CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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DECEMBER, 1942

MANPOWER LESSONS FROM ABROAD

LAST MONTH at the Cincinnati meeting of the American Institute of Chemical Engineers every session involuntarily drifted toward the one subject that seemed to be uppermost in everybody's mind—technical manpower. How to stretch the available, inadequate supply to meet the increasingly urgent demands of both the war industries and the Armed Forces is a problem that worries engineers, employers and educators, as well as the governmental officials. From the Institute's several discussions came these three constructive suggestions which were respectfully referred to the President of the United States and to the War Manpower Commission:

A. The loss of technically trained men from war production plants should be stopped immediately by cessation of voluntary enlistment or by a "freezing" order covering all such personnel and plants.

B. Selective Service Occupational Bulletin No. 10 of last June should be reaffirmed in principle in its provisions for the deferment of men in engineering training.

C. This directive should be modified in the light of the lower draft age by providing for the deferment of engineering students in established colleges to the end of the term in which they reach the age of 18, and thereafter, on a term-by-term basis as long as their academic records remain satisfactory.

Something closely approaching this general plan seemed to the five hundred chemical engineers there assembled as absolutely necessary if we are to maintain an acceptable level of engineering competence in war production and at the same time meet the specialized requirements of the Army and Navy for men with technical training. This plan follows, in several respects, the very illuminating experiences of both England and Canada, where similar problems have been met and solved, more or less satisfactorily.

In England, technical manpower scarcities have developed in approximately the following order: (1) engineers, (2) physicists, (3) doctors and dentists, (4) chemists, (5) metallurgists, (6) agriculturists, (7) mathematicians, (8) biologists, and (9) geologists. There, a single department of the government — the Ministry of Labour and National Service — handles the entire manpower problem. After the Cabinet decides how many men are needed in each of the services, the Ministry decides who is to go in order that the distribution of trained manpower can be kept in balance as between the military and industrial requirements.

The same procedure applies to students who are to be given scientific and technical training and to those who are to prepare immediately for military services or for skilled occupations in war industries. For those men already enrolled in the educational institutions, a central board assists the Ministry in deciding how long such training is to be continued and for what purpose. Youngsters coming up from the secondary schools are selected, again by a national authority, but on the basis of scholastic reports and other tests of aptitude. The job is to pick those who will best repay a year or more of general training before (1) enlisting in the military services, (2) entering the war industries, or (3) embarking on the longer period of professional training.

Canada followed the same general plan when the government asked the technical societies to help it set up its Wartime Bureau of Technical Personnel, which is directly responsible to the Minister of Labour. Its job is not alone to keep the records of individuals and their qualifications (as does our National Roster) but also to organize and exercise definite control over the placement of technical personnel in the war industries. It has the authority to assign "professional engineers, chemists, research scientists, physicists, architects, and other technically trained persons" into more essential from less essential work. The individual is protected with adequate provision for adjusted compensation and the eventual reinstatement to his former position. Permits must be had from the Bureau before a technical man can make any volun-

tary change in his employment. Again there is a selection of students for advanced training at either college or trade-school level or for direct assignment to the war industries or the military services.

President Roosevelt's executive order of December 5 transferring the Selective Service System to the War Manpower Commission and giving Governor McNutt much wider powers over manpower allocation would seem to be a move in the right direction. It incorporates our recommendations to curtail voluntary enlistment and to control employment in the interest of a more logical balance in the requirements of the war industries and the Armed Forces. It provides machinery "to insure the efficient utilization of the nation's educational facilities and personnel for the effective prosecution of the war." Much depends, of course, on the subsequent issue of the necessary rules and regulations. It is hoped that they will be forthcoming promptly and will take full advantage of those features of the British and Canadian systems which have proved most effective in actual practice.

CLARIFYING OCCUPATIONAL DEFERMENT

EVERYBODY gives lip service to the idea that highly skilled persons engaged in the production of essential chemicals should be kept on that job and not allowed to go into the Army. Actually that result is not now being achieved for a variety of reasons. And, still more unfortunately, Occupational Bulletin No. 24 of Selective Service system very much muddied the waters and confused many employers as well as local draft board members.

Perhaps the most serious defect in Bulletin No. 24 was the omission of all organic chemicals from the list of important products. One would think that Selective Service did not consider any of them worthy of consideration in draft cases. That difficulty will, however, be corrected as lists of products important for the war effort are made available both to local boards and to employers seeking to keep essential persons.

A second defect almost equally serious came about through difference in use of certain terms describing "chemical operator" jobs. The intention of the committee which formulated the bulletin was excellent. They wanted to protect from premature call those plant workers who must be experienced and must have specialized skills which cannot be imparted in a matter of a few weeks or a few months. They said this fairly well and then they spoiled the whole thing by selection of illustrations. For example, they said that "contact acid operator" was not included. What they meant was the routine helpers in the contact acid plant. But what they said implies that even the most skilled men of this general class should be taken from their jobs to tote a gun. Actually taking all of such men would shut down completely the sulphuric acid plants and automatically stop a great share of all war industry.

Chemical employers must meet this situation with careful explanations to the local boards. They must particularly emphasize that the payroll title is not the governing consideration. They must explain the degree of skill and the length of experience or training required. It is going to be hard to get all local boards, overworked as they are, to ignore the payroll label of these workers. But it is a job that must be done if we are going to keep on manufacturing at capacity in essential chemical business.

Every employer should make a careful inventory of his personnel, classified by position and responsibility, age and number of dependents. It is extremely important that the kind of work and skill involved be presented clearly.

HARRISON E. HOWE, 1881–1942

THESE pages were already on the press when we received the shocking news of the sudden passing of our dear friend and contemporary who since December 1, 1921 has so ably guided the Editorial destinies of *Industrial & Engineering Chemistry*. Doctor Howe was a true friend of the entire chemical profession. He held high its moral and human as well as its scientific standards. He contributed greatly to the advance of technical journalism for his influence was felt far beyond the field of industrial chemistry. Many, many times he answered the call for interpretation, guidance and leadership as the public interest demanded an authoritative spokesman for scientific research and development. Thus he will be sorely missed outside as well as within the ranks of the chemical industry and profession. His place in the affairs of the American Chemical Society will be difficult to fill. But the place he held in our hearts will always remain a cherished memory.

PURELY COINCIDENTAL?

SOMETIMES we think of wars as so destructive that they cast a blight on all technical progress. Possibly the reverse is true. In any event, there seems to be an interesting relationship between the chronologies of war and certain important chemical and chemical engineering developments. For example, Priestley's discovery of oxygen preceded our Revolutionary War by only a matter of months. In 1790 the LeBlanc soda process was the French reply to the British blockade during the Napoleonic Wars. The continuous chamber process for sulphuric acid was developed in 1812. In 1846 guncotton was first made by Schonbein. The Solvay ammonia process was developed in 1865. The contact process for sulphuric acid was first patented during the Spanish-American War of 1898. In the same year Herbert H. Dow made bleaching powder in the United States from electrolytic chlorine produced in his own type of cell. Haber perfected his synthetic ammonia process in 1913-14 so that Germany could start World War I. In 1915 Chaim Weizmann developed the fermentation process for the production of acetone and butanol. This paved the way for the low-viscosity nitrocellulose development that gave us the modern

lacquer industry. Nylon came on the American scene just before World War II got under way in Europe. 1942 saw a tremendous American production of magnesium from sea water. In 1943, ——?

A WELCOME PATENT POLICY

SECRETARY OF INTERIOR ICKES announced on November 25 that "ownership and control of any inventions developed by Interior Department employees on government time or with government equipment hereafter will be assigned to the Federal government." This is the only proper and honest plan of procedure. It is not at any time proper for public officials to exploit privately for their own gain the results of their professional activities which have to do with their government jobs.

This policy has long been in force in some of the other government departments. Its adoption in the Interior Department years ago was urged but denied. Some of the difficulties of dealing with the Department of the Interior have resulted from the delay in the fixing of this policy. Industry executives will be happy to know that Mr. Ickes has imposed on his department such a regulation of general application. For years many of the individuals in the department have voluntarily followed this practice. But there were just enough of the other kind of cases to make some dealings between outsiders and the Bureau of Mines, for example, of the sort that involved uncertainty or actual financial controversies.

TRULY A WAR CASUALTY

THOSE of us who knew him personally realize that the late William S. Farish was, as Mr. Boyd of A.P.I. has well said, "truly a war casualty." He drew heavily on his declining physical strength to serve courageously in the best interests of his country. The petroleum industry recognized him as an outstanding leader and a most able executive. But few outside of his intimate acquaintances knew that he was a poor Mississippi boy who had worked his way through college and later through law school to become the head of the largest corporation in the world. This could only happen in the America he loved so dearly.

WASHINGTON HIGHLIGHTS

AMMONIA supplies in the post-war period will be super-abundant. No one knows what we will do with so much potential fertilizer material when most explosives making stops. But a joint study is being made by the Department of Agriculture, the organized agronomists of the country, and the fertilizer industry. During November there was a conference which formally organized this committee which will study means for post-war nitrogen utilization. Anyone who has any ideas for expanding consumption in fertilizers, or for other industrial application, will do well to communicate with the secretary of the new committee, Mr. H. R. Smalley, National Fertilizer Association, Washington.

PRICE INCREASES made necessary by wage and salary changes generally require official approval. O.P.A. has set up rather complete regulations for the procedure involved when price ceilings must bulge to prevent hardship. It is obviously also the intention to use price ceilings for preventing wage and salary increases wherever possible. This is a measure of inflation control. Only when the boss is willing to take salary increases out of his profit does the government ignore such changes, and not always even then. Although initial regulations released on November 18 do not apply to everybody, there is an increasing tendency to spread the application of these rules as far as possible, even to small employers and to activities where price ceilings and other regulation have not previously gone.

TARIFFS by edict, and many other administrative changes affecting movement of goods and persons across our boundaries, would have been possible under the requested legislation which the Ways and Means Committee declined to foster. But it is a serious mistake to assume that the President is not going to have plenty of power to do every necessary thing for control of international movements of interest to this country. He probably could do everything requested in the bill which failed to start well, by working merely under the War Power Acts. Some old-school observers who gloated at the defeat of the proposed measure apparently do not understand these facts.

BUILDING MATERIALS that are abundant, relatively, must be substituted for the scarce types. Thus gypsum products, cement products, and many other special materials are being promoted by the government to replace metal and lumber. Chemical engineers in planning new construction must remember that many types of lumber are now almost as difficult to get as metals, strange as that may seem.

PROMOTION that is well deserved has advanced Ernest W. Reid from chief of the former Chemical Branch of W.P.B. to the post of director of the new Commodities Bureau. Equally deserved is the advance of D. P. Morgan from deputy branch chief to the position of director of the Chemical Division. The planning and leadership of these men has made chemical supply for war purposes more nearly adequate than the supply of almost any other important group of strategic commodities.

W. W. SKINNER, long associated with the Bureau of Agricultural Chemistry and Engineering, has been named chief, filling the vacancy caused by the death of Dr. Henry G. Knight in July. This is a logical and commendable selection. It means that the Bureau can carry on with the minimum of shock following the loss of an able leader. And it is a well deserved recognition of the long and distinguished career of Dr. Skinner who has probably done more than any other single individual to bring the Bureau to its present position of prestige and great public service.

Mobilizing New Technology for War Production

SIDNEY D. KIRKPATRICK *Editor of Chem. & Met.*

Chem. & Met. INTERPRETATION

The Office of Production Research and Development recently established in W.P.B. should help to bring a fuller impact of science and engineering to bear on the production problems of the war industries. To date there has been little or no coordinated effort in this direction despite brilliant work being done in some divisions and sub-divisions of W.P.B. and by some outside agencies. Likewise adequate financial support has been lacking, especially for the construction of pilot plants for the large-scale demonstration of meritorious processes. Nor has there been any over-all policy regarding the use of university and industrial research laboratories and developmental facilities for studying war production problems. If the new O.P.R.D. can adequately serve these needs, there may be no necessity for additional legislation. Meanwhile, however, several bills are before Congress which would call for mobilization—perhaps regimentation —of all technological resources, human and material.—*Editors.*

War is a business. So far the production department's job has been to turn out the largest volume of gods in the shortest possible time. Materials and manpower, rather than money, have been the limiting factors. With the Armed Forces, Lease-Lend, and the Maritime Commission all clamoring for increased output by the war industries, quantity has sometimes counted for more than quality. Now, however, we are reaching the stage where quality really counts. We need a research and development department to mobilize the creative functions of science and engineering in the war effort. We need new techniques, new ingenuity, and resourcefulness, if we are to produce new and better weapons of war in ever-increasing amounts.

The opportunity for just such a mobilization of technology is seen in the recent appointment of Dr. Harvey N. Davis to head the new Office of Production Research and Development in W.P.B. According to Board Chairman Donald M. Nelson, this agency is to parallel in the production field the extensive scientific research and development work being done on the actual instrumentalities of war through the Office of Scientific Research and Development headed by Dr. Vannevar Bush. The latter organization, created by Executive Order No. 8807 of June 28, 1941, has already mobilized perhaps five thousand scientists and engineers, and through the National Defense Research Council, is administering approximately a thousand no-profit, no-loss research contracts. Most of these have been placed with universities and colleges throughout the country, although a number have been made with industrial laboratories. The exact nature of the work being done by N.D.R.C. is among the deepest of our war secrets, but it is primarily concerned with the origination and improvement of the actual weapons of war.

Prior to the appointment of Dr. Davis there was no single comparable technical agency concerned with war production problems. An unsuccessful attempt had been made last Spring to set up an Office of Technical Development in the W.P.B. division of governmental requirements, but the effort failed largely through lack of technical direction and support. Meanwhile, many of the industry and commodity divisions and sub-divisions of W.P.B. had developed their own ways and means of bringing scientific and engineering assistance to bear on their particular problems.

The metal and mineral divisions, working largely through Dr. C. K. Leith of the University of Wisconsin, as W.P.B. technical consultant, had set up a cooperative arrangement with the National Academy of Science and the National Research Council to prepare technical reports on a wide variety of products and processes. More than a hundred reports, such as the one on alumina which was abstracted in *Chem. & Met.* for September, 1942 (pp. 138-40), were prepared under the general direction of the War Metallurgy Committees headed by Clyde Williams, director of Battelle Memorial Institute.

The chemical division, after working closely with a group of about fifteen advisory committees originally set up in June, 1940, by the Chemical Alliance to serve the Army and Navy Munitions Board, organized its own Referee Board to pass technical judgment on competing processes. Under the chairmanship of Dr. Donald B. Keyes, of the University of Illinois, this committee is composed of a group of twelve chemical and chemical engineering consultants and university department heads (see *Chem. & Met.*, August 1942, p. 129).

Meanwhile, too, ideas have been pouring into the National Inventors Council of the Department of Commerce at the rate of 300 to 400 a day and, except for preliminary evaluation by its own staff, there has been no well-organized machinery in W.P.B. for handling those inventions that might directly benefit war production. Likewise, hundreds of independent industrial and university research laboratories, engineering experiment stations, etc., have offered their services to W.P.B. and other war agencies, but often without any takers.

In announcing the appointment of Dr. Davis on Nov. 9, 1942, to serve as Director of the O.P.R.D., Mr. Nelson outlined four principal functions of that office, as follows:

1. To provide the chairman with technical information on problems with which he is directly concerned, and on research and development work now in progress in W.P.B. The office is also to provide the W.P.B. divisions and

branches with research information and findings on work which they have in progress.

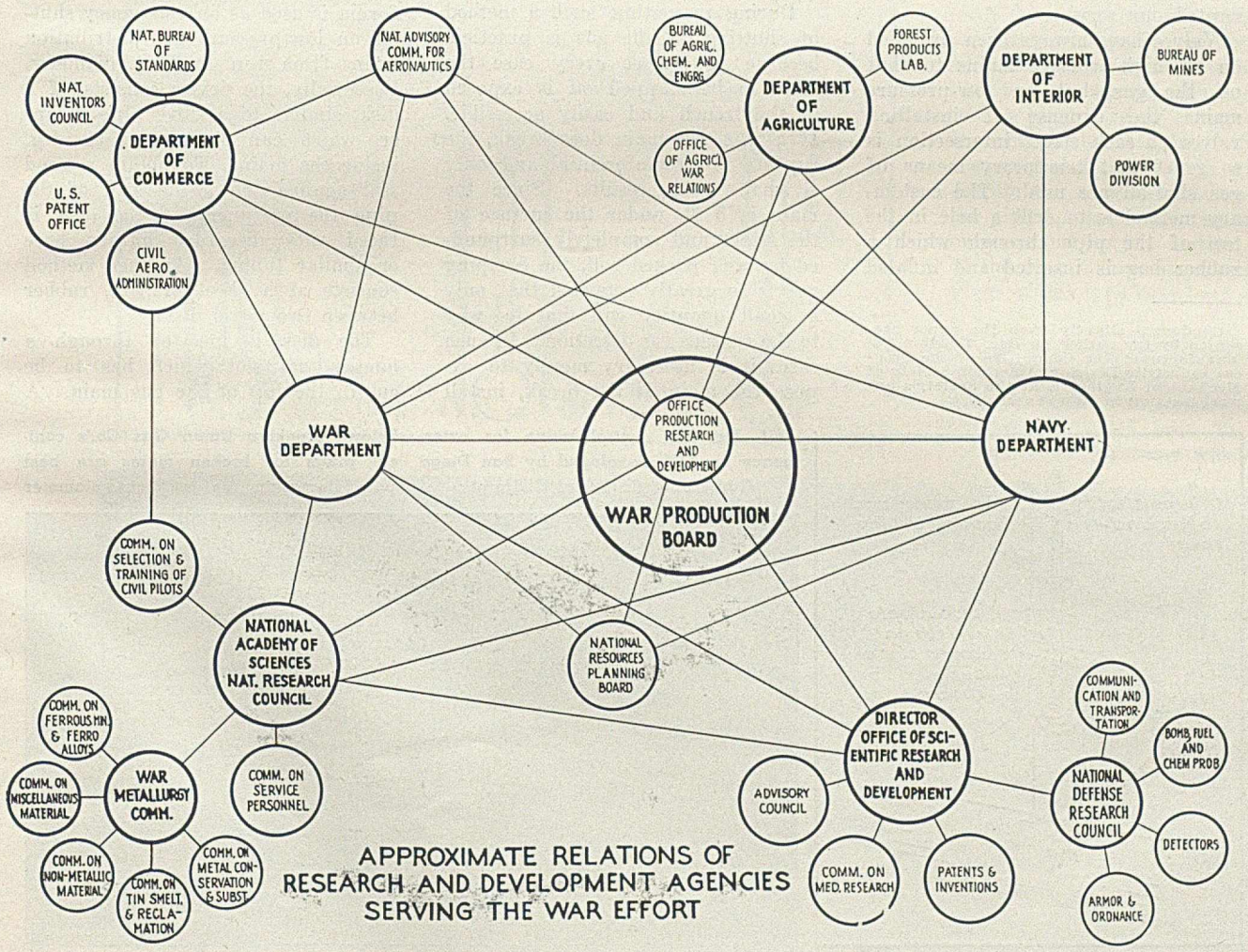
2. To initiate evaluation and analysis of specific scientific or technological proposals, through the establishment of expert committees or through reference to existing research groups in government, education or industry.
3. To get needed research accomplished by contracting with outside laboratories or agencies for experimental work.
4. To bring about development of such projects or processes as are found to merit it through contracting for the construction of prototypes or the erection of pilot plants.

These functions follow in the main the recommendations made in October by a survey committee of scientists and engineers headed by Dr. Webster N. Jones of the Carnegie Institute of Technology (see *Chem. & Met.*, October 1942, p. 123).

While the Office of Production Research and Development was being organized within W.P.B., several legislative proposals have been before various congressional committees. Senator Harley M. Kilgore, of West Virginia, and Representative Andrew Edmiston, of the same state, have introduced identical bills in the Senate and House (S-2721 and H.R. 7591) "to establish an Office of Technical Mobilization, and for other purposes." Such proposed legislation would set up an elaborate agency entirely independent of W.P.B., and would provide funds up to $200,000,000 per year, which is several times the entire appropriation of W.P.B. It would provide the agency with drastic powers to "integrate technical development into the war production program" by compelling the licensing or seizure of all patents, secret processes, and special technical information bearing on war production. It would establish new research facilities, build and equip pilot and semi-works plants, requisition personnel and technical assistance from government offices, agencies, or private organizations. In short, it would marshall all technological resources—human and material—in one over-all agency.

Still another legislative proposal would go still farther and take over all war agencies into a single "Office of War Mobilization" run by a $20,000 executive or war dictator. This office would have four branch organizations: one for production and supply, a second for manpower, a third for technological mobilization and a fourth to control economic stabilization. Into this bill have been pooled the interests and proposals of the several investigating committees headed by Senators Truman, Pepper, Murray and Kilgore and by Representative Toland.

Few believe that these drastic proposals have a chance of passing Congress, at least in their present form. But it is significant that they are receiving increased interest and support. Mr. Nelson himself appeared Nov. 18 before the Sub-committee on Technological Mobilization and declared that "there is a great deal of good" in the Kilgore bill. He sees a "tremendous need for all-out technological mobilization in many directions . . . not alone from the standpoint of chemistry and physics, but of mechanics as well, and the development of new weapons."



APPROXIMATE RELATIONS OF RESEARCH AND DEVELOPMENT AGENCIES SERVING THE WAR EFFORT

Emergency Repairs for Gas Mains

G. S. GOLDSMITH *Engineer of Distribution, Brooklyn Union Gas Co., Brooklyn, N. Y.*

Chem. & Met. INTERPRETATION

Before the War, gas companies were well equipped to deal with the ordinary hazards of their business, but the possibility of bombing raids, with consequent widespread damage to mains, introduced new problems for which there was little precedent prior to the British experience in 1940-41. Since that time much attention has been given to emergency repair methods, many of which will be equally useful for large industrial producers and consumers of fuel gases. These methods are commended to their study.—*Editors.*

THREE MONTHS before the tragedy of Pearl Harbor, distribution engineers in our company began thinking about what we would do about shutting off the gas flow and making emergency repairs to gas mains if a severe bombing raid disrupted our service.

Valves have always been provided on all high-pressure mains to shut off the gas, but on low-pressure mains the expense of installing valves at each street intersection is so great that temporary means of gas shut-off are used. The customary method is to drill a hole in the top of the pipe through which a rubber bag is inserted and inflated with air; or a similar device, known as a "stopper," may be used in place of the bag. Either of these devices will withstand the few inches of water-column pressure that is usually found in low-pressure mains.

During peace-time such a method of shutting off the gas is practical because in almost every case the main to be stopped off is exposed in the trench and easily accessible. If a cast-iron main does break, the rupture is circumferential and only a small crack results. Since the main is 3 ft. under the surface of the street and completely surrounded by well packed soil, the escaping gas is so greatly retarded that only a small quantity will find its way to the surface for detection. In such cases it is necessary merely to expose the main at the break, install a clamp and back-fill, with no interruption of service.

In war-time, however, when the possibility of bombing is always present, other methods must be developed, because an exploding bomb in the street will remove a large section of the main, thus permitting gas to escape in large quantity from each end of the severed pipe. Furthermore, as gleaned from the experience of England, the gas is almost sure to ignite.

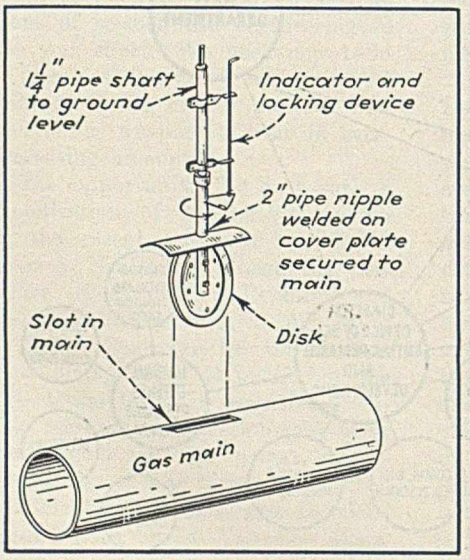
The more important of these shut-off methods include: (1) Butterfly control valve; (2) conical plug or stopper; (3) plastic materials; and (4) inflated bag.

BUTTERFLY CONTROL VALVE

A device developed by the San Diego Gas & Electric Co. of California is used as an emergency shut-off on low-pressure gas distribution mains from 4-in. to 30-in. diameter. Essentially, the device consists of a disk, similar to a stove pipe damper, which can be rotated 90 deg. inside the main. To obtain a good seal against the inside wall of the pipe the periphery of the disk is faced with discarded garden hose or similar tubing. Another method consists of a sheet of $\frac{1}{4}$-in. rubber between two metal disks.

