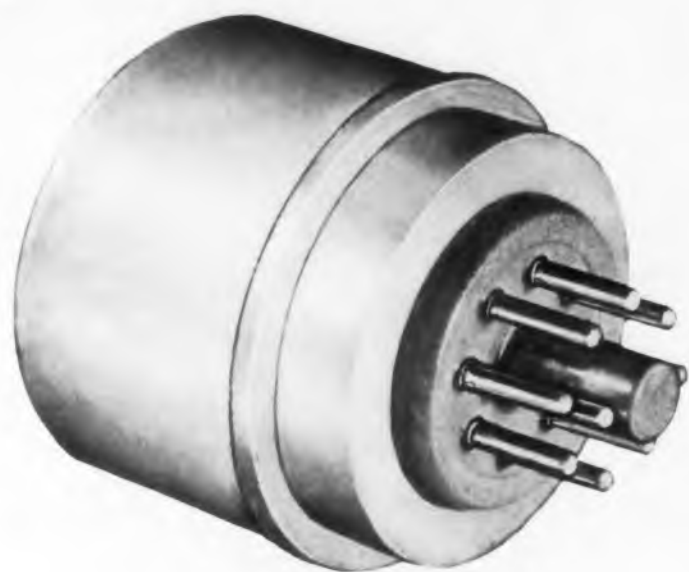


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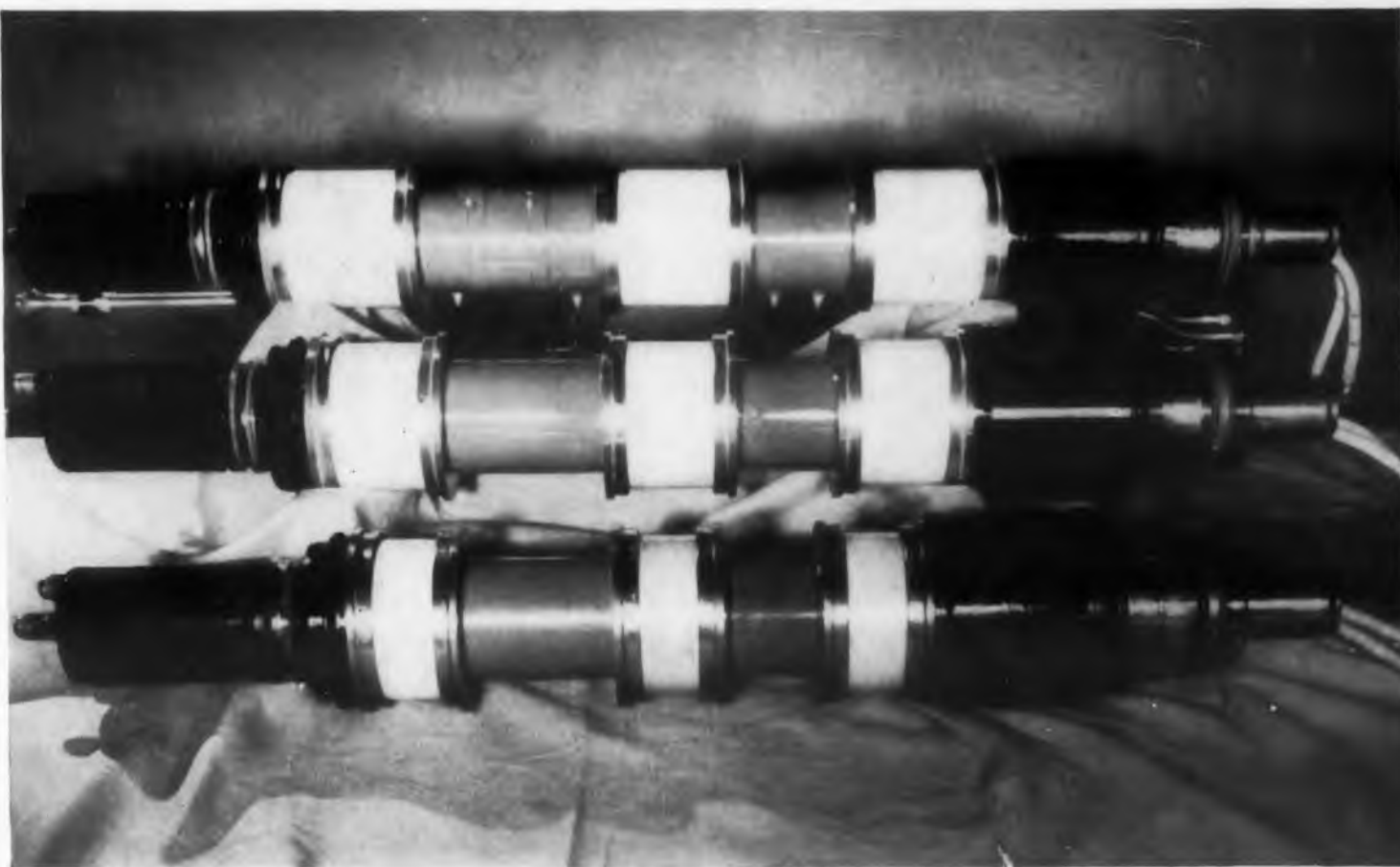


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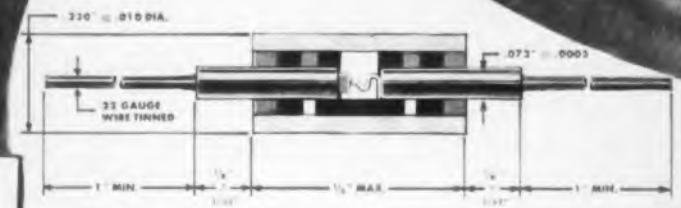
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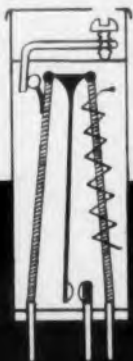
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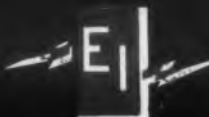


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Electronics Unlimited

Visitors to the recent Radio Engineering Show in New York City certainly must have been impressed with the growth of the electronic industries. The wide variety of products, new developments, and services displayed were enough to convince even the most conservative and the usually cautious skeptics that the industries have progressed and that their growth is unlimited.

We think that the man who deserves most of the credit for the progress made is the electronic design engineer. For regardless of the number and variety of research developments in the field and the financial backing available, progress is not made until he incorporates these new ideas into new and better products.

The electronic design engineer is the man through whom all developments must filter before they become practical realities. All one has to do to gauge the present practical status of the electronic industries is to see what designers are doing with presently available information.

ELECTRONIC DESIGN will continue to see that designers are kept informed on the latest developments that can help make their task easier, more efficient, and more productive.

Some of the things we saw at the Radio Engineering Show indicate that real progress has been made. Some of the papers we heard at the many technical sessions indicate that designers have many new ideas to exploit, and that the future of the industries is truly unlimited.

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Engineering Review . . .

Closed Circuit TV Cameras . . . Two new TV cameras which should do much to popularize the use of closed circuit TV systems in industry, laboratories, and even in the home, were demonstrated at the recent Radio Engineering Show in New York City. Both units use an ordinary home TV receiver as the viewing apparatus in the closed circuit system.

One of these units, developed by the RCA laboratories, is a simplified camera containing a vidicon pickup tube and a 3-tube signal amplifier. It is about the size and weight of a 16mm motion picture camera. All power requirements and the signal pulses which control the scanning action of the camera are taken from the receivers through adapters placed between the tubes and their sockets.

The other camera, developed by the Allen B. Du Mont Laboratories, is known as the "Tele-Eye". It is actually a complete camera chain with all associated power, synchronizing, r-f, monitoring, and output equipment, plus the camera itself contained in a small camera head about the size of a portable typewriter case. It can be used with any standard v-h-f TV receiver by simply plugging the unit into a standard wall socket and attaching the camera's output cable to the TV receiver.

DME Aids Jet Fuel Problem . . . According to Rear Admiral W. E. Cleaves, U. S. N. (ret.) of Bendix Aviation Corp., a new electronic navigational system known as airborne distance measuring equipment (DME), should help save jet aircraft fuel. This equipment gives the pilot a continuous instrument panel measurement between the aircraft and ground beacons. It permits him to be very accurate in timing his descent and helps him make a successful landing on the first try, thereby saving the fuel that would be wasted if he had to circle the field for another landing attempt.

Electrostatic Ignition System . . . An American manufacturer (Heckethorn Mfg. & Supply Co., Littleton, Colo.) has been licensed to manufacture and distribute a French electrostatic ignition system for use on automobile, stationary, and marine engines. The small, self-contained generator-distributor is tamperproof, requires no adjustment or timing throughout its entire life, and eliminates coils, capacitors, and breaker points. No interference to

radio, TV, or radar is created with the new system, and no current is required from the battery.

Dictating Machine . . . A new, low-cost, dictating machine uses page-size "talking paper" instead of discs, belts, or tape and is capable of recording up to 2500 words per sheet. Known as the "Dictorel", it combines recording and transcribing in a single portable unit which features instantaneous backspacing, immediate split-word correction, and high fidelity sound reproduction. The device, which uses sensitized sheets of "Dictogram" paper, is made by Pentron Industries, Inc. of Chicago, Ill. A single sheet will take from 10 to 12 average business letters and can be erased either manually or automatically.

Computers vs. Meter Readers . . . Investigation of the possibility of utilizing telemetering to record electrical consumption without sending meter readers into the field indicates that this system is not economically feasible, according to an AIEE technical paper by J. R. Macintyre (General Electric Co., Lynn, Mass.) and W. C. Israel (Detroit Edison Co.). New telemetering methods and possibly new metering means are needed.

The economics of using a portable computer to calculate the electric bill right at the customers' premises also was investigated. The study showed that use of such a portable bill computer would result in cost increases and therefore was undesirable.

Noncritical Magnetic Material . . . An interesting new "soft" magnetic material made of noncritical metals has been developed in the Naval Ordnance Laboratory's Magnetism Division, White Oak, Silver Spring, Md. Known as "16-Alfenol", it is composed of 16% aluminum and 84% iron.

Though the alloy was used by the Japanese during World War II, it could not be rolled in sheets efficiently because of its extreme hardness and brittleness. Under the leadership of J. F. Nachman, metallurgists at NOL found a way of cold rolling the alloy at 575°C and formed it into thin tapes, only a few thousandths of an inch thick. These tapes are tough, ductile, light in weight, and they have isotropic magnetic properties and a high bulk resistivity. In addition, the tape "grows" its own insulating layer when rolled, a highly desirable characteristic.

Semiconductor Lectures . . . A series of four lectures on the general theory of semiconductors will be presented at the Polytechnic Institute of Brooklyn (99 Livingston St., Brooklyn, N. Y.) by Dr. H. K. Henisch of the University of Reading (England). Sponsored by Sylvania Electric Products, Inc., Bay-side, N. Y., the lectures will take place in the evening on four successive Thursdays (April 23 and 30, and May 7 and 14), and they are open without fee to all interested persons.

Ultrasound in Diathermy . . . A comparison and analysis of heating deep tissue by means of high frequency sound waves and by electromagnetic heating has indicated that the former is superior. High frequency sound can be used for many of the same applications as electromagnetic diathermy. However, the wavelength of the sound waves in their useful range is considerably smaller than that of electromagnetic waves, even in the shortest permissible length. This makes it possible to beam the sound waves much more sharply and permits efficient irradiation.

Improved Power Line Carrier Equipment . . . A redesign program on existing power line carrier current apparatus has resulted in new equipment which features flexibility as its outstanding characteristic. The new system contains frequency shift, relaying, and communications equipment. The frequency shift portion is designed for operation with impulse rate, duration, and frequency type telemetering; for load and supervisory control; for remote and transfer trip; and teletype.

The relaying equipment is suitable for both distance and phase comparison relaying, with push-to-talk communications and other auxiliary functions. The communications equipment is suitable for manual and automatic switched single frequency operation, and two-frequency duplex operations, with both code bell and dial signalling. New types of line coupling tuners and tone equipment also are employed.

"Heat Pulse" Testing Technique . . . A testing technique in which a rapid "heat pulse" is applied to produce the same effects as those obtained by a long heating run is described in a report called, "A New Instrument for the Rapid Measurements of Capacitor Temperature Coefficients". Available from the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. at \$1.00 per copy, the (Naval Research Laboratory) report presents the theory underlying the techniques; describes the equipment developed for applying the new technique and its method of operation; and correlates the technique with earlier, more fundamental methods.

MANY electronic design developments have had a profound effect upon human performance. Some have eliminated various human operations so that new and formerly impossible jobs can be done. Others have enabled jobs to be done faster, more accurately, and in some instances more cheaply. What has frequently happened, however, is that while certain problems have been eliminated by electronic equipment, others have been created. The remaining jobs in the system, whether operational or maintenance, often become more complicated.

Electronic digital computers, for example, eliminate tedious hand computations, but create the "bottle-neck" job of programming. Newer electronic systems have speeded-up point-to-point transmission and display of information immeasurably but have also increased operator training time approximately sixfold. Often faster and more accurate operation is required to keep up with the high performance characteristics of new equipment. There may be more instruments to watch and more controls to operate. Of equal importance is the fact that higher premium on speed usually means a higher cost per error.

Unfortunately, while electronic improvements have been many, human beings remain essentially unchanged. With increasing frequency the new demands placed upon humans exceed their psychological and physiological capacities. One upshot of this situation has been the development of the new science of human engineering or engineering psychology. It is a composite science, drawing from psychology, physiology, and anthropology as well as from the various branches of formal engineering. This new ally science can make a valuable contribution to electronic design. So far, somewhere in all equipment systems one or more humans serves in an operating or maintenance capacity. As long as this situation exists designers must consider humans as elements that must be evaluated, stated and specified into system designs.

Unfortunately the human is frequently forgotten or inadequately considered. When this happens, system performance, sales appeal, and customer satisfaction are unfavorably affected. Specific illustrations of such occurrences, and how they were or might be prevented, are presented in the following experiences of Dunlap and Associates, Inc., a company that specializes in human engineering.

Radar antenna control unit

An antenna control unit obstructed the visibility of a radar control panel. The amount of obstruction depended upon the distance of the operator's eyes from the scope and the part of the scope under observation. When watching the scope at a distance of 27-1/2", the operator was unable to see the top row of switches. With eyes 16-1/2" from the scope, he was unable to see these switches and two control knobs on either end of the row. When 15" from the scope,

he couldn't see any of the controls, and had to make gross head and body adjustments to view them.

The job for which this radar was designed required frequent and quick reference to the control panel. Consequently, the operation was slowed down and operators became unduly fatigued. By reducing the thickness of the antenna control unit to 2", which

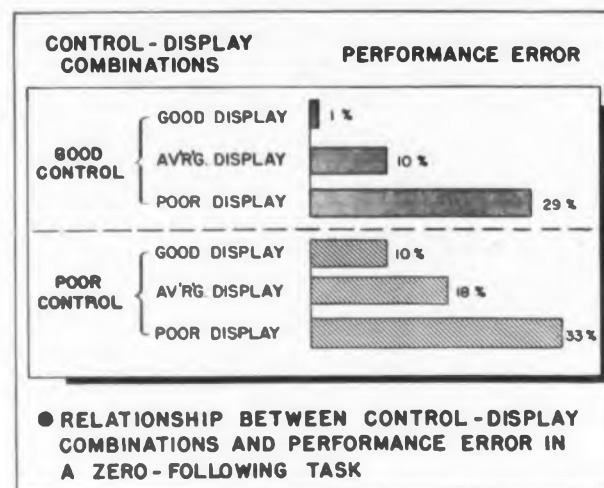


Fig. 1. Performance error of 18 operators.

was possible and cheap from an engineering standpoint, the greatest head and body movement required was 3". By reducing the unit's thickness to 1", which was also possible but more expensive, the operator with eyes 11" from the scope could view all controls without moving at all. An alternative partial solution was to use a tactual shape-code for the controls.

Radar scale

Another radar evaluation found the azimuth scale printed on the scope cover glass in numerals so numerous and large that the effective area of the screen was reduced. Having the scale printed on the cover glass resulted in parallax between scale and tube large enough to cause non-permissible reading errors. These reading errors were effectively reduced by printing the scale directly on the tube. The effective screen area was increased by reducing the size of the numerals and recommendations were made for

further study to determine minimum numeral size for accurate azimuth readings.

Testing device

An electronic testing device designed for use by factory inspectors was unsatisfactory even for engineers. It had seven different types of scales on 20 instrument dials. Not only was there a lack of overall standardization but there was no standardization for any one sequence of scales that had to be read. Preliminary study showed that only one engineer in 40 tested read all 20 settings correctly. Overall standardization alone increased this figure from one to 20 and by improving the legibility of the standard scale, 35 out of the 40 read all 20 settings correctly.

Switches

Switch position, arrangement, direction, and tactual resistance is a recurring human engineering problem in electronic design. Switches are often necessarily numerous on electronic consoles and frequently must be operated quickly without looking. One console had nine switches relating to nine different control knobs. There was no logical relationship between the switches and the controls they operated. Both switches and control knobs appeared to have been placed in random fashion on the control panel. A study of the operator's task showed that some of the switches were operated more frequently than others and that there was a functional sequencing of the switching operations. The panel was modified to arrange and label the control knobs in order of use frequency and to place the related switches so that they corresponded to this arrangement. This modification was cheaply accomplished and reduced operating time and error considerably.

Control-display combinations

Fig. 1 shows the percentage of errors for 18 operators who performed 16 tracking problems under six conditions. These conditions consisted of various combinations of "good", "average", and "poor" displays with "good", "average", and "poor" controls. The operator was required to make a moving pointer on a display return to zero by manipulating either a

joy stick or two handwheels to accomplish the task.

The comparison is quite revealing. Note also in Fig. 2, that it took five times as long to respond to the *poor* control-*poor* display combination as to the combination of *good* controls and *good* displays. These results indicate a natural or expected relationship between controls and indicators for best performance to occur.

Television consoles

The design of television consoles has challenged and intrigued the human engineer. Questions such as the effect of screen frame design on the overall impression which the viewer receives, the optimal number and kind of adjustments the viewer should be given the opportunity of making, and a host of others dealing with consumer appeal and satisfaction might be asked him. Questions such as these are important in this competitive industry and profit increases or decreases might hinge on their answers.

One simple example was a situation of excessive customer complaints about the difficulty of making satisfactory contrast-brightness and horizontal-vertical hold adjustments. Maintenance men were answering the complaints but could find no reason for the difficulty. They had no trouble at all in making the adjustments satisfactorily. In this particular set the knobs controlling brightness and contrast were placed one inside the other as were the controls for brightness and vertical hold. Like many other sets the inner knob controlled one dimension, the outer the other. The complaint was that when the user adjusted one dimension the other would go out.

Observation showed that when the maintenance man attempted the adjustment he used two hands, one to make adjustment, the other to keep the additional ring in place. The customer, however, preferred to use one hand. Since there was excessive friction between the two rings they wouldn't turn independently. Brightness would change when the

contrast knob was turned and vice versa. The same was true for the horizontal and vertical hold controls.

