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Report on Conferences between Employers and Inspectors concerning

Methods for Suppressing Dust in Asbestos Textile Factories

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Home Office,
10th April, 1931.

To the Right Hon. J. R. CLYNES, M.P., His Majesty's Principal Secretary of State for the Home Department.

Sir,

In the Report by Dr. E. R. A. Merewether and Mr. C. W. Price published in March, 1930,* it was made clear that the principal safeguard against the ill effects of asbestos dust on the lungs of the workers is to be found in improved ventilation and dust suppression. At the same time it was indicated that new problems in ventilation were involved and that much experimental work would be necessary—more particularly in the textile branch of the industry—before a decision could be reached as to the best methods to be applied to the various machines used in the processes.

Following on the publication of the Report, the asbestos textile manufacturers were invited to a Conference at the Home Office to discuss these problems. At this Conference there was complete agreement that everything possible must be done to suppress dust and the manufacturers undertook to render every possible assistance.

As an initial step, it was decided to set up a Committee consisting of three representatives of the industry and two of the Engineering Inspectors of Factories. This Committee was constituted as follows:—

Mr. Leonard Ward, H.M. Senior Engineering Inspector of Factories (Chairman).
Mr. J. Gow, The Cape Asbestos Co., Ltd.
Mr. W. C. Fenton, British Belting Asbestos, Ltd.
Mr. P. G. Kenyon, Turner Bros. Asbestos Co., Ltd.
Mr. C. W. Price, H.M. Engineering Inspector of Factories.

I now have the honour to submit the Report of this Committee. Complete agreement was reached, and a most helpful series of recommendations (pages 9 to 35) adopted by the Committee has been subsequently confirmed by a second Conference of Manufacturers held on 17th March, 1931. This Report has also been communicated to the General Council of the Trades Union Congress, who have made certain suggestions which will be taken into account in drafting a Code of Regulations under the Factory and Workshop Act, 1901, to give statutory effect to the Agreements arrived at by the Conferences.

There is one matter referred to in the Committee's Report which calls perhaps for some comment.

* Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry. *H.M. Stationery Office* (34-206, Price 1s. 5d. with postage).

The Committee have pointed out (page 6) that in some textile processes, the amount of dust normally evolved appears to be too small in the light of present knowledge to warrant special recommendations being made for its suppression, and that they have therefore embodied in the Agreements their opinion in respect of each of these processes whether or not the amount of dust calls for the application of remedial measures at the present time.

This opinion is necessarily based on one important assumption, namely, the existence of a critical limit of dust concentration below which workers may be employed without injury to health. As the Committee rightly observe, the only working basis that can be adopted at present is a finding in the previous Report which suggests that the conditions in flyer spinning carried on without exhaust may be regarded as the "dust datum"; it is however desirable to emphasise that this limit is clearly provisional and is subject to alteration in the light of further medical experience.

In conclusion, I wish to record my high appreciation of the public spirit shown by the leading manufacturers in this industry, through their ready consent to pool for the benefit of their industry their experiences in regard to the difficult problems to be solved, and also of the valuable results which have only been achieved by the expenditure of much time and labour on the part of the Committee.

I am,

Sir,

Your obedient Servant,

GERALD BELLHOUSE.

Chief Inspector of Factories.

REPORT ON CONFERENCES BETWEEN EMPLOYERS AND INSPECTORS CONCERNING METHODS FOR SUPPRESSING DUST IN ASBESTOS TEXTILE FACTORIES.

The Report issued in March last on " Effects of Asbestos Dust on the Lungs and Dust Suppression in the Asbestos Industry " * showed that, while exhaust ventilation had been applied with success at many points in both the textile and non-textile branches of the industry, practical difficulties hindered its application to a number of processes, more particularly in the textile factories, in which dust is produced in harmful amount. An informal Conference of asbestos textile manufacturers and Home Office representatives was therefore arranged to consider these difficulties and the best methods which could be adopted generally for suppressing dust in manufacturing and other processes. The Conference, which was fully representative of the Trade, took place at the Home Office on the 8th July, 1930, under the Chairmanship of Mr. D. R. Wilson, C.B.E., H.M. Deputy Chief Inspector of Factories.

The Conference agreed unanimously that everything practically possible should be done to suppress dust and the manufacturers promised their full assistance to secure this result. It was then decided to set up a Committee consisting of three Trade representatives and two technical members of the Factory Department to consider the problem in detail and to collect all information available concerning dust suppressing methods. As the appointed Trade representatives are connected with the larger works they have direct knowledge of the conditions under which the great majority of asbestos textile workers are employed.

The Committee have reviewed the conditions in each textile process and have given special attention to those processes in which the provision of adequate remedial measures has hitherto presented many difficulties, e.g., mixing and blending (in preparatory work), card cleaning, spinning and weaving, and also to the special difficulties appertaining to mattress making, strictly a non-textile process but carried on to an important extent by several textile manufacturers. It was therefore felt that this Report would be incomplete unless this process were dealt with.

The Committee have sought assistance from all asbestos textile manufacturers including those not represented at the July Conference.

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* Referred to throughout this report as " The Asbestos Report."

During the period covered by the Committee's deliberations, opportunity has been taken by the Trade Members of the Committee to experiment, in their factories, with new or improved dust removal apparatus applied to the various processes in which the special difficulties already referred to are met with. The experiments include (1) the use, in place of hand strickles, of a traversing brush, fitted with an exhaust connection to a portable vacuum plant, for cleaning the cylinder and doffers of carding machines; (2) the application of exhaust to mixing and blending (in opening processes) and to ring spinning; and (3) new methods of applying exhaust to weaving. These experiments, which are described later in this Report, have resulted in a gratifying measure of success.

A series of Agreements covering all the processes reviewed has been reached, in most cases embodying specific recommendations for securing the suppression of dust by exhaust ventilation. In addition, the Agreements deal with such matters as ventilation, heating, and the settling of dust extracted from the workrooms.

In some textile processes, the amount of dust normally evolved appeared to the Committee to be insufficient, in the light of present knowledge, to warrant special recommendations being made for its suppression. The Committee have therefore embodied in the Agreements their opinion whether or not the amount of dust so evolved calls for the application of remedial measures at the present time, with the reservation that revision may be necessary if there is variation from the working methods generally adopted, or in the materials now used. The Committee have found valuable guidance from Dr. Merewether's view, stated at page 12 of the Asbestos Report, " that in order to prevent the full development of the disease (asbestosis) amongst asbestos workers within the space of an average working lifetime, it is necessary to reduce the concentration of dust in the air of the workrooms to a figure below that pertaining to spinning at the time over which these cases (i.e., those dealt with in the Asbestos Report) were exposed." For practical purposes, the conditions arising from flyer spinning carried on without exhaust under good general conditions may, it seems to the Committee, be taken as the " dust datum ". Flyer spinning is less dusty than ring spinning to which process exhaust ventilation has now been successfully applied. If, therefore, a particular process appears to give rise to dust in excess of that associated with such flyer spinning, the Committee regard the need for preventive measures as established.

This criterion is simple to apply to processes such as mixing, blending, carding and dry weaving which are obviously more dusty than flyer spinning. But difficulties were found to arise as regards other processes, partly because the Committee felt that they lacked

necessary information of the nature and amount of the fibre or dust in the atmosphere, produced by these processes. The assistance of Dr. Merewether, and of Mr. McNair, Engineering Inspector of Factories, who has made important investigations on dusty atmospheres, was therefore sought concerning these difficulties, which were as follows:—

(1) In certain processes on opened material from which dust has been efficiently removed, a considerable amount of floating fibre may be given off into the air by attrition of the material. The collection by hand, at carding machines, of uncondensed carded fibre, the recovery of side waste from the condensers of finisher cards, and the handling of opened material in disintegrator chambers are cases in point. The Committee were not satisfied at first that in such cases, where there may be much visible long fibre, there is of necessity also finer dust in excess of that produced in flyer spinning, which may be readily inhaled into the lung. From the examination of samples, Dr. Merewether has come to the conclusion that such visible floating fibre is always associated with finer particles invisible to the naked eye, and these are being continually augmented by fracture of the larger fibres. The Committee accept this view and have based some of their recommendations upon it.

(2) In some cases, precise determinations in individual factories may be necessary to ascertain whether the dust evolved in a particular process is in excess of the criterion suggested above.

Similarly, such determinations may also be required to show the extent of the improvement effected by the introduction of any particular method of dust suppression. A gravimetric method of determining the dust content in the air is briefly described in the Appendix, page 36. The Committee recognise that such investigations may have to be undertaken in the future, but felt that the position was such that this report ought not to be delayed on this account.

Notes on each Agreement will be found in the text together with descriptions and, where necessary, drawings of the dust-suppressing plants recommended.

The Asbestos Report contained a number of Recommendations, many of which the Committee have adopted. They have concentrated on Recommendation 1 (application of efficient localised exhaust ventilation at dust-producing points) as being the prime essential. They feel confident that at any rate the majority of the difficulties attendant on carrying out this Recommendation can be overcome, in which case other precautionary measures recommended in the Report become unnecessary.

The Agreements as a whole are aimed at interfering as little as possible with existing working methods or lay-out of premises, e.g., substitution of mechanical methods for handwork, separation of

processes and wider spacing of plant are not specifically urged and, apart from the process of hand strickling (cleaning) of card cylinders and doffers, prohibition of any existing working methods is not suggested. The Committee recognise that improved conditions for the workers might be obtained in some cases by such changes, and indicate later in the report the advantages resulting from the adoption of mechanical methods, but are convinced that the effect of applying exhaust ventilation on the more extended lines which they recommend will result in such a degree of dust control as to leave only minor operations in which the conditions as regards dust are in excess of the "datum" suggested.

The Trade representatives on the Committee are unanimous in supporting the Agreements arrived at, as presenting a practicable solution of many of the problems confronting the industry, but desire to emphasise that they do so in their capacity as individual members and that they cannot commit the Trade as a whole.

The Committee realise that provision of means for carrying out some of the recommendations must take a considerable time, and the Trade representatives expect that a sufficient period will be allowed before requirements based upon them are enforced. They have also in mind that the British factories may be subject to unfair competition if restrictive requirements enforceable in this country are not adopted in foreign countries. They hope, therefore, that some appropriate action may be possible which will lead to uniform international requirements.

W. C. FENTON. - BBA
JAMES GOW. — Cape
P. G. KENYON. - TBA
CHARLES W. PRICE.
L. WARD, Chairman.

8th January, 1931.

AGREEMENTS.

1. *Crushing,—including preliminary Sack Emptying, Rough Mixing on Floor near Crushers, Feeding and Discharging.*

All processes give rise to dust and exhaust draught should be applied. Crushers of both types, i.e., fixed pan and revolving pan, and those of small size, e.g., bowl crushers, should be enclosed except for the necessary working openings. Feed and delivery lattices to be enclosed and/or exhaust applied.

The crusher (Fig. 1), enclosed and exhausted as recommended in the Agreement, is fed mechanically from the enclosed elevator which is supplied from the hand-fed lattice. Exhaust connections are provided at the feeding point of the lattice and at the elevator enclosure.

Where a rough mixing of different grades of asbestos is made on the floor beside the crusher, the exhaust draught applied to the crusher may be utilized, as shown in Plate 1,* to control the dust evolved. The crusher (mortar mill type) is completely enclosed, except for the working opening, in a wooden structure. The enclosure is extended in front of this opening to form a mixing chamber, which is open in front to the extent shown in Fig. 2. The exhaust draught applied to the top of the crusher enclosure extracts the dust produced in the mixing chamber. Work in the chamber is reduced to a minimum. The sacks are taken into the chamber to be hooked on the hoisting rope passing through the top, but are hoisted, turned over and emptied upon the floor from outside. Mixing is also accomplished from outside by long-handled tools. The men enter the chamber to feed the pan after the dust produced in mixing has been extracted. As an additional precaution, respirators are worn. The crushed material is shovelled from the pan through an opening in the side of the enclosure, a cover, kept closed during the crushing, being provided in the woodwork. The material falls into the fully enclosed hopper feed of a sieving machine (see Agreement 6).

2. *Mixing and Blending of Crushed Asbestos.*

The process is dusty and exhaust draught should be applied.

Exhaust ventilation has recently been applied, in one large factory, Plate 2. An exhaust pipe, 12 ft. long is symmetrically placed about 3 ft. 6 ins. above the mixing area which may measure some 15 ft. × 10 ft. Extraction takes place at a series of slots, 6 ins. × 1½ ins., on both sides of the pipe near the bottom. The average duct velocity provided for is 3,000 ft. per minute corresponding to a discharge of about 4,000 cubic ft. of air per minute from the mixing area. This is the first application of exhaust to this hand process but, although much dust is removed, it is not yet clear that this arrangement will fully meet the case. The Committee think, however, that it should be accepted at the present time but it may be that enclosed mechanical mixing machines will be developed in the future.

3. *Sack Emptying and Filling, Floorwork and preliminary Handling Processes involving contact with Asbestos Fibre.*

These operations are dusty and exhaust draught should be applied.

The Agreement is intended to apply to all manipulation of asbestos in opening processes whereby dust is produced. The filling and emptying of

* The Plates follow page 36.

