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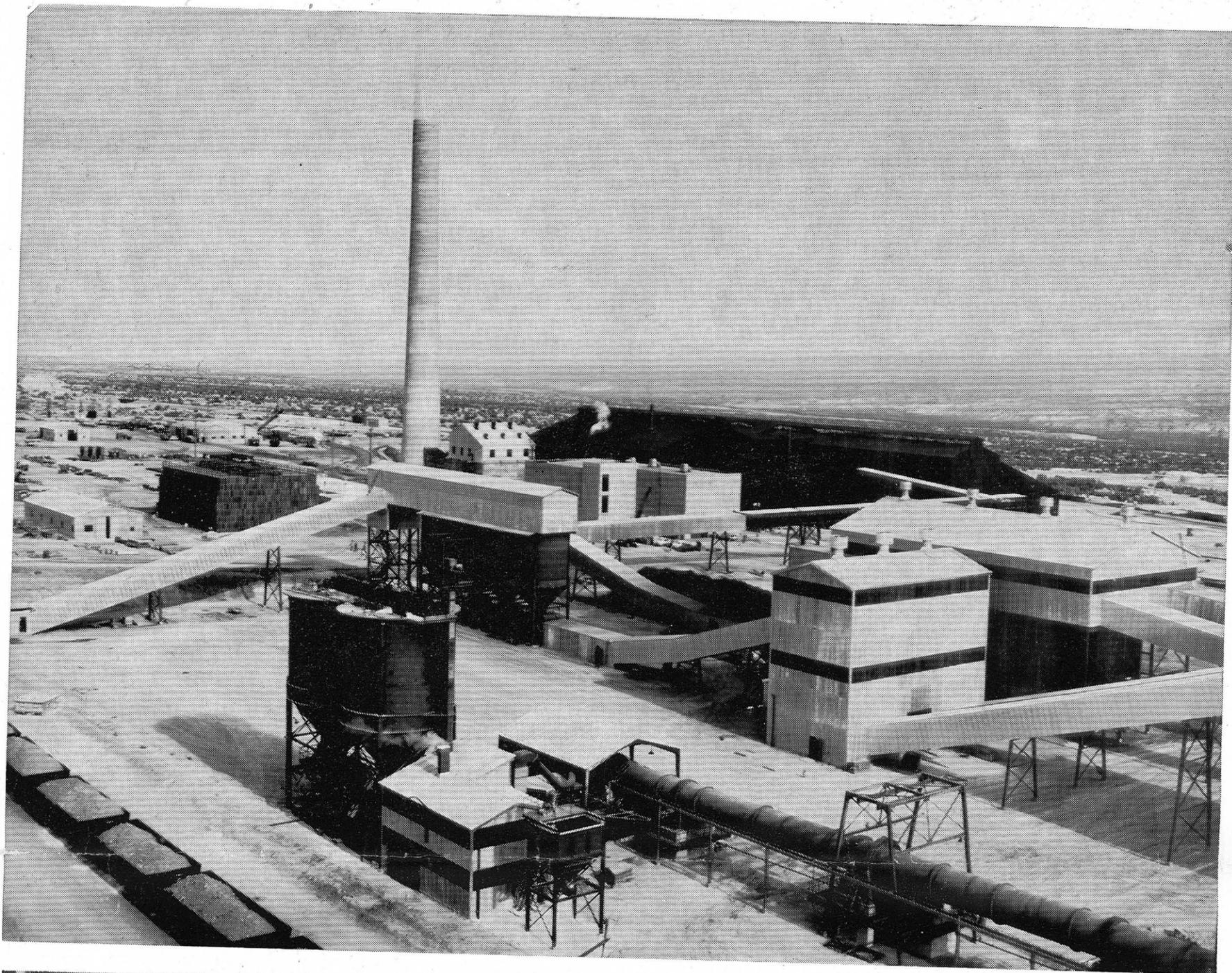
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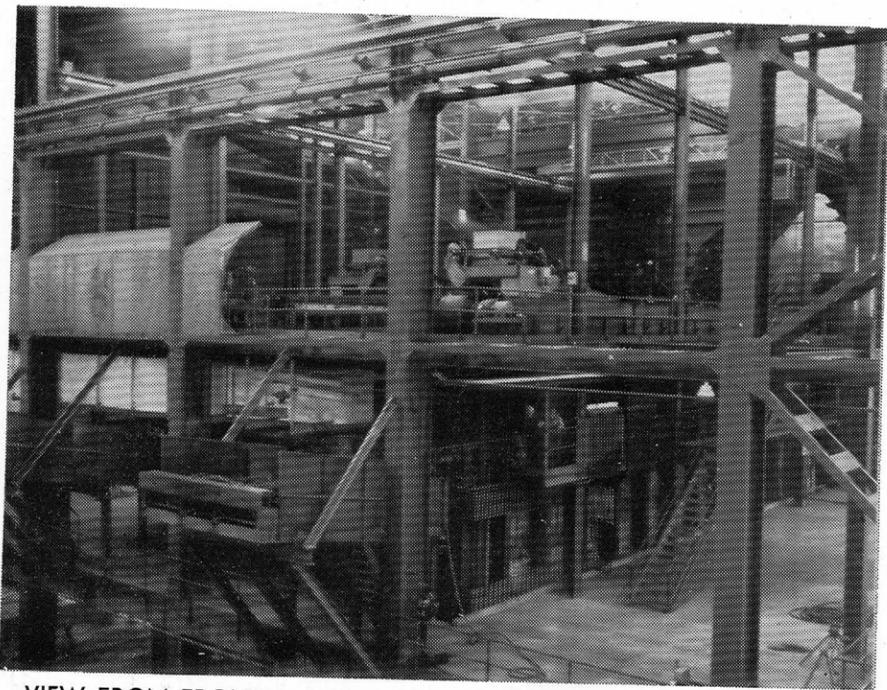
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# San Manuel . . . The Smelter



VIEW OF THE smelter and stack with the flux and lime plant in the foreground.