Hearing aid

Electronic equipment doesn't have to be complicated for human performance to be hampered. Here is a simple illustration—the use of a hearing aid by an elderly person. The set itself was small, light, and attractive. However, several shortcomings were noted.

For example, the help of a person other than the wearer was required to attach the device neatly to the wearer's dress. The volume and pitch controls, which had to be adjusted by the thumbs, had notches so small that movements and accurate adjustments were extremely difficult. Also the numerals on the controls were too small to be read without considerable difficulty. The on-off switch gave no direct tactual or visual indication of being on or off. To determine that the switch was off the user either had to listen for a click, or push the control several times to know that it could be pushed no further. The ear piece was well designed to fit comfortably, but considerable fumbling was necessary to insert it properly.

Another difficulty noted was that, while the instructions advised removal of the battery every night, there was no latch or handle or pull-apart feature for reaching the battery. It was actually necessary to pry open the door with a finger nail. Finally, the mike-telephone switch was so small that it was extremely difficult for the average person to operate it. This set had many shortcomings for persons of average age.

These shortcomings assume still greater importance when it is remembered that hearing aids are used more by older persons.

System Performance, Cost and Value

Commonly used human engineering criteria, such as speed, accuracy, legibility, comfort, etc. can be misleading. Their use can actually lead to worse sys-

tems in some cases. For this reason instead of starting directly on the improvement of individual system components human engineering is tending more and more to end rather than start with such activity. Man-equipment systems do not have the function of producing speed, or accuracy, or comfort. The true function of a system is to shoot down enemy bombers, or to destroy enemy shipping, or to produce automobiles, or to provide electric power to a community, and so on. The way in which speed, accuracy, and other such criteria contribute to the true goal of the man-equipment system is generally complex and often obscure.

As a matter of fact, such criteria can be antagonistic to one another. For example, seven-figure log tables can be read much more accurately than four-figured ones. But it takes longer to do it. If a cursor is provided for a radar scope the accuracy with which the operator can read range and bearing will be increased, but it will take him longer to do it. In this case, obtaining more accurate information may result in less accurate system response, especially if the plane being tracked is maneuvering to avoid missiles. In short, very careful thinking about the criterion against which to judge hoped for improvements must precede any human engineering or other system change, to obtain desired results.

Fig. 3 gives a generalized version of what this means. The horizontal axis represents system performance, that is, what the system actually does. The vertical axis represents increasing degrees of value and cost, namely, what system performance actually accomplishes, such as amount of enemy shipping destroyed, and the cost of doing it. What is really desired is not maximizing value or cost, or system performance, but optimizing net value, that is, value minus cost.

When such an analysis has been completed, human engineering can be then applied where it is most needed with previous knowledge of its potentiality for improving net value.

Conclusion

The work of design engineers, both electronic and "human", will be more efficient if their efforts are coordinated early in the design process. Modification of prototype equipment is much cheaper than modification after manufacturing facilities have been geared for production. It is cheaper yet, when made in the blueprint stage.

Don't forget the human element—whether it is the operator or the maintenance man. He is still with us, and will be for some time. As long as he is part of a system, his needs, his capacities, and his limitations must be considered.

They must be evaluated, stated and specified into system designs. It makes sense and it makes money for those that take advantage of it!

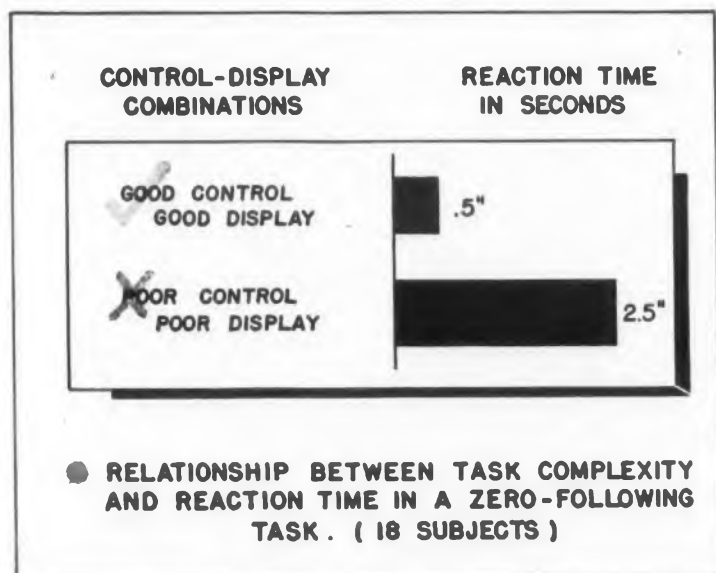


Fig. 2. Reaction time for task analyzed in Fig. 1.

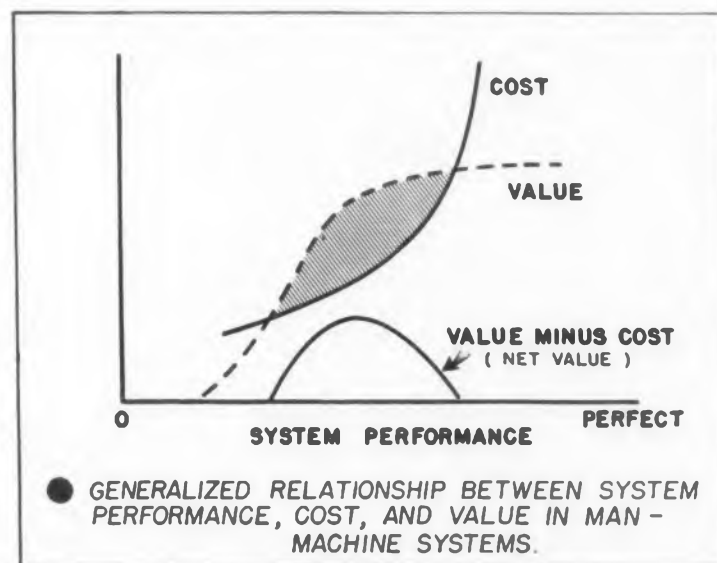


Fig. 3. Effect of improvements on net worth of systems.

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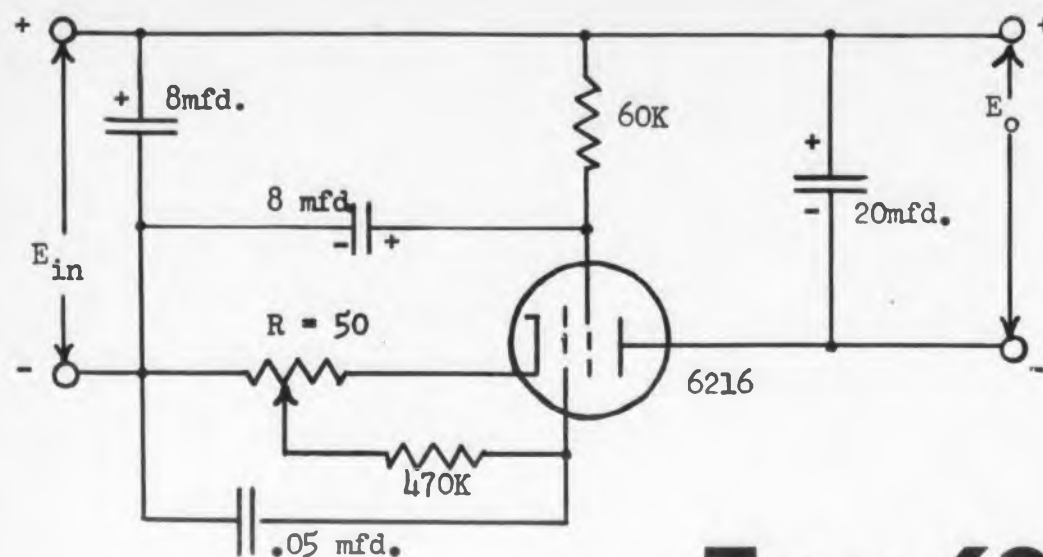


Fig. 1. The Type 6216 in a typical filter reactor circuit. The potentiometer R is adjusted for minimum a-c voltage across the E_o terminals. The curves shown below were made with such an adjustment in effect.

Type 6216

A Filter Reactor Tube

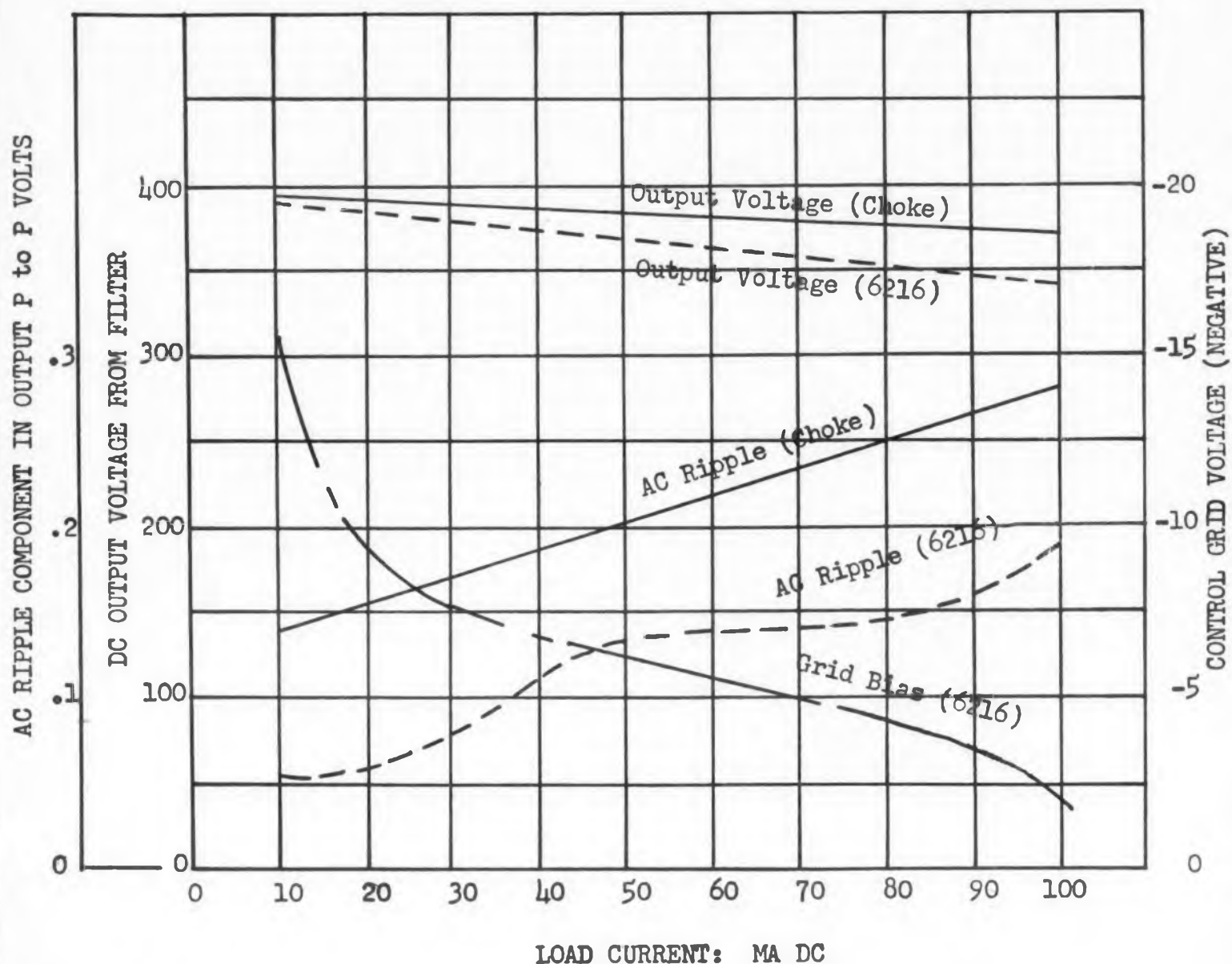


Fig. 2. Comparison of the filtering action of the Type 6216 with a 12h, 150ma iron core choke.

ELECTRONIC circuit designers will be interested in the Type 6216 miniature 9-pin beam power electron tube. When used in appropriate circuits, it can replace the iron-core filter choke in airborne and vehicular electronic equipment to effect considerable weight and space savings. Manufactured by CBS Hytron of Danvers, Mass., it is equivalent in performance to a 12henry filter choke rated 100ma and having a d-c resistance of 350 ohms.

A circuit using the new tube is shown in Fig. 1. The operation of this circuit depends on the high impedance of a pentode when operating above the knee of the $I_b - E_b$ curve. The tube is connected in series with the load, and the high a-c impedance of the tube limits the ripple current. The circuit shown employs inverse feedback to suppress ripple further.

A small voltage developed across the lower portion of the cathode resistor is applied to the grid through the 0.05mfd capacitor. This voltage is amplified and develops a ripple voltage across the load in phase opposition to the ripple voltage of the load.

Electrically, the tube has an extremely low tube drop and very high plate resistance. For this reason, it out-performs such tubes as Types 6W6GT, 25L6GT, and 50C5 in applications where high circuit efficiencies are required.

Under typical filter-reactor operation the following characteristics apply:

Heater	6.3v, 1.2amp
Plate supply (input to filter).....	400v
Output voltage (output from filter).....	335v
Cathode current (output).....	110ma
RMS Ripple voltage (in output).....	210mv
Plate voltage (plate to cathode).....	60v
Grid No. 2 voltage	100v
Grid No. 1 voltage	-1v

The low ripple voltage above is obtained by adjusting the potentiometer R for minimum a-c output across the output terminals E_o .

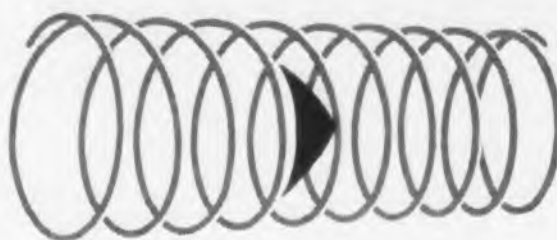
The curves in Fig. 2 show a comparison of the filtering action of the Type 6216 with that of a 12h, 150ma iron core choke.

The current handling capabilities of the Type 6216 can be increased by using two or more tubes in parallel. However, connecting two tubes in parallel has the same effect as when two iron core chokes are connected in parallel—the d-c resistance is reduced by one half, the current for a given I-R drop is doubled, and the a-c impedance also is reduced.

In addition to its use as a filter reactor device, the Type 6216 can be used in Class A, B, and C amplifier applications, as a passing tube in electronic voltage-regulated power supplies, in wide-band video amplifiers, and in passive switching applications.

In Class A audio amplifier operation the tube provides a maximum signal power output of 3.8w with 200v on the plate, 100v screen voltage, and -6v control grid voltage; and a load resistance of 4500 ohms.

There's a 10-turn Helipot to meet your requirements



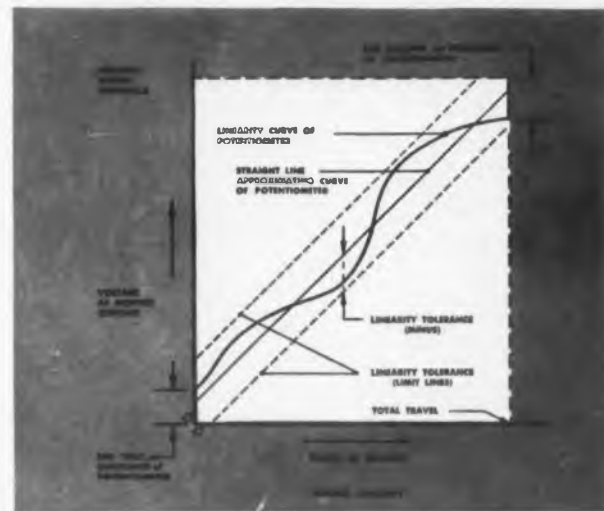
With the development of the original HELIPOT—the first multi-turn potentiometer—an entirely new principle of potentiometer design was introduced to the electronic industry. It made possible variable resistors combining high resolution and high precision in panel space no greater than that required for conventional single-turn potentiometers.

The Helipot Principle... High resolution and precision settings require a long slide wire. But by coiling a resistance element into a helix, it is possible to gain desired resolution and precision without wasting panel space. This principle is applied in various Helipot models with slide wires ranging from 3 to 40 helical turns.

Advantages are immediately apparent. In the case of the widely-used 10-turn Model A Helipot, for example, a 45" long slide wire—coiled into ten helical turns—is fitted into a case 1 3/4" in diameter, and 2" in length. Another advantage of the 10-turn pot is that, when equipped with a turns-indicating RA Precision DUODIAL, slider position can be read directly as a decimal, or percentage, of total coil length traversed.

10-TURN HELIPOT MODELS—CONDENSED SPECIFICATIONS			
	Model A	Model AN	Model AJ
No. of turns	10	10	10
Resistance Range	10 ohms to 300,000 ohms	100 ohms to 250,000 ohms	100 ohms to 50,000 ohms
Resistance Tolerance:			
Standard	±5%	±5%	±5%
Best	±1%	±1%	±3%
*Linearity Tolerance:			
Standard	±0.5%	±0.5%	±0.5%
Best	±0.05% (1K ohms and above)	±0.025% (5K ohms and above)	±0.1% (above 5K ohms)
Power rating @ 40°C	5 watts	5 watts	2 watts
Mechanical Rotation	3600° +4° -0°	3600° +1° -0°	3600° +12° -0°
Electrical Rotation	3600° +4° -0°	3600° +1° -0°	3600° +12° -0°
Starting Torque	2 oz. in.	1.0±.3 oz. in.	.75 oz. in.
Running Torque	1.5 oz. in.	0.6±.3 oz. in.	.60 oz. in.
Net Weight	4 oz.	4 oz.	1 oz.

*i.e. INDEPENDENT LINEARITY. The above linearity tolerances are based on the following definition recently proposed to clarify and standardize nomenclature related to precision variable resistors. . . . "Independent linearity is the maximum deviation in percent of the total electrical output of the actual electrical output at any point from the best straight line drawn through the output versus rotation curve. (This line shall be measured through the extent of the effective electrical angle.) The slope and position of the straight line from which the linearity deviations are measured must be so adjusted as to minimize these deviations."



The slope and position of the straight line from which the linearity deviations are measured must be so adjusted as to minimize these deviations."

10-Turn Helipot Highlights

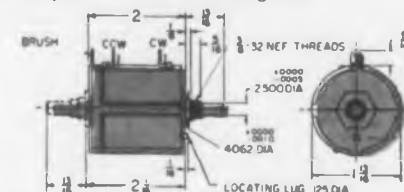
From the basic Helipot principle, model variations have been developed to meet new requirements:



Model A Helipot

the original 10-turn Helipot—provides a resolution from 12 to 14 times that of conventional single-turn potentiometers of same diameter (1 3/4"); linearities as close as ±0.05% in resistances as low as 1K ohms.

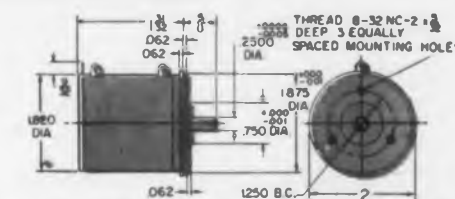
The same multi-turn principle is also available in 3 turn units (Model C), and larger-diameter units of 15 turns (Model B), 25 turns (Model D), and 40 turns (Model E)—a type for every application from 5 ohms to 1 megohm.



