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Welder at work: left, without exhaust ventilation; right, with exhauster working.

Fume Control in Shipyards

By WILLIAM E. LAWRENCE

Safety Engineer, New York Shipbuilding Corporation, Camden, N. J.

SAFEGUARDING workers exposed to respiratory hazards resulting from contact with fumes, dusts, vapors, acid gases, and mists ranks among the important safety measures on new construction jobs in shipyards.

Because of the importance of welding operations in shipbuilding, much attention has been paid to the control of hazards and fumes involved. The large number of persons engaged in welding, tacking, burning and heating or straightening has necessitated increased protection against possible fume fever hazards or later complications.

In our plant there are at present some 3600 welders, tackers, burners and heaters whose jobs require special provisions for ventilation, especially in innerbottoms and other small compartments. Every shipyard should know by now that the most satisfactory method of fume control is exhaust ventilation.

Extensive experimentation with different types of equipment during the past decade has proved that the surest method is to remove the trouble at its source. Accordingly, blowers and exhausting devices have been developed and placed in service with satisfactory results. Respirators fitted with metal fume filters also give protection when fume concentrations are low.

Plant medical staffs are exercising great care in routine re-checks and re-examinations of workers exposed to welding fumes. To the best of our knowledge, we have not had one case of lasting or permanent ill effects to anyone associated with welding, tacking, burning or heating.

Many of the oxides encountered are irritating and tend to aggravate pre-existing conditions. For instance, workers with colds should not be exposed to zinc fumes or, for that matter, to any fumes.

Data accumulated through re-examination and case histories of our welders may be expected to provide a great deal of valuable information for medical study. However, it must also be remembered that a large part of the problem concerns not only the welders but other workers in the vicinity. They must be protected not only from the fumes but from eye flashes as well.

There is a relatively new development which consists of carbon arc burning in smoothing off large countersunk heads of tap bolts in armor plate decks. These heads are 1⅞ inches in diameter and were formerly chipped and ground off flush with the deck plates. This was a long, tiresome, rough and costly operation.

By use of the carbon arc, these heads are burned off so that only a small amount of grinding is necessary, thus cutting time and labor to a minimum.

Of course, the fume and dust hazard had to receive special consideration. This was taken care of by use of a compressed air jet which blows the slag and carbon residue into exhauster funnels located at the ends of two 3-inch metallic flexible tubes with powerful portable exhausters at the outlet ends.

As required, this equipment is skidded easily along the deck and is kept close to the job at all times, even eliminating the necessity for respirators. Protection against heat and glare is, of course, a necessity.

In winter, there is the special

From a paper presented at the Marine Section, 32nd National Safety Congress.

A safety campaign stressing accident prevention was the need, for we realized the obvious—an accident prevented is an accident that cannot occur. The campaign had to be simple, effective and instantaneous in its results.

With the activity assigned to me, at the start, I reviewed the principal safety magazines and several textbooks. I found, however, that their editorial articles were prepared by authors writing to seasoned, veteran safety engineers and consequently over the head of the novice. Nevertheless, in practically all of the articles I found continued reference to a fundamental: "Safety is a matter of education and it has to be 'sold'."

That single word "sold" instantly removed much of the mystery of safety engineering and put me on familiar ground. Though I recognized my deficiency in safety engineering experience I realized then that I could fall back on the experience most familiar to me—advertising—and from that draw the lines for my campaign.

I knew that I, singlehanded, could not possibly hope to sell each individual employee for time was of the essence. The problem, then, resolved itself into mass selling. I had to have salesmen who could sell the ultimate consumer and for my salesmen I selected our mill and construction job superintendents. It was then up to me to give them the material for their sales talk and I went to work on a "market survey" so that each would know what he had to sell, why he had to sell it and to whom he had to sell it.

On completion of the survey, I called a meeting attended by the vice-president and general manager, who acted as chairman, and the various superintendents were called in from the field and the mill.

