A description of a new horse shoe which expands to the foot : invented by Bracy Clark

A

DISCLOSURE

OF THE APPARATUS FOR MAKING

THE

NEW TABLET SHOE OF EXPANSION.

SECOND EDITION.

These Instruments I divide into four classes.—I. *For forming the Shoe itself.*—II. *For making the Tablets.*—III. *For rivetting the Shoe.*—IV. *For taking the Shoe to pieces when required.*

I. *For forming the Shoe.*

THE process of making the shoe will be perhaps best explained to a workman, by presenting to his view the bar at every stage of its advance, as it is seen figured in plate 2, by which any workman, in the least expert, may very soon embrace it; and which single page of figures exhibits the naked result of some hundred experiments made for the purpose of ascertaining the best means of effecting this object, and which are here brought into one connected view.

Fig. 1, is a square bar of iron, weighing, for a common-sized shoe of five inches diameter, about eighteen ounces, and shorter by a full inch than the intended shoe; which inch, as it will lengthen in the working, so we shall have but little to cut off at last in waste. A convenient form of the bar we found to be about one inch wide by five-eights thick, for a shoe of five inches width. The first step is to flatten it about the middle, a little more than the half through its width; the purpose of this proceeding is, that in bending it, it may not become too thick on the inside at the point of flexion, which would inconvenience the subsequent process.

Fig. 2, is the bar bent and of nearly equal thickness, and somewhat less in circuit than the intended shoe, as it will fly open by the next process.

Fig. 3, with the branches or limbs hollowed out on the upper side, and flat beneath.

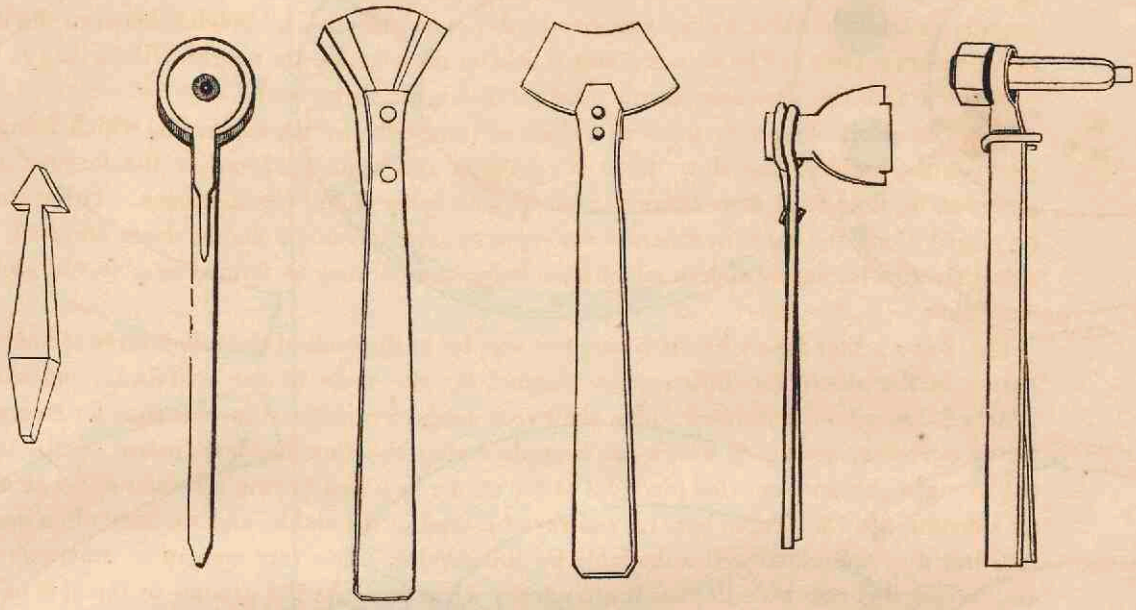
Fig. 4, shows a large rounded depression in front, to spread thin and prepare it for the rebat; being summarily performed by a blow or two of the round hammer* upon the bick of the anvil, depressing both sides of the iron at once.

Fig. 5, with a well defined triangular deep mark, made by placing upon it the *measurer*, pl. 1, fig. 3, and striking it hard on both edges in succession, with the heavy forge hammer. This tool is made of a triangular piece of steel, thinner in the middle and thick upon the edges; being con-

* Called turning hammer by the smiths.

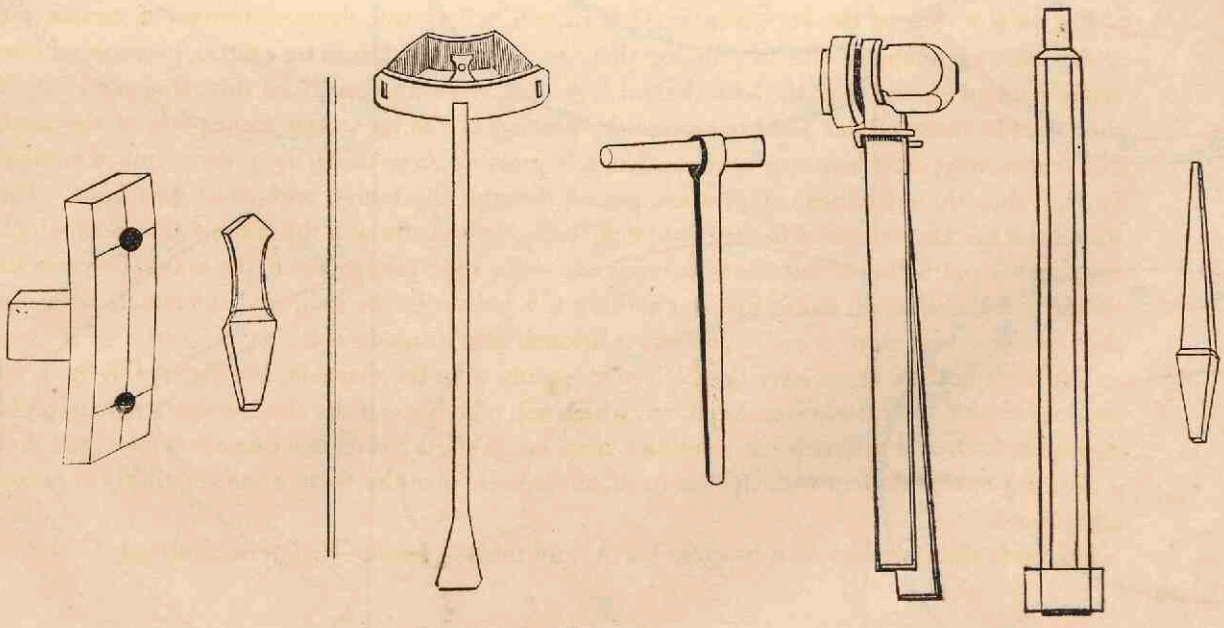
Plate 1.

