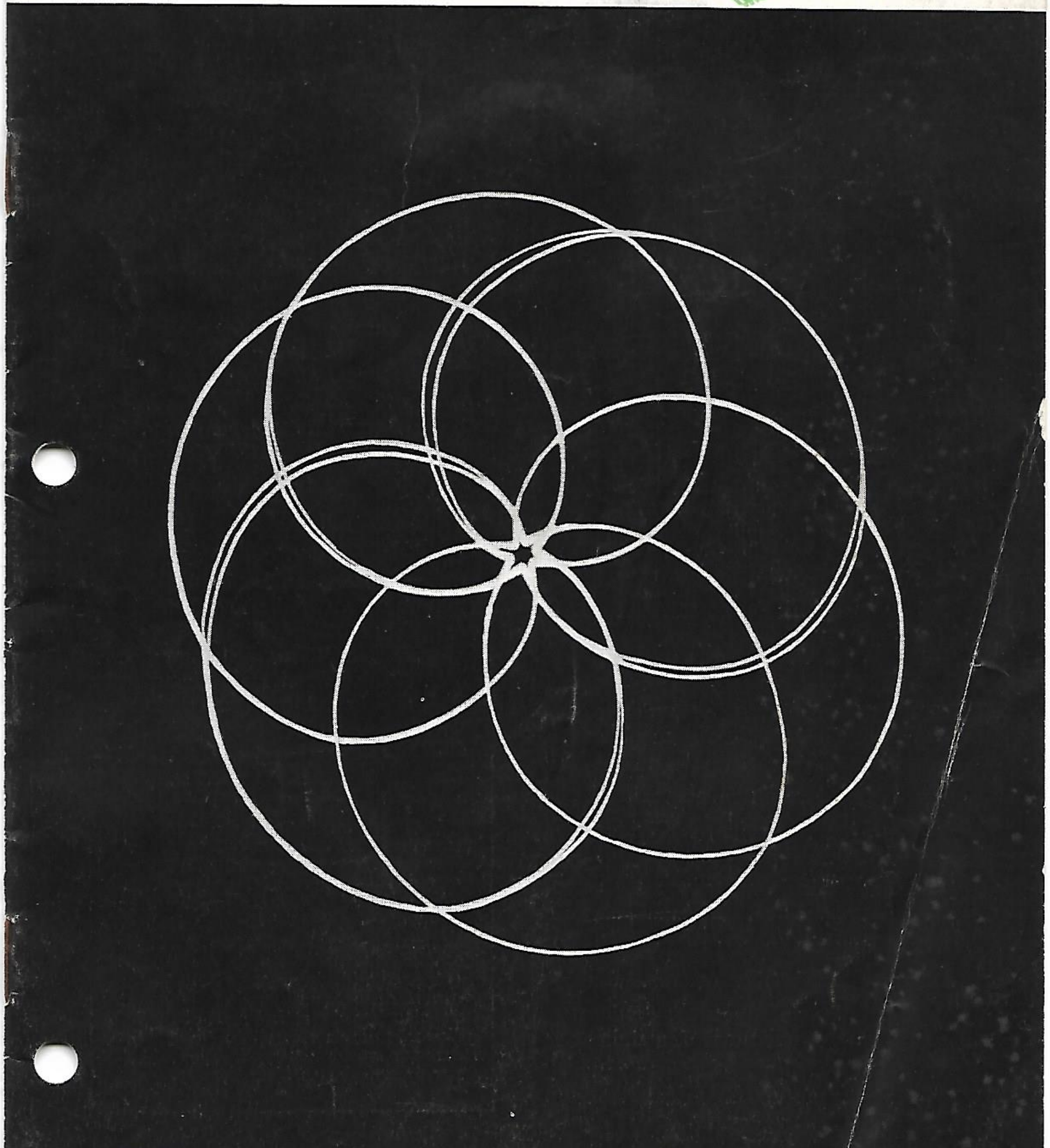
THE OSCILLOGRAPHER

Vol. 11, No. 3 JULY-SEPT., 1949



TYPE 314-A CAMERA SYNCHRONIZED AT 3000 RPM SEE PAGE 2

DU MONT ESTABLISHES NEW SERVICE DEPOTS

In order to make available more rapid and efficient service to users of Du Mont equipment, the Instrument Division of Allen B. Du Mont Laboratories, Inc. has instituted a new chain of service depots, located strategically throughout the United States and Canada, making virtually local service available in any part of the country. In a relatively short time, this new service network has proved itself invaluable by eliminating the need for long-distance shipment of instruments requiring maintenance and repair service.

These depots, nine in number, are staffed by trained personnel and are fully equipped to service Du Mont equipment with the exact materials specified by the designer, thus assuring the most prompt, satisfactory service possible.

Du Mont Service Depots are located at the following points:

Hill, J. T., 800 W .11th Street, Los Angeles 15, California.

Sterling, Seymour, 13331 Linwood Avenue, Detroit 6, Michigan.

Crossley, Alfred, 549 W. Randolph Street, Chicago 6, Illinois.

Waters, Robert A., 4 Gordon Street, Waltham, Massachusetts.

Engineering Products Company, 4905 Ross Avenue, Dallas 6, Texas.

Radio Communications Labs., P. O. Box 711 Municipal Airport, Atlanta, Georgia.

Vandal, William, 5229 28th Avenue, South; Minneapolis 17, Minnesota.

Powertronic Equipment, Ltd., 494 King Street, East; Toronto 2, Ontario, Canada.

Allen B. Du Mont Laboratories, Inc., 1000 Main Avenue, Clifton, New Jersey.

THE OSCILLOGRAPHER

A publication devoted exclusively to the cathode-ray oscillograph, providing the latest information on developments in equipment, applications, and techniques.

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1000 Main Ave.
Clifton, N. J.

Neil Uptegrove - Editor

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AN INVITATION

You are cordially invited to visit the Du Mont display at the National Electronics Conference to be held at the Edgewater Beach Hotel in Chicago, September 26, 27, 28. Du Mont will occupy booths 25 and 26 where it will demonstrate cathode-ray instruments and industrial-type cathode-ray tubes.

ON THE COVER

This pattern, photographed from the screen of the Du Mont Type 275-A Cathode-ray Polar Coordinate Indicator, represents the Du Mont Type 314-A Oscillograph-record Camera synchronized at 3000 rpm, or 25 inches of film per minute. This oscillogram was made by coupling the small two-phase generator (supplied with the Type 275-A) to the camera motor, and applying a 60-cycle test signal to the radial input of the indicator. Complete details of the procedure for synchronizing the Type 314-A are given on Page 7.

THE NEW DU MONT TYPE 314-A OSCILLOGRAPH-RECORD CAMERA

A Report on the Changes in this Versatile Instrument, Together with Notes on Extending its Utility

By H. P. Mansberg[1]

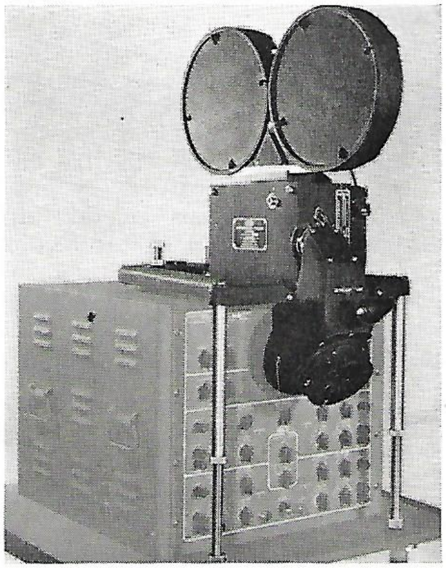


Figure 1. Type 314-A Oscillograph-record Camera with Type 2515 Magazine Adapter, mounted on a specially designed four-channel indicator.

THE OCTOBER-DECEMBER, 1948 issue of the *Oscillographer* described a new, versatile oscillograph-record camera, the Du Mont Type 314. This camera has recently been redesigned, both mechanically and electrically, effecting considerable improvement in construction and flexibility of operation.

Mechanical Changes — A great aid to those who had difficulty in loading the camera are two "swing-back" film pressure rollers which replace the pressure shoes of the Type 314. Figure 2 shows an internal view of the film compartment of the camera, with this new feature clearly visible. To load the Type 314-A, it is necessary only to push back the rollers, thread the film over the sprocket, and snap the rollers back into position. The construction is such that the camera-access door cannot be closed unless the rollers are snapped back into operating position. These rollers, in addition to simplifying loading, greatly reduce friction, permitting the use of recording paper at high speed.