Model AN Helipot

an ultra-precision version of the basic 10-turn Helipot. Produced in volume to extremely close electrical and mechanical tolerances, this unit features precision ball bearings (Class 5), servo mounting lid, plus linearity tolerance as close as ±0.025% as low as 5K. A 3-turn unit (Model CN) is also available.

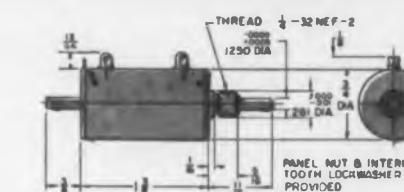
Models AN and CN are particularly recommended for precise servo-mechanism applications and represent the most advanced design and highest quality available today in the field of precision potentiometers.



Model AJ Helipot

a 10-turn miniature Helipot only 3/4" in diameter, weighs 1 oz., has slide wire 18" long. Also available with servo mounting (Model AJS) and servo mounting with ball bearings (Model AJSP). Linearities as close as ±0.1% as low as 5K.

Designed for long life under severe operating conditions, the AJ Series is widely used where small size and weight are vital.



Design details on above units are subject to change without notice. Certified drawings available upon request.

Only Helipot is able to supply—in volume—multi-turn helical potentiometers with special features to meet your particular needs. . . . Special Shafts, Extra Spot Welded Taps at any position, Ganged Assemblies (except AJ), Special Temperature Coefficients, etc. Send us your requirements!

For complete details contact your nearby Helipot representative. Or write direct.

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CIRCLE ED-5 ON READER-SERVICE CARD FOR MORE INFORMATION

ALONG with the increasing complexity and specialization of military and commercial equipment there is a growing awareness of the scope of feedback technique. It is being used to provide automatic control and to create functions not readily available otherwise—all with spectacular accuracy and stability over long periods of service. "Feedback amplifier" is a term which connotes quality and fidelity. Important branches of engineering endeavor, such as servomechanisms and automation, rest squarely on feedback principles.

The art has made its greatest strides in the communications field where feedback techniques have been consciously and vigorously applied for many years. In this field feedback is used primarily to enhance the performance of components and circuits. The promised reward of feedback, however, often proves to be a siren call. Too much feedback, easy to design into a system, can turn a potentially superlative device into a worthless one plagued by incipient or persistent hunting and regenerative oscillations. By using the graph shown in Fig. 1, and design equations which will be listed later, one can determine the minimum feedback which will insure overall accuracy, and minimize the effort required to avoid oscillatory behavior in the system.

In general, feedback does not eliminate errors or unwanted effects but rather serves to reduce them by transferring the responsibility for accuracy to a few simple and stable control elements. If the benefits of feedback are to be predicted in a specific case, the designer must know beforehand the characteristic behavior of his component elements under every conceivable field condition. No mathematical statement can predict the quality of the finished product unless those facts are known. Occasionally one hears the assertion that for a system with 1% error the loop gain should be 100; or for an error of 0.1% the loop gain should be 1,000; and so on. This statement has no meaning as a description of accuracy or reliability since the facts of component behavior are not considered in its formulation.

The basic feedback equation taken from the diagram shown in the graph is: $G = A/(1+A\beta)$. When $A \gg 1$, G becomes equal to $1/\beta$. In the expression, A is the forward gain subject to changes due to component variations within the system. β is the feedback control element. $A\beta$ becomes the loop gain. In systems employing appreciable amounts of feedback, β normally determines the overall gain G as shown by the second equation: $G = 1/\beta$.

What are the important facts which, along with loop gain, will determine accuracy and reliability of the product? In electronic circuits they are, first, the original tolerances on components such as vacuum tubes, mixing resistors, and any element whose value is critical in the circuit. Second, the effect of power supply (including tube heater supply) and load variations is important. Third, the behavior of the

circuits and components under variations in ambient conditions, especially temperature, must be known. Finally, aging effects must be considered. Original tolerances on resistors, capacitors, and inductors are given by the manufacturer. Tolerances on vacuum tubes may be in the form of JAN limits or manufacturer's guarantees. The effects of power supply variations can best be judged by applying them to breadboard circuits. The effects of extreme environmental conditions also can be determined best by laboratory tests. Aging considerations are focused on vacuum tubes and tuned circuits. For tubes, the data may be available in statistical form based on life tests of large numbers of samples. It should be noted that, where cathode biasing resistors are left un-bypassed or other local feedback loops are employed, the tube variation to be considered is that of the entire stage.

Design Judgement Needed

It is at this point that the good judgment of the designer can minimize the time and expense which will go into the final development phase.

The actual determination of variations in internal gain to be expected can be made as follows. First, measure or otherwise determine A for the average circuit at room conditions. Then, by creating conditions most unfavorable for internal gain, measure the lowered value of A . This can be done by selecting end-limit tubes and components, lowering power supply outputs, creating extreme environmental conditions, plus consideration of aging effects. Let the fractional change in internal gain be A_n . Similarly, by creating conditions most favorable for internal gain, measure A_p , the positive fractional change in A . Let us call G_p and G_n the change in overall gain resulting from A_p and A_n respectively. Then solving for loop gain yields

$$(A\beta)_p = \frac{A_p/G_p - 1}{1 + A_p}$$

$$\text{and } (A\beta)_n = \frac{A_n/G_n - 1}{1 - A_n}$$

How Much Feedback?

Alan Bossinger
Project Engineer

Alexander Dzilvelis
Asst. Project Engineer

Sperry Gyroscope Co., Great Neck, N. Y.

where $(A\beta)_p$ is the minimum loop gain which will hold the change in overall gain down to G_p , where the rise in internal gain is A_p , etc. The plot of those equations is shown on the graph. It is important to note how much more easily $(A\beta)_n$ can assume large values than $(A\beta)_p$. Hence minimum loop gain is most often determined by the predicted loss in internal gain, A_n rather than by A_p . In any case the higher $A\beta$ must be used in designing the system.

Typical Problem

Let us consider the design of a decade voltage amplifier to be used in an instrument circuit. The overall gain is to be $100 \pm 1\%$. It is intended to achieve this accuracy by employing feedback from output back to the input of the amplifier. It has been calculated that the internal gain may vary $+10\%$ to -30% during the period of guaranteed accuracy. Here $A_p = 0.1$, $A_n = 0.3$, $G_p = G_n = 0.01$. From the curves $(A\beta)_p = 8.18$ and $(A\beta)_n = 41.4$. Hence the feedback loop must incorporate a minimum gain of 41.4 (32db) in order to insure the desired overall accuracy. If insufficient amplification exists within the proposed circuit to provide this much feedback, more must be incorporated and the problem then must be recomputed.

Where the device is guaranteed to have some nominal gain within stated tolerances as in the above example, and where the expected variations in internal gain are not greater than say $\pm 50\%$, the required accuracy can be achieved with even less feedback than indicated.

This requires, however, that at final adjustment the overall gain be offset from the nominal value by an amount which is calculated readily.

Note that in the example a larger $A\beta$ was required to compensate for the variation A_n than for the variation A_p . Now, a different overall gain, G_a , slightly higher than the nominal one, can be selected such that the $A\beta$ required to compensate for both A_p and A_n is the same. This resulting value of $A\beta$ will be less than that required if the high and low variations in the overall gain were individually considered. The

adjusted gain is given by the following expression:

$$G_a = \frac{2G}{2 + \frac{A_p}{1 + (1 + A_p)A\beta} - \frac{A_n}{1 + (1 - A_n)A\beta}}$$

and the new required $A\beta$ is given by

$$A\beta = \frac{(A\beta)_p + (A\beta)_n}{2}$$

For the above example G_a becomes 100.4 and $A\beta$ becomes 24.8 as compared with the former requirement of $A\beta = 41.4$. Thus by intentionally introducing an error into the overall gain equal to almost half the prescribed tolerance, one can design the amplifier with less $A\beta$ and hence less trouble from regenerative oscillations and still meet the specified accuracy.

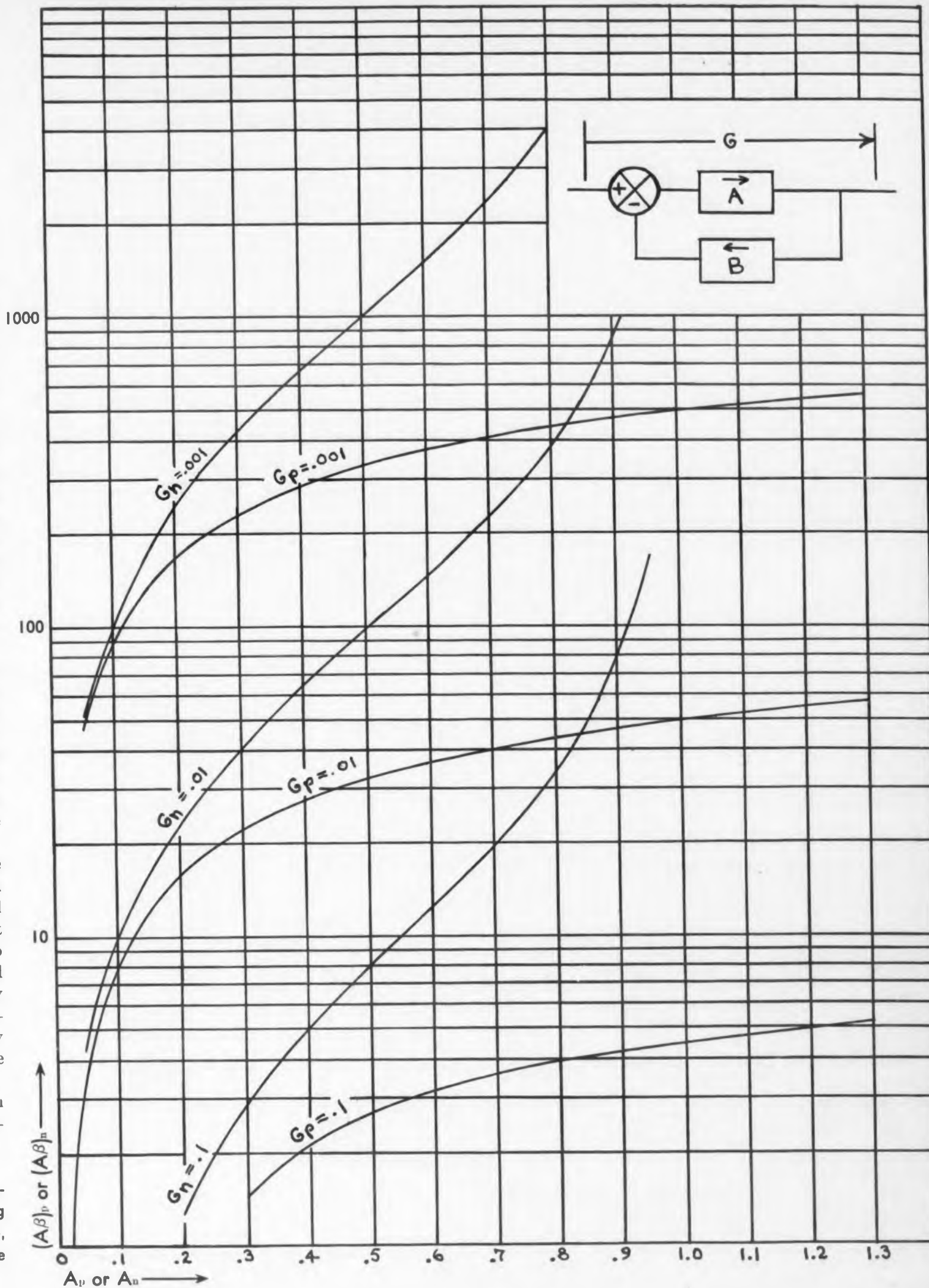
It can be seen from the equations and curves presented that large amounts of feedback alone are not the answer to the accuracy problem. The components within the system must be as reliable and drift-free as possible. The continual drive for greater precision in military equipment has brought demands for isolation and computing amplifiers with accuracies within one part in ten thousand over a life of many hundreds of hours. A costly mistake can be made trying to achieve these accuracies by extremely high feedback ratios alone.

Trick circuits such as "starved" pentodes, positive feedback and sharply tuned sections can be employed to make very high internal gains available for feedback. Many such critical circuits are inherently subject to large variations during their operational life and in addition may require selected components in manufacture. In such cases the same accuracy may easily be attainable through less feedback and more reliable circuits.

The question of stability against oscillation once the necessary loop gain is determined has not been mentioned. It is a wide subject which has been treated profusely in the literature. The well designed product must have sufficiently large margins of stability to insure against oscillation and to provide the desired transient characteristics. These margins of stability are also subject to variation due to aging, environmental changes, etc., and may be investigated by simulating extreme service conditions using the methods outlined above.

The material in this article has been extracted from a larger, unpublished work titled "Loop Gain Requirements for Accuracy in Feedback Systems".

Fig. 1. Curves showing the loop gain required for accuracy vs. predicted variation in internal gain. By using these curves and the design equations in the article, minimum feedback to insure overall accuracy can be determined.



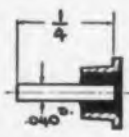
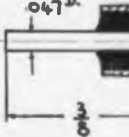
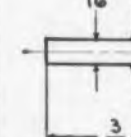

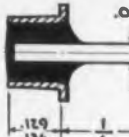

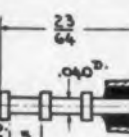
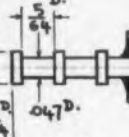
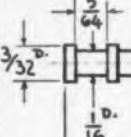
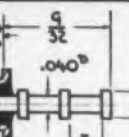
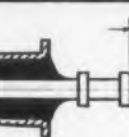
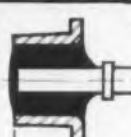
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Packaged Plug-In Circuits

EASE of electronic design, reduced service problems, conservation of space, and increased reliability are features provided by this series of packaged plug-in circuits. These characteristics are particularly important and advantageous in equipment where large arrays of similar circuits are banked together, as in computers, data coding telemetering, and similar types of equipment.

Originally developed for the Armed Services by Electronic Engineering Co. of California, these units now are generally available in 26 catalog types and 40 secondary versions. Standard circuits include amplifiers, flip-flops, multivibrators, squaring circuits, pulse gates, crystal oscillators, "and" circuits, "or" circuits, pulse amplifiers, and many others.

These units consist of an octal plug and a miniature tube socket with components mounted turret-style as shown in Fig. 1. The entire unit is encased, including the vacuum tube, in a die-cast aluminum shield assembly 4-1/8" high x 1-1/2" diam. The tube

shield is removable to permit tube replacement. Fig. 1 also shows the R-C components which comprise a typical plug-in flip-flop circuit together with the socket hardware, shield cans, and a completed unit.

The R-C components are mounted between the tube socket and the plug and are self-supporting. The tube socket is fastened with a collar and a U-ring to the top of the main shield can. The entire component assembly is covered with a dielectric anti-fungus and moisture-proofing agent before being inserted in the outer shield case. The tube shield and tube are held in place by a helical coil spring in the top end of the tube shield case. The main shield case is assembled with drive pins and a grounding collar which fit over the standard octal base.

The packaged plug-in circuit presents a series of design advantages which can be realized by the designer in many branches of electronics and allied industries. One of the primary features is new freedom for the design engineer who by using the pack-

Fig. 1. The packaged plug-in circuit, with all the components that go into the "packaged" units like these, effect space savings, reduce equipment down time, and greatly simplify maintenance problems, especially in equipment where large numbers of circuits are employed. The assembled unit is shown in the center.



aged units as "building blocks" becomes a "block diagram man" in the sense that he may expend his major effort on general equipment configurations and comprehensive circuit considerations. Minor circuits become stock items which are called out on the bill of material just as a resistor or capacitor are specified.

As a corollary to this "building block" concept, uniformity of circuitry contributes another important design feature. Each packaged plug-in unit is wired identically, packaged identically and individu-

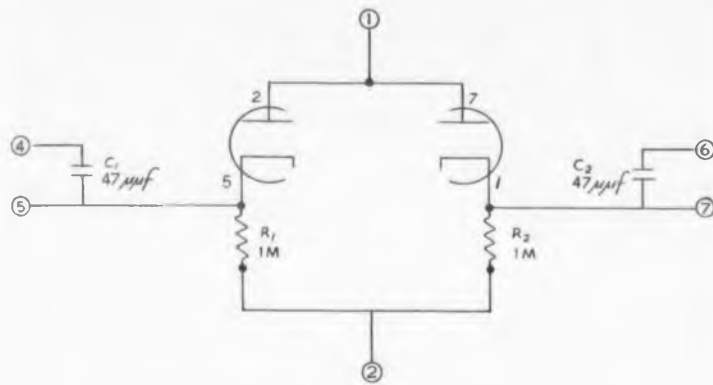


Fig. 2. (Above) Conventional circuit diagram of a typical unit, and (right) simplified version which can be used to save drafting repetitive circuits.

ally tested to insure operating parameters as nearly identical as possible for like units.

Equipment construction with plug-in circuits presents a functional, uniform appearance together with a reduction in the size of the panel or chassis required for mounting. Because most small components are mounted within the plug-in case, the backs of the panels or chassis need carry only power supply and interconnection wiring.

A secondary design consideration is illustrated by the two schematic drawings shown in Fig. 2. One drawing is that of a conventional circuit which shows each of the components of the minor circuits in the general configuration. The other schematic is a template drawn version with the plug-in circuits shown as equivalent symbols. The result is a saving in drafting room labor costs because all minor circuits may be quickly templated in by a detailer.

Still other advantages of the plug-in circuit include lower maintenance costs because of the ease of replacement of an entire circuit or stage thus slashing "down time" on equipment and stepping up the maximum inherent reliability of the equipment itself.

Packaged plug-in circuits also reduce the number of individual parts normally stocked with large arrays of electronic equipment, and afford a reduction in the purchasing, material control, as well as many accounting costs.

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Hermetically-sealed. G-E Permafil capacitors also offer high insulation resistance and negligible capacitance change over the entire temperature range. They're available in case styles CP53 and CP61, in ratings of .05 to 1.0 muf, 400 volts DC. Metallic containers are hermetically-sealed with G-E long-life silicone bushings. For full information, see your local G-E representative or write for Bulletin GEC-811. Address Section 442-2, General Electric Company, Schenectady 5, New York.

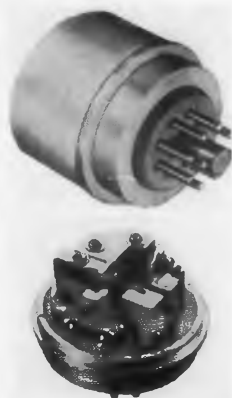
GENERAL  ELECTRIC

CIRCLE ED-8 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

High Frequency Impulse Relay

Free From Contact Bounce



Completely free from contact bounce, the Type T high frequency Impulse Relay (shown here and on the front cover) is capable of a large number of operations at high speed. Originally designed for use in an analog computer, its characteristics make it useful for many applications where a highly sensitive relay is required.

