

FENCING OF STEAM- AND GAS-ENGINES.

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The author having been requested to submit a short Paper upon the Protection of Steam- and Gas-Engines, with a view to diminishing the risk of accidents to the attendants, fears, however, it is a subject limited in its scope. The various types of steam-engines have been redesigned by the leading makers during the last decade, and embody in a large measure provision for protecting the moving parts. The author will briefly review the usual modern practice in this regard, and make a few suggestions for additional safeguards not generally included in the standard equipment.

In arranging guards on steam and other similar engines the contingency to be kept in view is to provide ample protection for the attendant, without rendering the moving parts, bearings, &c., difficult of access, as this may contribute to neglect on the part of the attendants, and result in damage to the engine.

In a well-appointed works or factory, the engine-room should be separate from the shops and other departments, and be so arranged that none of the operatives or members of the staff have occasion to pass through or into it, and in cases where this is not practicable,

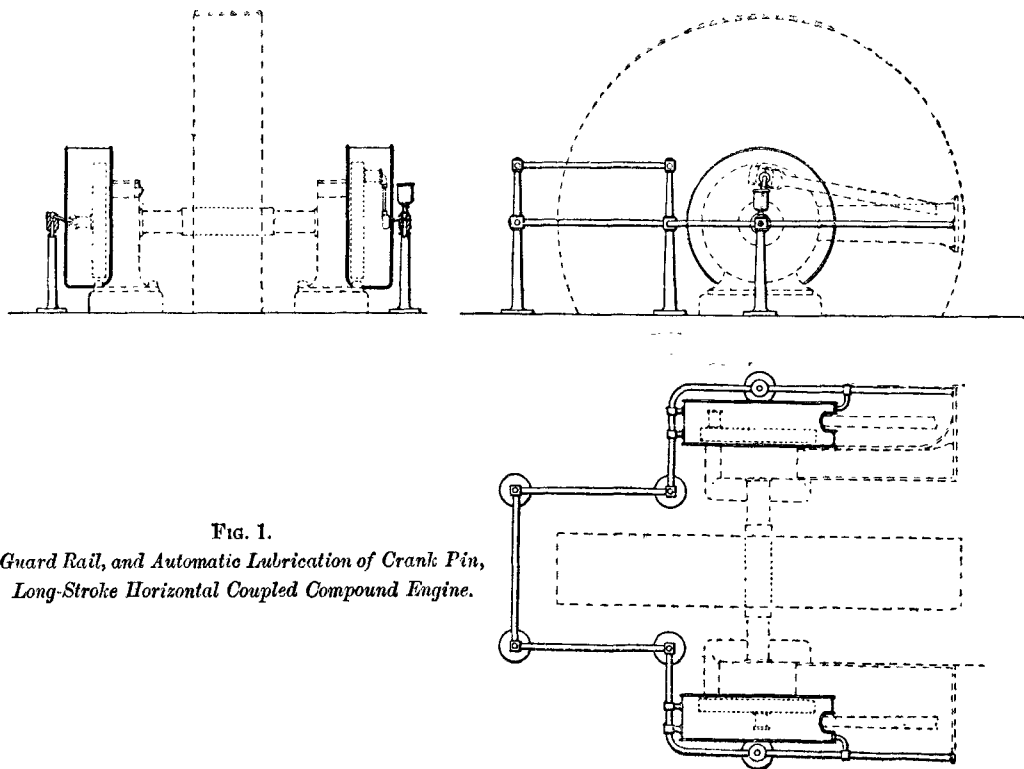


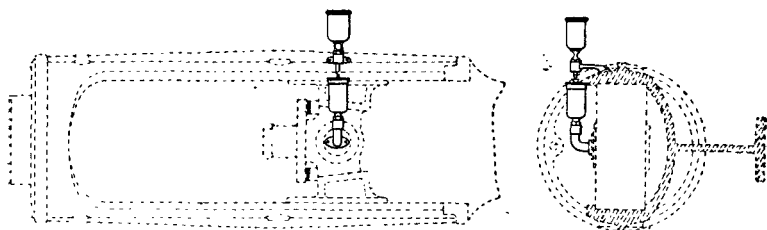
FIG. 1.