Another useful new feature is a "tell-tale" film indicator which, by means of a rotating disk on the camera door, indicates whether the film is in motion. This device performs a function that the film footage indicator did not cover entirely, since the footage counter operates whether there is film in the camera or not. The "tell-tale" rotating disk is operated by friction between the film and the top film roller.

In order to provide smoother operation and to reduce friction in the camera gear assembly, greater rigidity has been given to the assembly mounting plate. This re-

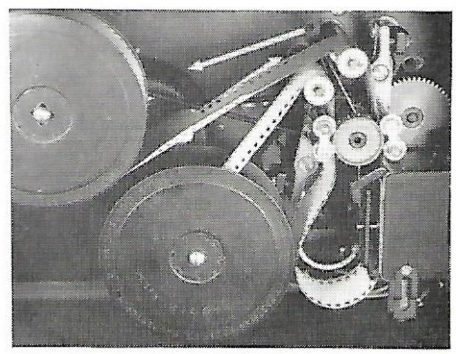


Figure 2. Internal view of film compartment. "Swing back" rollers at sprocket wheel simplify loading.

1 Engineer, Applications Engineering Section, Instrument Division, Allen B. Du Mont Laboratories, Inc.

sults in a lower operating temperature of the motor.

The number of points in the camera requiring lubrication has been reduced by the use of self-lubricating bearings wherever feasible.

The shape of the camera casting has been modified and an extra base support has been provided so that the camera can stand on a table or bench with better stability.

Electrical Changes — In the Type 314 Camera there was the possible danger of shock due to the fact that the filaments of the thyratron tube and the data card lights were operated from the same transformer winding. This shock could occur between the data card and electronic control chassis when an external ground was connected to the ground binding post.

The circuit of the Type 314-A has been changed so that a separate transformer winding is provided for the data card lights, as shown in the schematic diagram of Figure 3. The new circuit eliminates all possibility of shock from this source.

To minimize the waste of film normally occuring during slowing down when the camera is operated at high speeds, an electrical brake has been added. The brake is particularly useful when making a series of exposure runs at the top speed of sixty inches per second. At this speed, without the brake, the camera would normally coast to a stop after the motor switch was turned off, and thereby waste about 5½ feet of film. The same length of film is required to bring the camera up to full speed from a standstill. Obviously, not many runs could be made on a 100-foot roll of film when 11 feet of film per run are wasted. The electrical brake provided in the Type 314-A will stop the film with less than 17 inches of coasting. By utilizing the gear-shift knob coincidentally with the electrical brake, so that the film speed is reduced by sixty to one before the brake is applied, the film coasting can be reduced to about one inch. The brake is automatically applied by means of a relay

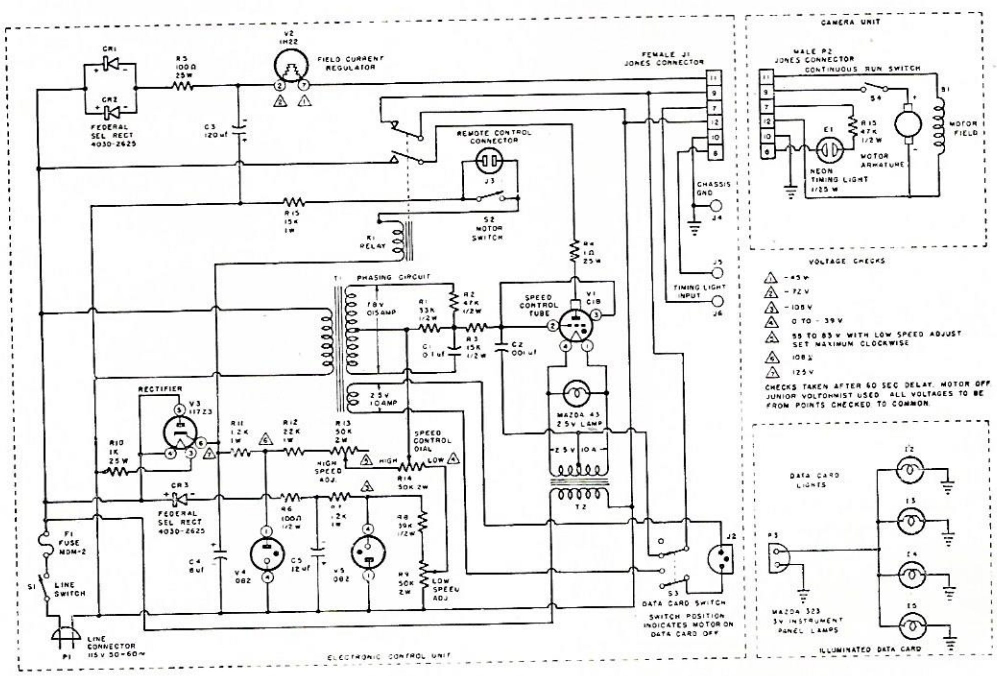


Figure 3. Schematic of the Du Mont Type 314-A Oscillograph-record Camera.

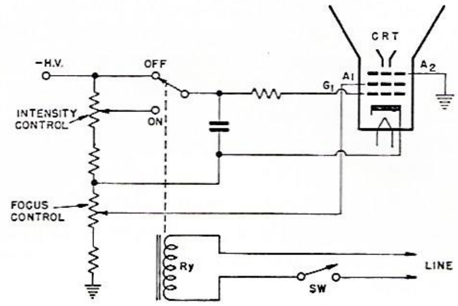


Figure 4. Circuit for relay control of cathode-ray tube beam.

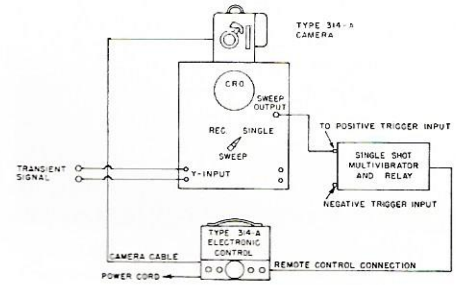


Figure 5. Block diagram of system for automatic transient recording.

in the electronic control, either when the motor switch is turned off, or when a remote control switch is operated (See Figure 3). The combination of electrical braking and remote control makes possible many new applications of the camera. For example, the camera may be used for remote monitoring of certain phenomena being displayed on an oscillograph located in an area inaccessible to personnel.

To provide more uniform firing of the speed-control thyratron, the resistor R_1 in the grid circuit, (see Figure 3) has been changed from 33,000 ohms to 10,000 ohms.

NOTES ON EXTENDING USEFULNESS OF TYPE 314-A CAMERA

Remote Control of Camera — It was mentioned above that remote control connections were available on the electronic control unit which could start the camera and operate the electrical brake. To make use of this feature, it is necessary only to connect a switch with an extension cord and plug to the remote control receptacle. Closing the switch will start the motor, and opening the switch will apply the brake. However, there are several possible arrangements whereby complete control of both the camera motor and of exposure can be obtained. The Rapax shutter with which the camera is equipped has provision for a cable release or synchronizer solenoid. A standard solenoid can be used for remote tripping of the shutter. Because the shutter is a double-action type requiring resetting each time, this method of providing remote exposure control is not always desirable.

A better method for the remote control of exposure is to provide a beam control relay in the grid or cathode circuit of the cathode-ray tube. One suggested circuit arrangement is shown in Figure 4. The relay biases the cathode-ray tube to cut-off and prevents fogging the film through the shutter which is left open. In this method, the film is advanced by means of a remote control switch and then the beam relay is operated to provide exposure.

More versatile circuit arrangements have been made with oscillographs having automatic beam control and single-sweep circuits.[2]

For example, a simple arrangement is

2 Du Mont Cathode-ray Oscillographs having beam control and single sweep circuits are the Types 247-A, 248-A, 250, 250-H, 256-D, 279, 280 and 280-A.

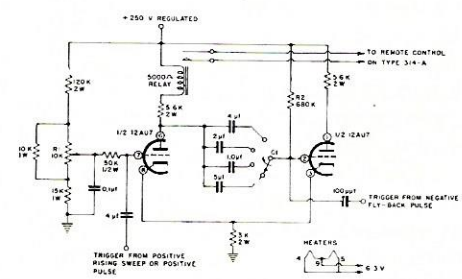


Figure 6. Schematic diagram of monostable multivibrator circuit.

