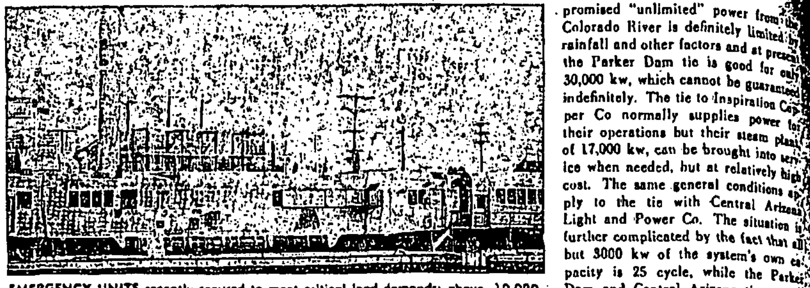
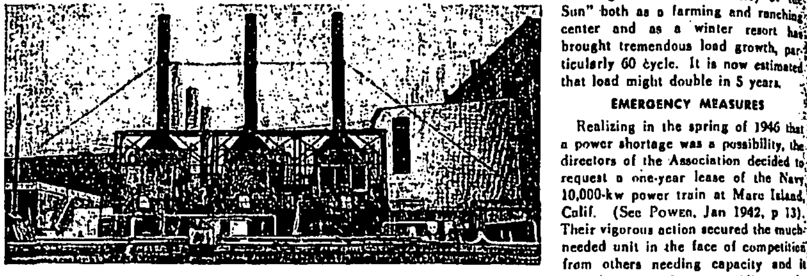




EMERGENCY UNITS recently secured to meet critical load demands: above, 10,000-kw Navy mobile plant on siding at edge of pond; below, war-surplus Victory-ship boilers installed to bolster steam-generating capacity, reduced by change in fuel

ticles (mostly babbitt). This produced a hard film on bearing surfaces, which resisted mechanical removal although it could be removed by applying commercial muriatic acid with a sponge. Formation of such films reduced bearing clearance and led to the final destruction of the bearing metal.

To cure these troubles, the lubricating-oil system was redesigned to include centrifuging and fuller's earth filtration. The present system is shown in the diagram. A single centrifuge serves both engine sumps. There are two fuller's earth purifiers, each with its own strainer, pump, steam heater. The fraction of the oil continuously purified returns to the sump, to which makeup oil is also admitted. A blower removes oil vapors from the sump tanks. Oil from the engines discharges into the sump through a screen and a pump draws oil off for return to the engines. There are sludge blowdowns.

Further lube-oil savings are made by reclaiming cylinder oils, which would normally be discarded. Dirty oil flows first into the top of a vertical steam-heated cylinder, passing through a cotton-waste-packed basket where heavy particles are caught. It then flows through a 100-mesh wire screen into a 4-in. pipe, the lower part of which is surrounded by a steam coil. Oil leaves the cylinder at a point just below the screen and passes to a second cylinder of similar design. Both have sludge blowdowns at the bottom of the precipitation chamber. Oil from the second cylinder goes to a steam-heated storage tank with a floating pump suction through which oil flows to a 200-mesh screen and is then pumped into a fuller's earth purifier. Clean oil goes to a storage tank for return to the engine sump tanks as crankcase makeup.

Turning from the mechanical problems of operation which have been solved to the problems of system operation and development, which are now proving difficult, let's review the system picture a bit. Of the generating capacity, on the system itself, just about ⅔ is hydro derived from irrigation-flow regulation and therefore dependent on rainfall conditions to a large extent. To supplement the system's own firm capacity, there are ties, but these are not fully effective.

Experience has indicated that the promised "unlimited" power from the Colorado River is definitely limited by rainfall and other factors and at present the Parker Dam tie is good for only 30,000 kw, which cannot be guaranteed indefinitely. The tie to Inspiration Copper Co normally supplies power for their operations but their steam plant of 17,000 kw, can be brought into service when needed, but at relatively high cost. The same general conditions apply to the tie with Central Arizona Light and Power Co. The situation is further complicated by the fact that all but 3000 kw of the system's own capacity is 25 cycle, while the Parker Dam and Central Arizona ties are 60 cycle and changer capacity is limited.

Recognition of the "Valley of the Sun" both as a farming and ranching center and as a winter resort has brought tremendous load growth, particularly 60 cycle. It is now estimated that load might double in 5 years.

EMERGENCY MEASURES

Realizing in the spring of 1946 that a power shortage was a possibility, the directors of the Association decided to request a one-year lease of the Navy 10,000-kw power train at Mare Island, Calif. (See POWER, Jan 1942, p 13). Their vigorous action secured the much-needed unit in the face of competition from others needing capacity and it went into operation on a siding at the Cross Cut plant in July. It is still contributing to the system.

