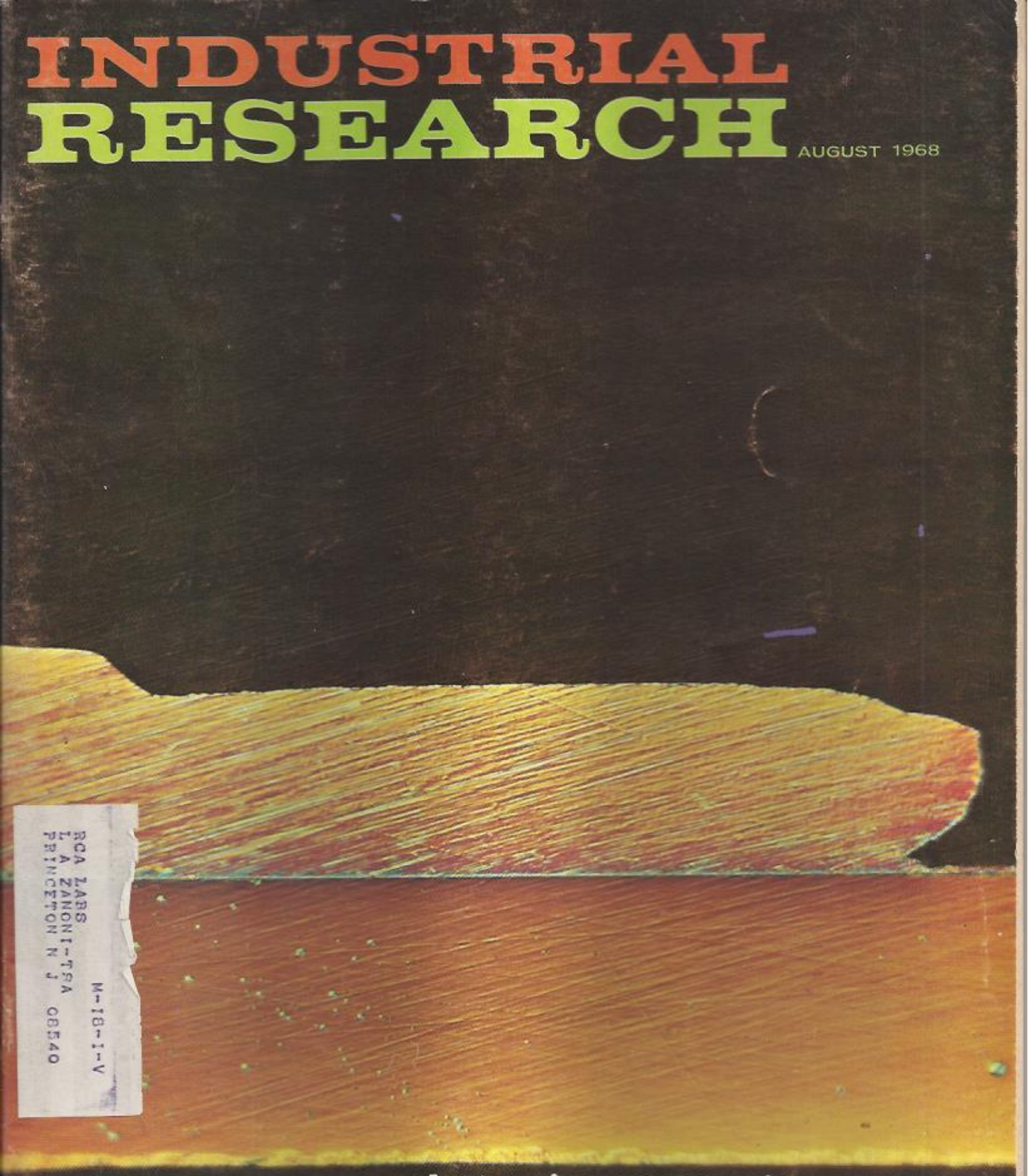
INDUSTRIAL RESEARCH

AUGUST 1968



electronic components & instruments

AN INDUSTRIAL RESEARCH INC. MAGAZINE

MATERIALS APPLICATIONS

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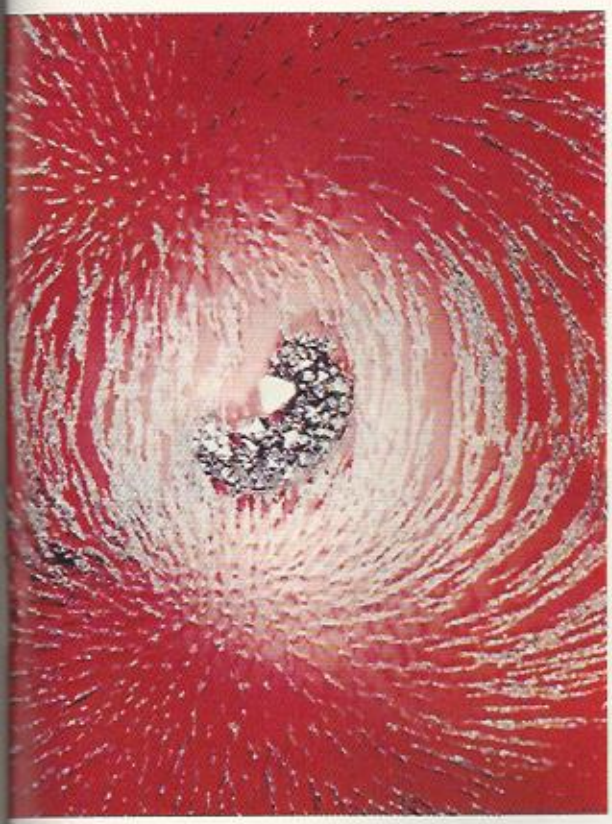
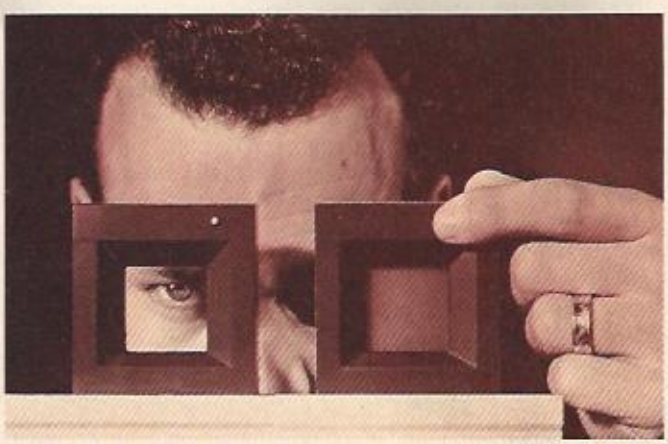


Progress in electronics is keyed today to advances in materials. This month, recent research and development in liquid crystals conducted at RCA is featured. Applications for the newly active technology include alphanumeric displays and a new type of television. Other materials covered include silicon nitride for passivation of MOS FET's . . . underground plastic ducting . . . and a new steel that conquers stress corrosion.

AN INDUSTRIAL RESEARCH INC. SUPPLEMENT □

MATERIALS APPLICATIONS*

An array of applications springs into being as liquid crystals enter electronic materials field



OPACITY *or transparency of liquid crystals recently demonstrated by RCA is controlled by the application of current to the glass-crystal sandwich on the right (above). Numerous uses will become possible in the near future for a wide range of electronic equipment applications. Sawfish and giant turtles scraped and bit rubber hose used by oceanarium divers. By substituting an extruded USI Chemicals EVA hose, divers are safe, hose floats.*

"THE LIQUID CRYSTAL DISPLAY gives promise for the first time of a practical thin-screen competitor to such vacuum tube displays as the oscilloscope used in radar, the 'Nixie' tube used to display changing letters and numbers, and perhaps eventually, the picture tube used in television sets." Thus spoke Dr. George H. Brown, Radio Corp. of America's executive vice president for research & engineering, announcing that firm's recent involvement in materials research with liquid crystals.

Inherently cheap and relatively common (one of every 200 organic compounds is a liquid crystal), power requirements for these materials are very small, leading to their use in conjunction with solid-state and integrated circuitry.