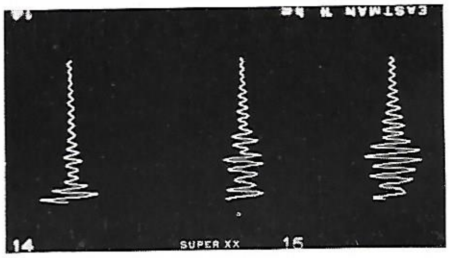


Figure 7. Film strip showing transients recorded by the automatic system.

to leave the camera shutter open and set the oscillograph to the triggered-sweep position, with the cathode-ray tube beam at cut-off. The phenomenon to be photographed triggers the sweep and turns on the cathode-ray tube beam to cause an exposure. The film is then advanced by operating the remote control switch.

TABLE I

"SYNCHRONOUS" SPEEDS AVAILABLE FROM TYPE 314-A WITH SLIGHT MODIFICATION

Film Speed in/min. or in/sec.	RPM
60	7200
55	6600
50	6000
45	5400
40	4800
35	4200
30	3600
25	3000
20	2400
15	1800
10	1200
5	600

NOTE — The low and high speed adjustments must be reset after changing C_3.

Automatic Transient Recorder — The above system may be made still more versatile by providing automatic film advancement for automatic transient recording. A block diagram of the suggested arrangement is shown in Figure 5. This system makes use of the sweep output signal available on many cathode-ray oscillographs to eliminate the need for manual film advancement. The sweep which is obtained when the transient occurs is used to trigger a single-shot multivibrator or thyratron circuit which closes a relay connected to the remote control receptacle. The film is advanced automatically at the end of each sweep and is in position for the next exposure. No attempt should be made to trigger on the camera motor at repetition rates greater than once per second, since the heavy starting current will cause the motor to over-heat, or the fuse to blow.

In Figure 6 a schematic diagram of a typical monostable multivibrator with relay is shown. The circuit constants are given for an experimental unit that was constructed at the Allen B. Du Mont Laboratories. The potentiometer R_1, controls the sensitivity and therefore determines the time at which the circuit will trigger. By carefully adjusting this control and the tension in the relay spring, the relay can be made to close exactly at the end of the sweep travel throughout the range of sweep speeds. The time during which the relay remains closed is determined by the time constant, R_2 C_1. The capacities selected by the switch in the diagram provide film-advance times of approximately 0.25, 0.5, 1.0, and 2.5 seconds. By setting the camera speed control at the appropriate value and selecting the proper RC time constant, any desired amount of film advance can be obtained.

The oscillograms of Figure 7 show the results that may be obtained. In recording these transients, the film was advanced automatically after each sweep.

For some applications it may be desirable to start the camera at the *beginning*

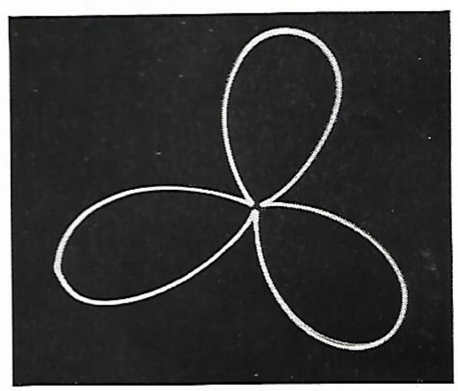


Figure 8. Polar diagram showing ratio of 3:1 of line frequency to motor speed.

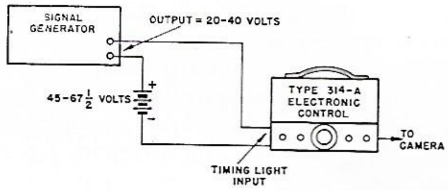


Figure 9. Method of biasing a signal generator to operate neon timing light from low signal voltages.

of each sweep. In this case, the sweep output is connected to the negative trigger input of the multivibrator so that the flyback pulse initiates the circuit. This will work only if the CRO single-sweep circuit is of the conventional gas triode-diode type where the spot is normally on the right side of the cathode-ray tube screen. For the oscillographs having other types of triggered sweep circuits, an external trigger must be provided to initiate the relay before the start of the transient. This method can be used also to set the film into continuous motion simultaneously with the occurrence of long-time phenomena.

By the use of standard timing switches combined with the systems described above, completely automatic recording systems may be set up which initiate the transient or phenomenon, and photograph it from the face of the cathode-ray tube without the necessity for operating personnel.

Synchronous Operation of Several Cameras — On occasion, certain applications require that several cameras be operated simultaneously at exactly the same speed. This can be accomplished effectively without the necessity of building synchronous motors into the cameras. The only change that is necessary is to replace the 120 microfarad field supply filter condenser C_3, (See schematic diagram of Figure 3.) with a four-microfarad electrolytic condenser. This introduces a small amount of sixty-cycle ripple into the field exciting voltage. The 60-cycle ripple causes the motor to tend to lock with line frequency at certain speeds with the tendency being strongest at 3600, 5400 and 7200 rpm. Since the camera mechanism is geared so that the film runs at speeds of one inch per minute or per second, for every 120 rpm of the motor, the corresponding film speeds are 30, 45 and 60 inches per minute or second. However, many other so-called synchronous speeds can be obtained with reliability. Table I gives the speeds at which cameras can be run synchronously. When the filter condenser C_3 is replaced (Caution! Do not turn on control with condenser removed) by the smaller value, the low, and high-speed adjustments, R_9 and R_{13}, in the electronic control must be re-adjusted so that the dial calibrations are correct. Once these adjustments are made and the speeds at which the cameras will tend to synchronize are determined, these synchronous speeds can be reproduced reliably with line-voltage variations of 95 to 125 volts.

The best way of determining the actual film speed is to measure the angular speed of the motor shaft or flywheel. This can be done either with a stroboscopic light source such as the General Radio Strobotac, or more accurately by means of a cathode-ray oscillograph. The Du Mont Type 275-A Cathode-ray Polar-Coordinate Indicator[3] is an ideal instrument for measuring rpm. A simple method of making this test is to couple the small two-phase generator supplied with the instrument to the motor shaft of the camera, thereby ob-

3 See THE OSCILLOGRAPHER, Vol. 9, No. 5; Sept.-Oct., 1947.

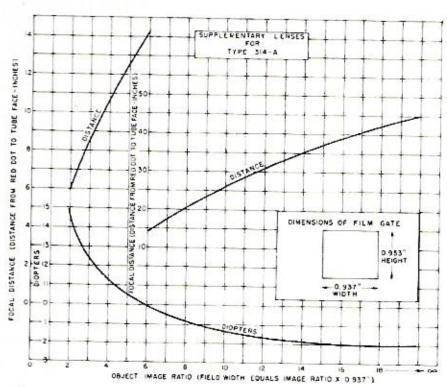


Figure 10. Graph for determining the proper supplementary lens for a given application.

taining a circular trace on the cathode-ray tube which has the same rotational speed as the motor. By switching the radial deflection selector knob to the test-signal position, a 60-cycle radial signal is obtained which results in a polar-coordinate pattern such as the oscillogram in Figure 8. The pattern shown illustrates a ratio of three to one. Since the 60-cycle test signal is equivalent to 3600 rpm, the motor speed in this case is 1200 rpm.

Timing Marker Light — For providing time markers on the film so that film speed can be checked from the recording, the neon timing marker light may be connected to a source of timing signal of about 70 to 120 volts. Binding posts on the rear of the electronic control chassis are provided for this purpose. However, when these binding posts are connected to the 60-cycle line, 120 cycle markers will be recorded due to the fact that both elements of the neon bulb light alternately on the positive and negative peaks. If 60-cycle markers are required, a rectifier placed in series with the neon bulb will cause only one element to glow. Also, the neon bulb may be rotated into such a position that one element is shadowed by the other so that every other marker will record with less density.

Often the sinewave or square-wave generator available has insufficient output voltage to ignite the neon light. By simply raising the average voltage level of these signal generators with a series battery of sufficient voltage, as in Figure 9, the neon bulb can be made to operate satisfactorily.

