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CONTENTS

IDENTIFICATION OF PIPE LINES

We will now throw the meeting open to a discussion of the identification of piping systems. I represented the Council on the committee formulating this code; we had a meeting in New York in June, at which several questions were raised, including this: Whether or not color schemes should be used for identifying pipe lines in chemical industries or whether they should depend upon some kind of markings which would appear in black and white—possibly the contents of the line actually printed on the line in the form of a sign. Another point was whether or not the National Safety Code should include conduits. We find in many plants that conduits run parallel with the pipe lines, yet when it comes to distinctive marking of conduits we are really getting into the electrical field.

I would like to go to the next meeting of the committee and present your ideas, especially as to whether or not color schemes should be used, whether we should have black and white markings or some other arrangements.

MR. PORCH: We use the color scheme quite extensively throughout our operating buildings, but we never carry it outside of the plant. We find that it works very satisfactorily. We use vivid colors and good paint, generally an oil-base paint, that will last for a long time, and never use the stencil idea. I believe I would prefer the color scheme and paint the whole pipe line.

Some of the paints are attacked and we have to paint a little oftener in some buildings than we do in others. At the present time we have not made any particular study of the type of paint, from a chemical standpoint, that is best fitted for the work. We have been doing this now for about a year and I do not believe we have painted more than twice.

CHAIRMAN KERSHAW: I will introduce our next speaker, Mr. Nichols.

INDUSTRIAL VENTILATION AS APPLIED TO DUST AND FUME REMOVAL

H. M. NICHOLS, MANAGER DUST COLLECTING DEPARTMENT, AND F. R. ELLIS, MANAGER HEATING AND VENTILATING DEPARTMENT, B. F. STURTEVANT COMPANY, BOSTON, MASS.

To quote an official of one of the leading insurance companies: "Industrial or occupational diseases are becoming recognized more and more completely as being compensatable. That is to say, the insurance carriers (and therefore the employers, since they have to pay the insurance costs) now have to consider not only the obvious immediate injuries to employees from hazards, such as burns from corrosive fumes or deaths from explosions of combustible dusts and vapors, but also the indirect and sometimes slow-acting internal injuries to employees, such as lead poisoning and other toxic actions in human organs and tissues."

It is, therefore, becoming a matter of economy as well as humanitarian motive to control these agencies so that they will not endanger the

health of the workers, and mechanical ventilating systems play an important part in such control.

GENERAL METHOD OF ARRANGING MECHANICAL VENTILATION

In this paper we shall treat of the general method of arranging mechanical ventilating systems for the removal of those dusts and fumes which, on account of their poisonous or irritating qualities, are a menace to health, and those which, when mixed with air, form explosive combinations. No attempt will be made to go into the constructive details of the various appliances, as these of necessity vary with the local conditions surrounding the individual case and for best results should be especially planned by someone experienced in the art. We will also undertake to summarize the principles governing the design of the various classes of applications.

The necessity for ameliorating the conditions created by machines producing irritating dust was recognized long before the days of liability insurance or of workmen's compensation legislation; in fact, the beginnings of the fan business were inspired by the necessity of finding some way to get rid of the irritating dust from buffing machines in the shoe industry. It was for this purpose that B. F. Sturtevant, the father of the industry, about 1860, conceived his first fan.

The treatment of this form of hazard, namely, all processes producing fine, irritating dusts from wheels or cutters, is today very much the same as the arrangement evolved in the application of this first fan. In this class come buffing, grinding and polishing wheel operations, also some textile, hat manufacturing machinery and sanding operations. Many classes of cutting operations may be treated in a similar manner.

INCLOSE WHEEL OR CUTTER AS COMPLETELY AS POSSIBLE

In general, the wheel or cutter is as nearly wholly enclosed as possible by a metal hood which is attached to and becomes a part of the piping of the exhaust system; the hood should be designed to take advantage of any movement given the dust by the operation. Thus, if a cutter throws the dust in a horizontal direction, the hood should be so arranged that the dust will be thrown into it. Where the material is thrown vertically upward or downward the hood should be placed above or below the wheel or cutter. It is obvious that by carrying away the dust in the direction in which it is thrown the trapping and removal of the material will be the most effective.

