bine at the highest attainable velocity without shock; then it is retarded in an accelerated ratio, and expanded in volume in like manner, until the moment it reaches the edge of the bucket, as above, with 8 per cent of its living force yet remaining, the 92 per cent having been expended in reaching and urging forward the turbine. A reasonable allowance of 12 per cent, for loss in reaching the bucket and friction of the machine, leaves 80 per cent as the efficiency of the turbine.

To force back 90, or even 80 per cent of the water used, by any machine, is simply out of the question for the reasons shadowed forth in the foregoing. If 70 per cent can be forced back, it may be considered excellent work. A system of weight and measurement, by proper apparatus and competent persons, is, however, infinitely superior. It tells the whole story, "The truth, the whole truth, and nothing but the truth."

A. M. SWAIN.

Metallic Roofs in Thunder Storms.

To the Editor of the Scientific American:

A communication in the last SCIENTIFIC, signed John Wise, has the passage: "While I am not prepared to say positively that a metal roofed building cannot be injured by a stroke of lightning, I have never found one so roofed, in my fifteen years' investigation, that has been injured by a thunderbolt," etc.

Will you do your subscribers the favor to give your views as to whether a metallic roof is a protection against lightning?

Wilmington, N. C. L. M.

[Answer: A metallic roof upon a building, if connected with the earth, is undoubtedly a protection against the injurious effects of lightning. Even when lightning rods are not used, a connection is generally established, between the roof and the earth during a thunderstorm, by the water spouts or the wet walls of the building. A metallic roof, if it were insulated from the earth would be a source of danger, and not a protection.—EDS.

THE INTERNATIONAL EXHIBITION OF 1872.

The second of the series of international exhibitions at South Kensington (London) was opened on the 1st of May. The leading features of this year's exhibition are cotton fabrics and paper, and the machinery used in the manufacture of those goods.

The process of envelope manufacture is illustrated by a series of machines by Messrs. Dickinson & Co., of the Old Bailey. The first is a Tidcombe paper cutting machine, which cuts the continuous paper from reels into sheets of the required size. The apparatus will cut five or six thicknesses of paper from reels at the same time, by which means the necessity for collecting single sheets, and the employment of collectors during the night hours, is avoided. The paper, after having been cut into sheets 30×22 inches by the Tidcombe machine, is placed between plates of brass and submitted to a pressure of from twenty to thirty tuns in an adjoining press. By this means it receives a glazed surface, and the sheets are then passed to the adjacent envelope cutting machine, which is one of Hughes and Kimber's. From this machine, the blanks are passed on to the next department, where they are gummed and placed to dry in a rack heated by a steam coil. When dried, the gummed blanks are passed to the relief stamping counter, where there are three machines and as many operators manipulating them. The folding is effected by means of three folding machines, mourning envelopes being previously black bordered in a machine by Mr. J. Parkins. Finally, the perfect envelopes are banded, labelled, and packed in card boxes, which are made at a stand close by.

Near Messrs. Dickinsons' interesting series of exhibits is a handy little envelope folding machine by Messrs. R. Fenner & Co. The uppermost blank of a pile is raised by a pneumatic mouthpiece, working vertically, and the end is seized by a pair of tongs having a horizontal traverse, and by which the blank is drawn under a plunger, which, descending, carries it into the interior of the machine, where it is folded and embossed in relief, the edges being gummed just before the descent of the plunger. Messrs. Goodall & Son exhibit a neat machine for a similar purpose, in which a revolving table with three plungers is used. This machine gums the envelope and works two dies at one stroke, one with the maker's name and the other with the monogram or device on the outside of the envelope. The remaining apparatus in this gallery are those used in ruling account books, marbling paper and book edges, embossing and lettering in gold, etc., Messrs. Letts exhibiting all these processes.

On the ground floor of the eastern range, the ceramic display of last year is replaced by an array of musical instruments and jewelry, the latter being of a very costly character, the exhibits of one firm being, in one case, valued at $400,000, and in another, at $100,000.