The key to this survey was our accident report file. I reviewed and carefully studied each accident report for the six months' period preceding, making a number of notations as each report was reviewed for later illustration on a series of charts to be used as ammunition in selling my salesmen. I first obtained the total number of accidents for the entire period without regard for separation as to no-lost-time accidents and lost-time accidents. I wanted to stress frequency rather than severity for if frequency was reduced then it was likely that severity would automatically come down. The total gave a general over-all picture of what had happened during the preceding six months' period.

That total number of accidents was, in turn, broken down into *Accident Totals by Months* for the purpose of determining whether or not the seasons influenced frequency. These monthly totals were then studied against the general weather reports for the period and it was found that such was the case but only to a limited extent. These monthly totals were further compared against the experience of the company for the same period and it was discovered that a distinct relationship existed between frequency and the months when the demand for increased production per worker was the greatest. These are the months of February, March and June.

The accident total was then further broken down into *Accidents by Days of the Week* to determine if week-end partying, which means foggy heads on Monday morning, was a factor. If that were true, then the greatest number of accidents would occur on Monday and appropriate corrective measures could be taken. Except for Saturday and Sunday—the company was working a five-day week at that time and our activities were closed down on those two days—Thursday proved to be the low while Monday and Tuesday were next low and Wednesday was the high day. We have been unable to ascribe any reason for this and have had to be content with the knowledge that the week-end was not necessarily a contributing factor.

Hours of the day next came in for attention and the 169 accidents were thus distributed. It will be noted that a sharp peak occurred in the morning at 10 o'clock and a correspondingly sharp peak occurred at 2 o'clock in the afternoon. This gave rise to the reasoning that workmen go through a "warm-up" period in the first hours of the morning and reach full speed at about mid-morning while the same thing occurs after the luncheon period.

It was believed that a rest period

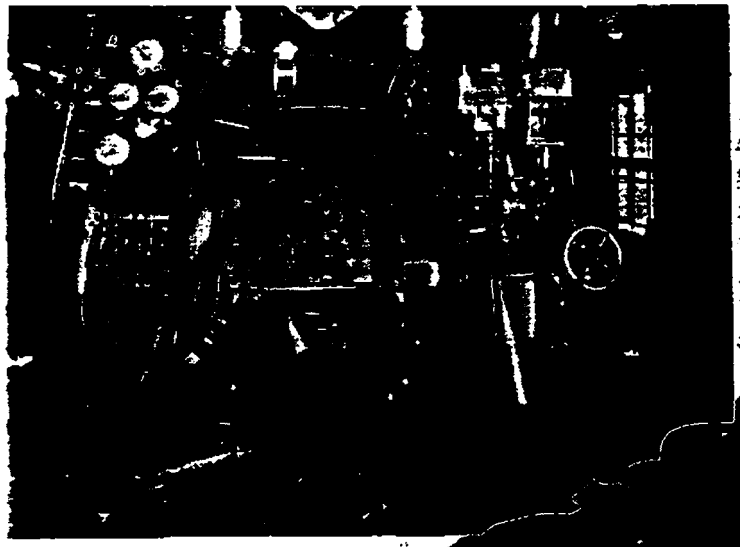
J. S. Fluor, Jr., vice-president, The Fluor Corporation, Limited

resulting in reduced pressure in the morning and afternoon would effectively take care of this situation and consequently a smoking "recess" now occurs in our mill during mid-morning. Our personnel department introduced a vitamin period during which all workmen pause for a vitamin-charged citrus drink in the afternoon. These rest periods produced the desired relaxation from the pressure of production.

Every sales talk has to have a climax and for my climax I showed each one of the job superintendent-salesmen two charts, *A Breakdown of Accidents by Jobs and Departments* and *An Accident Frequency Chart by Jobs*. The first showed the total number of accidents by jobs and the per cent of each for the grand total. The second illustrated the number of accidents for each job applied against the total number

(Continued on page 62)

Peter S. Fluor, Executive Vice-President



Speed, power and many automatic safeguards against the possibility of human error are combined in the modern locomotive. Below is the Mohawk type Class L-4 of the New York Central. At the left is the interior of the cab.