It was only a small step from the removal of dust from buffing operations to the removal of refuse from woodworking machinery and while many woodworking operations do not produce refuse in a finely divided state, the handling of this class of machinery is very similar to the method of handling buffing machinery.

With another class of machinery it is not feasible to closely hood the machine, and in these cases hoods over or adjacent to the machines are provided to collect as much as possible of the impalpable material. In this class come such machines as rubber mills, package-filling machinery,

sandblasts, crushers, pulverizing mills and devices at the loading and unloading points of various types of conveyors. It is possible, in many cases, to completely enclose conveyors, in which case the best results, of course, are obtained.

TYPICAL EXAMPLE OF REMOVING DUST HAZARD

As a typical example of reducing the dust hazard, it may be of interest to mention the applications made in the granite industry. Surfacing and cutting machines, in many granite sheds, have been equipped with a hood attached to the cutting bar and connected to an exhaust system by means of flexible tubing. The dust formed by the surfacing tool is almost entirely collected, without inconvenience or hindrance to the workman.

The treatment of obnoxious fumes is similar to the collecting of dust. In all cases where it is possible to completely enclose the device producing the fumes the best results are to be obtained. This is usually possible in chemical laboratory cabinets and in many of the processes in the manufacture of chemicals. By far, however, it is more often necessary to place hoods adjacent to the machinery, which must be left open to permit its operation; in such manner are treated most dipping processes, both of acid and molten metals, sizing, cooking, dyeing, bleaching and the removal of fumes from various kinds of melting furnaces.

In treating the fumes, gases or vapors of these many classes, the hoods should be placed as close to the source of fumes as possible, with due regard to the movements of the operator. When the hood has to be placed at some distance above the machine it should be large enough to encompass an area of considerable extent, as diffusion usually is quite rapid. Further consideration must be given to the natural movement of the fumes; for those that are lighter than air the hood should be over or above the machine and where they fall to the floor the connection to the exhaust system should be underneath. The removal of the gases of combustion of internal-combustion engines in automobile factories was formerly accomplished in this manner, but more modern practice is to connect the engine directly to an exhaust system. In the Ford Motor Company plant, where the engines are tested on a moving conveyor, the exhaust is connected by a flexible tubing to a moving duct.

WHEN FUMES ARE DIFFUSED THROUGHOUT BUILDING

There still remains a class of ventilation for the removal of those fumes that are diffused throughout the building. This treatment is by dilution through general ventilation, either by a supply or an exhaust system. When the dilution is by means of exhaust ventilation, intakes to the system must be located with reference to the nature of the fumes to be eliminated. By removing a large volume of air continuously, infiltration through openings and around windows and doors replaces the air exhausted. This becomes a dilution method and the greater the volume of air handled the more complete the dilution, and, consequently, the more satisfactory the ventilation.

Ventilation by dilution is also accomplished by mechanically supplying fresh air, allowing the contaminated air to escape through a ventilator or monitor; frequently the results justify the expense of both a supply and an exhaust system. It is usual with supply systems to deliver the air near the floor, in order to maintain a breathing space clear of fumes and to float the fumes off through the roof monitor. The ventilation of lacquering and doperooms and some paintrooms is usually accomplished by the dilution method, and in this case the fumes, being heavier than air, are exhausted from near the floor. Foundries are best ventilated by supplying air near the floor and floating off the smoke and gases above the breathing line. Another class of dust and refuse removal can only be accomplished by intermittent cleaning; in such cases the work is not classed as ventilation.

PORTABLE AND INSTALLED VACUUM CLEANING SYSTEMS

By means of vacuum cleaning systems, either portable or installed, dust explosion and fire hazard is greatly reduced. It is generally believed that most dust explosions are cumulative in action. A small explosion may occur near a machine and its result will not be serious, but if such small explosion occurs in a room where the walls, ledges and beams are covered with fine dust the effects of the explosion may be sufficient to throw into suspension a large volume of material that had settled on roof trusses, wall ledges, etc. This dust is thrown into the air just in time to continue the propagation of the flame, with the result that an explosion of destructive violence occurs. By frequently cleaning a building, to prevent the accumulation of explosive dust, such hazard is greatly reduced. This applies to grain elevators, flour mills, starch and sugar factories, and frequent cleanings in textile mills reduces the fire hazard. At the present time a very large grain elevator is being supplied with dust-collecting systems and vacuum cleaning apparatus to eliminate this danger.