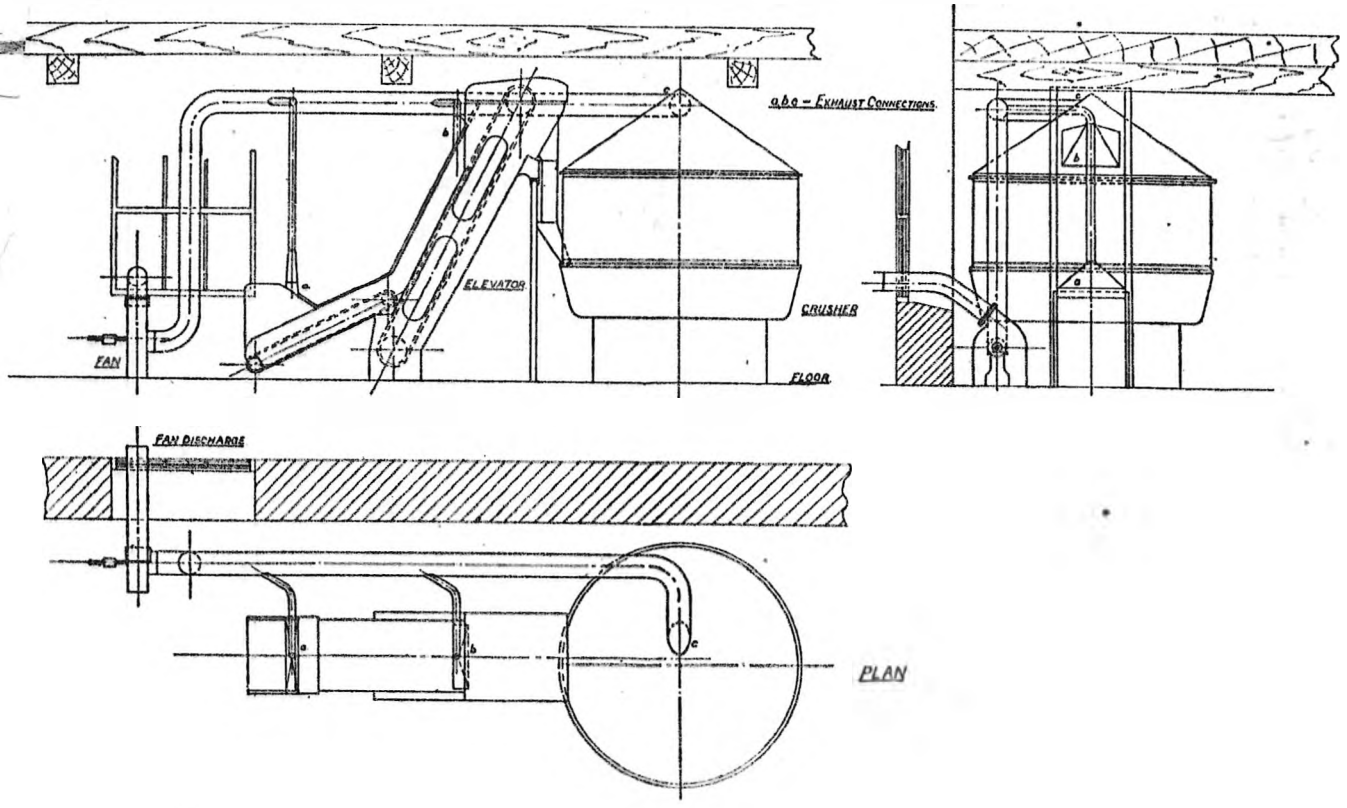


Fig. 1.

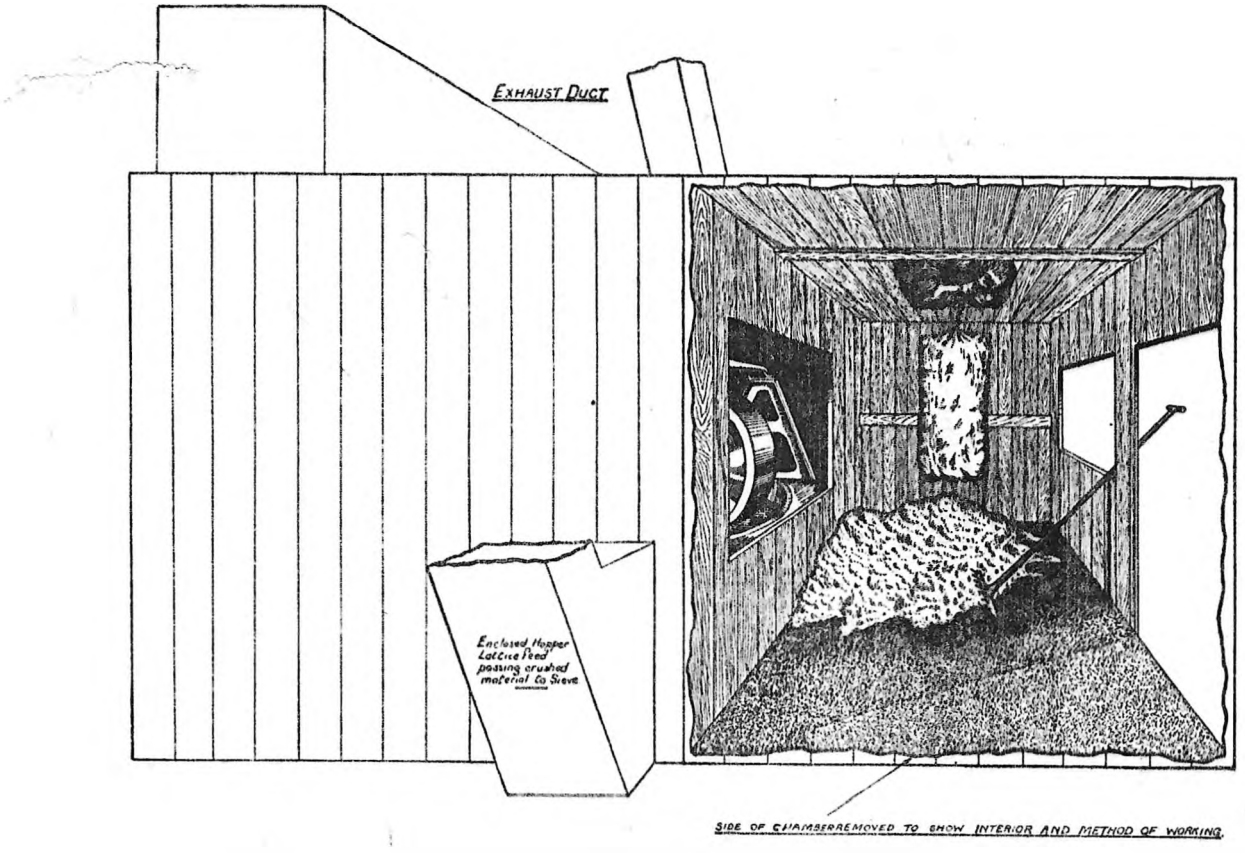


Fig. 2.—Mixing and Crushing Chambers.

:cks and skips, shovelling, raking and weighing are included. The method f applying the exhaust will depend upon circumstances. Plate 1 shows ne method. For such manipulation as is involved in mixing or blending Agreement 2), the exhaust arrangement shown in Plate 2 can be adopted. For manipulation work in chambers, see Agreement 10.

The delivery on the floor of material from machines, entailing subsequent re-collection, should be dispensed with to the greatest possible extent. Bagging lattices, see Agreement 7, can be adopted in many cases, the reversible type (Fig. 3) being of special utility where work is continuous and rapid.

4. *Filling of Lattice and Other Hoppers.*

These operations are dusty and exhaust draught should be applied, or the hoppers so enclosed as to prevent escape of dust.

Lattice and other hoppers covered by the Agreement include those at crushing plants, sieving machines, disintegrators, Crighton openers and cards. Examples of exhaust applied at lattice hoppers are shown for opening plants in Plates 3 and 4—the plant in Plate 4 being fed by shoot from an upper floor—and for a hand-fed disintegrator (Fig. 5).

Safeguards adopted in one factory for the feeding of card hopper lattices are described under Agreement 11.

5. *Separating, to remove Iron.*

The process should be so enclosed as to prevent escape of dust.

Electromagnets can always be enclosed so that dust cannot escape. The Agreement is directed against the use of open apparatus which may give rise to dust.

6. *Sieving.*

(a) *Jig Type.*—The process is dusty. The machine should be effectively covered over on the top and enclosed at the sides, and exhaust applied.

(b) *Rotary Type.*—Dust is produced at the feeding point to which exhaust should be applied. The machine should be enclosed and/or under exhaust.

The Agreement applies to the sieving of both crude and crushed asbestos.

Hitherto, jig sieves have not been enclosed to the extent possible. The sieve shown in Plates 5 and 6 (*a*) is almost completely enclosed, with exhaust draught applied to the top of the enclosure; escape of dust is greatly reduced. The material can be collected at short inclined bagging lattices, thus avoiding the dust associated with hand collection and floor shovelling.

Where a rotary sieve is fed mechanically as from an elevator, and the feeding point is enclosed by the elevator connection (see Plate 4), the exhaust is applied to the casing.

7. *Crighton Openers.*

Dust is produced at the feeding point and at the delivery (e.g., lattice) and both should be under exhaust. The exhaust applied

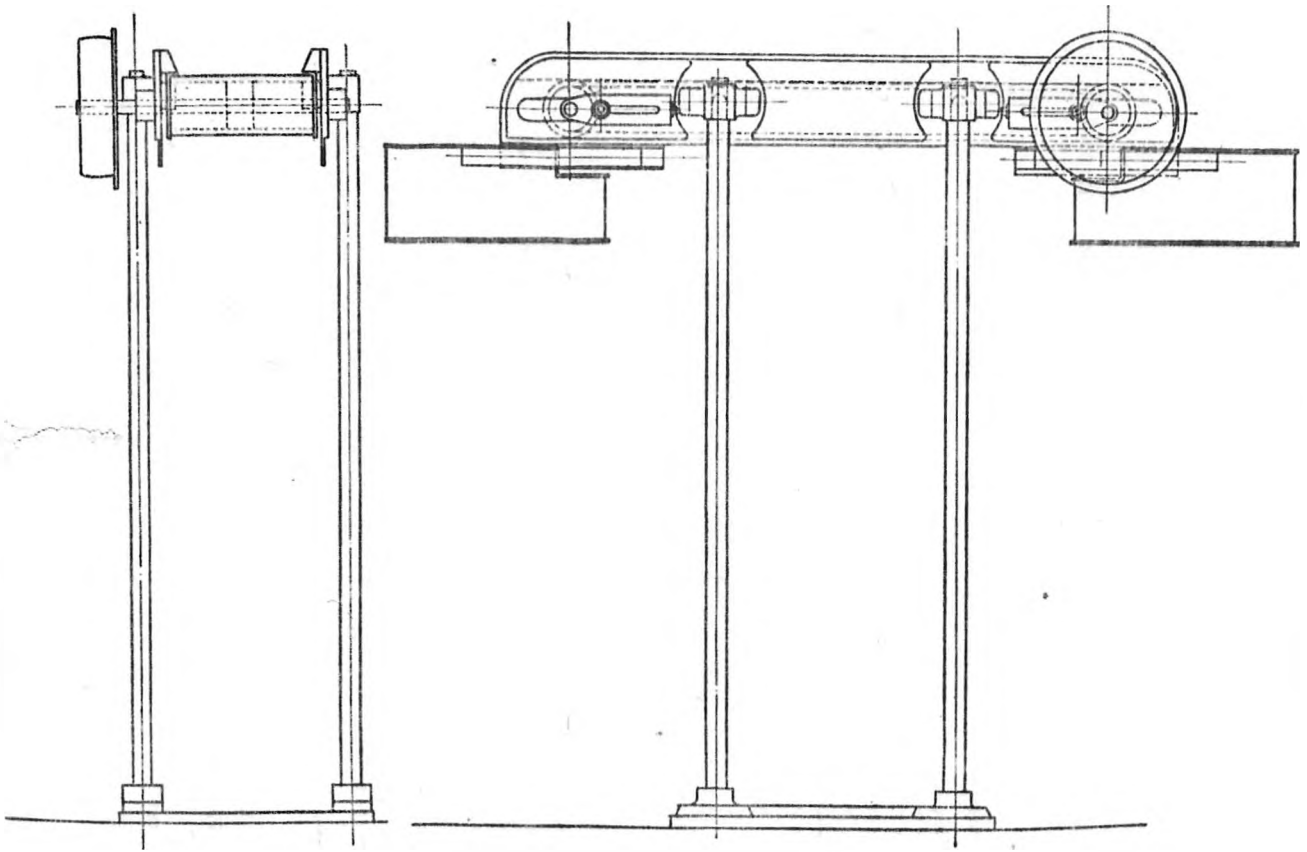


FIG. 3.—REVERSIBLE BAGGING LATTICE.

to the delivery cage by the machine fan may not deal with dust produced on the outside of the cage or lattice and an independent haust connection is then required.

The Agreement applies to openers of both types, i.e. horizontal and rtical.

Exhaust draught should be applied both to hand feeding, and to open echanical feeding, as from an exposed lattice. Exhaust applied to the eding points of vertical Crighton openers is shown in Plates 6 (*a*) and (*b*).

Although the amount of dust produced at delivery lattices or other delivery apparatus connected with Crighton openers varies considerably, the amount in all cases is sufficient to render application of exhaust draught necessary. Delivery lattices and bagging lattices may be enclosed at the sides and above, and exhaust applied as in Plate 6 (*b*). In this case, much of the dust produced within the machine is withdrawn by a self-contained fan through exhaust passages in the framing, connected to the perforated cage from which the opened material passes to the delivery lattice. The draught thus applied is usually incapable of controlling the dust produced at the delivery lattice.

8. *Opening by Willeys, Teasing and similar Machines.*

Dust is produced at feeding and delivery lattices and both should be under exhaust. The exhaust applied to the delivery cages or otherwise by the machine fan (if any) may not deal with dust which may arise from feed rollers, etc., due to overfeeding or other cause and independent exhaust is then necessary.

