MFI. 94.

UNIE VAN SUID-AFRIKA

Department of Mines.

DEPARTEMENT VAN MYNWESE

(Silikose-navorsingsafdeling)

STOF IN ASBESMEULE

Dust in Asbestos Mills.

Die Staatsdrukker, Pretoria
[illegible]

The hand-cobbing of asbestos-bearing rock must be done in the open and in places where dust liberated from other operations does not blow towards the persons engaged in the work.

It was noted also that full advantage is not always taken of the prevailing winds for sweeping out or diluting dust created in the mill.

Mills should be so situated and designed that full advantage can be taken of the prevailing winds for sweeping out or diluting dust created in the mill.

Fig. 1 illustrates a shed which allows the winds to have relatively free passage through the building and yet offers protection from the rains.

It is perhaps hardly necessary to add that as far as possible workmen should operate *from* the windward side, that is, in simple language, they should operate with the wind blowing on their backs so that dust made in any operation should be blown away from them.

Winds, however, will not always be blowing and cannot be relied on entirely to remove dust from the mill. [illegible] ~~of dust production~~ in the notes that follow [illegible] milling.

The general method of dust control and removal described is by means of enclosures and hoods located at the source of production—such enclosures and hoods being connected by means of ducts with an exhausting fan.

The dumping of rock from trucks into the bins constitutes one of the first of the more important dusty operations, and comprehensive consideration of dust control and elimination might well be started from this point in the circuit. When rock is tipped into the bins, unless adequate preventive measures are taken, dust is produced [illegible] workmen exposing them to heavy dust concentrations. Such exposure is unhealthy and needless, since it can easily be avoided by causing the air to downcast through the " bin ".

The bins are connected to the main exhaust system of the mill in such a way that a downward draft of air over the top opening to surface is maintained. In order to do this the surface of the opening should be reduced as much as possible, leaving only sufficient space for the rock to be tipped. Fig. 2 illustrates ducts along the two sides of the bin. These are placed just below the top level of the bin. To prevent rock falling into the ducts deflection plates should be provided as shown in Fig. 2 (*a*).

The size of the duct openings can be obtained in a simple manner. If the area allowed for tipping is 40 sq. ft. and a downward draft velocity of 200 ft. per minute through the bin opening has been decided on, then 8,000 cu. ft. of air per minute must be exhausted. The velocity of the air, passing into the ducts, required to capture the dust is, say, 1,500 ft. per minute. Since 8,000 cu. ft. of air per minute must be exhausted through the two ducts, or 4,000 cu. ft. per minute through each, the open area of the slot must be 2⅔ sq. ft. The ducts should extend the length of the bin. If this measures 8 ft., the width of the duct opening must be ⅓ ft., or 4 inches. In other words, the opening on each side of the bin must be 4 ins. wide by 96 ins. long.

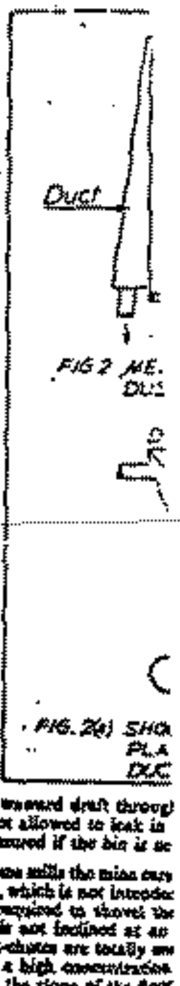

FIG 2 ME...
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FIG. 2(a) SHO...
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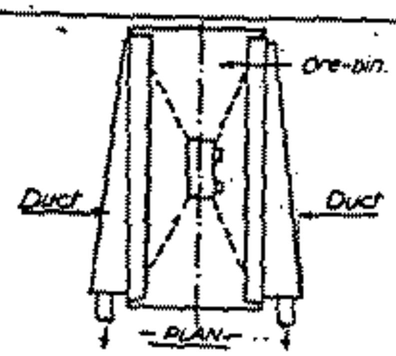

FIG. 2 METHOD OF EXTRACTING DUST FROM ORE-BIN.

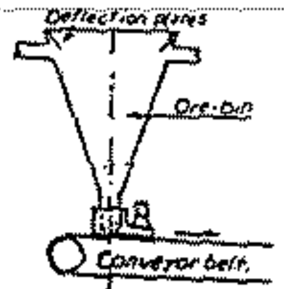

FIG. 2(a) SHOWING DEFLECTION PLATES IN FRONT OF DUCT OPENINGS.