VIEW FROM FRONT end of reverberatory furnace where the concentrate is melted down to form a "matte" which is sulphur, iron, and copper in its molten state. Charging the furnace is done from the tripper belt conveyors shown above. The returned slag from the converters is poured into the launders shown protruding from the front.

## San Manuel Smelter

The copper concentrate, amounting to approximately 750 tons per day, averages about 28% copper. The concentrate is drawn from the storage bins in the smelter building by conveyor belts and is fed to the 32-foot by 100-foot reverberatory furnace through hoppers located along each sidewall of the furnace. The concentrate is smelted in the furnace at a temperature of approximately 2700° F., using natural gas for fuel.

Gases from the reverberatory furnace operate two waste heat boilers which furnish steam at 475 P.S.I.G. to the powerhouse. A 10,000 KW turbo generator and two 30,000 C.F.M. turbo blowers form the main steam-driven equipment in the powerhouse.

All gases from the reverberatory furnace and the converters pass through an electric precipitator prior to entering the 500-foot high stack. Practically all the small particles of solid matter are removed from the smoke. This dust has a high copper content and is returned to the reverberatory furnace.

When the charge is smelted, the furnace wall is tapped for slag which is allowed to run into railroad car slag pots of 200-cubic foot capacity. The slag pots are then hauled to the slag dump. After the slag is skimmed off, the matte, which is chiefly copper, sulphur and iron, is tapped into 200-cubic foot ladles and poured into the 13-foot by 30-foot Pierce-Smith type converters. There are three converters in the smelter, and two 60-ton overhead cranes handle the ladles.

After the matte has been poured into the converters, a flux with a high silica content is added. This flux, with the iron, forms a slag which is skimmed off and returned to the reverberatory furnace. The molten copper is transferred by ladle into the holding furnace.

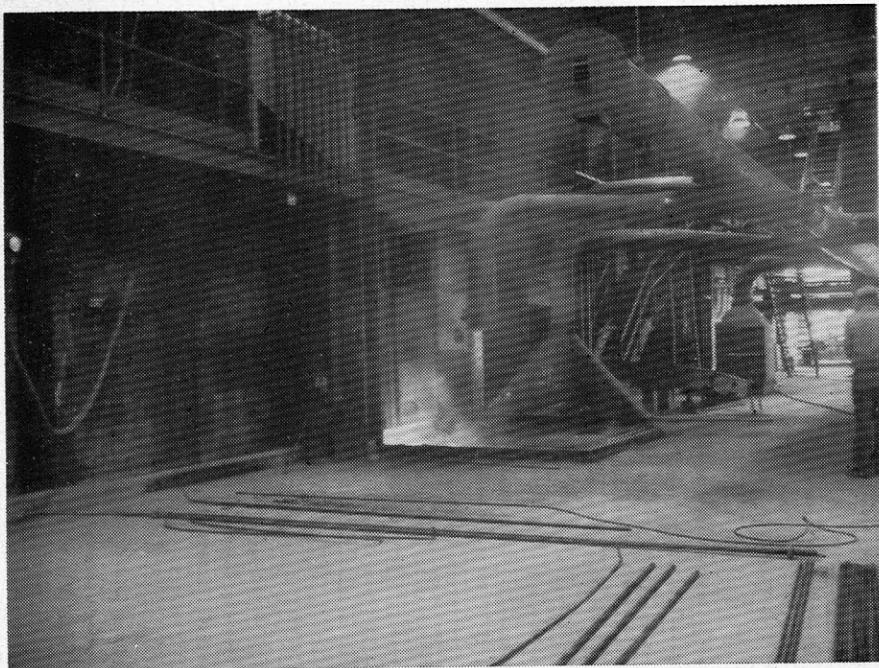
In the holding furnace the oxygen is burned off by the burning of wooden poles. The copper is poured into anode moulds located on a 34-foot diameter casting wheel. The finished anode slabs, weighing 700 pounds each are cooled in water in a bosh tank. The anodes are then removed by overhead crane and stacked on the storage floor where they are later inspected and loaded on flat cars by fork lift truck for shipment to the electrolytic refinery.

**MISCELLANEOUS FACILITIES.** The flux plant is between the smelter and concentrator buildings and includes receiving bins and crushers for handling limestone and silica flux. A lime kiln for calcining limestone and a slaker has been built to provide metallurgical lime for the concentrator.

Other Plant facilities include a machine shop with locomotive service and repair pit, carpenter and auto shops, warehouse, time office, and change house.

