

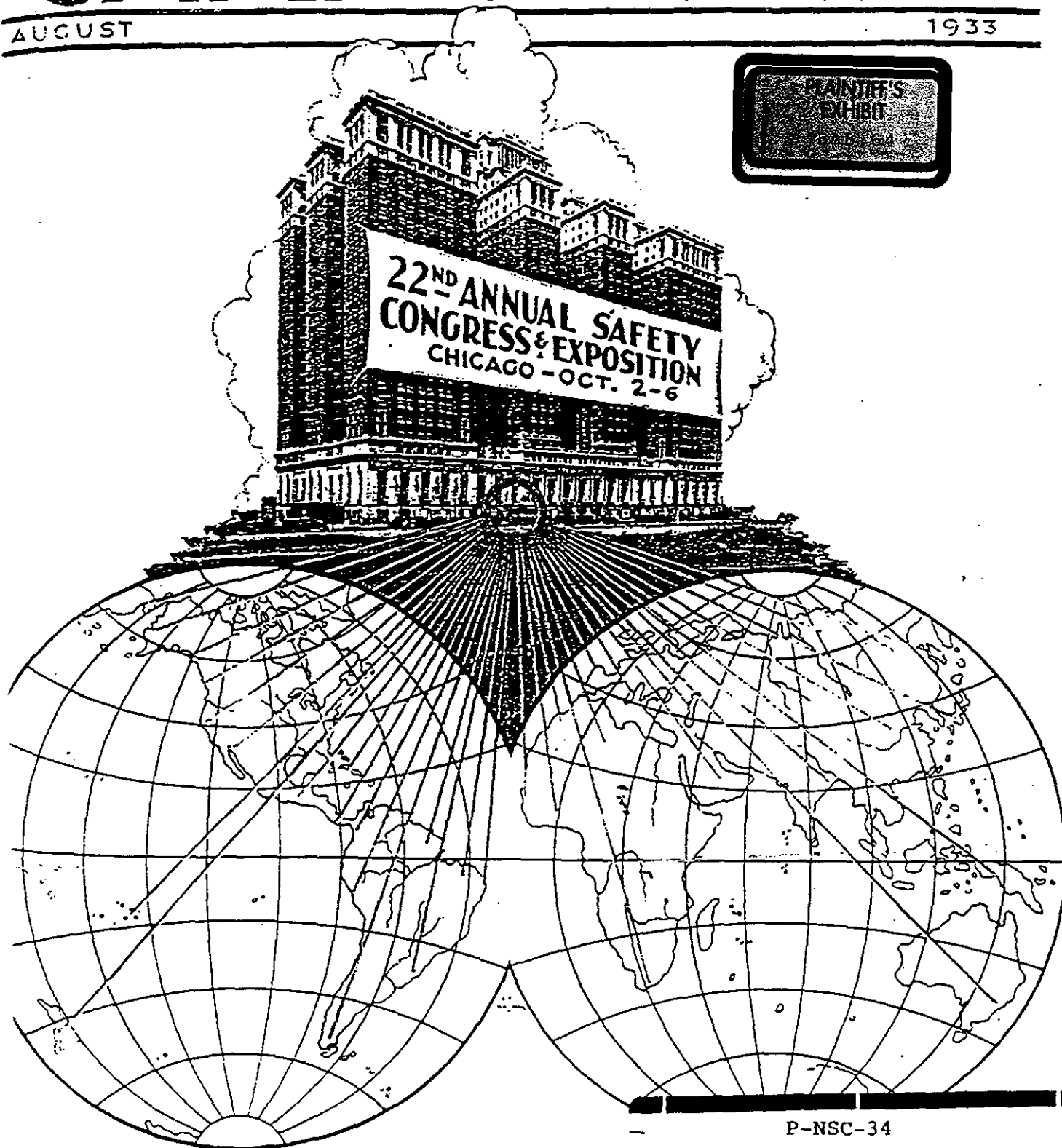
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The Mechanical Control of Occupational Diseases

By DAVID S. BEYER*

THE mechanical control of industrial disease cannot be covered adequately in a single article; all we can hope to do is to touch upon a few of the important points encountered by the plant managers who are struggling with this problem today.