Use of Supplementary Lenses — The focal distance of the lens of the Type 314-A as used with the periscope or a tripod mount is 14¼ inches from the face of the cathode-ray tube. However, the camera can be used to obtain different image reduction ratios (6:1 is the normal object:image ratio) or to photograph smaller or larger fields such as in photocopying by the use of supplementary lenses. The supplementary lenses may be attached to the camera lens by standard adapter rings such as the Telek series. For the f/2.8 camera lens, use a series VI, 1½ inch diameter adapter, and for the f/1.5 camera lens, use a series VII, 1¾ inch diameter adapter. Depending upon the object:image ratio desired, either a positive or negative supplementary lens may be used. For object:image ratios greater than 6:1, negative supplementary lenses are used while for object:image ratios less than 6:1, positive supplementary lenses are used. Supplementary lenses up to +5 diopters and —2 diopters are commercially available. As a handy guide, the graph of Figure 10 may be used to determine the proper supplementary lens for a given application.

The graph shows the focal length of the supplementary lens (given in diopters) required for a given object:image ratio or field size, and the distance at which the object will be in focus. To obtain the number of diopters required for a specific object:image ratio or field size, project a vertical line from the object:image scale to the diopter curve, and a horizontal line from there to the positive or negative diopter scale. To obtain the focal distance for this case, project a vertical line from the diopter curve to the distance curve and from the point located on the distance curve, project a horizontal line to the distance scale. It will be noted that for most integral object:image ratios, the diopter lens required is not an integral number. Although lenses of any strength can be supplied by most optometrists, it is preferable to obtain a standard supplementary lens and to use the corresponding object: image ratio closest to the desired one; or, with a standard supplementary lens, the focus of the camera lens may be readjusted slightly to obtain the desired object: image ratio.

NEW ACCESSORIES —

Type 2515 ***Magazine Adapter***: When it is desired to make long recordings, the use of the Type 2515 is recommended. The Magazine Adapter is made for use with standard 1000-foot or 400-foot, 35 mm. magazines. It consists of an attaching bracket supporting a motor with a magnetic clutch for the magazine takeup drive. The complete assembly may be readliy attached to the Type 314-A Cam-

(*Continued on P.* 19)

A NEW LENS FOR PROJECTION OSCILLOGRAPHY

The new Type 2542 Projection Lens is designed to provide an efficient and inexpensive method for obtaining an enlarged image of the pattern that appears on a cathode-ray tube. Its design features certain mechanical advantages over the discontinued Du Mont Type 2088, which it now succeeds. To facilitate use of the Type 2542, the focusing mechanism has been simplified, provision has been made for rapid mounting and dismounting of the lens on the instrument, and safety stops have been added.

Optically, the Type 2542 Projection Lens is identical to the earlier Type 2088. It is a two element, symmetrical, objective lens with a relative aperture of f/3.3, and focal length of 7.7 inches. Overall length of the lens is approximately 8-½ inches, closed up, and 12 inches, fully extended. Its weight is 8-¾ pounds.

The Type 2542 Projection Lens may be mounted on any cathode-ray oscillograph employing a Type 5RP-A or Type 5XP-Cathode-ray Tube or other tube types capable of the extremely high light output required for satisfactory projection.

The design of the lens allows images appearing within an area three inches square to be projected to an area twelve feet square at the maximum focusing distance of approximately 30 feet. Complete darkening of the lecture or demonstration room is unnecessary in most cases.

Mounting — An important advantage of the Type 2542 over the Type 2088 is the ease with which the Type 2542 may be attached to an oscillograph. Provided the instrument is equipped with a Du Mont Type 2501 Bezel, the Type 2542 Projection Lens may be mounted in a matter of seconds by slipping it into the bezel and rotating a knob which causes a clamp-ring to expand against the inside of the bezel, locking the lens securely in place. The Type 2501 Bezel is supplied with most Du Mont cathode-ray oscillographs, and it can also be obtained separately from Du Mont.

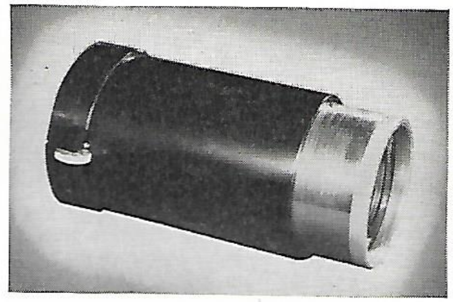


Figure 1. The new Du Mont Type 2542 Projection Lens.

The safety stops meet the edge of the bezel, and make direct contact between the tube screen and the lens barrel impossible. Thus they eliminate the danger of damaging the face of the cathode-ray tube during mounting.

Focusing — Mechanical focusing of the Type 2542 is accomplished simply by rotating the inner lens barrel. This method eliminates the need for coarse- and fine-focus adjustments.

To focus the oscillographic pattern on a projection screen, the pattern is first focused electrically. This is accomplished by looking through the attached lens, directly into the screen of the cathode-ray tube, and adjusting the intensity and focus controls of the instrument. The projected pattern then is observed, and the lens is focused as described above.

Image Polarity — It must be noted that, when any projection lens is used, the image on the projection screen will be reversed with respect to the pattern on the screen of the cathode-ray tube. When non-symetrical patterns are observed, or when it is desired to avoid this optical effect, it is necessary to reverse the leads to the deflection plates of the cathode-ray tube. With a reflective type projection screen, it is necessary to interchange only the vertical leads; with a transmissive screen, both vertical and horizontal leads must be transposed.

Dr. Allen B. Du Mont, President of Allen B. Du Mont Laboratories, Inc., was born in Brooklyn, New York, on January 29, 1901. In 1924 he received the degree of Electrical Engineer from Rensselaer Polytechnic Institute. From 1924 to 1928 he was employed by the Westinghouse Lamp Company as a development engineer engaged in the design and production of vacuum tubes. In 1928, Dr. Du Mont joined the De Forest Radio Company, where he served first as Chief Engineer, and then as Vice President.

In 1931, he organized Allen B. Du Mont Laboratories.

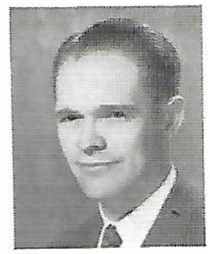
He was awarded the honorary degree of Doctor of Engineering by Rensselaer Polytechnic Institute in 1944 and by the Brooklyn Polytechnic Institute in 1949.

Dr. Du Mont has many patents to his credit, chiefly in the fields of cathode-ray tubes and television, and he is the author of many technical papers on these subjects.

Dr. Du Mont is a Fellow of the Institute of Radio Engineers, the American Institute of Electrical Engineers, and the Television Society. He is a member of Sigma Xi and is a director of the Television Broadcasters Association and the Radio Manufacturers' Association.

Leonard F. Cramer, Executive Vice-President of Allen B. Du Mont Laboratories, Inc., was born in Alden, New York, February 19, 1910. He was educated in public schools in Buffalo, N. Y. and graduated from Nichols Preparatory School, Buffalo. His first employment was with the Cadillac-La Salle Division of the General Motors Corporation where he received basic training. Later he was employed by the Shell Oil Company as a special investigator.

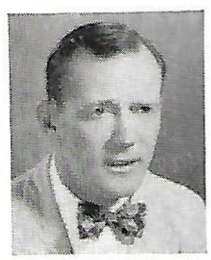
Mr. Cramer joined Du Mont Laboratories in 1935. He was elected Vice President in 1942. During his career with Du Mont Laboratories, he has participated in every phase of television and electronics, including engineering, production, sales, and broadcasting. He directed the operation of WABD, New York, and WTTG, Washington, D. C. and supervised the construction of Du Mont's Wanamaker Studio, the first major television studio to be constructed. Mr. Cramer now functions in the capacity of Executive Vice-President, but still devotes much of his time to problems concerned with the manufacture of receivers and electronic parts.



Dr. Thomas T. Goldsmith, Jr., Director of Research of Allen B. Du Mont Laboratories, Inc., was born on January 9, 1910. He received the B.S. degree in physics from Furman University in 1931 and his Ph.D. degree from Cornell University in 1936. During part of his time as a graduate student at Cornell, he was in charge of the electronics laboratory, directing both undergraduate and graduate work. During the year of 1936 Dr. Goldsmith served as a physicist at the Biophysics Laboratory. Since 1936, he has been associated with Allen B. Du Mont Laboratories, Inc. as Director of Research. In this capacity he has the responsibility for directing the advanced circuit research, the cathode-ray tube research and the patent activities for Du Mont.

Dr. Goldsmith is also a member of the Board of Directors, to which position he was elected several years ago. He is active in many industry committees regarding television standardization with Radio Manufacturers Association, Society of Motion Picture Engineers, Television Broadcasters Association and activities concerning the Federal Communications Commission.

