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TORONTO, CANADA

AUGUST 1958



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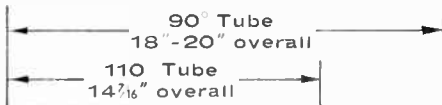
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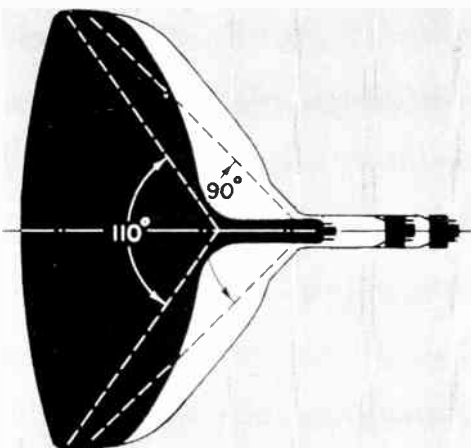
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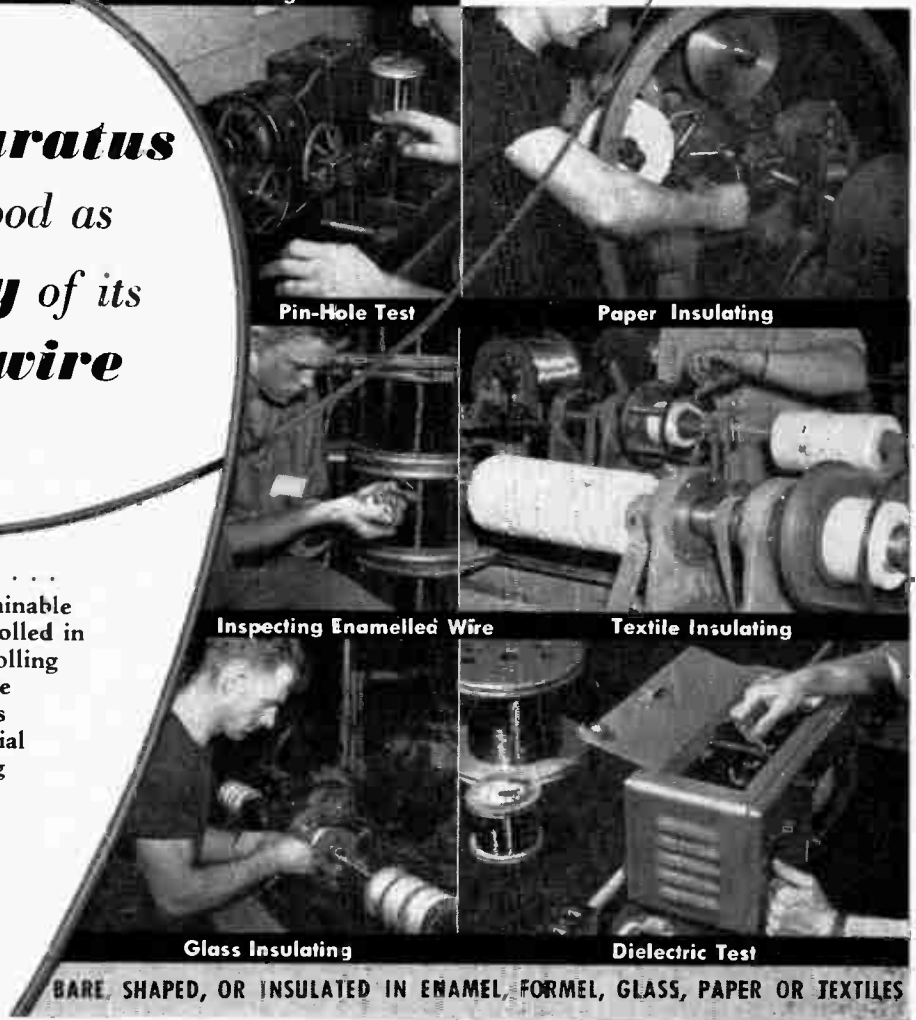
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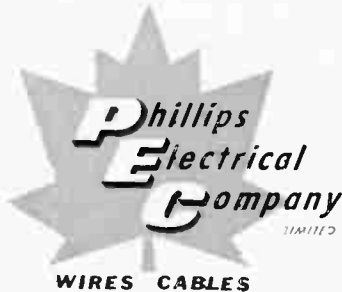


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For further data on advertised products use page 59.



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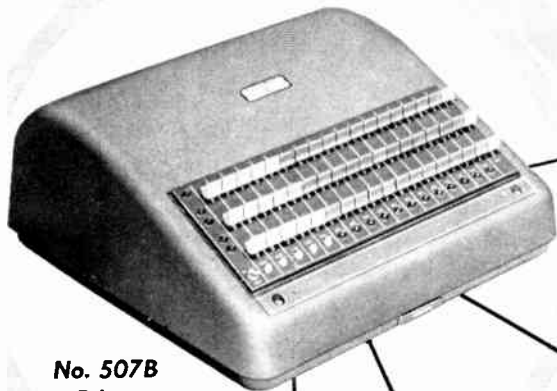
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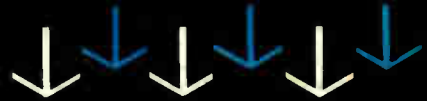
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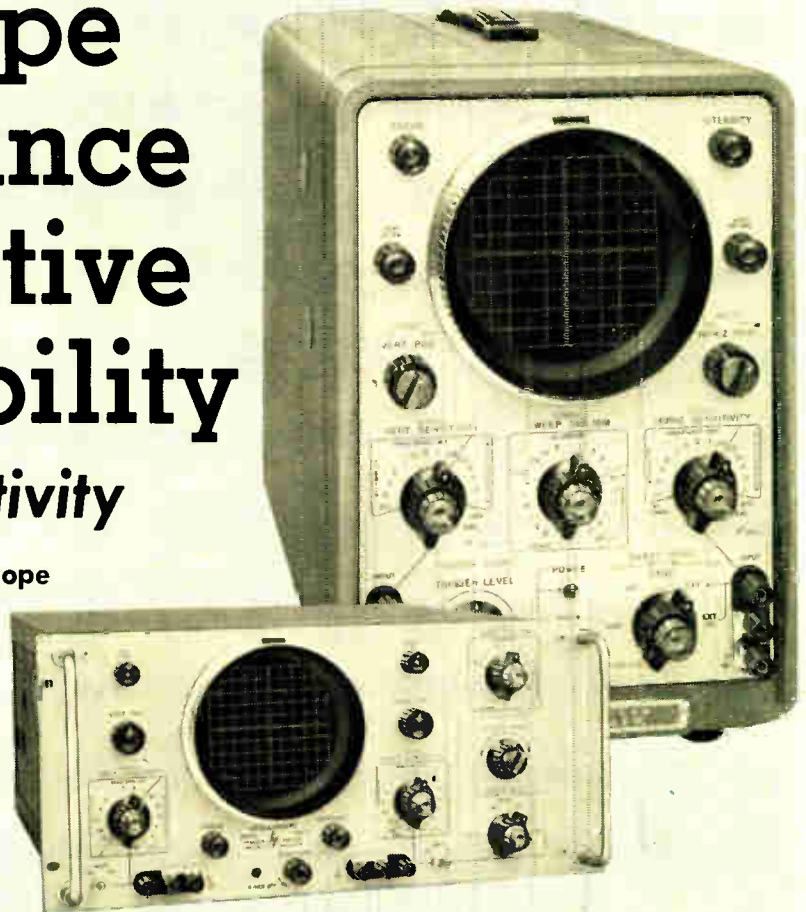
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For further data on advertised products use page 59.

editorial

U. K. Atom Power For Canada

According to Keith F. Beam, writing in the British newsletter Overseas Service Of Aims Of Industry, "Britain's manufacturers are confident that they will set most of the Dominions up with their first full-scale atomic power plant in the next five years or so, at any rate by 1965. They reckon they can secure eight of the ten contracts likely to be placed by 1960 for atomic power stations abroad, mostly in Europe. Then by 1965, they are hopeful of big sales also to Canada, Australia, South Africa, Japan, perhaps India and possibly the United States.

They base their confidence not only on Britain's established lead in commercial generation of power from nuclear plant but on four factors:—

Demand for electricity in these countries doubles itself every ten years or so.

From planning to operation, a nuclear power station takes four to five years.

Economically feasible hydro-electric sites are fast being developed to the full and costs for coal — and oil fired stations will rise.

Atomic technology is advancing so rapidly that nuclear costs will soon be cut to levels competitive with other power sources.

The first two points imply that planning must always be well in advance of needs. The third is supported by most Dominion power experts. For instance, in his review for Canada's Royal Commission on power needs (the Gordon Commission) John Davis says: "In so far as Canada's principal centers of population and industry are concerned power costs are expected to follow an upward trend." This rise is indeed a world factor and in itself will make nuclear power increasingly more competitive. Davis and other authorities also broadly accept the fourth point.

Enumerating many technical reasons, Sir Christopher Hinton, chairman of the U.K. Central Electricity Generating Board, made this forecast of the cost of electricity (in mills per unit sent out):—

Stations commissioning in	1960	1970	1980	1990
Nuclear Stations	7.47	5.48	4.43	3.70
Conventional Thermal Stations	6.99	7.81	8.51	9.79

If our calculations are accepted, said Sir Christopher — and he listed all the details on which they were based — we see that nuclear power will be cheaper than power from conventional stations by 1962 and that by 1982 it will amount to less than half the cost.

With costs cut, there will obviously soon be an increasing demand for such stations in power-short places like southern Ontario, South Australia and the Cape. They are already competitive in Europe at a cost of \$56 million (£20 million) to \$70 million (£25 million) each. English exporters calculate that orders from the Dominions and other non-European countries in the five years to 1965 will total \$1260 million (£450 million), including the initial fuel charge which costs about \$14 million (£5 million) for a 150 megawatt plant using natural uranium.

Many parts of the Commonwealth will want stations even smaller than that as soon as they can be produced and operated economically — both in the medium range of 50 down to 20 megawatts and in the smaller range below that.

Much research work still has to be done on the small reactor and the U.K. Atomic Energy Authority's economic adviser, J. A. Jukes, declares that it will be the mid-sixties before an economic commercial version of proved reliability can be achieved. However, he has worked out "purely illustrative but, it is hoped, not unrealistic figures" for 10- and 20-megawatt stations at that time. They gave these costs per unit sent out:—

Station capacity	10 MW mills	20 MW mills
Load factor 75 p.c.	14.9	11.2
Load factor 25 p.c.	27.4	23.9

Jukes emphasizes that these figures relate to a hypothetical reactor but the assumptions on which he arrived at them are probably sufficiently representative to cover a number of possible reactor systems. At least they illustrate that it is possible to work out a basis of comparison with other power sources before all the technical problems have been tidied up.

In terms of power programs, the mid-sixties are not far away—as those who plan the programs realize. A significant statement comes from Professor Harry Messel, director of the nuclear research foundation at Sydney University.

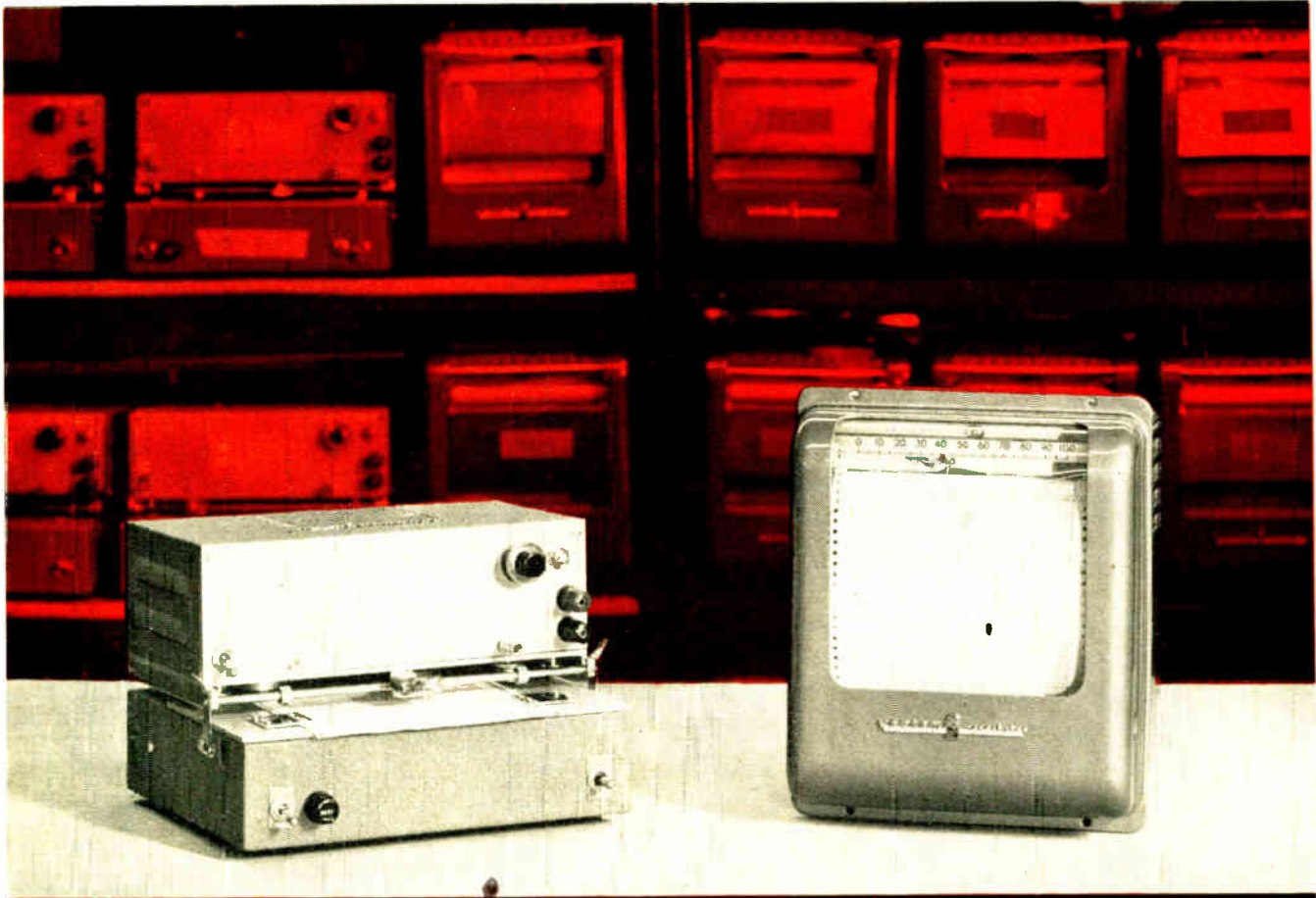
Within two years, he says, Australia ought to be building a prototype nuclear power station followed soon after by a number of package nuclear plants, generating from 20 to 50 megawatts, for places like the big inland mining centers of Mount Isa and Broken Hill. The next stage would probably be about 1968, with the construction of full-scale nuclear power plants of 100 to 300 megawatts, he said.

That is indeed the sort of program which many countries are now envisaging. As to the financing of them, there is comfort for the planners in the words of two English economists, J. R. Cuthbertson and J. Brodrick. Reviewing the financial aspects of nuclear energy for the Federation of British Industries recently they declared: "Perhaps the most important thing about nuclear capital costs now being quoted is the virtual certainty that after five or ten years of technical progress they will look outrageously high."

Judging from the foregoing it would appear that the U.K. atomic energy authorities are not only well advanced in the science and technology of the atomic arts but well advanced in their plans for capturing export markets, all of which leads us to wonder where Canada stands in this particular field of endeavor. In so far as Canada is concerned this observation is evoked by reason of the understanding that Canada has ranked as one of the leaders in the art of applying atomic power for peaceful purposes.

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Varian G-10 — Portable for laboratory or bench use where chart accessibility is of prime importance. Base price \$340.

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For further data on advertised products use page 59.

business briefs and trends

★ "Analmatic", a system of automation of routine work essential for control of industrial and other scientific processes, thus releasing the scientist for original thought in research and development was displayed in Frankfurt, Germany, recently by a British laboratory equipment company. Applications of the system range from full scale "automatic laboratory" for process control to provision of simple instruments such as a dispensing unit which adds precise volume of reagent to large numbers of samples in test tubes.

* * *

★ The first order for a television nuclear reactor camera has been placed with Pye Limited of Cambridge, England. The camera will assist engineers at the Central Electricity Generating Board's Bradwell atomic power station to inspect the interior of the station's two reactors when they go into operation during 1960. The first of three Pye TV cameras for exclusive use in the atomic energy industry was put into use at Calder Hall in 1956. The second camera, designed quickly for a special purpose in 1957, led to the development of a camera which incorporates facilities for handling objects within the reactor core.

* * *

★ The Executive Director of the Japan Trade Centre in Toronto recently contended that Canadian-Japanese trade has every prospect of maturing into a giant that can contribute tremendous rewards to both nations. "Japan is no longer merely a manufacturer of consumer goods," Mr. Ijima said. "Steel and other metals, machinery, ships, tools and precision instruments — these industries contribute more than one-third of all the products Japan exports to world markets today."

* * *

★ New growth in Canada's electronics industry and its ever-growing emphasis on sales and marketing activities are reflected in space bookings for the Institute of Radio Engineers' 1958 Canadian Convention. The prediction is that the number of exhibitors this year will exceed those for last year and will cover a broader range of products, services and scientific achievements. The rate at which new companies are entering the nucleonic and electronics fields and developing new products is one of the reasons for anticipating a record number of exhibitors at the 1958 Convention.

* * *

★ The world's first solar-powered portable radio called the Trans-Solar was recently announced by the Hoffman Electronics Corporation of Los Angeles, California. This personal-sized model uses silicon solar cells which convert light energy into electricity. The cells are encased in a built-in solar battery pack in the top of the set and may receive their energy from either sunlight or from a standard 100-watt incandescent bulb.

* * *

★ Business equipment sales in Canada have advanced very rapidly in the last few years in Canada. From total sales of around \$125 million in 1956, the record shows that sales rose to approximately \$200 million in 1957. The trend towards automation accounted for this growth in the business machine equipment industry.

* * *

★ A telephone development of the future is anticipated in the elimination of the telephone bell in favor of a musical tone electronically generated by a transistor in the equipment.

* * *

★ The Belgian Air Force has selected Canadian-designed and manufactured electromechanical instrumentation equipment for installation in its Canadian-built CF-100 jet interceptors by placing an order with Canadian Applied Research Ltd. of Toronto for an R-Theta navigation computer system costing around \$1 million. The air forces of other European countries are also giving consideration to the acquisition of R-Theta navigation computer systems.

Continued on page 12

business briefs and trends

★ The Council of the Association of Professional Engineers of the Province of Ontario recently approved the registration of over 500 new professional engineers out of the class of 800 engineering graduates of 1957 applying for registration. Of this number only about one per cent of the applicants proved themselves qualified for the status of professional engineer by passing the Association's examinations.

* * *

★ The Ontario Department of Lands and Forests finds that the equipment used in its vast radio network of some 900 stations, one of the largest communication systems in the world, must be overhauled and serviced regularly by its technicians to give adequate and reliable service in its continuous, year-round operations. Testing and servicing of this equipment often reveals the need for considerable replacement of small components in the various types of radios used to carry out the Department's important task of forest fire prevention and other protective measures.

* * *

★ The Ontario Hydro has begun to install an electronic computer which, when completed by or before the Spring of 1959, will provide a province-wide system, one operation of which will be the processing of some 1½ million customer accounts annually. This computing system, Remington Rand's Univac II, is the first installation in Canada, and only the second such installation to be made anywhere in the world.

* * *

★ Canadian Electronics Ltd. has received an order for a Motorola two-way radio system to be installed in Woodstock, Ontario, on behalf of the Woodstock Public Utilities Commission. This type of communications system is reported to be in wide use in many parts of Canada, because of its time-saving advantages in making contact between public utilities commissions and their personnel out on trucks.

* * *

★ A tandem style particle accelerator, at a cost of \$1 million, is to be shipped mid-year to the Atomic Energy of Canada, Ltd. at Chalk River, Ontario. The unit is being produced by High Voltage Engineering Corporation of Burlington, Massachusetts, and should be assembled and ready early in 1959 for nuclear-physics research.

* * *

★ Although Toronto acquired a type of DDD (Direct Distance Dialing) on May 25, the distinction of having the first wholly automatic DDD service was given to Guelph on June 15 with the installation of automatic recording equipment permitting localized automatic message accounting, known as LAMA. This system automatically records, by making perforations on paper tape, the calling number as well as the called number and the connect and disconnect times of each call made, thus dispensing with the aid of an operator.

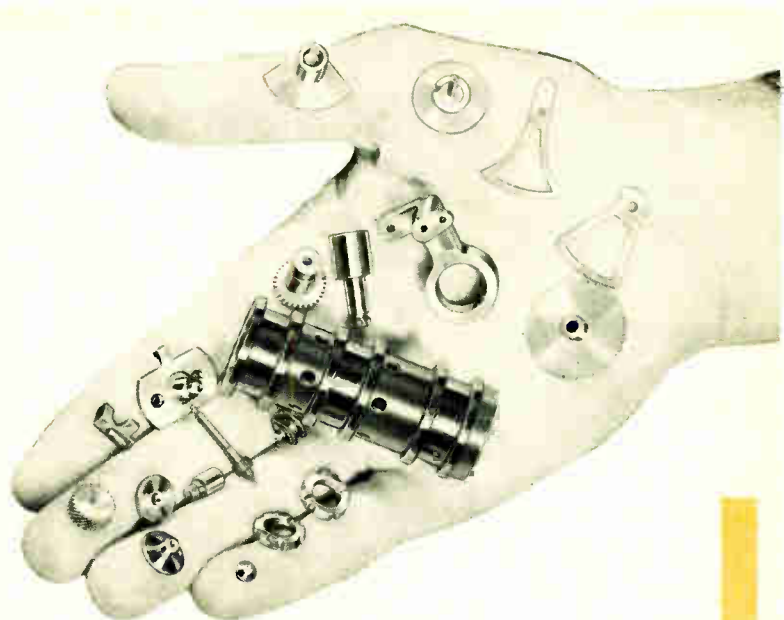
* * *

★ Aviation Electric Ltd. of Montreal has been awarded a \$1½ million contract from Canadair for electronic components for use in the Sparrow II missile.

* * *

★ A pay-TV system has been tried out in Oklahoma unsuccessfully. Telemovies' closed-circuit showings of motion pictures began last fall with an original charge of \$9.50 per month, which was knocked down to \$4.95 in the early part of this year. While new subscribers were being added, the rate of increase was not sufficient to stem the tide of monthly dollar losses. The promoter holds the view that a meter which allowed subscribers to pay for pictures individually would be the answer, rather than to make a flat monthly charge.

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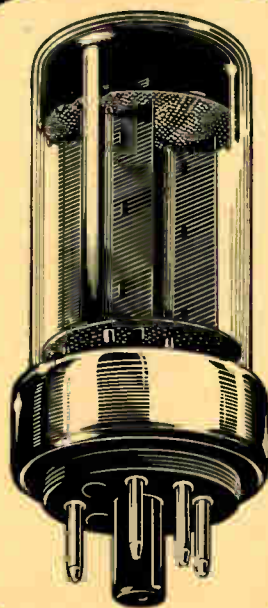
SALES OFFICE: ENGELHARD INDUSTRIES (QUEBEC), LIMITED

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For further data on advertised products use page 59.

Rogers 5AR4 Special Quality* general purpose rectifier is a universal replacement for numerous commonly used 5 volt rectifiers. Designed for efficiency and long life, the 5AR4 is of pressed glass base construction. Other features of the tube include a 5 volt 1.9 amp. heater; a peak inverse voltage of 1500 and a maximum r.m.s. current output of 250 mA. The 5AR4 has a low voltage drop ensuring maximum output. Write for full details on this special quality rectifier.

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★ Rogers Electronic Tubes are sold through Canada's Independent Electronic Parts Distributors

This is the second and concluding part of Mr. McAdam's article on heat-dissipating electron tube shields and deals with tube performance in terms of electrostatic shielding and the mechanical retention of tubes.

Heat-dissipating electron tube shields

Part 2

By John C. McAdam*

To this point, the heat-dissipating characteristics required of — and supplied by — IERC shields has been discussed. A shield must also perform in terms of electrostatic shielding and mechanical retention of the tube. The solid cover provided by the JAN shield is not essential to proper electrostatic shielding. This probably arose for no other reason than convenience of manufacture. A screen or open-work shield of solid metal, if well grounded, stops electrostatic radiations. All of the IERC shields have proved electrostatically effective.

The problem of tube retention is a little more complex. In applications such as those encountered on aircraft and missiles, it is necessary that the shield retain the tube in environments of extreme shock and vibration. The Military Type B¹¹ and the TR Type^r have been tested to 2000 cycles of vibration and 90 G's of shock. 2000 cycles is the limit of present tube shield specification requirements.^s 90 G's of shock was the limit of the test machine. There are no U.S. Military specifications for shock tests on tube shields. There is no doubt that these shields will exceed these limits.

Studies by Aeronautical Radio, Inc.^t rate vibration second only to high temperature as a cause of tube failure. It is interesting to relate the effect of the type of tube shields being discussed to this vibration problem.

¹¹ — See Ref. 22
^r — See Ref. 25
^s — See Ref. 26
^t — See Ref. 8

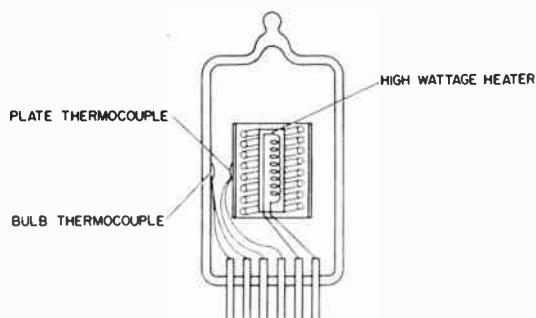


Figure 16. Cornell Thermatron.

A test was conducted to determine the dampening effect of the spring finger liners in the shields.¹¹ This test was made in accordance with the micro-phonics test described in MIL-E-1. A signal was fed into a tube which was under vibration; then the variation in the amplitude of tube output was measured. Results showed a 30% reduction in the variation when the tube was retained by a shield with a spring finger liner, compared with an unshielded or JAN-shielded tube.

Checking Tube Shield Effectiveness

So far, our discussion has concerned itself with the need for heat dissipation to reduce tube and equipment failures and with the qualities and characteristics of the heat dissipation tube shields designed to meet the problem. Important for the user are uniform methods of test by which product standards may be established and product performance verified.

The Cornell Aeronautical Laboratory^v has been investigating tube temperature and tube shield problems for the past several years. The laboratory — by measuring

¹¹ — See Ref. 25
^v — See Ref. 20

*Vice President Engineering
 International Electronic Research Corporation.

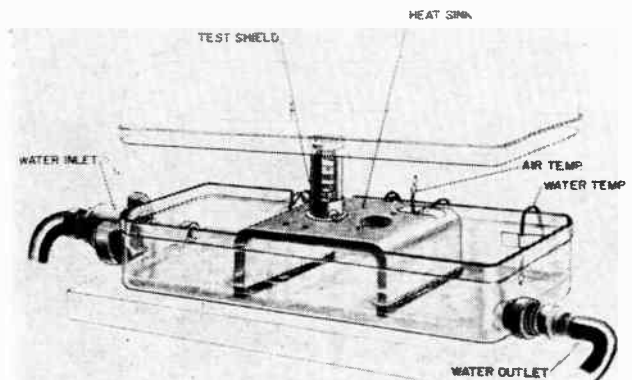


Figure 17. Constant Temperature Heat Sink.

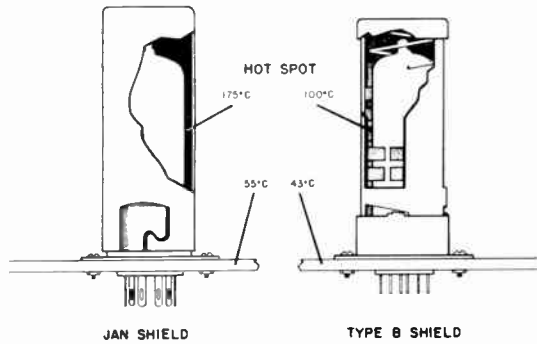


Figure 18. Chassis temperature—JAN shield versus heat-dissipating shield.

tube element temperatures within the tube — found instances in which certain shields, intended for heat dissipation, were apparently effective for reducing bulb surface temperature, but were actually reflecting heat back through the glass with resulting increases in the plate temperature. The use of standard tubes, modified for internal temperature measurement, was found to be a tricky and difficult procedure, with added problems caused by variations in individual tubes. So, in search of more consistent results and to facilitate further testing, the Cornell University Electrical Engineering Laboratories developed instrumented tubes which they call "Thermatrons".^w (Figure 16).

These Thermatrons are standard tubes with the filament and cathode elements removed and replaced with a heavy duty heater which can dissipate heat equal to the total amount of heat originally dissipated by the filament, plate and other elements. The laboratory found good correlation between the internal operating temperatures of the tube, using this method, as compared to standard tube operation. Thermocouples, attached to the plate and the inside of the glass bulb, are brought out through the unused pin leads. Using this method, the wattage of the tube can be easily varied and the plate and bulb temperatures can be monitored during tube shield tests.

Cornell Aeronautical Laboratory has also determined that — since heat conduction was of prime importance in evaluating tube shields which are mounted to chassis and heat sinks — correct data cannot be obtained unless an infinite or constant temperature heat sink is used during the test. They devised an infinite heat sink, shown in Figure 17.

This consists of a heavy copper chassis standing in circulating water and enclosed in a clear plastic case to eliminate uncontrolled convection currents. The use of these methods should eliminate much controversy and confusion in testing tube temperatures and tube shields.