In the eastern portion of the range of building are placed the stationary exhibits, which range from a sheet of brown paper to a gorgeously appointed valentine, and from a penny account book to a banker's ledger of gigantic proportions.

In the western portion of this building are several models of machines relating to the paper manufacture. Mr. T. H. Saunders, of Upper Thames street, sends a roll of continuous paper, as supplied to the *Times* for printing with the Walter machine. The paper is 2¾ miles in length, and weighs 634 pounds. Mr. Saunders also exhibits a sheet of parchment paper, which is carrying a weight of 5 cwt., and is stated to be capable of sustaining 9 cwt.

This portion of the exhibition is devoted to those articles which come under the head of scientific inventions, of which there are several deserving of notice. Amongst the most striking is a full size model section, taken transversely, of a gun, designed by Mr. Bessemer, to carry a 5 tun projectile. The bore has a diameter of 30 inches, the metal being only 8 inches in thickness. The gun is on Mr. Bessemer's continuous low pressure principle, and will be 60 feet in length. The inventor is having one made a quarter full size, with which he intends experimenting. Mr. Bessemer also exhibits a model of the projectile to be fired by his big gun, as well as models of the Woolwich 12 inch 35 tun gun, in transverse section, and its projectile.

At the northern end of the machinery annexe is a Walter printing machine, on which the *Mail* is printed three times a week. At this point, also, M. Charles Kastenheim exhibits a set of type setting and distributing machines, as used in the *Times* office.—*Engineering.*

Wire Cut Bricks---An Interesting Patent Suit.

An improvement in brickmaking machinery, which is coming extensively into use both in this country and England, consists in forcing the clay from the machine in the form of a rectangular mass or block and then dividing the block by means of wires into bricks of the proper size. Bricks are thus more quickly made, and are found to be of better quality and truer shape than when separately pressed in molds in the ordinary manner.

In this connection, we present the report of a recent patent suit in England, which contains some interesting information concerning wire cut bricks and machinery for their production.

MURRAY *vs.* CLAYTON.—By his specification the plaintiff claimed:—"Particularly cutting the clay into the form of bricks by forcing the clay forward by means of a pushing board or otherwise against a series of fixed wires, so arranged that the clay is pushed or forced past the wires on to a 'moveable board' provided with handles, so that 12 or any other convenient number of bricks may be removed at the same time." The defendants denied the validity of the plaintiff's patent mainly on the ground that the invention had been anticipated by a patent known as Dahlke's, which was founded on an invention made in Germany by one Sachsenberg, and by a machine which the defendants themselves made after Sachsenberg, with some variations. The Vice Chancellor was of opinion that the defendants had made out their case, and he dismissed the bill. The plaintiff appealed. Lord Justice James said that the case had occupied a long time, but when the real questions between the parties came to be eliminated from the mass of the evidence, they did not require any very long time for discussion nor present any great difficulty in determination. The plaintiff had given the usual *primâ facie* evidence of his being the first inventor, and he had produced, in favor of the novelty and practical utility of his invention, a mass of evidence greater than his Lordship had ever witnessed in any similar case. There was the evidence of brickmakers, engineers, Government contractors, who had not been cross examined. One of these witnesses said that bricks made by the plaintiff's machine were worth 50 cts. per thousand more than other bricks. All this evidence was practically uncontradicted. Then came the question whether the invention was novel *de jure* as well as *de facto*—that is, whether it had been anticipated. His Lordship was of opinion that the plain meaning of the plaintiff's specification was that he claimed the machine, the combination which enabled him to effect the result, so that by one or more turns of the wrist he could cut a mass of clay into a number of bricks without their being touched by the hand of the operator. The question was whether that had been anticipated in any manner. The only things relied upon to show that it had been anticipated were Dahlke's patent and the machine made at the defendant's works, and known as the German machine. As to Dahlke's invention, it was for a thing so substantially different from the plaintiff's in principle and in all its details that, if it were made now, it could not be considered in any respect an infringement of the plaintiff's patent. The only thing common to the two was the division of the clay by a cutting wire. After leading a fruitless existence of three years, Dahlke's patent was suffered to expire. As to the machine made at the defendants' works, which they made in 1864 after the German description of Sachsenberg's machine, substituting a table for rollers, there was a mass of evidence. It appeared that this machine was made at the defendants' works, and was exhibited at work at their shop to a great number of engineers and brickmakers. It did not appear to have been made for sale, but it was a working specimen. Of all those witnesses who saw it at work, not one said that he thought it a machine of the slightest utility. The evidence on the other side showed that it was an entire failure, that it was useless for any practical purpose whatever; the labor in working it was too great. The merit of every invention of this kind was that it saved labor. His Lordship was aware of no case where the exhibition of a useless machine had been held to affect the rights of a patentee who had made a useful machine, though there might be some similarity between the two. If there were defects in the German machine which the plaintiff cured, though he did not know of that machine, he would be entitled to maintain his patent. His Lordship thought it impossible that stronger evidence should be produced than had been produced here of the novelty of the plaintiff's invention. It was so simple, and so well calculated to effect the object intended, that the only wonder was that people had gone on for thousands of years making bricks without hitting upon it. With regard to the question whether the defendants had infringed the plaintiff's patent, it appeared to his Lordship that the defendants' machine was a mere transposition; they moved the wires against the clay instead of moving the clay against the wires, as the plaintiffs did. There was nothing but a colorable variation, and it was plain that the alteration could only have been made for the purpose of evading the plaintiff's patent. The object was effected by means of a much larger expenditure of power. But as was said by Lord Hatherley, in the case of "Daw *vs.* Eley," a clumsy invention might be an infringement, though it would not have been an anticipation. On the whole, his Lordship was of opinion that the plaintiff had made out his case; that he was the first inventor of a new and very valuable invention: and that the defendants had failed to make out that there had been any anticipation of it. It was proved also that the defendants had committed an infringement, and there must be a decree for a perpetual injunction against them, and they must pay the costs of the suit.

