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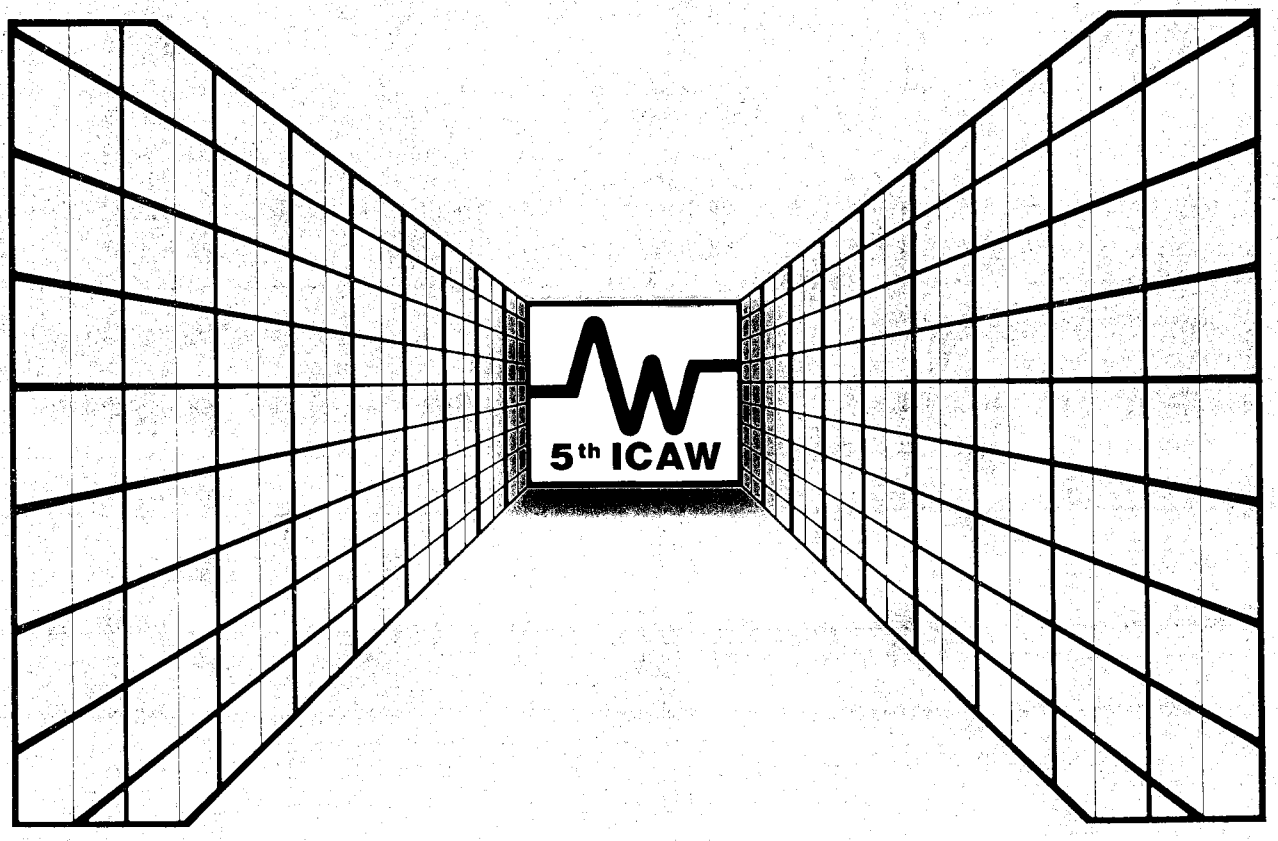

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Computer Controlled Conveying System with Integrated Buffer Storage

Wolf-Michael Scheid, Ph.D.
Tech Manager, Siemag Rosenkaimer GMBH
Leichingen, West Germany

COMPUTER CONTROLLED CONVEYING SYSTEM WITH INTEGRATED BUFFER STORAGE

DR. WOLF-MICHAEL SCHEID

SIEMAG ROSENKAIMER GMBH, LEICHLINGEN, WEST GERMANY

ABSTRACT

A German TV-maker introduced a fully automated conveying system to work with an "unmanned shift" in a certain section of the production flow.

This system includes an automated buffer storage. It is controlled by a Duplex Process Control Computer System.

The System was delivered by a JV SIEMENS/ SIEMAG in 1981. Availability is more than 97 %.

