INTERESTING EXPERIMENTAL BOILER EXPLOSION.

The first experiment by Mr. D. T. Lawson, of Wellsville, Ohio, was exploding a steam boiler of practical size, which contained the usual working quantity of water. It took place on June 16, 1881, and was illustrated and described in the SCIENTIFIC AMERICAN and SUPPLEMENT of December 24 and 31. As then stated, the object is to define the nature of the causes of boiler explosions, and to show the efficiency of the experimenter's patent device in the prevention of that class of explosions that occur upon opening the engine throttle valve or other principal steam outlet of the boiler after an interval of rest. Mr. Lawson's device consists of an arched perforated diaphragm fixed horizontally near the water line inside the boiler.

An illustration of it, as applied to a horizontal two-flue boiler, was given in the SCIENTIFIC AMERICAN of July 4, 1880.

In accordance with a determination formed after his first experimental explosion, Mr. Lawson had two boilers made of the best iron, duplicates in form, size, and materials of his first one. One of these contained the diaphragm and the other did not. They were horizontal cylinder boilers, thirty inches diameter by six feet long, the shell of two plates of three sixteenths inch and the heads of three-eighths inch iron. The heads were stayed by a one-inch iron bolt which passed from end to end through the center of both heads. The diaphragm in one of these boilers was of three-sixteenths boiler iron, flanged and riveted to each boiler head and along each side of the shell, as indicated by the rivet heads and dotted lines, Fig. 2. The top

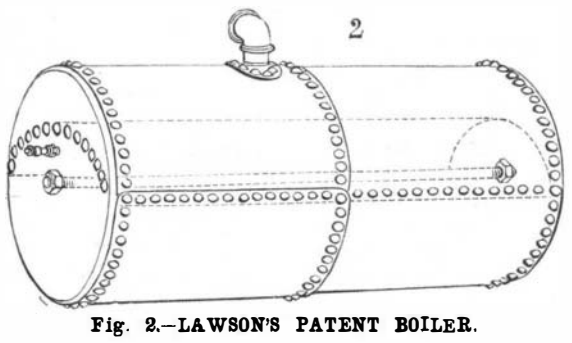


Fig. 2.—LAWSON'S PATENT BOILER.

of the arch of the diaphragm was about seven inches below the summit of the cylinder. There was also in the patent boiler a man-hole of the usual size in the rear head. The opening was re-enforced by a strong wrought iron rim riveted to the boiler head. There was no man-hole in the other boiler.

The second series began on February 17, and after an interruption of some time, occupied in perfecting arrangements and procuring standard pressure gauges, they were continued on and after March 7, and ended with the explosion, herewith illustrated, on March 22.

Fig. 1 shows the scene of the explosion, Munhall Valley, on the west bank of the Monongahela, about eight miles from Pittsburg, Pa. It was here the government explosion experiments were conducted in 1873, the buildings shown being the bomb-proof structures erected by the commission. The sectional plan on the right of Fig. 1 is that of the bomb-proof used by Mr. Lawson. A large upright boiler and a high pressure steam pump remain in the pump house, and an unused steam boiler lies near the upper bomb-proof, relics of the work of the commission. One of the buildings on the right (Fig. 1), also bomb-proof, was for the accommodation of visitors, who could there get a view of the whole line of operations through horizontal crevices cut in the joints of the heavy timbers.