Opening machines of the willey or teaser types also give rise to dust at feeding and delivery lattices, and the Agreement aims at securing application of exhaust, as already illustrated for Crighton openers (see Agreement 7). The amount of dust emitted at feed rollers may be increased by overfeeding or by an unsuitable speed, matters which should be kept under observation.

Self-contained fans for removal of dust generated within the machines are usually incapable of dealing with the dust at delivery lattices.

9. *Disintegrating.*

Dust is produced at the feed, and exhaust should be applied f the suction draught produced by the machine does not prevent he escape of dust.

The Agreement is intended to apply to all disintegrators. The suction raught produced at the feed point may not be sufficient to carry away ll the dust produced in feeding, in which case exhaust is necessary.

Mechanical feeding is adopted in many cases, but hand feeding is still etained where different grades are treated. The dust so produced is removed, in one factory, by the arrangement shown in Fig. 4. Exhaust is pplied to the chamber into which the fiberized material is delivered, thus roducing a much stronger draught through the feed opening of the disntegrator.

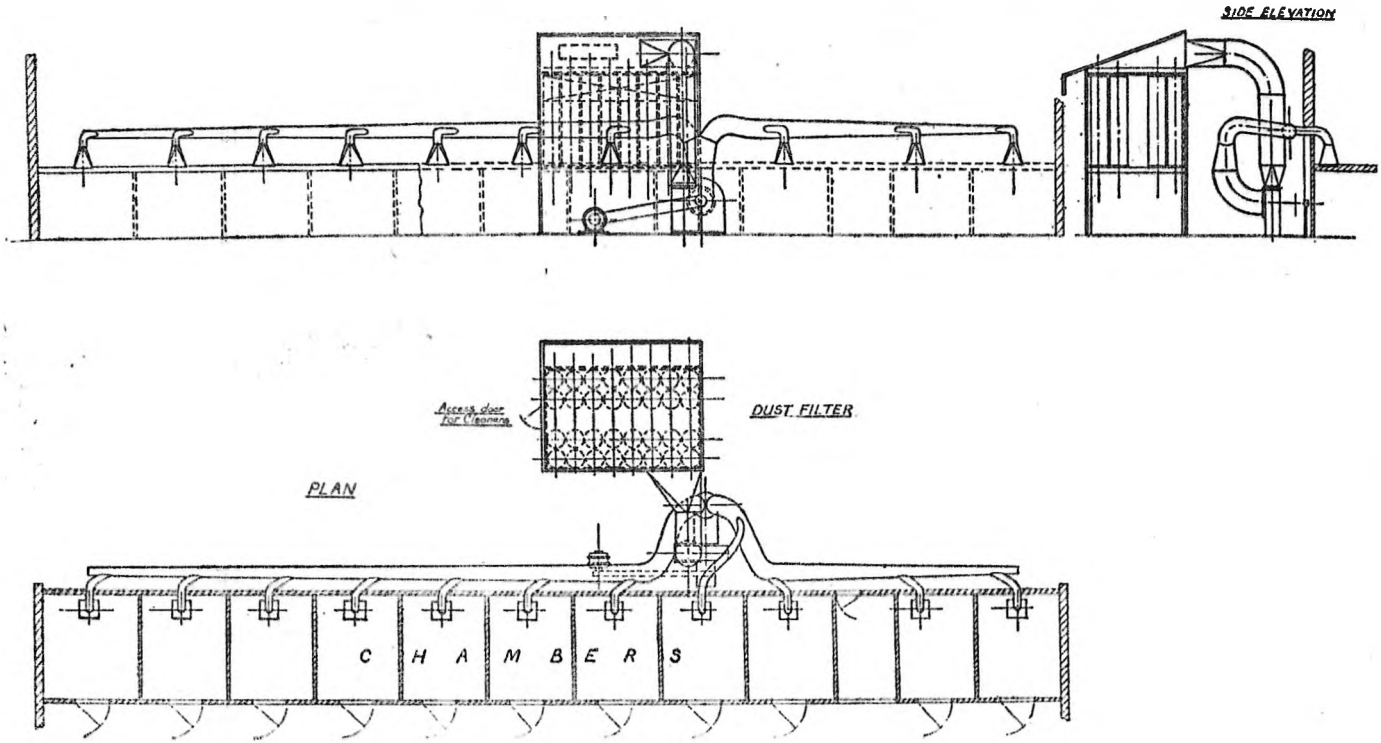


FIG. 4.—EXHAUST AT DISINTEGRATOR CHAMBERS.
Disintegrators (not shown) are above the chambers.

10. *Chambers in connection with Disintegrators, and Willeys, Teasing and similar Machines, and Bins for Opened Material.*

hambers are not necessary for delivery from willeys, teasers imilar opening machines for textile material, and automatic ection can be adopted. This is also true for disintegrators king on certain classes of material and it is hoped that it will ntually prove to be the case for all. In certain non-textile k, e.g., mattress making, a reserve of opened bulk material st be stored and chambers are regarded as essential. Whether se are entered or not, exhaust should be applied to handling nts and in addition possibly other safety measures, e.g., respira-, limitation of hours worked by individuals, etc. Bins to be eated as chambers. Handling includes shovelling, weighing and nilar manipulation.

The chambers dealt with in this Agreement are those in which opened terial is deposited—either by the direct action of the opening machinery by being blown forward by a fan connected to the discharge of the ening machinery—and which are entered by the workers.

Bins are open storage places to which material is taken and from which it re-collected when required.

In view of the serious risk of inhalation of dust resulting from work in mbers and at bins, the Committee have carefully considered whether it s possible to recommend their prohibition but regret that it is not so at present time.

Alternative arrangements can be used for much chamber work. Fig 5 ws a system now applied extensively to deal with opened material from integrators. An exhaust fan connected with the delivery from the dis-egrator blows the material into a large hopper container, from which it collected, under practically dust-free conditions; a travelling band at the e of the container conveys it to a reversible bagging lattice. The velling band is enclosed and "sealed" at the delivery point by a ssure roller. The air, freed of its charge of asbestos, is returned from the tainer, being re-circulated through the system to the fan inlet. Excess entering the system is released at a filtering "balloon" connected to a nch duct on the return air line.

f chambers are discarded, it is important that apparatus which is sonably free from risk should be substituted, e.g., bagging lattices fitted h exhaust as previously described. Storage chambers for mattress making be arranged so that it is not necessary to enter them for the filling of rs, etc. The filling is done from the front under the influence of an aust draught.

ll chambers which are entered should be under an exhaust draught but does not appear to be possible to prevent the inhalation of dust ciently by this means. Pending the elimination of chambers, other cautions should be adopted as indicated in the Agreement.

11. *Carding.*

Exhaust to be applied to all cards at feed apron, licker-in, l of cylinder and each doffer comb and brush. Collection of ed fibre is dusty and exhaust should be applied.

he Agreement is intended to apply to all types of carding machines.

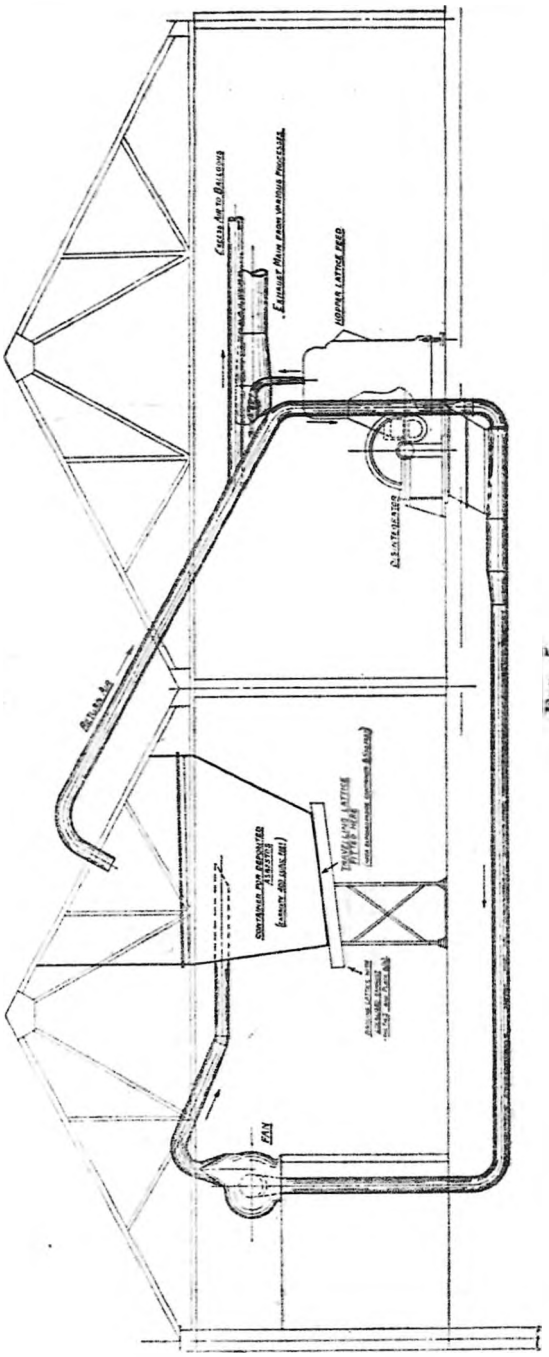


FIG. 5.

The different methods of applying exhaust adopted up to the present time are not equally successful. The Committee have come to the conclusion that the most successful method yet devised of applying exhaust ventilation to carding machines is that in use at Messrs. Turner Bros. Asbestos Co., Ltd., Rochdale. This firm have adopted a standard arrangement which is fitted to each new carding machine installed (Fig. 6). The following description has been prepared in the main from notes supplied by firm:—

Five machines as a maximum are exhausted by one main, the fan discharging to its independent settling plant. After installation, extensions and alterations are not permitted. Not more than one card on each set is permitted to be cleaned at one time. During cleaning a large auxiliary branch connection, which at other times is shut off by a slide damper, is brought into use at the head of the cylinder to increase the air removal from that

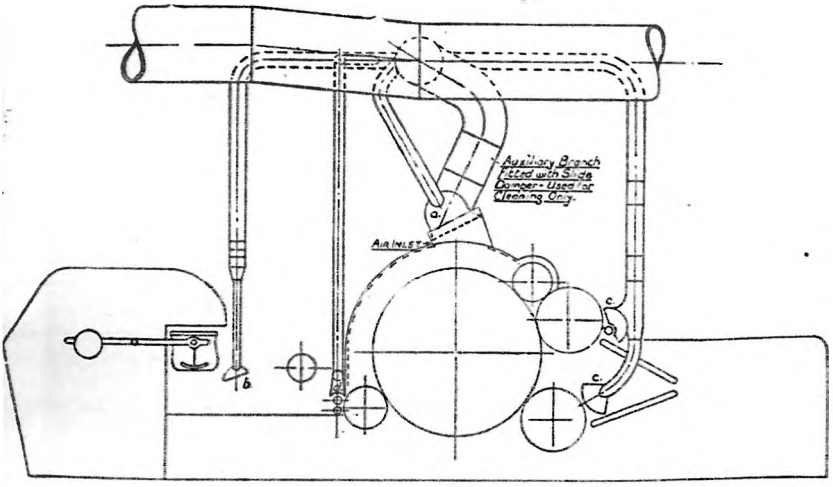


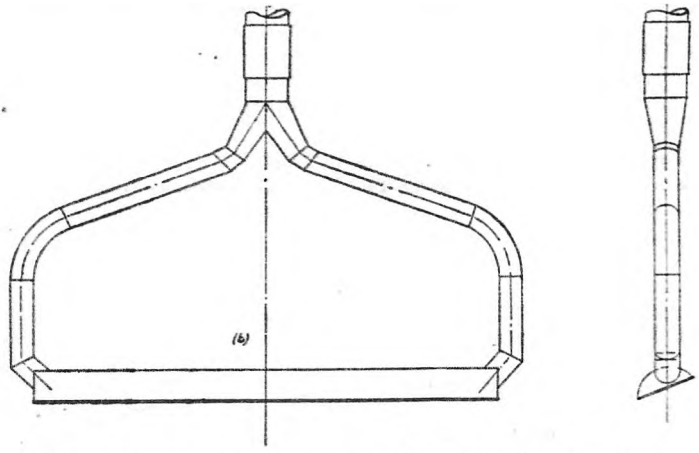
FIG. 6.—EXHAUST FOR CARDING MACHINE.

Applied at: (a) Cylinder head.
(b) Feed Apron.
(c) Fly Combs.
(d) Licker-in.

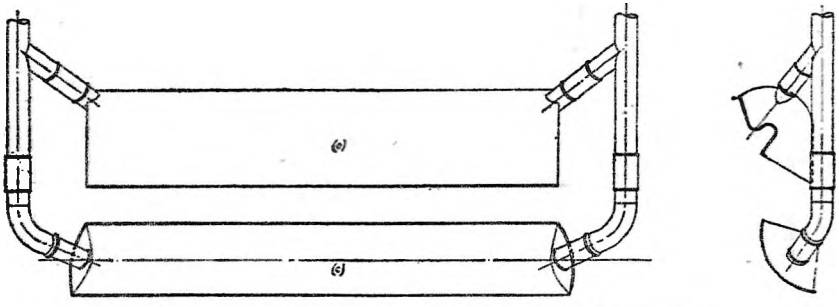
machine by a definite amount provided for in the design, as described below. No slide dampers are provided except those on the branch connection and the distribution of the draught cannot be interfered with. No filtering material is used in the settling system (described later); the resistance and the air volume remain constant.

Exhaust is applied at the following points:—head of cylinder, feed apron, fly combs, and licker-in, at all of which cover hoods are fitted. Branch ducts are connected to both sides of the cover hoods, except at the hood for the licker-in to which a single duct only is connected at one end, directed to control the dust across the entire width of card (Fig. 7). Pyramidal hoods with central branch duct connections have been entirely discarded.