Because they are read by means of reflected light instead of emitting their own light, displays using liquid crystal materials for some form of readout would gain in brightness as ambient light becomes brighter.

Other properties of liquid crystals have been attractive to the research community. For example, some change colors within a narrow temperature range, permitting their application to temperature measurement.

RCA was interested because certain liquid crystals can be made opalescent, hence reflectant, by application of an electric voltage. The temperature range over which this optical change takes place can be enlarged from its original narrow band of high temperatures to from —18 to 100 C.

Dr. George Heilmeier, who directed the research conducted at RCA's David Sarnoff Research Center, Princeton, N.J., described the new display technique as follows:

"A sandwich is formed of two clear glass plates separated by a thin layer of clear liquid crystal material about 0.0025 cm thick. A reflective mirror-like conductive coating is deposited on the inside face of one plate, contacting the liquid. On the inside of the other plate a transparent, electrically conductive coating of tin oxide is applied.

"When an electric charge [either a-c or d-c] is applied between the two coatings, the liquid crystal molecules are disrupted and the local sandwich takes on the appearance of frosted glass." The display is in effect a parallel plate capacitor with the liquid crystal acting as the dielectric.

The intensity of the tone change is proportional to the intensity of the applied voltage, which may range from 6 to 60 volts. Reflective display power requirements are but 0.155 mW/cm², either d-c or pulsed. The latter mode would be used when motion effects are desired, as in a television device. The pulses would be addressed sequentially through the use of integrated circuits in this application.

RCA representatives are chary of describing present work, which has proceeded to the product development

the cover

Set like jewels in a magnetic field, the cadmium chromide selenide crystals on the cover are part of the growing volume of research into electronic properties of a vast variety of materials. The crystals were grown by RCA.

for further information

You can obtain more information about the materials and applications discussed in Materials Applications *by writing the appropriate numbers in the boxes on the inquiry card provided at the end of this issue.*

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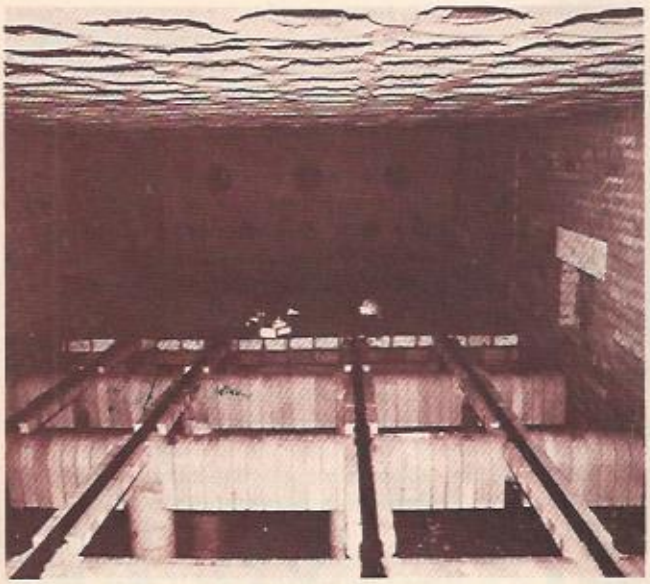
stage. Presumably, there will be immediate work in the "Nixie" and alphanumeric tube devices, where associated electronics are not nearly as complex as for so ambitious a project as development of a new consumer television apparatus. The latter is some years distant. For more information, write 201 on the inquiry card.

Getting skid rails 'off the skids'

WATER-COOLED SKID RAILS and support pipes used to move steel through reheating furnaces are inefficient affairs at best. Water-cooled to keep the skids from sagging under load at high furnace temperatures, the rails and pipes accomplish their purpose of movement and support, but can cause the loss of as much as 23-billion joules/hr in a typical small billet furnace (3.7 m^2).

Monolithic plastic insulation systems have been used to contain the lower temperature of the pipes, but there are numerous difficulties associated with these systems.



PREFORMED *refractory tiles for skid-rail and rail-support insulation offer ease of installation and long life. They are products of Harbison-Walker Refractories Co.*

They often are not flexible enough to accommodate slight flexure of the skids under load and chip or break. Also, installation has been difficult, with initial heat-up and curing procedures required prior to their use.

