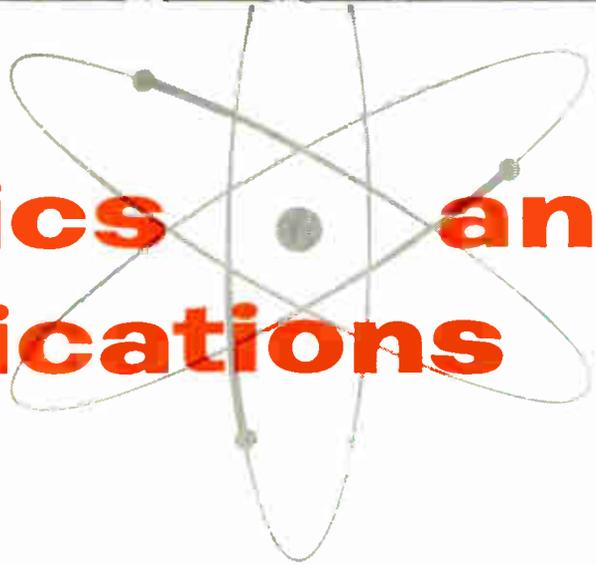


A 4½-inch image orthicon tube for CBC's new studios at Montreal and Toronto (description page 5)

electronics and communications

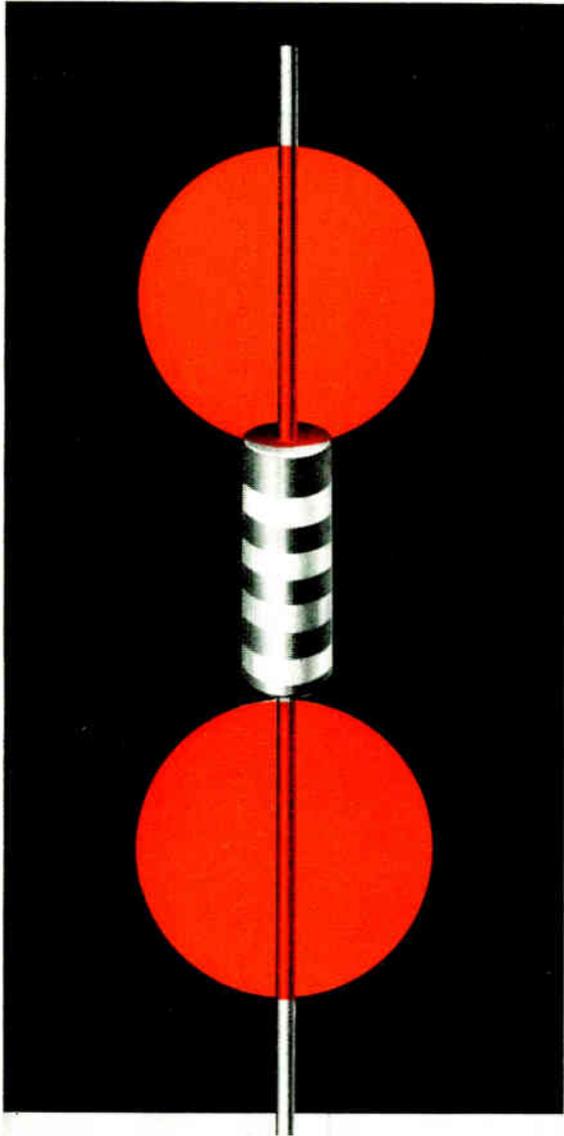


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Stackpole Coldite 70+ resistors solder easier and stay soldered more surely. Thanks to an extra solder coating applied AFTER the usual tin-lead coating, they solder perfectly by ANY method — dip or iron. Moreover, resistance variations from normal soldering heat are negligible.

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Coldite 70⁺

FIXED COMPOSITION RESISTORS

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For complete details check No. 15 on handy card, page 49

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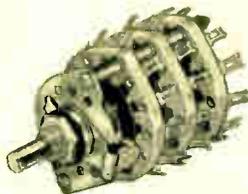
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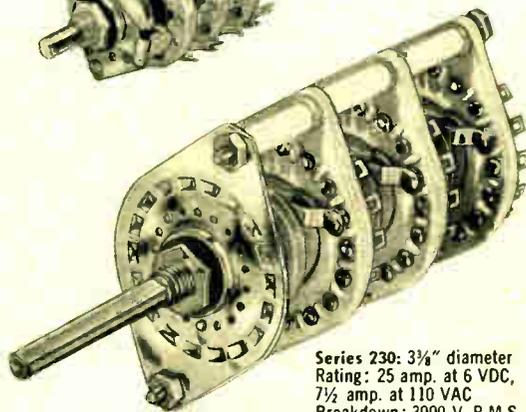
Series 100: 1 $\frac{1}{16}$ " diameter
Rating: 0.5 amp. at 6 VDC,
100 ma at 110 VAC
Breakdown: 750 V. R.M.S.
Up to 12 positions/section



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150 ma at 110 VAC
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150 ma at 110 VAC
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an age publication

Electronics and Communications

Canada's pioneer journal in the field of electronics and communications engineering

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Subscription Rates:
 Canada, U.S.A. and U.K. Possessions \$5.00 a year
 Foreign \$10.00 a year

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Authorized as second class mail
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PRINTED IN CANADA



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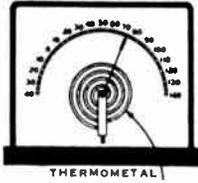
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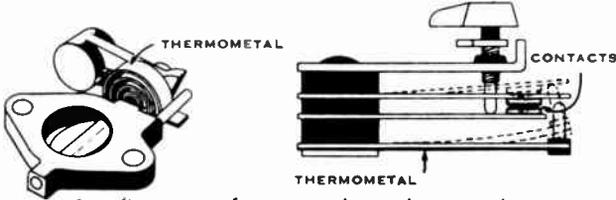
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COVER STORY

A 4½-inch image orthicon tube — pioneered for TV studio work by a British company in 1954 — is fitted into one of six Mark III TV cameras recently shipped to Canada by another noted British electrical firm for the new CBC studios at Montreal and Toronto.



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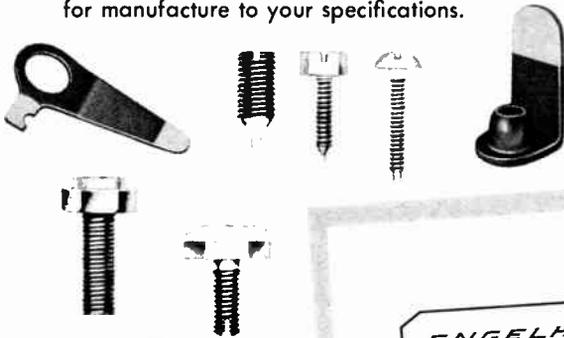


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For economy of installation, plus year after year economies of operation and maintenance, microwave wins hands down over other methods of transmission. But it pays to make sure of getting everything microwave has to offer in quality of transmission, performance, reliability and long life equipment. It pays to compare Collins Microwave and Carrier with all the rest . . . feature for feature, specification for specification, and dollar for dollar. And when you *do* compare you will find Collins gives you more . . . *far more . . .* than any other microwave system.

<i>Features which cut costs, improve transmission quality, and reduce maintenance.</i>	COLLINS Microwave	A Microwave	B Microwave	C Microwave	D Microwave
Built-in test and multiple reading metering facilities.	✓		✓		✓
Final system test before shipment. All inter-rack wiring and test data supplied to purchaser.	✓	✓			
True high density system. Expandable to 480 channels. Using one r-f system.	✓				
Convection cooling throughout. No blowers necessary.	✓	✓	✓		
Mechanically filtered carrier to eliminate cross-talk.	✓				
Corrosion resistant materials used entirely.	✓				
Space-saving by using both sides of rack.	✓			✓	
Interconnection panel at top of equipment.	✓				✓
Receiver AFC with adjustable "lockout" prevention circuitry.	✓	✓			
Loud speaker available in service channel.	✓		✓		
Hot and cold standby. Frequency and space diversity equipment available.	✓			✓	
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Synchronous carrier (all channels) — as required for high speed data.	✓				

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For complete details check No. 18 on handy card, page 49
ELECTRONICS AND COMMUNICATIONS, May, 1959

Two NEW
OSCILLOSCOPES
 each with
3.5-millimicrosecond
risetime



TYPE 581

The new Tektronix Type 581 is a general-purpose oscilloscope with excellent transient response and high-speed sweeps. Risetime is 3.5 μsec and sweep time is calibrated to 0.01 $\mu\text{sec/cm}$. Passband is dc to approximately 100 mc.

The vertical deflection system is designed for plug-in preamplifiers. A low-capacitance probe is an integral part of the Type 80 Plug-In Preamplifier, which provides a calibrated deflection factor of 0.1 v/cm. Sufficient signal delay is included in the main vertical amplifier to permit displaying the leading edge of the waveform under observation.

The wide sweep range of the Type 581 includes calibrated sweeps fast enough to take advantage of its risetime capabilities. Calibrated sweeps from 0.05 $\mu\text{sec/cm}$ to 2 sec/cm are available in 24 steps, and a 5-x magnifier increases the calibrated range to 0.01 $\mu\text{sec/cm}$. Sweep time is continuously adjustable from 0.01 $\mu\text{sec/cm}$ to 5 sec/cm.



Versatile triggering includes amplitude-level control, and preset stability for operating convenience. Lockout-reset circuitry provides for one-shot sweep operation.

A new Tektronix cathode-ray tube with distributed-type vertical-deflection plates is used in the Type 581. 10-kv accelerating potential assures a bright trace, even at low sweep-repetition rates. An amplitude calibrator is also incorporated in the Type 581, with square-wave output from 0.2 mv to 100 v in 18 steps.

TYPE 585

The Tektronix Type 585 has, in addition to the identical general specifications of the Type 581, a second time base generator. This time-base generator, designated TIME BASE B, acts as a delay generator, providing a wide range of calibrated sweep delay. Two modes of sweep delay are available—triggered (delayed sweep is started after the

delay period by the signal under observation), and conventional (delayed sweep is started at the end of the delay period by the delayed trigger). Calibrated sweep delay is continuously variable over the range of 1 μsec to 10 sec. Color-correlated controls eliminate confusion, making this new high-performance oscilloscope easy to operate.

PRICES

- TYPE 581**, without plug-in units **\$1375**
- TYPE 585**, without plug-in units **\$1675**
- TYPE 80** Plug-In Preamplifier, with Probe **\$ 150**

(Other plug-in preamplifiers are currently in development.)

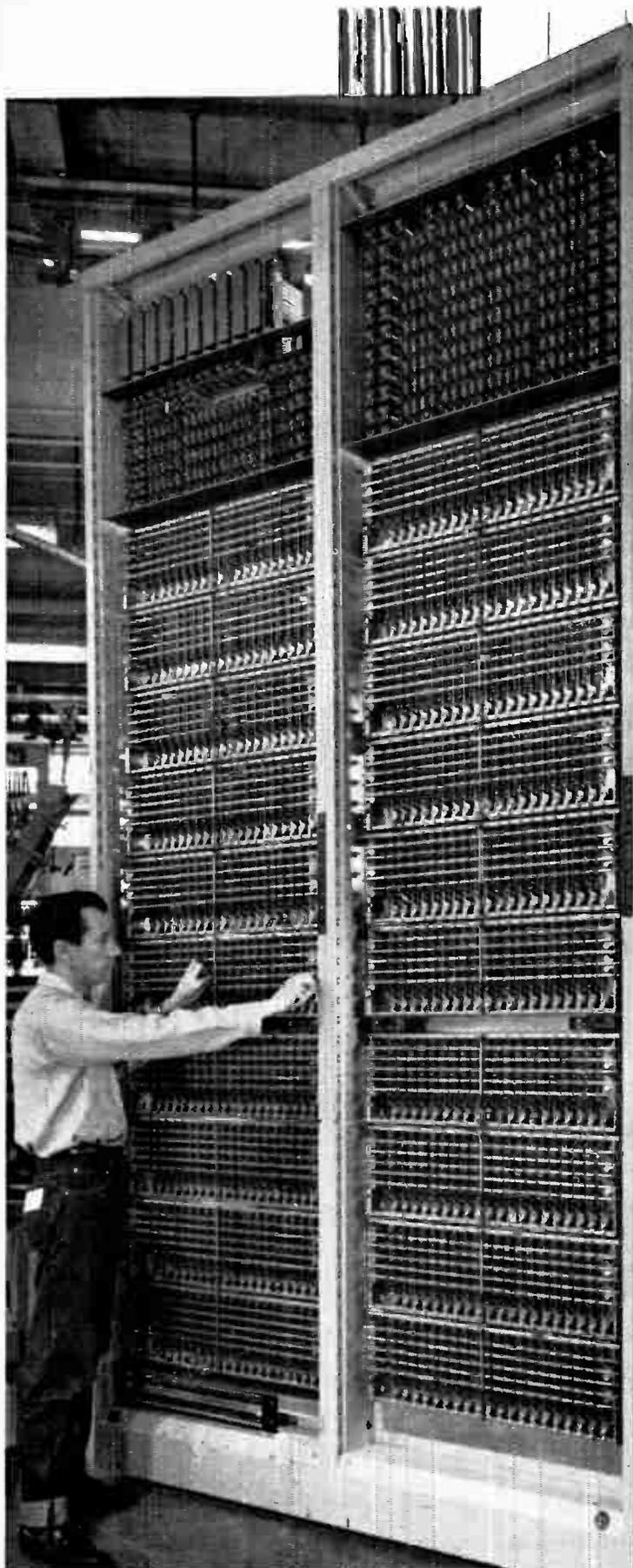
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 Phone CYPress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

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 3 Finch Avenue East, Willowdale, Ontario
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The shortest time between two points

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Northern Electric designs and manufactures a large proportion of Canada's telephones and its related complex equipment. Their extensive and long experience in telephone communication coupled with their modern manufacturing facilities are at your command. Branches are strategically located across Canada to serve your needs.

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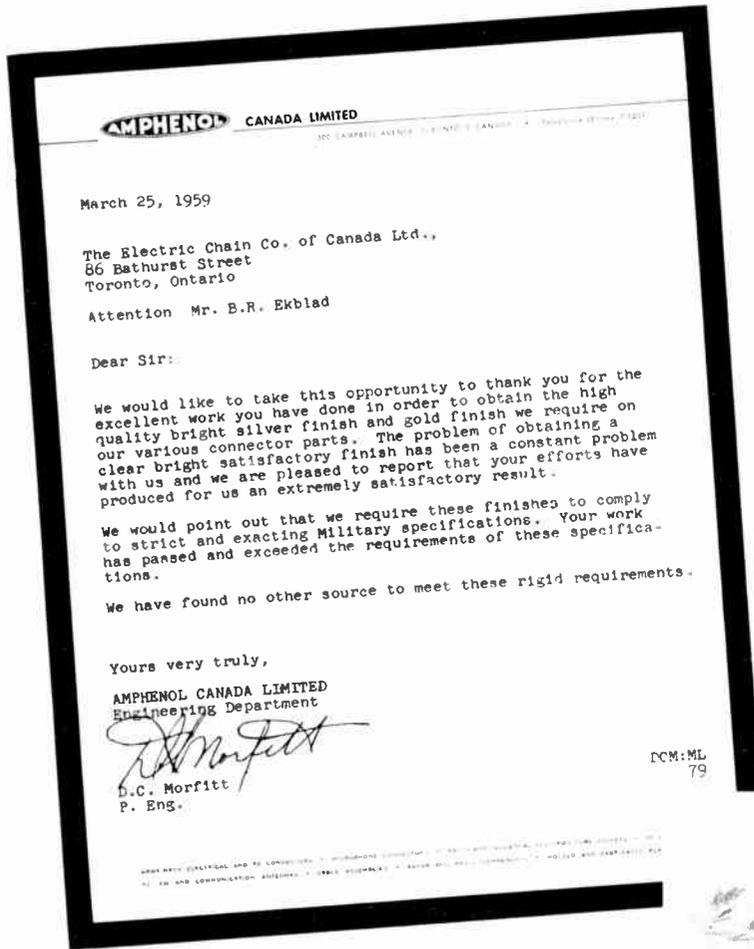
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ELECTRONICS AND COMMUNICATIONS. May, 1959

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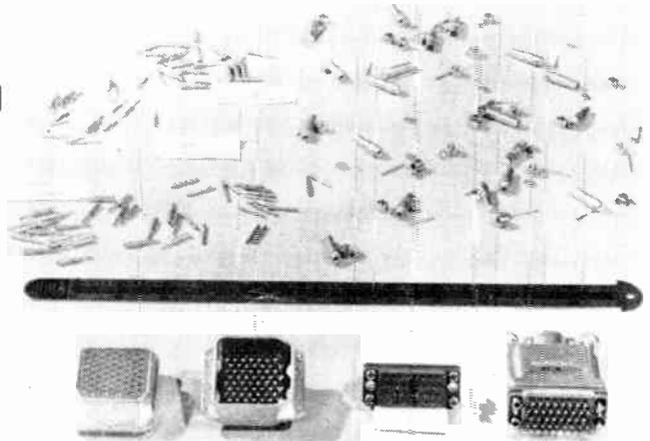
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Compliance with strict and exacting military specifications calls for the use of the very best materials . . . the highest standards of quality. That's why Amphenol Canada Limited specifies SEL-REX "Karatclad" Hard Gold and Bright Silver Plating Processes for the finish required on their Poke Home Connectors. The exceptional testimony given by this leading manufacturer, in relation to the SEL-REX processes, is received with considerable pride by The Electric Chain Company of Canada Limited.

SEL-REX "Karatclad" Hard Gold and Bright Silver Plating Processes are available in Canada through The Electric Chain Company of Canada Limited. We invite your enquiries. Let us tell you more about these remarkable processes . . . how net costs are lower . . . how they have been proved by comparative tests to give unbelievably greater protection than that afforded by any type of conventional plating.

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TORONTO 2B, ONTARIO

For complete details check No. 21 on handy card, page 49

EIA Report

By Basil Jackson, A.R.Ae.S., Tech. M.C.A.I.

EIA All Set for 30th Annual Meeting

Plans are now ready for the 30th Annual Meeting of the Electronic Industries Association of Canada to be held at Bigwin Inn, Muskoka, Ontario on June 18 and 19.

Guest speaker will be J. H. Warren, Assistant Deputy Minister, Department of Trade and Commerce, Ottawa. Mr. Warren will speak on "Current Problems In International Trade" with emphasis on the import problem as it affects the economy.

Recent EIA Meetings

The Board and the three divisions of EIA met during April in Toronto. Various engineering committees and others held meetings prior to the divisional meetings.

EIA Holds Graduation Dinner

Fifteen graduates of the first industry-sponsored night school course on television servicing received their diplomas at a ceremony at the Royal York Hotel in Toronto recently.

Sponsored by the Electronic Industries Association of Canada, the course started last October at the Ryerson Institute of Technology. For practicing television service technicians, it has enabled those enrolled to upgrade their technical education and to learn the latest servicing techniques.

The course just concluded was a pilot course to test the curriculum. Now that it has proved to be successful, the course is being extended to other cities and towns across Canada. This is being done by the formation of local industry/educational advisory groups. This coast-to-coast upgrading of the technical education and servicing experience of practicing TV technicians will raise the standard of servicing across Canada.

Radio Imports Slash Canadian Sales

The grave effects on the Canadian electronics industry by the rapid rise in radio set imports was discussed at a recent Board of Directors' meeting. The problem is now very serious — over 30 per cent of all radio sales made in Canada during 1958 were of imported sets.

DBS figures on radio importation for the past three years are as follows:

IMPORTS OF RADIO SETS INTO CANADA (DBS)

	1956		1957		1958	
	Units	Value	Units	Value	Units	Value
United States	52,737	\$1,610,803	56,735	\$1,522,392	74,822	\$2,400,503
Japan	16,828	136,690	69,233	588,827	155,324	1,843,886
West Germany	5,577	302,489	8,371	498,137	30,474	1,585,479
Netherlands	464	17,873	7,957	177,829	18,570	434,999
United Kingdom	2,733	97,138	4,349	150,354	7,240	223,617

United States TV-Radio Service a \$2.5 Billion Industry

Figures released by EIA of United States show that Americans spent \$2.5 billion on home electronics repair and installation during 1958. This amount included replacement parts, components, tubes, repairs and installation. The 1958 figure was slightly lower than the figure for 1957.

Industry observers think that television service expenditures will increase over the years due to the increase in the number of sets in use and to the increasing life-spans of sets. The average life-span is now about nine years and is expected to average eleven years in the next decade.

Television set designers are reported to be more concerned over "designing for maintenance" than they used to be, providing easier access to components, simplicity of replacement, and making printed circuits easier to check.

EIA of United States Joins CCIR

The Electronic Industries Association of United States was accepted as a member of the Consultative Committee on International Radio (CCIR) at the opening plenary assembly sessions at Los Angeles recently. The CCIR and International Telegraph Union (ITU) are holding radio spectrum allocation meetings this year.

EIA of Canada's Stereo Committee

EIA of Canada recently formed an Ad Hoc Committee on Stereophonic Broadcasting. It is currently studying the proposals made to the American National Stereo Committee, to which eighteen different proposals on stereo broadcasting have already been made.

Newsletter

Canadian Radio Technical Planning Board

WHO'S WHO IN THE PLANNING BOARD

No. 14 — Canadian Electrical Manufacturers Association

The Canadian Electrical Manufacturers Association was formed in 1944 and incorporated under Dominion Charter in 1945. It has in its membership the principal electrical manufacturers in Canada, whose combined output approximates 85 per cent of the total output of the Canadian electrical manufacturing industry. Membership is open to Canadian corporations, firms and individuals engaged in the manufacture of electrical products for sale in the open market.

The objects of the Association, as expressed in the Constitution, include promoting the use of electricity and electrical products, promoting industry standardization and co-operating with Canadian Standards Association in drawing up safety standards, appearing before and co-operating with legislative committees, government departments and agencies, and the collection and dissemination of information on electrical matters both inside and outside the Association membership.

The Association engages in various industry-wide promotional activities through its Market Development Council and The Electrical Bureau of Canada (formerly Canadian Adequate Wiring Bureau).

In the field of standardization, the Association has produced, through its sixty-six groups (Divisions, Sections, Committees and Technical Committees), over eighty CEMA Standards and Specifications covering a diverse range of electrical products. Member company representatives are active on practically all CSA Committees and Sub-Committees on the Canadian Electrical Code and CSA General Engineering Specifications of an electrical nature.

Provision is made for general committees such as the Statistics Committee, Tariff Committee, Traffic Committee and Industrial Relations Committee, among others, to ensure the industry of adequate contact with both public and government. — CEMA.

Recent CRTPB Meetings

The Executive Committee met in Toronto on April 21. Among business on the agenda was the EIA recommendation to the Department of Transport regarding radio frequency allocations for the CCIR and ITU conferences. These recommendations have now been sent to DOT. At the meeting it was noted that the recently-approved CRTPB Constitution and By-Laws had been distributed to all concerned, and that the new organization chart was nearly ready.

The Tropospheric Scatter Committee met on April 17 at the CRTPB office in Toronto.

New Directors for Canadian Overseas Telecommunication Corp.

The Minister of Transport has announced the appointment of N. E. Peter Hardy of Toronto and of Paul Pelletier as directors of the Canadian Overseas Telecommunication Corporation, each for a three-year term.

EIA's Recommendations of Frequency Allocations

The Electronic Industries Association's recommendations on radio frequency allocations, recently transmitted to the CRTPB and sent to the Department of Transport, were the result of special meetings of the chairmen of various EIA engineering committees and the EIA Director of Engineering. The recommendations find no basic conflict with the frequency allocation recommendations made at a CRTPB-DOT meeting in October 1958, although there were minor differences in certain frequency areas.

The EIA recommendations included an expansion of the mobile service into the television broadcasting area and the EIA Microwave Committee had suggested changes in the 590-890 mc. band.

Transatlantic TV Relay Proposed

A transatlantic television relay system has been proposed to link Canada and the United States with Scotland. Financial support has been given by private concerns for a wideband North Atlantic common carrier for the exchange of television programs and civil and military communications.

Preliminary engineering studies have been completed and the project has been discussed with representatives of the government concerned. It is understood that Canadian Deputy Prime Minister Howard C. Green is "intensely interested in the plan and . . . sure it would get high-level support."

Proposed route is from Baffin Island, Greenland, Iceland, the Faeroe Islands, and Scotland, with connections to the rest of Europe. The longest span would be the close to 300 miles from the east coast of Iceland to the Faeroes. Tropospheric scatter techniques are proposed.

