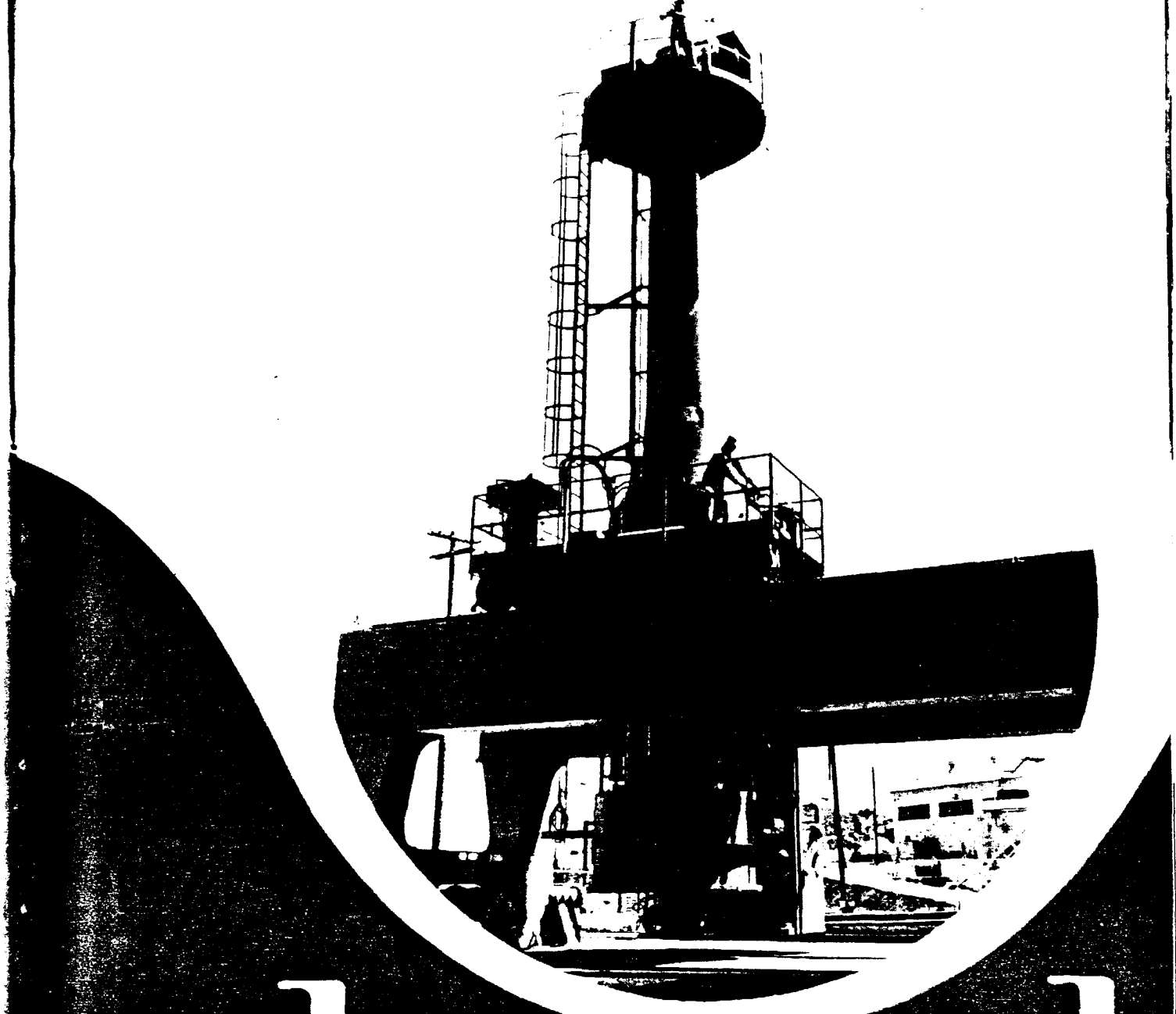
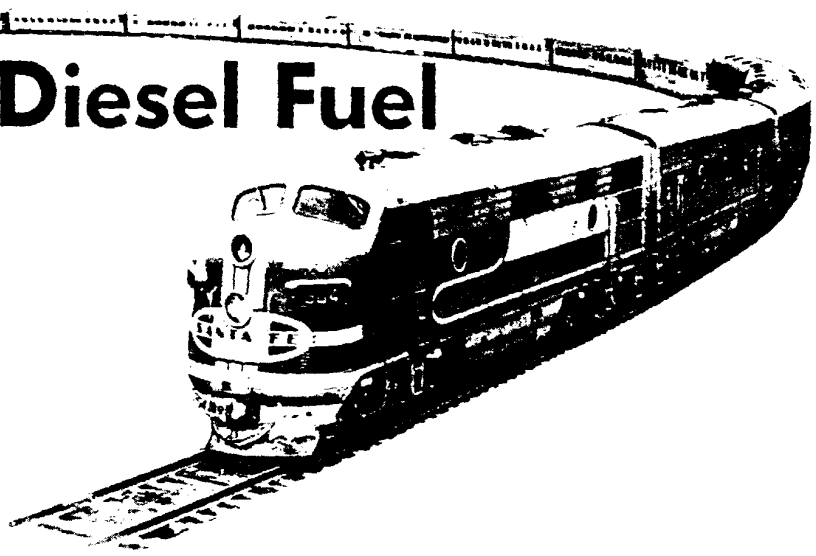


lead

LEAD INDUSTRIES ASSOCIATION, INC.