An insulating system which takes care of the basic inefficiency of water-cooled skids and supports—without introducing any of its own—recently was patented by the Harbison-Walker Refractories Co., Pittsburgh, a Div. of Dresser Industries.

Covered by U.S. Patent No. 3,169,754, the key element of the development is a protective insulating tile assembled from preformed, fired shapes of high-alumina (85%) refractory material.

These formed refractory tiles, having a minimum thickness of 3.7 cm, use existing H-W refractory materials, and are positioned around all but the load-bearing surface of the skid-rail pipes. Protective tile 6.3-cm thick surrounds all support members. Harbison-Walker mineral fiber coating is used as backing for the support pipes; 6 mm of the firm's rollboard is used to back the horizontal skid-rail insulation.

The manufacturer lists high strength, ability to endure thermal shock without spalling, and excellent resistance to scale or high iron-oxide slags as the reasons for the materials' long service life. Because the system employs preformed shapes snugly fastened to the pipe, some degree of load-flexure is possible without breakage. Vertical insulators are held together with lugs, so there is no separation. For further information, write 202 on the inquiry card.

'Nice weather for ducts'

COMMUNITIES NESTLED among giant mountains often are so tucked away that line-of-sight television tower transmission is unable to reach them. For years, these communities went without "the tube." Several years ago, however, community cable firms started springing up about the landscape, and now very few of these formerly isolated locations are without broadcast programing.

One problem faced by the cable enterpreneurs was selection of a ducting material for their cables. Weather conditions often are severe in the locales so isolated, leading to difficulties with freezing and cable burial. Metal tubing, though effective, is expensive and inflexible; plastic tubing, though cheap, often is inflexible on one extreme, unable to withstand burial loads on the other.

Now there is a high-density corrugated polyethylene tubing, "Philduct," manufactured by the Phillips Products Co., Inc., a subsidiary of the Phillips Petroleum Co., Bartlesville, Okla., that satisfies virtually all climatic and physical requirements.

Cables to Colorado Springs, Colo. are run through the new ducting by the Vumore Video Corp., Colorado Springs.

"We presently are using large quantities of the Philduct in preference to other forms of duct, because of its flexibility during installation. It is readily adaptable to all climatic conditions, a quality lacking in smooth-wall polyethylene ducts. In our construction program we are able to use Philduct to form sweeps and 90-degree angles for entrance into vaults and pedestals. It is considerably lower in cost, and performs as well as regular rigid sweeps," said William L. Ross, Vumore's vice president for engineering.

Phillips Products said the new tube is in the early stages of industrial development, and that design limitations have not yet been established. They expect the tubing to be used to convey water, chemicals, hot air, cables, and even to serve as vacuum cleaner conduits for the built-in units currently gaining in popularity with housewives. For further information, write 203 on the inquiry card.

Unclouded lights

CHILDREN IN THE SOUTHWEST cherish the small bits of clouded, purplish glass they find in the desert. The soft, elegant color is nice to look through, and an imaginative mind can conjure a time when all bottles were this pretty hue of purple. The piece you have found is a "rare" fragment, maybe even valuable.

Solarization is what alters the glass from its original clear state, and though the changed glass may fascinate the child who thoughtlessly discovers it, solarization is a problem for both makers and users of fluorescent lamps. Cloudiness hampers brightness and life of the devices.

Penetration of ultraviolet light through the phosphor layer of the tubes causes solarization. When UV energy impinges on the glass, color-center formation takes place. Electrons are either trapped or displaced in these centers, forming "traps" or "holes." The glass in these areas then absorbs visible radiation, giving the darkening effect. Lamp efficiency and light quality are impaired.

Scientists have found a way to prevent solarization of tube lamp glass at the Westinghouse Electric Corp. Lamp Div., Bloomfield, N.J. Their solution is in the form of titanium oxide added to the glass while it is in the molten state during processing. Because the oxide is a multivalent ion, it acts either as a scavenger or as a donor, giving an electron to holes, taking one from a trap. The visible-absorbing color centers simply fail to materialize.

There is an added bonus in initial luminance output.