HYDRAULIC RIVETING.—TWEDDELL SYSTEM.

The increased use of wrought iron, and especially of riveted wrought iron work in construction, calls for convenient and efficient rivet driving machines. The system of hydraulic riveting machines, invented by Mr. Ralph H Tweddell, of London, England, has been extensively introduced in England, on the continent of Europe, and to some extent in this country. Mr. Tweddell's machines are made either portable or stationary, and many ingenious arrangements have been contrived suited to various kinds of rivet driving. In the early power rivet driving machines the riveting die was moved back and forth a fixed distance by a crank, cam, or toggle joint movement, and the work done was not of necessity uniform, inasmuch as variation in size or length of rivet, thickness of the iron plates, or size of the holes to be filled, caused this, at all times equal, motion of the riveting die to

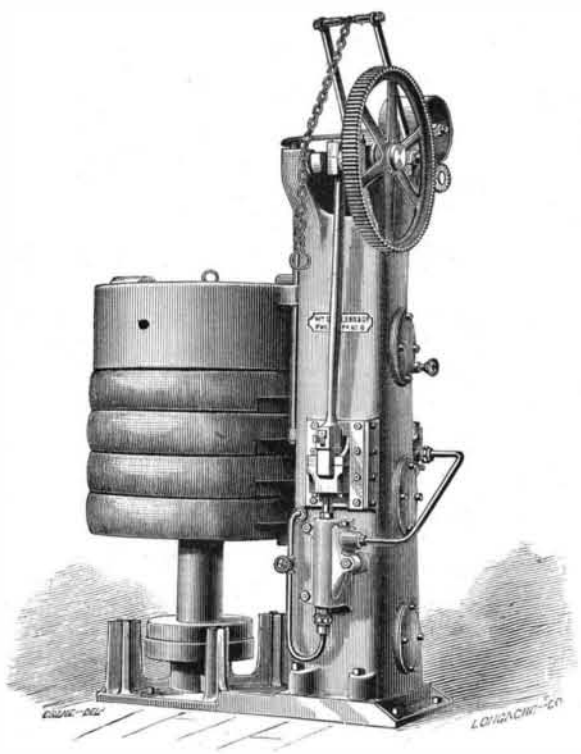

Fig. 1.—PUMP AND ACCUMULATOR.

compress either too much or too little, as the case might be. Direct acting steam riveting machines next came to be used, and with them equal work is done, even with very considerable variation in both rivets and holes, so long as the boiler pressure actuating the machine is kept uniform.

Direct acting steam riveters are not readily made portable, on account of the low pressure of steam and the consequent large size of the cylinder required. Thus, steam riveting machines for boilers are made with cylinders from 31 inches to 42 inches diameter, according to the work required. Steam used is generally 70 to 80 pounds pressure to the square inch. Hydraulic riveting machines with cylinders 6¼ inches diameter, and with water under a pressure of 2,000 pounds to the square inch, will do the same work as a steam riveting machine with 36 inch cylinder, with 60 pounds of steam. The

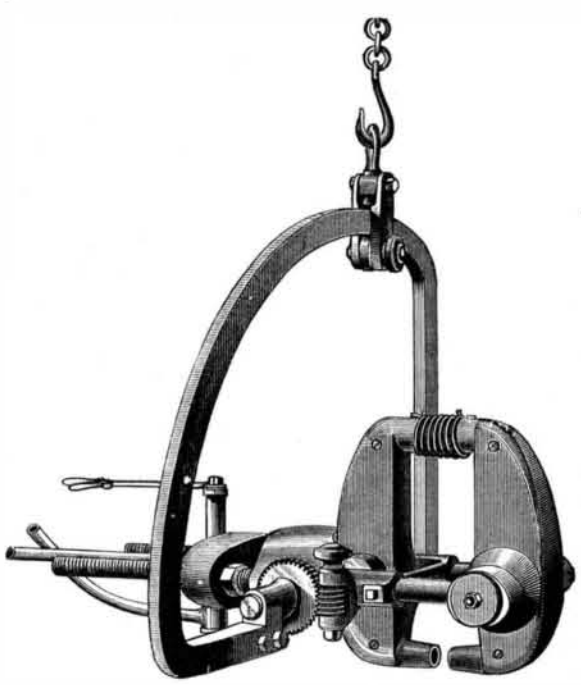

Fig. 2.—SUSPENDED RIVETING MACHINE—SIDE VIEW.

important feature of Mr. Tweddell's system of riveting machines, apart from the ingenious arrangement of the special machines, lies in the use of an accumulator, in which the water is stored under pressure, and from it admitted to the cylinder of the machine, where its power depends upon the load on the accumulator plunger; by adjusting the load on the accumulator to suit the size of rivet to be driven, the utmost uniformity is insured in the riveted work.