TOOLS FOR MAKING THE SHOE.



1 2 3 4 5 6

TOOLS FOR FORMING THE TABLET.



7 8 9 10 11 12 13

structed exactly two-thirds of the size of the steel tablet: it is lashed by a rivet or two to a thin flexible handle of plate iron. If the handle be made too thick and inelastic, a blow carried a little too far, no unfrequent occurrence, is apt to break it. This impression is most useful in guiding the crimper, and will cause it, however far carried, exactly to fit the tablet; a result one should not have expected, and by which a great obstacle was overcome.

Fig. 6, exhibits the shoe after the rebat has been extended and drawn out by a curious operation, we have called, for want of a better name, *crimping;* see the Crimper Instrument, pl. 3, fig. 1. Without this mode of proceeding, the shoes were continually liable to break at the shoulders, the common set condensing the iron against the shoulder, and finally bursting it, which danger this proceeding fully removes.

This useful instrument we first made with the heads of the hammers strongly fastened in by two rivets, in a square frame, see pl. 3, fig. 1. We now find that welding the head on, is the simplest and the best mode, by an oblique welding surface, strongly shouldered. These heads are formed of blister steel. And for making small shoes, we have lately set both the hammers at one end of the bar, upon the same centre pin: in this case it is necessary to bend or incurvate the shafts of the hammer, in order to bring them into the guide notch, see pl. 5, fig. 2. I had almost forgotten to state that the faces of these hammers are oblique or slanting, which drives the metal in the same direction as the slope of their surfaces. Each is worked from the shoulder to the middle of the recess, then beginning again from the shoulder, striking upon these heads by the turning hammer, with a quick and not too hard stroke, the metal being made pretty hot.

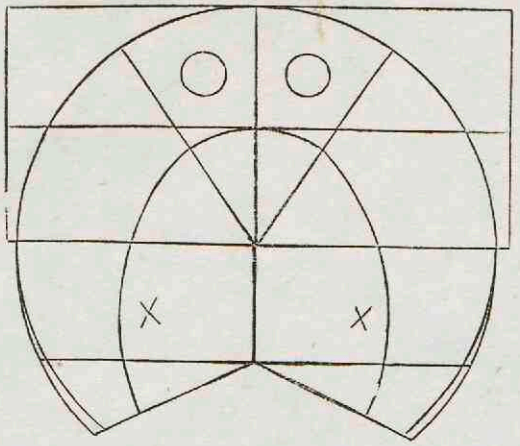
Fig. 7. The shoe fullered, stamped, and pritched.

Fig. 8. A deep division in the middle of the shoe, which will break asunder whenever required by a blow closing the shoe upon the anvil, rending the front part; extending the heels over the bick, ruptures also the back part of the fissure. The axe for the division is seen plate 1, fig. 5, first measuring the exact middle below, then bringing it over to the upper side, and forming the cleft with it: this fissure would be liable to choke with dirt if cut on the other side. A bolster with a longitudinal middle line for cutting it upon, is seen pl. 4, fig. 4; and the axe we have latterly used, is not with a guard as in the figure, but simply convex and rounded upon the edge, thereby cutting deepest in the middle.

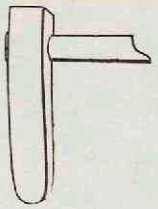
Fig. 9, shows the shoe marked for the rivet holes, the tablet having been selected and applied to it, and marked through the holes with a brass wire; it is perforated and stampt out by a punching tool constructed as seen at pl. 4, fig. 5; and in its improved state, pl. 5, fig. 1. It is a useful precaution before you begin to use the stamp to dress your anvil, and give its face not a sloping inclination, but a direct and true level surface, otherwise your tools will be very likely to sustain damage, as really happened to several of mine before I considered the cause; for it is evident a direct perpendicular blow on an anvil whose surface is inclined, is as mischievous to the tools as would be an oblique blow on a level or horizontal plane; therefore this point should be attended to. The shaft also, or stem of the stamping tool, should be firm and straight in the hole of the anvil, otherwise it may incline, while the bolster remains straight to the plane of the anvil, and so the instruments will get damaged; most probably the effect will be felt on the edges of the hole in the bolster: the smiths did not seem much aware of the necessity of these measures.

Fig. 10. The shoe in all respects ready for rivetting; the perfect shoe being represented in the frontispiece and other places, is not unnecessarily repeated here.

PLATE 2.



THE DIAGRAM PLATE.