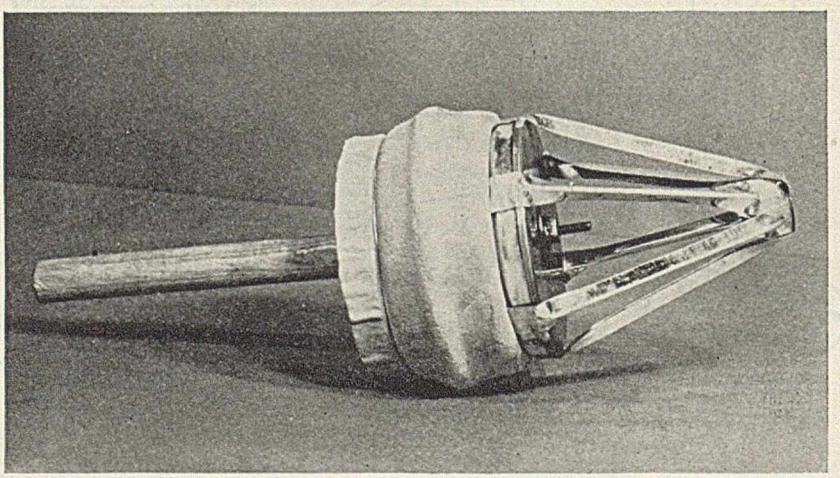
The disk is inserted through a longitudinal slot which has to be cut in the top of the gas main. A

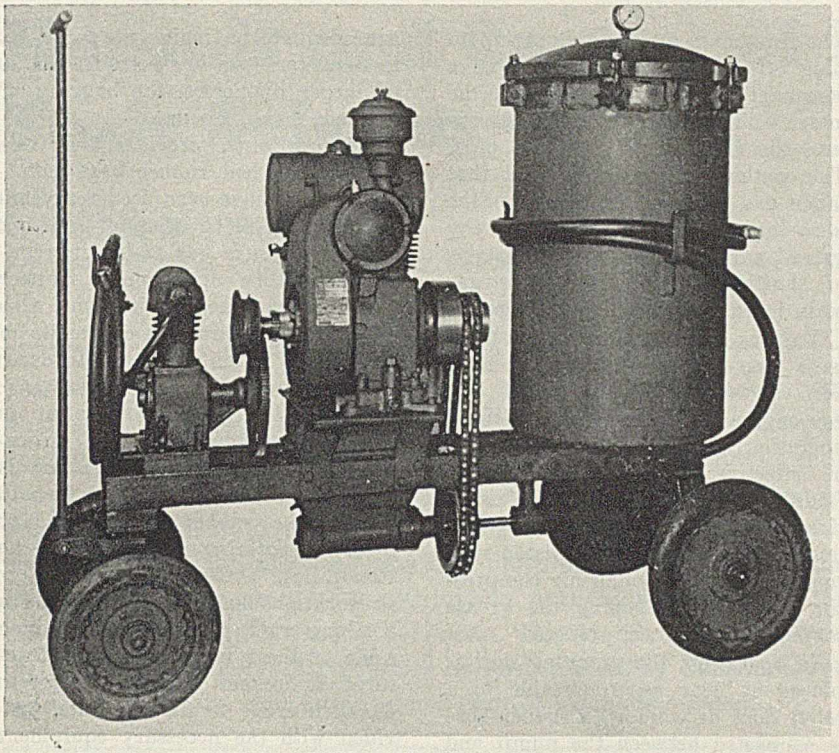
Condensed slightly from the paper presented by the author on Dec. 3 before the Manufactured Gas Committee of the Process Industries Division, American Society of Mechanical Engineers, at the Society's annual meeting in New York.



Left—Butterfly control valve for emergency shut-off, developed by San Diego Gas & Electric Co. of California

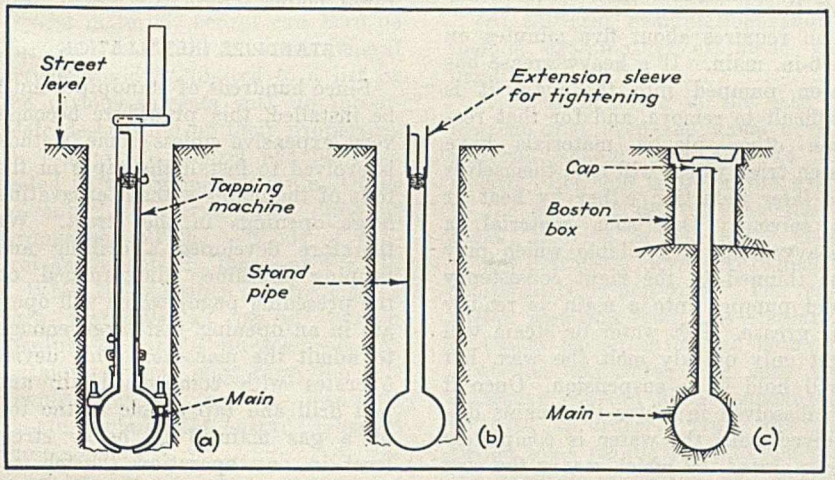
Below—Brooklyn Union Gas Co.'s conical plugs for broken mains are best suited for mains up to 12 in. diameter





Above—This machine, first conceived by Philadelphia Gas Works Co., plugs a main by pumping in a heavy "plastic"

Below—Three steps in installing a standpipe in a main, through which a rubber bag can be inserted for blocking

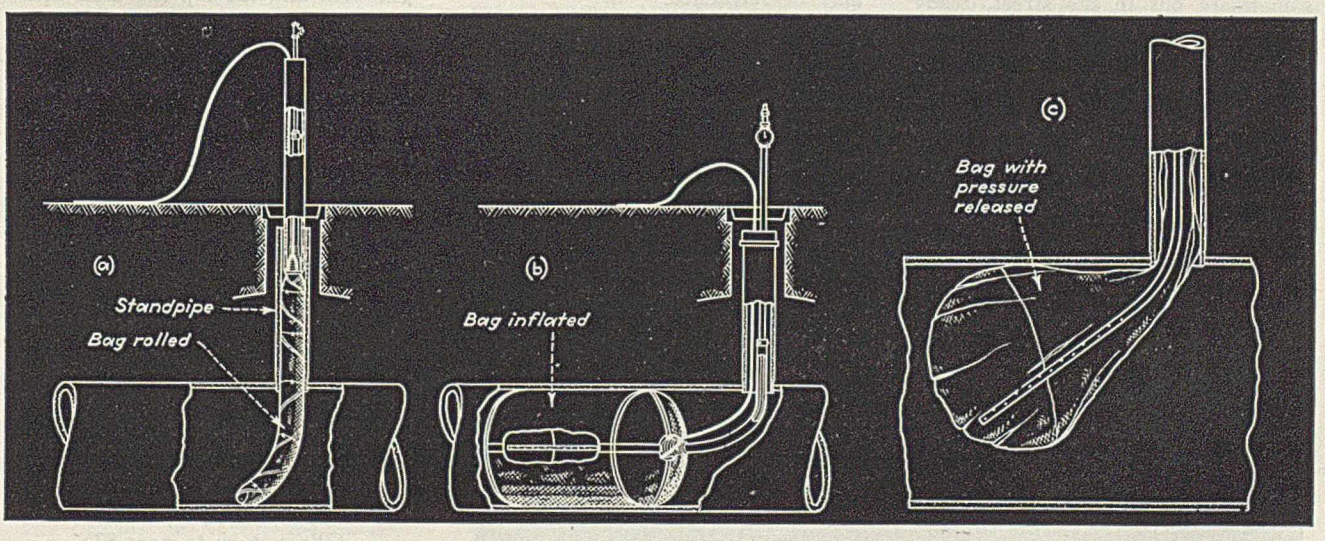


cover plate is then bolted or clamped to the main to seal the slot. A rod or shaft is fastened to the disk and extended upward through a stuffing box and into a receptacle placed in the pavement so that the valve may be operated from street surface.

CONICAL PLUG OR STOPPER

Where the ends of the broken main are exposed and not covered up with debris, conical plugs are felt to be the simplest and most practical method of shutting off a main. To date the most satisfactory design has been a plug with a can-shaped body made of 32-gage crimped tin plate and a 26-gage head for added rigidity. Cone-shaped vanes are attached to the head of the can to aid in guiding the plug into the main. The can-shaped body has a concave bead drawn around the periphery at each end of the plug, which serves the double purpose of strengthening the plug and providing a means for fastening a leather sheath. This leather sheath (made of meter diaphragm leather) is draped on the outside of the plug body over a piece of $\frac{3}{8}$-in. O.D. gum rubber tubing, located between the two beads, and the leather is then lashed to the can body. The maximum diameter of the plug is small enough so that the entire plug can be pushed into the main and thus obtain a shut-off despite the ragged broken edges of the pipe. A heavy coating of grease or soap put on the leather portion of the plug insures an effective seal. Plugs of this type have been designed

Below—Three steps in the use of an inflated rubber bag for sealing off a large-diameter, low-pressure main: (a) inserting the folded bag; (b) bag inflated; (c) bag being withdrawn



and built for mains up to 12-in. in diameter.

The plug is fastened to a wooden pole of sectional construction (and hence, of variable length) by means of a strong flexible joint. This flexibility is necessary in order to allow the man handling the plug to stand on the edge of the crater rather than in front of the broken main, and thus avoid to a great extent the issuing gas, or flames if the gas is burning. The pole can be extended to any length required by merely adding sections. The flexible joint and the construction of the plug permit the plug to align itself properly inside the main, regardless of the angle at which it is introduced. The plug, of course, may be left in the main and the handle removed until it is convenient for permanent repairs to be made.

The weight of the plug at the end of the pole is supported by a cable that is carried by two men walking on opposite edges of the crater. In this way the man carrying the pole is relieved of the dead weight at the end of the pole and the operation is carried out much more smoothly and accurately.

Another type of plug, one that has been used extensively in England, consists of a metal cone followed by a rubber disk. The disk is made of discarded conveyor belting cut to the inside diameter of the pipe and the edge is chamferred so that it can be inserted easily. Tests show, however, that the seal effected by this type of plug is not nearly as good as that obtained with the can-shaped plug.

PLASTIC MATERIALS

Since the premises of every gas consumer is connected to a gas main somewhere out in the street, ready access to the interior of a main may be had through the small pipe known as a "service," which leads from the main to the premises.

The Philadelphia Gas Works Co., who first made use of this set-up to plug off a main, gained access to a consumer's cellar, disconnected the meter and pumped a heavy grease into the main via the service pipe. The method was so successful that other gas companies picked up the idea, improved upon it, and thereby gained a simple but effective means of shutting off a low-pressure gas main in case of bombing damage.

Various types of pumping units have been tried, most of which have been powered by compressed air, gas engine or electric motor. Hand operation of a pump is too slow to be effective. We use a self-contained unit in which all the essentials are combined. A 2½-hp. gasoline engine drives a piston-type pump and also a small air compressor to assist in feeding the grease to the pump by air pressure.

In operation, the pumping unit is placed as near as practicable to a cellar door or window, a rubber hose is connected between the pump and the consumer's end of the service and a sufficient quantity of plastic material is pumped into the main to seal off the gas flow. The whole operation requires about five minutes on a 6-in. main. If a heavy grease has been pumped into the main it is difficult to remove, and for that reason other plastic materials have been tried which will lend themselves to later reduction either by heat or a solvent. One such material, a heavy wax, is available which may be thinned to the right consistency and pumped into a main as readily as grease. Hot water or steam will not only quickly melt the wax, but will hold it in suspension. Once it is dissolved in water it remains dissolved until the water is completely evaporated, by which means the wax may be reclaimed.

INFLATED BAG

The methods of sealing off low-pressure gas mains by means of conical plugs or plastic materials are adequate on mains up to 12 in. in diameter. On low-pressure mains of larger diameters, the bagging-off method has to be used.

As mentioned previously in this paper, spherical rubber bags inflated with air have been used for years and are still being used for shutting off low-pressure gas mains in regular peace-time operations. Rubber bags may be used in war-time also if certain preparations are made in advance to permit the bags to enter the mains quickly.

Briefly, the preliminary set-up is to install standpipes in the larger-size low-pressure mains at intervals of three or four blocks and then to modify the rubber bags to adapt them for entering the mains via the standpipes. After such preliminary preparations have been made and a bombing raid occurs, during which some of these large mains are fractured, it becomes a simple matter to dispatch crews to the incidents, provided with the necessary equipment to insert the bags quickly down through the standpipes, inflate them with air, and thus close off the ruptured mains.

STANDPIPE INSTALLATION

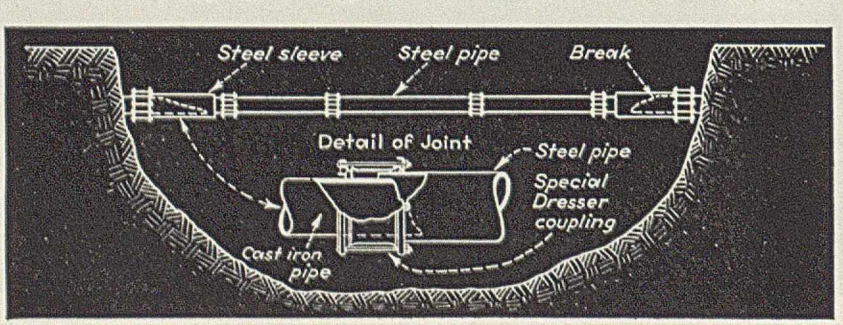
Since hundreds of standpipes must be installed, this procedure becomes very expensive unless some method is evolved to install the pipes in the tops of the mains without excavating large openings in the street. We therefore developed a drilling and tapping machine (diagrammed on the preceding page) which will operate in an opening just large enough to admit the machine. This device operates with compressed air and will drill and tap a hole in the top of a gas main 3 ft. below street level in one operation (sketch *a*). The drill and the tap are then withdrawn and a length of pipe of the required diameter is inserted down through the machine and screwed into the top of the main without the escape of gas (sketch *b*). The machine is then removed, the opening is backfilled with dirt, a Boston box is installed, and the standpipe is ready for use in any emergency (sketch *c*).

EMERGENCY REPAIR

After the flow of gas has been stopped by any of the described methods the next concern is how best to restore the ruptured main for the resumption of service. Here again our peace-time methods are not applicable because they are too

(*Please turn to page* 87)

Method of bridging a long gap in a broken main using steel pipe and special couplings of a type shown in the detail drawing



Hazards and Control of Industrial Toxic Solvents

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Chem. & Met. INTERPRETATION

The probability of chronic poisoning is often ignored by many technical men. This may be due to faulty training as well as to the concentration of literature in journals not widely read by chemical engineers employed in industry. However, especially in such times as these when industrial solvents are being used on an unprecedented scale and often by inexperienced and untrained personnel, it would be wise for every plant engineer to pay particular attention to the possible hazards from these chemicals. Herein the author outlines the symptoms of solvent poisoning as exemplified by benzol, occurrence of exposure and engineering control methods.—*Editors.*

THE NUMBER of industrial solvents is so large that only one typical material, benzol can here be discussed in detail. A more general article would be limited to a list of the various solvents with an incomplete description of their properties. In this article, benzol has been selected as the typical example. Other solvents, of course, have different properties, but the methods of control are essentially the same for all.

While the volatility and toxicity of such materials as benzol, carbon disulphide, carbon tetrachloride, or trichloroethylene may vary, the following general control measures should minimize the hazards from all these solvents:

(1) Obtain complete analyses of materials used.

(2) List all compounds used.

(3) Check list for toxic materials.

(4) Study operations where toxic materials are used for possible employee exposure.

(5) Determine the concentration of toxic materials in the air.

(6) Bring toxic concentration within safe limits by substitution, enclosure, or exhaust.

(7) Check efficiency of control by periodic physical examinations.

(8) Physical examinations should include examination of blood and urine.

It is unfortunate in the case of benzene that even the name of the material should contribute to the hazard. Benzene is the name given to the coal tar derivative which is toxic. Benzine is the name given to the petroleum derivative which is comparatively non-toxic. The confusion resulting from this similarity of names has often caused both unsuspected exposures and also unnecessary concern about nonexistent hazards. In order to avoid this confusion some people refer to the coal tar product as benzol, and in this article we will conform to this practice.

Benzol is a colorless liquid with a distinctive odor. The boiling point is 80.1 deg. C. and the refractive index is 1.5016. It is inflammable, and in addition to the toxic hazard, the fire and explosive hazard of this chemical should also be kept in mind. The material freezes at 5.5 deg. C. and will flash at 10 deg. C.

Although this article deals principally with chronic poisoning, benzol also acts as an acute poison. In contrast to silica or to the ordinary exposures to lead, death may result after a short exposure to benzol. In one case a man was found dead twenty minutes after entering a still which had contained benzol, although the still had been emptied and washed out.

Fatal cases have also been reported from repair work on benzol stills, from leaks in stills, and from failure of the cooling water in the condensing unit on stills.

SYMPTOMS OF POISONING

The symptoms of acute benzol poisoning, according to Greenburg[5], are faintness, dizziness, headache, apprehension of death, tremor, rapid pulse, cyanosis, collapse, coma, acute mania, or delerium preceding sudden death. In very high concentrations, death may result from respiratory paralysis.

Concentrations of 13,000 parts per million will kill dogs in twenty minutes. However, 1,500 to 3,000 parts per million can be borne for six hours without serious symptoms insofar as acute exposure is concerned.

The following three cases have not been previously reported. In the first case, a man lifted the cover from a vessel containing benzol heated to 120 deg. F. He shouted to another man and collapsed across the vessel and was dead before he could be removed to a safe location.

The second case concerned a laboratory worker who had used rather moderate amounts of benzol in certain extractions. This man died about five hours after leaving work. The third case concerns a man who used benzol in large quantities to remove tar from his body after cleaning a tank. He did not die, but was very sick for several days.

In acute poisoning it is not unusual for the patients to recover completely, if they recover at all. The fourth case involved an accident from benzol resulting in the loss of sight. In this instance a woman was using a rubber cement containing 90 percent benzol. In squeezing the tube containing the cement she forgot to remove the cap and the cement came out of the back of the tube and struck her eye. Although medical attention was given shortly afterward, the woman lost the sight of the eye. This case is mentioned because it is be-

This is last of a series of articles designed to acquaint the chemical engineer with the hazards and prevention of chronic poisoning in industrial chemical operations. "Combatting Chronic Poisoning in Chemical Operations," dealing with general principles, appeared in August; "Preventing Heavy Metal Poisoning in Industrial Operations," appeared in September and "Silicosis: Occurrence and Control" in November.—*Editors.*

lived to be one of the first of its type.

Table I gives a list of the toxic limits of a number of industrial solvents. It will be noticed that on this particular list the maximum allowable concentration for continued exposure is 75 parts per million. In addition to this, Hunter[2] states: "It is doubtful whether any concentration of benzene greater than zero is safe over a long period of time." Dr. Hunter bases his conclusions on two fatal cases which tend to substantiate his contention that the maximum allowable concentration of 75 parts per million is too high.

The first case was that of a man who had worked as a cobbler for twenty years. An analysis of the air indicated concentrations of benzol less than 25 parts per million from benzol and benzol-containing cement. This patient died in spite of the low concentration, and an autopsy confirmed the benzol diagnosis.

The most unusual case was that of a telephone operator who used benzol to clean off her switchboard every evening. Although the concentration was estimated at less than 10 parts per million, she was treated for some time for anemia and finally died.

According to Greenburg, the symptoms of chronic poisoning are headache, loss of appetite, burning of the eyes, nausea, vomiting, general weakness and damage to the nervous system. There are also marked blood changes.

PHYSIOLOGICAL ACTION

It is difficult to explain the action of benzol without the use of medical terms, which are not of interest to most chemical engineers. For our own purposes we consider the action as being one of very marked effect on the blood. This effect may be anemia, which is the most common and generally accepted idea of its action. The action may, however, be a decrease or increase in white cells, or an increase or decrease in the size of the cells. In old cases, the spleen may be enlarged.[2]

Benzol poisoning may also appear with an infection some time after the exposure has stopped. In this it is similar to lead, although the cause is different. In the case of lead, the bone was a storage place and with an infection there was likely to be a discharge of lead into the circulating blood stream. In the case of benzol, the action is to impair the function of the bone marrow in forming new blood cells. According to Hunter this damaged marrow can function during health, but produces an erratic blood condition during even a mild infection.[2]

Table I—Maximum Concentration of Toxic Solvents as Suggested by the State of Massachusetts[1]

Gas or Vapor	P. P. M.
Amyl acetate	400
Aniline	5
Benzene	75
Butyl acetate	400
Carbon bisulphide	15
Carbon tetrachloride	100
Dichlorbenzene	75
Dichlorethyl ether	15
Ether	400
Ethylene dichloride	100
Formaldehyde	20
Gasoline	1000
Methanol	200
Monochlorbenzene	75
Nitrobenzene	5
Sulphur dioxide	10
Tetrachlorethane	10
Tetrachlorethylene	200
Toluene	200
Trichlorethylene	200
Turpentine	200
Xylene, coal tar naphtha	200

1. Bowditch, Drinker, Haggard & Hamilton, *Jour. Ind. Hygiene & Tox.*, **22**, No. 6 (June, 1940).

OCCURRENCE OF EXPOSURE

Industrial exposure to benzol may be divided into two types: those exposures in which the user knows that he is handling benzol, and those in which the exposure is not known. The first group includes the manufacture of benzol by distillation of coal tar and its use in large chemical plants. In addition to the fact that the operators know of the hazards, the operations are very likely to be carried out in a closed system.

Determinations on air samples from one company that used thousands of gallons of benzol daily for blending with motor fuel indicated a much smaller exposure to this solvent than a small paint shop that used only five gallons a day in a paint remover. In the case of the blending plant, the operators knew the material with which they were dealing and how to avoid unnecessary exposure. Periodic urine sulphate determinations were made to detect any unsuspected absorption. In addition, the benzol was handled by pumping from tank to tank and there was little need for any actual contact by the employees. The highest value for exposure was 50 parts per million of benzol.

In the case of the paint shop using the benzol paint remover, the management did not know that there was any benzol in the plant. In addition, they did not seem to be concerned if there was such a benzol exposure, and it was necessary to convince them that exposures to 300 parts per million of benzol were dangerous. The type of exposure where benzol is being handled by men with experience should give us little concern. On the other hand, the cases in which the exposure exists without the knowledge of the workers are likely to give the most trouble.

An example of the type of difficulty which results from using solvents about which nothing is known is the following case history. The company concerned branched out into the manufacture of phonograph records. In part of the process as they carried it out, the hot record was dipped into a solution designated by a trade name. The record was then dried and cooled by a blast of air which was warmed by the cooling records. In order to conserve heat this warm air was used to heat one small department. The result was that one man was dead in about three months, and several others made ill. The firm that supplied the solvent had given no indication of any possible harmful effects from its use. The solvent proved to be 30 percent benzol and the trouble resulted chiefly from ignorance of exposure. In a good many cases trouble results because of faulty specifications by the purchaser.

One group of cases occurred in printing shops doing rotogravure printing. A fast drying ink containing a high percentage of benzol was supplied to the print shops. Several men died before the cause was traced to the benzol content of the ink. In the manufacture of artificial leather there have also been recorded a number of fatalities from benzol. The use of paint removers can be a source of considerable exposure.

The rubber industry has also had a number of benzol cases. These exposures were due to the excellent solvent properties of benzol for rubber. The cementing of crepe rubber soles on shoes gave estimated concentrations of 500 parts per million, and a large number of cases resulted in a short time. One of these was fatal after six months of illness.[2]

DETECTION OF BENZOL

In the control of the hazard, it is important to determine the benzol concentration. This can be done by forming dinitrobenzene and then adding butanone, which gives a typical color reaction. The color thus obtained can be compared with color standards to arrive at the concentration of benzol. The method is quite sensitive and for a concentration of 25 parts per million it is only neces-

Table II—Physiological Response of Man to Various Concentrations of Benzol

For Cases of Acute Poisoning[1]

Milligrams per Liter	Parts per Million	Length of Exposure	Effect
5–10	1,570–3,130	Several hours	Slight symptomatology
10–15	3,130–4,700	One hour	Possible serious symptomatology
61	19,000	Short exposure	Fatal

[1]U. S. Dept. of Interior, Bureau of Mines, *Technical Paper 272* (1921).

sary to take a 500 c.c. sample of the air.

