The more the memory is cultivated the more active it be comes. A second foreign language is learned more easily than the first, and so on.

This is the age of bald and barren speculation. Alongside of those who earnestly and patiently labor for the truth are those who tie a few stray facts together and deduce a string of paragraphs. As for Mr. Verdon's theory, it corresponds with his own name. ALIQUIS.

Coal Dust Fuel.

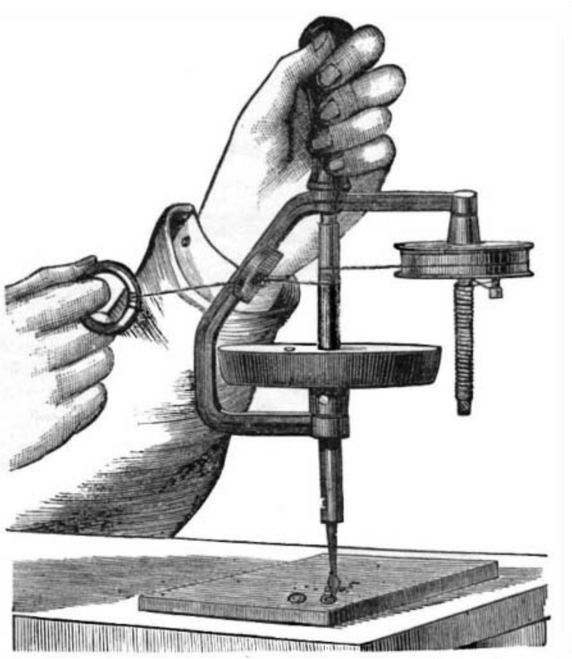
To the Editor of the Scientific American:

I notice your article of January 9, on burning coal dust with a blower, and wish to speak of the disadvantages of this method and its remedy. When a blast is used on fine coal dust, nothing can keep a large amount of fine particles of fuel from being blown out at the top of the chimney, and this has resulted in numerous cases of fire and the total destruction of mills and surrounding property. It makes an unnecessary waste of fuel by virtually melting the coal on the grates; again, it injures the boiler by having a steady blast on the same spot, and a boiler run with a blower will not last near as long as without it. It requires considerable power to run a blower, also more than the users suppose, as shown by indicating the engine on different parts of machinery. Coal dust, with small mixture of soft coal, is now being used as fuel, without the use of a blower, on boilers set with the Jarvis furnace, at Boston, Worcester, Providence, Brooklyn, Jersey City, New York, and other places. By this setting, the gases generated on the grate are utilized by hot air; the joining of the gases, carbonic oxide with the oxygen, makes an immense flame. The gas flame is formed on the principle of the blow-pipe. Three boilers set this way will make as much steam as five the old way.

Boston, Mass. A. F. UPTON.

QUICK-SPEED DRILL.

We extract from *Iron* the annexed engraving of a new quick-speed drill, which consists of a frame, a spindle with the socket for the drill, a pulley with a spiral spring, and a hollow casting which acts as a flywheel and also serves as a case to contain the ratchet and pawl necessary to prevent the possibility of the motion of the drill becoming reversed.



QUICK-SPEED DRILL.

The action is as follows: The workman on drawing his hand toward him actuates the drill, and at the same time tightens the spring attached to the pulley, which spring, on the tension of the hand being relaxed, reverses the motion of the pulley and takes up the slack of the cord; but the motion of the drill is not reversed, owing to the ratchet and pawl in the flywheel, and to the rotation of the flywheel itself. There is thus obtained for the drill a constant revolving motion, with a speed which can be regulated to suit any metal from the hardest to the softest, while the feed, which is effected by the hand, is at all times felt and controlled. These machines can be worked in any position, and, from the important fact that the motion is continually in the same direction and that there is consequently no pause in the cutting, the work can be got through in less time and with far less breakage of drills than by the older contrivances. They are as yet made only in a very small size, and are therefore serviceable chiefly to the makers of small machinery, such as clocks, sewing machines, etc.