The unit has a pull-in time of 120 μ sec and a drop-out time of 100 μ sec, which enables it to follow 2,500cps (aperiodic to 1000cps). In a typical application, it has a life expectancy (following a run-in period of 1×10^6 operations) of 5×10^9 operations with a 0.75ma contact load over a six month period without readjustment.

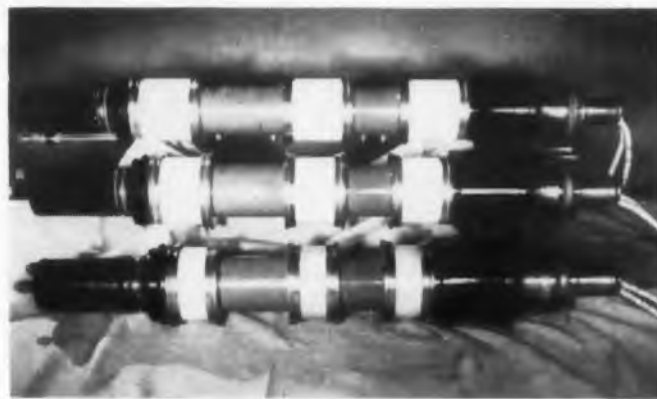
To achieve the features of high speed and no bounce, the device is built to extremely close tolerances, with a high degree of precision. C. P. Clare & Co., Dept. ED, 4719 W. Sunnyside Ave., Chicago 30, Ill.

CIRCLE ED-9 ON READER-SERVICE CARD FOR MORE INFORMATION

5kw Klystrons

Cover 470-890Mc TV Band

The entire u-h-f TV band from 470Mc to 890Mc can be covered by these Type 3K20,000L Klystrons (shown here and on the cover). In typical operation



the tubes provide a peak sync power output of 5.5kw with a power gain of 20db to 25db, and a 14kw collector dissipation.

Three types are available, covering 470Mc to

580Mc (channels 14-32), 580Mc to 720Mc (channels 33-55), and 720Mc to 890Mc (channels 56-83) respectively. They are cascade type klystrons with low-loss, externally tuned ceramic cavities and metal-to-ceramic seals. The cavities can be readily cooled by a small amount of forced air, and the other parts of the tube are water-cooled. Eitel-McCullough, Inc., Dept. ED, San Bruno, Calif.

CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION

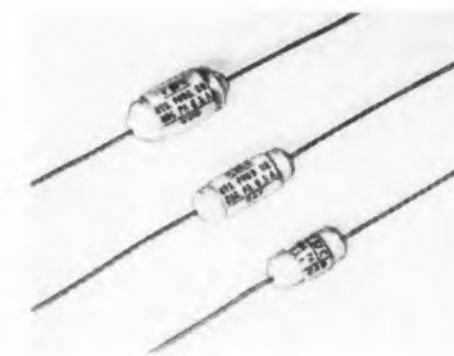
Hand Wound Coils Of Tungsten and Molybdenum

Coils, of tungsten and molybdenum, hand wound to exacting standards are now being fabricated by the company for use as emitters, filaments, coiled cords, and for other applications.

Also available are leads, with or without beading, fabricated from tungsten, molybdenum, nickel, nickel-clad copper, and alloys. Electronic Parts Mfg. Co., Inc., Dept. ED, Union City, N. J.

CIRCLE ED-11 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire Wound Resistors For Aircraft Applications



The Type C precision Wire Wound Resistors have been tested in some of the Armed Forces' most critical applications. Their small size and light weight make them self-supporting, a feature which

makes them especially useful in aircraft applications.

The units are made in three sizes: 1/2" long x 9/32"diam, 3/4" long x 9/32"diam, and 3/4" long x 3/8"diam. The units are insulated and enclosed in a rugged plastic jacket. The steatite winding forms have high insulation with a low coefficient of expansion. The windings are impregnated in a special compound for protection against dust, salt spray, humidity, and mechanical damage. Resistance Products Co., Dept. ED, 714 Race St., Harrisburg, Pa.

CIRCLE ED-12 ON READER-SERVICE CARD FOR MORE INFORMATION

Step Frequency Oscillator Provides 17 Fixed Frequencies



A Step Frequency Oscillator providing 17 fixed frequencies at the turn of a single knob has been added to the company's line. Weighing only 7 lb, the instrument is portable for field main-

tenance, and its accuracy, stability, and low distortion make it valuable in the laboratory for such applications as testing of amplifiers, filters and recorders. It also is useful in telemetering applications.

A gain stabilizing circuit holds amplitude variation over the entire frequency range to less than ± 0.2 db. Use of toroid coils assures an overall frequency stability of more than $\pm 1\%$, including replacement of tubes. The 60db signal-to-hum ratio is maintained at all output levels, and known resistive output impedance is provided through use of "T" pad attenuator. Pulse Techniques, Inc., Dept. ED, 1411 Palisade Ave., West Englewood, N. J.

CIRCLE ED-14 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubeless Power Supply For Transistor Applications



The Model 110 Tubeless Power Supply is a regulated d-c, dual unit designed for use as a power source for transistors, laboratory experimentation, battery simulation for guided missiles, etc.

Utilizing semi-conductor diodes in a bridge rectification circuit, together with saturable reactors, the unit provides for input line regulation. Good d-c regulation results from low diode voltage drop and the use of low resistance filter components.

Dual outputs are provided for supplying both collector and emitter voltages in any combination of positive or negative polarity for either point contact or junction transistors. Each output is continuously variable from zero to maximum d-c voltage, and both outputs are isolated from each other. Output No. 1, rated at 60ma max, can be adjusted for any of three ranges: 0-1v, 0-10v, or 0-100v. Output No. 2, also

rated at 60ma max, yields an output of 0-100v d-c. Internal d-c impedance is low, 100 ohms or less. The unit is line regulated for an input variation of 95v-125v, 60cy. Maximum power consumption is 20w. Electronic Research Associates, Dept. ED, Box 29, Caldwell, N. J.

CIRCLE ED-15 ON READER-SERVICE CARD FOR MORE INFORMATION

Cathode-Ray Oscilloscope Has Flat-Faced C-R Tube



The Type 514-AD is a portable, laboratory type Cathode-Ray Oscilloscope with applications for the electronic design, development, and research engineer. Features of this instrument include a 6cm undistorted vertical deflection with direct-coupled vertical amplifier,

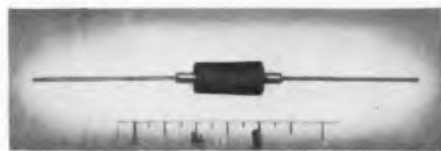
a flat-faced cathode-ray tube, a variable duty cycle calibrator, and a direct-coupled unblanking.

Operating characteristics include a rise time of $0.04\mu\text{sec}$, a signal delay of $0.25\mu\text{sec}$, a time base range of $0.1\mu\text{sec/cm}$ to 0.01sec/cm , an accuracy to within 5% of full scale, and an improved 5x sweep magnifier.

The unit's square wave calibrator has a variable output from 0 to 50v, an accuracy to within 3% of full scale, and a duty cycle variable from 2% to 98%. Direct-coupled unblanking insures uniform C-R Tube bias regardless of sweep time and repetition rate. The instrument has a 3kv accelerating potential, and all d-c voltages are regulated. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

CIRCLE ED-16 ON READER-SERVICE CARD FOR MORE INFORMATION

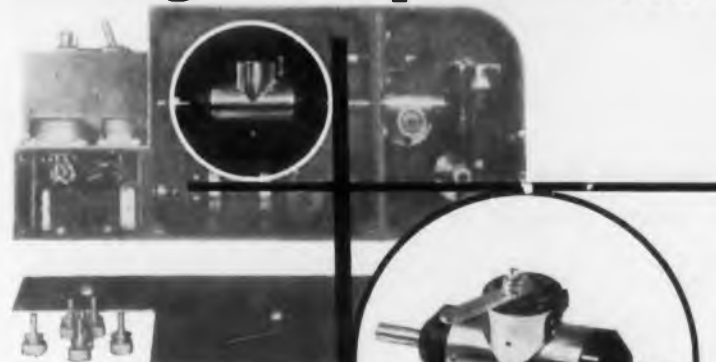
Gold Bonded Diode Has High Forward Conductance



Gold Bonded Germanium Diodes, designed for extreme ruggedness and reliability, have been added to the company's line. Features of the unit include a back resistance greater than a megohm at 100v inverse and high forward conductance. The unit is mechanically interchangeable with clip-in types. Transitron Electronic Corp., Dept. ED, 407 Main St., Melrose, Mass.

CIRCLE ED-17 ON READER-SERVICE CARD FOR MORE INFORMATION

Design Simplified...



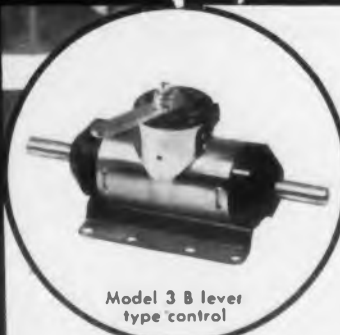
with the **Metron** VARIABLE SPEED DRIVE

- Permanently lubricated
- Your choice of 6 controls
- Speeds up to 10,000 RPM
- Nominal output .025 HP



For further information about how Metron units can simplify your costly speed changing problems, write for Bulletin 99.

Metron



Model 3 B lever type control

Design engineers at Century Geophysical Corporation make use of the Metron Variable Speed Changer to give them continuously adjustable chart speeds in their miniature oscillograph.

Century engineers find that it is simpler and more economical to use Metron Miniature units as components than to design and build their own.

Metron Variable Speed Changers are designed into countless products that call for changes in speed. The units are small—only 4 3/16" long—to fit minimum space. They are smooth and accurate in operation and cover infinitely variable output speeds from 5:1 step down thru 1:1 to 1:5 step up.

INSTRUMENT COMPANY

450 LINCOLN ST., DENVER 9, COLO.

CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION

Quick Switches

are a

DAVEN

Specialty



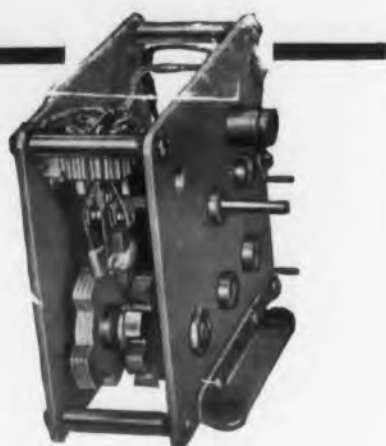
And the "specialty of the house" is double-barreled . . . first, choose from hundreds of standard units to satisfy your needs—for quick switch delivery . . . second, Daven can effect quick 'switches' or changes from standard units to special switches, by using components at hand. That, too, makes for speed, dependability, economy. Write for more detailed data.

THE DAVEN co. 169 Central Ave.
Newark 4, N. J.

CIRCLE ED-19 ON READER-SERVICE CARD FOR MORE INFORMATION

AMGLO DC MOTOR

FOR ACCURATE
TIMING CONTROL
FROM BATTERIES
OR DC LINE



SPEED

Magnetic reed drive provides constant speeds with instantaneous self-start to full speed. Speeds from 1 REV. PER DAY to 900 REV. PER MINUTE.

SIZE

3 1/2" x 2 1/2" x 1 5/8", Wght.—10 oz. and 2" x 3 1/2" x 3 3/4", Wght.—15 oz.

VOLTAGES

From 3 to 110 Volts. These units are custom built to your requirements: voltage—current—speed—torque.

Write for details and recommendations

AMGLO CORPORATION

2037 W. Division St., Chicago 22, Illinois

CIRCLE ED-20 ON READER-SERVICE CARD FOR MORE INFORMATION



Designed and manufactured under strict quality standards, PRECISION COIL BOBBINS provide superior insulation, moisture resistance and heat dissipation. Exact tolerance control affords maximum winding space. Spiral winding and heat treating under compression results in greater strength and lighter weight.

Cores are furnished in an infinite variety of sizes and shapes—in kraft, fish paper, acetate or combinations. Flanges cut to specification—plain or fitted with leads, slots or holes—plain or embossed.

Send specifications for sample. Request Arbor List of over 1500 sizes.



PRECISION PAPER TUBE CO.

2055 W. Charleston St., Chicago 47, Ill.
Plant No. 2: 79 Chapel St., Hartford, Conn.
Also mfrs. of Precision Paper Tubes

CIRCLE ED-21 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Analog-to-Digit Converter Has Accuracy of 0.1%



The Type 24A "Teleducer" automatically converts analog voltages into decimal digits with an accuracy of 0.1% (1000 counts full scale). This unit operates upon demand, digitizes an input voltage and holds the digital representation for a controllable period of time for purposes of display, recording, or any desired readout form. The digital output can be recorded by means of punched cards, an electric typewriter, magnetic tape, or punched tape.

Low voltage is digitized without d-c amplification, and high voltage by means of attenuators. The instrument uses a simple-bridge balancing circuit which does not hunt or oscillate and requires only 0.8sec or less to reach balance. Telecomputing Corp., Dept. ED, 133 East Santa Anita Ave., Burbank, Calif.

CIRCLE ED-22 ON READER-SERVICE CARD FOR MORE INFORMATION

Transparent Electrical Tape With "Mylar" Film Backing

Designated "Scotch" No. 5, this Transparent Electrical Tape has a polyester film backing made from "Mylar" and a pressure-sensitive, heat resistant, electrical grade adhesive. Only 3 mils thick, the material combines high tear strength with a high dielectric and has very good non-corrosive qualities.

The tape is stable under temperatures up to 125°C and has been designed for use in fine wire coils, transformers, and in miniaturized components. It is not subject to cold flow and can be used in applications where very low temperatures cause other plastics to become brittle.

Specifications include a tensile strength of 35 lb/in, stretchability to 150% before breaking, an insulation resistance of 100,000 megohms, a dielectric strength of 5,500v, and an electrolytic corrosion factor of 1.0. Minnesota Mining and Mfg. Co., Dept. ED, 900 Fauquier St., St. Paul 6, Minn.

CIRCLE ED-23 ON READER-SERVICE CARD FOR MORE INFORMATION

To meet the strictest requirements of both
Government and Industry, specify

JAN TYPE



Germanium Diodes

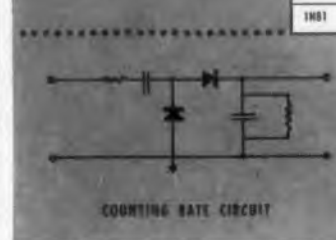
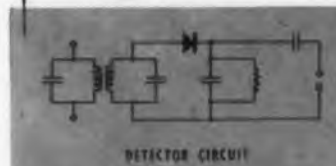
Precision made, easy to handle, easy to assemble—the tapered shape shows polarity at a glance! Make Radio Receptor Germanium Diodes your first choice in the large variety of electronic circuits where JAN types are a must.

1N69
1N70
1N81

TYPICAL USES

COMPUTER CIRCUITS
CLAMPING CIRCUITS
RF DETECTORS
CONTROL CIRCUITS
DISCRIMINATORS

MODULATORS
NOISE ELIMINATORS
CLIPPERS
LEVEL SETTERS
RESTORER CIRCUITS



JAN TYPES - ALL VALUES MEASURED AT 25°C.

CODE NO.	Min. Forward Current at 1 Volt (mA)	Max. Reverse Current (Micro-Amperes)	Average Rectified Current (MA Max)	Minimum Reverse Volts	Max. Cont. Reverse Operating Volts
1N69	5.0	50 μ A—10V 850 μ A—50V	100	75	80
1N70	3.0	25 μ A—10V 300 μ A—50V	30	125	100
1N81	3.0	10 μ A—10V	30	50	40

Rectification efficiency: 35%, minimum in 100 MC test circuit.

*Average half wave rectified current at 60 CPS and 25°C. Consult us for ratings at other conditions.
†For zero dynamic resistance.

Radio Receptor Germanium Diodes may hold the answer to many of your problems. Our engineers will be glad to study your requirements and submit their recommendations. Many other types, both standard and special, are available. Write us!

Seletron
and Germanium
Division

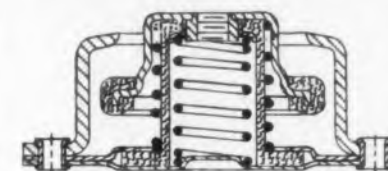
RADIO RECEPTOR COMPANY, INC.

Since 1922 in Radio and Electronics
SALES DEPT. 251 West 19th Street, New York 11, N. Y. • FACTORY 84 North 9th Street, Brooklyn 11, N. Y.

CIRCLE ED-24 ON READER-SERVICE CARD FOR MORE INFORMATION

(Advertisement)

SHOCK AND VIBRATION NEWS



NEW VIBRATION
ISOLATOR
UNCHANGED BY
CONTINUED SERVICE

The Barry Corporation announces two new ALL-METL vibration isolators, Type 7630 and Type 7640, specifically designed to eliminate loss of efficiency due to damper packing. These units are respectively JAN cup-type Size 1 and JAN cup-type Size 2.

Previous wire-mesh unit vibration isolators exhibited a definite loss of damping efficiency after a period in actual service, because the wire-mesh damper tended to pack down and become stiffer after repeated shock and vibration. The new unit Barrymounts are so designed that the load-bearing spring returns the damper to its normal position on every cycle, thus preventing packing and removing the difficulty.

Additional features of the new units are very light weight, a new hex top to simplify installation, high isolation efficiency, ruggedized construction, and wide temperature tolerance. Barry Product Bulletin 531, describing the isolators in detail, is free on request. For further information, write, wire, or phone The Barry Corporation, 775 Pleasant Street, Watertown 72, Mass.

CIRCLE ED-25 ON READER-SERVICE CARD FOR MORE INFORMATION

Headquarters for ...

HUDSON
RADIO & TELEVISION CORP.



In Stock for
Prompt Delivery!



Hudson carries a complete line of
RCA TUBES
to meet every
INDUSTRIAL, LABORATORY
and COMMUNICATIONS
requirement

Complete Line of
RCA TEST EQUIPMENT
RCA BATTERIES • RCA PARTS

FOR FAST SERVICE
on RCA TUBES, TEST INSTRUMENTS,
BATTERIES, PARTS . . . Call HUDSON
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Send for your **FREE** Catalog today!
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48 WEST 48th ST. • 212 FULTON ST.
New York 36, N. Y. New York 7, N. Y.

CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

ANOTHER FAMOUS MARKET PLACE — Central Market
(Halles Centrales)

**ELECTRONIC
DESIGN**

... pin-points
its attention on the
**Electronic
Designer**

presents him with
concise but compre-
hensive Design Data

brings him feature
articles, nomographs,
composites, tabulations,
charts and graphs.

* Market Place for
Electronic Design
Innovations

Hermetically Sealed Relay

For Use in Communication Equipment



Series 4000 Hermetically Sealed compact, precision-built Relays have been designed for use in all types of ground and airborne communication equipment. The spst units are available with 9mw sensitivity and dpdt units with 15mw sensitivity.