Polarized Light.

We have all noticed that when the sun shines directly through a window hung with figured muslin curtains, the reflection of the pattern of the curtains in the window interferes with the prospect.

When this reflected image is viewed through a Nicol's prism, it disappears when the prism is rotated, leaving the prospect unobstructed; the experiment is very interesting, and can be performed by any one who has a polariscope attached to a microscope, and it is only necessary to observe that the image is viewed at the proper angle. The effect will possibly be best when the sun's rays make an angle with the curtains and the glass nearly coinciding with the polarizing angle. (In my case, the angle was 36° 52'.)

Tyndall has mentioned a case in which the haze obstructing the view of a mountain top was rendered transparent by the Nicol.

The readers of *Nature* have probably observed how completely the leaves of the ivy polarize light; viewed through the Nicol and a pink selenite, the plant appears covered with blossom.—*R. S. Culley, in Nature.*

Hunting Truffles.

As the annual gathering season comes round, the truffle hunters, who lease of the proprietors of the woods the right to dig for these delicacies, commence their operations. To discover the whereabouts of the truffles, small dogs, trained for the purpose, are used. The education of the dogs consists in hiding under the soil a wooden shoe filled with earth, and containing a piece of truffle and a piece of bacon. The smell of the latter attracts them, and causes them to scratch up the shoe to get at the morsel of food. By degrees they confound the two scents, and cannot perceive that of a truffle without thinking of the bacon, and digging up the earth.

Twenty dollars is about the price of a good truffle dog. Dogs of the sporting breeds are never trained for the purpose, as they would be liable to hunt game instead of truffles, if the former happened to fall in their way. When the trained dog comes on the scent, the truffle hunter proceeds to hoe up the ground pointed out by the animal as the bed of the truffles. In the south of France, a certain species of lank lean pigs are trained and employed in the same manner as the dogs in more northern districts.—*Once a Week.*

Improvement in Gig Saws.

