Eimac News

FEBRUARY • 1945

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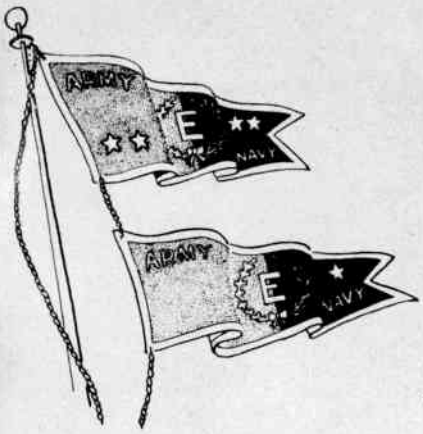

Volume 3

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Number 15

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● THE COVER PHOTO

Completely evacuated transmitting tube is removed from the manifold of a rotary exhaust apparatus at the end of a 3-hour pumping cycle, in which occluded gases in the tube have been driven out by internal electronic bombardment.

INQUIRIES CONCERNING EIMAC PRODUCTS MAY BE ADDRESSED TO THE SALES ENGINEERING DEPARTMENT, EITEL-McCULLOUGH, INC., SAN BRUNO, CALIF., OR TO THE FIELD ENGINEER NEAREST TO YOUR LOCATION. EIMAC FIELD ENGINEERS ARE STATIONED AS FOLLOWS:

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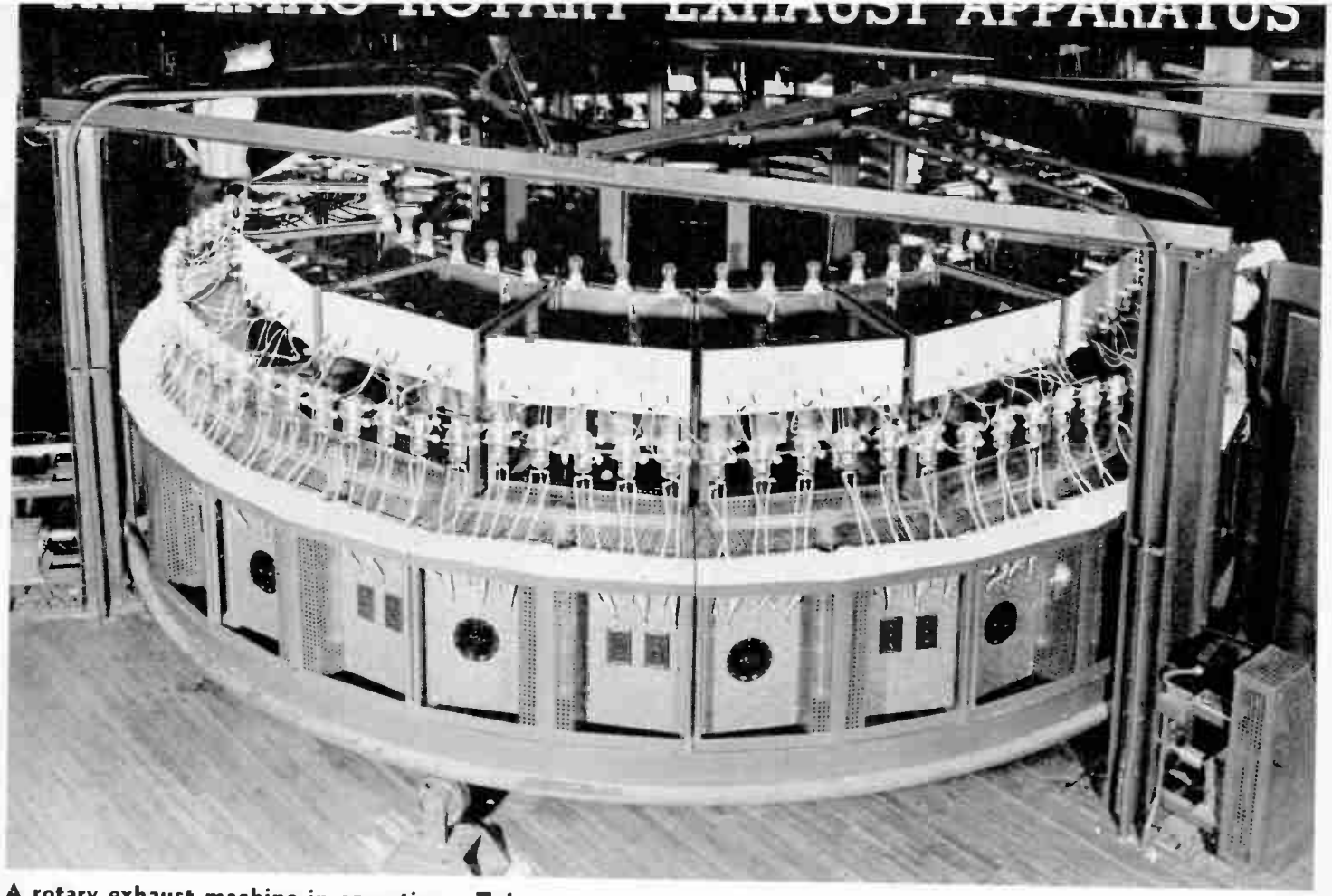

A rotary exhaust machine in operation. Tubes on part of machine facing camera are undergoing final evacuation process, a prolonged treatment at high electrode temperatures to remove the last traces of gas. Note the air-blast cooling unit at the extreme right. Two of the driving motors may be seen at lower left and right.

The problem of meeting ever-increasing demands for transmitting vacuum tubes without impairing the quality which led to the demand has been a major concern of much of the Eitel-McCullough organization for several years.

Of all the problems involved in plant expansion, the one of evacuating or "pumping" has probably been the greatest. When Eimac tubes were built on a small scale, tubes were pumped almost "by hand." Each pump operator was familiar with the operation of transmitting tubes, and each tube was handled with almost loving care while on the pump. There was at that time no lack of time or facilities for pumping or trained personnel to operate the pumps and make the necessary alterations when changing from one type of tube to another.

Eimac's eight rotary exhaust units with their arcs of white-hot tubes are a constant source of amazement to visitors to the Salt Lake and San Bruno plants. Since their installation, these units have made possible the production of more than 150,000 transmitting tubes per month.

With the outbreak of war in Europe and a sudden increase in the demand for both regular and special types of Eimac tubes it became evident that a drastic revision of tube pumping techniques was required if production schedules were to be met. Neither space nor personnel was available to evacuate in the allotted time the number of tubes required, with the type of evacuating equipment then being used.

Many possible mass-pumping arrangements were considered and rejected before the design finally adopted was selected. The first requirement for the exhaust mechanism was that it must result in no reduction of the quality of the tubes produced. This requirement ruled out stop-cocks, rubber hose, rotating joints and other conventional receiving-tube techniques in the high-vacuum side of the system—each tube would have to be sealed onto the vacuum system with a glass-to-glass seal and tipped off at the end of exhaust in the manner which had proved so successful in the past. It was also decided that the heating of the electrode structure would continue to be done by internal electronic bombardment, rather than by some form of induction heating, since the internal-bombardment method had a long history of successful application.

The fortunate development of the HV-1 air-cooled oil-diffusion pump by the Eimac laboratory solved a most pressing problem in the design of the evacuating mechanism, since it removed the necessity of supplying cooling water required by the water-cooled diffusion pumps then in use. The greater pumping speed of the HV-1 (70 liters per second, as compared with two liters per second for the old-style pump) also showed a small reduction in pumping time, although an exhaust cycle of approximately three hours was still maintained for each tube to obtain the highest possible degree of vacuum.

The final exhaust machine design, as conceived by

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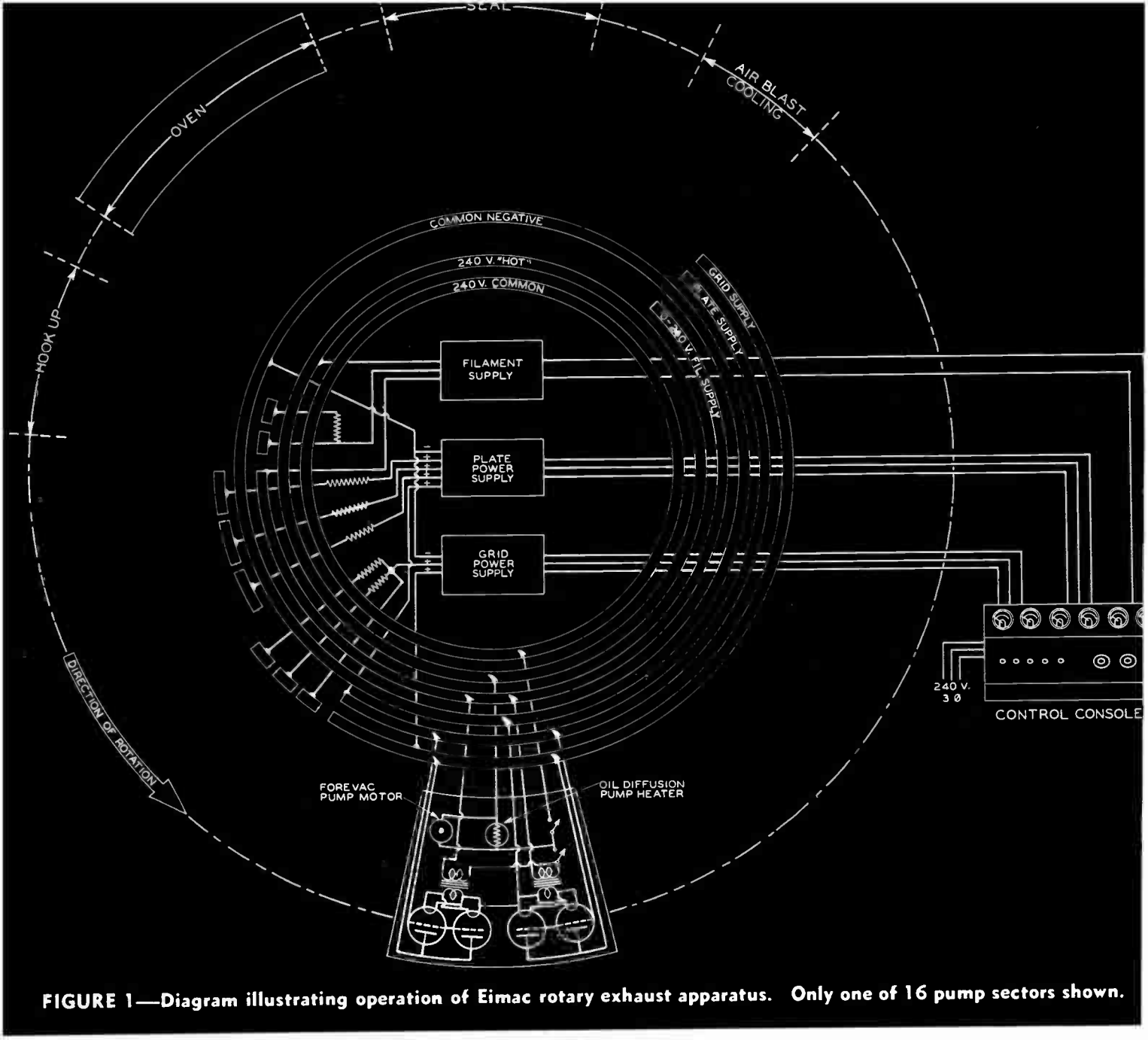