^w — See Ref. 27

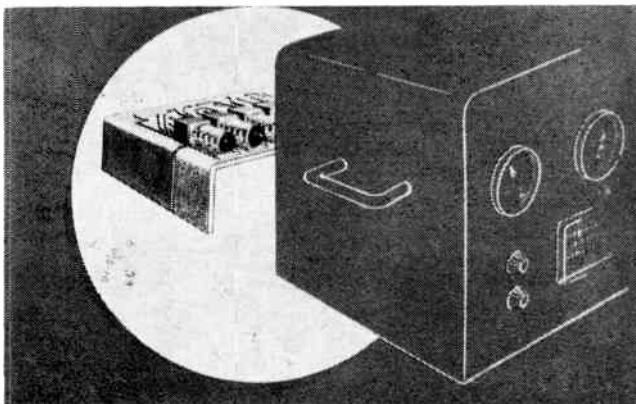


Figure 19. Conventional tube mounting.

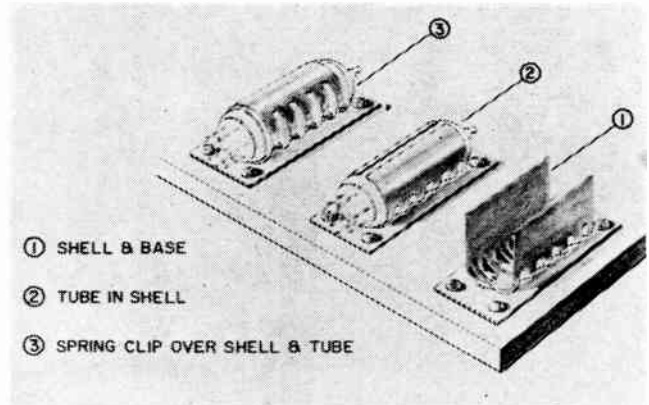


Figure 20. Horizontal type wrap-around shield.

At the present time, U.S. Military specifications^x require that the heat dissipating properties of tube shields be determined in the following manner:

An aluminum slug the shape of a tube and containing a heating element in its center and thermocouples embedded in its surface is raised to and stabilized at a temperature of 180°C. The appropriate shield is then placed on the slug and the temperature reduction of the slug is noted. This slug is mounted in a tube socket in the center of an aluminum sheet metal chassis four inches square and two inches high with the appropriate base also mounted with the socket. This method was devised about five years ago for the want of a better standard method and was placed in the specification.

It seems apparent to many that a more suitable test method is needed. The method outlined above has the following specific faults:

1. The metal test slug is made of heat conducting material and assumes an even temperature over its entire surface. The glass surface of an actual tube, by contrast, is non-conducting and has at its center a high temperature spot as described earlier in this paper. Obviously, a shield designed to lower the temperature of the test slug would not necessarily meet the problem of the hot spot temperature on a glass bulb.

2. Since, as has been noted, certain shields may lower the glass temperature of a tube, but reflect heat back through the glass to increase plate temperature, it is also obvious that the metal slug test provides no means for ascertaining this fault.

3. The specification method provides for use of a small test chassis, four inches square and two inches high. Since

^x — See Ref. 26

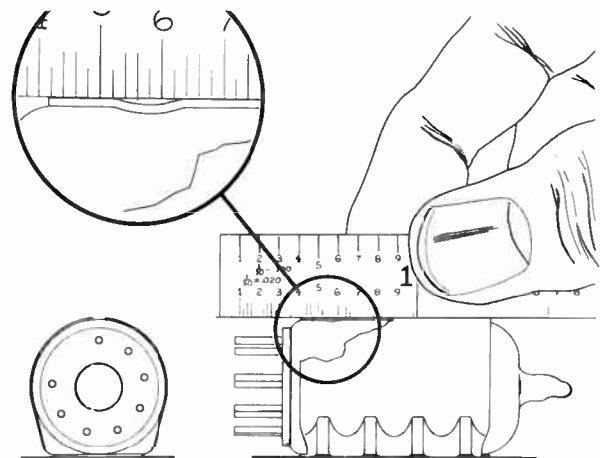


Figure 21. Soft wrap-around shell conforming to irregular tube surface.

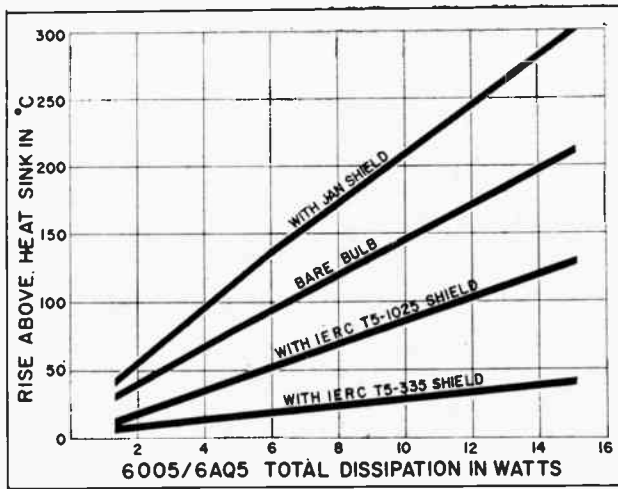


Figure 22.

one of the heat dissipating properties of a well designed tube shield is conduction — the heat being conducted from tube to shield to base to chassis or heat sink — the small chassis is deficient in its ability to reflect accurate comparisons of conductive properties. This fact appears readily when it is realized that the amount of heat conducted between materials in thermal contact with each other depends upon the temperature difference. When a small chassis is used, the efficient heat conducting shield will raise the temperature of the small chassis substantially more than will the less efficient shield. Thus, the less efficient shield gains the benefit of a greater temperature difference between shield and chassis. These circumstances distort performance curves on both the efficient and inefficient shields so that effective comparisons are not possible. The true values of various shields cannot be tested without a test chassis or heat sink that simulates a standard condition.

A further note of warning needs to be stated with reference to evaluation of chassis temperature determinations in connection with heat dissipating shields. In speaking of the conductance of heat to the chassis by an efficient heat dissipating tube shield, the impression may be created that effective shields will so heat up the chassis as to risk damage to other components. While this might be dismissed in view of our earlier determination that only a small fraction of all equipment failures are traceable to failure of other components, it seems more to the point to demonstrate that the conclusion is untrue.

Higher chassis temperatures actually result with the use of non-conductive JAN shields and bases. The reason is that the JAN shield increases the temperature of the tube by many degrees. There is then a higher hot spot temperature available in close proximity to the chassis. This condition can, and does, cause a higher chassis temperature around the tube. A comparison of this temperature condition with that of the Type B heat dissipating shield is shown in Figure 18.

The Type B Shield, as shown, produces a lower chassis temperature in the vicinity of the tube. This is because it lowers the hot spot temperature of the tube and spreads the heat over the surface of the shield from which it is dissipated by radiation and convection as well as by the conductance through the base to the chassis.

Further Developments In Heat Dissipation

The heat dissipating tube shields discussed so far are vertically mounted shields for use in conventionally constructed equipment.

As you will note (Figure 19), there are thermal problems scattered throughout most such equipment. Many equipments will continue to be constructed in the future as they are today. The heat dissipating shields we have

discussed are available now to eliminate a significant percentage of the unreliability problem in these equipments.

Such shields as we have discussed, however, cannot be considered the end of the matter. Tubes are the most unreliable component in an equipment and they also represent the majority of high temperature parts. This leads us to recognize that tubes need to be given prime consideration, not alone for what can be done to lower their temperatures after an equipment has been designed, but in the initial thermal design of the equipment, itself.

IERC has been engaged for the past five years in a continuous program of research and development to improve electron tube and equipment thermal problems. We feel this work has been productive:

The heat dissipating tube shield shown in Figure 20 mounts horizontally to a heat sink. This shield, with its soft wrap-around shell in intimate contact with the tube glass, conducts the heat to its base.

In figure 21, you will note that in addition to the effective heat dissipating properties of this shield, it provides an excellent retainer of the tube in extreme shock and vibration environments as it places the tube in a position with a low center of gravity. And because the soft wrap-around shell conforms to the glass and forms a cushion between the hard glass and the hard spring clip there are no resonances set up in vibration.

This assembly, with its base attached to a heat sink as shown, will maintain the tube bulb at less than 5°C above the heat sink temperature per watt of dissipation in the tube. This is shown in Figure 22.

When all the tubes are mounted to a heat sink as shown in Figure 23, this eliminates the need for scattering heat generating tubes throughout the equipment; it isolates the problem by transferring the heat into the heat sink. These conditions greatly simplify the thermal problem. All the heat is concentrated in one area and can be transferred in simple manner from the equipment by various methods, dependent on the volume of heat present.

If the amount of heat to be dissipated is in a low range, the heat sink may be a simple metal plate of sufficient thickness to conduct the heat away to the frame of the equipment or to some other point as shown in Figure 24.

If the amount of heat to be dissipated is in the medium range, the heat sink may be a hollow duct, possibly containing fins, through which cooling air can be passed to transfer the heat. (This is an efficient method of using forced air for cooling, contrasted with blowing air, at random, inside an equipment.) If the amount of heat to be dissipated is in the high range, the heat sink may contain ducts for the circulation of liquid coolants.

This type of arrangement solves two problems: it separates the electron tubes — which are the main source of heat in an equipment — so that thermal problems of other components are greatly reduced; it also places the tubes in a condition where their temperature can be maintained most effectively at as low a point as desirable.

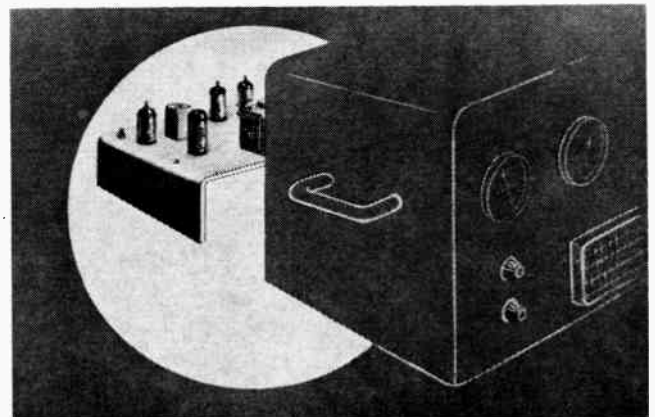


Figure 23. Tubes thermally mounted to heat sink.

All of the shields shown so far have been for application to miniature and sub-miniature tubes. The same problem of heat dissipation and mechanical retention exists with tubes of the larger octal and power tube sizes.

Figure 25 shows a shield which has a Beryllium copper spring finger liner for grasping the tube and transferring the heat to the shell. The shell fastens to the base with a positive snap action lock. Note that the base has a good solid thermal and mechanical contact to the chassis or heat sink. This shield will retain the tube at 2000 cycles of vibration and 90 G's of shock, as well as meeting all of the general tube shield requirements of heat dissipation, salt spray, and heat resistance, installation and withdrawal forces, etc. of the Military Tube Shield Specification MIL-S9372.⁷

ARINC has been testing the T12 shield shown in Figure 25 on 6080 type tubes in radio receivers and on 5932 type tubes in radar repeaters. They report in a letter dated September 12, 1957 that the use of these T12 shields on the eight 5932 tubes in each radar repeater decreases the failure rate of these tubes from 36 per cent to 12 per cent in a 10,000 hour period. In other words, the 24 failures that had been occurring in each equipment every 10,000 hours were reduced to 8 failures during the same period when the heat dissipating shields were applied.

The 5932 tube costs approximately \$10.00 each, so that \$120.00 worth of tubes are saved each 10,000 hours, or about \$600.00 worth in a five year period for each radar repeater. This saving considers only the tube cost and not the associated maintenance saving, nor the elimination of down time of the equipment in time of need.

Conclusion

Many persons concerned with electronic reliability have perhaps jumped to a conclusion that since tube shields are relatively simple devices they need little consideration. Among many there has been a tendency to concentrate on the inherent properties of tubes — even though millions of dollars in research in this direction have produced relatively minor increases in efficiency and reliability.

It is hoped that this presentation has served to show that the problem of heat-dissipating tube shields involves a variety of considerations: the effects on internal temperature, the types of mount, the capability of retention in

⁷ — See Ref. 31

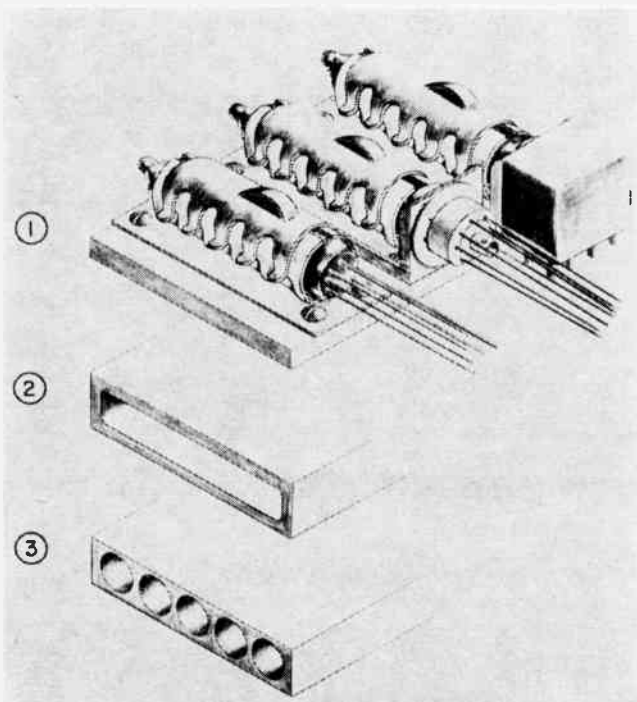


Figure 24. Types of heat sinks.

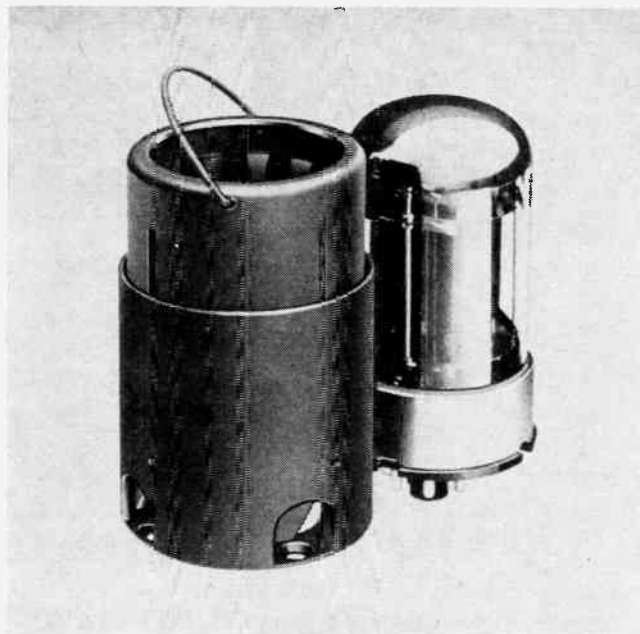


Figure 25.

shock and vibration environments, the methods of test, the methods of disposing of heat from the area of the equipment, and many other points. We would be remiss if we regarded as indicating ultimate answers have been reached in any direction. Yet, in spite of the confusions which still exist, we feel we are accurate in stating that the heat dissipating tube shields discussed do represent an important solution to a major part of the electronic reliability problem.

In the United States the confusion is gradually being resolved. The U.S. Air Force in 1953 tested the Military Type B shield¹¹ after conducting other tests which showed the alarming temperature increase caused by the JAN type shield. As a result of these tests they wrote a heat dissipating tube shield specification, MIL-S-9372 (USAF) in 1954. This described the Military Type B shield. Until recently, use of the JAN shields was still permitted. In January 1958, the Air Force cancelled future use of JAN type shields, and established requirements that MIL-S-9372 shields be used. The shields covered by this specification have been illustrated. Figure 10 shows the Type B shield now specified for new equipment and Figure 12 shows the Type TR which is specified for retrofitting.

But this specification still does not describe shields for tubes other than vertically mounted miniature tubes. No consideration is given subminiature, horizontal miniature, or octal and power type shields.

An attempt was made about two years ago to coordinate this specification among the three U.S. Military services, the Navy, Army and Air Force. But because of personnel turnover and resulting confusion respecting data on the subject, no conclusion was reached. The Navy, pressed by its own need for heat dissipating tube shields, then undertook its own specifications, MIL-S-19786 (Navy). This specification is less comprehensive than that of the Air Force.

During the past five years equipment manufacturers who recognized the problem and were willing to put forth an effort on their own to bring about a solution in spite of the confused specification requirements, have readily accepted and applied these shields in their equipment. It is felt that a good degree of the success of many missile projects is due to the application of the shields described here. Designers of such missiles as the Matador, Regulus, Talos, Nike, Atlas, Sparrow, Hawk, Bomarc and many others have solved their electron tube thermal

¹¹ — See Ref. 28

and mechanical mounting problems through the use of these shields.

In addition, many missile ground control and telemetering system designers have recognized and applied this significant reliability aid. Other ground and airborne equipment designers have likewise recognized the value and importance of applying these heat dissipating shields. It is significant that they have done so without military requirement, but because of their interest and deep concern over performance of their equipment.

Still other companies — aware of the heat problem, but unaware of the shields on the market which could solve it — have sought solutions of their own. Many of

these attempts have lacked success for the reason indicated earlier — lack of full understanding as to the complexities involved.

It is hoped that the foregoing has helped to clarify some of these complexities and to provide data from which those interested may reach more useful conclusions than in the past. To move forward we shall need effective standardization — in defining the job that heat dissipating shields must accomplish, in setting manufacturing specifications, sizes and test data. Meanwhile, with so much at stake in the reliability of so much vital electronic equipment, we trust that a deep and concerned interest will be taken by all involved.

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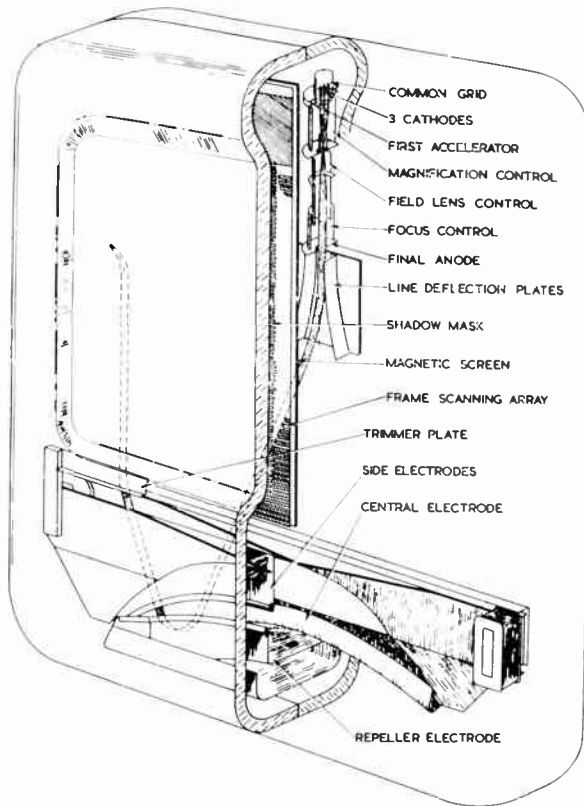
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ELECTRON-OPTICAL SYSTEM

Figure 1, showing the "Permalloy" flat metal plate which acts as a magnetic screen in the flat cathode-ray tube for monochrome or color television. The tube, on which the inventor has worked for four and a half years, is being developed by the National Research Development Corporation, sponsored by the United Kingdom Government.

A revolutionary new type of flat cathode-ray tube for monochrome or color television, which has no neck and is only a few inches (centimeters) in depth, is described in the following article.

The flat cathode-ray tube for television

By Douglas Walters

The idea of a flat television cathode-ray tube first occurred to the inventor after reading an advertisement in the "Saturday Evening Post".

The same year he filed his first patent and now, after four and a half years of research and development in the laboratories of the Department of Electrical Engineering, University of London, Dr. Gabor and his small team of post-graduate students have reached a stage where further development to the commercial standard must be left to industry.

Patent rights assigned

In 1953 Dr. Gabor assigned his patent rights to the Government-sponsored National Research Development Corporation which, from that time, has assumed complete responsibility for financing and developing the invention.

This is not the only flat tube, for, in 1953, working independently, W. Ross Aiken of the Kaiser Aircraft and Electronics Corporation, of Oakland, California, filed a patent for a tube of similar shape, but apart from two

basic features there is very little similarity between the two. Both inventors, however, keep in close touch, and Aiken and the N.R.D.C. have pooled their patents on this type of tube in a world-wide agreement.

Different from conventional

Unlike the conventional long-neck cathode-ray tube in which the electron beam is normal to the screen, in the Gabor tube the electron path is mostly parallel to the screen. This is due to the novel electron optical system used.

Because of this peculiar design a 21-inch (53.34-centimeter) tube is less than 5 inches (12.7 centimeters) in overall depth and a 12-inch (30.48 centimeter) tube only 3½ inches (88.9 centimeters) deep.

It is, in effect, a flat cathode-ray tube which can be hung on the wall, or propped up on the table like a picture frame.

The tube is probably too complicated in construction to be an economical proposition for the reception of

monochrome television signals, but its inventor maintains that it would be easier to manufacture than any existing color tube.

The main points in its favor are: there is no reasonable limit to its size; when used for color television far fewer controls are required than are found on present-day color receivers; no frame oscillator is needed and the associated circuitry is less complicated.

Like a square glass box

In appearance, the tube resembles an almost square glass box and, fixed in the middle, so that it effectively divides the "box" into two halves, is a flat metal plate made of "Permalloy", to act as a magnetic screen.

Attached to the top center of this plate, on the side remote from the phosphor screen, is the electron gun which fires vertically downwards (Figure 1).

A color tube has a common grid and three separately modulated cathodes, one for each fundamental color.

The line-scan frequency is imparted to the beam by the X-deflector plates in the normal manner, and this produces a swing of about 15 degrees on either side of the vertical in a plane parallel to the "Permalloy" metal screen (Figure 1).

The beam then enters what is called the "reversing lens", and this, undoubtedly the most important and novel component of the electron optical structure, is situated at the bottom of the tube (when this is in the vertical viewing position) and below the metal screen.

It consists, essentially, of a lower trough-shaped electrode at cathode potential called the "repeller", a central positive electrode known as the "spine" and two side plates, also at positive potential (Figure 2).

Three years seeking a design

This reversing lens has to perform a number of important functions, and it took Dr. Gabor and his assistants three years to arrive at a satisfactory design.

First, as its name implies, it has to reverse the direction of the fan of rays from the X-deflector through an angle of 180 degrees, so that every principal ray is turned round under the "spine" and proceeds vertically upwards on the other side of the metal plate, adjacent to the phosphor.

Secondly, the rays must emerge from the reversing lens in the same plane. Thirdly, the horizontal deflection must be linear with the line-scan voltage on the X-deflector plates.

The beam emerges from the X-deflector plates with a total sweep of about 30 degrees. Any attempt to greatly increase this electro-static deflection would inevitably lead to focussing errors that could not be rectified easily, and so another function of the reversing lens is to multiply the deflection of every principal ray by something like four times.

Traversing width of screen

This provides a final deflection of about 120 degrees — an angular sweep sufficient to traverse the entire width of the viewing screen down to only a few inches (centimeters) above the lowest point.

On leaving the reversing lens the beam, which is now sweeping ± 60 degrees in synchronism with the line-scan frequency, next passes through a "collimator" lens, the only magnetic device used in the construction of the tube (Figure 2). The function of this magnetic "lens" is to maintain the rays in a vertical plane.

An ingenious system of self-scanning is employed, using an array consisting of some 91 parallel conductors made of silver-coated nichrome wire. The actual number of conductors is unimportant and bears no relation to the television line frequency, for their main function is to deflect the vertical beam on to the screen.

Not connected to circuit

The conductors run parallel across the screen, but where supported at the sides they are bent in a U-shaped loop and staggered slightly upwards (Figure 3). They are not connected to any part of the circuit, for they are charged and discharged by the electron beam itself.

Consider the position of the beam shown in Figure 3. The lower conductors are positively charged and the upper ones are negative in relation to the phosphor-coated screen which is at maximum positive potential. Mid-way between these two voltage levels there is a transition zone extending over about four conductors (Figure 3).

When the vertical beam, sweeping horizontally in rhythm with the line-scan frequency, reaches the lower conductors in the transition zone, it is deflected towards the screen and automatically focussed by the system of "deflection focussing". Normally a disadvantage of electrostatic deflection, this in this tube is turned to useful account.

Travels in a straight line

During the time that the beam lies within the area bounded by the screen, as there is no variation in the charge on the conductors, it travels in a perfectly straight line.

On arrival at the end of a line-scan the beam enters the loop at the right-hand side (Figure 3) and sprays electrons on one or more of the conductors in the transition zone.

As these are adjacent to a low potential area there is an absence of secondary emission, and the conductors are discharged, resulting in the transition zone moving a little downwards so that the next traverse of the spot will occur at a slightly lower level.

At the conclusion of one complete frame scan, the beam arrives at the bottom and the scanning array is discharged.

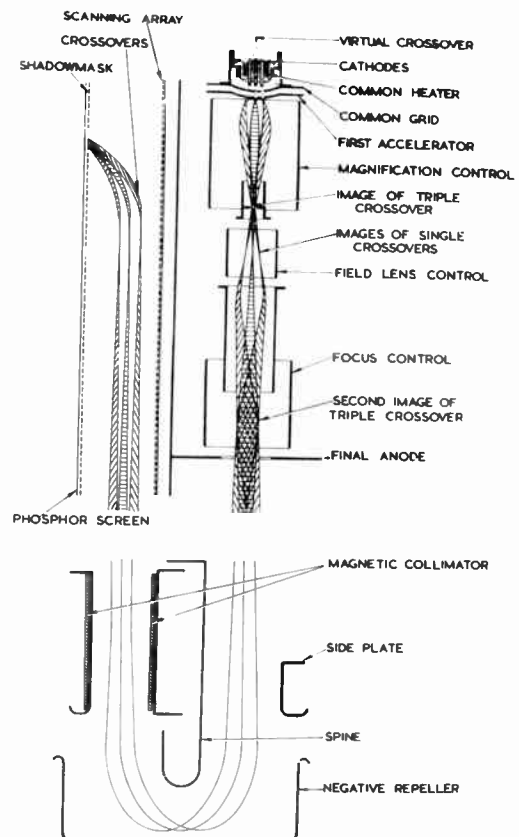


Figure 2, showing the electron optics and color control in the flat cathode-ray tube for television.

Maximum potential grid

At this point the line-scan is arrested, and the beam moves into the loop at the left-hand side. Here, unlike the opposite side, there is a screen-grid interposed between the beam and the array. This grid is at maximum (ultor) potential, and consequently it attracts electrons released by secondary emission from the conductors in the loop, a process which charges them up to the maximum potential again.

At the top there is a metal electrode called the "C Plate" which is maintained at near-cathode potential. At the beginning of a new frame the line frequency is switched on again, and as the beam moves it is deflected by the C Plate towards the screen, so that scanning begins again. When operating conditions are correct this produces a normal television raster.

One of many points with which this flat tube scores heavily over the conventional color tube is the way in which the blue, green and red beams are concentrated into almost one composite beam throughout most of their travel and so individual colors are less affected by stray magnetic fields.

Fewer correction controls

Because of this the number of correction controls is greatly reduced.

For color reception the shadow mask principle is used, and because of the large convergence of the beams the distance between the mask and phosphor screen is only about 1/40-inch (.0635-centimeter) instead of the customary 1/2-inch (1.27-centimeter).

This makes it possible to attach the mask directly to the screen and avoid costly precision alignment.

Various forms of shadow mask have been made. One of these is fabricated from 0.0015-inch (.0038-centimeter) copper sheet which is printed, using an acid-resist, with about 45 parallel lines to the inch (2.54 centimeters), leaving 25 per cent of the metal exposed.

The sheet is then crimped by passing between spiked rollers which make a number of folds or ribs, each about 1/40-inch (.0635-centimeter) in depth. This determines the spacing between mask and phosphor. The underside, including the ribs, is then coated with acid-resist.

Immersion in acid solution

After another mechanical process to strengthen the ribs, the sheet is immersed in an acid solution until the exposed parallel lines are eaten away, leaving intact the intervening blank spaces and the ribs.

The resist is next removed, and the mask attached to the screen, using a silicone resin which remains sticky until the tube is baked.

Finally, the phosphors are applied by dropping each color, in turn, in stagnant air through the slits in the mask on to the tacky surface of the screen.

Surplus powder is removed either by blowing air, or by electro-static attraction, and the tube is then ready for baking. This relatively simple process would not be feasible, were it not for the very close spacing between the shadow mask and the screen.

Three color beams in one

It has already been explained that the three color beams — one from each cathode — travel in one composite beam.

This holds true until a point is reached just before the beam is bent towards the screen in its "writing" position (Figure 4).

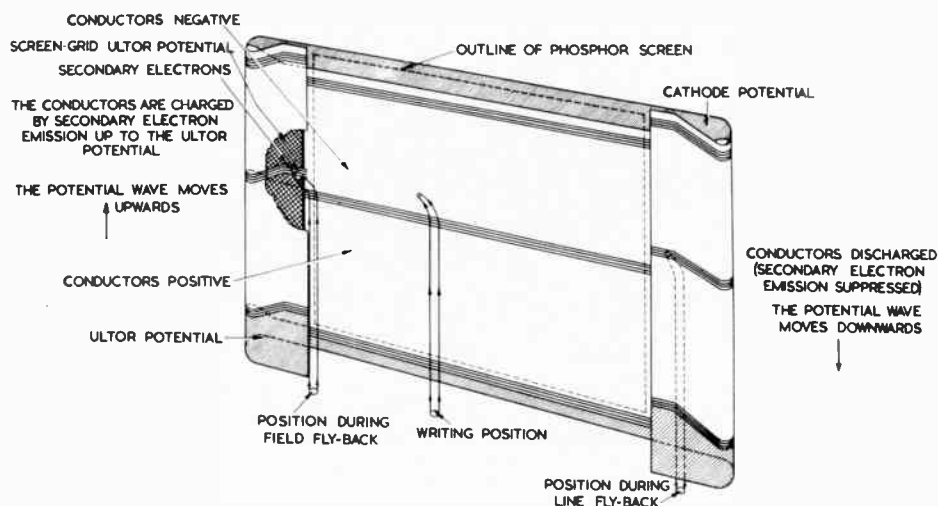
Here the individual color beams separate and then converge again, but at different angles, to the screen by way of the slots in the shadow mask. By slightly pre-focussing the beam the vertical spot width is reduced to 1/20 of the spacing between screen and scanning array.