By means of air conditioning the explosion hazard can be reduced in industries where volatile explosive solvents are used and by proper humidification of the air static electricity can be prevented from accumulating and causing destruction when it is discharged. A moist atmosphere is a conductor of electricity and if machinery and shafting is grounded the static electricity can be carried off as it is produced; the dipping and coating rooms in rubber factories are so treated.

Air conditioning is further used to prevent dust in many industries. By carrying on operations in properly humidified rooms dust arising in the process can be greatly reduced. A most notable example is found in the stripping-rooms of tobacco factories, where, if the leaves are dry and brittle, a great deal of dust results; when soft and pliable, as they become in humidified rooms, much less dust is formed. The lint or "fly" in textile mills is also greatly reduced by proper humidity.

The disposal and recovery of dust or fumes are not treated here, as that branch of the art is a subject of such magnitude and importance that it should be treated separately. Fire dampers and explosion doors are employed in dust and fume removal systems, but as this paper is intended

to cover only the basic principles of such system, no details of construction will be gone into.

ENDEAVOR TO ENTRAIN DUST AT ITS SOURCE

It should be stated that the first broad principle, and the one of greatest importance, is to entrain the dust or fumes where they originate, if it is possible to do so. Do not allow them to escape into the atmosphere, for if they do it is much more expensive to remove them and they can never be as completely collected. By maintaining a negative pressure in a dust-producing machine inward leakage prevents the escape of dust through joints or openings.

Another rule of importance is to arrange the inlets to your conduit so that the natural direction and velocity of the dust or gas deposits it in the pipe and assists the air current. If the material naturally falls, arrange the intake so the material will fall into it. If the material rises, or is thrown horizontally, locate the hood so the material will rise or be thrown into it.

IN CASE OF DOUBT SECURE SERVICES OF EXPERT

In all cases where the sources of the dust or fumes can be fairly closely hooded, the observance of these two points, combined with proper piping and a fan of suitable capacity, will insure success. It is necessary to state the matter thus broadly because, in most cases, there is no theoretical way of determining the amount or velocity of air for a given connection. In many cases a certain size and form of hood, with a certain suction in the connection to it, has been determined by experiment and experience to give the best results on certain widely used machines. When a new form of machine or process has to be treated, a man experienced in the proper treatment of a wide variety of other machines and processes, by analogy, can tell pretty nearly what to do, but he cannot always tell another how to do it. In the case of dust or fumes that, for one reason or another, cannot be entrained at their source we must resort to the dilution or general ventilation method.

(After reading his paper Mr. Nichols exhibited slides showing several installations of ventilating systems.)

DISCUSSION

MR. T. C. KING (Maryland Casualty Company, Milwaukee, Wis.): I would like to put up to Mr. Nichols a little problem: The removal of acid fumes from pickling vats. We have an exhaust system and there is a considerable space between the top and the end of the vat on account of handling material. The exhaust works very effectually during warm weather, but on a cold day it is almost impossible to see in the pickling vat. Have you a solution for a problem like that?

MR. NICHOLS: I think it could be cured by putting an exhaust along the floor.

The Section then adjourned.

WEDNESDAY MORNING SESSION

CHAIRMAN KERSHAW: We have with us this morning a number of gentlemen representing different manufacturers of respirators; with your approval we will hear what they have to say. (Several gentlemen appeared before the meeting and exhibited different types of respirators, after which a vote of thanks was extended them by the members of the Chemical Section.)

CHAIRMAN KERSHAW: We will now hear the report of the Committee on Industrial Poisons. This committee has done excellent work during the year.