There are some forty different diseases included in the compensation acts of various American states; in Massachusetts, Connecticut and several other states there is no definite list of diseases that are compensated, but these diseases are considered as "personal injuries" under the law and compensation is paid without any specific schedule of diseases.

Many of these diseases are of frequent occurrence. Probably most of us outside the medical profession have never even heard of "Gonioma Kamassi" (African boxwood) or "miner's nystagmus," which appear on some of the state lists. A half dozen of the more important diseases, however, will probably cover ninety percent of the total payments being made throughout industry for all industrial diseases today.

An analysis of approximately \$300,000 in losses of one insurance company doing a general workmen's compensation and liability business, for recent industrial disease claims, showed 54 per cent for cases involving pneumoconiosis (including silicosis, asbestosis, etc.) 26 per cent for lead poisoning, 9 per cent for various forms of dermatitis, 5 per cent for benzol, and the remaining 6 per cent for scattering causes such as carbon monoxide, carbon tetrachloride, chrome and chlorine.

We will accordingly look at the subject from the standpoint of these few important causes, bearing in mind that the most important of all is covered by the general heading of pneumoconiosis, or diseases caused by dust. Of these diseases the most serious come from inhaling the silica found in sand, granite dust, abrasive powders, etc.

*Vice-President and Chief Engineer, Liberty Mutual Insurance Company, Boston, Mass. (A paper read at the Twelfth Annual Safety Conference of the Massachusetts Safety Council.)

- Both the engineer and the physician are needed in protecting the health of the worker and the pocket book of the employer. In this article Mr. Beyer presents the engineering side of the problem. In the June issue Dr. W. Irving Clark discussed it from the point of view of the physician

When the subject of dust is mentioned most of us probably think of visible particles. In fact, much of the dust removal work, even by companies specializing along this line in the past, has been directed at this form of dust.

Medical research has shown us, however, that the dust that is most dangerous, through its deep inhalation into the lungs, is so small that the individual particles are invisible and can only be seen by the naked eye if they are gathered in a dense cloud, which may have the appearance of a gray fog.

We are told that the amount of dust found in the lungs of miners who have died of silicosis is about 13 grams, or approximately half an ounce -- about enough to fill a ten-cent soda-mint bottle.

Microscopic Menaces

Some idea of the problem of collecting such infinitesimal particles may be had when we further learn that these 13 grams contain some 20 million million particles; many of them are about the size of the tiny globules of tarry substance that make up cigaret smoke, that is, about a hundred thousandth of an inch in diameter. If they were equipped with legs they could march fifty abreast through the hollow center of a human hair!

So little has the seriousness of this hazard been appreciated in the past that it is not uncommon to go into a plant and find four or five tons of this fine dust which has floated in the air and settled on the roof trusses and overhead structures of the building. Here it may be dislodged by gusts of air or vibrations from moving cranes, etc. If one

*See Dust Respirators, U. S. Bureau of Mines Technical Paper 341, P. 1

stops to figure how many 13-gram bottles are contained in a ton of this dust, its potentialities are appalling. The first need is to get rid of these unnecessary accumulations, and then try to prevent their recurrence.

Many a plant manager will say, "Why go to all the trouble and expense necessary to catch this dust when, in most cases, it isn't worth anything after it is caught?" The answer is that it is better to spend the money and effort in getting rid of the dust than to be overwhelmed by occupational disease claims, as is the case with many industrial concerns today.

In one section where there is a so-called "dusty" trade employing only about 2000 men on an annual basis, there have been 92 occupational disease claims during the latest available five-year period (68 of them for death or permanent total disability) with combined losses of nearly \$300,000.

In some industries the cost of industrial disease is now four or five times that of all other industrial accidents combined. Many concerns that have serious occupational disease hazards extending over a period of years find themselves virtually uninsurable, because of the heavy liability for claims that has been built up as the result of past exposure.

A Matter of Self-Preservation

It follows, therefore, that as a matter of self-preservation plants in these industries must start immediately a comprehensive program of improvement that will at least check the development of new cases.

In general, the most reliable way to correct a dust hazard is to install exhaust

the point where it is generated
been worked out very effectively for such
equipment as grinding and buffing
wheels.

Unfortunately a complete system of
dust collecting and separating for a
large department costs a lot of money—
more than many plants feel they can
possibly afford under present business
conditions.