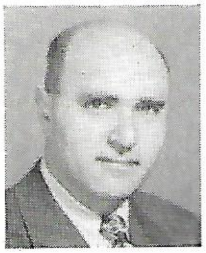
He is a member of Sigma Pi Sigma, Sigma Xi, American Physical Society, Radio Club of America, the Montclair Society of Engineers, and is a fellow of the Institute of Radio Engineers and the Society of Motion Picture Engineers.



C. Edwin Williams, General Manager of the Tube, Instrument, and Transmitter Divisions, received his Bachelor of Science degree from St. Lawrence University in 1925. From 1925 to 1933, he served on the editorial staff of several newspapers, and a large industrial relations publishing house. In 1933, he was appointed Secretary-Manager of the Passaic Area Industrial Chamber of Commerce of New Jersey and assisted in locating the many new industries which were entering that region.

He first made contact with the Allen B. Du Mont Laboratories, Inc. when he aided in the establishment of operations in what is now Plant I in Passaic, New Jersey. During the war, he served as department chief for the transformer industry on the War Production Board, assisting in the expansion of the Radio and Radar industries to meet wartime requirements.

Immediately after the war, he joined the Du Mont staff in his present capacity.



Rudolf Feldt, Head of the Instrument Division of Allen B. Du Mont Laboratories, Inc. was born at Berlin, Germany, on August 14, 1907. He studied at the Technische Hochschule in Berlin and received his Engineer's diploma in 1931. Between terms Mr. Feldt was employed by A. E. G., Telefunken, and C. Lorenz. From 1931 to 1933 he was employed as research engineer with Lignes Telegraphiques et Telephoniques S. A. at Conflans Ste. Honorine, France, where he was mainly engaged in problems connected with oscillographic applications on telephone cables and repeaters.

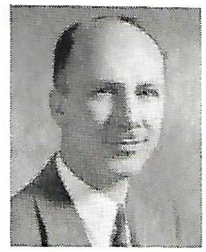
From 1934 to 1942, he was associated as chief engineer with the Radiophon Company in Paris, which served as distributors for American manufacturers, particularly the General Radio Company and Allen B. Du Mont Laboratories, Inc. This activity was interrupted by his enlistment in the French Army from the beginning of the war in 1939 until after the Armistice in 1940.

Mr. Feldt has been employed in this country by Du Mont Laboratories since 1942. He first served as a development engineer in connection with cathode-ray tube development, and before his appointment as head of the Instrument Division, he was chief engineer of the Applications Engineering Section.

Dr. P. S. Christaldi, Engineering Manager of the Instrument Division, was born on November 26, 1914, in Philadelphia, Pennsylvania. He graduated from the Rensselaer Polytechnic Institute in 1935 with the degree of Electrical Engineer, returning as a graduate fellow in physics, specializing in wave-guide communications. He received his Ph.D. from Rensselaer in 1938.

In that same year, Dr. Christaldi joined the Allen B. Du Mont Laboratories, Inc., as engineer engaged in the development of cathode-ray tubes and oscillographs. In 1941 he became Chief Engineer, and in 1947 he was appointed Engineering Manager of the Instrument Division.

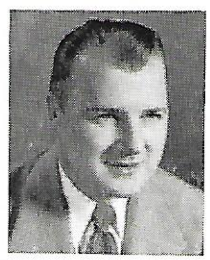
Dr. Christaldi is a member of Sigma Xi, the Radio Club of America, and is a Senior Member of the I.R.E.



G. Robert Mezger, Technical Sales Manager of Du Mont Laboratories, Inc., was born in New York City in 1914. He graduated from Rensselaer Polytechnic Institute in 1936 with the degree of Electrical Engineer. In 1936 he joined Allen B. Du Mont Laboratories, Inc. as a development engineer, a position he held until 1939, when he became Technical Sales Manager.

Mr. Mezger entered the Naval Reserve in 1933, and in 1941 was called to active duty, first at the U. S. Naval Academy, and subsequently at the David W. Taylor Model Basin, Washington, D. C. where he worked on electronic instrumentation problems arising in connection with the design and propulsion of ships, until 1944. During 1944 and 1945 Mr. Mezger was on the staff of the Electronics Maintenance School at Pearl Harbor, from which he was transferred to Naval Research Laboratory, Washington, D. C.

In 1945, Mr. Mezger returned to inactive duty in the Navy with the rank of Commander to resume his duties as Technical Sales Manager with Du Mont. He is a member of the I.R.E. and the A.I.E.E.



Mr. Robert R. Svozil, Manufacturing Manager of the Instrument Division, was born and educated in Garfield, New Jersey. He joined the Du Mont organization in 1941. Mr. Svozil's career illustrates the policy of Du Mont Laboratories of selecting executive personnel from the ranks wherever possible. Starting as an assemblyman, he rose through group leader, sub-foreman, supervision, and section manager, to be appointed manufacturing manager of the instrument division in 1946. Mr. Svozil's activities in the company also included establishing the methods department and the photographic department, and serving as manager of Du Mont's Plant #2 in Passaic, New Jersey, where he was in charge of radar contracts during the war.

THREAD TENSION TRANSDUCER

A Description, Electrical and Mechanical, of an Experimental Device for Determining Tension of Filaments

By Mark T. Nadir[1]

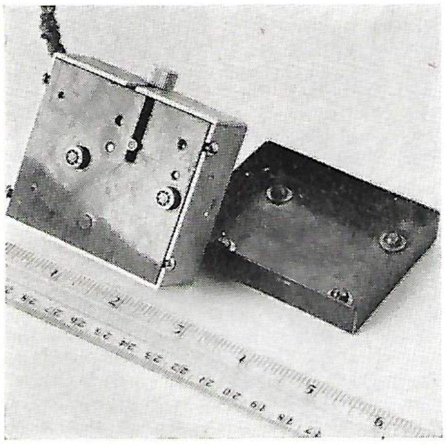


Figure 1. Thread tension transducer is a small, compact unit. Dust cover is shown at right.

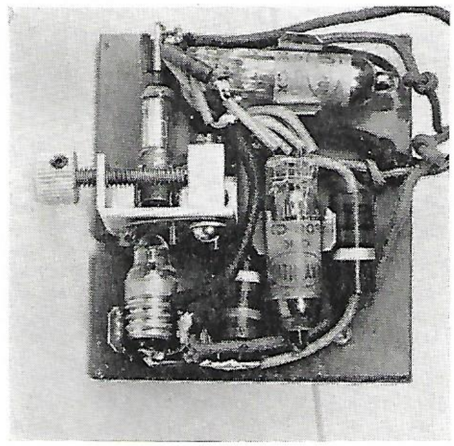


Figure 2. Internal view of the experimental thread tension transducer, showing arrangement of components.

During recent experimentation in the textile field[2], a thread tension pickup was devised which was used in conjunction with a Du Mont Type 250 Cathode-ray Oscillograph to observe and record the tension of the threads of the warp of the loom. Although no other experiments have been conducted, measurement of filament tension with this transducer need not be confined to the textile field.

The Type 250 Cathode-ray Oscillograph was used for these experiments because two types of tension present on the loom warp threads necessitated an instrument with d-c amplifiers. When the loom was at rest, the threads were under a constant, static tension; during actual operating conditions, dynamic variations introduced by the weaving process were superimposed on the static tension.

The experimental thread-tension pickup, shown in Figure 1, is a compact and rugged unit. This has obvious advantages in industry where, more often than not, limitation of space is an essential consideration. Also shown in Figure 1 are the two guide bearings and the rider bearing on which is loaded the thread whose tension is to be measured. The dust cover (at right in Figure 1) protects these bearings when the transducer is not in use. Figure 2 is an internal view of the tranducer showing the arrangement of the component parts of the unit.

Four essential elements comprise the thread-tension pickup; (1) a light source, (2) a mechanical-optical converter, (3) an optical-electrical converter, and (4) an amplifier circuit. A General Electric Type 222 pen-light bulb with a built-in lens acts as the light source and projects a cone of light over a fan-shaped window in the bracket supporting the mechanical-optical converter.

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1 Engineer, Applications Engineering Section, Instrument Division, Allen B. Du Mont Laboratories, Inc.

2 See, "Cathode-ray Oscillograph Applications in the Textile Field." OSCILLOGRAPHER, Vol. 10, No. 3; July-September, 1948.