In this procedure, the air sample is pulled through a bubbler containing equal parts of concentrated sulphuric acid and fuming nitric acid. The acid is neutralized, and butanone is added to the warmed solution. After shaking, the butanone is separated and placed in a colorimeter tube with additional caustic for comparison with the standard.[4]

CONTROL METHODS

In Massachusetts, it is required that material containing over five percent benzol be labeled, and also that there be included a printed caution that it is poisonous. It is compulsory that any container used for benzol either for shipping or in the plant, be so labelled. This seems to be a very excellent control method and it is very difficult for unsuspected cases of benzol exposure to exist when this system is used. However, it does seem to be a bit unfair that benzol should have to be labelled, while other solvents such as the chlorinated hydrocarbons are not included.

It would be desirable insofar as the prevention of benzol poisoning is concerned, if all states had a law similar to that of Massachusetts, but there is no evident reason why this law should apply only to benzol. The practical possibility of getting an all-inclusive labeling law for all toxic materials is remote. It is desirable both from an economic as well as from a safety standpoint either to request an analysis of trade name products or to have an analysis made.

One of the steps in occupational disease control is to set up a card index of all the materials used in the plant. It is sometimes found that a good many materials being used have rather meaningless trade names. If the suppliers will not give information regarding the analysis and it is difficult to obtain one, it may be possible to obtain a guarantee that there is nothing harmful in the purchased material.

When information is requested about solvents, it is sometimes found that the supplier himself knows nothing about the product he is selling. The supplier merely uses a trade name material as one ingredient without knowing what it contains. A list of every material used in a plant with its composition is a great control measure; the consideration of the safety angle by the purchasing department is another very important control measure. When materials are being purchased, consideration should be given not only to the quality and price, but also to the cost of the precautions necessary to use the product safely.

Engineering methods of control of benzol hazards are the same as those suggested on the other types of exposure, such as the dusts. If it is possible to use a non-toxic material to replace the hazardous one, this may be a simple way out of the difficulty. This method of substitution is not as simple as formerly, due to difficulties caused by the war. It was at one time considered good practice to substitute toluol for benzol, but due to the demands of the munitions industry this is not possible at present. Inasmuch as there is no solvent which will compare with benzol in solvent properties and which is neither toxic nor very flammable, the problem of substitution is not a simple one.

If substitution is to be made, the process should not be changed to counteract the substitution. In one case, for example, substitution was made of a chlorinated hydrocarbon for benzol which made a theoretical improvement in the toxic hazard. However, in order to get better results, the plant process was changed so that the new material was heated, causing a higher concentration in the air. The increased concentration more than made up for the lower toxicity.

Enclosing operations or covering any containers will prevent the escape of the vapor into the air. On operations where it is not possible to completely cover the work, local exhaust hoods are the solution. It is much better to use local exhaust hoods which remove the vapors at the point of origin than to use general ventilation. On enclosed operations it is sometimes desirable to maintain a slight negative pressure on the tanks. This will prevent leakage to the atmosphere from a process which may be only partially enclosed.

A good deal can be done in the way of control by having urine analyses made at intervals. The ratio of organic to inorganic sulphates in the urine is an indication of benzol absorption. It is possible by means of periodic checks on the urine to see whether the other control measures are adequate.

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GAS MAINS

(*Continued from page* 84)

slow. In regular practice, if a cast-iron main has been badly damaged or torn up by any one of several causes, such as a cave-in or a contractor's steam shovel, the jagged ends of the pipe are cut off and lengths of additional pipe are installed to fill in the gap. This method is practical since only one such break is encountered at a time and the final result is a permanent repair.

A bombing raid, however, might conceivably produce dozens of such instances and length of time for restoration becomes the prime consideration. Working in collaboration with the Dresser Mfg. Co., makers of pipe couplings and special fittings, we finally developed what we believe to be the simplest method of restoring a main in the least possible time.

The essential design of this device is a long steel sleeve of sufficient diameter to slide back over the end of the broken cast-iron pipe, which is coupled thereto by means of a rubber gasket and follower ring. The fill-in pieces used to bridge the gap between two of these special fittings are lengths of ordinary steel pipe coupled together with standard mechanical couplings. Hence, any distance between the two broken ends of a cast iron main may be bridged without loss of time in cutting and fitting pipe.

CMP and the Chemical Industries

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Chem. & Met. INTERPRETATION

After the first of next July, it will be virtually impossible to purchase any steel, copper or aluminum without first having been assigned an allotment number from one of the seven Claimant Agencies operating under the new Controlled Materials Plan. Chemical process industries, although not direct consumers of the controlled metals, will be affected because of needs for construction, maintenance and repairs. This article has been prepared to help *Chem. & Met.* readers to understand the plan and its workings. — *Editors.*

THE CONTROLLED MATERIALS PLAN is our first really comprehensive plan. In it we take a further step toward adding up in advance all supplies and requirements for certain key materials so that essential military and civilian programs can be adjusted to available resources and facilities. It is a fact that a great deal of totalling has been done right along but, heretofore, it was not done on the basis of programs balanced and approved in advance. It cannot be too strongly emphasized that raw materials accounts must be balanced on a cash basis. Where a shipment of steel is overdue production stops and this type of shortage cannot be balanced by deficit financing.

In its present form, the Controlled Materials Plan applies to only three raw materials, though it is set up in such a way that other materials may be brought under control at will. All three of the first materials to be brought under control are metals—steel, copper and aluminum. The control provided by the Controlled Materials Plan is primarily vertical, but horizontal control is also provided. The vertical control extends from the raw material at the mill level up through all stages of intermediate fabrication to the finished plane, tank, ship, etc. Horizontal control is introduced by forcing all the agencies which want these planes, tanks, ships, etc. to compute their requirements for steel, copper and aluminum in advance and submit budgets by months for the next 18 months. The sum total of all such budgets will then be compared with corresponding estimates of the total available supply. After these budgets have been adjusted to bring aggregate supply and demand into balance, allotments of the controlled materials will be made to each agency.

In the evolution of this plan, it is understood that many schemes were submitted for consideration and that the best points of each were merged into a single program. Except for minor modifications, the resultant plan is believed to be roughly similar to the systems used in England, Germany and Russia. The controls applied by the British are said to be somewhat less formal and rigid. And it is possible that looser controls might be adequate for them because their problems are less complex and because, to some extent, deficits can be balanced by Lend-Lease. On the other hand, in the case of Germany or Russia, one would expect a more rigid and formal system as industry is practically a part of government in those countries. Presumably the industrial side of such a war program is operated like a single huge corporation.

By and large the main features of the Controlled Materials Plan are simple. As has been said before, it applies to the supply and requirements of steel, copper and aluminum. Accordingly, the Steel, Copper and Aluminum Divisions of the War Production Board are charged with the duty of estimating the available supplies of the materials under their supervision. Also, when the wheels start to turn, these so-called "Controlled Materials Divisions" will direct the production of the mills under their supervision into the proper channels, e. g., in the fabrication of steel, copper and aluminum. The suppliers of the three raw materials controlled by the plan are represented, therefore, in the picture by their respective divisions in the War Production Board.

The consumers of these controlled materials are represented in the plan by the so-called "Claimant Agencies" of which there are seven, as follows: The War Department, the Navy Department, the Maritime Commission, the Aircraft Scheduling Unit (agent for the Army Air Forces and the Bureau of Aeronautics), the Office of Lend-Lease Administration, the Board of Economic Warfare, and the Office of Civilian Supply. These seven agencies represent everyone that is to get any steel, copper or aluminum.

These agencies get their allotments of metal by submitting budgets which will receive the approval of the Chairman of the Requirements Committee only after being adjusted to bring the aggregate sum of all budgets into balance with the estimated total supply of the corresponding controlled materials. The budgets submitted by the Claimant Agencies are based on data obtained from bills of materials. Except for products on the Class B list, to be discussed later, these bills of materials are used to determine the amount of each controlled material directly or indirectly required in the manufacture of a product needed by the Claimant Agency. This information is obtained from the so-called "Prime Consumers" or "Secondary Consumers." In other words, if a manufacturer wants to produce tanks for the Army, he must tell the Army how many tons of steel, copper, and aluminum he needs. Furthermore, he must say when the metal will be needed to bring about delivery of the tank on the desired schedule. Moreover, if the tank manufacturer buys a sub-assembly, which is not on the Class B list, he must obtain a bill of materials from his supplier which is combined with his own for his Claimant Agency.

Through these budgets, based on bills of materials, the plan provides a vertical integration which will trace the use for production purposes of controlled materials from the finished plane, tank or ship back to the mills producing the required steel, copper, and aluminum. The steps in

this process are illustrated in the accompanying diagram which shows the procedure followed—how requirements obtained through bills of materials are processed from the Secondary Consumers through the Prime Consumers to the Claimant Agencies where the total demand is determined for submission to the Controlled Materials Divisions and the Requirements Committee. It also shows the procedures followed in distributing the available supply down the line from the Requirements Committee.

In the foregoing discussion, the controlled materials were consumed as raw materials for production purposes. In actual practice chemical manufacturers, as distinguished from equipment manufacturers, consume almost no controlled materials for production purposes though large amounts of controlled materials, both raw and fabricated, are consumed in the construction of plants and for plant maintenance, repairs and operating supplies. These other uses are recognized in the plan which calls for separate bills of materials or estimates to be submitted by the Claimant for the maintenance of plants owned and operated by the Agency and for the plants under construction whose output will be used exclusively for the benefit of the Agency.

The Claimant Agency, therefore, must segregate the information submitted in its budget into three categories: (a) production materials, (b) construction materials and (c) maintenance, repair and operating supplies. Moreover, care must be taken not to include materials required for the manufacture of Class B items. In the latter group fall nuts and bolts, rivets, washers, motors, generators, pumps, compressors, and a lot of other items which are so widely distributed that the tracing-through process would be too difficult to carry out. The procedure to be followed in the case of the Class B list will be described later.

Having totalled its requirements, the Agency is ready to submit its estimates to the Requirements Committee. In other words, through the use of bills of materials, the need for steel, copper and aluminum has been traced from the finished plane, tank, ship, etc. through all intermediate stages in fabrication to the mills in which the ultimate raw material must be produced. After this information has gone up the line to the Requirements Committee and after the necessary adjustments have been made there, the decisions of the Chairman of that Committee are handed down in the form of allotments. These are made to the Claimant Agencies and it is the duty of the Claimant Agency to divide the metal allotted among its offices and among their programs. A million tons of steel, allotted to the Army, for example, might be divided by that Agency so as to give Chemical Warfare Service 100,000 tons, the balance to tanks, ordnance, etc. It would then be the duty of the Chemical Warfare Service to divide its 100,000 tons among its previously estimated needs of raw and fabricated items for production, for construction, and for maintenance, repair and operating supplies. This sub-allocation by the Chemical Warfare Service is then conveyed to its prime contractors and by them to their sub-contractors and so on down the line until finally all the allotments percolate through the many stages in the processing chain of industry to become eventually orders for metal to be placed with the producing mills.

The procedure to be followed with the Class B products is somewhat different. The Class B list has been broken into two parts: Group I and Group II.

There are significant differences in the way these two groups are handled. In the case of the Class B Group I items, the Claimant Agencies collect reports of requirements in terms of numbers of fabricated units (so many motors, compressors, pumps, etc.), but do not convert these estimates into pounds of component metals. In other words, bills of materials are not required. The conversion to pounds is made in the aggregate by the End Product Division, e. g., General Industrial Equipment for pumps. The requirements, for steel in this case, are then submitted through Civilian Supply to the proper Controlled Materials Division (Steel) and after adjustment to the Requirements Committee. If the budget is approved by the Requirements Committee an allotment of steel is made by the Chairman to the End Product Division (General Industrial Equipment, in this case) which sees to it that the pump manufacturers get their steel. This is done by allotments issued by the End Product Division to the manufacturers of pumps, in this case. At the same time a preference rating is assigned which will enable them to purchase Class B products and other materials.

As may be seen, there are not many items on the Class B Group I list which are used as production

CLASS B PRODUCTS LIST

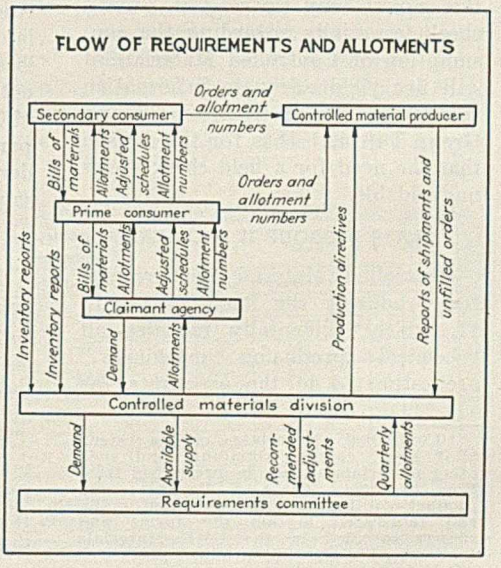
The War Production Board booklet "General Instructions on Bills of Materials" contains lists of Class B products. Some of the items of possible interest to the chemical process industries are given below. The WPB booklet should be consulted for official information.

Class B — Group I

Batteries
Blowers and fans
Boilers
Burners, gas & oil
Compressors & vacuum pumps
Conveying equipment
Electric motor controls
Gas cylinders
Heat exchangers
Instruments
Motors & generators
Pressure vessels
Pumps
Speed reducers
Stokers
Switchgear
Transformers
Tubes, electronic
Turbo-blowers

Class B — Group II

Abrasive wheels
Asbestos end products
Bolts, nuts, nails, etc.
Bus supports
Carbon brushes
Ceramic mfg. machry.
Chemical producing machinery
Containers
Dust collecting equip.
Electrical conduit
Electroplating & anodizing equip.
Fibrous glass prods.
Fire extinguishing devices
Fittings, pipe
Hardware
Hose, metallic
Industrial explosives
Industrial safety equip.
Laboratory equip.
Maintenance & repair parts
Mining machinery
Mixers
Pulp & paper machinery
Refrigeration machinery
Scales & balances
Unit heaters
Valves
Welding equipment



materials by the chemical industry. In fact, from the viewpoint of the chemical industry, most of these items would be used for new construction or for maintenance, repair and operating supplies.

Under such circumstances, the question will be raised what provision has been made by the Controlled Materials Plan for estimating the metal required for Class B Group I items, for uses other than production. The answer, it may be said with some assurance is that the Class B Group I items, as well as Controlled Materials and Class A items* in our new construction projects, should be obtainable. However, it will be difficult to find all projected minor plant expansions not included therein (the dividing line between construction and maintenance and repair has been set at $500.00). Also, maintenance and repair requirements are difficult to estimate for a wide list of products like those included in Class B Group I which comprises many different types of articles all the way from boilers and compressors down to $\frac{1}{4}$-in. O.D. ball bearings.

The difficulty and importance of this problem of estimating maintenance and repair requirements cannot be overemphasized. And, lacking a better basis in the brief period of three weeks at our disposal, the Chemicals Division is planning a spot check in the field. To be sure, considerable data regarding metal consumption is available on the PD-25-A forms filed by Class I chemical companies that use in excess of $5,000 of metals per quarter and which are therefore large enough to come under the Production Requirements Plan. Still, although this source may provide an overall check, especially regarding the consumption of Controlled Materials, it will not yield adequate information regarding Class A items or Class B Group I items. It is for this reason that the need for a field check seems unavoidable.

CLASS B GROUP II PROBLEMS

Controlled Material requirements for producing the items in Group II, which incidentally includes all "chemical producing machinery," are estimated in the aggregate for the whole industry and not on the basis of individual requirements. These estimates are made by the End Product Division of the War Production Board having supervision over the production of the item in question in conjunction with the Office of Civilian Supply. For example, in the case of the chemical equipment industry, the combined budget for all producers will be worked out by Civilian Supply with the aid of the Chemicals Division, without reference to the Claimant Agencies. Incidentally, it is understood that the policy will be to keep Class B Group II industries operating at a high level subject to limitation orders.

The mechanism by which the acceptance of orders corresponding to allotments is assured is the allotment number. This is, in effect, a warrant for the delivery of a given amount of material on a specified preference rating in a particular month.

As has been noted before, the allotment number is accompanied by a preference rating. This rating is important in determining the scheduling of orders for the delivery of controlled materials and Classes A and B products. It is significant also, that the distribution of all scarce materials and products not covered by the Controlled Materials Plan is to be effected by the existing preference rating system.

Since this is not an order on a stipulated concern, it may be necessary for the prime or secondary contractor to shop around to fill his orders. And, to this extent, the allotment number is analogous to a fishing license. Yet, according to the Plan, the stream is protected and the fish are there in the right quantities for each licensee, though the late comer may find it difficult to locate pools that have not been fished out. The appropriate Controlled Materials Division will assist companies with allotments to place orders when such assistance is necessary.

SUMMARY

That is the essence of the Controlled Materials Plan. The Navy, for example, finds how much steel it will need by summing up all the data on all the bills of materials obtained from its prime contractors. The latter, in turn, get their information from other secondary contractors and so on, down the line to the mill. The Requirements Committee adds the Navy's request to those of the Army and of other agencies obtaining a total which, no doubt, will exceed the total supply. Adjustments are made and finally an allotment of steel is issued to the Navy which divides its quota among its offices and they, in turn, issue allotment numbers to their contractors who extend them to sub-contractors and so on eventually to the producing mills.

Clearly, the Controlled Materials Plan has a positiveness that is most welcome. It will force the War Production Board to face frightening issues regarding the use of steel for planes, tanks, and ships as compared with the maintenance of mills making soft drinks and ladies' underwear.

Again, this is the first plan to provide for rigid vertical integration plus the vitally essential feature of totaling all budgets horizontally across the board in advance of allotment. Still, the amount of detailed work to be done is immense and there is a very real administrative problem involved in meeting the rather close time schedule which has been laid down. To illustrate the plan is to become effective in the second quarter and to be mandatory in the third quarter of 1943. This means that initial deliveries should be made early in April. And, since the processing period for some fabricated articles is at least 45 days, it will be necessary to place orders at the mills about the middle of February. Considering that the Chairman of the Requirements Committee is scheduled to make his allotment on February 1, it is clear that the process of passing along allotment numbers must be carried to completion in such instances with great rapidity.

The Controlled Materials Plan undoubtedly will be found to have many minor defects and probably some major ones. Yet, it provides for positive planning of the war program and it is difficult to see how certain much-needed decisions regarding the essentiality of various civilian activities can be evaded. The administration of the Plan will be a problem and its timing schedule is exceedingly close. Still, the Plan has the great advantage of providing for operation on a cash basis and for settling issues regarding supplies and requirements in advance before the account is overdrawn. Despite the difficulties involved, the urgent need for balancing the books is a very strong argument for the Controlled Materials Plan.

* Controlled Material: carbon steel, alloy steel, copper, aluminum and such other materials as may be prescribed from time to time. Class A Product: any product containing any controlled material fabricated beyond the forms and shapes specified in the CMP Materials List except a Class B product.

Manning Tables for Manpower Inventory

Chem. & Met. INTERPRETATION

To assist essential industry in the concurrent process of manpower withdrawals and replacements, and in taking manpower inventories, the government has prepared the so-called Manning Table Plan. Worked out by the War Manpower Commission in cooperation with the Selective Service System, the plan represents, in the opinion of the sponsoring officials, the first forward step toward a systematic solution of essential industry's manpower problem in any war situation. Herein the editors of *Chem. & Met.* have abstracted outstanding features of the plan from a report published in the November issue of *Factory Management and Maintenance*.—*Editors.*

AVAILABILITY of labor has hitherto been one of the less considerable factors in a manufacturer's plans. Henceforth it will be paramount. The long-predicted general shortage of manpower is visibly at hand. This is shown by such signs as the "certificate of release" procedure introduced to enforce an "employment stabilization" order to save the sagging curve of production in copper mines, anti-pirating agreements prevailing in certain industrial centers, women invading industry in a way that only a shortage of men could make possible.

One need not be an alarmist to recognize in these facts a need for planning. The United States government is now urgently asking industry to think of the nation's manpower supply in terms that are entirely new. However, the tension already evident in the labor market provides certain clues to the manpower problem that lies ahead.

Meanwhile, men in government positions who are making manpower policy must contend with a host of imponderables and variables, many of which lie wholly beyond the possibility of anything close to accurate prediction.

Out of all this confusion, only these things are reasonably clear today: (1) Practically all men of military age and fitness *must* enter the armed forces of our country; (2) replacements for essential industry *must* be drawn from the reserve labor forces; (3) to achieve the minimum indicated expansion, intensive regulation will be needed. To increase, or even to maintain it, *total* regulation will be required.

Because time is short, industry must both plan and act at once. It must take a continuing inventory of essential manpower needs simultaneously as it withdraws and replaces workers.

PURPOSE OF MANNING TABLES

The Manning Table Plan is a system to provide for the listing of the personnel requirements of essential war industries according to job classification. *This means a listing of jobs, not men.* Its immediate objectives are (1) to facilitate the orderly withdrawal of replaceable workers from essential industries into the armed services in the *inverse order* of their essentiality, and (2) to provide for their replacement by workers taken from reserve labor sources with the least possible disturbance.

Further objectives of the plan are to provide the basis of a complete inventory of essential manpower needs; to reveal to employers the necessity and the opportunity for training and upgrading of workers; to call to their attention ways in which women, older workers, and handicapped workers can be utilized; and to provide the necessary data for a reasonably accurate forecast of future labor requirements.

The plan will provide the justification for deferment of men in essential positions when such action is in accordance with Selective Service regulations. A manning table is prepared by an employer and is then officially validated. After that it serves as a guide to local Selective Service Boards in determining deferments. The plan has been endorsed by the Management-Labor Policy Committee of the War Manpower Commission.

Manufacturing plants whose business volume is 75 percent or more in war work, and certain essential industries such as utilities and railroads, will participate in the plan. National and regional industrial groups and trade associations will assist in passing upon applications and determining some job classifications.

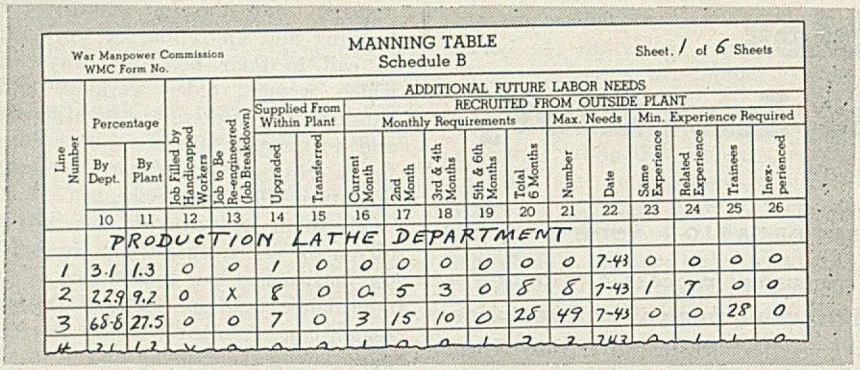
PROCEDURE FOR FILING

A prospective applicant obtains, fills out and returns the manning table application issued by the regional or area director of the War Manpower Commission nearest him. If the application is approved, the applicant will receive five copies of the manning table with instructions for compiling it. A manning table is filled out for *one plant*, not a department and not a company having several plants.

The applicant retains one copy and forwards the other four to the regional or area W.M.C. director who arranges for validation, retains one copy, sends one to the state director of Selective Service, one to the area director of the United States Employment Service, and one to Washington. Selective Service pro-

War Manpower Commission WMC Form No. — MANNING TABLE Schedule A — Sheet 1 of 6 Sheets

Line Number	OCCUPATIONAL IDENTIFICATION DATA: Plant Job Title	Occupational Dictionary Job Title	Dict. & Plant Code	Minimum Training Time (hrs.)	Present Number Employed: White M	White F	Other M	Other F	Total
	1	2	3	4	5	6	7	8	9
	PRODUCTION	LATHE DEPARTMENT							
1	FOREMAN	FOREMAN-II	5-72.765	5000	2/0	0	0	0	3
2	LATHE HAND (1ST CLASS)	ENGINE LATHE OPERATOR - I	4-71.011	2400	15/0	S	0	0	22
3	LATHE HAND (2ND CLASS)	ENGINE LATHE OPERATOR - II	6-71.011	600	46/20	S	0	0	66
4	DRILL PRESS OPERATOR	SENSITIVE-FEED DRILL PRESS OPERATOR	6-78.083	400	1/0	1/0	1/0	0	3



War Manpower Commission
WMC Form No.