Characteristics include a coil resistance up to 50,000 ohms, contacts in either silver or palladium, and ratings of

1.5amp at 24v d-c (resistive) in the silver, and 3amp, 24v d-c (resistive) in the palladium. The unit will withstand severe operations from sea level to 80,000 feet and a temperature range of -65°C to $+85^{\circ}\text{C}$. It also withstands severe humidity conditions, salt spray, and dust, and is rated 10G's vibration at 15mw. Advance Electric and Relay Co., Dept. ED, 2435 N. Naomi St., Burbank, Calif.

CIRCLE ED-27 ON READER-SERVICE CARD FOR MORE INFORMATION

Brazing Alloys

For High Vacuum Systems

Two brazing alloys, designated "Incoro 60" and "Incosil 15", have been added to the company's line. These materials have application in high vacuum systems, such as power tubes, vacuum capacitors, etc.

"Incoro 60", compounded of gold, copper, and indium, has a melting range of 810°C to 830°C . "Incosil 15", compounded of silver, copper, and indium, has a low vapor pressure and a very low melting range of 640°C to 687°C . Western Gold and Platinum Works, Dept. ED, 589 Bryant St., San Francisco, Calif.

CIRCLE ED-28 ON READER-SERVICE CARD FOR MORE INFORMATION

Disc Type Ceramic Capacitors

With Range of 0.001mfd to 0.01mfd



These disc type Ceramic Capacitors are intended for use in radio and TV applications. They are insulated with phenolic resin and are wax impregnated to resist moisture.

The units range from 0.001mfd to 0.01mfd, and their basic element is a ceramic disc of high K dielectric, with a silver paste on either side, reduced by heat treatment to metallic silver. Allen-Bradley Co., Dept. ED, Milwaukee, Wis.

CIRCLE ED-29 ON READER-SERVICE CARD FOR MORE INFORMATION

UHF and MICROWAVE ENGINEERS

This rapidly growing organization in South Central Wisconsin, which is approximately 100 miles from Chicago, Ill., has several openings for Junior and Senior Engineers in the UHF and Microwave Field.

UNUSUAL SALARY OPPORTUNITIES

exist under ideal working conditions in large well equipped laboratories. Personnel benefits such as sickness, accident and life insurance in addition to a very liberal pension system are offered.

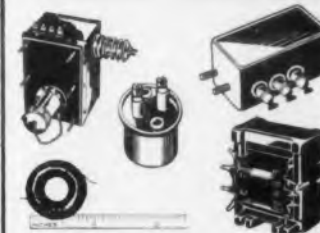
For more information concerning the positions that are open, we invite you to write to

Personnel Director, Dept. A.

**GIBBS MANUFACTURING
& RESEARCH CORP.
Janesville, Wisconsin**

CIRCLE ED-30 ON READER-SERVICE CARD FOR MORE INFORMATION

— FREED — TRANSFORMERS INSTRUMENTS



MILITARY COMPONENTS TO
SPECIFICATIONS MIL-T-27 & ANE-19
AND COMMERCIAL TYPES

Pulse Transformers
Filter Reactors
Charging Reactors
Saturable Reactors
Toroid Inductors
Low Pass Filters
High Pass Filters
Band Pass Filters
Discriminators
Plate Transformers
Power Transformers
Filament Transformers
Vibrator Transformers
Input Transformers
Interstage Transformers
Driver Transformers
Output Transformers
Modulation Transformers
Blocking Oscillator Transformers
Band Elimination Filters



NO. 1020 B
MEGOHMMETER
DIRECT READING

Self-contained and
A.C. operated with
electronically regu-
lated supply. 1
megohm to 2 mil-
lion megohms.



NO. 1010
COMPARISON
BRIDGE

Self-contained and
A.C. operated. For
rapid and accurate
test of Resistors,
Condensers and
Inductors.

OTHER FREED INSTRUMENTS
NO. 1030 Low Frequency B.
Indicator
NO. 1110A Incremental Inductance
Bridge
NO. 1150 Universal Bridge
NO. 1170 D.C. Supply
NO. 1210 Null Detector and
Vacuum Tube Voltmeter
NO. 1140 Null Detector Amplifier
NO. 1040 A.C.—V.T. Voltmeter
NO. 1250 Decade Condenser
NO. 1410 Harmonic Distortion
Meter
and Decade Inductors

SEND FOR COMPLETE CATALOG DESCRIBING ALL
FREED INSTRUMENTS AND TRANSFORMERS

FREED TRANSFORMER CO., INC.
1727 Weirfield St., Brooklyn (Ridgewood) 27, N. Y.

CIRCLE ED-31 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Scintillation Counter

Has High Gamma Detection Efficiency



The Model SC-2A is a Scintillation Counter that provides a high efficiency for gamma detection when used with a 1" x 1" Na.I (T1) crystal. The unit utilizes the RCA Type 6199 multiplier phototube, together with the best possible optical coupling between crystal and tube.

Dimensions for the instrument are 2"diam x 7". It features a long plateau, excellent reproducibility of results, and a 6' cable for convenient connection to the Geiger-Mueller input of any conventional scaler or ratemeter for a wide variety of gamma counting problems. Nuclear Research Corp., Dept. ED, 2563 Grays Ferry Ave., Philadelphia 46, Pa.

CIRCLE ED-32 ON READER-SERVICE CARD FOR MORE INFORMATION

Elapsed Time Indicator

Operates at -55°C to $+85^{\circ}\text{C}$



The Type HM-2ET Elapsed Time Indicator, designed for installation where panel space is limited, is a hermetically sealed unit, tamperproof and immune to environmental conditions of humidity, temperature, and

dangerous atmospheres. Although the meter measures only 2-1/2"diam, the indicator is easy to read.

The motor starts readily and operates continuously at temperatures ranging from -55°C to $+85^{\circ}\text{C}$. It is available for registering in 1/10 hour steps to 9999.9, or hour steps to 99999 and has a self-starting synchronous motor either 110v to 125v or 220v to 250v for 50cy or 60cy a-c operation. The drawn steel case provides magnetic shielding. Marion Electrical Instrument Co., Dept. ED, Manchester, N. H.

CIRCLE ED-33 ON READER-SERVICE CARD FOR MORE INFORMATION

VACUUM



CAPACITORS



LOW LOSS, COPPER ELEMENT CONSTRUCTION



Outstanding features of UNITED vacuum capacitors are the employment of large elements and large periphery glass to copper seals, as illustrated. This construction results in a low temperature co-efficient, low R.F. losses and low inherent inductance. End terminals are gold plated to prevent corrosion.

Type designations of UNITED vacuum capacitors symbolize their capacitance ratings and their maximum current and voltage ratings— thus CAP 50/60/35 means:

C
= Capacitance
(50 uuf)

A
= Amperes
(60)

P
= Potential
(35 KV)

The numerals are significant as shown in direct relation to the prefix letters.

When the older types of vacuum condensers were designed, the sole conception of advantage was to attain a voltage breakdown characteristic higher than could be accomplished with condensers of the same physical size with air or other substance as dielectric.

The limitations of the old types of vacuum capacitors resulted principally from high R.F. losses and a high temperature co-efficient. This caused considerable capacitance drift, and the added heat losses in the glass envelope led to external voltage breakdown or internal breakdown due to the liberation of gas. Actual seal puncture in these early type vacuum capacitors was also a frequent cause of failure. Extraneous inductance was caused by the use of conventional ferrous metal rod seals and copper strand leads soldered to the terminal caps, in the old type of construction. The higher the frequency and R.F. power, the more these limitations were accentuated.

All metal parts of UNITED vacuum capacitors are oxygen free, high conductivity copper.

For complete information on UNITED vacuum capacitors, transmitting and special purpose electron tubes write for Catalog 2-GPW.

Type	Capacitance uuf	Maximum Current	Peak R. F. Voltage	Overall Dimensions		Drawing Opposite Page
				Length	Width	
CAP-6/30/20	6	30 amps.	20 KV	3-11/16"	3"	A
CAP-12/30/20	12	30 amps.	20 KV	3-11/16"	3"	A
CAP-25/60/20	25	60 amps.	20 KV	3-11/16"	3"	A
CAP-50/60/20	50	60 amps.	20 KV	3-11/16"	3"	A
CAP-50/60/25	50	60 amps.	25 KV	4-1/2"	2-5/8"	B
CAP-6/30/35	6	30 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-12/30/35	12	30 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-25/60/35	25	60 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-50/60/35	50	60 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-75/60/35	75	60 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-100/60/35	100	60 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-150/60/35	150	60 amps.	35 KV	6-19/32"	2-13/16"	C
CAP-200/60/35	200	60 amps.	35 KV	6-19/32"	3-1/16"	D
CAP-250/60/35	250	60 amps.	35 KV	6-19/32"	3-1/16"	D
CAP-450/60/20	450	60 amps.	20 KV	8-15/32"	3"	E
CAP-500/60/20	500	60 amps.	20 KV	9-7/32"	3"	F

CAPACITY TOLERANCES

All capacitors identified by Drawing A have a capacity tolerance ± 1 mfd, except CAP-6/30/20 which is ± 0.5 mfd. All other capacitors listed have capacity tolerance $\pm 2\%$ of rated values.

Above table lists standard sizes. Special sizes can be furnished within capacity and voltage ranges shown, and inquiries are invited.

UNITED ELECTRONICS, 42 Spring Street, Newark 2, N. J.

Since 1934

CIRCLE ED-34 ON READER-SERVICE CARD FOR MORE INFORMATION

VACUUM



CAPACITORS

UNITED ELECTRONICS

LOW LOSS, COPPER ELEMENT CONSTRUCTION

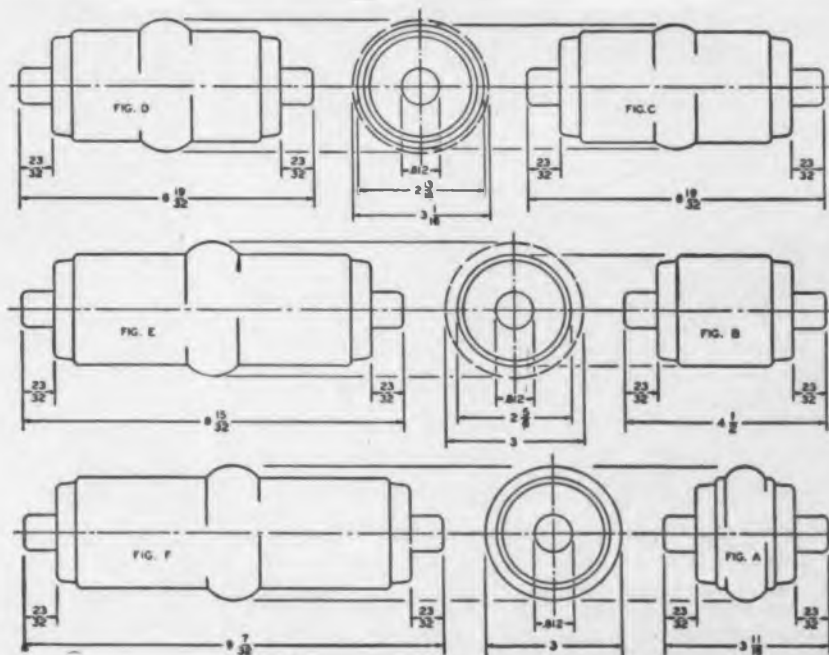


COMPARISON OF THE VACUUM CAPACITOR WITH THE MICA, OIL, AIR AND PRESSURE TYPES

The present and potential advantages of vacuum capacitors, compared with air, mica, oil and pressure types will be quickly appreciated by a study of the following tabulation. The comparison is based on a unit or combination for each class condenser of 1000 uuf, 30,000 volts rating. Sizes, values, weights and costs shown are approximate.

Size	Vacuum 6 1/2" x 4 1/4"	Air 10 condensers in parallel 14 1/4" x 9 3/4" x 12 1/4" ea.	Mica 4" x 4" x 6"	Oil 3 cond. in series. 15 1/2" x 18" x 5 1/4" ea.	Press. Cond. 12" diam. 30" long
Total Weight	5 lbs.	250 lbs.	10 lbs.	120 lbs.	100 lbs.
Current	100 amps. 30 Mc.	70 amps. 5 Mc. 140 amps. 10 Mc.	20 amps. at 3000 KC	100 amps. at 540 KC	60 amps.
Cost	\$100	\$200	\$100	\$450	\$300
Comparative Characteristics	Completely enclosed, needs no cleaning; self-healing; immune to changes in atmospheric conditions; minimum capacity drift.	Needs frequent cleaning and affected by changes in air pressure and humidity.	Needs no maintenance but is ruined by puncture of insulation.	Relatively high loss but is dependable and self-healing on arc-over.	In case of arc-over may have to be taken apart to clean plates. Requires connection to nitrogen tank and intermittent check on the pressure.

VACUUM
CAPACITORS
DIMENSIONS



UNITED ELECTRONICS, 42 Spring Street, Newark 2, N. J.

Since 1934

CIRCLE ED-34 ON READER-SERVICE CARD FOR MORE INFORMATION

Rectangular Cathode Ray Tube

For Miniaturized Oscilloscopes

Designed for miniaturized oscilloscopes, this Rectangular Cathode Ray Tube, designated as the Type 3XP "Rayonic", provides a greatly improved brightness without sacrifice of deflection sensitivity.

The Type 3XP provides a light output four times greater and a vertical sensitivity twice as great as



comparable cathode ray tubes operating at similar anode potentials. In addition, low interelectrode capacities are maintained.

These characteristics make the tube especially useful for high frequency video work, as well as low repetitive operation. Because of its unique shape and size, the unit lends itself to multi-tube oscilloscopy. It is available in P1, P2, P7, and P11 phosphors. Waterman Products Co., Inc., Dept. ED, 2445 Emerald St., Philadelphia, Pa.

CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION

Scaling Unit

Has Electrically-Reset Timer and Register



The Model 182 Scaling Unit features an electrically-reset timer and register to speed counting procedures in radioisotope laboratories. Two models

are available: 500v to 5000v or 500v to 2500v variable power supply, with electrically reset timer and register or manual reset register with no timer.

The device has a Higinbotham scale of 256 with an 8-position scale selection switch. High voltage is indicated on panel-mounted 4" meter and is controlled with coarse and fine adjustments.

The unit has a resolution time of 2μsec, and the amplifier circuit has a rise time of less than 0.2μsec. It can be used with scintillation and proportional counters, as well as with Geiger Counters. Nuclear Instrument & Chemical Corp., Dept. ED, 229 W. Erie St., Chicago 10, Ill.

CIRCLE ED-36 ON READER-SERVICE CARD FOR MORE INFORMATION

Top-liner
for Top Designers

PUSH BUTTON CASTELL
LOCKTITE HOLDER AND
CASTELL IMPORTED LEAD

- One-hand clutch operation avoids touching lead, smearing fingers or drawing.
- Exclusive collet holds lead in bulldog grip, prevents it slipping back into holder.
- Clean, balanced, efficient for every type of drawing, sketching, rendering, coloring.

CASTELL Imported Lead

18 degrees, 7B to 9H—gives more prints — cleaner and sharper prints — than any other drawing lead. Lasts 25% to 33½% longer. Black or colored. Your Drawing and Art Supply Dealer has them.

CASTELL
the drawing pencil with the Master Degrees

AW FABER-CASTELL
PENCIL COMPANY, INC. NEWARK, N. J.

CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

New MANUALLY OPERATED

COAXIAL SWITCHES

BY

TRANSCO



Fulfill the industry's need for reliable and highly efficient RF switches for all applications.

- ★ SINGLE POLE FOUR THROW, multi-circuit types.
- ★ SINGLE POLE DOUBLE THROW, flexible, general purpose type.
- ★ DOUBLE POLE TRANSFER type, extremely good cross-talk protection.

Same RF head construction and performance as famous TRANSCO remote control switches.

Compact, rugged and lightweight. Utilize type "N" connectors and can be panel or chassis mounted.

For complete specifications, write for DATA SHEET M 200.

TRANSCO PRODUCTS, INC.

12210 NEBRASKA AVENUE
LOS ANGELES 25, CALIFORNIA

CIRCLE ED-38 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products...

Miniature Relay 3-1/2 oz, dpdt Unit



This miniature, hermetically-sealed, dpdt PR-9100 Series Relay weighs 3-1/2 oz and has been designed to operate through a wide range of environments. Its perfectly counter-balanced features enable the unit to withstand high acceleration, vibration, shock, and tumbling. It meets the shock requirements of MIL-E-5400 specification and will withstand continuous acceleration of 50G's without malfunctioning.

Certain contact combinations can be furnished with a required coil power as low as 20mw, and any relay in this PR9100 series can be obtained with a coil resistance as high as 15,000 ohms. Under test, one of these relays with resistive load of 3amp at 28v d-c has performed satisfactorily for more than 1-3/4 million operations. Phaotron Co., Dept. ED, 151 Pasadena Ave., So. Pasadena, Calif.

CIRCLE ED-39 ON READER-SERVICE CARD FOR MORE INFORMATION

Rugged Phone Plug 3-Conductor Type



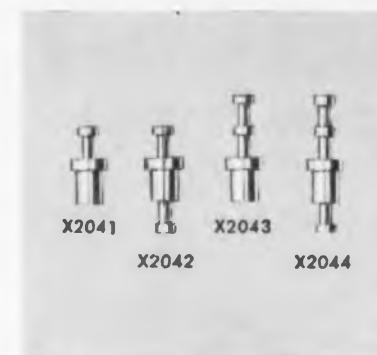
The No. 480 "Littel-Plug" has been designed for use in military communication and industrial equipment. This rugged unit has been designed in accordance with JAN-P-642 specification.

Features include a one-piece tip rod which, together with the sleeve, dead ring, and ring sleeve, are assembled into the mold as inserts, providing a finished plug with continuity of thermo-plastic insulation between all the metal parts of the plug. A 3-conductor type, the unit has a 0.2065" diam sleeve and is furnished with 3-tinned terminals fastened by screws. Switchcraft, Inc., Dept. ED, 1328 No. Halsted St., Chicago 22, Ill.

CIRCLE ED-40 ON READER-SERVICE CARD FOR MORE INFORMATION

(Advertisement)

Terminal Lugs Standard or to specifications



(Shown Double Size)

New expanded line includes every popular type: turret, split, double end, heavy duty, midget and threaded. All are silver plated brass, coated with water dip lacquer to keep terminals chemically clean for soldering. On special order, finishes available include hot-tin, electro-tin, electro-tin-lead, cadmium, gold or gold over silver.

Recent additions to the line are miniature terminals, Series X2040, shown above. These fit the same size mounting hole with no change in swaging tools, resulting in a considerable saving in assembly time. Their identical configurations permit a cleaner design.

The Series X2040 terminals will be of extreme interest to manufacturers of miniaturized equipment as this series requires a minimum of space yet provides adequate wire capacity. C.T.C. will also make, in production quantities, terminal lugs to your specifications.

All C.T.C. finishes, materials, and processes meet applicable government specifications or your own special requirements. Prompt delivery. For details and prices write: Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION

Tiny parts for the DC-6 get THOROUGH check-up with FLASH-O-LENS



Small parts for the hydraulic system of the famous Douglas DC-6 are inspected for symmetry with FLASH-O-LENS — the handy device that *lights* the work and *magnifies* it.