FIGURE 1—Diagram illustrating operation of Eimac rotary exhaust apparatus. Only one of 16 pump sectors shown.

The Eimac Rotary Pump (continued)

Messrs. Eitel, McCullough and T. C. Hall, in the latter part of 1941 and carried out by A. M. Newhall and the Engineering Dept., and T. C. Hall and Arthur Arrigoni of the Construction Dept.. called for a circular rotating structure based on a 14-foot wheel and carrying 16 individual V-shaped sectors. Each sector was to be a complete evacuating unit less plate and grid power supplies, but including the necessary filament transformers. Each sector was to be capable, through the use of interchangeable manifolds, of providing for the evacuation of from two to 12 tubes, depending upon the tube type. The first unit, which was intended for the VT-127A type, was to carry six tubes per sector and make one revolution each three hours. This unit was thus to provide for the evacuation of 768 tubes per 24-hour working day.

Construction

Except for the heavy work involved in bending the rim of the supporting wheels, each of the machines has been built in the Eitel-McCullough shops. The Machine Shop, under the direction of George Callwell, took care of the mechanical work, while the Construction Dept., directed by T. C. Hall, handled the electrical work. At the time the first rotary exhaust unit was being built, the material situation was most critical, and had it not been for the ingenuity of individual employees in both the Machine Shop and Construction Dept. the project could easily have been delayed several months. Through the help and interest of these people, however, everything went along smoothly, and construction progressed so rapidly that at times the Drafting Department was hard put to keep ahead of the construction work.

(Continued on next page)

The Eimac Rotary Pump (continued)

Operation

The operation of the rotary exhaust machine can best be described with the aid of the drawing on page 4. Tubes are sealed onto the glass manifold as it passes the position marked "Seal." The movement is sufficiently slow so that there is no difficulty in sealing to the moving manifold. After sealing, the switch on the front of the sector controlling the mechanical and diffusion pumps is thrown to the "on" position by the operator. The tubes next pass through a gas-fired oven, where the envelopes are heated to a temperature of 450 degrees Centigrade to remove occluded gases from the glass.

Before and after leaving the oven, the tubes are tested for leaks with a high voltage spark. After baking, if there are no leaks on the sector, the grid and plate leads are connected to the tubes and the filament switch is turned on. The filaments do not have voltage applied, however, until the filament-supply brush reaches the first sector on the filament-supply commutator ring. Upon reaching this position the filaments are heated to approximately normal temperature for one-half to one minute. Upon traveling to the next filament-supply commutator segment the filaments are "activated" at approximately twice normal voltage for two to five minutes.

The next filament-supply segment applies approximately 40 per cent overvoltage to the filaments; this voltage is maintained during the entire evacuation schedule. At the time this filament voltage is applied, plate power is also applied through a bank of light bulbs which act as a series resistor. The non-linear IR characteristic of the tungsten filament lamps allows them to act as a current-limiting device to compensate for unstable tube characteristics during the early stages of exhaust. As shown on page 4, the plate voltage is raised in two more steps, by employing power supplies having higher output voltage. At the end of the third plate sector, the initial outgassing of the plates is complete.

Next, the grids are outgassed in three steps, in a manner similar to that used for outgassing the plates.

At the conclusion of the initial outgassing of the grids, power is applied to both grids and plates, and both elements are heated to a high temperature for a period which varies from one to two hours, depending upon the tube type. This period provides for the removal of all free gases remaining in the electrodes.

After the prolonged heating, the filament, plate and grid brushes drop off their respective commutator segments and the tubes are cooled by passing before an air blast. As each sector comes up to the sealing station, the filament switch is turned off, leads are disconnected, tubes sealed off, and the vacuum-pump switch is turned off. The manifold is then ready to have another set of tubes sealed on.

Each rotary exhaust machine requires the constant attention of only one or two operators. The number of operators required depends both upon the number of tubes being evacuated per sector and the speed of rotation. One operator can handle as many as 50 tubes per hour without difficulty.

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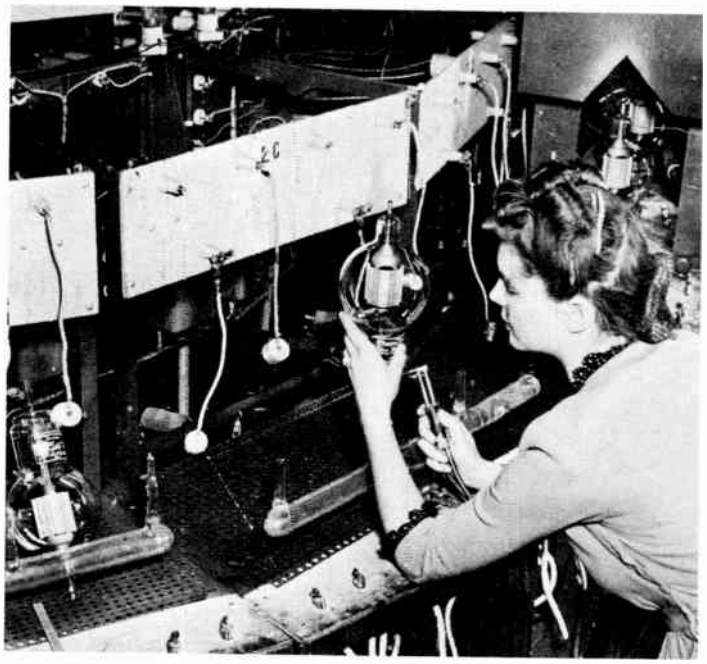
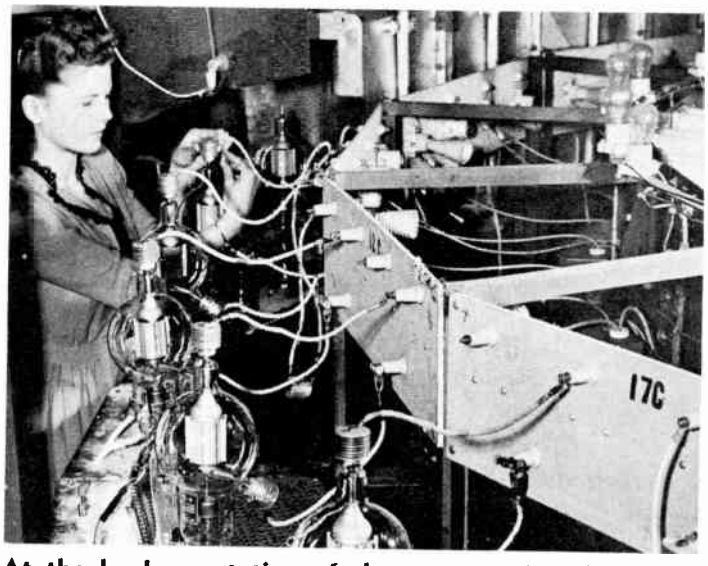
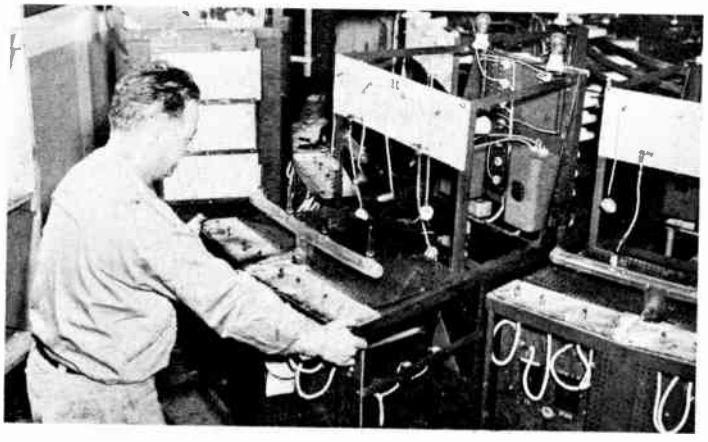


Highly skilled girl operator seals an Eimac 450TH onto manifold of a rotary exhaust unit by means of a hand torch. Note mounted tubes in oven beyond operator.



At the hook-up station of the rotary unit, where the tubes have their grid, plate and filament leads connected after leaving the oven. BELOW: Sector of rotary unit being removed for servicing. A spare sector can be installed in less than two minutes.



TYPE 4-125A

Tentative Data

Filament: Thoriated Tungsten

Current	6.2 amperes
Voltage	5.0 volts

Direct Interelectrode Capacitances (Average)

Grid-Plate (without shielding, base grounded)	0.03 $\mu\mu$fd.
Input	10.3 $\mu\mu$fd.
Output	3.0 $\mu\mu$fd.