Canadian Radio Technical Planning Board
200 St. Clair Avenue West, Toronto 7, Ontario

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R. C. POULTER, Director of Public Relations; F. W. RADCLIFFE, Secretary-Treasurer

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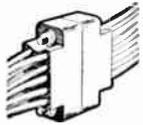
Connectors

Components

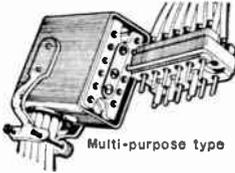
Compression Tooling

FOR SOLDERLESS RELIABILITY

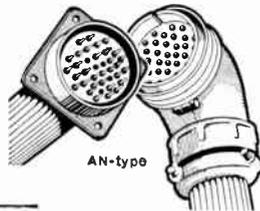
PLUG and RECEPTACLE CONNECTORS



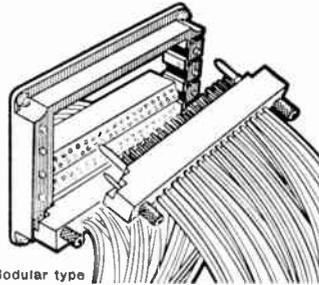
Miniature MS-type



Multi-purpose type



AN-type



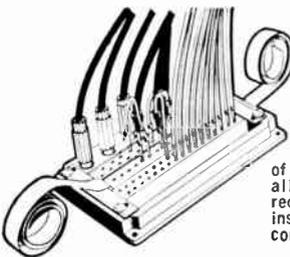
Feed-through, Modular type



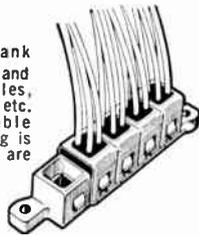
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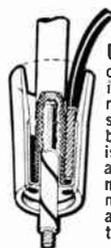


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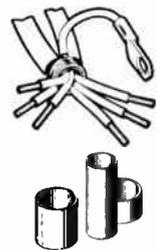
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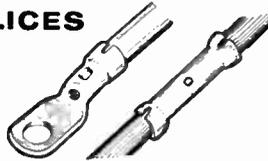
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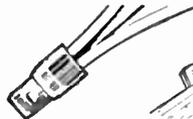


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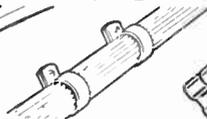


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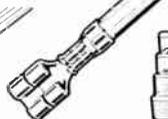
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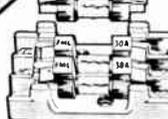
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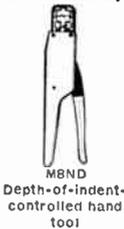


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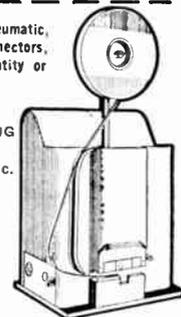


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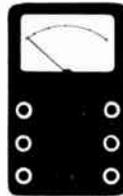
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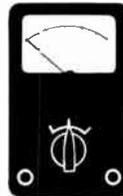
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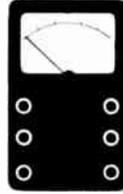
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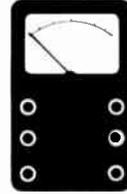
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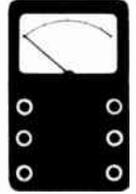
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377	1/2.5/5/10/25/50/100/250/500/1000 D.C. Volts at 1000 ohms per volt
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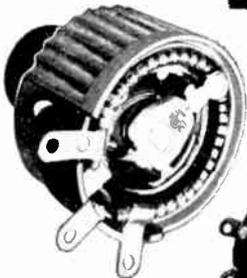
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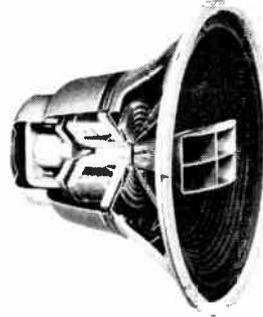
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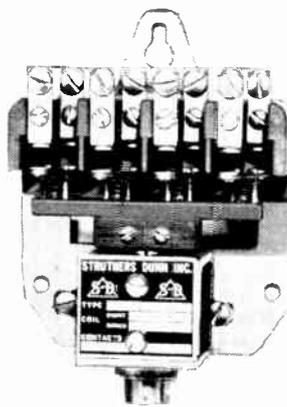
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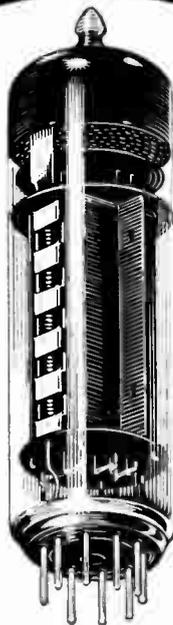
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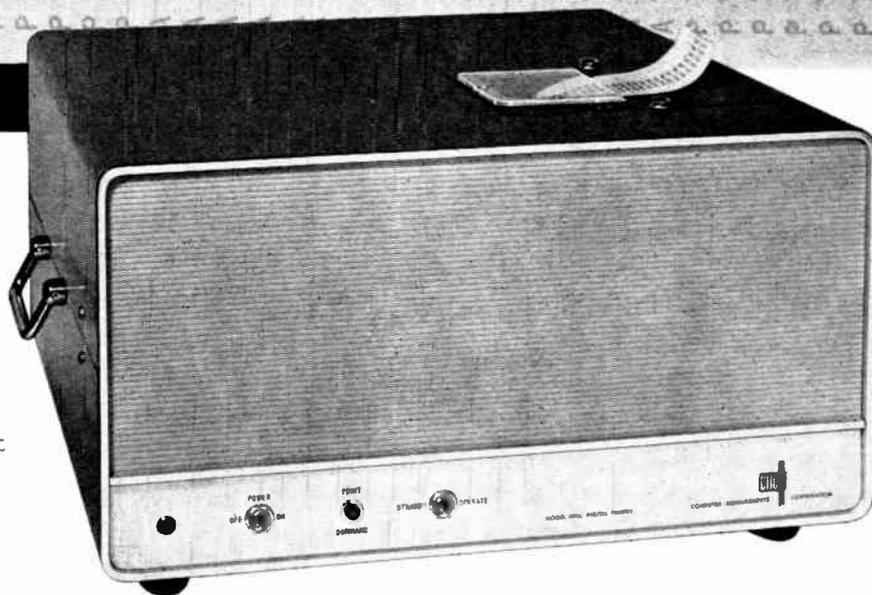
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A design refinement in particle accelerators whereby the ion beam energy can be stepped up as much as four times to increase the utility of such machines in basic nuclear research.

Tandem electrostatic accelerators

by R. J. Van de Graaff, M.I.T.

In most accelerators, the particles are given their energy either by the repeated application of voltage at radiofrequency or by the single application of a constant voltage (DC). The constant-voltage type, to which the electrostatic accelerators belong, has advantages in precision and flexibility, but on the other hand is limited to relatively low output energies, because in its conventional designs the voltage can be applied only once to the acceleration of the particle beam.

However, the principles of tandem acceleration make it possible to apply the constant voltage either two, three, or four times to the accelerated ion beam, thus correspondingly increasing positive-ion output energy, while retaining the precision and flexibility associated with constant-voltage acceleration. Also, in tandem accelerators, the output energy for medium-weight particles can be increased many fold by the stripping of electrons from the ion beam. Another gain by the tandem design is the complete accessibility of the ion source and beam-injection equipment, these being located at ground potential and outside the high-voltage generator.

Two-stage tandem accelerators

In the case of the usual type of electrostatic accelerator, positive ions are produced inside the high-voltage terminal and then accelerated to ground in one stage of acceleration. In the case of a two-stage tandem accelerator, negative ions are produced at ground and then accelerated to a high-voltage positive terminal. Within the terminal, the swiftly moving negative ions are stripped of electrons, thus becoming positive ions, which then receive an additional acceleration from

the terminal to ground. Since the particle beam receives two stages of acceleration instead of one, the device may be called a two-stage tandem accelerator.

The principles and techniques used in tandem accelerators have been originated and developed during a long period of time and in various laboratories. It is regretted that lack of space prevents full acknowledgments here. However, reference should at least be made to the following names: Dempster, Bennett¹, Kaufman, Alvarez², Marshall, Woodyard, Herb, Stier, and Danforth³.

- ¹ W. H. Bennett and P. F. Darby, *Phys. Rev.* 49, 97, 422, 881 (1936).
- W. H. Bennett, U.S. Patent No. 2,206,558 (1937).
- W. H. Bennett, *Rev. Sci. Instr.* 24, 915 (1952).
- ² L. W. Alvarez, *Rev. Sci. Instr.* 22, 705 (1951).
- ³ J. L. Danforth, *Can. Electronics Eng.* (July 1958).

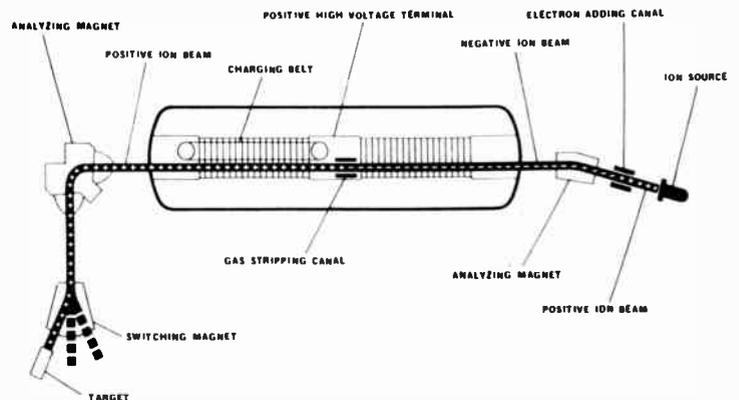


Figure 1 — Two stage tandem accelerator

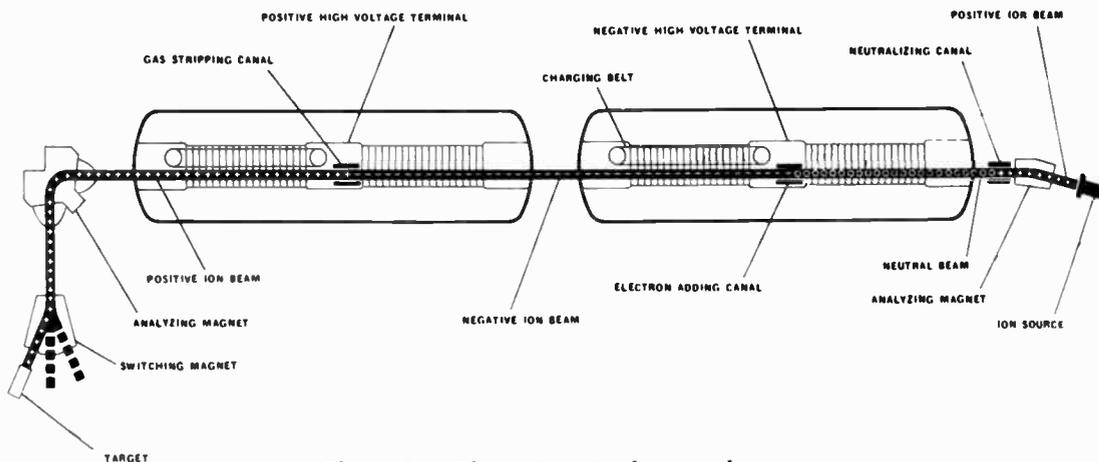


Figure 2 — Three stage tandem accelerator

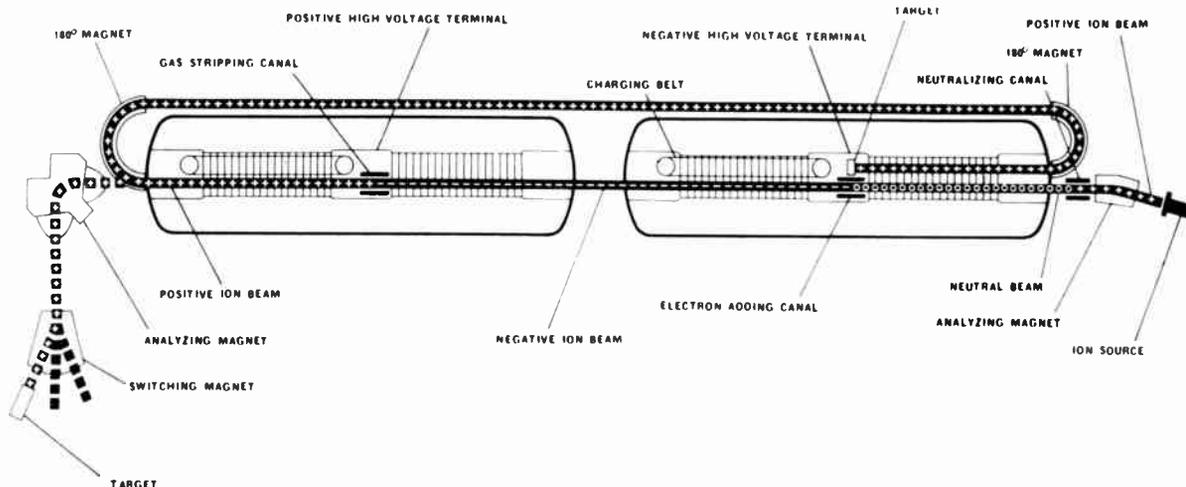


Figure 3 — Four stage tandem accelerator

The principles of operation of a two-stage tandem accelerator may be seen in more detail from the diagram in Figure 1. The positive-ion beam from the ion source at the right passes into the electron adding canal. A flow of hydrogen in this canal causes the successive attachment of two electrons to some of the positive ions, thus transforming these into negative ions. The negative-ion beam is then deflected slightly by an analyzing magnet, so that negative ions of the correct mass and energy are caused to proceed along the axis of the main vacuum tubes, and thus to be accelerated to the terminal which is at a high positive voltage. There the negative-ion beam passes into a second canal, where the presence of gas causes it to be stripped of its electrons, so that it emerges as a positive-ion beam and is then given its second acceleration which brings it back to ground. The positive-ion beam is then deflected through a 90° analyzing magnet before proceeding through a switching magnet, where it can be directed to any one of three targets.

A two-stage tandem accelerator has been constructed by the High Voltage Engineering Corporation for the Chalk River Laboratory of the Atomic Energy of Canada Limited. This machine, which is housed in a pressure tank eight feet in diameter and 35 feet long, has now been reassembled at Chalk River. In the tests of the accelerator before shipment, proton beams up to 13.4 Mev were obtained, corresponding to a terminal potential of 6.7 megavolts. After 90-degree analysis, a proton beam of 1.5 microamperes was focused on the target over a wide range of voltage. Quite recently proton beams up to seven microamperes have been obtained in the initial tests of a second tandem accelerator.

Measurements on proton beam after deflection by the 90-degree magnet, showed that it was homogeneous in energy to ± 0.02 per cent. In some of the tests, negative oxygen ions were injected into the accelerator. When the terminal was at four megavolts, observations at the target showed that some of these negative ions were completely stripped in passing through the terminal, thus reaching an energy of 36 Mev. Before shipment of the accelerator to Chalk River, some neutron threshold measurements⁴ were made in the proton energy range from 1.8 to 10.5 Mev.

Some possibilities for future development

An important feature of the tandem design is that the ion source and initial accelerating and focusing arrangements are situated outside the pressure tank, rather than inside the terminal and tank, as in the usual type of electrostatic accelerator. This external location will greatly facilitate the future development of improved ion sources and injection. It also affords ample space and accessibility for the possible introduction of various new injection devices such as multiple-ion sources, apparatus for the polarization of particle beams and equipment for beam pulsing.

Let us now turn to the consideration of future possibilities for the attainment of higher particle energies by tandem acceleration. Obviously, one method is by the use of higher terminal potentials. At present the ceiling in this direction is represented by the ONR accelerator at M.I.T., built by J. G. Trump, and used since 1951 by W. W. Buechner for nuclear research at

⁴ H. E. Gove, J. A. Kuehner, A. E. Litherland, E. Almqvist, D. A. Bromley, A. J. Ferguson, P. H. Rose, R. P. Bastide, N. Brooks, and R. J. Connor, Phys. Rev. Letters, 1, 251 (October 1958).

Figure 4

POSITIVE ION	TWO-STAGE	THREE-STAGE	FOUR-STAGE
Hydrogen	13.4	20.1	26.8
Helium	20.1	26.8	40.2
Oxygen	60.3	67.0	120.6

POSITIVE-ION ENERGIES IN MEV for Three Different Arrangements of Tandem Accelerators

Assumption: Terminal potential = 6.7. megavolts.
Complete stripping of positive ions.

terminal potentials up to 10 megavolts. It is to be expected that in future accelerators there will be continuing increases in the terminal potentials attainable, due not only to growth in the size of accelerators but also to continued progress in high-voltage techniques which will make possible the insulation of still higher voltages in a given size of accelerator.

A more radical method of seeking higher tandem particle energies is by the use of more than two stages of acceleration. Figure 2 shows a diagram of a possible arrangement for a three-stage tandem accelerator. The positive-ion beam from the ion source at the right is deflected by an analyzing magnet so that the desired positive ions are directed along the axis of the acceleration tubes. In the neutralizing canal these positive ions encounter an amount of hydrogen which, though relatively small, is nevertheless sufficient to cause the attachment of a single electron to most of the positive ions, thus producing a beam of neutral particles which proceeds to the negative high-voltage terminal. In passing through the electron-adding canal situated in this terminal, some of the neutral particles capture an additional electron and become negative ions. These then receive their first main stage of acceleration in passing from the negative terminal to ground, where they are injected into the second pressure tank as a negative-ion beam of considerable energy. In this tank, the beam receives its second and third stages of acceleration.

The operation in this tank is quite similar to that shown in the tank in Figure 1, except that in Figure 2 the injected negative ions are about 100 times more energetic and are correspondingly more homogeneous in energy, so that they can be focused with great accuracy through the stripping canal in the positive terminal.

It is evident that an alternative arrangement for a three-stage tandem accelerator would be to have the complete apparatus for producing the negative ions installed within the negative high-voltage terminal.

However, the use of a neutral particle beam, as indicated in Figure 2, appears more promising, as it would make it possible for the particle injector to be external and at ground, a situation having enormous long-run advantages, some of which have been already mentioned. Obviously such use of a neutral particle beam is practical only if the associated particle scattering is quite small. Some encouraging experimental observations in regard to the scattering effect have been made both at HVEC⁵ and M.I.T.⁶

Figure 3 shows how a four-stage tandem accelerator could be made by the addition of two 180° deflecting magnets and an additional section of acceleration tube, the target being located inside the negative high-voltage terminal.

Figure 4 is a table showing possible positive-ion output energies for hydrogen, helium, and oxygen. It is for three different tandem arrangements. The table is based on the assumption of a 6.7 megavolt terminal potential and on complete stripping of positive ions.

In the case of the four-stage tandem it is obvious that the inaccessibility of the target is a serious disadvantage. However, the effect of this difficulty could be much reduced by the development of special techniques and devices. It thus appears possible that four-stage tandems may later find usefulness for certain types of research needing mono-energetic positive ions in an energy range somewhat higher than otherwise available.

Nuclear research is a most promising field for tandems. It appears possible that, even with a three-stage accelerator, sufficient particle energies could be attained for very effective bombardment of even the heaviest atomic nuclei. The precision and flexibility of constant-voltage particle acceleration would thus be made available for nuclear investigations throughout the periodic table.

⁵ P. H. Rose (unpublished).

⁶ S. F. Philp, Doctorate Thesis, M.I.T. (1958).

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In the short 12 years since the first experiments in numerical control of machine tools were carried out at the Lincoln Laboratories of the MIT, this automation technique has become one of the largest single contributions toward cost reduction in the metalworking industry.

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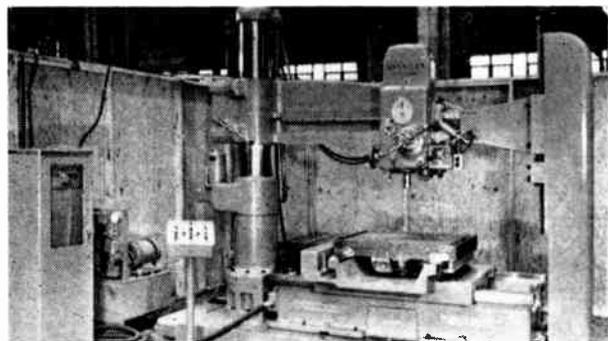
This control system accepts dimensional information from standard 1" eight channel tape which is prepared on any standard tape preparation equipment, such as the Frieden Add-Punch machine for example.

This tape replaces the usual jigs or fixtures and is inserted in the tape reader seen in the control cabinet.

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tion with the actual position of the machine table as indicated by the transducers. The difference between command and actual table position is referred to as the error signal, and this error signal is amplified and used to operate a hydraulic valve which drives a piston. The valve drives the piston until the error signal disappears, and table position coincides with the command.



This American Tool Works' table is tape controlled and automatically positions work under the drill with an overall accuracy of better than ± 0.0005 ".

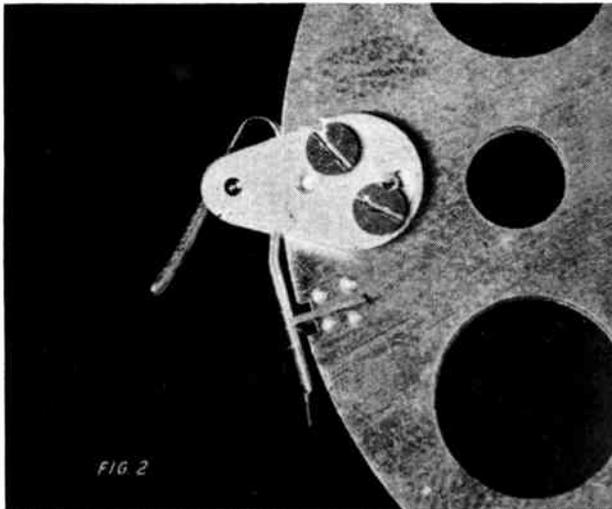
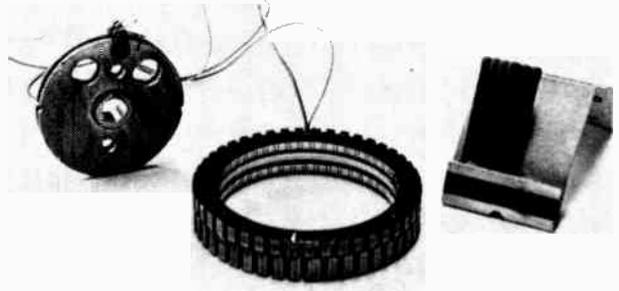
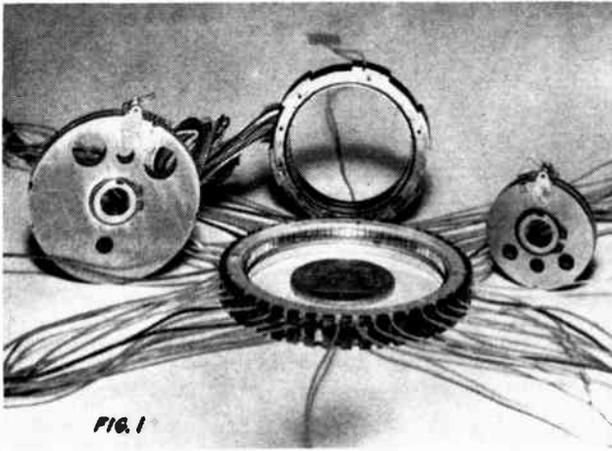


Fig. 3

Fig. 4



When adequate test information is available early in a program, customers are assured of satisfactory operation of . . .

Miniature low level telemetering commutators

by Charles A. Logan*

Some five years ago, the Instrument Development Laboratories undertook to develop its first rotary switch. It is a rather simple switch by today's standards, being a 3-pole 12-channel, 10 RPS unit with liberal contact resistance and permissible brush bounce specifications. IDL had some background experience with slip ring and commutators due to commercial and military products, but compared to the knowledge and

techniques that are available today, it would appear to be incidental.

Since the development and production of the first type of rotary switch, many different and varied switches have been considered and designed. In general, the number of channels and rotor speeds have agreed with Telemetering Standards, the highest number of samples per second being 900. This maximum number of samples per second are obtained by sampling 30 channels, 30 times per second; 45 channels at 20 times per second; or 90 channels at 10 times per second.

* Director of the Product Development Department, Instrument Development Laboratories, Inc., Attleboro, Massachusetts.

Other combinations will give the same result, but these are the more common.

The initial wafer was designed to have a 1½" bore which lent itself well to 30 break before make contacts with duty cycles of up to 80% ON time, or 60 make before break contacts. Gear box and motors are designed interchangeably to provide common switching rates of 900, 600, 450, 300, 150, and 75 samples per second. When customer requirements increased to 45 and 90 break before make channels per pole, the 1½" bore wafer was not suitable due to the higher angular tolerances that would have to be held and the narrowness of the dead segments in comparison to the length of the brush foot. A 50% increase in bore of the wafer was sufficient to permit realistic angular tolerances and dead segment lengths. Forty-five contacts with a 70% ON time duty cycle is possible in a single wafer section at this diameter. Figure 1 is a comparison of the 1½" and 2¼" bore wafers. Also included are the respective balanced brush assemblies showing the fully pivoted jeweled brush suspension. Figure 2 is a close-up of the jeweled brush suspension. If these switches may be compared to fine watches, the simpler 3-pole switches contain 12 jewels, and the more complex, upwards of 24 jewels. Figure 3 is a variation of the 2¼" bore wafers with which 90% BBM duty cycles are obtained in either 45 or 90 channels per pole.