MR. A. L. WATSON (Hooker Electric Chemical Company): The members of this committee are Mr. H. V. Berg, The Krabs Pigment & Chemical Company, Newport, Dela.; Mr. E. H. Brown, American Cyanimid Company, Niagara Falls, Ont.; Professor C. E. A. Winslow, Safety Institute of America, New York; Mr. A. H. Nuckolls, Underwriters Laboratory, Chicago, and myself. Any credit which may be due for the preparation of this paper should be given these gentlemen, particularly Mr. Brown, who expended a great deal of time and energy in its preliminary preparation. I wish to take this opportunity, as Chairman, to express my appreciation for the co-operation which they have given.

DUST RESPIRATORS IN INDUSTRY

REPORT OF INDUSTRIAL POISONS COMMITTEE, A. L. WATSON, CHAIRMAN

Foreword

In the investigation conducted by this committee into the subject of dust respirators and in the preparation of this report it has been the purpose of the committee to accomplish the following results:

1. To emphasize the harmful effect of the condition which exists in industry of persons working in dust-laden atmosphere without being equipped with proper respirators which will prevent dust from being breathed in through the nose and mouth.

2. To endeavor to explain some of the reasons for respirators not being used more extensively, by pointing out the weaknesses of existing respirators.

3. To compare the values of respirators which are being marketed at the present time.

4. To bring out, if possible, the requirements which are necessary for respirators which will be looked upon with favor by the man on the job who is expected to wear them.

It is not the purpose of this report to discuss, from chemical or medical standpoints, the injurious effects which various kinds of dust will have upon the human system if inhaled, nor to consider the different types of dust with which we have to contend. Unfortunately, the committee did not have sufficient time to conduct experiments, nor to make a study of particular industrial processes where dust conditions exist. The report, therefore, will deal chiefly with respirators, as such, and in a somewhat

limited manner, because of the short time available in which our investigations had to be made.

Consideration is given only to the mechanical filter type of respirator designed to filter particles of dust from the air. The report does not consider face masks or hoods having a hose attached through which uncontaminated air is supplied to the wearer. There is no question as to the merits of this type of breathing apparatus when used under certain conditions and, of course, in instances where the wearer is not required to move about in too great a radius to make the use of a hose impractical. Neither does this report deal with gas masks, nor with self-contained oxygen breathing apparatus. These latter two are subjects which require a great deal of discussion and should be handled as separate propositions, in the opinion of this committee. It has no reference to any devices which are designed to afford protection from gases or acid fumes, and the committee wishes to emphasize that respirators such as are dealt with in this report should never be used where a gas or acid fume condition exists.

THE PRESENT SITUATION

The relation of atmosphere to human life has been the subject of numerous scientific investigations and it is admitted that there has been a vast amount of superficial observation (which serves no practical purpose) on the dust problem in industry.

It is assumed that those interested in the dust problem recognize the seriousness of the situation, particularly when we read that certain medical authorities estimate that in seventy trades more than 50 per cent of deaths between the ages of 25 and 44 are caused by respiratory diseases or their after effects. A situation such as this surely demands both individual and collective action, for it concerns not only the workmen who pay a needless toll in death and respiratory troubles, but it places a heavy burden upon industry.

It is assumed that we realize the serious effect upon labor-turnover which dusty working conditions will cause and the growing difficulty in securing men who will work in dusty atmosphere. This difficulty is aggravated by the fact that, through the Americanization movement, foreign-born workmen are being educated to expect and demand the kind of job where they do not have to contend with unpleasant and unhealthful conditions, such as contaminated atmosphere. Growing restrictions upon immigration are decreasing the supply of workmen who can be expected to take dusty jobs until industry is found fighting the dust problem with its "back to the wall."

It is further assumed, we recognize, despite the remarkable progress which has been made in eliminating dust, that we still have dusty conditions; dusts both toxic and irritating, which, when inhaled, will injure the delicate membranes lining the respiratory tracts and set up inflammation—that as a result there is lessening resistance to disease and, as a consequence, common colds, influenza, pneumonia and the causative organism of dread tuberculosis become present. Without question the solution of our problem would be to eliminate all injurious dusts from the air—to take the "dust" out of "industry." While there are unquestionably

a great many existing dust conditions which could be corrected by providing proper mechanical apparatus for removing the dust, it is unreasonable to expect that all conditions of dust-laden atmosphere could be economically corrected in this manner. Even where the best devices are in use, for dust reduction or abatement, accidents to apparatus occur requiring shut-downs and at such times other means of protecting workmen become necessary.