R-F POWER AMPLIFIER CLASS-C TELEGRAPHY	BELOW 120 Mc.		170 Mc.		215 Mc.		
	TYPICAL	MAXIMUM	TYPICAL	MAXIMUM	TYPICAL	MAXIMUM	
D-C Plate Voltage	3000	3000	2200	2200	1800	1800	volts
D-C Plate Current	167	225	200	225	200	225	milliamperes
Plate Dissipation	125	125	125	125	125	125	watts
D-C Screen Voltage	350	400	350	400	350	400	volts
D-C Screen Current	30	.....	40	.....	37	.....	milliamperes
Screen Dissipation	10.5	30	14	30	13	30	watts
D-C Grid Voltage	−150	.....	−150	.....	−200	.....	volts
D-C Grid Current	8	.....	10	.....	10	.....	milliamperes
Grid Dissipation	0.8	2	0.8	2	1.2	2	watts
Plate Power Input	500	.....	440	.....	395	.....	watts
Plate Power Output	375	.....	315	.....	270	.....	watts
Plate Efficiency	75	.....	71	.....	68	.....	per cent
Driving Power (approx.)	2	.....	2.7	.....	3.2	.....	watts
Peak R-F Grid Voltage	270	500	.....	500	.....	500	volts
Power Gain	187	.....	116	.....	85	.....	

THE 4-125A--A NEW POWER TETRODE

The trend toward the high frequencies presents two outstanding difficulties to the transmitter design engineer. As frequencies go higher he finds it difficult to obtain driving power; neutralization, which is a nuisance at any frequency, begins to become a problem of major concern.

It has long been the belief of Eimac engineers that both of these difficulties could be solved by the proper type of power tetrode. The new 4-125A is such a tube.

The 4-125A is a radiation-cooled power tetrode having a plate dissipation rating of 125 watts. It is capable of operation as an unneutralized class-C amplifier at full ratings to frequencies as high as 120 Mc. With the addition of neutralization, it may be operated at slightly reduced ratings up to at least 215 Mc. The full high-frequency capabilities have not as yet been fully investigated, however.

Through careful design it has been possible to achieve the almost unbelievably low grid-plate capacitance value of 0.03 $\mu\mu$fd. in the 4-125A. Furthermore, this low capacitance is obtained without the use of external shielding other than the usual metal chassis base on which the tube socket would ordinarily be mounted.

The input capacitance of the 4-125A is 10.5 $\mu\mu$fd., a value which, though higher than that found in many triodes, is still low enough to allow the use of conventional linear grid tank circuits operated at their fundamental resonance mode at frequencies up to 160 Mc. Above 160 Mc. a linear tank circuit employing a capacitor-type shorting bar has been used successfully. (See Figure 6.)

The output capacitance of the 4-125A is 3.0 $\mu\mu$fd., a value low enough to hold the charging current flowing in the plate lead down to a reasonable amount at the higher frequencies.

The necessity for internal insulators has been avoided in the 4-125A by the simple expedient of supporting each electrode on its leads, and making the electrodes as short and rugged as possible. The result of this approach is a "clean" appearing tube, with a complete lack of internal hardware. Of more importance than the aesthetic ap-

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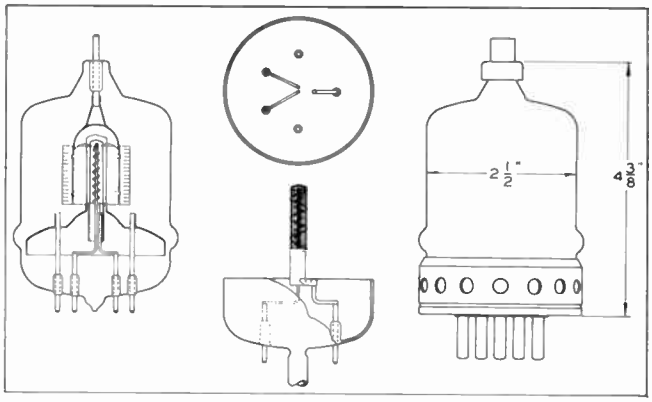
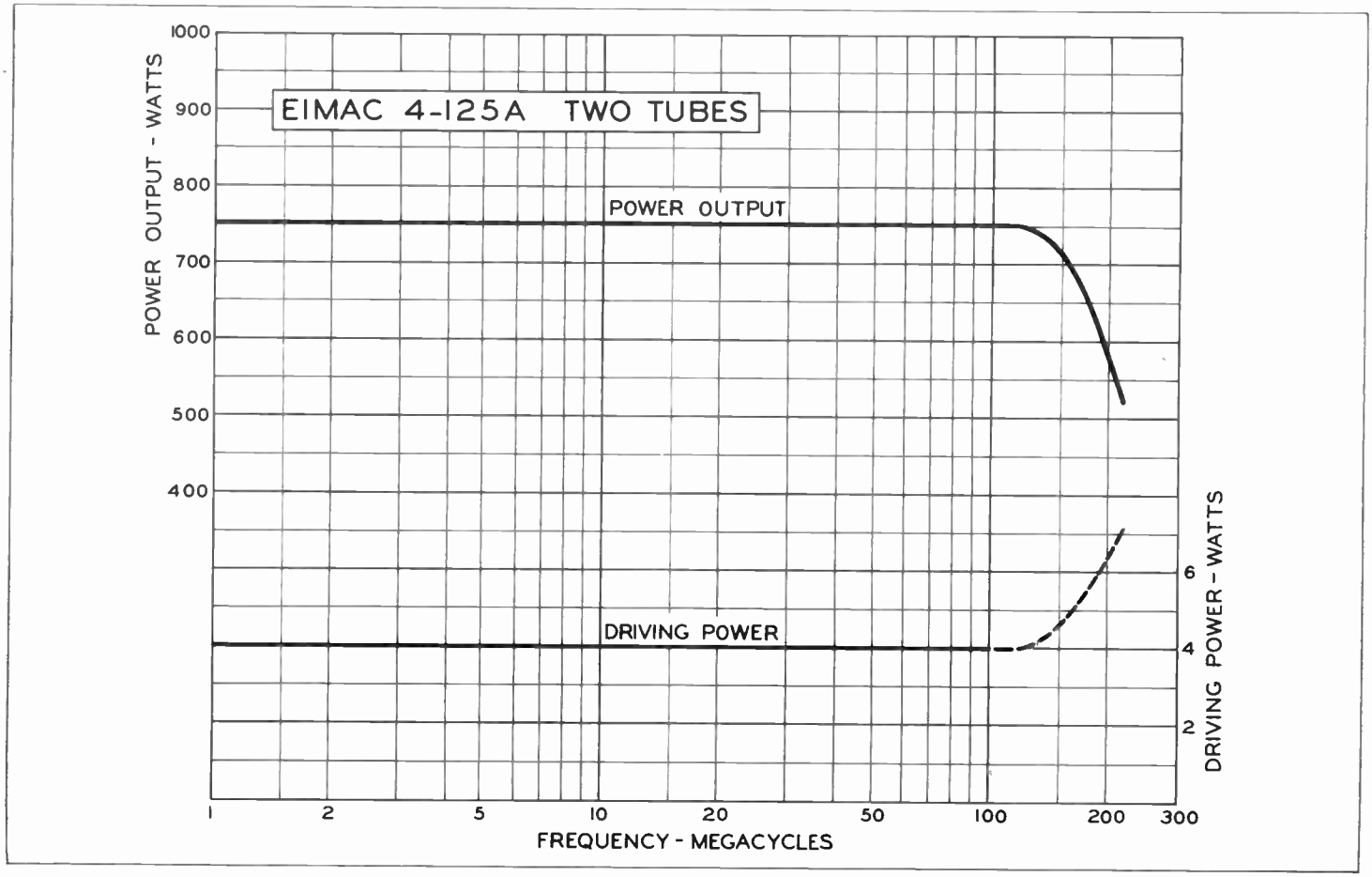


Figure 1. Constructional features of the 4-125A. Left: Filament, screen and plate supports. Center: Control grid support. Right: External dimensions.



Power output vs. frequency. Solid lines are measured values. Dotted portion of line indicates estimated driving power.

peal, however, is the exceptional high-frequency performance this type of construction allows.

Lead inductance in the 4-125A has been kept to a minimum through the use of the very compact "dish" type stem assembly illustrated in Figure 1. Short, direct leads connect the filament, grid and screen through the stem to the base pins. The screen-lead inductance has been kept to a minimum through the use of two screen leads. These leads support a large shield disc which in turn supports the screen grid. The shield serves to divide the tube into two sections, with the input and output electrodes falling on opposite sides of the shield.

High-Frequency Operation

In spite of the dual screen leads there is, of course, some screen-lead inductance remaining in the 4-125A. This inductance, coupled with the grid-plate capacitance, produced some rather surprising effects in some of the early experimental models of the tube. One of the early models (experimental type X-103), which had a grid-plate capacitance of 0.25 $\mu\mu$fd., was first tested as an amplifier in the frequency range of 130 to 150 Mc. The tube performed quite satisfactorily at these frequencies; no neutralization was required, driving power was low, and the efficiency was good. Tests at higher frequencies showed that neutralization was required, as might be expected, but, peculiarly enough, the neutralization was accomplished by adding capacitance external to the tube in *parallel* with the internal C_{gp}. This seemed unusual, but even more strange was the fact that the tube was later found to require neutralization of the conventional 'crossed" variety over a considerable range of frequencies below 130 Mc.

It was then determined analytically, and later proven experimentally by means of special dummy tubes in which leads were brought directly through the envelope from the screen, that the particular combination of screen-lead inductance and C_{gp} which existed in the X-103 caused self-neutralization in the region of 130 to 150 Mc. Below this frequency, the feed-back due to the C_{gp} predominated, and conventional neutralization was required. Above the self-neutralizing frequency, however, the feed-back due to excessive screen-lead inductance predominated, and it became necessary to, in effect, add to the C_{gp} to neutralize the tube.