BASIC SYSTEM IDEAS

For a few years, automated testing units have been available that can check all the electronic parts of a TV set for precise manufacture and the reliability to be expected. Regarding the cost of investments such testing units should operate 24 hours per day, even if production is carried out in 1 or 2 shifts only, i.e. up to 16 hours per day.

All these electronic parts are borne by a special tray that is on one hand the transport and storage unit within the system and on the other hand will afterwards form an integrated part of the TV set.

Every individual tray is characterized by its type, the manufacturing date and the current production number. This information is printed on a label in OCR-characters and attached to the tray. The tray therefore can be automatically identified within the system as well as by maintenance and repair staff even months or years later. (Furthermore as identification of an individual TV set that had been purchased by somebody).

SYSTEM LAYOUT (Refer to Fig. 1 next page)

The system is fed with trays from 3 production lines. The trays are identified by their labels via an automatic recognition unit (called VIDEOMAT).

After identification they either are transported to the testing units and tested or stored - if no capacity for testing is available - in an automated buffer storage. After testing they are either sorted out for delivery to other plants or handed over to further treatment or transported to a special tray-type chain conveyor. The latter case happens when either the test results are insufficient or the system operates in the "unmanned shift" (no staff available for further handling in the following production steps).

The special tray-type chain conveyor offers trays to be repaired to the staff in a repair area and has a connection to the automated buffer storage. This storage has been materialized in high rise warehouse technology. As it was thought that there would be little sense in storing trays seperately from each other (high turnover capacity for storage/retrieval machines required !) up to 12 trays form a special pallet that is stored.

Therefore every entry of or withdrawal from the storage involves palletizing or depalletizing of trays.

With due regard to the space available and its costs, all sections of the system that normally do not require access by staff have been assigned to a second "upstairs" level. As a result only the testing units, that may require adjustments when assigned to other types of trays, the delivery conveyors (packing !) and the repair area (electricians doing repairs !) are situated at floor level.

So-called step elevators, i.e. vertically operating paternoster-type elevators, connect both levels and provide a high transport capacity.

CONTROL SYSTEM (Refer to Fig. 2 next page)

Trays and their labels, resp. are identified automatically by so-called VIDEOMATs.