*Guard Rail, and Automatic Lubrication of Crank Pin,
Long-Stroke Horizontal Coupled Compound Engine.*

the engine should be enclosed by a rail or screen within which none but the attendant or other authorised person is allowed. In addition to this, however, certain guards and rails should be provided on the engine; and the author will take as a typical case a long-stroke horizontal coupled compound engine, and describe briefly what is the usual equipment. These engines are now made chiefly with the girder type of bed, the crosshead being thus safeguarded within the slides, and an additional protection is frequently provided by running a rail along the open side of the guide path up to the cylinder. In some cases the crosshead path is entirely closed by removable casings made of light material, with handles and fixings which permit of ready manipulation. From the other end of the

FIG. 2.

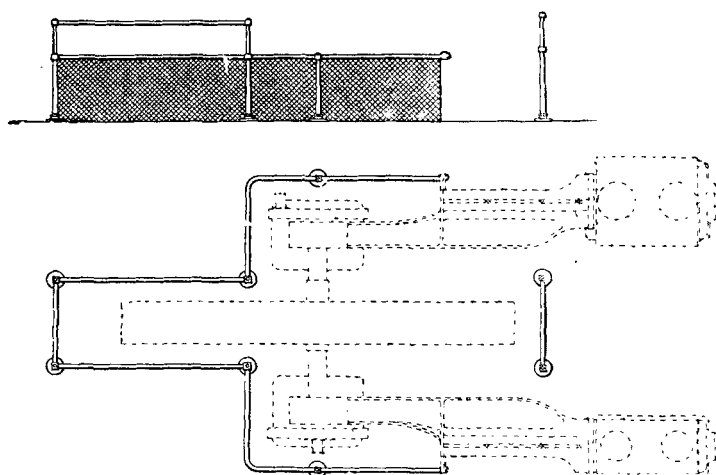
Lubrication of Crosshead Pin by "licker."



guide path the rail should extend beyond the crank or disc, and return either to the main bearing or a pillar placed in a convenient position. There should also be a pillar opposite the centre of the crankshaft which can be utilized for supporting the rail at this point, and also for carrying a lubricator to supply the crank-pin with oil, the latter being fed from the lubricator into a small receiver carried from the crank-pin by a tube, as shown in Fig. 1, thus making the lubrication at this point automatic, and obviating the necessity of the attendant touching any moving part when replenishing the supply of oil. The lubrication of the crosshead pin can also be effected from a stationary lubricator by leading a pipe therefrom to a point over the oil-box on the crosshead, and fitting this oil-box lid with what is known as a "licker," so that at each stroke of the engine a drop of oil is wiped off the end of the

tube leading from the stationary lubricator, and finds its way into the oil-box on the crosshead and thence to the crosshead pin, Fig. 2 (page 213). A desirable refinement in an engine is a system of continuous lubrication; this is adopted in several large factories and installations of machinery. By means of a force pump which circulates oil through the principal parts of the engine, a continuous feed is maintained, the oil being collected, filtered and used over again.

FIG. 3.
Double Rail-Guard fitted with rigid Wire Netting.



In enclosed type self-lubricating engines it is an essential feature to have a continuous flow of oil, which may be effected either by splash, or forced through by a pressure of about 10 to 15 lbs. per square inch. Any such systems protect the attendant in some cases as much as a great amount of fencing, although this may be demanded by the requirements of the Factory Act. Where the arrangement of the drive will permit of it, the rail (preferably double) should be continued round the fly-wheel, and in any case the belt or rope race should be suitably fenced. The fly-wheel may also be entirely boarded in on both sides, thus preventing anything

falling into the arms of the wheel. Where the race is sunk below the floor level, and the sides are accessible, a light screen, such as rigid wire netting or fender board, may be fixed from the bottom rail to the floor to prevent anything rolling from the floor into the belt race, as illustrated on Fig. 3 (page 214).