HUNDRED SPECIFIC PROBLEMS

So the fact remains that some types of respirators are a necessity at the present time, and we must bear in mind that there is no general respirator problem, but rather a hundred specific problems, each conditioned by a particular process and a particular type of dust involved. We cannot say: "If you have a dust-laden atmospheric condition here is a respirator that you should use." Each industrial process must be studied, first to determine whether the use of a respirator is a proper solution or whether there are convenient and economical methods for eliminating the dust from the air. In the second place, where it is found that respirators are needed, the type of respirator to be used must be determined according to the kind of dust to be eliminated, the severity of concentration and, of course, after considering the question of convenience to the wearer.

Undoubtedly you have read the expression used so often by compensation rating board inspectors in their inspection reports: "Respirators furnished, but not worn by all employees." This is the problem we are up against in industries where respirators are the proper means for eliminating dust from the human system. Workmen will not wear them. Many industries require men to wear respirators, but the rule is honored more in the breach than in the observance.

The question then presents itself: "Why should a workman be hostile toward a device which is designed ostensibly for his comfort and to conserve his health, and which is furnished to him without charge?" One pertinent answer to the question was given a member of this committee by a superintendent: "For the same reason you and I would not wear them if we had the same kind of a job." This statement, while it does not help toward a solution of our problem, is probably correct, for is it not a fact that the man who labors in a dust-laden atmosphere will prefer to take a chance on impairing his health (which to him is a matter of the distant future) rather than to suffer now the discomforts which the wearing of a respirator are said to entail?

If it is true that such an attitude prevails, it is a serious indictment against those of us who are endeavoring to conserve life and health and we should be inspired to bend every effort toward the improvement of present types of respirators, or the development of new ones, which will meet the least possible objection from the persons expected to wear them.

TYPES OF RESPIRATORS ON MARKET

There are many types of respirators on the market. Probably you are all fairly familiar with them and with their merits and defects. The

New York State Industrial Commission has said that some of them are almost useless. We shall consider a few of the available types which are among the best known and most widely used:

Exhibit No. 1 (pig-snout type): This is probably one of the most widely known respirators at present on the market. The body is of rubber and the filtering medium consists of a thickness of cloth in combination with a sponge. It is intended that the sponge should be kept moistened at all times while in use. An exhalation valve is provided on the side to assist natural respiration.

Among the objections to this type are that it is too heavy and too stiff. It is made only in one shape and it therefore becomes necessary to keep it pressed tightly against the face to insure against leakage. The edges are usually sharp, causing discomfort, irritation of the skin, excessive perspiration and consequent further irritation, and possible serious injury when dust collects around the edge. It should be noted that manufacturers of rubber respirators, in at least one or two instances, are endeavoring to mold a contact edge which is considerably thinner than the rest of the body, and with this thin edge flaring in a manner which tends to cause a more even, close, automatic contact with the facial lines. (Showing sample which demonstrates this.)

This type projects too far out in front of the face, obscuring the vision; it also interferes with the proper wearing of goggles. The head bands are not durable, requiring frequent renewal when used in certain kinds of dust which attacks the fabric. The relief valve becomes clogged, preventing proper seating, and thereby allowing dust to be inhaled. Too much attention is required in the way of cleaning, sterilizing, moistening the sponge and renewing parts.

Exhibit No. 2: This respirator is very similar in principle to the pig-snout type, but has some features which might make it more desirable under certain conditions. The body is also of rubber but is molded in such a shape that it does not project out so far from the face and therefore does not obstruct the vision as much as the pig-snout. It is made in three styles with body construction the same in each. One style employs a dry-disc cotton-filter medium and has no relief valve. The second style is essentially the same except that a relief valve is provided to assist natural breathing. The third style has a wet-sponge filter like the pig-snout. The manufacturers of this type of respirator recommend the use of the dry-filter style in preference to the wet-sponge style, because they claim that with it breathing conditions are more uniform than with the wet sponge, where evaporation occurs. We believe, however, that there is considerable to be said on this point and this report will touch upon it later.