The outfit required for the Tweddell system of hydraulic riveting consists of a pump and accumulator and the machine proper; the latter may be either stationary or portable. We give (Fig. 1) a cut of the pump and accumulator. In this the pump is double acting, operated by crank motion. It takes its water from a reservoir in the upright; the return water, re-entering the reservoir, passes through a mass of sponge to filter it. The water on its passage from the pump to the accumulator goes through a relief valve on the back of the upright. This valve is so constructed and controlled by the motion of the accumulator as to relieve the pump from work without stopping its motion when the accumulator is full, and starts it to pumping into the accumulator as soon as the accumulator weight has descended a short distance. When the valve is open the water under pressure in the accumulator is shut off from the pump; the pump relieved from pressure draws water from the reservoir and forces it back into the same reservoir, maintaining the action without strain, but is ready to resume its work when required. When the relief valve is closed the pump forces water directly into the accumulator.

The accumulator holding enough water for, say, two strokes of the riveting machine, is soon filled by the pump; when full the pump must either be stopped or the water be discharged elsewhere. To stop the motion of the pump each time the accumulator fills involves its being started again as promptly when required. This is not readily done, and risks the loss of water and entrance of air into the pump chamber, while standing. To continue to run the pump and discharge under a safety valve, involves an expenditure of power when no work is being done. The arrangement employed maintains the motion of the pump ready for immediate action, and yet relieves it from strain when not required to do work.

The accumulator is arranged with weights suspended below the main casting, so made as to be readily released from it in order that the pressure may be adjusted to the work being done. Each weight represents a pressure of 250 pounds per square inch on the ram of the riveting machine. The maximum pressure obtainable when all weights are in place is 2,000 pounds per square inch, and it may at will be made 1,000, 1,250, 1,500, 1,750, or 2,000 pounds per square inch.

For bridge work construction in the shop the pump and accumulator are placed in any convenient position, and the water under pressure is carried from the accumulator through jointed or flexible pipes to the portable hydraulic riveting machine suspended from an overhead carriage.

The work, resting on trestles, remains stationary; the machine is moved along it from rivet to rivet to be driven. The riveting machine itself is adjustable within a hanging bail, and can thus be made to present itself properly to seams, horizontal, vertical, or oblique. In Figs. 2 and 3 we show the portable riveter in these positions. The dies are carried by levers, and the hydraulic cylinder acts upon levers of the third order, so proportioned that the die pressure is two-thirds of the cylinder pressure.

The overhead carriage, which is usually applied to these machines, has a motion of 50 feet in one direction and of 6 feet at right angles to the first motion, so that the riveter can act anywhere over a space of 50x6 feet of the shop floor. In this space the work rests on trestles, and the riveting machine is moved along or around it.

One man raises or lowers the riveter and moves it along the work. The rivet driver adjusts it to the work and closes the dies by a motion of the valve lever; on beam work as many as 10 to 16 rivets can be driven per minute. For boiler work the riveting machine is made stationary, as shown in Fig. 4, and the work is presented to it hanging from a suitably arranged crane.

Sometimes for deep girder work a portable machine, similar to the stationary one, is suspended upside down from a hydraulic crane, and made to move from rivet to rivet over the deep girder, all the motions being controlled by the operator.

Hand riveting is a trade of itself; on boiler work the same number of men form a gang to drive one rivet at a time as is required to run a hydraulic riveting machine and to operate the hoisting machine. With hand riveting the work stands still and the men move about it. With the stationary riveter the entire boiler or other construction must be taken to the machine and moved about it. The men required to work the hydraulic riveter are not trained riveters. In riveting boilers by power the necessity of holding the rivet until it is cool limits the operator to five rivets per minute, to do good work. If it were not for this reason ten rivets could easily be driven per minute; but even with this restriction it is claimed that the comparison between hand and power riveting in the same shop is ten to one in favor of power riveting in reference to the number of the rivets driven, taking into consideration all the time required to move the boilers to the machine, or lost in setting up the work. In girder work the difference is greater in favor of power rivet driving; as many as 5,000 rivets aresaid to have been driven by one gang with one portable hydraulic riveting machine in ten hours, including all the lost time of setting up the work and removing it when done.

Many experiments have been tried to determine the efficiency of direct acting power-riveting machines in comparison with hand driving. The hand rivet fills up the hole very well immediately under the head formed by the hammer, but sufficient pressure could not be given to the metal, or rather it could not be transferred far enough to affect the metal some distance from the head.