As the C_{gp} was reduced in steps in subsequent versions of the tube, the self-neutralized frequency became progressively lower, while the maximum frequency at which no neutralization was required became higher. In the final model of the 4-125A the two frequencies merged at approximately 80 Mc. With careful circuit design it is possible to operate the 4-125A without neutralization at frequencies as high as 120 Mc., however.

The experience gained with the self-neutralizing X-103 has led to the neutralizing arrangement shown in Figure 2. In this circuit neutralization is accomplished by series tuning

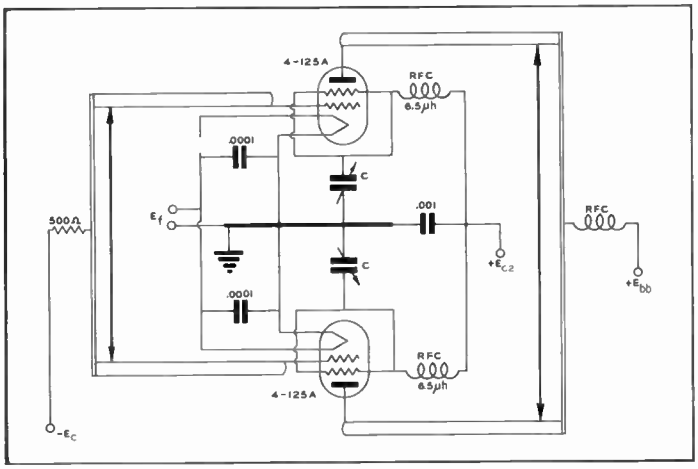


Figure 2. Screen-tuning neutralization circuit for use above 100 Mc. C is a small split-stator capacitor.

$$C\ (\mu\mu fd.) = \frac{640{,}000}{f^2\ (Mc)},\ \text{approx.}$$

the screen to ground to obtain the proper screen impedance for neutralization. Tests to date have shown this circuit to be effective up to at least 215 Mc. The circuit is, of course, frequency sensitive, and the neutralizing capacitance must be changed when appreciable changes in frequency are made.

Driving Power

The driving power requirements of the 4-125A are exceptionally low for a tube of this size having both low grid-plate capacitance and a wide range of useful operating frequencies. Two watts of driving power is sufficient for 750 watts output at all frequencies up to at least 100 Mc. Below 100 Mc. it is possible to calculate the driving power

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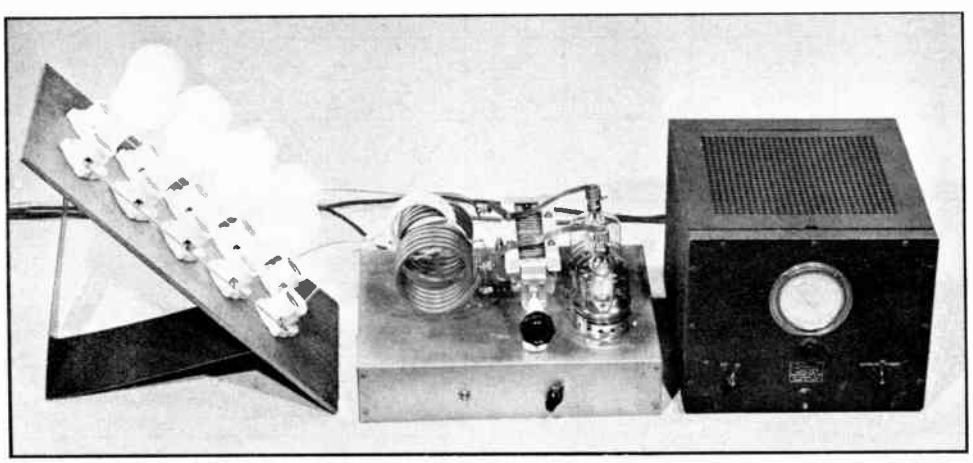

Figure 3. A 14 Mc. test amplifier unit used to illustrate low driving power of 4-125A's. A standard Meissner Signal Shifter serves to drive two of the new tetrodes to 750 watts output.

HEALTH & SAFETY AT EIMAC

Maximum protection of employees is main objective of long-range program centered around new medical building

The opening last month of a new medical center at the San Bruno plant of Eitel-McCullough, Inc., was marked by singularly little fanfare, considering its importance in the company's long-range health and safety plan.

There was actually no occasion for fanfare, however, since the completion of the new center, a miniature hospital, was accepted by everyone at Eimac as just the latest step in the evolution of a well-rounded program of employee protection.

In two years or less, welfare at Eimac has outgrown the stage of mere adequate attention to the more obvious perils of industry, the removal of outright hazards to life and limb.

It has progressed well into the more advanced field of protecting the individual's health through the elimination of such hazards as bad air, bad lighting, bad posture, dust and noise and fumes.

It has established at least a foothold in the less-explored territory of industrial medicine, the prevention of sickness, the treatment of allergies, the creation of a healthful and comfortable as well as safe environment for all who work at Eimac. This last is more than an idealistic program—it is a condition of efficient production of high-quality, precision material.

Safety protection of the more obvious variety has been practiced at Eimac so long now that it is taken for granted, and the company's record for scarcity of accidents is quite remarkable. The year-average accident rate for 1944 was 8.44 on frequency, 0.74 on severity, considered by the insurance carriers to be extremely low considering the natural hazards of glass and metal working.

While the exposure to serious injury is not great at the two Eimac plants, high voltage is dangerous enough, and metal and glass and acids are thoroughly respected for their ability to maim.

In the early days of the company, First Aid was handled by volunteer Red Cross certificate holders among the employees on each shift, working from First Aid kits scattered through the plant. As the plant expanded, however, the need for more complete attention became imperative, and it was decided to employ trained nurses.

Kay Tynes, the first nurse, expanded the service rapidly, and before she left a year ago saw its establishment in the well-equipped unit which was recently vacated for the new building. Roberta McMahan, who succeeded Kay Tynes as head nurse, has been instrumental in developing the program to its present status, and has ambitious plans for future expansion of the company's medical service to employees.

Medical, safety, welfare and service work is coordinated by Palmer Evarts, safety engineer and head of the safety and welfare department, which was recently separated from the personnel department to simplify the administrative setup.

By insisting that *every* injury, however slight, must be given immediate attention in the First Aid room by a trained nurse, infections have been almost eliminated. The compulsory use of free safety equipment where required has further cut down the injury toll.

Safety glasses and goggles in a wide variety are provided free to cope with the greatest single hazard — eye punctures, from glass and metal products. Properly tinted lenses offer protection against glare for those working with open flames, high-voltage arcs or welding torches. Gloves, caps, aprons, shields and guards are also free, and plentiful.

Equipment containing high voltage wiring is caged and screened, with doors interlocked so as to cut off the juice when the cage is opened.

Inter-lock pull-switches are conveniently located in the danger areas to cut off the current in the entire section in the event that anyone should get dangerously entangled.

Under the heading of good housekeeping — easily one of the most important factors in the safety program—come such precautions as keeping aisles painted and clear of obstructions; cleaning up stock piles, storage racks and closets; removing oil spots from floors, chaining up heavy tanks, guarding fans, providing mirrors at collision corners, covering stairs with non-skid material, keeping the whole plant thoroughly swept.

X-ray emission from high-voltage apparatus is carefully screened, and regular checks are made on equipment and operators by various scientific methods to guard against accidental or previously undetected exposure.