A downward draft through the top of the bin will only be maintained if air is not allowed to leak in through the bottom of the bin, and this can only be assured if the bin is never emptied.

At some mills the mine cars tip the asbestos-bearing rock into an inclined box-chute, which is not intended for storage purposes. It is often seen that a native is required to shovel the rock down this chute due to the fact that the floor is not inclined at an angle sufficiently high for the rock to run. These box-chutes are totally enclosed as a protection against rain and there is usually a high concentration of dust in the air in these enclosures. By increasing the slope of the floor of a box-chute there is no necessity for any person to work in this place, and the dust made during the tipping of rock can be confined by rubber-belting curtains closing the inlet and outlet openings of the box.

[illegible] Fig. 3 (a) illustrates a hood suitable for dust removal at the point where a chute feeds on to a belt, and Fig. 3 (b) shows a hood arranged for collecting dust made during the transfer of rock from one conveyor belt to another. The ventilating volume required at each of these points is 750 cu. ft. of air per minute. It is common practice to hang leather or canvas strips over the openings to cut down the air leakage, but enough open area must be left for air to enter otherwise the dust will not be carried away.

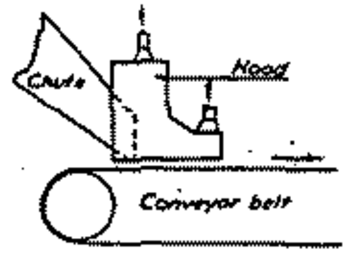

FIG. 3(a) ARRANGEMENT FOR COLLECTING DUST MADE AT DELIVERY POINT TO CONVEYOR BELT.

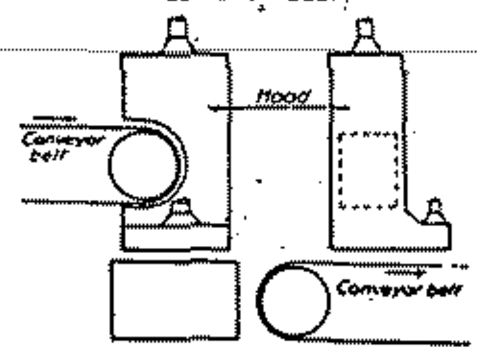

FIG. 3(b) ARRANGEMENT FOR COLLECTING DUST MADE DURING TRANSFER FROM ONE CONVEYOR BELT TO ANOTHER

[illegible] To overcome the dust problem, crushing units usually have to be completely hooded as illustrated in Fig. 4. The discharge from the crusher can be dealt with in a similar manner to that indicated for conveyor belts.

transfer points. Fig. 3 (a) illustrates a ... point where a chute feeds on to a ... used for collecting dust made during ... belt to another. The ventilating ... is 750 cu. ft. of air per minute. It ... canvas strips over the openings to ... open area must be left for air to enter ... away.

...eyor belt

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...aking down lump rock to a finer size ...anied by the production of much dust. ...hing units usually have to be completely ...he discharge from the crushers can be ...hat indicated for conveyor belts.

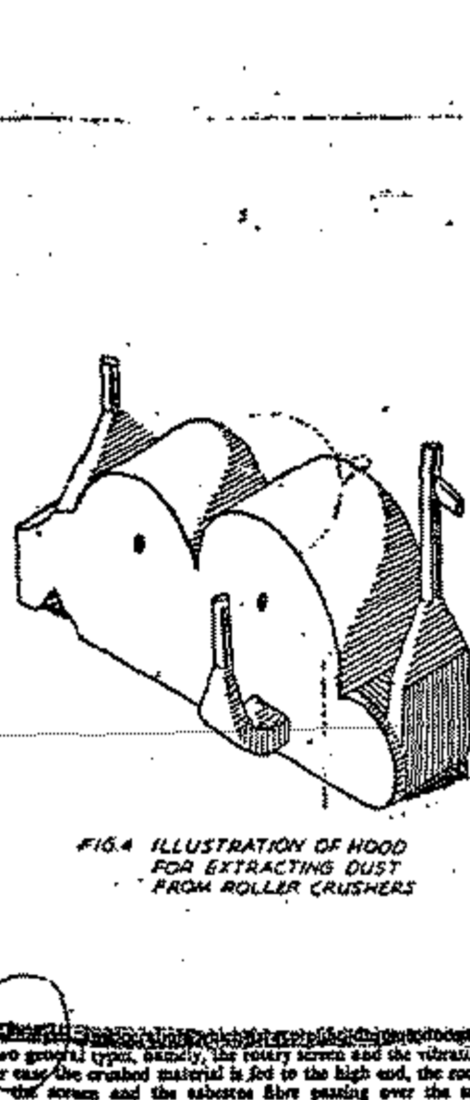

FIG. 4 ILLUSTRATION OF HOOD FOR EXTRACTING DUST FROM ROLLER CRUSHERS

[illegible] Screens are of two general types, namely, the rotary screen and the vibrating screen. In either case the crushed material is fed to the high end, the rock passing through the screen and the asbestos fibre passing over the screen and delivering into the chute at the lower end. Arrangements for removing dust made at screens are shown in Figs. 5 and 6.