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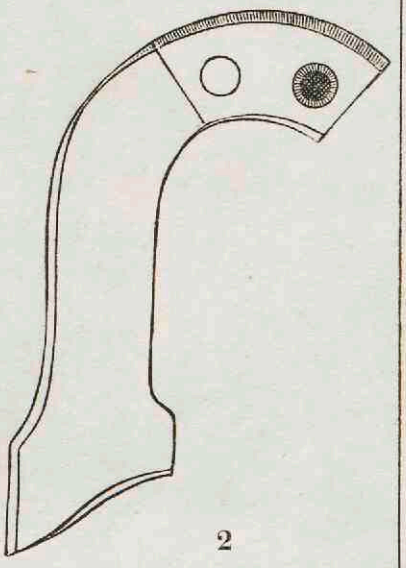

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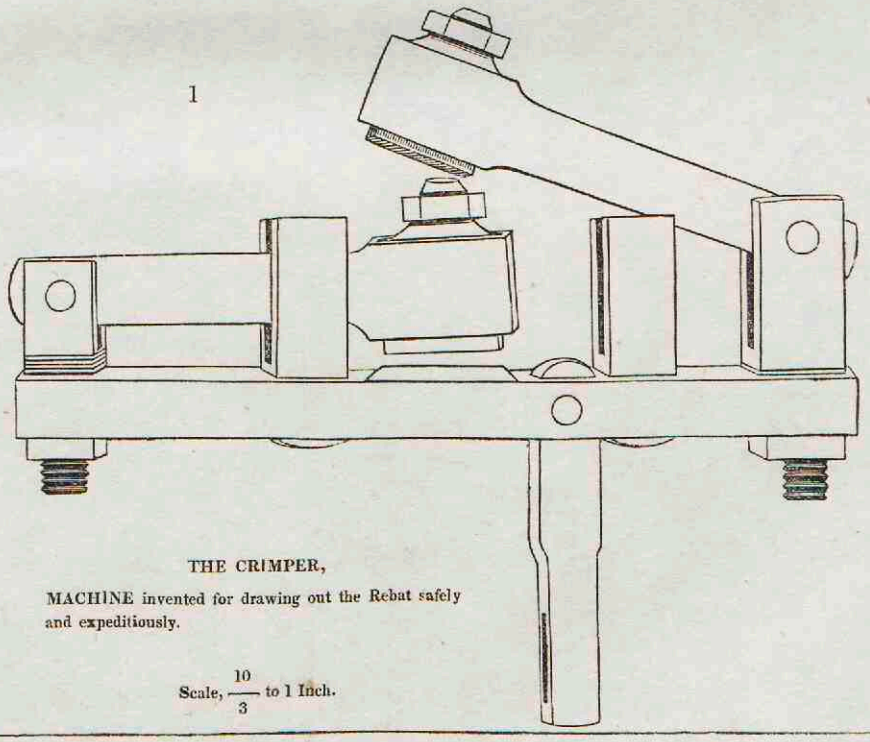


THE CRIMPER,

MACHINE invented for drawing out the Rebat safely and expeditiously.

Scale, $\frac{10}{3}$ to 1 Inch.

To perfect it, however, we now add two *clips* to it near the tablet, to prevent the shoe being driven backwards by the horse, and loosened. These clips should be a little concave or hollow to the inside next the foot, and should stand almost outside the rim of the shoe, so that very little horn should be removed from their fitting place, that the whole strength of the horn may be reserved for them to act against and defend from the impression of the stroke: we often see a grievous inattention to this circumstance by almost a denudation of the quick with their huge rasps and knives. This exterior situation of the clips is especially easily accomplished in the cast shoes.

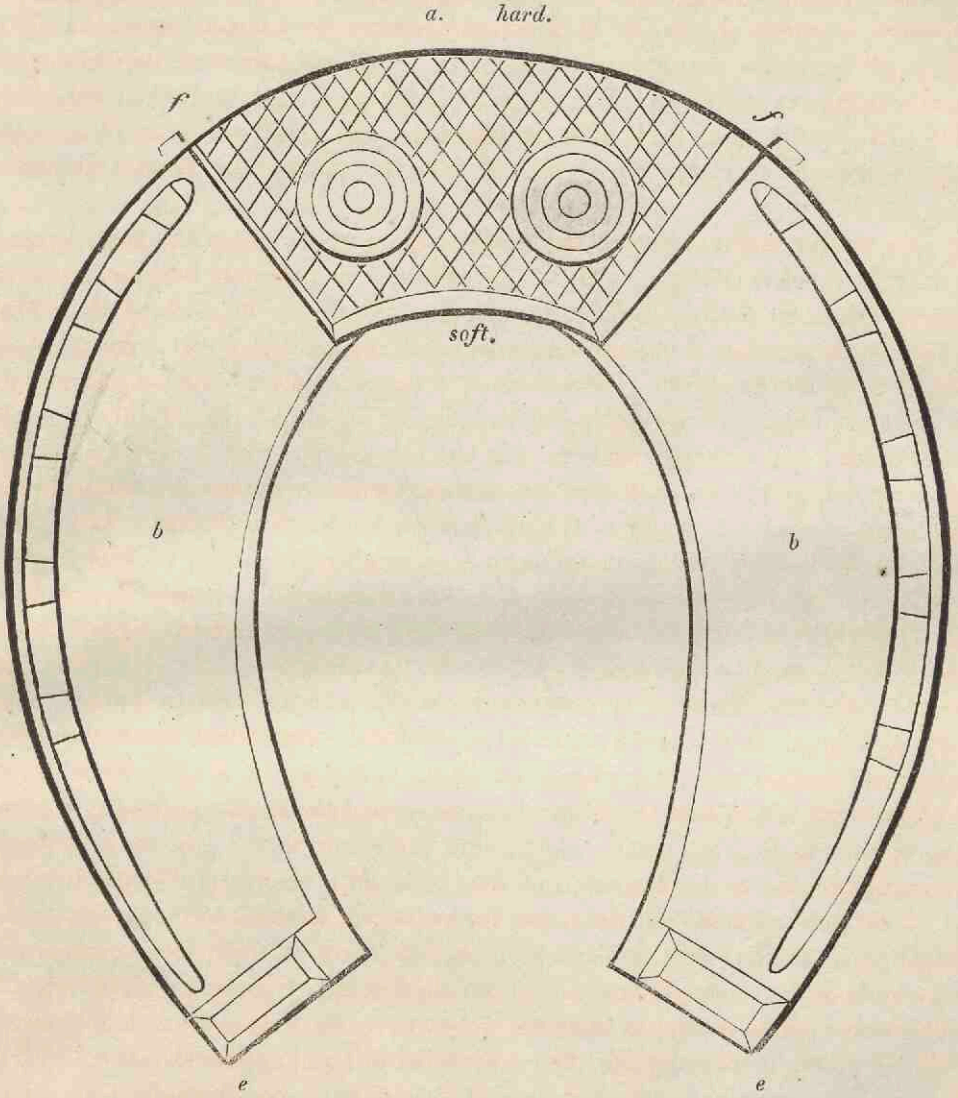
We now clean out with a rough file the corners and sides of the rebat, which are left full, especially in cast shoes, on account of the shrinking of the metal in setting, which would impoverish and weaken these places if left scant. The tablet being duly adjusted and the holes properly countersunk, it is applied and rivetted.