NEW YORK ACADEMY OF SCIENCES.

A meeting of the Chemical Section of the New York Academy of Sciences was held on Monday evening, January 14, at their rooms, 64 Madison avenue, Dr. Eggleston in the chair.

Mr. George F. Kunz exhibited a specimen of alexandrite from the Ural mountains. It is purple by night and deep green by day. He also showed a specimen of harmotone, a silicate of baryta and alumina, from a new locality in Brazil.

Mr. Chamberlin exhibited specimens of anchorite from the Phœnixville Tunnel, and of fulgurites from Carrol county, Ill. The latter are partially fused and vitrified tubes of sand produced by the action of lightning.

Professor D. S. Martin announced the appearance of the first number of the "Annals of the Academy."

NITRIC ACID IN HEALTHY URINE.

Professor Albert R. Leeds then read a paper on the presence of nitric acid in healthy urine, and a method for its quantitative determination.

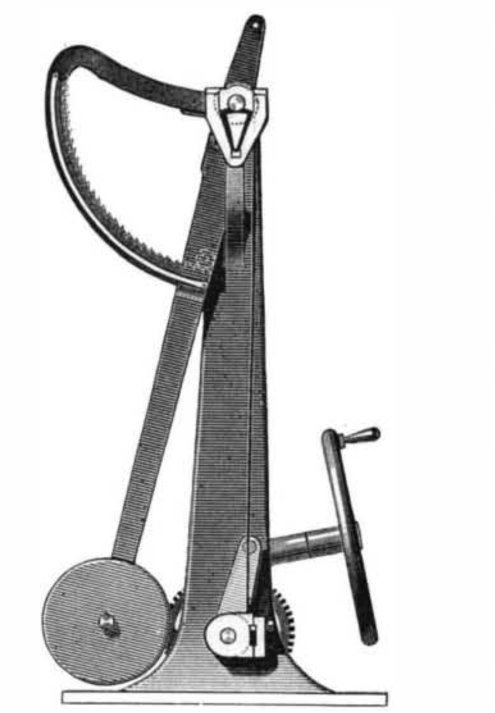


Fig. 2.—WIRE TESTER.

In the course of some experiments to determine the relative amounts of oxidized and non-oxidized compounds existing in drinking water (described in the SCIENTIFIC AMERICAN of January 5), it became important to ascertain this relation in the case of urine, one of the organic impurities of some drinking waters. The Passaic water consumed by the inhabitants of Hoboken contains ten times as much nitric acid as of free and albuminoid ammonia. In passing through the system, the nitrates present in the water undergo reduction, and if they are not assimilated or voided as non-oxidized nitrogenous substances, may be expected to appear to some extent at least in the urine. Although no mention is made of the presence of nitric acid in healthy urine in any of the works to which the speaker had access, he determined to submit the question to the searching methods of inquiry which a recent discovery had placed in his hands.

A retort was freed from all traces of ammonia by distilling pure water in it; 1·023 grammes of fresh healthy urine were then added, and the distillation continued. The distillate was collected in portions of 50 or 100 c. c., pure water being added as was necessary. In each case the ammonia passing over was separately determined by means of the comparator previously described. The ammonia came over in continually decreasing amounts, the total amount evolved in 15 distillations being 1·725 milligramme. The decomposition of what remained was then accelerated by the addition of a gramme of sodium carbonate. The ammonia contained in 56 distillates amounted to 7·1525 milligrammes. In the next place 50 c. c. of a solution of potash and potassium permanganate were added to what remained in the retort. The first distillate then yielded 0·32 and the twenty-second 0·005 of a milligramme of ammonia.

Total for the 22 distillates..........	1·31	mgrm.
" with sodium carbonate	7·1525	"
" by simply boiling...........	1·725	"
	10·1875	

From the last result the conclusion was drawn that all the albuminoid ammonia had been obtained, and that reducing agents should now be used to decompose any oxidized nitrogenous substances which might be present.