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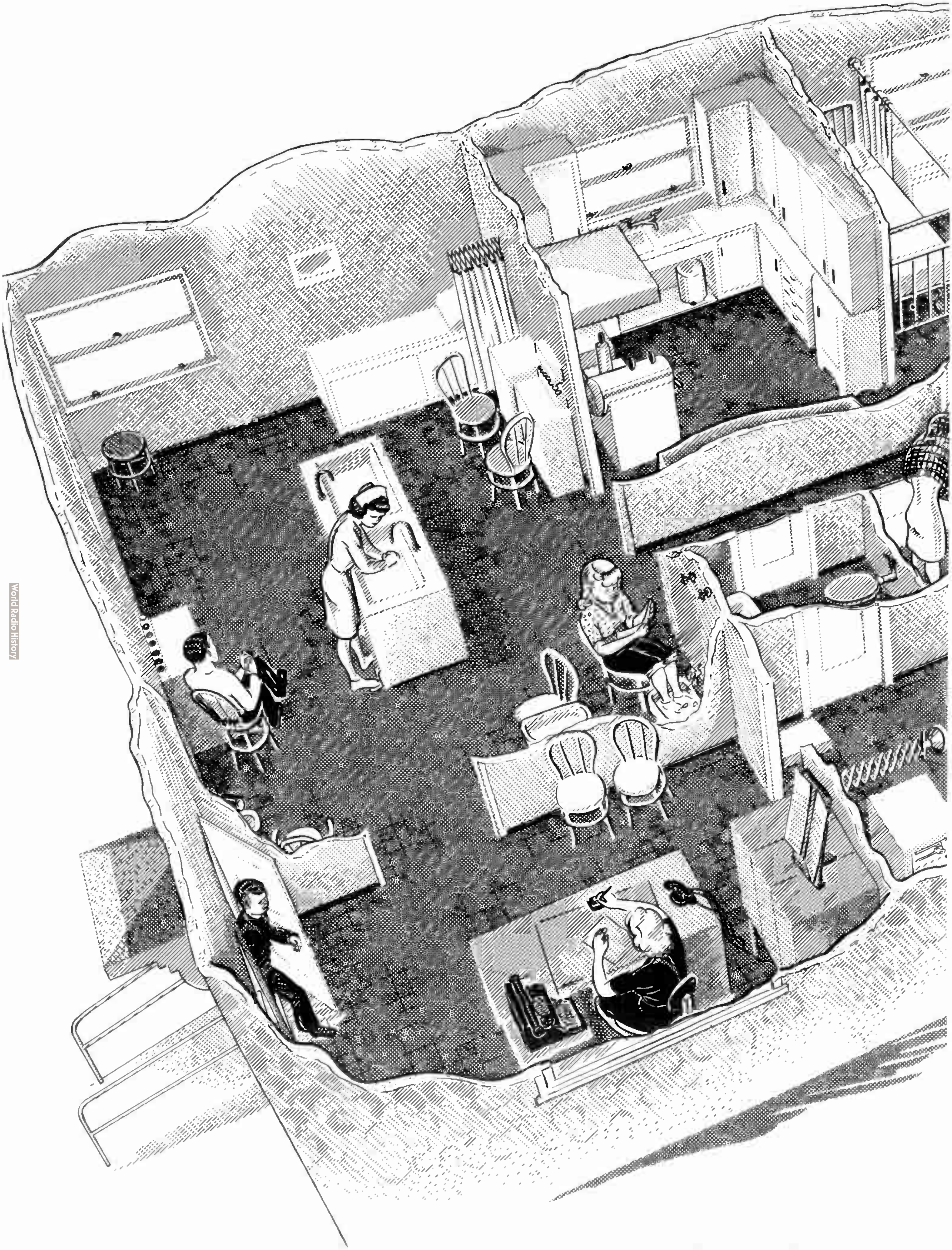
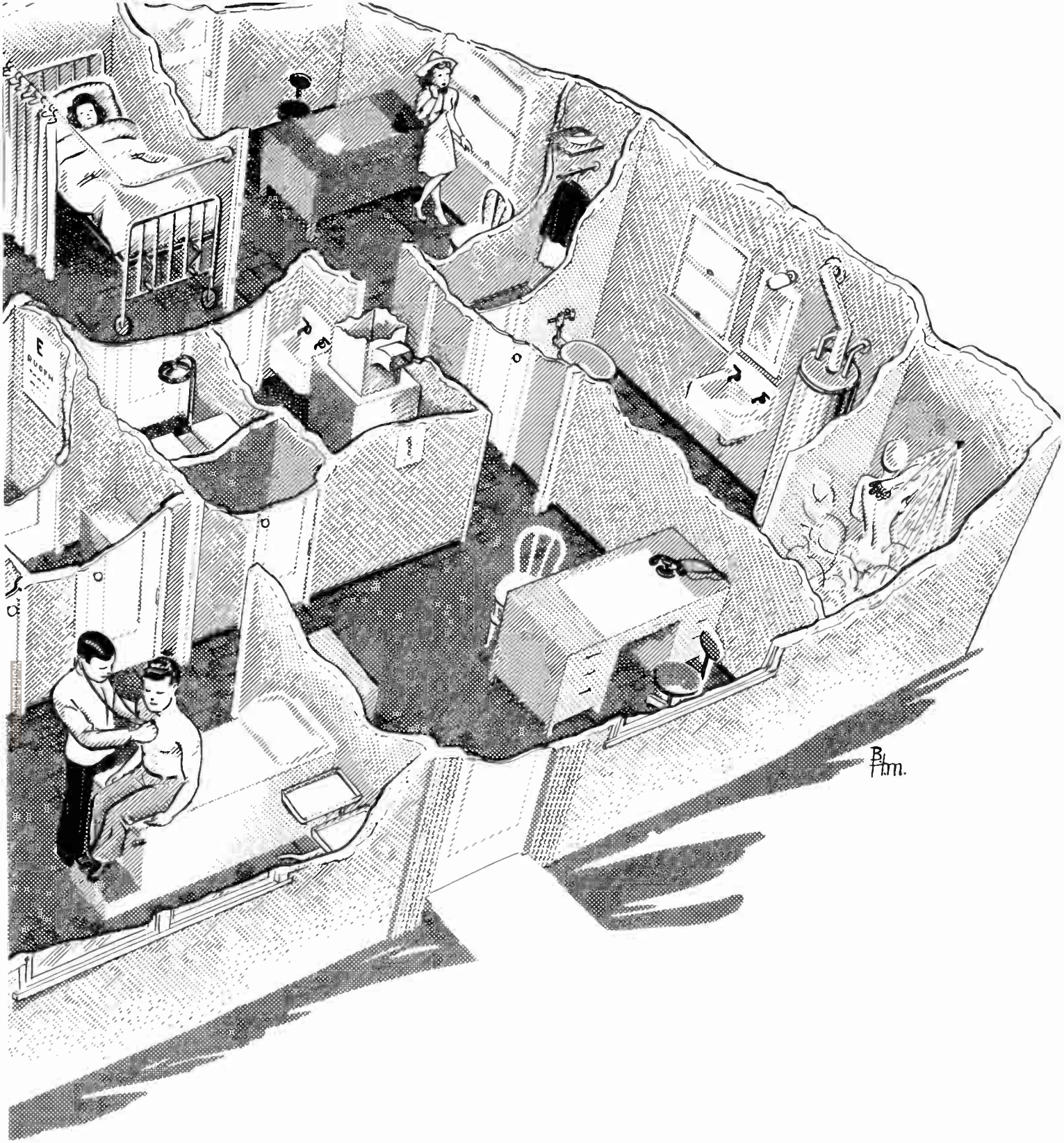




THE NEW EIMAC MEDICAL CENTER

San Bruno Plant

Health & Safety at Eimac (continued)

Instrument readings are taken on the toxic limits of chemical fumes where employees are unavoidably exposed, and the efficiency of the exhaust systems used to eliminate such fumes is frequently measured.

Monthly meetings with department heads, daily tours, spot discussions with operators and supervisors, close attention to all ideas submitted through the plant suggestions committee, are among the routine duties of the safety engineer.

Volunteer fire crews and first aid crews are trained to use the emergency equipment strategically placed throughout the plant. Fire aisles and automatic stairway exits can empty the plant of its several hundred people on any shift in one minute flat. Fire drills maintain this high speed operation.

Automatic sprinklers cover virtually every yard of ceiling space and are located under benches and stairs as well. All pipe lines are color charted.

Complete safety equipment is provided free for all employees, including such specialized gear as this girl operator is demonstrating.

Even the smallest injury gets expert attention

Separate emergency power, automatically controlled, assures operation of the fire alarm system, the water pumps and lights for all exit-ways under any conditions. City water is supplemented by a well and settling tank on the premises. Explosive gases are stored in a separate, blast-proofed building.

From such physical protection, it was a short and effortless step to proceed to protecting lungs and sinuses by covering the floors with linoleum (swept daily) to keep down dust, to protect feet from splinters, to reduce fatigue, to curb drafts, to keep out vermin.

Air - borne dust (and germs) disappear into the plant-wide air-conditioning system which changes

(*Cont. on next page*)

Good housekeeping, social activities, air conditioning and posture chairs are a part of the Eimac welfare program, too

Health & Safety at Eimac (continued)

all the air in the work areas every four minutes and maintains even, draft-free circulation of clean air.

Indirect (fluorescent) lighting is supplemented by spot-lighting where needed on machines and work areas. Color painting of machinery increases visibility, reduces eye strain.

Individual posture chairs, padded and adjustable, reduce fatigue and fatigue's step-child, accidental injury. They also reduce backaches among the bench workers, predominantly women. Fatigue and nervous tension are further reduced by music played over a loudspeaker system about 15 minutes out of the hour, in accordance with schedules arranged by the employees themselves. Smoking is permitted almost everywhere in plant and offices.

All these measures are, of course, merely a part of a larger program in which nutrition and various activities play such closely inter-related parts that it is impossible to separate them. Free vitamin capsules and mid-shift rest-period refreshments are a part of the nutrition program, for example, but their effect can best be measured in reduced accident frequency, improved health.

Athletic and recreational activities enhance morale, but they also provide healthful exercise. The shuffleboard courts and horseshoe pits and bowling tournaments and golf matches and baseball and basketball teams are as good for physical health as they are for mental well-being.

(Continued on next page)

Health & Safety at Eimac (continued)

The company pays half the premium on a group health, accident and life insurance program which has been in effect since early in 1942. This program provides benefits for lost time, doctor and hospital bills and for injuries not covered by industrial compensation.

This insurance is effective from 90 days after hiring, and is open to all employees without restriction. The schedule follows:

Class	*Monthly Earnings	Life Insurance	Principal Sum Accidental Death & Dismemberment	Weekly Accident & Sickness Indemnity	Daily Hospital Indemnity	Maximum Special Hospital Fees	Maximum Surgical Operation Benefit	Maximum Medical Fees	Employees Semi-Monthly Contribution
A	Less than $100.00.... (up to $.55 per hour incl.)	$1,000.00	$1,000.00	$12.00	$5.00	$25.00	$150.00	$75.00	$1.06
B	$100.00 to $130.00.. ($.60 to $.75 per hour incl.)	1,000.00	1,000.00	15.00	5.00	25.00	150.00	75.00	1.15
C	$130.01 to $165.00.. ($.80 to $.95 per hour incl.)	2,000.00	2,000.00	20.00	6.00	30.00	150.00	75.00	1.52
D	$165.01 to $200.00.. ($1.00 to $1.15 per hour incl.)	3,000.00	3,000.00	25.00	6.00	30.00	150.00	75.00	1.85
E	$200.01 to $250.00.. ($1.20 to $1.40 per hour incl.)	5,000.00	5,000.00	30.00	6.00	30.00	150.00	75.00	2.36
F	Over $250.00..... (Over $1.40 per hour)	7,000.00	7,000.00	35.00	6.00	30.00	150.00	75.00	2.88
G	Over $300.00..... (Over $1.75 per hour)	10,000.00	10,000.00	40.00	8.00	40.00	150.00	75.00	3.65

*Monthly earnings are computed on a basis of a 40-hour week

Beyond these perhaps indirect approaches to good plant health is the medical program, dealing directly with aches and ills by the best available therapeutic methods, with the best available equipment.

Five registered nurses now cover the three shifts, and

(*Continued on page 18*)

The main treatment room of the new medical center at Eimac's San Bruno plant is a miniature hospital.