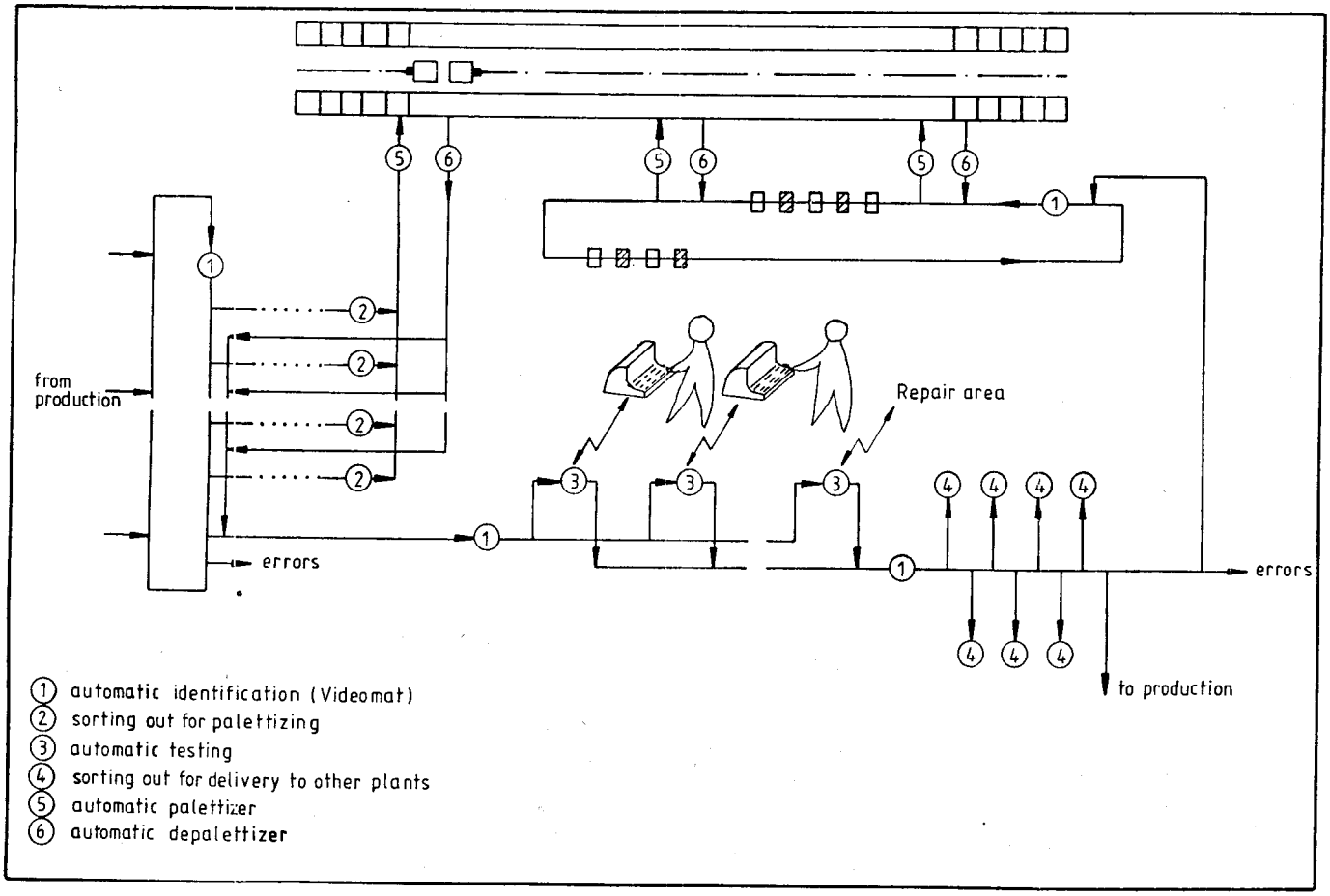

Fig. 1. System Layout

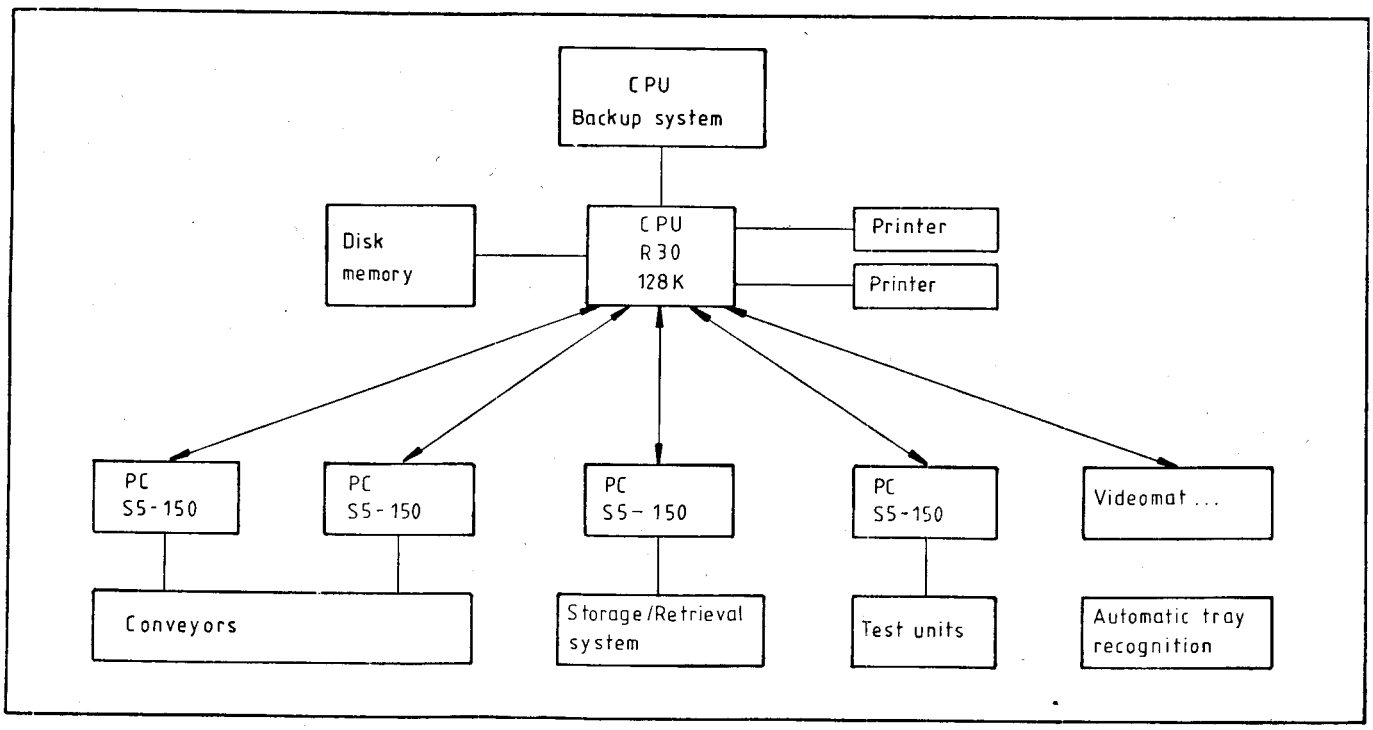

Fig. 2. Control System

Each VIDEOMAT consists of a TV-camera with a special micro-processor that regocnizes the OCR-characters and converts their data into the adequate digital form.

