



Plating-Room Controls For Pollution Abatement

*A guidebook of principles and practice for curbing losses of solutions
and metals that otherwise might find their way into water courses.*

Reference Data Publication compiled by

Metal-Finishing Industry Action Committee

**OHIO RIVER VALLEY
WATER SANITATION COMMISSION**

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By way of explanation

This manual should have special appeal for managers of metal-finishing plants. Among other things, it tells how to cut operating costs.

But that is incidental to the reason for its publication by the Ohio River Valley Water Sanitation Commission. From the Commission's viewpoint, the primary purpose of the booklet is to show how stream pollution can be curbed by reducing waste discharges.

It is a happy circumstance when pollution abatement and operating economics can be achieved from the same effort. Yet, that is exactly what can be accomplished if metal-plants practice the "good-housekeeping" principles set forth in this manual. Here has been compiled the experience of sixteen management representatives, who comprise the Metal-Finishing Industry Action Committee of the Ohio River Commission. Their names and their companies are listed on the inside cover page.

This committee under the leadership of Walter L. Pinner, manager of research, Houdaille-Hershey Corporation, is preparing several manuals for guidance of the metal-finishing industry in curbing stream pollution. The present manual is the first; another deals with defining the plant-waste problem in terms of analysis and flow measurement; and a third will evaluate methods for treating waste waters.

The thoroughness with which the committee is developing these manuals is exceeded only by their fitness for the task to which they addressed themselves. In printing and distributing this information, the Commission hopes that the nearly 2,000 metal-finishing establishments in the Ohio River Valley will use it to further stream clean-up measures and their own best interests.

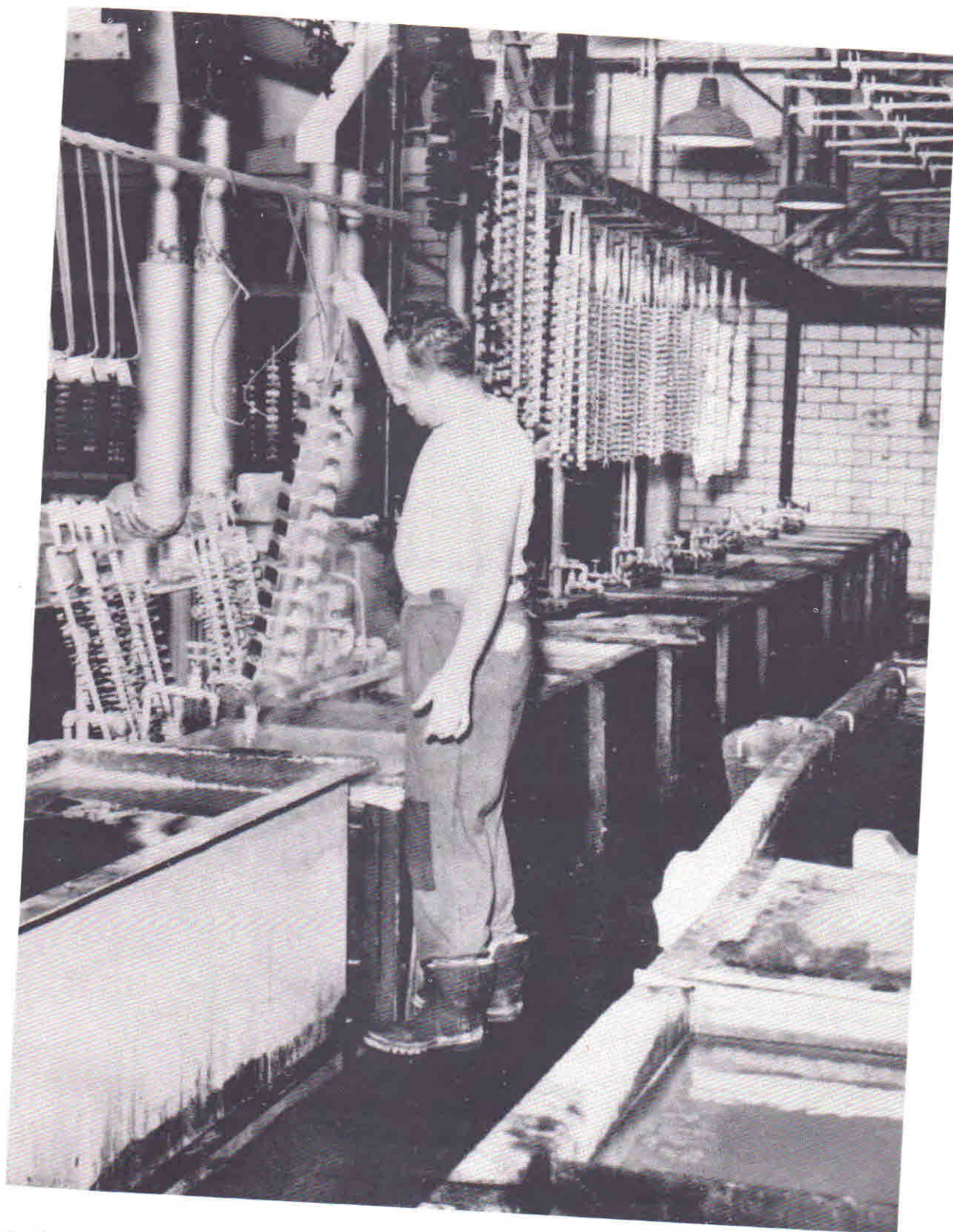
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Waste-control measures should start in the plating room. Practice good housekeeping there -- and reduce waste. (Products Finishing)

Plating-Room Controls for Pollution Abatement

Metal-Finishing establishments can further pollution abatement by:

These save money:

1. Reduction in dragout and all other incidental losses of useable and valuable plating materials. This automatically reduces the amount of waste discharged.
2. Purification of contaminated processing baths so that they can be reused.
3. Exchange or sale of processing baths that cannot be purified.

This costs money:

4. Installation of waste-treatment facilities. The need for and elaborateness of such facilities will depend on the effectiveness of the first three methods for pollution prevention.

The easiest, cheapest and most efficient waste-control procedure is to minimize the amount of waste produced. This can be accomplished by good housekeeping.

Treatment of waste is expensive; control of waste is profitable.

Operations of the metal-finishing industry require large volumes of water. This industry, therefore, is in a favorable position to take advantage of dilution factors as long as it keeps dragout at a minimum. Other industries, using little rinse water, are faced with discarding large quantities of materials in concentrated form.

The concentration of contaminants in waste waters from metal-finishing plants

may be low enough to meet state requirements. When concentrations exceed allowable limits, a reduction in amount of contaminants is necessary. This may be accomplished by instituting changes in process operation that permit more efficient use of the plating chemicals and by reducing losses to the sewers.