So far the tube has only been operated in a demountable vacuum tank, and no attempt has been made to build a sealed-off version. This, the designer believes, is better undertaken by the industry.

The most difficult problem

By far the most difficult problem encountered in the development of this new tube was the design of the reversing lens. Over a hundred different arrangements of the three main electron optical components, the reversing lens, the collimator and the X-deflector, either singly or in combination with each other, were tried before a satisfactory system was reached.

This work was facilitated by the use of a vacuum tank,



PRINCIPLE OF SELF-SCANNING BY WRITING BEAM.

Figure 3, showing the parallel conductors in the flat cathode-ray tube for monochrome or color television.

which provided up to eight independent movements operated through vacuum-tight glands.

Because of the particular shape of this tube, for a 21-inch (53.34-centimeter) model a flat glass screen would need to be one inch (2.54 centimeters) thick, if made of ordinary annealed glass, and, therefore, it is planned to use pre-stressed glass which is six times tougher than normal.

Also, if broken, it does not break into dangerously large splinters — although this is a relatively unimportant point, for the metal screen in a flat tube would greatly limit the dangers of implosion compared with those of a tube of conventional shape.

It has even been suggested that a flat tube made of toughened glass could do without the usual safety screen if dipped in a transparent plastic.

Promise of many advantages

Although much further work remains to be done before this tube is ready for manufacture, it promises many advantages to the designer of a color television set.

All the voltages used are either maximum H.T. (8-10kV), or within five per cent. of cathode potential, no frame frequency generator is required, and the number of external color correction controls needed are fewer than are fitted to existing color receivers.

Also the size of the tube would enable sets to be made with smaller cabinets and consequent saving in manufacturing costs.

There are other, possibly more important, applications which the author envisages for this flat cathode-ray tube. These are for certain military uses, particularly in connection with airborne navigational aids and radar, for which the present type of long-neck tube imposes severe limitations on miniaturization.

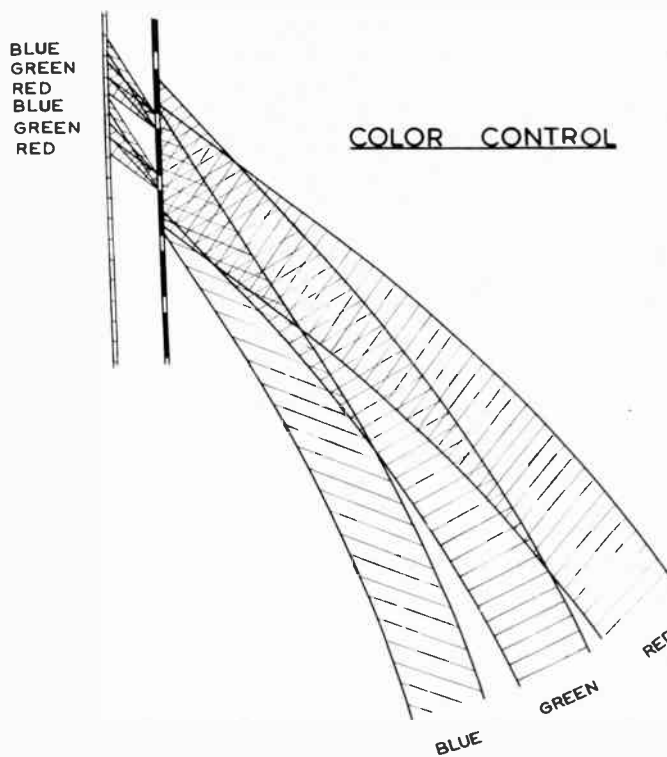


Figure 4, showing the color control in the flat cathode-ray tube for television.

Nuclear energy in foundry control

An electronic device which uses nuclear energy to "peer" through the hot walls of foundry furnaces to keep a constant automatic check on the level of material inside, has been developed by Nuclear Corp. of America.

Called the Indicon I-100, the device projects gamma rays through the furnace to two Geiger counters, one mounted at the maximum fill level and the other at the minimum level. All components are outside the furnace, so the instrument is safe from corrosion and mechanical damage. Its signal can be harnessed to actuate automatic furnace controls, or it can register on a control board hundreds of feet from the furnace if desired.

If rays pass through the cupola to both counters unhindered, the unit registers the fact that the material in the furnace is below minimum level. If rays reach the top counter unhindered but reach the bottom one weakened by passage through material, the unit reports that the furnace has been charged to the right level for operation. If the rays reaching both counters are weakened by passage through material, the cupola has been overfilled.

Ruggedly built and involving no moving parts, the device is unaffected by heat, vibration, impact or continuous use. It can be used on cupolas up to 30 ft. in diameter. The standard unit is sensitive to within plus-or-minus 1/100th of the diameter. It requires only 150 watts, 115 v., 60 cy.

Charge-level, or "stock-line," control is an important factor in foundry practice. Overcharging can cause clogged ducts, "hang-up" of and damage to the loading bucket, and improper furnace operation. Undercharging results in

inefficiency and high operating costs.

Until now, cupola operators have had to gage stock level manually by plunging rods into the furnace. If a rod fails to go all the way in, it is presumed to have encountered stock, giving a crude indication of the level. These devices are undependable because the rod may strike or create a void in the stock and thus go all the way in even though the stock level actually is above the rod. The rods frequently stick in the stock or are bent by falling material, making them useless until repairmen can get inside the furnace.

The Indicon I-100 uses cobalt 60 as its radioactive source. The source is mounted in a lead safe with an aperture in it. When not in use, the source is kept away from the aperture so that no radiation escapes. During operation of the unit, a remotely controlled solenoid moves the source up into the aperture. The source's useful life is about three years. It can be replaced at minor expense.

In the Dearborn Iron Foundry installations, the Indicon's signal is harnessed for automatic control. The loading bucket is made inoperative when the maximum charge level is reached. When the material drops below the minimum level, a time-delay relay is triggered which, if the charge is not brought up to the proper level in three minutes, shuts off the furnace.

Another feature of the Indicon I-100 is that the radiation picked up by the counters increases noticeably as the brickwork inside the cupola crumbles away. The increase is not enough to interfere with the unit's main function, but it does tell the operator that the wall is thinning and may need repair.

The search to further understand the phenomena of geomagnetic and ionospheric eruptions and to solve the problems of their adverse effect on communications is dealt with in the following article which is based on recent research by the Telecommunications Establishment of the Defense Research Board.

The prediction of geomagnetic and ionospheric disturbances*

By T. R. Hartz

Every communications engineer is well aware of the freakish behaviour of the earth's ionosphere at certain times. This abnormal behaviour results from a change in the radiations which arrive at the earth from the sun. The normal ionosphere is produced by electromagnetic radiation in the ultra-violet and X-ray region of the spectrum and any large sudden increase in the intensity of this radiation is reflected in an ionospheric disturbance of relatively short duration. This phenomenon is known as the sudden ionospheric disturbance, or SID. Such a disturbance usually lasts no longer than about 30 minutes and does not hamper the communications engineer a great deal. There is another type of ionospheric disturbance which is of considerably longer duration than the SID and is also of greater magnitude. Occasions have arisen when communications have been completely disrupted for several days at a time. These latter events are produced by solar particles.

Since the particles take several days to travel from

the sun to the earth, it is possible to predict the ionospheric disturbances if suitable solar observations can be made. For this it is necessary to observe the cloud of particles as they leave the sun, and then subsequently to observe them in the intervening regions so as to determine numbers, direction of travel, and velocity. Not all of these measurements can be made easily, but in many cases it is possible to obtain approximate data.

At the Radio Physics Laboratory of the Defense Research Board of Canada a study has been in progress for a number of years which has been aimed at making such measurements on the solar particles where possible. The objective has been to determine a sequence of events on which a prediction of ionospheric storms might be based. The circumstances surrounding a number of

* Contribution from the Radio Physics Laboratory, Defense Research Telecommunications Establishment, Defense Research Board, Ottawa. This work was performed under project PCC No. D4R-28-01-02.

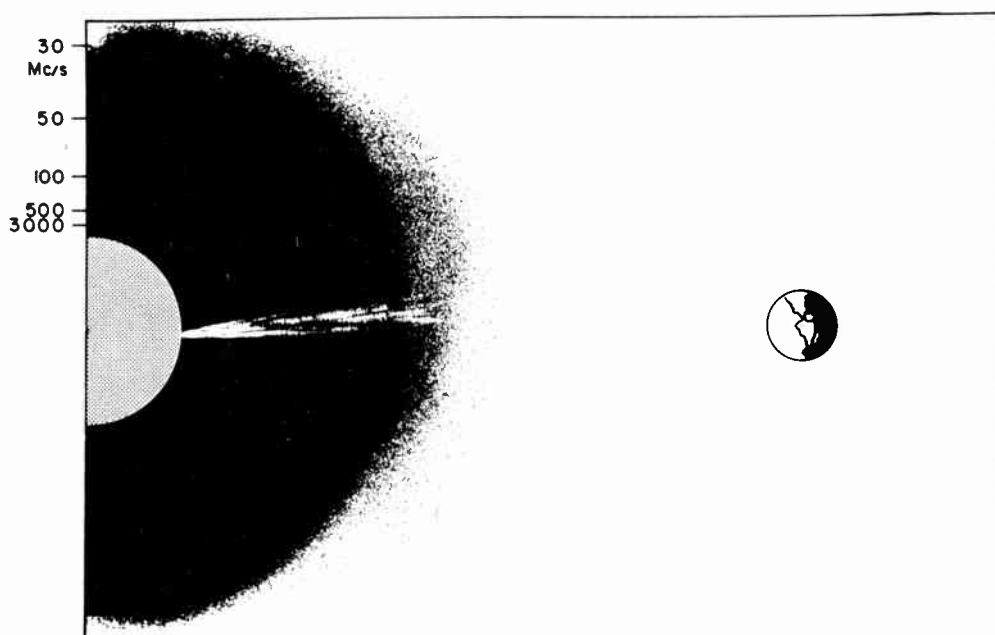


Figure 1. A diagrammatic representation, not to scale, of the sun and the earth, showing the regions in the solar corona from which the respective radiations originate.

specific solar phenomena were examined to find evidence of the particles (a) leaving the sun, (b) traveling in the region between the sun and the earth, and (c) arriving in the immediate vicinity of the earth. The preliminary results tend to show that there is a consistent sequence of events, and consequently, that predictions of ionospheric disturbances can be made.

Origins of the corpuscles

There are a number of distinctive solar phenomena which are capable of producing particles energetic enough to reach the earth. These include solar flares, sunspots, surge or eruptive prominences, disappearing filaments, and M-regions. With the possible exception of M-regions, visual or photographic evidence of the occurrence of these solar events can be readily obtained. Consequently, on the assumption that each such event produces an eruptive cloud of particles, the time at which the particles leave the sun can be specified in each case.

The visual evidence also furnishes information as to the magnitude of the solar event, and provides the position on the sun from which the particles are emitted. This is valuable since it seems likely that the ejection is mostly radially from the sun. The particles probably travel radially outward for some considerable distances, and then some portion of them change their direction of motion by a scattering process or by electrostatic repulsion so as to approach the earth.

Corpuscles between the sun and the earth

Evidence of the solar corpuscles traveling in the region between the sun and the earth can be obtained from radio noise observations. It is well known that at the time of a solar flare, or very soon after, bursts of radio noise can be observed from the sun. It is also well known that this radiation which reaches the earth origi-

nates not on the photosphere, but at some height in the sun's atmosphere where the electron density is sufficiently low to permit the radio waves to propagate. This means that for each frequency there is an envelope in the sun's corona from beyond which radiation cannot reach the earth. The starting time of a noise burst occurs when the mechanism which generates the radio noise, namely, the traveling cloud of particles, reaches that envelope.

The respective envelopes for the different frequencies lie at different heights in the corona. Hence by noting the starting times of the noise bursts which are associated with a large solar flare at a number of frequencies one can follow the progress of the cloud particles through the sun's atmosphere. From this it is possible to deduce the velocity of the traveling cloud of particles at the different heights in the corona.

Figure 1 is a diagrammatic representation of the solar corona, showing the regions from which the respective radiations originate. Figure 2 shows recordings made at three frequencies of solar noise radiations following a large solar flare. The different starting times for the noise bursts at the various frequencies can be seen clearly. Knowing the heights in the sun's atmosphere at which the respective noise radiations can originate, it is possible to compute the velocity with which the particles are moving. A typical case is illustrated in Figure 3, where a graph of the deduced velocity is presented as a function of distance from the sun's surface. The solid curve has been computed from the noise measurements, while the dashed portion of the curve was deduced for free flight in the sun's gravitational field. From this diagram, and other similar graphs, it would appear that the solar corpuscles are accelerated outward through the sun's atmosphere until they attain a height of about 10^6 km above the photosphere, at which place they attain something like a constant velocity. It is not unlikely that their subsequent motion is controlled only by gravitational forces, in which case their arrival time in the vicinity of the earth can be predicted fairly well.

Solar flares are very energetic phenomena, and the radio noise bursts which accompany the flares would indicate that the particles are ejected in the form of a

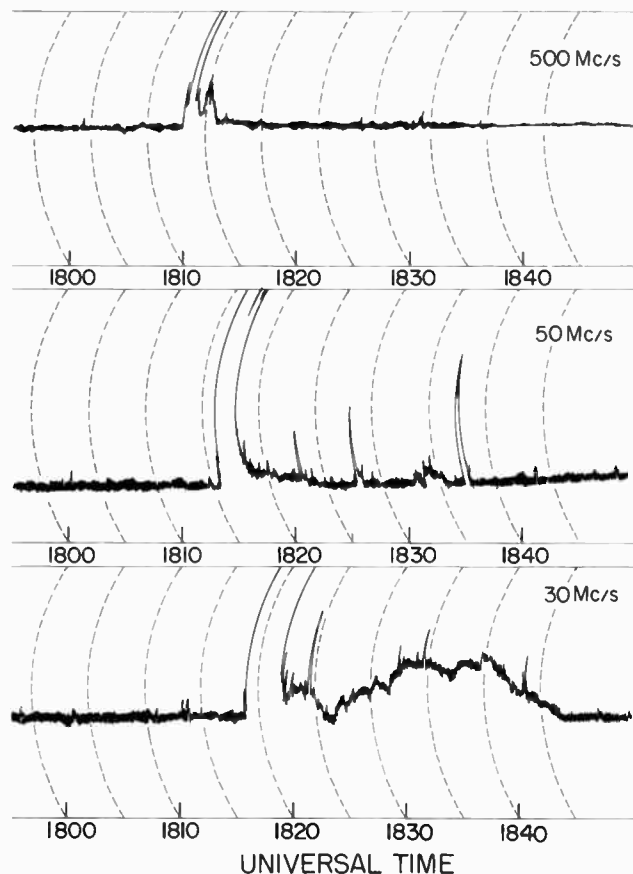


Figure 2. Examples of noise bursts at three radio frequencies following a solar flare.

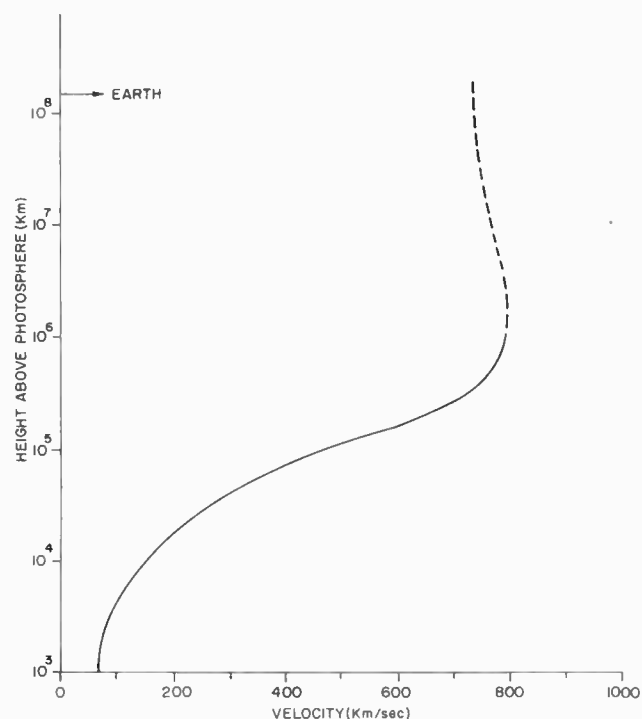


Figure 3. The velocity deduced for a cloud of particles at different heights in the corona.

fairly coherent cloud. There are other eruptive events on the sun which do not seem to produce the same kind of coherent particle clouds. These are the erupting prominences, disappearing filaments, and large sunspots. For each of these events a noise storm is usually observed on the noise records. Such a storm lasts for hours or even days, and leads one to believe that the particles are ejected in a large diffuse or turbulent cloud rather than as a single coherent group. Under these circumstances velocity measurements are not readily obtained.

However, the occurrence of solar noise radiations at these times is an indication that a disturbing mechanism (particle cloud) has reached an upper region of the corona, from which the radio waves can propagate to the earth. The frequencies on which such characteristic radiation can be detected provide a measure of the distance from the sun that the particles have traveled. For example the reception of 30 mc noise means that the particles will have traveled at least 4.8×10^6 km from the sun's surface.

This distance may seem insignificant compared to the sun-earth distance of 1.5×10^8 km. However, a glance at Figures 4 and 5 will show that in traveling this relatively short distance, the particles will use up 40 per cent of the energy required to take them to the earth. In Figure 4 are shown the energies required by a proton to reach the earth from different regions in the sun-earth space. Figure 5 portrays this same information in a somewhat different form. The ordinate gives the percentage of E_T (the total energy required to just move a particle from the sun's surface to the earth against the gravitational field) that is used in bringing the particle from the photosphere to that region of the corona specified by the abscissa. The specification is made in terms of electron density rather than distance, so that the abscissa is the critical frequency corresponding to the electron density that is known to exist at the respective ranges from the sun.

Because the traveling cloud of particles generates radio noise, corresponding approximately to the critical frequency of the region through which it is passing, the observation of the respective frequencies provides an indication of the minimum energy possessed by the cloud. Obviously, the lower the frequency at which the noise measurements can be made, the more complete the knowledge of the corpuscular energies can be, and hence the more reliable the predictions of terrestrial conditions.

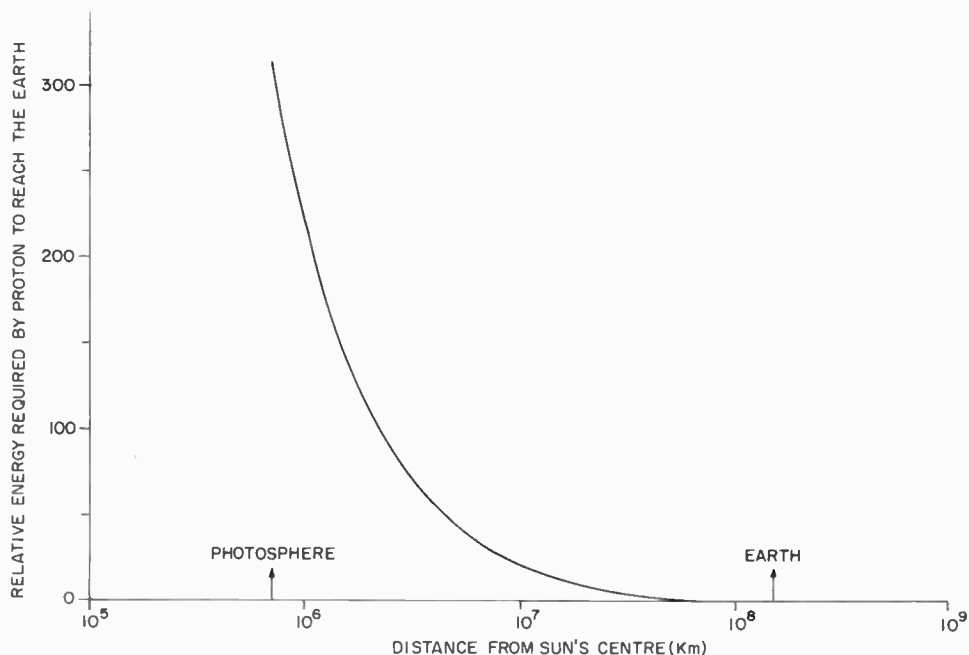


Figure 4. The relative energy required by a proton to overcome the sun's gravitational attraction and reach the earth as a function of the distance from the sun's center at which the particle starts.

Arrival of the particles at the earth

There are extant a number of theories which attempt to explain the details of how the solar particles influence the earth's atmosphere. This article will not treat any of these theories, but will list only several observable effects which provide evidence of the arrival at the earth of the solar corpuscles. These are:

- (1) High planetary magnetic indices.
- (2) Very poor transmission quality on a long distance H. F. circuit which skirts the auroral zone.
- (3) High rates of scintillation of a radio star, as observed at Ottawa.
- (4) The occurrence of aurora in southern latitudes.

It has been found that there is a high degree of correlation between these different measures, implying that each and all are manifestations of ionospheric disturbances produced by solar particles.

The prediction of storms

The results of the study at the Radio Physics Laboratory have shown that it is possible to obtain visual evidence of particle emission from the sun, and radio evidence of the particles traveling in the corona, approximately two or three days before an ionospheric disturbance. This systematic picture has formed the basis of a quantitative scheme for predicting geomagnetic and ionospheric storms.

Each of the following factors has been considered in this scheme, namely:

1. Visual evidence of unusual solar phenomenon,
2. Magnitude of the solar phenomenon,
3. Position on the sun's disc,
4. Velocity of the associated particle cloud,
5. Magnitude of the particle cloud (inferred from the magnitude of the associated noise radiation),
6. Evidence that the particle cloud has actually reached or passed through the upper corona.

These factors were graded in importance, and described by arbitrarily weighted integers. The sum of the integers then provided an index figure which was taken to give a relative probability with which an ionospheric disturbance could be expected to follow the solar event within an interval of two or three days.

The weightings for the various factors were assigned on the basis of observations for a six month period in 1955. Then, in order to test the predictions, the data

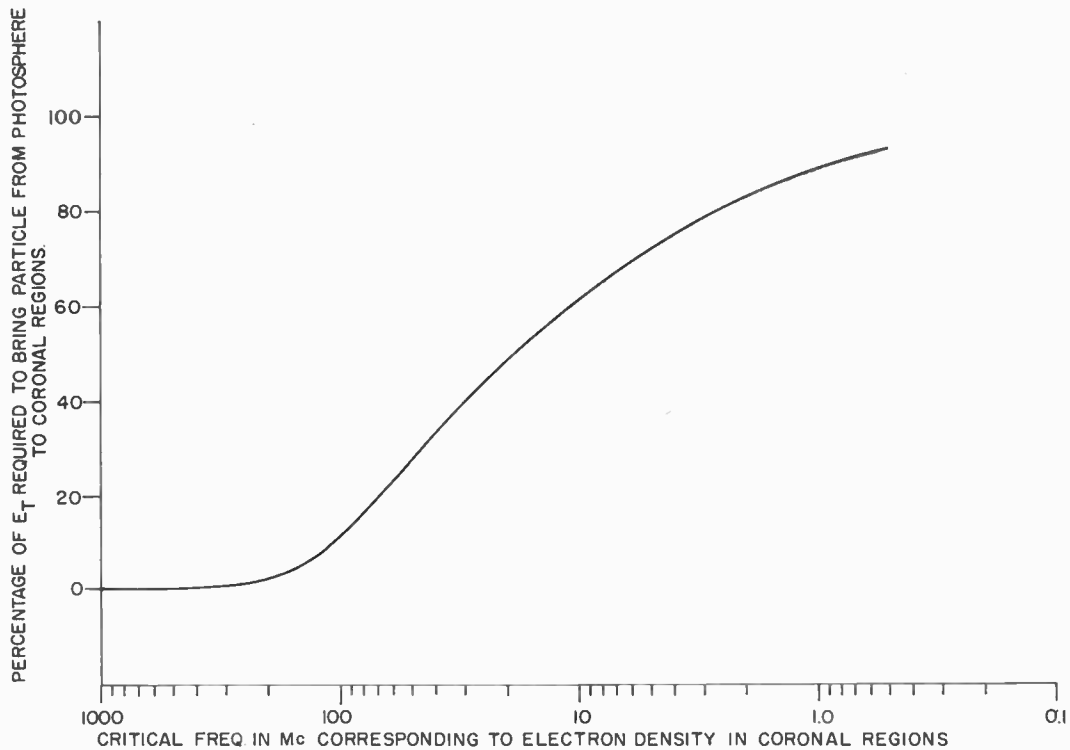


Figure 5. E_T is the minimum energy required by a particle to overcome the sun's gravity and reach the earth. The diagram shows the percentage of E_T necessary to bring a particle from the sun's surface to a region of the corona specified by the critical frequencies shown.

for the 12 month period in 1956 were examined. The ionospheric disturbances were graded in magnitude, and the grades were compared to the predicted index figure for that particular disturbance. A correlation coefficient of +0.65 was obtained for these data. This is sufficiently high to show that predictions can be made with some assurance.

It should be noted that the 'predictions' to date have been made in retrospect. The data for the year 1957 are now available and the observed storms will be compared to indices derived for each case from the solar measurements. At present the weightings for the various factors are being reconsidered and revised in an attempt to improve the correlation before the 1957 data are examined.

Inertial system for flight into space

Flights of the hypersonic X-15 research aircraft—designed to rocket a human pilot to the orbital fringes of space and back—will be directed by an exceptionally advanced flight instrument system. This was disclosed by the National Advisory Committee for Aeronautics, U.S. Air Force, and Sperry Gyroscope Company.

The new system is patterned to protect America's first exploratory spacemen-pilots with automatic inertial flight aids and sensing devices—that will display precise position and navigating data visually, for human judgment and selection of optional maneuvers the pilot may command. In effect, the human pilot is "designed into" an extremely accurate short-time-of-flight inertial system, as a super-intelligent servo link.

Reliable instrumentation even during periods of weightlessness—not yet attempted for unmanned satellites after these enter orbital paths—becomes a requirement for the man-carrying space research vehicle. Another technical first for human-piloted rockets is the inclusion of missile-style altitude-sensing inertially, carried to even tighter degrees of precision.

Principal function of the system is to assist the pilot in controlling the research rocket to prevent it from burning up by re-entering denser atmosphere too steeply, or "bouncing back" too high from too shallow a trajectory. The system also feeds electronic information into airborne recorders which permanently chart each flight.

The inertial system is composed of a three-gyro stable "platform" which provides critical attitude, velocity, dis-

tance and altitude sensing, and a light-weight computer which digests and interprets the data. Sperry also is developing highly specialized flight instruments to display the information pictorially for the pilot.

Miniaturized to meet space and weight premiums of the X-15—and capable of operating in weightless environment and at temperature and velocity extremes—these systems may be adaptable to many forms of missile guidance and other space-age navigation or stabilization needs. Proposed flexibility provides Doppler or pure inertia modes, or optional coupling with a star-tracker for celestial-inertial functions as well.

Another feature is ability to provide altitude information inertially. Sperry-developed accelerometers, or "space speedometers," record changes in velocity in any direction, including components of altitude. Conventional barometric altimeters would be useless in the upper limits and beyond the earth's atmosphere.

These accelerometers are a "force-feedback" type, and also measure velocity changes affecting the distance to target and any deviation from the intended course. Thus, the system provides an absolute "fix" on the aircraft's position in space at any moment.

The flight instruments associated with the Sperry project include the all-attitude indicator and special inertial altimeters, total space velocity and vertical rate indicators. Each is essential to the safe return of the pilot and aircraft from the space research missions.



Figure 1. General view of the self-contained ultra-sonic gage for automated production.

An equipment that measures the thickness of metals and plastics ultrasonically from one side and records it at the same time and which with suitable attachments can be set up to take corrective action automatically in such functions as maintaining dimensions of machined parts within preset limits.

Ultrasonic gaging design for automation

By Peter K. Bloch*

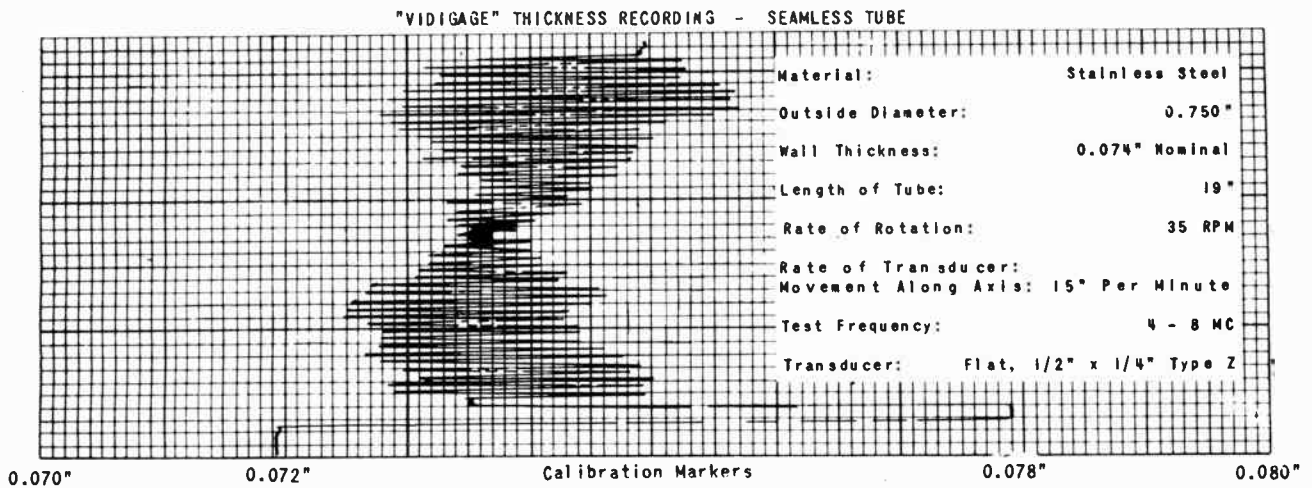
An ultrasonic gage which not only measures thickness, but feeds back this information to control machining or sorting operations automatically, has recently been developed for applications where automatic, accurate control of thickness is required.