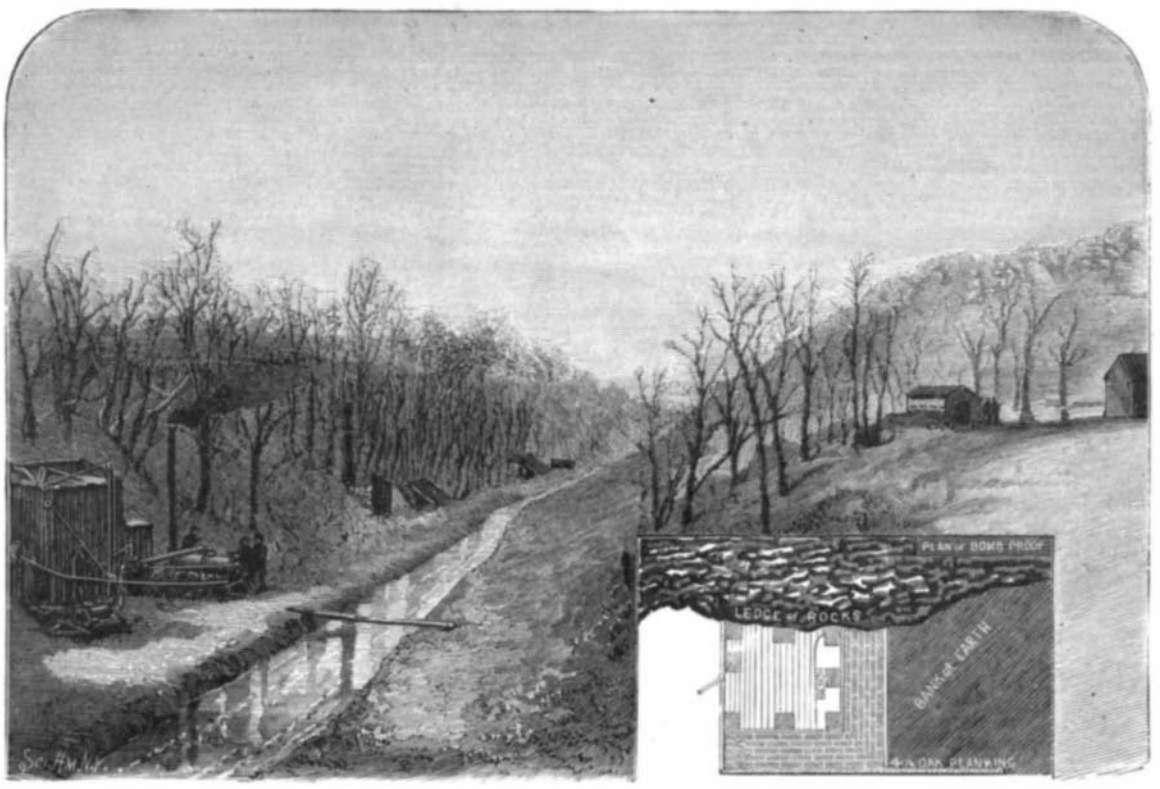


Fig. 1.—VIEW OF THE MUNHALL VALLEY, SHOWING THE ARRANGEMENT OF LAWSON'S EXPERIMENTAL BOILER.

On February 17, Mr. Lawson's patent boiler having been set up, as shown in Figs. 1 and 3, the second series of experiments began. The boiler was set in masonry, and connected with it were fifteen feet horizontal and about three feet vertical lengths of three and a half inch wrought iron steam pipe, leaving the top of the boiler at the middle of its length and entering the stuffing box of an old empty steam engine cylinder eight inches diameter and thirty-six inches long. Near the elbow of the pipe which turned downward toward the old cylinder was a three and a half inch quick-opening gate valve, seen in Fig. 3, and enlarged in Fig. 4, of the Eddy pattern. In the head of the old cylinder was a Mississippi gauge cock, which could be operated from the interior of the bomb-proof. The boiler furnace was fitted with a half-inch iron pipe, which entered through the side wall just below the bottom of the boiler and extended in a perforated section across the furnace for the distribution, upon the incandescent coals, of liquid fuel supplied from a barrel placed at a safe distance in a cavity of the bluff (seen at the left of Fig. 1). The flow of oil from the barrel could be regulated by a valve at the door of the bomb proof, as shown.

Inside the bomb-proof were two pressure gauges (only one at first experiment, February 17), both connected to the front head of the boiler, one above and the other below the diaphragm, to indicate the pressure and the disturbance in the steam and in the water pressure when the three and a half inch gate valve was suddenly opened.

