

and the other to give the final squeeze for reducing the bulk into as small a compass as may be desired. This has generally been effected by tossing the hay into cubical cases, where it is trodden down by men's feet before the final pressure is applied; but this method is open to many objections. The hay is bruised and broken by this rough treatment; no uniformity can be secured in the packing; and the plan enables unscrupulous dealers to fill in the interior of the bale with a damaged or inferior article. Besides this, the form of the bales is very inconvenient, so that they require four men to transport them from place to place.

The hay press exhibited in action by Mr. Th. Piltet, of Paris, at the Cattle and Implement Show under the auspices of the French Minister of Agriculture and Commerce, is improved by him from an American model, and patented in England and France. The hay, thrown on to a platform, is delivered continuously in small quantities up to a circular plate, and passes through two narrow slits, into which it is uniformly fed by two revolving cones, which impart to it a corkscrew motion. The hay is, in fact, roughly spun into a double threaded screw of very fine pitch, and forced onward with gentle pressure until a sufficient quantity has been collected to form a cylindrical bale of the weight desired. A pressure of about 6 cwt. to the cubic yard is then applied, giving the density which is found most desirable; a pressure of 8 cwt. to the square yard may, however, be given if required. The bale is then bound by two steel wires, crossing one another in a longitudinal direction; they are previously looped at each end, and are fastened by simply inserting in the loops a curved link like a small belt hook before it is flattened. On the pressure being relieved the mass slightly expands, stretching the wires; and the bale falls out of the press, a solid uniform cylinder, 2 feet $1\frac{1}{2}$ inches in diameter, which may be rolled along by one man. A bale weighing from 2 to $2\frac{1}{2}$ cwt. is found most convenient, and for this a power of only three horses is required.

A perspective view, engraved from a photograph of the press exhibited at Paris, is given in Fig. 1. The machine rests upon a pair of wooden carriages, similar to those of a waggon, connected by stout longitudinal frames of angle iron; it is, therefore, easily moved to wherever required for work. The main shaft extends the whole length of the frames, and is supported in bearings, one at each end of the right hand frame or that removed from the point of view in the engraving. A pulley keyed on to the end of this shaft receives motion, by a belt, from a horse gear, portable engine, or any source of power. This shaft carries three spur pinions of equal diameter, arranged quite near the bearings, two at the front end and one, not visible in the engraving, at the back; they all run loose, but are capable of being made fast by friction clutches. When none of the pinions are in gear the main shaft only revolves. When the two hindermost pinions are both made fast on the shaft, they cause the two large spur wheels of equal diameter, arranged along the centre line of the machine, to revolve together. That nearest the front end is fast on the second shaft, which is hollow, and forms the nut of a screw. The other is merely a ring having a flange cast on to it, which is carried by three friction rollers; it has, however, a couple of ribs, cast on the inside of the ring, which fit into notches in the circular head of the press, so that they revolve as one piece when the hay is fed in at the back end. This head is guided by two T irons bolted to the back plate and attached to a collar carrying arms at the front end. The head is also bolted to a square bar of wrought iron, which slides through the centre of the screw, and passes out at the front end. When both the spur wheels are in gear, the second shaft, forming the nut, and its screw revolve together; but when the back wheel is stationary, the revolution of the nut causes the screw to advance, forcing the head toward the hinder end. For bringing back the screw a smaller spur wheel, the boss of which also forms a nut, is made to revolve in the contrary direction by means of an idle wheel or carrier; and the front spur pinion is thrown into gear by a double clutch at the front end. A bevel wheel cast on to the annular spur wheel at the back end (not seen in the engraving) turns the cones, which are centred in the ribbed plate, and also takes into a bevel pinion, giving motion to a short longitudinal shaft, which, by means of a pair of mitre pinions, rotates a transverse crank shaft, actuating the shakers. There are four of these shakers with rake teeth, two on each side of a central division (not shown) for keeping separate the two streams of hay fed in by the two cones. This division is made movable for permitting the wires to be inserted for binding the bales.