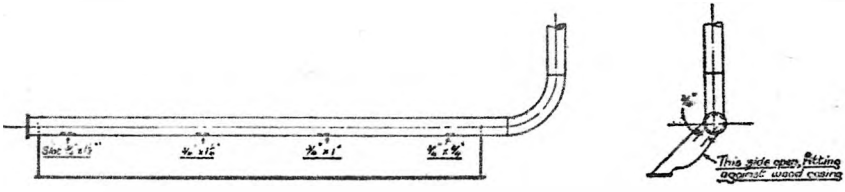
The cover hood for the cylinder head which is specially designed is symmetrically supported 4 ins. above an opening in the top of the cylinder cover, a gap of this depth, as seen from the feeding or licker-in side of the machine, being left for inflow of air from the room (Plate 7). The opening in the cylinder cover is 40½ ins. long (for a card 50 ins. wide) and 13 ins.



FEED APRON COVER HOOD AND EXHAUST CONNECTIONS.



FLY COMB COVER HOODS AND EXHAUST CONNECTIONS.



CLOSE FITTING COVER HOOD FOR LICKER-IN AND EXHAUST CONNECTION.

Note: Alternative to (d).

FIG. 7.

The back and sides of the cover hood are sealed off during carding « swivel wooden flap " valve " shown. The effect of this arrangement t dust rising from the cylinder head is caught by the air entering the ı from the room through the front gap, and carried away with the ıt. Where hoods are fixed directly to an opening in the cylinder this satisfactory result cannot be obtained. The wooden flap, when i back, permits the cylinder cover to be raised when preparing for ıg.

average duct velocity throughout the system should be 3,000 feet per e. An effective area of 152 square inches is provided in the main duct ıch card, 48 ins. to 60 ins. wide, accounted for as follows:—

(a) *For Carding.*

	Sq. Ins.
Cylinder head: two 4-inch connections	25
Feed apron and Licker-in: one 4½-inch connection	16
Fly combs: two 2½-inch connections	10
(approx.) ...	51

(b) *For Card Cleaning and Grinding.*

n additional 100 square inches, for the special 11 in. auxiliary branch nection (cross section 95 sq. ins.), brought into use as required, as pre-ısly explained.

llowing for one grinding connection being in use, effective main duct neters for the set of 5 cards are 14, 15½, 17, 18½, and 20 inches.

he uniformity of distribution throughout the system is further ensured by eful designing, e.g.:—

Reductions of diameter in the main duct are made on the top, ensuring a horizontal base line, and so avoiding any settlement of dust in the main duct.

Branches enter the main at an angle of not more than 30° to the line of flow.

Junctions are smoothly finished internally.

Tinned iron is used to minimize friction.

Sliding and cleaning doors are not necessary but end caps are provided for examination purposes.

Muff couplings are provided for the connections which have to be broken and re-made for cleaning purposes. Pipe ends terminating in muff couplings are wired internally and finished smooth; muff couplings are wired externally.

'arded Fibre.—As previously referred to, the collection by hand of carded e results in attrition of the material which may subject the workers to t. Suitable precautions are necessary including the application of efficient aust draught, which the Committee recognize may be difficult. This can avoided by adopting automatic collection at the machine, as found in tain factories, an inclined lattice (Fig. 8) being provided in front of the fer, to which exhaust is applied as in Fig. 6.

'Scotch" feed and other lattices, for feeding between breaker and sher cards, may give rise to some amount of floating fibre. The move-nt is slow and the material, in the form of a fleece, is but little dis-bed. The Committee regard the amount of floating fibre as likely to o small, provided the lattices are maintained in efficient order, as to er special precautions unnecessary.

e Committee's recommendations to deal with dust in the filling of e hoppers (see Agreement 4) are intended to apply to hopper feed es at carding machines. In one large works, the opened material ought in bags of rubber-proofed fabric; the mouth is somewhat larger

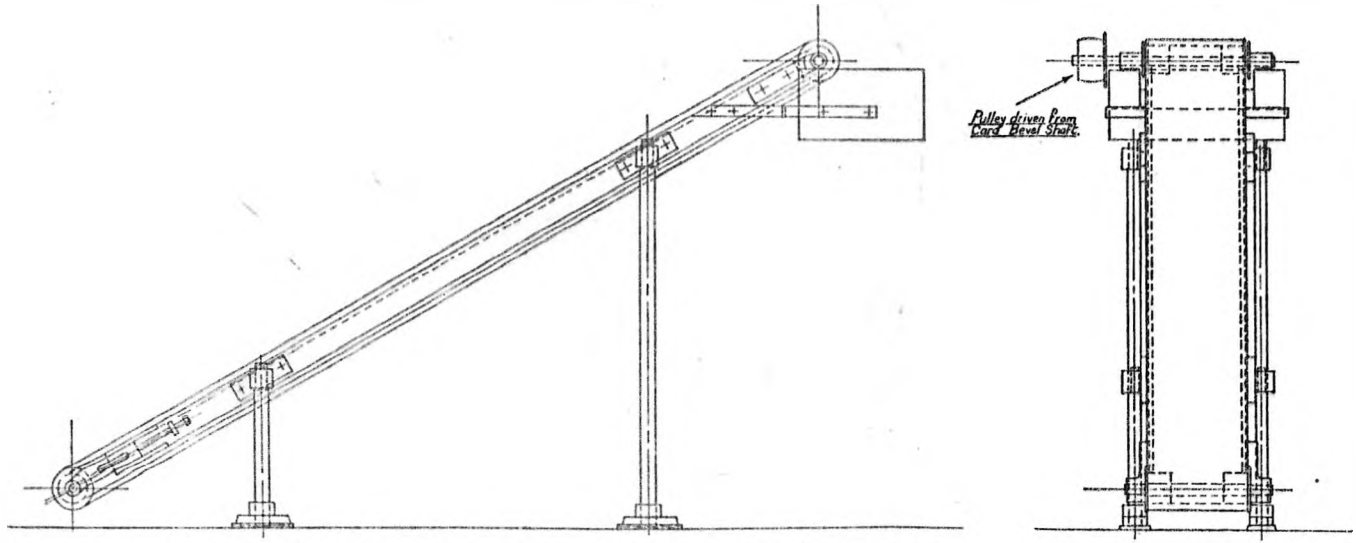


FIG. 8.—LATTICE FOR COLLECTION OF CARDED FIBRE.

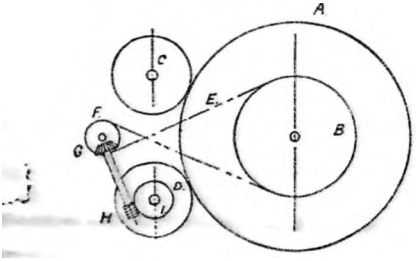
than the bottom. These bags give rise to much less dust than the ordinary sack, as shaking out is not required to loosen clinging material. They are being brought into use for all transport of asbestos within the factory. At this factory, all the lattices are fitted with metal covers kept closed during the process except when feeding is necessary. For this operation, the bag is inserted in the feed opening provided in the cover. Some feed hoppers are provided with cloth covers, but these cannot be recommended.

12. *Card Stripping (Cleaning).*

Hand strickling, or other hand cleaning process before grinding, gives rise to very dusty conditions and should be prohibited.

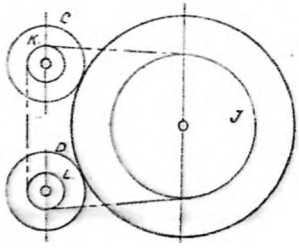
The Asbestos Report drew special attention to the extremely dusty operation of card and doffer cleaning with hand strickles, and to the inadequate standard of dust suppression reached. The Report also referred to the possibility that a mechanically-operated brush might be devised which, with exhaust applied, would be effective in reducing the dust. The Committee find that a brush of this description (Plate 8) designed by Messrs. British Belting & Asbestos Ltd., Cleckheaton, has been on trial for some time and has given much satisfaction both for cleaning and for dust suppression; the Committee are glad to report that the firm have no objection to other asbestos firms adopting this appliance. The following particulars have been prepared from notes supplied by the firm.

A revolving cylindrical brush, faced with card clothing, is almost completely enclosed within a cover, connected by flexible armoured hose to a portable vacuum plant. The exposed portion of the brush effects the cleaning, the dust created being removed by the draught. The brush is mounted on a " Dronsfield " traverse wheel grinder mechanism (No. 120) by which it is moved slowly to and fro across the cylinder or doffer as required. The mechanism is set up in the grinding brackets and is driven in the manner adopted in many textile works for cross traverse card grinding. When the card has run clear and all rollers, clearers, fancies, etc. have been removed, the two doffers are drawn back ¼ in. from the cylinder, suitable distance pieces, e.g. washers, being inserted between the doffer carriage and the main frame. A " Dronsfield " slow motion drive is fitted to the bottom doffer shaft (Fig. 9), this giving the necessary motion, from the opposite side of the machine, to the upper doffer and the cylinder (Fig. 10). The



Diameters A-Cylinder 50"
B. Grooved Rope Pulley 24½"
F - 8"

FIG. 9.



Diameters J - Fancy Pulley, 29"
K and L - 12"

FIG. 10.

diameters of various pulleys required are as marked; that of the card cylinder shown is 50 ins. The pulley B (Fig. 9), which is normally a fast pulley, must be convertible into a loose pulley. For this purpose, a lock bolt has been provided as used in lathes.

The overall diameter of the brush, i.e. over the stripping wire, should be the same as that of the grinding roller. The brush used has an outside diameter of 7 ins. and a speed of 400 revolutions per minute. A surface speed of the card clothing of about 20 ft. per minute has proved satisfactory.

The speed of the traverse is so arranged that for one complete revolution of the cylinder or doffer, the brush, 3 ins. wide, moves slightly less than the width of the wire thereon; in the present instance the movement is 2¼ ins The pitch of the traverse screw is 1½ ins. and a further means of adjustment is provided by the twin pulley drive shown in Plate 8. The pulley A on the tube drives the double jockey swinging pulley B by means of a belt. A second belt drives pulley C, which is fixed on the traverse screw and made so that it can be slightly expanded, allowing the rate of traverse to be adjusted as required. A Sturtevant No. 4 turbine vacuum cleaner is used for collecting the dust.

The Committee feel that, in view of the success achieved with this mechanical cleaning brush, the Trade should at once take steps to adopt it and that the hand process should be prohibited.

13. *Card Grinding.*

Card grinding may be productive of asbestos dust and efficient exhaust should then be applied.

The Agreement applies to the grinding of cylinder and doffers; very little metallic dust is produced and if preliminary cleaning is efficiently done, as with the mechanical brush described under Agreement 12, the amount of asbestos dust should also be small and the ordinary exhaust arrangements provided at the machine capable of effecting its removal.

14. *Grinding of small Card Rollers at Grinding Machine.*

This process is dusty and efficient exhaust should be applied.

Efficient exhaust is readily applicable (Plate 9) to the grinding frame or machine normally used. The enclosure of the machine should be as complete as practicable. The present method of collecting the heavy debris which falls within the machine, by raking the material to the shop floor, gives rise to much dust which would be obviated if shallow containers, e.g. trays, were provided, to receive the material as produced.

15. *Card Waste End Machines.*

The delivery of the fibre by blowing it upon open perforated cages produces dusty conditions and efficient exhaust should be applied.

Waste ends should be collected only under " suction " conditions (Fig. 11). Where a machine of the type shown in Fig. 12 is adopted, the fibre being blown upon perforated cylinders to which exhaust is not applied, dusty conditions are inevitable. The Agreement, in effect, would prohibit the use of such a machine.

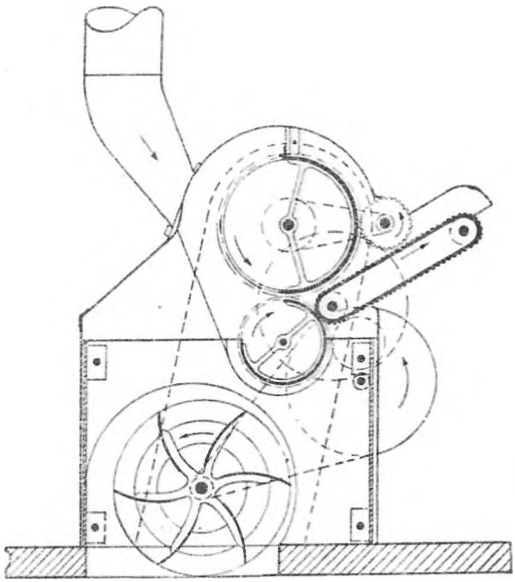


FIG. 11.—CARD WASTE END MACHINE.

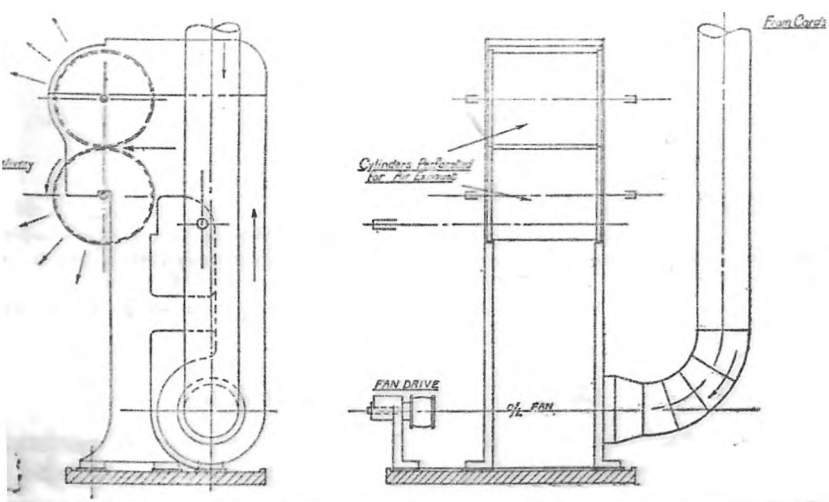


FIG. 12.—CARD WASTE END MACHINE.

