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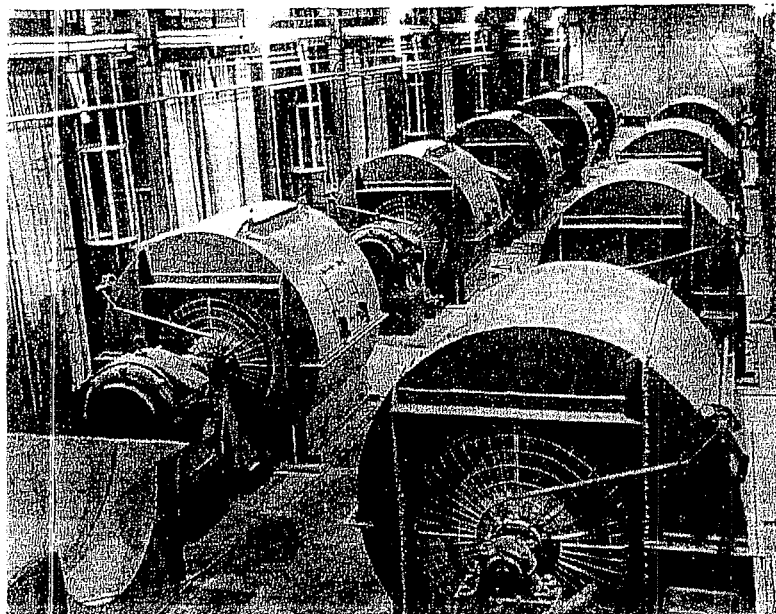
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PLAINTIFF'S
EXHIBIT

MSC-32

Industrial Ventilation

Providing clean air for the workplace



DUST CONTROL system for removal of asbestos fiber from ore milled in the building. Capacity is 2,500,000 cfm. Area of cloth bags in filter system is about 30 acres, with four miles of ducts and 4,000 dust enclosures. (Johns-Manville Corp.)

CLEAN AIR is necessary for the health and comfort of those who occupy any enclosed space. For some occupancies, open windows may be adequate. For others elaborate exhaust systems may be needed to remove contaminants from the workroom air. Ventilation also includes control of heat and humidity.

Maintaining air hygiene requirements may be complicated by the generation of toxic or nuisance air contaminants in industrial processes.

Air pollution has become a problem for whole areas as well as for individual plants. In some regions, particularly those which are built up and where the topography does not permit the quick dissipation of contaminated air, gases, dusts, and combustion by-products must be treated to make them safe and unobjectionable before venting to the outside.

Natural ventilation—air circulation through openings in walls unassisted by mechanical equipment—is satisfactory only when the building layout permits free circulation of air and where plant processes

do not generate objectionable air contaminants.

Principles of ventilation. Ventilating systems are based on either of two general principles, or a combination of the two:

1. **Plenum ventilation.** Air is driven into the room by fans, diluting the room air with fresh air, forcing out stale air through doors, windows, and cracks. This method is limited to buildings where contaminants are non-toxic and limited in quantity.

2. **Exhaust (vacuum) systems.** Air is drawn from a room by fans and is replaced by air entering through doors, windows, and other openings.

General Ventilation

Where processes are not injurious to health, general ventilation is usually satisfactory. It is also satisfactory where dilution of air contaminants will keep the concentration below permissible limits for continuous exposure. Standards for many contaminants have been compiled

by the American Standards Association.

Where contaminants are toxic, removal at their source is necessary.

Ventilation is often complicated by the necessity of maintaining a comfortable temperature. Exhausting impure air is usually practicable but in cold weather it may be difficult and expensive to warm large volumes of incoming air.

Natural ventilation is adequate for some buildings housing non-hazardous operations. Air circulation is aided by doors, windows, roof ventilators, and monitors. The number of outlets should be planned for hot weather when the temperature difference inducing the draft is at the lowest point.

Air intakes should be located so that incoming air is properly tempered and does not cause uncomfortable drafts in cold weather.

Artificial general ventilation requires properly located inlets and outlets. Air coming into the room must be uncontaminated and discharge points should be located to avoid recirculation.

Contaminant heavier than air can be removed most effectively through openings at floor level.

Fans and blowers. Both portable and stationary types are useful in increasing circulation of air which affords relief from heat. They are not substitutes for exhaust ventilation where air contaminants must be removed.