The outlets, at the hopper and the screened-fibre-chute, should also be fitted with hoods as previously illustrated. The air volume for ventilation of screens is calculated on the basis of 75 cu. ft. of air per minute per square foot of cross-sectional area for rotary screens, and screen box area for vibrating screens.

Mixing of the various grades of fibre is one of the dustiest operations in the mill. To minimise the dust made by this operation, it is preferable

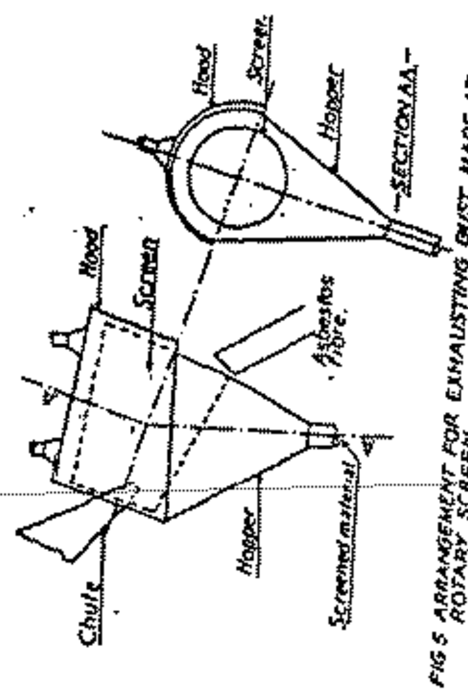

FIG 5 ARRANGEMENT FOR EXHAUSTING DUST MADE AT ROTARY SCREEN.

that mixing should be done by mechanical means, that is, with the aid of a rotary screen where possible, and the usual precautions taken against the liberation of dust into the atmosphere. If mixing is done manually, the fibre may be turned over, under a large canopy, the bottom edge of which is below breathing level, by means of long-handled forks made of some light material. The apex of the cone-shaped canopy is connected to the exhaust air system. This is illustrated in Fig. 7.

[illegible] fibre is another operation where the workman [illegible] very dusty atmosphere [illegible] the rush of air [illegible] blown [illegible] upwards. [illegible] may be over-come by installing a hood over the bag being filled. The workman's arms are pushed into loose fitting sleeves which are a tight fit round the wrists.

See p.9 Diagram

FIG 5 ARRANGEMENT FOR EXHAUSTING DUST MADE AT ROTARY SCREEN.

..., that is, with the aid of a ... ions taken against the ... is done manually, the ... bottom edge of which ... that forks made of some ... opy is connected to the

... tion where the workman ... asbestos into the bag ... ds. This may be over- ... The workman's arms ... as it round the waist.

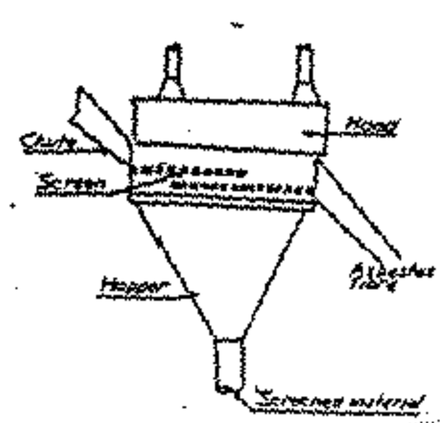

FIG 6 ARRANGEMENT FOR EXHAUSTING DUST MADE AT VIBRATING SCREEN

A window is provided through which he can see what he is doing. If a stamp is used to press the fibre into the bag, the hood must be made sufficiently high to accommodate one, the hood is then reduced in size to connect to the dust exhaust system. (See Fig. 4). The velocity of air required to control the fibre dust is 30-50 ft. per minute.

The dust exhaust system must be properly balanced, that is, sufficient suction must be provided to capture the dust and the air velocity must be high enough to convey the dust to the point of disposal. On the other hand, the air in the system should contain the highest possible concentration of dust in proportion to the quantity of air used.