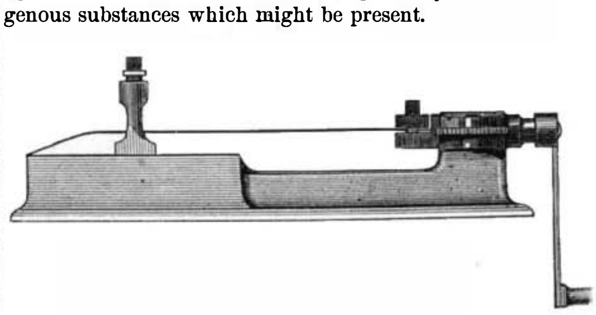


Fig. 3.—TWISTING WIRE TESTER.

Six grammes of zinc were digested with a slightly warmed solution of neutral cupric sulphate, and after careful washing the residue, together with freshly precipitated copper, was introduced into the retort. The following result was then had:

1. 100 c.c. =	...0·10	mgrm.	9. 100 c.c. =	...0·0575	mgrm.
2. "	....0·03	"	10. "	...0·0325	"
3. "	....0·025	"	11. "	...0·06	"
4. "	....0·0125	"	12. "	...0·065	"
5. "	... 0·04	"	13. "	...0·0225	"
6. "	....0·16	"	14. "	...0·0005	"
7. "	....0·07	"	15. "	...0·0000	"
8. "	....0·12	"	16. "	...0·0000	"
Total.................................0·7955					

From this result must be subtracted 0·29 mgrm., the amount of ammonia previously ascertained as existing in the form of an impurity in 50 c. c. of the permanganate solution used in the distillation.

This leaves 0·5055 mgrm. of ammonia due to the reduction of nitrates in the urine, and corresponds to 1·887 mgrm. of nitric acid or 0·18 of 1 per cent. Professor Leeds concluded by reading letters bearing upon the subject from Professor Theodore Wormly, Dr. Ezra M. Hunt, and Professor Robert O. Rogers.

Remarks were made by Drs. Ellsberg and Hopper, who expressed their belief that nitric acid might reasonably be expected to be a normal constituent of urine.

On motion of Dr. Ellsberg, a vote of thanks to the Rev. J. J. Robertson was passed for his donation of 37 volumes to the library of the Academy. Adjourned. C. F. K.

PAPER AND WIRE TESTERS.

We illustrate three testers for special materials. Fig. 1 shows a paper tester, which works with unvarying accuracy and absence of liability to derangement. As the paper is tested by the direct action of a weight, all the variations which arise in the use of springs for this purpose are entirely avoided, and continued working has no tendency whatever to cause the machine to give inaccurate tests. The machines are all graduated by the application of actual weight, in such a manner as to insure every one being perfectly accurate, and as all parts of the mechanism are fully open to view, it can without difficulty be kept clean and always ready for use. The machine is in use by many of the largest paper users. It is very portable, occupies but little space, and can be worked with considerable speed even by an inexperienced operator.

The wire testers, Figs. 2 and 3, are the invention of Mr. Carrington, of London, who having, as engineer of the Wire Tramways Company, found the want of a machine by which the wires composing the ropes used could be expeditiously and accurately tested, without the great expenditure of time required by the use of the ordinary forms of testing machines, designed the apparatus shown. By it a wire may be attached and tested both for tenacity and ductility in the space of one minute. The machine requires no foundation, when not in use occupies very little space, and can be used by one man of ordinary intelligence.