For moving large volumes of air, blowing is more efficient than suction.

Devices for air circulation come less effective as temperature and humidity rise.

Caution should be used in air movement, particularly with velocities over 200 fpm. When relatively cool air is blown over workers at high velocity, objectionable drafts are created.

Control Measures

Where there is a definite source of air contamination, general ventilation alone is seldom sufficient. Control involves three steps:

1. Identifying the substance and locating its source.

Atmospheric sampling to determine nature and extent of contamination.
Engineering control measures.
Control at the source may include one or more of these measures:

1. Isolation or enclosure of the hazardous operation.
2. Local exhaust ventilation.
3. Operational changes; substitution of process or materials.

Isolation confines the operation to a definite location. Exposure is eliminated or restricted to a selected, trained, and equipped group of workers.

Installations which combine exhaust ventilation with isolation and include: sandblasting, shake-out and tumbling-bar operations in foundries, dry cleaning, and mixing of volatile liquids.

Processes creating excessive heat, noise, or noise should also be controlled whenever possible.

Local Exhaust Systems

Local exhaust systems are an important means of occupational air pollution control. Their purpose is to

create a sufficient movement of air to withdraw contaminants at point of origin and convey them to a safe point for disposal.

An exhaust system consists of four major parts:

1. Hoods or enclosures near source of contaminant.
2. Piping to connect hoods into system.
3. Collection equipment.
4. Fan.

Dust is usually more difficult to control than gases, vapors, mists, and fumes. Dusty operations tend to project particles so that the hood must provide velocities sufficient to draw them into the exhaust system.

Exhaust hoods should enclose the process as completely as possible or the hood should be located to take advantage of the directional effects of the dust flow.

Dust-removal systems generally require higher air velocities and ducts of heavier gauge metal than those designed for gases.

Each part has its independent function but all must be designed to work together efficiently.

The exhaust hood is the most important part of the system. It should enclose the process as com-

pletely as possible. Air velocity decreases approximately with the square of the distance from the hood opening.

Air velocity for effective control varies with the process and material exhausted. Generally speaking, the better the enclosure and design of the hood, the lower the velocity needed.

Hoods or enclosures may be in the form of booths, canopies, lateral hoods, downdrafts through grill openings below the process, or slot-type hoods. The object is to remove the contaminants without drawing it through the breathing zone of the operators and with minimum interference with processing.

Hoods can be made more efficient by addition of flanges.

Ducts connect the hoods to the central fan, distribute the air flow in direct proportion to the requirements of each inlet, and maintain adequate pipe velocity to convey the contaminant to the point of discharge.

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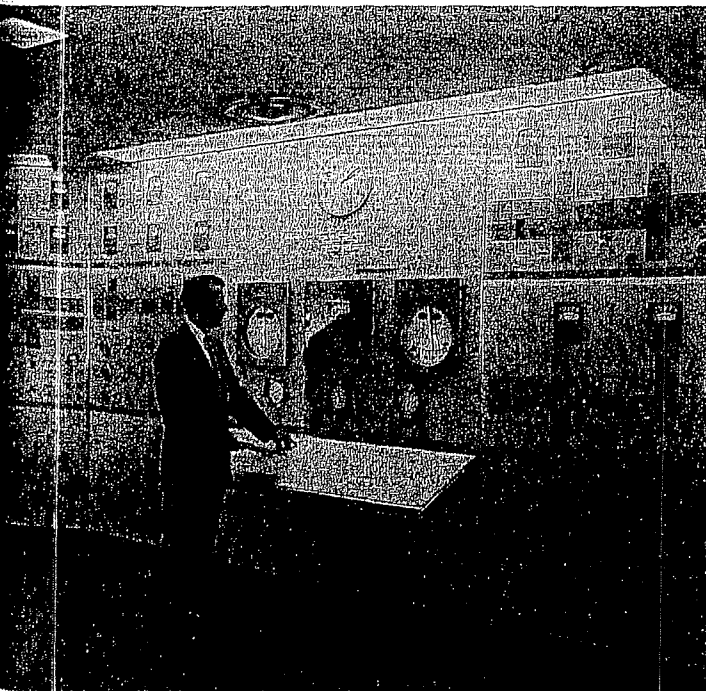
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CONDITIONS under control. Heating, ventilating, and air-conditioning in the Reynolds Metals Company's office building, Richmond, Va., is regulated from this central control panel. (Minneapolis-Honeywell.)

hooks and hangers on elevators are used instead of lockers in some industries, such as foundries. Damp work clothes can be dried between shifts and drying can be hastened by coils at the ceiling. This arrangement conserves floor space.