For years, many metal-finishing departments have operated uneconomically, heedlessly disregarding the wasteful use

of supplies. Unbelievable quantities of metal salts, acids, and cleansers are rinsed off or permitted to drip directly into the sewer. Batches of partly contaminated and weak solutions are dumped without an effort at salvage. Large losses also occur through breaks in lines, vats or storage units. These practices, if not curtailed, add to the size and cost of

required waste-treatment facilities. Treatment-plant operation costs also are increased.

A plant can profit by salvaging materials through application of just plain common sense. Here are some simple, good-housekeeping principles:

Reduce Dragout Losses

Rinse Effectively

Prevent Leaks and Losses

Salvage Solutions for Further Use; Don't Discard Them

Sell or Exchange Baths That Can't be Purified

Reduce Dragout Losses

Work drainage -- The work -- the material being plated -- removed from any processing bath should be allowed to thoroughly drain directly back into the bath unless such practice interferes with the quality of processing. In manual or hoist-operated equipment, if timing of the operation permits, work coming from the tank may simply be allowed to drain over the tank a few seconds instead of being immediately moved forward to the next tank. An automatically timed, hoist-raising device can be designed to provide an adequate period for drainage. Such timing devices are much cheaper to use than waste-treatment facilities.

On hand-operated tanks the simple expedient of a bar or rod located over the processing tank, but otherwise out of the way, serves as an excellent temporary resting place for the small racks while the metal is draining.

One case history showed that use of a drainage bar on a hand-operated chromium tank for plating hub caps resulted in a reduction of chromic-acid consumed from 16 to 3 lb per 1,000 hub caps processed. This meant a saving of \$3.64 per 1,000 caps with no increase in labor. The chromic-acid saved did not have to be removed from the plant effluent and was available for further plating.

This principle -- work drainage--- applies to all types of plating and processing. An exception occurs where high temperatures may lead to surface drying;

but even here, work drainage is practical with fog rinses.

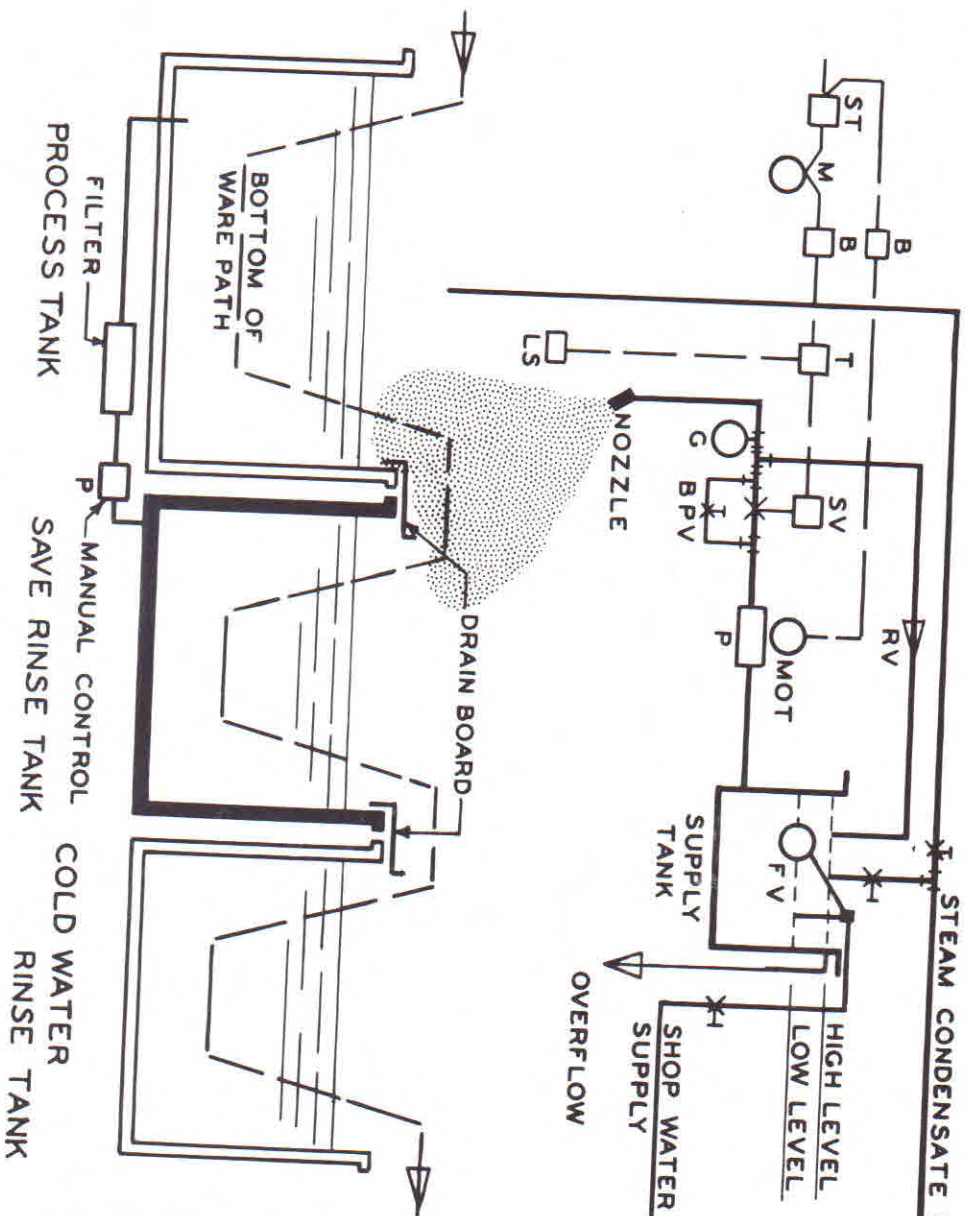
Save-rinse tanks -- In moving forward from a processing bath, any solution necessarily remaining on the work should be rinsed in a still-water or save-rinse tank. This rinse water should be returned to the processing tank (Figs 1, 2, 3). Save-rinse tanks are necessary for any system, particularly if the operation does not allow thorough work drainage.

Many case histories are available showing substantial savings of costly supplies through the use of save-rinse tanks. Dragout losses account for 60 to 100% of all supply costs -- excepting anodes -- depending upon the type of plating operation.

One save-rinse tank may reduce chemical supplies used by about 60%. Two rinses will result in nearly 80% savings of the supplies. Chemicals salvaged for reuse do not need to be removed from waste water.

Number of rinses -- The extent to which concentrations of metal salts build up in the save-rinse solutions should determine the number of rinses to be employed. Another important consideration in determining number of rinses is design of parts being processed.