At the first experiment of this series it was found that the apparatus was not complete, and especially that the pressure gauge was 50 to 100 pounds "too fast" when compared with the United States standard gauge used by the local inspectors of steam vessels, as far up as that standard reached. The pressure was, however, run up on this first occasion to 275 pounds by the imperfect gauge, which was estimated to be equal to 225 by the standard, and a number of shocks were made by pulling open the steam gate at various pressures below, and at the maximum pressure then obtained.

On the 7th of March, the plain boiler having been set up a little further from the bomb-proof, the adjourned experiments commenced; but after several attempts to get a high pressure in this boiler (having no diaphragm or man-hole, but in all other respects like the patent one), it had to be abandoned, one of the heads having cracked on three short radial lines around the center bolt, so as to cause a leak, which prevented the increase of pressure beyond about 220 pounds. These cracks were apparently started by the violent use of a large drift pin, to enlarge the bolt hole, unmistakable marks of which appeared on cutting out the center portion of the head for repairs. A prominent lip was turned all around the inner edge of the hole. The patent boiler was reset substantially as before, with more perfect appliances for handling the gate valve, the lever of which had proved insufficient, and on the 20th of March steam was again raised, and shocks were made at every 25 pounds rise till 300 pounds pressure by the standard gauge was indicated, when a last shock was given without producing an explosion. The diaphragm was then cut out except a margin all round, through which the rivets passed, about three inches wide (see Fig. 5). The main portion, which was too wide to pass through the man-hole, was left loose in the boiler.

On the 22d of March the operations of the 20th were repeated, with twenty inches depth of water in the boiler.

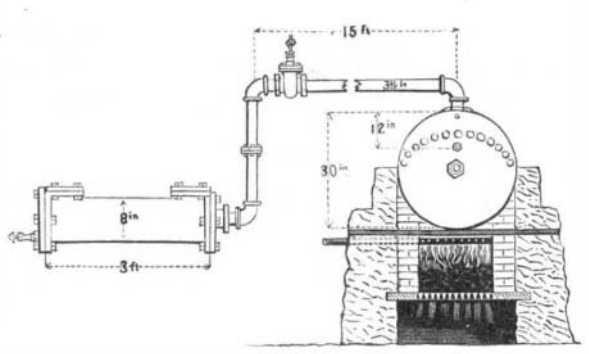


Fig. 3.—ENLARGED ELEVATION OF LAWSON'S APPARATUS.

The pressure rose in six minutes from 175 pounds to 235, the valve having been opened every 25 pounds as before, and the last time after a rise of 10 pounds. When the gate was opened at 235 pounds pressure the boiler exploded with terrific force, all the water disappearing in an atomized form; each elementary globule of one thousand pounds of water, at 400° Fah., simultaneously (not progressively as powder burns) exploded and was diffused in practically ultimate atoms, like a cloud of steam in the air, Fig. 6.

The boiler was literally torn into shreds, beginning probably with the breaking of the one-inch stay bolt, which was the most heavily loaded section of the parts of the boiler. Thus, if the bolt sustained one-quarter of the load on the thirty-inch boiler head when the pressure reached 235 pounds, it would be subjected to a strain of 66,000 pounds to the sectional square inch, or 40,000 pounds upon the six-tenths of a square inch, which it had at the threaded ends—quite enough to break a threaded bolt. The sudden pulling of the nut through the boiler head would have been followed by similar phenomena, namely, an apparently simultaneous destruction of all the stronger parts of the boiler, which are then acted on by a moving and not a statical force, as when the boiler was whole; moreover, the force acts on