II. *On making the Tablets.*

These pieces being of steel and of considerable strength and thickness, and of an irregular figure, gave us a great deal of trouble in accomplishing their formation; and after the trial of a variety of unsuccessful ways, which we shall not trouble the reader with a recital of, or at least of but one of which there is a plate of explanation, we at last discovered one that was truly easy and of great liberty in the exercise of it, and of much compass and exactness in its use. The first means we used is seen at plate 1, fig. 9, 10, 11, &c. The process was as follows:—a piece of old coach spring steel, for such at length we found to be the best for our purpose (after using for a long time shear steel), was beaten up, thickened and drawn out, and turned round to a circle of rather less than five inches diameter, being thinned on the inside and left thick on the outside; the instrument fig. 9, pl. 1, was applied by the fireman's assistant to the outside of this circle, and having two converging chisels fixed into it at the proper angle, the fireman struck with a hammer each successively, which gave the true angle of the tablet and its size. He then used the tool No. 10, and placing it on each side the concave of the central figure in the tool No. 9, he marked it for the holes, and then proceeded immediately to countersink them, instead of doing this after perforation, which would be the natural course of proceeding, and had, during two years, led us into difficulties and embarrassments. This simple change of proceeding rendered the accomplishment comparatively easy, and altered the whole line of proceedings and of tools; being first countersunk with No. 11 very deep, the perforation was accomplished without much difficulty by the steel stamp fig. 12, over a bolster fig. 7. The holes were then opened with a gaged broach, fig. 13, to the size of the rivets. And the holes of the shoe were then countersunk by the tool fig. 8, to the size of the rivet-head. At plate 3, fig. 2, is seen a piece of old coach-spring, in its process of forming a tablet, being almost finished, before it is severed from the bar.

At plate 4, fig. 8, is seen a most useful instrument invented by me, for making the tablets upon a very simple principle, that one man may without assistance, make many in a day. A square thick plate of iron is made to hold the whole apparatus for marking, countersinking, cutting, and perforating; the steel being made hot is worked above the tools, and does not in receiving its figure, come at all in contact with the anvil, which always rapidly cools it. The satisfaction and pleasure this instrument has given to several excellent mechanics, has been very great; as in this

PLATE III. Fig. I.



The same Shoe much improved, from three months' actual practice with it :—a, the Steel Toe-piece thinned backwards; b, b, the Quarter Pieces, deeply fullered; e, e, the Extremities or Heels, slightly turned up. The Nail Holes also finished with a Pritchel, having a Shoulder gaged to the Head and Shank of the Nail. f, f, the two clips which render a nail less sufficient towards the heels.

way may be readily wrought almost any figure in steel, and that of the tablet is not among the least difficult. The process is as follows: take a piece of old coach-spring steel, heat it in the fire, and thicken it by hammering to the required substance; then curve it, thinning it to the inside edge. Now place it against the stop *a*, and strike it two successive blows, one on each point *x x*; these points determine the distance of the two rivets, adjusting them by the screw *b*. Another adjusting screw *c*, regulates the distance from the front edge, the proper space being found by trials. The steel, deeply impressed by the two points, is conveyed to the blunt cone *d*, and there smartly hammered till a deep hollow is made; it is then warmed again and carried to the obtuse or truncated cone *e*, which gives the countersink its true figure. This accomplished, we have next to obtain the true angle of the sides of the tablet, and for this purpose place it on the two thin marking chisels *y* and *z*, adjusting the distance, and consequently magnitude of the tablet, by the point *f*; previously, however, to this, it is necessary to place the steel on the bed-piece *g*, and with the knife *h*, mark the middle exactly between the two holes;* this line obtained, it is then applied to the point *i*, keeping a view of the other end of the line to *k*, and resting the steel on the chisels, touch it lightly with the hammer on each, the upper side being downwards, as it can be best seen; this line carried to the large thick chisel *l*, it is cut off, and so of the second line, and it then gives the tablet with great truth of figure; I have often in good hands seen them as much so as the line and compass could give them. In this mode of working the steel there is little loss of heat, and no confinement or difficulty in the use of the tools, but all is free and open; punching them in moulds the way I first attempted, or through a mask, was grievously inconvenient in this respect, the metal swelling in the moulds and sticking fast, and the obliquity or unevenness of the figure of the tablet, making plain stamping out difficult; and they broke, in Birmingham, some strong engines in attempting it. The countersink being first prepared, though simple, was a grand step; it saved the metal, and made the after-perforation easy. Forming the tablets in this way leaves a bur in the holes, which is removed by placing the tablet in the guide-tool *m*, and with a punch having a long handle, it knocks out the bur over the hole *n*, and finishes it; this tool is made of one solid piece of steel. *o* is a square hole in the plate, through which a shaft goes to fasten the apparatus upon the anvil, tied below by a pin. In a former edition another figure is seen of this apparatus, and somewhat different.

The instruments, many of them though simple in their present appearance, were only arrived at through more complicated processes, and were perfected by several successive changes of great trouble, in which my importunities wearied the patience of not much less than a score of smiths, submitting to their extortions, delays, and most provoking mistakes, though often forging for myself; and at length I erected a building on purpose for it, with its proper furniture, without which the object had certainly never been attained: and with all this, if I had not been blessed with an extraordinary share of health, and vigor of constitution, and the blessings of a kind providence on my labours, it had never been effected; for, by most, the undertaking was derided as impossible, and as a visionary scheme that would only end in my own destruction.

