camera housing was restricted thus to permit entry into any manhole opening in use in the Cincinnati system.

The face of the camera case is ¾″ thick Plexiglass installed in moistureproof rubber gasketing. Access to the camera mechanism is through the rear cover plate which is moisture-protected with "O" rings. The camera cable connection is waterproof, and flexible.

In operation, the camera is suspended, through a rotatable support frame on the trailer, by means of interlocking sections of square aluminum tubing, and a cable, see Figure 1. The cable provides means for raising and lowering the camera with the work being done by a small electric-powered winch. The square tubes give the camera stability, and are the means of controlling camera rotation through 360 degrees.

Light for the camera is provided by two 150-watt floodlamps, in waterproof sockets, clamped to the square aluminum tubing.

A 17″ video monitor and camera power and control unit are mounted on the trailer, with the monitor screen shrouded to prevent daylight and reflections from washing out the image. A part of the standard system equipment is a Polaroid camera for photographing underground conditions shown on the monitor screen.

All camera functions, including optical focus, may be adjusted at the camera control-power unit mounted under the monitor. Features of the system include a crystal controlled transistorized timer for vertical and horizontal deflection frequencies; automatic target control; vacuum tube voltage regulation; aperture correction for sharper, better reproduction of fine picture detail, and a special protection circuit that prevents pickup tube damage through loss of horizontal or vertical deflection.

The camera is sufficiently watertight to withstand accidental submersion. Indeed it is deliberately submerged on occasion to view intercepter sewer outlets into the Ohio River.

Mr. A. D. Caster, Principal Sanitary Engineer of the City of Cincinnati, Ohio was the motivating force in the development of this highly efficient mobile system. Mr. Caster estimates that the cost of the system will be saved in two years in labor savings alone, and that the value of the equipment, in terms of safety, cannot be measured.

Atomic Reactor Tubes Are "Worth Looking Into"

Closed-circuit television in hazardous radiation areas is now usual practice, but how do you put a television camera inside a reactor tube with a 3″ I.D.?

The answer seems simple — just build a camera 2¾″

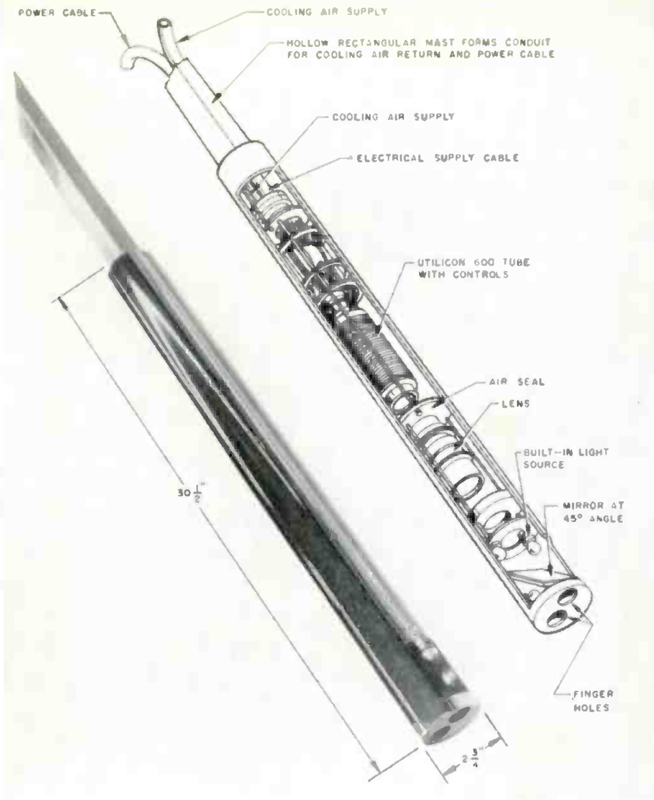


Figure 3 — Diamond Reactor Tube Inspection Camera, just 2¾" in diameter and 30½" long, is in daily use inspecting reactor tube welds. Camera must operate inside tubes only three inches in inside diameter.

Figure 4 — Diamond Underwater Television System uses Vidicon camera pickup tube in a watertight housing for relatively shallow water work. This system is used effectively at depths up to 500 feet. Other Diamond cameras using the Image Orthicon camera pickup tube in a pressurized waterproof housing work effectively at depths of 1000 feet.

O.D. That requires some ingenuity! Our answer was to take everything possible out of the camera leaving only elements essential to operation of the pickup tube, a lens, a mirror set at 45 degree angle and four tiny "flashlight bulbs" for scene illumination. The camera case is of thin wall stainless steel tubing just 2¾" O.D. and 30½" long. This case is secured to rectangular steel tubing which serves four main functions. 1 — The tubing permits control of the camera in and out of the reactor tubes, and rotation of the camera within the reactor tube. 2 — It serves as a duct for the camera and lighting power cable. 3 — It serves as a duct for the flexible tube which introduces cooling air into the camera compartment. 4 — The tube itself becomes the return air line from the camera.

Tubes of the reactor are built up of welded sections of stainless steel. Under radiation the interior tube walls are blackened, but any flaw in a weld shows as a white spot. This is the condition that must be detected promptly, and corrected quickly, because a weld flaw means radiation may be leaking, increasing operating hazards.

In this tube inspection system, as in the sewer inspection system, a conventional Diamond Model 500 closed-circuit television set is used, but packaging ingenuity has put it to use in a situation where the place "worth looking into" is accessible in no other way.

Undersea Exploration is a Television "Natural"

Even the magnificent imagination of Jules Verne in his classic adventure story "20,000 Leagues Under The Sea" did not predict the use of a device similar to television. The spectacular use of television as a tool of navigation in today's Nautilus is one example of television undersea. But the more routine uses send the camera down, while the "divers" stay on the surface — until their objective is found, and their presence is required on the bottom.

Diamond Underwater television is in regular service with the Bureau of Commercial Fisheries of the U. S. Fish and Wildlife Service at Woods Hole, Massachusetts. And in this case it can perform work that divers cannot do. One routine job is in connection with studies of trawl net design, and the reactions of fish within the net. In these studies the television camera is towed ahead of the net, and looks into the net.

The camera housing is pressurized with nitrogen to prevent moisture infiltration, and to permit camera operation at depths of as much as 500 feet. Shipboard equipment includes a portable camera monitoring console, and viewing monitors in the ship's main salon and in the pilot house.

Other Diamond underwater television units using vidicon camera pickup tubes in watertight, but non-pressurized housings, are used in watching underwater construction, tracing underwater pipelines for study of exterior condition and evidence of leakage, and for underwater exploration and supervision of underwater salvage operations.

Case histories have been selected for discussion because each one tells a slightly different story of closed-circuit television application to a difficult or hazardous task of visual observation. And because each one shows so clearly that, although the electronic components may be standard items; in each case there is a need for ingenuity and creative engineering. It is not always possible to buy creative engineering "off the shelf." Perhaps that is why the challenge of doing the difficult jobs is so attractive to the Diamond organization.

The Future is "Worth Looking Into"

Just a brief glance into the past development of closed-circuit television in this country shows a growth from zero dollars per year to more than seven million. Market predictions go as high as 75 million a year, but it is felt that such a figure cannot yet be predicted for a specific year in the future. From one company in the field in 1946 there has been growth such that now more than 18 companies aggressively market closed-circuit systems. Color systems are now relatively common in medical/surgical educational applications in major hospitals. The industry is now in the era of "acceptance" wherein more and more companies will enter the field every year. Over the next six to eight years there will be many changes in the industry and some companies will drop out entirely. Finally, it is believed that the industry will settle down to perhaps eight or ten major manufacturers with some of them concentrating entirely upon educational or merchandising systems, and the balance of the companies deeply rooted in the tough, rugged, industrial applications of television that are already beginning to show as more than simple doodles on the engineer's scratchpad.

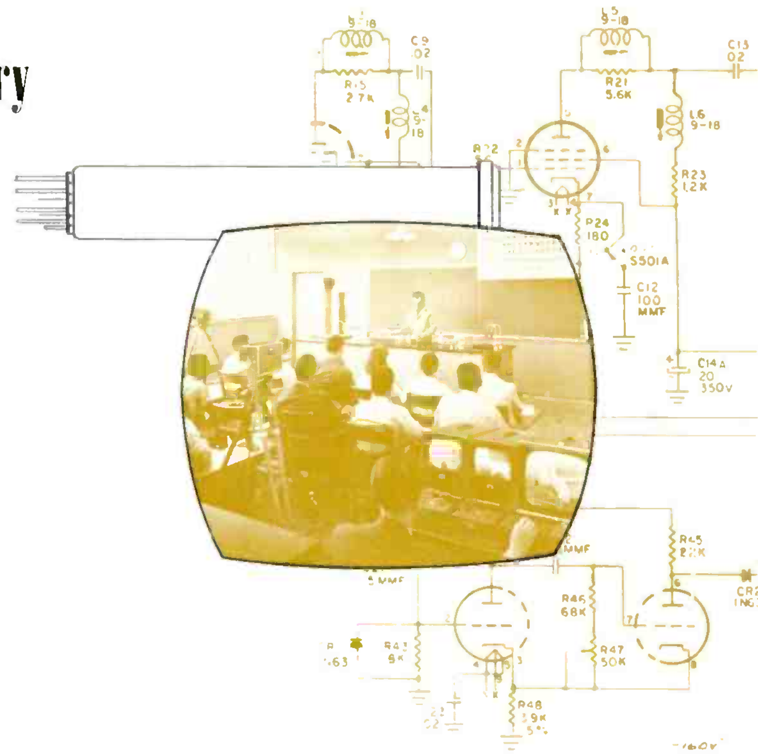
MACHLETT LABORATORIES, INCORPORATED

Photosensitive Tubes

GENERAL CHARACTERISTICS						
TUBE TYPE	DESCRIPTION AND APPLICATION	PHOTOCATHODE SIZE DIAGONAL	DEFLECTION METHOD	SPECTRAL RESPONSE	SIGNAL OUTPUT	NOTES
ML 5820	Image orthicon capable of high resolution over a broad range of illumination. Used for high quality studio work as well as low light level field work.	1.8″	Magnetic	S-10	3 to 24 μ amperes	
ML 7038A	General purpose CCTV vidicon. Tube is self-aligned. G_3 is aluminized on inner surface of precision glass envelope for ruggedness. Operation in any position.	.62″	Magnetic	S-18	.1 to .3 μ amperes @ 2 to 14 foot candles	G_4 mesh assembly is an integral part of tube envelope and acts as photoconductor guard. Tube can be operated in any position.
ML 7291A	High quality vidicon especially for broadcast work in television.	.63″	Magnetic	S-18	.1 to .3 μ amperes @ 2 to 14 foot candles	Similar in construction to 7038A. Rugged and exceptionally low microphonics.
ML 7351	High sensitivity, low light level CCTV vidicon. About twice the persistance and ten times the sensitivity of 6198.	.63″	Magnetic	Peak at 6000 A	.1 to .32 μ amperes @ 2 to 14 foot candles	Considerable sensitivity in the red range of visible spectrum. Recommended for slow moving scenes.
S-522B	High sensitivity tube for special applications requiring near UV sensitivity.	.63″	Magnetic	Near UV	Radiant sensitivity at 4000 A° .4 μA/μW	Considerable sensitivity in the blue region of the visible spectrum.