The Eimac Rotary Pump (continued)

A typical evacuation schedule is as follows:

Operation	Time (Minutes)
Seal On	5
Bake Out	30
Hook Up	2
Heat Filament	½
Flash Filament	4½
Heat Plate (1)	8
Heat Plate (2)	8
Heat Plate (3)	8
Heat Grid (1)	7
Heat Grid (2)	8
Heat Grid (3)	8
Heat Plate and Grid	75
Cool	20
Seal Off	5
Total Time	189 Min.

Wide variations in evacuation schedules are made possible through the use of interchangeable driving pulleys to control the speed of rotation and through changes in the lengths of individual commutator rings to control the relative lengths of the individual processing steps. Obviously, the rotating evacuation apparatus is suitable only for large production runs, where one machine serves for one tube type for a reasonable period of time. This is the intended purpose of the machines, however, and they have fulfilled that purpose admirably.

Power Supplies

The power supply equipment for each exhaust machine is located in the plant basement, one complete power unit being placed directly below each machine. Each of the grid and plate rectifier systems uses Eimac RX-21 mercury-vapor rectifier tubes in a three-phase, full-wave circuit. All controls and instruments for each machine are grouped in a "console" on the main factory floor facing the machine which they serve. Oil-cooled variable autotransformers are used to control the primary voltage to each power supply, the autotransformers themselves being contained in oil tanks directly below the console unit. During normal operation, an exhaust machine will operate for weeks without attention to the controls except during short shut-downs for maintenance.

Maintenance

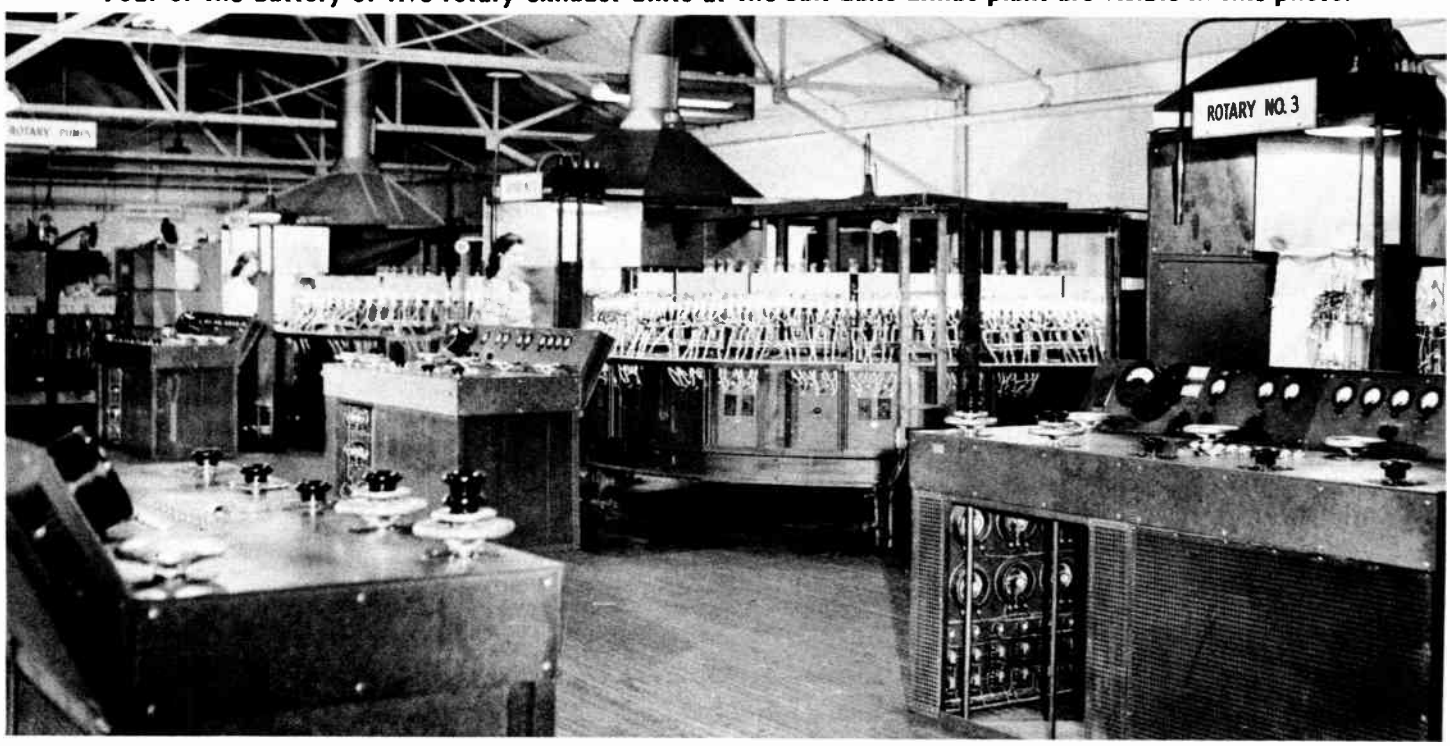
To allow maximum ease in service and maintenance, each individual sector is removable from the machine by the simple expedient of removing a locking pin at the front of the frame. After removing this pin, the sector may be moved forward onto a small dolly for transportation to the Maintenance Department. Four spare sectors ready for operation are held in reserve for each machine, and one of these spares is placed in the machine as soon as a defective unit or one due for periodic servicing is removed. The time lost in the replacement of a sector averages less than two minutes.

Results

The rotary exhaust machines have made possible Eimac's prodigous production of transmitting tubes. At the peak of production eight of the machines handled more than 150,000 tubes per month. Moreover, a degree of uniformity has been obtained which would have been impossible with conventional stand-pump equipment.

The original design has withstood the test of time. Aside from slight changes in the control circuits the machines remain today as originally conceived.

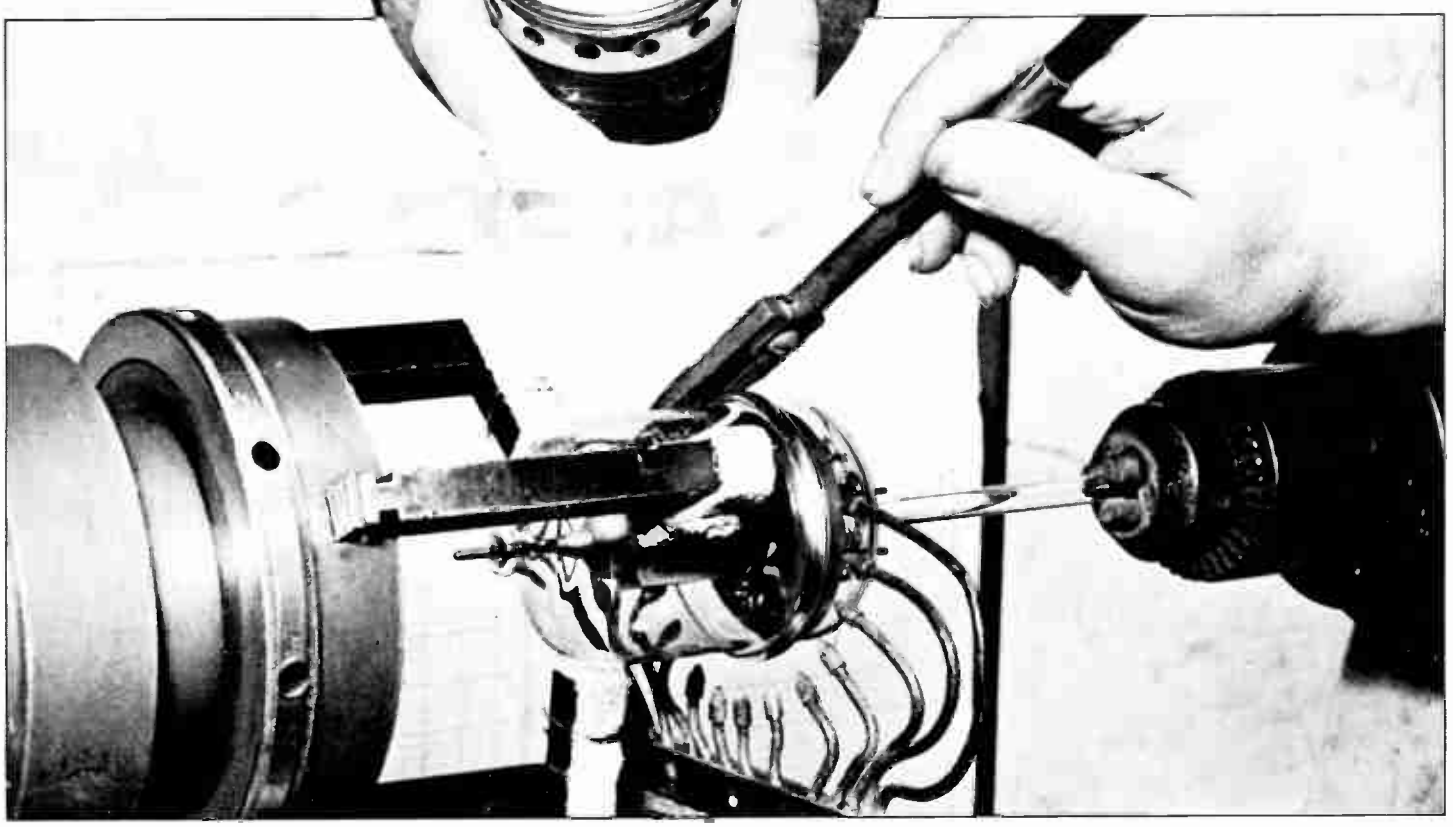
Four of the battery of five rotary exhaust units at the Salt Lake Eimac plant are visible in this photo.



THE 4-125A IN PRODUCTION

Internal electronic bombardment heats the electrodes of three 4-125A's on the manifold of an exhaust apparatus (above). At right, the last step—soldering the base pins on the completed tube.

Off-set jaws in a spot-welder join a 4-124A screen grid mount to its supporting leads.