This tablet instrument did the business so extraordinary well, that we were almost tempted to work it in private as a secret, but this being derogatory to all my other proceedings, I laid it open to all who desired information upon it.

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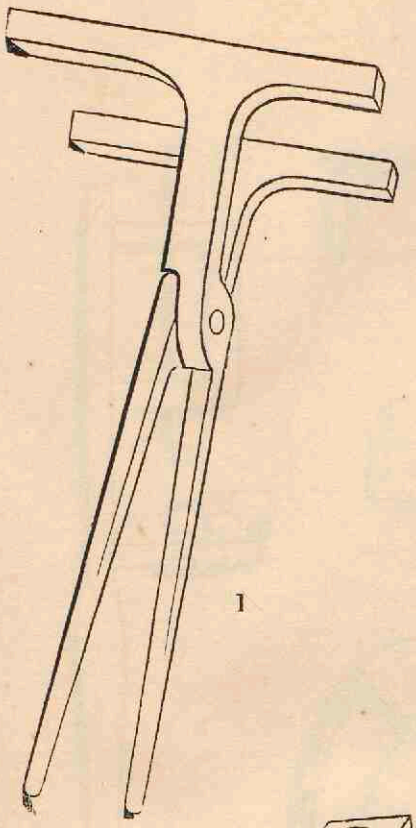
* We have sometimes, with good workmen, not used this part.

PLATE IV.



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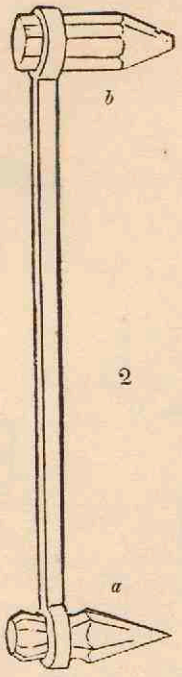

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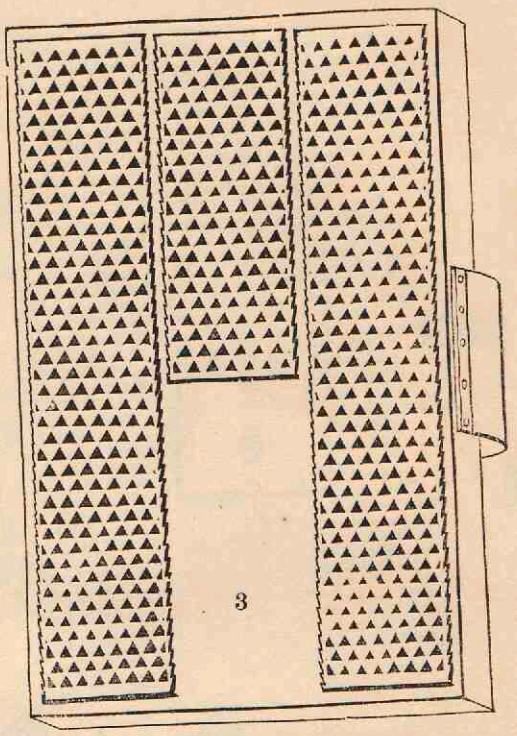

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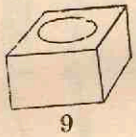

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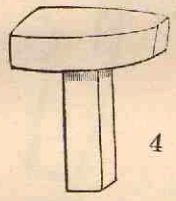

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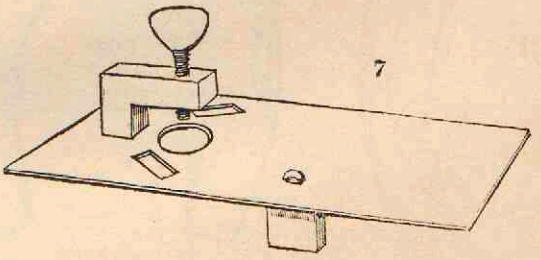

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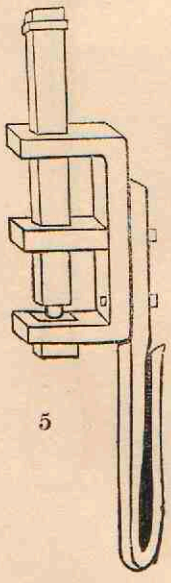

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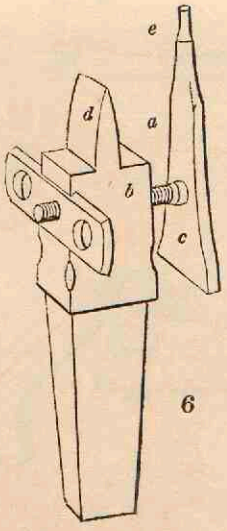

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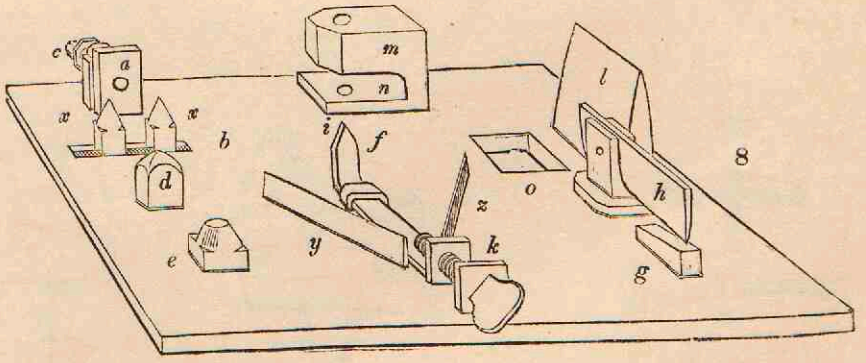

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III. *On the Rivets.*

I soon found that making the rivets at random would not do; they caused the shoes to be unsatisfactory, and rattle before they were worn out, and were in the end a loss. I therefore was obliged to pursue a more correct mode of proceeding, giving to them a precision almost mathematical, for if they fit their holes and countersinks well, they will remain steady to the last point of the wear of the shoe. To effect this I made the drill, pl. 1, fig. 1, of a certain determinate figure, that could always be known, and easily imitated, the head being formed by admeasurement into an exact equilateral triangle, or whose sides and base were exactly three quarters of an inch, and where this drill diminished to three eights of an inch, there began the shank of the rivet, it being always made in the larger and middle shoes, of this diameter. In this way we proceeded with great satisfaction, and did not afterwards suffer the inconveniences which before we had so severely felt.