The automatic "Vidigage" as the instrument has been named is ideal for production applications, as, for example, in checking the wall thickness of extruded tubing or shapes. Depending on whether the extrusion rotates or not while the transducer is moved laterally, either a

straight-line or spiral profile will be obtained. Thickness of steel, glass or plastic sheet may be similarly checked, and the soundness of welded or brazed joints and clad metals may be continuously monitored.

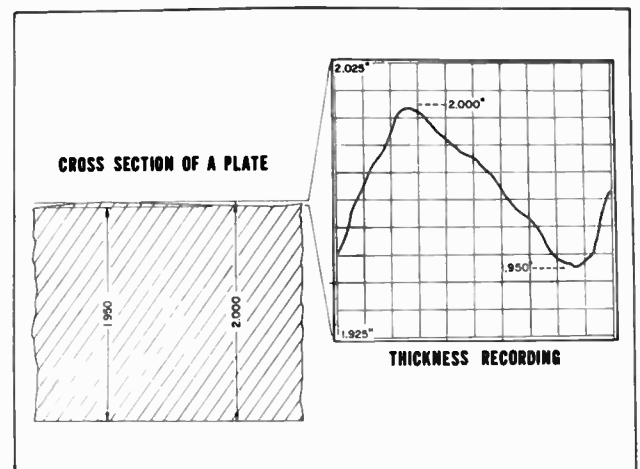
In chem-milling large aluminum wing skins, a constant check of metal thickness is important to prevent over-etching, which could ruin the entire piece. With a properly protected ultrasonic transducer probe attached to the wing skin while immersed in the etchant, continuous thick-

*President Branson Instruments Inc.



Top: Actual sample of strip chart recording, taken in checking seamless steel tubing. Note variation in wall thickness, from a minimum of 0.0725 in. to a maximum of 0.0757 in. Because transducer moved about 1/2 in. along tube per revolution, a spiral trace was obtained. One cycle of pen—to the right, left, and back to the starting position—represents one revolution of the tube.

Right: The Automation Converter produces a voltage which is proportional to the distance of the resonance signal from the edge of the gate. This voltage, which is a function of the thickness, actuates a recording pen and produces a record of thickness on the recorder. Extremely high accuracies—as high as 1/50th of 1 per cent—have been achieved with automatic recording.



ness readings can be obtained. Over-etching is then impossible, for when the correct size is reached, the instrument activates machinery to lift the aluminum out of the etchant.

Functionally, the equipment is divided into 3 parts: the resonance gage for measuring, the gating and alarm circuit, and the automation converter.

In the resonance gage, the output of a sweep oscillator is converted into mechanical vibrations by a ceramic transducer (the probe), coupled to the part under test by water or oil. Maximum-amplitude vibration of the transducer, and thus maximum power output, occurs when its frequency matches the resonant frequency of the part. This increased oscillator load at resonance is indicated on a cathode ray tube by a vertical line.

Because the resonant or natural frequency of a metal, plastic, and other rigid material varies inversely with its thickness, interchangeable oscillators, and scales calibrated in inches or millimeters are placed in front of the screen. Thus, a direct, instantaneous thickness reading is obtained with micrometer accuracy.

The gating circuit detects the presence of a strong resonance signal within a pre-set frequency range. This

range is visible on the CRT as a bright base line of a certain length. Because frequency is a function of thickness, the gate can be adjusted to coincide with the allowable thickness range of the material. A strong signal within gating limits then shows that the desired dimensions have been reached, and trips a relay to actuate indicating, alarm, or operating mechanisms. Extra gating circuits, for sorting parts according to thickness, can be added.

The automation converter, acting as an FM discriminator, converts the difference between resonant frequency and one edge of the gate into a varying voltage signal. This voltage can then be used to control almost any mechanical device.

Output from the automation converter also controls a strip chart recorder. Besides keeping permanent track of thickness variations, important in corrosion control, the recording trace represents an enlarged profile of the part. Small thickness changes which are barely visible on the instrument's screen are magnified and easily seen on the recording paper.

A marker generator produces 2 pips at fixed locations, for each range to calibrate and check both strip chart and CRT.

COVER STORY

Splicer Jack Hobson works in the maze of cables in the vault of Vancouver's new Amherst automatic office which will replace the Kerrisdale manual system. The photograph is by Jack Lindsay and is reproduced by the kind permission of Telephone Talk, official publication of the British Columbia Telephone Company.

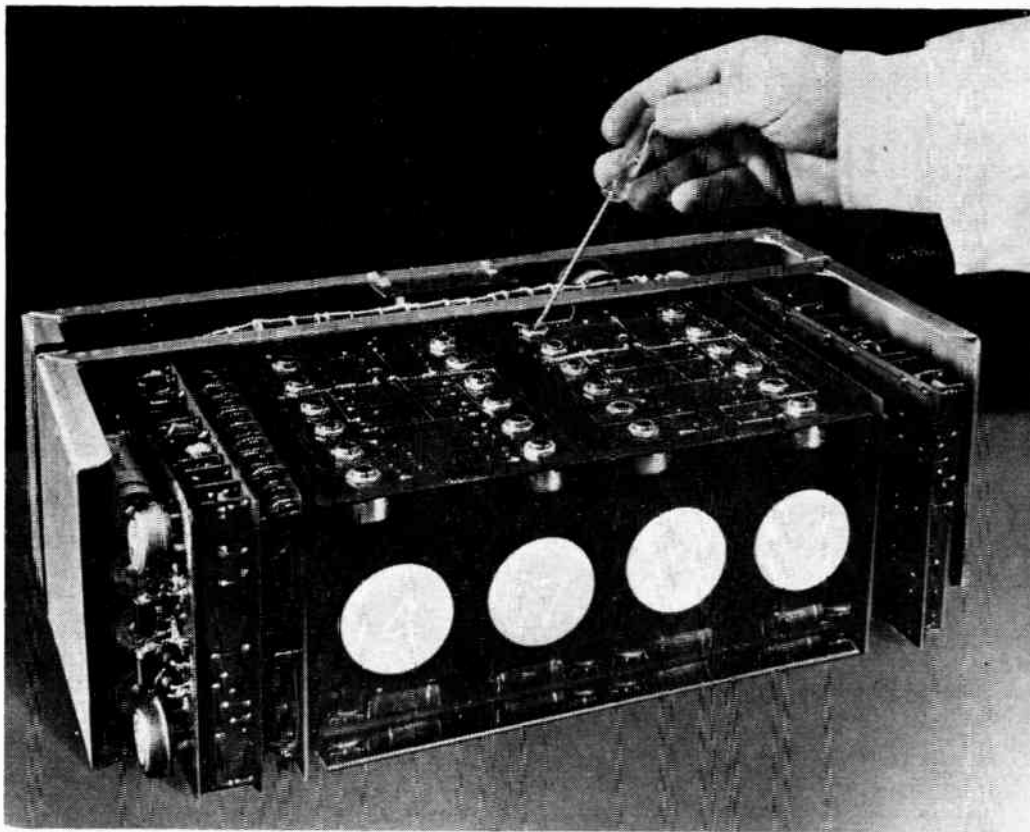


Figure 1. Demonstration of the ease with which the potentiometers of the control circuit of display device can be adjusted.

A digital display device using Lissajous patterns for the formation of numbers and with all wave shapes being derived from a 60 cycle center tapped sine wave source constitutes a recently developed

Electronic digital display device for the computer field

A completely electronic digital display device for the computer and instrumentation fields has been developed to fill a critical need in industry and research for an easily read and reliable digital display. The instrument features all electronic circuitry and has no moving parts. It has printed circuit plug-in panels with completely passive components. On its two inch cathode ray tubes it provides readout for two, four or six digits with the benefits of wide angle viewing, low power consumption and ultra-fast response.

The instrument has been designed for use in conjunction with decade counters, elapsed time indicators, EPUT meters (events per unit time) frequency meters, analog-to-digital converters, punched card and tape readers and digital volt meters.

The display medium is a two inch cathode ray tube. In a cathode ray tube, the image is displayed by exciting the phosphor coating on the face of the tube. This fact gives very desirable viewing qualities to the display. The viewing angle is quite large and does not have the limitations of edge lighted panels or horizontally aligned grids. The viewing brightness is constant since there is nothing in front of any of the numbers. In many other types of displays a number is viewed through several other number elements. This yields a display of varying brightness with a relatively short viewing distance. The cathode ray tube display is readable at almost any distance.

In the block diagram of the electronic digital display (shown elsewhere), the dotted lines indicate the external contact closures that must be made to display the number

"0682". The first digit explains the operation. The external contact closure connects the low voltage 100 KC signal from the oscillator to the number two high voltage R.F. transformer on the units digit high voltage generator board. The high voltage R.F. from this board is applied to the units gate board. The vertical and horizontal number waveshapes are continuously applied to the gate boards. The high voltage R.F. is rectified on the gate board and used to open two gates. These two gates allow the vertical and horizontal waveshapes to be applied to the corresponding deflection plates on the units CRT.

Separate R.F. transformers are used for each number in each digit to allow external control from pulse magnetic amplifier decade counters and other logical circuitry.

100 KC Oscillator

In the 100 KC oscillator circuit, the output voltages are taken across the R.F. chokes in the collector circuits. Two digits are energized from each phase. This oscillator is the same type used to power the pulse magnetic amplifiers that will be used in conjunction with this digital display unit. This circuit is contained on a printed circuit board along with its associated low voltage D.C. supply, and the high voltage supplies for the cathode ray tubes.

High Voltage Generator

The high voltage generator printed circuit board consists of 20 R.F. transformers. These transformers are tuned to 100 KC. The primaries are excited through a silicon diode by the 100 KC oscillator when the proper external connection is made. There are 10 transformers per digit and two digits per board. The input voltage is a rectangular pulse 5 microseconds wide and 12 volts in amplitude at 20 milliamperes. The output is a sine wave of 250 volts RMS.

Gate Board

The high voltage R.F. from the high voltage generator board is applied to the appropriate number gates on the gate board. There are two gates per number: a gate for

the vertical waveshape and a gate for the horizontal waveshape. All the gates for one digit are constructed on a printed circuit board. The number waveshapes are always present at the input to the gates. The waveshapes cannot pass through due to the back to back diodes of the gate. When the 100 KC high voltage is applied to a pair of gates these two diodes are brought into a conducting state by rectification of this voltage. This allows the number waveshapes to pass through to the common output terminals which go to the deflection plates.

Number Generator

The number waveshapes are generated by circuits that are constructed on a printed circuit board. The numbers are formed by Lissajous patterns. A horizontal waveshape and a vertical waveshape are generated for application through the gates to the proper CRT deflection plate. All waveshapes are derived from a 60 cycle, center-tapped, sine wave source.

Reliability is achieved in the design by the use of only passive elements to generate the necessary waveshapes. That is, the only components used in the number generator circuits are resistors, capacitors and silicon diodes. No active elements such as vacuum tubes or transistors are used. Since only passive components are used, the number circuits cannot become faulty or inoperative due to changes in gain or other troubles commonly associated with active elements. Simplicity of design is another factor that contributes to the reliability of the device. All circuits utilize standard techniques of diode clipping, diode limiting and/or phase-shifting.

The zero is derived in the usual way, from two sinusoidal waveshapes with a 90° phase difference.

Number one, of course, requires only a vertical waveshape. A sine wave is used since it can be taken directly from the zero vertical waveshape.

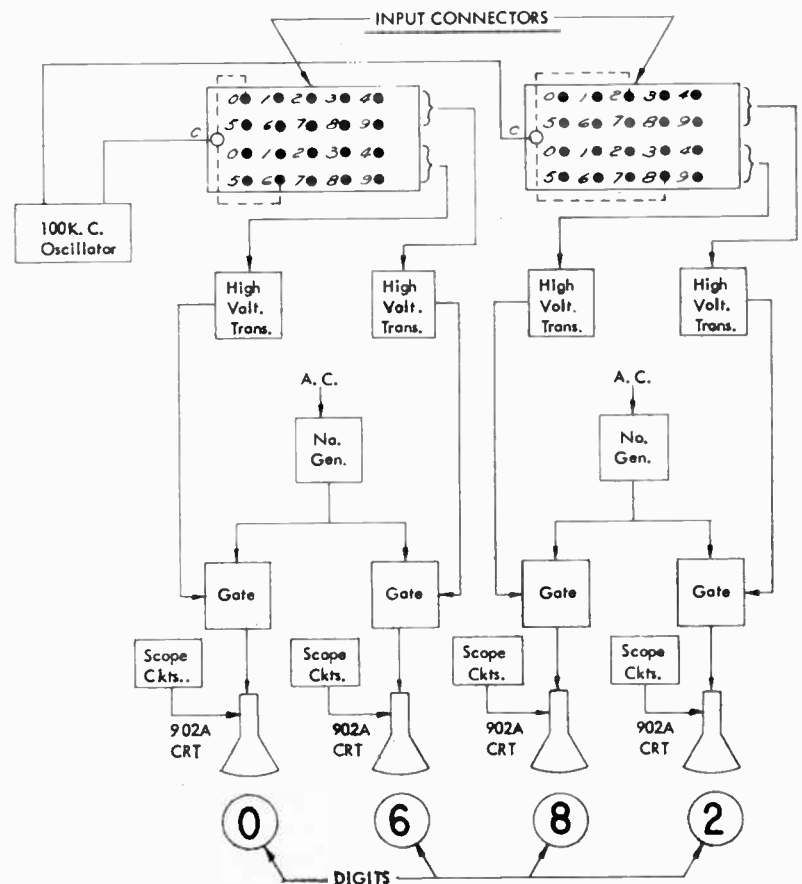
The vertical waveshape for number two is an unshifted sine wave with a diode limiter on the negative excursion. The horizontal waveshape has three components. Two of these are derived from phaseshift networks and the third

Figure 2. Block diagram of the decimal unit contact closure with method of operation as follows: A contact closure on the input connector between the common 100 k.c. connector pin and a given number pin, causes the following series of events to occur:

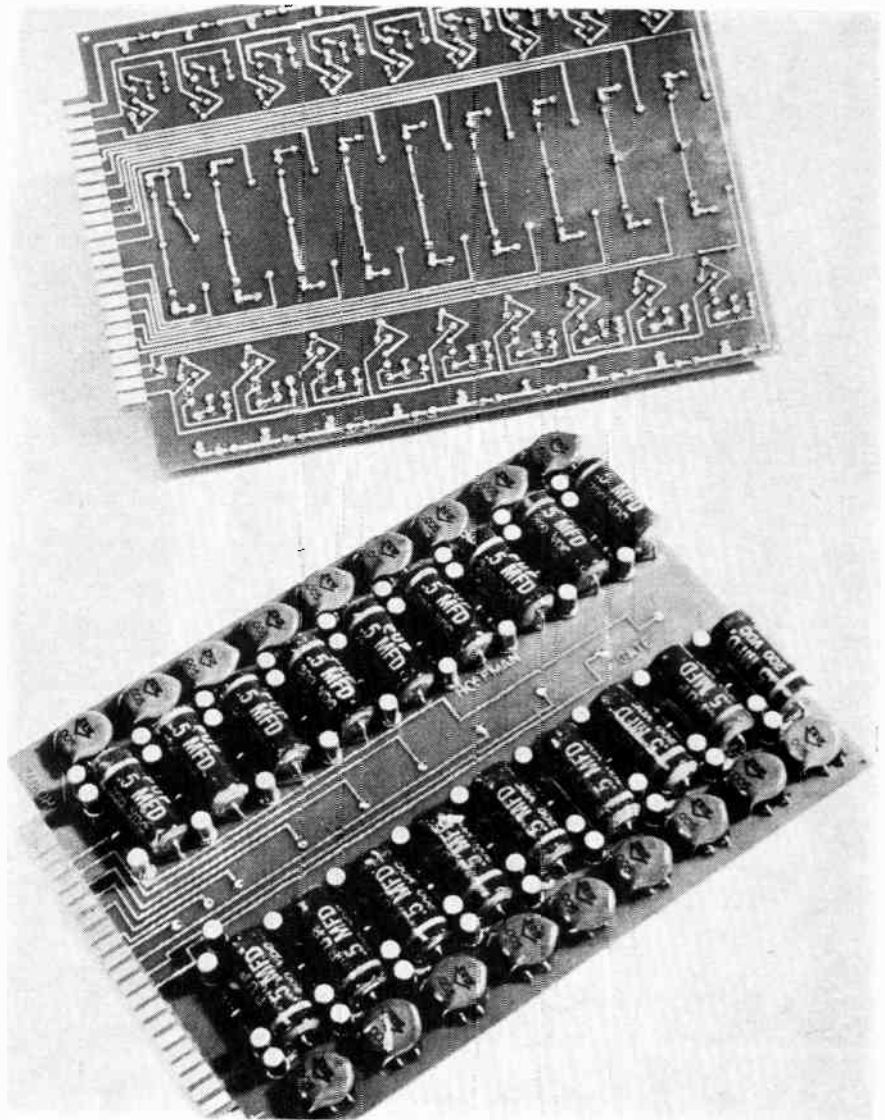
1. The high voltage 100 k.c. signal is applied to the appropriate number gate.

2. This opens the gate, allowing the horizontal and vertical waveshapes from the number generator to be applied to the cathode ray tube's deflection plates.

3. This displays the selected numbers on the face of the cathode ray tubes.



The digital display device features eleven printed circuit panels. Shown are the front and back of a typical printed circuit made for the units. This panel is a gate control unit for helping form the numbers on the face of the device's cathode tubes. The printed circuits are "plug-ins" (note the plug at the top end), which are simply designed for automatic production. They can be simply assembled in the chassis of the digital display device in a modular board fashion. The panels use silicon diodes, which are the round, metal units shown above. The other components are capacitors and resistors.



directly from the supply. The positive portions of these waves are summed into a common point to yield the number two horizontal waveshape.

The vertical waveshape of number three is a shifted sine wave with the positive excursion of smaller amplitude than the negative excursion. This is accomplished by shunting a diode with a resistor. The horizontal waveshape has four components. Two of them are derived from phase-shift networks and the other two directly from opposite phases of the supply. The positive portions are summed together to yield the number three horizontal waveshape.

Number four is generated in the following manner: The vertical waveshape is a series of negative half sinusoids with every other one clipped slightly below maximum amplitude. This is accomplished by clipping the positive excursion from one phase of the supply and summing in the positive excursion of the other phase unclipped. The horizontal waveshape is a negative half sinusoid clipped at half amplitude and summed with a positive half sinusoid of slightly greater amplitude.

The vertical waveshape of number five is an unshifted sine wave with a diode limiter on the positive excursion. The horizontal waveshape has three components. Two of these are derived from phaseshift networks and the third is taken from one phase of the supply. Series resistors are used with two components to reduce their amplitudes. All three components are summed to yield the number five horizontal waveshape.

Number six is derived from two phase shift networks with diodes by-passing the capacitors. The vertical circuit

is from one phase of the supply to the center-tap. The horizontal circuit is across the total supply.

The vertical waveshape for number seven is the conventional half-wave rectifier waveshape without filtering. The horizontal waveshape is the conventional full-wave rectifier waveshape without filtering with alternate half sinusoids of smaller amplitude.

Number eight has a phase-shifted sine wave for the vertical waveshape. The horizontal waveshape resembles the horizontal waveshape of seven except that a capacitor is used to round out every other valley.

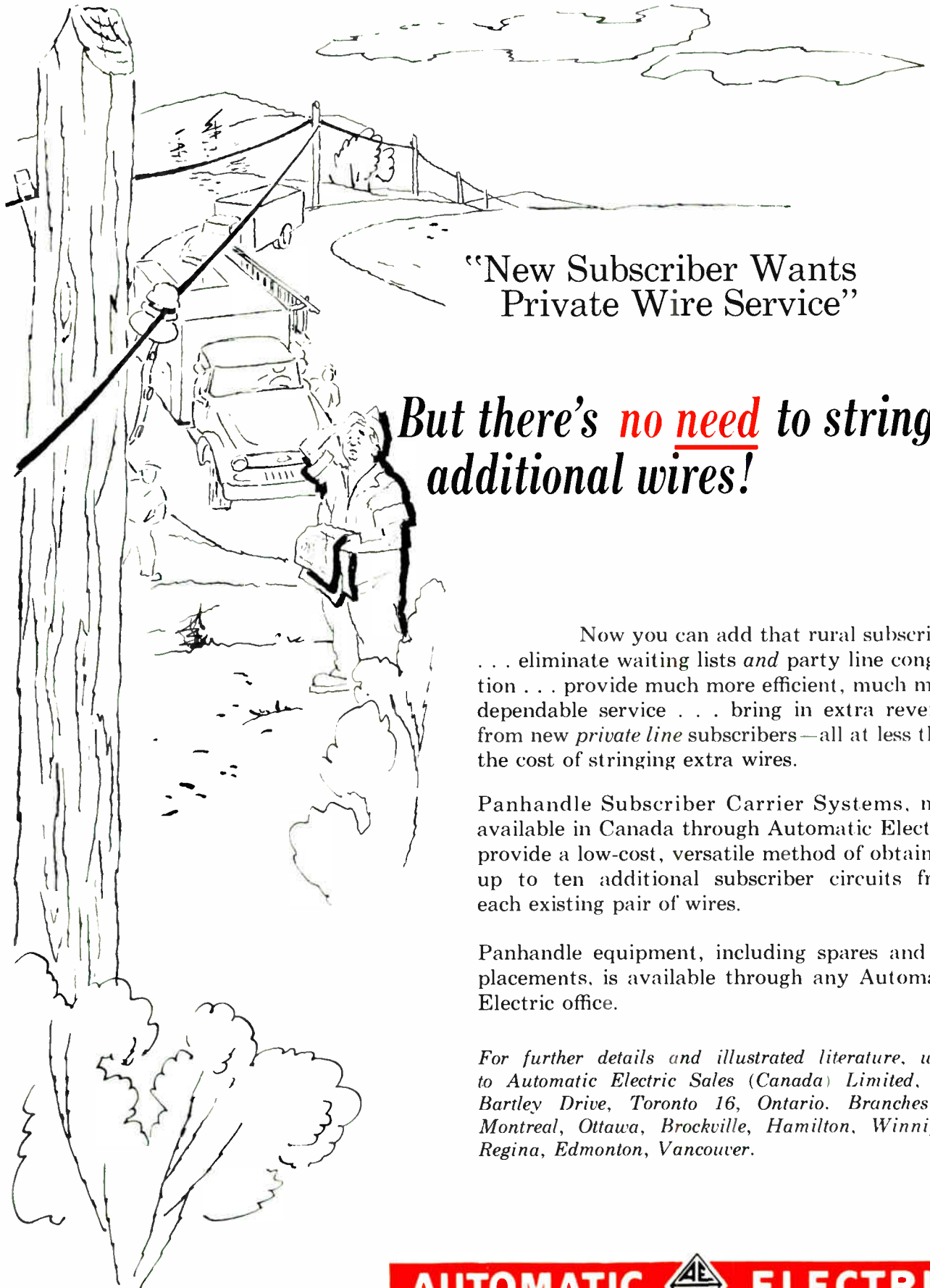
A phase-shifter from one phase of the supply to the center-tap, by-passed by a diode to the other side of the supply furnishes the vertical waveshape for number nine. The horizontal waveshape comes from a negative half wave rectifier without filtering.

This completes the generation of all ten numbers.

The numbers are generated at the voltage levels required by the deflection plates of a two inch cathode-ray tube. This puts a high back voltage requirement on the diodes in these circuits. For this reason, silicon diodes type 1N222 are used. The silicon diodes also contribute to increased reliability due to their better temperature characteristics and inherent low back current.

Four scope circuits are used. One printed circuit board contains the scope circuits for two cathode ray tubes.

The entire display unit is composed of printed circuit cards that slide into a U-shaped chassis. All interconnecting wiring is done on the back of the chassis. A smaller U-shaped chassis containing the power transformers and input connectors fits on the back of the main chassis.



“New Subscriber Wants
Private Wire Service”

But there's ***no need*** to string
additional wires!

Now you can add that rural subscriber . . . eliminate waiting lists *and* party line congestion . . . provide much more efficient, much more dependable service . . . bring in extra revenue from new *private line* subscribers—all at less than the cost of stringing extra wires.

Panhandle Subscriber Carrier Systems, now available in Canada through Automatic Electric, provide a low-cost, versatile method of obtaining up to ten additional subscriber circuits from each existing pair of wires.

Panhandle equipment, including spares and replacements, is available through any Automatic Electric office.

For further details and illustrated literature, write to Automatic Electric Sales (Canada) Limited, 185 Bartley Drive, Toronto 16, Ontario. Branches in Montreal, Ottawa, Brockville, Hamilton, Winnipeg, Regina, Edmonton, Vancouver.

AUTOMATIC  ELECTRIC

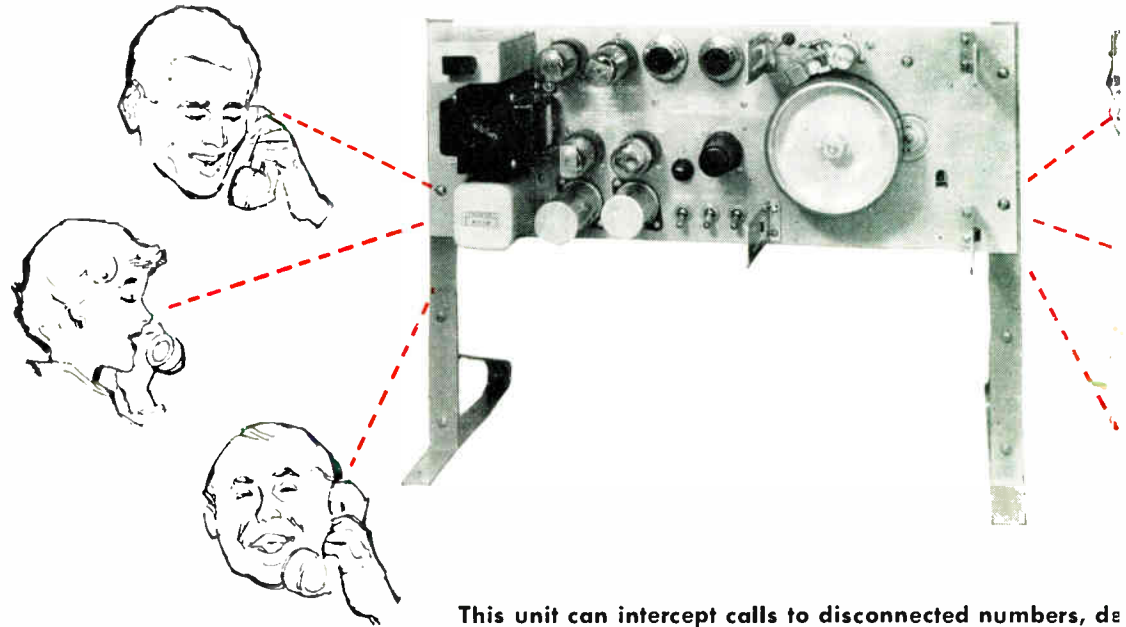
ORIGINATORS OF THE DIAL TELEPHONE



Reduce Service Costs

WITH **AUTOMATIC INTER** **OF PROFITLESS CA**

Now that many dial exchanges are unattended, Recorder-Announcer becomes an important factor telephone service costs.



This unit can intercept calls to disconnected numbers, de levels, etc. and gives proper dialing instructions to callers automatically, without going through any manual exchange.

IMPROVES SERVICE AND REDUCES COST

You can provide faster service to your customers and reduce service costs substantially with Automatic Electric's new single-channel, compact recorder-announcer. The Type SCC with the necessary trunk circuits will serve up to 70 callers at a time. You simply record the announcement you wish to make by speaking into a standard telephone handset . . . set the announcer to run continuously or on a start-stop basis. Each caller receives the information quickly and automatically at *minimum expense to you*.

COSTS SO LITTLE TO OPERATE

The Type SCC recorder-announcer consumes very little power—even when transmitting to the maximum of 70 callers. The dependable design and construction of this equipment assures you that maintenance costs will be negligible.

DESIGNED FOR COMPACT

If you wish you can move it calls closest to their point . . . move it around. And compact panel and is delivered compact. If more than one intercept . . . be glad to show you how . . . Keep your operators free . . . with the SCC recorder-an

Address: Automatic Electric
Toronto 16, Ontario. Branch
Winnipeg, Regina, Edmonton

AUTOMATIC  **ELECTRIC**

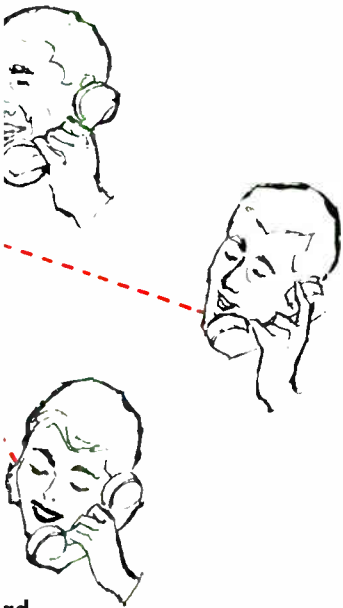
ORIGINATORS OF THE DIAL TELEPHONE



For further data on advertised products use page 59.

CEPTION ALLS

the SCC
n cutting



ad
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nge!

'NESS AND PORTABILITY

ne announcer to any outlying exchange to intercept
of origin. It is so light and portable that *anyone* can
act too! The SCC is mounted on a 19" x 7" steel
npletely assembled and ready for immediate use.
ecording is required, two units can be used. We will
his recorder-announcer can best help your company.
to handle revenue-producing calls . . . cut toll costs
nouncer. Contact Automatic Electric for full details.

Sales (Canada) Limited, 185 Bartley Drive,
es: Montreal, Ottawa, Brockville, Hamilton,
n and Vancouver.

5712-R

4 more
ways
to increase
telephone service



Give your subscribers all types of information, quickly and efficiently—without calling the operator! Recorder-Announcers relay the message in clear life-like tones, at the least possible cost to you! These four types of Recorder-Announcers improve service and build goodwill.

