In 1949, when Ilario Properzi of Milan, Italy, started filing a series of applications for U.S. patents covering both continuous casting machines and hot rolling mills, they were designed for processing lead and zinc metal into rod. As experience was gained and as improvements were developed, they came into world-wide use for processing aluminum from ingots to rod. The degree of success achieved by processors using these machines for aluminum rod varied, probably because fundamental engineering problems in some instances were not identified and solved. A contributing factor, of course, was that the users were highly competitive and therefore not disposed to exchange operating and maintenance information.

As time passed, there was increasing speculation as to whether these machines, which could process aluminum at 1300 °F, were capable of producing copper rod at temperatures just below 2000 °F. Properzi, with this possibility in mind, developed and built the large No. 7 casting machine and the complementing No. 7 hot rolling mill. An excellent detailed description of these Properzi machines was published in October 1961 by James B. Russell of Nichols Wire and Aluminum Company. But even with these larger processing facilities, success in casting and hot rolling copper rod from scrap or cathode required the identification and solution of difficult problems of many kinds—heat transfer, structural strength, expansion and contraction, adhesion and cohesion, impurities in the copper at temperatures ranging as high as 2000 °F.

To undertake such a development involved the expenditure of substantial financial funds and the assumption of essentially equally substantial financial risk.

In August 1963 press releases announced that a joint engineering development project by the Southwire Company and the Western Electric Co. Inc. had been successful in producing copper rod by the Properzi process at the former’s plant at Carrollton, Georgia. Although not revealed at the time, the specified single objective of the development project was achieved on several occasions: i.e. the production of 3/8" copper rod at a rate in excess of 10 tons per hour of a quality such as to be drawn successfully to 22, 24, and 26 gage wire at a spooling speed of 10,000 feet per minute. While not a fully developed commercial process, certainly the feasibility of producing good copper rod continuously with Properzi machines was no longer in doubt.

The prospects for commercial success appeared so good that the Western Electric Co., Inc. proceeded without delay to obtain and install both a No. 7 Properzi casting wheel and a No. 7 Properzi hot rolling mill at its copper scrap recovery operation at the Nassau Smelting and Refining Company, Tottenville, N.Y. Improvements over the Carrollton, Georgia set-up were made to plant facilities where experience indicated.
This new installation has been in operation on a development basis since midyear 1965.

(Fig. 1 Casting Machine and Hot Rolling Mill - Properzi Machine Installation at Nassau Smelting and Refining Co.) After first having verified the feasibility of the Properzi process to produce copper rod, it is now undergoing modifications aimed at placing it in regularly scheduled multi-shift operation.

In this report an attempt will be made to outline many of the presently recognized problems generated by this new copper rod manufacturing process and to offer clues to their solution where, in fact, they are known. It is unlikely that all of the problems will have to be solved for successful commercial operation; however, some among those to be presented cannot remain unsolved.

The problems to be reviewed can be listed as: heat transfer, cross-sectional design of the cast bar, grain structure of the copper during the processing, and the effect of oxides and other impurities as inclusions in the copper rod.

Experience indicated that some anticipated major problems did not appear during the many trial runs which have been made to date:

1) Molten copper does not seize to the surface of an adequately cooled chrome plated copper rim.

2) Heat checking was not observed on the casting surface of copper rims. Rim losses occurred primarily because of unintentional nicking or other mechanical damage to the edge of the rim where it should seal to the steel band.

3) Low carbon steel can be used for the restraining belt if the welded joint is good and accurate and if the belt is replaced at relatively short intervals.

While many problems remain to be solved and much "know how" has yet to be acquired, at present it appears most likely that the Properzi continuous casting and hot rolling mill concept can be reduced to satisfactory and profitable commercial practice in the near future. Certainly no problems identified to date appear to stand in the way.

(Original copy of the complete version of the paper available upon request)