It will pay you to put FLASH-O-LENS to work on your inspection jobs. Built-in bulb throws light *only* on field of vision — *not* in worker's eyes. Accurately ground lens gives sharply detailed enlargement.

Write for free descriptive literature on battery-operated and plug-in types.

E. W. PIKE & COMPANY

492 NORTH AVE.

ELIZABETH, N. J.

CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION

FORD

control motors...

for extremely low inertia and high frequency response

10 Watt



Rotor Inertia
0.23 oz-in.²
Weight
4.3 lbs.

HIGH VOLTAGE MOTORS

60 Cycle, 1½ - 5 - 10 watt models
Designed specifically for electronic systems—operate directly in the plate circuit of a vacuum tube amplifier.

LOW VOLTAGE MOTORS

60 and 400 Cycle, 2½ - 5 - 10 watt models
Recommended for normal two-phase applications.

advantages

Write for Descriptive Brochure about all Ford Control Motors.

- Linear torque—voltage characteristics
- Linear torque—speed characteristics
- Withstand continuous stalling
- High torque efficiency
- Flexibility of mounting

FORD INSTRUMENT COMPANY

Division of The Sperry Corporation
31-10 Thomson Avenue, Long Island City 1, N.Y.

CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

Compare!

POWERSTAT Variable Transformer TYPE 10



... with rheostats or other resistance type controls. You will find POWERSTAT type 10 the ideal variable a-c voltage control for 50-100-150 watt loads.

RATING:
INPUT 120 volts, 60 cycles, 1 phase.
OUTPUT 0-120 volts, 0-132 volts, 1.25 amperes, 150/-165 volt-amperes.
WEIGHT 1 lb., 13 ozs.

- **EFFICIENCY** is high . . . does not control by dissipating power in the wasteful form of heat.
- **SPACE REQUIREMENT** is only 2 1/16 by 3-1/8 inches. Since it does not produce heat there is no ventilation problem.
- **CONSTRUCTION** is rugged for long life and dependable service.
- **ADAPTABILITY** to any load within its rating is possible without tailoring.
- **RATING** is conservative with the rated output current available at any brush setting.
- **MOUNTING** is simply accomplished by a single hole in the panel. It is locked in position by a keying arrangement.
- **OPERATION** is smooth, stepless and silent.
- **PRICE** is low—comparable to any other type of a-c voltage control apparatus of equal capacity and characteristics.

POWERSTAT type 10 is a compact autotransformer of toroidal core design with a movable brush-tap. Rotation of the tap delivers any output voltage from zero to, or above, line voltage. It is tapped to allow compensation for a 10% drop in line voltage.

For information, write to:
1704 Mae Ave.,
Bristol, Conn.

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT



CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION

Infrared Meter For Radiation Work



The Type DW-69 Infrared Meter is designed to measure radiant-energy intensities up to 10w per square inch. It has special applications for determining in seconds the intensity of high range, radiant-energy sources, and for studies of infrared radiation effects

concerning absorption and transmission. This pocket-sized unit is inexpensive, and its operation is simplified because no separate thermopile or other accessory equipment is needed.

The radiation receiver is a sensitive thermocouple especially designed for radiation work. A thin thermo element provides rapid response, so that the meter can be exposed for only a few seconds when making measurements. Accuracy is $\pm 5\%$ of full-scale value over a response range of 300-3500 millimicrons. General Electric Co., Dept. ED, Schenectady 5, N. Y.

CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION

Sub-Miniature Potentiometer For Precise Circuit Trimming



The Model 120 "Trimpot" Sub-Miniature Potentiometer is designed for precise circuit trimming in miniaturized equipment. Measuring 9/32" x 5/16" x 1-1/4", the unit can be ad-

justed accurately by turning the exposed slotted shaft with a screwdriver. Electrical settings are securely maintained during severe shock, vibration, and acceleration. Mounting can be done individually or in stacked assemblies with two No. 2-56 screws through the eyelets in the body.

Characteristics of the unit include a resolution as low as 0.25% over the 25-turn adjustment range, power of 1/4w, standard resistances of 250 ohms, 500 ohms, 1000 ohms, 2000 ohms, 5000 ohms, and 10,000 ohms, an acceleration of 100G's, and vibration of 5-10G's, 0-1000cy. Bourns Labs., Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE ED-46 ON READER-SERVICE CARD FOR MORE INFORMATION

MEET

JAN-I-225, 16E4 (Ships) and MIL-I-6181 Specifications for Radio Interference Suppression!

ACE SCREEN ROOMS



Pre-built

Features

1. Attenuation of 100 DB and higher from 0.15 to 10,000 MC.
2. Prebuilt, immediate installation, easy to relocate or to enlarge.
3. Standard and special types and sizes to meet practically any requirement.
4. Special filter entry and door construction.
5. Special service entrance for gas, air, water, etc., when required.

Write, wire or 'phone for details



ACE ENGINEERING and MACHINE CO., Inc.

3644 N. Lawrence St., Philadelphia 40, Pa.
Telephone: REgent 9-1019

CIRCLE ED-47 ON READER-SERVICE CARD FOR MORE INFORMATION

Where do you get your
radio frequency Connectors?

DAGE, of course!

DAGE—produces top quality RF Connectors.

DAGE—quantity production assures quick shipment!

DAGE—provides personalized attention to all my connector orders.

WRITE DAGE TODAY

DAGE



ASK FOR CATALOG 101

DAGE ELECTRIC CO., 65 N. Second St., BEECH GROVE, IND.
CIRCLE ED-48 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Sub-Miniature Rate Gyroscope

Less Than 1" diam, 2" Long



The Model 7 rugged Sub-Miniature Rate Gyroscope is less than 1" diam, 2" long, and weighs 3 oz. The small mass of its components makes it unusually insensitive to shock and vibration. Ap-

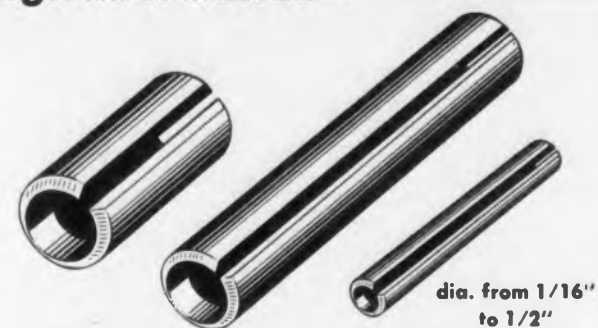
plications for the unit include aircraft instruments, guided missiles, and radar antenna stabilization.

The instrument is hermetically sealed. The rotor spins at 24,000rpm on 6.3v at 400cy. The a-c pickoff provides an output of 14mv per degree per second input, maximum output occurs at an input of 420°sec. Minimum resolution is better than 0.05°sec.

Resonation in the instrument takes place at 85cy with a 0.5 damping factor. Sanders Associates, Inc., Dept. ED, 137 Canal St., Nashua, N. H.

CIRCLE ED-50 ON READER-SERVICE CARD FOR MORE INFORMATION

Design information—



dia. from 1/16"
to 1/2"

ROLLPIN

. . . the slotted tubular steel pin
with chamfered ends

- Easily driven into holes drilled to normal production tolerances
- Self-locking . . . exerts constant pressure against hole walls
- Easily removed with drift or pin punch
- Fits flush . . . is reusable

Offers assembly-time savings over rivets, set screws, straight, serrated or cotter pins, dowels, hinge pins and many others.

WRITE for detailed catalog—Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, N. J. Address Dept. R18-457.

CIRCLE ED-52 ON READER-SERVICE CARD FOR MORE INFORMATION

IT'S **ALLIED** FOR **RCA** Authorized Distributor

ELECTRON TUBES FOR INDUSTRY

Quick, Expert Service
ALLIED stocks for quick shipment, the world's largest distributor inventory of RCA special-purpose tubes. We specialize in supplying the needs of industrial, broadcast, governmental and other users. To save time, effort and money—phone, wire or write to ALLIED for quick shipment. Fill all your electronic needs from one complete source.



ALL TUBE TYPES IN STOCK

- Vacuum Power
- Thyratrons
- Vacuum & Gas Rect.
- Ignitrons
- Cold-Cathode Phototubes
- CR Tubes
- Camera Tubes
- Monoscopes
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FREE Interchangeability Directory

Valuable guide to selection of proper RCA tube type replacements. Lists 1600 tube types. Write for Free RCA Guide No. 37-046.

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1953 ALLIED CATALOG

Refer to your ALLIED Catalog for all electronic supplies. Write today for FREE copy of the complete 236-page 1953 ALLIED Catalog.



CIRCLE ED-49 ON READER-SERVICE CARD FOR MORE INFORMATION

Bridge Indicator

For Precise Bridge Balancing



The Type 615-A Bridge Indicator permits rapid, accurate, and convenient balancing of measuring bridges. An output jack for earphones is provided to assure

precise aural nul-detection without extreme concentration or strain on the part of the operator, even in noisy surroundings.

The unit's approximately logarithmic response allows balancing from coarse to extremely fine without usual range changes. Precise visual nul-detection is provided by a large indicating meter.

Frequency response is flat from 60cy to 20Ke. Input ranges include 0-1v and 0-100v, and the instrument has a maximum output of 1v. The unit measures 9" x 6" x 11" and weighs 7 lb 11 oz, and has a built-in 117v a-c power supply. It also may be used as a tuned detector by connecting accessory filters to a filter output jack. Herman Hosmer Scott, Inc., Dept. ED, 385 Putnam Ave., Cambridge 39, Mass.

CIRCLE ED-51 ON READER-SERVICE CARD FOR MORE INFORMATION

Special TO SPECIFICATIONS—
IN ANY QUANTITY

COILS
TRANSFORMERS
PRECISION WIRE WOUND RESISTORS

We offer a complete Engineering and Manufacturing Service with emphasis on Special Applications. Small pilot runs, or full scale production executed economically and on schedule. Consult us for these products:—

COILS:	TRANSFORMERS:
High Freq. Air Core	Audio • Power
Multi-Layer Solenoids	Elevator
Peaking	High Voltage
Synchro Windings	Pulse Applications
Television RF, IF, etc.	Synchros, etc.

Experimental Samples promptly submitted,
usually without charge. Write to:

COMPONENTS MFG. DIV., Dept. ED 4

TRANSVISION, INC.
NEW ROCHELLE, N. Y. NE 6-6000

CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION

ANOTHER FAMOUS MARKET PLACE
D'Étaples (Calais)



ELECTRONIC

...brings New
Application
Information
to

You

and to a
select group
of key
**ELECTRONIC
DESIGNERS!**

*It helps make your
work easier, more
efficient and more
productive by pro-
viding valuable data
on new products,
parts, materials,
components, and test
equipment that
influence design.*

* Market Place for
Electronic Design Innovations

Medium-Mu Twin Triode

For ON-OFF Control Applications



Type 6211 is a Medium-Mu Twin Triode of the 9-pin miniature type. It is designed especially for frequency-divider circuits in electronic computers and other ON-OFF control applications involving long periods of operation under cutoff conditions.

To accomplish this control, the tube maintains its emission capabilities even after long periods of operation under cutoff conditions and thereby provides good consistency of plate current during its ON cycles. Balance of cutoff-bias between the two units is closely controlled during manufacture.

Class A amplifier characteristics include a plate voltage of 100v; a cathode-bias resistor of 470 ohms; an amplification factor of 27; a plate resistance of 7500 ohms; a transconductance of 3600 μ mhos; and a plate current of 4.6ma.

Separate terminals are provided for each cathode to facilitate flexibility of circuit arrangement, and a mid-tapped heater to permit operation from either a 6.3v or a 12.6v supply. The heater is made of pure tungsten to give long life under conditions of frequent ON-OFF switching. Radio Corp. of America, Tube Dept., Dept. ED, Harrison, N. J.

CIRCLE ED-55 ON READER-SERVICE CARD FOR MORE INFORMATION

Octal Sockets

Ceramic or Plastic Insulated



Octal Sockets, designed to JAN-S-28A specification, are now available with several variations. They can be obtained with either Grade L-4B or better ceramic insulating base, or with Type MFE low loss phenolic plastic insulation.

Mounting saddles are nickel-plated brass with four ground lugs hot-tinned for easy soldering. Saddles are available with 0.156" diam mounting holes, or with threaded extrusions for 6-32 screws. The contacts, hot tin dipped after assembly, are available in phosphor bronze or beryllium copper, silver plated.

The units are designed for maximum strength, with optimum electrical properties, resistance to corrosion, high tube retention, and good pin contact even under severe vibrating conditions. Sylvania Electrical Products, Inc., Parts Div., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE ED-56 ON READER-SERVICE CARD FOR MORE INFORMATION

SMALL PARTS can play a **BIG PART** in...

Lower Production Costs!

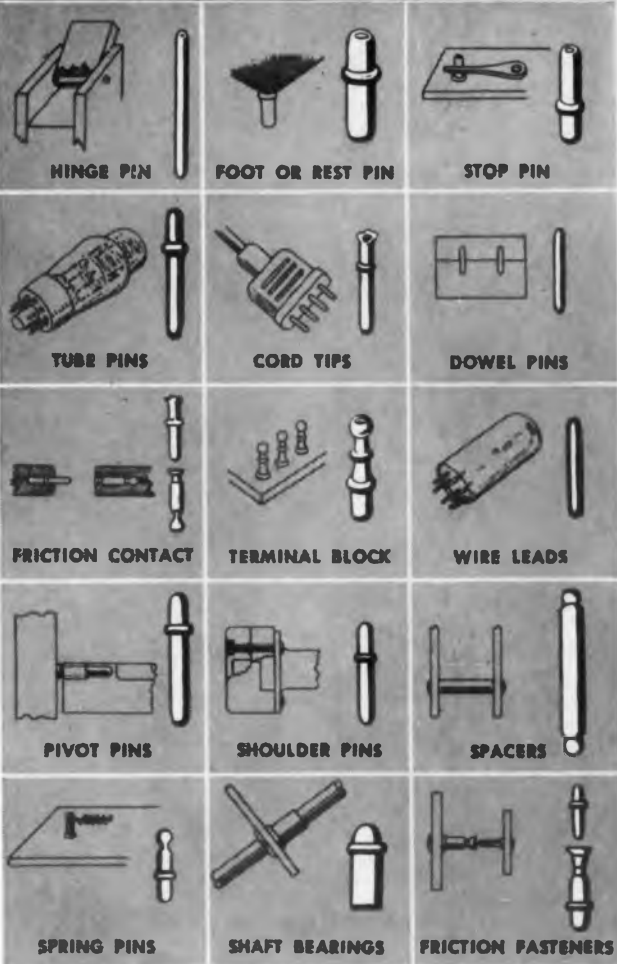


Leading manufacturers in the electronics, machinery, appliance and toy fields have been saving substantially by using precision Multi-Swage parts instead of those previously made by turning, drilling, stamping or forming.

HERE ARE ONLY A FEW TYPICAL TINY PARTS MADE BY BEAD CHAIN'S Economical, Dependable **MULTI-SWAGE METHOD**

LET BEAD CHAIN MAKE YOUR

Tiny Parts to your Specifications at far less cost!



The advanced manufacturing method developed and used exclusively by Bead Chain swages practically any type of small tubular part from flat stock into precision forms with positive, tight seams . . . and does it *Automatically*. If you can use high-volume production . . . we can deliver it at a much faster rate . . . and at far less cost! Scrap is eliminated! Deliveries to you are dependably prompt!

We can supply you with parts that are beaded, grooved, shouldered and made with almost any metal. Diameters up to 1/4", lengths to 1 1/2"

This catalog can save you a lot of production time and money! Write for it



GET PROOF-POSITIVE COST COMPARISONS!

Send us a blueprint or sample and quantity requirements. We will quickly show you the big economies we can deliver.

BEAD CHAIN

Original and World's Largest Producer of Bead Chain



THE BEAD CHAIN MFG. CO.
BRIDGEPORT 5, CONNECTICUT

Please send me your Catalog of Multi-Swage Parts

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

KEY NO. 58

THE BEAD CHAIN MANUFACTURING CO., BRIDGEPORT 5, CONN.

**first
in
stainless
steel
fastenings**



In the *ELECTRONICS* industry, buyers have learned to depend on ANTI-CORROSIVE for fast, dependable service on all types of stainless steel fastenings. Draw on our IN STOCK inventory of more than 7,000 items and sizes and a production capacity geared to produce precision fastenings in large or small quantities, from huge $\frac{7}{8}$ " hexagon head bolts to tiny #0-80 machine screw nuts.

Write for Catalog 53J today.

anti-corrosive metal products co., inc.
castleton-on-hudson, new york

New Literature . . .

Sound Measuring Devices 59

A 12-page, 2-color bulletin presents information on the company's sound measurement equipment, including a sound-level meter, vibration measurement instruments, calibrators, power supplies, and survey meters. Each item is illustrated and specification and application information is presented. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Printed Circuits 60

A 4-page, 2-color brochure describes the company's printed circuit process for wiring assemblies, electronic calculators, v-h-f and u-h-f tuner plates, etc. Photographs illustrate the various types of circuits, and a description of the construction and operation of these circuits is provided. Circuitron, Inc., 400 Ninth St., Hoboken, N. J.

Paper Capacitors 61

An 18-page catalog is available describing the company's line of paper dielectric capacitors. The information provided includes temperature characteristics, specifications, and general applications. Charts, photographs, and diagrams also are included. National Capacitor Co., 585 Washington St., Quincy 69, Mass.

Electrical Connectors 62

An 8-page bulletin, consisting of data sheets, presents specification data on the company's line of terminals, multiple electrode sealed headers, and glass sealed tubes, available in various types of glass and metal finishes. Circuit diagrams and photographs provide further information. Hermaseal Co., Inc., Elkhart, Ind.

Tantalum Capacitors 63

A 4-page technical bulletin describes the company's Type XT tantalum electrolytic capacitors, designed for extreme temperature electronic applications. Circuit diagrams illustrate dimensional and mounting data. Electrical characteristics are described, along with information on capacity tolerance, leakage current, d-c working voltage, shelf life, as well as various other technical data. Photographs and charts provide additional information. P. R. Mallory & Co., Inc., Indianapolis 6, Ind.

Resistors and Rheostats 64

A 13-page, 2-color catalog describes and illustrates the company's products: power rheostats, fixed resistors, adjustable resistors, resistor mountings, etc. Technical and engineering data are included and illustrated by graphs, charts, resistor mounting diagrams, etc. Tru-Ohm Products, Div. of Model Engrg. & Mfg., Inc., 2800 North Milwaukee Ave., Chicago 18, Ill.

Electric Controllers 65

Catalog 1530 (56-page, 2-color) describes the company's "Electronik" controllers, with illustrations of the various types of instruments used to measure and control a multiplicity of process variables. Included are detailed specification and control action descriptions and ratings for both electric and pneumatic type controllers. Engineering data on the company's electric control relays are also included. This catalog is punched for convenient reference filing. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Station 64, Wayne and Windrim Aves., Philadelphia 44, Pa.