MANNING TABLE
Schedule B

Sheet 1 of 6 Sheets

Line Number	Percentage		Job Filled by Handicapped Workers	Job to Be Re-engineered (Job Breakdown)	ADDITIONAL FUTURE LABOR NEEDS											
					Supplied From Within Plant		RECRUITED FROM OUTSIDE PLANT									
							Monthly Requirements					Max. Needs		Min. Experience Required		
	By Dept.	By Plant			Upgraded	Transferred	Current Month	2nd Month	3rd & 4th Months	5th & 6th Months	Total 6 Months	Number	Date	Same Experience	Related Experience	Trainees	Inexperienced
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	PRODUCTION LATHE DEPARTMENT																
1	3.1	1.3	0	0	1	0	0	0	0	0	0	0	7-43	0	0	0	0
2	22.9	9.2	0	X	8	0	0	5	3	0	8	8	7-43	1	7	0	0
3	68.8	27.5	0	0	7	0	3	15	10	0	28	49	7-43	0	0	28	0
4	5.2	2.0	X	0	0	0	1	0	0	1	2	2	7-43	0	1	1	0

cedure, after validation, will be discussed later.

In general, the code references of the *Dictionary of Occupational Titles* (Superintendent of Documents, Washington, D. C., price $2.00) will be used but employers may file their own job descriptions.

Manning tables will be kept current by periodic review of not less than each six-month period and by special review whenever the personnel requirements of a plant are substantially changed.

MANNING AND SELECTIVE SERVICE

The manning table must be accepted by the state director of Selective Service of the state in which the plant is located before it is applicable to any Selective Service activity. When the state director has accepted the plan, he will assign his state acceptance number to the employer, who will then be authorized to use this number and to place the prescribed state acceptance stamp on the affidavit (Form 42A), indicating that the time for replacement of an employee is in accordance with the table.

When an employer has been notified that his table has been accepted, he is authorized to use his state acceptance stamp on the affidavits (Form 42A) which were filled in accordance therewith. The employer will file Form 42A for all employees within the ages liable to military service for whom occupational deferment is then necessary. Form 42A filed under the Manning Table Plan and bearing the authorized state stamp will be forwarded by the employer direct to the local board and will supersede any previous request for occupational deferment.

The new Form 42A will show how long it will take to replace the employee, the time indicated being taken from the accepted manning table.

Until further notice, it will not be necessary to file a Form 42A for registrants who have wives and children, or for registrants who have children with whom they maintain a bona fide family relationship.

The employer should, however, file an Occupational Certification by Employer (Form 42B) for such employees. Whenever the director of Selective Service determines that it is necessary to reclassify men in this status, the employer may file a Form 42A. This will enable the local boards properly to classify the registrant and to notify the employer if the registrant is classified or reclassified.

When an employer has filed Form 42A or 42B for a registrant, the local board will be required to notify the employer on Notice to Employer (Form 59 revised) whenever the registrant is classified or reclassified.

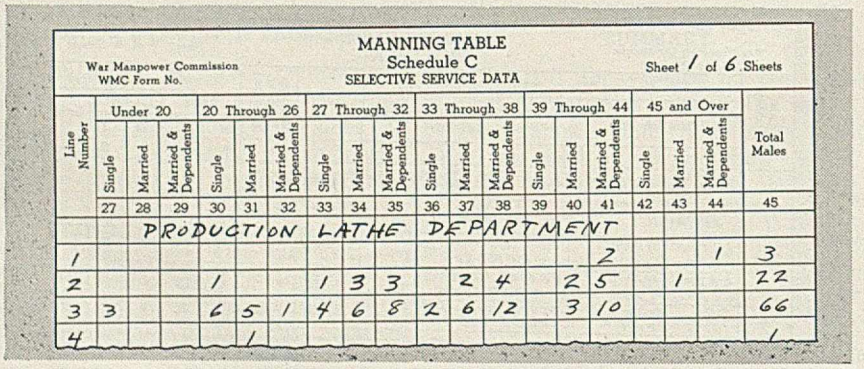
When an employer has filed an affidavit (Form 42A) for a registrant, this form shall be considered to be written evidence of the occupational necessity of the registrant. The employer may appeal to a Board of Appeal from any classification of the registrant by the local board under the provisions of Section 627.2, Selective Service regulations.

Full responsibility for classification as prescribed in Selective Service regulations remains with the local board, and all classifications are subject to the usual appeal procedure.

Acceptance by the state director and use of the approved state stamp informs the local board that careful consideration has been given to occupational classification requirements and the time required to replace registrants by the employer, the War Manpower Commission, and by the state director of Selective Service. Local boards will, however, continue to give the same serious consideration to requests for deferment from plants which do not use the Manning Table Plan as they have in the past.

Legislation making men 18 and 19 years old available for military service will probably cause slight changes in some of the forms illustrated on these pages.

The manning table consists primarily of schedules A, B and C, sections of which are reproduced on these pages. The numbers entered in the "line number" column of schedule B should correspond to those entered in schedule A. The same holds for schedule C. The proper procedure for filling out the forms is made self-evident by the forms themselves.



War Manpower Commission
WMC Form No.

MANNING TABLE
Schedule C
SELECTIVE SERVICE DATA

Sheet 1 of 6 Sheets

Line Number	Under 20			20 Through 26			27 Through 32			33 Through 38			39 Through 44			45 and Over			Total Males
	Single	Married	Married & Dependents	Single	Married	Married & Dependents	Single	Married	Married & Dependents	Single	Married	Married & Dependents	Single	Married	Married & Dependents	Single	Married	Married & Dependents	
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
	PRODUCTION LATHE DEPARTMENT																		
1															2			1	3
2				1			1	3	3		2	4		2	5		1		22
3	3			6	5	1	4	6	8	2	6	12		3	10				66
4					1														1

ESSENTIAL DATA

Other forms than those reproduced on these pages can be used. However, the basic information which any job description must contain regardless of the form chosen is as follows: (1) Name of company; (2) line number, page and department in the manning table to which each job description refers; (3) plant job title or titles if job is known by more than one title; (4) minimum time required to train a qualified inexperienced person to reach normal production; (5) unusual physical requirements; (6) type of supervision given or received; (7) a description of exactly what is done on the job under consideration, including the purpose of the job and listing the machines, tools, special skill, knowledge, and judgment used or required; (8) percentage of total time spent in performing each of the major tasks which comprise the job.

Special Kettle Setting Simplifies Temperature-Cycle Control

WILLIAM J. SHORE *Industrial and Heating Engineer, New York, N. Y.*

Chem. & Met. INTERPRETATION

An oil processor for the varnish industry had the problem of heating a 500-gal. batch of a special oil to a high temperature, according to a stepped heat-and-hold schedule. The problem was solved in a simple and effective manner by direct firing with either gas or oil, using a heavy refractory setting for the kettle. The heat storage of the setting, coupled with adequate insulation, made it possible to hold practically uniform temperature at each level. Cooling was accomplished by spraying the kettle bottom with water to reduce the oil temperature by 3 to 4 deg. per minute.—*Editors.*

An instructive example of the use of a heavy refractory furnace setting as a means for achieving close temperature control in a process vessel, through release of the heat stored in the setting, recently occurred in a direct-fired kettle installed for processing a varnish oil. The kettle was of 1,000 gal. capacity, for treating a 500-gal. batch of a special oil of high viscosity. To withstand corrosion and to avert darkening the color of the oil, the kettle was of stainless steel, 5 ft. 6 in. in diameter by 6 ft. high. It was designed for operation under a reasonably high vacuum to permit the removal of fumes and the recovery of valuable byproducts by means of a condenser, and it was equipped with efficient agitating apparatus for rapid and thorough heat distribution throughout the kettle contents.

The manufacturer's problem was to heat this viscous oil according to a definite temperature schedule, raising the temperature in several definite intervals to predetermined temperature levels, at each of which the temperature was held for a period. After holding at the highest temperature for the required time, it was necessary to lower the oil temperature rapidly. Although the actual figures cannot be given, for sake of illustration it can be assumed that the batch was to be heated from room temperature to 350 deg. F. at the rate of about 9 deg. per min., and this temperature was to be maintained for one hour. The temperature was then to be increased from 350 to 425 deg. F. and held for one hour; increased from 425 to 475 deg. and held for one hour; increased from 475 to 550 deg. and held for one hour. After this heating cycle, the batch was to be cooled at the rate of 3 to 4 deg. F. per minute. In each stage the volatiles were to be recovered or discarded, depending on conditions.

The author was called in to determine the best method of achieving this heating and cooling schedule and after considerable study decided on a direct-fired installation, arranged for burning either oil or gas with forced draft, and with the setting so designed that flame impingement on the kettle would be avoided, since this would be harmful. A novel method of cooling was used, with water sprays playing directly on the kettle bottom to effect the rapid cooling necessary. The kettle has now been in operation for over a year and despite this apparently drastic treatment, no evident disintegration of the setting has as yet taken place.

Assuming an overall efficiency from fuel to heat in the product of 40 percent, it was evident that a fuel consumption of 20 gal. of oil per hour would meet the requirements. However, in order to obtain this high heat release, it was essential to design the combustion chamber carefully and, since flame impingement on the kettle bottom must be avoided, to design the chamber so that the kettle would be heated only by the products of combustion and by the radiant heat from the brick setting. Also, since only the kettle bottom and a small portion of the side would be exposed, an intensely hot flame in a highly radiant fire box was called for, thus requiring the use of forced draft on the burner to supply all the air needed for combustion. A burner of this type may be used either for oil or gas and may be completely sealed, thus doing away with open flame hazards.

The design chosen for the setting is shown in the accompanying drawing. The flame is directed into a straight tunnel about 6 ft. in length, at the end of which it enters the circular combustion chamber in a tangential direction. The flame whirls about the circular passage, heating the side walls to a white heat and thus achieving complete combustion. After a flame travel of about 18 ft., the hot products of combustion, continuing in their circular path, pass around the sides of the kettle and leave the chamber in a tangential direction through a short section of sheet steel breeching to an adjoining stack. The breeching has an access door to permit entrance into the combustion chamber for any necessary repairs.

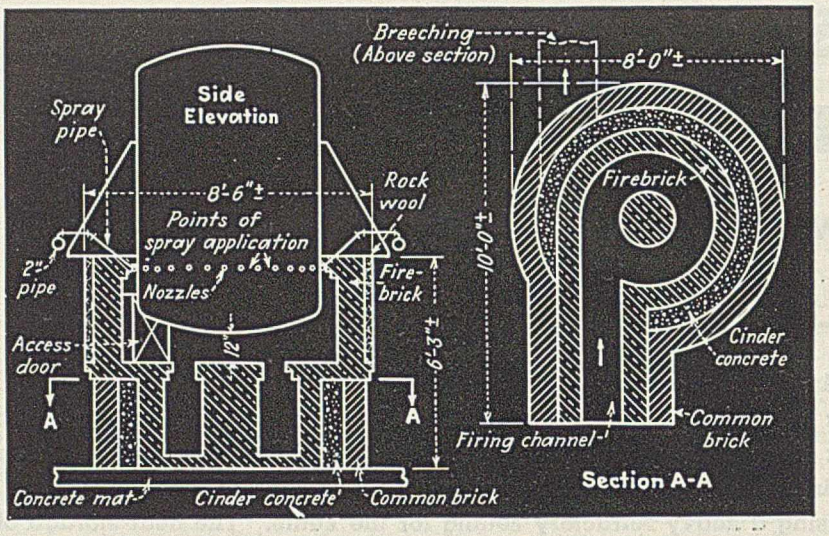
In planning this installation, low initial investment cost, reliable operation and the simplest possible type of control were necessary. The author is by no means against automatic temperature control or use of light-weight modern types of refractories, but in this particular instance heat-storage refractories were desirable and their use made it possible to dispense with all control equipment except a recording thermomcter and the necessary manual burner and cooling water controls.

The required temperature schedule specified that the temperature be held at each of the several levels for a period of one hour, with a variation no more than plus or minus 5 deg. F. This could be accomplished with a heavy firebrick setting and an efficient job of insulation. Firebrick is capable of absorbing and

storing large quantities of heat, but having a low coefficient of heat transmission, it gives this heat up slowly, after the burner has been shut off, and over a long period of time. When the flame is extinguished, for a short time the high-temperature refractories give up their heat at a rapid rate to the kettle contents, raising the oil temperature about 5 deg. F. and reducing the refractory temperature to a level only slightly higher than that of the oil. From that point on, steady radiation of heat to the kettle largely supplies what heat loss there is, the oil showing a temperature drop of only about 8 deg. in each holding period of one hour. Rock-wool blanket-type insulation 3 in. thick on both the kettle and the firebrick setting meets the requirement.

Since it is possible to predict quite closely how much heat will be given up by the setting after the burner is extinguished, and how much heat will be lost from the kettle contents thereafter, an extremely simple method of temperature control is available. For the type of work required, sufficient accuracy is attained, free of all complications of control equipment and wiring. The method eliminates the necessity for flame-failure protective equipment and is foolproof in every respect. No experienced attendant is necessary since, once the plant technician has adjusted the burner air and fuel controls, and the cooling water rate, it is only necessary for the operator to start the burner, shut it off as it approaches the desired temperature and start it again an hour later for each phase in the heat treatment.

When the plant was originally started, the technician ran a sample batch, preparing a temperature chart which indicated at what time to light the burner and when to shut it off. With this schedule the operator has little to do except to note the temperatures on the thermometer chart. As they reach points shown on the sample chart which is before him, he turns the burner on or off accordingly, and for the final operation opens a quick-opening water valve controlling the cooling water supply. The cooling water rate has previously been adjusted with a globe valve in the line, so even this operation requires no judgment on his part. Further adjustments are not necessary since these were initially set to give the correct air and gas or air and oil mixtures and the correct fuel flow for the desired rate of temperature rise.



Elevation and cross section of direct-fired kettle setting

In putting the burner into operation, the operator merely opens the fuel valve wide after the blower has been started and applies the gas lighter. From that time on until the desired temperature has been reached he need pay no attention to the flame.

Occasionally during each run the operator takes samples which are tested to make certain that variations in his raw material, which is a natural product, do not require slight changes in the time-temperature schedule.

Since rapid cooling is essential after the batch has been held at 550 deg. F. for an hour, an efficient method of cooling was necessary. While there are many possible ways, the standard methods were difficult of application in this instance. Originally it had been intended to cool the oil by adding an equal amount of the cold finished product, but the viscosity was so high that the idea was abandoned. With the necessary cooling rate 3 to 4 deg. per minute, it was evident that air cooling would be insufficient as it was found that the maximum drop would be 1 deg. in 6 minutes. The writer proposed spraying cooling water directly on the kettle sides from inside the setting, using a row of 24 stainless steel nozzles equally spaced about the kettle circumference, all nozzles spraying simultaneously.

Installed Cost of Heating and Cooling System for 1,000-gal. Autoclave

Concrete foundation	$100
Supporting steel columns	45
Operating platform, ladder	125
Rigging kettle into place	75
Gas and oil burner	60
Motor-driven blower	300
Electric wiring, air and oil piping	150
Firebrick combustion chamber	750
Insulation installation	100
Exhaust breaching	75
Recording thermometer	175
Water cooling system	400
Total	$2,355

The question of possible adverse effects on the kettle was put up to the kettle manufacturer who concluded that a uniform cooling rate of 4 deg. per minute should not affect the kettle any more than a 4-deg. rise. The effect on the setting was also questioned. At first impact, of course, the water is turned into steam upon hitting the kettle, but experience has shown that much of the water flows down the side of the kettle and drops on to the firebrick. Actually, nothing much happens except that the water runs out at the bottom of the setting. Doubtless, eventual failure of the bricks will occur somewhat more rapidly than with less drastic cooling, but the setting is so built with standard shapes, which are laid in such a manner, that they are easily replaceable, either from the inside or the outside.

In any event, that part of the combustion chamber which is difficult of access is not subjected to water. Firebrick is not expensive and, as has already been noted, one year's operation has shown no harmful effects.

The drawing shows how the water is applied. The 2-in. header around the outside of the setting is provided with individual ⅛-in. branches running to the 24 stainless steel spray nozzles. Each nozzle has a ⅛-in. opening. By this arrangement all nozzles receive their water at full pressure. Since the entire equipment is in an unheated shed, a valve is provided to empty the header of all water.

In operation, the operator of the equipment stands near the temperature recorder, at which point he can reach the quick opening valve for turning the water on and off. The temperature drop is 4 deg. per minute from 550 to 350 deg. F., and from there down, the drop is at the rate of 3 deg. per minute. It requires about 18 lb. of water per minute at 60 deg. F. to produce this temperature lowering.

A year's experience with this equipment has shown that it can treat a 500-gal. batch in an 8-hour shift with direct costs including: direct labor, $6; fuel oil at 4c. per gal., $2.50; and electricity for stirring, the blower, and vacuum, $2.20.

The installation described is an interesting case where the use of extra-heavy refractories and effective insulation made possible the elimination of much equipment ordinarily considered necessary, thus giving low initial and operating cost, without adverse effect on the operating characteristics. The accompanying tabulation of setting, burner and cooling equipment and installation costs gives an idea of the economical nature of the installation. The table includes no figures for the kettle itself, nor for its piping or condenser, referring only to the heating and cooling equipment. Furthermore, oil storage and pumping equipment were already available and the cost of burner piping included only the actual piping from the existing system.

In conclusion, the author acknowledges the assistance and cooperation of the Anthony Burner Co., who supplied the gas and oil firing equipment; and of the Blaw-Knox Co., manufacturers of the kettle installed as part of this installation.

Unloading Tank Cars Containing Flammable Liquids

EDITORIAL STAFF SUMMARY

Chem. & Met. INTERPRETATION

The following discussion of safe means for unloading steel tank cars filled with flammable liquids is a brief abstract of the 9-page bulletin on this subject recently published by the Manufacturing Chemists' Association. For full details the reader should refer to the complete bulletin, described as Manual Sheet TC-4, which may be obtained at a price of 12 cents per copy by addressing the Manufacturing Chemists' Association, 608 Woodward Building, Washington, D. C.— *Editors.*

At least six states prohibit unloading flammable liquids from tank cars through bottom outlets while some states prohibit syphoning. Others require official approval of unloading sites and exert supervision over storage tanks and unloading equipment. All requirements pertinent to the locality of the receiving plant should be familiar to the consignee.

[Applicable paragraphs on tank car shipments of flammable liquids, from the regulations of the Interstate Commerce Commission, appear in the complete text of Manual Sheet TC-4, identified by ICC section numbers.]

The unloading track should be level and the car should be accurately spotted. Brakes must be set, the wheels blocked and appropriate caution signs must be displayed until the car is unloaded and disconnected from the unloading line. Use of derails at the open end or ends of the siding is recommended.

Unloading should be carried out by a properly instructed responsible person who should not unload by artificial light unless approved closed electric lights are available. Cars should not stand connected after unloading nor be unattended while connected. The permanent storage tank must be properly vented and care taken to ascertain the car contents and to avoid mixing of products. Non-sparking tools must be used and car fittings must not be struck with hard objects. Tools must be kept clean, and in opening or closing dome covers or completing dome connections, wrenches should be pushed (not pulled) to minimize possibility of the workman slipping. Naked flames and smoking must be prohibited.

Before the car is connected with or contacted to the unloading line or unloading equipment, the tank car must be grounded effectively. Fig. 1 shows a suggested method of doing this. Approved explosion-proof electrical equipment should be used around the unloading dock and in the vapor area. The area should be provided with approved fire extinguishers, safety fire blankets and a suitable type of "No Smoking" signs.

In some cars the discharge pipe extends into a fitting on top of the dome for top unloading. Cars with both a discharge pipe and a vacuum relief valve do not require removal of the manhole cover before unloading when top unloading by pump or syphon is contemplated. If cars are not so equipped, however, definite methods must be used in removing the manhole cover. The screw type must be loosened with a bar of non-sparking metal. Two complete turns expose the vent openings. If the sound of escaping vapor is heard, the cover must be screwed down and the pressure vented as later described. During unloading the cover must be in place, but not entirely screwed down, to permit air to enter. With the hinged and bolted type, all nuts must be unscrewed one complete turn and the same precautions regarding pressure used as above. With the interior type, dirt and cinders must be removed before the yoke is unscrewed and during unloading the yoke screw must be tightened to bring the cover within $\frac{1}{2}$ in. of closed. With the protective housing type, one housing cover pin is removed to lift the cover, exposing valves and fittings. When unloading through the dome or through the bottom outlet of cars equipped with interior manhole covers, the manhole must be protected against entrance of sparks by an asbestos or metal cover or by covering with wet burlap or fire retardant cloth.

UNLOADING

Where bottom unloading is prohibited, tank cars equipped only for bottom unloading must be unloaded by means of a special top-unloading device consisting of a special cover which is placed over the opened manhole and through which a pipe is inserted. (The Manufacturing Chem-

ists' Association will provide details on this device.) In all cases, top unloading is recommended rather than bottom outlet unloading. Air pressure must not be used, but pumping is recommended. Use of water displacement or inert gas pressure should be made only on instructions from the shipper. To relieve pressure in a tank car before unloading, the tank can be cooled with water or it can be vented by raising the safety valve or opening the vent on the dome at short intervals, providing a dangerous accumulation of flammable vapor outside the car will not result.

To unload through the top, in case of a car not equipped with an eduction pipe, it is necessary to open or remove the manhole cover and insert a 2-in. pipe of non-sparking metal to within about 1 in. of the bottom. The closure is removed from the valve through which the car is to be unloaded, the eduction pipe unloading valve is connected to the pump suction line, and the valve opened. If the car does not have a vacuum relief valve on the dome the manhole cover is opened as previously explained. Then the pump is started.

When the car is to be unloaded through the dome with a syphon (the top of the storage tank must be below the bottom of the tank car), the procedure is as just described except that the eduction pipe unloading valve is connected to the syphon unloading system as shown in Fig. 2. The syphon tank is filled with a liquid similar to that in the car, the valve on the car opened and the valve on the syphon tank opened to start the syphon.

To unload a car through the bottom (not recommended), extreme care is necessary since if the car should be struck and the bottom connection torn loose, probably the entire contents would be lost with hazard to life and property. The manhole is opened and the car vented as described above. Then the outlet leg valve cap is loosened after a pail has been set to catch any liquid in the outer chamber and to check for continuous leakage. If the leakage cannot be overcome by operating the outlet valve handle several times to seat the valve, then unloading must be accomplished through the dome.

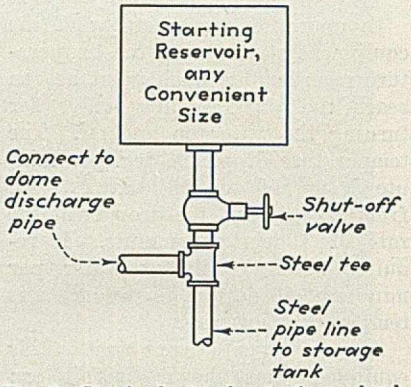


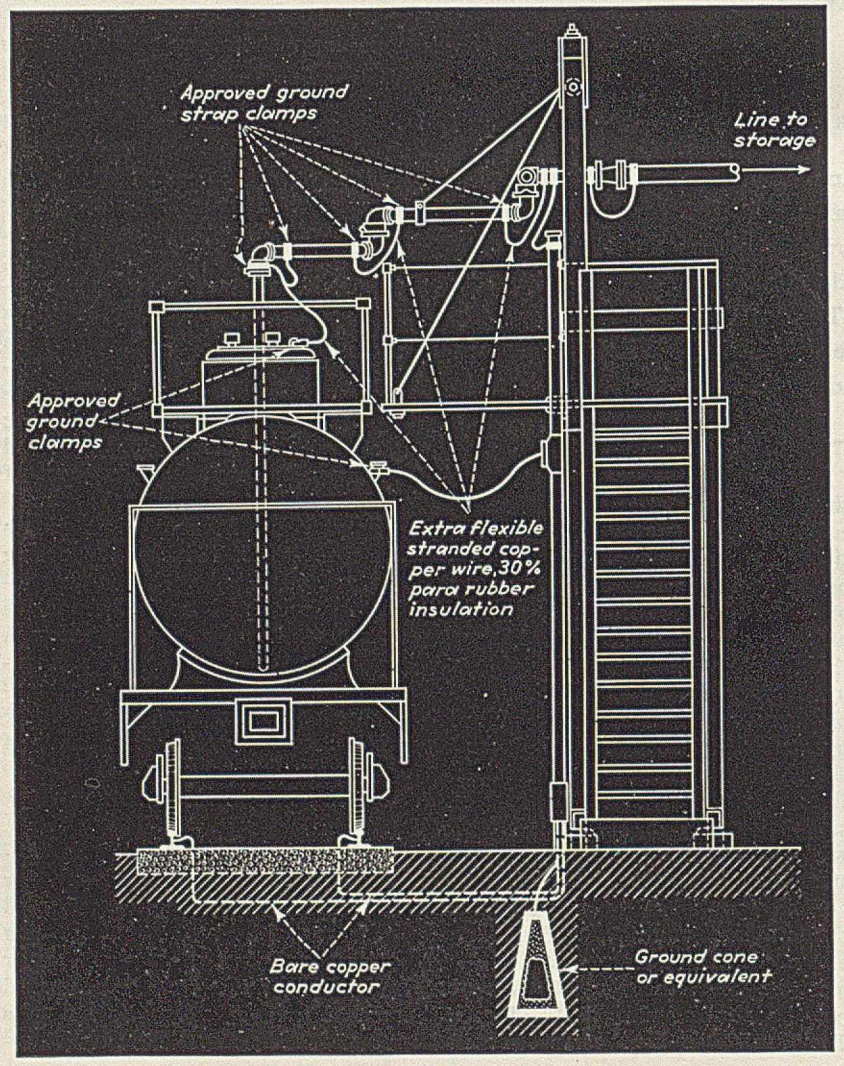
Fig. 2—Simple device for starting unloading syphon

The unloading line should be of standard full-weight wrought iron or steel pipe with standard fittings, although short sections of flexible metal or equivalent hose may be used for flexibility where rigid connections are impracticable. Piping should be secured to prevent vibration, and allowance should be made for expansion and contraction. Approved shut-off valves should be installed in the suction and discharge lines at the pump, convenient to the storage tank. If the latter is above the pump, an approved check valve must be used.

