

or that they are moved solely by a consideration for their own pockets. Ninety per cent. of the accidents in a mill are the result of want of care on the part of the sufferers, and might be avoided by the exercise of a little discretion. Hence it was natural that manufacturers should feel that the responsibility for them did not lie on their shoulders. But the voice of Parliament has declared that the employer must compensate his hands for the effects of all accidents, whether the result of carelessness or not (except it be of a wilful type), and hence the matter bears a different aspect from what it did. The legal responsibility is now laid on the master, and the question of blame ceases to be of much interest. The factory inspector becomes now an expert to be consulted, instead of an interfering official, whose demands were to be shirked as far as possible.

Her Majesty's Chief Inspector of Factories, Mr. Arthur Whitelegge, deputed Mr. Beaumont and Mr. Richmond to make a special inquiry into the dangers attending the use of machinery in cotton manufacture, and they have just reported the results of these observations.* They appear to have visited a number of mills, and also the works of several makers of cotton machinery. Here a most interesting matter was discovered. Machinery which is constructed for Germany and Russia is always fitted by the makers with elaborate guards, while the same machines intended for this country have often the guards omitted. In Russia the managers of cotton mills have been sent to prison in certain cases where avoidable accidents have occurred, and their responsibility has been brought home to them in a most effectual fashion. It is said that in certain mills in France a clerk is kept whose duty it is to be arrested, and undergo the penalty inflicted, usually of fine, but possibly of imprisonment, in case of accidents occurring at the mills. A somewhat similar plan was adopted by the French newspapers under the Empire. The articles likely to draw down the displeasure of the Government were signed by a member of the staff who was usually quite illiterate, but earned his salary by an occasional visit to prison. They manage things better in Russia, and put the responsibility, whether in regard to machinery or journalism, on the right shoulders. The fact that the Continental Governments are often more strict than our own in relation to safeguards on machinery, renders it easier for us to enforce the use of such appliances, seeing that the plea of foreign competition cannot be raised against their introduction. When the makers have the patterns and drawings in existence the expense cannot be very serious.

This, of course, applies to new machinery. The old is more difficult to deal with, and sometimes it would be cheaper to scrap it than to remodel it to suit the demands of the inspectors. The authors of the report suggest that time should be given for the gradual elimination of the present dangers, except in cases where accidents occur, when orders should be given to fence all similar machinery. This reminds us of the policy of the London County Council. Some time ago they devised a new system of house drainage, but they do not make it generally obligatory in existing property. Should, however, a child develop scarlet fever, or other notifiable disease, on the premises, they immediately insist on a reconstruction of the drains. The result is that most owners of house property take the work in hand as opportunity occurs without waiting to be coerced; they know it will have to be done sooner or later, and it is better to do when convenient than under compulsion. Probably a similar practice will be established in cotton mills, and a steady course of improvement will be instituted.

The inspectors state that, as a result of their inquiry, they desire to make certain recommendations which pertain to all machinery, cotton or otherwise, and these recommendations they consider should be enforced by positive enactment. They are:

1. That no projecting set screws be allowed on anything that revolves. This will apply not only to machines themselves, but also to the couplings and loose collars of shafting.
2. That toothed wheels be effectively covered, so

* Report of two H.M. Inspectors of Factories appointed to inquire into and report upon the prevention of accidents from machinery in the manufacture of cotton. London: Her Majesty's Stationery Office. [9d.]

ENGINEERING.

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PREVENTION OF ACCIDENTS IN THE COTTON TRADE.

THE attention of the Home Office has been directed to one dangerous trade after another, until, in course of time, it has been turned on the cotton trade. This is not one of the seriously dangerous trades, for out of more than 300,000 employes of both sexes there were, in the year 1897, only nine fatal, and 2114 non-fatal, accidents caused by machinery moved by power; while in 1898 there were 19 fatal, and 2299 non-fatal, accidents from the same cause. In the latter year, seven out of the 19 fatal accidents were caused by cranes, hoists, and lifting tackle, which are, of course, not peculiar to the cotton trades, leaving only 11 to be attributed to textile machinery. The list of minor accidents is, however, sufficiently heavy to call for greater precautions than at present exist. Now that the Employers' Liability Act is in force, there will be much less difficulty in inducing millowners to make provisions for safety than there was. It is not that they are unmindful of the loss and suffering endured by their hands,

that there shall be no danger between the guard and the wheels.

3. That loose pulleys and strap forks be provided for all machines.

4. That plate wheels, or wheels filled in, be substituted, wherever possible, for exposed arm wheels running at high speed; where this is impracticable the wheels should be guarded.

5. That exposed shaft ends be securely covered.

6. That all persons oiling mill gearing or otherwise employed near it, be supplied with and shall wear close-fitting jerseys or boiler suits.