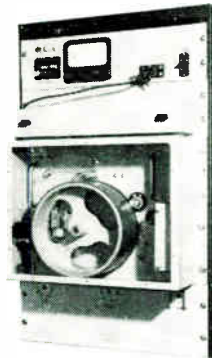
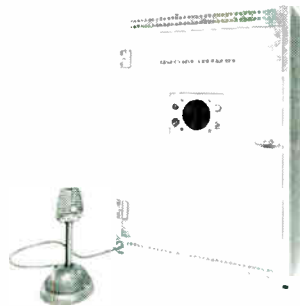


AUTOMATIC TIME ANNOUNCER (TYPE A)

Automatically "broadcasts" time every 15 seconds. Each "broadcast" may be preceded by commercial or public service announcements. Up to 6 different announcements, each of 6 seconds duration can be made and changed at will. 50 callers can listen at once.

SHORT MESSAGE "INFORMATION PLEASE" (TYPE FML)

For installation with fire departments, theatres, transportation companies etc. Takes 6½ or 12-second messages. 30 callers can listen at once. Batteries provide standby power. Sample: "Fire at Jones Service Station, Main and Centre Streets . . ." or "The feature movie begins at 7.09 and at 9.40 p.m. It is called . . ."

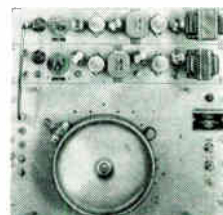


WEATHER AND LONGER MESSAGE ANNOUNCER (TYPE VMC)

With the necessary trunk circuits up to 100 callers can simultaneously hear any message—weather forecasts, advertising, store announcements—of up to 4 minutes length. Messages can be recorded any time, from anywhere. Correct audio output is constantly supervised by automatic control.

VERSATILE AUTOMATIC INTERCEPTOR (TYPE MCF)

Provides repetitive services such as interception of calls to disconnected lines, dead levels etc. Will repeat from one to five messages to a maximum of 70 callers simultaneously on each message.



Power consumption and maintenance is very low for all four models. For more information write today for circular 1845A.

linemen *(naturally)*

electronic assemblers
(without a doubt)

(and even) **lab technicians**

all agree...

— the very best in tools and equipment
for their jobs come from

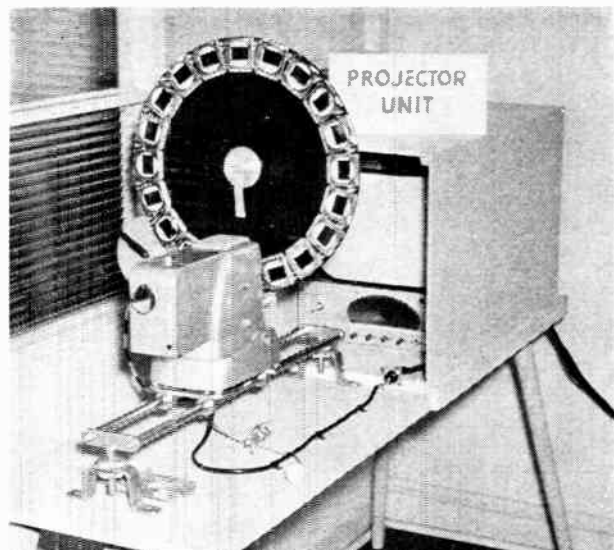
AUTOMATIC ELECTRIC

SALES (CANADA) LIMITED
185 Bartley Drive, Toronto 16

MONTREAL • OTTAWA • BROCKVILLE • HAMILTON
WINNIPEG • REGINA • EDMONTON • VANCOUVER

5637-R

For further data on advertised products use page 59.



Shown above is the standard transmit/receive unit with control at extreme left. Information is written on the face of the screen with grease pencil and transmitted via co-axial cable to similar monitors. Following transmission of the message the inscription may be erased from the screen with a duster.



Shown above is the projector unit in which twenty black and white or color slides may be inserted and fed automatically to the projector. Equipment shown in the above photograph is of English origin but Canadian produced equipment will use larger screens.

A new application of the flying spot scanner has resulted in a novel

Two way visual and sound intercommunication system

By J. W. Paddon*

This system is based on the flying spot scanning technique. A blank television raster is produced on the cathode ray tube of the transmitting unit and information to be transmitted is written with a special pen or pencil on a transparent surface over the face of the tube. Alternatively a prepared transparency can be used and is particularly useful when handling tabulated information since it is possible to add handwritten information to a pro forma transparency. A photo-multiplier, mounted in the hood above the screen, collects light passing through the transparency from the cathode ray tube source. The electrical output from the photomultiplier represents the visual information to be transmitted and is amplified and fed to the receiving unit via a co-axial cable line. Here the signal modulates another similar television raster to produce a facsimile on the screen. Depending on the type of cable used and the picture requirements, units can be separated by up to 1,200 yards. Where this distance has to be exceeded, simple line amplifiers are necessary. The speech section is based on a conventional amplifier operating in a transmit/receive intercommunication circuit. Independent transmit/receive controls are provided for speech and vision.

Facilities

The system is extremely flexible and any number of units can be interconnected to form comprehensive communication networks. Information from two or more of the Master Units can be mixed and displayed simultaneously. Another facility which enhances the value of the system is the re-transmission of a received picture. This enables operators to add their own information to a picture received from other sources and re-transmit the resulting composite picture.

A major advantage offered by the system over closed circuit television is that it operates in normal lighting conditions. If, however, a 'live' picture is necessary an input from a television camera can be introduced in a Deccafax communication network.

The signal is carried on inexpensive co-axial cable. The cable, being only one quarter inch in diameter, is unobtrusive and very easily handled. Unlike closed circuit television equipment, this system can be properly maintained by a competent TV receiver service technician, eliminating the necessity of expensive and complicated test equipment.

Since the equipment is based on standard TV techniques, replacement parts are inexpensive and readily obtainable. Neither lenses nor the expensive vidicon or orthicon tubes are used in the apparatus.

TV distribution system tie in

The Deccafax system can be connected into existing TV program distribution networks such as are installed in hotels and apartment houses and the signal can be fed into a vacant channel to provide an internal means of displaying advertising or announcements. An automatic slide projector permits the transmission of twenty transparencies in regular sequence for advertising or display purposes and the slides may be removed and replaced at will.

The output of the system can be connected into a standard TV transmission network, a technique that is used by the BBC for effects and annotations.

Foreseeable applications for the system, according to the manufacturers, are numbered in the dozens and include railways, airlines, shipping lines, government, commerce, hotels and the armed services.

*Decca Radar Canada Limited.

New Products

New Product specifications published in *Electronics and Communications* have been briefed for your convenience. If you require further information on any of the items published you may readily obtain such by using our Readers' Service, Page 59. Just mark the products you are interested in on the coupon on Page 59 and the information will be in your hands within a few days.

Silicon Power Rectifiers

Item 2026

Optional mounting bases and reverse polarity types in all ratings and mounting styles are design features of the expanded line of hermetically sealed, all-welded silicon power rectifiers for all industrial applications, now in full production at International Rectifier Corporation, El Segundo, California.

This series, rated at 45 to 150 amperes (half-wave) with PIV voltage ratings from 50 to 800 volts (pipe-thread, long machine thread and standard machine thread) offers reverse polarity types in each rating and mounting style.



Also available are military types conforming to MIL-T-12679/26 (Sig. C.) All types are designed and manufactured to meet the most rigid military requirements of MIL-T-19500. Thus long-term reliability under extreme conditions of environment, such as humidity and moisture, shock, vibration, centrifuging and temperature cycling, may be expected.

Applications for these rectifier types include battery chargers, welding equipment, plating equipment, etc., as well as all types of military equipment. They may be operated at base temperatures up to +200° Centigrade.

Further data obtainable from International Rectifier Corporation, El Segundo, California, U.S.A.

Enclosed Relay With Observation Window

Item 2027

Visual inspection of enclosed relays is made practical by a series of enclosed plug-in relays with plastic observation windows announced by Magnecraft Electric Co., 3354RC W. Grand Ave., Chicago 51, Illinois.

The enclosures are dust tight; of conventional metallic construction with a heavy plastic insert in the end of the container for visibility.

Currently available for AC and DC operation with contact combinations to 6DPT. Can be supplied with contacts ranging from bifurcated (twin) contacts for switching extremely low voltage and low current to power contacts rated 10 amperes at 115 V AC, non-inductive load.

Literature may be had on request to Magnecraft Electric Co., 3354RC W. Grand Ave., Chicago 51, Illinois, U.S.A.

Closed Circuit TV Without A Camera

Item 2028

Scan-A-Graph is an electronic closed circuit visual communication system, operated without a television camera. It has been devised by the creative engineering staff of Television Utilities Corporation, and is the first of its kind.

Scan-A-Graph is a one-man communication center, seated at a desk, housing all operating equipment located in a central position. It transmits all vital information instantly to one or 500 TV monitors. There are no delays, no uncertainty. It provides centralized control for better co-ordination without the expense of costly supervision.

No trained personnel is needed and operators become experts quickly. Scan-A-Graph transmits high definition, clear and crisp pictures with 600 line resolution, instantaneously and simultaneously to all monitors.

This equipment has many applications — it will transmit typed, printed, written or photographed information; diagrams, blue-prints, bank and insurance records, documents; airport schedules; secret and confidential information for the military.

Scan-A-Graph is the newest means of low cost communication without the requirement of complicated camera installation and it saves time and money.

Further data is available from Television Utilities Corporation, Colonial Avenue, Corona 68, N.Y., U.S.A.

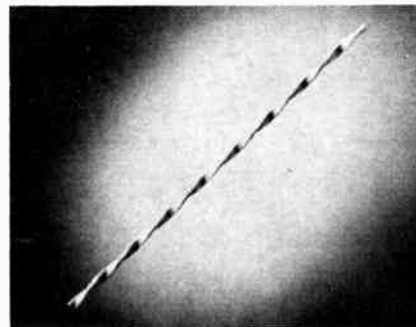
Magnet Wire

Item 2029

Daglas magnet wire—a new product offering greater flexibility, superior adhesion and resistance to surface abrasion — is being manufactured by Federal Wire & Cable Division, H. K. Porter Company (Canada) Limited.

Daglas magnet wire is manufactured by wrapping bare or enameled copper wire with a combination of Dacron and glass fibres, and then heated to fuse the glass fibres in place. An overall coating of varnish is applied, providing a smooth finish and improved abrasion resistance.

The wire is manufactured with double Daglas insulation over bare copper in round, square and rectangular cross-section.



Single Daglas construction is available over round enameled wire. Depending on customer requirements, a standard or silicone varnish is applied.

In addition to these advantages, the provision of the glass wrap provides actual separation of the turns in case of excessive heating of the coil. Ideal applications of Daglas magnet wire include starting windings of motors, and in the coils of welding, battery charging and test equipment.

Daglas is a Phelps-Dodge registered trade-mark.

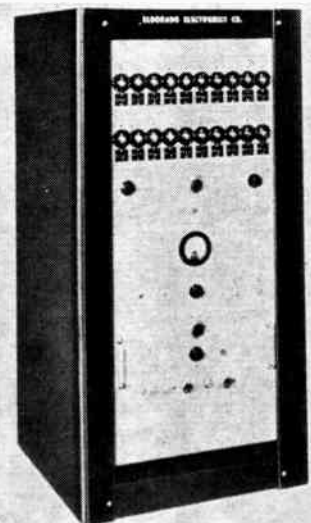
Federal Wire & Cable Division, H. K. Porter Company (Canada) Limited, Guelph, Ontario.

Timing Device

Item 2030

A timing device that measures time intervals as short as a billionth of a second has been developed by Eldorado Electronics Company, Berkeley, California, manufacturer of nuclear instruments. The new instrument known as "Nanosec" extends the art of time measurement three orders of magnitude from the millionth of a second range possible with present equipment. A billionth of a second (or nanosecond in the metric system of measurement) is the time it takes light to travel approximately three feet.

Intended originally as a nuclear research tool, "Nanosec" can be used in the fields of radar, computer and solid state physics where requirements have outstripped the ability of conventional instruments. "Nanosec" applications include neutron time-of-flight measurement, determining the half-life of short-lived radioisotopes, fast coincidence circuit studies, delay line calibration in radar circuits, and transient time studies.



"Nanosec" consists of two basic elements, a time-to-amplitude converter and a 20 channel amplitude analyzer. In use, a time interval under measure is converted to a pulse of proportional height. The pulse height is measured by the amplitude analyzer and registered in one of the analyzer channels. Each channel corresponds to a known time interval. By noting which channel registers, the operator can determine the time interval.

For further information, please address the Canadian representative, Radionics Limited, #230 Mayrand Street, Montreal 9, Que.

Interlocking Wiring Devices Brochure

Item 2031

A new brochure on Hart-Lock Interlocking Wiring Devices is now available from Arrow-Hart & Hegeman (Canada) Ltd.

All the construction and operating features of the Hart-Lock line are described in the booklet — the new one-piece contact design, optional back-or-side wiring, and 3 and 4 wire grounding types.

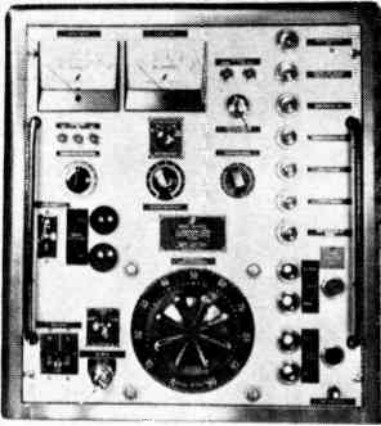
Ordering and catalog data is also included.

For complete information and a copy of the brochure, write to Arrow-Hart & Hegeman (Canada) Ltd., Industry Street, Toronto 15, Ontario, Canada.

High-Voltage AC Power Supplies

Item 2032

The new Beta Series 7000 high-voltage AC power supplies are available in 19 models, operating on 220 or 440 V, 60 cycle, single-phase inputs, with output voltages ranging from 0-25 to 0-150 KV, at 5 to 100 KVA. These ruggedly constructed two-section units have a continuously adjustable automatic rate of rise in conformance with ASTM standards, so that they can be used for dielectric testing in accordance with ASTM specifications.



The supplies are furnished with two 4" square bakelite panel instruments with $\pm 5\%$ full-scale accuracy. These are a dual-range (3/10) kilovoltmeter and a milliammeter. Other features include overcurrent and overvoltage relays adjustable from 20-120% and 10-115%, respectively, zero-start interlock, and caster-mounted high-voltage sections.

The protective features of these units are noteworthy. Gaseous discharge devices prevent damage to meters and relays from shorts and overloads. A spark gap to ground from the meters and transformer primaries protects the components against high-voltage transients. Also furnished is a rear access door interlock, plus provision for external interlock, consisting of a receptacle on the control cabinet that must be shorted before high-voltage can be turned on.

Complete specifications will be furnished on request to Beta Electric, Division of Sorensen & Co., Inc., Richards Avenue, South Norwalk, Connecticut, U.S.A.

Bulletin On Lightning Arresters

Item 2033

The Northern Electric Company Limited of Montreal, P.Q., has issued a descriptive bulletin on Slater-Hubbard Autogap Lightning Arresters.

The Slater-Hubbard Autogap Lightning Arrester is another member of the family of electrical products made available in Canada by the N. Slater Company. The Autogap Lightning Arrester was first introduced in the U.S.A. by Slater's associates, Hubbard and Company, and is backed by many years of field experience.

Substantial laboratory facilities provide for the testing of lightning arresters under practical conditions. Both production and experimental arresters are subjected to rigorous tests to verify their performance in the light of latest information available on the effects of lightning on distribution systems. Such research work is keyed to the ever developing lightning protection needs of the industry, and gives assurance that the Slater-Hubbard arrester will continue to provide efficient and dependable operation.

Further particulars on these arresters may be obtained from Northern Electric Company Ltd., 1600 Dorchester St. West, Montreal, Que.

New Mica Capacitors

Item 2034

High-quality silvered-mica sheets, the same material as is used in the 0.1% Type 1409 Standard Capacitors, are now used in the General Radio Type 505 Capacitors. Although using the same construction as the standard capacitors, the Type 505's are adjusted to $\pm 0.5\%$ and are packaged in a less-expensive case. The result is a unit which sells at a substantially lower price, but whose characteristics and stability are entirely adequate for many laboratory, production, and instrument applications.

The Type 505 Capacitors are available in a 1-2-5 series extending from 100 uf to 0.5uf. Dissipation factor for the 1000-uuf and higher sizes does not exceed 0.0003. They are housed in low-loss molded-phenolic cases and are equipped with both screw- and lug-type terminals and mounting flanges.

The Type 980-G and Type 980-H Decade Capacitance Units are new assemblies of the Type 505 Capacitors to furnish decades of 0.01 uf and 0.001 uf per step, respectively. Previously available was the Type 980-F with 0.1-uf steps. A new Type 980-P1 Switch is used in these decades and is also available separately. The switch is a low-capacitance, low-loss unit which complements the characteristics of the Type 505 Capacitors to provide low-loss decades suitable for use in a-c bridges, resonant circuits and filters.

An assembly of the three decades in a "decade box" is available as the Type 1419-K Decade Capacitor. This unit, with a maximum capacitance of 1.11 uf in steps of 0.001 uf, replaces the older Type 219-K. Dissipation factor of the new decades is one-third that of the older units and the long-term stability of capacitance values is better than 0.1%.

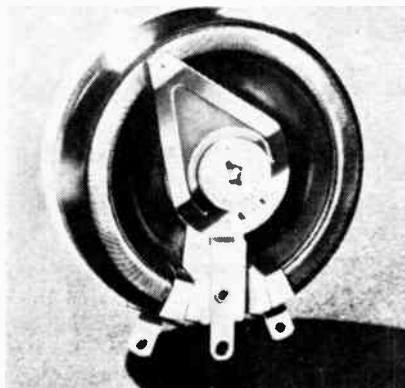
For further information write General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Mass., U.S.A.

Vitrohm Ring Rheostat

Item 2035

Ward Leonard of Canada Limited announces two new additions to its standard line of Vitrohm Ring Rheostats. Embodying many "proven" design features found on the smaller sizes, these new 100 and 150 watt rings are recommended for rheostat or potentiometer use in electronic, industrial and other control equipment where smooth, gradual resistance change is essential.

Key design features include: Exclusive "twin-shoe" self-lubricating contacts; molded ceramic base and core featuring high density, low porosity and high dielectric strength; Vitrohm vitreous enamel permanently bonding base and core and securing high stability resistance wire, minimum back-of-panel depth.



Ratings of 100 and 150 watt rings are based on a 300C rise in 40C ambient. Both sizes are now available from stock in resistance values to 10,000 ohms. On special order, tapered windings, tandem mountings, dial plates and other accessories are available.

Ward Leonard of Canada Limited, 1070 Birchmount Road, Toronto 16, Ontario.

Tape Wound Cores

Item 2036

New guaranteed performance limits are being followed by Magnetics, Inc. in the manufacture of tape wound cores. This standardization of core performance within narrow limits by Magnetics, Inc. puts cores on the same catalog basis as vacuum tubes, resistors and other components with published characteristics. Published for the first time by any manufacturer, Magnetics, Inc. has available performance data which includes rigid and close maximum and minimum variations from nominal for B_{max} , B_w/B_{max} , H_l and gain for several tape sizes and materials.



Now it is possible for the magnetic circuit designer to select and order cores without many hours of costly experimental time fitting cores to circuit performance. With data reliability guaranteed, the designer is sure at every stage of design and production.

The guaranteed parameters are the standards recommended by the Working Group on Core Matching and Grading of the A.I.E.E. in February, 1958. Also recommended by the Working Group were two standard methods of testing tape wound cores — the constant current flux reset test and the sine current test. The flux reset test has long been a standard at Magnetics, Inc.

Copies of Magnetics, Inc. guaranteed performance limits for tape wound cores are available by writing Magnetics, Inc., Butler, Pa., U.S.A.

D-885 Synchronous Receiver

Item 2037

The Muirhead D-885 Synchronous Receiver is designed to give a remote indication of angular position. When used with a suitable transmitter it adopts the same angular position as that transmitter and can be used to turn a pointer or any other low torque device.

Small and light-weight, the receiver has the general appearance of a small motor — being approximately 1 in. in diameter and 1½ in. long.

The receiver can be operated remotely from a commutator or potentiometer-type transmitter. When the receiver is used with a commutator-type transmitter (sometimes known as an M-type transmitter), the permanent magnet rotor responds to movements of the transmitter in 30° steps. With a potentiometer-type transmitter, rotation is continuous with a following accuracy of $\pm 3'$. A three-wire connection is required between the transmitter and receiver which can be almost any distance apart. The action of the receiver — following the rotational movements of a remote transmitter — can be likened to that of a flexible mechanical shaft.

The maximum output torque of the receiver is 0.5 oz. in. when the rotor is 90° from its correct line-up position; the torque gradient is 0.0085 oz. in. per degree.

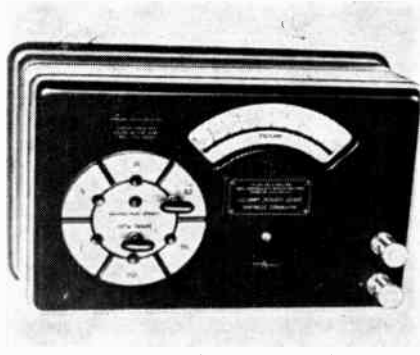
This equipment is made in Canada by Muirhead Instruments Limited, Stratford, Ontario, who will be glad to supply Data Sheet D-885 which provides technical information and dimensions.

Reference Standard Direct Current Ammeter

Item 2038

The new heavy current precision D.C. ammeter, developed by Sensitive Research Instrument Corporation, fills the need for accurate measurement of a wide range of currents at a moderate cost. This is the first time that a D.C. ammeter with ranges from 1 to 100 amperes and accuracy of .2 of 1% is available in a self-contained unit. Built-in shunts are plug-selected for speed and convenience plus accuracy. Ranges are selected by means of positive-fitting tapered plugs and holes.

This new instrument is simple and easy to use. It is entirely self-contained. It consists of a long scale precision millivoltmeter, ring connected to a series of precision adjusted current shunts. To obtain any range, simply plug the tapered hole at the range desired. This plug and the heavy current blocks are specifically designed to create a low resistance current circuit.



The instrument known as Model CHC has a scale length of 6.3 inches and is available in two range combinations: Combination No. 1 — 0-1/5/10/20/50/100 amperes; Combination No. 2 — 0-1.5/3/7.5/15/30/75 amperes.

The millivoltmeter movement used is Diamond Pivoted for the utmost in reliability and fine performance. Its Diamond Pivots are combined with shock mounted jewels and high torque springs, to provide an extremely sturdy, stable instrument.

The instrument is supplied mounted in a walnut case with dust cover. The top surface is of highly polished black bakelite. The case size when covered is 16 $\frac{3}{8}$ " x 10 $\frac{1}{2}$ " x 8 $\frac{3}{4}$ ". Weight 21 lbs.

Sensitive Research Instrument Corporation, 310 Main Street, New Rochelle, N.Y., U.S.A.

'Cintel' Microsecond Chronometer

Item 2039

This instrument is one from the new range of 'Cintel' transistorized equipment for time and frequency measurement produced by Rank Cintel Limited of London, England.

Transistors are used throughout together with printed circuit techniques giving rise to an extremely light and portable instrument with very low power consumption.

To give extra lightness combined with great strength, the case is manufactured from fibreglass.

Specification

Time Range: 1 μ sec to 1 sec in 1 μ sec steps.

Accuracy: The accuracy is determined by that of the crystal plus the inherent gating error which is constant at $\pm 1\mu$ sec.

Crystal Accuracy: Without Oven: $\pm 0.002\%$. With Oven: Long term stability better than ± 2 parts in 10⁶ week. Greater accuracy, or a longer range of time measurement can be obtained by the use of an external frequency standard.

External Frequency Standard: Frequency: 30c/s to 1.2 Mc/s. Amplitude: 5V peak to peak. Input Impedance: 5k Ω 30 pF.

Gate: The gate is operated in response to +ve and -ve going pulses in any combination. Amplitude: 1 to 20V peak, Input Impedance: 500 Ω 30 pF, Rise Time: Not

important as separate start and stop triggers provided.

Output Frequency: Sub multiples of the internal crystal frequency are provided at a level of 5V peak in 2000 Ω . The following frequencies having a 1 in 4 duty cycle are obtainable: 10, 10², 10³, 10⁴, 10⁵ and 10⁶c/s. Accuracy to that of crystal.

Reset: Resetting of the equipment to zero after the completion of a measurement is obtained by manual operation of the reset button. Alternatively it can be accomplished by open circuiting the terminals provided.

Power Input: The instrument is designed for mains or battery operation and contains its own stabilized power supply. Mains Input: 110-120V, 200-250V a.c. in 10V steps. 40-100c/s. Battery Input: 12V d.c.

Consumption: 130 mA at 12V d.c. (without crystal oven). 505 mA at 12V d.c. (with crystal oven).

Transistors: 40 Mullard OCC44, 10 Mullard OC45, 36 Mullard OC71.

For further details write to Dawe Instruments Ltd., Canadian Division, 1654 Bank Street, Ottawa, Ontario.

Magnetic Rangers

Item 2040

New from Sorensen and Company, Inc. are two Magnetic Rangers, tubeless wide-range regulated 5-36 VDC power supplies. Model MR36-15 with 0-15A output and Model MR36-30 with 0-30A output. These units feature $\pm 0.25\%$ regulation accuracy, 0.2 sec. response time, 105-125 VAC input, 150 mv ripple, and continuously variable outputs.

The Magnetic Rangers have magnetic amplifier control circuits with transistorized power references and zener diode comparison circuits for long-term reliability. Use of transistors also results in reduction in size and weight.

Many circuit refinements are provided. One is remote sensing, which allows full use of the continuously variable adjustment for control of remote loads. Another is a separate ground terminal, which permits positive, negative, or floating output connection. There are also both coarse and fine voltage controls, for more accurate output adjustment.



Both MR36-15 and MR36-30 are available in either rack or cabinet models designed for maximum operating convenience. Rack-mount front panels, in choice of colors, allow more freedom for "color-keying" of laboratory instrumentation.

Units are equipped with meters, breakers, fuses, pilot lights, 3-wire input line cords, and all necessary terminals. The Model MR36-15 has a 19 $\frac{1}{8}$ " W x 12 $\frac{3}{4}$ " H x 15" D cabinet and weighs 100 pounds. The Model MR36-30 has a 19 $\frac{1}{8}$ " W x 21 $\frac{1}{4}$ " H x 15 $\frac{1}{2}$ " D cabinet and weighs 175 pounds. Rack panel heights are 12 $\frac{1}{4}$ " for the MR36-15 and 21" for the MR36-30.

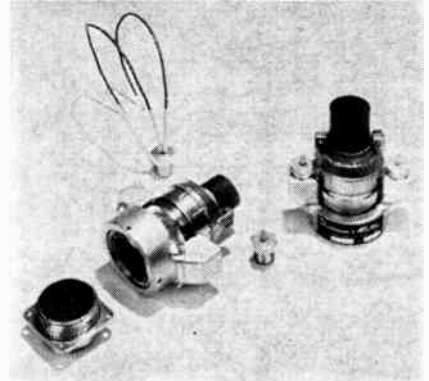
Complete information and prices of these Magnetic Rangers may be obtained by writing Sorensen & Company, Inc., Richards Avenue, South Norwalk, Connecticut, U.S.A.

Explosive Electrical Disconnect

Item 2041

Designed specifically for use in missile operations for umbilical disconnects or other severing functions where guillotine choppers are not feasible, the Beckman & Whitley Model 2011A Explosive Electrical Disconnect is designed around the 55-circuit Bendix pygmy connector. It converts this unit into a re-usable explosive-actuated device without altering in any way the electrical characteristics of the original connector.

Incorporated into the explosive structure are threaded receptacles for two electrical primers which can be of a wide variety of types.



Design of the unit is such that the connector is severed by the explosion of either or both primers thereby enhancing reliability and permitting selective circuit application if desired. Two shear pins are included in the structure to hold the connector firmly seated until it is deliberately fired.

For additional details write to Beckman & Whitley, Inc., 810 San Carlos Avenue, San Carlos, California, U.S.A.

G-Line Assemblies Have Expanded Frequency Ranges

Item 2042

The successful field applications of G-Line microwave transmission line assemblies by both the Armed Forces and commercial pipeline operators have caused Prodelin Inc. to expand the frequency ranges in which these economical surface wave transmission lines are available. Prodelin announced recently that G-Line assemblies would be made available for RF energy transmission from 1700 mc up to 9000 mc.

Three important factors have influenced the acceptance of the G-Line Assembly: (1) Compact packing and low weight (under 50 lbs. for a 500' high antenna system) for transportation ease and economy. This is especially important when setting up a remote or difficult-to-reach station. (2) Installation ease. Two field men can install a G-Line assembly in the time required for one installer to reach the antenna level for attachment. (3) Freedom from pressurization and reduced maintenance problems. The system requires no complicated plumbing such as elbows and bends because it operates without pressurization, and therefore reduces engineering and planning time.

The G-Line is a single-wire surface wave transmission line terminated at both ends by identical RF field transformers (launcher and collector) to provide efficient transition from a conventional feed line to the surface wave wire and back again at the antenna input end. Typical operating loss at 2000 mc is held down to 0.5 db per field transformer plus only 0.8 db per 100' of surface wave transmission line. The system also contains a built-in de-icing system and boasts a lower wind loading than any previously used transmission system.

Inquiries regarding prices or detailed specifications for any G-Line Assembly from 1700 to 9000 mc should be directed to the manufacturer, Prodelin Inc., Dept. GE-3, 307 Bergen Avenue, Kearny, N.J., U.S.A.

Test Picture Tube

Item 2043

A new test picture tube, designed to test the new 110° and standard 90° television receivers, is being introduced by the Electronic Tube and Components Division of Canadian Marconi Company.

The new tube, the Marconi 8YP4, meets the new requirements for a test tube imposed by changes in picture tube design. These changes, resulting from the introduction of wider deflection circuits, made the 53° and 90° test tube incompatible. With the 8YP4 there is no need to remove the cabinet-mounted television picture tubes to perform "bench service." The technician is also spared the need to discharge the 8YP4 each time it is used, since, for safety and to make the tube universally applicable in all 110° and 90° circuits, there is no external conductive coating applied to it.