(Unsuitable type for collecting Asbestos Waste End.)

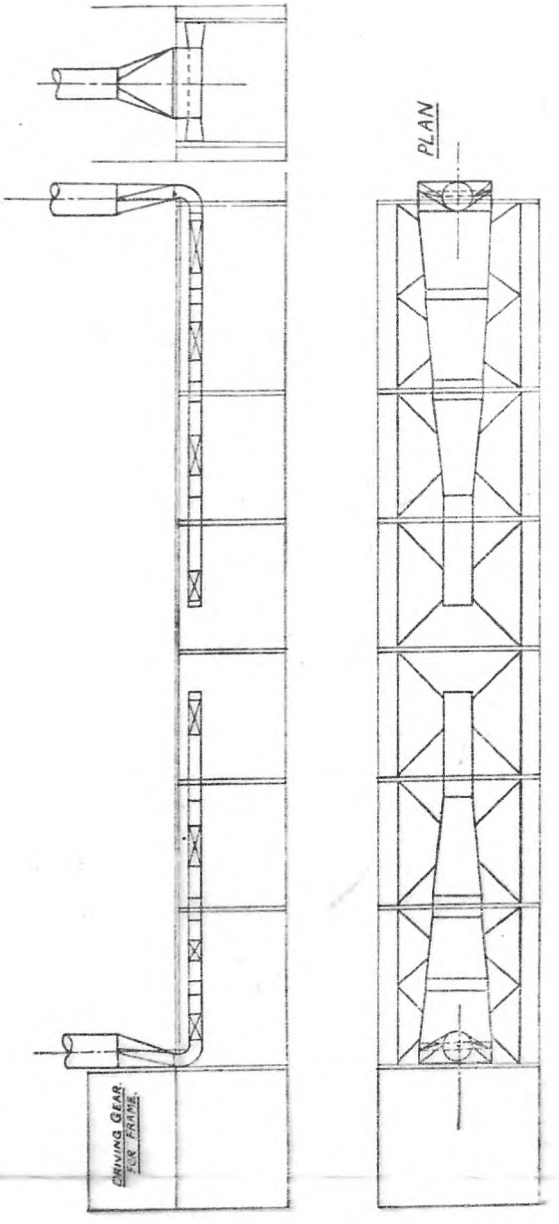


Fig. 13.—Exhaust at Ring Spinning Frame.

16. *Derby Doubler Machines.*

The " dust " conditions do not appear to call for special action at present.

Derby doublers are but little used and only give rise to a small amount of dust.

17. *Spinning, including Doubling, Plaiting, and Braiding.*

Ring spinning is dusty and efficient exhaust should be applied. The amount of dust produced in flyer spinning, doubling, plaiting and braiding is apparently not such as to necessitate provision of exhaust arrangements.

Ring spinning is obviously more dusty than flyer spinning. At the Cape Asbestos Co., Ltd., Barking, exhaust ventilation has recently been successfully applied to ring spinning, as shown in Fig. 13. and the conditions in consequence greatly improved, dust not being visible at breathing level. A series of hoods, connected to horizontal exhaust ducts above the tin rollers, are fitted behind the spindles on each side of the frame, each hood dealing with the dust from 4, 5 or 6 spindles. The lower parts of the frames and the ends have been closed in with wood panelling, to concentrate the flow of air to the exhaust hoods more completely at the spindle line. The total volume of air removed from each spinning frame is estimated at 3,400 cubic feet per minute. The arrangements do not obstruct the process.

The Committee have explained at an earlier stage of this Report that flyer spinning carried on without exhaust draught may be productive of so little dust that exhaust ventilation for its suppression does not, in the light of present knowledge, appear to be necessary. They have therefore not suggested precautionary measures for flyer spinning, but it may be that some spinning of this kind is carried on under less satisfactory conditions than those indicated and in that case precautions will be necessary. As exhaust ventilation has now been successfully applied to ring spinning, it appears that it could also be adopted for flyer spinning if necessary.

18. *Warping and Winding.*

The " dust " conditions at these machines do not appear to call for action at present.

The Committee have formed the opinion that the conditions in these processes are, in general, probably not less satisfactory than those in flyer spinning which the Committee have taken as the " dust datum." It may be, however, that dust determinations will show that in certain circumstances more dusty conditions prevail, in which case remedial measures should be adopted, e.g. by applying localized exhaust.

19. *Weaving.*

Dry weaving is necessary for certain classes of yarn and apparently cannot be discontinued. Dry weaving (except fine yarn listings) and much so-called wet weaving is dusty and exhaust

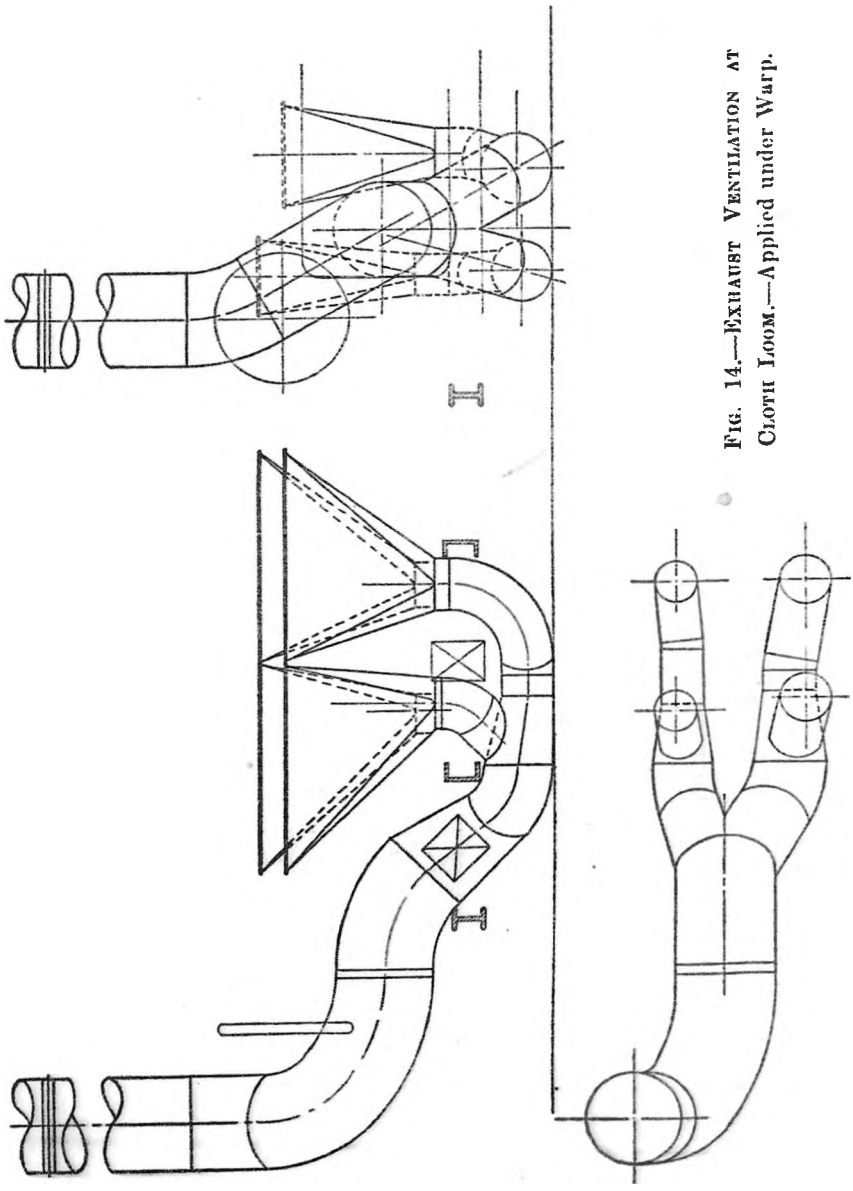


Fig. 14.—Exhaust Ventilation at Cloth Loom.—Applied under Warp.

should be applied at least (*a*) between the fell of the cloth and the healds and (*b*) between the healds and the back rest. The method of applying the draught cannot be standardised at present owing to the varying types of looms in use.

Since the issue of the Asbestos Report, the possibility of applying localized exhaust ventilation more effectively at looms has been investigated at the works with which the Trade representatives are connected. The results obtained show that it is possible by exhaust ventilation to render conditions in the process as satisfactory as in flyer spinning, but the cost is considerable.

The less dusty conditions have been obtained by applying the draught under the warp. Inverted collecting hoods are placed both in front of and behind the healds and as close to them as can conveniently be arranged (Fig. 14). The mouth of each hood should be as close as possible to the warp threads. For wide looms, two hoods in line should be used instead of a single hood, to ensure a more uniform draught over the entire width of the loom. The hoods must be arranged so as to afford access to the bottom racks or tappets. The under warp exhaust may be supplemented by an additional exhaust hood, of tapered form, fitted above the breast, connected at its larger end with a branch duct at the side of the loom. Examples are shown in Fig. 15. This provision is made to remove dust produced in beating up. The forward movement of the sley may prevent some of the dust from being drawn to the hood under the warp, in which case it is desirable that the breast hood should be fitted. The exhaust hoods and ducts are much larger than those hitherto adopted and the volume of air removed is considerably greater.

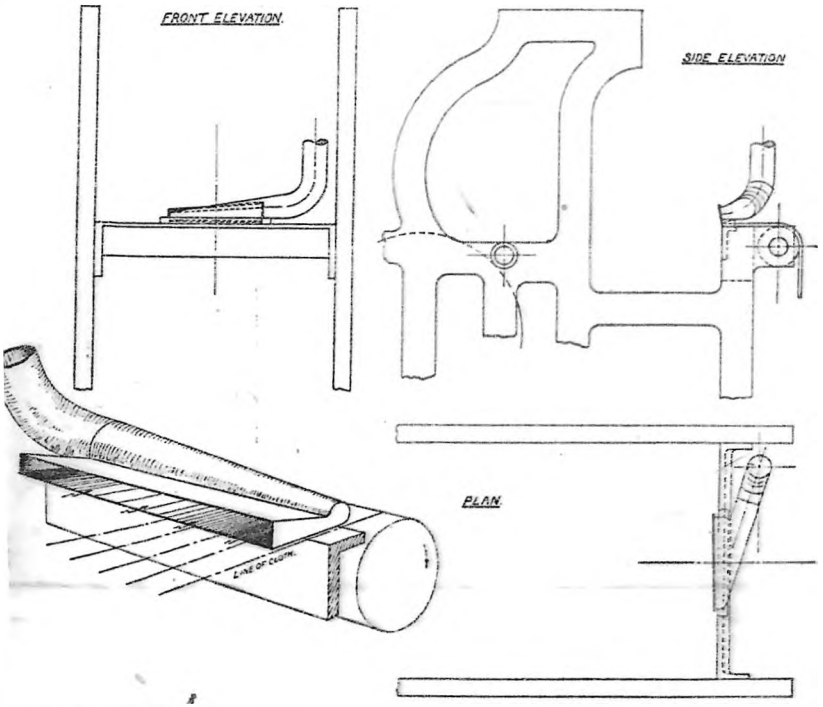


Fig. 15.—Exhaust Ventilation at Brake Band Lining Loom. Applied at Breast.

Plate 10 shows a recent application of exhaust in which hoods are fitted above the warp threads behind the healds, and at the beating-up point. This method follows the older practice, but the hoods are of large dimensions and the volume of air removed per minute is much greater than previously.

The considerable cost involved in providing exhaust ventilation on these liberal lines will inevitably lead the Trade to adopt wet methods wherever possible. Such methods hitherto have not, in many cases, reduced the dust to the low concentration required. Damping has been done in a more or less haphazard manner, e.g. by wet brushing of the warp or by dipping the shuttle cop in water. The Committee do not think any wet method should be accepted unless it can be shown, by actual test, that the necessary reduction of dust has been achieved.

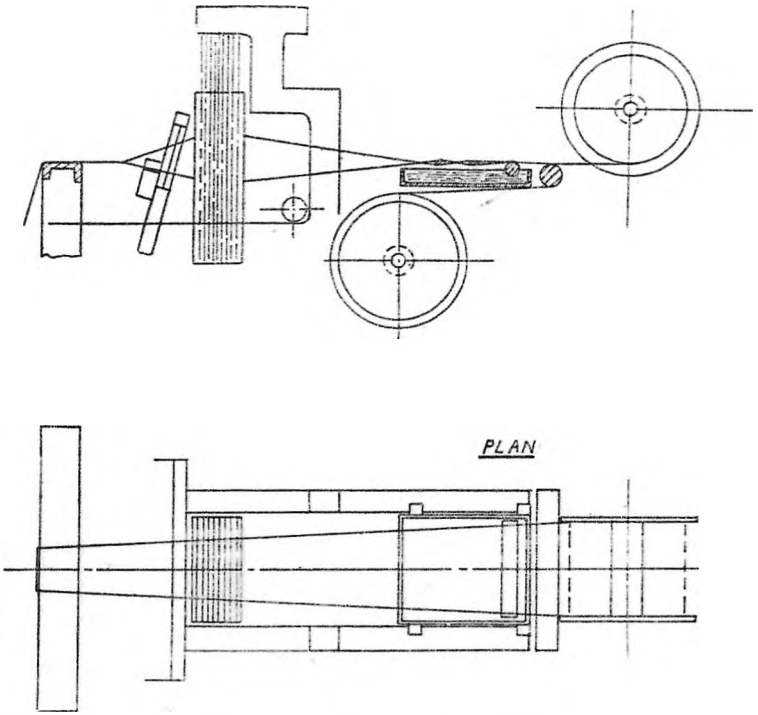


FIG. 16.—ARRANGEMENT OF WATER TRAY AND IDLE ROLLER FOR WET WEAVING.