To trace the evolution of switch designs, Figure 4 shows various models of rotary switches, telemetering switches, and others destined for use in pulse, amplitude, pulse duration and pulse width modulation systems. All of these switches use the 1½" bore wafers. Figure 5 shows the first switch design using the 2¼" bore wafers. This switch is a 4-pole unit with two poles having 90 contacts and a 10 RPS rotor speed and two poles being 45 contact with a 20 RPS rotor speed. This two-speed application was accomplished by mounting two brushes with 180° separation, thus effectively doubling the rotor speed, and wiring a 90-channel wafer as two independent 45-channel wafers. Using the same basic design approach as in the 1½" bore switches, the physical size of the switch increased proportionally.

Miniature commutator design

The desire of customers for minimum volume and weight necessitated serious redesign considerations. From these considerations emerged the company's Miniature, Low Level Commutator. Figure 6 is a picture of this switch. Outside dimensions are 3¼" height, 3⅜" wide, and 3¾" long. The capabilities of this switch are as follows:

1. Rotor speeds of 10, 20, and 30 RPS are available, the rotor being driven by a capacitor split phase, hysteresis synchronous motor.

2. Up to 4 poles are available with 90, 45, or 30 contacts per pole.

3. Multiple pole speeds are available; that is, it is possible to have a 90-channel, 10 RPS pole; a 45-channel, 20 RPS pole; and a 30-channel, 30 RPS pole within the same envelope with no increase in size.

4. Typical timing specifications for the 90-contact, 10 RPS rotor speed are that leading edges of adjacent channels within a pole may be held to the nominal 1,111 microseconds to better than ±50 microseconds. Phasing of leading edges of channels from pole to pole may be held to better than ±100 microseconds. The tolerance for the 45-channel, 20 RPS rotor speed is better than ±25 microseconds within a pole, and better than ±50 microseconds from pole to pole. To achieve these accuracies mechanically, it is necessary to main-

tain tolerance accumulation on 182 critical dimensions from exceeding ±.007".

5. A magnetic pulser is available on the 45-contact, 20 RPS units in lieu of a trigger pole if desired. The pulser output is 1 volt peak to peak when working into a 1,500-ohm load with a pulse width of 120 microseconds. Pulse to pulse time is held to ±25 microseconds and is not accumulative. Phasing of the pulser to the channels is arbitrary to customer specifications.

Now that some of the operational capabilities of this new switch have been given, let us consider the design of the switch to see how the reduction in size has been accomplished. Later we will return to some of the environmental and electrical tests that the switch has been subjected to.

The basic reduction in size was accomplished by positioning the motor within the switch rotor. Figure 7 shows the rotor. On this rotor you will note the landed rotor for the magnetic pulser, the metallic balanced brushes in their jewel pivots, the bearing seat, a ring gear which is a 64-pitch, 160-tooth gear, and the clearance cavity into which the hysteresis synchronous motor is inserted.

Figure 8 is a view of the wafers stacked into the barrel casting as well as the wires terminated to the header. Teflon insulated wire is used throughout the switch. On the side of casting are small ports by which

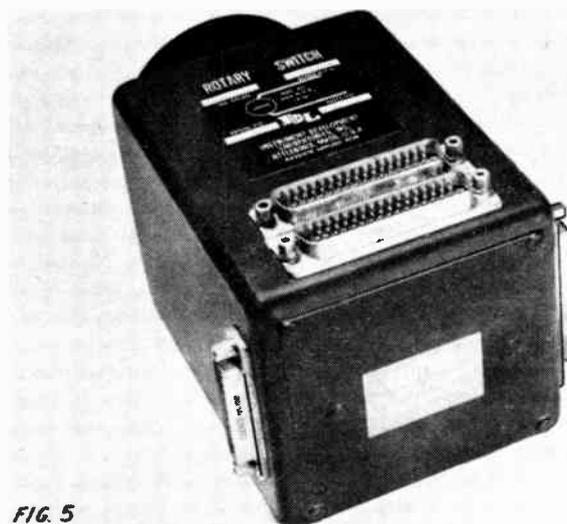


FIG. 5

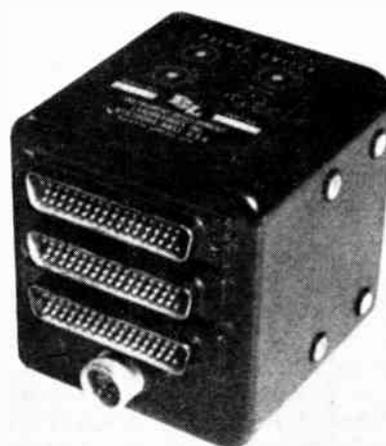
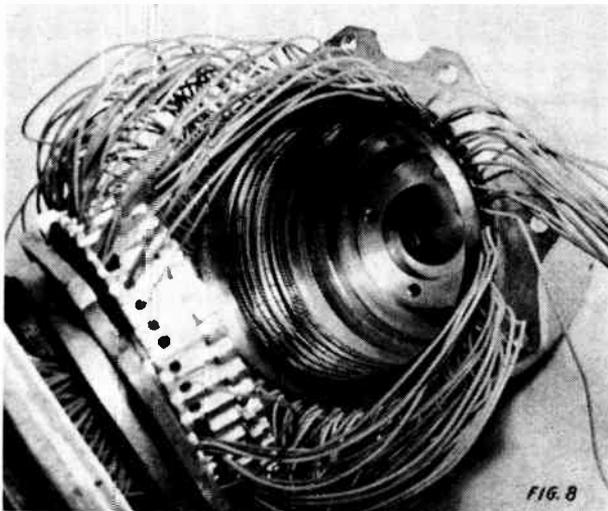


Fig. 6



Fig. 7



LOW IMPEDANCE NOISE TEST

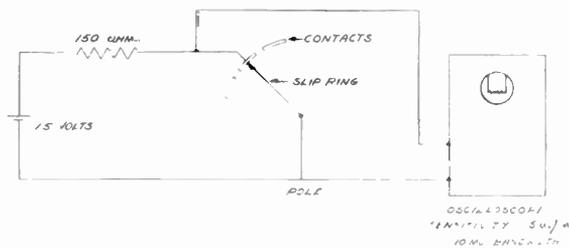


Fig. 9

THERMOCOUPLE TYPE NOISE TEST

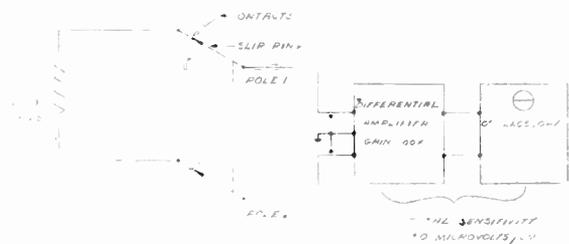


Fig. 10

phasing adjustments between poles are made. Set screws are inserted after phasing to lock the poles in place. The other parts shown in this illustration are a lead-wire spreader and bearing cap which supports the rear of the rotor.

The motor and rotor are inserted into the opening shown. The motor is piloted and retained on the rear face of the casting, and the rotor with the brushes retracted by a special tool, pilots into the I.D. of a ball bearing inner race, already inserted at the back of the barrel. Motor heat is dissipated by metallic contact of the motor onto rear face of the barrel, and thence to the outer case of the switch. The slip ring closest to the opening is for rotor grounding; its brush is therefore soldered to the rotor.

Aluminum parts have been used as much as possible to minimize weight.

The gear train, consisting of the motor pinion, idler, and the rotor ring gear, is located at the rear of the barrel casting. It is in essence a planetary system.

The motor for this switch is a 400-cycle, either 8 or 12,000 rpm, capacitor split phase hysteresis synchronous type. The capacitor is mounted internal to the switch. Power consumption is 15 watts starting, and 8 to 10 watts operating.

Some of the environmental tests the commutators have been subjected to are as follows:

Vibration

The commutators have been subjected to the vibration spectrum along each axis of MIL-E-5272A, extended from 500 to 2,000 cps at 10 g's. In addition, to meet a particular customer specification, the commutators were subjected to 40 g's from 200 to 500 cps along each axis.

Operationally, the switches have performed satisfactorily throughout the vibration spectrum with no evidence of noise, brush bounce, loss of signal, or other erratic behavior that could be attributed to the vibration amplitude or frequency. Initially some difficulty was experienced with an overstressed rotor loading washer which resulted in rather severe noise above 10 g's at certain frequencies. When this was corrected, the switch design was found to be basically sound for withstanding vibrations of this magnitude.

Temperature

The commutators have started and operated satisfactorily in ambients of 32°F to 167°F. Tests are underway to determine switch operation at 125°C. Insufficient tests have been run at -55°C to determine the permissible satisfactory operating range for a unit that must start and operate satisfactorily at this temperature.

Since dissipation of motor generated heat was of major concern, tests were conducted to determine the temperature rise within various parts of the switch when operating in an ambient of 170°F. Temperature indicators were placed on the outside of the motor, on the rotor, on the I.D. of the wafers, on the barrel casting, and in several places within the switch case. The maximum temperature rise was found to be at the motor shell and amounted to a 30°F above the ambient of 175°F. No other point within the switch had more than a 20°F rise above ambient. During these tests, the switch was mounted on a 6" by 6" aluminum plate 1/4" thick.

Life

IDL experience with other switches indicates a

guarantee of 500 hours service free life can be achieved. Our life tests to date (June 1958), have extended approximately 200 hours, at which time, in several instances, fretting corrosion of the motor shaft has been the sole cause of failure. One remedy for this situation is to reduce motor speed from 12,000 to 8,000 rpm. Other techniques are being worked out to correct the situation with both the ball bearing and motor manufacturers. The commutating section consisting of wafers and brushes have been tested in excess of 500 hours without deterioration. With the fretting corrosion problem under control, the switch will demonstrate 500 hours service free life.

Atmosphere

Because the unit is hermetically sealed with a military approved finish, sand, dust, rain, humidity, etc., are not serious considerations. The hermetic connectors are, however, subject to the usual altitude conditions. In most applications, the motor excitation voltage is 115 volts, 400 cycles, and when adjacent pins are used, the altitude limitation is about 80,000 ft. By separating the excitation pins, higher altitudes are permissible.

Operationally, the design of the commutator is such that either hi level, 0 to 5 volts, or low level, in the millivolt range, may be sampled by any pole of the commutator. IDL uses one noise circuit to determine brush contact resistance and another to test minimum noise when the unit is destined for use in thermocouple circuitry.

The first noise circuit is shown in Figure 9 and is known as the low impedance noise test. An oscilloscope with a sensitivity of 5 millivolts per centimeter is used to monitor the variations in brush resistance. Ten milliamps flow in the circuit when the slip ring passes over the contact, thus 0.5 ohms dynamic brush resistance is equivalent to 5 millivolts, which is easily read on the oscilloscope. Normal brush contact resistance is approximately 0.2 ohms.

Secondly, for low level, low impedance, transducers, such as thermocouple applications, the circuit shown in Figure 10 is applicable. In this circuit, both sides of the transducer are switched through poles which have been phased in line. A simulated impedance of 200 ohms is used to represent the transducer. A

differential amplifier is shown to reduce common mode interference. Some tests have been run with a single channel amplifier grounding one of the slip rings with the result that, in both cases, the noise generated is approximately 20 to 30 microvolts. Considerable care is taken to shield the leads adequately. Both sides of the motor excitation were floating during these tests.

The results on the noise tests were very encouraging, particularly in this new design wherein the motor is placed within the wafer structure. A series of tests were run prior to the switch design to test the degree of magnetic or electrostatic voltage that might be coupled into the wafers. The tests showed that magnetic coupling was immeasurable, and that electrostatic coupling in the millivolt region was present which could be reduced to a negligible quantity by an electrostatic shield. In the commutator, this shield is the rotor itself as connected to the very effective grounding slip ring that was pointed out in Figure 8.

Conclusion

The factors discussed in this article are those most important in the design and application of IDL's Miniature Commutator in particular, and the company's standard switches in general. The primary object being to permit a better understanding and appreciation of the characteristics of this type of telemetering commutator, as well as an insight into this particular design.

The importance of transmitting realistic and concise operational information to IDL early in a program cannot be too strongly emphasized. The project engineers responsible for the execution of prototype or product commutators welcome the receipt of this material in order that the commutators will undergo realistic operational tests prior to shipment.

The company's standard noise tests were arrived at after consideration of many customer specifications. They do not supersede specific customer specifications, but they are in general more rigid and usually result in customer satisfaction. The switches are subjected to specific test conditions when they are available. Thus, when adequate test information is available early in a program, the customer is assured that a satisfactory commutator will be delivered on schedule.

Electronics serves management labor relations

A novel method of keeping management and foremen up to date on union proceedings has been devised and put into use by Massey-Ferguson Limited. The system was designed and engineered by the Tandberg Division of Engineered Sound Systems Limited, in co-operation with the Bell Telephone Company of Canada.

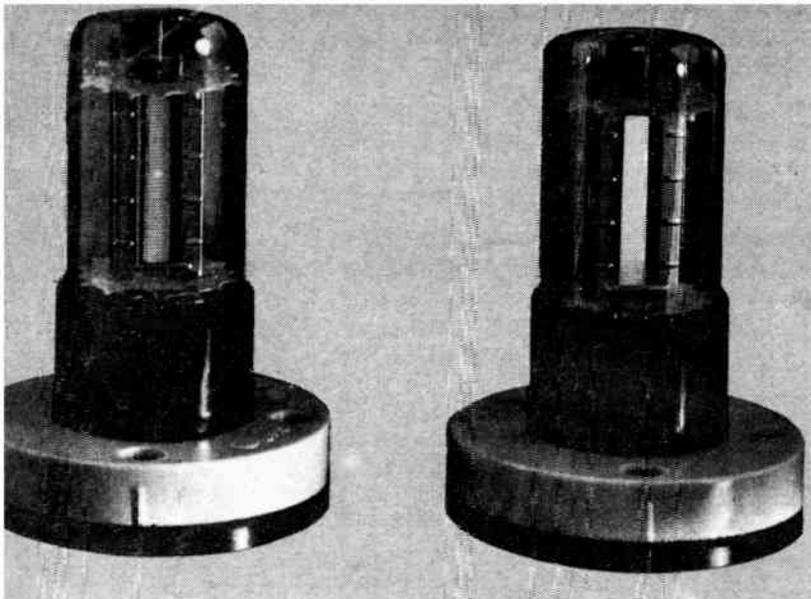
It consists essentially of a Tandberg Model 2F Tape Recorder, the stop, start and rewind functions of which can be remotely controlled, a special relay panel designed for this specific application by the Bell Telephone Company and six specially designated jack circuits on the local telephone switchboard.

Pertinent details and high points of previous days'

union proceedings are summarized into a three to five minute report, which is recorded on an endless tape loop and installed on the Tandberg Recorder each morning.

Upon receiving a call from any one interested in hearing the latest details concerning the union activities, the telephone switchboard operator has up to six circuits available into which she may connect the caller. The tape recorder starts immediately and continually repeats the prerecorded message as long as there is a patch cord plugged into any one of the six special jacks.

Massey-Ferguson report that this system has proven very satisfactory, and they say will be used again during the next round of management-union negotiations.



Cold cathode and hot cathode audio amplifier tubes, such as might be found in a hi-fi set, operate side-by-side. The outside plates have been removed to show difference in luminescent glow of new tube shown at right from older type tube (left). This glow is directly proportionate to electron emission and the uniform glow shown indicates stable cathode emission.

A new tube which approaches the transistor in power economy and even surpasses it in some other respects is seen as a major step toward new and more effective devices for our defense.

An MgO cold cathode electron source

by Dr. D. Dobischek*

A radically new cool-running radio tube, considered the first major breakthrough in basic tube design in more than 30 years, glows blue instead of red and uses less than one-tenth the power of a standard tube. Developed jointly by the U.S. Army Signal Corps and Tung-Sol Electric Inc., it is considered that the tube could have as great an impact on electronics as the discovery of the transistor.

The new "cold cathode" tube operates on an entirely new principle discovered by Dr. Dietrich Dobischek of the U.S. Army Signal Research and Development Laboratory, Fort Monmouth, N.J. It could be the forerunner of a new line of general-purpose tubes for broad military and civilian use.

Early reliability tests indicate the tube may well outlast any equipment in which it is used. This means future radios and TV sets equipped with cold cathode tubes may rarely if ever require tube replacement.

The cold cathode principle is believed adaptable to almost all types of electron tubes, including TV screens, giant radar and transmitting tubes, as well as nearly all general-purpose radio tubes. Miniature and sub-miniature tubes, which could rival the transistor in size, are also feasible.

It could also create a revolution in tube design by making possible the first reliable "secondary emission multiplier" — potentially the world's highest gain amplifier tube. The device would allow design of simplified miniature circuits, more efficient than today's bulkier units. Until now, though, this type of tube has always failed because the hot cathode contaminated other elements in the glass envelope. By eliminating

the hot cathode, the new tube solves this problem, and test models are under design.

Ordinary tubes, ever since their invention, have required a hot cathode element to generate needed electrons. But this heating takes a large percent of the power and forces the use of more complicated circuits or extra batteries. In the new tube, the hot element is replaced by a cold cathode — a tiny nickel cylinder specially coated with porous magnesium oxide (chemically identical to dried milk of magnesia). Instead of heat, a high voltage field causes the electron flow, which in turn produces the tube's characteristic phosphorescent blue glow.

This reaction requires a barely perceptible amount of electricity. A cold cathode tube can idle on 5 millionths of a watt, a tremendous saving over standard tubes. And future designs should be even more efficient.

The new tube also springs to life as soon as it is turned on, while an ordinary tube requires several seconds for warm-up.

Like the discovery of vulcanization and the X-ray, the new tube principle was uncovered by accident. While experimenting on field-enhanced secondary emission, Dr. Dobischek noticed that one of his experimental tubes kept running even though he turned off the primary current. After years of research at the Army Signal Corps Laboratory's Techniques Branch, he perfected a surface that would continue to emit electrons indefinitely.

The first models of these revolutionary tubes were demonstrated by being put to work in a high fidelity record player and a public address system.

The Army sees the discovery as leading to even

* U.S. Army Signal Research Development Laboratory.

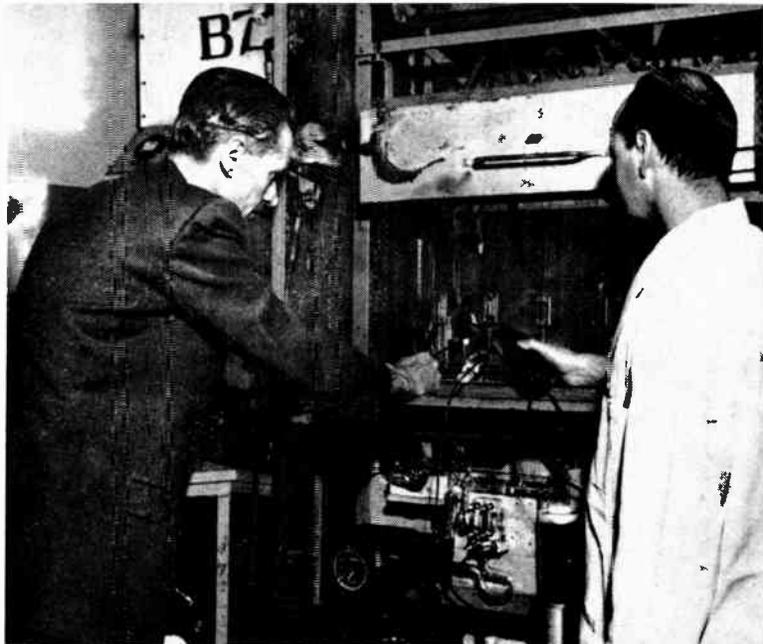
smaller, faster-acting walkie-talkies, and simplified design of other communications gear where the heat generated by conventional tubes poses serious problems.

The new tube is extremely resistant to heat and atomic radiation, important in military equipment which must withstand exposure to a nuclear blast or the searing heat of a missile nose-cone.

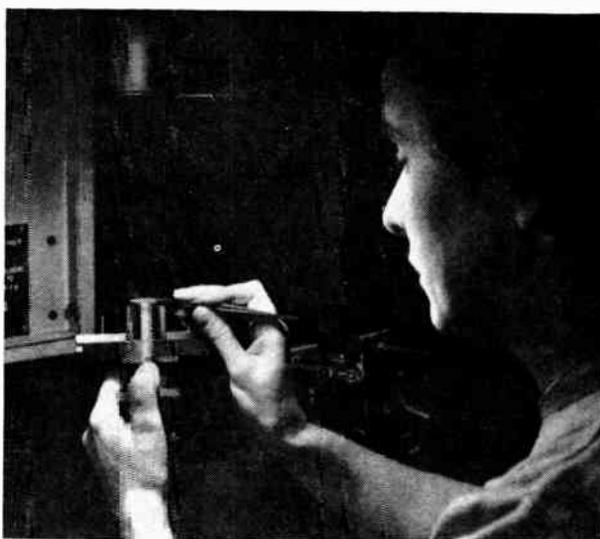
History and mechanism of the MgO cold cathode

The MgO cold cathode is an electron source which is based upon a unique electron emission phenomenon. This phenomenon was discovered at the Signal Corps Research and Development Laboratory, in the course of a study of the field-enhanced secondary emission from MgO. In these experiments, thin MgO layers were deposited on a nickel base and bombarded with electrons possessing sufficient energy to produce secondary electron emission from the MgO. The secondary electrons were collected at a nearby collector electrode, as commonly practiced in secondary emission studies. Once when the primary electron beam bombarding the MgO surface was turned off with the voltage still applied to the collector electrode, the surprising observation was made that the MgO layer continued to emit electrons without any external stimulus. Neither heat, as required for the operation of a standard thermionic cathode, nor external light, as required for the functioning of a photocathode, was necessary to keep alive the emission current from the MgO. By varying the voltage at the collector electrode, this self-sustained current could be controlled easily for many hours from a few microamps to several tens of milliamperes. It was natural that the discovery of this novel and interesting electron emission effect stimulated further exploration of the phenomenon for both theoretical and practical reasons.

It was soon discovered that the ability of the MgO to render self-sustained electron emission was extremely dependent upon the methods of preparing the MgO layers. Therefore, the prime effort was directed towards the development of suitable preparation techniques. The early methods, using vacuum techniques primarily, yielded highly emissive MgO coatings, thus strengthen-



Checking the vacuum on the exhaust machine.



Making the final mechanical assembly of the cold cathode tube.



(Above) Engineers check the mechanical tube dimensions against drawings.

(Right) Welding the assembled tube and checking its operation are carried out simultaneously.



ing the desire for practical use of these coatings as useful cathodes. However, the methods were inconvenient for large-scale production of the cathodes. Furthermore, the reproducibility of the results was unsatisfactory. Yet, during this phase of the work, much was learned about the basic requirements for obtaining layers with good emission qualities. For instance, it was recognized that a certain type of porous structure of the cathode coatings was very important for obtaining maximum emission yields. Heat treatment of the MgO coatings in O₂ was found to be an essential factor for the development of the self-sustained emission phenomenon. The damaging effects of moisture were detected, and many other pieces of helpful information were gradually accumulated. With all this knowledge attained, a simple technique was finally developed which was suitable for large scale production of efficient and reproducible MgO cathodes. This technique was then further improved, and the resulting cathodes were successfully employed in electron tubes under a Signal Corps contract with Tung-Sol Electric Inc.

A few concluding remarks on the concept of the mechanism of the self-sustained emission from MgO as it presents itself to date should be mentioned. From experiments done thus far, it is known that when the

emission is started from an MgO cold cathode, a positive charge is developed at the surface of the MgO layer. Since the cathode coatings are very thin, a high electrical field is created across the coatings. It is assumed that under the influence of this high electrical field, electrons liberated within the MgO are multiplied by an avalanche process, and gain sufficient energy to leave the MgO and enter the vacuum. The liberation of the electrons which initiates the avalanche, is tentatively assumed to be the result of a photoelectric effect in which photons are ejected during the recombination of positive ions with electrons. This concept of the self-sustained emission can be considered at present only as a first approximation in explaining the self-sustained emission phenomenon. Further proof of the validity of the basic theory is needed, and many details have to be clarified in future work. Experiments in this direction are under way, and it is felt quite strongly that the further exploration of the more fundamental problems will be rewarding in many respects. Not only will each piece of information on the mechanism of the self-sustained emission greatly aid in making the best use of the MgO cold cathode, but a better insight into the fundamentals might also lead the way to materials even more suitable for displaying the self-sustained emission effect than MgO.