Industrial Television for Industry

by CHARLES E. SPICER,
Sales Operations Manager,
Industrial Television Division,
Allen B. Du Mont Laboratories, Inc.



CHARLES E. SPICER

Mr. Spicer is the Sales Operations Manager of the Industrial Television Division, Allen B. Du Mont Laboratories, Inc. He has been a member of the Du Mont organization since 1949 engaged in work with television broadcast and closed-circuit systems. He was first a sales engineer for broadcast equipment and was next made sales engineering manager. He became sales operations manager in 1955. Mr. Spicer was associated with the General Electric Electronics Department before joining Du Mont. He was a Lieutenant in the U. S. Naval Reserve and holds a B.S. degree in Electrical Engineering.

Industrial or Closed Circuit Television is proving itself a useful tool in industry. It is rising out of the "gimmick" stage where it remained so long and there are good specific reasons for this change. First, recent improvements in the sensitivity of the vidicon tube, the pickup device for 99% of the industrial television equipment sold today, has been increased to the point where good pictures can be obtained with reasonable levels of illumination. Second, the equipment which operates this tube has also been made simpler and more reliable than the earlier equipment which was often patterned after elaborate broadcast television cameras. Third, the flexibility of the cameras has been increased which permits them to be remotely-controlled in almost any aspect. An operator a mile or so away can control the viewing angle of the camera, the distance at which it focuses, and the direction at which it points using standard off-the-shelf controls. The simplicity of equipment combined with the add-a-unit construction of these controls has resulted in a fourth very important feature in current equipment — low cost. By low cost, we mean roughly $2,500 per camera point installed and operating.

To show you how simple these television cameras are: the camera includes a total of only nine tubes, including the vidicon, about half as many as your TV set. Four of them are video amplifiers which amplify the picture signal from the vidicon target to a level of about 1 volt peak-to-peak and insert horizontal and vertical blanking and synchronizing pulses. A fifth tube is a small RF transmitter operating on a standard broadcast channel and modulated by the video output tube. Thus, the camera can feed either an industrial television video monitor or an ordinary home receiver. The vertical oscillator is synchronized with the incoming line voltage and provides the sweep of the beam in the vidicon from top to bottom of the picture. The horizontal oscillator is crystal-controlled at 15.75 kc and provides the sweep of this beam from left to right of the picture. Power for these tubes is supplied by a conventional power supply also included within the camera.

The complete unit is only 12″ long and is still large enough to accommodate the remotely-controlled motors which focus the camera and change the lens turret. The focus motor actually moves the vidicon and its deflection assembly with respect to the lenses, rather than driving the focus ring on the lenses. This provides the advantage of simple mechanical linkage and complete independence from the type of lens used. Lenses for use with vidicons are standard 16 mm. motion picture lenses. Panning and tilting is accomplished by mounting the camera in a mechanism with a tilt motor and a pan motor, Figure 2 (wall mounted). These motors are operated by a simple joy-stick control which operates the motors singly or in combination, so that the camera moves in the direction in which the stick is pushed.

The signal from the camera is connected normally through standard coaxial cable to the video monitor at the receiving point. Here a standard TV receiver can be used, although for maximum reliability and sharpest, brightest picture a video monitor is normally used. The monitor is similar to a receiver except that it does not have the tuner for selecting TV channels or a sound system. It does have an improved amplifier, improved power supply, and rugged construction for industrial applications.

That is all there is to it — two units and you have a television system. And these units can be a mile apart connected only by a coaxial cable (unless remote controls are required).

The best way to explain the use and operation of industrial television is to cite examples. The field of Security is one of the largest for present day industrial television systems. Figure 1 shows the guard at the main gate of the American Oil Company, in Texas City, Texas, looking at two compact 8″ monitors. Each monitor is connected to a camera one mile away where two remote gates are located. The guard looks over each employee wishing to enter or leave through the gate even inspecting his lunch box, if necessary. By push-button he releases the turnstile which permits one person at a time to pass.

The Resurrection Hospital in Chicago, Illinois uses television cameras in its children's wards. Children's wards usually have four to six patients who require constant attention. Because of this small number of patients per room there are a great many rooms for each nurse to oversee. In the Resurrection Hospital, nineteen of these rooms are equipped with remotely controlled television cameras, Figure 2, which permit the nurse stationed in the control room to look around the ward and see each patient. The pictures from these nineteen cameras are shown on either of two monitors, Figure 3, so that the nurse can constantly monitor any two of the nineteen rooms and periodically,

Figure 1 — Guard watching 2 monitors covering remote gates.

Figure 2 — Remote controlled camera in children's ward at Resurrection Hospital in Chicago.

Figure 3 — A nurse watching monitors and selecting room to view by push-button.

at the push of a button, look into all of the other rooms. Normally, she leaves the cameras pointed directly at the more critical patients, a child being fed intravenously for example.

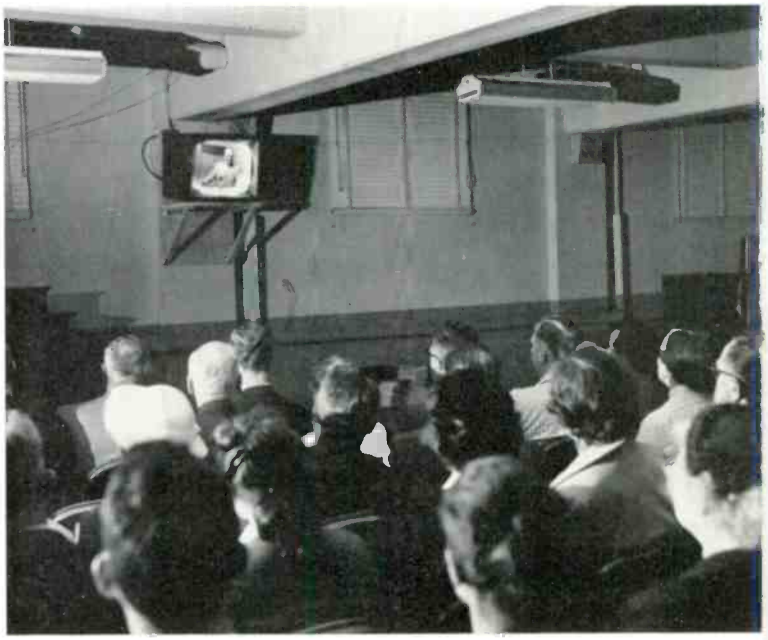
The Brookdale Baptist Church in Bloomfield, New Jersey, has solved the problem of its overflow congregation seated in relative isolation in the recreation room. A television camera covers the service and the picture is fed to monitors in the extension seating area.

Television has proven a valuable aid in our expanding educational system. Pictured in Figure 5 is an extremely simple two-camera television system used in the Joyce Roads School in Plainview, New York. The two remotely-controlled cameras are operated by a student at the small portable control table. One of the two cameras is panned and tilted to "close-in" and enlarge an experiment for example. While this camera is being positioned, the second camera with a wide angle lens for general coverage is "on-the-air." The picture from this studio classroom is fed by cable to other classrooms in the school. Usually, the televised instruction is scheduled so that the key instructor in a particular subject reaches all of the student body for a portion of each classroom period after which the regular classroom instructors carry on further discussions of the material.

Tellers in the Denver U. S. National Bank are of necessity far removed from the signature and ledger file rooms. Still they must check signatures before cashing large checks or passing on large withdrawals. Television is used to relay the signature or ledger balance to the teller from the file room. The camera is housed in a small, desk-height enclosure with a glass top, Figure 6. The signature card is placed face-down where it is illuminated from within by fluorescent lighting. The camera within the stand views the card and the picture appears simultaneously on the small monitor mounted on the teller's counter.

In Boston, Massachusetts, television cameras are being

Figure 4 — Overflow congregation of Brookdale Baptist Church watches in the recreation room.



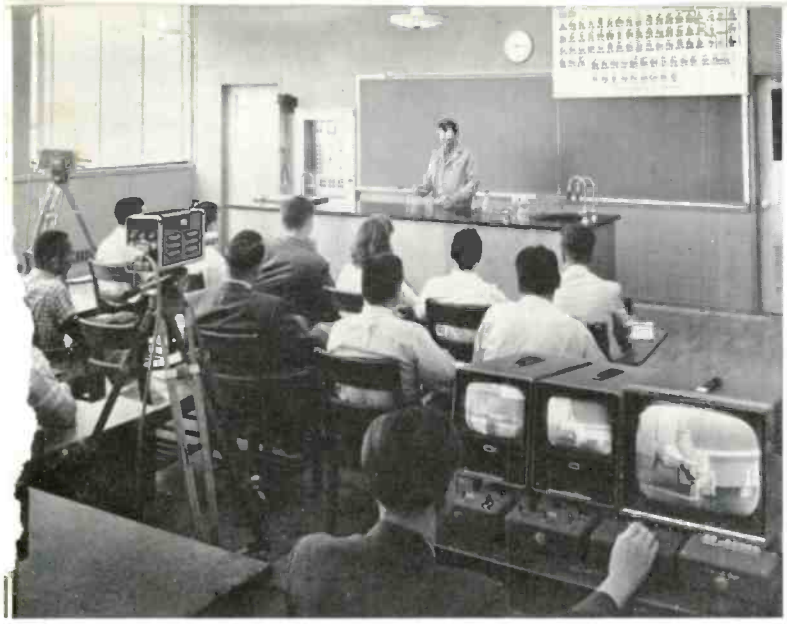


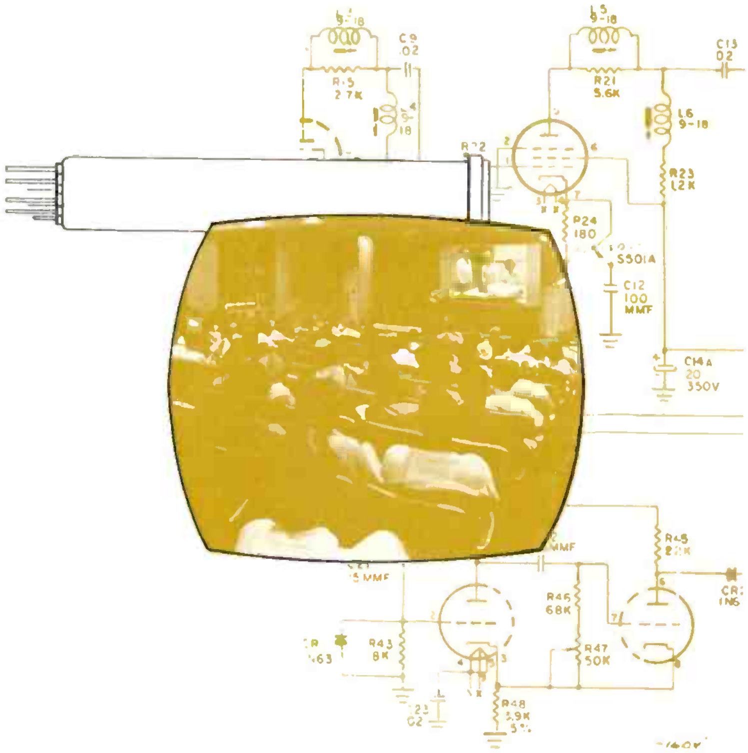
Figure 5—Simple two-camera television used in the Joyce Roads School, Plainview, New York.

installed in the tunnel along the Fitzgerald Expressway. One operator in the Administration Building maintains a watch over the complete tunnel and directs traffic remotely in emergencies by watching four monitors. One monitor automatically switches periodically to each of 8 cameras in the north roadway, while a second monitor automatically switches to each of 8 cameras in the south roadway. The third and fourth monitors can be "held" on any one of the cameras in either roadway. Should trouble develop in the tunnel; i.e. an accident, a flat tire, a traffic jam, the operator speaks to the drivers over a powerful sound system. He advises them that a repair truck is coming, to stay in their cars, etc., and then directs traffic around the troubled area by controlling traffic lights located throughout the length of the tunnel.