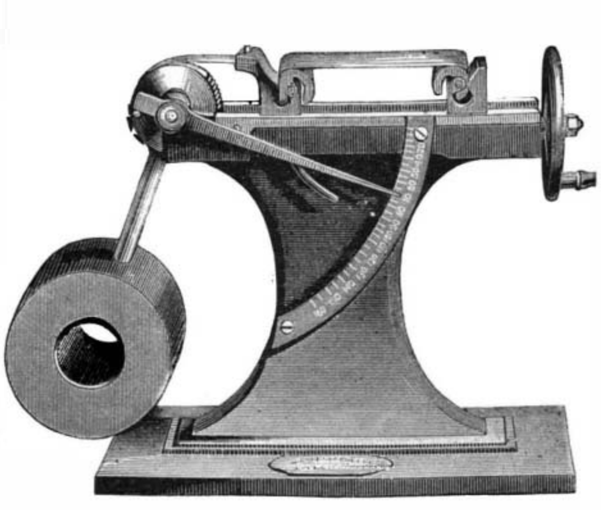


Fig. 1.—PAPER TESTER.

As the strain is applied very gradually, and by the application of the same weight, all liability of erroneous tests from changing or moving of weights, as in ordinary machines, is avoided. The extension of the wire also is accurately measured, and a length of 50 inches can, if necessary, be tested, thus giving a much truer result than if a short piece were subjected to tensile strain. The smaller machine, Fig. 3, is used for testing the wire by twisting one end while the other is held firmly in the machine, the greater number of twists it will bear being the better evidence of its softness. These machines will test either up to 3,000 pounds or 5,000 pounds, as required.

We are indebted to the *British Trade Journal* for our engravings.

Soap-Bubble Lecture Experiment.

BY IRA REMSEN.

In setting fire to soap-bubbles filled with hydrogen or with oxyhydrogen gas, it is customary to make use of a taper at the end of a rod, which is managed by the assistant. Every one knows that the operation is apt to be a clumsy one, and, besides being annoying to the assistant, it is usually distracting to the audience and the lecturer. I have lately made use of a simple contrivance, which I am led to mention, as it is in every way more satisfactory than the usual arrangement, and works perfectly.

At a height of five or six feet or more above the center of the lecture table a glass funnel of the largest size is suspended by means of wires attached to the ceiling, or some other appropriate support, the broad part of the funnel being directed downward. A fish-tail gas burner is fixed horizontally at the center of the mouth of this funnel, so that, when the gas is lighted, the broad flame is spread out in a horizontal plane over as much of the space included in the mouth of the funnel as it will cover. The attachments may be made to suit the conditions of the room and table. It would be a simple matter to have a permanent gas jet arranged in an appropriate position for the experiment.

It is only necessary to allow the bubbles to separate from the pipe in about the same perpendicular line as that corresponding to the axis of the funnel; they will invariably come in contact with the flame, and this, of course, is all that is necessary. If the bubbles contain hydrogen, the flame frequently fills the funnel for a moment, and presents a very pretty appearance. The experiment is very easily performed, and success is certain.

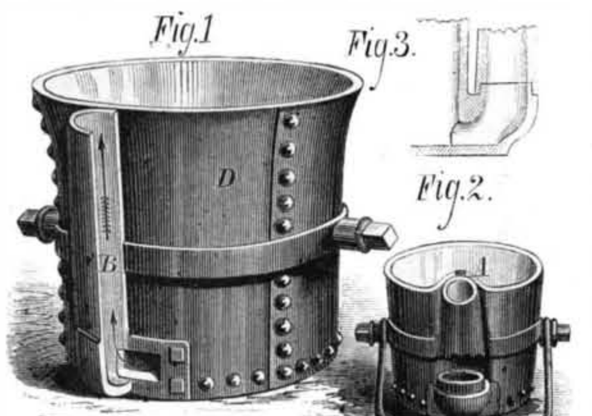
FAWCETT'S IMPROVED LADLE.