High-speed facsimile document transmission

To meet the demand in industry for a rapid means of transmitting graphic information, Muirhead & Co. Limited have designed and produced Mufax Business Machines which make it possible for unskilled personnel to effect a rapid facsimile transmission of any type of document over any distance.

Documents — carrying written, printed or drawn information and measuring 14 in. x 8½ in. can be transmitted in under three minutes; smaller documents take proportionally less time.

The document is wrapped around a drum and a small area of the copy is brightly illuminated. Through an objective lens, an image of this area is focused on to a small white screen. An aperture in this screen allows light from an element of the image to fall on the photo-cathode of a photo-multiplier cell which in turn controls the amplitude of the carrier signal sent to line. The carrier amplitude at any instant is thus a function of the density of the element being scanned.

During transmission, the drum is rotated and the optical system is traversed parallel to the drum axis.

The entire document is thus scanned line-by-line in the form of a close spiral.

When the required amount of copy has been scanned, the transmitter automatically reverts to a stand-by condition.

At the receiver, electrosensitive paper is drawn between a stainless steel writing edge and a platinum wire helix which rotates in synchronism with the transmitter drum. Current is passed through the paper at the point of contact — causing a chemical action which marks the paper. The density of the mark depends on the magnitude of the current which, in turn, is controlled by the signal from the transmitter.

The rotation of the helix and the movement of the paper cause the point of contact to scan the paper in a series of parallel lines — each line corresponding to a scanning line round the drum. Where current passes, a mark is produced and so a facsimile of the original document is built up.

Once installed, the receiver functions automatically and requires no operator.



(Above) The transmitter drum being loaded with information to be transmitted. (Left) Transmitted information being received on the receiver unit of Mufax equipment. Photos courtesy — Rolls Royce Limited.



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ORIGINATORS OF THE DIAL TELEPHONE



ELECTRONICS AND COMMUNICATIONS, May, 1959 For complete details check No. 5 on handy card, page 49



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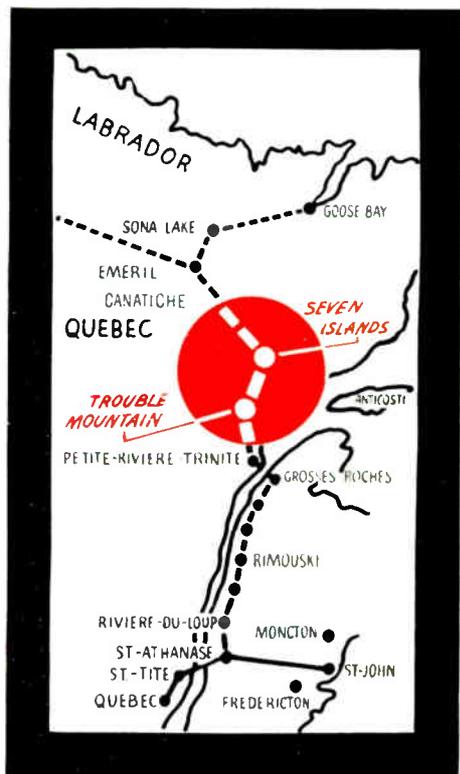
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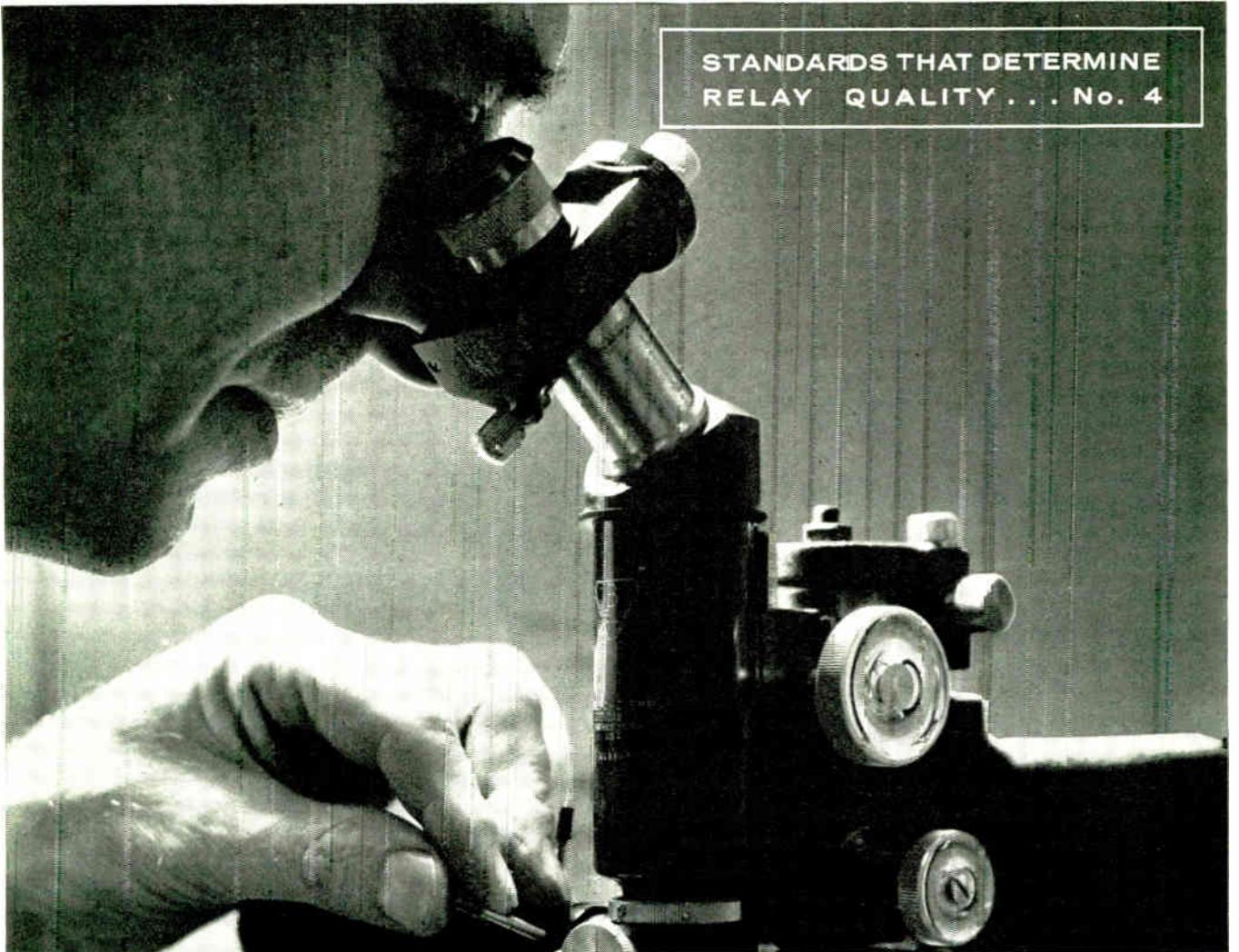
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STANDARDS THAT DETERMINE
RELAY QUALITY . . . No. 4



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the **ideal** relay iron

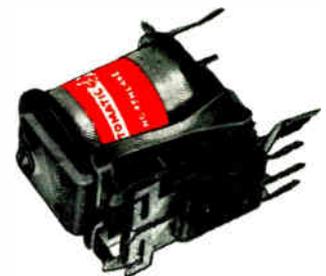
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5926

News Report

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

Union Carbide Canada creates new executive post

The election of F. Perry Wilson to the newly created office of executive vice-president, Union Carbide Canada Limited, has been announced by A. A. Cumming, president of the company. Mr. Wilson's election took place at



F. Perry Wilson

a meeting of the board of directors held at the company's head office in Toronto on April 14, 1959.

Mr. Wilson joined the Bakelite organization in 1941. He assumed the position of vice-president in charge of sales of Bakelite Company, Division of Union Carbide Canada Limited in 1953, becoming president the following year. In 1956, Mr. Wilson was appointed a vice-president, and in 1958 he was elected a director of Union Carbide Canada Limited.

In his new position at Union Carbide, Mr. Wilson assumes added responsibilities for the direction of one of Canada's foremost manufacturing organizations.

EIA chairman speaks at electronics industry luncheon

Announcement has been made of the acceptance of Ronald M. Robinson, vice-president and general manager of the Canadian General Electric Company Limited, and chairman of the Electronic Industries Association of Canada, to be guest speaker at the 16th annual Canadian Luncheon to be held in the "Beverly Room" of the Conrad Hilton Hotel, Chicago, on Tuesday, May 19. This event is in connection with the 1959 Electronic Parts Distributors' Show which will be in progress in the Conrad Hilton Hotel, Chicago, from May 18 to 20 inclusive.

Luncheon reservations may be made by contacting the luncheon secretary — John Rochford, 25 Taylor Drive, Toronto 6, Ontario.

Election of Officers IRE Toronto Section

The officers for the 1959-1960 season of the IRE Toronto Section were elected at the April 7th meeting of the group.

They are: Chairman — R. J. A.

Turner, Lake Engineering Company, Limited; Vice-Chairman — K. MacKenzie, McCurdy Radio Industries Limited; Secretary-Treasurer — G. T. Quigley, Philips Electronics Industries, Limited.

E. E. Whittaker changes office location

Effective May 1, 1959, the head office of E. E. Whittaker, electronic manufacturers' representatives, was moved to 2137 Niagara Drive, Ottawa, Ontario. The previous address was P.O. Box 3255, Arnprior, Ontario.

Pacific Electronics Ltd. established in Vancouver

G. D. McRae and J. S. Baxter, formerly on the staff of Canadian Marconi Company, have left that organization to establish their own company in Vancouver under the name of Pacific Electronics Limited. The new company, which opens early in May at 1641 West Second Avenue, Vancouver, will have 5,000 square feet of warehouse space and office accommodation with an adjacent 4,000 square foot parking lot.

Pacific Electronics will handle a complete line of electronic tubes, components and equipment for service technicians and industrial accounts in British Columbia.



G. D. McRae



J. S. Baxter

For the last five years Mr. McRae has been general sales manager of the Electronic Tube & Components Division of Canadian Marconi in Toronto. Previous to that he was manager of Radiotron Sales, assistant sales manager in the Montreal office, and midwest district sales representative with headquarters in Winnipeg.

Mr. Baxter has been branch manager of Canadian Marconi in Vancouver for the past seven years, where he was responsible for all product lines of Canadian Marconi in British Columbia. Prior to that he was B.C. and Alberta sales representative. He is widely known in the electronics industry in Western Canada.

Allied Industrial Electronics move to Streetsville

Allied Industrial Electronics of Canada Ltd. have announced their recent amalgamation with C. C. Meredith & Co. Ltd., of Streetsville, Ontario, manufacturers of variable resistors.

The company will be known as Industrial Electronics of Canada, Division of C. C. Meredith & Co. Ltd. The address is 80 Thomas Street, Streetsville. Contact may be made through a Toronto telephone number — ATwater 9-9001.

In their new quarters Industrial Electronics have ample space to cope with the increasing demand for their line of dry plate rectifiers, silicon and selenium types, together with the latest developments in magnetically regulated rectifiers and power supplies for communication and industrial services.

R & M Bearings distribute Weston Oil and Fluid Seals

The appointment of R & M Bearings Canada Ltd. as exclusive industrial distributors in Canada for Weston Oil and Fluid Seals was recently announced.

Stocks of all standard seals will be maintained at R & M's eight warehouses for use on original equipment and for maintenance applications.

The Weston line includes leather, synthetic rubber and "special" seals to suit requirements related to speed, temperatures, pressure and the fluid to be sealed.

Full details, including size ranges, are available from R & M Bearings Canada Ltd., 1006 Mountain Street, Montreal, Que.

Conway Electronic Enterprises represents Kelvin Sales Co.

Kelvin Sales Company, 5921 Noble Avenue, Van Nuys, California, has recently been formed to function as a distributor of products manufactured by Kelvin Electric Company, of Van Nuys, California, Kelvin Corporation, Fajardo, Puerto Rico, and other component manufacturers.

Kenneth T. Eckardt, president of Kelvin Sales Company, announces that the sales company will operate on a national basis through representatives. The Canadian distributor for this concern is Conway Electronic Enterprises, 1514 Eglinton Avenue West, Toronto 10, Ontario. Telephone: RU. 3-6576.

TV SERVICING COURSE GRADUATING CEREMONY

Eitel-McCullough Inc. holds dedication

On April 16, 1959, Eitel-McCullough Inc., manufacturer of Eimac electron-power tubes, observed the dedication of its new corporate headquarters and manufacturing facility at San Carlos, California. A press conference and luncheon preceded the actual dedication ceremony.

The guest speaker on that occasion was E. Finley Carter, president of Stanford Research Institute, who remarked on the evolution of communications including new modern methods and those of the future. To demonstrate this communications theme, one in which the company has been involved during its 25 year history, plans were made to attempt a long distance radio contact at UHF using lunar echo techniques, the signal being transmitted from Alaska to the moon and reflected to the San Carlos plant.



Sponsored by the Electronic Industries Association of Canada, the 16-week night school course on television servicing concluded with the presentation of diplomas to fifteen graduates. Shown above are head table guests at the graduation ceremony, Royal York Hotel, Toronto: (Left to right) Cowan Harris, exec. secretary of EIA; James Sands, radio and television service manager, Philips Electronics Industries Ltd.; Fred Ratcliffe, general manager, EIA; William Hodson, field service representative, Canadian Admiral Corp. Ltd. and chairman, Service Committee, EIA; Eric Palin, administrative assistant to the principal, Ryerson Institute of Technology and general chairman, IRE Canadian Convention; Stuart Brownlee, president of Canadian Admiral Corp. Ltd.; and Herbert W. Jackson, director of electronics, Ryerson Institute of Technology.

DDP contracts for electronics and communications fields

In the month of March 1959 contracts for electronics and communications equipment were awarded by the Department of Defense Production as follows: radar equipment — Abercorn Aero Ltd., Montreal, Que., \$21,682;

electronic equipment — Cossor (Canada) Ltd., Halifax, N.S., \$11,124; Intronics Ltd., Stittsville, Ont., \$24,380; R.C.A. Victor Co. Ltd., Ottawa, Ont., \$55,311; Sperry Gyroscope Ottawa Ltd., Ottawa, \$12,462; Bayly Engineering Ltd., Ottawa, \$46,876; Electronic Materials International Ltd., Ottawa, \$68,297; Measurement Engineering Ltd., Arnprior, Ont., \$64,001; Stand-

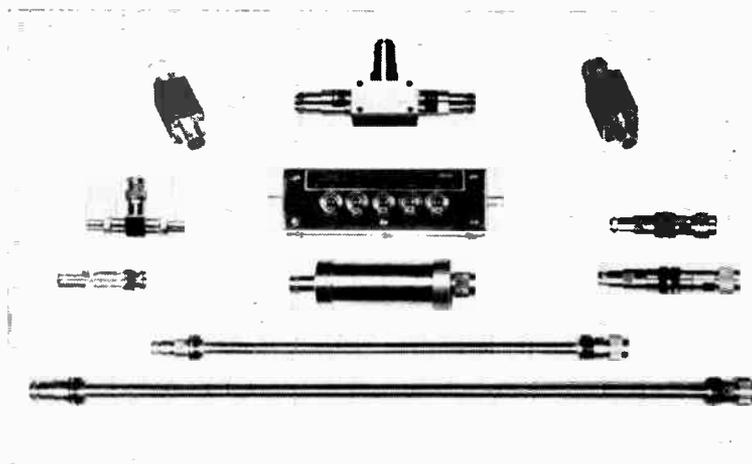
ard Telephones & Cables Mfg. Co. (Canada) Ltd., Montreal, \$71,635; electronic tubes — Ahearn & Soper Co. Ltd., Ottawa, \$19,527; Canadian General Electric Co., Ltd., Toronto, \$12,352; electronic components — Marsland Engineering Ltd., Waterloo, Ont., \$30,875; communications equipment — T.M.C. (Canada) Ltd., Ottawa, \$13,800.

COAXIAL R. F. ATTENUATORS



All the above types designed and manufactured in Canada by PYLON

Write us
with your special
attenuator problems



PYLON
PYLON ELECTRONIC DEVELOPMENT company, Ltd.
Communications Systems and Equipment
161 CLEMENT ST., LASALLE, MONTREAL 32, QUE.

Precision Tube appoints Canadian Research Institute

Precision Tube Company, Inc., of North Wales, Pennsylvania, recently announced the appointment of Canadian Research Institute, Toronto, as their representative in Canada.

Precision Tube Company manufacture all types of miniature precision tubing which is available in many materials in any specified diameter or wall thickness down to 0.010" outside diameter. These small tubes find wide use in fine instrumentation, meter pointers, vacuum tubes, Bourdon tubes for pressure gauges, and miniature plumbing.

Canadian Research Institute is located at 46 St. George St., Toronto 5, Ontario.

F. C. Burrige handles Sigma sales in Eastern Canada

Sigma Instruments, Inc. of South Braintree, Massachusetts, manufacturer of sensitive relays, has recently appointed Frank C. Burrige as district sales manager for Eastern Canada and the New England States.

Well known to electronics firms in this area, Mr. Burrige has been active in a sales-engineering capacity for the past several years.

VICE-PRESIDENT, SALES



P. A. MacPhee

J. R. Wolter, president, Croven Limited (formerly W. Gary Wright Electronics of Canada Ltd) recently announced the appointment of Paul A. MacPhee as vice-president, sales. Mr. MacPhee will be responsible for the direction of sales, sales promotion and advertising in this company's rapidly expanding quartz crystal and crystal oven market in Canada, the United States and overseas.



LR and MR Series RUGGED, WATERPROOF CONNECTORS by CANNON

- Sealed for protection against severest weather. Impervious to water, ice and mud.
- Standard MS insert arrangements available in both series.
- Anodized finishes provide extra protection. Other finishes available.
- Machined from top quality bar stock for much greater strength.
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Write for Bulletin LRMR-1.

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(CANADA) LIMITED

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Factories also in LOS ANGELES, SALEM, LONDON, MELBOURNE

Licences in PARIS, TOKYO

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For complete details check No. 16 on handy card, page 49

Meters ? ?
Test Equipment ?

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for

- the Unusual
- the Difficult

For over 25 years Canada's largest manufacturer of Electronic Test Equipment.

FIRST in Canada to produce. . .

Tube Testers . Volt-Ohm Milliameters . Oscilloscopes
Signal Generators . Vacuum Tube Voltmeters . Kits
Panel Meters . Portable Meters . Ruggedized Meters
Hermetically Sealed Meters . 250 Degree Meters . and
soon - Taut Band Suspension Meters.



STARK ELECTRONIC INSTRUMENTS LTD.
Ajax, Ontario

For complete details check No. 51 on handy card, page 49

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FOR PIN-POINT SOLDERING

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MINIATURE SOLDERING IRONS

Now available in Canada — the world's smallest, finest and most efficient soldering instrument.

FULL WEIGHT JUST ½ OZ. — for most models.

FULL LENGTH ONLY 6" — ideal for precision lab or production.

QUICK HEATING — low-voltage design achieves maximum rated heat in seconds, assures long, trouble-free life.

INTERCHANGEABLE TIPS — precision plated or solid nickel.

REQUEST DETAILED INFORMATION — Canadian sales representative.

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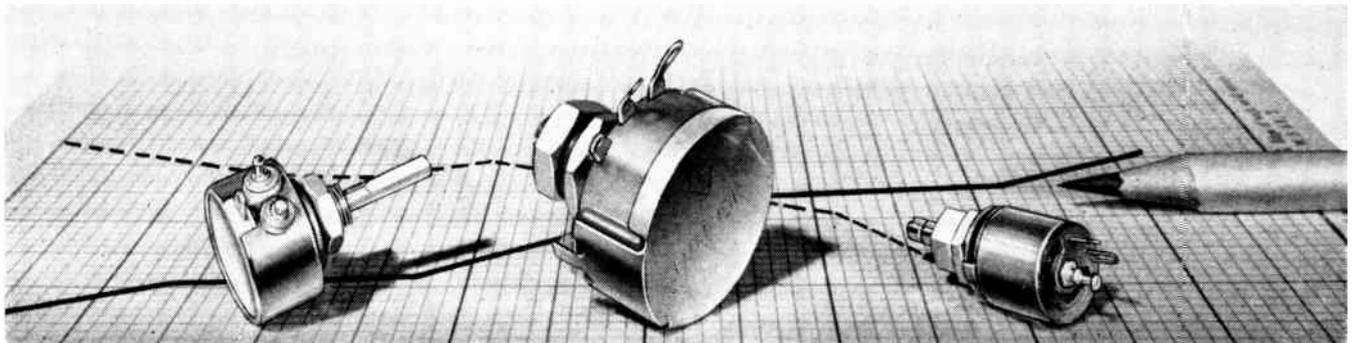
1794 Avenue Rd., Toronto, RU. 1-5232
or your local supplier.

For complete details check No. 24 on handy card, page 49

Complete Range of

VARIABLE COMPOSITION RESISTORS

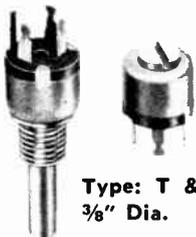
Built to highest industrial and military requirements.



1.5 Watt
(Type R.A.)

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(Type L)

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Complete Environmental Test Lab

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Alpha Aracon Radio Co. Ltd., Toronto.

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For complete details check No. 40 on handy card, page 49

Potter & Brumfield Canada appoints plant manager

Marlin A. Kirk has been appointed plant manager of Potter & Brumfield Canada Ltd., Guelph, Ontario, according to R. M. Brumfield, president of the company. Potter & Brumfield



M. A. Kirk

Canada manufacture a wide range of electromagnetic relays. Mr. Kirk, a P & B employee for more than seven years, is a native of Princeton, Indiana. He has held a variety of production and sales positions with the company in both Princeton and Laconia, New Hampshire, and joined the Canadian operation in July 1958.

Dayrand Ltd. represents Carl W. Schutter

Dayrand Limited of Montreal, Que., has been appointed the exclusive Canadian representative for Carl W. Schutter Microwave Corporation of Long Island, N.Y., producer of waveguide and waveguide fittings of all types. The announcement was made by D. S. Wilson of Dayrand Limited.

Information on Carl W. Schutter products may be obtained by contacting Dayrand Limited, 4612 St. Catherine St. W., Montreal 6, Que.

General manager appointed for Renfrew Electric Co.

William M. Keddie, M.Sc., has joined the Renfrew Electric Co. Limited, Renfrew, Ontario, as general manager, according to a recent announcement by J. R. Longstaffe, president of the company, succeeding H. Young who retired last December.



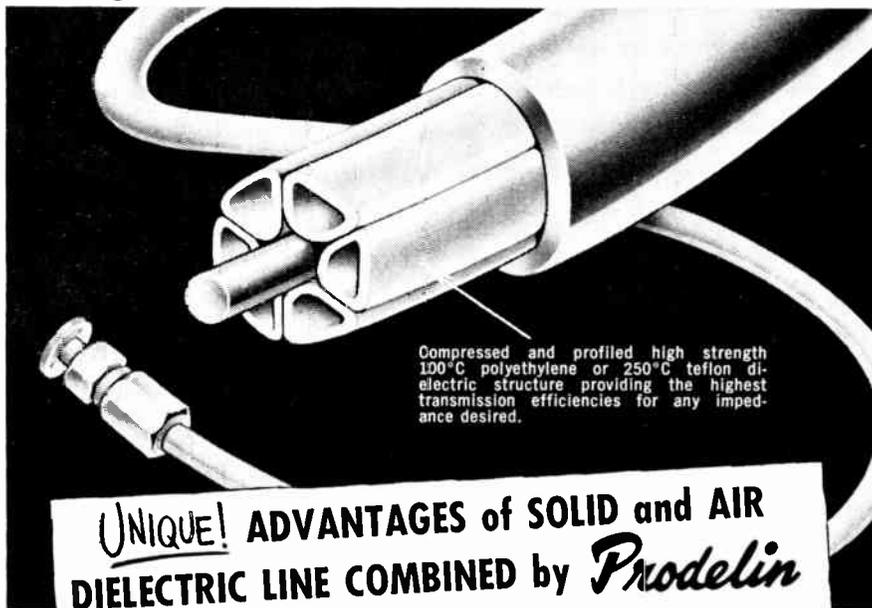
W. M. Keddie

Mr. Keddie, retired RAF Group Captain, brings to his new post many years of wide and valuable engineering and administrative experience. He is a graduate of Queens University in mechanical engineering, a graduate from Massachusetts Institute of Technology in aeronautical engineering and is a member of the Association of Professional Engineers and of the Canadian Aeronautical Institute.

Prior to joining Renfrew Electric Co. Limited, Mr. Keddie was vice-president of Renfrew Aircraft & Engineering Company of Renfrew, Ontario.

NEW All-American! Spir-O-line[®]

SEMI-FLEXIBLE ALUMINUM TRANSMISSION LINE



Compressed and profiled high strength 100°C polyethylene or 250°C teflon dielectric structure providing the highest transmission efficiencies for any impedance desired.