For reasons of system reliability there are several identification points in the system:
- at system entry
- before sorting out to testing units
- after testing
- special tray-type chain conveyor entry
- at each testing unit

At system entry, the process control computer checks as to wether a testing unit is assigned to the type of tray entering the system and further,whether test capacity is available. If the result is negative the tray is sorted out and stored. The sorting conveyors permit palletizing of trays of only one special type per pallet even if several types are being produced simultaneously.

On the other hand the process control computer decides (especially in the "unmanned shift") which type of still untested trays should be taken out of storage,depalletized and tested.

Depending on the test results and the production data (fed into the computer) it is decided whether the tray is sorted onto a certain delivery conveyor, is transported to further production lines or is stored. It goes without saying trays with negative test results are transported to the repair area.

The process control computer recognizes whenever a certain tray on the special tray-type chain conveyor is bearing a tray with electronic components or not, and further recognizes whether there is staff in the repair area or not. The computer is therefore capable of deciding whether the trays are to be stored before repair (as not enough repair capacity is available at this time) or whether additional trays out of the storage are to be offered to the repair staff.

There obviously is a hierarchy of control equipment to realize all the functions mentioned (see Fig. 2).

Thus the automated buffer storage serves as buffer for deviations between production and testing capacity, between the number of trays to be repaired and repair capacity available, between types produced before system entry and types required to leave the system.

MAJOR SYSTEM COMPONENTS

Main elements have been listed (see Fig. 3 next column). Pushers and palletizers/de-

quantity	component
6	step elevators
50	pushers
3	automatic palettizer
3	automatic depalettizer
12	sorting lines
9	test units
3144	storage capacity (trays)
2	process control computer (cpu)
5	programmable controls (PC)
14	VIDEOMATEN (automatic recognition)

Fig. 3. Survey of major components

palletizers are operated pneumatically. No mechanical limit switches or similar elements are used (contactless controls !).

The system operates at a 10 sec. cycle (tray entry possible every 10 seconds), although the "bottleneck" of the system (i.e. the step elevator that leads to the testing units) is designed to transport up to approx. 900 trays/hour (which represents a 4 sec. cycle).

OPERATING EXPERIENCE

The decision to build this system was taken in early 1980. It was designed and delivered by a JV SIEMENS/SIEMAG in 1981.

There have been typical mistakes in the initial phase of operation, but the system reached about 97 % availability in May 1981. Complaints and/or difficulties no longer occured thereafter.

BIOGRAPHICAL

Dr. Wolf-Michael Scheid, Manager in charge of Sales & Technology at SIEMAG ROSENKAIMER, Leichlingen, West Germany.

This company specializes in material handling systems for light weight piece goods used for order picking, assembly lines, postal facilities, baggage handling and conveying of cargo containers on airports. It is part of the SIEMAG group of companies.

Dr. Scheid has been engaged in planning and manufacturing of complex material handling systems since 1971 (as consultant, project manager, scientific assistant at the Logistics Department of Dortmund University; since 1979 as manager within the SIEMAG group). He is a member of the German Society for Logistics (DGfL) and also a member of the German Association for Industrial Engineers (VWI).