LPG + TML = Diesel Fuel



LPG, or liquefied petroleum gas, is an inexpensive fuel with many advantages

TML, or tetramethyllead, makes it possible to use LPG in big diesel locomotives

Exactly 30 years ago a locomotive made history by hauling the Burlington's "Pioneer Zephyr" from Chicago to Denver in 14 hours. Steam engines took 26 hours for the same trip. In the intervening years, 28,000 diesels replaced 50,000 steam engines, the whole picture of railroading changed, and the Smithsonian Institution accepted the "Pioneer Zephyr's" original engine for display as one of the milestones in railroad history. The reduced fuel and maintenance costs have saved the railroads about a billion dollars a year, according to experts in the field.

With an eye to even greater savings in fuel cost, railroaders have explored the use of liquefied petroleum gas instead of conventional diesel oil. It is quite inexpensive in those areas of the country where it is produced. In addition, its clean-burning properties suggest added savings in engine maintenance costs. But since it is not available at this cost advantage in all areas of the country, a successful conversion to LPG gas requires the diesel to run on conventional fuel as well.

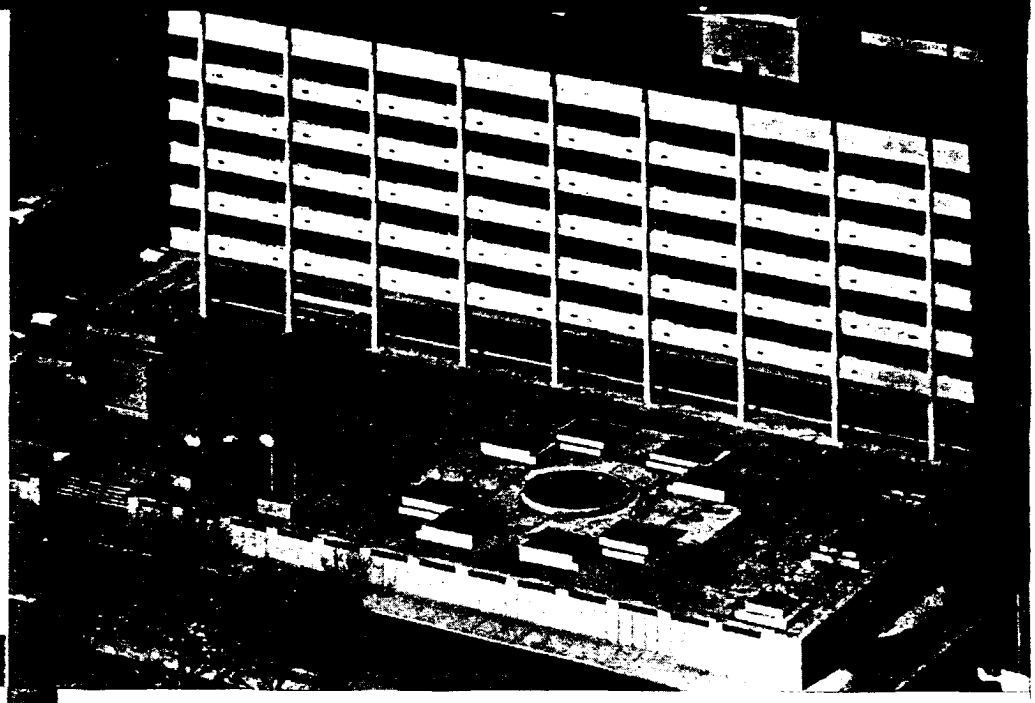
Unlike the diesel fuel, LPG does not ignite when it is compressed in the normal diesel engine. In working on this problem, researchers of the Ethyl Corporation learned that mixing 10 per cent or less of diesel fuel with the LPG produces predictable ignition. In practice, they use just enough diesel fuel to insure good ignition and vary the feed of LPG to meet the power demand.

Depending, as it does, on heat from compression rather than sparkplugs for ignition, the diesel must have a fairly high compression ratio. LPG does not work well at high compression. In fact, engine knock became violent when the engine was run at only 60 to 70 per cent of rated power. One way to prevent knocking is to lower the compression ratio. The compression ratio required to stop the knock was so low, however, that the ignition could only have been effected with sparkplugs. And this was not practical because it meant that the engine could not be used with conventional diesel fuel.

This is where tetramethyl lead came in. Adding TML at a concentration of one milliliter per gallon of LPG, Ethyl researchers found that they could achieve knock-free operation of a small engine at 100 per cent of rating. Testing moved on to full-scale engines.

Tests of regular locomotive diesels running on the leaded LPG-diesel mixture showed good performance (44 per cent better than without lead) but the engine could not quite deliver full rated power without knocking. At this point the compression ratio was lowered from 13.6 to 11.9 — not enough to affect the self-ignition of the fuel — and the desired results were attained. Not only was full-power knock-free operation at 100 per cent rating attained (using only 0.65 ml of TML per gallon), it was found that with 2 milliliters of TML the engine could be pushed to 20 per cent above rated load without knocking.

A happy piece of research "fallout" from the railroad diesel work is the prospect of better conventional LPG engines. Elimination of knocking with TML has indicated the way toward better tractors and trucks.



The pools and plant boxes in front of the Blue Cross Building, St. Louis, form the Service's insignia. The underground garage entrance is at the right foreground.

BLUE CROSS POOLS

When expanded services and a greatly increased staff forced St. Louis Blue Cross Hospital Service to move from its old quarters, a decision was made to build rather than to lease existing office space.