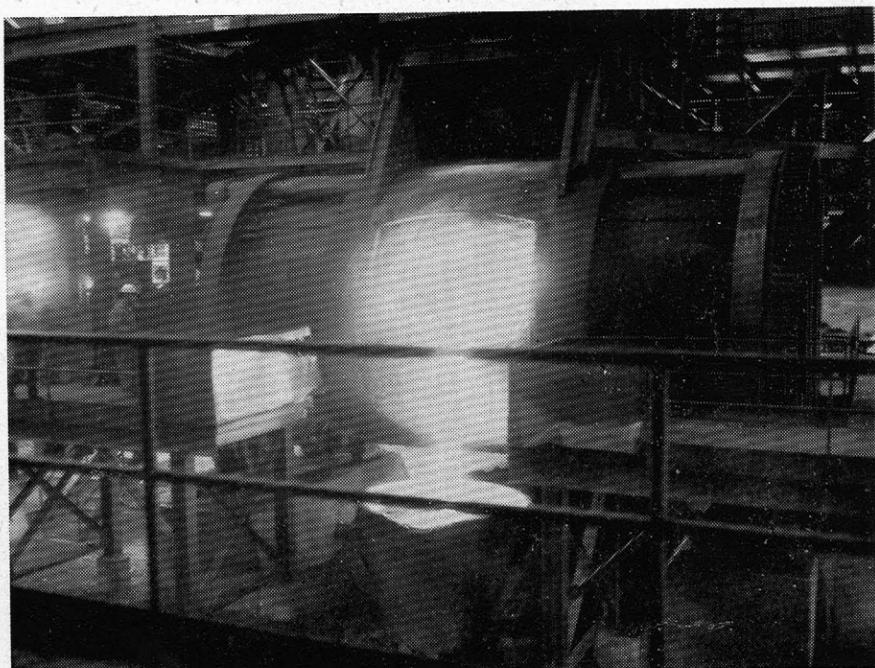
The San Manuel Arizona Railroad Company operates 30 miles of standard gauge railroad from the Plant to connect with the Southern Pacific at Hayden. Current timber and other operating supplies are being brought in. All of the anode copper is transported by rail.

## Tapping Matte



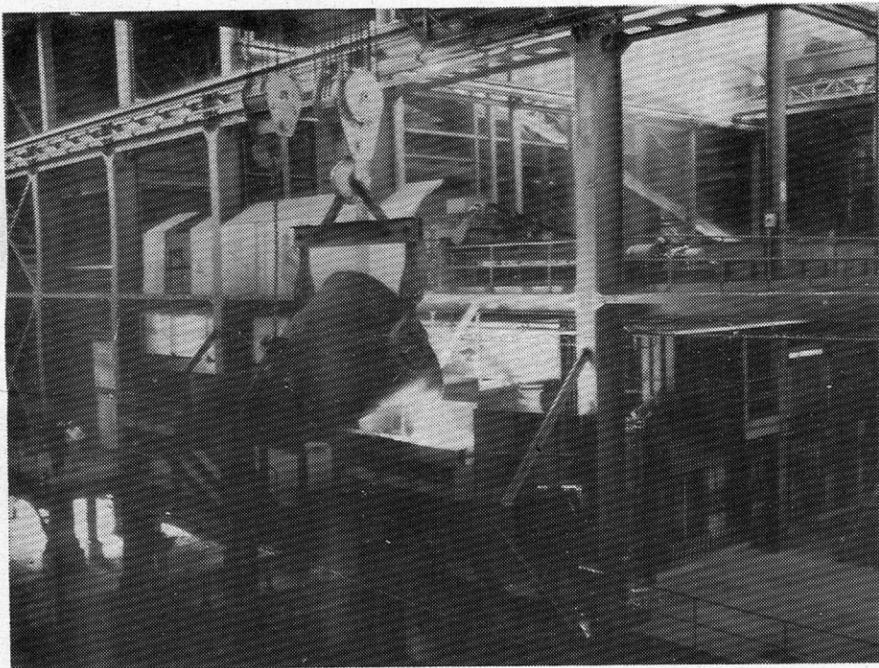
TAPPING MATTE from the side of the reverberatory furnace. The pipes shown are part of the fumes disposal.

## Pouring Slag



SLAG BEING poured from a converter into a 200 cubic foot ladle.

## Returning Converter Slag



RETURNING CONVERTER slag to the reverberatory furnace. The ladle is 200 cubic foot capacity and is handled by one of the two 60-ton converter aisle cranes.