These examples sound simple and straight forward, but each required careful engineering planning before the installation and careful service following the installation. Consideration of lighting levels, camera angles, cabling distances, and general operating conditions is very important. Television has solved many a tough problem, but sometimes a careful examination by experienced engineers has indicated that television was not the most practical answer. Such a decision involves on the spot investigation of the application under consideration and this investigation should be conducted by a reliable local organization. The installation should then be made with considerable care and consideration of the particular and often difficult requirements in which the cameras and monitors must operate. Skillful maintenance is also important to top performance as with any electronic equipment.

Good television systems, well planned, carefully installed and properly serviced can offer increased economy and safety to an extraordinarily wide-range of industries. We suggest you think about your own business. You will usually find that an "extension of your vision" with television will improve your operations.

Figure 6 — A television camera inside the Dumont camera stand views a signature card placed face down on its glass top, at the Denver U. S. National Bank.



Closed-Circuit Television Solves the Problem

Television Case Histories

by N. M. MARSHALL, Associate Director of Sales, GPL Division, General Precision, Inc.

N. M. MARSHALL

Mr. N. M. Marshall is Associate Director of Sales, GPL Division, General Precision, Incorporated, Pleasantville, New York. A graduate of Brown University, he was an electronics officer in the U. S. Navy during World War II specializing in communications, radar, and countermeasure techniques. He is currently a lieutenant commander in the Navy Reserve. Before joining GPL in 1950, he produced and directed experimental educational television programs at the Navy Special Devices Center. He became Eastern Regional Sales Manager for the Industrial Products Division in 1953 and was named to his present post in 1955.

Problem #1: Quick answers are sought for engineering tests of a car's suspension system when it is cornering sharply or bouncing over a rough test road. Also, observation of engine "rock," fan blade "bending" or action throttle and choke controls is necessary — the latter in conjunction with stroboscopic lights which "stop" the action of fan blades as they whirl.

Solution: A small, rugged, bomb-shaped GPL television camera Model PD-150 gives the engineers a picture of what goes on underneath an automobile under various conditions. The picture is transmitted through a closed-circuit TV system to a 14-inch monitor in the rear of the test car. This mobile system was used for the first time in automotive research by General Motors Technical Center.

Engineers believe it is the best system for quick answers in test work. Ordinarily, they would use motion picture cameras for such visual aids in testing — and they still do — but working with film is slower and less flexible than live TV. Also, it is possible to use such a system with the picture flashed to a large screen in an office or laboratory where a group of engineers can watch the action of a car cruising along a test road miles away. In addition to testing suspension systems in action, and using the TV system as described above, the mobile TV unit is used for observing tire roll when a car is going around a corner. Other automotive tests are being studied with the use of remote TV "eyes" in mind, not only with moving cars but also in test cells or laboratories where high speed rotating parts would be hazardous to observe first-hand.

Problem #2: How to see without being seen, how to observe and teach without being in the way.

Solution: At the Nebraska Psychiatric Institute in

Figure 1 — A small, rugged, bomb-shaped GPL television camera Model PD-150 gives the engineers a picture of what goes on underneath an automobile under various conditions.

Figure 2 — Five-pound television camera peers through glass window into children's therapy room at recently opened Nebraska Psychiatric Institute in Omaha. Closed-circuit ii-TV system, installed by General Precision, Incorporated, Pleasantville, N. Y., is first such project used to show experts actually treating mental illness to advanced students.

Omaha this was solved by installation of a closed-circuit TV system developed and produced by GPL. This system is being used to show advanced students experts actually treating mental illness — and the result will be more specialists trained in less time.

This application is helping to meet America's crying need for doctors trained to treat the mentally ill. Mental patients now occupy more than half of America's hospital beds and the number is growing due to scarcity of adequate treatment facilities. It is estimated that there are only some 8,000 psychiatrists practicing in the United States while at least 40,000 are needed. Less than 1,000 new specialists a year are estimated to be entering the field and mental health experts say that each psychiatrist saves the public at least $50,000 a year by curing mental patients who would otherwise require custodial care. The installation at Nebraska's Institute at a cost of less than $15,000 is thus expected to be recovered quickly and should pay for itself many times over by making it possible to expand and improve the Institute's teaching facilities.

The treatment of mental illness can best be taught by actual demonstration. To avoid disturbing the doctor and his patient, however, this ordinarily requires students to peer through one-way windows into the treatment room — and only a few students can watch at a time. Now, thanks to TV, large groups of students can watch demonstrations simultaneously in the Institute's auditorium, seeing and hearing as clearly as if they were seated next to the psychiatrist. Each treatment room has a special camera port, through which the camera-man can shoot without disturbing doctor or patient. The sound is picked up by microphones permanently installed in the ceiling of each treatment room.

Three lightweight GPL cameras, mounted with their controls and monitors on small carts to form mobile units, are set up to cover those treatment rooms where the most interesting therapy is taking place. All three TV reports go to the monitor receivers in the control room where the most significant treatment is selected for transmittal to the auditorium. There, via the GPL television projection system, everything that is happening can clearly be heard and seen larger than life, on a wall screen. The entire operation is carried out by staff members.

Although the Nebraska closed-circuit installation is believed to be the first of its kind in America, closed-circuit television has found a wide range of uses in other medical education applications.

Problem #3: How to save on the electric bill of an industrial concern who is billed on a demand power basis.

Solution: Remote monitoring of demand meter saves a manufacturer $10,000 annually.

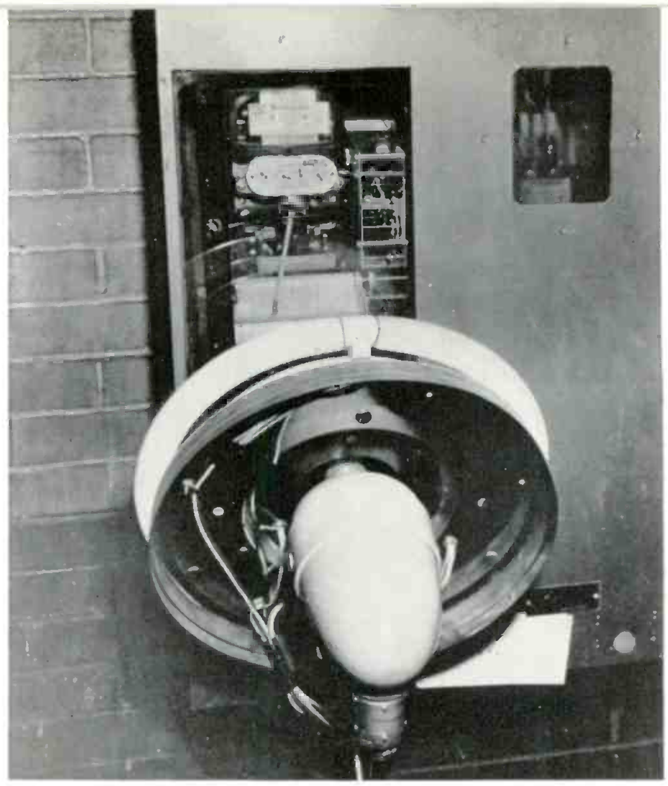


Figure 3 — GPL television camera, circled by neon light tube, views demand meter at power company sub-station. Picture of meter is relayed by coaxial cable to monitor screen in manufacturer's control room for remote reading.

The company, a manufacturer of zinc oxide products, is billed on a demand meter basis by the electric power company, a type of billing used with many industrial concerns. This means that the electric bill for the month is based on the peak load used during this period, even if this peak occurs for just an instant. This method is used because the power company has to install power lines and generating equipment capable of handling this peak load. Since the power company does not permit tapping onto the demand meter for remote indication — and placing a man in the company's sub-station for monitoring is both impractical and expensive — a small, 5 pound GPL TV camera is mounted to furnish a close-up view of the meter. Some 500 feet away in the plant control room, a plant engineer watches the meter reading on a TV monitor and makes the necessary load adjustments to keep the demand from exceeding certain limits. In most cases this can easily be done by switching electric furnaces or other machines. The manufacturer, with an investment of only $4,000 in the GPL TV system, now enjoys a monthly saving of about $850.00 in electric bills.

Problem #4: How to insure personnel and operational safety in hazardous atmospheres.

Solution: A GPL TV camera with wide-angle lens and enclosed in a protective housing is mounted to survey the critical area. The continuous picture of workmen on the job, transmitted into the foreman's office 300 feet away, permits immediate action if required. A similar picture appears on another receiver installed in a shift inspector's office.

This problem occurred at the Esso Research and Engineer-

Figure 4 — Up to eighty psychiatrists or students will observe enlarged picture of patient treatment on auditorium screen via closed-circuit television at recently opened Nebraska Psychiatric Institute in Omaha. Projection Television System, installed by General Precision Laboratory, Incorporated, Pleasantville, N. Y., is first such project used to show experts actually treating mental illness to advanced students.