Mr. Henry W. Bullard, of Poughkeepsie, N. Y., has lately patented an ingenious and useful improvement, applicable to gig saws and other mechanisms. It consists of a device to regulate the extent of throw or stroke of the saw, and is so arranged that, by merely pushing a lever, the stroke of the saw may, at any moment, be increased or diminished, at the will of the operator, without stopping or changing the driving belt. This result is accomplished by shifting the crank pin to which the saw is attached. The crank pin is so arranged that it can be made to slide in or out from the center of the head or pulley to which it is attached; and this movement of the crank pin may be made while the saw is in full operation. The invention has been in practical operation for more than a year past, and its excellence is fully established. No gig saw machine is complete without it.

Available Nitrogen.

P. P. Deherain (in *Comptus Rendus*) advances a somewhat novel theory of the reduction of atmospheric nitrogen to an available form for the support of plant life. He endeavors to prove that the free nitrogen of the atmosphere is brought into combination during the oxidation of organic matter in the soil. To demonstrate this, he dissolves glucose in a dilute solution of ammonia in water, placed in a large flask filled with a mixture of equal parts of nitrogen and oxygen. Having closed the flask, he heats the mixture gently for one hundred hours, at the end of which time the whole of the oxygen has disappeared, and 5·9 per cent of nitrogen has been taken up. The same process with humic acid and potash shows a loss of 7·2 of nitrogen. If these results are confirmed by subsequent experiments, they will throw light on the hitherto obscure subject of the production of nitric acid.

EVERY young man, after he has chosen his vocation, should stick to it. Don't leave it because hard blows are to be struck, or disagreeable work performed. Those who have worked their way, up to wealth and usefulness, do not belong to the shiftless and unstable class, but may be reckoned among such as took off their coats, rolled up their sleeves, conquered their prejudices against labor, and manfully bore the heat and burden of the day. Whether upon the old farm, in the machine shop or factory, or the thousand other business places that invite honest toil and skill, let the motto ever be: Perseverance and Industry.

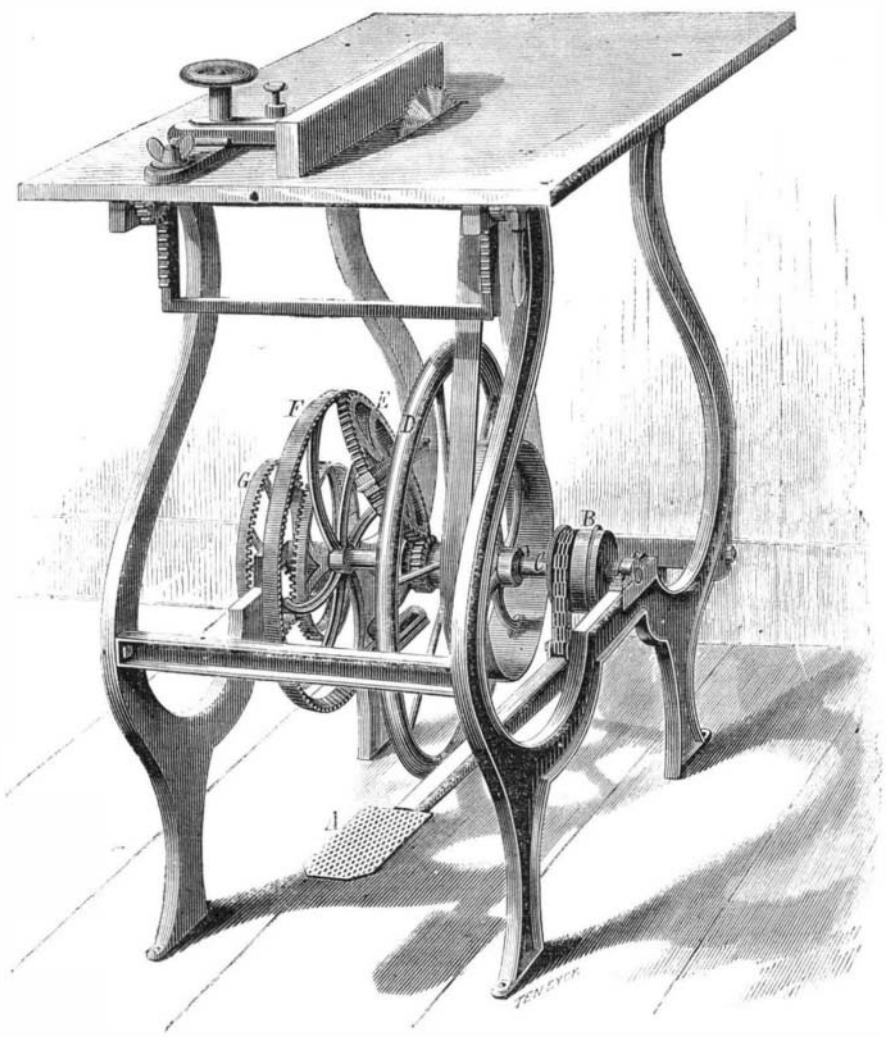
Foot Power Buzz Saw.