Pumps should be located in a separate fireproof building at a safe distance from the storage tank and other buildings and should have all electrical equipment of explosion proof construction. Approved type pumps should be used, preferably of the centrifugal type. The pump should be equipped with a relief bypass if of the positive type.

Great care must be used in examining empty cars. They should not be entered before they have been thoroughly cleaned by steaming or other approved methods, nor should lights other than an approved flashlight be used for examination. If persons must enter the car after proper cleaning, they must be provided with a hose mask and safety belt with rope attached, and another person should be stationed at the manhole. Since metal is liable to create sparks, men entering the tanks should not be allowed to use metal tools and should be equipped with a proper type of safety shoes.

Fig. 1—Suggested method of grounding tank car before unloading



Manufacture of Butadiene From Ethyl Alcohol—I

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Chem. & Met. INTERPRETATION

Comparatively little technical information has been published on processes for manufacturing butadiene from ethyl alcohol. Yet this subject is of vital importance today and need for detailed information is acute. The authors have covered and digested thoroughly the literature on the subject and present herein the first of two installments outlining to chemical engineers the technology of the various porcesses for producing butadiene from alcohol.—*Editors.*

SUCCESSFUL production of marketable synthetic rubber from ethyl alcohol depends upon an abundant supply of inexpensive alcohol from which to produce 1,3-butadiene, the basic constituent of Buna rubbers. Accordingly, rubber manufacture from ethyl alcohol has received particular attention in Russia with its large resources of fermentable grains, and also in Poland, prior to the present military occupation, where the alcohol was produced principally from potatoes.

Starting from ethyl alcohol as the raw material, the manufacture of butadiene rubber is divided into three phases: (1) synthesis and purification of the butadiene, (2) polymerization of the butadiene, and (3) compounding of the butadiene polymer.

There are a number of ways by which butadiene can be produced from ethyl alcohol, depending upon the type and sequence of the reactions used and upon the intermediate compounds involved. A bird's eye view of the inter-relations that exist between the different methods that can be used and of the pathways that lead from ethyl alcohol to butadiene is given diagrammatically in Fig. 1. In the present discussion, the methods for producing butadiene from ethyl alcohol are divided into six groups:

1. Direct conversion of ethyl alcohol.
2. The aldol method.
3. Ethylene methods.
4. Acetylene methods.
5. Acetaldehyde condensations and conversion to butadiene.
6. Crotonaldehyde methods.

DIRECT CONVERSION

The direct process for the conversion of ethyl alcohol to butadiene consists of the simultaneous dehydration and dehydrogenation of ethyl alcohol as developed in Russia by Lebedev.[1,2] This process is the result of the simplification of the Ostromysslenski method for the condensation of acetaldehyde with ethyl alcohol[3], and of the development of a pyrolytic process established by Ipatieff in 1903[4].

Synthesis and purification are carried out according to the flow diagram given in Fig. 2, which is based on a catalyzing chamber or conversion tube approximately a foot in diameter and 12 feet in length. The catalyzing chamber is constructed of steel and lined on the inside with a glass enamel. It is set within a heating chamber, the heat for which is supplied by a furnace fired with the gaseous by-products of the process. Several conversion tubes of small diameter are preferable to one of large diameter, in that heating of the catalyst is facilitated by using a long narrow tube. Previous to the conversion, the vapors of ethyl alcohol and water, as well as the air that is used to dilute the alcohol, are superheated to 450 deg. C. in the superheater, so that the temperature of the gaseous mixture when it enters the conversion chamber is about equal to that of the catalyst itself.

Alcohol vapors are injected through a nozzle at the top of the conversion chamber, which is usually set in a vertical position and which is maintained at a temperature of 400-425 deg. C. The vapors, as they traverse the length of the tube, are converted by a catalyst mixture of alumina and zinc oxide to butadiene and other products. These gaseous and volatilized reaction compounds are drawn from the conversion chamber and passed through a cooler which is maintained at 0 deg. C., to condense the unconverted alcohol and other products condensable at this temperature. This condensation creates enough vacuum to draw the alcohol vapors through the converter at pressures slightly below atmospheric pressure, namely, at about 680-710 mm. mercury.

The cooling operation condenses and separates the gaseous products from the liquids. In Table I are given the compositions of the gaseous and liquid fraction as determined by Akobzhanov[5]. The liquid fraction consists for the most part of unconverted ethyl alcohol with

Table I—Products of Direct Catalytic Dehydration and Dehydrogenation of Ethyl Alcohol

Products	Percent Yields
Gases:	
Hydrogen	1.3 – 1.6
Carbon monoxide	0.2 – 0.5
Methane and homologs	0.4 – 0.6
Ethylene	5 – 8
Butylene (pseudo-butylene or butene-2)	3 – 4
Butadiene	20 –25
Pentene-2	0.5 – 0.7
Hexene	0.4 – 0.5
2, 4-Hexadiene	0.6 – 0.8
Liquids:	
Piperylene	0.5 – 0.7
Toluene	0.1 – 0.2
p-Xylene	0.5 – 0.7
Bivinyl dimer	0.05 approx.
Ethyl ether	2.0 – 5
Ethyl butyl ether	0.5 – 1
n-Butyl alcohol	2 – 4
Crotyl alcohol	0.5 – 1
n-Hexyl alcohol	0.5 – 0.8
n-Amyl alcohol	0.1 approx.
n-Unsaturated hexyl alcohol	0.05– 0.1
n-Octyl alcohol	0.3 approx.
Acetaldehyde	2.5 – 5
Butyric aldehyde	0.1 – 0.2
Crotonaldehyde	0.05
Acetone	0.3 – 0.5
Methyl ethyl ketone	0.1 – 0.2

small amounts of higher alcohols and water; whereas the gaseous fraction consists principally of butadiene and unsaturated hydrocarbons.

A fractionating unit is used for separating the constituents of the liquid fraction coming from the cooler. The ethyl alcohol is recycled through the superheater and utilized. The gaseous fraction from the cooler is purified for the removal of butylene and other hydrocarbons.

To achieve this, the butadiene mixture is pumped into the scrubber tower at the base and made to rise in counter current with the descending butadiene solvent. Turpentine has usually been used as such a solvent. The scrubber tower is packed with petroleum coke and removes from 90 to 92 percent of the butadiene, a large part of the butylene, and a small amount of other gaseous components. The results of the scrubber operation are shown in Table II, where the percentage composition before and after absorption is given.

Unabsorbed gases from the scrubber, consisting principally of ethylene and ethers, are highly combustible, and are used as fuel in the converter furnace. Despite the presence of small percentages of butylene, which can be converted to butadiene by dehydrogenation, the separation and purification of the butylene from the scrubber gas is prohibitive because of the difficulty of separating butylene from the other gases.

Turpentine solvent is passed from the scrubber tower into a separator where the butadiene is distilled from the turpentine, which is recycled and used continuously for the absorption. The butadiene still contains active impurities which are removed by fractional distillation under a pressure of 3-4 atmospheres and by passage through a 50 percent caustic soda solution. The latter operation serves to remove traces of acetaldehyde. The gaseous mixture is subsequently dried. In Table III is given the composition that the product will have at this point.

The final purification step is the separation of butadiene from the butylene and the ethers. The gas is brominated to produce compounds with distinct and more widely separated boiling points, thus permitting efficient separation of these compounds in the fractionating column. Thereupon, the tetrabromobutane, the brominated product of butadiene, is easily reduced by metallic zinc, giving practically pure yields of butadiene.

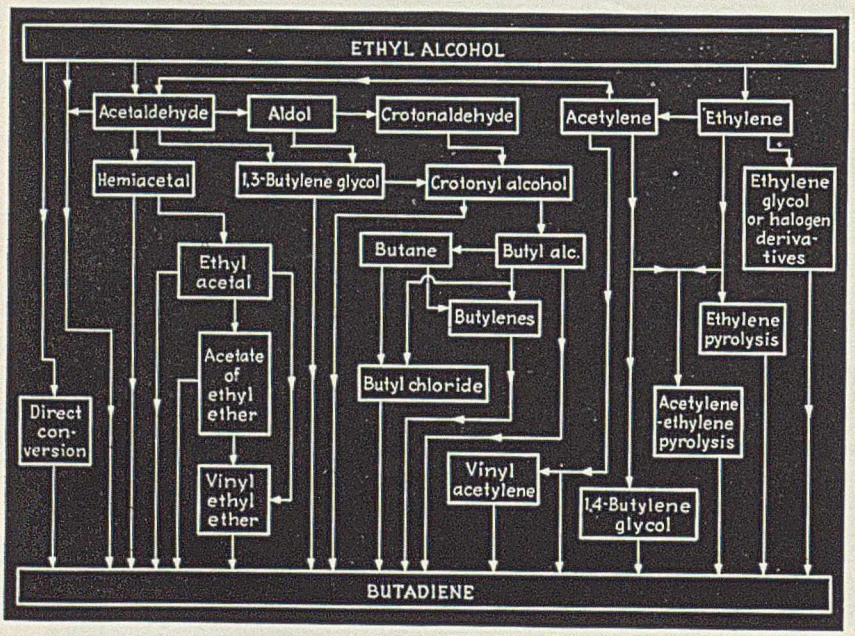
By reason of the relatively high liquefying temperature of butadiene, storing it in liquid form under pressure is practicable. In Fig. 3 the liquefying pressures of butadiene are plotted against temperature.

The possibility of substituting another purification method is highly probable, since the new method does not require as large a quantity of critical materials of construction. In place of turpentine as an extraction solvent, a mixture of chlorides of copper and calcium, glycol, and acetonitrile is used, which gives very satisfactory results in that it absorbs about 4.75 cu. ft. of butadiene per gal. of solvent[6]. By repeatedly subjecting the gas mixture to this solvent, the impurities can be reduced to less than 10 percent, of which the greater part is butylene, which is removable by vacuum distillation after its polymerization.

Table II—Composition of Converter Gas Before and After Scrubber Operation in the Direct Conversion of Ethyl Alcohol to 1,3-Butadiene

Gas	To Scrubber	From Scrubber
Hydrogen, %	40 approx.	53–65
Oxygen, %	3–4	5 approx.
Carbon monoxide, %	0.5–1	1–1.5
Carbon dioxide, %	1–2.5	1.5–3
Saturated hydrocarbons, %	45–55	25–35
1,3-Butadiene, gm. tetrabromide from 1 L. of gas	0.5 approx.	0.05–0.048

Fig. 1—Interrelations between the different methods that can be used for making 1,3-butadiene from ethyl alcohol



As to the reaction mechanism occurring in the catalyzing chamber, no conclusive data are yet available. Nevertheless, an understanding of the possible reactions underlying the conversion of ethyl alcohol to butadiene may be helpful in bringing about further improvements in the process, and for this reason it is worthwhile to mention two possible mechanisms.

Some believe that the conversion occurs through the formation of an active molecule of ethylene, which condenses under the effect of the dehydrogenating substance with ethyl alcohol, leading to the formation of butadiene[7]. The conversion is represented by the following reactions:

$$CH_3CH_2OH \rightarrow CH_2:CH_2 + H_2O$$
$$CH_2:CH_2 + CH_3CH_2OH \rightarrow CH_2:CHCH:CH_2 + H_2O + H_2$$

The alternative theory is that alcohol is converted to acetaldehyde, which condenses with an equimolecular quantity of ethyl alcohol, and that the condensation product in turn loses water in passing through a series of changes leading to the formation of butadiene[8]:

$$CH_3CH_2OH \rightarrow CH_3CHO + H_2$$
$$CH_3CHO + CH_3CH_2OH \rightarrow CH_3CH(OH)OCH_2CH_3$$
$$CH_3CH(OH)OCH_2CH_3 \rightarrow CH_3CH(OH)CH_2CH_2OH$$
$$CH_3CH(OH)CH_2CH_2OH \rightarrow CH_2CH:CHCH_2OH + H_2O$$
$$CH_2CH:CHCH_2OH \rightarrow CH_3CH:C:CH_2 + H_2O$$
$$CH_3CH:C:CH_2 \rightarrow CH_2:CHCH:CH_2$$

OPERATING FACTORS

Problems encountered in the production of butadiene from ethyl alcohol by the direct conversion meth-

od consist mainly in (1) reducing by-product formation and thereby also increasing the butadiene yield, (2) increasing and maintaining the activity of the catalyst, and (3) keeping the fuel consumption for the conversion at a minimum.

Yields as high as 40 percent are obtained by properly controlling the temperature of the catalyst mixture within the range of 400-425 deg. C. Higher temperatures cause the formation of liquid hydrocarbons, these being the result of catalyst inactivation; whereas, lower temperatures bring about the formation of gaseous hydrocarbons other than butadiene. When the vertical type of catalyzing chamber is employed, this is usually heated so that the alcohol vapor charge is subjected to about three times as much heat during its passage through the first third part of the chamber as it is subjected to in the other parts. The reason for this lies in the fact that in the initial reactions involved in the conversion, the amount of energy required is much greater than that consumed in the reactions that follow.

In order to increase the efficiency of the catalyzing chamber and also to prevent fluctuations in the temperature of the catalyst mass, the alcohol vapors are superheated to at least 450 deg. C. previous to injection into the catalyzing chamber. Instead of using absolute alcohol, dilute alcohol, varying from 65-95 percent, is used. This acts as a source of water vapor, though water can also be supplied in the form of steam. The alcohol-water mixture acts as a better heat transfer medium than alcohol itself and also gives more uniform heat distribution throughout the body of the catalyst. The steam tends to absorb the shocks due to sudden variations in temperature and reduces the tendencies toward higher yields of by-products, especially of the resinous and carbonaceous compounds, as the result of the inactivation of the catalyst at higher temperatures. The presence of steam regulates the reaction velocity as well.

In certain instances, air enriched with carbon dioxide is used in conjunction with steam as a diluting gas, which mixture of gases serves also as an adjunct for controlling the reaction rate, so that the conversion may not occur instantaneously and thereby cause resination and carbonization on the surface of the catalyst.

Table III—Composition of Direct Conversion Product After Initial Purification

Components	Percentage Composition
Butadiene	77–80
Butylene (pseudo-butylene or butene-2)	20–15
Ethers of more than 5 carbons	3 approx.
Acetaldehyde	less than 1

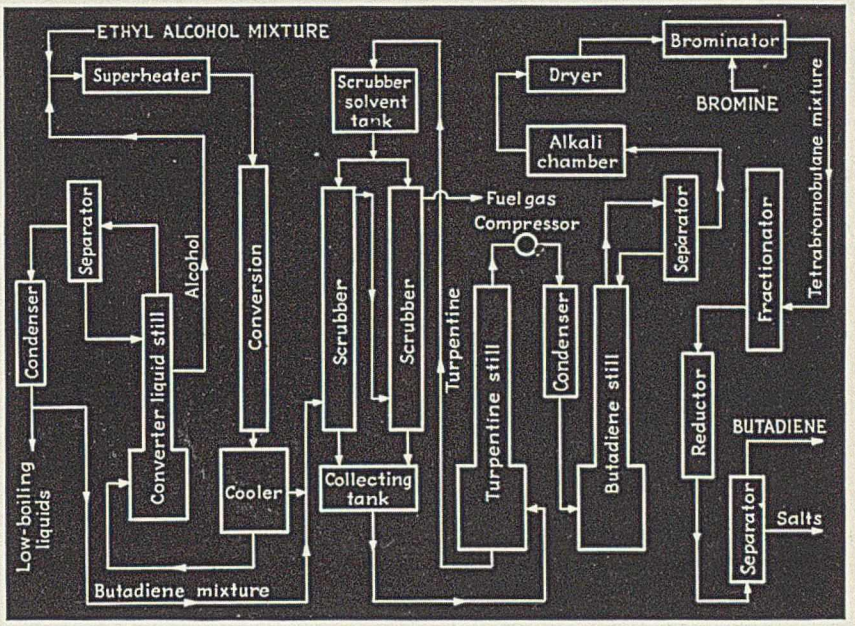


Fig. 2—Flow diagram for the production of butadiene from ethyl alcohol by the direct conversion process

Satisfactory yields are obtained with alcohol with as high as 35 percent water content, although the amount of butadiene produced is less than that obtained when using 95 percent alcohol. Ordinarily, 85-95 percent alcohol is used, mainly because of material cost considerations.

Most satisfactory catalyst is a mixture of three parts of dehydrating agent to one part of dehydrogenating agent operating at 425 deg. C. The usual catalyst is a mixture of aluminum oxide for dehydration and zinc oxide for dehydrogenation. However, as dehydrators, uranium oxide or hydrosilicates or basic sulphates of aluminum may be used, and as dehydrogenators, oxides or salts of magnesium or zinc will serve satisfactorily.

The catalyst is prepared so that the shape is worm-like, and varies from 1-3 mm. in diameter. Finer granules cause excessive packing and increase the rate of reaction; whereas, larger granules tend to lower the yield because of the smaller surface area factor. The catalyst mixture should be highly porous and hygroscopic, and to this end care must be taken in its preparation to avoid unnecessary packing and compression of the catalyst. This is important in that significant decreases of butadiene result by the use of dense catalysts.

Inactivated catalyst resulting, for instance, from resination on the surfaces by high temperatures, is continually re-activated by the oxidation of the coating on the catalyst through introduction of oxygen in the form of air, which is simultaneously introduced with the alcohol-water mixture as a diluting gas.

When aluminum oxide in the pure state is used as a catalyst, large quantities of 1,2-butadiene (methylallene) are produced. This compound does not have the characteristics of 1,3-butadiene that make the latter useful for polymerization to synthetic rubber. In order to prevent 1,2-butadiene formation, or to convert to 1,3-butadiene any of this compound formed, additional heat is required in the presence of the catalyst. The practice is, therefore, to use impure aluminum oxide. The condition of purity of the zinc oxide, on the other hand, is not as important a factor, although the best results are obtained when it is used in a relatively pure form.

The rate of reaction is controlled by the temperature, the catalyst, the dilution gases, and by the rate of injection of the diluted alcohol vapors. The size of the tube is determined by the heating facilities; the larger the diameter, the greater the need for heating the catalyst mass by other means, in addition to heating externally. Heater tubes are installed in the large-diameter tubes in

the mass of the catalyst. The addition of steam, as already mentioned, helps to conduct and distribute the heat within the converter tube.

Secondary factors appearing in the conversion are those that are related to the material of which the catalyzing chamber is constructed. Enamel-lined tubes are used because of their resistance to corrosion and because they have no detrimental effects on the catalyst or the reaction. Furthermore, it has been observed that in glass tubes the butadiene begins to form at 360 deg. C.; whereas linings of nickel require 440 deg. C., and those of aluminum require 500 deg. C.[8]

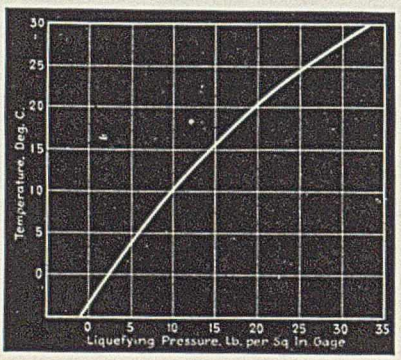
Condensation of the reaction products keeps the pressure of the system below atmospheric, but the decrease in pressure, amounting to 50-80 mm. of mercury, is not sufficient to produce the required velocity of gas flow in the converter for adequate removal of the products. Vacuum pumps are, therefore, used to reduce the pressure to about 0.25 atmosphere. These pressure conditions give sufficient gas flow in the converter to maintain an equilibrium shift for efficient conversion and, in the same operation, the gaseous products are also separated from the liquid products.

BUTADIENE BY ALDOL METHOD

A process widely used in Germany and proposed in the United States is the aldol method for the manufacture of butadiene. This process involves the conversion of either acetylene or ethyl alcohol to acetaldehyde, the choice between acetylene or ethyl alcohol depending upon the availability of these materials at the point of production.

Dehydrogenation of ethyl alcohol to acetaldehyde occurs at 250-350 deg. C., but the rate of reaction is too slow for commercial application. Copper and silver or certain of their compounds are the usual catalysts

Fig. 3—Liquefying pressures of 1,3-butadiene



used for accelerating the reaction. The form of the equipment and the operating conditions vary considerably among the different manufacturers using this process. Within the last fifteen years a number of patents have been issued that cover chiefly the use of the catalyst and temperature control. In general, however, the method consists in passing a mixture of preheated alcohol, water vapor, and air over the catalyst. The temperature recommended for the reaction zone of the converter varies widely and ranges from 250-650 deg. C.

Immediately upon leaving the converter, the mixture is cooled to about 15 deg. C. This separates the inert gases and unutilized oxygen from the condensable fraction, which consists almost wholly of acetaldehyde and unconverted ethyl alcohol. The gaseous portion is recycled as a diluent and the liquid portion is treated for condensation of the acetaldehyde to aldol by mixing the acetaldehyde with a solution of caustic soda or soda ash. A 2:1 mixture of acetaldehyde and a 1.25 percent solution of caustic soda may be used.[9] Methods for bringing about the condensation using soda ash, and also a method using a neutral condensing medium buffered with sodium acetate have been proposed and are covered by patents.[10,11] The condensation occurs with almost quantitative yield. Usually no initial accelerating factor is necessary. The temperature is held between 0–20 deg. C. From the aldol condensation chamber the mixture is fed to a fractionating column for removal of unused acetaldehyde. This mixture of aldol with water and some ethyl alcohol that has come through from the alcohol-acetaldehyde conversion is then acidified so as to bring the pH within the range of 1.5-6.0, but usually to about 4.8, with acetic acid.[12] Only small amounts of acid are required to neutralize the small percentage of alkali employed for the aldol condensation.

The acidified solution of crude aldol and alcohol is then pumped into the top of a vertical, cylindrical high-pressure vessel having an interior lining of acid-proof material, and which is packed with a catalyst consisting of finely divided copper deposited on Fuller's earth. The catalyst must be entirely free of alkali. The temperature is regulated so that the upper half of the chamber does not exceed 80 deg. C. nor go below 60 deg. C., whereas the lower half is heated to 120 deg. C. As the solution enters the top and passes down over the catalyst, hydrogen under pressure of 90 atmospheres is also forced in at the top and the product is removed continuously from the bottom of the chamber. The rate of catalysis is regulated chiefly by controlling the discharge of product from the base, but to some extent also by varying the hydrogen feed. Since the aldol is completely hydrogenated, the product is essentially an aqueous solution of 1,3-butylene glycol and ethyl alcohol with sodium salts of acetic acid.

In the succeeding step of separating the alcohol and some of the water from the mixture, the resulting solution of butylene glycol is preheated enough to be passed directly into the dehydrator, which consists essentially of a column still.[13] The dehydrating agent can be supplied directly to the still with the butylene glycol. Sulphonic acids together with sulphuric acid are used, as well as a number of other dehydrating agents. It is important that the mixture of butylene glycol and catalyst be slowly preheated before it is fed into the dehydrating still in order to prevent excessive foaming and resinification of the glycol and catalyst.

Dehydration can be carried out as a continuous operation until the accumulation of by-product residue in the still becomes too voluminous. Hereupon, the butylene glycol supply is interrupted and the temperature of the still gradually raised as long as butadiene is evolved. The residue is then drawn off from the still. The butadiene and vaporized liquids are conducted from the top of the column to a condenser operating with water at about 18 deg. C., whereby the intermediate products and water are separated.