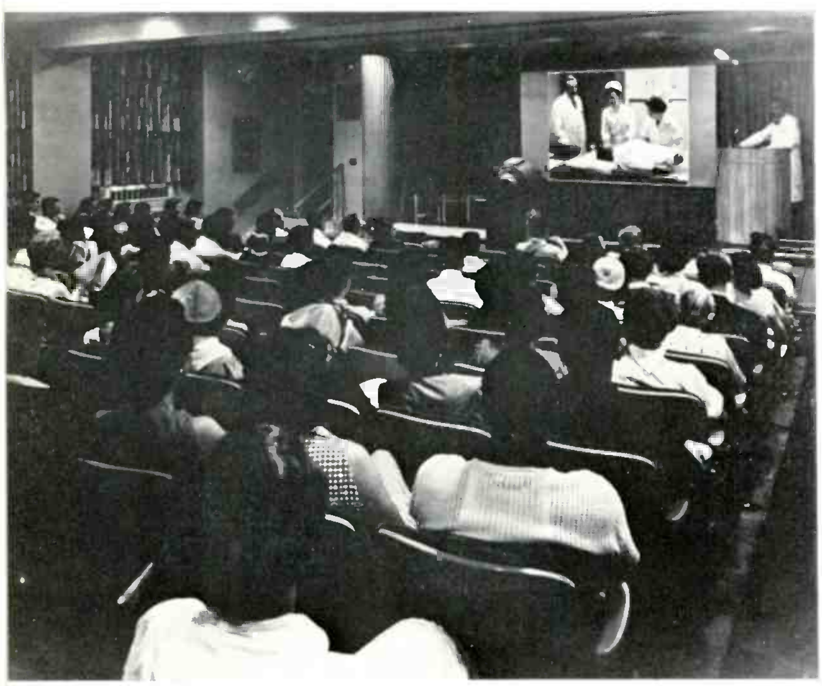


Figure 5 — Shift foreman at Esso Research and Engineering Company pilot plant at Bayway, New Jersey, checks safety of workmen on job at unit 300 feet away via GPL closed-circuit television system.

ing Company where hazardous atmospheres in the propane deasphalting pilot unit make it desirable for the shift foreman located in a nearby building to observe the area, so that emergency measures may be taken if trouble develops or an operator falls ill.

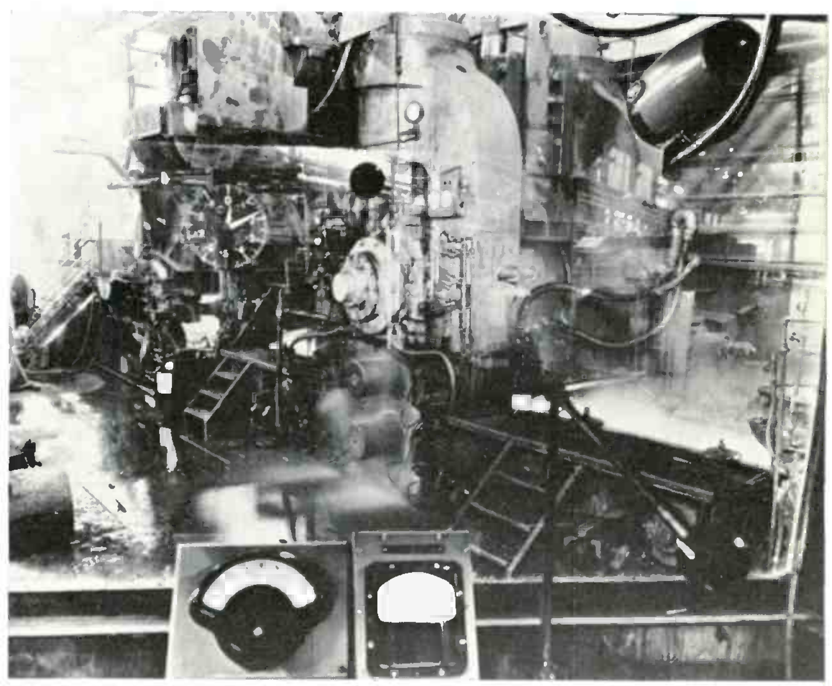
Problem #5: How to efficiently coordinate roughing and rolling mill operations at the Canadian plant of Dominion Foundries and Steel Ltd., Hamilton, Ontario.

Solution: Replace the previous method of maintaining contact by telephone, whistles and signal lights with a GPL closed-circuit TV system which gives the chief operator of the roughing mill a detailed view of what is happening at a second, "reversing" mill more than 700 feet away.

A standard GPL camera transmits pictures from the control booth of the second mill to the chief operator in the roughing mill's control booth. By glancing at his receiver, he can read a gauge at the reversing mill which enables him to accurately adjust table and roller speed so the billet will be ready at just the right moment.

The importance of the TV installation to the steelmaking process is emphasized by the fact that a 15 second delay in the roughing mill can reduce the temperature of the steel enough to make it difficult to roll during the final stage. The 2-HI roughing mill takes the red-hot 2300°F billets and passes them back and forth through the rollers about 19 times, thus reducing them to one-inch thickness. The strip is then passed to the 4-HI, 60-inch reversing mill that completes the operation, rolling down to gauge size required for tin-plate and pipe production. Two operators control each mill from the air-conditioned control positions above and in front of the roller.

Figure 6 — GPL television camera (upper right) keeps an eye on both the gauge and rollers at the reversing mill. Receiver mounted 700 feet away in roughing mill pulpit helps operators co-ordinate production.



No. 8 Mill at Crocker Burbank houses huge, high-speed paper-making machinery. Quality of the Mill's output is closely controlled via closed-circuit television by a Laboratory located nearly one-half mile away.

Centralized Laboratory Control

With On-the-Spot Availability at Remote Location through Closed-Circuit TV

Barkley & Dexter Laboratories, Inc., of Fitchburg, Massachusetts, is an organization with engineering experience in practically all branches of the physical sciences. They serve as consultants on problems for industry, Government and the Military Services in such fields as communications, control and automation, optics, closed circuit television, special instrumentation, geodesy, telemetry, microwave circuits and antenna design, medical electronics, vision in industry, special product design and broadcast engineering problems including preparation of engineering data for submission to the Federal Communications Commission.

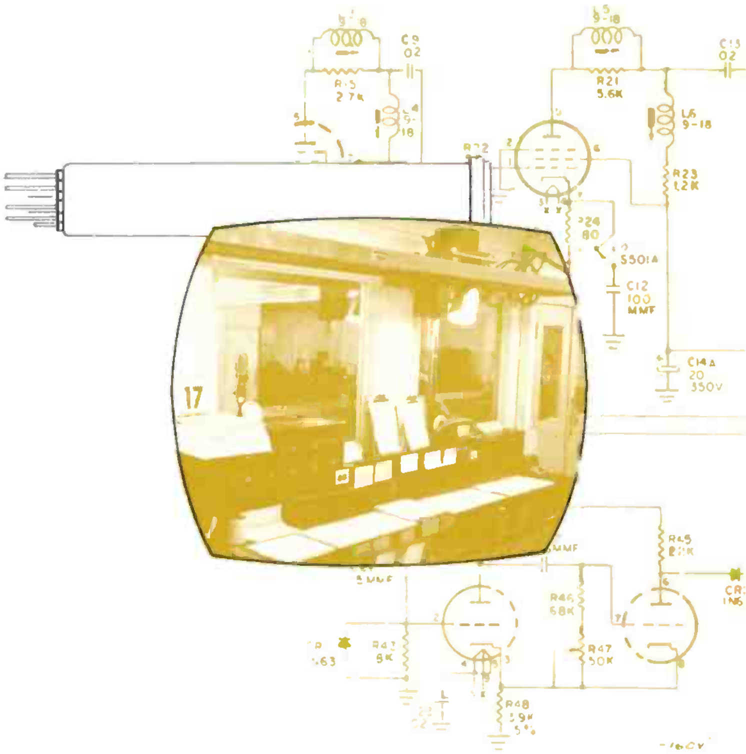
Barkley & Dexter Laboratories, Inc., is currently engaged in a research program for a government agency to investigate the performance characteristics of closed circuit television systems to determine if commercially available equipment will provide the degree of performance required for the considered application. A series of precisely controlled test procedures have been developed to measure objectively such characteristics as horizontal resolution, low and high frequency phase shift, grey scale response, linearity, lens aberrations, microphonics, signal to noise ratios and "readability."

At the conclusion of the evaluation tests, a complete set of specifications for a multi-camera installation with remote control console and relay switching will be formulated.

The firm has also been engaged as consultants in the field of TV and instrumentation by firms engaged in missile and space vehicle projects.

Other applications of closed circuit TV equipment developed by Barkley & Dexter Laboratories, Inc., have been in quality control and automatic control of precision machines. A unique use of the TV system in conjunction with optics was utilized to generate precise control signals from a work piece of milli-inch proportions to enable the work chuck to be positioned automatically.

People at Barkley & Dexter Laboratories, Inc., believe that the use of closed circuit television by industry has many uses yet unexplored. A campaign is now underway to acquaint management with the potentials of this new tool. An excellent example of what closed circuit TV can do to solve a knotty quality control problem is illustrated in the following article.



DONALD P. WISE

Donald P. Wise has been associated with the electronics field since 1933. He has been a staff engineer for Westinghouse Broadcasting Company; Chief Engineer, Radio Station WHDH, Boston, Mass.; Chief Engineer for Television Station WWOR-TV, Worcester, Mass. During World War II he was assigned as a Commissioned Officer to the Royal Electrical and Mechanical Engineers where he was in charge of British Army Units responsible for installation and calibration of heavy anti-aircraft radar units used for the defense of the City of London. Other military assignments included that of Post Signal Officer at Sondrestrom Fjord, Greenland, and engineering survey officer for the Chief Signal Officer.

During the Korean emergency, he was on leave of absence to head the Army Radio Engineering Branch of Ft. Meade, Maryland.

Mr. Wise joined the firm of Barkley & Dexter Laboratories, Inc., in 1955. He is currently in charge of the Laboratories' antenna design section, industrial TV applications and the broadcast engineering group. He has been responsible for the design of the spiral slot antenna developed for an Air Force exploratory high altitude rocket, a radiation dosimeter reader to indicate the accumulated gamma radiation received by microdoscimeters of the miniature glass rod implant type.

Crocker-Burbank & Co. Assn., makers of a broad spectrum of fine papers, have turned to closed-circuit television as an answer to the difficult problem posed by the need to maintain centralized laboratory control over high-speed, paper-making machines. Between the Laboratory and the Superintendent in charge of the paper-making machines, there must, at all times, be available a ready, rapid communication system. The superintendent needs to know the answer to this question. "Is the machine producing to the right specifications now?" The Laboratory (using the in-process paper sample sent by the superintendent) must answer "yes" or "no" in terms permitting the superintendent to alter the process at the right place in the right amount, and this must be done while a machine is producing paper, for example, at the rate of 4500 pounds per hour.

Prior to the use of closed-circuit TV as much as an hour's production of paper could have been lost while the desired quality information was in transit, out via jeep and back by telephone.

The task of developing Crocker-Burbank's closed-circuit plans was assigned to the Fitchburg engineering firm of Barkley & Dexter Laboratories, Inc. Crocker-Burbank developed plans calling for the use of a pneumatic system to bring paper samples from the machines in remote mills (2600 feet of tubing was used) and a closed-circuit system to display the laboratory information via television monitors. Approximately 80 seconds are required to get the sample to the Laboratory; an additional 10 minutes normally suffice to put the needed data on the screen.