The saw represented in our engraving is run by an application of the principle, involved in Mr. L. S. Fithian's vertical multiplier, which was described by that gentleman on page 251, Vol. XXII. of the SCIENTIFIC AMERICAN. The treadle, A, is supported, as shown, by lathe chain wound on the small drum, B. This drum is loose on the shaft, C, but is governed in its motions by a contained ratchet wheel, keyed to the shaft, and so arranged that when the treadle is depressed the drum, ratchet wheel, and shaft are made to revolve, and the chain is unwound. On releasing the treadle, a weight at its far end brings it again into position; and a weight attached to the drum reverses its motion and causes it to rewind the chain; but the ratchet, being now free, does not affect the motion set up in the shaft, which is continued by means of the balance wheel, D. This balance wheel has attached to it a small pinion on the one side and the driving pulley on the other (as seen in the engraving), which are all loose on the shaft and driven as described hereafter. E is an intermediate wheel revolving, in the position represented, on one of two arms projecting from and revolving with the shaft. This intermediate wheel, E, engages with the pinion of the balance wheel, D, and gives motion thereto. The wheel, F, also engages, on its opposite side, with the outer gearing of the reverse wheel, E, as shown. This wheel, F, is loose on the shaft, and is connected by its inner gearing at the side with a small intermediate wheel, which, in its turn, engages with the wheel, G. This last wheel, G, is keyed to the shaft, and is the conveyer of the power. The other parts of the machine can readily be understood from the engraving.

Without going into the principle of operation in this combination, we may state that, in the saw shown us, the balance wheel revolved seventeen times to one revolution of the shaft.

The inventor states that the revolutions in this machine are from one to one hundred and two, forty steps on the treadle per minute giving four thousand and eighty revolutions of the saw. The sawing is as smooth and true as fine planing; and to one who is accustomed to the treadle and remembers that he can do no more than put his weight upon it, the work is as easy as any manual labor can be.

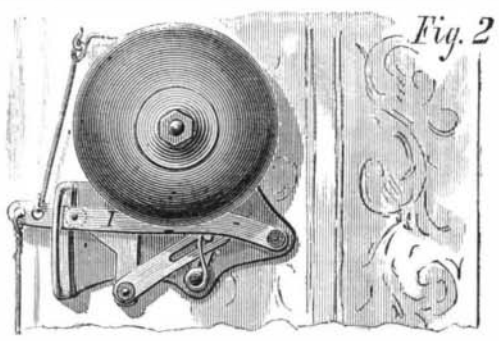
Patented in the United States and Europe through the Scientific American Patent Agency. Address H. A. Miller, President, Room 9, 23 Dey street, New York, or Charles B. Fithian, 341 North Third street, Philadelphia, Pa.