Blue Cross wanted to obtain closer communication with the central city and accordingly chose a site on Olive Street, a main avenue to the heart of downtown St. Louis. Regarding the building itself, Blue Cross wanted maximum efficiency of internal space and, to provide some return on the investment, additional office space for lease.

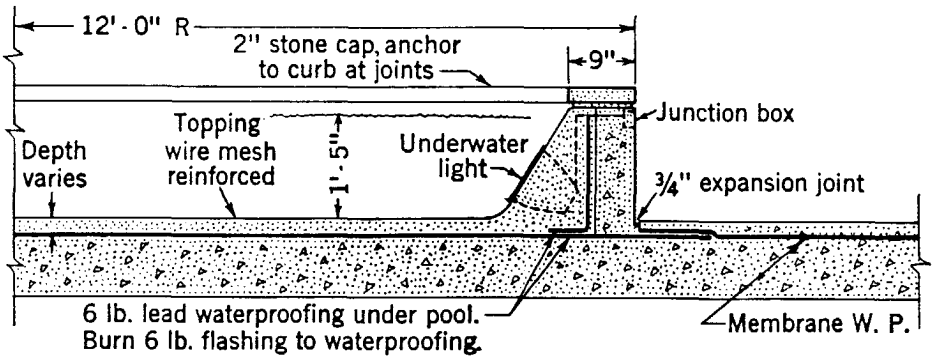
The architects, Hellmuth, Obata & Kassabaum, Inc., utilized the sloping site to create a raised court on a broad terrace in front of the building and placed a parking garage under it. The court is enhanced by a cluster of square plant boxes around a circular pool at the eastern end. In plan, this arrangement reproduces the familiar Blue Cross insignia. The 100-car garage neatly solves the problem of where the building's occupants can park during the working day.

Because the pool and plant boxes might allow water to seep through the terrace to the garage below, a completely reliable water proofing material was needed. The architects chose lead.

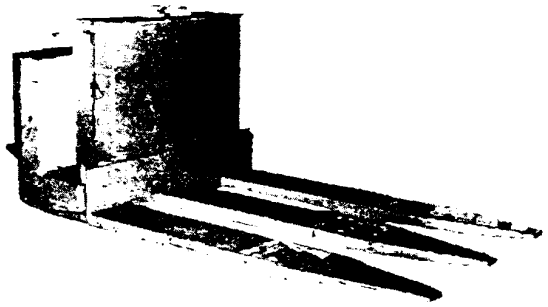
Six pound sheet lead was used to line the plant boxes and pool, totaling approximately 16 tons. All joints were burned. The pan for the pool bottom was carried through under the pool bulkhead and then interleaved with the membrane waterproofing used in the remainder of the plaza. All vertical flashings were burned to the lead underlayment to complete a watertight assembly.

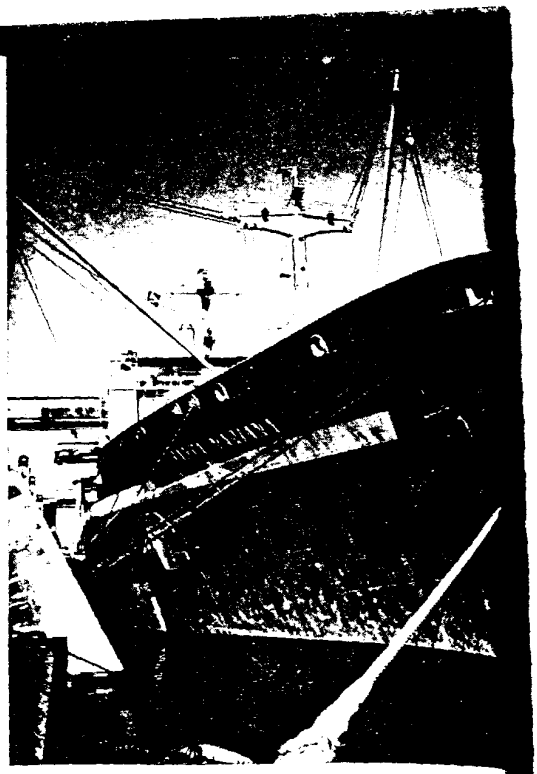
In all cases the lead was first painted with a heavy brush coat of asphaltum for protection against the corrosive effects of free lime in the cement used to line both pool and plant boxes. This is a standard precautionary measure taken wherever metal is in contact with fresh cement or concrete.

Lead work for both pool and planters was done by the Corrigan Company, sub-contractor to the Dickie Construction Company, both of St. Louis, Mo.



Section through pool showing the position of the sheet lead waterproofing.





BATTERY TRUCKS GO TO SEA.

As any old salt can tell you, a ship doesn't produce revenue in port. On the other hand, she must load and unload fuel and cargo in order to return to the high seas. Thus, a quick, efficient turnaround is in order. And, one of the best ways to assure this is with an up-to-the-minute, integrated, materials handling system.

Just such a system is in use onboard each of Grace Line's four new passenger/cargo liners, the *Santa Magdalena*, *Santa Maria*, *Santa Mariana*, and *Santa Mercedes*. These 20,000-ton sister ships only joined the Grace Line Fleet in 1963, but their swift cargo-handling capacity is years advanced.