This respirator is much lighter in weight than the one first exhibited and, therefore, is much more desirable from the viewpoint of the man who has to use one. The contact edges, you will note, are thinner than the rest of the body, affording some relief from the irritation to the skin previously mentioned. Long continued wearing, however, will cause irritation and perspiring, dust will collect around the edge and in this respect about the same objections prevail as in the pig-snout type.

IRRITATION OF SKIN A SERIOUS PROBLEM TO OVERCOME

It is well to mention that the matter of skin irritation, where patented types of respirators are worn, is really a serious one and is probably the strongest reason for workmen objecting to wearing them. At least one case is known where rubber respirators are furnished to workmen and where the men feel that they must wear them because of the severe dust condition. These men, it has been found, take their respirators home and have a piece of soft flannel sewed around the contact edges to prevent irritation. We would not recommend that respirator manufacturers do this because it would be extremely unsanitary unless frequent sterilization were practiced and we know that frequent sterilization will not be practiced in a large majority of cases. However, we believe it would be well for all manufacturers of respirators to take note of this most serious objection to their product and to bend their efforts at once toward the development of the most comfortable and least irritating contact edge that it is possible to produce. Some relief has also been secured from the effects of irritation by greasing the face with vaseline or similar preparations. It should be noted, however, that this cannot always be done satisfactorily, because certain kinds of dust will collect upon the greased skin and become hardened.

Coming back to exhibit No. 2, the relief valve will be found to be of a different construction from that shown in exhibit No. 1. The working part is extremely delicate and is sure to require frequent renewing under certain dust conditions. It is claimed that this valve has been tested in paint spraying operations and has withstood the test satisfactorily where other types of valves have failed.

METAL RESPIRATORS SUITABLE FOR MANY USES

With regard to headbands and attention required in sterilizing, cleaning and renewing parts, this respirator meets the same objections as those pointed out in the first exhibit, and the very light wires which hold the aluminum cap in position are not calculated to last long in the hands of an unskilled wearer. This type also interferes with the proper wearing of goggles, but not so much as the pig-snout type.

Exhibit No. 3 (aluminum body): This respirator has an aluminum body, a rubber pneumatic cushion edge, a fine brass screen in combination with a sponge to form a dust filter, and is provided with an exhalation valve. This style is also made with a dry disc filter. The aluminum makes a very light, yet durable body and the pneumatic cushion edge is comfortable and makes an easily adjustable contact with various facial lines. At least two different styles of relief valve are provided on this type of respirator, one having a metal body and metal or mica disc valve, and the other the all-rubber flapper style, like those used on army gas masks. There is a question as to the merits of and objections to these two styles of relief valves. The cost of this respirator is necessarily high in comparison with other types, but when consideration is given to the metal body, which should last a long time, and to the fact that most of the parts which are subject to deterioration can be replaced, it may be

found that the average costs, including renewals and repairs, will compare quite favorably. Practically no interference with the wearing of goggles will be encountered in some makes of this type of respirator.

This respirator requires similar attention to the other types exhibited so far as cleaning, sterilizing and renewing parts are concerned. In purchasing a respirator of this metal-body type it is recommended that consideration be given to the following points which the committee has noted in examining samples:

1. Weight of respirator. This point is of vital importance to the wearer.
2. Obstruction of vision. Some makes will be found more satisfactory than others in this respect.
3. Method of inflating the pneumatic cushion. Where a pump is required it will cause a great deal of inconvenience.
4. Location of relief valve. With this valve located at the top of the body of the respirator, there may be danger of blowing dust into the eyes during exhalation.
5. Method of fastening head bands. It is much more convenient to fasten bands at the back of the head if hooks and eyes are provided than with the pin type fastener where one end of the elastic must be inserted through an eye and two prongs then forced through it for securing.
6. Possible interference with the wearing of goggles. This, of course, is of supreme importance in selecting any kind of respirator, as invariably goggles must be worn in any atmospheric condition which requires the use of a respirator.
7. Extent of filtering area. It will be found that some makes provide a larger filtering area than others. Under some conditions, where the dust concentration is light and where the wearer is not subjected to hard manual labor, this point may not affect the value of the respirator, but where a workman's natural respiration is increased because of physical exertion and in an atmosphere containing heavy dust concentration the largest possible filtering area would be the most desirable.