NEW LIFE for the IRON HORSE

THE latest pride of New York Central's Motive Power Department is the Mohawk type Class L-4 steam locomotive, speedy for the fastest schedules and powerful for the heaviest freight trains.

The acquisition of the new L-4's, of which 50 are now in service has come at an opportune time to aid the Central in its tremendous war job. Each is busy today rolling up an average of approximately 11,000 miles per month.

The L-4's, all constructed during the last two years by the Lima Locomotive Works, show an increase over the earlier L-3's, built during the three previous years, in the driving-wheel diameters from 69 to 72 inches and in the cylinders from 25½ to 26 inches. Thus, greater speeds for faster schedules were attained while the tractive force for the heaviest loads was retained.

Both these classes are a recent development from Classes L-1 and L-2 locomotives of 4-8-2 wheel arrangement, which were originally designed for heavy-duty freight service on the New York Central System. The first L-1 was built in 1916 and the last L-2 in 1930. They are still faithful servants in heavy freight service.

An innovation apparent on the new Mohawks is the great size of their tenders. They are extraordinarily large, with a capacity of 43 tons of coal and 15,500 gallons of water. Tenders of such enormous capacity contribute importantly to the versatility of these locomotives in universal main-line service, enabling them to make long through runs without intermediate stops for water or coal.

Befitting the finest motive power yet designed by New York Central engineers, these new Mohawks are also equipped with all the best automatic safeguards against accidents and the possibility of human error.

Notable among these are automatic train control, valve pilot and speed indicator, heat indicators on all locomotive and tender journal boxes and boiler low-water alarm.

Automatic train control is an

(Continued on page 104)

Fire extinguishers, gas masks, inhalator, portable lights, wrecking tools, etc., are carried on this emergency equipment wagon. It can be hoisted onto ships by cranes.

Men working with water-repellent asbestos insulation are equipped with dust respirators.

hazard of salamanders and other receptacles for fires, which may generate deadly quantities of carbon monoxide gas in addition to causing an oxygen deficiency in a closed space. Also there is the danger of fumes from fires in ships on the ways and in the water after launching. Many of these fires occur because welders, tackers and burners do not observe the rule requiring them to know what is below or above, or on the other side of bulkheads before starting work.

Sparks will often ignite welding leads, portable light wires, air hose and rubbish, especially when housekeeping, or as we call it, shipkeeping, is poor. More than 90 per cent of these fires are caused by failure to observe this important rule.

Although many of the fires may be minor, there is always the possibility of men being trapped by smoke and toxic fumes without possible escape. This is where the trained safety inspector or watch force man comes into the picture. Quickly he must don a mask, hook on a life rope, and go down to make sure everyone has escaped. He must be followed as closely as possible by another worker with a powerful electric lamp. If any deficiency of oxygen is suspected, an oxygen breathing mask must be worn. Ventilation must be provided at once, smoke and fumes exhausted, and a fresh supply of air blown in.

Much could be said about the maximum allowable concentration for carbon monoxide and carbon dioxide, but the main point to remember is that carbon monoxide is the No. 1 poison killer in both industrial and non-occupational life. Wherever there is smoke, you may suspect carbon monoxide.

Constant alertness on the part of watch force men and safety inspectors is an absolute necessity in combating such hazards. The education of the men by their supervisors and use of warning posters are recommended, but exhaust ventilation and introduction of fresh supplies of air are imperative under such dangerous conditions. A number of almost fatal accidents in shipbuilding can be attributed to carelessness rather than ignorance. Men forget to think.

Use of insulation cement containing toxic solvents, such as carbon tetrachloride, is a menace to workmen unless adequate precautions are taken to safeguard them. A large shipyard recently re-distilled its entire supply of a toxic solvent and substituted a safer one, thus eliminating the hazard without loss of material, but with a tremendous increase in production and safety.