The mechanical-optical converter consists of a vane, formed as a quadrant of light metal, which is soldered to the sensing arm, as shown in Figure 3. A ball bearing at one end of the sensing arm pivots the vane in front of the window. For the highest fidelity of response to variations of tensions, the sum of the masses of the vane, arm, and bearing is kept at a minimum. At the other end of the sensing arm, a force-fit bearing acts as a rider for the thread. A spring wire, soldered to the sensing arm, acts as a spring return. A good grade of piano wire insures precise return of the vane to its original position. A piece of clear acrylic plastic, made matt by rubbing it with sandpaper, is placed behind the window to diffuse the light reaching the optical-electrical converter, which is a type 1P42 phototube.

The amplifier circuit consists of one stage of amplification and a cathode follower; both stages employ subminiature triodes. Selection of rugged tubes avoids microphonic disturbances which would ordinarily result from excessive vibration of the loom shed machinery.

Operation — The first three components of the thread tension pickup serve the combined function of transducing thread tension into an equivalent electrical signal at the output of the phototube. The thread to be measured for tension is run under the two guide bearings and over the force fit bearing of the sensing arm. These bearings reduce the coefficient of friction and prevent lateral motion of the thread from producing ficticious indications. The position of the sensing arm, and consequently the position of the vane, is determined by the tension of the thread and the opposing tension of the return spring. The position of the vane, in turn, determines the amount of light which can pass from the source through the window to the phototube. The window is fan-shaped so that for every increment rotation of the vane an equivalent increment of light is permitted to reach the phototube. Once the beam has been transmitted, it is diffused

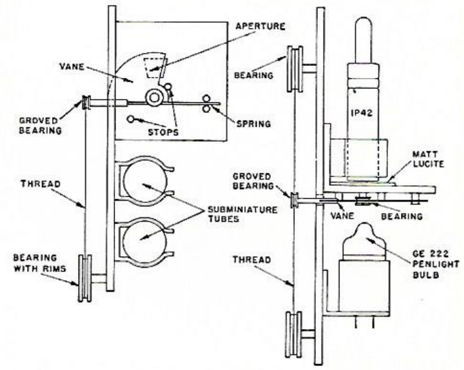
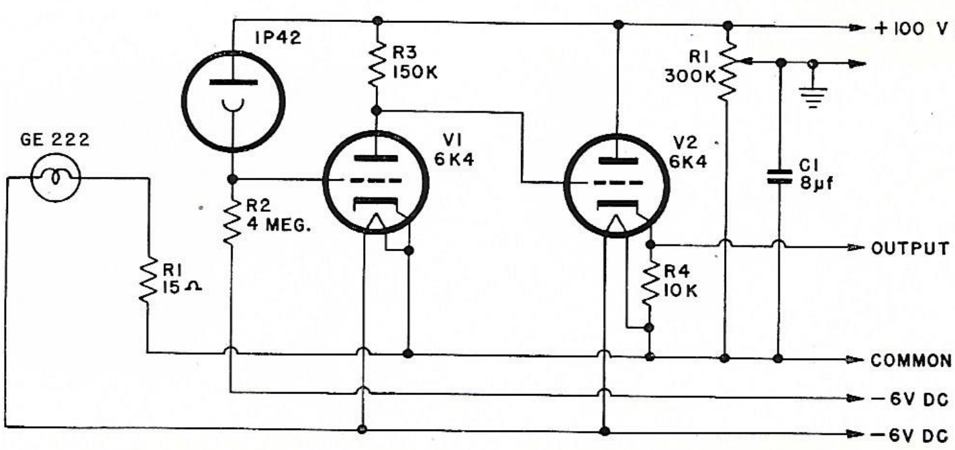


Figure 3. Diagramatic drawings of the thread tension transducer, from the bottom (Left) and the side (Right).

Figure 4. A schematic diagram of the amplifier of the pickup.



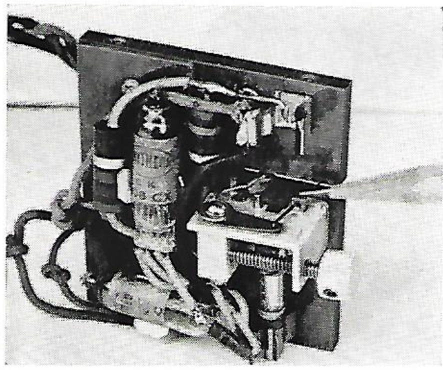


Figure 4. Internal view of pick-up. Pencil points toward light-controlling vane.

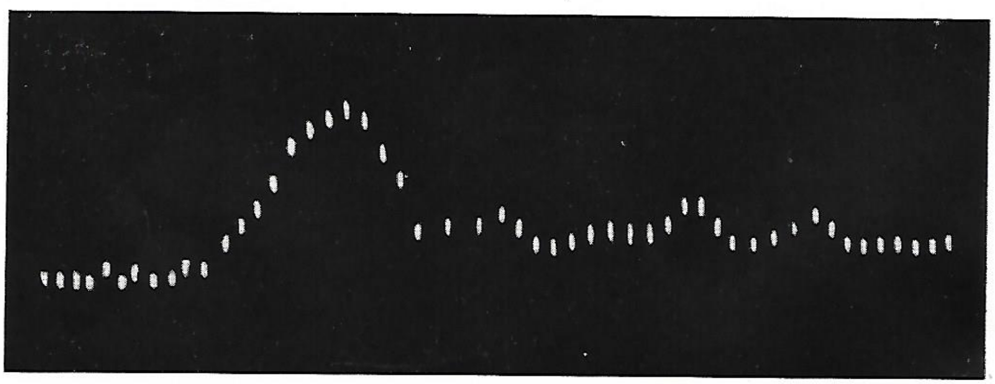
by the acrylic sheet, insuring even distribution of the light over the photosensitive area of the phototube. Otherwise, the output of the phototube wou'd not necessarily be proportional to the variations in light intensity.

Amplifier — As shown in Figure 4, the output of the phototube is directly coupled to the grid of the amplifier tube V_1. The amplified signal, which appears at the output of V_1, is then applied directly to the grid of the cathode-follower, V_2. The amplifier stage affords more than adequate sensitivity, and the low impedance of the cathode follower eliminates stray pickup. Output impedance of the transducer is in the neighborhood of 200 ohms. With no load on the input of the transducer, the potentiometer R_5 is adjusted for zero output. With a thread loaded on the transducer, the vane permits light to pass through the window to the detector. This causes an increase in the potential applied to the grid of V_1. The increased output is then applied to the grid of V_2, resulting in a change in potential across the cathode resistor of the cathode follower. The difference in voltage between the cathode of V_2 and the arm of R_5 will then represent the static tension of the thread. Dynamic tensions of the thread will cause rapid rise and fall of potential across the output circuit of the cathode follower and will appear as a-c superimposed on the static d-c signal.

Calibration — The transducer is connected to a power supply and an oscillograph with a fifteen-foot cable. It should be noted that R_5 is part of the power supply and not part of the transducer.

Once the potentiometer has been adjusted, the transducer may be calibrated. To calibrate, a known tension is applied to the pickup and the output is applied to the Y-axis of the oscillograph. The screen pattern is then observed and the deflection measured in volts by using the internal calibrating voltage of the Type 250. Using a series of known tensions, thread-tension can be plotted against voltage. Experience with this experimental thread tension pickup has shown that good reproducibility is obtained over the normal range of tensions encountered in the textile field.

Figure 5. An oscillogram made using the thread tension transducer, photographed from a Du Mont Type 250 Cathode-ray oscillograph. Trace is intensity-modulated to facilitate correlation of thread tension to the weaving cycle.



A Balanced-Input Adapter

By M. Maron[1]

[Editor's note: Frequently tests and measurements performed with the cathode-ray oscillograph may be greatly facilitated by the use of various accessory devices. Limiter and clipper circuits, delay lines, special sweep synchronizing and triggering circuits, voltage calibrators, balanced-input adapters, transducers, and attenuators are but a few examples. The following article is the second of a series describing the design and function of such accessory devices.]

The balanced-input adapter discussed here is designed to serve two major functions: (a) To make full use of both halves of a balanced signal in order to obtain a stable single-ended signal which may be applied to a standard oscillograph; and (b) to serve as a differential amplifier for studying the difference between two signals which are very nearly equal in amplitude.

Theory — In figure 1:

e_1 and e_2 are the two signals applied.

N is the ratio

$$\frac{R_1}{R_1 + R_2}$$

or the portion of the signal (e) which reaches the grid of V_1.

i_1 is the change in current through V_1.

i_2 is the change in current through V_2.

e is the change in voltages at the cathodes.

R_k is the cathode resistor.

R_L is the load resistor.

