RIVETING.

BY ROBERT GRIMSHAW.

The rivet is a device employed, in general, to unite two plates of metal quite firmly together. Occasionally, as in a pair of scissors, the rivet acts also as a pivot ; but ordinarily it is not a centre of turning. In most cases the strain upon it is a lengthwise pulling or tension, as in boilers, although in some substances, as in lattice bridge work on the English system, there is, instead of a pulling strain, a *shearing* action crosswise of the length of the rivet.

The ordinary rivet is of wrought iron, and has, when made, a first head, which may really be called the *tail ;* and a cylindrical shank, body, or stem ; and after being placed has a second head given to it, by upsetting the cylindrical stem. In Fig. 1 is shown a rivet uniting two plates, and it has marked on it the proportions which the various parts should have, as compared with the diameter of the stem. It will be seen that an "inch rivet," that is, one having a stem 1 inch in diameter, should have a head 1·8 inch diameter and 0.6 inch high, and that the shank should be long enough to project from 1.3 to 1.7 inch through the two or more plates which are to be united. Fig. 2 shows this rivet headed up by hammer blows delivered obliquely, and thus forming a conical head 2 inches in diameter and 0.8 inch high. These dimensions are larger than those of the first head, as the metal is less perfectly compressed and the shape not so advantageous. If a cup or former, sometimes called a "snap," be used, so as to finish the conical head, the conoid form is given, as in Fig. 3, and which has the advantages of sightliness, regularity, and slightly increased strength. In Fig. 3 the first head is not spherical in shape, but more flattened. Figs. 1 and 2 show plates which have had the holes drilled in them ; rather expensive in any case, and unnecessary with iron plates. In Fig. 3 the holes have been punched, and as the die is always larger than the punch, to give "clearance," the holes are tapering. This form is better in those cases where the strain on the rivet is one tending to pull the heads off, as the metal of the shank is forced out (or ought to be) into an hour-glass form. Of course the plates are so put together as to bring the small ends of the holes together. Where a hole is necessarily drilled, as in a steel boiler plate, reaming or counter-sinking, as shown in Fig. 4, gives the same result as is afforded by the taper holes of the punching machine. The second head in Fig. 4 is flatter than in the others, as is sometimes demanded. In fact, there are cases where the head must not project at all, as in iron ship-building ; and in this case the sheet is counter-sunk quite deeply, as shown in Fig. 5, and there is very little head left projecting after finishing. It is difficult to assign a length for a shank for this case, as in those shown in the first four cuts.

Good Norway iron will rivet quite well cold, but where it is required that the joint be very staunch, it is best to have the rivet fully red hot, so that one may be more certain that the hole is fully filled by the shank, and that the contraction of the shank in cooling may draw the plates still tighter together and keep the plane faces of the heads in absolute contact with the plates.

For bridge-work it is essential that the proportions of the rivets be very carefully determined and adhered to. Fig. 6, 7 and 8 show round, elliptical, and sunken heads. Hammering the head of the rivet, and the plate in its vicinity, is not calculated to better the resistance of the plates, as these last are really stretched as by *pening.* Steam riveting is largely employed, but hydraulic pressure is much better, and causes the shank to fill the hole absolutely and tightly ; besides, the hydraulic machine is more readily controlled.

Where a rivet acts as a *pin*—that is, where it resists shearing strain, its strength may be calculated by mathematical formulæ. Figs. 9 and 10 show two modes of connecting links by rivets ; Fig. 10 is chain riveting, and is mostly seen in bridge-work. The proportion between the thickness and strength of the plates and of the rivets should always be closely studied. We may say in general that for bridge-work rivets of great diameter, at comparatively great distances apart, are better than small ones close together.