Save-rinse facilities should be designed so that the concentration in the last rinse tank does not exceed 5% of that of the processing bath. It is true that operation of a number of rinses may incur added labor cost in the metal-finishing



LEGEND

| | |
|-----|---------------------------------------|
| ST | DRIVE MOTOR STARTER |
| M | DRIVE MOTOR |
| B | CIRCUIT BREAKER |
| T | TIMER |
| LS | LIMIT SWITCH SET TO START TIMING SEQ. |
| SV | ELECTRIC OPERATED SOLENOID VALVE |
| BPV | BY PASS VALVE |
| N | ATOMIZING NOZZLE FOR WATER SPRAY |
| P | PUMP |
| SY | SYPHON |
| RV | RELIEF VALVE |
| G | PRESSURE GAUGE |
| FV | FLOAT VALVE FOR MINIMUM WATER LEVEL |
| DB | DRAINBOARD |

FIG 1-PLATING SOLUTION RECOVERY SYSTEM
METHOD 1 USING STEAM CONDENSATE
FOR SPRAY & PROCESS TANK SUPPLY

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department. But additional labor is also required to run a waste-treatment plant.

Save rinse vs fresh water -- Plating facilities should be designed to permit easy return of save-rinse solution to the processing bath by pumps, air lifts, or siphons (Fig 1, 2). Steps should be taken to make it difficult or impossible for an operator to add fresh water to a processing bath.

Concentrate save rinse -- Rate of evaporation of processing baths is frequently so small that effective use of save-rinse solutions is difficult. In such case provision should be made for concentrating save-rinse solutions by heating (Fig 3).

Impurities that interfere with this method of solution recovery can be minimized by employing properly lined tanks. Impurities might be removed by deionization.

Drag-in -- Minimize drag-in of water from the rinse tanks preceding the processing tank by draining the work as completely as possible. Otherwise more water has to be evaporated from the processing or save-rinse tank before the save-rinse solution can be utilized fully. Where evaporation losses are high, this is easily done; when a solution is maintained at room temperature, evaporation losses are likely

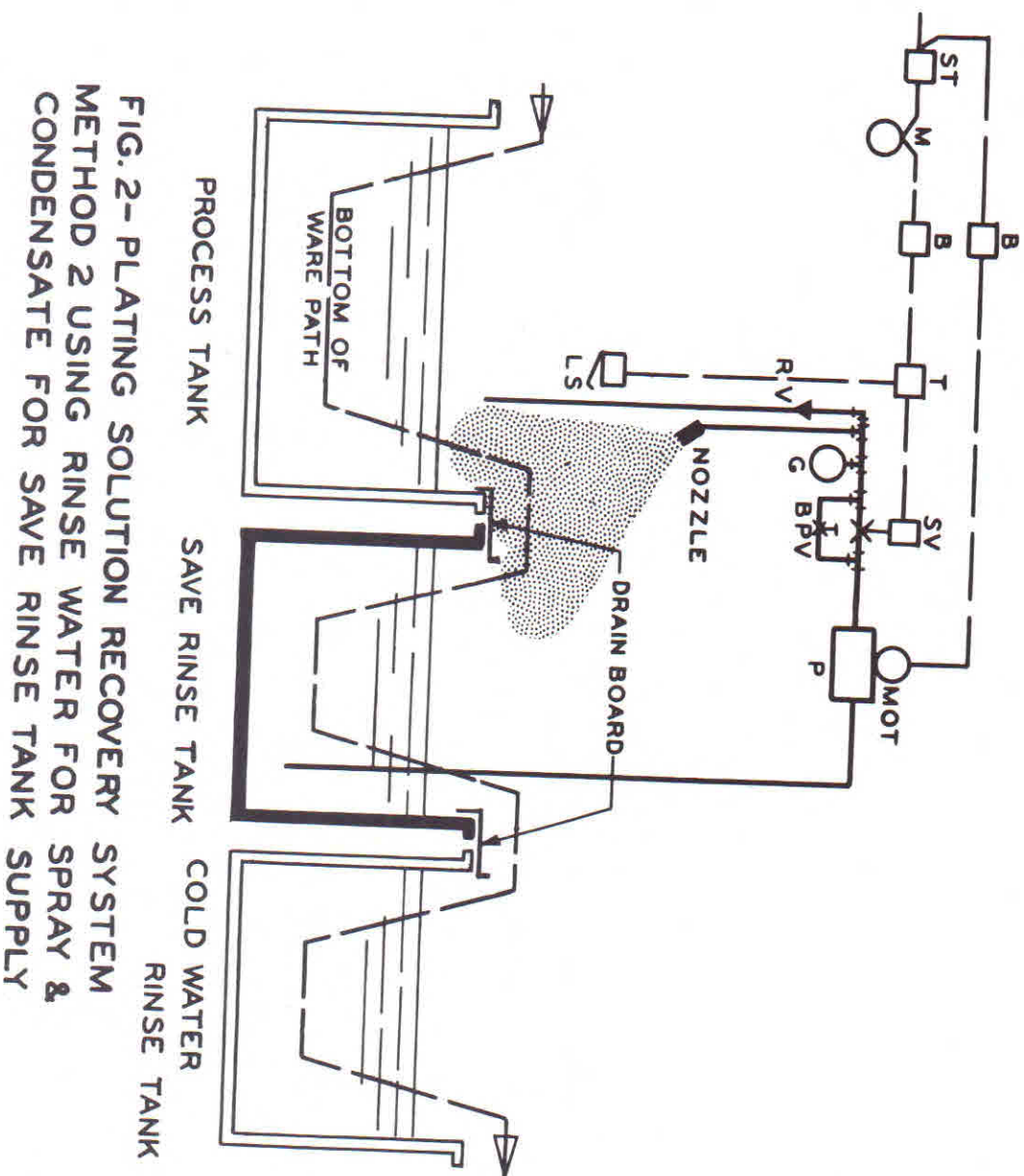
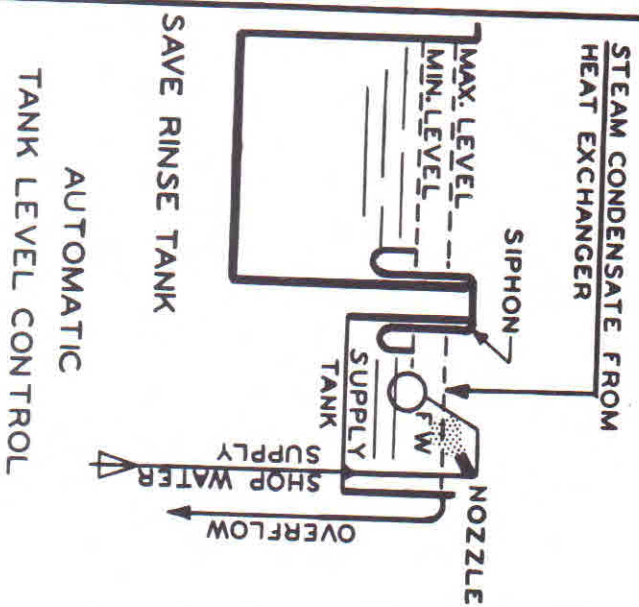
to be small. Save-rinse solutions must then be concentrated.

