

to the claim that, in ordinary practice, one knife will do as good work as two. Further basis is given to this claim by the fact that less power is required to remove all the material between A and A at one cut, with the momentum of a whole revolution to help, than would be required to remove it in two cuts with only the momentum of half a revolution behind each. Can you not remove twice as large a chip, with an axe, when you have room to give it a full swing, as when the length of your stroke is limited by one half? Very few, indeed, are the planers or moulders on the work of which any difference could be detected if one knife were set back a quarter of an inch. This is not equivalent to saying, however, that, with ordinarily careful adjustment, the knives may not be made to do approximately the same amount of work.

Probably the nearest approach to an absolutely equal cut by two knives is attained in the use of solid knives on a shaper. In such case the knives are set and balanced with as high a degree of accuracy as is humanly attainable; while the head is steadied, relatively to the work, by the bearing of the guide collar. In these conditions lies most of the reason for the high quality of work usually done by these machines.

It is probable that, even though two knives may not be set with sufficient accuracy to leave evidence of their work, the lighter cut involves less tearing up of the fibre, and so, in many cases, gives better results. Other than this, it is the belief of the writer that as good work may be done, while twice as much wear may be had from the knives, by setting one well back till the other is dull; then setting the sharp one ahead and the dull one back.

### SAFEGUARDING MACHINERY.

In Great Britain, and probably still more in Germany, the care of the workman is apt to be more rigid on the part of the Government than it is in perhaps any other countries. In the opinion of many people who have watched the statistics of accidents, the effect of this care has been largely nullified in Great Britain by the countervailing influence of the Employers' Liability Act, which provides compensation for a workman, irrespective of whether the accident was due to his own wilful disobedience of safety rules or not. It may seem curious that personal injuries should increase as a result of certain compensation. It can scarcely be believed that any man would wilfully injure himself, and one can only attribute such increase of injuries to the unconscious effects of the acts for compensation.

But it is certain that workmen do take extraordinary risks without being called on to do so. Often one may hear an employer blamed because some poor fellow has gone home crippled, in order to put gold into his employer's pocket, but, careless as some employers may be, it is true that the workers are more often to blame than their employer. Men will dip under a suspended weight to save an extra yard in going round it. They will risk their own lives and their employer's solvency for the sake of a trivial economy of time.

The writer was once forced to lower a weight with tackle not safe for half the load put upon it. All hands were called clear, and the extreme danger pointed out, and yet men would pass beneath the load in this dangerous condition, and it was useless to attempt to stop them. If every one were to detail his experiences of carelessness, it would seem that some men cannot be trusted to care for their own lives or for those of others. They do not mean to be hurt; they

simply think it will be all right this time, and probably say to themselves "for the last time," resolving not to do it again, and they do this once too often.

Among the inspectors of the Home Office, which is the department of the English Government that cares for these things, nothing is left to chance. Often more is enforced than ought to be, for one is sometimes compelled to place fences so that they add to the danger, as when placed too near to a small gas-engine flywheel, so that it is difficult to start the engine by the usual method for small engines, namely, by turning of the flywheel. Probably, in time, no gas-engine will be allowed to be started except by an accumulated air pressure. Wheels are guarded very completely. A pair guarded only on their top or in-running sides were ordered to be fully cased in because "some time it might happen" that in some extraordinary way they would turn the other way round.

Machinery fencing is of two sorts. There is the guard over the pair of wheels or other detail, and there is the general guard or fence or cage which contains the whole machine and prevents all access to it except by key. Some things cannot be guarded, such as the cutters of certain wood-working machinery, and these are perhaps the worst things for accident producing, for they are almost invisible when most dangerous. A circular saw might often be better caged than guarded, but a saw may be very considerably protected by a distance guard, when it is impossible to guard by a close cover. The Home Office takes account also of child labor, of overtime for women and young persons generally, of heating, lighting, ventilation and sanitation, and especially of the precautions to be adopted when persons are employed, as in the glazing of pottery. All pottery people are on the qui vive to find a leadless glaze. One hears of leadless glaze, but investigation generally reveals a hidden source of lead. The trouble comes in the putting on of the glaze in solution, and all the evils of lead-poisoning accrue, so that a strict watch is kept on all who are employed in respect of medical examination for detecting the first symptoms. Yet people who know they have symptoms will endeavor to hide them, and pass the doctor. Fans for removal of dust, and all manner of respirators and other safeguards, are more or less attended to by Home Office inspectors.

Every industry has its own peculiar crop of accidents, from unexpected directions and least suspected causes. It almost seems necessary for accidents to happen in order that weak points in design may be shown up, just as the true stresses in machinery and structural work only show up in actual work, though this is less the case now than formerly, when the failure of bridge details began to teach men that they could not allow the same nominal unit stresses in all details, but must take account of the manner of approach of the stress-producing agent or load.

Familiarity may lead to accident. It may also serve to prevent accident. Thus, if the people of England began to-morrow to walk upon the tracks of a railroad in the way usual in America, many thousands would be killed. In a week's time very few would be even hurt. So it is with ordinary machinery. The worker does not get hurt so often as might be thought likely, but nevertheless he does sometimes suffer from lack of guards to the more dangerous parts. The knowledge of what to guard, and how to guard it, is quite a special knowledge, demanding acquaintance with the machine and the method of its operation, and a general acquaintance with machinery and with accidents of all kinds.