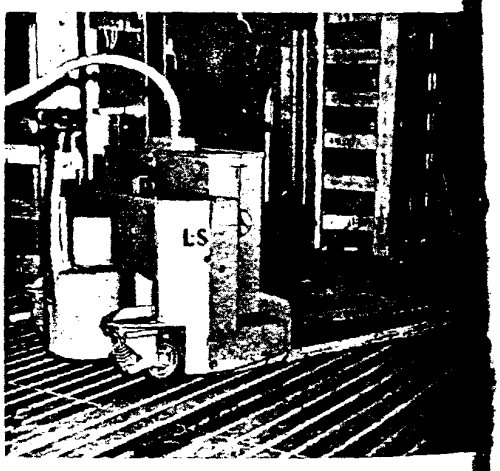
There are several good reasons why these ships can move cargo rapidly: through the use of containerization, palletized cargo, central controls and mechanized equipment. It will come as no surprise then, that the battery-powered fork lift truck has a part in this achievement. Using fork trucks, one man can move loads up to five tons with great ease. It is not uncommon to whisk pallet-loads of such things as balsa wood, coffee beans, bananas, and cacao beans in and out of these ships at the rate of 60 per hour.

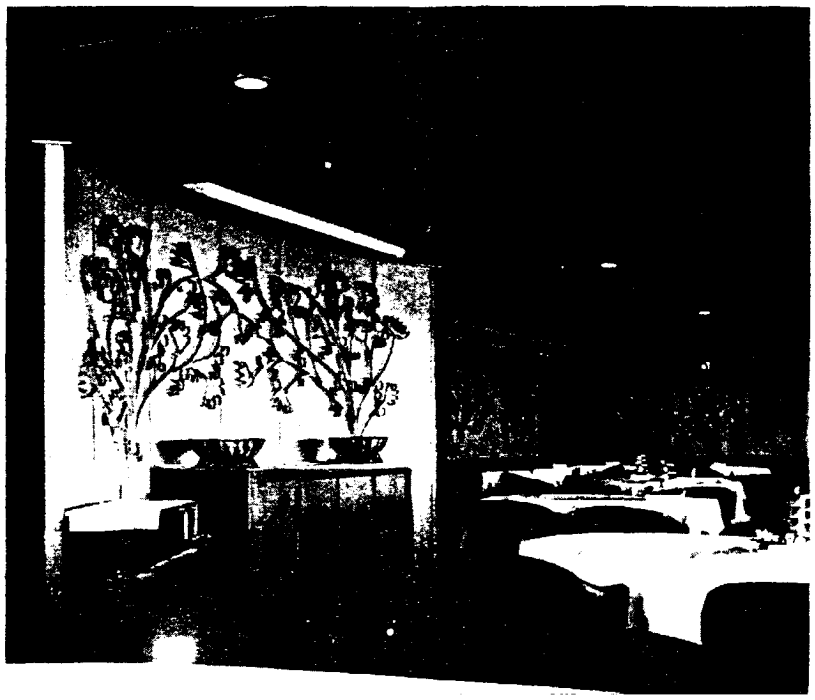
Since the trucks are permanent — they ride with the ship into every port — there is no waiting for dockside equipment to get onboard, either. Each ship carries 12 of these work-horse trucks — one in each cargo hold, for a total of 48. This is all a part of a highly coordinated operation involving the use of conveyor belts, elevators, deck-mounted gantry cranes and a variety of palleted and containerized loads.

Each fork lift truck holds 12 high-capacity lead-acid batteries, enough to power the trucks through a full shift (eight hours or more). Besides full shift capabilities, these trucks must often emphasize their reliability in holds where the temperature ranges from 0° to 32° F.

The use of economical lead-acid battery power which emits no exhaust gases makes these trucks ideal for use in an enclosed area with limited ventilation. As an additional safety factor, the ship's charging system, located in the cargo control rooms, has special vent tubes that must be affixed to the truck's battery compartment before charging can begin.

Recharging the batteries of a Lewis-Shepard fork lift truck on board the *Santa Magdalena*, one of Grace Line's four new passenger/cargo liners, note the tube which collects charging gases and vents them to outside.





Dining room onboard the *Santa Mariana*, one of Grace Line's four new passenger/cargo liners . . . catering to just 117 passengers per voyage, the *Santa Mariana* and her sisters sail weekly on 26-day, two-ocean cruises to ports in the Caribbean and Pacific Coast of S. America via the Panama Canal as far south as Callao, Peru (port for Lima).

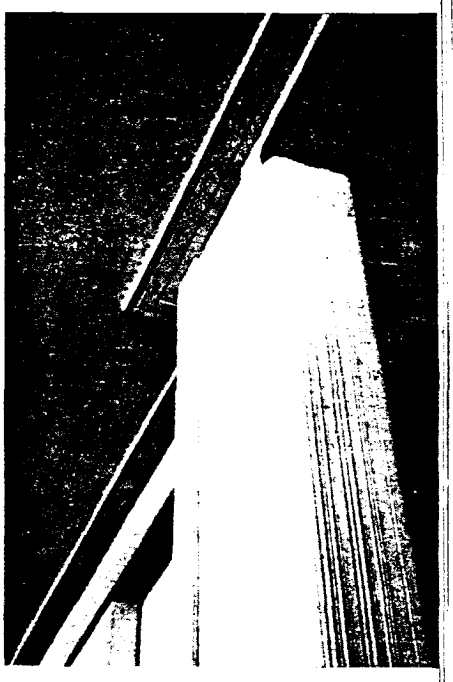
. . . PORCELAIN ENAMEL TOO!

