FLY-WHEELS.

In connection with a fly-wheel there are many points which render it one of the most important features of a thoroughly well-balanced steam-engine. The necessity for its use arises from the irregularity of the crank-action, upon which most steam-engines depend for the transformation of reciprocatory into rotatory motion; but besides its character of being a regulator of motion, it is also a reservoir of power, useful when variations occur in the load an engine has to carry. In some cases, also, it is used in conjunction with a belt or band, which acts as a sort of pulley, as a means of communicating power.

For a fly-wheel to be truly proportioned, it should be impossible to detect any variation in its speed, or in the motion of the engine. This being equivalent to uniformity of power, the dimensions of the fly-wheel must be determined by the nature of the work to be accomplished.

Various formulæ are employed by engine builders to assist them in judging the proper size and weight of fly-wheels. For instance, the Buckeye Engine Company, in order to arrive at the weight of rim per horse-power, divides 6,500,000 by the diameter of the wheel in feet and by the square of the number of revolutions per minute; *e.g.*, an engine making 100 turns per minute would require for a 13 foot wheel $6,500,000 \div (13 \times 10,000) = 50$ pounds per horse-power in the rim. This is for automatic engines; but for those of the throttling type, the Buckeye Company would substitute 5,000,000 for the former figure. If a small wheel is required, equal in efficiency to a large one, its weight should be universally as the square of the diameter to centre of rim thickness, as compared with that of the larger wheel. For example, if the diameter of the large wheel to centre of rim is 18 feet, and that of the small wheel 14 feet, then the weight of the small wheel should be as $18 \times 18 = 324$ is to $14 \times 14 = 196$, compared with the large one.

In order to have the least amount of friction, the best position for a fly-wheel is as near as possible to the crank.

To produce a full effect, they should be accurately centered and balanced; and the speed at which they run should be also duly supervised. It is difficult to lay down any definite rule on this point. The true proportion must be determined by the nature of the work in hand, the length of stroke of the engine, and the accurate balance of the rotating parts. In cases where the speed has to be decreased or increased suddenly, a very heavy fly-wheel, or one rotating at very high speed, should be avoided.

BOILERS.

The causes of deterioration in boilers are varied. In some districts, the feed-water contains an excessive quantity of salt, or of acid; or it is taken from copper mines or artesian wells. All these are detrimental to the good condition of a boiler. The feed-water should be the best obtainable, and many explosions have been caused by negligence in this respect. Boilers should never be set in damp places, for external corrosion is injurious. The introduction of a fresh supply of water is, owing to the rapid generation of gases and the sudden excess of pressure, another fruitful cause of explosions. For the same reason an explosion sometimes takes place when the engineer, discovering low water, raises the safety-valve and starts the engine; it relieves the pressure of steam, causes the water to rise and strike the heated parts, and steam in consequence is generated over-quickly.

It would materially decrease the risk of explosions if the following points were always observed:—

There should at all times be a sufficient quantity of water.

There should never be a higher pressure of steam than can be helped; the pressure allowed by the inspector should under no circumstances be exceeded.

The boiler should be allowed to cool down before being refilled.

Before starting the fire, it is well to try the water gauges and to see that the water is at proper level in the glass gauge.

Glass gauges and gauge cocks should be kept in perfect order; the openings should never be allowed to stop up. Otherwise, owing to the quantity of scale and sediment, one is apt to be deceived as to the real water-level.

The safety-valve should be kept in good working order, be lifted and oiled at short intervals, to prevent corrosion, and occasionally it should be ground in.

If the steam gauge and safety-valve are found not to correspond, the former should be tested, and if defective, repaired without delay.

The steam gauge should not be exposed to much heat. The pipe should be so arranged that the condensed water will act on the gauge and not the steam direct. There should be a small cock to prevent the freezing of condensed water in cold weather.

The boiler should be cleaned often, and after each cleaning, it should be examined internally so that any defectiveness in the braces, fire-box, crown-sheet, or other part should be discovered and rectified at once.

Water should not be put into a boiler at low temperature. It is best to use feed water heaters or injectors, which, in the long run, are economical, and add to the boiler's lease of life. The feed-pumps should be kept in good order.

A stop-valve should be placed between the check-valve and the boiler, so that the former may be easily examined at any time.

Finally, the best safeguard against the risk of an explosion is to take great care in keeping every part of the boiler thoroughly clean and in good working order.

ELECTRICITY AND STEAM.

It seems a curious anomaly that at the very time that the application of electricity to all the purposes of civilization has shown such an extraordinary development, the demand for steam-engines has increased in almost the same proportion. People used to think, because electricity was coming into use as a motive force, that steam would go out of fashion. The event has proved far otherwise. It is true that there are ten hundred electric cars running now to every one running a few years ago; but here comes in the question, where does the electric force itself come from? In a few exceptional cases it is generated by the power of falling water or by that of chemical mixtures; but for all practical purposes it may be said to be steam converted into electricity. The same holds good when we consider electricity as an illuminant. The light is formed by the passing of an electric current between two poles; but the current itself, traced back to its source, is found to spring from an engine worked by steam. In no way has steam-power become obsolete; it has merely taken in a partner.