In making car wheels, manufacturers generally use great care and skill in selecting a variety of the best brands of pig iron, with a view of combining their different qualities, for the purpose of producing a uniform wheel of the required strength and necessary depth of chill. The disorders to which cupolas are liable, and the different degrees of fusibility of the several grades of iron, have a tendency to change the results and cause considerable variations in the life, strength, and mileage of car wheels. Before casting, a large ladle is filled with molten metal from the furnace. This is done without reflecting that there has been a circulation going on in the molten metal similar to that which prevails in all hot liquids. Each grade of iron tends to assume its own particular level in the molten mass, according to its density, all impurities and iron of a light and loose texture rising to the surface, while the dense and close-grained qualities sink to the bottom by their own superior gravity.

Wheels cast with iron taken from the top of a large ladle or receiver are not of the same quality of metal, strength, or depth of chill as those cast with iron from the bottom. This explains why some wheels, cast on the same day, from the supposed same mixture and ladle, have such an irregular and uncertain life.

William Fawcett, of Omaha, Nebraska, has patented in the United States, England and Canada, an improved ladle, which is designed for the purpose of giving a uniform mixture all through the heat, and prevent spotting, putting the best iron where it properly belongs, namely, the tread of the wheel. It is simple in construction, and inexpensive, and can be easily attached to any ladle, old or new.

In the annexed engraving, Fig. 1, D represents the ladle, and B the vertical conduit on the side which opens into the bottom of the ladle, so that, as the latter is tilted, the purer and close-grained metal at the bottom passes up the conduit

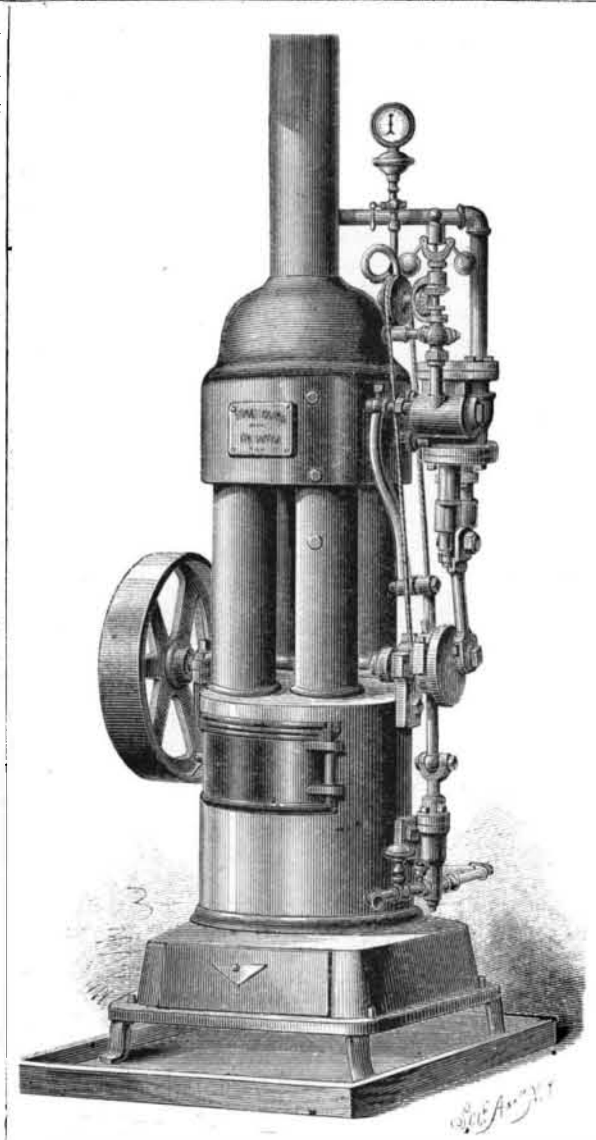


and discharges into a smaller ladle, shown in Fig. 2. This is similarly constructed for the purpose of first delivering into the mould the hot metal in its best fused and most dense state, leaving in the ladle the cold, unamalgamated iron, with the scoria floating on the top; thereby producing with the same material a greatly superior wheel, of greater purity, and of more uniform density on the tread than can be produced by the ordinary manner of pouring metal from the top of a ladle, as such a loose system as this always gives chance results. Fig. 3 is a detailed section of Fig. 2. A lip at the top of the inner wall, A, insures the discharge from the outlet in the direction of the arrows, without spilling over the lighter metal floating on the top within the ladle. The labor of skimming is thus entirely obviated. For further particulars address the inventor as above.