IN the construction of any public enclosure — whether it's in a building or on a ship — selection of the best wall finish is always a problem. Usually, the result is a compromise. Until recently, there had been no finishing material available to answer all the requirements, both functional and aesthetic. Some of these are: strength, extreme durability, choice of colors, thin and light, flexible, and most important, fireproof.

However, when Smyth Urquhart & Marckwald, Inc., interior decorators for the Grace Line's four new passenger cargo liners, *Santa Maria*, *Santa Mariana*, *Santa Magdalena*, and *Santa Mercedes*, selected wall paneling for the public rooms in these sea-going resorts, the choice was easy: porcelain enamel on aluminum.

This thin, hard glass coating on aluminum is one of the most durable finishes to be found. And it's flexible! Enameled sheets were actually hand-formed around steel struts, trim and panel connector pieces. Color was no problem either. Hamlin-Stevens, Inc., enamelers for the job, could have supplied porcelain enamel panels in any color. Pleasing hues of blue, eggshell, beige, and "greige" were chosen. Finally, joiner contractors, Arno Marine Div., Kahr Bearing Corp., installed the panels. All four of these modern liners were built by Bethlehem Steel's Shipbuilding Division.

International cuisine makes dining aboard Grace Line's four new *Santas* a gourmet's delight.



Close-up view of porcelain-on-aluminum showing how this flexible, glass coated skin was wrapped around steel posts without chippoge.

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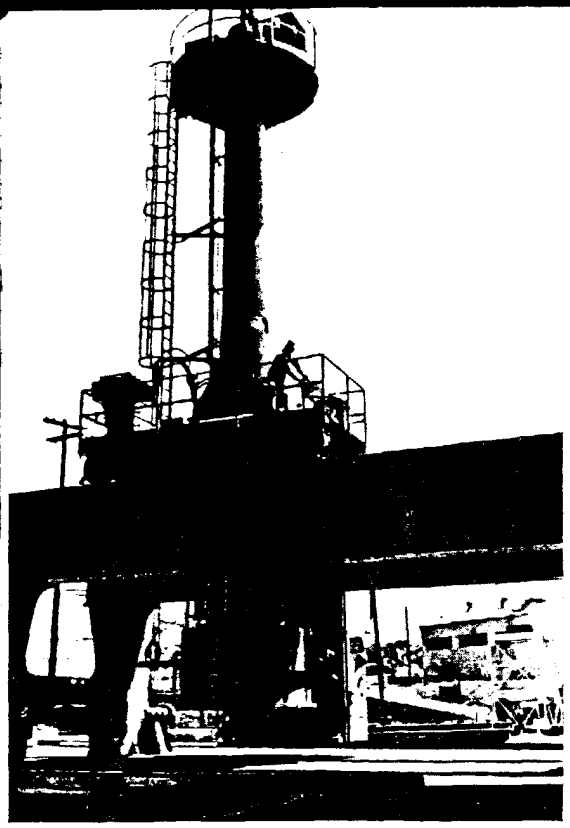


Fuel handling device for the Hallam reactor. The chamber filled with 100 tons of lead shot extends up to the lower platform. The entire machine is 54 ft. high. (Photo courtesy of National Lead Co.)

100 Tons of Lead Shot Shields Reactor Loader

LEAD

LG

One of the touchiest problems facing atomic reactor operating engineers is the safe handling of highly radioactive fuel elements when they are loaded and unloaded in the reactor. The principal danger is from highly penetrating and destructive gamma rays. In most installations where shielding weight and volume are important considerations, lead is the preferred shielding material for gamma ray protection. It provides equal shielding for less weight and far less space than most other shielding materials.

The fuel handling device for the Hallam Reactor in Hallam, Nebraska operated by the Consumers Public Power District, was a design that presented unusual problems that were solved in a novel way by the designers of Atomics International Corp., builders of the reactor complex. The total weight of the machine was so great that it was felt best to be able to add the shielding material as construction progressed. So, rather than use a large solid lead cylinder with the chamber for the fuel rods in its center, two concentric cylinders were constructed and the space between them was filled with 100 tons of lead shot.

The soft lead shot was an extra pure grade and the size of individual shot ranged from 0.07 in. to 0.12 inches in diameter. The designers considered that the volume of shot has a shielding efficiency approximately 75% that of a like volume of solid lead.

In the unloading operation, for example, the 54 ft. high precision machine travels on its gantry until it is positioned over the reactor sunk into the earth. When the reactor cover is removed exposing the core, the large diameter cylinder at the base of the handler is delicately lowered into the reactor and the fuel rod assembly is withdrawn up into the shot-shielded chamber, and safely lifted out of the reactor.

The entire machine then travels along its tracks until it is over a water-filled "canal" about 25 ft. deep. The spent fuel assembly which is both radioactive and thermally hot is then lowered into the water where it is allowed to cool. After cooling, the fuel rods are transferred to shipping casks (see LEAD Vol. 27, No. 3, "Radioactive Fuel—a Packaging Problem") and removed.

The electrical distribution
ments for the 1964 New York
Fair cover underground distr
and communications syste
about 250 exhibits, street
ornamental lighting effects, s
lar fountains and numerous ot
trically powered features. A
reliable underground distribut
work of lead sheathed power
will supply up to 85,000 kva
Fair.