## Converter

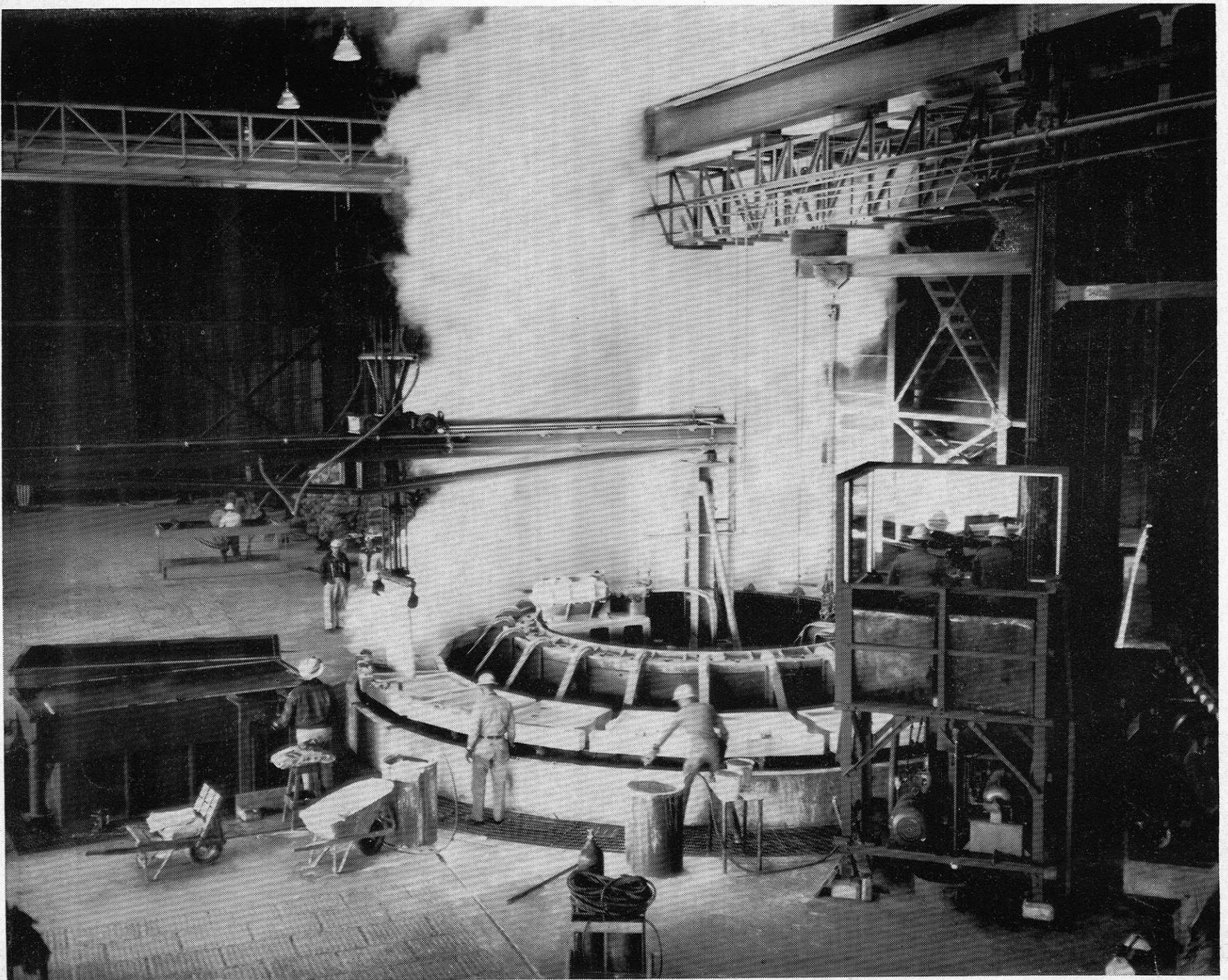


13 x 30 CONVERTER with hood open. The converters receive the matte from the reverberatory furnace to burn off the sulphur through the addition of air. Silica is added, floated off the top with the iron and returned, in ladles, to the reverberatory furnace. The molten copper is poured off, conveyed by crane in ladles, and poured into the holding furnace where oxygen is burned off by means of burning wood poles and the copper is made ready for casting.

## Pouring Copper



HOLDING FURNACE pouring copper into the spoon which allows pouring to be done evenly in the moulds on the casting wheel.



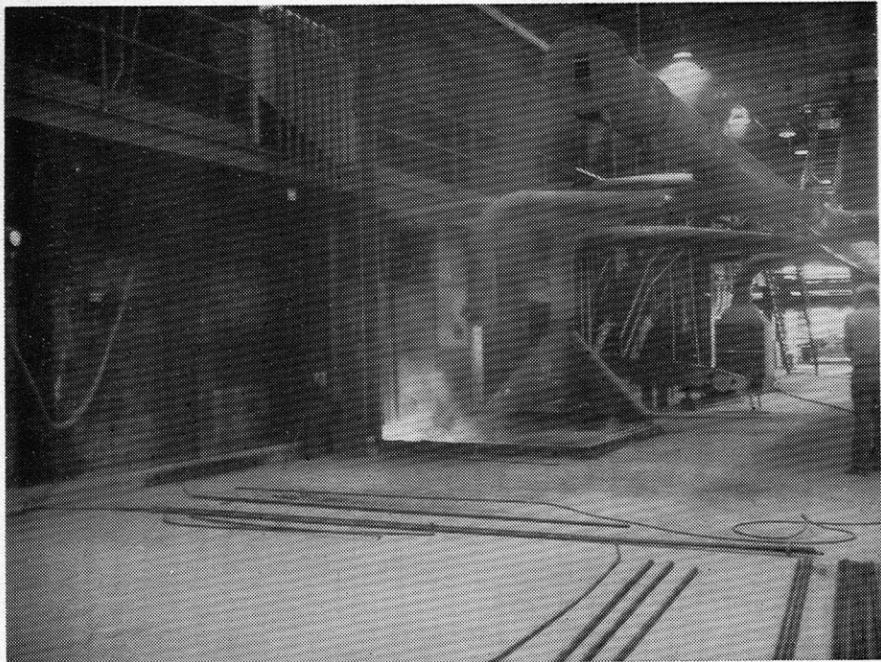
34-FOOT DIAMETER casting wheel shown at the take off side. This wheel is rotated in increments of the time taken to fill each mould. There are 22 moulds which form copper slabs called anodes. The anodes weigh 700 pounds

each and are cooled off in water (bosh tank) to facilitate quick handling for stacking by the overhead crane.