The use of water-repellent asbestos insulation has recently replaced some types of material formerly used in ship work. For protection against dust or possible asbestosis, it is recommended that such mate-

(Continued on page 90)

A shipyard worker wearing oxygen-breathing apparatus. In the background is a display of protective equipment, showing goggles, hard hats and safety shoes.

An all-service gas mask may be used in atmospheres where there is no oxygen deficiency.

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No. 309 Long or short sleeved shirt with reinforced tab pocket. Slacks have tapered legs, deep pockets and stitched crease.

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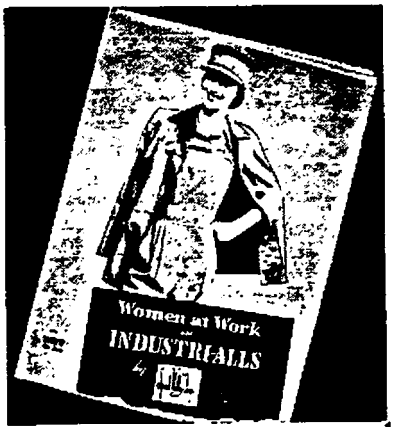

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Fume Control

(Continued from page 17)

rial be dampened wherever possible, and that dust respirators be worn in addition to the provision of special ventilation. Periodic medical examination of those exposed is also necessary.

Men working with fiberglas or glass wool may not be particularly bothered by fume hazards, but may experience trouble if a toxic solvent is used in the cement. Experiments have shown, however, that the dust inhaled by men working with fiberglas does not cause damage to the lungs.

Since fiberglas workers may contract dermatitis, especially in hot weather, extra changes of loose coveralls with cheesecloth or soft unbleached muslin worn around the neck are recommended. Eye protection and dust respirators are also provided.

Shot and sand blasting with its silicosis hazards can be done safely if standard sand blast rooms or cabinets are provided. Such installations should be approved by a state department inspector, and special ventilation must be provided and frequently inspected. Regular, periodic examinations, including X-rays, are mandatory.

A leaking facepiece can be detected easily by the operator, and should be reported at once to the safety department for immediate correction. If an operator tastes sand, he will realize at once that his equipment is not safe.

Fumes and dust from friction saws in shops are easily removed by proper exhaust ventilation, and should be carried by ducts from the machine to dust collectors, out of the shops if possible.

Plating room fumes with modern ventilating systems now available are no longer a problem in an up-to-date shipyard. A few years ago, however, a different story could have been told.

Recent changes in painting specifications on vessels have provided for the use of zinc chromate which, although perhaps not particularly toxic, must be considered when

sprayed in small compartments. Respirators are advocated along with safe ventilation.

When operations take place in big shops where sizable plates are sprayed, the use of air line respirators is recommended since these areas are too great for efficient exhaust ventilation. Crane operators, however, who must handle material in such locations and especially above pickling tanks, should be provided with respirators. Fans may be placed in the crane cabs to blow fumes and vapor away from the operators.