This 6-car unit contains a complete condensing steam plant and all auxiliaries, requiring only a fuel supply and condensing water. Fuel lines were run from the existing storage tanks and a 16-in. water line installed from the Cross Cut hydro-plant penstock to the unit's circulating pumps. There is sufficient head available with this arrangement to cut out the pumps and conserve the power they would normally consume. A special crew was trained to operate the emergency plant.

Early in 1947 the quality of fuel oil available to the plant became so bad that slag conditions required cleaning boilers at about 30-day intervals. Cleaning a boiler required about one week and with three boilers this meant loss of one unit for 20 days in every 90.

To avoid this impossible condition three war-surplus Victory-ship boilers were purchased and installed to provide the additional steam-generating capacity required to maintain full plant capacity. Each of these units has a capacity of 37,000 lb per hr and their combined capacity replaces one of the main boilers while out of service.

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

3—Elements of Electron Tubes

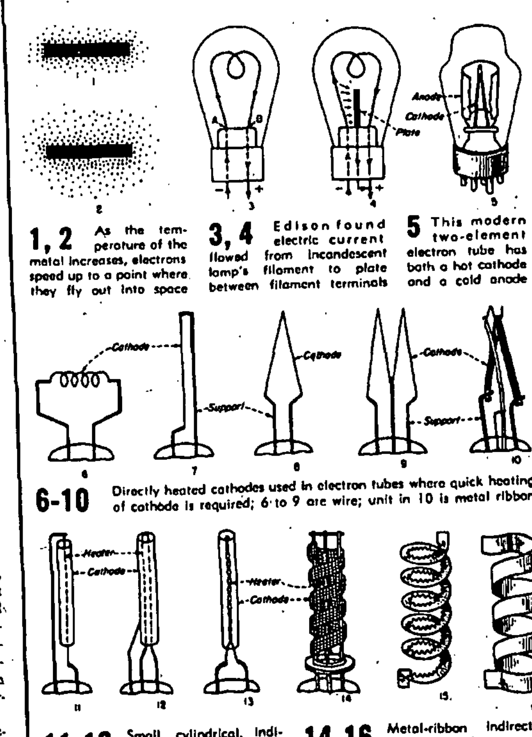
▶LAST MONTH we learned that all matter is composed of atoms, which consist of electrons, protons and neutrons—tiny particles of positive and negative electricity. We examined the arrangement of electrons in atoms and the way they act under different conditions. We are now going to find out how electrons are released from atoms and how they are put to work on many jobs.

Electrons may be released from atoms of solids or liquids in several ways, but the two we are most interested in are: thermionic and photoelectric emission. Thermionic emission occurs when the temperature of a solid increases to where electrons actually fly from its surface into space. In photoelectric emission, application of light releases electrons from a light-sensitive plate.

Thermionic Emission. Temperature at which electrons are emitted from a solid varies with the material. When tungsten is heated to a temperature of about 3300 F the electrons of some of its atoms reach a speed of 620 miles per sec. At this speed they break through the metal surface and fly out into space, as indicated in Fig. 1. The distance that the electrons are shown from the metal is much exaggerated because they probably do not, at the assumed temperature, get more than about four one-hundred thousandths of an inch (0.00004 in.) away from the metal surface.

As metal temperature increases, electrons speed up in their orbits until at about 4000 F they reach a speed of 8000 miles per second, and some of them may fly out 0.04 in. from the metal surface, giving an effect similar to Fig. 2. The number of electrons emitted from a hot-metal surface increases rapidly with temperature. For example, in Fig. 2 about 75 times as many electrons are released at 4000 F as at 3300 F, in Fig. 1.

Electron-Tube Cathodes



1, 2 As the temperature of the metal increases, electrons speed up to a point where they fly out into space

3, 4 Edison found electric current flowed from incandescent lamp's filament to plate between filament terminals

5 This modern two-element electron tube has both a hot cathode and a cold anode

6-10 Directly heated cathodes used in electron tubes where quick heating of cathode is required; 6 to 9 are wire; unit in 10 is metal ribbon

11-13 Small, cylindrical, indirectly heated cathodes work at comparatively low temperatures

14-16 Metal-ribbon indirectly heated cathodes are used in medium and larger current tubes

When electrons leave a metal surface, their corresponding positive protons of the nucleus are left behind and the metal becomes positively charged. Unless there is a stronger external positive force to act on them than that of the parent metal, most of the electrons are attracted back home. As a result, from a red-hot-metal surface, under no external influence, electrons are being emitted continually but are attracted back into the surface again. This action is like popping corn in a popper. As the kernels reach a given temperature