THE NEW BAXTER PORTABLE ENGINE.

In the annexed illustration we represent the new Baxter portable engine, a one horse power machine, designed especially to meet the large and increasing demand for small motors for light work. It was to engines of this description that we had reference in our recent article calling the attention of farmers to what good service such apparatus could be put in numerous operations about the farm. It could easily drive small barn machinery, such as grain cleaners or feed cutters, run a small circular saw for firewood, or pump water, and perform a large variety of other work at much saving of time and labor.

The chief novel features of the present machine, which is the invention of Mr. William Baxter, already well known as the inventor of the Baxter engine and steam canal boat, lie mainly in the construction of the boiler and the manner in which the engine is attached thereto. The base is 2 feet square and the total of the machine is 4 feet. The cylinder parts are about 15 inches in diameter at bottom and top, which are connected by four upright sections, all being cast in one piece of the best car wheel iron. This form is claimed to impart all the strength of a sectional boiler, with no large flat surfaces, nor any great volume of water or steam in any one



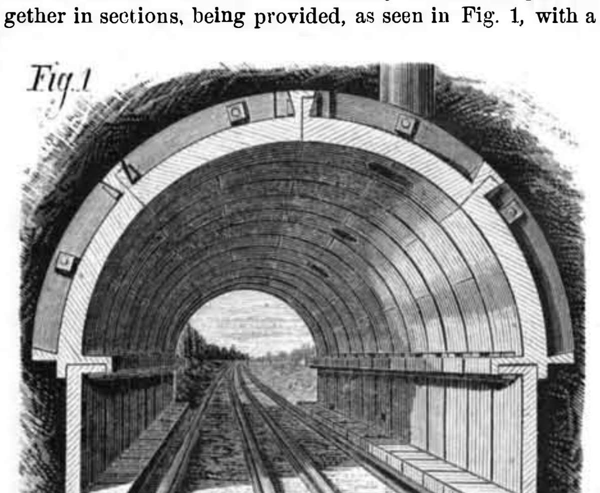
THE BAXTER PORTABLE ENGINE.

part. The tubes through which the heat passes are of the best lap welded boiler tubing, and act as braces to the lower and upper heads, as in any ordinary flue sheets. There is a water space all around the furnace, as in ordinary upright boilers. Steam and water gauges, gauge cocks, safety valve, blow-off and check valves, and a rocking grate to dump the fire should occasion require, are all provided. Every boiler is, we are informed, tested to a hydrostatic pressure of 200 pounds to the square inch. The engine has a 3 x 3 inch steam cylinder, which is rated at from $1\frac{1}{2}$ to 2 horse power, all made in simple and substantial manner, with a plunger and pump attached to feed the boiler regularly while the engine is in motion. The manufacturer claims that the engine can be run on about 10 cents' worth of coal or wood per day. The entire weight is 650 pounds.

For further information address the manufacturer, Mr. Joseph C. Todd, 10 Barclay street, New York city.

METALLIC ARCHES FOR TUNNELS.

We illustrate herewith an improvement in the construction of arches to be used for tunnels, buildings, sewers, and all other purposes. In building the tunnel it is preferable that the side walls should be made entirely of iron and put together in sections, being provided, as seen in Fig. 1, with a



shoulder and downward projecting flanges, which straddle the top of the foundation wall, and a flange on top to which the bottom section of the arch is bolted. The arch consists of any desired number of cast iron sections, Fig. 2, having upward projecting flanges, A, through which bolts pass for securing the sections together. Other flanges, B, parallel with the body of the section, lap over the other sections for the double purpose of supporting the sections in position and closing the joints, where they come together, to prevent leakage.