Sealed Relays

66

A 4-page, 2-color brochure describes the company's "Diamond H", Series R aircraft-type, hermetically-sealed relays, which meet all requirements of military specification MIL-R-5757. Application data are provided, as well as specifications that include contact rating, inductive, special ratings, temperature, shock and vibration, speed of operation, etc. Photographs, dimension drawings, wiring diagrams, and charts provide additional information. Hart Mfg. Co., Hartford 1, Conn.

Galvanometers

67

Various types of pointer and mirror galvanometer movements are described and illustrated in this 4-page, 2-color brochure. Photographs and circuit diagrams illustrate the construction and function of these types, and charts provide further specification data. G-M Laboratories, Inc., 4300 No. Knox Ave., Chicago 41, Ill.

Photoelectric Recorders

68

A 12-page, 2-color bulletin, No. GEA-5536, describes applications of the photoelectric recorder for fatigue and research testing, light-intensity study, etc. A listing of the recorder's typical rating is included, and photographs, charts, and circuit diagrams provide numerous illustrations. General Electric Co., Schenectady 5, N. Y.

Laboratory Equipment

69

This 28-page, 2-color brochure describes and illustrates the company's laboratory equipment. Such units as attenuation networks, decade resistance boxes and individual resistance units, volume level indicators, transmission measuring sets, noise and distortion meters, output power meters, are detailed with photographs, descriptive copy, technical data, and diagrams indicating specifications, impedances, etc. Daven Co., Dept. LE, 191 Central Ave., Newark 4, N. J.

Nickel Alloys

70

"66 Practical Ideas" is a 40-page, 2-color bulletin describing the "Inco" nickel alloys, which have been designed to meet resistance to corrosion, heat, fatigue, and abrasion in electronic and electrical products. The problems dealt with in selecting a metal are operating temperatures over 400°F, corrosion, springs, vibration stamina, spark erosion, and magnetostriction. The types of alloys described are "Monel", "Inconel", "Permanickel", and "Duranickel". Numerous photographs illustrate the various applications for these alloys. Tables illustrate physical constants, average mechanical properties, alloys and available mill forms, etc. International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Oscilloscope

71

The Model 401 Oscilloscope is described and illustrated in this 8-page, 2-color bulletin. This high gain, wide band instrument, capable of quantitative measurements of high and low speed electrical phenomena, is suited for the precise examination of pulse waveforms and transient phenomena, as well as for customary oscilloscope applications. Electrical, mechanical, and general features of this model are listed, and performance features and specifications are described. Laboratory for Electronics, Inc., 43 Leon St., Boston, Mass.

Molded Rubber Parts

72

"Molded and Extruded Parts of Natural and Synthetic Rubber" is the title of an 8-page, 2-color catalog describing the company's various types of molded and extruded rubber parts. A dozen molded parts are described and illustrated in detail, and application information for each is provided. Two charts are included: one is a key to rubber and synthetic rubber compounds for automotive and aeronautical applications; the other shows the relative properties of natural and synthetic rubbers. Tyler Rubber Co., Andover, Mass.



we don't shrink heads...
but we do shrink

Transformers!

If you think Jivaro Indians were experts at shrinking things . . . (human heads, that is) . . . look what STANCOR engineers have done with transistor transformers! Recently they designed and are now producing the smallest transformer ever built!

How big is this new transformer? Well, it's just $\frac{1}{4}$ " x $\frac{3}{8}$ " x $\frac{3}{8}$ " and it weighs only 0.07 ounce. Designed especially for transistor applications, this unit is no larger than the transistor it powers.

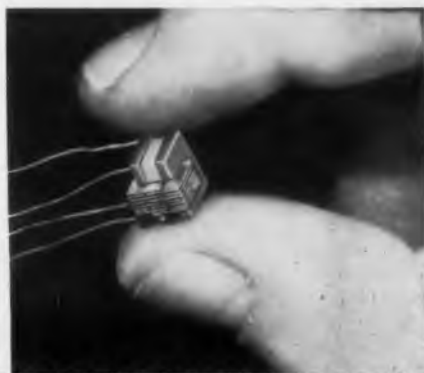
It is one of a series of transistor transformers, being built by Stancor, for development and commercial applications. If you are planning to use transistors, take advantage of Stancor's knowledge of engineering and manufacturing of ultra-miniature transformers.

STANCOR TRANSISTOR TRANSFORMERS

These stock transistor transformers are available through your Stancor distributor:

TYPE	APPLICATION	PRI. IMP.	SEC. IMP.
UM-110	Interstage	20,000	1,000
UM-111	Output or matching	1,000	60
UM-112	High imp. mic. to emitter	200,000	1,000

Other transistor transformers, built to your special requirements, are available for original equipment production only. Write for Bulletin 462.



STANCOR TINYTRANS Miniature, cased audio transformers

Here are four new cataloged high fidelity transformers for use where space is at a premium. These units have a frequency response of ± 1 db, 30-20,000 cps. They are impregnated and sealed in a $\frac{3}{4}$ " square, drawn aluminum can, with $\frac{1}{8}$ " terminals mounted on a phenolic terminal board. Total height is $1\frac{1}{4}$ ".

TYPE	APPLICATION	PRI. IMP.	SEC. IMP.
TT-11	Mic., pickup or line to single grid.	50, 200/250, 500/600	50,000
TT-12	Mic., pickup or line to push-pull grids.	50, 200/250, 500, 600	50,000
TT-13	Dynamic mic., to single grid.	7.5/30	50,000
TT-14	Single plate to single grid.	15,000	60,000



Ask your Stancor Distributor for Bulletin 463 on Stancor Tinytrans, or write us for your free copy.



STANDARD TRANSFORMER CORPORATION

3576 ELSTON AVENUE • CHICAGO 18, ILLINOIS

EXPORT SALES: Roburn Agencies, Inc., 39 Warren Street, New York 7, N. Y.

When You Think of
TOROIDAL COMPONENTS...

Think of
COMMUNICATION
ACCESSORIES CO.



UNCASED COILS ADJUSTED TO YOUR SPECIFICATIONS

A wide variety in physical size, power capacity and frequency range is offered. Coils are wound to comply with customers' requirements and specifications. Engineering assistance and suggestions are offered without charge.

Coils may be supplied to a tolerance of plus or minus one percent, or matched to a standard inductor to a tolerance of one-tenth percent, or one turn.

Coils may be supplied with temperature coefficient of 180 parts per million per degree Centigrade, or may be supplied with 0° C. coefficient through a limited temperature range.

MOISTURE PROOF PLASTIC COATED TOROIDS

To eliminate the possibility of damage to the exposed winding during assembly, we offer toroids coated with tough thermal setting plastic coating. These coated toroids are recommended where coils are subject to high humidity and where coils must be mechanically mounted. Plastic coating is available in all types of toroidal coils.

STEEL CASED TOROIDS AND FILTERS

C.A.C. engineers, with years of experience in the design of filter networks are at your service to design or help you design the proper networks for your requirements. Where space requirements are severe, filters may be miniaturized by the use of wedding ring toroids and special capacitors. Typical filter cases are shown. However, cases may be fabricated to your specifications.

Write for our
latest catalog



COMMUNICATION ACCESSORIES
Company

HICKMAN MILLS, MISSOURI

New Literature . . .

Reflex Klystrons 75

Four types of reflex klystrons (broad-band microwave oscillator tubes), are described in this 18-page, 2-color brochure. Specifications for these klystrons are presented, along with mechanical, electrical, and operating data. Photographs, charts, and circuit diagrams provide further illustration. Sylvania Electric Products, Inc., Electronics Div., 1740 Broadway, New York 19, N. Y.

Cases and Covers 76

A 6-page, 3-color, foldover catalog and supplements list the company's precision drawn standard cases and covers, including square, round, rectangular, and special shapes. Specifications for each type are provided, and circuit diagrams and photographs illustrate their construction. The supplementary sheets contain additional information on the various types and shapes of cans and covers. Hudson Tool & Die Co., Inc., 118-122 So. 14th St., Newark 7, N. J.

Silicone Rubber 77

Bulletin No. CDS-13, titled "Silicone Rubber: A New Insulating Material for Wire and Cable", is an 8-page bulletin reprinted from an article by M. G. Noble, one of the company's silicone engineers. A description of the processing of silicone rubber and property data are illustrated with charts and tables. A section on applications deals with the use of the heat and flame resistant material for Navy and ignition cable. General Electric Co., Chemical Div., Pittsfield, Mass.

Potting Compounds 78

A catalog, consisting of a number of technical bulletins issued by the company, describes its adhesives and potting compounds, including anti-corrosion coatings. Specifications and properties for these materials are included, along with operating factors, applications, etc. Houghton Labs., Inc., Olean, N. Y.

Pulse Generator 79

Bulletin B-2 is a 6-page, 2-color, fold-over brochure describing the company's Model B-2 pulse generator. Specifications for the instrument are provided, including external trigger input, synchronizing pulses, internal delay, main pulse, and controls. Rutherford Electronics Co., 3707 So. Robertson Blvd., Culver City, Calif.

Terminal Blocks 80

A 12-page, 2-color brochure describes and illustrates the company's types of terminal blocks for use in radio, radar, electronic equipment, etc. Among the types described are screw type terminals, eyeletted solder terminals, etc. Circuit diagrams, dimensional drawings, charts, and photographs illustrate each type. Also included are descriptions of marker strips and jumpers which can be used on the blocks. Kulka Electric Mfg. Co., Inc., 633-643 So. Fulton Ave., Mt. Vernon, N. Y.

Precision Resistors 81

This 6-page, 2-color brochure contains descriptive material on precision wire wound resistors, hermetically sealed resistors, and miniature resistors. Individual charts, diagrams, and tables provide technical information, including wattage dissipation, tolerances, temperature coefficients, and maximum resistance values with different types of wire, physical dimensions, and types of mounting. The Daven Co., Dept. RB, 191 Central Ave., Newark 4, N. J.

Precision Potentiometers 82

This 4-page, 2-color brochure provides information about this company's Series L-400 precision potentiometers. Applications and specifications of these instruments are listed and illustrated by photograph and diagram. Features are described, including electrical and mechanical rotation information, resistance accuracy, power ratings, contact materials, weight, case, mountings, vibration, temperature, and humidity. DeJur-Amseo Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

79 **Analog Data Recorder** **83**

A 4-page, 2-color brochure describes the company's analog data recorder, that provides visual or printed records of a physical quantity converted into a corresponding voltage. Typical applications are listed, along with specifications data. Diagrams and photographs illustrate the operations of the instrument. Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

80 **Wiring Assemblies** **84**

Catalog D-1 provides information on the company's electrical connectors and wiring assemblies, for use in aircraft, ordnance, and electronic equipment. The types of units described are "AN" connectors, ordnance connectors, wiring assemblies, and other wiring components. The devices are illustrated by photographs and circuit diagrams. Specifications for each type are provided. Monowatt Dept., General Electric Co., Providence 7, R. I.

81 **Loudspeakers** **85**

This 4-page, 3-color catalog contains information on all the company's speakers, including the new high-fidelity speakers and speakers for auto, PA, intercom, outdoor, radio and TV, portables, permanent magnet, and electrodynamic applications. Illustrations of the various speakers are included. Oxford Electric Corp., 3911 South Michigan Ave., Chicago 15, Ill.

"Mycalex" Insulation **86**

This 24-page, 2-color, "Engineers Handbook and Catalog", presents a listing and description of "Mycalex" insulation products. Outstanding properties are presented, along with data and specifications, design, electrical and mechanical properties, sizes and weights, of the various molded and machined insulators. Tables and photographs provide further illustration, as well as circuit diagrams. Some of the products described in the catalog are hermetic seals, synthetic mica for formulations, tuning coils, relay spacers, and transistor sockets. Mycalex Corp. of America, Clifton Blvd., Clifton, N. J.

Mercury Plunger Relays **87**

A 4-page catalog describes and illustrates seven types of mercury plunger relays. Typical features of these devices are indicated, along with information on coil voltages, dimensions, operating characteristics, and other technical specifications. Ebert Electronics Co., 185-09 Jamaica Ave., Hollis 7, N. Y.

Electrical Resolvers **88**

This 4-page, 2-color brochure illustrates and describes this company's resolver systems for use in computers and computing systems. This system is compounded of a summing network box, a high-gain computing amplifier, and a resolver. The two types described in this brochure are the basic resolver and the vector solver. Circuit diagrams illustrate the construction and operation of the systems, and charts provide power supply data for amplifiers, and ratings and technical data. Ford Instrument Co., Div. of the Sperry Corp., 31-10 Thomson Ave., Long Island City 1, N. Y.

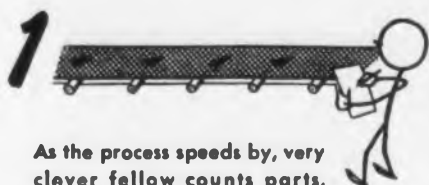
Industrial Triodes **89**

Characteristics, technical data, and applications of three 2-5kw industrial triodes (Types ML-6556, ML-6257, and ML-6258) are covered in one of the articles appearing in the Vol. 10, No. 1 (1953) issue of the *Cathode Press*. A high voltage x-ray tube, a betatron for cancer treatment, a new super power transmitter for the "Voice of America", and an article on communication transmitters also appear in the issue. Machlett Labs., Inc., Springdale, Conn.

Electronic Components **90**

Supplement No. 133 has been added to the company's 1953 Catalog No. 131. Consisting of 48 pages, the supplement features new popular electronic components, parts and equipment. The items listed include phonographs, high-fidelity equipment, picture tubes, transistors, diodes, industrial and service test units, converters, etc. An index is provided. Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.

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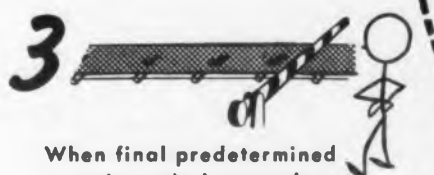
1 As the process speeds by, very clever fellow counts parts, inches, revolutions or machine operations up to 60,000 per minute without a mistake . . .

with a



2 At a precise preselected count short of the total, alert foreman signals for reduced speed or other preliminary control action . . .

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3 When final predetermined count is reached, gates close, shears cut or other machine control takes place — on the fly, without stopping . . .



4 With operation completed, tireless manager instantaneously calls for complete recycle without missing a count.

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without human error

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0.002% per degree C, above 100 ohms.
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New Literature . . .

Attenuators 93

The 12-page, 2-color pamphlet covers many types of the company's r-f and video attenuators. Units such as variable attenuators, fixed attenuators, impedance matching networks, decade attenuator units, attenuation networks, and components in the 10Mc and 225Mc range, are detailed with pictures, descriptive copy and diagrams as to types, specifications, impedances, etc. The Daven Co., Dept. RF, 191 Central Ave., Newark 4, N. J.

Precision Metal Parts 94

A 4-page catalog lists the company's small precision metal parts, including special pins and pivots, screw driver blades, all types of rotary swaged rods, wires and tubing in practically all kinds of metals, abrasive points and polishing metals, perforating punches, and tapered or pointed wires, etc. Torrington Co., 500 Field St., Torrington, Conn.

Solders 95

Catalog No. 52-A is a 4-page, 2-color bulletin covering the company's regular solder products, available in all standard alloys for radio, electrical, electronic, radar, and similar applications. The various types of solders described and illustrated include bar, wiping, drop or segment, ribbon, pig, spray gun, and body solders, Anchor Metal Co., 244 Boerum St., Brooklyn 6, N. Y.

Packaged Speed Drive 96

"Thy-mo-trol" (thyatron motor control) is described in two 4-page, 2-color bulletins, GEA-5827 and GEA-5829. A simplified drive for 3/4hp to 3hp applications is discussed in bulletin GEA-5829, and bulletin GEA-5827 describes a drive for 3/4hp to 10hp. Photographs and diagrams illustrate the system that is designed for use on testing equipment and other applications. General Electric Co., Schenectady 5, N. Y.

Tachometer 97

A 16-page, 2-color booklet, No. 197, describes the company's "Strobo-Check" Tachometer, a precision instrument for measuring speed of rotation and checking such speed against a standard. Various parts of the instrument are described and illustrated by circuit diagrams, and other instruments also are featured. Service tables, parts lists and a disc chart are included. Standard Electric Time Co., 89 Logan St., Springfield, Mass.

Integrator 98

This 4-page bulletin describes the company's electro-mechanical integrator, which has application in the integration of stress strain curves, analysis of graphical data, totalizing illumination, integration of rocket thrust, continuous process weighing, etc. Information provided includes a general description, principle of operation, and specifications. Instron Engineering Corp., 2 Hancock St., Quincy 71, Mass.

Cooling Devices 99

A 60-page, loose-leaf catalog describes the company's line of cooling devices for electronic equipment. The various items described include blowers, fans, heat exchangers, tube supports, airflow switches, and auxiliaries. Photographs, charts, and diagrams are included, as well as engineering data, application notes, and tube data. The catalog is organized according to specific types of information and items for convenient reference. Rotron Mfg. Co., 7-9 Schoonmaker Lane, Woodstock, N. Y.

Connector Assembly 100

"OK Methods" is the title of a 40-page, 2-color brochure (Manual C3) describing assembly and wiring of electrical connectors and components. The devices described include power plug assemblies, audio plugs, cable assemblies, removable contacts, multiple wire coding, flexible conduits, connector assemblies, etc. The booklet is a revised version of a World War II manual, greatly expanded and brought up to date. American Phenolic Corp., 1830 S. 54th Ave., Chicago 50, Ill.



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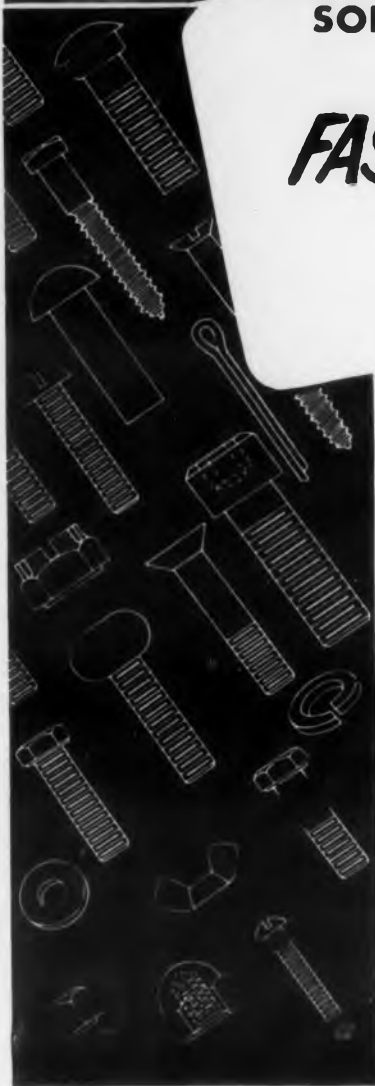
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Patents . . . By John Montstream

Timing Circuit . . . Patent No. 2,622,195.
J. W. Smith, Cedar Rapids, Iowa. (Assigned to Collins Radio Co.) See Fig. 1.

The timing circuit covered in this patent has particular application to control apparatus which has a release time different from the connect time. For example, it may be desirable to energize a relay immediately upon closing of a switch, and have the relay remain energized for a predetermined time after the switch is opened. With such a circuit, momentary opening of the switch will not cause the relay to drop out.