In some operations drag-in can be minimized by tumbling the work in an empty tank preceding plating. By thus reducing the drag-in of water, the level in the plating tank will drop through normal operation and permit addition of the save-rinse tank solution. Returning this save-rinse solution to the plating bath as frequently as possible is another aid in reducing losses of plating material to rinse water.

One company added another cam to its automatic barrel-plating units. The cam allowed the barrels to rotate and drain for one minute before entering both the save-rinse and flowing-rinse tanks. This installation resulted in saving plating solution.

Consider the possibilities of an air blow-off. It will dislodge much plating solution when the work is transferred from plating to save-rinse tanks.

Drip boards -- Incidental drip of processing solution into the sewer can be prevented by installation of drip boards between tanks. The accumulation on them is flushed back intermittently into the processing tanks with save-rinse water. This also reduces corrosion on the outside of the tanks (Fig 1).



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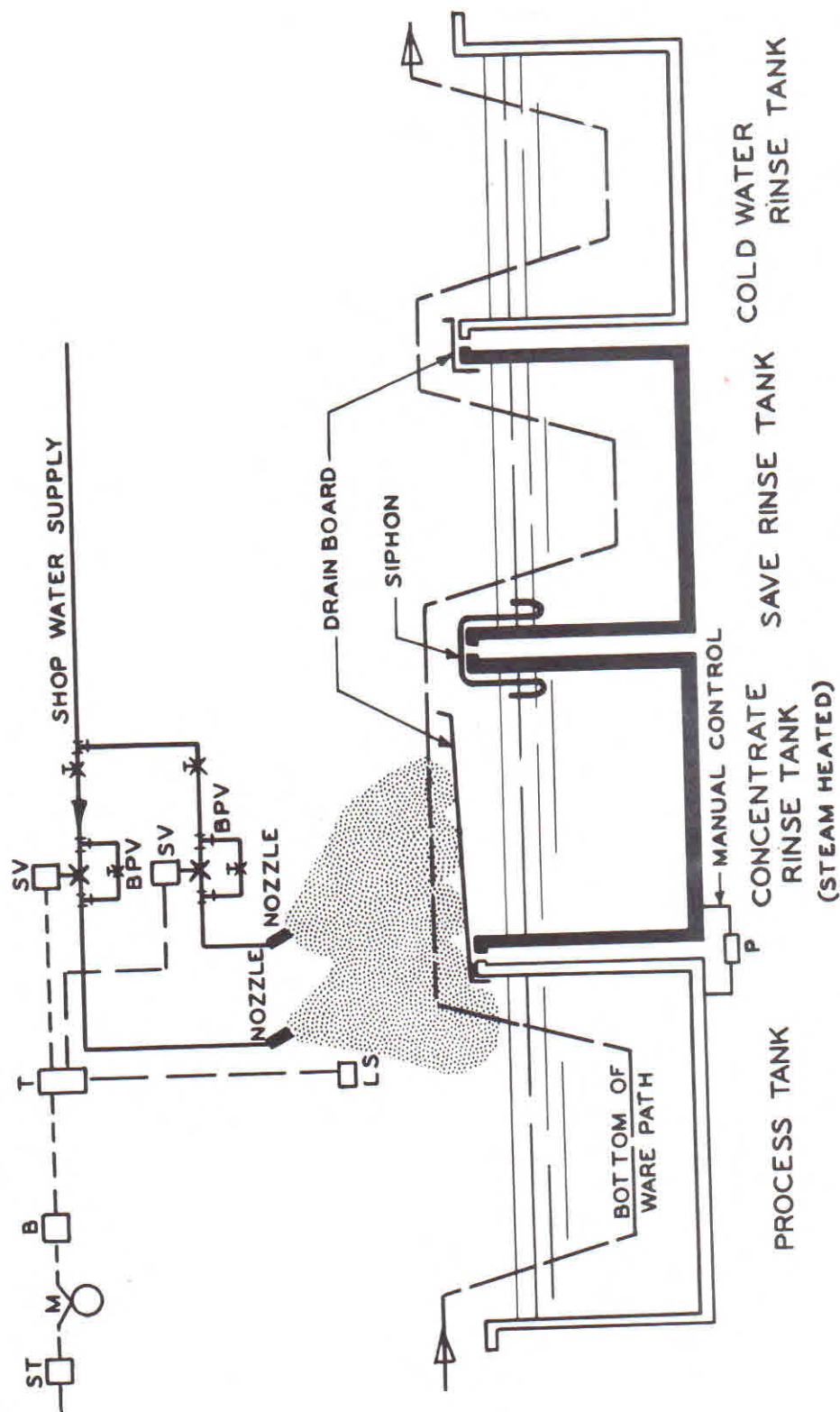