μ is the amplification factor of V_1 and V_2.

R_p is the plate resistance of V_1 and V_2.

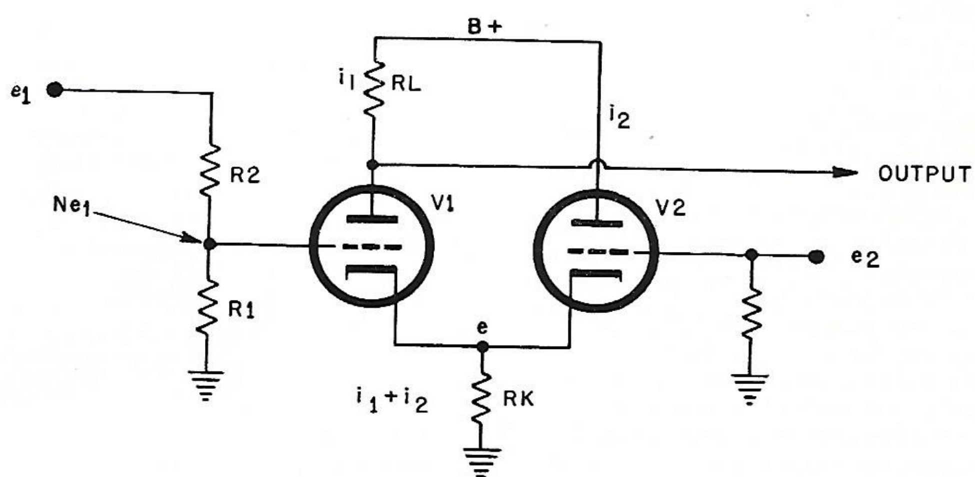
It can be seen that a signal applied to the grid of V_1 produces an output signal which is 180 degrees out of phase with respect to the output signal obtained from the same input applied to the grid of V_2. For ideal operation, there should be no output when e_1 equals e_2. This can be accomplished only if N has the proper value (see Figure 1). To solve for N, some mathematical manipulation is necessary:

By Kirchoff's Law

$$\mu(Ne_1 - e) = i_1R_L + i_1R_p + e \quad (1)$$

[1] Engineer, Instrument Engineering Section, Instrument Division, Allen B. Du Mont Laboratories, Inc.

Figure 1. A typical balanced-input adapter circuit.



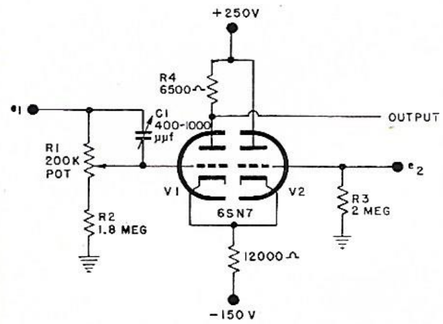


Figure 2. Schematic of an experimental balanced-input adapter.

$$\mu\,(e_2 - e) = i_2R_p + e \qquad (2)$$

where by Ohm's Law

$$e = (i_1 + i_2)R_k \qquad (3)$$

Since the output must be zero when e_1 equals e_2, i_1 must be zero at the time. On substituting e_1 for e_2 and zero for i_1 in equations (1), (2), and (3) above, the following relationships are obtained:

$$\mu(Ne_1 - e) = e \qquad (1')$$

$$\mu(e_1 - e) = i_2R_p + e \qquad (2')$$

$$e = i_2R_k \qquad (3')$$

Subtracting (2′) from (1′)

$$\mu(Ne_1 - e_1) = -i_2R_p \qquad (4)$$

Substituting (3′) in (1′)

$$\mu(Ne_1 - i_2R_k) = i_2R_k \qquad (5)$$

On simplifying (4) and (5)

$$\mu e_1(N - 1) = -i_2R_p \qquad (4')$$

$$\mu Ne_1 = i_2R_k(\mu + 1) \qquad (5')$$

Dividing (4′) by (5′)

$$\frac{N-1}{N} = \frac{-R_p}{R_k\,(\mu + 1)}$$

On Simplification

$$N = \frac{R_k\,(\mu + 1)}{R_p + R_k\,(\mu + 1)} \qquad (6)$$

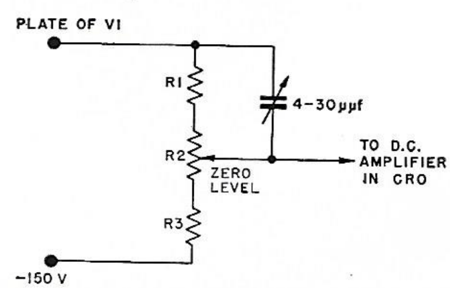
Practical Considerations — A typical input adapter circuit might consist of a twin triode, such as a Type 6SN7, with B+ at 250 volts, R_L at 6500 ohms and R_k at 570 ohms. The resulting value of N is approximately 16, and the gain of the circuit is about five. This circuit operates quite satisfactorily when the two input signals are balanced with respect to ground for dc as well as for ac.

If the signal to be observed, however, represents the small difference between two relatively large signals, or if the pair of balanced signals is not balanced for d-c level with respect to ground, serious distortion can be expected. With zero signal input, the cathodes of the two sections are normally at about 8 volts above ground. Therefore, if the average of e_1 and e_2 goes beyond 8 volts below ground, the cathode will not follow, for the cathode will be at ground potential after it has dropped 8 volts. Serious distortion will be observed even before this point.

Another factor to consider is saturation by positive signals, which also causes undesirable distortion. Since R_k is small, the cathodes will follow only about half of the increases in the average of e_1 and e_2, resulting in conduction by at least one of the two grids when the average level of e_1 and e_2 reaches about 16 volts.

To remedy these limitations, R_k is made very large and is returned to a negative voltage. If R_k is made about 12,000 ohms, and returned to a point of —150 volts, then with no signal input, the cathodes will have approximately the same level with respect to ground as they had with R_L at 6500 Ohms (see Figure 2). However, N will now be 0.97. Thus a greater portion of the signal can be utilized, and the gain of the system is raised from 5 to about 8.5. The cathodes are now capable of following as much as 50 volts negative or positive variation in average e_1-e_2 level with negligible distortion, since the cathode now can swing below ground for high negative signals and can follow without attenuation high positive variations in average e_1-e_2 level.

Figure 3. Circuit for d-c coupling of the balanced-input adapter to the oscillograph.



The total current that is drawn by the system will vary by only about 33% for average e_1-e_2 variation of 50 volts from ground.

For best results, a small trimmer potentiometer (R_1 of Figure 2) should be provided to Adjust N to the proper value. The adjustment is made by applying the same signal to the two sections of the adapter and adjusting N until no output is observed. The trimmer condenser, C_1, is connected from the input of the e_1 signal to the grid of V_1 for high-frequency compensation.

Once the circuit is properly adjusted, it may be used to examine any very small difference between two relatively large signals. For example, should two signals of nearly equal amplitude have peaks which reach values as high as 30 volts, and at no time differ by more than .05 volt, each may be fed to an input of the circuit of Figure 2, and the output of the circuit applied to an oscillograph, where the difference between the two signals will be accurately represented.

The output of the circuit of Figure 2 may be coupled to the oscillograph either through a capacitor or by means of a resistance divider, if d-c coupling is required (see Figure 3). The potentiometer, R_2, is adjusted so that with no signal applied, the output of the circuit is at zero level. It should be kept in mind that d-c coupling as shown in Figure 3 produces an attenuation of more than 2:1, and is subject to instability unless the supply voltages are well regulated.

It is sometimes desirable to precede the input to the adapter by a balanced, compensated input attenuator to make use of signals which would otherwise saturate either or both sections of the twin triode. Such an attenuator is shown in Figure 4. The input circuit should first be trimmed for the 1:1 position by employing the same signal for both e_1 and e_2, and adjusting R_1 for zero output. The 10:1 position is then adjusted to give no output with two equal signals applied by adjusting the potentiometer R_5. The circuit may now be used for examining the difference

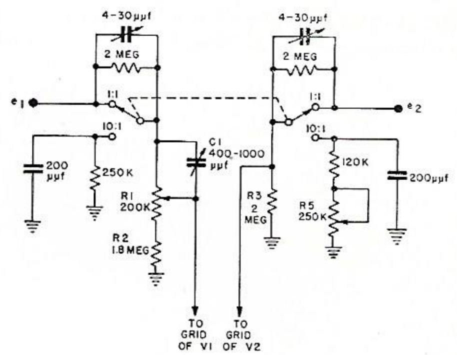


Figure 4. Schematic of attenuator for insertion ahead of the input of the adapter.

between two signals, of almost equal amplitude and form, whose peaks are as great as 300 volts above or below ground; or the circuit may be used to examine a difference as great as 60 volts between two signals (such as a pair of balanced signals). If, in a particular application, it is necessary to examine signals whose average level is considerably greater than 300 volts, or whose difference is much greater than 60 volts, additional positions (i. e. 100:1 or 1000:1) must be included in the input-attenuator switch.