A new method has recently been adopted which is apparently more effective than those referred to. An idle roller, partly immersed in a shallow tray of water, is provided under the warp. (Fig. 16). All the warp threads in turn make contact with this wet roller. The Committee feel that this method, and others which suppress dust, may be found to be satisfactory.

The fine listings referred to in the Agreement are very narrow " tapes " which give rise to little or no dust.

20. *Processes subsequent to Weaving, i.e., Cloth Examining, Pressing, Calendering, etc.*

The conditions as to dust do not appear to call for special action at present.

The final processes on woven fabrics are not entirely free from dust, but it appears that the concentration is less than in flyer spinning.

21. *Mattress Making.*

Mattress making gives rise to much dust. Fibre-filled mattresses should be effectively damped and, if this is not sufficient to suppress the dust, exhaust should be applied. Such exhaust may be by cross ventilation of the room. Benches and floors should be water sprayed. Efficient respirators should be worn during filling, beating or levelling.

Localized exhaust ventilation has not yet, so far as the Committee are aware, been applied to mattress making. The problem presents exceptional difficulty, especially as regards large mattresses. The Committee believe, however, that precautions can be taken which should reduce the dust in the air to a low concentration (except during the intervals required for filling and for beating or levelling out) but little different from that found in flyer spinning. The precautions recommended are:—

(a) Directional cross ventilation applied in each workroom as in Fig. 17. The ventilation effected is equivalent to about 15 changes of air per hour. The fresh air supply, suitably warmed in cold weather, is admitted on one side of the room at about 4 ft. above the floor, at a series of openings on the inclined upper face of the air trunk, so being directed slightly upwards. Other openings, e.g. windows, are kept closed. The dust-laden air is extracted at the other side of the room through an opening in a large duct, which is exhausted by a propeller fan, discharging to the atmosphere. The benches are placed parallel to the line of air flow.

(b) Division of workroom by parallel partitions into two, three or more similar compartments, as shown. During filling, which is done by one or two workers, the other workers are withdrawn to adjoining compartments to work on filled mattresses. A continuous passage-way is left along the extraction side of the compartments, doors being provided in the partitions on this side.

(c) Wide spacing of benches. Over-crowding of mattress making workrooms with benches, materials, etc. is particularly undesirable.

(d) Damping of floors, workbenches and mattress covers. The Committee attach special importance to this precaution which, when done efficiently, suppresses the dust appreciably. Effective means for spraying floors and benches should be provided. Floors and benches should be kept damp during working hours. The covers for fibre-filled mattresses should be thoroughly sprayed previous to filling, and the same precaution adopted as far as possible for mattress covers generally.

Most of the mattresses made in textile factories are filled with asbestos fibre, "magnesia" or other compositions which contain a proportion of asbestos not being used. The Agreement has been drawn up with special regard to the conditions under which fibre-filled mattresses (the making of which is doubtless attended with the greater risk) are manufactured. The Committee feel, however, that their recommendations, with certain exceptions, can and should be applied to the making of all insulation mattresses productive of asbestos dust.

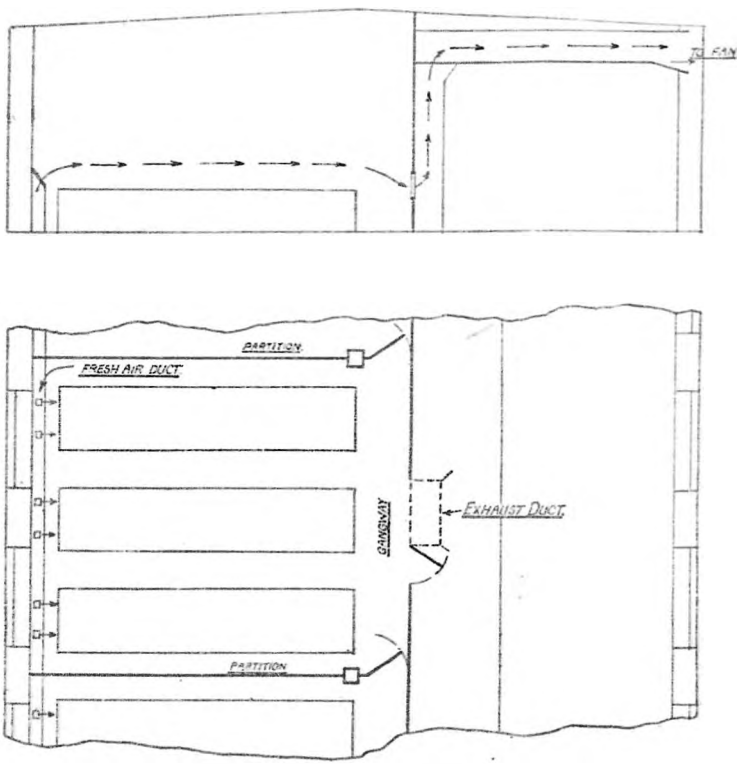
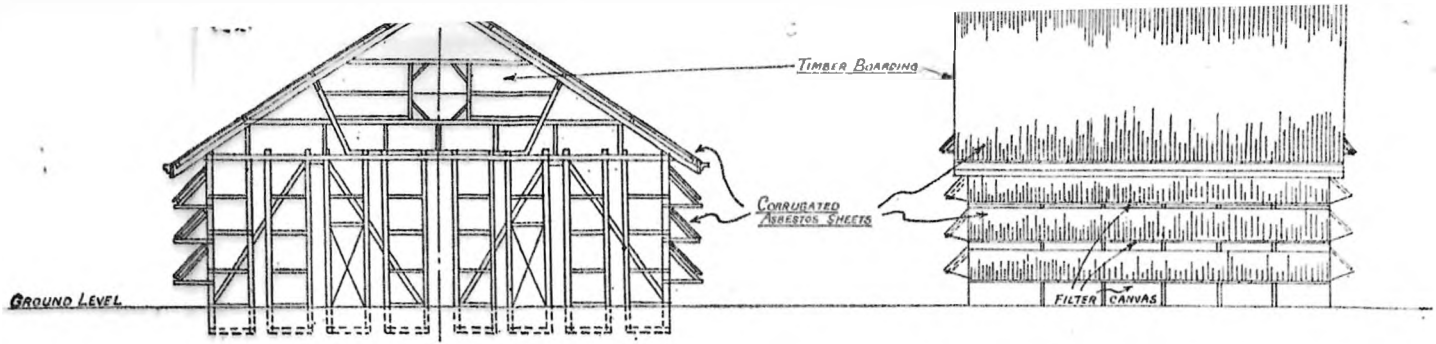


FIG. 17.—CROSS VENTILATION AND SUB-DIVISION OF MATTRESS MAKING ROOM.


TIMBER BOARDING
CORRUGATED ASBESTOS SHEETS
GROUND LEVEL
FILTER CANVAS
NOTE: FAN DISCHARGES INTO UNDER-ROOF SPACE

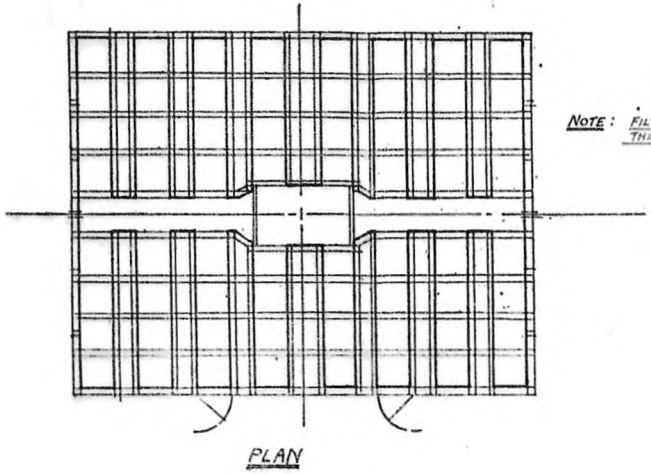

NOTE: FILTER CANVAS SHEWN IN THICK BLACK LINES ON PLAN.
PLAN

FIG. 18.

22. *Separation of Dust Collecting Apparatus from Workrooms.*

Dust collecting and separating plants, including balloons, should be effectively separated from workrooms and the air discharged from such plants should not be allowed to escape into any workroom.

The Agreement is directed against the practice of installing dust collecting plants, and particularly those provided with filtering fabrics to arrest fine dust, in the workrooms.

23. *Dust Filtering Apparatus.*

Dust filtering apparatus provided in connection with a system of exhaust ventilation should be so designed and maintained as not to affect the efficiency of the exhaust side of the system.

The Committee recognize that the Trade generally must be prepared to instal plant of the highest efficiency and so to maintain it. Some of the particulars given in various Agreements are intended to suggest minimal requirements for various details of such plants, and these and other particulars will afford, the Committee hope, useful guidance to designers.

The usual practice in the Trade is to use filtering fabric for dust settling, but the overall area of such material is often insufficient. Lack of room may be the reason for this. Fig. 18 shows an external dust filtering structure used in one large works. The material, a coarse fabric, permits some dust to pass into the atmosphere, but the structure is in the open air and well separated from all the factory buildings. The deep eaves and the inclined shields under them prevent the fabric becoming wet in rainy weather. The deep rectangular cavities made in all the sides afford a much larger filtering area than would otherwise be possible on an equivalent space.

As filtering fabrics become dirty, the dust removal cannot be constantly maintained at the highest efficiency. Automatic cleaning apparatus might, to a large extent, remedy this but it has not yet been adopted. One firm has abandoned filtering fabric in favour of a dust settler which consists of a large chamber into which the fan discharges and where the heavier dust collects, and a cyclone for settling finer dust, connected directly to the chamber (Fig. 19). This settling plant takes up a large cubic space. Its effect on the dust removal plant does not vary—an important advantage. Cleaning is only necessary once every few months, the men concerned then wearing respirators. A cyclone used in this way appears to be a more efficient apparatus for settling fine dust than when used for receiving dust-laden air direct from the fan.

24. *Factory Ventilation and Heating.*

Each workroom should be ventilated so as to ensure the efficient operation at all times of all dust removal plants therein. The air admitted for ventilation should be sufficiently warmed, when necessary.

The dust removal plants in asbestos textile works are on such a large scale that inadequate ventilation of the factories need not be anticipated. But the arrangements for the supply of fresh air may be inadequate in some cases to ensure the necessary air movement to the extraction points. Should this occur, the efficiency of the dust removal will fall. The Agreement is intended to obviate this. In many factories, plenum ventilation, with arrangements for heating the air supply in cold weather, are installed, and this should be the general practice.

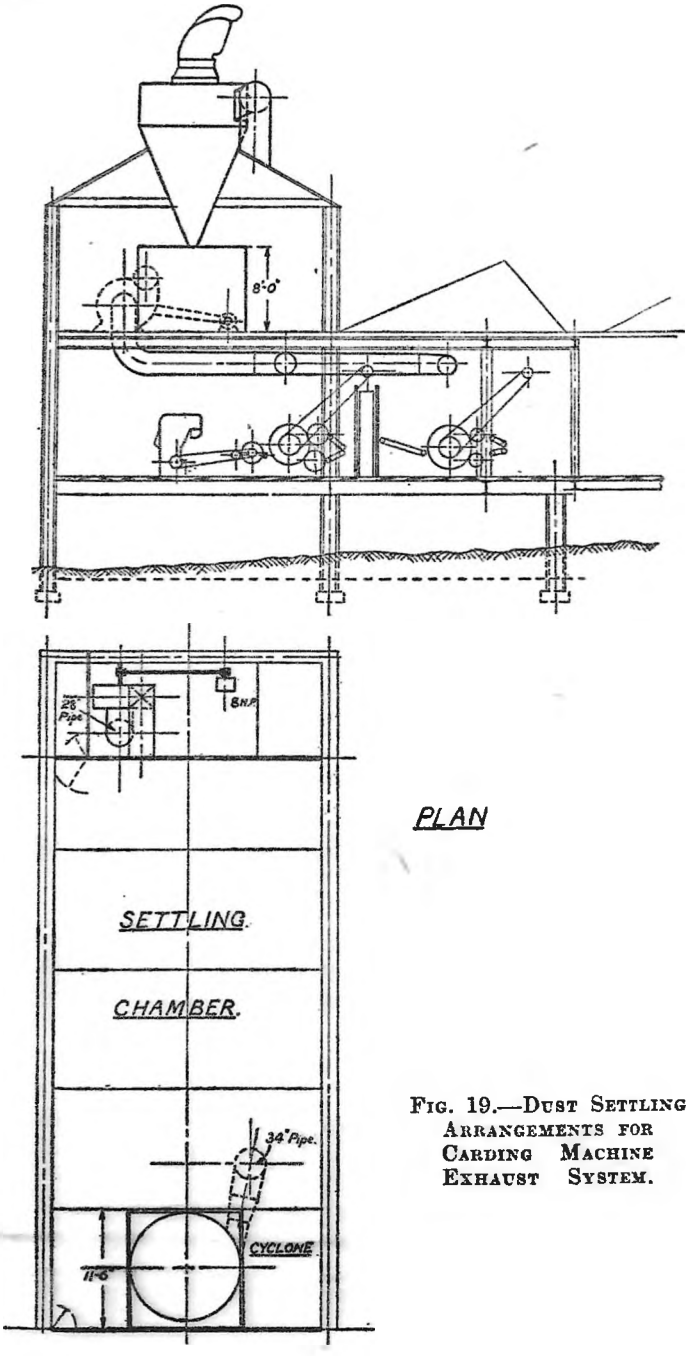


FIG. 19.—DUST SETTLING ARRANGEMENTS FOR CARDING MACHINE EXHAUST SYSTEM.