No exhaust system can function as intended if it is forced to draw air from a partial vacuum, so that, although it is impracticable to enclose the source of dust, enough opening area must be left for air to enter otherwise the material will not be carried away.

[illegible] system and depress [illegible] points where the dust is to be collected [illegible]. A common position of a leak is at joints of the pipes and leaks at these points become more serious the nearer they are to the intake to the fan.

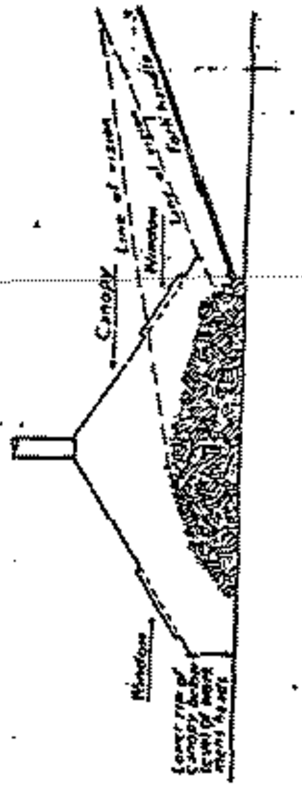

FIG 7 CANOPY FOR EXHAUSTING DUST MADE DURING HAND MIXING OF ASBESTOS FIBRE

The purpose of an exhaust system is to bring dusts, etc., into a hood and to convey them to a suitable place for disposal. This is accomplished by creating an air movement in the vicinity of the source where the dust is generated. The air movement must be great enough to keep the dust from dispersing into the air. In general, most substances are controlled when the air velocity at the source is roughly about 200 ft. per minute. The followin has upset the balance of a dust extraction where the dust is to be collected, of power. l at joints of the pipes and leaks at these nearer they are to the intake to the fan.

FIG. 7 CANOPY FOR EXHAUSTING DUST MADE DURING HAND MIXING OF ASBESTOS FIBRE

em is to bring dusts, etc., into a hood and er for disposal. This is accomplished by vicinity of the source where the dust is ust be great enough to keep the dust from l, most substances are controlled when the y about 200 ft. per minute. The following

equation is used for calculating the quantity of air required to draw dust particles into freely suspended small exhaust hoods, e.g., the hood suspended over a conveyor belt:—

$$Q = V(10x^2 + A).$$

where Q = quantity of air in cu. ft. per minute.
A = area of hood opening in sq. ft.
V = control velocity in linear ft. per minute (control velocity is the air velocity required at the point of escape of the contaminant into the atmosphere to accomplish a satisfactory capture).
x = distance in feet from hood face to point of contaminant release.

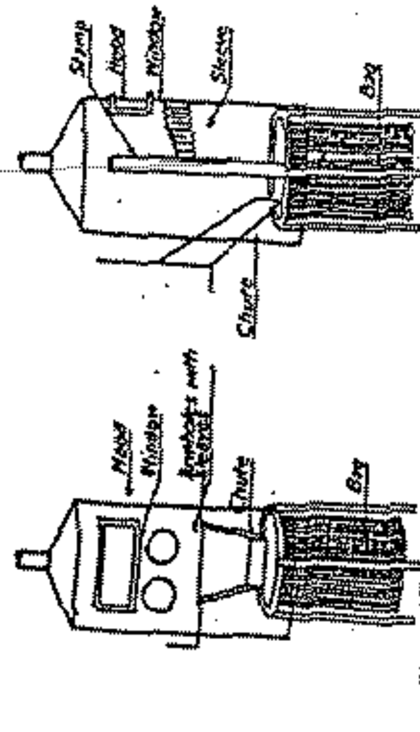

FIG. 8 [illegible] EXHAUSTING DUST MADE DURING [illegible]

The piping of the dust exhaust system must be properly propo[rtioned]
to achieve the object of capturing the dust and conveying it to the dis[charge]
point. A well-designed system is one where the main pipe at any po[int]
has an area equal to the area of all the branches together from the furth[est]
end to the point in question. Take, for example, the layout shown in Fig[. 9.]
What should the area of the main at A_4 be?

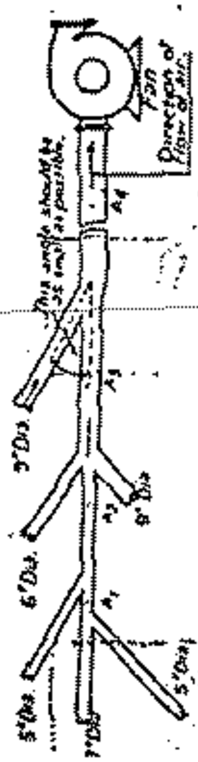

FIG. 9. LAYOUT ILLUSTRATING DUST EXTRACTION SYSTEM.