The frequency response of the circuit shown in Figure 2 is good to approximately 200 kc, and it can be extended to approximately 4 mc by reducing R_4 to about 1000 ohms, and inserting a peaking choke in series with it. Although this modification will reduce the gain of the circuit by one third, there is usually no noticeable effect, since the output of the circuit is customarily fed to the high-gain, vertical amplifier of an oscillograph.

The alternate, balanced-input adapter shown in Figure 5 has several advantages over that of Figure 2. Since the balance adjustment here is located at the output of the cathode-follower stage, rather than at the input, the problem of supplying a balanced-input attenuator is somewhat simplified. Another advantage is the lower input capacitance resulting from the cathode-loaded input stage.

Applications — There are numerous applications in which the balanced-input adapters described above have proved themselves extremely valuable. A typical example is the study of ripple voltage across a swinging choke. Both ends of such a choke are generally either above or below ground, and therefore is is dangerous to connect an oscillograph across it, since such an arrangement would bring the cabinet of the instrument either above or below ground. However, with the balanced-input adapter, the voltages at the ends of the swinging choke are applied to the input of the circuit, and the output is a single-ended signal (one side grounded), which is the voltage across the swinging choke (amplified). This output signal is then suitable for application to the input of a standard cathode-ray oscillograph.

The balanced-input adapter may also be used for such operations as examining the voltage between the grid and cathode of the cathode-ray tube in a television receiver. The grid and cathode are both generally off ground, the actual d-c level being quite high in comparison to the small signal representing the voltage difference between the grid and cathode. This examination is accomplished in a manner similar to that mentioned above. The grid and cathode voltages are both coupled to the inputs of the balanced input adapter, and

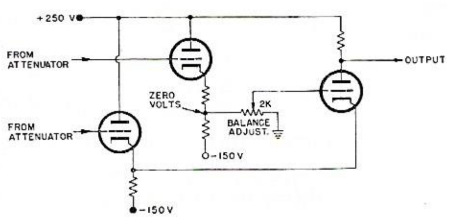


Figure 5. An alternate balanced-input adapter circuit.

the output (one side ground) may then be connected to the input of an oscillograph. The pattern on the screen of the oscillograph is an amplified representation of the voltage difference between the grid and cathode of the cathode-ray tube.

The balanced-input adapter also facilitates the study of phase inverters, by permitting the use of both parts of the balanced output signal of the phase inverter, to produce a single-ended output which may be applied to a standard cathode-ray oscillograph.

This circuit may be used as a wide band subtraction circuit in computers. Any two complex, pulse signal patterns may be applied at the inputs to the balanced-input adapter, and their difference (amplified) will appear at the output of the circuit. This difference then may be observed on a standard cathode-ray oscillograph.

A highly specialized, but very important, application for the balanced-input adapter is found in the medical field, for studying such physiological phenomena as nerve and muscle-action potentials.

Ordinarily, when nerve or muscle potentials are to be applied directly to the oscillograph, the patient must be enclosed in a shielded cage. Otherwise the 60-cycle "pick-up" would completely obscure the signal under study. A satisfactory shielded cage involves considerable expense, occupies a great deal of space, and is not sufficiently portable.

The balanced-input adapter minimizes the need for such a costly and cumbersome arrangement. The signal from the nerve or muscle is applied in balanced fashion to the two inputs of the input adapter. The output, which is fed to the vertical amplifier of the cathode-ray oscillograph, consists merely of the desired signal. The 60-cycle "pick-up" signals applied to the two inputs are exactly equal in amplitude (having a difference of zero) and therefore do not appear in the output signal of the differential amplifier.

The balanced-input adapter serves to illustrate how the range of application of the cathode-ray oscillograph can be vastly extended through the use of a simple accessory circuit. Additional information concerning the design and application of this and other accessory circuits and devices is available from the Instrument Division of Allen B. Du Mont Laboratories, Inc.

DU MONT SPECIAL PRODUCTS SECTION PRODUCES INDICATOR CONTAINING TWO CATHODE-RAY TUBES

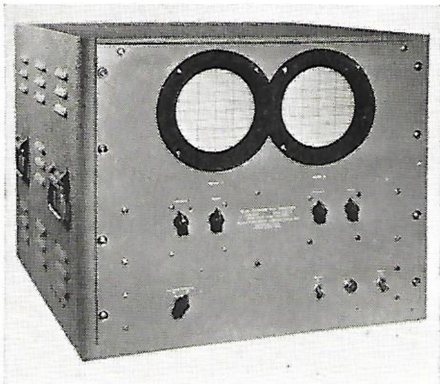


Figure 1. Specially designed indicator containing two independent cathode-ray tubes.

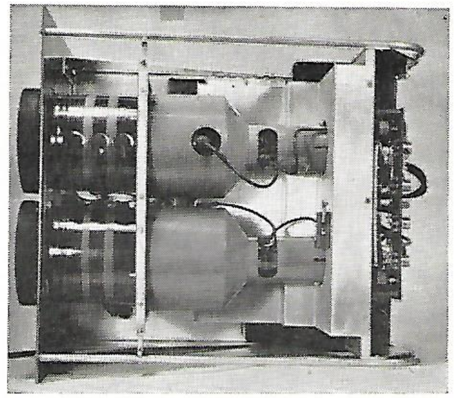


Figure 2. Top internal view of the indicator produced by the Special Products Section.

An unusual cathode-ray indicator which contains two cathode-ray tubes in a single housing has been developed by the Special Products Section of the Instrument Division, Allen B. Du Mont Laboratories, Inc.

This indicator, specially designed and manufactured for a large research laboratory, is intended for the simultaneous observation of both current and voltage characteristics of extremely high-speed transient pulses. It is similar to the Du Mont Type 281-A Cathode-ray Indicator, except that it contains two Type 5RP11-A (or 5XP11) High-voltage Tubes, mounted side by side. Otherwise, electrical specifications of the special instrument are similar to those of the Type 281-A Cathode-Ray Indicator.

The Du Mont Type 286-A High-voltage Power Supply is used to provide the high potential required to operate the two cathode-ray tubes. No modification of the power supply was needed.

This specially designed indicator illustrates the service of the Special Products Section. Should the requirements of a highly specialized application be beyond the capacities of commercially available instruments, the Special Products Section can modify existing equipment or design wholly new equipment.

Additional details concerning the facilities of the Special Products Section may be obtained by writing to the Instrument Division, Allen B. Du Mont Laboratories, Inc., 1000 Main Avenue, Clifton, N. J.

Type 314-A Camera

(*Continued from P.* 8)

era by removing the cover plate over the film opening in the top of the camera which is held in place by two screws. A light trap release mechanism is provided with the adapter for automatically opening the light traps in the magazine when the camera acccess door is closed.

Type 2516 *Universal Mount*: This mount is especially recommended for use with a 1000-foot magazine and Type 2515 Adapter. It consists of a sturdy horseshoe shaped casting supported at the front end by two long adjustable legs which rest on the table or work bench, and at the rear end, by two shorter adjustable shock mounted legs which rest on the oscillograph cabinet. This mount supports the camera and periscope independently of the oscillograph, thereby permitting the entire assembly to be moved readily from one instrument to another. All that is required is to readjust the legs to accomodate the height of any standard oscillograph. This mount eliminates the need for extra mounts when the camera is to be used interchangably on several instruments. The shock absorbing feet which are provided minimize the transmission of vibration from the camera motor to the oscillograph. Both the Universal Mount and the Magazine Adpater with magazine are shown mounted on a specially designed four-channel indicator in the photograph of Figure 1.

Type 2513 35 mm. ***Portable Film Dryer***: This drying rack consists of a light weight, collapsible, all metal, motor driven reel that is quickly set up for use. It is supplied with infra-red heat lamps to hasten drying time, and a film squeegee is provided to remove excess moisture from the film as it is wound onto the reel. When not in use, the Type 2514 may be folded up into a carrying case furnished with it.

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