For boiler-work the necessity of avoiding leakage makes it imperative that the rivets be close together ; for thin sheets the diameter and the distance apart of the rivets should be proportionately greater than for thick sheets. Fig. 11 shows a single row of rivets in section and on top view ; Fig. 12, double riveting, the rivets being placed "staggering," as they should invariably be. The edges of the sheets should, if possible, be cut with a slight bevel, to facilitate calking ; and this calking should invariably be done with a round-nosed tool, so as to ensure perfect contact and to prevent *scoring* of the under plate. The joints of cylindrical boiler shells ought to run spirally around the shell, to give the greatest strength.

In using rivets of *very* long shanks, that is, with stems disproportionately long for the diameter, care should be taken not to heat the stem too hot, or else not to heat it throughout its whole length, as otherwise the contraction in cooling tends to pull the heads off.

While it is best to drill all rivet holes in steel plates, on account of punching altering the temper and causing liability to crack, the holes may be punched somewhat smaller than needed, and then reamed out ; or the sheet may be annealed after punching.

Recent experiments in punching iron sheets show that a punched hole is stronger, than a drilled one—that is, leaves the plate stronger ; for in punching there is a good deal of metal that is crowded into the sides of the hole instead of being punched out, and the deeper the hole in proportion to its diameter the more of this flow of metal and condensing it in the walls of the hole do we find.

DANGERS OF ELEVATORS.

We have more than once called attention to the dangers of elevators, and to the certainty that as they are now used a great many serious accidents must from time to time happen to them. An efficient contrivance for diminishing the danger of the worst of these accidents seems to be that of Mr. Ellithorpe, who has hit upon the device of putting an air-cushion at the bottom of the well to check the blow in case the car falls. A tight box is provided at the bottom ; into this the falling car plunges, and the air, that is compressed beneath, forms the cushion which breaks the fall. The principle is familiar, and indeed has been applied to the same use in Gray's safety attachment for elevators. An experiment was safely tried the other day at the Biddle House in Detroit. An elevator car containing seven persons was dropped sixty feet by cutting the rope from which it hung. The car fell with frightful swiftness, but brought up safely at the bottom. A bench, which seems to have been overloaded, broke, but the passengers were unhurt, and a dozen eggs, with which heroic hardihood had strewn the bottom of the car, escaped unbroken. A previous experiment at the Parker House in Boston had not been so lucky, and showed the danger which is common to inventors of overlooking, while their attention is fixed on the main feature of their invention, the collateral conditions on which its success may depend. The well in the lower story was closed by a door. This with its casement was blown out of the wall by the compressed air, which, escaping, let the car down abruptly enough to shake and bruise the passengers in a way that sent them to their beds, though without permanent injury, we believe. The car and the passengers in this case weighed some four thousand pounds, and fell through a height of about eighty feet. It was certainly a naïve confidence that expected any ordinary door-casing to withstand the shock of this tremendous impact ; nor is it quite easy not to smile at the innocence of the passengers, who prepared themselves to meet the worst by seating themselves upon the floor of the car, thus carefully presenting the end of the spinal column to meet the apprehended shock and transmit it directly to the brain. We would remind all our friends who may venture on similar experiments that boys, when they jump from sheds, with a safe and native instinct take pains to light upon their feet with loosened knees, which breaks the jar by a natural spring.—*American Architect and Building News.*

Galvanic-relief Plates.—A recent French patent contemplates the embellishment of metallic plates, to be tinned or galvanized, by submitting them, after being suitably polished and grained, and printed upon with the pattern to be shown in a greasy ink, to the action of an acid bath by which the exposed parts of the plate are bitten in or deepened, and the parts protected by the ink are left in more or less relief as may be desired. The necessary relief having been secured, the plates are removed from the acid bath, the ink removed either with the aid of heat or of solvents, and the plates submitted to the galvanizing or tinningbath, or to an electro-plating process, as may be desired.

The Deepest Diving.—The deepest depth to which the diver has descended in pursuing his dangerous occupation, was that reached in removing the cargo of the ship *Cape Horn,* wrecked off the coast of South America, when a diver by the name of Hopper made seven descents to a depth of 201 feet, and at one time remained down 42 minutes.