UNIQUE! ADVANTAGES of SOLID and AIR DIELECTRIC LINE COMBINED by Prodelin
in revolutionary All-Aluminum Cable and Connector

2 WAY MOBILE RADIO uses *Spir-O-line*[®] Prodelin's air dielectric coaxial cable, instead of solid dielectric line. *Spir-O-line*'s lower loss makes possible the use of smaller size cables at lower cost. The complete reliability of the *Spir-O-line* cable and *Spir-O-lok*[®] connector assembly eliminates costly maintenance.

FEATURES

- No special tools required to make up cable-connector assembly
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- Aluminum sheath makes cable 100% radiation free
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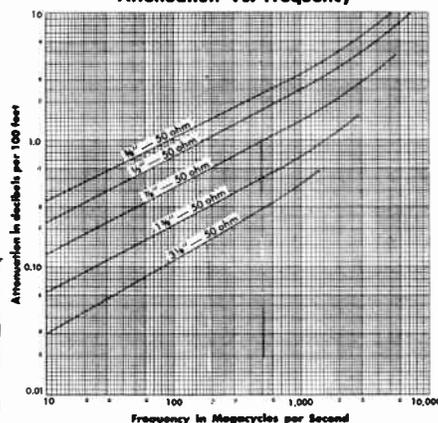
Spir-O-lok[®]
CONNECTORS



Amazing Prodelin development! Adequately pressure-tight for lab use when hand-tightened . . . ready for field service when wrench-tightened. Specifically designed for use with soft aluminum tubing to provide highest tensile strengths without tube distortion. No special techniques, bulky fixtures, or non-standard tools required. May be used again and again without redressing tubing or replacing connector parts! Saves time and money! EIA (RETMA) dimensioned.

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Attenuation Vs. Frequency



Reconsider your cable requirements now and ask how *Spir-O-line* can provide new life with added economies in your service! WRITE FOR CATALOG 591 TODAY!

Dept. EC5
307 Bergen Ave., Kearney, N.J.

For complete details check No. 41 on handy card, page 49

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 49. Just mark the products you are interested in on the coupon on Page 49 and the information will be in your hands within a few days.

Miniature lowpass filters

Item 2333

Miniature Lowpass Filters are available from TT Electronics, Inc., P.O. Box 180, Culver City, California. These small-size, low-cost filters have 50 db minimum attenuation at the critical frequency. Attenuation of 25 db or more is maintained as high as 10 times this specified frequency. The passband insertion loss falls to 3 db at 0.01 times the maximum attenuation frequency. Rejection frequencies as low as 20 cps can be specified for these RC Networks.

These Miniature Filters are encapsulated in an epoxy resin for stability under extreme environmental conditions. The cylindrical package is $\frac{1}{2}$ inches in diameter and $1\frac{1}{2}$ inches high. Mounting is accomplished by means of three ± 18 solid copper tinned leads. Variations of this printed-circuit board package are available. Also available are hermetically sealed and encapsulated Lowpass Filters with the same frequency characteristic and with 55 or 60 db critical frequency notches. Deposited carbon resistors and Mylar capacitors are used in these low cost Networks for good temperature stability.

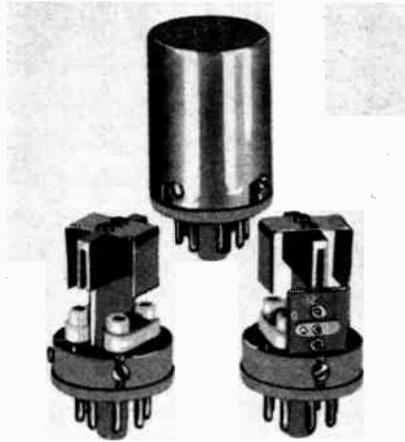
For additional information, contact TT Electronics, Inc., P.O. Box 180, Culver City, California, U.S.A.

Crystal ovens

Item 2334

Significant advancements in the design of crystal ovens have been announced by Croven Limited (formerly W. Gary Wright Electronics of Canada, Ltd.), Whitby, Ontario, with the development and production of ovens incorporating the Stevens Snap-action thermostat. Internal switching for voltage selection is accomplished by simply rotating a rugged self-locking switch. This facility substantially reduces customers' inventory.

Aside from the advantage of greatly improved temperature stability as compared to the conventional creeper-type thermostat control, this new design assures greater life due to the more positive action of the Snap-action thermostat. Extensive filter networks normally associated with conventional ovens are no longer required.



The almost negligible amount of thermal aging contributes greatly to the marked improvement in stability.

For further details and design information to individual specifications, contact Croven Limited, 628 Kent Street, Whitby, Ontario, Canada.

Mercury plunger flashers

Item 2335

Philips Electronics Industries Ltd., representing Ebert Electronics Corporation, are pleased to announce the immediate availability of Mercury Plunger Flashers, having a wide variety of factory pre-set flash rates.

The operating principle of this new product utilizes a flashing mechanism which controls a low power (8 watts or less) coil of the Ebert Mercury Plunger Relay. Load power is applied through a hermetically sealed, mercury-to-mercury contact, controlled by a freely floating plunger, and is inherently capable of withstanding inrush currents of ten to twenty times the rated value. Failures due to fused contacts, surge currents, or arcing are entirely eliminated and there is no contact bounce.

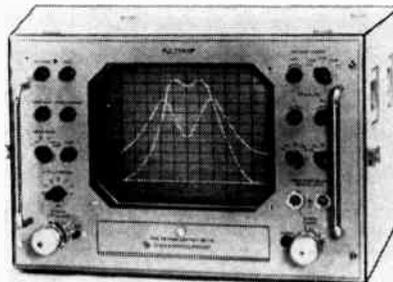
Since the system is entirely free of mechanical constraints, operating life in excess of ten million cycles may be realized.

For further information, write to Philips Electronics Industries Ltd., 116 Vanderhoof Avenue, Toronto 17, Ontario, Canada.

Electronic measuring instrument

Item 2336

A new type of electronic measuring instrument that can be used for checking almost any four-terminal network is now available in Canada from The Ahearn and Soper Company Limited.



Known as Polyskop Type SWOB BN 4244, the instrument was developed by Rohde & Schwartz to meet stringent laboratory and test department requirements. It displays two separate quantities as a function of a given frequency — in the form of continuous curves, making tedious point by point measurements unnecessary.

In the sweep signal generator, a frequency modulated oscillator produces the swept-frequency test signal. The centre frequency of the bank to be swept is adjustable in five ranges covering 0.5 to 400 mc, and the sweep width is continuously variable between +0.2 and +50 mc. The source impedance adjusts automatically to zero, and an attenuator permits adjustment of the generator output voltage — the EMF being variable in 10-db steps between 1mv and 1v.

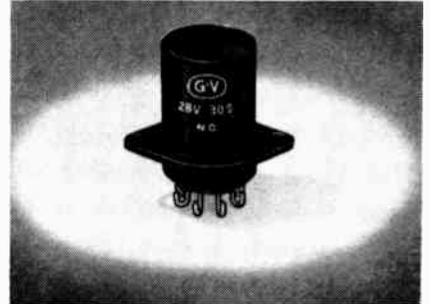
Crystal-controlled or external-frequency markers can be spaced as required to provide a frequency scale corresponding in length to the sweep width of the sweep signal generator. The vertical scale, a replaceable plexiglass graticule with linear subdivisions can be calibrated with an accuracy better than 0.5 db. Calibration is unaffected by characteristics of rectifiers in the circuit under test and indicates overloading immediately.

For further details and illustrated literature, write to: The Ahearn and Soper Company Limited, 384 Bank Street, Ottawa, Ontario, Canada.

Thermal time delay relay

Item 2337

G-V Controls Inc. announces a new hermetically sealed thermal time delay relay of subminiature size. The new unit, which has a seated height only $\frac{7}{8}$ " above mounting panel, utilizes the same basic principle of longitudinal expansion as G-V's larger relays and is designed to withstand continuous 20 g vibration at frequencies up to 1,000 cps.



Contacts are single pole, single throw, either normally open or normally closed. Rating is 2 amps resistive at 115 volts AC or 28 volts DC. Time delays are factory set and sealed. Relays are offered in ten standard delays from 2 to 75 sec. and for standard heater voltages of 6.3, 28, and 115 volts. Non-standard delays and heater voltages are available on special order.

There are no resonances in the frequency range up to 1,000 cps. No false contact operation either in the de-energized or the saturated condition results from 20 g vibration over this range or from shock of 50 g, 11 ms. Ambient range is up to 85°C for continuous energization, up to 125°C for energization up to 3 minutes. Hooked terminals are provided. Pin connections and mounting dimensions are the same as those of standard miniature flanged relays. Diameter is $\frac{3}{4}$ "; height above panel $\frac{7}{8}$ "; overall body height $1\frac{1}{8}$ ". Weight is approximately $\frac{3}{4}$ oz.

G-V Controls Inc., Okner Parkway, Livingston, New Jersey, U.S.A.

Portable radiotelephone

Item 2338

Spilsbury & Tindall Ltd. announce the design and manufacture of a new, lightweight portable medium frequency radiotelephone. Model "PRT-20" weighs 9 lbs., complete with lightweight batteries; covers a frequency range of 2 to 6 mc, and has a power output of one and one-half watts. The set has been partially transistorized, and uses miniature components throughout. Transceiver, batteries, microphone, wire aerial, and instruction manual, are all contained in a compact leather carrying case, measuring $8\frac{1}{4}$ " x $11\frac{1}{4}$ " x $4\frac{1}{2}$ " — about the size of a lady's handbag.

This unit will find particular application in forestry, survey, and field work, where its versatility enables it to be used either as a fixed station with heavy-duty batteries and a pre-cut aerial; or, during the fire season or as the necessity arises, it can be taken out and worked with its lightweight batteries from a random length of wire, or can serve as a "walkie-talkie", using the clip-on whip which fastens to the end of the case.

The unit has recently been tested by the Department of Transport, and listed as suitable for licensing.

Spilsbury & Tindall Ltd., 120 East Cordova Street, Vancouver 4, B.C.

Continued on page 40



DYNAMIC MUTUAL CONDUCTANCE



TUBE TESTER

(VALVE CHARACTERISTIC METER)

Completely analyzes practically all receiving tubes and many small transmitting types.

Will provide you with: complete tube characteristic measurements... plate, screen and grid currents... amplification factor, plate resistance... mutual conductance... interelectrode insulation measurement in megohms... breakdown of cathode or heater to other electrodes in megohms... cathode-heater insulation in megohms... heater continuity... quick "Good/Bad" reading... overload cut-out.

Designed to meet progressive trends in tube development.

R.H. Nichols 584
LIMITED

4544 DUFFERIN STREET, TORONTO

TORONTO MAIL: P.O. Box 500 DOWNSVIEW, Ontario
OTTAWA P.O. Box 113
VANCOUVER 624 Vancouver Block 736 Granville Street

For complete details check No. 35 on handy card, page 49



Pocket size



MULTIMINOR

- Pocket size, pocket wise... a great little instrument at a low, low price.
- Made by the makers of the famous Avo Meters
- 10,000 ohms/volt on DC.
- 19 Ranges: To 1000 volt AC and DC (first indication 2mV on DC) To 1 amp DC (first indication 2 microamps) Resistance to 2 megohms
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- Stock delivery.
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ELECTRONICS AND COMMUNICATIONS, May, 1959



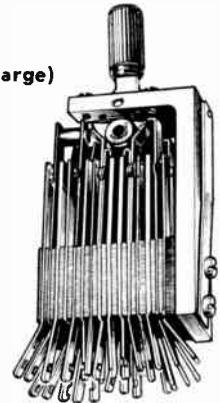
CONTROL KEY SWITCHES

for LOW VOLTAGE MULTIPLE
SWITCHING

T.M.C. CONTROL KEY SWITCHES, precise in design and of robust construction, are today performing their vitally continuous work in varying apparatus all over the world.

Lever type control switch (Large)

■ Operators feeling the clean and positive "Make and break" action in any of the fifty standard spring combinations forget any fear of failure.



Lever type control switch (Small)

■ The contact springs made of nickel silver operated by hard plastic rollers on steel cams and silver contacts, ensure perfect performance.

Plunger type control key switches

■ Platinum or other metal can be supplied for special operating conditions.



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has the
right seat
for the job



MODEL 621
MICRO-NITE
SWIVEL STOOL
Simply turning the
handwheel adjusts
seat height effort-
lessly.



You know that good seating promotes efficiency of office workers - it will do it for factory workers, too. Although Royal factory seating offers virtually all the same posture-type features, *their cost is only a fraction of that of the lowest priced office chair.* Wide range of chairs and stools - adjustable or stationary heights - round or square seats. (Masonite or upholstered). All-welded steel construction. Ten-year structural guarantee.



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GALT, CANADA.

I am interested in prices and literature on the following—

- MODEL 515 MODEL 501
- MODEL 625 MODEL 621
- ALL ROYAL FACTORY SEATING

COMPANY _____

ADDRESS _____

CITY OR TOWN _____ PROV. _____

MY NAME _____ 58-8

For complete details check No. 48

New Products

Direct reading R.F. head Item 2339

Itek Corporation, Waltham, Mass., announce immediate delivery of their new Model 30X5 R.F. Head for use with their Model SA30 Microwave Spectrum Analyzer to cover the important 8,500 to 9,700 mc's range of the X band.

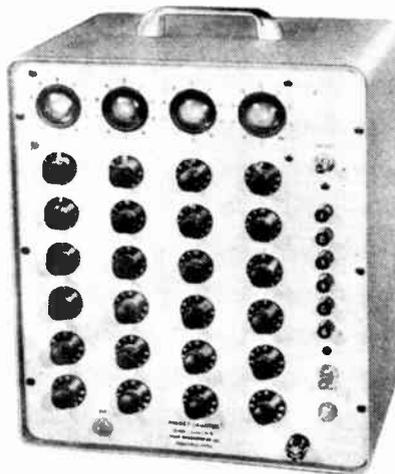
With direct reading frequency dial, this unit is accurate to 0.05% or better. As a result, it is outstanding for speed with exceptional accuracy in all design, production, test and maintenance facilities. It features automatically tracked Reflector Voltage for constant display centering and a precision 80 decibel RF Input Attenuator.

Complete technical bulletins on the 30X5 R.F. Head and the SA30 Microwave Spectrum Analyzer are available on request to Itek Corporation, 1584 Trapelo Road, Waltham 54, Mass., U.S.A.

Multiple preset counter Item 2340

Freed Transformer Company, Inc., Brooklyn, N.Y., is now making delivery on its new Multiple Preset Counter, Type 2020-4-6, designed and developed for counting and sequential predetermining control applications. This unique, high speed Freed Preset Counter is ideally suited for applications when a machine or a process is started manually and stops automatically at several preset counts in one operation. For example, one of the vital industrial operations which this new Multiple Preset Counter can be applied to is the winding of tapped torodial or transformer coils. The Freed Counter, Type 2020-4-6 performs this and scores of similar complex operations accurately and at great speed.

The new Freed Multiple Preset Counter is constructed only of premium components, using a minimum of computer type vacuum tubes, simplified circuits and a silicon power supply. As a result, this greater attention to overall instrument design has produced a quality preset counter which is extremely reliable and completely free of maintenance problems.

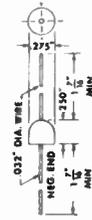


Specifications of Freed's new Preset Counter, Type 2020-4-6 include a maximum 4 digit count of 9,999, operated at counting speeds of 4,000 per second, and presets one through six. Various inputs supplied include Photocell, Switch Closure and Pulse. Output is a Relay DPDT-5 Amp. Contacts, with a 105-125, 50-60 cycles power supply. Dimensions for Type 2020-4-6 Preset Counters are 11 x 13 x 8 3/4" deep. Complete unit weighs 19 1/2 lbs.

For further information about the new Multiple Preset Counter, Type 2020-4-6 and other Freed Preset, Totalizing, Batching and Timing Counters write directly to manufacturer, Freed Transformer Company, Inc., 1716 Weirfield Street, Brooklyn (Ridgewood) 27, New York, U.S.A.

750 MILS TO 55°C 100 TO 600 PIV

Tarzian F SERIES SILICON RECTIFIERS

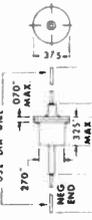


- Positive Environmental Seal
- Extra Heavy Duty Junction
- Low Cost
- Axial Leads (No Heat Sink)
- Low Forward Drop
- Low Reverse Current

AMPERES D.C. (100°C)	PEAK INVERSE VOLTAGE	TARZIAN TYPE	MAX. RMS VOLTS	MAX. RECURRENT PEAK AMPERES (100°C)	MAX. SURGE AMPERES 4MS
0.75*	200	F-2	140	7.5	7.5
	400	F-4	280	7.5	7.5
	600	F-6	420	7.5	7.5

*75A to 55°C, .5A @ 100°C.

Tarzian H SERIES SILICON RECTIFIERS



- Hermetically Sealed (Double Seal)
- Heavy Duty Junction
- Low Cost
- High Efficiency
- Axial Leads
- Low Forward Drop
- Low Reverse Current

AMPERES D.C. (100°C)	PEAK INVERSE VOLTAGE	TARZIAN TYPE	MAX. RMS VOLTS	MAX. RECURRENT PEAK AMPERES (100°C)	MAX. SURGE AMPERES 4MS
0.75*	100	10H	70	7.5	7.5
	200	20H	140	7.5	7.5
	300	30H	210	7.5	7.5
	400	40H	280	7.5	7.5
	500	50H	350	7.5	7.5
	600	60H	420	7.5	7.5

*75A to 55°C, .5A @ 100°C.

Write for design notes No. 30 and 31

SARKES TARZIAN, INC.
RECTIFIER DIVISION
Dept. EC-3, 415 North College Ave.
Bloomington, Indiana

In Canada: 700 Weston Rd., Toronto 9, Tel. Roger 2-7535
Export: Ad Auriemo, Inc., New York City

For complete details check No. 47

New Products

Decade oscillator

Item 2341

0.01 c/s (one cycle in a hundred seconds) to 11.2k c/s is the frequency range of this new, low frequency decade oscillator. Over the whole of this range the output is constant within ± 1 db.

The circuit of this oscillator, which represents a new approach to the problem of providing very low frequency selective circuits, is based on a development of a circuit covered by British Patent No. 781,374 granted to the National Research Development Corporation; the instrument is made under license agreement and incorporates several improvements.

The principle of operation is that of solving a 2nd order differential equation with damping by using two integrator stages and a sign changer. More simply, the overall phase shift of 360° which is required for oscillation to occur is achieved by two electronic integrating circuits — each having a phase shift of 90° — and a sign changer circuit having a phase shift of 180° .

Two outputs — 90° apart — are taken from the integrator circuits and are available at a level of 10 volts. Both outputs are directly coupled and the DC content is adjusted to a very low value by preset controls. The "0° output" is suitable for feeding into a load of 600 ohms and is adjustable by an output attenuator down to -62 db ref 10 volts; the 90° output is suitable for a load of 10k ohms and is adjustable down to zero by means of a potentiometer.

In addition to forming part of the Muirhead Transfer Function Analyzer this oscillator finds many applications in the servo-engineering field where the study of low frequencies is of increasing importance.

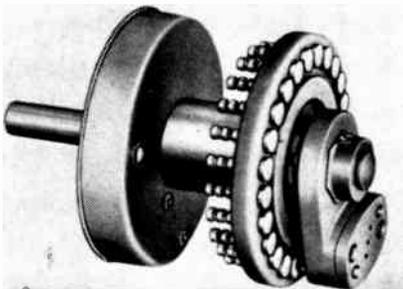
Other features of the instrument include its frequency accuracy, its very low harmonic content and the equality, or proportionality, of the two output levels.

Muirhead & Co. Limited, Beckenham, Kent, England.

Gold-laminated contacts and switches

Item 2342

The Daven Company, Livingston, New Jersey, announces the development of switches using special gold-laminated contacts and slip rings for use in extremely corrosive atmospheres.



In tests recently conducted on the Daven Type 11-CM-32 (a single-pole, 32-position, shorting type switch), the unit was suspended in a sulphur atmosphere at 45°C for 245 hours. The initial contact resistance reading before suspension in this atmosphere was .001 ohm to .002 ohm. After completion of the tests, the contact resistance was still only .0021 to .0025 ohm. The gold-laminated contacts and slip rings are available on all Daven switches where extreme reliability is demanded of a switch which will be used in a highly corrosive atmosphere.

For further information write to The Daven Company, Livingston, New Jersey, U.S.A.

Soldering is **EASIER FASTER BETTER** with American Beauty Soldering Tools

American Beauty electric soldering irons are the highest quality made. The finest engineering, best materials and on-the-job experience since 1894 is yours with every American Beauty. There is a right model, correct tip size and proper watt input to do any soldering job easier, faster and better.

TEMPERATURE REGULATING STANDS

Automatic devices for controlling tip temperatures while iron is at rest — prevents overheating of iron, eliminates frequent retinning of tip, while maintaining any desired temperature. Available with perforated steel guard to protect user's hand.



201-B

NO. 3125
3/4" TIP
60 WATTS

NO. 3138
3/4" TIP
100 WATTS

NO. 3150
3/4" TIP
200 WATTS

NO. 3170
3/4" TIP
300 WATTS

NO. 3190
1 1/4" TIP
550 WATTS

WRITE FOR 20-PAGE ILLUSTRATED CATALOG CONTAINING FULL INFORMATION ON OUR COMPLETE LINE OF ELECTRIC SOLDERING IRONS—INCLUDING THEIR USE AND CARE.

AMERICAN ELECTRICAL HEATER COMPANY

DETROIT 2, MICHIGAN



For complete details check No. 2 on handy card, page 49



a new
WELWYN
MOLDED

DEPOSITED CARBON RESISTOR

Welwyn Series N molded resistors employ a thermoplastic insulating material, combining economy with endurance and long term stability.

They meet the requirements specified by MIL-R-10509B and show negligible changes in resistance when subject to several one hour cycles of immersion in boiling water, along with D.C. polarization. Continuous operation at 150°C causes no damage.

The transparent molded insulation has an effective resistance in the order of 10^{13} ohms, and with a thermal conductivity 10 times that of air, vastly improves the load life under conditions of excessive dissipation.

Available in 4 physical sizes and in values of 10 ohms to 10 megohms.

For complete data and specifications write

WELWYN CANADA LIMITED

1255 BRYDGES STREET

LONDON, CANADA
H-8349

For complete details check No. 57 on handy card, page 49

New Products

High-temperature chromatograph

Item 2343

A new high-temperature chromatograph capable of separating and analyzing substances with boiling points up to 600°C has been announced by Consolidated Electro-dynamics Corporation.

The instrument, known as the Type 26-203 High-Temperature Chromatograph, has a maximum operating temperature of 500°C, which is beyond the range of conventional chromatographs. This is sufficient to vaporize samples with boiling points up to 600°C. It is especially designed for laboratory analysts and researchers, particularly in the petroleum, petrochemical, and chemical industries.

In performing quantitative analyses of gases, liquids, and solids by the elution method, the chromatograph readily accom-

modates high-molecular-weight waxes, oils, plasticizers, silicone oils, fatty acids, biphenyls, terphenyls, glycols, phthalate esters, nitriles, and diglycerides.

In addition to high-temperature applications, the 26-203 may be used as a general-purpose laboratory instrument for all standard chromatographic analyses above 50°C. It is fast and easy to operate. Its performance at high temperatures is made possible through heat-shielding design and heat-resistant materials in the analyzer. The heat sink is composed of a special bronze alloy that will not corrode at elevated temperatures; seals on the detectors are made of Ceramicite, a high temperature insulating and vacuum-sealing compound; and the entire oven assembly is insulated and ventilated. Temperatures can be regulated within $\pm 0.5^\circ\text{C}$.

Modular design makes it possible to expand the instrument as analytical needs change. Several analyzer units may be operated from a single control unit, and since each analyzer can employ a different type column, the change-over from one type sample to another can be accomplished rapidly.

Further information on the 26-203 High-Temperature Chromatograph, a product of CEC's Analytical and Control Instrument Division, appears in Bulletin 1847, available from Consolidated Electro-dynamics Corporation, 300 North Sierra Madre Villa, Pasadena, Calif., U.S.A.

Universal transistor tester

Item 2344

A universal transistor tester has been announced by The Reflectone Corporation, Stamford, Conn.

Designated Model TT-1, the device provides tests for both NPN and PNP type transistors, of the low, medium and high power types, and both socket and external leads are provided to accommodate the various transistor types. The tester checks leakage and gain characteristics as well as testing for shorts, and may also be used to check the reverse and forward current ratio on all diodes.



The unit provides an easy-to-read sensitive 50 microampere movement mounted in a sturdy case, is entirely self-contained, and requires no external power connection.

For further information, write The Reflectone Corporation, Post Road and Myano Lane, Stamford, Connecticut, U.S.A.