FIG 3-PLATING SOLUTION RECOVERY SYSTEM
METHOD 3 USING SHOP WATER FOR SPRAY

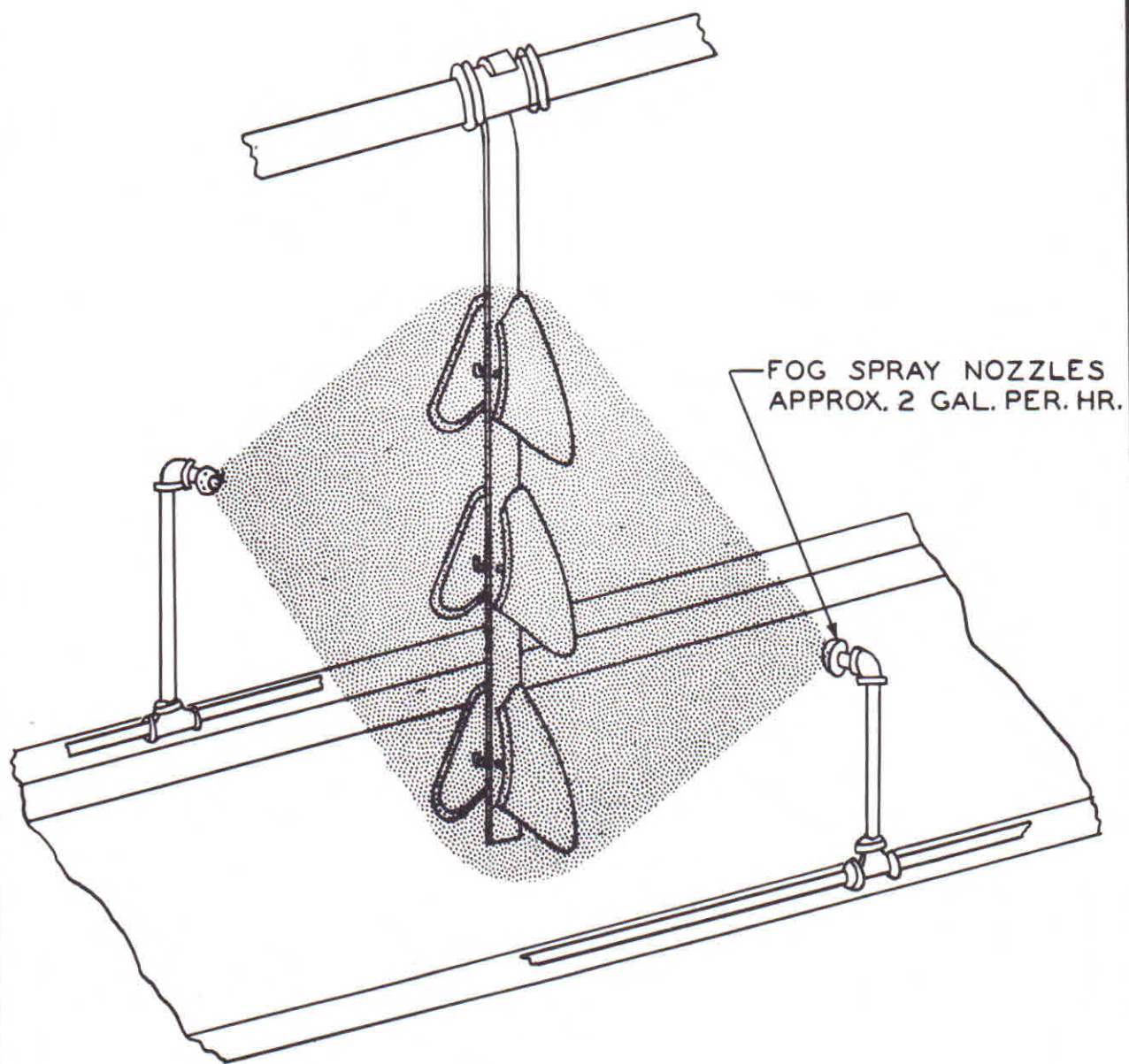


FIG 4- TYPICAL SPRAY HEADER INSTALLATION

Rinse Effectively

Clean racks -- Free rinsing can be assisted by utilizing racks and fixtures that are maintained in good condition -- free from incidental metal buildup or corrosion. Clusters of nodules on plating racks do not rinse freely. Economy can be achieved by properly maintained and coated plating racks. Plate deposited on rack parts, or rack metal attacked by process solution, is material wasted. When the metal is attacked, the solution is contaminated. It is a frequent and deplorable practice to permit the area of rack build-up to equal or exceed the area of the work being processed.

The practice of coating in the plating field means:

Decreased dragout in cavities, crevices and on exposed area, which poisons subsequent solutions.

Reduction in loss of metal that should be plated on processed parts.

Useful life of coated racks is longer than that of uncoated ones. Coating reduces rack-arm breakages. This decreases process interruptions.

An old plating rack (Fig 6) -- with exposed parts built up to a point where the rack should no longer be used -- has a center spline that is still in excellent shape due to its protective coating. It would be preferable if individual hooks were also coated, -- excepting at those

points where actual contact with the work occurs.

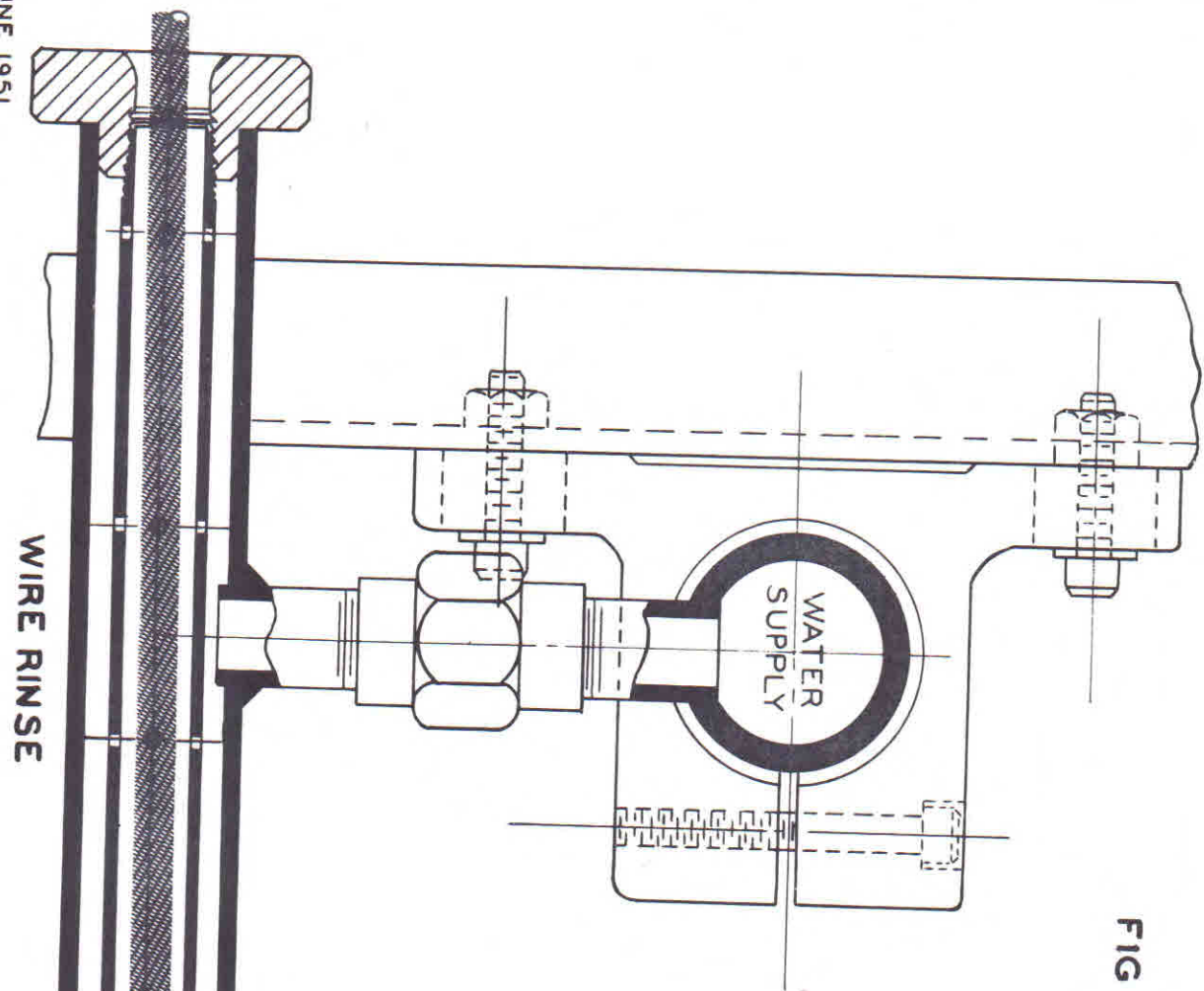
The worst kind of practice -- in which no member of the rack has been protected from metal buildup -- is represented in Fig 7. This fixture has an exposed-rack surface that is probably at least equal to or greater than the area of the work being plated.