Temporary Expedients

For such cases there may be other al-
ternatives or temporary expedients that
will at least tide matters over until im-
proved business conditions warrant the
installation of a permanent dust re-
moval system.

For instance, the manager of a plant
recently visited by the writer stated that
they had already spent \$80,000 in ex-
haust equipment and had not yet fully
solved the dust problem. In this indus-
try, the use of oil which has been sprayed
on the material in some cases in the past,
to improve its handling in the machinery
and processes, offers a promising solu-
tion to the dust problem. Dust counts
in some plants using the oil show reduc-
tions of 90 per cent or more in millions
of particles per cubic foot, and if further
tests corroborate these results it offers
a simple and comparatively inexpensive
method of correcting the dust hazard in
one industry.

In other operations, such as the
shaking out of foundry castings, it may
be possible to do this work at night, by
men who are protected by respirators,
and thus eliminate a common exposure
to employees engaged in other opera-
tions in the same room. The use of en-
closed mechanical conveyors and mate-
rial handling systems, properly exhaust-
ed, instead of the old individual hand
methods where the workers were brought
into close contact with dusty substances,
offers a solution in other cases.

The treasurer of one concern with
whom I recently discussed the hazard of
his foundry said, "Maybe we have the
answer right here," and he brought out
the design of a machine which was fab-
ricated entirely from sheets, plates,
angles and other structural shapes,
riveted and welded together, which
would entirely eliminate the castings of
which it was largely composed in the
past.

Where the dusty work is in a perman-
ent location, and too great freedom of
movement is not required, the air-fed

for sweeping and cleaning up dust, the
improved types of filter respirators may
be adequate. In some cases substitutes
may be found for the substance causing
the trouble. This has already been done
in some processes where benzol was
formerly used, and efforts are being
made to extend the use of this principle.

The use of water to overcome dust
hazards is one of the first suggestions
that is usually made. I recently tried to
explain this problem to an industrial
manager and after telling him that the
dust which causes the trouble is less
than 10 microns in size, a micron being
about 1/25,000th of an inch, and being
encouraged by his nods which seemed to
indicate that he was following my ex-
planation perfectly, I was a little dis-
concerted at the end to have him say,
"Why can't you get rid of those microns
by washing the air?" Apparently after
all my efforts he still thought a micron
was something like a microbe!

Water has been found rather effective
for laying the dust in some operations
such as mining, sweeping up dusty
floors, etc. In other cases, it has been a
disappointment as, for example, on
grinding wheels, where a dry exhaust
system has proved to be more satisfac-
tory than wet grinding.²

During the conference in South Africa
in 1921, one of the speakers pointed out
the futility of trying to completely re-
move dust clouds by water sprays or at-
omizing, adding the further comment
that a tiny droplet of water may collect
as many as 800 dust particles and then
being inhaled is like bombarding the
lungs with shrapnel instead of single
rifle fire.

Unwarranted Confidence

Where exhaust equipment is installed,
poor maintenance of these systems
whereby their value is reduced or entire-
ly vitiated is altogether too common. An
inquiry in a plant recently as to how the
dust filtering apparatus was working
brought the reply, "Fine!—we haven't
had to even look at it for six years!"
When we climbed a ladder to the roof to
see this miraculous equipment, a touch
on the screens shook a pail-full of dust
from the "clean" side of the separator.

Another common and dangerous prac-
tice in many dust removal systems is

would be lost if it were discharged out-
side the building. In five such systems
where dust counts have been made dur-
ing the past few months there was only
one where there was even a question as
to whether or not the air was fit to be
returned. In one case over forty-seven
million dust particles per cubic foot were
found in the air that was being re-circu-
lated, or many times what we would con-
sider a safe limit!

Ineffective Installations

The salesman who had put in the
equipment had persuaded them that the
filtered air was so much purer than
God's product as represented by the out-
side atmosphere that he had even piped
it into the office; so the manager was
breathing the dust as well as the factory
employees. (Perhaps that might be
called cooperation!)

While it may be going too far to say
that no filtering equipment can make
dusty air suitable for re-breathing, the
constant chance of the system getting
out of order makes it almost as question-
able a practice as an attempt to recover
drinking water from a sewage system.