The Marconi 8YP4 has a conventional 8YP4 shell base because of its proven durability under repeated use. However, two adaptors are packed with every tube — one for 110° and one for 90° receivers.

The tube operates within an extensive voltage range — any set, from the largest console model to the smallest portable, can be tested. It is designed to operate from a filament supply of 6.3 volts at 600 ma, 6.3 at 450 ma or 8.4 volts at 450 ma.

Other features include electrostatic self-focusing using internal connections between grids 2 and 4; approximately 80% light transmission; and a white P4 Phosphor which has short to medium persistence.

The compact test tube, which weighs only 2 pounds, is 6" high, 8" wide and 8¾" long. For ease of carrying, each tube is packaged in a durable corrugated cardboard carrying carton.

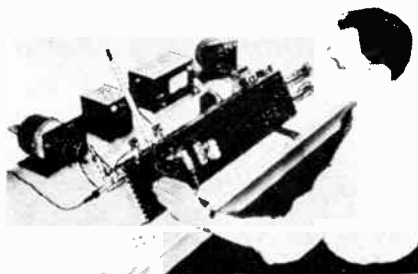
Additional information may be obtained by writing to **Canadian Marconi Company, Electronic Tube and Components Division, 830 Bayview Avenue, Toronto, Ontario.**

Transfer-Function Meter

Item 2044

The performance of most electrical devices and circuits can be described by specifying a transfer function, which is the ratio of an output to an input quantity, or vice versa. The new General Radio Type 1607-A Transfer-Function Meter can measure these functions over the frequency range from 25 to about 1500 megacycles, and can also measure any two-terminal impedance or admittance over the same range.

Among the many transfer functions that can be measured are: the "alpha" and "beta" current ratios of transistors, the transconductance of vacuum tubes, the gain of amplifiers, and the loss of attenuators and filters. Transistor and tube characteristics can be measured at these high frequencies under dynamic conditions, and



provisions are included for applying dc to both the input and the output of the network under test. The r-f signal level can be held below 5 millivolts for low-level transistor measurements.

The Transfer-Function Meter is a basic measuring tool. Answers, direct reading except for a multiplying factor, are obtained in terms of complex components by a null method. The instrument is well suited for laboratory measurements because of its versatility, accuracy, and wide frequency range. It can also be set up for rapid, routine, production tests and

no high degree of skill or knowledge is required on the part of the operator.

Further data on this equipment is available from **General Radio Company, 99 Floral Parkway, Toronto 15, Ont., Canada.**

Frequency-Regulated DC-AC Inverter

Item 2045

Highly stable frequency-regulated d.c.-a.c. inverter with all the advantages of transistorization in a package smaller than a rotary inverter of comparable power.

75 VA (24V, 400 c.p.s., 3 ϕ) output from 22-29 v.d.c. input. Frequency regulation ± 3 per cent total with line and load. Harmonic distortion below 5 per cent. Efficiency at low line 65 per cent.

Solid state design utilizes stabilized saturable core oscillator, transistor amplifiers, and d.c. regulators. Extremely high vibration and shock stability. Two-package housing separates heat-sensitive elements from heat-producing elements.

Completely Mil Spec Unit. For mobile Gyroscope applications.

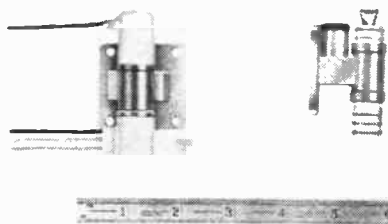
Conway Electronic Enterprises Regd., 1514 Eglinton Avenue West, Toronto 10, Ont., Canada.

Ceramic Reflex Klystrons For X- And K-Band

Item 2046

A new series of ceramic-metal X- and K-band reflex klystrons has been added to the Eimac line by Eitel-McCullough, Inc., San Bruno, California, manufacturer of power electron tubes.

The 1K20 series consists of four lightweight, ruggedized tubes that cover the 8500 to 11,700 megacycle range at output power levels to 50 milliwatts. Specifically designed for use in the severe environment of airborne and missile radar systems, these tubes incorporate the advantages of Eimac ceramic-metal construction and integral external tuning cavities. They will withstand vibration levels of 15g in any reference plane, with less than 100 kilocycle frequency deviation.



Rated for use at any altitude, the 1K20 series tubes are conservatively rated at $\pm 250^\circ\text{C}$. seal temperature. A new non-contacting, non-microphonic tuner permits noise-free tuning of these tubes through their complete ranges. Tuning is conveniently adjusted by a single screw in the external cavity. Low beam voltage requirement and simple radiation cooling minimize the weight and complexity of associated equipment.

Further information on these new reflex klystrons is available from **Eimac's Canadian Representative, R. D. B. Sheppard, 2036 Prince Charles Rd., Ottawa, in the form of an 8-page illustrated brochure entitled: "The Adaptation of Ceramics to a New Line of Reflex Klystrons."**

Liquid-Filled Potentiometers

Item 2047

Helipot, the components division of Beckman Instruments, Inc., has added to its line of precision potentiometers three liquid-filled potentiometers which are already in production. These are the 10-turn, 1½" model 4203; 10-turn, 2" model 4613 and 3-turn, 2" model 4713. These unique potentiometers offer a life span of at least 10-million shaft revolutions, increased dielectric strength, greater heat dissipation, extremely low noise throughout life, and operation under water.

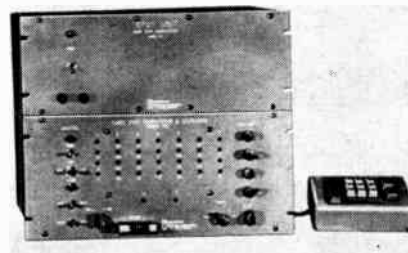
For the designer with airborne problems there is the new 5200 series . . . single-turn, 1½" A.I.A. diameter pots, built to take 2,000 cps at 30G's, 50G's shock, 100G's acceleration and 150°C operation.

Helipot Corporation, Newport Beach, California, U.S.A.

Card Tape Converter And Keyboard

Item 2048

The new Model 275 Card Tape Converter and Key Board (Digital to Analog Converter), recently developed by Electro Instruments, Inc., converts coded decimal and straight decimal inputs to a proportional analog DC voltage. Electronic switching utilizing transistor and magnetic circuits is used exclusively in the new instrument, eliminating vacuum or gas tubes. Five slave relays are used to make its controlled circuits compatible with existing accessory equipment.



Although the new Model 275 is designed specifically for keyboard, punched tape and punched card applications, it will accept the output of most digital equipment. Its primary use is with the Electro Instruments Model 200 Series, X-Y Recorders, but can be modified for many industrial applications.

Through its electronic symbol generation feature, the Model 275 can command a recorder pen to describe the following notations:

Each of these symbols may be chosen manually or automatically from cards.

Complete information can be obtained from the Canadian representative — **Electromechanical Products, Markham Rd., Agincourt, Ontario.**

Three Meter Industrial Analyzer

Item 2049

Believed to be the first produced in Canada, the Canadian Research Institute Model E-3372 Three Meter Industrial Analyzer permits rapid checking of industrial single, two and three phase circuit without external accessories on loads up to 100 kilowatts.

Housed in a sturdy portable steel cabinet attractively finished in baked hammerlin, with slip-hinged lid deep enough to accommodate test leads during storage, the instrument comprises a three range voltmeter 0/150 300 600 volts, a three range ammeter 0/5 25 125 amperes and a 9 range polyphase wattmeter. Voltage between any two leads, or the current in any leg may quickly be determined without shifting test leads. Since voltage, current and wattage are indicated simultaneously, power factor or phase angle may be easily determined.

All connections are made to heavy duty binding posts arranged to minimize danger of shock to the operator. Three switches on the engraved arboron panel give almost instant choice of ranges.

The Model E-3372 Industrial Analyzer may be used on any 110, 220, 440, or 550 volt single, two or three phase circuit in 25, 50 or 60 cycle areas. It is ideal for trouble shooting on motors, transformers, distribution panels and may be used with external current transformers for loads beyond its self-contained capacity. Made in Canada, price and delivery are both good.

Canadian Research Institute, 46 St. George St., Toronto 5, Ontario.

Chemical Spray Spots Component Failures

Item 2050

Intermittent failure of circuit components caused by temperature change can be spotted instantly with the use of a new chemical spray called "G.C. Zero-Mist." According to the manufacturer, General Cement Mfg. Co., Rockford, Illinois, the new chemical instantly locates all trouble resulting from temperature changes in resistors, capacitors, transistors, cold solder and oxidized junctions.

"The long and tedious search for intermittent component failures can be eliminated with "Zero-Mist," said Russell D. Gawne, General Cement vice president and general sales manager. This chemical instantly reduces the temperature of components sprayed. Trouble or failure often shows up under the resulting temperature difference. The laborious task of removing or isolating individual components before they can be checked is eliminated and circuit repairs are made faster and easier.

"The great saving in time is important to technicians and servicemen," said Mr. Gawne, "since with them time saved is money made." G. C. "Zero-Mist" is available in 16 oz. spray cans (G. C. 8667).

Those desiring further information and a copy of the latest G. C. Electronic Chemicals Catalog should write direct to General Cement Mfg. Co. (a division of Tectron Inc.), 400 South Wyman Street, Rockford, Illinois, or their Canadian representatives, Charles W. Pointon Limited, 6 Alicia Avenue, Toronto 10, Ontario.

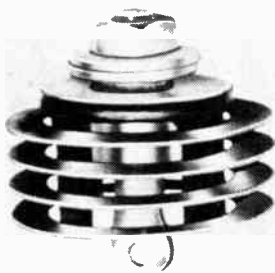
Diode Radiator

Item 2051

A new heat-dissipation device designed to prevent "thermal runaway" in power transistors has been developed by the Birtcher Corporation, Los Angeles.

The "runaway" spiral of ascending temperatures occurs when an increase in temperature brings an increase in cutoff current, which raises the power dissipation at the collector junction which, in turn, elevates the junction temperature, etc.

The Birtcher Diode Radiator consists of a series of black ebanol finished metallic rings or fins mounted on a plate which is interposed between the diode and the mica insulating washer atop the chassis. The radiator in no way interferes with servicing



or operation of the diode. Tests have indicated that the device reduces operating temperature of diodes as much as 30°C under typical conditions and brings temperatures well under the manufacturers recommended maximums. Designated as part No. 3B640, the Diode Radiator complies with requirements under MIL-E-5272A (Vibration) and MIL-STD-202A (Environment).

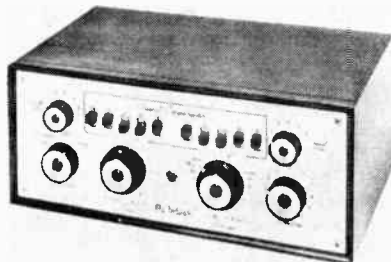
For further information, contact: The Birtcher Corporation, Industrial Division, 4371 Valley Blvd., Los Angeles 32, California, U.S.A.

McIntosh C-8S Control Unit

Item 2052

The McIntosh C-8S is a control unit that sacrifices absolutely nothing when Stereo

is added. Balance of tonal quality from unmatched equipment such as amplifiers and speakers can be achieved only with the C-8S because of the complete flexibility of equalization and tone compensation. The C-8S does not obsolete any other equipment, it can be used with any other preamplifier!



Added flexibility:

1. Stereo Balance Control; to properly balance both sides of the system with one control.
 2. Stereo mode selector; stereo, stereo reverse (Volume does not change between stereo and stereo reverse) left channel, right channel, or monaural through both amplifiers and speakers.
 3. Ganged Master volume control; raise and lower volume on both channels with one control without changing balance.
- McIntosh Laboratory, Inc., 4 Chambers St., Binghamton, N.Y., U.S.A.

Transistor Test Set

Item 2053

An accurate system which determines the basic parameters of a transistor has been designed into this new Transistor Test Set by Armour Electronics Inc., of Van Nuys, California.

The test set accurately measures Beta, I_{co} and I_{cbo} of both PNP and NPN type transistors at any desired operating level assuring the flexibility required for circuit design. Component matching accuracy of approximately 2 per cent is provided. Simplicity of the control panel and test procedure makes the tester compatible with the requirements of high rate quality control testing.

Modern circuit techniques are used throughout the unit which weighs only 4¼ pounds and is enclosed in a cabinet 5 inches high, 11 inches wide and 9 inches deep. All electrical power is derived from four mercury cells.

The value of Beta, that is, the static ratio of the collector to base current, is essentially the current gain of the transistor in the common emitter circuit. This parameter is measured by forcing a set current level through the collector circuit while simultaneously measuring the base current. This measurement is made while operating in the linear region of the transistor's characteristics.

I_{co} , the reverse current of the collector diode, was chosen as a test parameter because of its importance in the common emitter configuration. During circuit operation it appears at the base-emitter junction and is amplified, resulting in a large residual collector current for which compensation must be supplied.

The Figure of Merit, I_{cbo} , which is the base current required to reduce the collector current to zero, is directly associated with the current stability variations. Its magnitude defines the point of class B operation and the limit of class C operation, providing the designer with a direct measure of the circuit stability variations from transistor to transistor.

Further information concerning the Transistor Test Set is available from Armour Electronics Inc., 15002 Oxnard Blvd., Van Nuys, California, U.S.A.

Micro-Miniature Relay Item 2054

Price Electric Corporation, manufacturer of Husky Relays, has just unveiled a new micro-miniature relay — the Husky Style 6. The Style 6 is a versatile and reliable relay of the crystal can type . . . available in a variety of terminations and styles.

The lightweight Husky Style 6 offers the capacity and reliability of a much larger relay in a miniaturized enclosure weighing only 0.5 ounce. It has been designed for dependable performance in missiles, computers, control systems and other critical applications where capacity, weight, size and reliability are factors.

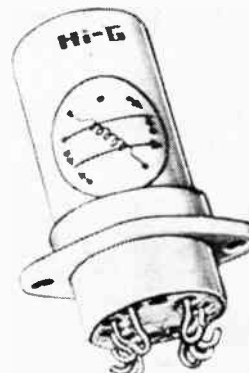
The Husky Style 6 is now in production. The simplicity of its design allows for mass production of high quality, thoroughly reliable relays. It is designed for continuous use in ambients of -65°C to 125°C with a minimum life expectancy of 100,000 operations. The Style 6 meets the applicable portions of Military Specifications of MIL-R-25018 and MIL-R-5757C. All popular types of mountings are available, including plug-in solder and printed circuit terminals.

For further details on the new Husky Style 6 micro-miniature relay, write for Bulletin No. 10, Price Electric Corporation, Frederick, Maryland, U.S.A.

Two-Pole Relay

Item 2055

Hi-G, Inc. of Bradley Field, Windsor Locks, Conn., now offers this two-pole relay on special order to those who need vibration immunity to two or three times the normal limitation of 20 G at 2000 cps. Engineering assistance is offered in selecting the proper mounting method and coil characteristics.



The relay will withstand temperatures to 125°C , standard, and to 200°C , special. Contacts are rated to 5 amperes resistive, and for dry circuit application.

This relay features a balanced rotary armature, and is designed for the ultimate in reliability.

For further information contact John Herring & Co., 3468 Dundas Street West, Toronto, Ontario, Canada.

Printed Circuit Kit

Item 2056

U. M. & F. Manufacturing Company, manufacturer of the SeeZak Circuit Assembler System, has recently developed another product which will be a boon to the electronic circuit technician and engineer.

The new SeeZak Printed Circuit Kit can be used to construct prototype circuits, check them out, and determine how they will function in a system.

The kit is composed of a plastic laminated pegboard, fifty "presto" (snap into place with the twist of a screwdriver) terminals, and a three foot length of 28 gage wire. Using carbon ohmite resistors, the wire is laid into place in notches in the "presto" terminals and the circuit can be tested before soldering.

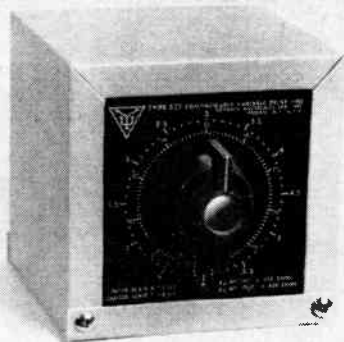
Complete information and a new complete catalog can be obtained by writing the U. M. & F. Manufacturing Company, 10929 Vanowen Street, North Hollywood, California, U.S.A.

Continuously Variable Delay Lines *Item 2057*

Type 521 Series was developed to meet an increasing need of continuously variable time delay with maximum delay time over 15 microseconds. This device consists of two parts: (1) A continuously variable delay line, which is essentially a condensed RF cable with one conductor changed into a long thin coil and the other conductor spaced closely to the first producing a large amount of time delay, yet maintaining low attenuation at high frequencies; (2) A step variable delay line, which consists of 60 sections of LC m-derived networks and a 1-pole, 60-position rotary switch.

The unit has a coaxial shaft: The continuously variable delay line is controlled by the inner shaft, and the step variable delay line is controlled by the outer shaft. For variation of time delay, the continuously variable delay line is used as fine adjustment, and the step variable delay line is used as coarse adjustment. For the purpose of minimizing a reflection, it is recommended to have source impedance equal one-half of the characteristic impedance of the delay line $R_0/2$, terminals A and B terminated by the characteristic impedance of the line R_0 , and the output terminal coupled to a high impedance load, such as the grid of a vacuum tube circuit of an amplifier or a cathode follower.

Since the physical size is small, 4" x 4" x 4", and weight of the unit is exceptionally light, approximately 2½ lbs., it is particularly suitable for incorporation in any instrument where continuously variable time delay with maximum time delay over several microseconds is needed. In addition, there are a number of outstanding features for this device, such as excellent stability, fast rise time, repeatability better than ½ millimicrosecond, and complete freedom of time jitter.



There are three models available with different maximum time delay: 6.1 us for Type 521a; 9.15 us for Type 521b; and 15.25 us for Type 521c. The rise time is less than 8 per cent of the time delay at any point. The cutoff frequency is higher than 20 megacycles for the continuously variable delay line for all types; for the step variable delay line, the cutoff frequency is 3 mc for Type 521a, 2.2 mc for 521b, and 1.3 mc for Type 521c. The characteristic impedance is 500 ohms for Type 521a, 750 ohms for Type 521b, and 1200 ohms for Type 521c. The resolution time is less than 8×10^{-11} second for all types.

Advance Electronics Lab., Inc., 249-259 Terhune Ave., Passaic, N.J., U.S.A.

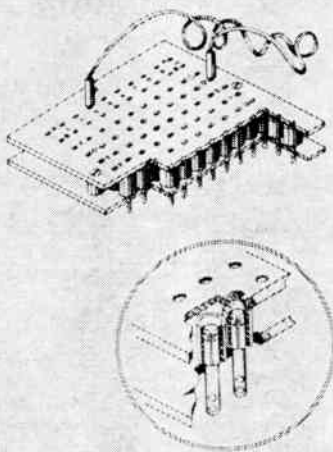
Computer Patchboard *Item 2058*

Vector Electronic Company announces a new line of computer patchboards providing a simple, economical answer to the need for multi-connection single conductor patching. They are particularly useful for test panels and low cost computers where "pre-programming" is not a necessity.

Standard units are made up in blocks of 100 receptacles on 0.265" centres, ten rows of ten receptacles each. Other sizes, shapes

and hole patterns can be readily made up to order. Various color finishes are available to harmonize with the user's equipment. Where necessary, rows or columns of terminals can be skipped to provide space for printing designations. Standard printing provides horizontal rows lettered alphabetically and vertical rows labeled numerically.

A sandwich of two sheets of phenolic punchboard is assembled with metallic terminals and spacers as shown in the illustration. The panels have 0.095" diameter holes. When the outer panel is removed the receptacles are exposed and can be easily changed or adjusted for optimum contact pressure. Since the outer panels are inexpensive, extra ones may be printed for different set-ups and are easily placed in position when needed. Plug pins should be 0.089" — 0.093" diameter.



Any number of 100 receptacle units can be assembled together for larger assemblies. Receptacles are phosphor bronze silver plated and gold flashed. Patch cords for the units are available.

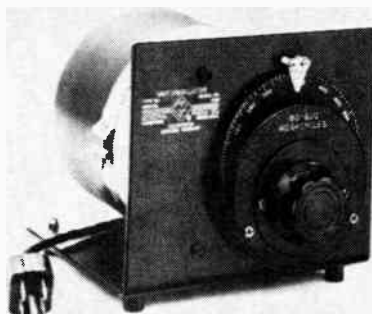
For details contact: Vector Electronic Company, 1100 Flower Street, Glendale 1, California, U.S.A.

Unit Oscillator

Item 2059

Designed primarily to cover the military aeronautical bands, the new General Radio Type 1209-BL Unit Oscillator has a single frequency range from 180 to 600 megacycles. The 4-inch dial with slow-motion drive is direct reading in frequency with a guaranteed accuracy of $\pm 1\%$.

A modified butterfly circuit with no sliding contacts is used in this oscillator. This type of tuned circuit, used in many GR Unit Oscillators, has gained wide acceptance because of its stable characteristics and trouble-free operation. At least 300 milliwatts output power is available into



50 ohms at any frequency. A jack is provided for plate modulation from an external audio-frequency source. Other power supplies and accessories are available.

For additional information write General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

"Package" Control For Machine Use

Item 2060

A new "package" control has been designed and developed for use on shears and other machines that cut and fabricate sheets of metal, plastic, fiber and other materials. It is a fully contained electronic unit that can be readily adapted to accomplishing numerous functions, a few of which are: controlling steel sheet operations; counting all cuts; measuring productivity; automatically operating many types of machine tools; insuring true production counts; eliminating rejects; eliminating expense waste; overcoming human factor.

Originally designed for controlling the operation of a large shear in a sheet metal plant, the unit is equally adaptable to controlling the operation of many other types of machines and the working of varied materials.

Designated as a Sensory Shear Director unit, it has electronic touch sensors and a photo-sensor, combining to control the shear for insuring correct dimensions, straight sides and square corners. Totalizing counters record the number of sheets fabricated and the number of actual pieces obtained.

The "package" is furnished complete with all external sensors and photocells, requiring only connection to a power source and mounting. Details of control design may be modified to suit varying requirements. Dimensions are 20" height x 16" width x 6" depth.

For full details please write to Sensory Incorporated, 504-94 Pleasantville Rd., New Vernon, N.J., U.S.A.

Direct Writing System

Item 2061

A new space-saving packaging method is now used for 6-channel Sanborn 150 series direct-writing oscillographic recording systems. A single vertical, mobile cabinet contains the Model 156-5466 Basic Assembly, comprised of six driver amplifier-power supply units and 6-channel recorder assembly. To complete the system, the user adds any of 12 optional, interchangeable plug-in "150" preamplifiers.

The six driver amplifier-power supply units, which accept the interchangeable plug-in preamplifiers, occupy 42 inches of panel space above the recorder assembly. Overall dimensions of the vertical, mobile cabinet are 78" high x 22" wide x 25" deep. Recorder location places the chart at a convenient height for viewing and making notations.

The system also provides all characteristic "150" features, including 1% overall linearity; current feedback driver amplifiers and regulated power supplies for each channel; clear, inkless recordings in true rectangular coordinates by heated stylus on plastic-coated Permapaper charts; individual stylus heat controls; nine chart speeds from 0.25 to 100 mm/sec.; choice of optional Preamplifiers including AC-DC, Carrier, Servo Monitor, DC Coupling, Log Audio, Low Level, Stabilized DC, AC Wattmeter, RMS Volt/Ammeter, 400 cycle Frequency Deviation, Frequency Meter and Triplexer.

Further data and complete specifications are available on request from Sanborn Company, Industrial Division, 175 Wyman Street, Waltham 54, Mass., U.S.A.

Regulated Rectifiers

Item 2062

Of special interest to communication engineers and laboratories is a new line of Regulated Rectifiers, completely static in operation and using the latest techniques in magnetics and semi-conductors.

Where required, regulation of, and ripple content in the D.C. output can be reduced to negligible values. Expendable components are kept to a minimum, thus eliminating the need of regular servicing.

These Regulated Rectifiers are now available in popular ratings from Allied Industrial Electronics of Canada Ltd., 9 Torbarrie Road, Toronto 15, Ontario.

News Report

A monthly roundup of news and personnel changes in the Canadian electronics industry

Measurement Engineering Ltd. Converted To Public Co.

Measurement Engineering Ltd., of Arrnprior, Ontario, manufacturer of special electronic instruments, communications equipment and industrial controls, has been converted from a Private Company to a Public Company. At the same time the common stock was split to more nearly represent its current value.

D. A. Bamford, general manager, reports that fairly large blocks of stock have been placed privately and no further stock is being offered for sale at the present time.

The company has received substantial contracts recently from the Department of Defense Production for military electronic equipment and from the Department of Defense Production for electronic navigational aids.

Measurement Engineering also manufactures industrial control devices such as photo electric controls, liquid level controls, smoke density indicators, brightness meters, and electronic timers.

The new financing recently obtained will be used to strengthen the position of the company in this field.

Harvey L. Pollock Joins Philips Electronics Ltd.

A recent announcement was made by Philips Electronics Ltd., Toronto, of the appointment of Harvey L. Pollock as sales manager in the Aviation and Electronic Components group of that organization.

Previously Mr. Pollock was with Avro Aircraft Ltd.

Quebec Radio & TV Distributors Elect President

The Quebec Radio and Television Distributors Association Inc. has announced the election of R. J. Clatworthy of Philips Electronics Industries Ltd. as president. Mr. Clatworthy has been with Philips since 1947. He was appointed Montreal Branch Manager in 1955.

World Power Conference Meets September 8-11

Energy in all its aspects—hydraulic, thermal, nuclear and even solar—will be under close study for four days in September, as experts from fifty different nations gather at the Queen Elizabeth Hotel in Montreal from September 8th to 11th inclusive.

Meeting in Canada for the first time in its history, the conference will receive some 150 papers under three main divisions: production, transportation and utilization. Presenting them will be scientists, engineers, economists and other experts representing most of the conference's 52 member countries.

None of the papers to be presented will actually be read at the meeting, according to Major-General H. A. Young, Canada's Deputy Minister of Public Works and chairman of the Canadian Committee. Instead, pre-prints will be distributed in advance to the delegates, and sessions will consist of reviews of the papers prepared by general conference reports and of discussion and debate on selected topics of interest.

Overall conference theme will be "Economic Trends in the Production, Transportation and Utilization of Fuel and Energy."

McMaster University Installs Digital Computer

The newly installed electronic brain at McMaster University, Hamilton, Ontario, is designed to speed up research in physics, chemistry, metallurgy, engineering, economics and statistics, and nuclear studies.

"The use of a computer," says Dr. M. A. Preston, Associate Professor of Physics at the University, "will not only save vast amounts of time but will make it possible to solve problems which might never be attempted by manual calculation due to the infinite amount of paper work involved."

For example, Dr. Preston explained, one of the first problems to be attempted was a check of the energy distribution of electrons emitted by radioactive nuclei. The computer will be in use about 100 hours for this extensive calculation. A manual effort, he said, would run into many months of laborious mathematical calculation.

Dr. J. W. Hodgins, Dean of Engineering, said the new computer would be used extensively in the new engineering course.

During the first month of its operation K. Colbourn, representing Computing Devices of Canada Limited, is instructing staff members in the use and maintenance of the new Bendix computer. Fifty faculty members and research students are receiving two-day courses in its operation. Use of the computer is being programmed to permit staff and research students to have access to the computer during regular laboratory work.

Gold Medal Award Won By Philips

Philips Electronics Industries Ltd., Toronto, Ontario, have announced that the Philips Research Laboratories, Eindhoven, Netherlands, has been honored with the Kamerlingh Onnes Gold Medal for 1958 in recognition of achievement in the development of Gas Liquefiers.

It was in Leiden in the year 1908 that Professor Kamerlingh Onnes produced the first liquid helium and to mark this occasion the Netherlands Society of Gas Liquefiers are celebrating the 50th anniversary of this event this year.

The Philips unit is claimed to be the first efficient and reliable apparatus ever developed in this field with higher efficiency than all other types of small cooling machines. Additional citations include mention of the fact that almost continuous operation may be permitted to meet the needs of industrial or research laboratories.



Atlas Instrument Corporation's Travelab, a mobile showroom containing a wide variety of the company's instrumentation equipment, has recently completed a tour of southern and central Ontario, the western provinces and British Columbia. It is now touring eastern Canada. The Travelab, according to company officials, has been found to be one of the most efficient means of exhibiting equipment to potential customers.

First Canadian Production Of "Teflon" Rods, Sheets

Manufacture for the first time in Canada of rods, tubes and sheets from "Teflon" tetrafluoroethylene resin is being undertaken by Joseph Robb and Company Limited, Montreal, plastics molders and extruders.

Installation of extrusion and sheeting facilities at the company's plant has resulted from increased demand. Such Canadian industries as oil, paper-making, electrical, machinery, electronics, aircraft, plumbing and automobile may now buy in Canada products of "Teflon" that previously had to be imported.

The new facilities at the Robb Company plant provide for ram extrusion of rods and tubes in diameters from one-half inch to two inches. In sheet form the "Teflon" is pressed and baked to sizes up to three feet square. The rod, tube and sheet production has been added to existing company molding operations.

Gaskets, packing, pipe thread seals and valve seats are a few of the items now being made of "Teflon" in Canada. Because they required the special characteristics found only in this plastic, these products are increasingly finding their way into industry.

Dayrand Limited Represents Amco Engineering Company

Amco Engineering Company of Chicago, manufacturer of equipment and instrument enclosures, recently announced the appointment of Dayrand Limited, Room 301, 901 Victoria Square, Montreal 1, Que., as its exclusive representative in the Province of Quebec.

The Amco line features extraordinary flexibility, with matched design of all products: steel racks and cabinets, pedestals, consoles, and accessories. This concept affords the custom builder an almost endless variety of mounting arrangements.

The complete line, including writing surfaces, drawers, blowers, and dollies, is stocked in Canada by Elder Electronics, Burlington, Ontario, for rapid delivery.

Directors For IT and T Electronics Service Co.