This drill, for strength, was bevel-edged on one side only, as is common with the smiths; but when greater accuracy was demanded, as in making original moulds and patterns, I preferred to use a drill with a head, and edges bevilled on both sides, as in the common bow or stock drill, which being filed exactly to a $\frac{3}{4}$ inch notch in a plate, could be brought in its figure to very great delicacy, and we used it chiefly for forming our countersinks in the tools. This notch is seen on the side of the diagram plate, at fig. 1, pl. 3. It is from both the cutting edges being on the same plane that gives to it a more certain figure.

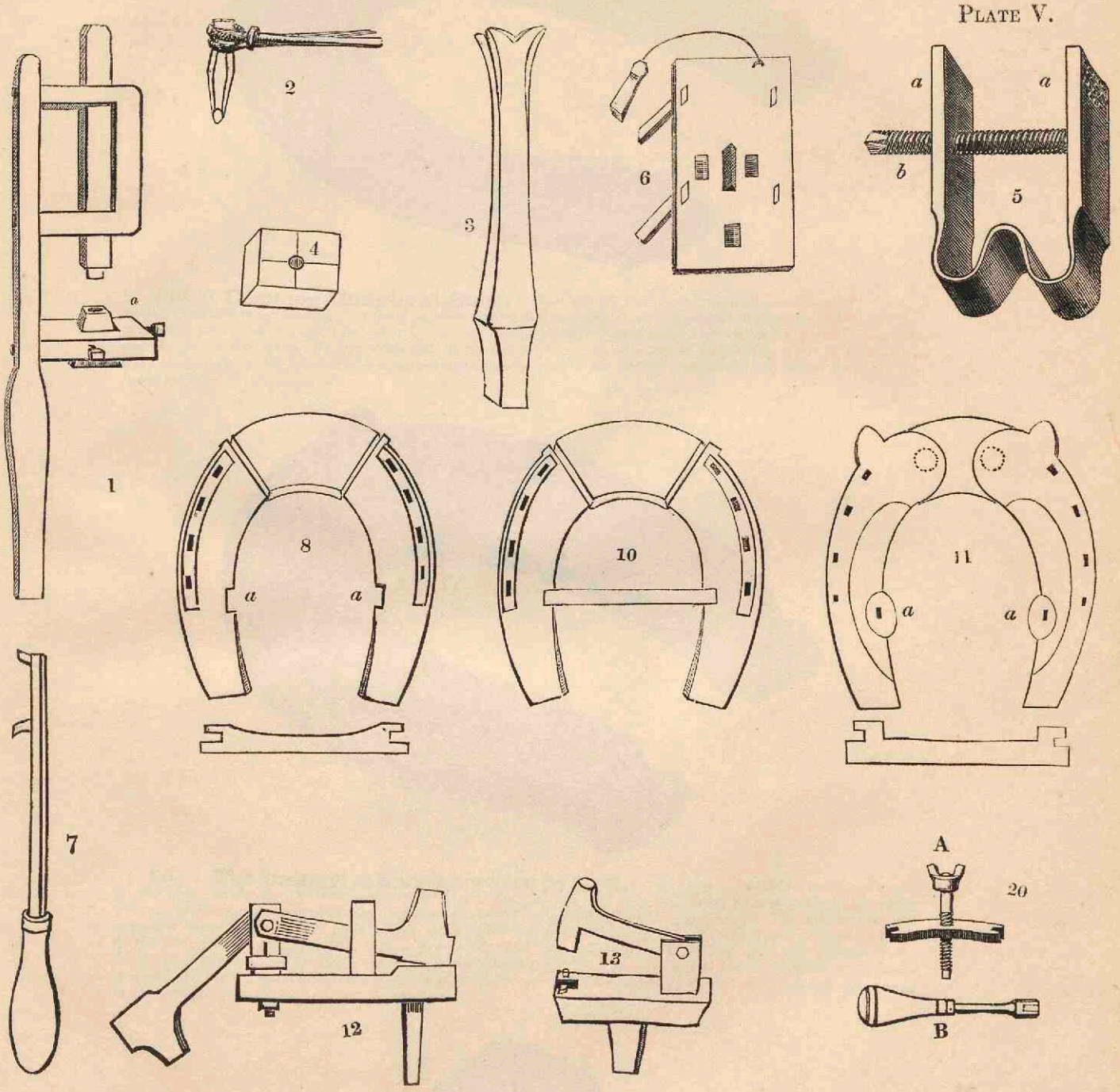
In order to make these rivets expeditiously, and more conveniently also, I formed the tool seen at pl. 4. fig. 5. It is fixed in the anvil by the stem of it passing into it's square perforation. The horizontal screw *a* passing through the stem *b*, and carrying the vertical steel-piece *c*, approaches the chisel *d*, and determines very exactly the length of the piece to be cut off from the rod; the proper length for the rivet being ascertained by previous trials. The piece cut hanging only by a narrow neck, is thrust into the tool seen at pl. 1, fig. 2, and is there hammered smartly to form the countersink of the head; if they stick in the tool, which they are sometimes apt to do, we knock them out over the point *e*, which though not represented here, is provided with a guide frame to give it a right bearing over, or upon, the point of the rivet. The above tool, pl. 1, fig. 2, I need hardly say, is the common rivetting tool of the smiths; formed by enclosing a thick piece of steel rod within a bar of iron turned round it, and welding it in, and then drawing it out afterwards into a handle. The steel being countersunk, and perforated, and hardened, is ready for use. This tool we prefer to the perforated steel bar mentioned in the first edition of this work.