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CHEM & MET REPORT ON

Production and Maintenance Equipment at the Shows

TO PRODUCTION MEN AND EXECUTIVES OF PROCESS INDUSTRIES

Although the War has left its definite imprint on the equipment shows, there is still much that chemical engineers can learn from two that have just been held: the Second National Chemical Exposition, in Chicago, and the fifteenth National Power Show, in New York. The first of these, a relative newcomer, was larger than its predecessor, but still much smaller than the last Exposition of Chemical Industries, that is, the New York Chemical Show. The Power Show had shrunk by about 50 percent as compared with the exposition of two years ago. In each case, attendance was excellent and much better than would be expected, considering travel restrictions and the difficulties which busy engineers now find in breaking away from their jobs. In the main, few exhibitors at either exposition found it possible to show startling new developments. A surprising feature was the comparative lack of emphasis on maintenance methods and on new materials, or materials which are readily available to substitute for those which are scarce. Still, the editors feel that enough in the way of new ideas was uncovered amply to justify a perusal of the seven pages which follow.

CHEMICAL AND METALLURGICAL ENGINEERING • DECEMBER, 1942

Production and Maintenance Equipment at the Shows

SUMMARY AND CONCLUSIONS

Although they were to a considerable extent curtailed by the restrictions of wartime, two expositions which have recently been held have made it possible for chemical engineers to pick up a surprising amount of information on new developments in production equipment and apparatus. To a somewhat lesser extent, these expositions also served as idea sources on maintenance of the vitally needed equipment already in use, and on possibilities for materials substitutions available to engineers who cannot secure metal critically needed in the war effort.

Somewhat surprisingly, the question of maintenance methods was not emphasized to nearly the extent that would be expected in these days when it is necessary to secure the last ounce of production from equipment already installed. Equipment exhibitors were, of course, ready and willing to discuss the best means for the conservation of the equipment they made. A relatively small number of exhibitors emphasized maintenance methods, including the welding torch, metal spray gun, and new types of welding electrodes. Tool manufacturers exhibited new tool developments to assist in maintenance, while several producers of refractory coatings were present to show how such coatings are employed to increase the life of high temperature masonry structures.

In the case of materials substitutions, examples were more numerous. Considerable cast iron was used where steels and other metals had been employed before, while wood was shown substituted for metals and for plastics, and plastics also were substituted for metals. For example, pulleys and sheaves of wood were in evidence, substituted for cast iron and steel. Both wood and plastics were employed for fan blades. Plastics were substituted for rubber in truck wheels. One rather surprising substitution was the use of platinum in a corrosion-resisting heat exchange application, rather than the unobtainable tantalum normally used in this application. The NE steels were in evidence, substituted for higher alloy steels, while steam specialty manufacturers showed many uses of cast iron, where brass had formerly been employed.

The Chemical Show

CHICAGO entertained the second National Chemical Exposition sponsored by the Chicago Section of the American Chemical Society and held during the six days, November 24-29, at the Hotel Sherman. (This exposition was briefly previewed in our November issue, on the basis of material supplied to us by a number of the exhibitors.) *Chem. & Met.* editors considered this exposition carefully from the standpoint of new production equipment which had been developed or announced in the two-year period since the first Chicago Chemical Exposition, held in 1940.

Wartime restrictions prevented many exhibitors from showing their new developments. Some of these are being held for announcement after the war, while others could not be displayed on account of equipment stringencies and transportation restrictions. Nevertheless, a considerable number of new developments in production equipment, construction materials and process control equipment and apparatus was uncovered.

Under the classification of production equipment may be mentioned the Denver Hydroclassifier, manufactured by Denver Equipment Co. This is a fine sizing and de-sliming machine, consisting of a shallow cylindrical vessel with a slightly coned bottom, equipped with a spiral rake for moving settled material to the central discharge. Provided with an overflow launder around the periphery, the machine is used for accurate separations in the range of 100 mesh and finer. The feed is brought into a center feed well and distributed in a quiet zone, the coarser material settling to the sloping bottom and the finer material overflowing the circular rim into the launder.

The Hydro-Treator shown by the Dorr Co. is a new self-contained water treatment unit for purifying industrial water supplies by means of softening, and turbidity or color removal. Feed enters the bottom of the cylindrical tank through orifices in a rotating distributor, immediately above which is a mechanical agitating zone in which flocculation takes place. After flocculation the clarified water overflows at the top of the unit through an annular effluent channel, while the solids settle into a central sludge cone where they are thickened and withdrawn through a sludge pipe. A substantially constant amount of solids remains in the flocculation zone to form a sludge blanket for the entrainment of fine solids.

For acid-resisting applications, Ertel Engineering Corp. has introduced a new pump made of a relatively non-critical plastic material. The new pump is of the gear type, with both the body and the gears made of fabric-reinforced plastic. These pumps are self priming and are suitable for handling hot liquids

up to 200 deg. F. They are provided with a built in stainless steel manual bypass for pressure and flow control, and are available for both direct and belt drive in sizes delivering from ¾ to 50 gal. per min.

Fansteel Metallurgical Corp. exhibited several new developments in hydrochloric acid and anhydrous HCl equipment. A new cooler for acid gases consists of Karbate impervious carbon tubes in series, arranged one over the other, with a water distributing system above the top-most tube, and splash boards between tubes to distribute the water flowing from one tube over the next tube below. A chamber preceding the entrance end of the cooler proper, also constructed of Karbate, is used for the spray cooling of the hot gas as it enters, to obtain an initial radical drop in temperature. Several types of flowsheet have been developed by this company for the production of anhydrous HCl by distillation with strong sulphuric acid. The company has also evolved new hook-ups for the absorption of HCl in water to produce acids of various strengths, from various strengths and sources of gas.

A tumbling barrel type of mixer which can be remotely controlled for use in the manufacture of explosive powders and pyrotechnics was exhibited by the Globe Machine and Stamping Co. The barrel has been adapted from this company's tumbling barrels for metal finishing and consists of a mixing cylinder in the form of a truncated cone, supported at one end at its central axis and rotated above this axis at any angle to the horizontal which is desired. The inner end of the barrel is formed at an angle to the axis in such a way that material placed in the barrel is forced to slide back and forth as the barrel rotates at an angle slightly above the horizontal. Both the handwheel which controls the angle of tilt and the drive motor may be remote from the mixer, on the other side of a partition.

A novel idea in filtering equipment, developed primarily for the filtration of coolants in metal machining operations, but very possibly of direct application to process industry uses, was shown by Olson Filtration Engineers. The Olson coil-spring filter consists of a horizontal trough in which is a horizontal shaft carrying two disks between which a large number of tightly wound coil springs are hung. One disk is solid while the other is hollow, serving as a header connecting with the interior of the coil springs. The shaft is hollow, connecting with a vacuum pump, but this shaft can also be rotated. The assembly of shaft and springs is submerged in the liquid to be filtered which is then drawn through the interstices between the adjacent coils of the springs by means of the pump. Solids are caught on the outside of the springs which, in effect, act as porous pipes. At the end of the filtration cycle, when cleaning is necessary, the filter assembly is rotated by means of a handwheel, thus stretching the springs slightly by centrifugal force and breaking up the accumulated mass of insoluble particles which are completely washed from the surfaces and spaces between the coils.

New developments in chemical feeding and lime slaking equipment were shown by Omega Machine Co. The company's gravimetric feeder for water treating chemicals employs a novel feed method. A continuously driven conveyor belt is balanced on a scale beam so as to weigh the amount of material on the belt. This weight is communicated to a mechanically operated vibrating device which drives a vibrating apron suspended beneath the feed hopper at such a rate as to deliver material to the weighing belt at the rate desired. Should the weight increase, the vibration of the feed apron decreases, and vice-versa. The mechanical vibrator consists of a pair of jaws tapering toward the bottom, between which is suspended a resilient wedge. One jaw is mechanically oscillated through a fixed amplitude. The other jaw is connected to the apron feeder. The resilient wedge, which is suspended from the scale mechanism, serves to communicate all or a part of the motion of the first jaw to the second and hence to the feeder. The lower the wedge rides in the opening (less weight on the scale), the more motion is communicated to the feeder and the faster it feeds. If the weight on the scale increases beyond the desired amount, the wedge rises and communicates less motion.

The company's lime slaker, which is used in conjunction with the feeder just described, consists of a tank with a single slaking compartment, having a clinker trough at the front, vapor removal equipment on top, an agitator and a thermostatic control valve. The slaker has a range of 30 to 360 lb. per hour with an accuracy, according to the manufacturer, within 2 percent. A multi-compartment slaker can be provided, with a capacity up to 3,000 lb. per hour.

This company also showed a novel type of variable speed drive for volumetric feeders. The driven shaft carries two cams of special shape which are both eccentric and roughly conical in appearance. This shaft may be displaced in an end-wise direction for speed adjustment. Riding on the cams are arms connected to free-wheeling clutches on the output shaft. Rotation of the cams on the imput shaft causes alternate oscillation of the two arms and hence rotation of the output shaft. Contrary to the performance obtained with certain other transmissions which resemble this one, the shape of the cams is such that the angular velocity of the arms is linear rather than harmonic, so that a uniform rate of rotation of the output shaft is obtained. Output speed may be adjusted in an infinite number of steps between zero and a maximum.

Two totally new ideas in the realm of capillarity were shown by the

(All illustrations from the Power Show, New York, 1942)

Selas Co. Endeavoring to determine uses for its Microporous ceramic filters, outside the normal applications for such filters, the company has completed preliminary development work on two applications which may eventually lead to important industrial uses. One case can be described as a "motionless centrifugal." Two filters are employed, one treated to permit the passage of water while it repels oil, while the other is hydrophobic, treated to pass oil and repel water. The device is capable of separating a rough emulsion of oil and water into its pure constituents, the water passing through the hydrophilic filter, and the oil through the hydrophobic filter. On the other hand, it has been noted that such filters can be used conversely, through the application of higher pressures, to produce an oil-in-water emulsion with a hydrophobic filter, and a water in oil emulsion with one which is hydrophilic.

Another surprising use for these filters is for pressure relief. When a ceramic filter is saturated with water, the capillary effect will hold the water in the pores against the pressure of a gas inside the filter, until the pressure rises to some value dependent on the pore size. Once this value has been reached, the water is blown from the pores and thereafter the gas passes readily. It is possible to control the pore size over a considerable range so as to obtain filters having bubbling pressures ranging from a fraction of a pound to well over 100 lb. per sq.in.

Several improvements were shown in the Pulsafeeder manufactured by Wilson Chemical Feeders, Inc. Whereas the first of this company's feeders employed a pulsating tube as the pumping element, later designs also include models using a pulsating diaphragm. A late model is completely inclosed, presenting a streamlined appearance, with only the stroke adjustment and the inlet and discharge connections outside the casing. Pumps manufactured by this company all operate on the same principal, namely a motor-driven reciprocating plunger drives a piston working in a liquid cylinder. By means of an adjustable stop, the stroke of the liquid piston can be varied. The liquid, which is neutral in character, then causes alternate compression and expansion of a tube of plastic material, or causes reciprocation of a diaphragm. Thus, the only moving parts in contact with the liquid being pumped are the valves and tube or diaphragm.

CONSTRUCTION MATERIALS

A variety of improvements in construction materials and methods of equipment construction were in evidence. New flux-coated aluminum bronze welding rods were shown by Ampco Metal, Inc., having strength up to 100,000 lb. per sq.in., and hardness up to 350 Brinell. These rods, suitable for gas, metallic or carbon arc welding methods are said to combine ease of handling, smooth arc action and marked freedom from porosity. The rods possess properties similar to this company's Ampco metal. The coating used on the rods makes it unnecessary to use a separate flux.

A new coating for metals, shown by Chicago Vitreous Enamel Products Co. and known as Armor-Vit, is now available for resistance to corrosion, heat, impact, and abrasion. Said to be resistant to both acids and alkalis, the coating is produced in colors ranging from gray to black and may be applied by means of a spray gun. The coated metal is then baked at a temperature ranging from 250 to 800 deg. F.

Among the newer applications of Corning Glass Works' recently developed Vycor 96 percent silica glass, was a thermocouple tube made for use at high temperature, as a substitute for high temperature metallic protection tubes.

That paper has many substitution possibilities was evident from a sample of laminated paper pipe made by Federal Electric Co. Paper is laminated with Vinsol resin, producing a pipe which is said to be equal to steel mechanically on a weight-for-weight basis and suitable for use as an electrical conduit or for temporary low-pressure piping.

Some of the things that can be done with the new plastic, Saran, in the production of pipe, fittings, couplings and tubing were shown in the exhibit of the Haveg Corp. This material is available as small-diameter tubing, and in iron pipe sizes from 1 to 2 in., with larger sizes to be made in the future. It is readily welded at 350-400 deg. F., and can be threaded with ordinary pipe tools. Fittings are easily fabricated by cutting and welding, and standard flanges and tubing couplings are available.

A complete line of chemical porcelainware pipe, fittings and valves in sizes from 1 to 6 in. was exhibited by Illinois Electric Porcelain Co., a newcomer in the field of chemical porcelainware. Pipe and fittings have ground ends for gasketing. In addition to the standard line the company is prepared to supply special shapes such as crosses, Y-branches, and similar pieces. Valves are produced in both Y and angle designs in sizes from 1 to 4 in. Raschig rings are produced in sizes from $\frac{3}{8}$ to 3 in.

For simplified lead burning, the Insto-Gas Corp. showed a new lead-burning torch for use with the bottled petroleum gases distributed by this company. Use of the torch is readily learned by any mechanic, according to the manufacturer, although it is not claimed that the torch is suitable for use on more complex lead-burning problems.

Several new applications of the chemical porcelainware manufactured by Lapp Insulator Co. were in evidence at the exposition. In the Lapp booth was a flush-bottom outlet valve for glass-lined kettles and tanks, designed and manufactured in cooperation with the Pfaudler Co. Made in sizes for 3, 4 and 5 in. I.D. outlets, the design features a porce-

lain plug and seat, so arranged that the plug can be turned to grind away crystals or dirt on the seat before it is tightly closed. The Pfaudler Co.'s booth also contanied a somewhat similar sort of outlet valve design, combining glass-coated steel and Lapp porcelain. Another cooperative effort shown by the Lapp concern was a porcelainware pump, designed and manufactured by Worthington Pump & Machinery Corp., using a volute, impeller and shaft sleeve of porcelainware.

New members of the Tygon family of synthetic resin materials were shown by the U. S. Stoneware Co. The material can now be used not only for the lining of tanks and pipes to meet a variety of corrosive conditions, but for the impregnation of fabrics, for extruded tubes, for the shatter-proofing of glass, for the insulation of wires and cables, for the manufacture of tubing couplings and, in one new form, as a "strippable" film for the temporary protection of highly finished surfaces.

Structural carbon is constantly finding new applications. One novel use was a leaf for a rotary filter, shown by Goslin-Birmingham Mfg. Co. The body of the leaf is formed from Karbate impervious carbon, while the filtering surface is of porous carbon.

PROCESS CONTROL

Several new developments in equipment and apparatus having a bearing on process control were exhibited, although very few of the manufacturers of industrial instruments were represented. The Graver Tank & Mfg. Co. showed a new controller for the feeding of chemicals, claimed to be accurate within 2 percent at all flow rates. The primary element is a contact meter which signals the control apparatus when each increment of liquid to be treated has flowed in predetermined volume through the meter. The controller turns a drum through a predetermined amount at each impulse, the drum paying out a cable which is connected to a swing pipe draw-off line installed in the tank containing the reagent chemical.

The new Empire thermostatic drum filler, exhibited by the National Meter Division of Pittsburgh Equitable Meter Co., has a number of novel features. The filler is started by opening a quick-opening nozzle valve. The meter then operates until a predetermined volume of material (automatically corrected to the density at 60 deg. F.) has passed, whereupon the nozzle valve trips shut. Any quantity from 10 to 100 gal. per cycle can be discharged, the control of quantity consisting of a "quantity chain" on which is a lug to trip the closing device. The chain is driven by the meter until the lug and tripping device meet. Thus, the length of chain employed determines the delivery cycle.

Several new models of its Magnetrol level controller were exhibited by Fred H. Schaub Engineering Co. This device consists of a float to which is attached an armature, the latter rising and falling in a non-magnetic metal tube. Outside of the tube is a balanced high-intensity permanent magnet connected to a mercury switch in such a way that when the armature comes within the field of influence of the magnet, the magnet is attracted toward the armature, tipping the mercury switch so as to make or break the contact. New types include high-pressure models, multi-point controls, controls for extreme differentials, and types adapted to explosion-proof, weather-proof and splash-proof service.

Wheelco Instruments Co. showed several of its more recent developments in level controllers of the remote type, employing electronic actuation. The method is adapted to the control of level, interface and flow, using pick-ups which may be either inductive or capacitive. A vacuum tube oscillator connected to the pick-up is tuned when an object enters the field of the latter, resulting in a current change which operates a relay. Or, a liquid may serve as one plate of a condenser, the capacity of which is changed as the liquid level changes.

Several new pieces of apparatus for routine analytical control of chemical processes were on display, including the new infra-red spectrophotometer developed by National Technical Laboratories. This device, now available only for war industry use, is being employed primarily for the analysis of hydrocarbon mixtures by spectral absorption in the infra-red region between approximately 2 and 12 microns. It consists of an infra-red source, monochromater, absorption cell and associated gas handling system, thermocouple and galvanometer. At present the instrument is being used chiefly in the production of aviation gasoline and synthetic rubber.

Other new analytical instruments for the petroleum industry were exhibited by Podbielniak Centrifugal Super-Contactor Co. This apparatus included automatic and semi-automatic devices for fractional distillation for use in controlling such operations as alkylation, catalytic cracking, and the manufacture of butadiene. One type is suited to the super-fractionation of motor fuels, styrene mixtures, creosote, etc.

The emphasis of the exhibit of the Permutit Co. was on the application of its ion exchangers, not for water treatment alone, but primarily for use in a variety of industrial processes. Consideration has been given to such applications recently, with the development of the resinous ion exchangers. It is believed that by the use of proper types and combination of types of ion exchangers, economical processes can be developed for the recovery of valuable electrolytes present in solutions; removal of small quantities of ionic impurities from low-cost products; separation of electrolytes from non-electrolytes; separation of ions from ions of different valence; catalysis; and purification of gases.

The Power Show

Always held during the week of the Annual Meeting of the American Society of Mechanical Engineers, the National Power Show occurred November 30 to December 5, at Madison Square Garden, in New York. In many ways, the 1942 Power Show differed materially from those which have gone before. For example, much less heavy equipment was in evidence, boiler manufacturers were conspicuous by their absence, and few industrial instrument manufacturers were present. Pipe and fittings had few representatives, and motor and electrical control manufacturers were missing.

In the field of power transmission, American Pulley Co. exhibited new compressed plywood sheaves for V-belt drives which were originally developed for powder plant use, shortly before the metal stringency began to make itself felt. The company showed new plastic wheels for materials handling trucks, and exhibited its new reduction drive, a simple 13-to-1 gear reducer in a cylindrical casing which is mounted without separate foundation on the shaft to be driven. By varying the ratio of the V-belt drive which turns the high-speed shaft of the reducer, any driven speed between 11 and 154 r.p.m. can be secured. The company also showed a new line of endless cord transmission belts constructed of fabric, cord and rubber, prestretched and highly flexible to conform to the pulley of a short-center drive without absorbing internal stresses.

Dodge Mfg. Corp. showed a new line of wood V-belt sheaves and pulleys of laminated construction. The solid pulleys are built entirely without the use of metal, except for a setscrew. A few bolts only are required for the larger pulleys.

The latest member of its line of variable-speed transmissions developed by Reeves Pulley Co. is the Vari-Speed Jr., shown in this company's booth. It is similar to the original Vari-Speed drive, except that it is smaller, for a lower rating, and employs a V-belt instead of a flat belt with tapered edges. The motor pulley is a variable sheave consisting of two opposed conical disks mounted on the shaft and forced together by means of a spring. The motor is mounted on a screw-adjusted sliding base for controlling the effective pulley diameter.

LUBRICATION EQUIPMENT

Two manufacturers showed interesting developments in forced-feed lubrication equipment. A new distributor for oil which handles four bearings automatically was shown by the Nathan Mfg. Co. This device receives oil from a standard piston-type lubricator and uses this oil, first to supply motive power for its own operation, and then for distribution to four points to be lubricated. The distributor contains four cylinders arranged radially, 90 deg. apart, and has pistons, the opposing pairs of which are coupled together. Pressure of the oil on the first piston causes it to move inwardly, discharging the oil contained in the opposite cylinder. This movement causes a partial rotation of the piston, which automatically valves the oil pressure to one of the second pair of pistons. As long as pressure is supplied, the device operates continuously, delivering equal discharges of oil to each of the four bearings connected to its ports.

A new multiple-outlet, positive, forced-feed system of lubrication, using either oil or grease, was shown by Trabon Engineering Corp. The system comprises a lubricant reservoir feeding a variable stroke three-piston rotary pump, with a maximum capacity of about 1 lb. of grease per hour. A block of distributors for six or more outlets is connected to each of the three pumps. Each distributor unit has two outlets, a block comprising three or more units. If desired, any one of the outlets may serve another block of distributors instead of a single bearing. Each unit is machined from a solid steel bar and contains a four-lobe piston which reciprocates under oil or grease pressure, discharging from each end. The system is so hooked up that each block of distributors must discharge in a definite sequence at the various outlets, delivering a definite quantity of lubricant. It is impossible for any outlet to be bypassed.

New developments in materials handling equipment were shown by several manufacturers. Barrett-Cravens Co. exhibited the PowerOx, a combination hand and electric lift truck which provides a manual hydraulic lift, but is moved to its destination by electric power. Control of the electric drive is exerted by a button on the handle which is used for lifting the load and guiding the truck. The truck is driven by two motors, one for each rear wheel and has a capacity of 4,000 lb.

Lewis-Shepard Sales Corp. showed its new center-drive electric- and gas-powered telescopic fork trucks. These machines, which are practically identical, except for the power source and for operating speed, both have a 3,000-lb. capacity, and a 9½-ft. lift. The electric model lifts the full load at 18 ft. per min., and the gas model at 30 ft. per min. The former has a 5-6 m.p.h. traction speed, and the latter, a speed of 7.5 m.p.h. Both tilt and hoist by hydraulic power, and both feature an exceptionally small turning radius.

Service Caster & Truck Co. showed its new Lever-Lift hydraulic lift truck in which the handle is used only for pulling and guiding, while a separate lever on top of the hydraulic mechanism is used to lift the load. This company has now standardized on a line of lifters of the telescopic type, which formerly were built special to customers' specifications. These lifters are hydraulically operated, and since they do not require a reversing motor, can read-

ily employ explosion-proof electrical equipment. Control is by means of a two-button switch on the end of an 8-ft. cable.

Little new control equipment was on display. Brooke Engineering Co. showed its new photo-electric smoke indicators and recorders, and a new automatic combustion control system, using an electronic relay, which combines the more conventional control functions of draft and pressure with photo-electric examination of the flue gases to maintain the optimum smoke color. Operation of this control depends on the fact that the flue gas color changes for each fractional percent change in CO_2 when operating near the maximum efficiency point of the furnace. The control integrates the effect of draft control, steam pressure, fuel rate, and flue gas color, the last-named function using a time-delay electronic relay to adjust the forced-draft air regulator. The company also demonstrated a similar electronic relay in use for flow control, as with a rotameter flowmeter.

Among other new electrically operated timers, R. W. Cramer & Co. showed a new multiple-contact timer of the programming type, using double cams for each circuit to obtain quick "make" and "break" action. Since the double cams are mutually adjustable, the time between make and break for each circuit can be readily adjusted.

Among the instruments exhibited by Cambridge Instrument Co. was a new combustible analyzer designed primarily for determining the total CO and H_2 in the exit gases of industrial furnaces operating under reducing conditions. This instrument employs a variation of the thermal conductivity method. The gas is first analyzed as received by passing through one thermal conductivity unit, after which the CO is converted to CO_2 and the H_2 converted to water by contact with hot copper oxide, heated electrically. The gas then passes through the second unit of the thermal conductivity bridge, and the differential is recorded as total combustible.

Maintenance equipment at the show included an improved metal-spray gun, the Mogul Gun, Model P, shown by the Metallizing Co. of America. This heavy-duty gun uses any fuel gas without adjustment. It is said to provide finer atomization and positive wire feed, with a turbine powerful enough to straighten even kinky wire without fluctuation.

A new device for holding work to be welded in the most favorable working position was shown by Lyon-Raymond Corp. This device, which is operated hydraulically, comprises a tilting table on which the work is secured, designed to support 2,000 lb. It can be raised or lowered, tilted at any angle from vertical to horizontal,. and rotated through 360 deg.

FLUIDS HANDLING

Among devices for the handling of fluids was an interesting universal gear joint for the operation of shafts at an angle, primarily for valve control. The device is hinged so that the two shafts may operate at any angle from zero to 92 deg. The gears are of a unique ball-and-socket design which mate properly at any angle of use within the range of the equipment. The range of available sizes is from $\frac{3}{4}$ to 2 in.