Portable electronic counter

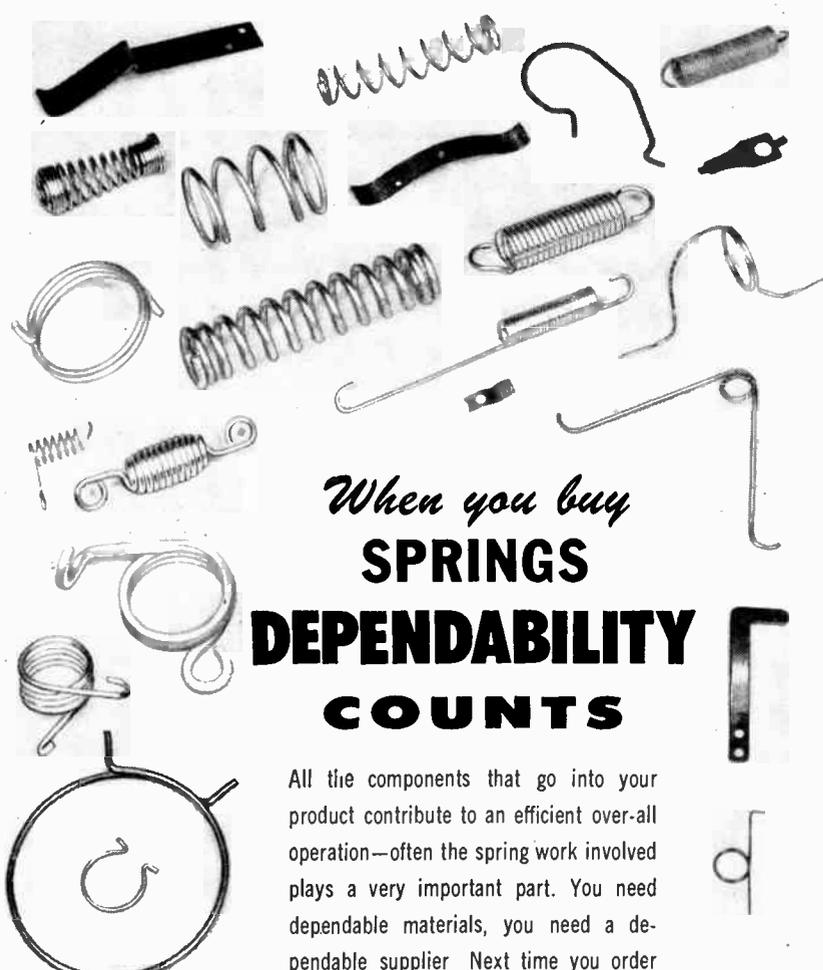
Item 2345

A new Portable Electronic Counter, Model 1000-B, is announced by Performance Measurements Co. of Detroit, Michigan. Capable of counting speeds to 12,000 counts per minute, this instrument combines a plug-in electronic decade with a five-digit mechanical register.

The Model 1000-B meets a variety of laboratory, production and process counting needs. This instrument fills the gap between slower electro-mechanical counters and elaborate, high-speed multi-decade units. Counting pulses may be from photoelectric cells, magnetic pickups or contact closures. Input signals can be sinusoidal, rectangular or slow-rising.

Enclosed in a rugged aluminum case, the Model 1000-B counter weighs only seven pounds. The counter circuitry consists of an input amplifier, pulse sharper and electronic decade. With an accuracy of ± 1 count, the instrument will respond to electrical pulses with a peak amplitude of $\pm 2\frac{1}{2}$ volts. Operating from 105 to 125 volts AC, the counter contains an accessory power outlet of 90 volts DC for photocells etc. Special variations on basic design can be performed on request to Performance Measurements Co., 15301 W. McNichols, Detroit 35, Michigan, U.S.A.

Continued on page 44



When you buy

SPRINGS

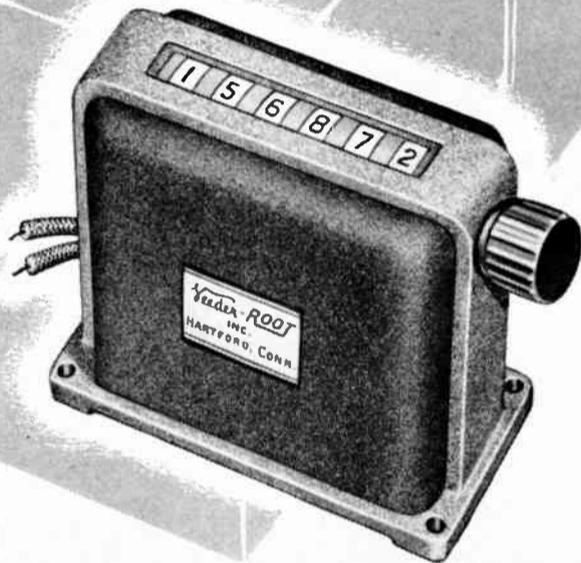
**DEPENDABILITY
COUNTS**

All the components that go into your product contribute to an efficient over-all operation—often the spring work involved plays a very important part. You need dependable materials, you need a dependable supplier. Next time you order springs, call Bohne Industries—hundreds of manufacturers rely on them.

**BOHNE INDUSTRIES
LIMITED**
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For complete details check No. 10 on handy card, page 49

Here's the Complete "Package" for Counting Electrically...



*Added Evidence
that —*

Everyone Can Count on **VEEDER-ROOT**

This Veeder-Root Reset Magnetic Counter (AC or DC) is actuated through electromagnets. And it may be connected in series with any device having a contact arrangement . . . like the specially designed Veeder-Root Electrical Contactor at the left, which insures positive operation of the counter, either in oscillation or connected directly to a revolving shaft . . . with the counter placed at

any distance from the machine or process on which the count is required.

This is another one of the hundreds of Veeder-Root Standard and Special Counting and Computing Devices developed for every conceivable counting duty, in every field from atomics to electronics.

What do you need to count? Just write:

VEEDER-ROOT of CANADA, Ltd.

955 St. James St., Montreal 3

Main Office & Factory: Hartford 2, Conn., U.S.A.
Offices & Agents in Principal Cities



Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.
Montreal 2, Canada • Dundee, Scotland
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"The Name that Counts"

For complete details check No. 56 on handy card, page 49

ELECTRONICS AND COMMUNICATIONS, May, 1959

43

*Designed for
bench line
production and
continual use.*



*Supplied in all
volt ranges.*

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voltage. The D.C. power requirements are generally 2% of the controlled power. The Reactor may be remotely controlled by a small potentiometer.

Saturable reactors are not expensive and have numerous varied applications throughout industry.

Write for Bulletin 5057.

INDUSTRIAL and SPECIAL TRANSFORMERS

HAMMOND MANUFACTURING CO. LTD.

H/13 GUELPH • ONTARIO • CANADA

For complete details check No. 29 on handy card, page 49

45

For complete details check No. 1 on handy card, page 49
ELECTRONICS AND COMMUNICATIONS, May, 1959

For complete details check No. 49 on handy card, page 49

ELECTRONICS AND COMMUNICATIONS, May, 1959

47

**PRECISION FREQUENCY
MEASUREMENTS...**
0.1 to 175 mc. At low cost!



IAMPKIN 105-B

New Products

Miniature telephone type relays

Item 2346

The MH Series Relay — considered to be one of the most widely used types of miniature telephone type relays in existence today — is now in production at the plant of Potter & Brumfield Canada Ltd. of Guelph, Ontario.

The MH is used in airborne computers, measuring devices, communications systems and is one of the P&B relays used in the Atlas ICBM system. It is also used in industrial controls and other applications requiring many switching elements (up to 6pdt) controlled by a small signal voltage, approximately 1.6 watts at nominal voltage. The small size of the MH relay also adds

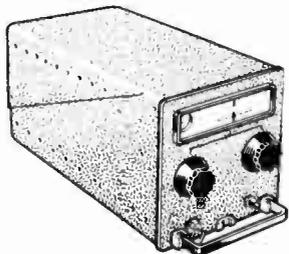


High Voltage, Glass-Encased Difilm® Vitamin Q® Capacitors

High-altitude and high-voltage capacitor applications in airborne electronic equipment are simplified with Sprague's new Type 205P Difilm Vitamin Q

AWA ELECTRONICS

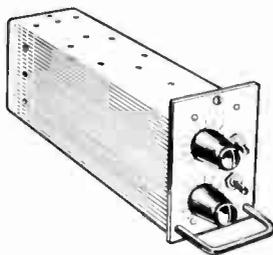
New concepts in electronics have been developed at AWA, as a result of experience with missile systems. Now they have a wider application. Here are some of the new AWA devices now available to industry.



U.H.F. WIDEBAND RECEIVER

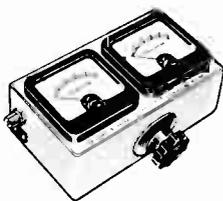
Basic arrangement consists of R.F. amplifier, mixer, local oscillator, I.F. amplifier (A.C.C. controlled), cathode follower output stage. Tuning indicator (EM 34) is also fitted to receiver. The standard forms: one for airborne racking with special separate power supply unit, the other on larger chassis including power supply unit (conventional 19" front panel). *Standard specification: 420-470 Mcs frequency range; 4 Mcs overall bandwidth, approximately 10 db noise factor; approximately 70 ohms input impedance. 200-250 V and 50-60 c/s input supply. Input is unbalanced, output is via low impedance (cathode follower) stage.*

TRANSISTOR GALVANOMETER AMPLIFIER

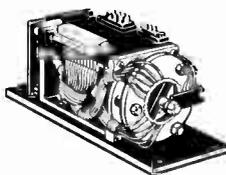


This Amplifier has been designed to drive viscous damped recording galvanometers which normally have a resistance of 50 ohms and a working range of DC to 2 Kc/s in frequency. The amplifier has a switched attenuator at its input and will accept single ended or push pull signals from ± 1 Millivolt to ± 500 volts and will feed a maximum of ± 50 Milliamps to the galvanometer. There is also a range of ancillary units available for use with this Amplifier as part of a comprehensive instrumentation system. *Standard specification: Dimensions: 4 1/2 in. x 3 1/2 in. x 10 in.; Frequency response: Flat from DC to 2 Kc/s, 5% down at 3 Kc/s, 3db down at 6 Kc/s; Noise Level: Less than 10 Microvolts; Input impedance: 40,000 ohms on range 5, 110,000 ohms all other ranges; Gain: Maximum 7.5 Milliamps/Millivolt, minimum 0.04 Milliamps/Volt; Power requirements: ± 6 Volts DC 220 Milliamps each line.*

DIRECTIONAL COUPLER



Of the 'Loop' type, suitable for measurements of RF power and Standing Wave Ratio in coaxial cables. Directional properties are largely unaffected by frequency changes, so coupler may be used to help obtain optimum termination of a 52 ohm coaxial system up to 600 Mc/s. *Standard specification: Size 7" x 4" x 2 1/2"; weighs 4 lbs. 3 ozs.; Power Measurement Range is Low range 1 w.cw.max.; High range 5 w.cw.max.; less than 1% attenuation; better than 2% accuracy at frequency of calibration.*



ROTARY SWITCH FOR TELEMETRY

Based on a conception of British Ministry of Supply's Research and Development Establishment, gives facilities previously unobtainable from mechanical sampling devices. The Standard Model enables two 24 channel banks to be sampled at speeds up to 200 r.p.s.

All devices are adaptable to suit customers' own requirements. For further information consult:

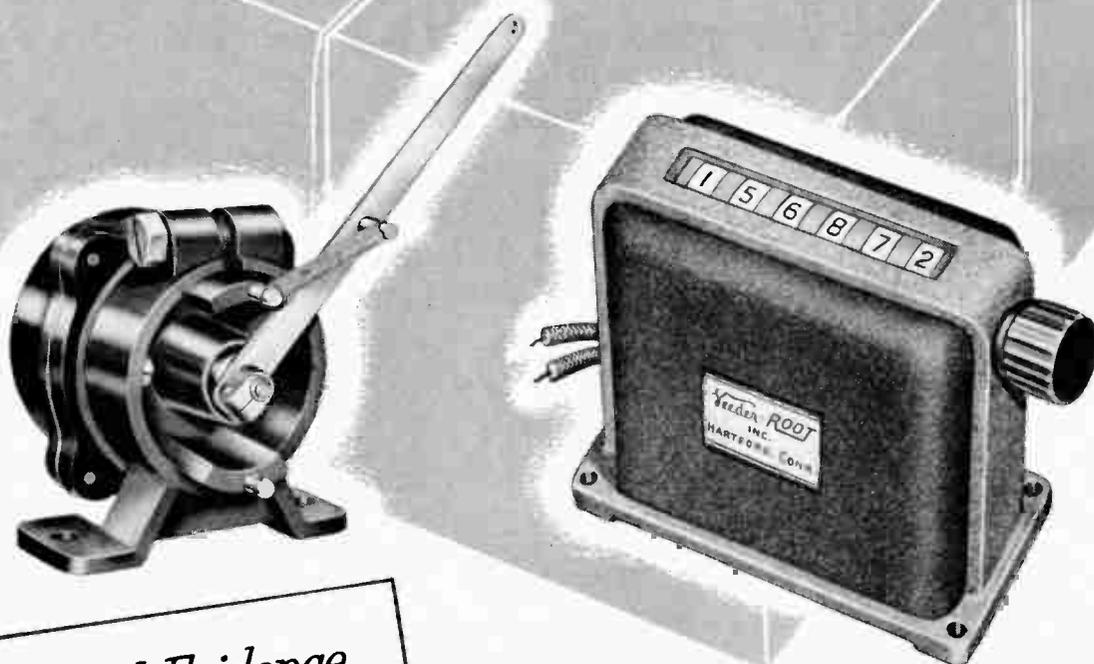
COMMERCIAL ELECTRONICS DEPT.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,
Baginton, Coventry.

MEMBER OF THE HAWKER SIDDELEY GROUP

For complete details check No. 4 on handy card, page 49

Here's the Complete "Package" for Counting Electrically...



*Added Evidence
that —*

Everyone Can Count on **VEEDER-ROOT**

This Veeder-Root Reset Magnetic Counter (AC or DC) is actuated through electromagnets. And it may be connected in series with any device having a contact arrangement . . . like the specially designed Veeder-Root Electrical Contactor at the left, which insures positive operation of the counter, either in oscillation or connected directly to a revolving shaft . . . with the counter placed at

any distance from the machine or process on which the count is required.

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What do you need to count? Just write:

VEEDER-ROOT of CANADA, Ltd.

955 St. James St., Montreal 3

Main Office & Factory: Hartford 2, Conn., U.S.A.
Offices & Agents in Principal Cities



Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.
Montreal 2, Canada • Dundee, Scotland
Offices and Agents in Principal Cities

"The Name that Counts"

For complete details check No. 56 on handy card, page 49

PRECISION FREQUENCY MEASUREMENTS...

0.1 to 175 mc. At low cost!



LAMPKIN 105-B

MICROMETER FREQUENCY METER

- Heterodyne type, A.C. operated.
- Measures nearby transmitters, 100 KC to 175 MC (to 3000 MC by measuring multiplier stages of crystal-controlled transmitters).
- Accuracy better than 0.0025%. Reset-ability 0.0005%.
- Automatic correction for temperature of crystal calibrator.
- Pinpoint CW signal generator 20 MC to 200 MC.
- Size only 13" x 8 1/2" x 5". Weight 9 1/2 lbs.
- Price \$220.00 net (does not include duty).

Satisfaction guaranteed or money refunded.

For indication of FM deviation, up to 25 KC swing, at carrier frequencies from 25 to 500 MC, use the companion unit: the LAMPKIN 205-A FM MODULATION METER.

Write today for technical data on both instruments.

LAMPKIN LABORATORIES, INC.

Dept. 707, Bradenton, Florida, U. S. A.

For complete details check No. 32

Standard Signal Generator...

NEW



Model 560-FM

Price - \$640.00

for mobile communications . . .

- Frequency ranges 25-54, 140-175, 400-470, 890-960 Mc.
- Fine tuning control shifts carrier ± 8 Kc.
- Peak deviation to ± 16 Kc. read directly on meter.
- Residual FM less than 100 cycles at 460 Mc.
- Output 0.1 to 100,000 microvolts accurate $\pm 10\%$ across 50 ohm termination.
- Excellent stability.
- Modulation by 1000 cycle internal or by external source.

Laboratory Standards

WRITE FOR BULLETIN

MEASUREMENTS
A McGraw-Edison Division
BOONTON, NEW JERSEY

For complete details check No. 33

New Products

Miniature telephone type relays

Item 2346

The MH Series Relay — considered to be one of the most widely used types of miniature telephone type relays in existence today — is now in production at the plant of Potter & Brumfield Canada Ltd. of Guelph, Ontario.

The MH is used in airborne computers, measuring devices, communications systems and is one of the P&B relays used in the Atlas ICBM system. It is also used in industrial controls and other applications requiring many switching elements (up to 6pdt) controlled by a small signal voltage, approximately 1.6 watts at nominal voltage.

The small size of the MH relay also adds to its utility. Measuring only 1 5/8" long x 25/32" wide x 1 1/8" high and weighing only 2 ounces (4pdt models), the MH is small and compact yet still provides multiple switching capabilities.

This relay can switch up to 5 ampere, 115 volts, 60 cycle, resistive loads. It can be furnished to operate on AC or DC voltage or DC current although AC operated models are limited to two poles and cannot be furnished enclosed.

For additional information write to Technical Information Department, Potter & Brumfield Canada Ltd., 135 Oxford Street, Guelph, Ontario.

AC voltage regulators Item 2347

A new line of compact, heavy-duty electromechanical AC voltage regulators is announced by the American Rectifier Corp. of New York. Called the Selenivac, these precision units are designed for 25, 50, 60 or 400 cycle operation and provide $\pm 1\%$ control with no waveform distortion. Input voltages may be one-phase, two-phase (3 or 4 wire) and three-phase. The highly efficient Selenivac is unaffected by line or system power factor.

The Selenivac is primarily intended for applications where large quantities of regulated power are needed. It has been successfully utilized in rectifier power supplies in all ratings and outputs where the instantaneous response of a magnetic amplifier is not required. The Selenivac can remain in the system with the regulator operating with no effect on either the equipment or the line.

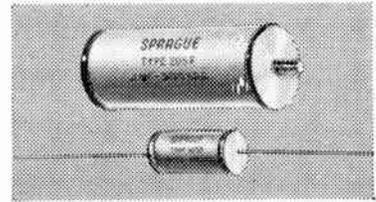


A switch permits either manual or automatic operation — a very desirable feature for testing voltage limits of equipment. Present line includes ratings from 1 KVA to 300 KVA and any input or output voltage up to 600 volts. Selenivac, featuring a wider input voltage range (greater than $\pm 10\%$), up to 100 KVA are also stocked. The response time is approximately 5 volts per second, depending on the size of the Selenivac and voltage range.

If DC regulation is needed, the Selenivac will sense against the DC output voltage with the same degree of accuracy.

Additional data and prices may be secured by writing directly to the manufacturer, American Rectifier Corporation, 95 Lafayette Street, New York 13, N.Y., U.S.A.

Continued on page 46



High Voltage, Glass-Encased Difilm® Vitamin Q® Capacitors

High-altitude and high-voltage capacitor applications in airborne electronic equipment are simplified with Sprague's new Type 205P Difilm Vitamin Q capacitors! These glass-encased, dual-dielectric capacitors are specifically designed to minimize corona problems.

SPRAGUE®

CANADIAN MANUFACTURING REPRESENTATIVE

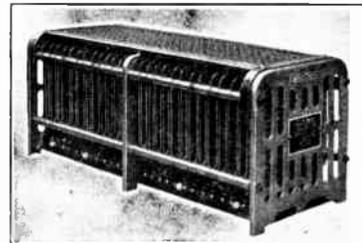
Micarta Fabricators Limited

18 Toronto Street
Toronto, Ontario

Phone EMpire 8-4251

For complete details check No. 50

Hartford Conn., U.S.A.



OHM-SPUN RESISTOR
Dummy Antenna—Heater Units
Wide Variety of Ohmic and Wattage Ratings

PHASE SHIFTERS

Phase Displacement continuously from 0° to 360°.

Made in
50 — 200 —
300 — 500 —
1000 VA.



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IRVING SMITH LTD.
2095 Madison Avenue
MONTREAL

For complete details check No. 52

FREED VARIABLE TEST VOLTAGE MEGOHMMETER



NO. 1620

The Freed Type 1620 Megohmmeter is a versatile insulation resistance measurement instrument with a continuously variable DC test potential from 50 to 1000 volts.

Components such as transformers, condensers, motors, printed circuits, cables and insulation material can be tested at their rated voltage and above, for safety factor.

- Resistance — 0.1 megohms to 4,000,000 megohms.
- Voltage — variable, 50 - 1000 volts.
- Accurate — plus or minus 5% on all ranges.
- Simple — for use by unskilled operators.
- Safe — high voltage relay controlled.
- Self contained — AC operated.

OTHER MEGOHMMETERS AVAILABLE:

Type 1620C MEGOHMMETER — a type 1620 with additional circuitry for testing capacitors.

Type 1020B MEGOHMMETER — a 500 volt fixed test potential. Range 1 megohm to 2 million megohms.

Type 2030 PORTABLE MEGOHMMETER — battery operated, 500 volt test potential. Range 1 megohm to 10 million megohms.

Send for NEW 48 page transformer catalog. Also ask for complete laboratory test instrument catalog.

FREED TRANSFORMER CO., INC.

1716 WEIRFIELD ST., BROOKLYN (RIDGEWOOD) 27, N.Y.

For complete details check No. 25 on handy card, page 49

ADCOLA
(Regd. Trade Mark)

SOLDERING EQUIPMENT

*Illustrated
The Adcola*

Cat No. 64
(3/16 bit)

CSA APPROVED

*Designed for
bench line
production and
continual use.*

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Canadian, British
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Reg. Designs.



*Adcola
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**operate at
correct soldering
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ensuring
permanent and
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*Supplied in all
volt ranges.*

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For complete details check No. 1 on handy card, page 49
ELECTRONICS AND COMMUNICATIONS, May, 1959

SMOOTH AND PRECISE ELECTRONIC CONTROL



LIGHTING



MECHANICAL POWER



ANNEALING



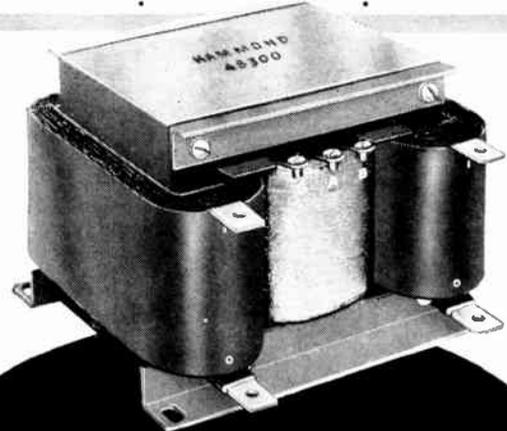
BATTERY CHARGING



CHEMICAL PROCESSING



ELECTRO PLATING



HAMMOND SATURABLE REACTORS

Hammond Saturable Core Reactors will control large A.C. powers with small amounts of D.C. Current. They are highly efficient, completely reliable and require no maintenance.

Available in all sizes, from milliwatt level to 50 kilowatts, and for all commercial power frequencies including 400 cycle. A typical Hammond Saturable Reactor, when connected in series with a load, will vary the load voltage from 10% to 95% of line voltage. The D.C. power requirements are generally 2% of the controlled power. The Reactor may be remotely controlled by a small potentiometer.

Saturable reactors are not expensive and have numerous varied applications throughout industry.

Write for Bulletin 5057.

INDUSTRIAL and SPECIAL TRANSFORMERS

HAMMOND MANUFACTURING CO. LTD.

H/13 GUELPH • ONTARIO • CANADA

For complete details check No. 29 on handy card, page 49

CANADA'S COMPLETE QUALITY PACKAGE

DU MONT® 2-WAY RADIO



Now available at competitive prices, 30, 60 and 100 watt mobile equipment for full coverage and extended range. Dumont 30 mc/s and 150 mc/s equipment features "strip chassis" construction utilizing new electrical and mechanical designs to provide base station stability in a mobile unit. Vibrator, dynamotor, or transistorized power supplies now available for most models. All Dumont models fully certified for land-mobile service and comply with D.O.T. type approval requirements for split channel use.



(Made in Canada)

Features

- Superior receiver sensitivity for crystal-clear reception
- Defies obsolescence
- Rugged mechanical design
- Base station stability in a mobile unit
- New "No Juggle" microphone
- Precision protection circuits
- Low power drain
- Long service life
- Simplified servicing
- Extremely low maintenance cost

ELECTRONIC SERVICE SUPPLY COMPANY

210 - 9th Avenue East Calgary, Alberta

Branches or Representatives in Most Canadian Cities

For complete details check No. 22 on handy card, page 49

New Products

3-pole commutator switch

Item 2348

Mycalex Electronics Corporation, exclusive licensee of Mycalex Corporation of America, has designed a new 3-pole commutator switch which can provide 450 contacts on a 3-inch diameter plate. The precision switch, incorporating rectangular contacts precision molded in Supramica* 555 ceramoplastic, very easily exceeds the parameters of reliability and noise level achieved by segmented contact rings of printed circuit plates.