Lead sheathed rubber in
power cables have been utilized
mammoth project according t
Ortiz, project engineer, Syska
nessey, Inc., electrical consultin
neers for the Fair, after th
evaluation.* The factors the
sidered included the soil, wat
other environmental conditions
Fair site: the history of power
reliability during and after th
Fair; and the accumulated exp
with lead sheathed cable in th
during the last twenty five year

"Most areas of the Flushing
ows site were, before the 1939
Mr. Ortiz wrote, "dumping g
for ashes and rubbish. The 19
tribution cables were of the

*"Fair's Distribution
Ortiz *Electrical*

Crossed bars at tube mouth prevent the cable from twisting within the conduit.

Workman strapping neutral conductor onto pulling eye for easy pulling into conduit.

sheathed power cable
GHTS THE WORLD'S FAIR

rubber insulated type, protected with asbestos braid and installed in underground concrete ducts. The high operational and maintenance cost resulting from the use of this type of cable in the last Fair was not commendable.

"The installation of lead sheathed cables and splices requires highly skilled labor and consequently is high in initial cost as compared with nonmetallic sheathed cables. However, the high initial cost was balanced by the expected benefits of greater endurance, reliability and lower maintenance costs observed by Con Ed for lead sheathed cables in this area. Moreover, the electrical distribution system is one of the many Fair features which were designed to remain as permanent Park improvements after the Fair. The lead sheathed cables' excellent service record in the Fair's site promises the long life required."

The present site which also served the 1939 Fair will be improved to a large, modern park after the present Fair closes. This area, in the franchised territory of Consolidated Edison Company, is served by the Corona Substation supplying power at 27 kv.

All available data from the past Fair was analyzed and modified to include the expected electrical load increases due to generally accepted higher illumination levels and widespread use of air conditioning. It was decided that the most economical distribution plan was to reduce the 27 kv supply from the substation to 4160 v in three major substations from which radial feeders could supply all areas of the Fair.

More than 600,000 ft. (about 118 miles) of lead sheathed cable have been manufactured and supplied by Phelps Dodge Copper Products Corporation for the installation which is virtually complete. As a rough estimate, this amounts to more than 567 tons of lead.

The radial feeder cables are installed in an extensive system of asphalt-covered galvanized steel conduits. The main 4160 v feeder cables are butyl rubber insulated, copper conductor, with lead sheathing. Each main feeder consists of three single conductors 500 MCM, 5 kv, grounded wye distribution type.

In each conduit bank and through all manholes a 500 MCM ground conductor is installed and connected to the substation ground bus and to all individual manhole ground rods. The entire distribution system is thus provided with a uniform and reliable ground system. The lead sheath of cables is tied to the ground bus system in all manholes for maximum safety and operating advantage.

Reel of three single conductor, 500 MCM, 5 kv, rubber insulated cables being positioned alongside a manhole.

Many individual pieces of sculptured sheet lead are used to overlay each window composition. After an individual piece is checked it is matched to the lead cames of the window (right). The pieces are then assembled and positioned (center). Finally, the gold leaf is "flown" on the sheet lead.

STAINED GLASS UNDER A NEW LIGHT

Until recently the full glory of the ancient art of stained glass making could not be realized without the sun's rays flooding through a cathedral window toward the spectator. Today, through the genius of Henry Lee Willet of Philadelphia, there is a new art form under the sun — and *without* it as well!

Someone has said that a stained glass window has two functions at the same time. One is adornment, the general qualification of the interior of the structure; while the other is the function of "speaking." Obviously the stained glass concentrates on the first function while the representational window accents the message, supplying adornment as an extra dividend. It is that "extra dividend" that Willet craftsmen have been able to capture no matter what the time of day or condition of light.

The spectacular new technique involves soldering sculptured 3-lb. sheet lead overlays to the basic lead cames which ordinarily hold the stained glass in place. These overlays are formed in relief and then incised with carefully formed and located slits of varying widths which allow the light to shine through the richly colored glass during the day. The "halation" of light through first the glass and then through these slits allows none of the beauty of the glass to be lost. At the same time, the sculptured lead, covered with gold leaf, fulfills the representational function of the window, in silhouette. It is at night however, when the glass normally is dark, that the interior lights reflect the golden design with startling intensity. Thus the window functions both by day and by night.

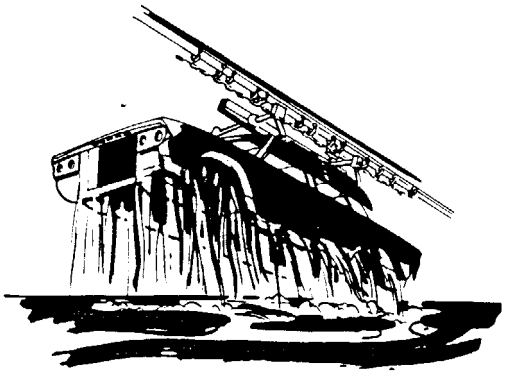
Actually the art of metallic sculpture is also an ancient art. The Willet Studios have simply combined the two venerable art forms and have added the 23 Karat gold leaf to give the brilliant metallic night effect and the artfully placed incised slits in the lead which permit halation of light during the day.

Cutting masks from 3 lb sheet lead with an electric saw.

Sculpting a mask in low relief by hammering a wooden stick along scribed lines on the lead.

Water thinnable LEAD PRIMERS

— a new weapon against corrosion



Modern automobile and truck designers are turning more and more frequently to "unitized body" constructions. These unitized bodies eliminate the conventional heavy frame as the main source of structural strength and rely instead on closed tubes, box girders and irregular shapes formed integrally in the body sheet metal.

While this construction does solve a number of problems for designers, it has also presented some new ones. Chief of these is rust and corrosion — compounding problems, of course, as metal thicknesses diminish.