Fog sprays -- Fine-mist sprays or fog nozzles can be employed effectively on the exit end of both the processing tanks and save-rinse tanks (Fig 4). Fog nozzles can be operated intermittently as the machine indexes. Foot-pedal operated valves can be utilized on manually-operated tanks.

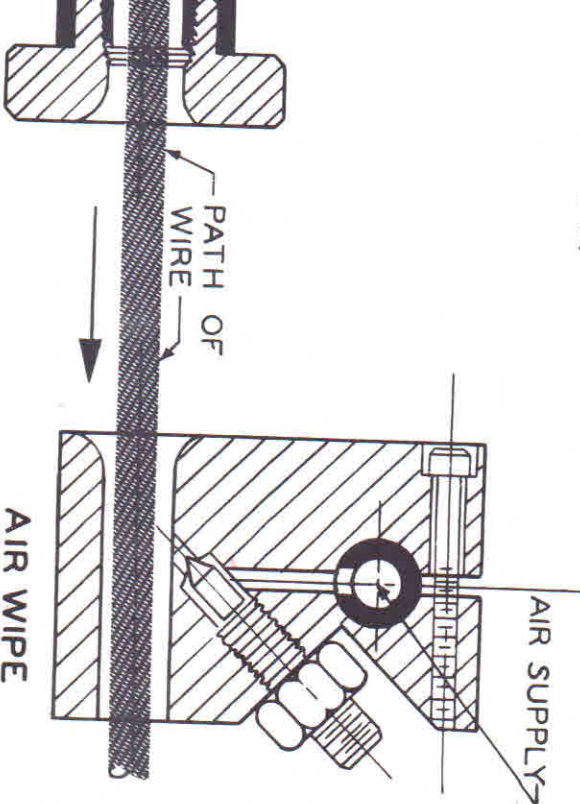
Uniform racking -- In keeping with other sound metal-processing principles, parts should be racked uniformly to speed up drainage. This serves a dual purpose by also avoiding contamination of subsequent processing solutions.

Rinse-tank design -- Thorough rinsing depends on passing the processed part through clean water. In final-rinse tanks this can be done with a minimum amount of water by providing a dam-type overflow across the full width of the tank. Fresh water should be introduced at the bottom of the end of the tank opposite the exit. Excessive amounts of rinse water should be avoided. Using more water than is needed for effective rinsing costs money and will make larger waste-treatment plants necessary.

**FIG 5-HOW TO REDUCE DRAG-IN
FOR WIRE PROCESSING**



NOTE: FOR WIRE RINSING, THE BELOW ASSEMBLY IS MOST EFFECTIVE. IT FULLY UTILIZES A MINIMUM VOLUME OF WATER AND THEN PREVENTS RINSE WATER DRAG-IN TO THE NEXT TANK BY DRYING THE WIRE WITH AN AIR WIPE.
DIAMETER OF WIRE TO BE GREATER THAN ONE-HALF INSIDE DIAMETER OF PIPE.