Figure 1 — Remote operated television camera scans Laboratory Reports, on table, to provide Paper Machine Superintendent with in-process quality control data.

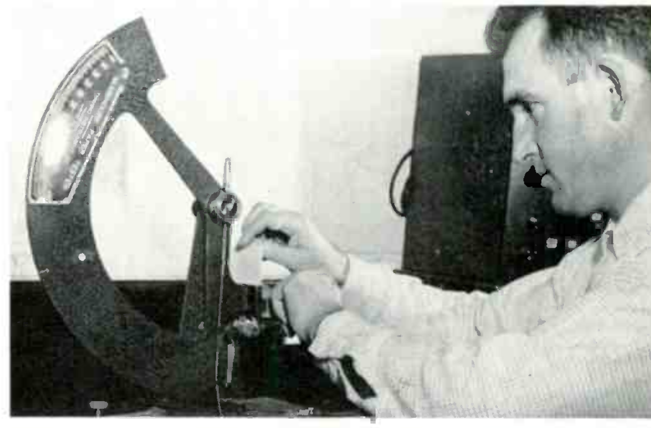


Figure 2 — Information feed-back cycle begins with paper testing. Elmendorf Paper Tester provides tear strength data as shown on scale. Via closed-circuit camera this information is relayed to Paper Machine Superintendent who directs adjustment of a Jordan Pulper.

The tests run on a normal paper sample include: caliper, or thickness; Elmendorf, or tear strength; "pop," or bursting strength; density, measured in terms of porosity, sizing, or the resistance to the passage of liquids; opacity; ash, or mineral content (related to opacity); and the pH or acidity or alkalinity, and others.

Consider the relation of test performed on the Elmendorf tear strength machine to the paper mill machine. A portion of the paper sample is placed in twin sets of jaws of the "Elmendorf" — one of which is attached to a weighted segment of an arc on which a scale is placed. As the segment "drops" or rotates, it tears the paper. Resistance to this rotation is noted on the scale by a pointer. The scale reading, used as a reference, indicates the strength of the paper. Since the paper strength is largely a function of the degree to which the wood pulp is macerated, the quick control of this process is essential to uniform production. (Pulp is macerated by hydration and fibrillation which creates "bonding" between fibers to create paper strength.)

Huge blades in a pulper slurry the pulp to the desired consistency. Refiners then hydrate and fibrillate the pulp. Control of this treatment is furnished by the Laboratory in the form of the scale reading provided by the Elmendorf machine. Any indication that the pulp fiber's condition must be changed can be quickly translated into a resetting of the Jordans and refiners — via the information presented on the TV monitor.

The accompanying photograph (Figure 3) shows an operator making an adjustment to the second of the two large machines involved in the pulping process. He is watching an ammeter on the motor driving one of the pulp treating machines called a Jordan. The reading on the ammeter is used to set the Jordan for the desired degree of pulp

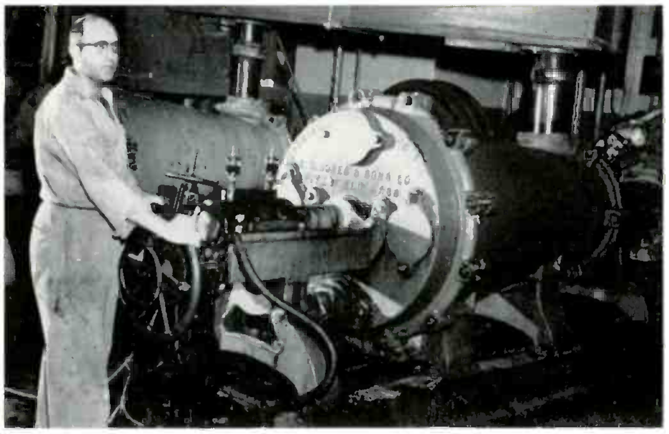


Figure 3 — A Jordan Pulper. This adjustment controls the condition of fiber pulp pieces. The degree to which the individual pulp fibers are beaten and frayed determines the paper tear strength, as well as other paper characteristics.

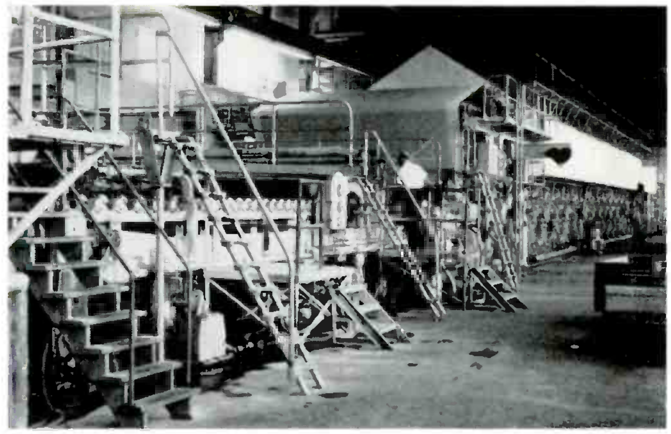


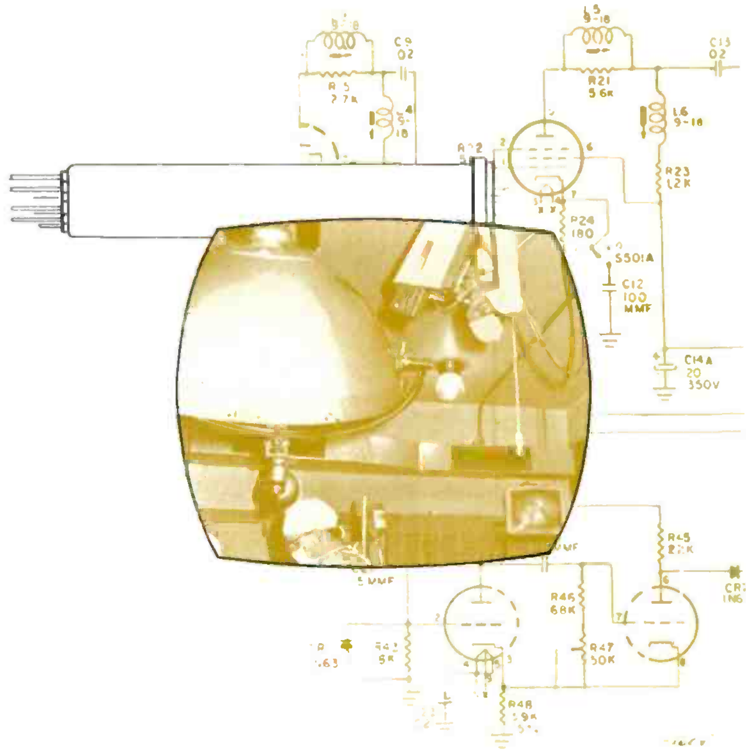
Figure 4 — Two hundred and ten inch wide Paper Machine. Proper strength of paper produced by this machine, operating at 4500 pounds of paper per hour, is controlled, in part, by Jordan Pulper adjustments. This sequence has shown only one of several quality control operations accurately maintained with use of closed-circuit TV.

treatment in accordance with the test laboratory results.

The vidicon camera tube which initiates the electronic part of the information feedback is mounted in a high quality camera and is operated face down, yet still provides a very satisfactory picture. Electrical switching controls can position the camera anywhere on a track several feet long. Remote controls permit the machine superintendent to energize the camera transport mechanism until he sees the desired test report on the screen (eight reports may be viewed in this fashion).

Legibility of the report is satisfactory for all needs. Report entries are made in pen or pencil in boxes of approximately $\frac{1}{4}'' \times \frac{1}{2}''$; as many as two or three hundred entries may have been made at the completion of a long run. By using a single report of this type — and by having it continuously available — Crocker-Burbank has derived many benefits: Freedom from errors in re-transcription or copying or from mis-hearing of telephoned figures; closer quality supervision; the machine superintendent has a complete running history of his production cycle. He can control tendencies and keep production within tighter limits. (An important aspect of this relates to the attitude of the operator himself. Because he can control more closely, he follows the production process with increased care and so maintains a higher degree of performance.)

What was once a cumbersome communications situation is now a precise and always timely system. The art of paper making at Crocker-Burbank has been refined one step more because of it. A maker of fine paper has not only been able to improve his quality but to lower his costs, thanks to the reliable performance of his closed-circuit television system.



Closed Circuit Television in Hospitals and Medical Centers

by JOHN R. HOWLAND, Sales Manager,

Closed Circuit Television, Philco Corporation

JOHN R. HOWLAND

John R. Howland has been identified with television for more than twenty-five years. He was a member of the National Television Systems Committee in 1941/2 and in recent years has been active in the design and planning of many hospital and school television systems and of the largest multiple-camera systems ever installed.

He is a graduate of the U.S. Naval Academy and of Loyola University Law School, his first business experience was with Otis Elevator Company and D. H. Burnham & Co., Chicago Architects. In 1935 he joined Philco as Assistant to the President and participated in early work in television. In 1939 he moved to Chicago where he supervised television and FM broadcasting activities for Zenith Radio Corporation as well as their Patent Department, Government Business, New Products and Trade Association Activities. During World War II he became Colonel, U. S. Army Signal Corps and served as Executive to the Chief Signal Officer, European Theater of Operations and as Director of Communications and Signal Officer United Kingdom Base.

Since 1953 he has been identified with the development and sales of communication and television camera equipment for Stewart Warner, and Thompson Products before returning to Philco in 1958.

Howland is a member of Society of Motion Picture and Television Engineers and a Director of the Armed Forces Communications Association.

Closed Circuit Television, as a time proved, multiple purpose aid to the Doctor and the Hospital Administrator, has been so successful in so many fields that its usefulness should not go unrecognized in the planning of any new hospital units or in the remodeling of older buildings. It has broad application in teaching and many additional uses which have gained acceptance in the daily work of the hospital and its specialized functions. A majority of these routine applications are so important they should be fully understood and their immediate installation considered.

Fortunately, the closed circuit television camera system is extremely flexible and, with appropriate provisions, a minimum amount of equipment can be used to serve a variety of needs. The same units can easily serve normal requirements, program needs, laboratory experimentation, or emergency communications to patients.

Generally, hospital television equipment falls into four categories: (1) Teaching and Medical Group Demonstration, (2) Routine — which also has teaching possibilities, (3) Service to Patients, (4) Protection of Personnel.