The newly designed commutator plate, C. P. 427 — tested satisfactorily without maintenance or adjustment for over 1,000 hours at 600 rpm — has a diameter of three inches. The contact system includes three slip rings and three circling rows of contacts including a 90-point inner row, and two outer 180-point rows. The individual contacts employ an exclusive rectangular design and are molded to within an accuracy of 0.0005 inch. Innermost row contacts are .0315 inch wide; middle row contacts are .021 inch wide; outer row contacts are .0275 inch wide. Thus a greatly increased number of low level signal contacts available in an accurately reproducible, dimensionally stable, finely miniaturized plate is added to the design potential of PDM systems for guided missile telemetry.

The plate in operation has extremely low noise; less than 10 microvolts from the mechanical action of the brush and a contact resistance of about one-tenth of an ohm.

Further details available from Mycalex Corporation of America, Clifton Boulevard, Clifton, N.J., U.S.A.

*Supramica, T.M. Reg. U.S. Pat. Office.

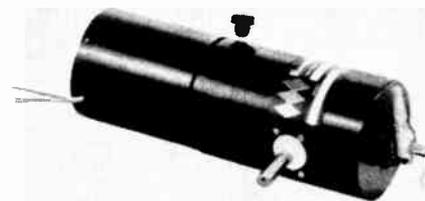
Miniature variable speed drive

Item 2349

A new lightweight miniature variable speed drive, so small it can fit in the palm of your hand, is being produced by Humphrey Products Division of Humphrey, Inc., San Diego.

Designated the Servotran, the tiny unit offers frequency response equivalent to a hydraulic system and triple that of an electrical system in a mechanical drive weighing only 1¾ pounds. The drive without motor is only 3¾ inches long by 2 inches in diameter.

A maximum of two inch ounces on the control shaft of the miniature Servotran changes speed from full forward to full reverse in .05 second. Output torque is constant and efficiency is between 85% and 95%.



The Servotran is available with several modifications to meet specific needs. Positive speed adjustment can be obtained by using an accurately calibrated dial. A flexible push-pull cable for manual remote control and solenoid control for electrical remote control can be supplied.

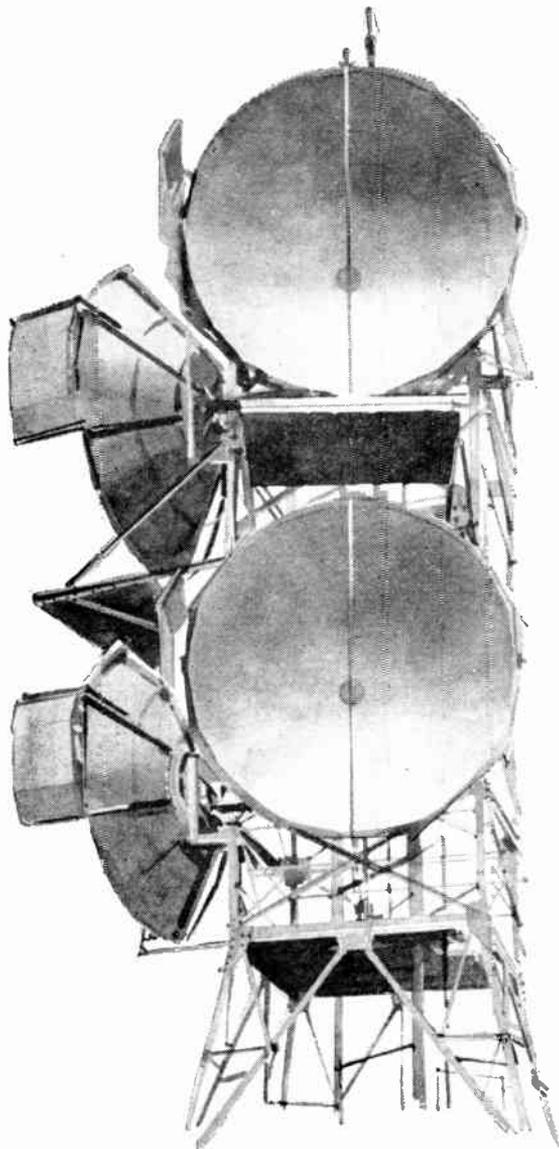
Applications for the new miniature Servotran include actuators, computers, recorders, integrators and in airborne instrumentation where low torque shifting, high efficiency, wide speed range and low noise levels are important.

For additional information write Humphrey Products Division, 3794 Rosecrans Street, San Diego 10, Calif., U.S.A.

Continued on page 51

STC **LEADERS** *in*

microwave radio systems



STC pioneered the first "micro-ray" telephone and teleprinter transmission across the English Channel in 1931 and installed the first major television link in Europe in 1952.

Thousands of route miles of STC microwave telephone and television links are in service all over the world.

Experience gained in the planning, the manufacture, and the installation of S.H.F. links throughout the world makes *STC the leaders in microwave radio systems.*

7000 Mc/s S.H.F. LINK

STC 7000 Mc/s F.M. S.H.F. radio link is designed for use on feeder routes and is capable of carrying several telephone supergroups or television. Facilities can be provided for interworking with other radio links or with coaxial cable systems.

PORTABLE S.H.F. LINKS

This equipment is light in weight and is quickly and easily assembled on site.

The technical skill and expert advice of STC engineers are at your disposal.



Standard Telephones and Cables Mfg. Co. (Canada) Ltd.

9600 St. Lawrence Blvd., Montreal 12, Que.

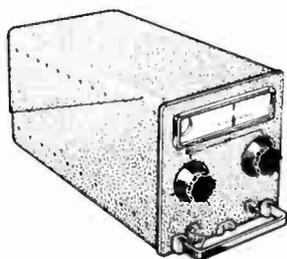
PRODUCTS FOR INDUSTRY—THE WORLD OVER

For complete details check No. 49 on handy card, page 49



AWA ELECTRONICS

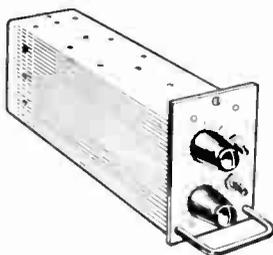
New concepts in electronics have been developed at AWA, as a result of experience with missile systems. Now they have a wider application. Here are some of the new AWA devices now available to industry.



U.H.F. WIDEBAND RECEIVER

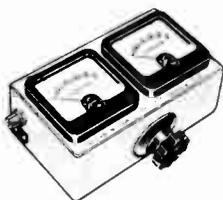
Basic arrangement consists of R.F. amplifier, mixer, local oscillator, I.F. amplifier (A.G.C. controlled), cathode follower output stage. Tuning indicator (EM 34) is also fitted to receiver. The standard forms: one for airborne racking with special separate power supply unit, the other on larger chassis including power supply unit (conventional 19" front panel). *Standard specification: 420-470 Mc/s frequency range; 4 Mc/s overall bandwidth, approximately 10 db noise factor; approximately 70 ohms input impedance, 200-250 V and 50-60 c/s input supply. Input is unbalanced, output is via low impedance (cathode follower) stage.*

TRANSISTOR GALVANOMETER AMPLIFIER

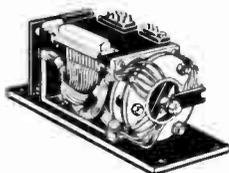


This Amplifier has been designed to drive viscous damped recording galvanometers which normally have a resistance of 50 ohms and a working range of DC to 2 Kc/s in frequency. The amplifier has a switched attenuator at its input and will accept single ended or push pull signals from ± 1 Millivolt to ± 500 volts and will feed a maximum of ± 50 Milliamps to the galvanometer. There is also a range of ancillary units available for use with this Amplifier as part of a comprehensive instrumentation system. *Standard specification: Dimensions: 4 1/4 in. x 3 3/4 in. x 10 in.; Frequency response: Flat from DC to 2 Kc/s, 5% down at 3 Kc/s, 3db down at 6 Kc/s; Noise Level: Less than 10 Microvolts; Input impedance: 40,000 ohms on range 5, 110,000 ohms all other ranges; Gain: Maximum 7.5 Milliamps/Millivolt, minimum 0.04 Milliamps/Volt; Power requirements: ± 6 Volts DC 220 Milliamps each line.*

DIRECTIONAL COUPLER



Of the 'Loop' type, suitable for measurements of RF power and Standing Wave Ratio in coaxial cables. Directional properties are largely unaffected by frequency changes, so coupler may be used to help obtain optimum termination of a 52 ohm coaxial system up to 600 Mc/s. *Standard specification: Size 7" x 4" x 2 1/2"; weighs 4 lbs. 3 ozs.; Power Measurement Range is Low range 1 w.c.w.max. High range 5 w.c.w.max.; less than 1% attenuation; better than 2% accuracy at frequency of calibration.*



ROTARY SWITCH FOR TELEMETRY

Based on a conception of British Ministry of Supply's Research and Development Establishment, gives facilities previously unobtainable from mechanical sampling devices. The Standard Model enables two 24 channel banks to be sampled at speeds up to 200 r.p.s.

All devices are adaptable to suit customers' own requirements. For further information consult:

COMMERCIAL ELECTRONICS DEPT.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,
Baginton, Coventry.

MEMBER OF THE HAWKER SIDDELEY GROUP

For complete details check No. 4 on handy card, page 49

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Signature Position

IF YOU ARE AN ENGINEER, PLEASE SO STATE — when it is not included in your job title. 5-59

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Name Position

Company Nature of Business

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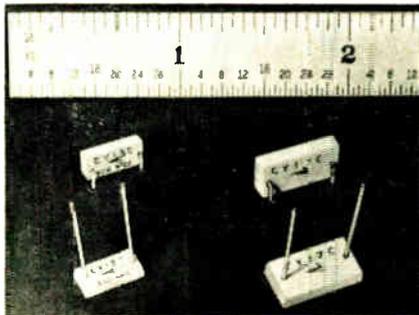


audited publication

New Products

"Vitramon" capacitor Item 2350

This new radial-lead CY17C "Vitramon" Capacitor brings capacity values in the Radial Series to 1,200 mmf at 50 to 300 vdcw. Like its predecessor, the CY13C, the CY17C in a larger case size features an exceptionally thin design (5/64 in.) whose lead geometry permits axial, radial or edge mounting.



One thousand of the smallest of this series occupy a space of approximately six cubic inches, making them particularly useful in minute circuit assemblies. Their monolithic porcelain construction leaves them immune to humidity and unaffected by high frequency vibration.

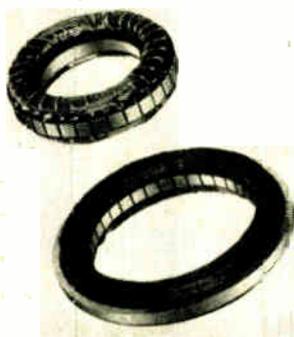
Dissipation factor is less than .0005 with a Q over 2,500. Insulation resistance is greater than 50,000; capacitance drift less than 0.05% with a TC of 115 ± 25 ppm/°C from -55°C to $+125^{\circ}\text{C}$ with absolute retrace, all units being within 5 ppm of one another. When ordered under Specification S-1002, an AQL of better than 0.5% is assured.

Vitramon, Incorporated, Box 544, Bridgeport, Conn., U.S.A.

Pancake synchros and resolvers

Item 2351

Luther Manufacturing Co. announces the availability of high accuracy pancake synchros and resolvers. These synchros and resolvers are precision manufactured and are designed to be used in instruments, such as inertial guidance systems where a pancake configuration is necessary for space and weight limitations.



These units are currently being supplied to leading instrument manufacturers in the inertial guidance field and are available in Size 20 and Size 27 featuring accuracies down to 5 minutes. The electrical properties of these units are designed to meet specific applications and can also be designed to match standard components for accuracy, voltage gradient and impedances.

It is also possible to obtain these units with flanges and hubs as an integral part for ease of installation and adjustment.

Literature and drawings will be sent upon request to Luther Manufacturing Co., 7312 Varna Street, North Hollywood, California, U.S.A.

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MUIRHEAD MAGSLIP BROAD SHEET

Write
for
your
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to-day



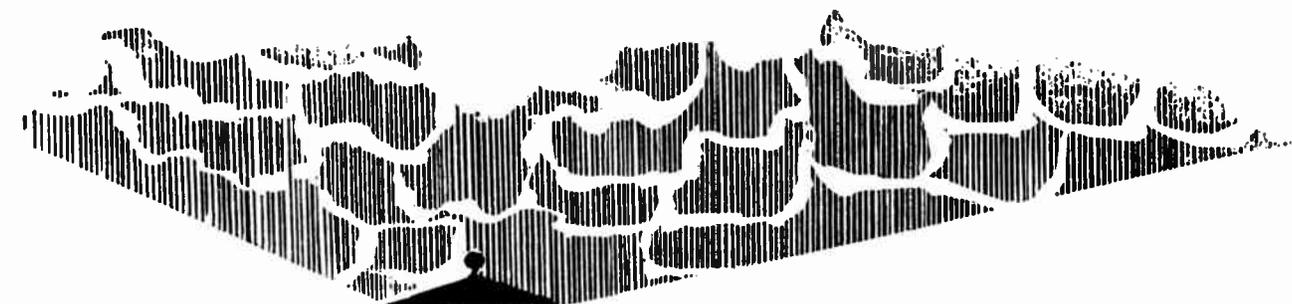
This handy broadsheet,
prepared in tabular form
for easy reference, presents brief
specifications of the entire range of
Muirhead Magslip elements.

A MUST FOR ALL DESIGNERS

MUIRHEAD INSTRUMENTS LIMITED
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For complete details check No. 34 on handy card, page 49



DEPENDABLE POWER



LISTER AIR COOLED DIESEL ENGINES

In every field, Lister engines have proven themselves—setting a high standard of reliability and economy for industry and utilities. They are particularly suited to use in generating assemblies—for continuous running without attention.

Among their varied uses, Lister engines are in use for pumping and construction machinery, generating sets and marine propulsion. Parts and service are available throughout Canada.

Lister HA air cooled range. Direct injection for cold starting and greater economy. 10 BHP per cylinder continuous rating. 1800 RPM. Designed for working under the most varied conditions.

Write us for your free copy of Bulletins LD, SL and HA which describe, in detail, the Lister air-cooled range of Diesel engines 3½—30 BHP. Indicate application.

Lister-Blackstone engines 3½—1400 BHP.

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In the U.S.: Lister-Blackstone, Inc., 42-32 21st Street, Long Island City 1, N.Y.

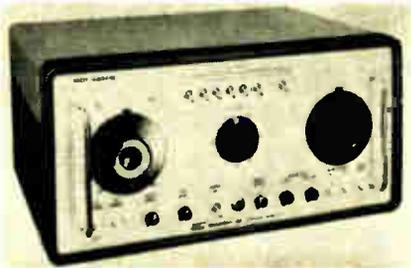
For complete details check No. 13 on handy card, page 49

New Products

High-precision sweep generators

Item 2352

New cabinet designs and improved circuitry are features of a line of high-precision sweep generators announced by Telonic Industries, Inc., Beech Grove, Indiana. Telonic models H-3, H-D, L-D and S-D are included in the test instrumentation line which, according to the manufacturer, is now available in "Sweep-Line" hinged top cabinets, with two-tone satin black and aluminum grey finish, perforated tops and integral cooling vents.



The new Telonic sweep generator models feature exceptional flatness, high output and low leakage. Designed for production test or developmental checkout applications, the units are engineered with crystal controlled single frequency, or harmonic plug-in markers, with external marker provisions on all models. Variable frequency plug-in markers are available on most models. Full-width top openings and slide-track chassis mountings give easy accessibility for servicing.

Unit dimensions are 20" x 10" x 15".
Telonic Industries, Inc., Beech Grove, Indiana, U.S.A.

MICRO-MINIATURE precision wire-wound RESISTORS

fixed, noninductive

newly developed Kelvin "RELAXED WINDING" techniques practically eliminate resistance drift with age and "shorts" or "opens" due to thermal shock.



PLASTIC ENCAPSULATED SERIES "EP"

The 0.05W micro-miniature type EP-00 is .080" dia. x .325" long, 50K ohms max. resistance. Available with radial and axial lead wires. ALL CONNECTIONS ARE WELDED. High temperature epoxy plastic is used in an exclusive vacuum encapsulation process. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -65°C to +125°C.

Send for literature



CERAMIC SERIES "CB"

The 0.15W miniature type CB-05 is 1/4" dia. x 1/4" long, 500 K ohms max. resistance. Available with radial and axial lead wires, or lug terminals. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -55°C to +85°C.

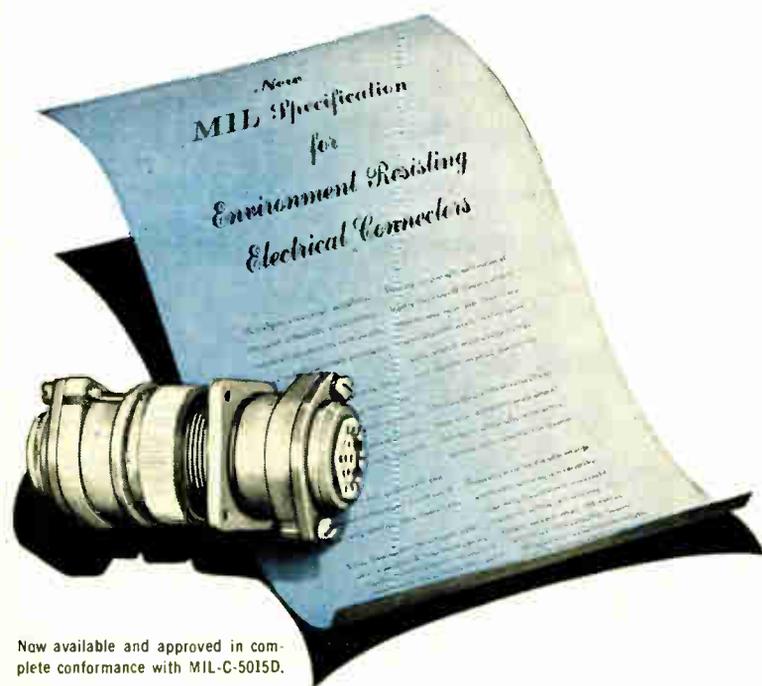
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Van Nuys, California

Exclusive Canadian Distributor:

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1514 Eglinton Avenue West
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For complete details check No. 31 on handy card, page 49

NEW BENDIX MS-R ENVIRONMENT RESISTING ELECTRICAL CONNECTOR



Now available and approved in complete conformance with MIL-C-5015D.

This new connector answers the demand from the aircraft industry for a shorter, lighter and more reliable environment resisting connector. This connector will inactivate practically all other MS types and the Military has assigned a new class letter R to insure incorporation of this better connector in all new designs.

An important reliability feature of the new MS-R connector is an "O" ring at the main coupling joint which provides for the best possible sealing and more positive inter-facial compression and assures complete performance compatibility among all approved MS-R connectors. Establishment of the MS-R connector as the "universal" military connector is testimony to the record of previous MS environmental resistant connectors using resilient inserts as pioneered by this Division. In the Bendix* connector, wire sealing is accomplished by an exclusive slippery rubber grommet which permits convenient wire threading and grommet travel over wire bundles.

Write for more complete information on this latest addition to the ever-growing family of Bendix electrical connectors.

*TRADEMARK



SCINTILLA DIVISION
SIDNEY, NEW YORK



Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N.Y.

Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec.

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ELECTRONICS AND COMMUNICATIONS, May, 1959

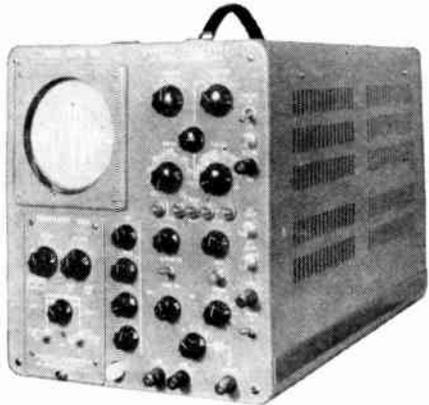
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FROZEN TRANSIENTS

with the Hughes MEMO-SCOPE®
Oscilloscope

Trial and error methods necessary to capture elusive transients on conventional scopes waste time, film, and precious research dollars. Never again need this happen. With the Hughes MEMO-SCOPE® oscilloscope you may instantly "freeze" wave forms with brilliant clarity for careful study, comparison and analysis.

The Hughes MEMO-SCOPE® oscilloscope retains these frozen transients until intentionally erased. Selected transient information may be triggered externally or internally. Successive wave forms may be written above, below or directly over the original information.



Sweep Speed for Storage: 10 microseconds to 10 seconds per division (0.33").

Frequency Response: DC to 250 KC down 3 db.

Sensitivity: 10 millivolts to 50 volts per division or with optional high sensitivity preamplifier 1 millivolt to 50 volts per division.

Applications: Trouble shooting data reduction equipment . . . switch and relay contact study . . . ballistics and explosives research . . . ultrasonic flaw detection . . . physical testing — shock — stress — strain.

Memo-Scopes® are stocked in Toronto and Montreal.



Write for complete technical bulletin and demonstration at your own plant.

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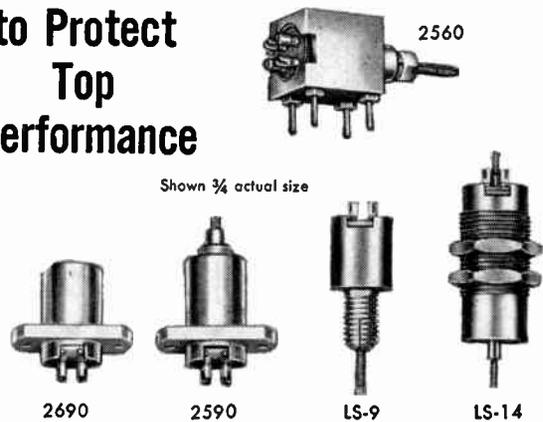
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For complete details check No. 43 on handy card, page 49

Shielded — to Protect Top Performance



Shown ¾ actual size

CAMBION® miniaturized, completely shielded coil forms provide the shock resistance needed for top performance in any "tight spot" applications — IF strips, RF strips, oscillator circuits, etc. Mechanically enclosed for maximum efficiency preventing circuit inter-action in closely packed spaces, they're available with coil forms of three different materials — paper phenolic, Polypenco or Kel-F — and in styles including flange mounted "top hat" with traverse tuning and the new half-inch cubical unit for printed circuits and difficult IF strip work.

Also, custom winding of CAMBION coil forms to meet specifications is a CAMBION engineering specialty that can cut your production costs and eliminate rejects completely. For further details write Cambridge Thermionic of Canada, Ltd., 2425 Grand Boulevard, Montreal 28, P. Q.

For complete details check No. 12 on handy card, page 49

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G-V
time delay
relay
does many jobs



other thermal
relays
cannot do . . .

- For military or industrial use
- Miniature and octal sizes
- Plug-in or flanged mounting
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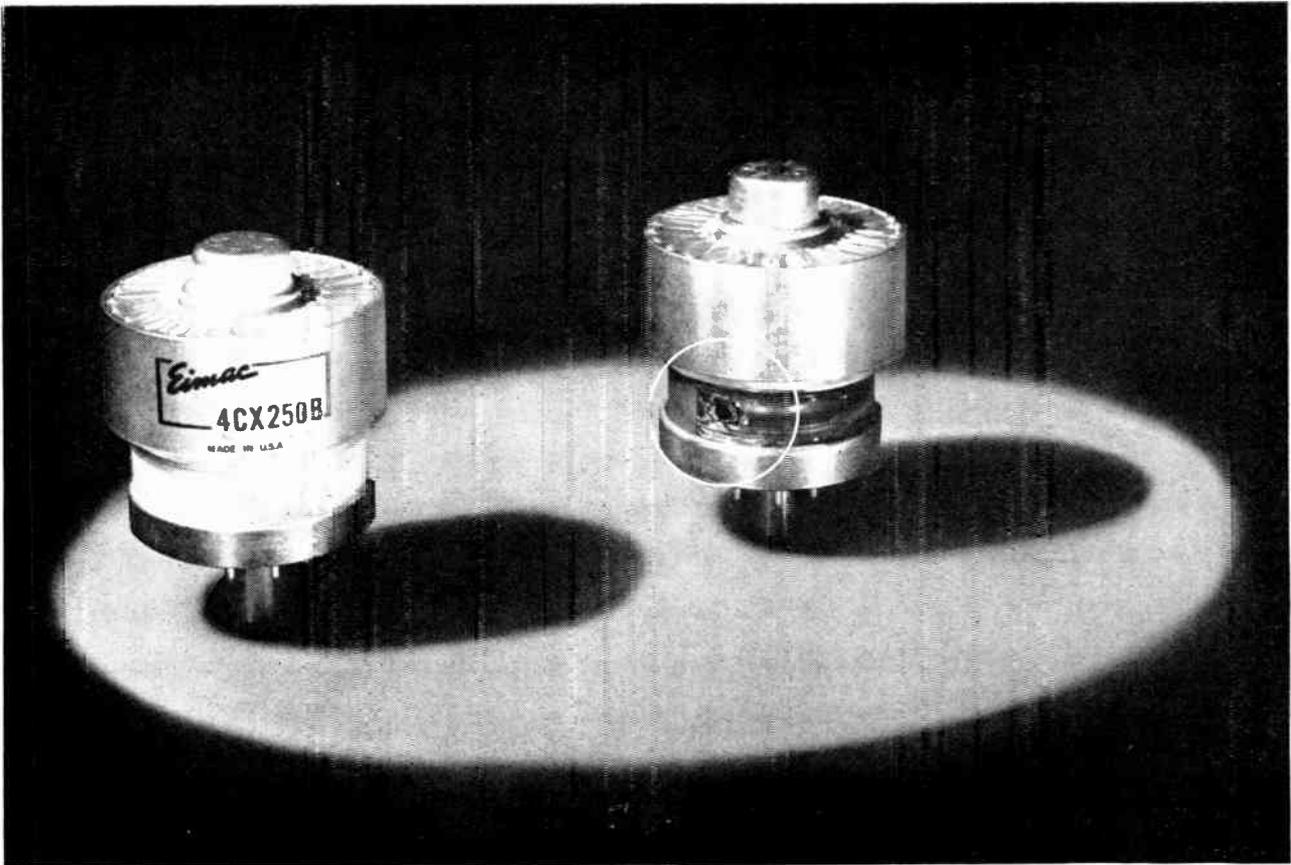
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Write for bulletin and help with your particular problems



G-V CONTROLS INC.
LIVINGSTON, N.J.