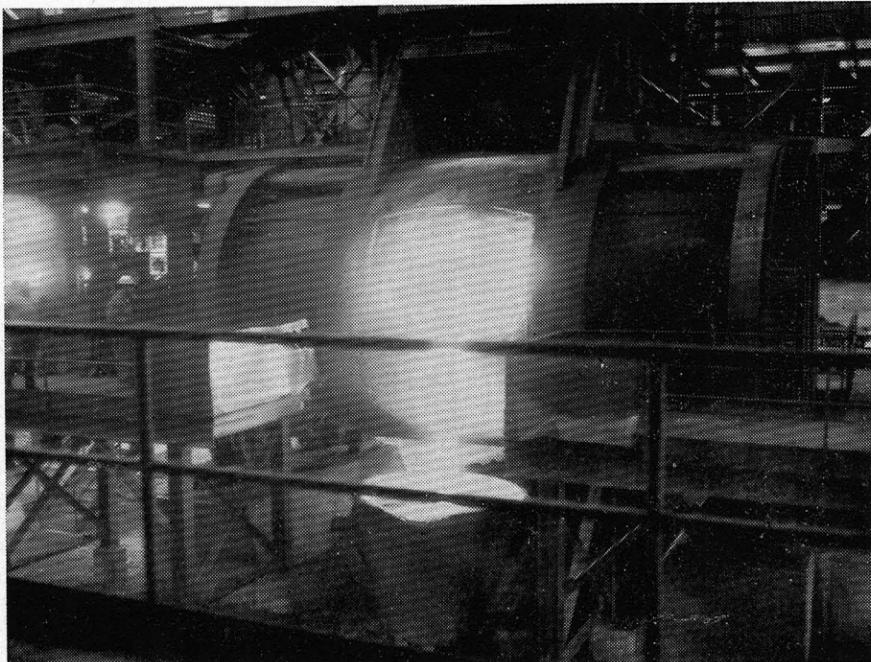
SPECIALLY RIGGED flat cars loaded with anodes on the smelter outgoing track, ready for shipment to the refinery via the San Manuel Arizona Railroad Company railroad which joins the Southern Pacific at Hayden, 30 miles away.

## Tapping Matte



TAPPING MATTE from the side of the reverberatory furnace. The pipes shown are part of the fumes disposal.

## Pouring Slag



SLAG BEING poured from a converter into a 200 cubic foot ladle.

## Returning Converter Slag



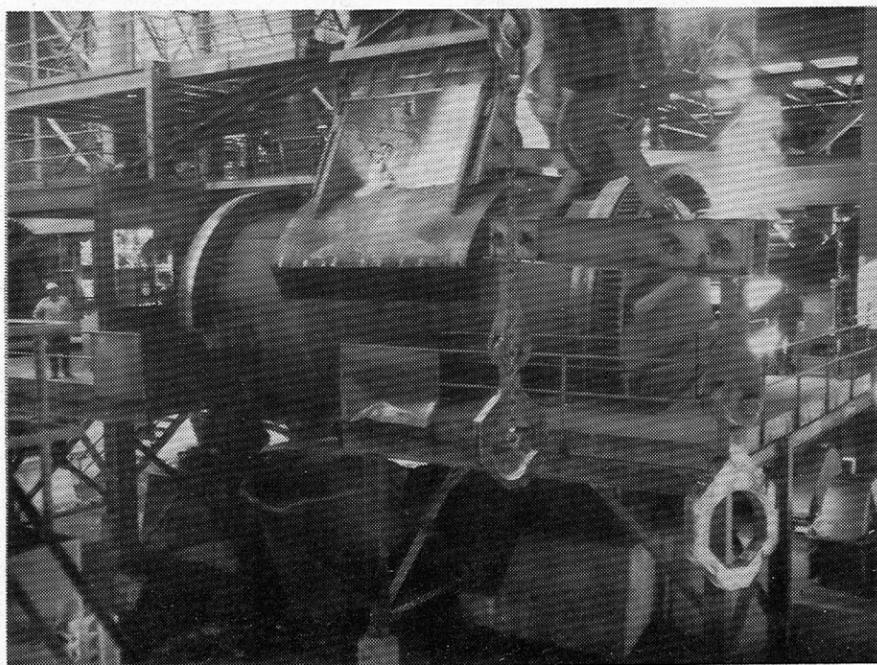
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## Converter



13 x 30 CONVERTER with hood open. The converters receive the matte from the reverberatory furnace to burn off the sulphur through the addition of air. Silica is added, floated off the top with the iron and returned, in ladles, to the reverberatory furnace. The molten copper is poured off, conveyed by crane in ladles, and poured into the holding furnace where oxygen is burned off by means of burning wood poles and the copper is made ready for casting.

# Statistical Data

## TYPE, SIZE, AND GRADE OF ORE DEPOSIT

Type—Disseminated copper.  
Gangue rock—Quartz monzonite porphyry.  
Metallic minerals—Pyrite, chalcopyrite, chalcocite, molybdenite, silver, and gold.  
Proved tonnage:  
Sulphide ore—367,624,000 tons.  
Oxide ore—111,876,000 tons.  
Average copper content:  
Sulphide ore—0.785%.  
Oxide ore—0.717% total copper.  
Average molybdenum content—0.02% to 0.04%.  
Gold and silver—Appreciable.

## PHYSICAL CHARACTERISTICS OF OREBODY

Outcrop—Triangular area, 300 x 400 feet; used for smelter flux.  
Shape of orebody—The control as to size and shape of the orebody is an arbitrary cutoff based on copper content of the mineralized rock. Therefore, that portion considered economically feasible to mine appears in the more northerly portion as a tabular mass up to 400 feet thick with its long dimension bearing northeast and lying at an angle of 55° from horizontal to the southeast. This attitude persists down dip for about 2,400 feet where it flattens and then rolls upward to form a cross-sectional fishhook shape.  
Fracture pattern—Intricate, three-dimensional network.  
Mineral occurrence—Disseminated through the gangue rock.