A glass technician "paddles" the final seal where the two halves of a 4-125A envelope are joined on a glass-blowing lathe. Note the fire bank focused on the seal area.

quite accurately, but since r.f. voltage measurements made at the grid terminal are not a true measure of the grid voltage above about 100 Mc., direct measurement is the only alternative. Due to the difficulty of making direct measurement of the small amounts of power involved, data are lacking on the exact driving power requirements above 100 Mc. Since no significant changes in operating conditions have been observed between 100 Mc. and 120 Mc. it is safe to assume that the driving power requirements do not increase appreciably up to at least 120 Mc.

The low driving power requirements of the 4-125A have been achieved without resort to the use of excessive secondary grid emission. Secondary grid emission, which lowers the "data sheet" driving power, usually necessitates the use of so-called parasitic suppressors to prevent negative-resistance type of oscillations in the grid circuit. Special precautions have been taken in the 4-125A to hold secondary emission to a minimum, even though such secondary emission would have made the driving power appear to be even lower than it is. Transmitter design engineers who were consulted concerning their opinions of the use of secondary grid emission to reduce driving power were most emphatic in expressing a preference for a tube requiring an increase of as much as 100 per cent in driving power to one having a negative-resistance grid characteristic. The 4-125A requires no "parasitic suppressors" to prevent dynatron oscillations in the grid circuit.

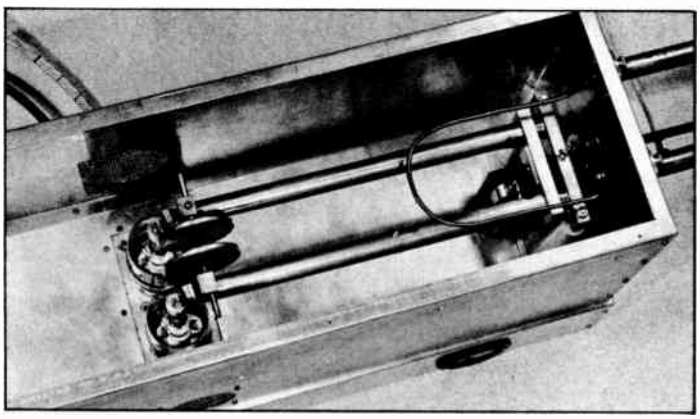


Figure 4. Top view of amplifier unit used in tests between 100 and 160 Mc.

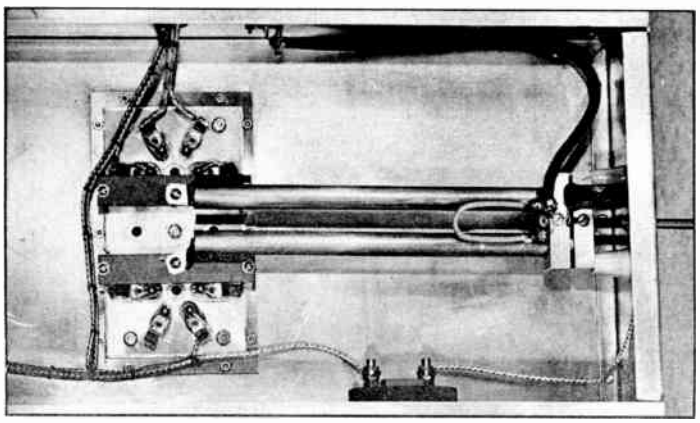


Figure 5. Bottom view of 100-to-160 Mc. test amplifier showing grid tank circuit.

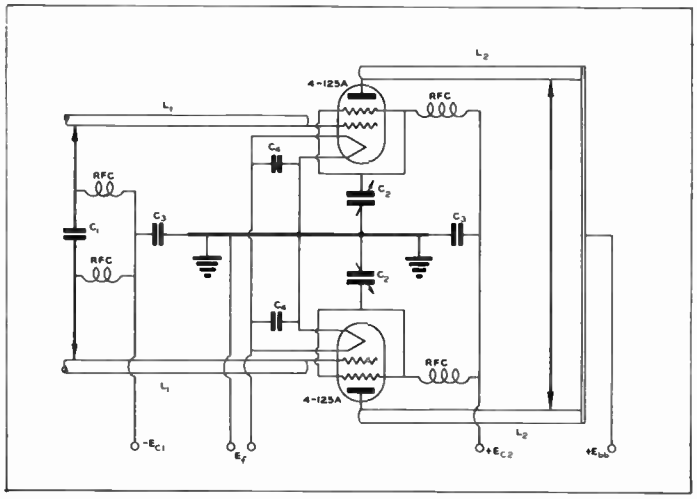


Figure 6. Circuit used for 160- to 215-Mc. tests.
C_1—75-uufd. L_1—⅜" dia, copper spaced
C_2—See Fig. 2 1" center to center, 6" long
C_3—.001-ufd. L_2—⅞" dia. brass, silver
C_4—100-uufd. plated, spaced 1½" center to center, 14" long.

On several occasions the low driving power requirements of the 4-125A have been illustrated by the unit shown in Figure 3. This unit is a 14-Mc., 750-watt output transmitter. The exciter is a Meissner "Signal Shifter," which employs a 6L6 oscillator-doubler and a 6L6 doubler-output stage. The 6L6 doubler provides adequate driving power for the two 4-125A's.

For tests in the range of 100 to 160 Mc., the unit illustrated in Figures 4 and 5 has been used. Above 160 Mc., a unit similar to that shown in Figures 4 and 5, but employing the circuit arrangement shown in Figure 6, has been used.

Design

A tube like the 4-125A does not materialize overnight, the inspiration of any one individual. Many persons in the Eimac Production and Laboratory groups have contributed to the final design. In all, 27 different models of this tube were built and tested before arriving at the type now known as the 4-125A. Each change in model required the production of from three to fifty special tubes.

No small amount of credit for the final design is due to those transmitter design engineers who provided test data on various applications, and valuable criticism on many of the experimental models. Particular thanks in this connection are due Vernon Vogel, Forrest Martz and Jack Smith of Collins Radio; A. P. Stuhrman, Lowel W. Zabel and John Alex Earp of Wilcox Electric; D. Martin and Glenn S. Whidden of Wilcox-Gay Corp., and William H. Sims, Jr., Russell S. Leister and Harry M. Huckleberry of Bendix Radio.

Application

The high power gain, and the simplicity of circuit design which it allows make the 4-125A an obvious choice for intermediate and power amplifier applications in f.m., a.m. and television apparatus operating in the v.h.f. region. These same features plus the advantage of low cost ($20.00 list) also provide the transmitter design engineer with a new and valuable tool in the design of conventional equipment for the lower frequencies.

FIELD NOTES

RANDOM OBSERVATIONS FROM EIMAC'S FIELD ENGINEERS

Tetrodes Answer to Television Difficulties

Royal Higgins, Eimac's mid-west field engineer, reports that Ed Brown of Zenith says the Eimac tetrodes have been the answer to their television difficulties. Zenith is operating a television amplifier that runs at better than 50% efficiency and the pictures are good.

Frank Kazda at Admiral Radio almost succeeded in selling Higgins one of their new "Commander-in-Chief" all-purpose radio receivers, a post-war model that leaves little to be desired: Television, AM, FM, automatic tuning, radiophone with automatic record changer and storage for records, PA system and everything but RF cooking.

Uruguay Radio Engineer Praises Eimac Tube Quality

From Radio Stations HJAH and HJAG in Uruguay comes an interesting comment on Eimac tubes, relayed by Frazar & Hansen, Eimac's export agents. The comment is in a letter from Eduardo Noguera M., chief engineer, who says:

"This is not just another letter praising the quality of Eimac tubes. It is a true story of the behavior of Eimac tubes in our transmitters. We operate 13 hours daily, and since I changed for Eimac tubes, the tube failures due to released gas are no longer a cause of interruptions in our programs. After several earlier failures with other tubes, I inisisted on Eimac tubes, and finally got six 450TH's and six 250TH's from your export agents, Frazar & Hansen.

"Immediately after they arrived, I installed a pair of 450TH's in the final class C stage of the 1050 Kcs. transmitter and modulator of same with excellent results.

"Meantime the short wave transmitter was operating with a pair of 250TH's three years old (roughly 25,000 hours), and still giving normal output! When I got the new 250TH's, I removed the TL's which were still in good shape and going so strong they are now serving as emergency spares. . . . "

Verner Jensen, Eimac's Pacific Northwest representative who is due in San Bruno for a visit early this month, reports from Seattle that R. Bargelt, past president of N.E.D.A., has opened a new jobbing business under the firm name of Bargelt Supply Company, at 1131 S.W. Washington St., Portland, Oregon.

New Jobbing House Opens in Sacramento

Herb Becker threaded his way through all the people drafting bills for the state legislature up in Sacramento to find a new jobbing house. The firm name is E. M. Kemp Company. It will distribute radio and electronic parts, and after the war plans a complete ham department.

Becker also was interested in the 118-Mc. apparatus the California Highway Patrol is using. Stew Naschke, radio supervisor of the Sacramento area for the CHP, and his crew are busy moving the control console from the first to the fourth floor, just down the hall from the big boss, E. Raymond Cato, head of the patrol, and right across the hall from Sgt. E. H. McKee, communications supervisor of the CHP's statewide system.

It was good to see the well-stocked shelves in the Sacramento Electric Supply Company store, Becker adds, as there aren't very many stores around the country in such good shape today. Becker concluded his tour with a chat with Al Lindfeldt, radio engineer for the Sacramento police.