Rest Room:

A rest room should be provided for 10 or more women are employed. Where there are fewer women and a separate room is not available, suitable space may be arranged off.

For 10 women, minimum space 10 sq. ft., with at least 2 sq. ft. for each additional woman employed.

For less than 100 women, at least 1 bed or couch should be provided. For 100 to 200 workers, 2 beds, and 1 bed for each additional 250 workers. * * *

Ventilation

From page 51

The system should be balanced so that each hood draws the proper amount of air. When this condition has been obtained, all means of adjustment should be permanently fixed. Areas of branch pipes and ducts can be calculated to give correct air velocities throughout the system.

Material used for ducts must resist abrasive action of dust or corrosive effects of gases and vapors. Sharp turns in ducts take extra power and cause a large pressure drop.

Traps with clean-out gates should be provided at the bottom of vertical runs, and clean-out gates at regular intervals on the bottom side of horizontal runs.

Fans should have a capacity slightly higher than calculated requirements to allow for leakage in the system, accumulation of material on fan blades, and similar difficulties.

Where the contaminant is hot and has a natural tendency to rise and the operation can be provided with an effective enclosure type hood, natural draft ventilation is often satisfactory.

Portable ventilators are used for supplying fresh air to confined spaces for temporary work. Examples are tanks, tank cars, vats, underground cable manholes, pipe galleries, ship holds, and airplane wing compartments and fuselages.

Where objectionable fumes are produced, as in welding under some conditions, ventilators exhaust contaminated air.

Disposal of Contaminants

Equally as important as collecting the air contaminants is its disposal.

Gases, vapors, and mists, may often be discharged to the outside atmosphere at a point where they will not recirculate around the premises in harmful concentrations.

Dusts, both harmful and nuisance, require the use of dust collectors in the system.

Recirculation of air is generally undesirable, particularly when the air has contained gas or fumes. Where only nuisance dusts are involved, recirculation after cleaning is often permissible.

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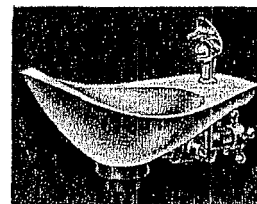


Model 8930
basic eye-wash unit

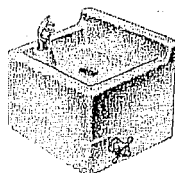
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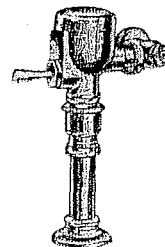
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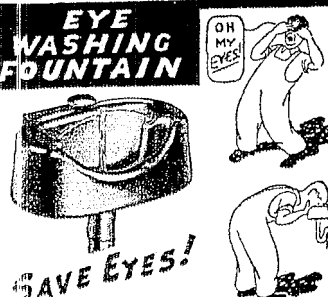
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Special shower head, no holes to clog—can be used where unfiltered water prevails.

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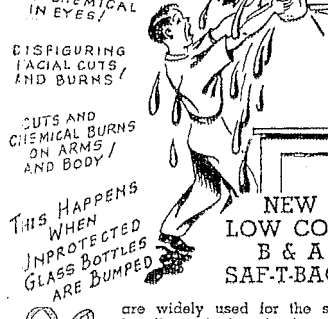
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are widely used for the safe handling of glass bottles containing harmful chemicals; also the storage and recovery of expensive serums, biologicals, and other costly products.

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Recirculation is not desirable when handling dusts containing such substances as lead, silica, and asbestos.

Air coming from the cleaning device must fall within the permissible range for toxic or flammable dusts.

Dust Collectors

Methods of removing dust from the air exhausted by the system include:

1. Filtration.
2. Electrostatic precipitation.
3. Wet collectors.
4. Dynamic precipitation.
5. Supersonic flocculation.

Filters are porous mediums through which dust-laden air is drawn. Some are designed to collect dust in the form of a layer on the upstream surface. This is characteristic of cloth and paper filters. Thicker types, such as those of metal mesh or glass fiber treated with oil, have greater dust-holding capacity but do not collect the finer particles.