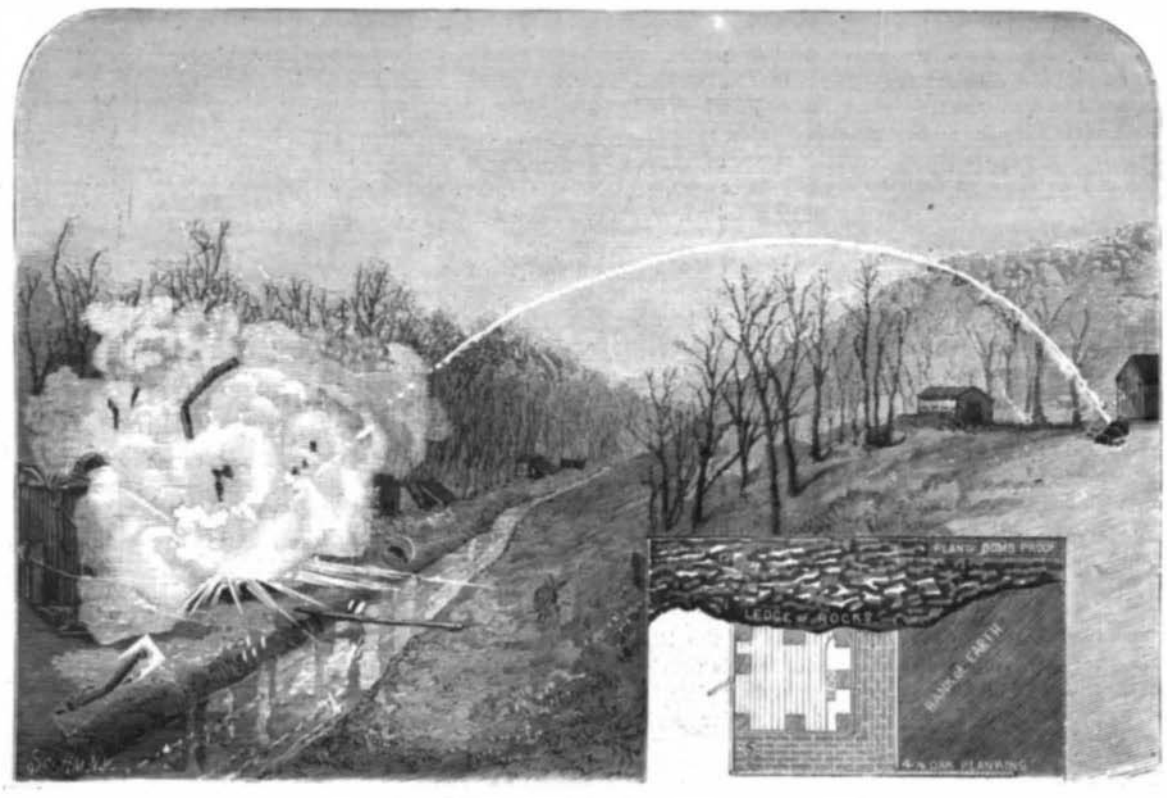


Fig. 6.—LAWSON'S EXPERIMENTAL BOILER EXPLOSION.

the plates of the shell once broken open in a cross-tearing direction, as one tears a sheet of paper, instead of as one would break a string, or as the test samples of iron are broken in a machine. It will occur to the reader that this construction of these experimental boilers was admirably adapted to the end Mr. Lawson had in view.

The cracking of the head around the bolt of the plain boiler, at the experiments of March 7 and 8, probably rendered it impossible to get a breaking strain on the bolt, and the rupture of the iron was slow enough to prevent the pulling through of the nut in a sudden manner before the pressure fell and equilibrium of force and resistance was established.

The record of the commission appointed by the Secretary of the United States Treasury—Supervising Inspector of Steam Vessels, John Fehrenbatch, of Cincinnati, O., and Deputy Inspectors Atkinson and Batchelor, of Pittsburg, Pa.—show that which was also observed by a representative of the SCIENTIFIC AMERICAN, namely, that the pressure always fell on opening the gate valve, and then the gauge fluctuated to a point above, settling at last sometimes at apparently the same, and sometimes at a lower point than that from which it started downward—a perfectly natural and often observed result of suddenly withdrawing one-tenth of the volume of the steam from a boiler to which a sensitive spring gauge is attached.