Recent tests on lead pigments suggest ways to provide protection for ferrous products with light structural members and for that matter, most other metal products demanding high corrosion resistance.*

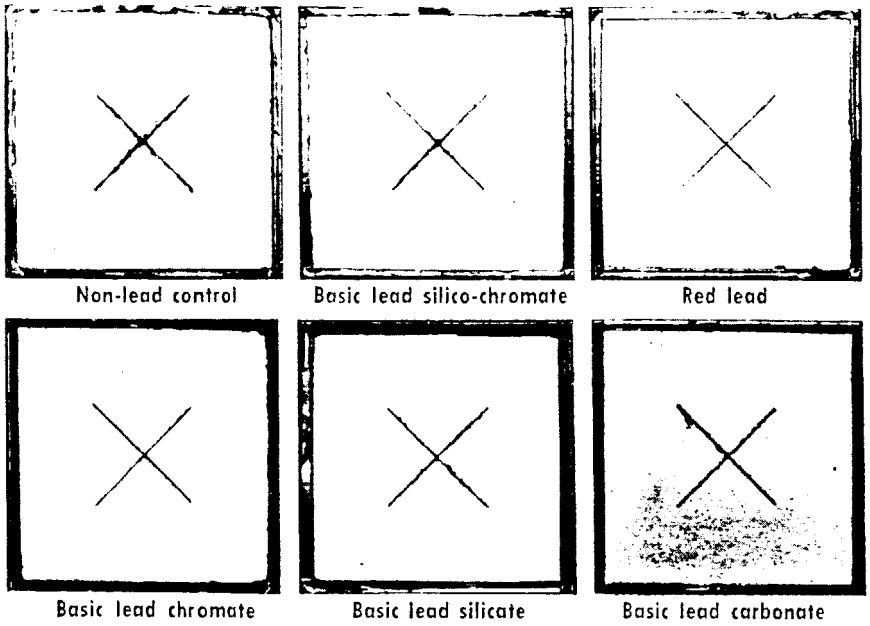
Dip priming has proved the best method for unitized body construction because it is the only way to get to the hidden surfaces where water, slush and dirt can get in through spot-welded seams. Water thinnable paints are preferred for the operation because when they are heat dried the pigments dry uniformly in place and there are no dangerous volatile solvents. In heat drying, the metal is heated unevenly so that there are hot and cool spots. Under these conditions, the solvent thinned system will evaporate solvent from the hot portions and condense it on the cooler areas. The condensing solvent almost completely removes the paint from the cool spots.

In addition to solving this "self-removal" problem, water based primers reduce fire and health hazards and are unaffected by moisture in the air or on the product.

Gist of the LIA tests: lead pigments improve the performance of water-thinnable paints, whether applied by brushing, spraying or dipping. Photos of the panels shown here after exposure to salt spray for 250 hours show how several of the lead pigments fared as contrasted with a panel coated with the non-lead primer and subjected to the same exposure. The results after 2000 hours were even more indicative of the value of the lead pigments.

In the evaluation of the primers about 65 different lead compounds were tested in typical water-thinnable ferrous metal primers. The different lead compounds were substituted on a volume basis for the original pigment of the primer. Test panels were subjected to as much as 2000 hours of salt spray and the paint was then stripped off to show the extent of rusting.

Test panel results after 250 hours of salt spray. Paint film has been stripped away.



*Official Digest, Journal of Paint Technology and Engineering; Feb., 1964; "Anticorrosive Lead Pigments in Water-Thinned Ferrous Metal Primers"; E. J. Ritchie and H. J. Hughes.

Special Materials for Noise Control

Long before the first "acoustic ceiling" was thought of, the Roman Emperor Nero was strapping lead plates to his chest to improve his singing voice. This historical curiosity has hardly anything to do with the modern practice of noise control, but it does illustrate the intuitive knowledge we have of lead's mass and limpness. Lead doesn't rattle or ring.

Today, "soundproofing" usually means adding light fibrous materials — ceiling tiles, carpets, drapery — to the treated area. And while there is no such thing as sound*proofing* by any manner of treatment which might be practically considered, the sound absorbing qualities of these materials can be a great aid in many typical problem situations.

Lead, by contrast, cannot itself absorb noise to any usable extent.* Instead it is used in two other ways. First, it can block the passage of sound waves from their source to the ear. It is the most efficient material commonly available for this purpose. Second, it can be used with suitable soft materials to damp the mechanical vibration of metal or other surfaces which set the sound waves in motion in the air. One common use of damping compounds, an example which does not make use of lead, incidentally, is the automobile undercoating used to quiet most new cars. While lead compounds for the same use are somewhat more expensive, their much higher effectiveness makes them desirable in critical applications.

The family of lead materials for noise control has grown so rapidly in recent years that it has been difficult for people interested in the field to keep track of them. The table presented here is a current round-up of available materials with some idea of their uses and availability. More detailed information is available in the "Sound Memo" published by Lead Industries Association, Inc.