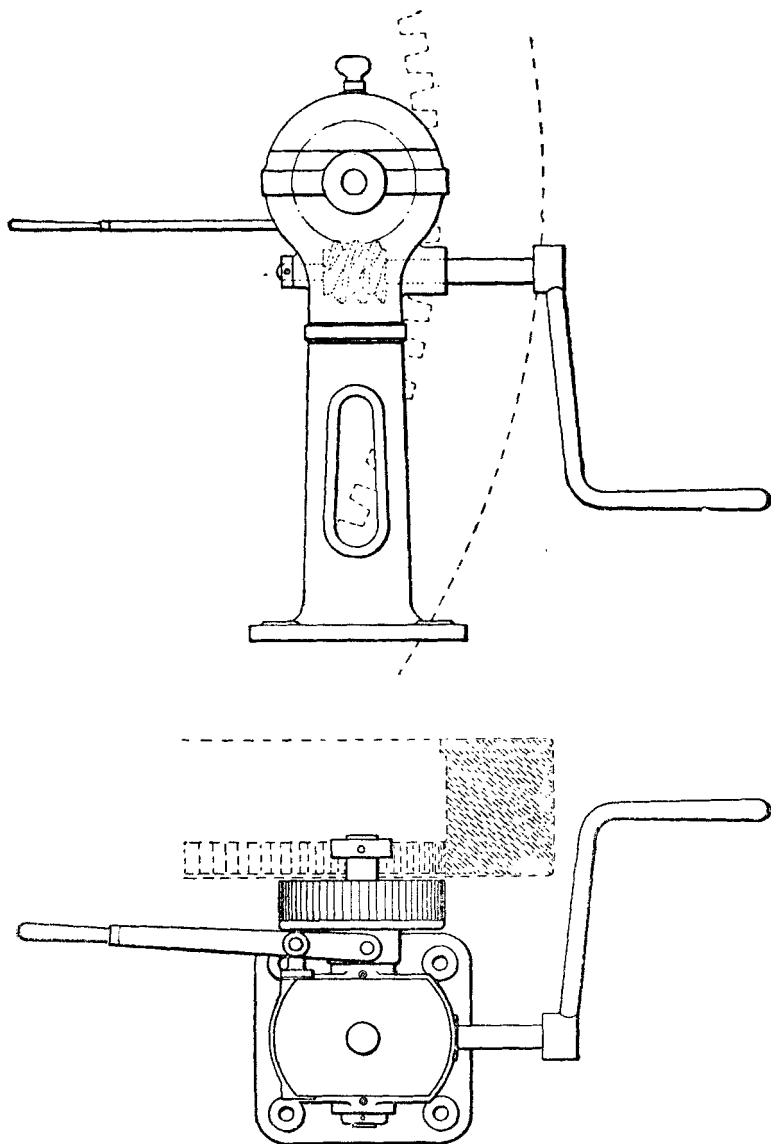
Where the cylinders have extended rods working through the back cover, the slipper path should be guarded by a cover ; or where an air or other pump is driven from this point by rocking levers, guard rails should be provided round the moving parts above the floor level, a fender plate or screen being provided round the opening in the floor, similar to that described for the belt race. A splasher plate, encircling the crank or disc with a slot for the connecting-rod to work through, as shown on Fig. 1 (page 212), makes an efficient guard for these revolving parts, and also prevents the oil being thrown about.

In cases where the governor is chain-driven, and the bracket carrying the chain-wheel projects, the railing should be arranged to guard this, or other suitable protection be provided, such as a light case over the chain and wheels to prevent the attendant's clothing catching.

It is now usual, except with quite small engines, to provide a means of racking the engine round by hand before steam is admitted to the cylinder, and the mechanism used for this purpose should be so arranged that, when the engine commences to be driven by the steam, the turning gear is automatically thrown out of action, thus preventing the risk of accident to the attendant when using the turning gear. A convenient and powerful type of turning gear is shown on Fig. 4 (page 216), from which it will be seen that a toothed pinion engages with a rack on the fly-wheel rim, this pinion being operated by a handle through the medium of a worm and worm wheel. The pinion in question is loose on the spindle or shaft, and has a ratchet engagement so that it runs free when the engine starts, until thrown out of gear by the lever as shown, thus preventing any danger of the operator being caught by the turning handle.

In addition to guarding the moving parts of an engine, care should be taken in arranging the drains from the cylinders or other