WIRE RINSE

AIR WIPE

PATH OF
WIRE

AIR SUPPLY

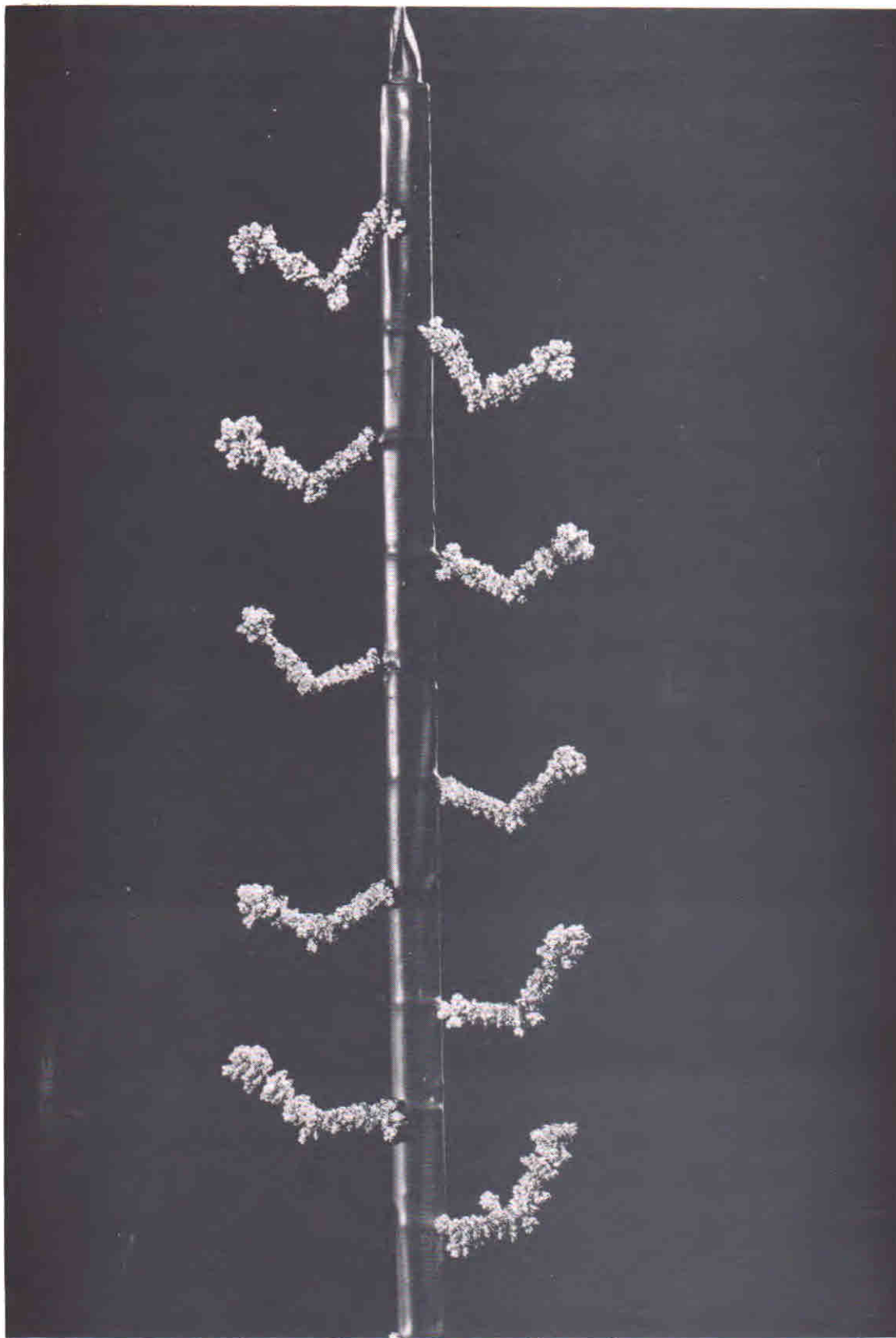


Fig 6 -- Coating protected the center spline of this rack. Similar coating on the hooks would have eliminated pits and crevices in which plating solution is dragged out.

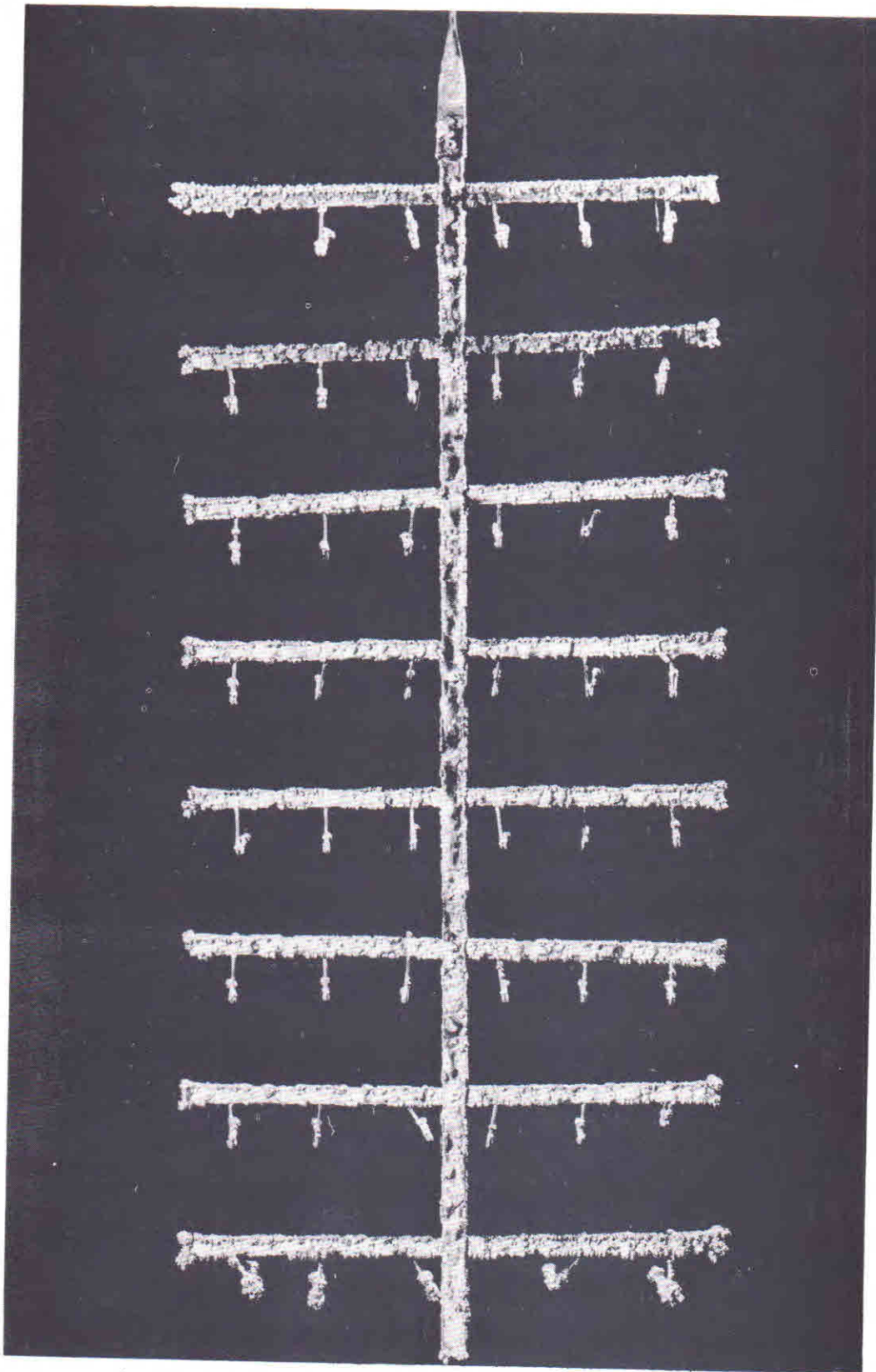


Fig 7 -- Metal nodules on an uncoated rack carry plating solution out of the tank. This valuable solution then becomes a source of pollution.

Prevent Leaks and Losses

Find leaks -- Any loss of solution through leaks is costly and causes waste-water contamination. Routine inspections and maintenance of all equipment should be scheduled, including inspection of tanks when empty.

One company has installed electrodes for continuous measurement of specific conductance in the steam condensate line used in heating plating solutions. A raise in the conductance -- signaled by a red light -- shows that there is a leak in the steam line in the plating solution. When this occurs the steam is shut off and compressed air applied to the steam line. The leak is easily located by the air bubbles that appear in the plating solution.

Don't hide equipment -- All pipelines and other equipment used for transferring solutions should be in plain view. Filters, pumps and similar equipment should be mounted over collector tanks or drain boards that lead to process tanks.

Above-surface filling -- Pipelines for filling process tanks should discharge above the normal solution-level. The operator then can tell when the supply is off or on. Also, an airbreak prevents back siphonage and prevents the possibility of contamination of drinking-water systems.

To prevent foaming when wetting

agents are present in the solution, make-up should be added through a funnel and a pipe extending below the surface. The water inlet should be located above the funnel to permit visual control.