Three Canadians have been elected to the directorate of IT & T Electronics Service Co. of Canada Ltd. These are Air Marshal W. A. Curtis, R.C.A.F. (retired), vice-chairman of A. V. Roe Canada, Ltd.; Henry G. Norman, president of the Montreal and Canadian Stock Exchanges; and Maurice P. R. Forget, president of the Quebec Natural Gas Corporation.

The company was organized in 1957 to service defense electronic and communications networks and provide field support for IT & T manufactured products in Canada.

Tele-Radio Systems Ltd. Canadian Rep For Secode

Electrical Communications, Inc. has announced the appointment of Tele-Radio Systems Limited as its sales engineering representative in Eastern Canada.

Tele-Radio maintains general offices in Toronto at 3534 Dundas Street West. The company is headed by Ivor Nixon who was formerly associated with Pye of Canada. Assisting Mr. Nixon is another communications specialist, John Fellows. The territory to be covered by Tele-Radio includes Ontario, Quebec and the Maritime Provinces.

In announcing the appointment of Tele-Radio as its representative, Robert Blodget, marketing manager, pointed out that the Canadian firm will introduce Secode dial-type selective calling systems to Canadian users of mobile radio. In addition, Mr. Blodget said that the firm will provide technical application engineering service, calling primarily on railroads, pipe lines, telephone companies and the Canadian armed forces.

Phono-Vision Opens New Main and Branch Stores

Phono-Vision Distributing Company Limited has recently settled into new

quarters at 641 Yonge Street, Toronto, where the telephone number is WALnut 4-7331. This new location (as well as their new branch store at 3279 Yonge Street, Toronto) will provide the company with greater office space to allow more efficient processing of customers' orders. Greatly increased warehousing space will be used to make sure that orders may be filled immediately, regardless of quantity or variety.

Ample free parking space directly behind the main store building will facilitate pick-up of rush orders. A fleet of three trucks, making two delivery runs each day, is maintained to take care of phone orders.

On-The-Spot IGY Narratives Bring Awards To Canada

Competing with U.S. and British networks, the Canadian Broadcasting Corporation recently won four out of a possible seven first awards in radio, at the 21st American Exhibition of Educational Radio and Television Programs, held at Ohio State University.

Among the award-winning radio programs was one entitled "Canada's Role in the Geophysical Year."

The on-the-spot narratives from IGY scientists in observatories—in the far north, on mountains and on the high


Continued on page 48



WELWYN

Hermetically Sealed

Deposited Carbon Resistors



High stability resistors sealed into glazed and vitrified ceramic shells for complete protection against ambient humidity changes. Silicone oil filled. Acts as efficient convective medium for improved heat dissipation. Also serves as infallible quality control for detecting seal leakage defects.

Each resistor is subjected to sustained pre-load test at 1½ times rated wattage. Insures against catastrophic failures under normal operating conditions.

Designed to meet military specifications.
MIL-R-10509 (current issue)

for complete data, write to:
WELWYN CANADA LTD.
 1255 BRYDGES ST. LONDON, ONT.

MEASUREMENTS' New STANDARD PULSE GENERATOR



MODEL 179

The Model 179 is uniquely suited for production and laboratory work where pulses of known repetition rate and width are required. It is extensively used in TV, radar, computer and nuclear fields.

- Wide, calibrated frequency range—60 cps to 100 Kc
- Continuously variable calibrated pulse width
- Triggered and free-running operation
- High-amplitude positive and negative pulses... +200 v to -150 v



Sales Representative: H. Roy Gray, Ltd.
46 Danforth Road, Toronto, Ont.

News Report

seas—were arranged in collaboration with National Research Council and were directed by Dick Halhead.

S. W. Caldwell Ltd. Exclusive Rights To Mobilux in Canada

Plans were finalized and a contract signed recently giving S. W. Caldwell Ltd. of Toronto, exclusive sales and production rights to "Mobilux" in Canada for both custom commercial production and the forthcoming library of ID's and local commercials for station lease.

Mobilux is a newly created optical animation effect with many unique advantages for television commercials—one of which is extraordinary speed in production. It has been described as "animation at live camera speed" and requires only one piece of art work for each desired effect, rather than the numerous "cells" required in normal animation.

This business arrangement was consummated between Gordon Keeble, vice-president of S. W. Caldwell Ltd., and Robert Davis, president of Robert Davis & Associates, whose production company holds commercial rights to "Mobilux."

E-Z-Hook Test Products Represented By Len Finkler

E-Z-Hook Test Products of Covington, Kentucky, have appointed Len Finkler & Co. as their exclusive manufacturer's representative for all of Canada.

The complete line of E-Z-Hook Test Connectors (Probe, Tip, Sub and Clip) will be stocked by Len Finkler & Co. for faster delivery of Canadian orders.

Len Finkler & Co. has headquarters at 330 Adelaide Street West, Toronto, Ontario, Canada.

Appointment Of President Linde Air Products Co.

The appointment of Whitford S. Wyman as president of Linde Air Products Company, Division of Union Carbide Canada Limited is announced by A. A. Cumming, President, Union Carbide Canada Limited.

Mr. Wyman joined the Linde organization 30 years ago, following graduation in mechanical engineering from Cornell University. He has held various positions in research, development, and plant supervision. Since 1956, Mr. Wyman has been vice-president and general manager.

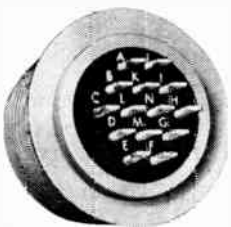
Mr. Wyman is a member of the Association of Professional Engineers of the Province of Ontario and is a past chairman of the Canadian Section, Compressed Gas Association.

Continued on page 54

AMPHENOL

CONTACT LETTERS on GLASS!

another
FIRST



INDENTOSEALS

Hermetically sealed connectors with contact identification.

- Eliminates wiring errors
- High humidity performance
- Higher hi pot breakdown
- Faster wiring
- Reduces inspection time.

Contacts marking unaffected by solvent acid — or base.

For further information — write to Dept. 24



CANADA LIMITED
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TORONTO ONTARIO

IRE CONVENTION and EXPOSITION

EXHIBITION PARK, TORONTO
October 8-9-10, 1958

Support it by attending it

12 minutes from downtown DETROIT FUN days & nights

Resort accommodations—air conditioned rooms, suites, kitchenettes with TV, radio & phones—with heated pool. Delightful dining and entertainment nightly by top stars in the Casino. Ideal for the family—baby sitter service.



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NIGHTLY REVUES
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HAWKESBURY WIRE

**For Every Application
in the Electronic Industry**



- * Single and multi-strand wires.
- Copper and alloy resistance types.
- Sizes from No. 40 to No. 50 or .0006 dia.
- Bare, film insulated or in various natural or synthetic textile servings.

Insulated for temperatures to 250°C.
Overnight delivery on many items.
Competitive pricing on carton, tray or spool orders.
Canadian manufactured on most items.

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Representing: Hawkesbury Wire Co. Ltd., Hawkesbury, Ontario.



the **1958**

Directory and Buyer's Guide of ELECTRONICS AND COMMUNICATIONS

** is still working hard
for both readers and advertisers —*

** during the first week in August . . .*

eight months after the Fourth Annual Directory and Buyer's Guide was published, over 40 enquiries on products advertised in it were received and relayed on to advertisers in Canada and the United States. Among those to whom enquiries were addressed were:

Electrovert Limited
Acme Electric Corp.
Canadian Stackpole Ltd.
Hackbusch Electronics
Ltd.
Aircraft-Marine Products
of Canada
Pye Canada Limited
Canadian Westinghouse
Co. Ltd.
RCA Victor Co. Ltd.
Canadian Marconi Co.

Alliance Motors
Radio Communications
Equipment &
Engineering
Centralab Canada Ltd.
Sperry Gyroscope Co.
of Canada
Sigma Instruments, Inc.
Electro Sonic Supply
Co. Ltd.
Erie Resistor of
Canada Ltd.

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Precision Electronic
Components
Northern Electric Co.
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Corp. Ltd.
R. H. Nichols Co. Ltd.

J. F. D. Electronics Inc.
Burton-Rodgers Co.
Computing Devices of
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Canada Wire & Cable Co.
Rogers Majestic
Electronics Ltd.
Measurement
Engineering Ltd.
Stark Electronic
Instruments
Sola Electric Company

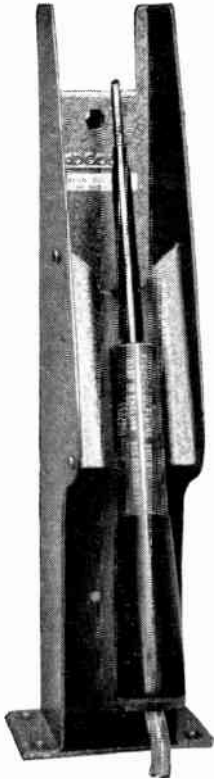
The Fifth Annual Directory and Buyers' Guide of ELECTRONICS AND COMMUNICATIONS is now being compiled and will be published in December, 1958 to serve all during 1959.

Here's your chance to make a bid for the attention and interest of Canadian Engineers and Buyers in an advertisement that will be able to work for you a full twelve months in 1959.

ADCOLA
REGISTERED TRADE MARK
 (Regd. Trade Mark)

1/8" Bit L. No. 70
 Shield L. No. 68

3/16" Bit
 L. No. 64



**C.S.A. APPROVED
 SOLDERING
 INSTRUMENTS**

**Designed in Three Sizes
 1/8" 3/16" & 1/4" Bits.**

**Manufactured for
 All Supply Voltages
 6/7 to 230/50 v.**

Instruments maintain soldering temperatures and through jointing is achieved in all the fields of soldering, from pin point to general work in all sound equipment.

Insulation standards are approved in all leading countries.

**All Designs Cover the
 Demands for Continual
 Bench Production
 Assembly.**

Canadian, British and
 Foreign Pats.
 Reg. designs, etc.



Canadian
 Representative:

L. J. LAMB
 Box 103 - Weston, Ont.

**Unusual opportunity for mature man with
 electronics background**

Well established manufacturing firm in the Electronics field needs a "MAN FRIDAY".

This man must be ambitious, industrious, and an orderly thinker with ability in sound business judgment.

His philosophy must be such that he prefers the environment of mutual confidence and personal respect of a smaller, owner operated firm to the allure and prestige often attributed to the "giants" of industry.

A basic knowledge of Electronics is required but not necessarily a university degree. Several years experience in the field of radio communications would be of considerable value.

Initial duties would centre around correlating customers' technical data for our office and plant. This would lead to further technical and managerial duties with the possibility of eventual company participation.

Age is not too important, but maturity is.

This man is needed to round out our management group and in many respects the right man could write his own ticket.

If you think you have what it takes and are looking for something like this, your enquiry is invited on a confidential basis.

BOX 5000,

ELECTRONICS and COMMUNICATIONS
 450 ALLIANCE AVE., TORONTO 9, ONTARIO

Airtron **HIGH**

**temperature
 flexible
 waveguide**

Another Airtron "First"

Available in all standard waveguide sizes, either straight lengths or preformed assemblies.

- Operating temperature range from -100°F to $+300^{\circ}\text{F}$.
- Can be pressurized for airborne or high power applications.
- Eliminates alignment problems in the assembly of complex rigid waveguide systems.
- Pliant construction isolates shock and vibration.
- Silicone rubber molded jacket.
- Individually tested to assure maximum reliability and performance.



* For higher temperature applications, or further information, write Dept. 26.

Airtron CANADA LIMITED
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**Get Diamond's NEW microwave
 catalog and price list!**



Diamond's handy "short-form" catalog #958 contains over 850 standard microwave items — thoroughly detailed — all on one side. Simple in format for efficiency in use.

Handsomely printed on coated card stock. Lacquered for extensive use without smudging or becoming dirty. Has tab for file folder use — is punched for 3-ring binder — lies flat when hung on wall, for ready reference.

Send for your free copy today!



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 ANTENNA & MICROWAVE
 CORPORATION
 7 North Avenue • Wakefield, Mass.

CONWAY ELECTRONIC ENTERPRISES
 1514 Eglinton Avenue West - Toronto 10, Ontario

For further data on advertised products use page 59.



By using the SHF Communications band and new, much smaller components, Westinghouse has developed a powerful yet compact MICROSCATTER system. Two MICROSCATTER components are shown above: The 2 K.W. Klystron Tube (right) and a model of the microwave block.

“Here’s how we put Microscatter on wheels!”

Now, Westinghouse has successfully reduced the size of microwave scatter—by developing an SHF system! And now, all radio equipment for a 5,000 mc. quadruple diversity *repeater* can be mounted in a 40-foot truck trailer.

For voice, teletype, television, facsimile and raw radar video . . . this advanced MICROSCATTER gives you high quality SHF transmission to points 100 to 200 miles away!

WESTINGHOUSE MICROSCATTER also gives you

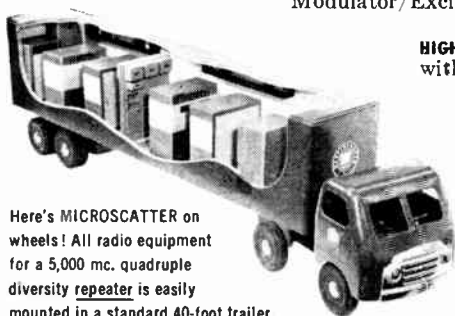
HIGH QUALITY TRANSMISSION with an extremely linear, wide band Modulator/Exciter.

LOW COST PER CHANNEL MILE . . . due to minimum operating and maintenance costs . . . and low power consumption.

HIGH RELIABILITY of up to 99.99% . . . with quadruple diversity.

SMALL, NARROW-BEAM ANTENNAS, from 8 ft. to 28 ft. in diameter.

For complete information, phone your nearest Westinghouse office. Or write to Canadian Westinghouse Company Limited, Electronics Division, Longwood Road, Hamilton, Canada.

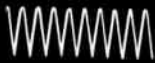


Here's MICROSCATTER on wheels! All radio equipment for a 5,000 mc. quadruple diversity repeater is easily mounted in a standard 40-foot trailer.

YOU CAN BE SURE...IF IT'S
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58C745



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RCA • GE • KEN-RAD • SYLVANIA
WESTINGHOUSE • CBS • EIMAC
WESTERN ELECTRIC • RAYTHEON • ETC.



TUBES

ENTERTAINMENT RECEIVING TYPES	OC3/VR105	.45	368A W.E.	2.00
1A3	OD3/VR150	.40	394A	3.00
1L4	1B24	4.75	422A W.E.	7.00
1LD5	1B27	7.50	429A W.E.	15.00
1S4	1B32	.25	446B	1.00
1S5	1B35	3.50	450TL	42.00
1T5	1B38	15.75	H500	35.00
1U4	1B53	10.00	522AX	.75
2X2/879	1B62	2.75	G599	25.00
5T4	2C26A	.25	705A W.E.	.50
5V4G	2C39A	10.00	707B	1.75
5Y4G	2D21	.85	714AY	35.00
6AB7	2D21W	1.00	715A	1.50
6AC7	2K26	25.00	725A	5.00
6AF6G	2X2	.15	730A	5.00
6AG5	3BP1	1.25	805	3.75
6AG7	3B24	.50	808	2.75
6AJ6	3B27	3.00	813	8.50
6AK5	3C37	20.00	814	1.75
6AK6	3DP1S2A	7.50	836	1.25
6BC7	3E29	7.45	837	1.00
6C4	3JP7	3.45	841	.50
6C6	KC4	75.00	843	.35
6C8G	4B22-EL5B	3.75	845	5.00
6D6	4B32	7.00	849	45.00
6F6	4J25	25.00	851	5.00
6G6G	4J51	25.00	860	3.50
6H6	4PR60A	35.00	861	20.00
6K7	4X150A	15.00	866A	1.50
6K7G	5B21	4.25	872A	1.00
6K8G	5C22	17.50	874	.50
6L5G	5JP2	2.75	876	.70
6L6GA	5JP4	2.25	891	75.00
6L7	5R4WGY	1.75	955	.20
6N7	5Y3WGT	1.00	K-1001	50.00
6R7	6AC7W	1.00	(Dumont)	
6S7G	6AJ5	1.00	1622	1.00
6SD7GT	6AK5W	1.75	1624	1.00
6SG7GT	6AN5	2.25	1625	.25
6SH7	6AR6	1.25	1626	.15
6SH7GT	6AS6	1.00	1632	.25
6SK7	6BM6A	33.00	1846	50.00
6SL7GT	6SL7WGT	1.25	ZB3200	75.00
6SN7GT	6SN7WGT	1.00	5517	1.00
6SS7	7AC7P19	35.00	5518	275.00
6ZY5G	(Dumont)		5650	40.00
7A6	7MP7	12.50	5654/6AK5W	1.50
7AG7	12DF7	24.00	5651	1.00
7F7	12DF7A	36.00	5667	100.00
7H7	26A6	.36	5676	.75
12A6	26D6	1.00	5703	1.00
12C8	FG32	3.75	5718	1.00
12K8	35T6	1.75	5718-SL	.50
12SF7	RK65/5D23	10.00	5719-SL	.60
12SR7	101D W.E.	2.50	5744	1.00
14A4	100TH	7.50	5801	3.50
14A5	RX-120	15.00	5803	3.75
14B8	F-127A	10.00	5814	.50
14J7	GL-152	10.00	5825	6.00
14W7	FG-154	10.00	5828	3.50
24A	FG-172	15.50	5838	5.00
25Z6GT	203A	2.50	5840-SL	.70
37	204A	25.00	5896-SL	.60
38	212E	25.00	5899-SL	.60
46	217C	1.25	5902-SL	.70
76	249C	3.50	5933	1.25
77	250TH	20.00	6021-SL	.50
78	253A W.E.	2.50	6035	10.00
83V	259A W.E.	4.00	6038	5.00
84/6Z4	267B W.E.	4.77	6073	1.25
89Y	272A	5.50	6096	1.75
BROADCAST SPECIAL PURPOSE INDUSTRIAL	274A	3.00	6080WA	6.00
OB2	322A	25.00	6098CT	2.00
	337A W.E.	3.95	8013	1.25
	342A	200.00	9001	.65
	355A	10.00	9002	.29
	356B W.E.	3.00		
	359A W.E.	1.75		

SL = Socket Leads

Partial list; many additional types in stock not listed here. WRITE TO DEPT. C FOR PRICE LIST.

CALVERT ELECTRONICS, Inc.

536 BROADWAY, NEW YORK 12, N.Y., U.S.A.

Cable Address: Calverton, N.Y. Tel. CA. 6-7400

\$39.55 trade-in-allowance
for your
OLD TUBE TESTER

"LIMITED TIME OFFER"



Here is your chance to move up into Quality Equipment at a price never before offered.

Price \$239.50
Less trade-in allowance 39.55
Your Cost \$199.95

For a limited time only, your distributor will accept any Tube Tester, regardless of age, make or condition, at a trade-in value of \$39.55, on a brand new STARK Model 8-77 Dynamic Mutual Conductance Tube Tester.

This is what you get when you purchase a STARK Model 8-77 Dynamic Mutual Conductance Tube Tester:

Dynamic Mutual Conductance . . . the time-proven, and patented "Stark-Hickok" method of precise voltage calibration that assures you of professional tube-testing accuracy.

Snap-in Master Socket Panel . . . a unique feature, socket panel slips off easily, exposing new 11-pin socket and saves time in replacing worn-out sockets.

High Speed Short Test . . . 12-times more sensitive! Automatically indicates shorts or leakage between elements and identifies which are shorted.

Grid Current Test . . . immediately determines if filament open or not.

Reserve Cathode Capacity Test . . . weeds out weak tubes.

Filament Voltages: In 18 steps from 0.6 to 117 Volts.

Scale Reading: Read directly on the 3-range micromho scale (0 to 3,000; 6,000; 15,000)

SEE — or — WRITE YOUR DISTRIBUTOR TODAY . . . Remember this offer is good FOR A LIMITED TIME ONLY.



STARK ELECTRONIC INSTRUMENTS LTD.
Factories and Sales Office: Ajax, Ont.
Foreign Division: 276 West 43rd Street
New York 36, N.Y., U.S.A.

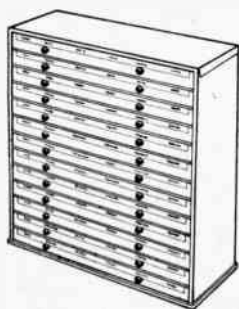


IS RESISTOR STORAGE A PROBLEM?

NEW IMPROVED

IRC
1/2 watt carbon resistor

"PACK of 5" DISPENSER



- 7700 resistors 100 each of the 77 E.I.A. 10% tolerance values 10 ohms to 22 megohms
- Ease of handling
- At a glance inventory control
- Complete inventories for today's requirements
- All metal attractively finished cabinet
- Drawer type construction.

For Further Information Write to Dept. 26.

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 SALES OFFICES:
 Radiovision Sales Ltd. 492 Somerset St. West
 325 Tenth Ave. West Ottawa
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SPECIFY Hoyt METERS

FOR EVERY APPLICATION



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High-visibility 3-3/4 and 4 inch scale AC or DC Panel Meters in handsome black bakelite cases feature quick response and good damping under all conditions. For original equipment component or replacement use.

Be sure of the highest accuracy, dependability, and readability PLUS economy with HOYT precision AC and DC instruments — the complete line of Panel Meters. Moving coil, rectifier, and repulsion types available in a wide variety of sizes, ranges, cases, and colors. Also, custom-designed (including 400-800+ cycle applications) to meet your most rigid specifications for a quality instrument.

Write Export Manager — new illustrated literature contains descriptions, engineering data, and prices.



Prompt Delivery — M/A Forms mailed on day of shipment.

Service Facilities — strategically located in Canada.

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Hoyt ELECTRICAL INSTRUMENTS
 Sales Div.: BURTON-ROGERS COMPANY
 42 Corleton Street, Cambridge 42, Mass., U.S.A.

World's First Battery Operated Pocket Tape Recorder



- Completely transistorized.
- Accommodates internal loudspeaker.

- Lowest cost on the market.
- Records up to 1 1/2 hours for pennies per hour.

Midgetape is pocket size. It has a variety of devices for confidential recordings. Power converters for non-battery use in car, office or home. One battery with visual life indicator. Ideal for engineers, lawyers, insurance investigators, doctors, public relations and salesmen, as well as for inventory taking.

INSTANTANEOUS RECORDING SERVICE

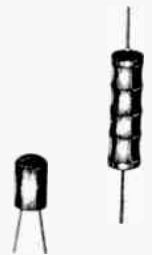
40-42 LOMBARD STREET TORONTO 1, ONTARIO
 TELEPHONE EMPIRE 3-5767

Daven's new winding technique cuts giants down to size

for MAXIMUM RESISTANCE IN MINIMUM SPACE

These fully encapsulated, miniature, precision wire wound resistors utilize a new winding technique that permits the use of extremely fine resistance wire to obtain two or three times the resistance value previously supplied on a miniature bobbin.

Type	Dia.	Length	Max. Res.	Wattage Rating
1273	1/4	5/16	400K	.1
1283	1/4	5/16	400K	.1
1274	3/16	3/8	100K	.1
1284	1/4	27/64	.5 Meg.	.25
1192	1/4	1	1.0 Meg.	.75



THE **DAVEN** CO.

Livingston, N.J.

Write for Complete Data and Catalog



WORLD'S LARGEST MANUFACTURER OF ATTENUATORS
 IN CANADA: ADAMS ENGINEERING LTD., Montreal and Toronto

QUICKER — MORE ACCURATE—MORE RELIABLE CIRCUIT DESIGN CONDUCTANCE CURVE DESIGN MANUAL

by Keats A. Pullen, Jr., Eng., D.

This vacuum tube working manual for the engineer thoroughly ties together circuit equations and the concept of small signal parameters for use in circuit design. It provides a group of data, in table and graph form, so organized that it helps the user design circuits which function in the manner desired, with a minimum of readjustment. With the manual, the engineer can use small signal parameters to predict large signal performance with the following benefits:

- makes it possible to optimize a design so that a given performance can be obtained with minimum tube element dissipation by permitting point-by-point determination of dynamic operating conditions anywhere within a tube's rating. Life and circuit reliability are enhanced and experimental readjustment is minimized.
- clearer understanding of in what manner circuit performance changes when any circuit parameters are varied. Makes it evident that when a required performance can't be obtained without operating the tube near or at its peak, another tube type with greater power handling capability should be chosen.
- aids in the design of conservatively rated circuits for greater reliability.

MANUAL DIVIDED INTO THREE PRINCIPAL SECTIONS

- ① explanation of the special curves and their application in typical R-C amplifier designs.
- ② tables useful in making tube substitutions and tables to simplify the selection of tubes for given applications.
- ③ a special set of conductance curves for more than 70 of the most representative vacuum tube types used in all services. Includes low power and high power tubes, triodes and pentodes, and several mixer tubes.

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Written by a man with many years of experience in the computer field, this 3 volume "picture-book" training course lays the foundation of digital computer system concepts from which any individual computer can be studied. Excellent foundation for training on all types and all brands of digital computers.

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Volume 3—deals with major units in a digital computer from a systems point of view. Discusses magnetic drums and core types of memory, timing pulses, control units, input and output. Static and dynamic types of registers including shift registers covered.

Basics of Digital Computers is ideal background for engineers, laboratory assistants as well as other technical personnel who wish to broaden their knowledge of this new, rapidly expanding field. The fundamentals of digital computers are presented idea-by-idea, page-by-page permitting the reader to build his knowledge step-by-step. Specially selected illustrations support the text and make it crystal-clear. At least ONE big illustration on each page!

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News Report

Appointed U.S. Air Force Communications Supervisor

A Canadian National Telegraphs expert has been appointed plant supervisor in charge of United States Air Force communications, it was announced recently by CNT's Newfoundland superintendent, A. C. Jerrett.

He is John Filyer, who during 1953-54 was selected to supervise the erection of about 47 miles of cable by Canadian National Telegraphs in Newfoundland for the national defense department. Mr. Filyer was also engaged in a similar capacity during



John Filyer

transfer of the 547 miles of Newfoundland long lines cable from the former Newfoundland Railway pole line to the new joint CNT-USAF pole line.

In 1955 he was appointed to the post of assistant plant supervisor, outside plant, USAF, at St. John's, with the promotion to supervisor now following.

Schlumberger NMR Analyzer Distributed Through Two Canadian Channels

Schlumberger Well Surveying Corporation, Ridgefield Instrumentation Division, Ridgefield, Conn., has appointed Scientific Supplies Co. Ltd., of Vancouver, B.C., and Philips Electronics Industries Ltd., of Toronto, Ontario, as its distributors in Canada for the new Model 104 Nuclear Magnetic Resonance (NMR) Analyzer, according to an announcement by A. Russell Aikman, Schlumberger Marketing Director.

Scientific Supplies Co. will cover the British Columbia and Alberta areas, while Philips Electronics will cover the rest of Canada.

"Intense interest in this research and production instrument," Mr. Aikman indicated, "has been manifested by Canada's expanding pulp and paper, tobacco and mining industries, and by its newer food processing, chemical, atomic energy and electronics industries.

"Before the advent of the NMR analyzer, routine moisture determination took hours, required highly skilled technicians and added considerably to a product's cost. Now, the instrument, manned by non-technical people, can run off an analysis in 30 seconds," said Mr. Aikman.

Continued on page 56

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News Report

Canadian Admiral Moves Montreal Sales Branch

Approximately September 15th Canadian Admiral Corporation's Montreal Sales Branch will move to the company's own building now in the process of construction on Ferrier St., according to Stuart D. Brownlee, executive vice-president of the company.

The new building, especially designed to meet Admiral's requirements, has 26,000 square feet of floor space, provides better facilities for the sales, service and parts departments, a larger showroom and more warehouse space.

Improved service for Admiral television and appliance dealers in the Montreal area, along with more efficient storage and shipping arrangements are expected to result when the new building is occupied.

Albert Reed is the manager of the Montreal Sales Branch, which is also headquarters for Guy Bell, assistant general sales manager in the company's eastern division.

Electromechanical Products Extend Their Representation

Electromechanical Products of Markham Road, Agincourt, Ontario, have recently announced their appointment as Canadian representatives for three additional organizations in the United States. These are Burr Brown Research Corporation, Box 64444, Tucson, Arizona; George T. Meillon Inc., 132 Nassau St., New York 38, N.Y.; and Levinthal Electronic Products, Stanford Industrial Park, Palo Alto, California.

TCA To Equip Viscount Fleet With Bendix Weather Radar

Announcement was recently made by W. S. Kendall, Marketing Director of Computing Devices of Canada Limited, Ottawa, that TCA's fleet of 51 Viscounts will be completely equipped with Bendix RDR-1 Weather Radar.

First deliveries commence this month and will continue at the rate of approximately five a month until complete. All negotiations concerning sale and installation have been handled by Computing Devices of Canada Limited, Canadian representatives of the Radio Division of Bendix Aviation Corporation. Bendix Weather Radar has already been installed on aircraft of a number of leading United States airlines.

Weather radar makes it possible for a pilot to plot a course around or between storm centres, for maximum passenger comfort.