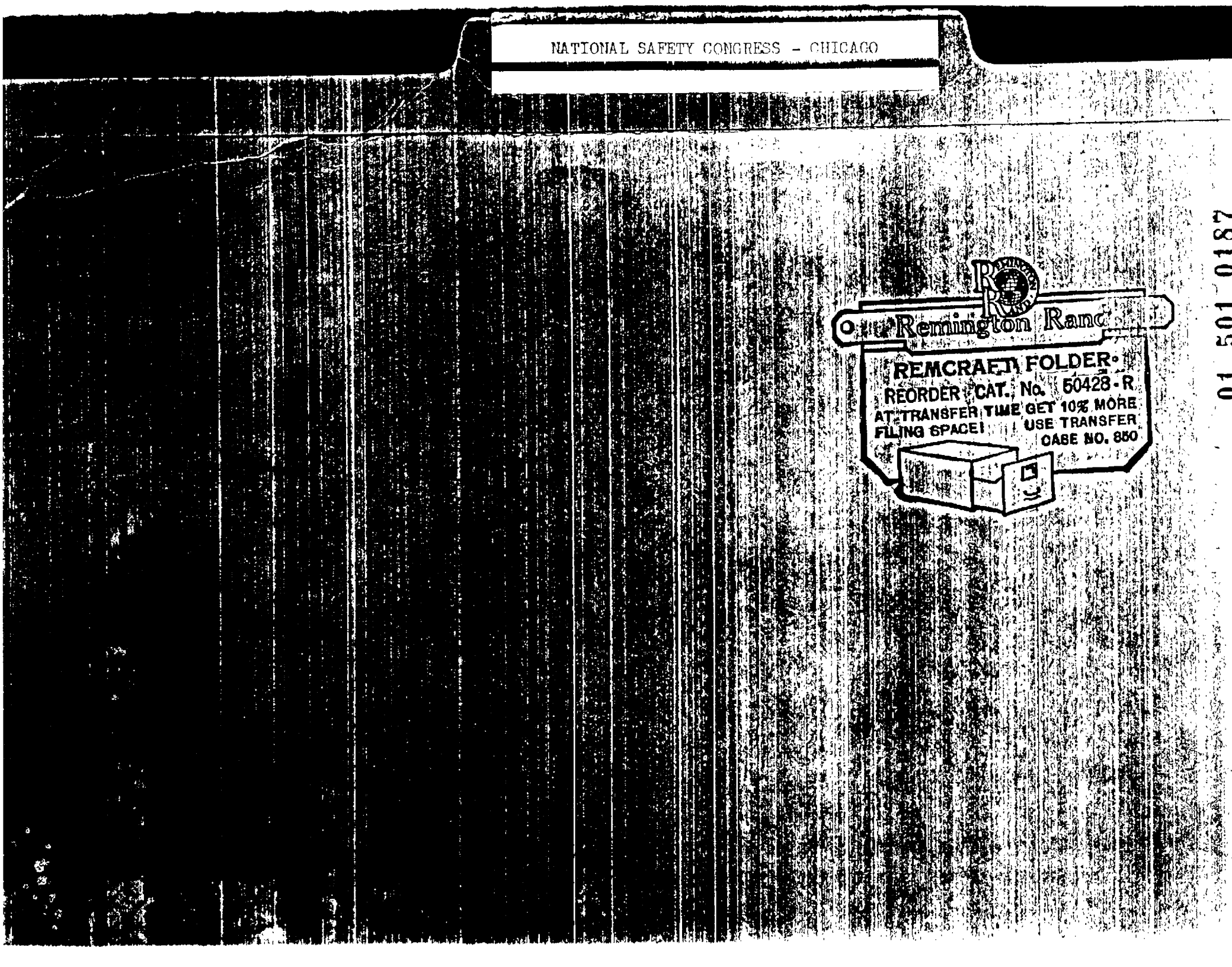
Protection must be furnished for any job in which dust, fumes or smoke from any substance containing lead is breathed daily. This applies when welding, cutting, burning, shrinking or straightening where material is metal, coated with paint containing lead.

Lacquer spraying, if done in approved booths properly ventilated, presents no great problem. If cleaning compounds are used, chemical cartridge respirators provide necessary protection if the concentrations are low.

Use of proper extinguishers on different types of fires must be carefully considered. Fumes from combustion gases and extinguishing agents are capable of causing death. Periodic demonstrations should be made for the benefit of firemen, watch force men, and safety inspectors, and the use of instructive posters and bulletins is also recommended.

Fumigation of refrigerator spaces in ships practically ready for delivery is important. Men whose duty it is to open and ventilate such spaces after fumigation must wear all-service gas masks. If a deficiency of oxygen is suspected, oxygen breathing apparatus must be used.

Management must be impressed with the necessity of providing ventilation of ships under construction, as well as the arrangement for permanent installations. Present construction of naval vessels practically prohibits the use of temporary ventilation units in engine and boiler rooms due to their inaccessibility and the difficulty of bringing in fresh air.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