LEAD MATERIALS FOR ACOUSTICAL USE

MATERIAL	DESCRIPTION	PRINCIPAL USES	AVAILABILITY
Lead sheet and foil	usual thicknesses for acoustical work are 0.001 to 3/32 inch	sheet lead is used alone and in laminates as a barrier	sheet & laminates commercial
		foil has been used with viscoelastic cements for damping	experimental
Lead asbestos anti-vibration pads	hermetically sealed lead envelope with asbestos and lead or steel sandwich fill. Size from a few inches to 6 x 10 feet and larger. Usual thicknesses are 1 to 3 inch.	in building foundations, machinery mounts, wherever a vibration path through a structure must be blocked	commercial
Flexible leaded plastic sheet	with or without fabric reinforcement. From 0.005 to more than 1/8 inch thick. Vinyl and neoprene most often used. Vinyl is available in tinted, embossed, or printed finish.	self-adhesive and cemented types as damping materials in office equipment, submarines, other military uses.	commercial and military
		free-hanging or laminated as barriers in aircraft, marine, architectural use.	commercial and military
Damping tiles	usually 1'x1'x1/2" weighing 4 to 5 pounds. Epoxy or urethane with lead or galena loading	damping structural steel and heavy machinery	commercial
	same dimension weighing 4.5 pound neoprene loaded with lead shot	ship hull damping	military
Casting compounds	epoxy loaded with lead or galena	potting, filling complex voids	commercial
Trowelling compounds	epoxy, neoprene, urethane loaded with lead or galena	damping structures, surfaces, resonant members, transformer core laminations, rattling panels, power steering squeal	commercial
		sealing cracks in noise barriers, closing openings for wiring, piping, etc.	commercial
Damping paint	fine lead powder in hypalon vehicle. Compatible with selected finishing topcoats.	reducing "boigggning" in large areas of light sheet metal	commercial
Miscellaneous	fabricated sheath of neoprene with loose lead shot in sealed compartments	exterior sheathing for submarines	military
	acoustic curtains and doors	general architectural	commercial

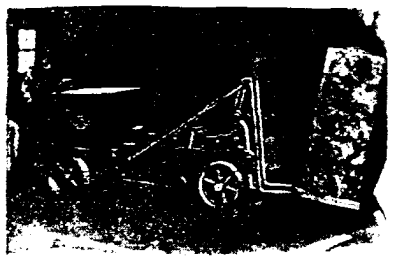
LIA26349

*It can enhance absorbent materials, however. A thin backing of lead on acoustic tile lowers transmission of sound through the tile and insures that sound will be reflected through the tile after its first passage.

Interesting Odds 'N' Ends... about Lead

So, shut up, already! NASA confidently predicted that communications satellite Relay I would cease to transmit during December 1963. The cutoff device was a lead wire in bath of corrosive electrolyte. Perhaps NASA should have chosen some metal with less ability to withstand corrosion for, as this issue of LEAD goes to press, Relay I continues to beep loud and clear!

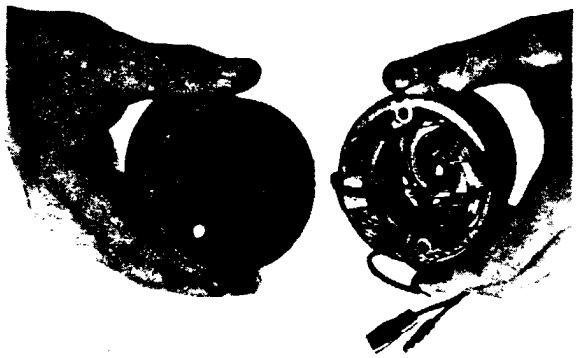
Battery powered industrial trucks are the safest type for use in such dangerous areas as those involving flammable liquids or vapors, gases, combustible dust or easily ignited fibers, according to Associated Mutual Fire Insurance Companies. Conventional lead-acid battery powered trucks do not use a combustible fuel and are safe for dust and fiber areas. Special trucks with spark enclosures, type EE, are used for all but the most dangerous flammable liquid-vapor-gas areas. Another special type, EX, is explosion proof and dust-tight and operates safely in the most hazardous environments.



Of all the lead-acid battery powered fork lift trucks manufactured in the United States in the last 20 years, 90% are still in service.

International Lead Conference Proceedings available – The 350-page, illustrated volume of the conference held in London in Oct. 1962 include 23 papers on lead cable sheathing, storage batteries, radiation shielding, research and lead and lead alloys in the chemical industry. Copies are $6.50 post free from the Lead Development Association, 34 Berkeley Square, London W 1, England, with payment to that organization.

Whose stack is "hot"? More radioactivity goes up the stack of a coal-fired plant than a nuclear one according to Merrill Eisenbud, professor of industrial medicine at N.Y.U. "For example, a 1000-Mw coal burning station will discharge about 6 millicuries of radium per year, assuming optimum practices for removing fly ash from waste gases. Making allowances for the differences in their biological and physical properties, this much radium is equivalent to 1,500 curies of krypton-85 and 1.2 curies of iodine-131, the two most significant isotopes in gaseous wastes from water reactors. Amounts of Kr-85 and I-131 actually discharged from reactors are much less."



Improved wiper motor. A ceramic permanent magnet (left) has replaced wire-wound stators (right) in current Ford automobile windshield wiper motors. The magnets reduce weight, simplify servicing and increase motor reliability — plus less heat and more shaft power. Most permanent ceramic magnets such as this are barium ferrites modified with certain additives . . . among them lead.

Thirty Years Ago

Grim evidence of the value of red lead for protecting metal was seen when the burning liner *Morro Castle* was beached at Asbury Park, N. J. One reporter wrote: "On the sides of the vessel the paint was blistering and peeling. Great flaps of it had come loose and were moving in the breeze. The ship had been black to the water line, and as the paint dropped off, it revealed the red lead beneath." And this was by no means derogatory to the black paint because the heat of the burning ship was so intense that iron and glass were melted.

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