New pipe and insulation assemblies for underground use, prefabricated at the factory, were shown by the Ric-wiL Co., for use in underground lines handling steam or liquids which must be kept warm. Standard units consist of a 20-ft. length of one or more pipes, packed in insulation and inclosed in an asphalt-coated corrugated tube, covered with asbestos felt. Units are assembled on the job by welding, after which the uninsulated ends of the pipes in adjacent units are insulated and sealed.

Among the proportioning pumps shown by Milton Roy Pump Co. were a number of newly developed models, showing a new method of stroke adjustment, new methods of inclosing the valves, and also plastic chambers for the step inlet and outlet valves which are used in the handling of corrosive liquids.

Developments in refractories and insulation, as well as in their use, were shown by several manufacturers. Armor-Clad Co. showed its new No. 200 Torrid coating for refractories, which produces a glazed and sealed monolithic coating on the brick, said to resist slagging and spalling. The coating is applied either with a brush or spray-gun, becoming glazed and bonding to the brick as soon as the vitrification point is reached when the furnace is heated. The coating is suitable for temperatures up to 3,000 deg. F.

Its new 9-lb. insulating board for low-temperature applications and roof-deck insulation was shown by Owens-Corning Fiberglas Corp. The glass fibers are compressed to 9 lb. per cu.ft. at which point substantially the maximum insulating efficiency is said to be obtained. The insulation is treated with a special thermosetting binder, and the surface provided with a heavy asphalt coating for water-proofing in some types, or with a heavy fiberboard surface on one side for other applications.

Several new methods of supporting refractories in industrial and boiler furnaces were shown by George P. Reintjes Co. One new design is adapted to the refractory lining of a horizontal cylindrical furnace shell, developed particularly for a new wartime chemical application. A hollow box casting, which is readily kept cool, supports an X-shaped casting which may be slid onto the box structure at any point and locked into place. The X-casting supports the refractory rigidly in all circumferential directions so that each block in a ring is independent of the blocks adjacent to it. This company showed a new air-cooled refractory air nozzle for furnaces, and exhibited a new design for the refractory outlet-constricting cone now being used in the Iso-Flo ver-

tical, cylindrical oil-industry furnace. Still another new development was a cast pipe hanger developed as a substitute for steel I and U bolts, for the support of horizontal pipes.

A variety of other new developments, hard to classify, were also found at the show. For example, American Car & Foundry Co. exhibited its new Berwick low-voltage electric screen heater, a device which will heat any metal screen in order to dry moist particles which otherwise would cling to the screen, and also to prevent the freezing of wet materials in winter when the screening is carried on in unheated spaces. The screen itself is used as the resistance heater.

Another case of materials substitution was found in the acoustical telephone booth for use in noisy factory locations, made by Burgess Battery Co. Formerly this company's booths were lined with perforated metal backed up by a sound-absorbent material. Perforated plywood has now been substituted for metal with equally good results.

Appropriate these days of possible aid raids is the line of steam and air operated sirens for industrial use, shown by Foster Engineering Co. These sirens reach their peak of sound in 3 to 5 sec. and can be used for signalling because of sharp sound cut-off. The smaller size produces a sound level of 112-115 decibels at 100 ft., while the larger size produces a level of 125-130 decibels. Either steam or air can be used as the motive power.

Hartzel Propeller Fan Co. exhibited ingenious new three-ply birchwood propeller blades which are being substituted for aluminum in its propeller-type fans. These blades are pressure impregnated with a plastic to give high strength and moisture resistance. The company also showed a laminated plastic cooling tower fan with a metal hub and adjustable-pitch blades, available in 10- and 12-ft. diameters. The larger size is said to save 450 lb. of aluminum per fan.

An interesting type of wet dust collector of high collecting efficiency, available in sizes of 2,000 to 40,000 c.f.m., was shown by Industrial Sheet Metal Works. Water flows over a weir and down a sloping baffle where it meets an upward current of air which carries the dust to be collected. The water is picked up in a fine dense spray which is then eliminated from the air as it travels upward through the apparatus by passage around a number of additional sloping baffles projecting from either side of the path.

STOKER IMPROVEMENT

Its latest development in pneumatic spreader-type stokers was shown by the Iron Fireman Mfg. Co. This stoker conveys steam-size coal from a hopper or main coal bunker to a transfer housing by means of a screw. In the housing, the coal is picked up by a stream of air, generally preheated, and is conveyed to the furnace through a pipe and adjustable spreader nozzle. The fines burn in suspension, while the larger pieces form a shallow fuel bed on the flat grate. The conveying air provides the over-fire air which enters with maximum turbulence, producing a desired effect in securing efficient and smokeless combustion.

A single nozzle is provided for units burning up to 1,600 lb. of coal per hour, and for higher burning rates, multiple nozzles are used. The feed hopper can be located at any desired point, above or below the furnace, or at one side.

Coal Specialties Co., in cooperation with the Liquid Carbonic Corp. showed an interesting new method of extinguishing coal-pile fires through the use of dry ice. At present, with the necessity of storing vast quantities of coal, spontaneous combustion has become a serious problem. When any method of determining overheating, such as Coal Specialties Co.'s Hot Spot indicators, shows the location of trouble, a pointed 3-in. pipe, perforated at the bottom, is driven into the coal bed, and lumps of dry ice are dropped down the tube. Bottom draft is then eliminated by sealing the coal pile to a height of several feet with building paper, or other impervious material. About 50 lb. of crushed dry ice is used in the pipe, which is then capped.

A valuable improvement in the packing of its proportioning pumps for the handling of corrosive liquids, was exhibited by Proportioneers, Inc. The method is simple but effective. It consists in forming a trough at the outer end of the stuffing box, which can then be filled with a liquid, such as a neutral oil, which will exclude air from the reciprocating pump shaft. Only one or two rings of packing are required on the stuffing box at the rear end of the trough.

A device for remote control of quick-opening valves, variable speed transmissions, throttles, and other controls, was exhibited by Sperry Products, Inc. The device, known as the Exactor hydraulic control, consists of a transmitter and receiver coupled by a single length of tubing. The transmitter and receiver are practical identical in construction, each containing a hydraulic cylinder and piston, the latter connected to a rocker arm. The opposite end of the rocker arm is forced upward by a heavy spring. The transmitter handle can be moved through any angle up to 50 deg., moving its piston and thus moving the receiver piston a like amount. When the handle is released the springs in transmitter and receiver return their handles to the initial position. The control will deliver 100 in.lb. torque on the suction stroke, and twice this or more on the pressure stroke.

Machinery, Materials and Products

CHEM & MET PROCESS EQUIPMENT NEWS

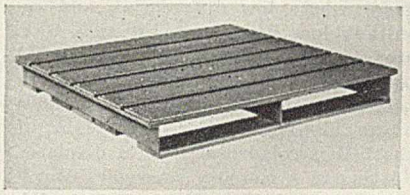
Steel-Saving Pallet

IN LINE with efforts being made to conserve steel for the war effort, Union Metal Mfg. Co., Canton, Ohio, has developed a new pallet for materials handling, consisting of top and bottom wood slats, reinforced with steel at the ends and in the center. Bolted construction permits easy replacement of the wood slats, while the steel ends protect the pallet from damage by power fork trucks. It is claimed that this conservation of metal is accomplished without sacrificing strength, ease of handling, or all-around usefulness. Sizes for all ordinary materials handling requirements are available.

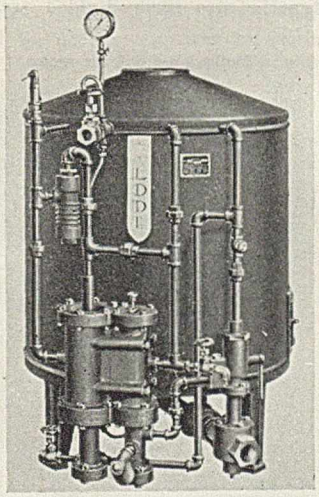
Automatic Steam Generator

SEVERAL new features in steam generation equipment are found in the new Lodi steam generator which has been developed and announced by Super Mold Corp., Lodi, Calif. Models are available in various sizes up to 70 hp. for pressures to 150 lb. They are available for operation with gas, oil or butane-propane gas burners. The generator is rapid in action, the 10 hp. model developing 150 lb. pressure from a cold start in less than 5 min. It has only three moving parts and is automatically controlled by mechanical devices which do not require electricity for their operation.

Wood-slat pallet



Automatic steam generator



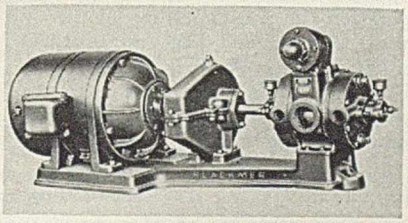
The boiler consists of a group of nested conical coils of continuous pipes, tested to 1,000 lb. pressure, so arranged with respect to the burner that a fire box and insulation are not required. A large amount of heat-transfer surface is provided and the flow of water through the coils, which at all times is under forced circulation, is such as to give a counterflow relation between the water and the hot products of combustion.

In addition to the boiler proper, the equipment includes a burner of the desired type, an automatic low-water fuel-shut-off, an automatic feed water pump, and a "jet-control" which automatically and without the use of thermostats or motor-driven pumps furnishes feed water in direct proportion to the amount drawn off as steam. The jet-control is said to assure steam of consistently uniform quality, regardless of varying load conditions. The entire generator is shipped as a unit, is light in weight and requires little space for its installation.

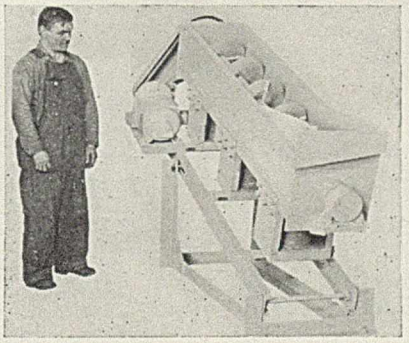
Steam-Jacketed Pumps

NEW DESIGN, said to be much simplified, is claimed for the steam-jacketed rotary pump recently added to the line manufactured by the Blackmer Pump Co., Grand Rapids, Mich. Several of these pumps have already been installed in war production plants for the handling of such materials as palm oil, tar, greases, and similar liquids which must be pumped or processed hot. The steam-jacketed heads are made of cast semi-steel, with threaded intake and exhaust steam ports and drain plugs, suitable for pressures up to 125 lb. The pumps are provided with sleeve bearings for grease lubrication, of heavy construction to eliminate shaft whip and distortion. Pumps for pressures above 100 lb. are furnished with anti-friction bearings. Packing glands are designed to simplify re-packing. Standard Blackmer pumps in capacities from 20 to 700 g.p.m., for pressures to 300 lb. are available with the new steam-jacketed head.

Steam jacketed pump



Magnetic log washer



Magnetic Log Washer

FOR THE TREATMENT of fine abrasives and similar materials in the wet state, Stearns Magnetic Mfg. Co., Milwaukee, Wis., has introduced an improved device, described as a magnetic log washer. The machine consists of a single ribbon-type screw conveyor operating at 30-32 r.p.m. on a slope with adjustable frame supports over the magnetic field, the conveyor being driven by a gear-reduction motor through a variable-pitch-sheave V-belt drive. Material to be treated is fed into the washer trough, the tailings being discharged at the lower end and the concentrates at the top. The magnetic flux is controlled by rheostats for maximum flexibility in adapting the equipment to the material being treated. Various sizes of magnetic log washer are made, ranging upward from a 12 in. x 72 in. size particularly adapted for small production and laboratory use. This size has overall dimensions of 7½ ft. x 44 in. x 4½ ft. high. The machine operates on direct current up to 300 colts, or from a motor-generator set where direct current is not available.

Thermoplastic Lining

BOTH CONCRETE and steel can be used for tanks to contain corrosive liquids, according to the manufacturer, through the use of Amercoat, a plastic-base coating, which is manufactured by American Pipe & Construction Co., P. O. Box 3428, Terminal Annex, Los

Angeles, Calif. This coating, composed of thermoplastic resins, is being used as a lining for concrete tanks for the storage of petroleum products. It is claimed to adhere tightly to concrete surfaces and to be impervious, producing a smooth, inert surface which is plastic enough not to check, crack or fracture when subjected to vibration and moderate expansion and contraction. Acids, alkalis and a variety of other chemicals are said not to affect this material which is odorless, tasteless, and dielectric. The material is applied cold by brush or spray on metal or concrete without the use of special tools or equipment.

Flow Colorimeter

FOR IMMEDIATE and direct indication of the light transmission of a liquid flowing continuously, as well as for the continuous registration of concentration and turbidity of solutions in chemical processes, Photovolt Corp., 95 Madison Ave., New York, N. Y., has developed the new Lumetron continuous-flow colorimeter, Model 400-S. The principle of the instrument is similar to that of the usual types of photoelectric colorimeters. The light from an incandescent lamp passes through a color filter and through the liquid, then impinging upon a barrier-layer photocell, the current of which is registered by a sensitive indicating instrument. The liquid under test passes through a glass tube, rather than being contained in an absorption cell or test tube. Once calibrated by means of a solution of known concentration, the instrument indicates the concentration continuously, obviating the necessity for taking samples and analyzing them at regular intervals. A variety of filters are available for use, depending on the character of the material to be tested. The instrument operates from a light socket, employing a constant-voltage transformer to insure constant light output.

This company has also introduced an electronic timer which is, in effect, an adjustable timing relay with immediate automatic resetting, for timing periods from 1/20 sec. on. The instrument is designed for single actuation as well as for sequence timing and recycling. It is employed to open or close an electrical circuit for a preset time interval. Its operating principle is similar to that of an hour glass which is comparable to a charged condenser, the discharge time of which can be controlled by adjustable resistors. During the discharge, amplifier tubes energize the relay, but when the discharge of the condenser is completed, the amplifier tubes become inoperative and the relay is de-energized. After completing the timing period, it does not take more than 1/60 sec. for the timer to be ready for the next operation. A series of these timers can be used to furnish a sequence of timed intervals by means of simple electrical connections. Individual timers are capable of carrying loads up to 1,200 watts, if non-inductive.

Copper-Saving Support

AN ACCOMPANYING ILLUSTRATION shows representatives of a new line of copper-saving supports for open wiring which have recently been put on the market by Delta-Star Electric Co., 2400 Block, Fulton St., Chicago, Ill. War requirements have dictated the need for methods to save time, material and man-power. As a consequence, open wiring is now being employed more extensively, following a recent interim amendment to the 1940 National Electrical Code which permits multiple circuits and the use of supports of this type up to 600 volts. Copper savings in excess of 50 percent, with equal or better voltage regulation and lower construction costs, are claimed to result from this practice.

Drum-Loading Trucks

EXTREME RUGGEDNESS, and ease of operation in the handling of heavy drums, barrels and kegs up to 1,000 lb. weight, are claimed for the new "Upsy Truck", a new addition to the line of pressed steel hand trucks manufactured by American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa. A sliding hook on the center rail of the truck catches the top bead or chime of the drum, permitting the trucker to pull down on the handle, tilting the drum toward him. Nose prongs then slide under the bottom chime and as the handles are lowered to trucking position, the drum is lifted off the floor. The balance is such that the load is said to be easily handled. The truck may be equipped with semi-steel wheels or "floor-saver" wheels, with roller bearings optional at additional cost.

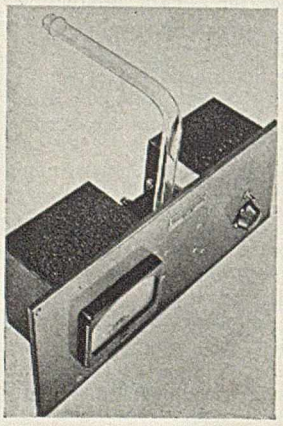
Rotary Air Motor

ESPECIALLY for applications where explosion-proof equipment is essential, as in munitions plants, Gast Mfg. Corp., Benton Harbor, Mich., is building an improved rotary air motor which employs no reciprocating parts or springs, has automatic take-up for wear, is positive starting in any position, and is decidedly compact in proportion to the power developed. The motor cannot burn out and is available in sizes ranging from 1/20 to 1 hp. These motors are equipped with ball bearings and self-adjusting shaft seals instead of packing.

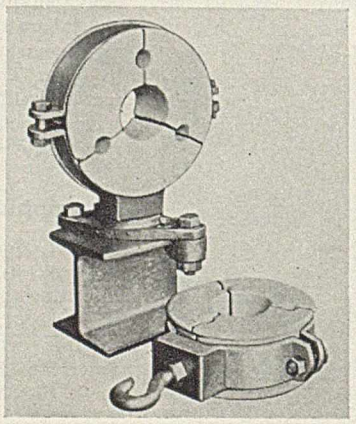
Flow Transmitter

STYLE H is the name given to a new low-pressure flow transmitter for use with the company's standard electric meter units, which has been announced by the Cochrane Corp., 17th and Allegheny Aves., Philadelphia, Pa. The transmitter is designed specifically for the measurement of low static-pressure gases where low differential, and resultant low permanent pressure loss, are of prime importance. Differential pressure created by flow through an orifice is applied to the opposite sides of an oil-sealed bell. The weight of the bell is compensated by a displacer floating in a mercury reservoir. Movement of the bell resulting from a differential pressure applied to it results in a corresponding movement of a magnetic core in a divided trans-

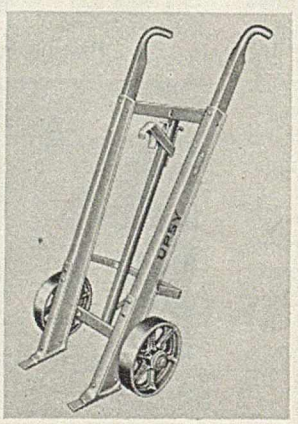
Flow-type colorimeter



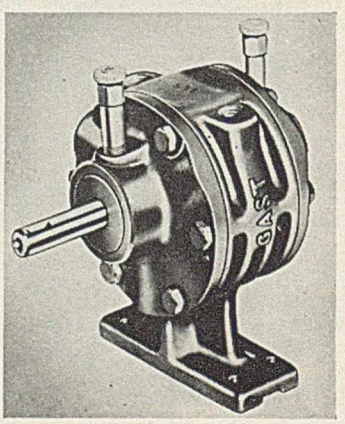
Open wiring supports

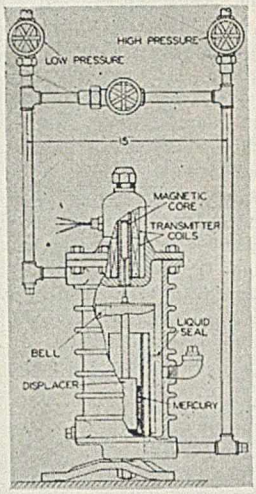


Drum-carrying truck

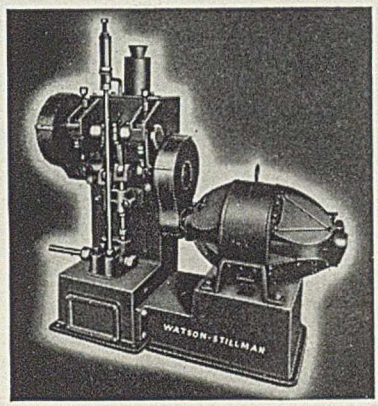


Explosion-proof air motor





Low-pressure flow transmitter



High-pressure starting pump

mitter coil of the induction balance type. The coil is connected by means of three wires with the receiving station, which corrects to uniform scale indication by means of the type of calibrated cam used in this company's flow recorders. The transmitter is designed for differentials ranging from 2 to 10 in. of water. The bell casing is designed for a maximum pressure of 75 lb. per sq. in.

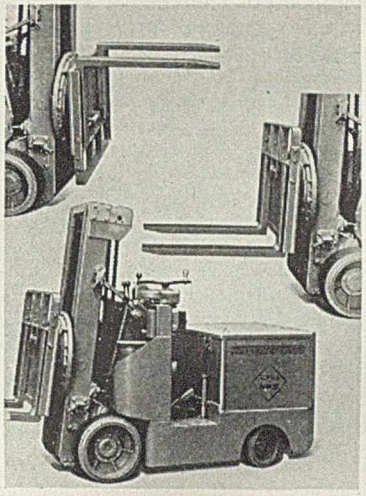
High Pressure Pumps

FOR HIGH-PRESSURE service, up to 4,000 lb. per sq. in., Watson-Stillman Co., Roselle, N. J., has introduced a new high-pressure starting pump designed for the starting of diesel engines, and for the testing or operation of hydraulic presses. The pump is a two-plunger vertical unit with ¾-in. diameter plungers having a 1½-in. stroke. Powered by a 2-hp. motor, the pump delivers 130 cu. in. of oil or water at a pump speed of 100 r.p.m.

Pay Roll Calculator

A SIMPLE DEVICE for the calculation of pay rolls and job costs in a fraction of the time usually required is available from the Berger-Bricker Co., 433 South Spring St., Los Angeles,

Pay roll calculator



Rotating-fork truck

Calif. The device includes all hourly rates of pay from 50 cents to $1.75, with a half-cent spread between rates. It covers all time periods up to 104 hours, with divisions of 1/10 hour. It consists of lacquered wood, and is designed to fit into a desk drawer.

Electric Trucks

ROTATING FORKS on a rotating base capable of making a complete revolution are now being supplied by the Elwell-Parker Electric Co., Cleveland, Ohio, on the company's center control trucks, Type F-23T. However, should the work call for only a partial revolution, as for body dumping into gondola cars, the base can be provided with stops to limit the swing to any angle up to 180 deg. At the top position the forks carry either suspended or supported loads, the latter for extra high tiering. When locked in place at the bottom, they handle pallets or low skids without adjustment. For handling rolled paper, the forks are interchangeable with rotating aprons to pick up or deliver the roll on the end or side. The truck is electric powered, handling up to 4,000 lb. with a telescoping tiering height to 140 in.

Another new development announced by this company is a combination crane and load-carrying truck which performs the several functions of load carrier, crane and tractor. The truck has an unobstructed platform area of 84x40 in., with a rated capacity of 6,000 lb., the crane being capable of handling up to 2,000 lb. at 42 in. on the boom. This unit also is also electric powered.

Equipment Briefs

MINE SAFETY APPLIANCES Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa., announces the redesign of the Comfo Dust Respirator to employ a filter case of black plastic and thus save metal for war production. The new respirator is said to be of better appearance and to offer less resistance to air flow, while at the same time it improves sidewise and downward vision. The new cases are non-conducting electrically and unaffected by perspiration.

TYPICAL of the many efforts now being made to avoid the use of critical materials is the new line of Victory Lockers made from wood and produced by Curtis Co., Inc., Clinton, Iowa. These lockers require no critical material, being made of plywood panels dovetailed into Ponderosa pine framework. The lockers are shipped knocked down and are easily and quickly assembled using a newly developed hardwood dovetail lock which fastens the various panels rigidly together.

ANNOUNCEMENT is made by the Acme Electric & Mfg. Co., Cuba, N. Y., of the availability of this company's new Model F-100-25 lamp ballast for use with four 100-watt fluorescent lamps. The new ballast is stated to provide equalized and balanced secondary voltage to each lamp and when starters and switches are in good condition, to assure all four lamps of the unit lighting at the same time without delay or flashing.

TO DETECT the presence of water in storage tanks of non-conducting liquids such as hydrocarbons, including petroleum products, Photoswitch, Inc., 21 Chestnut St., Cambridge, Mass., has developed an electronic water detector lock designated as Type P-15NH. The device consists of a controller and a probe fitting, the latter mounted in a standard pipe fitting on the top of the tank, with the probe rod projecting down through the tank to the level at which water seepage is to be detected, usually 3 in. from the bottom of the tank. When the probe rod contacts water, the electrical circuit is completed through the water, and the control element operates to turn off pumping equipment and to actuate an alarm.

TO INSURE PRIVACY in multi-station intercommunication systems, the Talk-A-Phone Mfg. Co., 1219 West Van Buren St., Chicago, Ill., has developed the All-Master Super Selective intercommunicating system which makes it impossible for third parties to listen

in while two people are speaking on the system. For additional privacy the use of an earphone is optional. The systems are available with various numbers of stations from 2 to 80 or even more.

ESPECIALLY for use in producing ultra-violet light at high efficiency and high intensity for the identification of solid inorganic substances by fluorescence, Pfaltz and Bauer, Inc., Empire State Building, New York, N. Y., are offering a new fused-quartz ultra-violet generator, said to be particularly suited to this purpose. The method may also be used for the detection of impurities.