These rivets, nicely fitted and inserted in the shoe, are rivetted by the hammer seen in pl. 3, fig. 14, which was afterwards ordered to be formed shorter as to length, and thicker; and with a pine or peene* in the upper side of it, in order, if we wished it, to spread the shank of the rivet.

After the shoe is firmly rivetted, it should be knocked about as little as possible, which some smiths are but too fond of doing, and of putting it into the fire again; all which unsets the rivets and makes them apt to become loose before the shoe is worn out; it is therefore best not to allow too much of this sort of proceeding. Before the rivets are put into the shoes, it is advisable to immerse them all over in some unctuous substance, as tallow or grease, that they may not rust or grow fixed, as may especially happen if the horse should be detained long in the stable before he is used, as has happened to us in one or two cases; it is indeed necessary, in order to give these parts at all times a more free motion.

* This is the English name given to it by our smiths, no doubt from *épine*, French, and *espine*, old French; and from the Latin *spina*, signifying any thing thorny or sharp.

PLATE V.



We may remark, that between the tablet and the shoe there is also considerable friction of surfaces impeding motion, especially if they are rivetted very tight; to prevent this, the rivetting should not be done too violently: and, indeed, if these surfaces were left a very little convex, or rounding in the middle, it would be most effectually prevented; and this would be especially necessary in the lap-shoes, or shoes made of one rivet and with a lap joint, therefore these surfaces should also be greased. If they are found after rivetting to be too tight, working them a little by the hands will often relax them; or by a few blows of the hammer, or by striking upon the head of the rivets a few blows over some hollow opposed to the shank, as a perforated bolster or hole of the anvil, &c.

There is also a friction against the hoof itself to be overcome, and in the part beyond the rivet in the contrary direction to the expansion of the shoe; so that the hoof should not be suffered to bear too strongly on these parts, but for the sake of easy motion be a little relieved by the rasp when great ease is desirable. The motion, however, on this part so near to the centre of motion, will be very small. It is also, we may remark, perfectly practicable to make these tablet shoes without any distinct rivets, at least the cast shoes, which may be done by casting the tablets with cylindrical nipples or upright pieces of iron at their backs, which being passed through the holes in the shoe, are rivetted. And in the lap joint shoe, it is obvious that only one of these upright pieces would be required.

I may suggest here, that it is not impossible to remove entirely this extra-central portion of the shoe. For this purpose we cast the shoe with the cylindrical pin or nipple for rivetting at the very extremity of it, battening out the tablet to the level, or leaving it void; in this way all friction from this cause would be done away: and in very fine elastic young feet, such a plan may be useful, but in the general way it will not be at all necessary, if the above precautions are observed.

IV. *Of Unrivetting.*

As we sometimes want to take a shoe that has been formed, to pieces again, to alter it or to give it a new tablet when such has been worn out, or to be changed, so to do this without damage to the shoe, if it has been well rivetted, will be found no easy matter. With an old shoe we have often proceeded very summarily by knocking it out per force with a punch and hammer, cold or made hot as may be requisite, but this often bursts the shoe: we therefore where it is of consequence to save the shoe, proceed with more caution, and first use a very sharp prick punch, fig. 2, to drive deep into the centre of the rivet, after which a drill works faster in removing it, the chief resistance being generally at the point of the drill. This prepares it for the drill, No. 7, and is then followed by a broader drill, No. 8, removing the head or shank of the rivet in a press machine, and afterwards *the blunt punch*, fig. 2, *b*, on the same handle as the sharp one, knocks out the rivet. Pl. 5, fig. 5 is a *perforated bolster* for knocking out the rivet upon.

Besides the instruments figured in these four plates, there are others I have since added that have much conduced to the rendering more practicable and easy this new art, and which instruments as they do not well arrange under either of the above heads, we propose to give an account of here.

V. *Extra Instruments.*

In plate 3. fig. 1. is seen the representation of a *diagram*, sketched on iron plate for working by, and which gives the law for forming the shoe, the tablet, and the rivet. The triangular notch or vacuity at the right hand corner, serves to form the head of the drill by cutting the sides

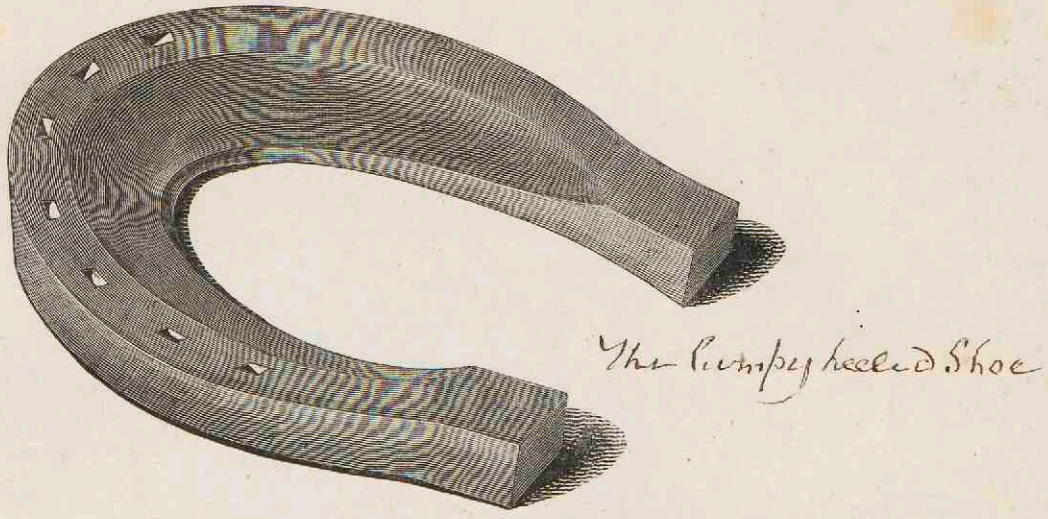


FIG. 1. **Common Unilateral Shoe.**—*This Shoe is faulty in being liable to come off. Also in having the heels progressively thickening to their extremities, causing a violent pressure upwards against the foot, producing pain, and often ecchymosis or Corns, and so little do horses often bring the heels to the ground from pain, and the shoe when taken off, and worn out at the toe, is frequently seen not to be sensibly worn in these parts. This thickening of the iron ever creates an unnecessary weight for the horse to carry, as also a waste of iron to the smith.*