In technique instruction, the hospital can draw upon the closed circuit television experience of the Military Services, some two hundred schools and universities, and certain industrial corporations as well as other hospitals. There is no longer any question that students can learn as well or better from television as from classical lectures and demonstrations. Attention can be focused on a teacher, on the intimate details of demonstrated work or equipment, and on a wide variety of visual aids, slides or films that can be scheduled into the presentation in a most effective way. The facts are scientifically documented by Pennsylvania State University, Michigan and Michigan State Universities, the Boards of Education of Chicago, Illinois and

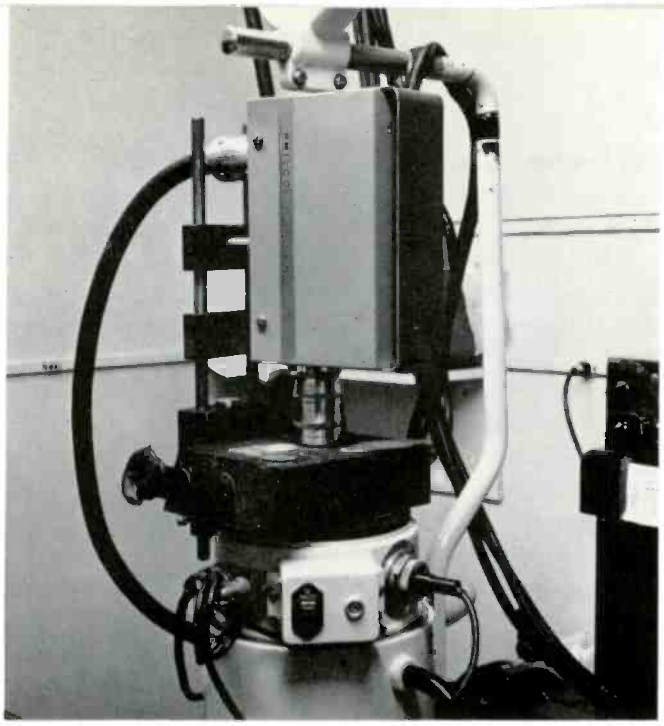


Figure 1 — Philco High Definition Television Camera mounted on Image Intensifier at St. Christopher's Hospital, Philadelphia, Penna.

Figure 2 — Philco Transistorized Unit Camera with Zoomar Mark VI lens mounted in Operating Room at St. Christopher's Hospital, Philadelphia, Penna.

Washington County, Maryland, and the Departments of Education of New York State and International Business Machine Corporation and others. These facts are recognized by the Ford Foundation, the U.S. Department of Health and Welfare, and the National Academy of Sciences.

Well documented, but less widely known, are the Routine Applications of closed circuit television in Medical or Clinical Work and Research. These have been developed by doctors and technicians with particular emphasis on the problems of their specialties and the accomplishment of results hitherto unattainable. Similarly, the Service-to-Patients Uses have developed as an answer to the particular problems of persons whose activities are restricted.

Protection-of-Personnel Uses involve remote observation where only a camera is placed in an area of high radiation or high x-ray intensity and the observer is not only saved from exposure, but has access to enlarged or amplified pictures which are easier to read, thus shortening the total time of the operation.

Closed circuit television is not difficult to use. Equipments are available which become the tools of the medical profession and are so simple in function that the camera focus and adjustment are directed by the doctor and all "production" can be handled by his assistant. Only the part-time of one television-trained technician should be required for maintenance in most hospital situations.

A hospital television camera chain should include a vidicon camera, its lens system and support, and a television monitor. The camera may be adjusted locally or at a distance or may automatically adjust itself for variations in light and voltage.

For any scene, such as a grouping of people, the active area concerned in an operation, or the image presented by image intensifiers, microscopes or meters, an appropriate lens will provide the operator and those near him with a large, bright presentation of what might otherwise be small, dimly-lighted images or a view impossible for more than one person at a time.

The camera, its lens and its local receiver therefore become the essential building block and, of themselves, provide a tool that is fully useful for any activities, perhaps in several locations during a month.

The first by-product of closed circuit television technique is the ability to display the televised picture not only on a local receiver, but simultaneously in one or more offices, classrooms, lecture halls, and on several receivers in an auditorium. The choice of location for additional receivers depends on the number of viewers, the people involved and the scheduling of the rooms. Flexible planning dictates that cables to each appropriate display room be fed from a centrally located "patch panel" where the connections may be changed as necessary to permit any or all of the meeting rooms to be connected to the television circuit. The "patch panel" is the television version of the telephone switchboard and becomes the center for distribution of television signals.

The connection of cables to the "patch panel" from each operating or work room completes a basic system permitting viewers gathered in any conference to observe, in intimate detail, any television subject matter. If the cables include audio wires as well as coaxial lines for the picture, the program can include the voice of the lecturer and questions by the audience simultaneously. Since the "patch panel" is mounted on a tall "rack" of standard dimensions, amplifiers and other accessories can be "patched into the circuits" simply and readily.

The "patch panel" can be located in or near a film room in which a television camera may be used to televise pictures from a "multiplexer" into which pictures are fed from a 16mm television film projector and "still" projectors of 2" x 2" slides and 3¼" x 4" slides. Lectures can be so arranged that a pre-determined series of slides may be used on signal from the lecturer and incorporated in the presentation of the subject matter.

A television picture recorder or a television tape recorder may be placed in the film room and so connected that a permanent record is made of any television program including, of course, any discussion that may accompany it. The entire record or edited portions of the program may then be retelevised at subsequent meetings.

Another third by-product of closed circuit television is the ability to insert appropriate equipment at the "patch panel" or at the point of origination to superimpose reference data like time, pulse or pressure indications around the edges of a picture of activity. This, of course, can be recorded for permanent record on film or tape as well.

Programs should be presented on a monitor or special television receiver capable of reproducing a picture of the same quality created by the camera. Sound should be delivered separately and handled by a specially designed public address system so arranged that questions can be asked from the floor and transmitted to the lecturer without causing interference in the sound system.

Where the lecture hall can be substantially darkened and special lighting fixtures prevent ambient light from reaching the screen, projection type TV receivers can be used behind a suitable screen where short-throw lenses can be accurately aligned without interference to the students or conferees. Excellent pictures with 10 foot lamberts in the high-lights can be produced in sizes up to 8 feet wide and 6 feet high in this way and viewed by audiences of as many as two or three hundred. Larger projection pictures tend to lose too much detail. Of course, no projection pictures can compare in brightness and sharpness with the 80 foot lambert picture created by a pinpoint of electrons on the inside of a television receiver tube. Standard size monitors should be used wherever the ultimate in detail is desired, wherever ambient light exceeding one or two foot candles is present and wherever the audience does not exceed thirty or forty persons per receiver.

The basic element in all television is the proper lighting of the subject to be televised. If a large area is specially lighted, there must be air conditioning to offset the heat released by the lighting equipment.

The use of black and white television in operating rooms presents no unusual lighting problems. The light normally used by the surgeon is adequate for television, particularly if a small spotlight is attached to the camera and operated to offset the shadows of the surgeon's hands in deep incisions.

With microscopes, image intensifiers, and similar research equipment, the problem is reversed. The light available on the subject matter is the maximum obtainable under the controlled limit of radiation or illumination as determined by its effect on living organisms and live tissue. Special adjustment of the camera and the selection of special lenses are employed and full advantage is taken of the fact that the camera views a flat sample of material or the image on fluorescent screen of great flatness and infinitesimal depth.

Illumination of any scene must contain light which will actuate the vidicon and pass through the lens system. Infrared light cannot be used alone unless a special vidicon tube is used in the camera. Ultravoilet light cannot be used alone unless special lenses are employed which will transmit it.

More than thirty hospitals are regularly employing television for viewing the image on 5 inch image intensifiers and as larger units are fully developed, television cameras are being adapted to present a picture of the course of the heart catheterization and other radiological explorations. The total radiation needed to give the doctor a clear view of the exploration has been reduced well below that necessary for viewing the image through a mirror tube. In almost every case where television has been applied, conventional viewing through mirror tubes has been abandoned.

First application of the TV camera to the image intensifier was accomplished at Temple University in Philadelphia by Dr. W. E. Chamberlain. Extraordinary new developments are being accomplished at Temple today by Dr. Herbert M. Stouffer and Archie W. Blackstone, E.E., and they have extended the television technique to the bronchoscope and biplane fluoroscopic equipment of Dr. Chevalier Jackson and to other medical instruments.

A complete system recently installed at St. Christopher's Hospital, in Philadelphia, typifies the ideal installation for pediatric work, including a camera on the image intensifier of Dr. John Kirkpatrick and a mobile unit camera employed in O. R. and examination rooms all connected through a "patch panel" to receivers in the class room and auditorium.

Whatever the availability of present funds to cover closed circuit television and the other pressing needs of every hospital, long range planning must recognize that these new techniques are becoming available in increasing scope. Many uses will pay for themselves in their public relations aspects. Many will pay for themselves in increased security for persons exposed to new rays. Many will provide the final means of reaching objectives not otherwise attainable and of reducing the time necessary to document discoveries or to exchange detailed information at a conference.

MACHLETT

For some time a need has existed for an adequate and complete guide for installing rotating anode x-ray tubes. Modern tubes which operate at higher and higher currents have accentuated this need as the installation and calibration of these tubes is a critical operation which should be done with great care so as to insure proper operation and long life. With a view toward promoting a fuller understanding of the many points which should be considered whenever a rotating anode tube is installed, Machlett Laboratories has prepared a pamphlet on this subject for distribution to the x-ray service organizations. The chapter headings of this pamphlet are as follows:

M	Make inspection of new tube
A	Analyze old tube failure
C	Check over x-ray machine
H	Hook-up new tube and accessories
L	Light and check filaments
E	Energize starter and rotor
T	Test and Calibrate
T	Tell Operator of any changes

While this pamphlet is primarily designed for use by the serviceman; it may be of interest to the user of x-ray equipment, and it is available without charge by writing to the Sales Department of Machlett Laboratories.

A Control Combining Either Dynapulse or Impulse Timing With Bi-Plane Film Changers or Conventional Equipment

by

RUSSELL WIGH, M.D.

and

CALVIN S. HAYS, B.S.

Department of Radiology, Medical College of Georgia, Augusta, Georgia

Elsewhere (1) there have been published comments concerning changes and additions to a biplane angiocardiographic unit which increased the versatility of this apparatus and expanded the scope of its usefulness. This arrangement reduced the need for costly additional space and the need to purchase other single-purpose diagnostic units. To insure maximum utility of all the assembled apparatus and ease of operation by one technician, a master electrical control had to be devised.

It was desired to have a flexible system which would permit: multiple uses of the film changer for a variety of examinations; either impulse or dynapulse timing to both tubes when used with the film changer; impulse timing to one tube and millisecond timing to the second tube simultaneously; single plane serialography with either type timer; dynapulse as well as regular timing with the general radiographic equipment; and a maximum of two radiographic tubes rather than a cumbersome three-tube arrangement, namely, two supporting the biplane changer and a third, the radiographic table. Indeed, a three-tube arrangement would not permit millisecond timing for the general radiographic examinations.

A biplane roll film changer and two dynapulse timing systems were added to a fluoroscopic-radiographic room, the size of which was somewhat larger than average. This room had previously been provided with a ceiling-crane tube support. The other radiographic tube is supported from the film changer itself.