Continued on page 58



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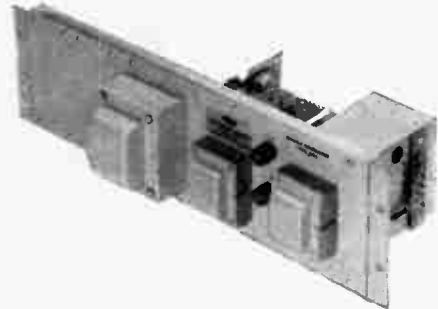
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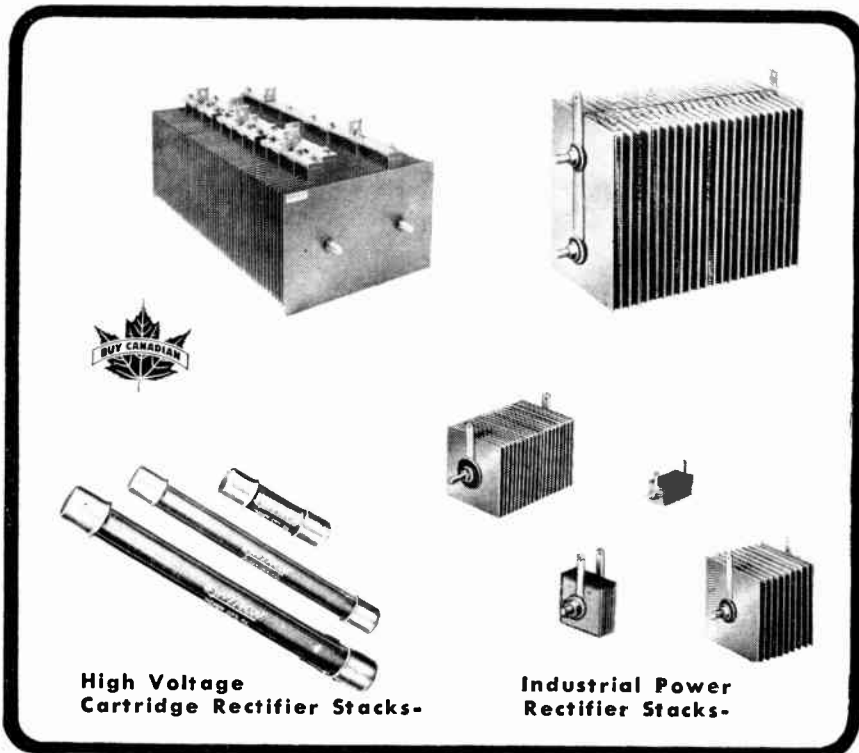


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News Report**Union Carbide Appoints
President National
Carbon Company**

The appointment of Gordon W. Patterson as president of National Carbon Company, Division of Union Carbide Canada Limited, is announced by A. A.



G. W. Patterson

Cumming, president, Union Carbide Canada Limited.

A graduate of the University of Toronto, Mr. Patterson joined the Union Carbide organization in 1935 where he served in various capacities in accounting,

office services, field sales, advertising and public relations.

Since 1956, Mr. Patterson has been vice-president of National Carbon Company, Division of Union Carbide Canada Limited.

**Allied Control Forms
Canadian Company**

The formation of the Allied Control Company of Canada, Ltd., with offices at 1500 St. Catherine Street West, Montreal, Quebec, was announced recently by E. H. Gillette, president of the Allied Control Company, Inc., New York, manufacturers of electronic, aircraft and electrical components.

The initial purpose of the new Canadian company is to facilitate supply of Allied Control and Siemens & Halske relays and other components. Also under consideration are plans for the eventual construction of facilities for the manufacture of the complete line of Allied Control products.

**Trimpot Manufacture
In Canada**

Douglas Randall (Canada) Ltd., Toronto, Ontario, has been authorized by Bourns Laboratories, Inc., of Riverside, California, to manufacture and market in Canada the Bourns lead-screw type potentiometers, trademarked TRIMPOT* (a military potentiometer used primarily in guided missiles and aircraft) and TRIMIT* (a commercial potentiometer for use in computers, instruments and similar ground equipment).

Production of the Bourns TRIMPOT* is scheduled for September at the Toronto plant of Douglas Randall (Canada) Ltd., 123 Manville Rd., Toronto, where it is one more step by this concern to provide Canadian manufactured products to the electronic industries.

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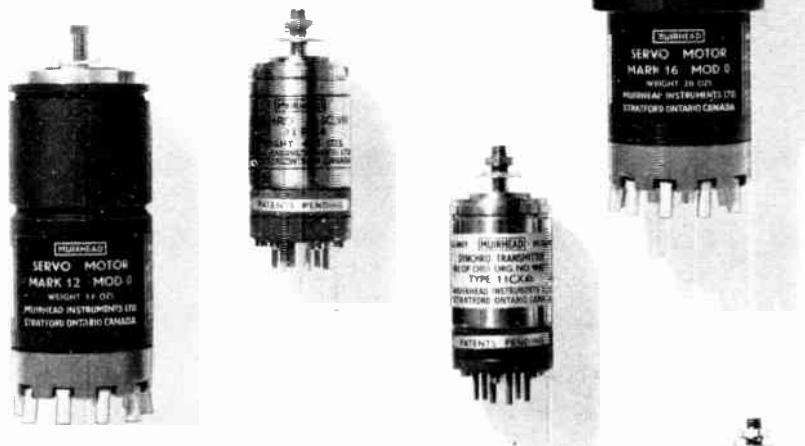


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For further data on advertised products use page 59.

World Radio History

News Report

Canadian Rep For U.S. Gear Corporation

H. D. Randall, Jr., president of Hudson Randall International, Toronto, has recently announced that his company has been appointed to market in Canada the products of U.S. Gear Corporation, Wakefield, Massachusetts.

In addition to the above, Hudson Randall International, who are located at 123 Manville Road, Scarborough, Ontario, also act as exclusive Canadian sales agents for a number of leading U.S. manufacturers including: Diehl (servomotors and generators), Litton Industries (multi-turn potentiometers), Microtran (custom built miniature transformers), Balco (special high temperature capacitors), Taurus Corp. (Teflon insulated terminals and punched card sensor units) and Electrix Terminal & Connectors (terminals).



Lorne R. Kersey, Associate Professor of Electrical Engineering in the University of British Columbia, has been elected chairman of the Vancouver section of the Institute of Radio Engineers for the coming year.

Bakelite Company Appoints Western Technical Rep

C. E. Knechtel has been appointed Western Technical Representative by Bakelite Company, Division of Union Carbide Canada Limited, according to an announcement by Arthur A. Allan, Jr., Bakelite Sales Manager. Mr. Knechtel's headquarters are at 2285 View Lynn Drive, North Vancouver, B.C.

After graduation from the University of Toronto with a B.Sc. degree in Chemical Engineering, Mr. Knechtel joined the Bakelite organization in 1954 and after training in Canada and the United States he was assigned to field work in Ontario on the Toronto Office staff.

Continued on page 65



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Eimac Ceramic Tetrodes from 325 to 11,000 watts

Generating a clean SSB signal is one thing . . . amplifying it to the desired power level with stability and no distortion is another. A modern Class AB₁ final amplifier designed around an Eimac ceramic-metal tetrode is the ideal answer to the problem. The Eimac ceramic linear amplifier tubes shown above — the 4CX250B, the 4CX300A, the 4CX1000A and the 4CX5000A — offer the high power gain, low distortion and high stability that is needed for Class AB₁ operation. Each has performance-proved reserve ability to handle the high peak powers encountered in SSB operation. Efficient integral-finned anode cooler

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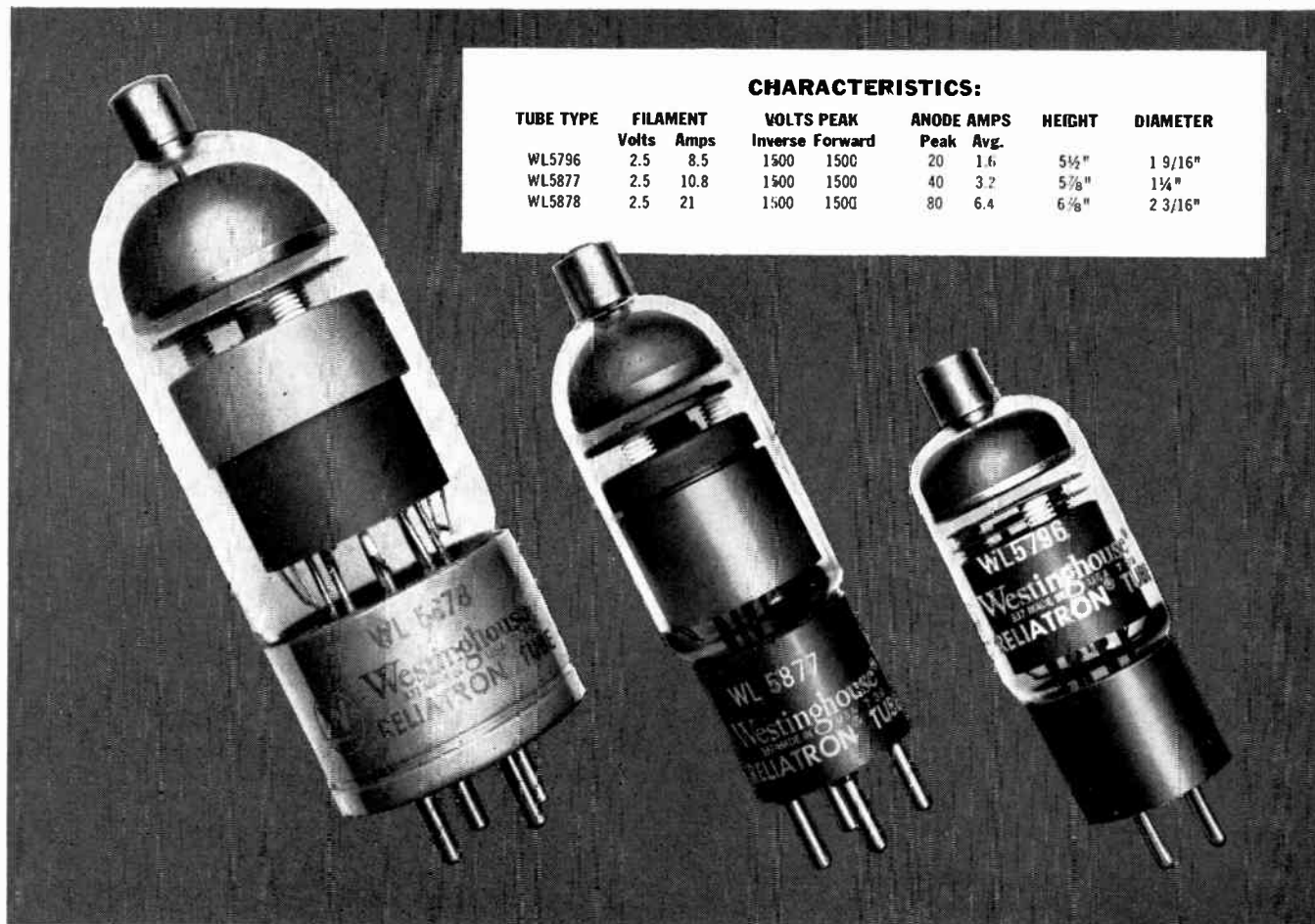
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CLASS AB₁ SSB OPERATION

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Plate Voltage	2000 v	2500 v	3000 v	7500 v
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World Radio History

New Xenon-filled Westinghouse THYRATRON TUBES IMPROVE welding equipment efficiency!



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WL5796	2.5	8.5	1500	1500	20	1.6	5 1/2"	1 9/16"
WL5877	2.5	10.8	1500	1500	40	3.2	5 7/8"	1 1/4"
WL5878	2.5	21	1500	1500	80	6.4	6 3/8"	2 3/16"

Compact new design saves space, gives superior performance and uniform quality!

If you are designing new welding equipment, you'll find new Westinghouse Xenon-filled Thyratrons the most advanced you can use.

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Electronic Tube Division

Hamilton, Ontario

For further data on advertised products use page 59.

News Report

Commonwealth Telecommunications Conference

Earlier in the summer experts from telegraph and telephone administrations of all member countries of the Commonwealth met in London, England.

The meetings gave an opportunity for a most useful exchange of views on a wide variety of questions relating to telecommunication services of the Commonwealth. In particular, recent developments in submarine telephone cable technique were discussed, in light of the success of trans-Atlantic telephone cable linking the United Kingdom with Canada and the United States. Traffic potentialities of telephone and Telex services between the Commonwealth countries were also explored. There was complete identity of view regarding pattern of cooperative development for the future.

Delegates left London to report back to their respective governments the agreed conclusions of technical and financial considerations affecting future developments in this field.

Constellation Components Co. Enters Electronics Field

C. G. (Chuck) Bell and E. (Jack) Mulvey have recently formed Constellation Components Company, with offices at 136 Tower Drive, Scarborough, Ontario, and 17041 Omega Place, St. Genevieve, P.Q.



E. J. Mulvey



Chas. Bell

This firm has been appointed as sole Canadian representatives for: Licon Switch Division, Illinois Tool Works, Chicago, Ill., manufacturers of precision switches for the aircraft industry, electronics industry and machine tools; Moog Valve Co. Inc., East Aurora, N.Y., manufacturers of electro hydraulic servo valves and actuators; Autotronics Inc., Florissant, Mo., miniature brakes and clutches for the electronics industry and controls; Electro Development Corp., Seattle, Wash., designers and manufacturers of specialty transformers, transistorized power supplies for the aircraft and electronics industries; Engel and Gibbs of Herts., England, manufacturers of telephone type relays, vacuum switches and mercury switches.

Continued on page 66



Here's a volt!

Here's a volt?

Two ways to look at voltage — only one way to read it accurately, *to the fraction!* When volt-splitting is vital, you need a BECKMAN Expanded Scale Voltmeter.

Why expanded? To make accuracy meaningful. Look at the BECKMAN meter above. It's accurate to ± 0.16 volt! And you can *read* it, easily, to 0.05 volt... because resolution of the expanded scale is ten times that of its conventional competitor.

Choose from 126 standard models... AC or DC... commercial or ruggedized... in a variety of shapes, sizes and voltage ranges. Need color coding, special ranges, assemblies? Yours for the asking. *Send for data file E 84.*

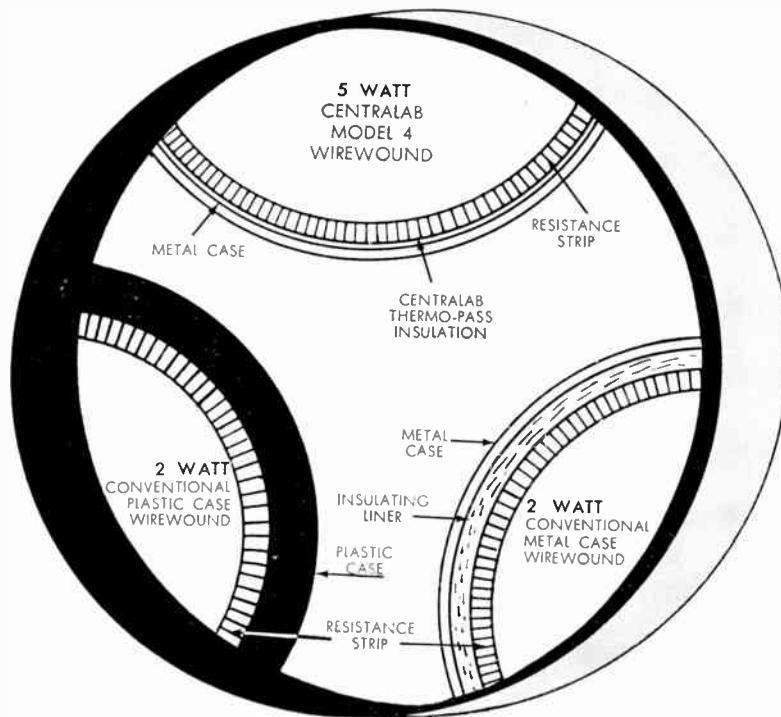
Canadian Factory:
No. 3 Six Points Road, Toronto 18, Ontario
Sales Representative: R-O-R Associates, Ltd.
1470 Don Mills Road, Don Mills, Ontario

Beckman / **Helipot** potentiometers... dials... delay lines... expanded scale meters... rotating components... breadboard parts

5 watt capacity - 2 watt size

Centralab **MODEL 4**

Miniature Wirewound Radiohms®



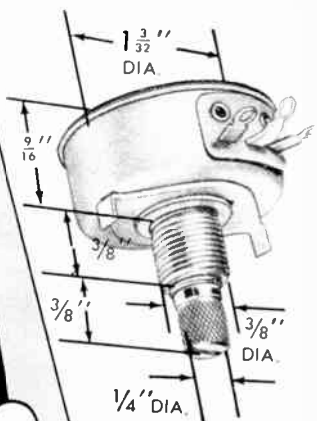
As you know, the rating and size of a variable resistor depends upon the speed with which heat can be transferred from the resistance element to the atmosphere. Centralab "thermo-pass" insulation combines exceptional heat transfer with a dielectric strength of 4500 volts per mil at 25° C. Result: Model 4 Radiohm, a conservatively rated 5 watt wirewound variable resistor smaller than a conventional 2 watt unit.

- Only 1 $\frac{3}{16}$ " diameter by $\frac{9}{16}$ " deep.
- Resistance range, 1 ohm to 15K ohms; linear taper.
- 295° rotation, stop strength 15 inch pounds.
- Minimum life, 25,000 complete cycles.
- Totally enclosed elements.

For detailed information write for Centralab Engineering Bulletin EP-493 or contact your Centralab sales representative. Ask your local distributor about the many values he carries in stock in the WW and WN series (listed in Catalog 30).

B-5810

Centralab Canada Ltd. 804 MT. PLEASANT ROAD
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Affiliated: CENTRALAB • MILWAUKEE 1, WISCONSIN
VARIABLE RESISTORS • SWITCHES • PACKAGED ELECTRONIC CIRCUITS
CERAMIC CAPACITORS • ENGINEERED CERAMICS • SEMI-CONDUCTOR PRODUCTS



ACTUAL SIZE

News Report

Daystrom Announces Formation Of English Subsidiary

Daystrom Incorporated, the parent organization of Daystrom Limited of Toronto, has recently announced the formation of Daystrom of England, a division of Daystrom International.

The new English subsidiary will manufacture a complete line of Heathkits in a new 10,000 square foot building to be constructed in the general vicinity of London. The American Heathkit line will be adapted to British requirements, and all of the parts will be manufactured in the United Kingdom by an initial operating force of some 70 employees. These "do-it-yourself" electronic kits of high fidelity and ham equipment will be sold exclusively by direct mail operation.

The new British company is expected ultimately to service not only the United Kingdom, but all the world's sterling areas, Mr. W. H. Westphal, general manager of Daystrom International, announced.



Eric Carnell

The appointment of Mr. Eric Carnell as President and General Manager of Ericsson Telephone Sales of Canada Limited has been announced by the directors of the company. Mr. Carnell held executive positions previously with the parent company, LM Ericsson, Stockholm, Sweden, and headed that company's operation in Argentina for a number of years. LM Ericsson is one of the world's leading suppliers of telephone, communication and electronic equipment.

Canadian
IRE Convention
Toronto
October 8-9-10, 1958

For further data on advertised products use page 59.

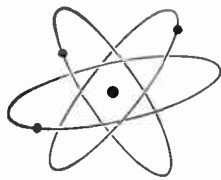


PLAN TO ATTEND IRE CANADIAN CONVENTION AND EXPOSITION

This is the one time during the year when all the electronics industry in Canada meets. Where the latest electronic and communication equipment will be on display. Where the latest Canadian electronic engineering achievements will be discussed by competent authorities. It is your opportunity to meet customers and friends.

Below is a view of a previous IRE Canadian Convention. The 1958 Convention will be bigger and better.

ELECTRONICS AND COMMUNICATIONS



PLAN TO ATTEND the 3rd annual

I.R.E. CANADIAN

CONVENTION

AND EXPOSITION

ELECTRONICS and NUCLEONICS *Register Now!*

The I.R.E. Canadian Convention is the ONE opportunity of the year for scientists, engineers and technicians to see all the latest developments in the field of electronics and nucleonics.

A three day programme of important technical papers, hundreds of outstanding exhibits and special features, combine to make this Canada's largest scientific convention and exposition.

Plan now to attend!

Programme sent on request

**OCTOBER
8-9-10**

1958

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I.R.E. CANADIAN CONVENTION

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Sponsored by the Canadian Sections of the Institute of Radio Engineers



Book Review

Transients In Electrical Circuits by Gladwyn V. Lago, Associate Professor of Electrical Engineering, and Donald L. Waidelich, Professor of Electrical Engineering, both of the University of Missouri.

This book on electrical transients has been written for junior and senior electrical engineering students. It assumes that these students have had courses in differential and integral calculus and at least one introductory course in electrical circuit theory.

In the first four chapters, attention has been paid to the classical method of solving ordinary linear differential equations by using electrical circuits as examples. Circuits containing current sources as well as voltage sources are analyzed. The concept of duality is introduced in these chapters and is used throughout the book.

After the classical method is explained, the Laplace transformation method of solving integro-differential equations is presented with its applications.

Various methods of factoring high-degree polynomials are set forth in such a manner as to familiarize the student with methods normally used in advanced servomechanism texts.

The book concludes with three chapters devoted to the theory and application of Fourier series, integrals, and transforms in the solution of various circuit problems.

Transients In Electrical Circuits is published by The Ronald Press Company, 15 East 26th Street, New York 10, N.Y., contains 393 pages and 398 illustrations, hard cover bound, price \$7.50.

Atmospheric Explorations, a bound collection of papers of the Benjamin Franklin Memorial Symposium of the American Academy of Arts and Sciences, and edited by Henry G. Houghton, Professor of Meteorology at Massachusetts Institute of Technology.

In celebrating the two hundred and fiftieth anniversary of the birth of its late Fellow, Benjamin Franklin, the American Academy of Arts and Sciences held a Symposium on January 11, 1956, at which the papers reproduced in this volume were presented and discussed.

The papers do not treat of Franklin's work or era but deal with the latest and most interesting developments in various fields of atmospheric exploration.

Atmospheric Explorations is published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N.Y., contains 125 pages, hard cover bound, price \$6.50.

History Of Mathematics by Professor D. E. Smith, Volumes I and II.

The word "Algebra" in 16th century England also meant bonesetting. Barbershops often displayed signs reading "Algebra and Bonesetting". This fact comes from D. E. Smith's 2 volume "History of Mathematics".

Within the compass of these two volumes, Professor Smith covers the entire history of mathematics from primitive number concepts to the calculus, and from the early near east to the western and far eastern worlds.

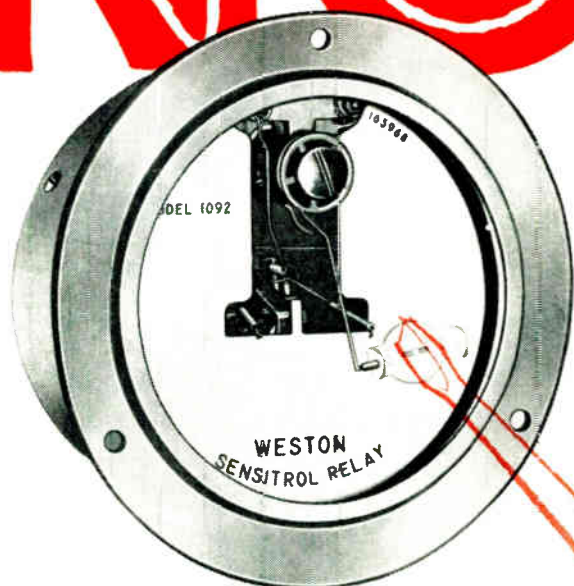
The first volume considers the history of mathematics chronologically arranged by man and country.

The second volume considers the development of mathematics in terms of specific fields and problems. The work of many hundreds of men is related to the gradual advance of arithmetic, geometry, algebra, trigonometry, calculus, calculating machines and many other topics. The evolution of dozens of famous problems under the hands of men of different countries and centuries is given in great detail with many variations of interest and importance to the history of mathematics.

History Of Mathematics is published by Dover Publications, Inc., 920 Broadway, New York 10, N.Y., and in Canada is available through McClelland & Stewart, 25 Hollinger Road, Toronto 16, Ontario. Volume I contains 596 pages; Volume II contains 725 pages. Both are paper bound books and may be obtained boxed as a set for \$5.50 in Canada.

For further data on advertised products use page 59.

NOW!



A FULLY-ADJUSTABLE, ULTRA-SENSITIVE RELAY

WESTON'S NEW LOW-COST SENSITROL RELAY PROVIDES A WIDE RANGE OF OPERATING VALUES

Weston introduces another important 'first': an all-purpose, fully-adjustable, sensitive relay. Available from stock and at low cost, it greatly simplifies many of the problems of engineers, designers and builders of alarm or control devices.

In breadboard circuits, the new SENSITROL relay makes it unnecessary to pinpoint electrical operating values through elaborate calculations or measurements. A single, movable contact adjuster provides an almost infinite number of accurately repeatable settings. In production equipment, the SENSITROL can eliminate the need for stocking a variety of relays.

A pair of SENSITROLS connected in opposition can provide close high-low control, adjustable over a wide range. The new relay can also be used for continuous pulsing control, or in a sensing control circuit to hold variables such as temperature, voltage or light level constant within very narrow limits.

SENSITROL relays contain built-in, re-set mechanisms and feature locking magnetic contacts. They can be set to close at any value of D-C from 5 to 50 micro-amps, or a comparable millivolt span of 10 to 100 . . . and will handle 100 milliamps at 120 volts A-C without chatter.

For complete information, write to Daystrom Limited, 840 Caledonia Road, Toronto 19, Ontario; 5430 Ferrier Street, Montreal 9, Quebec. A subsidiary of Daystrom, Incorporated. Or any office of Northern Electric Co. Ltd.

5821

WESTON

Instruments



now microwave standard frequencies

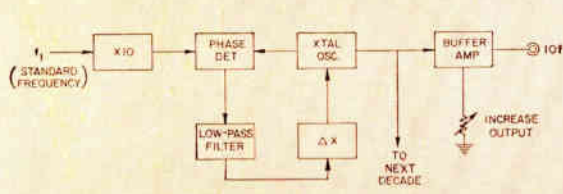
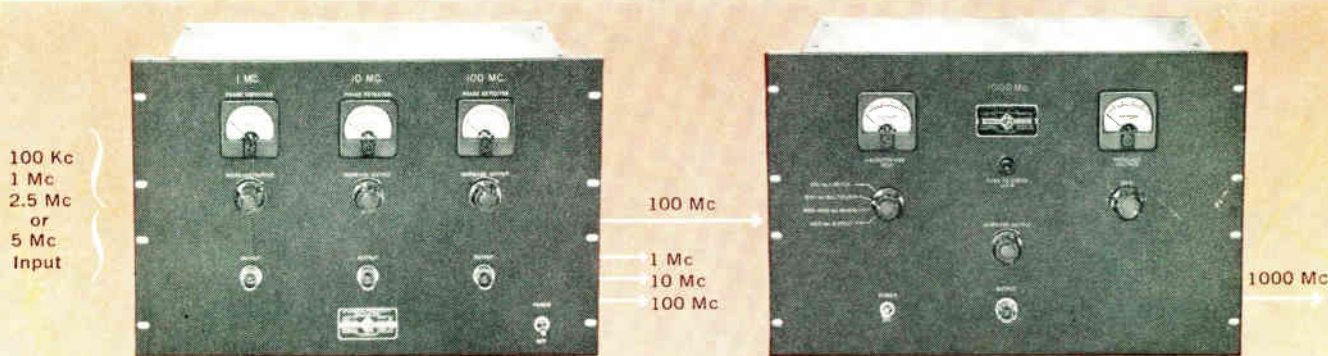
from NEW DECADE MULTIPLIERS

Two new Standard Frequency Multipliers, the Types 1112-A and 1112-B, extend the range of General Radio's line of frequency-measuring equipment to well beyond the X band.

Extremely low noise characteristics and high stability, primary objectives in the development of these instruments, permit their use for precise measuring applications. Telemetry, missile tracking, spectroscopy and atomic-resonance investigations, radar and navigation-systems work are but a few of the areas where signals of this quality are needed.

Submultiples of output frequencies are missing—all spurious r-f and sideband signals are more than 100db below the nominal output signal. Long-term frequency stability is dependent only upon the driving source. Short-term stability is actually so much better than that of other types of frequency multipliers that measurement of performance is difficult — data will be available later.

The new Multipliers are versatile and convenient in use; for example, accurate measurements of microwave frequencies may be made by using a simple distorting and mixing diode to produce higher frequency harmonics for comparison against an unknown signal. For such work, a "picket fence" of standard-frequency markers can be generated (with suitable adding network), against which the unknown can be located quickly, unambiguously, and accurately.



Type 1112-A Standard Frequency Multiplier

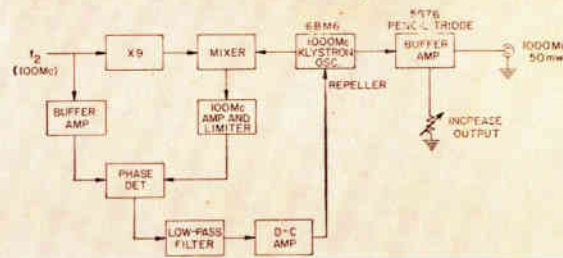
1-Mc, 10-Mc, and 100-Mc output frequencies are generated by separate crystal oscillators that are phase locked to the input frequency to insure extremely low f-m and a-m noise levels. (See diagram for typical decade.) Use of quartz-crystal resonators in each of these oscillators provides the highest possible Q for stabilizing amplitude and phase. With this technique, it is possible to avoid much of the noise commonly associated with multipliers that do not have such high-Q filters, and consequently, to actually improve the S/N ratio of the output signal.

INPUT: 1-volt, 100-kc sine wave from G-R Type 1140¹ -A Frequency Standard or equivalent. Can be driven by 1-Mc, 2.5-Mc, or 5-Mc standard-frequency signal as well.

OUTPUT: 1-Mc, 10-Mc, and 100-Mc sine-wave signals; output level of each independently adjustable with maximum of 20mw into 50 ohms.

STABILITY: Long-term stability dependent only upon driving source.

PRICE: \$1450.



Type 1112-B Standard Frequency Multiplier

1000-Mc output is generated directly by a 6BM6 klystron that is phase-locked to the 100-Mc input. Input is multiplied to 900 Mc and mixed with the 1000-Mc output from the klystron oscillator to produce a 100-Mc beat. The difference frequency is amplified and limited to reduce a-m noise, and then compared to the 100-Mc input in a balanced phase detector. The output from the phase detector controls klystron frequency by varying repeller voltage. Phase-modulated noise normally produced by a klystron is greatly reduced by a wide-band, or fast-acting automatic-phase control.

INPUT: 100-Mc sine wave from Type 1112-A or equivalent; input impedance is 50 ohms.

OUTPUT: 1000-Mc sine wave; at least 50mw into 50-ohm load.

STABILITY: Long-term stability dependent only upon driving source.

PRICE: \$1360.

Write for Complete Information on G-R Frequency Standards.

GENERAL RADIO Company

Cambridge, Massachusetts, U.S.A.

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Richard J. Provan

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