When the gate valve was opened it was equivalent to suddenly enlarging the steam chamber of the boiler about one-tenth of its capacity; but, inasmuch as the sudden lowering of the pressure was followed by an evolution of steam from the water, which had a normal temperature of 400° Fahr. when under a pressure of 235 pounds above the atmosphere, the theoretical effect of withdrawing one cubic foot of steam would, under these conditions, be a lowering of the pressure something less than one pound, provided no heat is entering the boiler at the instant or during the oscillations of the gauge pointer.

But the gauges used upon these occasions were graduated to five pounds, having no pound or half pound marks, and they were not reliable as indicators of actual variations. It appears, first, that the pressure at which these tests were made left but little margin of strength in the boiler; and, second, that the area of the opening from which the steam was suddenly withdrawn was about one two-hundredths of the surface area of the water, and these conditions, compared with the usual manner of opening the valves, will be recognized as immense exaggerations of the most vicious practices in the use of steam boilers.

While Mr. Lawson's experiments show that a boiler may explode while it contains a full supply of water, they do not, on the other hand, show that boilers do not sometimes explode from lack of water. While they also show that a big throttle valve may be suddenly opened with impunity while a proper margin of strength remains, they do not prove that a weak boiler will or will not break at the instant the engine throttle is opened, producing a very mild shock.

On the whole these experiments, so far as they have gone, are simply confirmatory, almost a demonstration, of the opinions held and taught by the SCIENTIFIC AMERICAN for many years, as well as by many well informed writers and thinkers on the subject of boiler explosions.

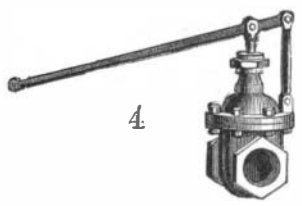


Fig. 4.—3½-INCH GATE VALVE.

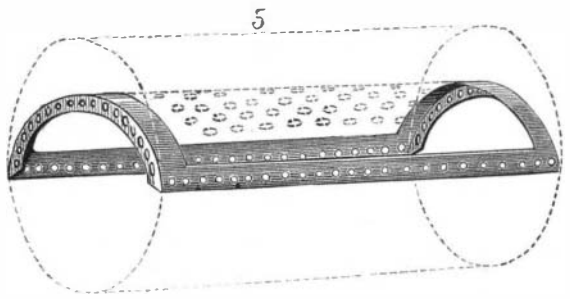


Fig. 5.—BOILER WITH DIAPHRAGM CUT OUT.

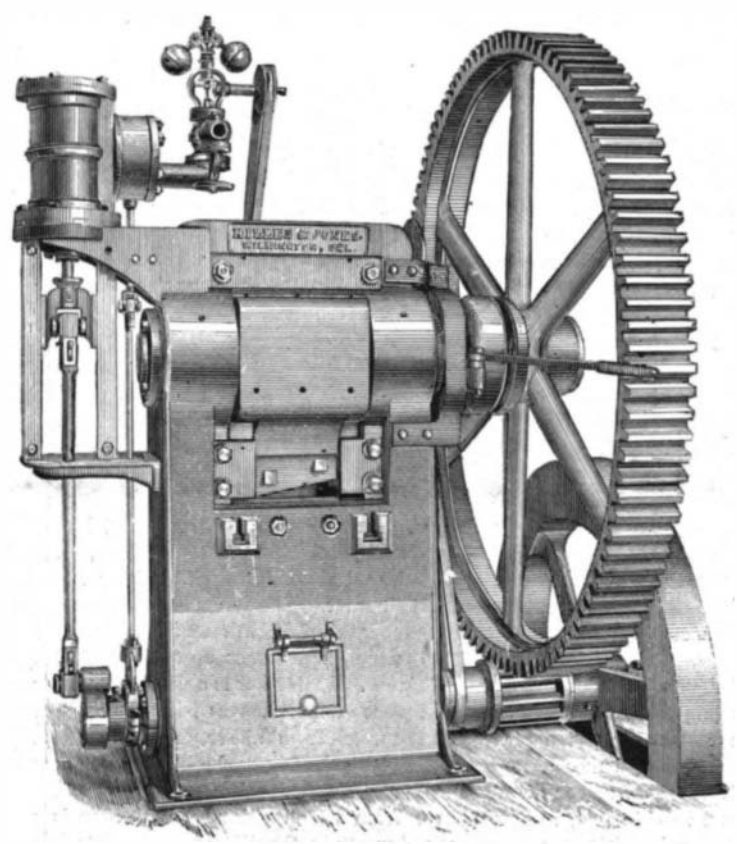
POWERFUL BAR IRON SHEAR.