With most of these suggestions engineers will heartily agree. As regards the first, no one can deny that projecting set screws are most dangerous; it is impossible to be in a mill or a workshop very long without seeing some narrow escape from a nasty accident caused by them. It is only the flimsiness of the fabrics worn by operatives that saves them in many cases. Nevertheless, the immediate removal of all set screws in cotton mills would mean a very serious expense, for they are often to be counted by thousands. The inspectors seem to suggest that, in certain instances, the heads might be cut off, and screwdriver gates made in the screws themselves, but this method is only practicable for very light work; a screwdriver is a very poor tool for tightening machine screws. The proper way, of course, is to thicken the boss, and form a deep recess in it for the head of the screw, which is then turned by a box key. This alteration cannot be made in existing bosses, and involves new wheels and pulleys. In some cases it can only be made by extensive alterations in design, as many set screws in cotton machines are awkward enough to get at with an ordinary spanner, and could not be reached with a box key. In regard to (2) the covering of toothed wheels there can be no question. They are too dangerous to be left open, and when an accident occurs in connection with them it is always serious. Loose pulleys and strap forks (3) are generally provided now, the exceptions being in the case of the lightest and the heaviest machines. In regard to the former the maker does not always know from which side they will be driven, and the women grow skilful in manipulating the belt by their hands; the practice is, however, not entirely devoid of danger. In large machines it is the carding engines which are most frequently found without strap forks, as these are often in the way when the cards are being ground. This is a difficulty which can be overcome, and it ought to be, for evidently it is running a very serious risk not to be able to stop a machine except by throwing off the belt. We do not quite understand the objection (4) of the inspectors to pulleys with arms. The arms are usually well inside the rim, and at reasonably high speeds they are no more likely to catch anything than is a disc. At the same time, plate pulleys are cheap enough in the smaller sizes, if they are preferred for new work. The covering of exposed shaft ends (5) has our hearty approval. They are most dangerous, particularly if they have keyways in them, as they often have. It is generally quite easy to put guards over them, or it ought always to be done. The provision of tightly fitting garments for those employed on or near mill gearing would undoubtedly be a safeguard, but it would be unfair to make the millowner responsible for them being worn. When all projecting set screws and keys have been covered, and all unauthorised persons forbidden to deal with the gearing, the millowner has done all that can be fairly expected from him.

In addition to these general recommendations, the inspectors have a number of detailed ones referring to different types of machines; but these are mostly comprised within those already set forth. We notice, however, that they give illustrations of a guard for keeping shuttles from flying out of looms, which they say is effective, and does not interfere with the work. It is the invention of Mr. Henry Dawson, of Bolton, and if it fulfils all that is claimed for it, will be of great value, as a blow from a flying shuttle is bad enough to bear on the wrist or the ribs, while on the face it not infrequently involves the loss of an eye. A number of guards are illustrated for different parts of mules, such as the quadrant scroll and pinions, the rim-band carrier, the draw-band pulley, the scroll on the back shaft, the faller stops, the back of the headstocks, the scroll and pulley of the middle drawing-out band, and the carriage wheels.

The inspectors have devoted a great deal of trouble to their task, and have added to their report

a brief account of the various processes used in cotton spinning, together with a large number of illustrations of the machines. They might, however, have found a great deal of valuable information ready to hand if they had consulted the very valuable volume published by the Society for the Prevention of Accidents in Factories, of Mulhouse, Alsace.* This book has always been of great use to those anxious to minimise the risks run by their workmen, but since the passing of the Workmen's Compensation Act the need for such a publication has increased. It deals with motors, transmission and gearing, lifts and hoists, wood-working machinery, cotton spinning, wool spinning, weaving, printing, dyeing and finishing, and miscellaneous industries. To illustrate the appliances recommended, there are thirty-seven double plates, printed in colours, each much larger than the double plates found in ENGINEERING. Those devoted to cotton spinning comprise safety appliances for beaters and openers, for battening machines, for willows, for carding engines, for lapping engines, for drawing frames, for combing machines, for frames having flyers, for mules, and for ring frames. All these are very fully illustrated, and although there are doubtless other ways of attaining the same results, yet the results put forward by a philanthropic society comprising manufacturers of very high standing must command our respect. The work has already attained a second edition, and is well worth perusal by all users of machinery.

The responsibilities of manufacturers under the Workmen's Compensation Act are so great that considerations of expense no longer stand in the way of alterations to secure safety. The provision of a single life-pension to an injured workman will often represent a capital sum sufficient to effect the necessary changes in a number of machines, and it is, therefore, good economy to take precautions in time. If the recommendations of the inspectors be not adopted, an accident in a cotton mill will often be followed by an order to effect changes which may extend to dozens of machines, and this expense will be added to the amount of compensation payable. Self-interest and humanity, therefore, pull in the same direction. Cotton machines do not now enjoy the wonderful longevity that they once did. The high speed at which they run, and the constant improvements which are made, render their use unremunerative in a few years, and they have to be renewed. It should cost very little more to obtain them fitted with all the requisite safeguards by the makers, and in future this will, we trust, be always insisted upon.

* "Collection of Appliances and Apparatus for the Prevention of Accidents in Factories." Thirty-seven Plates, with Explanatory Notes in French, German, and English. London: Dulau and Co., 37, Soho-square. [12s.]