## OVERBURDEN OR CAPPING

Description—Gila conglomerate and weakly mineralized monzonite.  
Average thickness of overburden—670 feet.

## MINE OPENINGS

Support of ground—All ground requires support, either timber, steel, or concrete.  
Water conditions—Newly opened areas may show appreciable flow. Ore body drains rapidly.  
Temperatures—Moderate.

## MINE PRODUCTION

Capacity: daily—36,000 tons.  
Capacity: annually—10,000,000 tons.  
Mining method—Full-gravity block caving.  
Underground haulage—Electric trolley locomotive.  
Ore-car capacity—12.5 tons.  
Cars per train—15 to 18.  
Trains per day—180.  
Hoisting ore to surface:  
Hoisted through—Two identical vertical shafts.  
First hoisting level—1475 feet.  
Second hoisting level—2075 feet.  
Third hoisting level—2675 feet.  
Hoists—Two 6000 HP double-drum.  
Hoisting speed—3000 F.P.M. maximum.  
Capacity, each hoist—900 tons per hour.  
Skips dumped per hour—50 each hoist.  
Capacity of skip—18 tons.  
Capacity of skip pocket—1500 tons, each shaft.  
Run-of-mine ore, maximum size—12 inches.

## ORE TRANSPORTATION—MINE TO MILL

Storage at mine loading point—Two 5000-ton bins.  
Ore moved by—Shuttle service railroad.  
Railway construction—Seven miles, standard gauge, 132-pound rail, level, minimum of curves with liberal radius.  
Type of cars—Bottom dump, air operated.  
Capacity of car—100 tons.  
Cars per train—35 to 40.

## ORE CRUSHING

Capacity ore receiving bin—10,000 tons.  
Two stage crushing—Two 7' standard Symons; four 7' short-head Symons.  
Capacity—2000 tons per hour.  
Fine ore bin capacity—45,000 tons.

## CONCENTRATION OF ORE

Capacity of concentrator—30,000 tons per day.  
Primary grind in open circuit—Eight 10' x 13' rod mills.  
Secondary grind in closed circuit with classifiers—Sixteen 10' x 10' ball mills and sixteen 16' x 35' drag classifiers.  
Flotation—624 48"-mechanical cells.  
Concentrate regrind—Four 8' x 12' ball mills.  
Cleaner concentrate—750 to 800 tons of concentrate to molybdenum plant for recovery of molybdenum.  
Molybdenum plant products—90% MoS<sub>2</sub> concentrate ready to market and 28% copper concentrate to smelter concentrate bins.

## SMELTING OF COPPER CONCENTRATE

28% final copper concentrate—To natural gas fired, side-feed reverberatory furnace, 32' x 100'.  
Reverberatory products:  
Matte—At 32% to 35% copper.  
Slag—To slag dump.  
Waste gases—About 50% of contained heat recovered by two waste-heat boilers. Copper bearing dust recovered from gases by electric precipitator before entering 20' x 500' stack.  
Matte to Converters—Three 13' x 30' Pierce-Smith type.  
Converter products:  
Slag—Return to reverberatory furnace.  
Waste gases—Join reverberatory waste gases to electric precipitator and stack.  
Blister copper—Delivered to holding furnace where it is poled then cast into 700-pound anodes (700-pound slabs) for shipment to electrolytic refinery.

## POWER SUPPLY

Outside source—Arizona Public Service by 115,000 KV transmission line.  
Waste heat boilers, steam—10,000 KW steam driven turbo generator.  
Supplemental Power—5,500 KW Gas-Diesel Plant at Mine.