So great is this difficulty that in hand riveting much shorter rivets must be used, because it is impossible to work effectively so large a mass of metal with hammers as with a machine. The heads of the machine rivets are therefore larger and stronger, and will hold the plates together more firmly than the smaller hand riveted head.

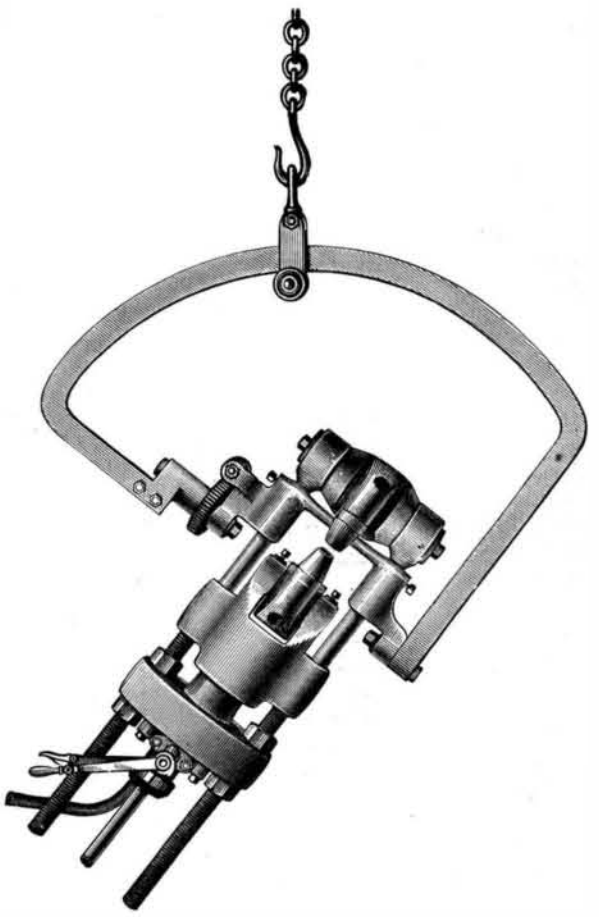

Fig. 3.—SUSPENDED RIVETING MACHINE—BOTTOM VIEW.

The cuts we have presented of Mr. Tweddell's riveting plant are illustrative of the machines as made in this country by Messrs. Wm. Sellers & Co., of Philadelphia. This firm controls the invention in the United States, and has added many improvements to the original machines.

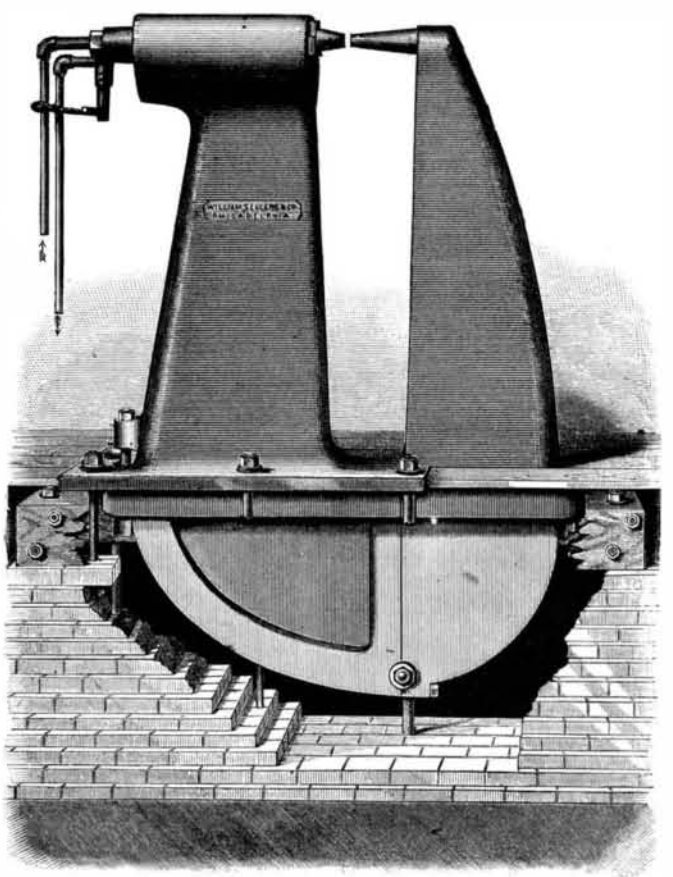

Fig. 4.—STATIONARY RIVETING MACHINE.