The changer accommodates two separate rolls of x-ray film. Each roll is 30 cm wide and 25 meters long. The films may be transported simultaneously and in planes at right angles to each other. A provided sequencing system permits exposures at a maximum rate of 12 per second. The events that occur at the fastest rate of film movement

[1]Wigh, R.: On Increasing the Versatility of Specialized Equipment, Radiology 74: 77-78, 1960.

Figure 1 — The dynapulse control panels are mounted in a position reasonably accessible but not necessarily in the technician's control area. They are used only to preset the millisecond timing and are not needed for initiating the actual exposure.

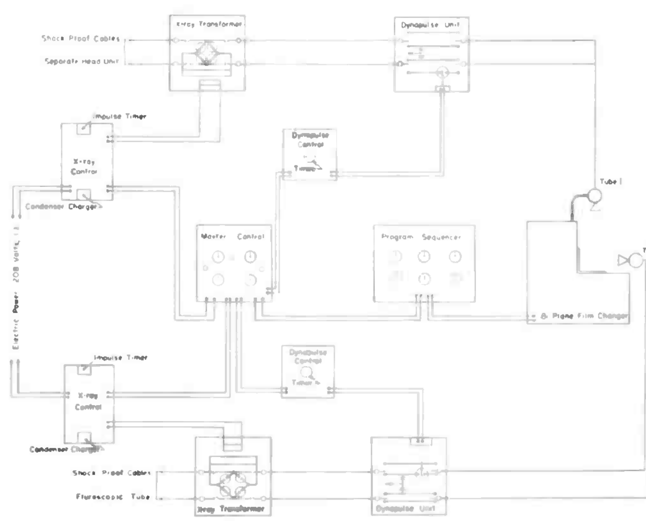


Figure 2 — A block diagram of two dynapulse units and a biplane film changer with a master control working from two 500 ma - 125 kilovolt single phase generators. Tube II is mounted on a ceiling-crane tube stand and may be used independently for general radiographic examinations with either dynapulse or impulse timing.

require that the maximum length of each individual x-ray exposure is not longer than 0.016 seconds. This requires special timing facilities and unusually heavy power. The dynapulse system meets these demands.

Each dynapulse unit is basically an energy storage device with electronic means for controlling the flow of current through an x-ray tube in increments of very short periods (2). An electronic switch in the form of a high vacuum, high voltage tetrode tube allows pulses of from 0.001 through 0.005 seconds to be drawn from a high voltage condenser. The pulses are constant potential and may extend as high as 125 kilovolts with a repetitive rate well over 12 discharges per second. The x-ray tube current can be as high as 1200 milliamperes.

For a biplane installation, it is necessary to have a separate dynapulse unit energizing each tube, together with separate x-ray generators. The two dynapulse controls (Figure 1) each include: a rotary switch for millisecond timing; a pressure type switch for x-ray exposure; a switch for exclusion of constant potential; and an "on-off" switch.

The complete assembly involves a multiplicity of switches on separate panels: those for both x-ray generators, those related to the dynapulse systems, those for charging and discharging both condensers, those for activating the biplane film changers and those integrating x-ray exposures with film-rest periods. The need for synchronized operation, as well as protection against damage, requires a master control which will interlock the separate units and bring automation into the exposure processes. A block diagram demonstrating our arrangement is presented in Figure 2.

Electric power is brought into each x-ray control stand. It can be distributed for either conventional x-ray work using load factors up to 500 milliamperes and 125 kilovolts

[2]Rogers, T. H.: An Electronic Switching System for Ultra-Short Rapidly Repeated Exposures in Angiocardiography. Cathode Press 13: 12-17, 1956.

or for dynapulse work. For conventional exposures without the film changer, one proceeds as he would with any control panel. On the other hand, if the power distribution is for exposures involving either the film changers or the dynapulse systems, a special switch on this panel transfers supervision to the "Master Control" (Figure 3). With this master control arrangement the dynapulse controls require attention only for presetting the milliseconds of exposure desired. The sequencing control provided with the film changers is also preset when this equipment is used.

Through the master control, either one or both dynapulse systems may be employed. By means of it, one chooses between dynapulse or standard timing; selects the milliamperage to be used; connects the film changer; and selects either single or serial exposures for one or both tubes. When these settings have been made, toggle switches (Master Control main switch) start the x-ray tube rotors in motion and at the same time begin to charge the condensers in the dynapulse tanks. A red light (for each system) indicates that the condensers are fully charged and in effect announces that this stage of preparedness has been reached.

The actual exposures are activated after deciding whether a single film or series of films is desired. For a series of films, a toggle button (Figure 3, lower center) is depressed to "on" position; this button establishes the circuits which permit multiple exposures as demanded by the preset requirements of the program selector of the serialographic unit. A hand-switch actually activates the x-ray exposure. For a single exposure, the toggle is in "off" position and a separate exposure button on the panel closes the circuit (Figure 3, upper center).

It would not be possible for one technician to operate all the individual switches without such an arrangement. All this is now done from one station (Figure 4).

We employ Dynamax "150" x-ray tubes. They are successfully handling loads of 1200 milliamperes at 100 KV constant potential for serial exposures of 12 per second with each exposure as long as 0.005 seconds. At 125 KV, the milliamperes are lowered to 800.

This arrangement with its ease of operation has provided us with a multipurpose room which includes single or biplane serial angiocardiography and cerebral angiography. Indeed, it has enabled us to develop a patient-propulsion technique for aorto-arteriography in continuity. Finally, it has prompted us to investigate constant potential radiography and its inherent reduction in x-ray exposure.

Summary

A circuitry has been described which allows one to combine conventional or dynapulse timing with serialographic apparatus either in single or biplane studies. At the same time it permits the selection of millisecond or impulse timing for use with general radiographic equipment.

Figure 3 — A photograph of the "Master Control" demonstrating its various switches. Refer to text.

Figure 4 — Control Booth. An arrangement satisfying manual requirements of the circuitry. Presetting areas of dynapulse controls, program selector and power supply for the second tube are not illustrated.

American Telephone and Telegraph Company Expands Single-Sideband Transmitting Facilities

Machlett Coaxial Triodes Are Used

by R. N. ROSE, Manager, Power Tube Renewal Sales, Machlett Laboratories, Incorporated

Greatly increased requirements for overseas radiotelephony have brought about recent expansion of the American Telephone & Telegraph Company's (Long Lines Department) transmitting facilities. At the Lawrenceville, N. J., overseas transmitting installation — the company's largest — particular interest has been generated by the installation of new transmitting equipment. Here a new wing has been added to the already sizeable main transmitter building and equipped with 14 new 30-kilowatt linear amplifiers (manufactured by the Westinghouse Electric Corporation) each using a pair of ML-6423 coaxial high-mu triodes.

With this facilities enlargement, impetus is given to an art with which the American Telephone & Telegraph Company has been associated since its earliest development — single-sideband communications. In overseas radiotelephone service for over thirty years, "SSB," now the subject of general commercial and military interest, is uniquely suited to the requirements of overseas radiotelephony. Early in 1918 the first commercial wire carrier telephone system was developed by the Western Electric Company and SSB was put to use. The desirability of SSB lay then, as it does now, in its efficient use of a transmitting medium. Single-sideband radiotelephony began, however, as an answer to transmitter power limitations and to the propagation characteristics of the antennas then used. This was in 1923 when the Bell Telephone System worked with members of the British Post Office to establish a New York-London circuit, opened four years later for general service.

The first major development following inauguration of London-New York service came with the establishment of the American Telephone & Telegraph Long Lines installation at Lawrenceville. Ready for operation in 1931, its 840-acre site included a main building, Building #1, and

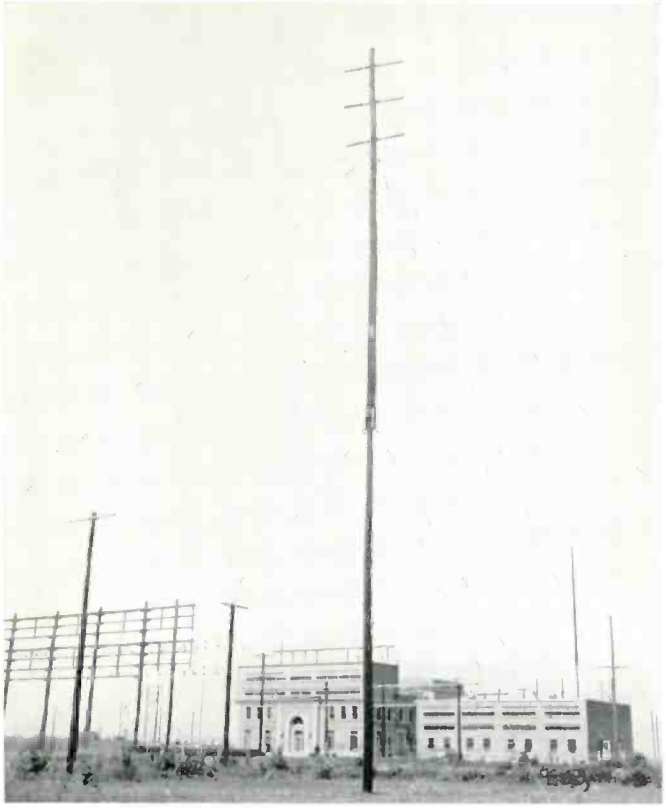


Figure 1 — The Main Building (Building #1) of the American Telephone & Telegraph Company's Long Lines installation at Lawrenceville, N. J. New building addition, right, houses the 30-kW Linear SSB Amplifiers recently added to the company's overseas radiotelephony system. The "high line" in the center is part of one of the many rhombic arrays.

Figure 2 — Main Hall, Transmitter Building #1.

a lineman's paradise of twenty-six steel towers, each one hundred and eighty feet high. However, almost simultaneous with the construction of these towers (needed for the directional arrays), was the development of the wide-range rhombic antenna; this simple device quickly superseded all the larger units.

Sixty-eight rhombics are now employed, with massed groups directed toward London, Moscow, Berlin, Berne and elsewhere. Served also are ships on the "high seas." Lawrenceville, the largest unit in the Bell radiotelephone system, is now one of five transmitting facilities comprising eighty-nine transmitters. An equal number of receiving stations are also employed.

Expansion at Lawrenceville

It had become apparent by 1954 or 1955 that additional facilities would soon be needed to carry the growing traffic: A modest start of approximately 2300 messages in 1927, had grown to over one million by 1958. Although the company's facilities could then handle a good proportion of present communications requirements, the further enlargement of transmitting capabilities became imperative.

Serving the major areas of Europe, Africa, and South America, the transmitters at Lawrenceville, and its associated station at Ocean Gate, N. J., transmit to nearly forty distant points, using a total of nearly 140 circuits. The first transmission to London and to other major European centers originated at the Rocky Point Station on Long Island. Subsequent "first transmissions" to South America, The Atlantic Ocean Islands, Moscow, and various important localities in Africa have originated at Lawrenceville. Throughout the years of growth since 1927 when service to London was opened, single-sideband has steadily displaced double-sideband equipment. Today the percentage of double-sideband units is almost negligible. Of more than 135 circuits originating in New York, only one remains DSB.