25. *Precautionary Leaflet for Workers.*

Precautionary leaflet for the guidance of workers in the industry should be prepared by the Home Office.

The Committee think much good would result and apprehension be allayed by distributing to all workers in the industry and to new workers entering it, a leaflet giving them information in simple terms of the risk attendant upon inhalation of asbestos dust, and how best this risk can be avoided. They understand that the leaflets issued in other industries for such purposes have been productive of much good.

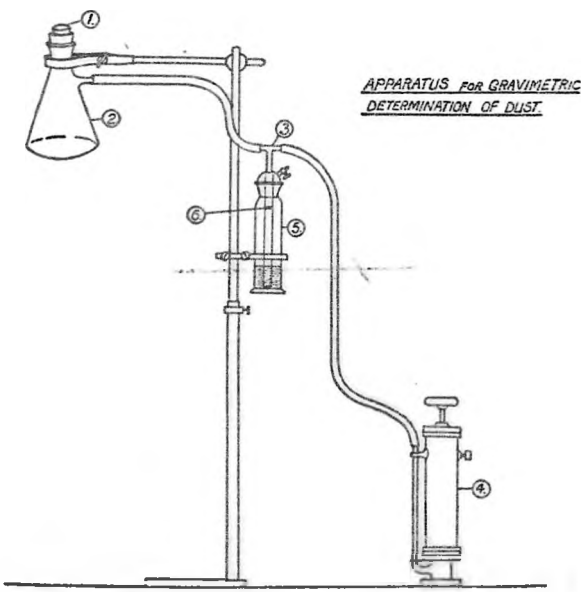
Note on Factory Cleaning.—The Trade members have made careful trials of various systems of vacuum cleaning and the Committee are disappointed with the results. The Committee think that when the improvements recommended above in this Report are effective, the danger attendant on dry cleaning will not be so great as was anticipated.

APPENDIX.

Gravimetric Determination of Dust.

The dust is arrested in a small quantity of sugar placed in a Gooch rucible, the sugar being afterwards dissolved in water and filtered through tared filter paper which is afterwards dried and re-weighed. (If preferred, n untared filter paper may be used and afterwards burnt to ash and eighed.)

The arrangement of the apparatus is shown in the drawing below. The ooch crucible (1) is fitted in the usual fashion into the neck of a filter ottle (2), which is connected by rubber tubing through a " T " bend (3) to n exhaust hand pump (4). The " T " bend dips into water in an otherwise osed bottle (5). At each stroke of the pump the water is drawn up the ertical tube and maintained throughout at the mark (6) so that each stroke exhausted under the same pressure conditions. The pump must be alibrated: this may be done by attaching it when set up, as if for use, to water meter placed beyond the Gooch crucible. A large glass vessel should interposed between the meter and the inlet to the Gooch crucible to event undue fluctuation of pressure. The volume equivalent of each stroke thus ascertained.



APPARATUS FOR GRAVIMETRIC DETERMINATION OF DUST

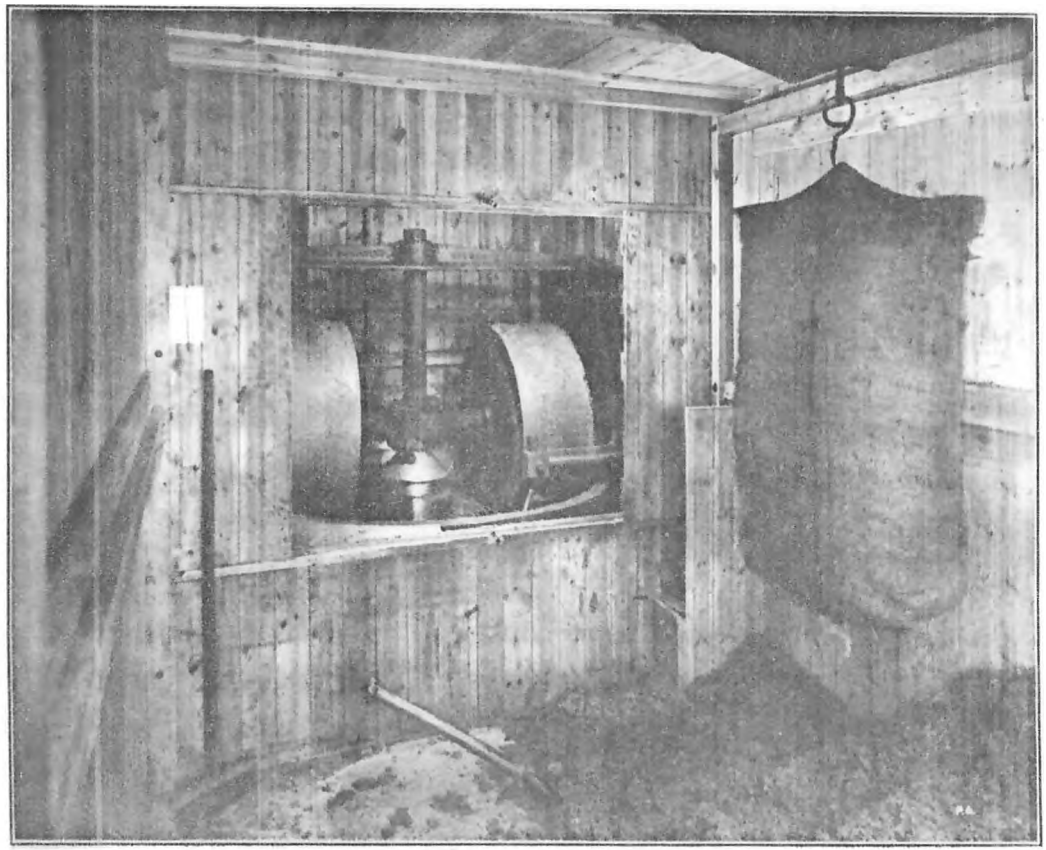


PLATE 1.

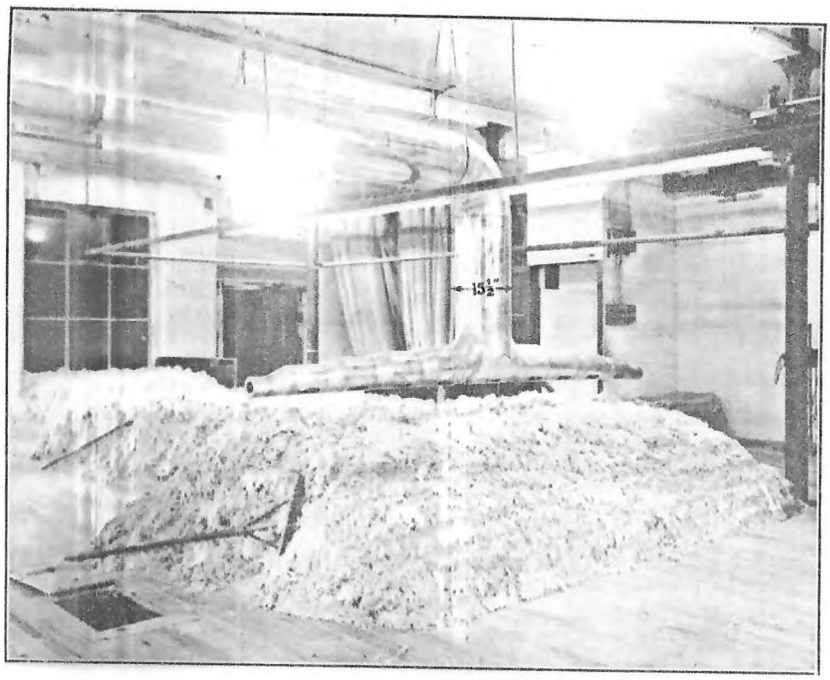


PLATE 2.

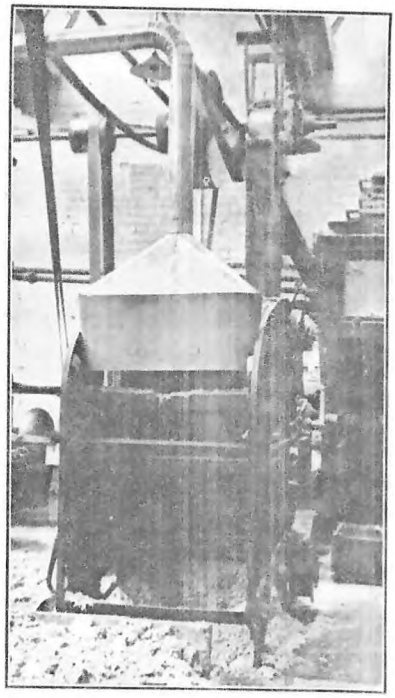


PLATE 3.

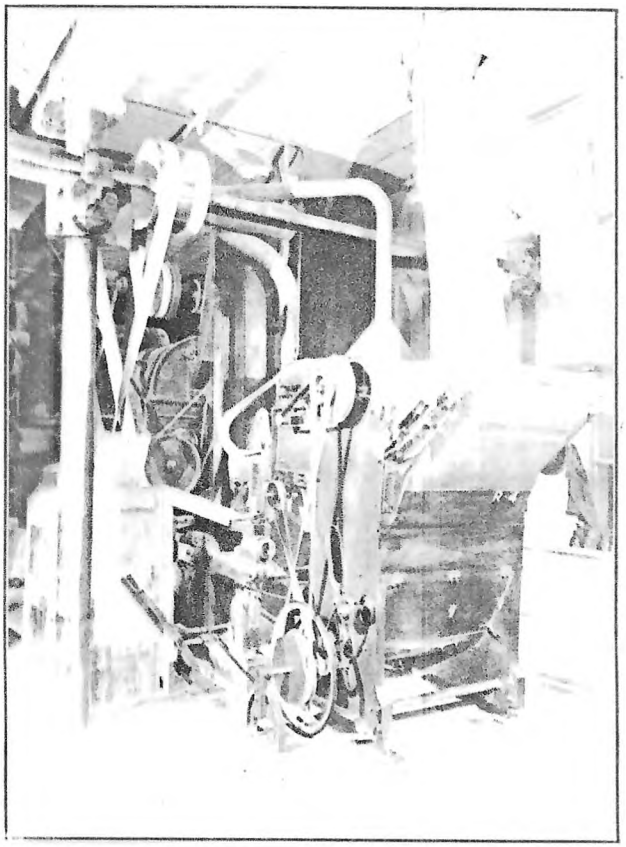


PLATE 4.

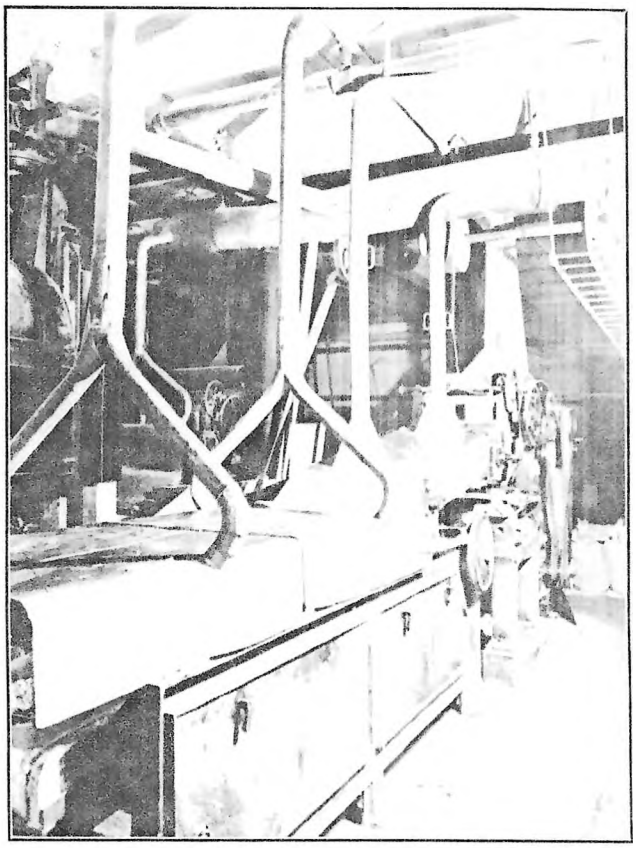


PLATE 5.

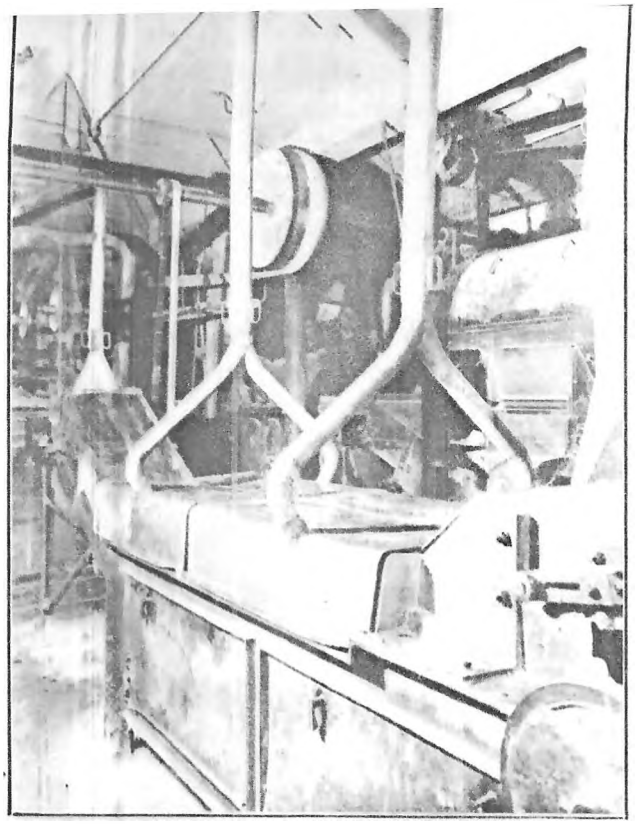


PLATE 6 (a).