With the switch S_1 open, the grid 17 of the second triode V_2 is negative and the capacitor C is charged negatively. Thus with the grid and cathode negative, this triode is non-conducting. Since the grid 16 of the first triode V_1 is connected with the cathode and capacitor of the second triode, it too is non-conducting or essentially so and the control device is unactuated. If the switch is closed, the grid 17 of the second triode V_2 is connected to ground so that it goes positive with respect to the cathode, and the capacitor is immediately discharged through triode V_2 . With the

potential on the capacitor going rapidly to ground potential, the grid 16 of the first triode V_1 rises rapidly to ground potential so that the triode V_1 is rendered conducting and the control device 11 is actuated.

If the switch S_1 is opened, the second triode is immediately cut off, but the first triode continues to be conducting until the capacitor C is negatively charged sufficiently to bias its grid and cut off the triode V_1 . The time constant of the capacitor C and resistor R_2 determines when the first triode V_1 is cut off, which may be three or four seconds after the switch is opened. If then the switch is again closed within this time interval, the control device remains actuated.

AFC Circuit for Television . . . Patent No. 2,622,146. *C. G. Sontheimer, Riverside, Conn. (Assigned to Radio Corp. of America.)*

An AFC (automatic frequency control) for a superheterodyne TV receiver in which the carrier is frequency modulated is the subject of the patent. Such TV signals are asymmetrical or of varying wave

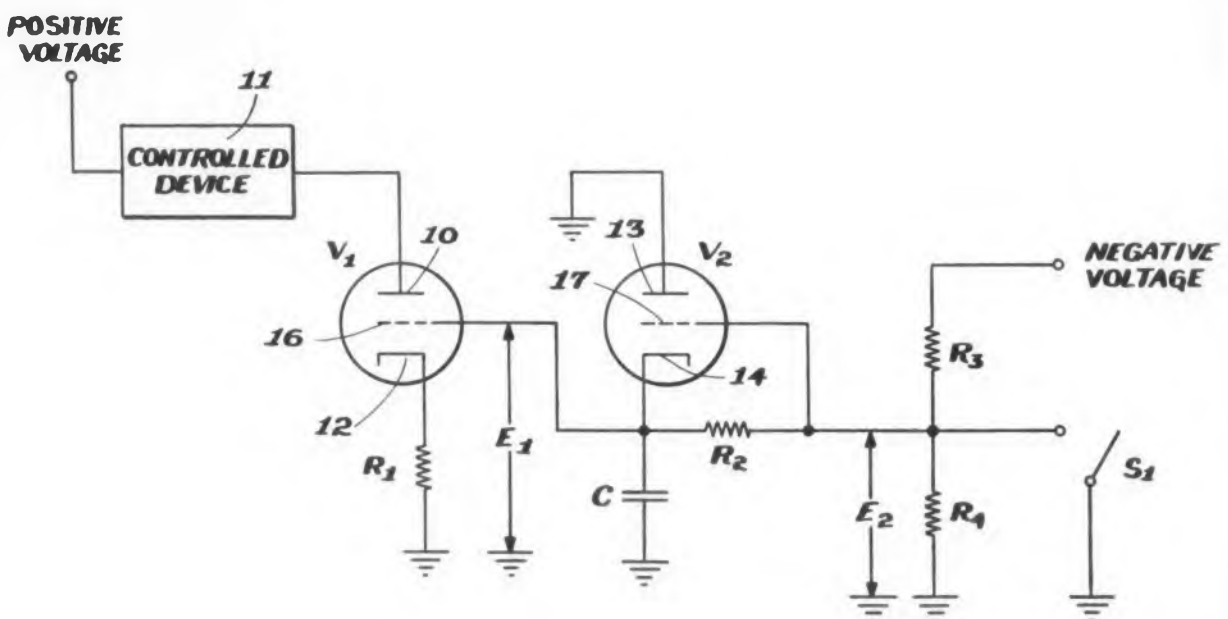


Fig. 1. Timing circuit for control applications.

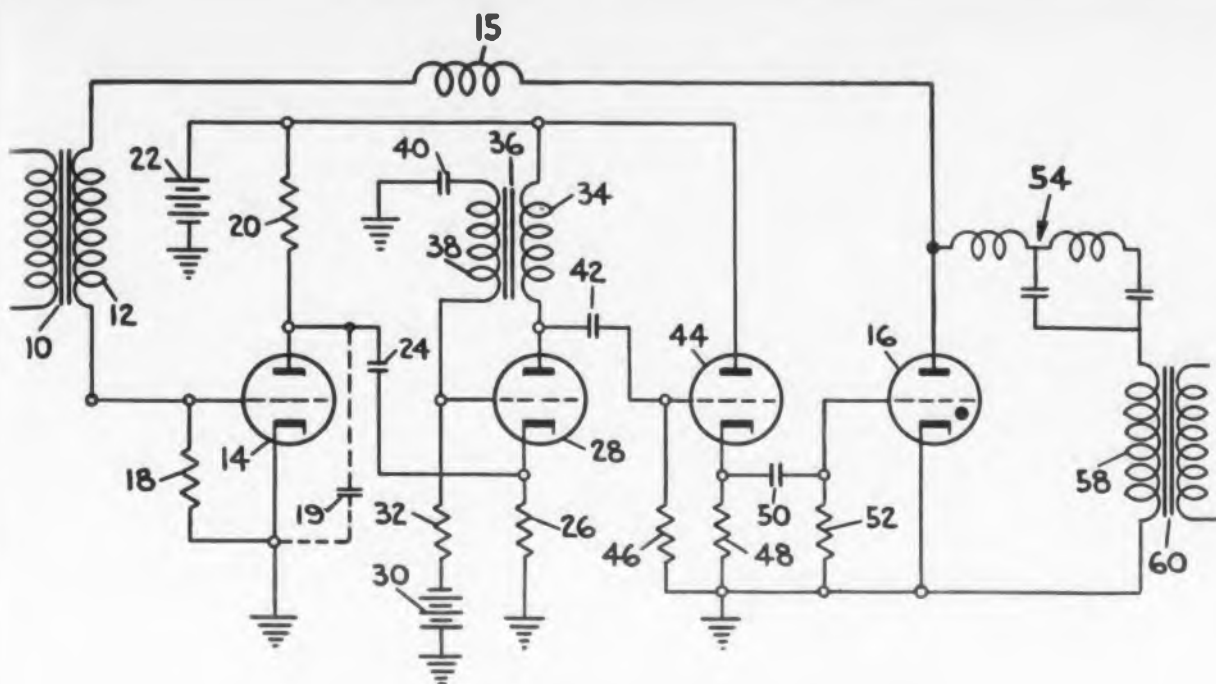


Fig. 2. Pulse forming circuit useful in radar systems.

form and the alternating current axis does not stay relatively fixed but shifts from one edge of the transmission band to the other, depending upon the image content and the average light condition of the scene. Because of this shift, the conventional discriminator for automatic frequency control of a local oscillator is unsatisfactory without making the band width excessively wide.

In the patented circuit, the discriminator responds to the intermediate frequency which is present in the receiver during the transmission of the synchronizing pulses, and hence is unaffected by the fact that the alternating current axis of the signal does not remain relatively fixed. The AFC potential is generated from the i-f amplifier by a pair of discriminators. One of these has a rising characteristic with a midpoint frequency corresponding with the frequency present during the synchronizing pulse. The other responds uniformly to all frequencies throughout the transmission band.

Each discriminator utilizes a triode having a tuned circuit connected in the plate circuit of each tube. Each tuned circuit is transformer-coupled to a diode having a load resistor connected with the cathode. The control potential is developed across the two resistors, and the characteristics of the discriminators are chosen so that the differential is zero when the receiver is properly tuned so that no automatic control potential is developed. If there should be a deviation, a control potential is de-

veloped which in turn controls the i-f oscillator to restore the receiver to properly tuned condition.

Pulse Forming Circuit . . . Patent No. 2,625,652. S. T. Krulikowski, Jr., Detroit, Mich., et al. (Assigned to Bendix Aviation Corp.). See Fig. 2.

This invention is a pulse forming circuit having general applicability, but finding particular usefulness in radar range systems because of the preciseness with which the pulse is produced in the cycle of alternating voltage, the optimum shape of the pulse, and the freedom from outside interference.

The circuit uses a network which forms a resonant charging circuit, and a thyatron tube shunts this circuit and a pulse transformer. When the thyatron is triggered the charging circuit is discharged through it to form the desired pulse.

The triggering circuit shown employs three tubes and a thyatron. The first tube is a clipping amplifier which produces a plate pulse having a sharp trailing edge, the pulse being differentiated to give a sharp and large triggering signal. The second tube serves as a blocking oscillator to amplify and sharpen the triggering signal. The third tube provides a cathode follower stage which is connected with the grid of the thyatron.

The thyatron is in effect a switch which is closed when triggered to discharge the charging network.

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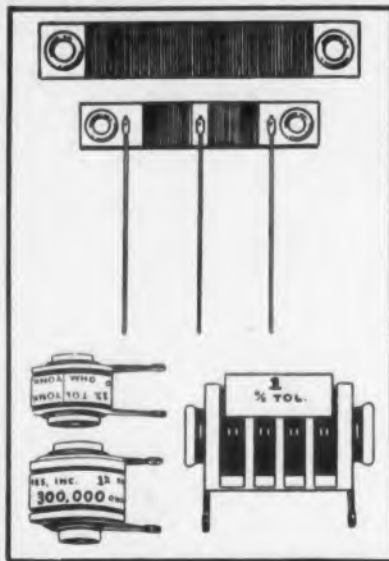
Working experience in advanced techniques employing the above fields will increase your value to the Company as it further expands in development of electro-mechanical devices. Large-scale use of electronically controlled systems in business and industry is a certainty within the next few years.

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RB 10	1/4	.5	1-5/32	9/16	.1 OHM	.75	.185
RB 11	1/3	1.0	%	%	.1 OHM	1.5	.30
RB 12	1/2	1.0	1	%	.1 OHM	4	.30
RB 13	1/2	1.0	1-9/32	3/4	.2 OHM	7.5	.75
RB 14	1	2.0	2-1/32	%	.5 OHM	15.0	4.0

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Tolerance: Standard tolerance 1%. Any tolerance within $\pm 0.01\%$ can be supplied at slight added cost.

Temperature Coefficient: Standard .02%/°C. wire with a coefficient of .002%/°C. can be supplied upon request.

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Meetings

Apr. 16-17: 9th Joint Conference of RTMA of United States and Canada, Ambassador Hotel, Los Angeles, Calif.

Apr. 18: IRE Seventh Annual Spring Technical Conference, Cincinnati, Ohio.

Apr. 26-30: SMPTE (Society of Motion Picture and TV Engineers) 73rd Convention, Hotel Statler, Los Angeles, Calif.

Apr. 27-May 8: British Industries Fair, Birmingham & London, England.

Apr. 28-May 1: NARTB (National Assn. Radio and Television Broadcasters) 1953 Convention, Biltmore Hotel, Los Angeles, Calif.

Apr. 29-May 1: Electronic Components Symposium, Shakespeare Club, Pasadena, Calif.

May 11-13: 1953 National Conference on Airborne Electronics, Hotel Biltmore, Dayton, Ohio.

May 18-21: 1953 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

May 18-23: 3rd International Congress on Electro-heat, Paris, France.

May 24-28: NAED (National Assn. of Electronic Distributors) 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

May 24-28: Scientific Apparatus Makers Assn. Annual Meeting, The Greenbriar, White Sulphur Springs, W. Va.

June 15-19: AIEE Summer General Meeting, Chalfont-Haddon Hotel, Atlantic City, N. J.

June 15-19: Exposition of Basic Materials for Industry, Grand Central Palace, New York, N. Y.

June 16-24: International Electro-acoustics Congress, The Netherlands.

June 20-Oct. 11: German Communication and Transport Exhibition, Munich, Germany.

Aug. 19-21: WESCON (Western Electronic Show and Convention), San Francisco Municipal Auditorium, San Francisco, Calif.

Aug. 29-Sept. 6: West German Radio and TV Exhibition, Duesseldorf, Germany.

Sept. 1-4: AIEE Pacific General Meeting, Hotel Vancouver, Vancouver, British Columbia, Canada.

Oct. 26-28: RTMA-IRE Radio Fall Meeting, Toronto, Ontario, Canada.

Nov. 2-6: AIEE Fall General Meeting, Muehlebach Hotel, Kansas City, Mo.

1954

Jan. 21-23: SPE (Society of Plastics Engineers) 9th Annual Technical Conference, Hotel Statler, Boston, Mass.

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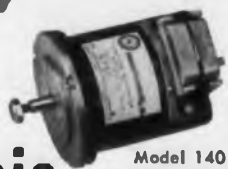
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New Books . . .

Development of the Guided Missile . . . By Kenneth W. Gatland. 133 pages, *The Philosophic Library, Inc.*, 15 E. 40th St., New York 16, N. Y. \$3.75.

This interesting volume is a brief survey of the evolution of guided missiles. Originally a series of articles in the British Journal *Flight*, the material has been fully revised. It contains a great deal of information of interest to workers in the field as well as those wishing to know something of the subject.

The introduction contains a commentary on the problems of defense against long range supersonic rockets. Some new information is cited on rocket armament for aircraft, and the appendix contains a table summarizing all the available information on more than 80 guided missiles.

The Second Audio Anthology . . . Edited by C. G. McProud. 124 pages, *Radio Magazines, Inc.*, Mineola, N. Y. \$3.00 (board cover); \$2.00 (paper cover).

This anthology, like its well known predecessor, is a compilation of a number of popular articles that have appeared in *Audio Engineering* since the last anthology was published. It contains almost 50 articles published during the period from January 1950 to July 1952. Errors in the original articles have been corrected, and a number of articles have been brought up to date. Subject matter is of interest to experimenters and audio hobbyists (and they are legion among electronic designers). The book is well worth having, as many back copies of *Audio Engineering* are difficult to obtain.

Numerical Methods in Engineering . . . By Mario G. Salvadori and Melvin L. Baron, 258 pages, *Prentice-Hall, Inc.*, 70 Fifth Ave., New York 11, N. Y. \$7.15.

The purpose of this book is to introduce the practicing engineer to those elementary numerical techniques which are used most often in the solution of technical problems. The five chapters of the book deal with the solution of high degree and simultaneous linear algebraic equations; elementary theory of finite differences and its application to numerical differentiation, integration, interpolation, and extrapolation; solution of ordinary initial-value problems; solution of ordinary boundary and characteristic value problems; and the solution of problems involving partial differential equations of the boundary, characteristic, and mixed types. It is assumed that the reader has a knowledge of the calculus and a smattering of differential equations.

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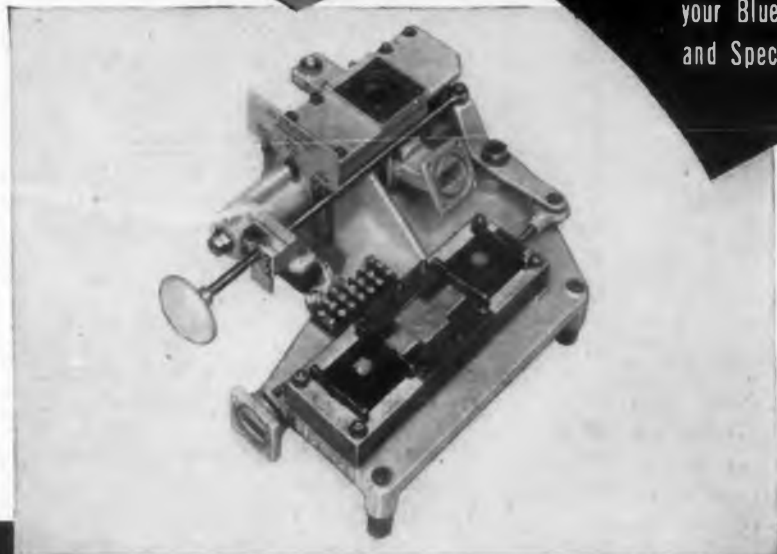
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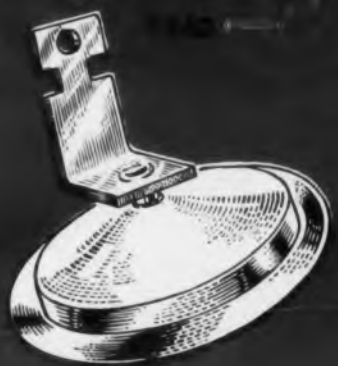
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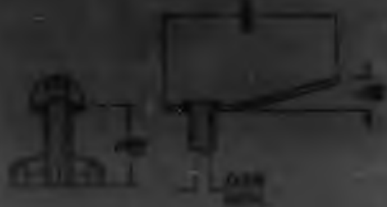
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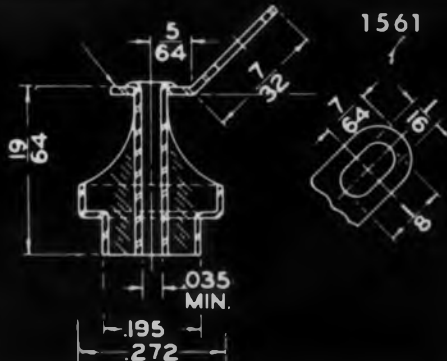
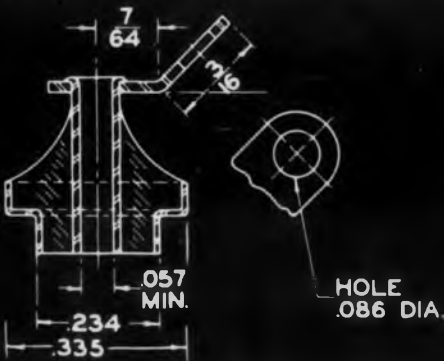
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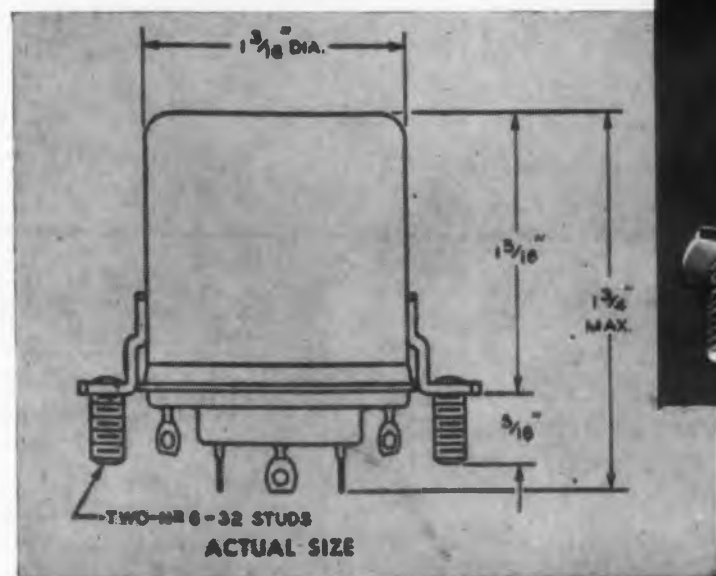
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