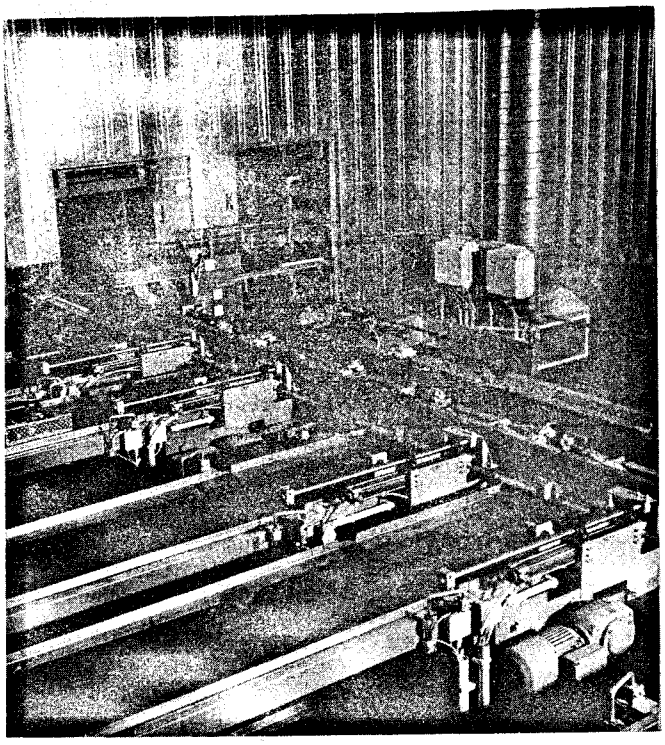

Fig. 4. Sorting conveyors in front of automated storage (Depalletizer on the left, palletizer on the right)

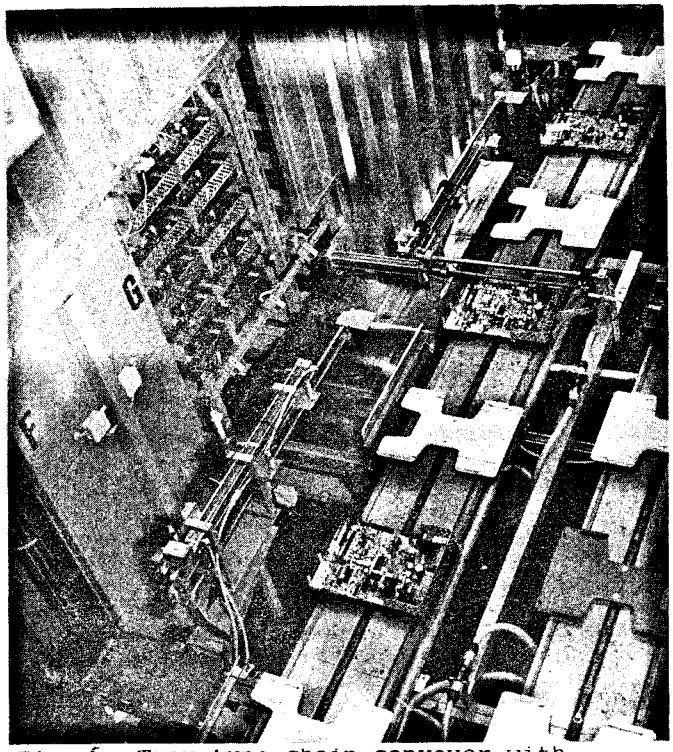

Fig. 6. Tray-type chain conveyor with palletizer

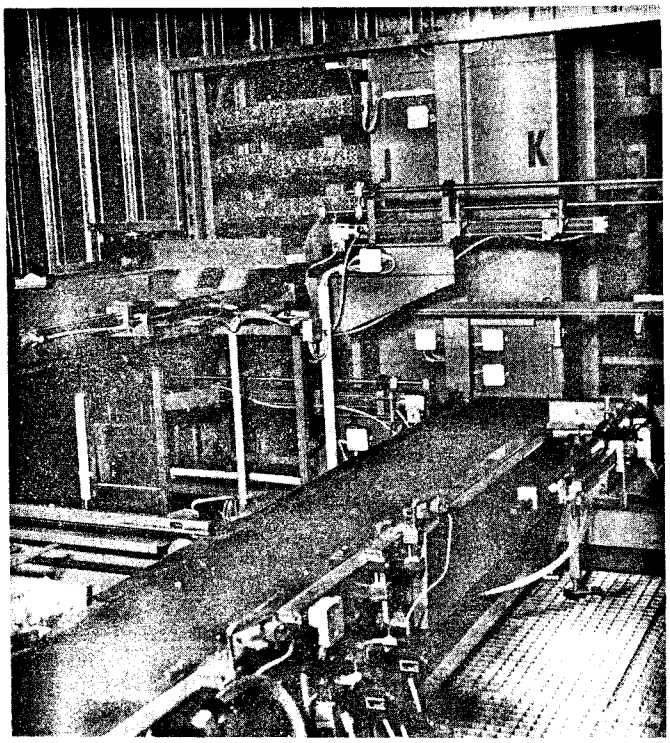

Fig. 5. Depalletizing of trays (left) - Conveyor in the center transports unchecked trays from sorting after system entry to palletizer