Having described the principal parts of the appliance, we will now proceed to give an account of the operation of compressing the hay and forming the bales. Both the large spur wheels are thrown into gear, so that the screw, nut, and head revolve to-

gether. The hay is then thrown by forks on to the platform by two men, one on each side, and is carried on by the shakers to the back plate, where it is drawn uniformly through narrow rectangular apertures by the revolving cones. The head is at first close up to the back end; but the pressure exerted by the cones, introducing the hay, forces it gradually forward; and teeth are attached to the head for preventing the hay from slipping round it. In order to cause sufficient resistance of the head on the square bar, the latter is provided with a brake screw, which is turned as tight as experience shows to be desirable. When a sufficient quantity of hay has been fed in to form the weight of bale required, the back pinion, spur wheel, and cones are thrown out of gear, and the large spur wheel at the front end kept in gear; as the boss of this wheel forms a nut to the screw, it causes the latter to advance and drive back the head until it has given the hay the amount of compression desired. The bale is then bound by the two steel wires as described above; the double lever clutch throws out the larger spur wheel, and throws in the smaller, thus bringing back the screw; and the bale falls out, ready to be rolled away wherever required.

The operation of the machine is one of the simplest character, requiring only a power of three horses, the labor of two men, and from three to five minutes of time, according to the size of the bale.

Fig. 2 shows the method of loading the bales into railway cars; and Fig. 3 a plan of the car with the arrangement of the bales as stowed away. It will be evident that this new hay press possesses considerable advantages over those which have preceded it.—*Iron*.

THE TRANSMISSION OF POWER BY BELTING.

The results of an extensive series of experiments on belts and belting have been published in France by M. Leloutre, in the "Transactions of the Société des Ingénieurs Civils." The subjects examined were the elongation, elasticity and breaking strain of driving belts made of leather, indiarubber, webbing and canvas; and the slipping of belts and cords. Some practical applications made of these results in the transmission of power by belts, are also given.

The experiments on elongation, elasticity, and breaking strain were made by cutting from any leather belt, or from the hide, a strip about 30 inches long and 2 to $2\frac{1}{2}$ inches wide, which was further subdivided into three or four narrower thongs, for testing in different ways. Two fine lines were marked across the thong, at a distance of 20 inches apart; and the width and thickness of the thong were carefully measured at several intervening places, to determine the corresponding transverse sectional areas, the minimum of which was taken for calculating the strains. Any probable errors involved in the results so arrived at did not exceed 2 per cent.

The general results of the experiments on leather, indiarubber, webbing, and canvas, are that the elongation produced by a tensile strain is in no respect proportional to that strain, but increases always less rapidly than the tension; in other words, the modulus of elasticity for these materials rises higher and higher as the load increases, while for metals it falls lower and lower. One curious fact, however, which the experiments disclose is that, while the elongations or successive increments of length become less and less up to a certain load, they then become greater and greater, showing a point of maximum power of resistance, which is then followed by a falling off; after this decline of resistance, the elongation again becomes less rapid up to the breaking strain, on approaching which the resistance is generally greater. In ordinary leather the maximum resistance to stretching is met with at a strain of about 850 lbs. per square inch; in indiarubber and webbing it occurs at rather a lower strain. It is evidently advantageous, therefore, that the working strain on a belt should be fixed as near as possible to that at which the maximum resistance to stretching occurs, or, say, from 700 to 800 lbs. per square inch. This is largely in excess of the tension generally recommended of 200 to 300 lbs. per square inch, which itself is even regarded with timidity by many engineers. Should the point of maximum resistance to stretching be accidentally exceeded by the strain in working, no trouble will be experienced. This is owing to the fact, demonstrated by experiment, that the elasticity of leather and webbing is perfect; for when thongs have already been twice torn asunder, the severed shreds, after having been stretched $1\frac{1}{2}$ inch per foot, have been found with fifteen months' rest to recover exactly their original length.

In experimenting on the slipping of belts and cords upon polished pulleys, the very first results obtained pointed to the