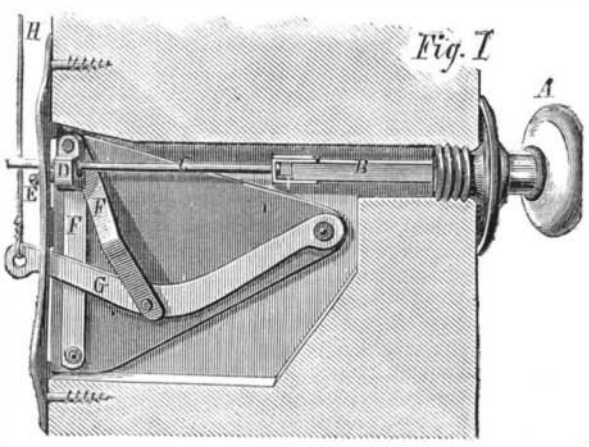


FOOT POWER BUZZ SAW.

BELL PULL AND BELL.

The bell pull, illustrated in Fig. 1 of our engraving, is designed to do away with the vexations attending the use of the ordinary street door pull. The engraving shows how the pull is attached to the door casing, and the whole arrangement will be understood from the following: By pulling the knob, A, motion is communicated through the shank, B, and





the extension wire, C, to the toggle, D, to which the wire, C, is made fast by the screw, E. This draws the top ends of the levers, F F, forward, and forces the lever, G, downward, thereby pulling the wire, H, which rings the bell. The wire, C, is cut off to the right length when adjusted. In the arrangement shown, the return of the knob to its original position is effected by the spring attached to the striking apparatus of the bell; when required, it may be effected by an independent spring attached to the pull. This bell pull insures reliable action with a very short pull on the knob. It is applicable to all kinds of bells, is easily put on in place of the old pull, and does not require a new knob.

In Fig. 2, the improved bell, the working parts are partly concealed by the bell. Suffice it to say that the lever, I, by an ingenious arrangement of levers, operates upon the striker both in its descent and recoil. Consequently two strokes are insured for each pull. It is not liable to be strained or broken by hard or sudden pulls.

Patents on the foregoing were obtained through the Scientific American Patent Agency, Nov. 7 and Dec. 26, 1871. For further information address the inventor and manufacturer, A. L. Swan, Cherry Valley, N. Y., or E. J. Swan, Laporte, Ind.

Lead Pencils.

A lead pencil is in itself a small affair, but considered as a manufactured product, it rises into much importance. To start a first class factory, with improved machinery and stock of well seasoned wood, requires a capital of about $100,000; ground covered is about half an acre, chiefly occupied by drying houses for the storage of red cedar. The Florida red cedar is mostly used in this country and in Europe—some "iben" wood, as the Germans call it, or English yew, is used in Germany—white pine is occasionally used for a common grade of a carpenter's pencil.

The "lead" of the pencils is the well known graphite or plumbago; the best of this is the natural, found in a pure state in masses large enough to cut into strips. Of this there is but one mine now up to the standard, which is in Asiatic Siberia, and pencils made from this graphite are all one grade, and pay here 50 cents per gross special, and 30 per cent *ad valorem* duty. The Cumberland mines in England were the first discovered, but are now almost exhausted. What was formerly refuse in cutting the graphite is now ground, cleaned and refined, and then mixed with a fine clay.

In mixing the clay and graphite, great care must be taken in selecting and cleaning the clay and getting the proper proportions; the mixture, with water, after being well kneaded, is placed in a large receiver and strongly compressed and forced out through a small groove at the bottom, in the shape of a thread of the thickness and style required—either square, octagon, or round. This thread, or lead wire, is cut in bars of the proper length (done by little girls), and then straightened, dried at a moderate heat, and packed in airtight crucibles and placed in the furnaces; the grade of the lead depends upon the amount of heat it is exposed to, the amount of clay used in mixing, and the quality of the plumbago. The coloring of the lead is by various pigments.

The wood, after being thoroughly seasoned, is cut in thin strips and dried again, then cut into strips pencil length. These strips are grooved by machinery, then carried on a belt to the glueing room, where the lead is glued in the groove, and then the other half of the pencil glued on. After being dried under pressure, they are sent to the turning room and rounded, squared, or made octagon, by a very ingenious little machine, which passes them through three sets of cutters and drops them ready for polishing or coloring—the former is done on lathes by boys, and the latter by a machine which holds the brush and turns the pencils fed to it through a hopper. After the pencil is polished, it is cut the exact length by a circular saw, and the end is cut smooth by a drop knife, the pencil resting on an iron bed.