The annexed engraving shows a powerful steam driven shear built by Messrs. Hilles & Jones, of Wilmington, Del. There are four sizes of this machine, the one shown in the engraving being the largest. It is capable of cutting flat iron six inches wide by two inches thick.

These machines will cut flat, round, or angle iron, and are made with a clutch for stopping and starting the cutter while the fly wheel and gearing are in motion. A bar of iron can be cut accurately to the mark, and a gauge is provided, set on the back of the machine, for cutting a number of pieces of uniform length.

This is is a most serviceable tool for locomotive builders, bolt makers, bridge builders, bar iron rolling mills, or for cutting puddle bars in sheet mills.

The machines are furnished with tight and loose pulleys for driving with a belt, or provided with a pony engine, as shown in the engraving.



HILLES & JONES' BAR IRON SHEAR.

New Electrical Regulator.

M. Salignac, one of the most active electricians of Paris, has discovered a new regulator which will be one of the curiosities of the next *grande soirée* given at the Observatoire on March 13th. Each of the two carbons is supplied with a parallel rod of glass, to which it is attached in asolid manner. These two rods being placed horizontally, are pushed by a spring, and the spark is lighted between them. But between the two glass rods there is a glass stopper which is warmed by the light in such proportion that the rods yield gradually to the pressure of the springs, and the carbons can approach each other, as is required for the constancy of illumination. A correspondent of *Nature* witnessed preliminary experiments which he states have been a wonderful success.

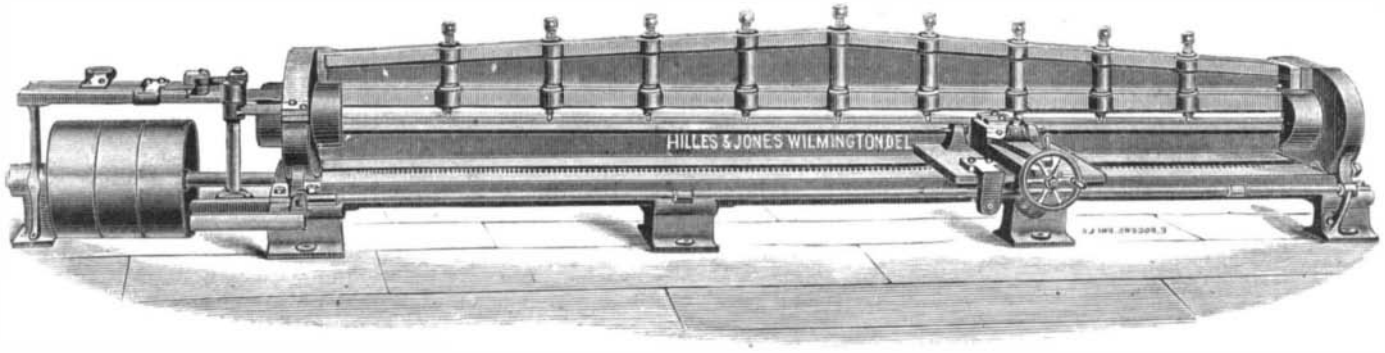
IMPROVED PLATE PLANER.

We give an engraving of an improved machine, made by Messrs. Hilles & Jones, of Wilmington, Del., for planing the edges of plates. This machine will plane 13 feet 10 inches long at one setting, and by resetting or moving the plate endwise will plane any length of plate. There are two separate tools on the tool post, and they are arranged on the saddle for easy and independent adjustment, and the cut is taken both ways on the plate; the hand wheel shown feeds both tools at the same time.