It was to be expected, then, that any expansion plans would serve to develop the art of single-sideband. At Lawrenceville, where the present program of enlargement is now substantially complete, a new wing has been added to Building #1, new 30-kW linear amplifiers have been added, and new rhombic antenna arrays have been added to provide additional signal coverage.

New Linear Amplifiers

The low distortion, long transmission range advantages of SSB can best be realized in multi-channel operation by use of high power transmission per channel. To provide this power and yet use existing equipment, it was decided to modify the existing single-sideband transmitters by adding an amplifier stage to each unit. A power gain of about 15 was satisfactory, permitting conservative operation of the Western Electric LD-T2 SSB transmitters, now used as drivers.

The transmitter amplifiers chosen are the Westinghouse type 30-kW MS Linear Amplifier. The power amplifier tubes used are the Machlett ML-6423 coaxial terminal triodes. Extremely high standards are required of commercial SSB. Non-linearity of amplification introduces intermodulation components falling near and in the useful sideband. In multi-channel operation linearity is, if anything, even more important. The AT&T Long Lines Department operates a four-channel single-sideband system, with two 3000 cycle channels on each side of the partially suppressed carrier.

The new linear amplifiers satisfactorily meet the needs of the system. Signal to distortion ratio is 40 db or more for all inputs below —5 db at frequencies up to 23 megacycles, or for inputs below —8 db at higher frequencies, when referenced to full driving power. Output of the amplifier is monitored by a Balance Detector which senses any unbalanced voltages in the output circuit. As compared to equivalent power double-sideband equipment, each 30-kW transmitter is approximately eight times as effective. Further, by nature of the transmission, high power is only consumed when a signal is generated.

Automatic Tuning

To permit continuous optimum service, the American Telephone & Telegraph Company maintains 163 frequency or channel allotments. To permit nearly instantaneous use of this valuable "property," transmitter switching capabilities must be excellent. Since, during any service period, a

Figure 3 — View of new Transmitter Building showing 30-kW Linear Amplifier installation.

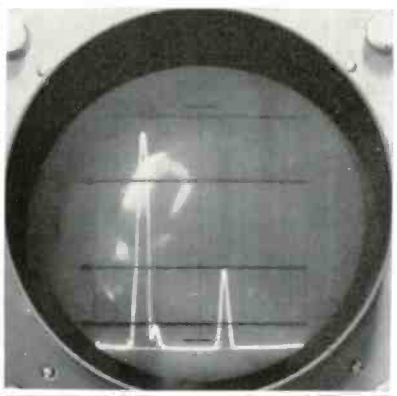


Figure 5 — Spectrum analyzer, used to regulate and control sideband interference. Pulse height difference indicates relative sideband and carrier strengths. Right pulse indicates that carrier is —20db. Carrier overlapping is indicated by pulse separation.

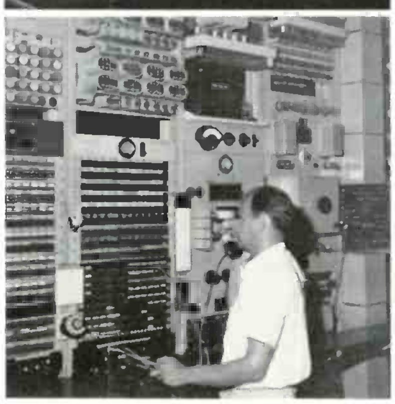


Figure 4 — Control Office: Monitor for the vast radiotelephone system operated at Lawrenceville. The control office maintains signal quality by tracking down interference, ordering frequency changes, changing antenna arrays.

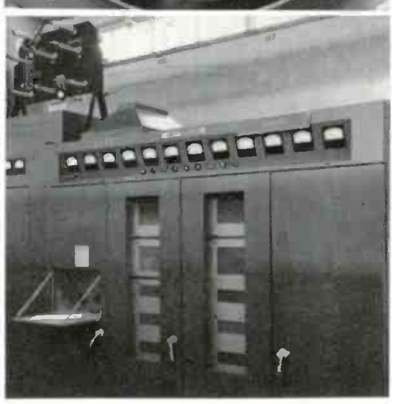


Figure 6 — Exterior of Westinghouse 30-kW MS Linear Amplifier employing two ML-6423 coaxial terminal triodes.

radiotelephone circuit merit may, because of atmospheric conditions or radio interference, become "hopeless" ("heard but unintelligible") or "poor" ("uncommercial") ready means must be at hand to remedy the situation. It may be feasible to patch in a different antenna or it may be necessary to change the frequency of transmission. The type MS Linear Amplifier provides, through a pushbutton operated servo system, a selection of 10 frequencies. (Output tuning over the entire frequency range is effected by two variable vacuum capacitors in parallel with two inductors. This arrangement eliminates switches or contacts carrying large r-f currents.) This new frequency selection system simplifies circuit supervision and correction.

ML-6423 — Coaxial Triodes

The ML-6423 coaxial triode* is used in the radio frequency power amplifier unit. The ML-6423 tubes were chosen because of their light weight, efficiency, and high-mu characteristics. In the SSB transmitter employing a grounded-grid circuit, a high-mu tube was preferred since the low bias requirement makes it possible to realize higher power gain. Grounded-grid circuitry offers good h-f stability, primarily because of the shielding afforded by the grid between the cathode (which is driven) and the plate. Input and output circuits are isolated and remain decoupled over a broad frequency band.

The aluminum fin radiator design of the ML-6423 is unique in the industry. Operating with the specially designed aluminum air distributor, the system provides cooling efficiency as well as considerable weight reductions, compared to standard forced-air-cooled types.

Conclusion

In the largest commercial overseas communications system — American Telephone & Telegraph, Long Lines Department, Machlett electron tubes play a dependable and useful role. In operation at most transmitting installations, and employed in force at the newest addition to the system, in Lawrenceville, "ML" coaxial terminal triode and other types have proven to be as valuable as they are widely used.

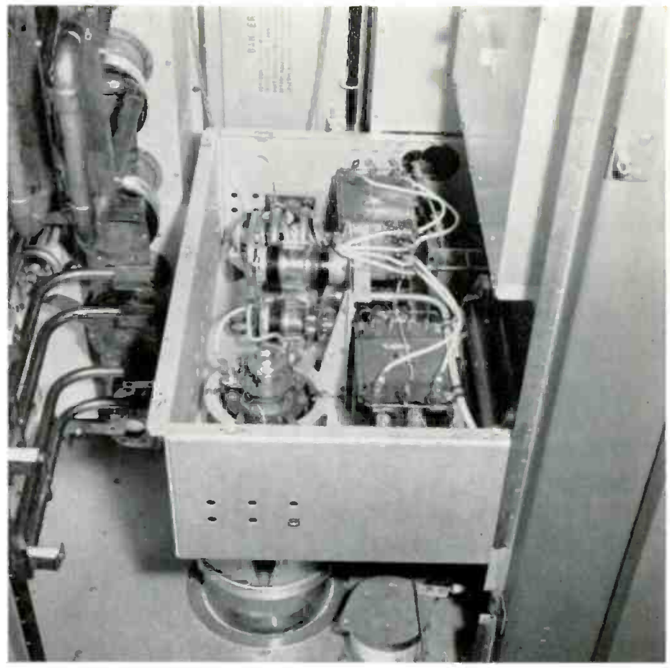
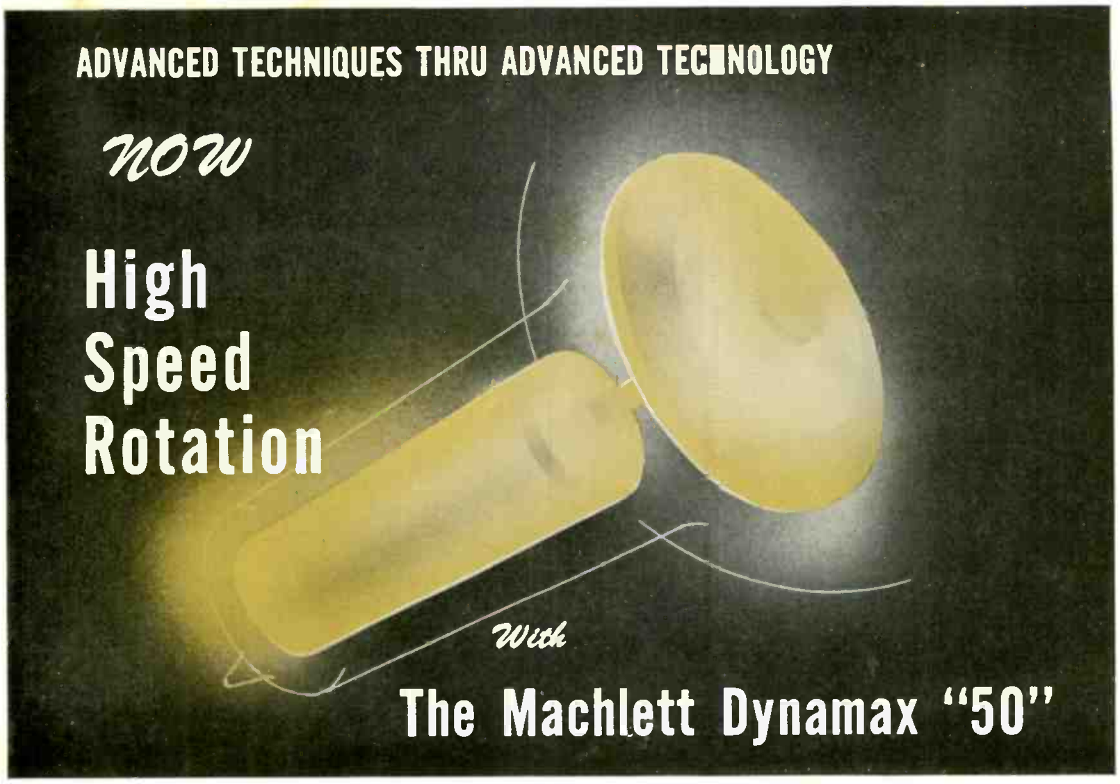


Figure 7 — View of radio-frequency unit of the MS Linear Amplifier showing installation of the ML-6423 tubes.

Figure 8 — ML-6423 — lightweight coaxial triode. This aluminum fin tube, anode dissipation, 12.5 kW, weighs only 15 pounds.

*For a discussion of other Machlett tubes used at Lawrenceville, see Cathode Press, Volume 16 No. 3, 1959, "Performance Gains, Increased Reliability for Radio Telephone Overseas Transmitters — through Machlett Coaxial Triodes." This is a discussion of transmitter conversion from ML-240B to ML-6426.



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