A filter should have:

1. Low initial resistance to air flow.
2. Reasonable length of service.
3. Efficiency under changes of temperature and humidity.
4. Low flammability.
5. Reasonable replacement cost or ease of cleaning.
6. Low maintenance cost.
7. Freedom from odors.

Electrostatic precipitation is highly efficient—particularly for fine dusts which are difficult to remove by other methods. It offers low resistance to air flow. First cost and maintenance cost are relatively high.

Portable units are helpful in removing dust and smoke from small rooms.

Precipitators are less effective in collecting large particles moving with considerable force. For high concentrations of dust they generally require pre-cleaners. They are valuable when the process requires a practically dust-free atmosphere.

A combination of viscous filter and electrostatic precipitation with a self-cleaning feature is used on some models. It solves the problem of dust capacity and of heavy particles.

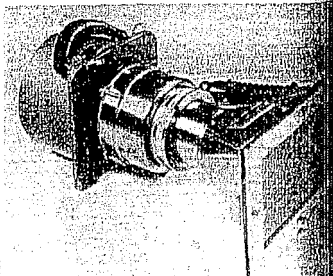
Cyclones. A cyclone consists of an outer cylinder fitted with an inverted cone-shaped hopper and inner concentric cylinder which serves as a discharge duct. Air from the main duct of the exhaust system, under high velocity, enters the large chamber where the air is given a circular motion. The heavier particles are thrown to the outer wall by centrifugal force and fall along the wall. Air escapes through the top.

Cyclones are the most effective for large particles, such as sawdust shavings, or heavy lint. After passing through them, air cannot be returned to the workroom without further filtering. Cyclones are relatively inefficient for removing small particles.

Multiple small diameter cyclones of small taper collect finer particles than the common large diameter ones, mostly because of higher velocities and greater centrifugal force.

Dynamic separators combine filter and collector in one unit. This type of separator is somewhat like a cyclone, but the centrifugal separation

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action is performed by the wiping blades. It is more efficient than the cyclone.

In some types water spray is introduced with the dust at the inlet. This collection increases efficiency for fine dusts.

Wet collectors use several devices for obtaining contact of water with the exhausted air so that dust particles form a sludge. One type consists of sprays or water curtains through which dust-laden air is drawn. These are efficient collectors for many types of dust.

An important application is in the prevention of dust explosions from collecting aluminum or magnesium.

Acoustic flocculation. Suspended dust is passed through a field of acoustic vibrations, inaudible to human ear, generated by a high-frequency siren. Vibration flocculates the fine particles, and the aggregates are then collected by cyclones or other measures for collecting relatively coarse particles.

General Measures

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National Safety News, March, 1959

Personal protective equipment is needed where exposure is occasional or where complete protection is not practicable. Removal of the hazard at its source should remain the objective.

Sanitation and maintenance must receive constant attention to keep equipment at top effectiveness and prevent development of unhygienic conditions.

Supervision and training of employees, particularly in hazardous operations, are important.

Medical control is an important check on other methods. Engineering control is sometimes inadequate and symptoms of absorption of toxic materials by a worker may be the first real warning.

The safety department should be notified of the introduction of new materials and processes so possible hazards may be assessed and safeguards provided.

Workers exposed to toxic substances should have frequent physical examinations. * * *

Wiping Up Grease

Removing oil and grease from machine tools and dies and other wiping jobs may be done by paper wipers, industrial wiping towels, and waste or salvaged rags.

Either of the first two methods is more likely to promote good house-keeping. Paper wipers are collected and burned at the end of the day, reducing the fire hazard. Convenient receptacles are needed. The paper is highly absorbent and has enough wet strength for use with solvents.

Wiping towels of sturdy cotton cloth are absorbent and offer some protection to the hands where work is done around metal chips and turnings or on rough surfaces. Cloth towels are furnished by industrial laundries.

With salvaged rags and waste, men sometimes keep partly used rags behind benches, in corners and under machines, creating a house-keeping problem and a fire hazard. Safe metal containers should be provided and their use required.

Cleanliness around steam pipes



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