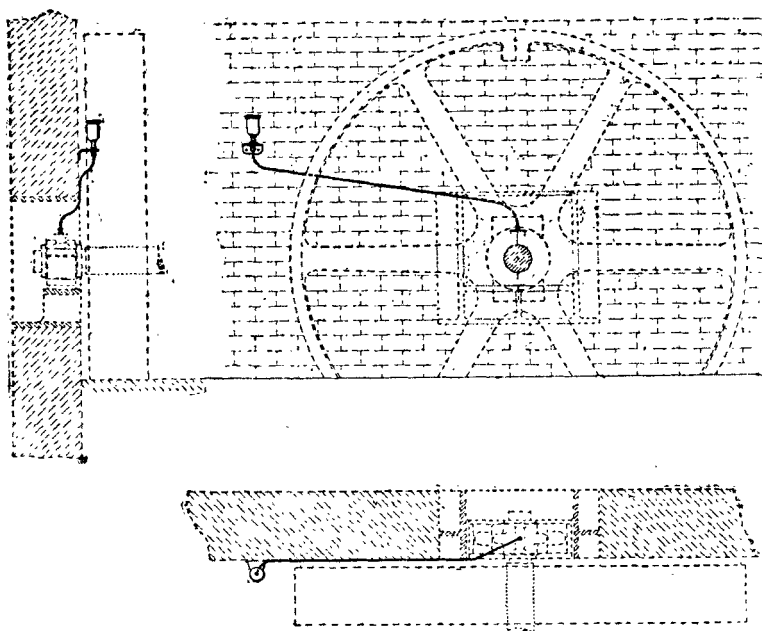
FIG. 4.
Safety Turning Gear.



parts subject to steam pressure, so as to avoid any risk of the attendant being scalded by the steam blowing back through the overflow from a steam-trap, which may be the case with some types of trap, if the pipes subject to pressure are coupled to the trap overflow, which should therefore be avoided if possible. Efficient arrangements should also be made, and suitable relief valves provided

FIG. 5.

Safety Lubricator for Wall-Box Bearing.



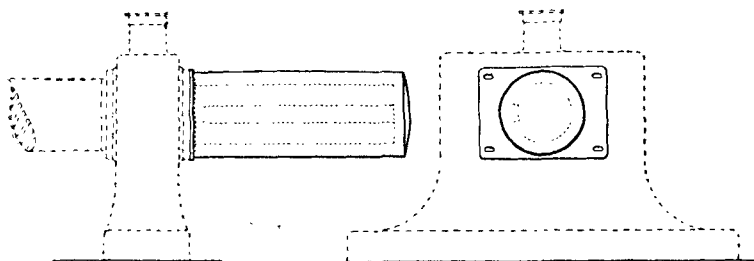
to prevent any accumulation of water in the engine cylinder, as many serious breakdowns have occurred from this cause. These latter points are perhaps outside the exact subject now under consideration, although they have to be considered in the safe running of an engine.

In addition to the type of engine just mentioned there are also in general use the following nine classes of engines:—

- (a) The Tandem Compound Engine.
- (b) Single-Cylinder Long-stroke Horizontal.
- (c) Short-stroke Horizontal self-contained engine with shaft extending beyond bearings.
- (d) Vertical Engines and Enclosed Types.
- (e) Portable and Semi-portable Engines of the overhead type.
- (f) Undertype Engines.
- (g) Winding and Hauling Engines.
- (h) Traction Engines and Road Rollers.
- (i) Gas and Oil Engines.

The author's remarks with reference to the coupled compound engine apply equally to (a) and (b), the features now under

FIG. 6.
Guard for Shaft End.



consideration being practically the same; but in cases where the outer bearing of the crankshaft is carried in a wall box, and the fly-wheel or pulley is placed in close proximity to the wall, means should be provided for lubricating the outer bearing without the attendant having to pass his oil-can through the arms of the wheel, or between the same and the wall. A convenient arrangement to meet this may be effected by carrying the lubricator on a bracket fixed to the wall, or in any accessible position, and leading a pipe from same to the bearing as shown in Fig. 5 (page 217). Or by a self-lubricating pedestal of the Mohler type, which only requires replenishing at intervals, which can be done during the time the engine is standing. With (c) the guarding required is somewhat less elaborate, as most

of the moving parts are within the engine frame, but when the shaft end projects beyond the bearing or driving pulley a sleeve of sheet brass or other suitable material will be found useful to prevent the rotating end of the shaft (in which there is usually a keyway) catching the attendant's hand or clothing. When there is no pulley outside the bearing, the sleeve can be pinned to the side of the bearing by suitable small screws, as shown in Fig. 6 (page 218), and in the case where a pulley is required, the sleeve can be carried by a pillar.

This arrangement is also applicable to vertical engines (*d*), and with this type there is little else required, except a suitable fence for the fly-wheel and belt, or ropes. For the enclosed or boxed-in types of engines usually running at a high speed, special provision is made in the design for closing in all the moving parts, the only part requiring extra protection being the transmission, and as these are generally direct coupled to a dynamo, or other quick rotating machine, the usual mode of fencing is to case in the fly-wheel.