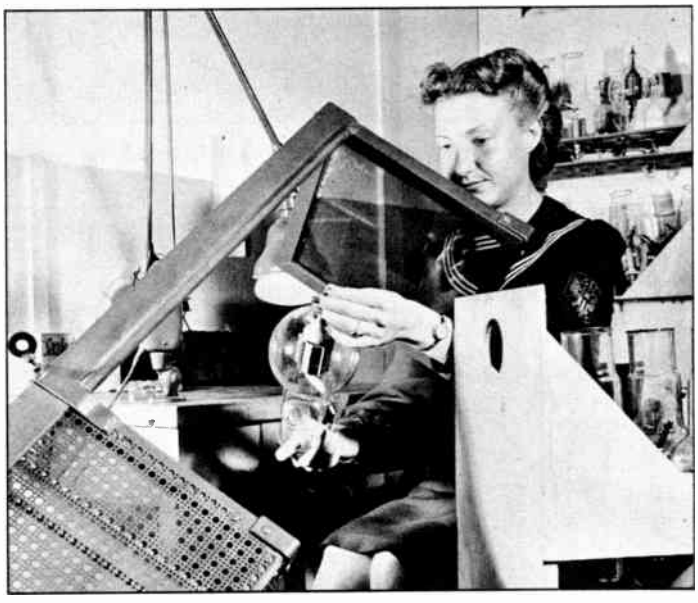
Health & Safety at Eimac (continued)

there is a full-time plant physician and an allergy specialist. Through the cooperation of these people with each employee's own personal physician and the various community health services, complete medical service is made available to everyone at Eimac.

Physical examinations are compulsory for those entering the employ of the company for the first time, or those returning after a long absence. A schedule of yearly re-examinations is maintained voluntarily. Chest X-rays and blood tests and inoculations have been furnished through the community services on a group basis.

Cold vaccines, oral and injected, are dispensed free under the direction of the two doctors.

Through the Red Cross visiting nurse service, supplemented by visits from the staff nurses, employees ill at home are assured of attention. This feature has been found to be particularly desirable in an area short of doctors and telephones.

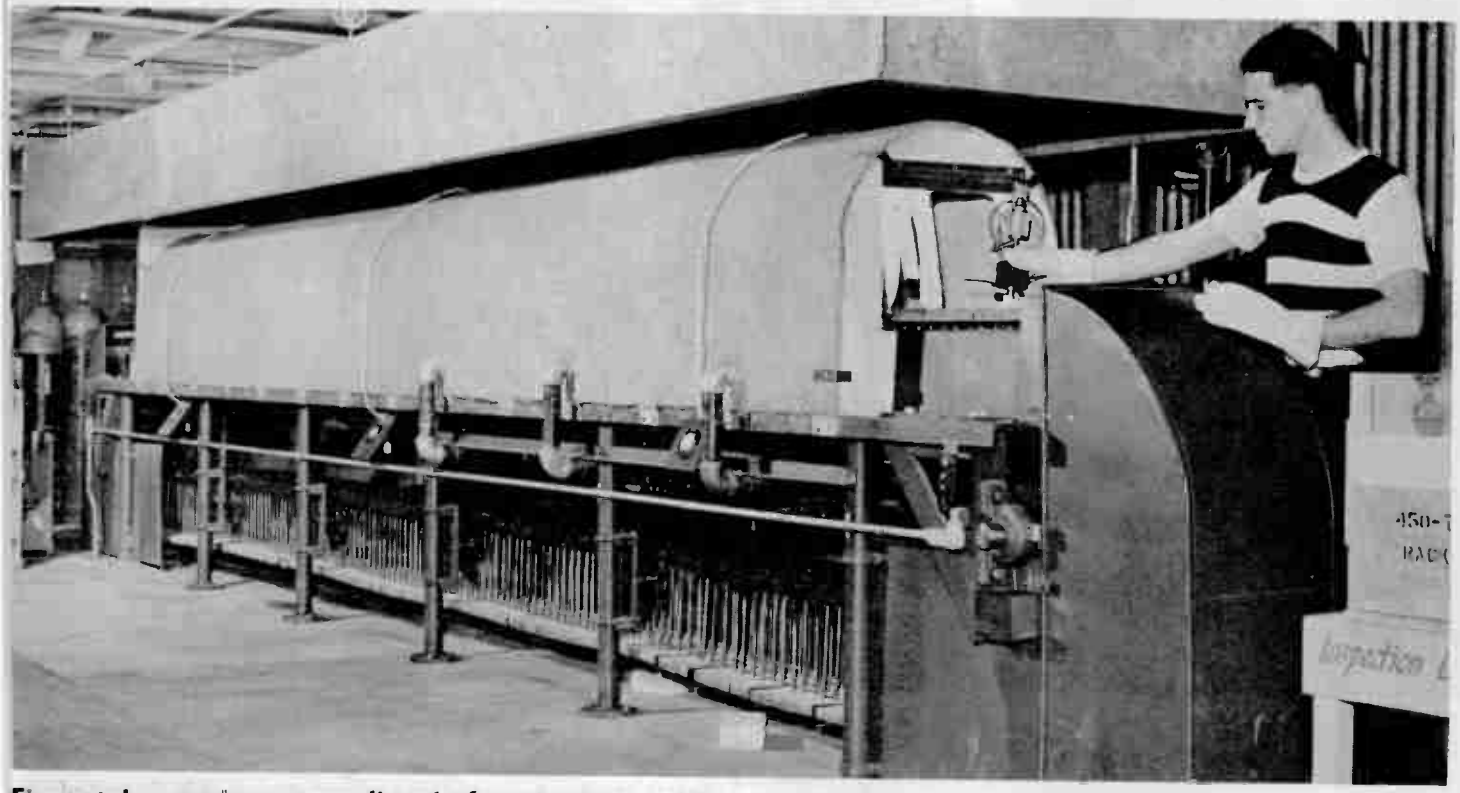


Glass strains incurred in sealing are quickly detected by this polariscope which shows strains as white streaks in the glass. Proper annealing removes the strain.

ALONG THE PRODUCTION LINE

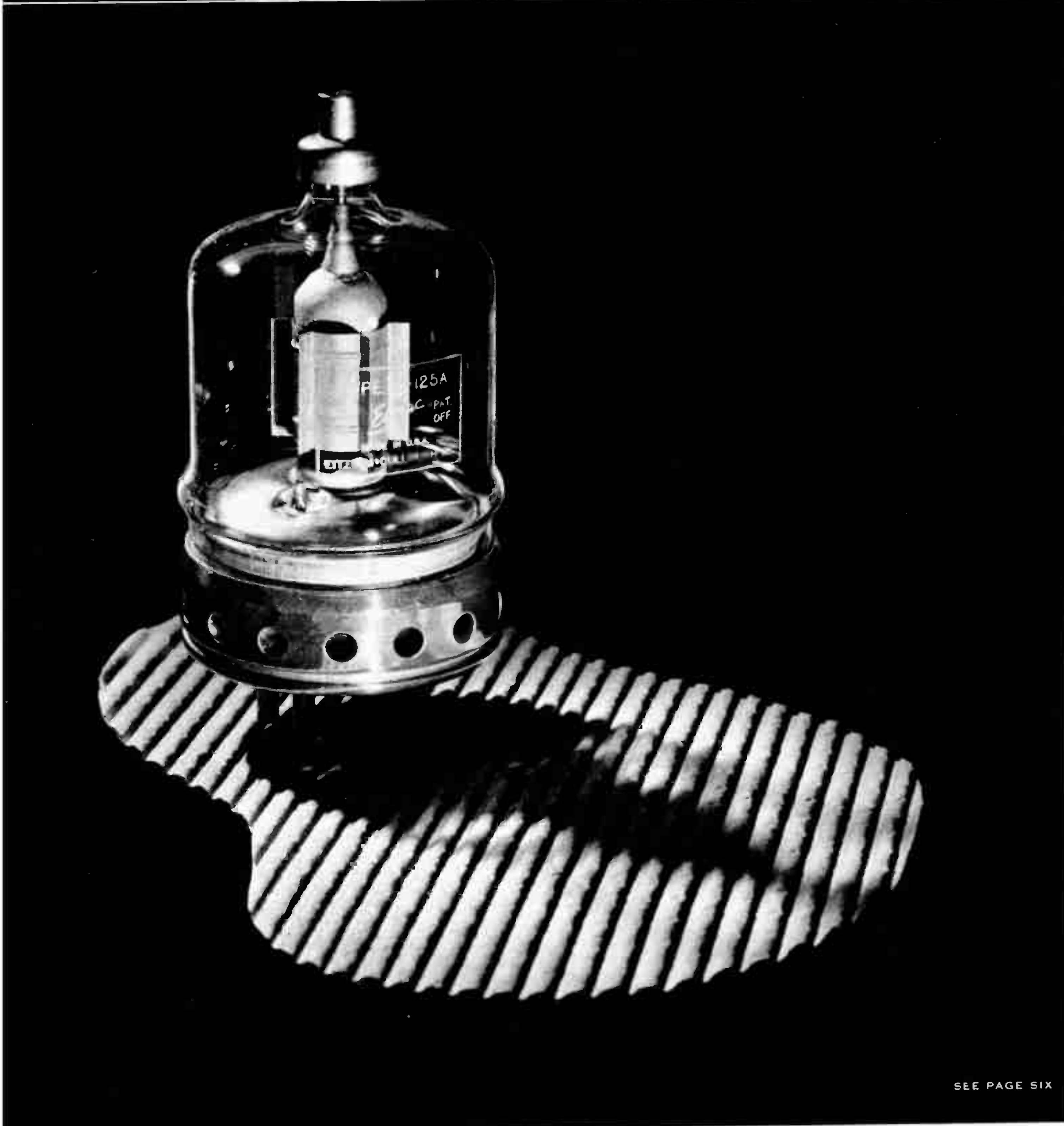
Mounted at the proper angle and elevation, this combination scale and magnifying glass serves as a handy measuring jig in winding spiral filaments at the San Bruno and Salt Lake plants of Eitel-McCullough, Inc. Filament fits over a mandrel (top) in focus behind lens.

Beaded leads undergo a close scrutiny from sharp-eyed Eimac Inspection Department operators with the assistance of this large magnifying glass with its shadowless illumination. Each bead is thoroughly examined for a number of possible defects which operators recognize.



Eimac tube envelopes are relieved of strains incurred in assembly by means of this continuous annealing oven. Traveling through the tunnel at temperatures graded from 575 C. at the entrance to about 200 C. at the exit, the tubes get a 25-minute annealing, followed by a polariscope inspection.

THE EIMAC 4-125A • A NEW POWER TETRODE



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