Beginning with the remote end, we have a diameter of 7 ins. Th[is]
corresponds to an area of 38·5 sq. ins. It is joined before the point A_1 by
5 in. duct having an area of 19·6 sq. in. The area at A_1 is, therefore, 38[·5]
+ 19·6 = 58·1 sq. in. The diameter at A_1, will be, therefore, that wh[ich]
will give an area of 58·1 sq. in. which is, to the nearest half inch, 8½ [in.]
Next we have a branch of 5 in., and adding this area to the area at A

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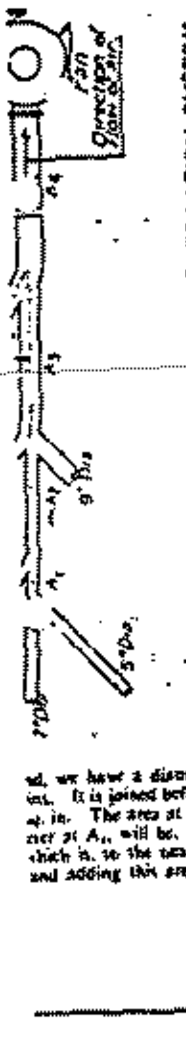

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which is, to the nearest half inch, 8½ in.
and adding this area to the area at A_1,

we get the area at A_2 = 58·1 + 19·6 = 77·7 sq. in. Adding to this the areas of the 6 in. branch (28·3 sq. in.) and the 9 in. branch (63·6 sq. in.) we get area A_3 = 77·7 + 28·3 + 63·6 = 169·6 sq. in. which gives a diameter, to the nearest half-inch, of 14½ in. Continuing to the last branch, 9 in. (63·6 sq. in.) we get the area at A_4 = 169·6 + 63·6 = 233·2 sq. in. The diameter equivalent to this area, which is also the area of the fan inlet, is slightly more than 17 in.

Often 20 per cent. excess area, which gives better distribution of flow and lower power consumption, is added to that of the main at every point where a branch enters. Where this is done, the diameters of the mains corresponding to 1·2 greater than those calculated above are obtained.

To secure the smoothest flow of air possible in the headers, branch pipes should enter the header at an angle as small as possible in the direction of flow of the air. The abrupt entry of air, as would be the case of air entering from a branch pipe at right angles to the header, causes turbulence which causes loss of momentum of the stream of air.

The suction at the fan is the sum of the suction at the hoods and the cumulative resistances of the piping, elbows, and other units, in series between the hoods and the fan.

On straight piping it is found that a pipe 40 times as long as its diameter causes a resistance to flow, or friction pressure, equal to the velocity pressure existing in the pipe, e.g., in a 6 in. diameter pipe with air travelling through it at a velocity pressure of 1 in. water gauge, it is found that for every 20 ft. of straight pipe (i.e., 40 times the diameter) the resistance will equal 1 in. water gauge.

Elbows and bends also cause considerable loss in power due to friction and should be eliminated wherever possible. Elbows or bends with a radius of approximately 1½ times their diameter have a friction loss equal to a straight pipe with a length of 6 times its diameter, e.g. a 6 in. elbow with a radius 1½ times its diameter is equivalent to adding 3 ft. of 6 in. pipe. The use of baffles for regulating purposes is not recommended.

It may be found that a well-designed plant is not working efficiently and this is usually found to be, if all the hoods and coverings are properly in place, due to partly choked pipes or a "silted up" fan, the blades of which are dirty. Fans will stay cleaner for a longer time if the dust trap or cyclone is between them and the sources of dust. Periodical inspection of the system to ascertain when piping and fan should be cleaned is essential in any installation and in this connection inspection doors with wing or thumb type nuts should be provided, and hoods and sealing equipment should be strong enough to stand frequent dismantling without distortion, so that the hoods or whatever is provided to prevent the dust nuisance will last as long as the plant itself.

The medium of transport of dust in a local exhaust system is air and the settling of dust in the piping system is usually due to insufficient velocity. Most dusts are conveyed at velocities exceeding 3,000 ft. per minute.

Dust traps which are properly sealed against air leakage might be provided where very coarse and heavy dust is produced. As this dust is usually from waste rock it can be allowed to fall into a tray of water, otherwise the trap should be damped down and cleaned during an off-shift