Float valves -- Level-control float valves can prevent overflowing in case of a break in the steam line, or if the make-up feed line is left open.

To save baths -- Storage tanks, sumps or pits without drains may be the means to save a bath if a processing tank springs a leak. This safeguard unit is usually located below the process tank. A flange or curb will prevent floor-wash waters from filling this sump or pit. Solution caught is eventually returned to the process tank.

Another method is to install the process tank within a tank. If the process tank springs a leak, the outer shell will save the solution.

Adsorb; don't flush -- Floor drains offer a temptation for quick, easy and unreported disposal of spills of solution or oil. Plugging the drains necessitates dry-spill disposal by sweeping or shoveling some inert adsorbing medium, such as Fuller's earth. This method of cleaning floors is particularly applicable to chemical-storage rooms where protective measures should be instituted against loss by spilling or leaching.

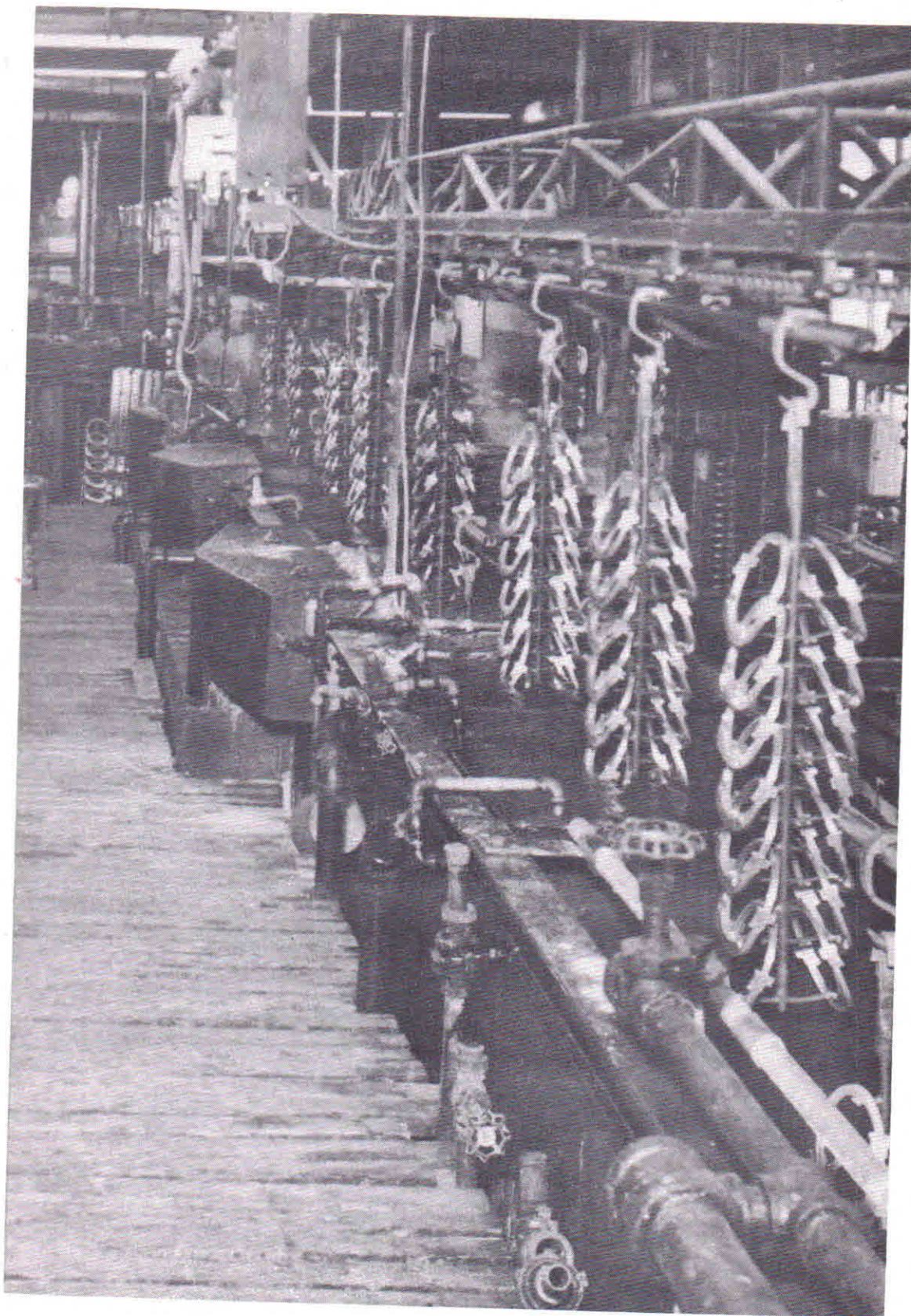


Fig 8 -- Good and bad practice in plating-room piping: Exposed piping permits prompt detection of leaks; underwater filling makes it difficult for the operator to know when the valves are closed. (Plating)

Salvage Solutions for Further Use; Don't Discard Them

Why purify? The expensive and ill-advised practice of discarding solutions which could be purified still exists. This practice continues in spite of published data on purification. Money goes down the drain when solutions are discarded. Extra expense and difficulty are incurred in replacing scarce raw materials.

No company can afford to discard any processing solution without first proving that it has no recoverable plating value.

It is cheaper to provide storage facilities for contaminated solutions that can be salvaged than it is to throw them away.

Purification procedures are established and in use for most of the processing baths. Here are eight possibilities:

- Activated-carbon treatments.
- Low current-density purification.
- High pH treatments.
- Oxidation.
- Low-temperature crystallization.

Settling and decantation.

Filtration.

Precipitation.

Typical examples of baths receptive to such purification procedures are:

Nickel solutions contaminated with all common metallic and organic impurities. Upper limit of pH should be 5.6 during purification to minimize nickel-hydrate precipitation.

All cyanide solutions contaminated with carbonate and metallic impurities.

Acid tin, copper, and zinc solutions contaminated with organic impurities.

Chromium plating solutions contaminated with excess amounts of catalysts.

Bichromate solutions contaminated with sludge build-up.

Sell or Exchange Baths That Cannot be Purified

A few solutions become contaminated in normal use so that they cannot be purified for further use. The possibility of selling or exchanging the condemned solutions to another industry should be investigated. Two examples are:

An acid-pickling-waste problem was solved at one plant when it was found that a neighboring firm needed a cheap source of dilute

sulfuric acid for manufacture of fertilizer.

Another case: The waste from dye manufacture consisted of sulfuric acid strong enough for pickling. Pickling with sulfuric acid produces ferrous sulfate as a waste. The dye manufacturer traded his waste acid to the pickling plant in exchange for the ferrous sulfate which he needed in his process.