HOME-MADE RESPIRATORS CHEAP AND COMFORTABLE

Exhibit No. 4 (improvised respirator): This is a home-made respirator consisting of a piece of muslin 33 inches long by 5 inches wide, with absorbent cotton filtering media 5 inches wide by 6 inches long, one-third ounce in weight, about three-fourths inch thick, and held in place by two small safety pins. The absorbent cotton is covered with a thin film of cheese cloth and the muslin strip is cut to allow free use of the eyes. The total weight of this respirator is two-thirds ounce.

This type of respirator was recommended by the bureau of inspection of the New York State Industrial Commission, in Bulletin No. 90, December, 1918, after a series of tests in which it was found that all dust was filtered out for a period of four hours or more. In these tests, dust-laden air containing a basic lead salt was drawn through the filtrating media at a rate equal to the amount of air breathed by an average individual (about 15.6 cubic feet per hour). Careful analytical tests revealed no lead drawn through the gauzy material forming the filtrating media.

This respirator is cheap, light in weight, does not obstruct vision, can be changed daily at little cost, and can be washed when necessary.

There is nothing to break, rust or wear out. It is claimed that it does not cause excessive perspiration, and absorbs what is produced, does not cause irritation of the cheeks, nose and chin, and can be more readily arranged to fit the face than the patented types. There is less incentive for a workman to appropriate the respirator of another. It was recommended that this type be accepted in compliance with rule No. 733 of the Industrial Code of the Labor Laws of the State of New York.

It is the opinion of this committee, based upon actual tests, that this improvised respirator will prove quite satisfactory under conditions where the dust concentration is not extremely heavy. There are, however, some dust conditions requiring the use of respirators where this type would be practically useless. It was shown by experiment that, placed upon men unloading cars of lime, they worked out very satisfactorily. The men apparently breathed comfortably and after being used a whole day there seemed to have been no lime drawn through to the inside. Many requests for them were received from the men after the samples had been tried, a considerable quantity were ordered and many are in use at present.

USE OF "MUZZLES" IN CERTAIN INDUSTRIES

On the other hand, when used in an atmosphere with very heavy dust concentration, the absorbent cotton became wet and matted from perspiration, saliva and moisture of the breath, and the dust soon filled up the pores of the filter, making it difficult for the men to breathe. The dust condition in which this latter test was made is very severe and no patented respirator has been found which would give satisfaction. The men wear improvised respirators, usually referred to as "muzzles." They consist of several thicknesses of flannel, folded to fit around the head and neck, so that the nose rests upon the top edges of the flannel. A piece of cotton sheeting covers the outside, wraps around the back of the neck and is tied in front. This type of muzzle is used quite extensively and seems to be liked by the men after they once learn how to breathe with it properly.

Cotton Waste as a Respirator: It is claimed, according to a discussion which took place at the Sixth Safety Congress, that simple cotton waste had been used with excellent results. It was stated that in a Brooklyn plant it had been almost impossible to induce the men to wear any kind of a respirator, but after showing them how easily cotton waste could be used, how it did not irritate the face, and how easily it could be changed, every workman was easily induced to wear it. It would be interesting to ascertain if any present have tried this scheme and with what degree of continued success.

Other Types of Patented Respirators: There are a number of other types of respirators on the market, all of which have undoubtedly been found satisfactory in some instances. We have endeavored to discuss in detail only the particular kinds which are most widely known and used. All of the others either employ practically the same principles as those exhibited here or are of a special nature and suitable for comparatively few dust conditions.

WET VS. DRY FILTERING MEDIUM

A discussion of the comparative values of the two types of filters will probably result in nothing, for it is obvious that each type is best for certain specific conditions.

The wet-sponge filter tends (to some extent at least) to cool the air which is breathed, and in this respect would be desirable in warm atmosphere. In a heavily laden dust atmosphere it will not become clogged with dust as readily as a dry filter. In most, if not all cases, it is easier and quicker to remove the sponge, moisten and replace it, than it is to remove a dry disc filter and put in a new one. It eliminates the necessity of keeping extra filters on hand. It will take up saliva and moisture from the breath without impairing its function. There may be some objection from the fact that the moisture in the sponge will evaporate and thereby increase the breathing resistance. We do not believe this objection to be a serious one. Dust, of course, will adhere to the wet sponge more than to the dry filter and there may be a question as to whether the sponge will take up more or less dust than the dry disc before the breathing resistance becomes objectionable.