In erecting the arch it is necessary to erect only a single center at the beginning, upon which the first line of sections is secured, and then all the other sections require only to be hoisted into position, and the flanges, B, overlapping those already up, will hold the sections in place, without any further fastenings in any form. In order to make secure a bolted coupling is passed over the top of the flanges wherever three or four come together. As the space on top of each section is intended to be filled in with cement or brick work, the flanges are constructed with a bevel, which projects inward over this filling, so that any uneven pressure only tends to pack it solidly under this projection.

An opening can be made at any point through the sections, communicating with the outer air, through which the smoke and gas from the locomotives can escape.

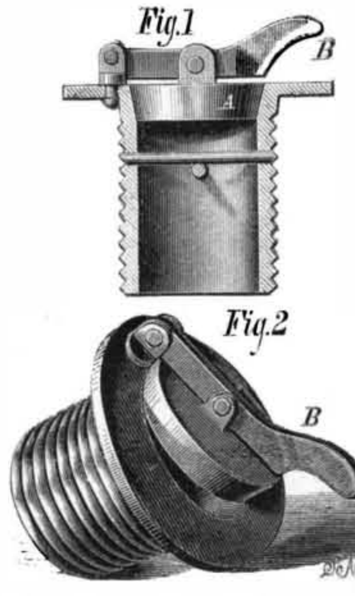
The Board of Managers of the Maryland Institute in 1875 resolved that the design was a valuable improvement. It was patented July 1, 1873, by Josiah Groves, of Ellicott City, Md.

For further information address John F. Corcoran, attorney, 63 N. Eutaw street, Baltimore, Md.

CARNES' IMPROVED BASIN STOPPER.

We illustrate herewith a new mode of attaching stoppers to washbasins, which dispenses with the chain ordinarily used for that purpose. It will be seen that the stopper, A, is suspended by lugs and a pin to a lever, B, one end of which is hinged to the strainer pipe and the other is provided with a handle. A space for clearance is left between the lever and stopper, so that the latter may oscillate slightly on the pin of the former. This enables it to be inserted vertically on its seat in the strainer independently of the circular motion of the pin on the hinge.

The device is exceedingly simple, and constitutes a neat and handy attachment. Patented through the Scientific



American Patent Agency November 27, 1877. For further information address the inventor, Mr. H. W. Carnes, box 143, Brookline, Mass.

New Inventions.

In an improved Trace Holder devised by Mr. William K. Hardenbrook, of Albia, Iowa, there is a combination of a double hook or holder with the frame that connects the back strap, crupper strap and straps that support the breeching. The traces are securely held in whatever position the horse may be.

An improved Button Fastening, invented by Mr. Charles M. Underwood, of New York city, consists of two plates placed together, one having an aperture and slot, the other a central aperture. The edges of the second plate are folded over those of the first. A loop of metal is slipped through the eye of the button and its ends brought together from a neck having a head which is passed through the slot in the plates, and secured by drawing the latter apart.

Messrs. George H. Thompson and George P. Muldoon, of Omaha, Neb., have devised a Wooden Spring for vehicles which is so constructed that it may be adjusted to sustain a greater or less load, and which will quickly recover its shape when pressure upon it is removed.

Mr. Alonzo T. Decker, of New York city, has patented a new Rear Sight for Firearms. It consists of a plate made elastic fastened at one end and provided with a sight at the other, combined with a slide and bed having stepped side flanges. It is arranged to give a lower elevation and consequently a more accurate aim for short distances than the rear sights now in use.

A Fastening for Pocket Books, invented by Daniel M. Read, of New York city, consists of a base plate with a longitudinal slot for the catch and a lateral slot beneath for the handle of the latch. The catch is inserted, and the prongs of the latch, which is pivoted on an inner plate, engage with it and hold it fast. It is a compact and serviceable fastening.