With portable and semi-portable engines (*e*), it is not usually considered necessary to provide anything which may be strictly designated a guard, but the arrangement previously mentioned for shielding the projecting end of the shaft is sometimes adopted, and where the piston-rods pass through the cylinder back covers, there should be a sleeve extended from the gland inside which the rod works.

In the case of under type engines (*f*), practically the whole of the moving parts, except the shaft ends and fly-wheel or pulley, are within the frame and under the boiler, so that, when an efficient arrangement is provided for lubricating the different points, there is no necessity for guards except round the wheel and belt race. With this type of plant the water-gauge glasses on the boiler front should have suitable protectors to prevent the attendant being injured, should the glasses burst while under steam pressure.

Winding and hauling engines (*g*) may be treated on the same lines, so far as the engine work proper is concerned, as the self-contained horizontal type. The gearing, etc., outside the engine should be fenced or guarded as the circumstances of each particular case may require.

Traction engines and road rollers (*h*) should have a light cover over the gearing which transmits the motion from the engine crank-shaft to the road wheels. Protectors should also be provided on the water-gauge glasses, and further than this there is not much scope or necessity for guards on these engines.

Gas- and oil-engines (*i*) are so closely allied in general form with steam-engines, that the remarks and suggestions *re* guarding may be taken as broadly applicable in both cases.

Except in cases where the engines are not self-starting, the fencing round the fly-wheel should be such that the attendant has easy access, or else in very small engines this should be removable.

The author might also add as a recommendation, that in starting off steam- or gas-plants the engines should be moved slowly for a few revolutions, especially in steam-engines, where there is a liability for water to lodge in lengthy steam-pipes, which are often carried a considerable distance, sometimes in the open and not always properly clothed. An efficient steam separator, close to the stop valve of a steam-engine, is a desirable accessory. In conclusion, the author would specially mention that all oil-boxes and reservoirs containing lubricants should be carefully cleaned from time to time to ensure regular and efficient lubrication, and they should also be placed in a convenient and easily accessible position to ensure proper care and attention from the engineer in charge.

As a rule, except under exceptional circumstances, the moving parts of an engine should not be cleaned whilst it is in motion.

The subject is illustrated by 7 Figs. in the letterpress, and Plate 9.

(For Discussion, see page 248.)

FENCING OF STEAM- AND GAS-ENGINES. *Plate 9.*

(*Mr. J. H. Crabtree's communication.*)

Fig. 8. *Guards to Press-Cogs and to Gas-Engine.*

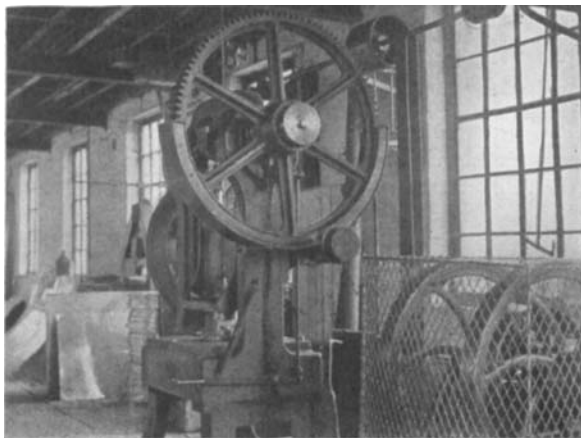


Fig. 9. *Fence to Gas-Engine.*

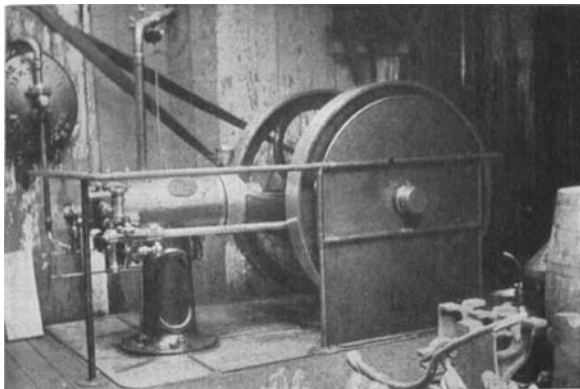


Fig. 10. *Fence to large Steam-Engine.*