## APPROXIMATE EMPLOYMENT

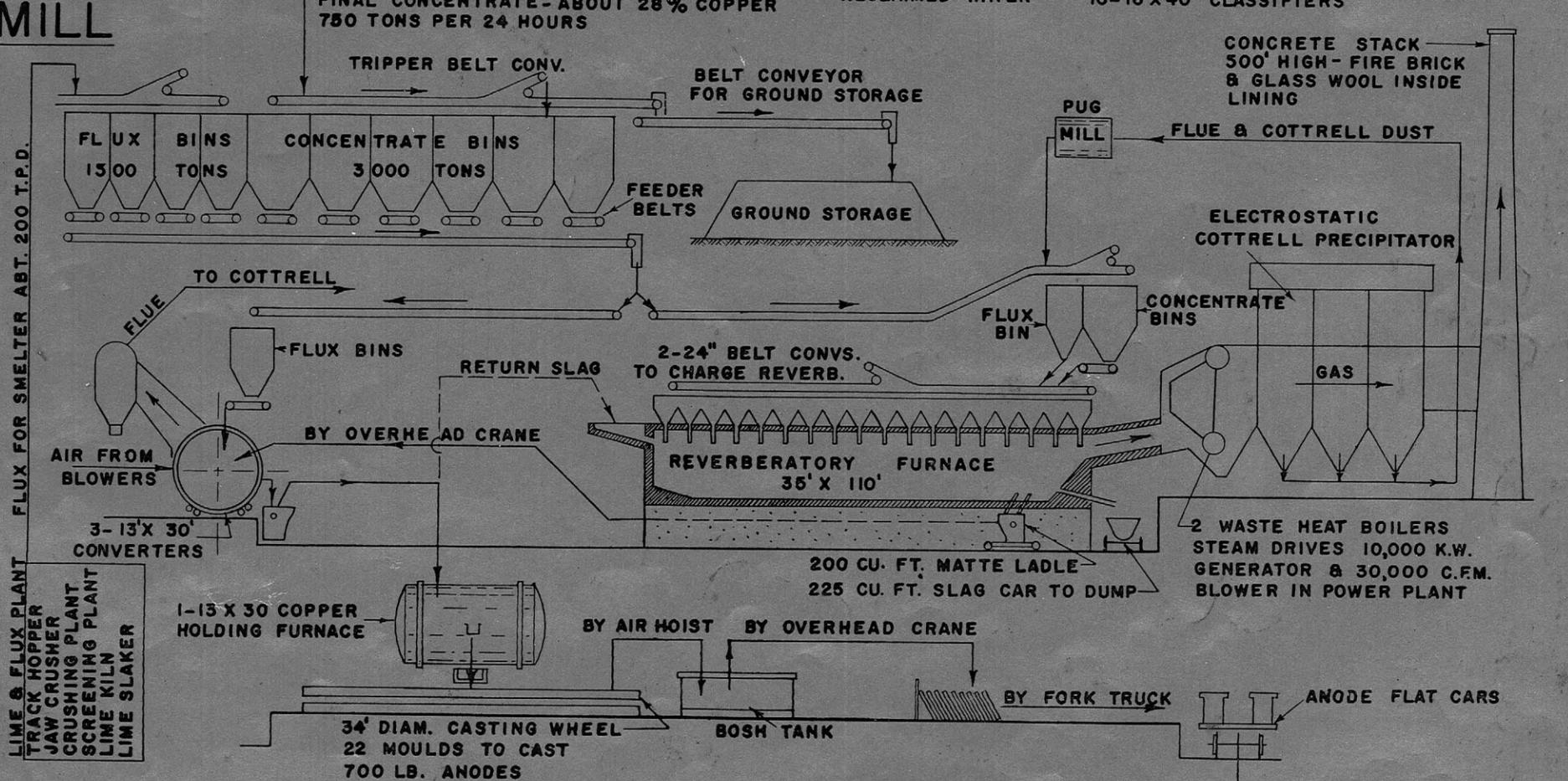
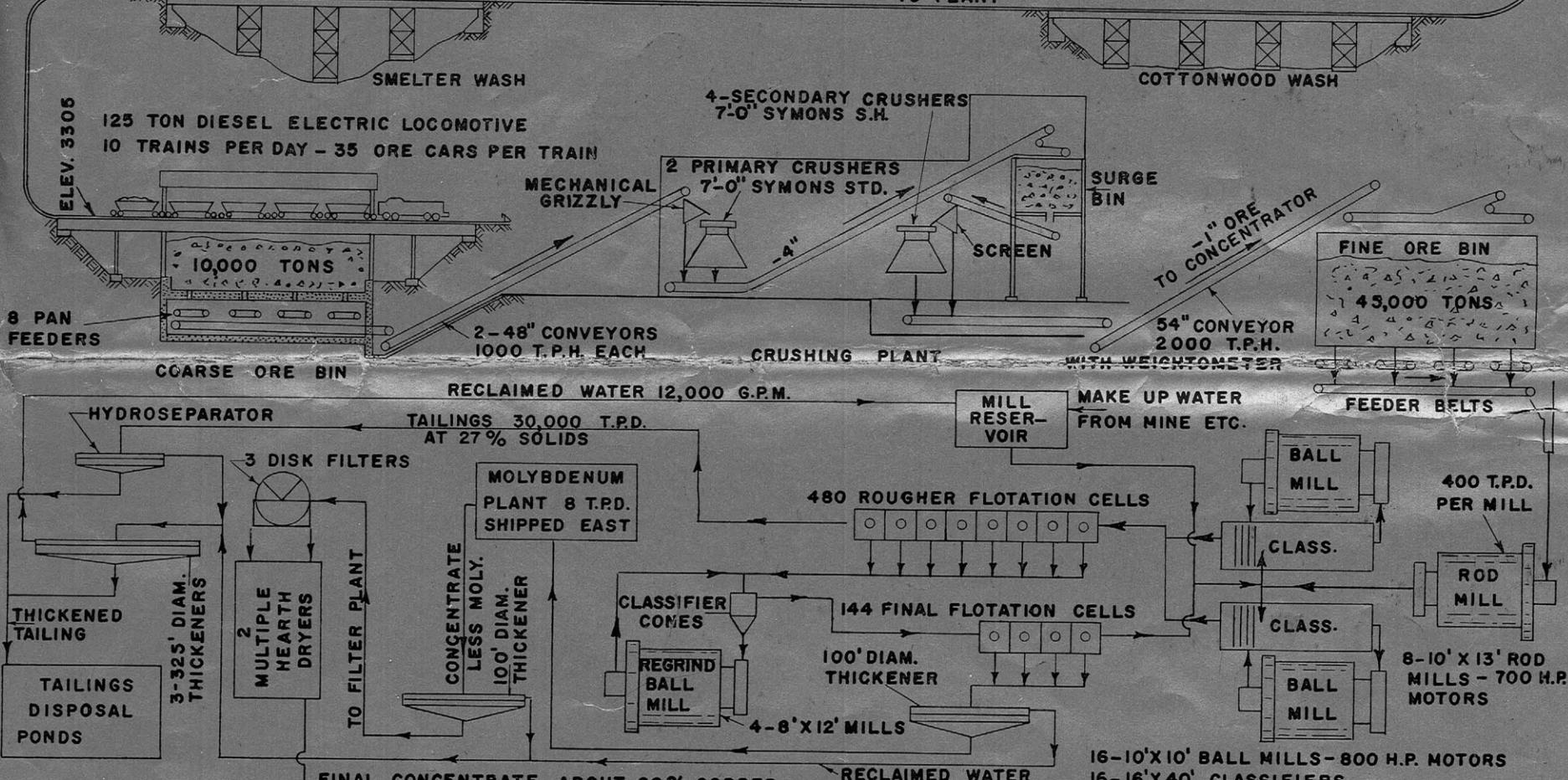
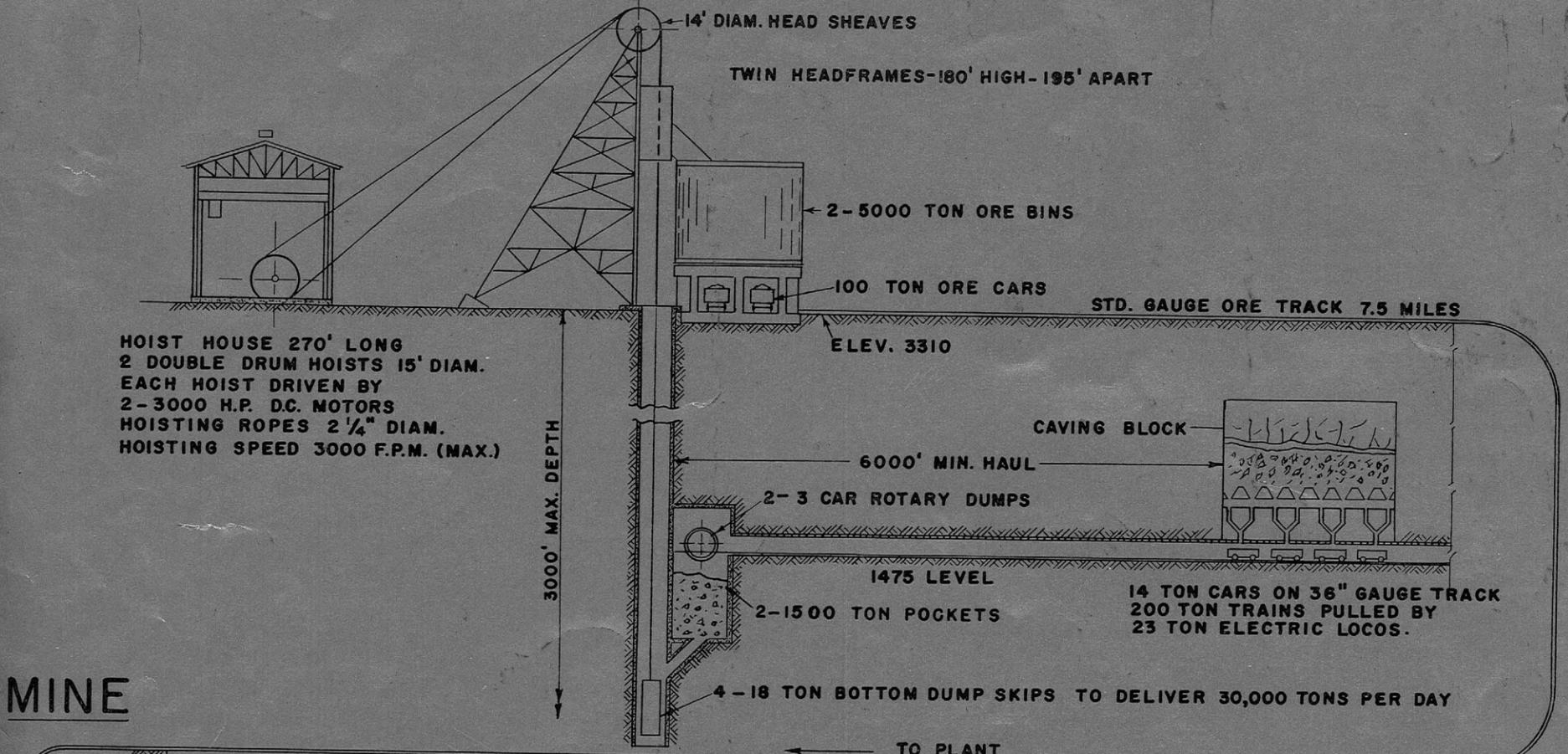
At capacity—1,850 to 2,000 men.  
Approximate Pay Roll—\$11,000,000 annually.

# Water Supply

Water requirements for the Plant operations amount to 800 gallons, or 3.34 tons, of water per ton of ore treated. The conservation of water is of prime consideration and is accomplished through the return of concentrate and tailings thickener overflow as well as recoverable water from the tailings disposal area to the mill circuit. Makeup water to replace evaporative and seepage losses amounts to 200 gallons per ton of ore treated.

The water supply for San Manuel Copper Corporation is provided for by a series of artesian wells along the San Pedro Valley below the Plant site. The well water is pumped to a central gathering station from which it is pumped to the town supply tanks and Plant supply tanks for distribution. In addition to the wells, the Mine makes about 3000 g.p.m. which supplies the Mine requirements, and the excess is pumped to the Plant for concentrator needs through an 18-inch pipeline.

# SAN MANUEL ORE FLOW SHEET



# SMELTER