"Octopus" Ventilator

FOR USE where a single exhauster or ventilator equipped with multiple outlets can be employed to take care of several working areas, Chelsea Fan & Blower Co., 1206 Grove St., Irvington, N. J., has developed the "Octopus" exhauster and ventilator which can be placed or hung in any convenient location between the working area and the open air. The unit is connected by means of flexible metal hoses to the several areas to be ventilated. A newly developed blower wheel designed particularly for this type of machine is used, together with a heavy-duty ball-bearing motor equipped with overload protection. The exhauster can easily be converted into a fresh air ventilator by changing the position of the tube adapter which is part of the equipment. From one to six of the nozzles can be used as desired.

More recently, following demand for a smaller portable unit, the company has announced the "Octopus Jr." This model handles 2,000 c.f.m. and can be equipped with either three 4-in. nozzles or four 3-in. nozzles.

Fire Fighting Equipment

AMONG the new developments announced by American-LaFrance-Foamite Corp., Elmira, N. Y., is Alcofoam powder, a single-powder foam producing chemical for the extinguishment of alcohol fires. This powder, used in any single-powder generator, combines with the stream of water flowing through the generator to produce a smothering blanket capable of extinguishing flames in alcohol, ketones, esters, ethers, and many other such flammable liquids. It is said also to be effective on petroleum fires. The new foam may be applied either through fixed connections on a storage tank, or directed through a hose and nozzle. It is stated to coat and insulate any burning surface, liquid or solid, vertical or horizontal. Approval has been granted by both Underwriters' and Factory Mutual Laboratories.

This company has also announced a new 100-lb. carbon dioxide engine said to be the only engine of this capacity approved by both Underwriters' and Factory Mutual Laboratories for use on both electrical and oil fires. The engine is equipped with an anti-static horn to protect the operator from static charges, and is designed for perfect balance at wheeling height and for ready handling. A third swivel wheel is provided for easy maneuvering.

Enameled Reflector

FOR GENERAL LIGHTING of high and medium bay areas in industrial plants, Westinghouse Electric & Mfg. Co., Lighting Div., Edgewater Park, Cleveland, Ohio, has introduced a new porcelain enameled line of high bay reflectors. The new reflectors are designed for use with either incandescent or high intensity mercury lamps, and are supplied either in a two-piece quick detachable construction, or a one-piece type for conduit or outlet box mounting. The multiple-coat porcelain enameled reflecting surface is said to be easily cleaned and to have a reflectivity of 80 percent.

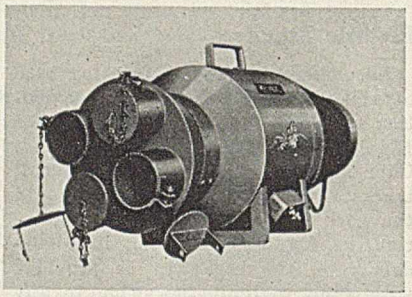
Alternating Current Welder

TO INCREASE the efficiency and step up the speed of the welding of heavier and thicker metals, Allis-Chalmers Mfg. Co., Milwaukee, Wis., has developed a new alternating current welder which is said to produce exactly the proper voltage for every current setting. An entirely new principle in welder design is employed, the transformer and reactor being built as an integral unit with the reactor coils surrounding the air gap so as to eliminate magnetic leakage. The arrangement provides continuous control from 35 to 250 amp., a safe, high, open-circuit voltage at low current, and a lower open-circuit voltage at higher current, where efficiency and power factor are important. The new welder is built without plugs, taps, or switches of any kind, the manual control at the top of the unit covering the entire welding range with less than a dozen turns of the control handle. These new welders range in capacity from 200 to 600 amp.

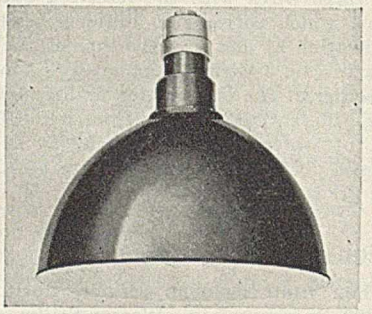
All-Position Electrode

AIR REDUCTION SALES CO., 60 East 42d St., New York, N. Y., has announced a new welding electrode designed specifically for all-position welding of mild steel with alternating current welders. Designated as Airco No. 230, the electrode is available in 1/8- and 5/32-in. sizes, complying with all requirements of the American Welding Society Classification E-6011, and other specifications. It is claimed that the metal deposited from this electrode is fully comparable to that of the best direct-current, reverse-polarity, all-position electrodes. Assuring a good ultimate tensile strength and elongation, the new electrode is said to permit the average operator to secure good fusion and complete penetration without difficulty, and to produce a finished weld deposit which is smooth and of uniform surface contour.

"Octopus Jr." ventilator and exhauster

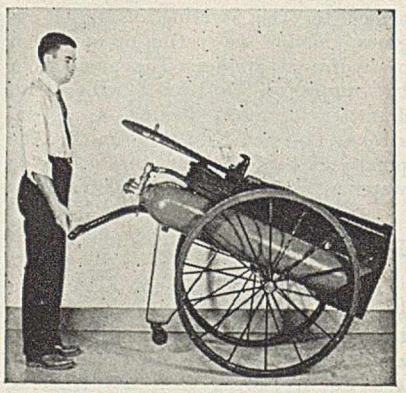


High bay reflector



Alternating current welder

100-lb. carbon dioxide engine

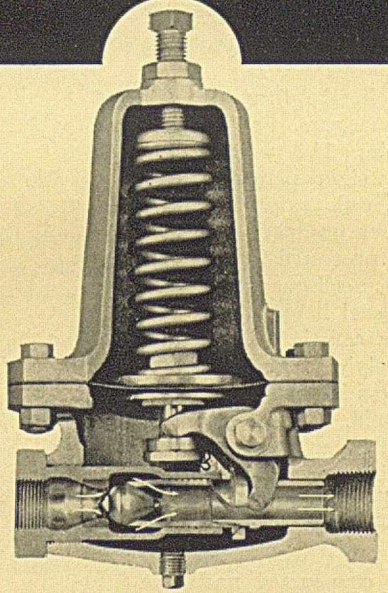


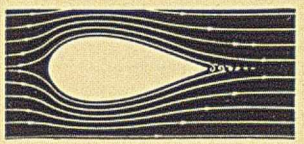
CASH STANDARD *Streamlined* REDUCING VALVES

TYPE 1000 PRESSURE

THEY'LL SEE YOU THROUGH WITH *Non-Stop Production . . .*

● Smooth, speedy, non-stop production is a vital thing today. It's a great advantage to have the dependability of operation—the smooth, even flow of steam, air, or oil—the better pressure control and greater capacity obtainable with the "1000" Valve. The Streamlined flow pattern you see at the right pictures for you the kind of valve action you get that is an important factor in keeping things going on your production front. Years after they have been installed, "1000" Valves perform so that you continue to realize all of the twelve benefits listed below. The "1000" is known as the "NO TROUBLE" Valve.





HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown above which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

POINTS THAT COUNT BIG IN YOUR FAVOR

You get all Twelve . . .

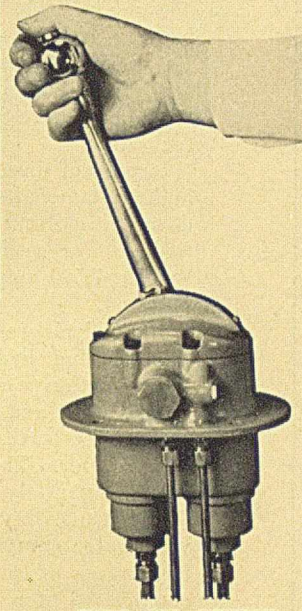
1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

You can find out full details on all of the Type 1000 benefits by reading Bulletin "1000" —send for it!

New CASH STANDARD *Remote* HYDRAULIC *Control*

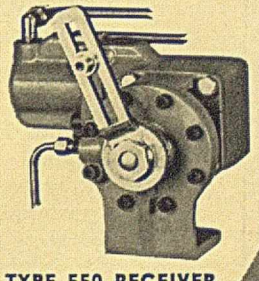
●

Transmits oscillating motion without mechanical linkage



TYPE 550 SENDER

● Primarily used by aircraft manufacturers and aeronautical laboratories on engine test cells for controlling throttle position and mixture — this Type 550 Remote Hydraulic Control may fit your needs too. It is good for use where you desire to control apparatus remotely—without mechanical linkage. To operate, depress button in control lever with thumb. This releases the automatic brake. Move control lever to any desired position, release button, and control is automatically locked in that position where it will remain indefinitely. The unit — A Type 550 Sender (above) and Type 550 Receiver (below), has positive hydraulic power in both directions — no springs, no cups on pistons. It transmits the total force applied to the control lever. There is no lost motion in either direction. The lever of the Receiver moves 90 degrees. It can be indexed to any position. For easy mounting, the bracket of the Receiver can be indexed to four positions. The Receiver can be installed above or below the Sender.



TYPE 550 RECEIVER

Write for Data

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS .. VALVES

Electrolytic Chlorine and Caustic Soda

A TYPICAL modern electrolytic chlorine-caustic soda plant is shown in the accompanying diagrammatic flowsheet. The photographs are from Hooker Electrochemical Co. and Michigan Alkali Co.

Rock salt is dissolved (some plants obtain brine from wells) and the usual impurities, calcium and magnesium sulphates and chlorides, are precipitated from the brine by addition of soda ash and caustic soda. The brine is clarified by settling and filtration. To increase the salt content to a practical maximum, the brine is heated and saturated with purified re-cycled salt before going to the cells.

Supply of direct current is obtained from high voltage, alternating current by step-down transformers, and mercury-arc rectifiers. For a circuit of 200 Hooker type S cells, 7,500 amperes at about 700 volts is required.

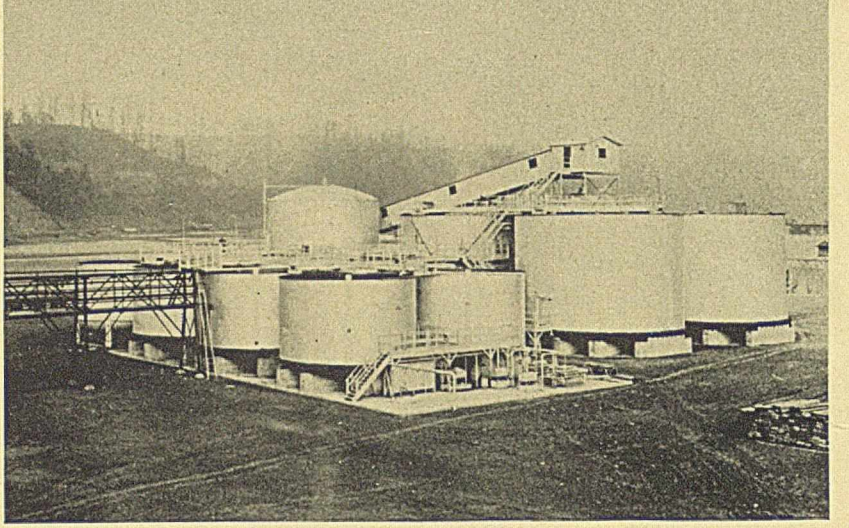
Electrolysis results in the formation of chlorine and hydrogen gases, and caustic soda solution containing 11.3 weight per-cent NaOH and 15 weight percent NaCl. The gases leave the cells saturated with water vapor. The three products are withdrawn separately and processed in different departments. Hydrogen cell gas is scrubbed with water sprays to cool it and to remove any traces of salt or caustic. It is then compressed for supplying various processes. Chlorine cell gas is cooled and then dried with sulphuric acid. The dried gas is compressed to 25-60 lb. per sq.in. It may then be used for various processes or sent to the refrigerated liquefying coils. The liquid chlorine is then transferred to tank cars or to storage.

The cell liquor is evaporated until the NaOH content is 50 percent by weight. Salt crystallizes out of the liquor as the NaOH content is increased, and is removed by continuous settling. Finally, it is washed free of caustic for re-cycling in the process.

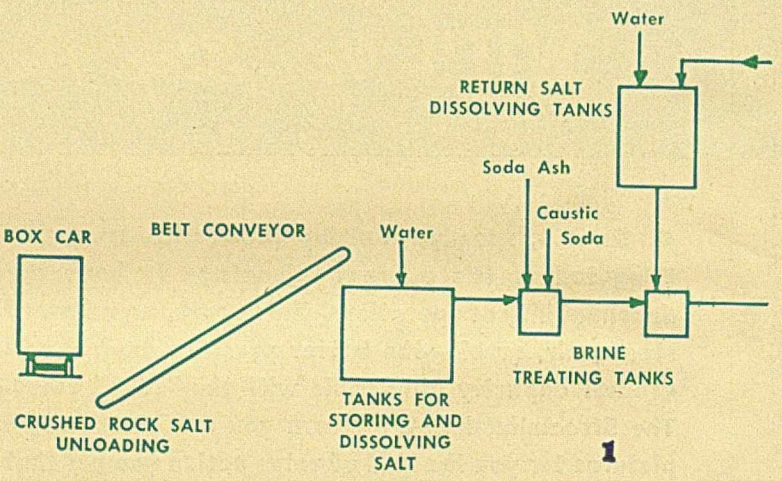
Evaporation of cell liquor in large plants is done in triple effect. Modern practice is to circulate the liquor rapidly in each effect through an external heater. Salt is removed continuously from the bottom cones of the first and second-effect pans. Salt separators continuously decant liquor from the salt.

Additional salt is removed from 50 percent caustic by cooling and settling. Standard 50 percent solution containing 1.1 percent salt is shipped as such, or may be evaporated in single-effect pans to 73 percent liquid caustic. Solid caustic is produced by evaporation and fusion of 73 percent material. Fused caustic, much of which is flaked, is packed in drums.

For further information on Hooker cell plants see Chem. & Met. vol. 45, pages 296-299, and 354-358.



1 Brine system: Salt unloading conveyor, salt storage and dissolving tanks, brine treating, settling, filtering and storage



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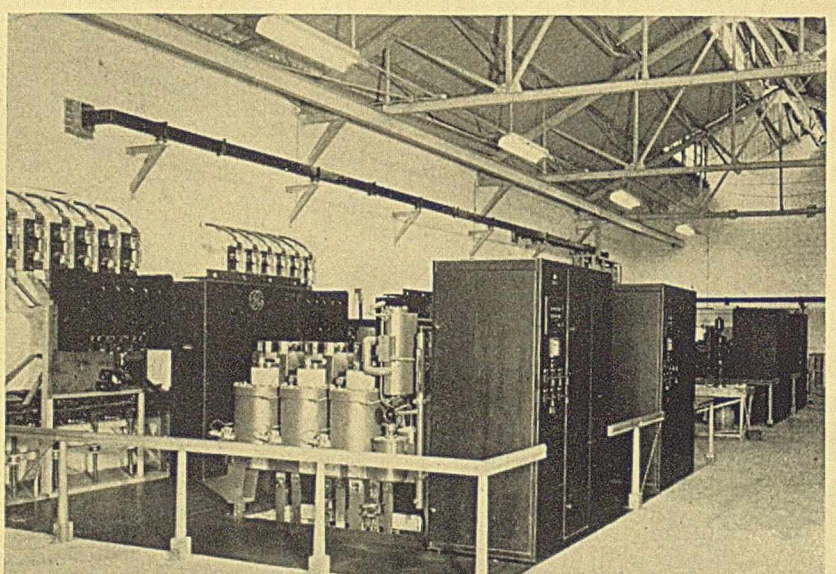
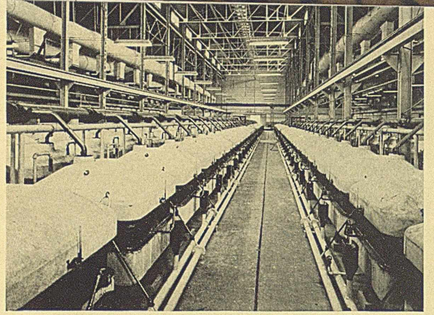
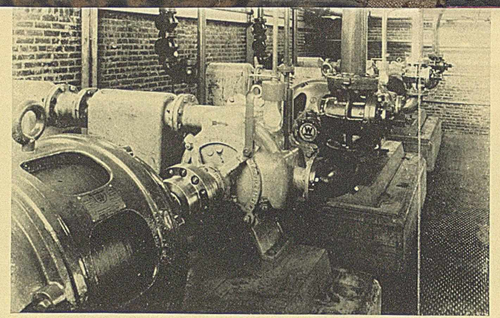
2 Rectifier installation: Mercury-arc rectifiers for supplying direct current for a large installation of cells



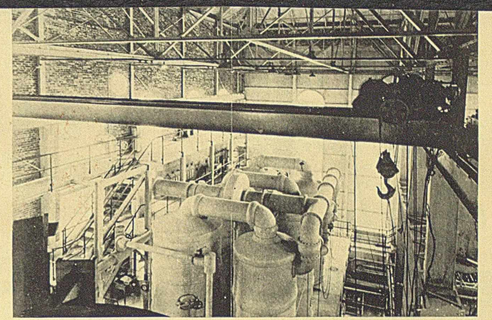


3 Hooker type S cell room: Cells connected electrically in series convert sodium chloride brine to chlorine, hydrogen and caustic soda

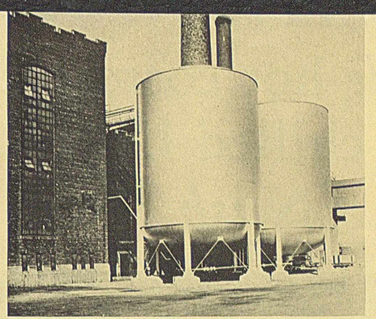


5 Rotary sulphuric acid sealed compressors: Chlorine gas, after cooling and drying, is compressed by means of rotary sulphuric acid sealed compressors

7 Liquid chlorine tank car: Liquid chlorine as required is loaded into insulated tank cars for shipment to all parts of the country

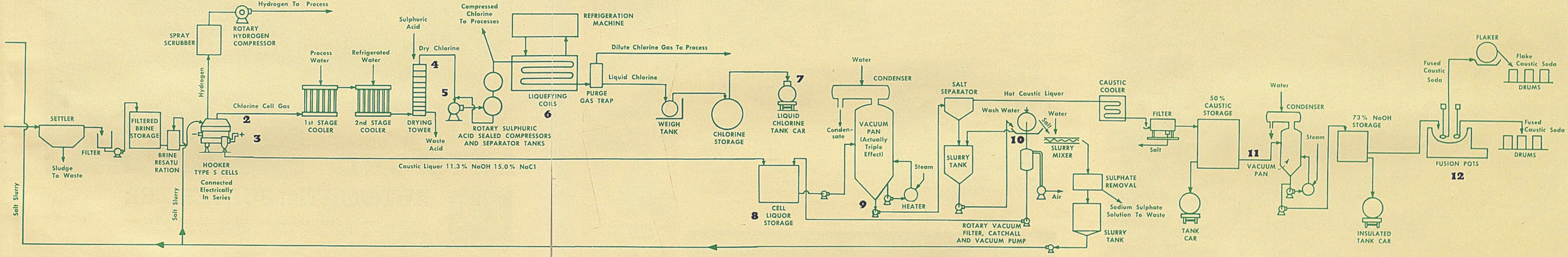


9 Triple-effect vacuum pans: Cell liquor is evaporated in vacuum pans. Salt is removed continuously as it crystallizes from the caustic liquor

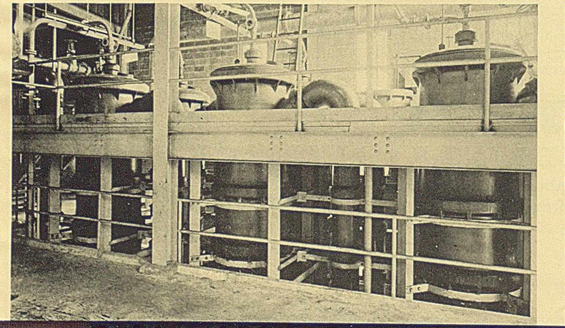


11 Caustic liquor storage tanks: After cooling, settling, and filtration, 50% NaOH liquor is stored in steel tanks

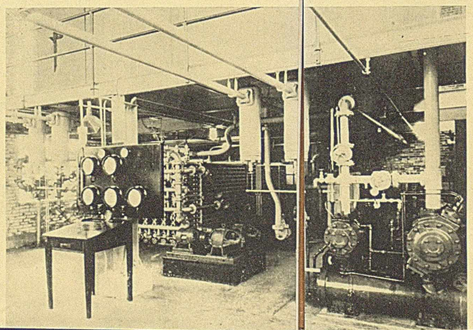
A Chem & Met FLOW SHEET



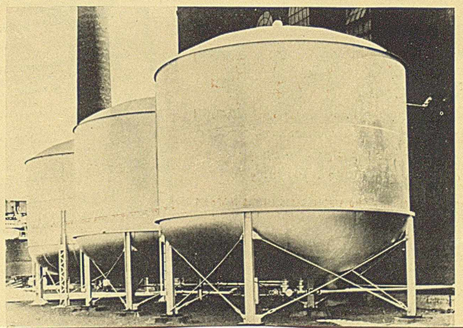
4 Chlorine drying towers: After cooling in the first and second stages, the wet chlorine gas is dried by sulphuric acid in ceramic towers shown here



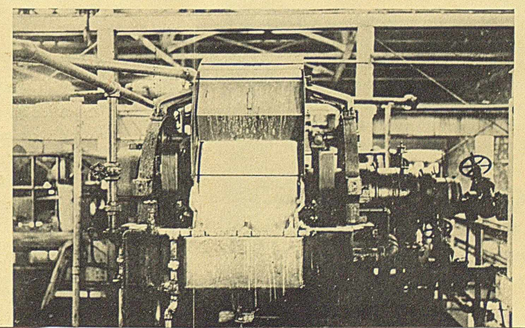
6 Refrigeration machinery: The compressed dry chlorine is liquefied in the refrigeration machinery shown for storage or shipment



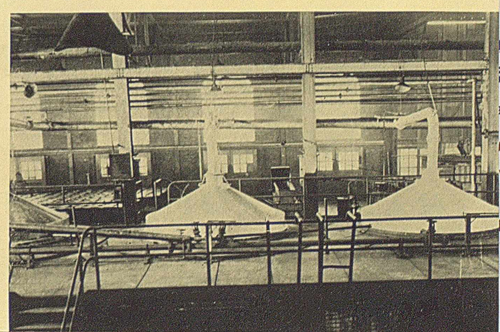
8 Cell liquor storage: Liquor from cells (salt and caustic in solution) is stored in order to provide surge between cells and evaporators



10 Rotary vacuum salt filter: Salt crystals from vacuum pans are partially separated from caustic liquor by decantation and are washed practically free of caustic



12 Caustic fusion pots: Liquid caustic soda of 50-73% NaOH is dried and fused by heating in direct-fired cast iron pots



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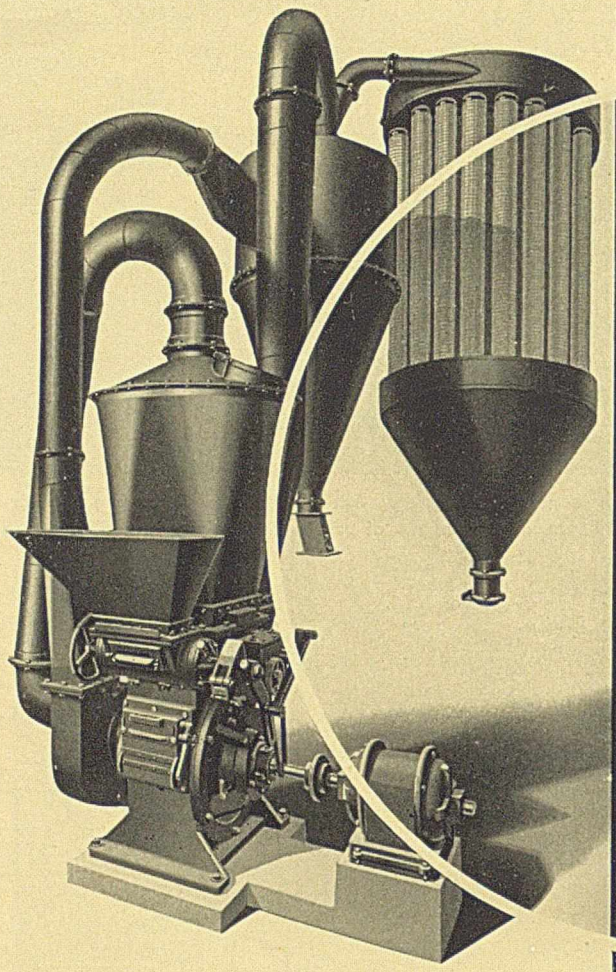

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