The dry-filter medium will permit of uniform breathing until the pores become clogged. The number of thicknesses can be regulated to suit the conditions. The fibre becomes moist from the breath, causing dust to adhere and quickly closes the pores of the filter. This is objectionable from the standpoint of convenience and expense, but perhaps makes a more sanitary appliance than with a wet sponge. There are some known conditions of heavy dust concentration where the dry filter is practically useless for the reasons just mentioned.

Consideration of the different types of filter media only tends to strengthen the statement previously made, that where respirators are required each industrial process must be studied by itself in order to determine the proper type to use.

EXISTING TYPES NOT ALWAYS SUITABLE

In spite of the large variety of respirators marketed we find a great many men working in dusty atmosphere and using no filtering apparatus whatever; a great many more use handkerchiefs, rags, waste, flannel, etc., evidently in preference to the more pretentious types of respirators—placing comfort before efficiency in results. We believe that there are very few respirators being used as compared with the number of existing dusty jobs where they should be used, and it would seem obvious that the reason for this must be that available types of respirators do not satisfactorily meet the requirements.

It is the belief of the committee that manufacturers of dust respirators would render a real service, not only to industry and to humanity, but with profit to themselves, if they would concentrate upon the development of a dust breathing apparatus which would embody the following features:

1. Lightness in weight.
2. Automatic adjustment to facial lines.
3. Comfortable correct edge which will not irritate.

4. That would not obstruct vision.
5. That would not interfere with wearing of goggles.
6. That would not offer serious breathing resistance (considering increases in volume of breathing with physical exertion).
7. Relief valve which will not become clogged.
8. That would not interfere with chewing and spitting.
9. Relief valve located so that dust will not be blown into eyes.
10. Durable headbands, easy to fasten.
11. Inflation valve easy to operate (if pneumatic contact edge).
12. Durable adjusting parts.
13. Requiring as little attention as possible.

DISCUSSION

CHAIRMAN KERSHAW: We have heard a very fine paper and we appreciate the work done by the committee.

MR. M. F. CRASS (Grasselli Chemical Company): It seems to me the muzzle is a very simple and convenient arrangement and would be more comfortable than any other heavy respirator that could be used in places where men stuff handkerchiefs in their mouths. Wouldn't it serve when unloading brimestone, for instance?

MR. WATSON: I have no reason to doubt that it would serve such purpose. A great many experiments have been conducted with this type of respirator and many were found to result satisfactorily.

A MEMBER: How about a man drawing off sulphate of sodas. There is a very heavy vapor.

MR. WATSON: I would not recommend it for use in any kind of vapor.

MR. CRASS: Men on those jobs usually stuff handkerchiefs in their mouths.

MR. WATSON: I would say that this type of respirator would serve the purpose much better, because in using a handkerchief the nose is not covered.

MR. CRASS: You can't make the men wear respirators of the ordinary type. They use a handkerchief; a simple thing like that does not interfere with chewing and spitting, or with their eyes.

MR. WATSON: This type seems to interfere as little as any type I have seen with chewing and spitting. It costs 5 cents.

MR. H. J. SEGRAVE (Mine Safety Appliance Company, Pittsburgh, Pa.): It appears to me that a sweat-proof binding in the form of a pad around a rubber respirator might be comfortable and easily sterilized; something that a flannel binding would not permit.

MR. WATSON: I do not believe the type of binding you mention would be more comfortable than many already in use; the most comfortable contact edge so far produced is the pneumatic cushion.

REPORT OF NOMINATING COMMITTEE

Mr. Crass then reported for the Nominating Committee, recommending the re-election of Mr. S. H. Kershaw as Chairman, Mr. E. J. Riederer as Vice-Chairman and Mr. G. E. Minshull as Secretary. (The gentlemen were thereupon unanimously re-elected.)