Represented in Canada by:
LEONARD ELECTRIC, LTD., 346 Bering Ave., Toronto 18
For complete details check No. 26 on handy card, page 49



Fifth in a series describing the advantages of ceramics in electron tubes. Previously discussed: impact, heat, vibration, compactness.

Lower Dielectric Loss is an Eimac Ceramic Tube Extra

Ceramic is considerably superior to glass in terms of dielectric loss at high frequencies. The ceramic Eimac 4CX250B and the glass envelope 4X250B shown above were operated in identical 500 megacycle RF amplifier circuits, under identical operating conditions. The glass envelope tube failed catastrophically within a few minutes due to RF heating and puncture of the glass envelope. Further tests of the 4CX250B at 500 Mc. with higher applied voltage showed no appreciable heating of the ceramic envelope material from dielectric loss effects.

Other tests compared glass envelope 2C39A tubes with 3CX-100A5's, their ceramic envelope counterparts. These tubes were

operated as oscillators at 2.5 KMc., under identical conditions. The 3CX100A5 ceramic tubes consistently showed a 10% greater output power than the glass envelope type, due to the lower dielectric loss of the ceramic material.

These ceramic tubes are just two of more than 40 Eimac ceramic tube types whose compactness, and resistance to damage by impact, heat, and vibration make them ideal for use wherever exceptional reliability and high performance are demanded.

Write our Application Engineering Department for a copy of the booklet "Advantages of Ceramics in Electronic Tubes"



Eimac First for high power amplifier klystrons.

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA



2036 Prince Charles Road, Ottawa.

5902

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Negative Grid Tubes
Reflex and Amplifier Klystrons
Ceramic Receiving Tubes
Traveling Wave Tubes

Vacuum Tube Accessories
Vacuum Switches
Vacuum Pumps

Includes an extensive line of ceramic electron tubes

For complete details check No. 20 on handy card, page 49

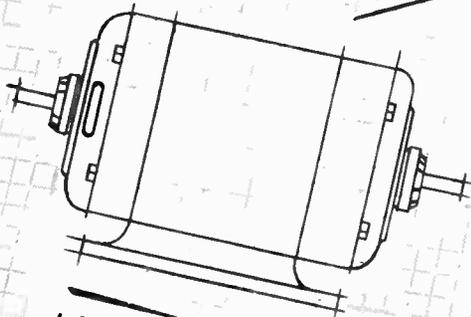
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55

FEDERAL ISONEL

Solves High Temperature Motor Problems

Reduce size but maintain H.P.



*Specify Federal's Isonel Magnet
Wire for the windings*

**Now available
in square and
rectangular shapes!**

The outstanding thermal properties of Federal's (Polyester) Isonel Magnet wire permit the operation of motors at higher temperatures—suitable for use at Class F (155°C) temperatures. This means the motor size can be reduced for a given horsepower, or greater horsepower can be obtained from a given size.

While having this advantage of higher operating temperatures, Federal's Isonel possesses the excellent heat shock, chemical and abrasion resistant properties of vinyl-acetal magnet wire. It has improved resistance to flow at high temperatures; and it does not craze, giving higher voltage breakdown and better shelf-life.

*Available in Pay-Off Paks
13-23 in 250 and 500 lb.
24-29 in 100 lb. packs.*

5901

Specify Federal . . . for the best in Magnet Wire.

FEDERAL WIRE

PORTER

& CABLE DIVISION

H.K. PORTER COMPANY (CANADA) LTD.

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For complete details check No. 39 on handy card, page 49

OPPORTUNITIES

These classified advertisements are published to assist those in the trade who have articles for sale, positions available, positions desired, sales agency openings or business opportunities. Charges are 25c per word or figure, not including heading or box number. Minimum charge is \$5.00 payable on submission. No agency commission paid.

There is absolutely no charge for "positions desired" advts. Send all material to the attention of the advertising manager of **ELECTRONICS AND COMMUNICATIONS**, 450 Alliance Avenue, Toronto 9.

POSITIONS AVAILABLE

SALES ENGINEER

with Communications Systems Engineering background for position in antenna and transmission line field. Salary open.

Andrew Antenna Corporation Ltd.
606 Beech Street
Whitby, Ontario.

ELECTRONICS ENGINEER

Toronto specialists, component manufacturer requires Design and Production Engineer. No age barrier. Replies held in strictest confidence.

Box 5008
Electronics and Communications
450 Alliance Avenue, Toronto 9, Ont.

ELECTRICAL ENGINEER

for design of electronic supervisory control systems. Must have experience in or with Canadian power utilities. For new company.

Box 5010
Electronics and Communications
450 Alliance Avenue, Toronto 9, Ont.

OPPORTUNITIES

PARTNERSHIP AVAILABLE

Small expanding business in the communications and signalling field. Some commercial experience desirable but not essential. Write for appointment to:

Box 5007
Electronics and Communications
450 Alliance Avenue, Toronto 9, Ont.

SALES AGENCY

U.S. Company requires Canadian sales agency for engineered line of relays of the following types: coaxial, differential, hermetically sealed, impulse, keying, latching, mercury contact polarized, power control and overload sensitive, stepping. Subminiature, telephone, time delay contactors, solenoids, dry circuit and crystal can size.

Box 5011
Electronics and Communications
450 Alliance Avenue, Toronto 9, Ont.

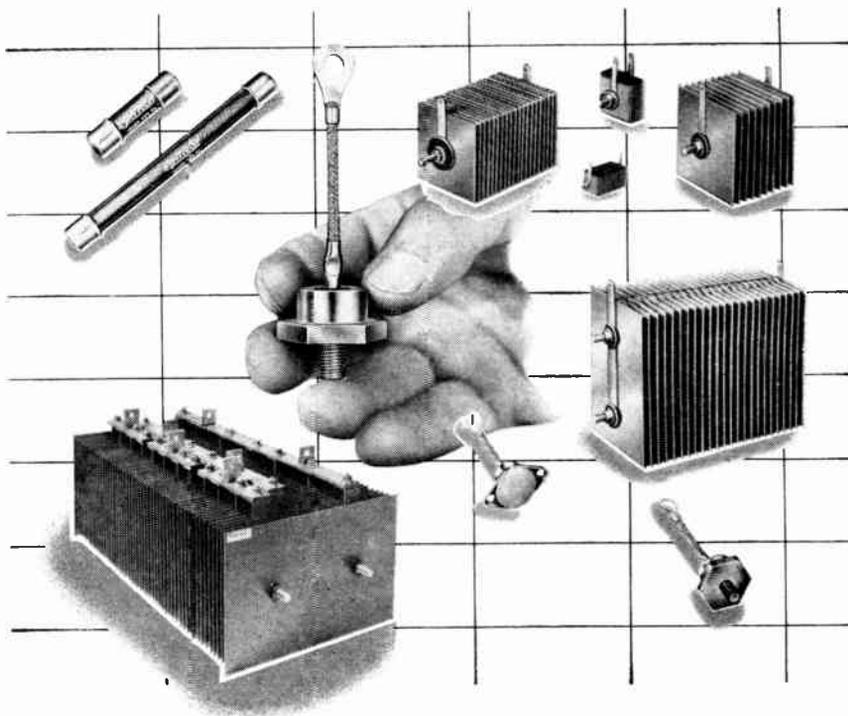
SALES REPRESENTATIVE

in Toronto and district wanted for established company. Must be familiar with all phases of electronic instrumentation. Late model car necessary. Remuneration includes salary, expenses, commission, fringe benefits as well as opportunity to invest in growing company. Reply in first letter, giving all details of qualifications and salary expected. All replies held strictly confidential.

Box 5012
Electronics and Communications
450 Alliance Ave., Toronto 9, Ont.

SYNTRON

SILICON OR SELENIUM RECTIFIERS



**Efficient, dependable, low-cost a-c to d-c conversion
— for all your d-c needs**

SYNTRON provides engineers with the advantages of either silicon or selenium semi-conductor materials.

SYNTRON Vacuum Processed Selenium Rectifiers offer the widest range of cell ratings in the industry.

High Voltage Cartridge Selenium Rectifiers are designed for dependability and long life. With direct current ratings up to 10 ma and 13,200 volts. Hermetically sealed and phenolic tube type.

Industrial Power Rectifiers are light weight, dependable and economical: High efficiency, i.e. — ratio of power output to power input for wide range of loads — low forward drop — high reverse voltages — voltages upward to 52 volt R.M.S. Plate sizes range from 1 inch square to 12 x 16 inches.

Silicon Power Rectifiers are designed for use in intermediate power level applications. Diodes are all-welded construction, hermetically sealed. Exceptional thermal efficiency — less than 2°C per ampere of forward current. Supplied as flat base or stud mounted units with either flexible or rigid positive leads.

The illustration above suggests SYNTRON'S complete line of Selenium and Silicon Rectifiers available for all your d-c needs.

Write for detailed literature and specifications

SYNTRON (CANADA) LIMITED
12 MAIN STREET EAST • Dept. K • STONEY CREEK, ONTARIO

editorial

U.S. largest buyer of British electronics

The U.K. electronics industry may be broadly defined as covering the manufacture of communications and radar equipment, scientific and industrial instruments and a wide range of other equipment utilizing electronics devices such as electronics valves and transistors. It is one of Britain's most rapidly expanding industries, and in size is exceeded only by that of the United States. The annual value of exports of electronic components and equipment in 1957 exceeded £43 million. The range of products extends from cathode ray tubes to nucleonic instruments and large digital computers.

United Kingdom scientists and inventors have been responsible for many of the basic advances in electronics. Sir Ambrose Fleming patented the first thermionic valve in 1904; the first television pictures were transmitted by J. L. Baird in 1925; the first public television service was started by Britain in 1936; radar was developed by Sir Robert Watson-Watt; electronic printed circuits were developed in Britain; and the basic research which led to the invention of the transistor was carried out by a British scientist. British firms lead the world in the design and production of systems for marine navigation aids and air traffic controls, and Britain has a world-wide reputation for high-fidelity sound reproduction equipment.

It has been estimated unofficially that the industry employs more than 200,000 workers. According to the Ministry of Labor and National Service, at the end of December 1957, 140,300 were employed in the manufacture of radio and television sets and gramophones, 52,300 in the manufacture of radio valves and electric lamps and 61,400 in the manufacture of telegraph and telephone apparatus. Most of the workers in these three groups are concerned with the electronics industry.

For statistical purposes the electronics industry in the United Kingdom is not treated as a separate industry and, therefore, full statistical information is not available. It has been estimated that the value of the industry's output, including telecommunication equipment, amounted to £300 million in 1956, and rose to about £340 million in 1957. An appreciable proportion of production is in the form of scientific instruments and measuring and control devices. Electronic equipment has a key role in the development of nuclear power and is a vital component in the design, production and operation of aircraft. Electronics are increasingly important in the defense services, a large element of the cost of guided missiles, for example, being accounted for by the incorporated electronic devices.

The building of electronic digital computers is a relatively new sphere of activity, but by the end of 1957 there were already more than 150 on order from British firms. Consumer goods are mainly represented by radio and television sets, but for future growth the industry is more closely linked with the production of capital goods, the range of which is being constantly extended by research and development. In 1957, for the first time, the total value of capital-equipment electronics exceeded that of consumer products.

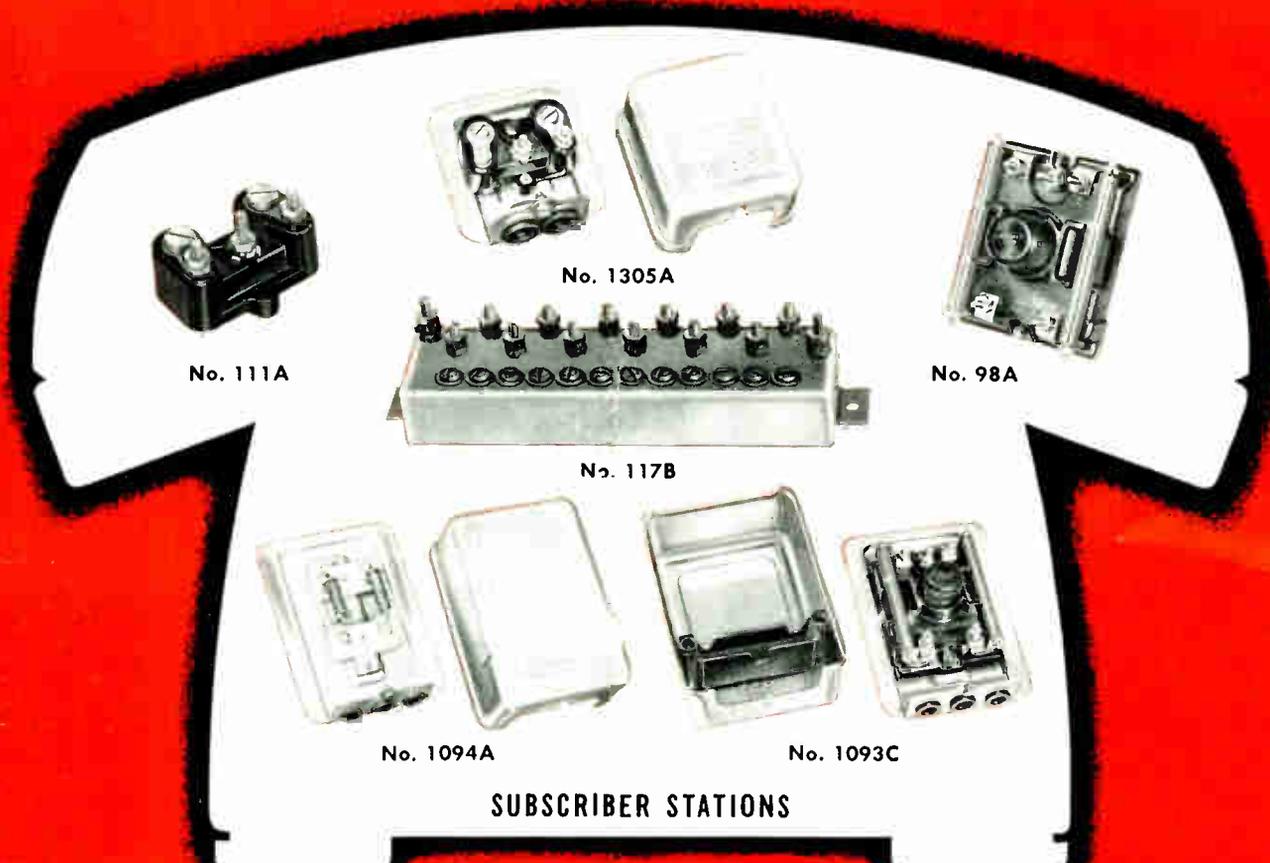
The manufacture of electronic equipment and components is one of Britain's most rapidly expanding export industries. The value of exports increased by nearly one-third between 1955 and 1957 to a total of £43.5 million. The rise in exports of marine and air navigation aids, of which the United Kingdom is the world's largest supplier, was particularly marked in the five years 1953 to 1957.

The largest market in 1957 was the United States, followed by Australia, South Africa and India. The most important European customers are the Netherlands and Sweden.

Imports in 1957 totalled £12.0 million, as compared with £11.0 million in 1956. The largest suppliers are the Netherlands, the United States and West Germany.

BETTER PROTECTION

for telephone installations



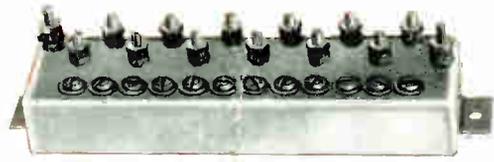
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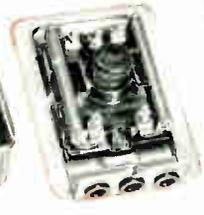
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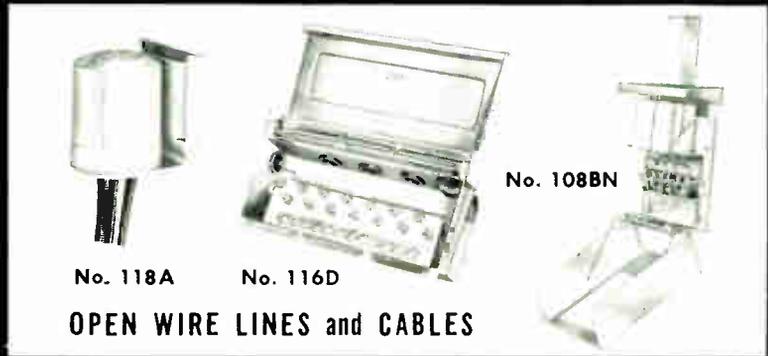
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SUBSCRIBER STATIONS



No. C50A

CENTRAL OFFICE



No. 118A



No. 116D



No. 108BN

OPEN WIRE LINES and CABLES

Contact your nearest *Northern Electric*
Distributing House for further details

For complete details check No. 38 on handy card, page 49

AN IMPORTANT **NEW** VHF-UHF INSTRUMENT

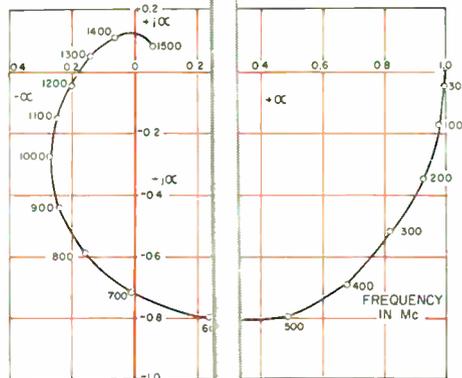
★ Measures Directly All Complex Impedance, Admittance, and Transfer-Functions of:

TRANSISTORS	VACUUM TUBES	THREE- AND FOUR-TERMINAL NETWORKS
$\alpha, \beta, h_f, h_r, h_i, h_o, r'_b,$ all short-circuit admittance and open-circuit impedance parameters.	$Y_m (Y_{21}), Y_{12}, Y_{11}, Y_{22},$ etc.	$Z_{11}, Z_{22}, Z_{21}, Z_{12}$ $Y_{11}, Y_{22}, Y_{21}, Y_{12}$ $I_2/I_1, I_1/I_2, E_2/E_1, E_1/E_2$

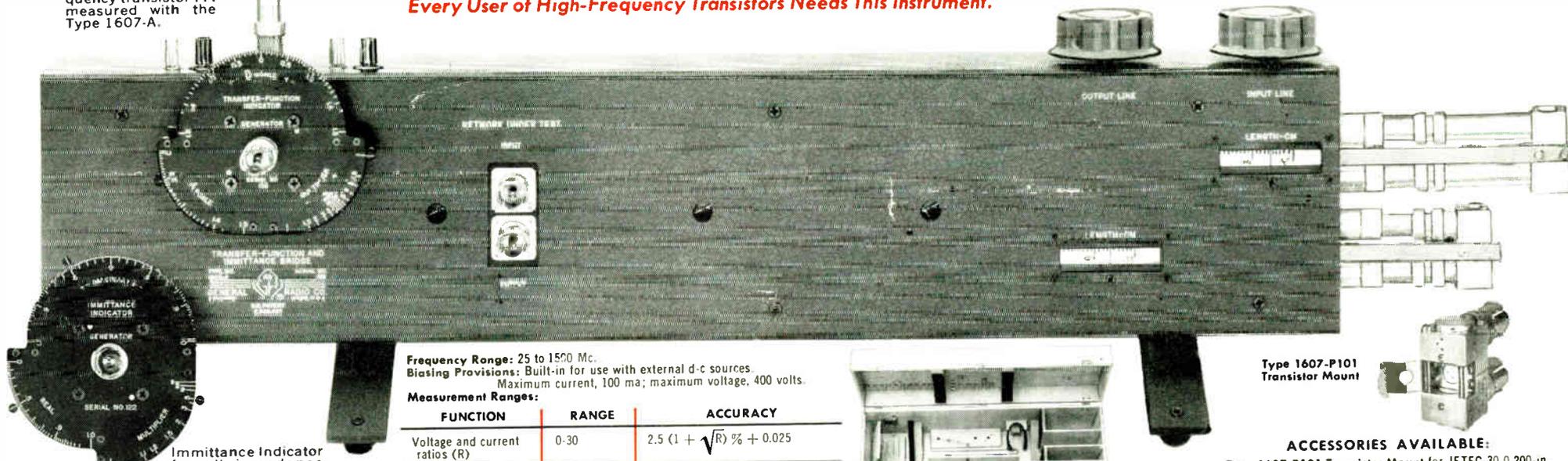
★ A Basic Tool for Measurement of: Gain and Phase Shift of Amplifiers, Transmission Circuits, and Other Active and Passive Four-Terminal Networks; Impedance, Admittance, Reflection Coefficient, and VSWR of Components, Coaxial Systems, and other Grounded or Ungrounded Elements.

★ Equally Suited for Advanced Laboratory Investigations and Rapid-Quantity Production Testing

Every User of High-Frequency Transistors Needs This Instrument.



Plot of Alpha versus frequency for an experimental high-frequency transistor... measured with the Type 1607-A.



Frequency Range: 25 to 1500 Mc.
Biasing Provisions: Built-in for use with external d-c sources
Maximum current, 100 ma; maximum voltage, 400 volts.

Measurement Ranges:

FUNCTION	RANGE	ACCURACY
Voltage and current ratios (R)	0-30	$2.5 (1 + \sqrt{R}) \% + 0.025$
Transimpedance (Z_{21})	0-1500 ohms	$2.5 (1 + \sqrt{\frac{Z_{21}}{50}}) \% + 1.25$ ohms
Transadmittance (Y_{21})	0-600 mmhos	$2.5 (1 + \sqrt{\frac{Y_{21}}{20}}) \% + 0.5$ mmho
Impedance (Z_{11})	0-1000 ohms	$2.0 (1 + \sqrt{\frac{Z_{11}}{50}}) \% + 1.0$ ohm
Admittance (Y_{11})	0-400 mmhos	$2.0 (1 + \sqrt{\frac{Y_{11}}{20}}) \% + 0.4$ mmho

Type 1607-A Transfer-Function and Immittance Bridge, \$1665.

GENERAL RADIO COMPANY

Canadian Engineering Office in TORONTO

99 Floral Parkway, Toronto 15, Ontario
Arthur Kingsnorth • Richard J. Provan
Tel.: CHerry 4-6221

Repair Service: Boyley Engineering Ltd., Ajax, Ontario

Type 1607-P101 Transistor Mount

ACCESSORIES AVAILABLE:

Type 1607-P101 Transistor Mount for JETEC-30 0.200-in. pin-circle triode with grounded-base arrangement. \$60.

Type 1607-P102 Transistor Mount for JETEC-30 0.200-in. pin-circle triode with grounded-emitter arrangement. \$60.

Type 1607-P201 Tube Mount, 7-pin miniature, grounded cathode for 6AF4, 6AF4A, 6AN4, 6T4, and other tubes with the same pin connections \$75.

ACCESSORIES SUPPLIED:

Frequency-Range Extension Unit; Two Calibrated Transfer-Function and Immittance Indicators; Terminations; Standards; 10-dB Attenuator; Air Lines, Patch Cords, and other Coaxial Elements.

Other mounts for tetrodes, 0.100-in. pin-circle triodes, and ungrounded components are in development and will be announced soon.

Generator and Detector: G-R Unit Oscillators and Type DNT Detectors are recommended.