The stamping is done by a hollow die, which is heated; the gold or silver foil is then laid on the pencil which rests in an iron bed, and the die is then pressed on it by a screw lever. The pencils are then ready to go to the packing room, whence they find their way to all parts of the civilized world at prices ranging from two dollars to twenty dollars per gross.—*American Exchange and Review.*

New Carriage Mountings.

These mountings, such as shaft, whiffletree, and pole tips, the nuts and rivets for top props, hub bands, etc., are made, as is usual, of iron, brass, or white metal, and are coated with hard rubber or gutta percha, leaving exposed, to be plated with gold or silver, a small portion for ornament. A whiffletree tip, for instance, has the "dragon tongue" and the neat bead at the base plated with gold or silver, and the remainder is coated with the hard rubber. A beautiful contrast between the highly polished metal and the brilliant jet black surface of the hard rubber is produced. It has more the appearance of an article of jewelry than one intended for hard service on a carriage. In addition to their beauty, these articles combine the important feature of durability. The surface of the hard rubber will not become scratched or dented as readily as metal, even malleable iron. It will not easily chip off, indeed can hardly be broken off with a hammer; and we are informed that it does not tarnish by exposure to the weather, and will not lose its color from the same cause. They are as strong as the same articles now in use, the hard rubber coating being only a little thicker than the ordinary close plate. When the ornamental parts become tarnished, they can be cleaned or replated without injury to the rubber portion.

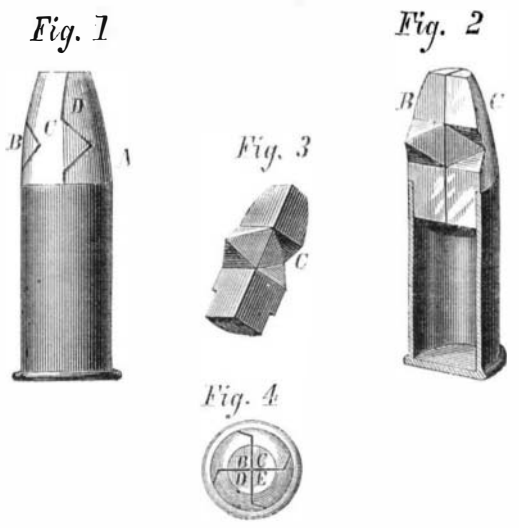
During the last few years, the public taste has been for showy gold and silver mountings, but there is a growing desire for something more quiet, which shall be at the same time rich and elegant; and our more prominent carriage builders are already using leather covered handles, prop nuts, etc. In Paris, rich gold and silver mountings, and the bright, gay inside linings of former years, have given way to things more sober, owing somewhat, no doubt, to the wide-spread affliction in that unfortunate nation. In the matter of price, we understand that the rubber mountings are of about the same expense as the best plated ones.—*The Hub.*

PROJECTILE FOR FIREARMS.

This improvement relates to that class of projectiles which are formed in sections. Hitherto the parts have been so constructed that, when fitted together, they were free to move one upon the other, and hence the slightest obstacle to the flight of the ball might cause separation of the sections and frustrate the purpose of the missile.

To remedy this defect, the inventor forms the sections as represented in our engraving, where Fig. 1 is a side view of the missile attached to a metallic cartridge case. Fig. 2 is a longitudinal section of Fig. 1, showing sections in perspective. Fig. 3 is a perspective view of one of the sections, and Fig. 4 is the top of the missile.

The missile, A, is thus composed of four parts, shown respectively at B, C, D and E, which are each provided with an angular projection and depression so that they will fit together and make a complete whole when in the gun barrel.



In this way bands are dispensed with, and the ball can be handled, even carelessly, without displacing its parts.

Further information can be obtained of the inventor, Mr. Carlos Maduell, of New Orleans, by whom patents of January 9, 1872, and reissue of March 19, 1872, were obtained through the Scientific American Patent Agency. Post office address, lock box 893, New Orleans, La.