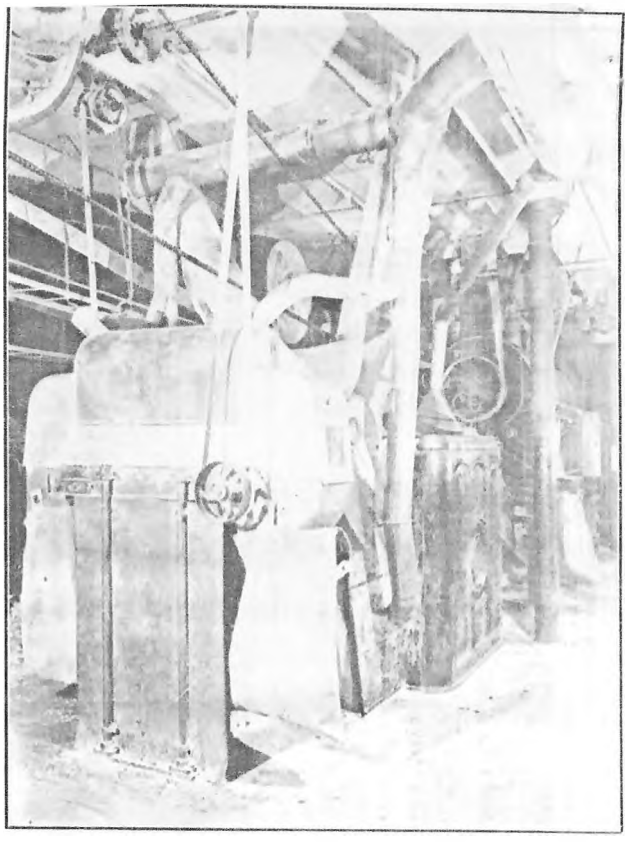


PLATE 6 (b).

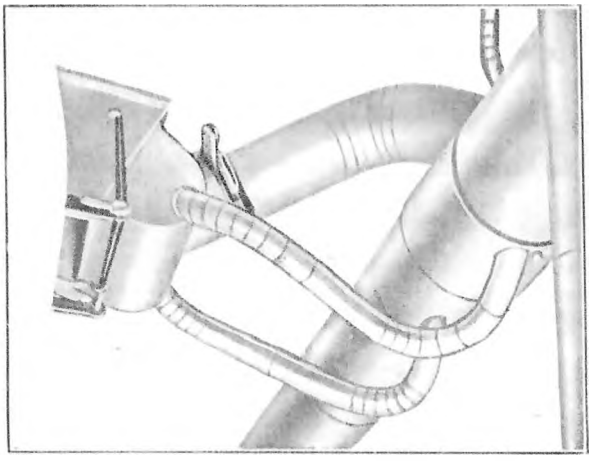
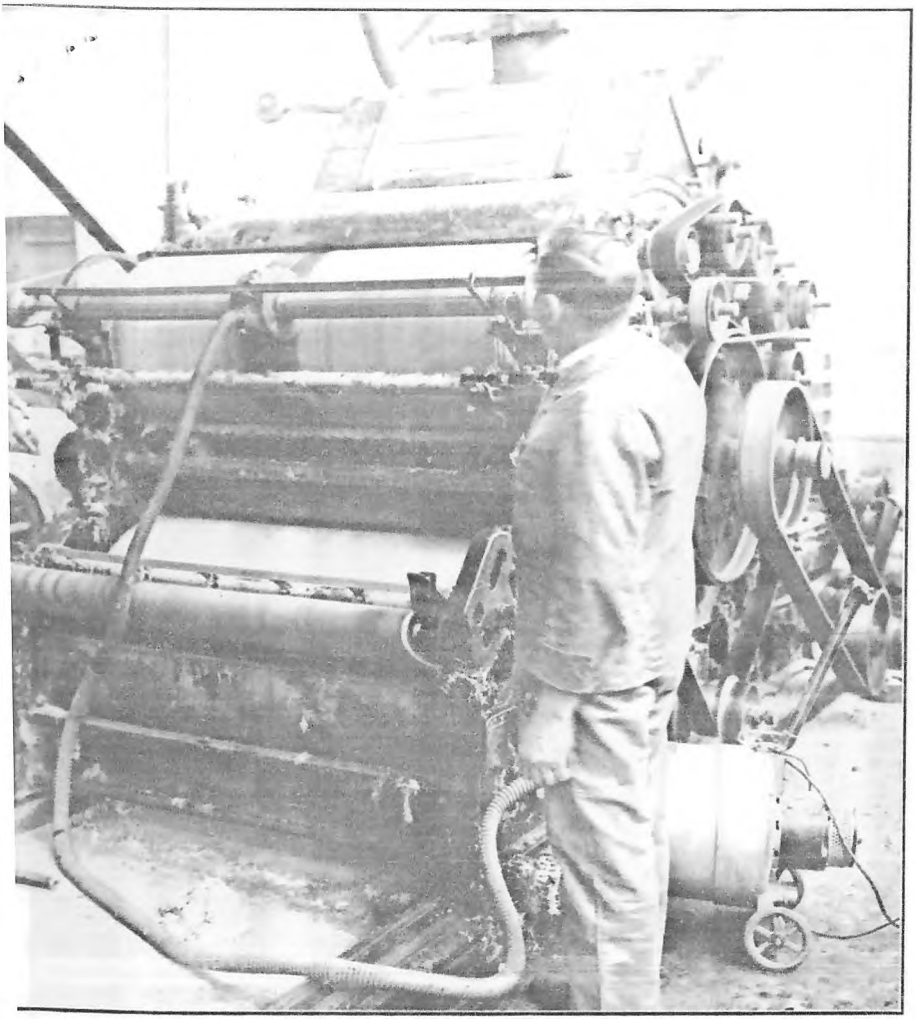


PLATE 7.



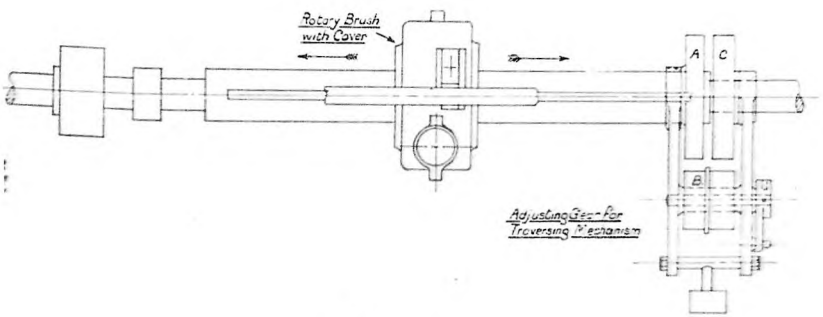

Rotary Brush
with Cover
A
C
B
Adjusting Gear for
Traversing Mechanism

PLATE 8.

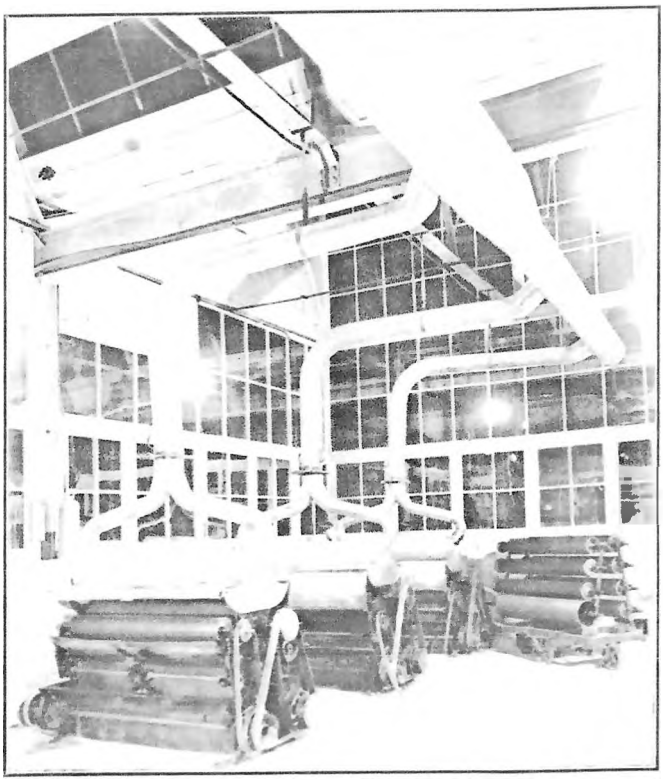
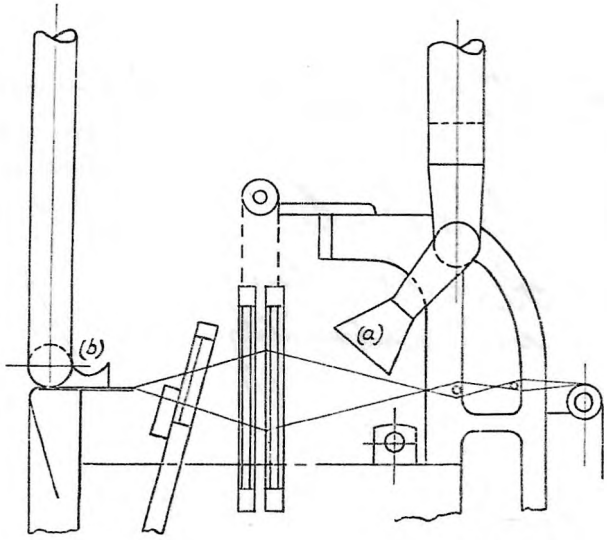
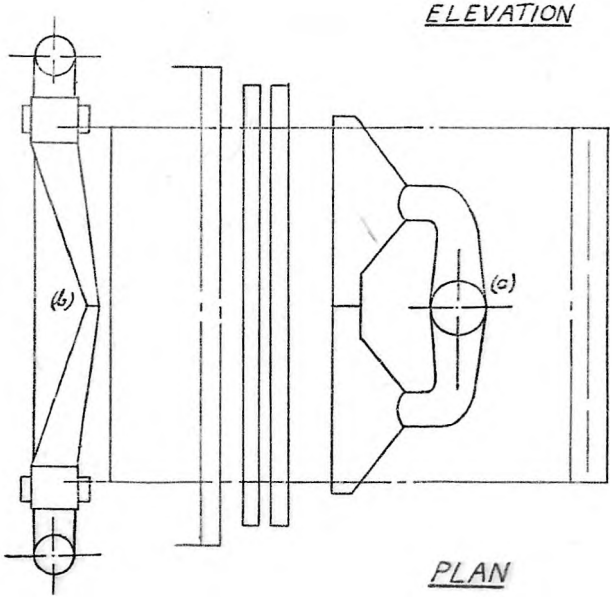


PLATE 9.

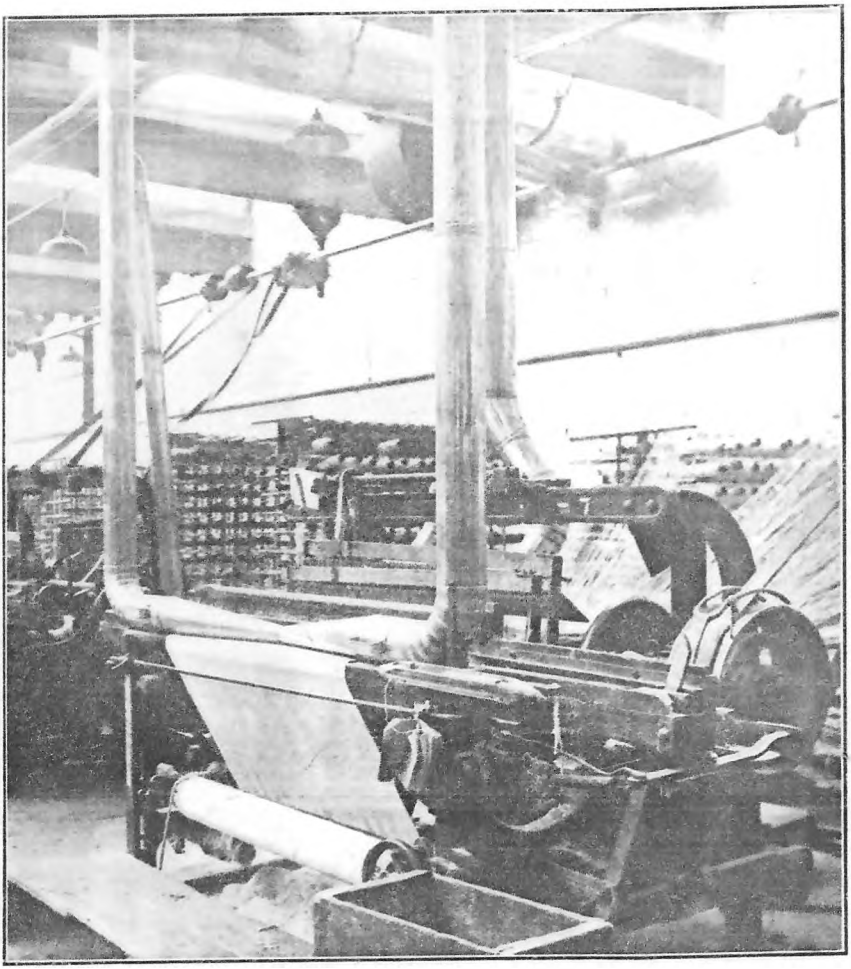


ELEVATION



PLAN

PLATE



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