The machine is so designed that the large table holds the plate and at the same time answers for a gauge for quickly setting the edge of the plate, so that no time is lost in measuring with a rule. The nine screws in the cross bridge are for straightening and taking the buckles out of the edge of the plate, and at the same time they assist in holding it securely while being planed.

The large steel screw that moves the saddle is supported its entire length, lying in a groove that keeps it always well oiled and prevents it from being sprung or bent. The belt shifting arrangement is such that a very short movement of the saddle is obtained when desired.

The manufacturers state that this machine will do as much work in one hour as the best boiler maker will chip in twelve hours. The machine will do it correctly, while the boiler maker will do it irregularly and in a great measure cut or score the adjoining sheet, thus weakening it.



MACHINE FOR PLANING THE EDGES OF PLATES.

MECHANICAL INVENTIONS.

A novel wire stretcher has been patented by Mr. Henry H. Hutchins, of Fennville, Mich. The invention consists of a hooked bar or plate carrying pivoted jaws at its hooked end, and provided near its center with a hooked lever having a pawl for securing the device to the fence post, and carrying at its straight end a clamping device for retaining the wire while a hold is being taken with the jaws, a suitable guide being provided for guiding the wire to and through the clamping device.

An improved system for transmitting motion has been patented by Mr. Antonio Samper, of Paris, France. This patent relates to improvements in a system of transmission of movement patented by the same inventor June 21, 1881, No. 243,226.

An improvement in paper pulp engines, patented by Mr. William E. Taylor, of Fulton, N. Y., consists in setting the blades of the cylinder at an angle or diagonally across the surface of the cylinder, so that they will have a shaving action or cut with the fixed blades in the bottom of the engine box.

An improved self-closing elevator door has been patented by Mr. Theodore M. Clark, of Boston, Mass. The invention consists in combining a pivoted latch bar and a bow spring on the door frame with a door having a stud and an elevator platform having a lug for engaging the spring. This device is simple and efficient. It allows the use of self-closing doors without its being necessary for the elevator attendant to hold them open.

Ordinarily in stereotyping the mould or impression is taken and dried on a steam table or heater specially constructed and used for that purpose alone. It is then placed in a casting box specially constructed for that work. These appliances are costly and occupy no little space. Mr. Marshall J. Hughes, of Jersey City, N. J., has patented a combined printing press and stereotype casting box which dispenses with these separate appliances by utilizing printing presses in the work of stereotyping and production of plates and type-high casts.

Mr. Frank A. Carnes, of Brookline, Mass., has patented an improved carriage axle box. By means of the collars or rings and the hollowing out of the nut or sleeve, the bearing surface of the sleeve upon the axle is greatly reduced, thus reducing the friction to the minimum. A hub of this construction can be made small and compact, and it is simple and cheap in construction.

Mr. Edgar H. Drake, of Newfield, N. Y., has patented a novel combination of simple and well known mechanism for applying power for domestic and other purposes. The invention consists of a combination of shafts, cranks, pinions, cog wheels, eccentrics, pitmen, walking beams, connecting rods, treadle, etc., supported in a suitable frame. The arrangement is such that the power may be applied by hand, foot, or by weights to operate a saw, churn, or washing machine.

Mr. George P. Clark, of Windsor Locks, Conn., has patented a cheap, efficient, and easily operated means for preventing backward movement of hand trucks while the load is being placed upon them. The invention consists of a spring-actuated holder or clamp placed upon the shaft or axle of the truck, the holder or clamp being adapted to be pressed down by the foot of the user to engage with the floor while the box, barrel, or other load is being tipped or pulled back or otherwise placed upon the truck.

An improved self-lubricating bearing for axles has been patented by Mr. Paul Decauville, of Paris, France. This invention provides small pieces of cane or reed, which dip continually into a reservoir of oil. The great porousness of the cane is specially advantageous in two respects for the purposes of this invention—that is to say, the oil is caused to rise by capillary attraction and by the suction caused by a vacuum. In the case of shafts revolving at a very low speed the lubrication is effected by capillary at-