Installations that are clogged, leaking
and otherwise ineffective are common.
One of our engineers found that the belt
connecting the exhaust fan to the motor
in an overhead installation had been off
for an indefinite period. The motor
switch had been thrown regularly but
no one noticed that there was no exhaust
at the grinding wheels it serviced.

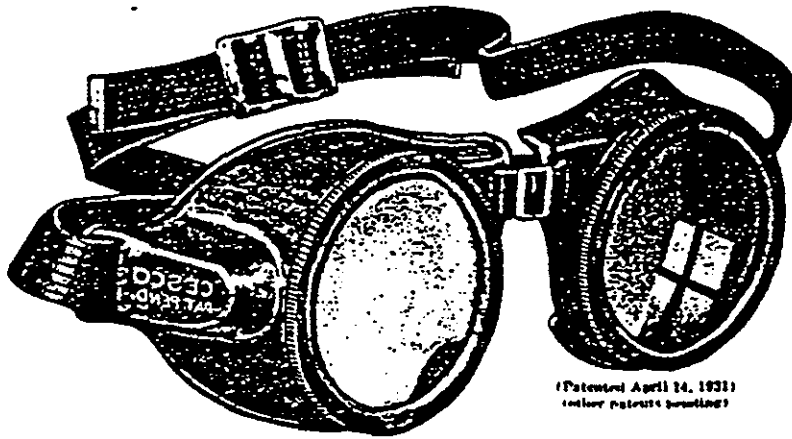
In another installation seen by the
writer recently, a handkerchief held be-
fore the wheel stood out horizontally
showing that the dust was being blown
out toward the operator instead of
being drawn in away from him.

An important point that should be
borne in mind in designing an exhaust
system is that it is highly desirable to
capture the dusts or vapors as close to
the point at which they are generated as
possible, before they have had a chance
to be diffused throughout the air of the
room.

General ventilation may be helpful in
reducing the concentration, but it is ob-
viously of little value to draw the ob-
jectional substances up through a roof
fan as is sometimes done, thereby carry-
ing them past the faces of the operators
who must draw them in with every
breath.

The design of a proper exhaust system
(Please turn to page 34)

¹ See Health of Workers in Dusty Trades
U. S. Public Health Bulletin No. 137,
p. 24.
² "Silicosis"—International Labour
Office, League of Nations, p. 22.



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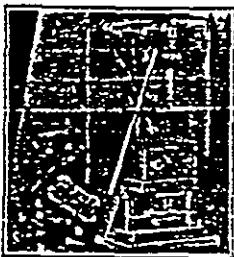
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to effectively control dust requires a thorough understanding of certain engineering principles that are completely lost sight of in many of the installations now in use.

For example, where the dust collector can be so arranged as to enclose the source of dust completely, or almost so, a very complete dust elimination may result, but where the inlet is five or six inches away from the source of the dust its efficiency may be reduced by as much as 90 to 95 per cent, and be wholly ineffective.

Where the exhaust equipment has been looked on in the past as more or less of a nuisance because it is non-productive and could accordingly be slighted at will, it must now be recognized as a primary operating problem, and responsibility must be placed on someone to see that it is kept in first class condition at all times.

And so, to summarize the results of this brief survey of the mechanical control of occupational disease hazards, it is the opinion of the writer that chiefly in this direction lies safety from some of the most serious diseases, if one also includes rearrangement of the processes under "mechanical control," in contrast with the "medical control."

While agreeing that medical supervision of new prospects for employment is of primary importance, in order to prevent placing new employees who have some physical impairment in a position where they will quickly break down as a result of the work hazard, and granting the value of medical follow-up of employees subjected to exposures such as lead and benzol, which bring about a temporary condition that may be checked by medical supervision and a change of occupation, it seems evident that in the most serious industrial disease hazard, that of exposure to silica dust, chief dependence must be placed on elimination or control of the dust.

In installing such equipment it will save money and grief in the long run, to employ a competent engineer who understands the difficulties of collecting impalpable dusts or vapors, and can have a reasonable assurance of getting an effective installation without too much of the "cut and try" method.

See "Velocity Characteristics of Human Under Section," J. M. Dallavalle, American Society of Heating and Ventilating Engineers, June, 1932 and "Studies in Design of Low Velocity Air Flow," J. M. Dallavalle, June, 1932.