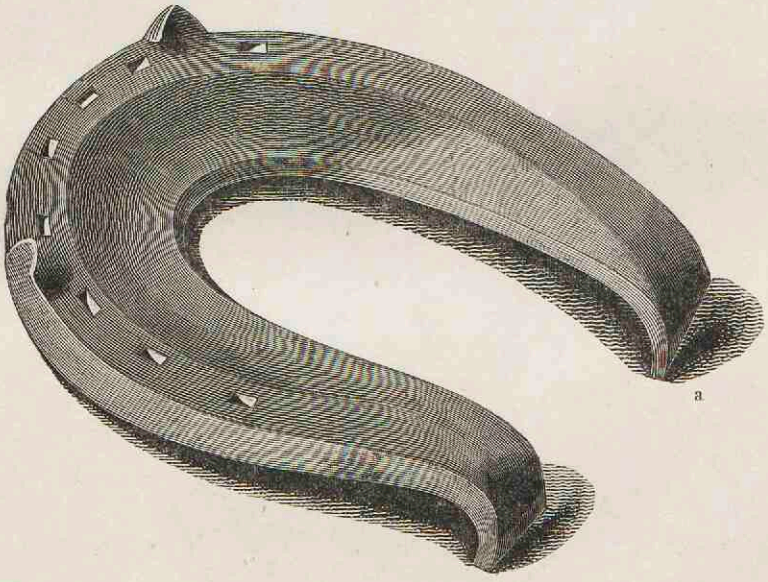


FIG. 2. **The Unilateral Shoe improved by B. C.**—*Two clips are made to embrace the sides of the pince rendering the shoe vastly more firm. The quarters and heels are made thinner posteriorly, which without weakening the shoe in its wearing parts renders it lighter behind where it is wanted. The reduced iron also is turned down in this shoe to form calkins, giving the horse great advantages by determining his tread and rest to the stronger parts of the foot. It is preventing also any unnecessary battering upon the ground of the furch, and inflexions. The inside calkin,* a, *is cut obliquely off, that it may be less liable to injure the opposite coronet. By these improvements the simple nailed shoe is perhaps carried nearly as far as it ever will be carried in its approaches to the natural laws of the foot.*

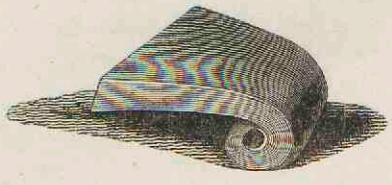


FIG. 3. *Is another mode of terminating the heels of this shoe by a convolution of the iron, which gives the elevation requisite, and removes the apprehended danger from the calkins, but which, if the foot has liberty, and is not benumbed by being embraced on both sides by the nails, and if the reins are at all judiciously used, is not so great a danger as is generally imagined.—The sharp edge of the convolution may be filed off next the other foot, or it may receive a semi-globular figure by impression while hot, in a mould.*

of the tool to correspond exactly to the sides of the notch, and the base of the drill to the extremity of the opening. It is necessary, however, in order to do this, to thicken the plate at this part by rivetting upon it a piece of iron, and fileing it afterwards exactly to the notch, it will then receive and gage the obliquely directed bevelled surfaces of the edges of the thickest drills, which it would not otherwise do.

Pl. 5. fig. 2. represents *a tool for making the clip*, by driving it into the red-hot upper surface of the shoe, near the front, and then finishing it by drawing it out upon the shaft, fig. 3, with four projecting points or corners, and which shaft is placed upright in the hole of the anvil; upon one of these corners the clip is brought out and completed.

Another instrument which I have found highly convenient and useful in this art, is formed of a thick plate of iron, on which to hold any shoe flat and firm in the vice whilst it is being filed at the rebat or shoulders, or any other part, or whilst we sawed the joint of the shoe and divided it, to give it free motion. The shoe in this case is laid upon the plate and made to rest against the projecting knob of iron, and the screw will then prevent any lateral movement; the square stem beneath the plate being griped between the jaws of the vice, holds all firm. See plate 4, fig. 7.

The same machine is made also to serve another very useful purpose in re-tabletting the shoe, after the tablet has been worn out; a blind tablet which fits the rebat is placed, and with the two halves of the shoe, screwed down to the plate; the tablet presenting through the opening is marked with a brass wire through the holes in the shoe, and then perforated with the sharp punch after being put in the fire, and being then reversed, is finished over the pointed and next over the truncated cone of the tableteer. The side holes are for the admission of the clips of the shoe.

At pl. 5, fig. 1, is seen a most convenient instrument for perforating the shoe, for to receive the rivets, that is the shoes which are formed from the bar-iron, (the cast ones having the holes ready made) and which takes out the piece very neatly, by a blow or two of the heavy hammer, the precise point for the operation of the punch is known by its being marked through the holes of the tablet, previously placed upon it in the desired position, with a pointed brass wire. The bolster is adjusted by lateral screws. This is also an improvement on the one represented in the former edition.

Pl. 4, fig. 3, gives a representation of a new kind of rasp, for preparing the hoof for the shoe. It is made of three pieces of a broad common rasp, which are let into a square piece of wood, and glued together, and laid so as to be perfectly flat and even; they are then wide enough to rasp all the parts of the hoof at once, and consequently bring it to a perfectly level surface. The back of this instrument has a loop of ferret or broad tape to go over the back of the hand like a curry-comb, and assists much in the using of it; or if an upright handle of wood was inserted, it might also serve the same purpose: a narrow rasp, even in good hands, was found an uncertain tool for this purpose. It is easy, if required, to bear more on one side than the other, and to leave the inside of the hoof rather fullest, which we apprehend is agreeable to the intentions of nature in the plan and wear of the hoof.

Fig. 9 is a small steel cup, punched hot with a conical tool, roughly, and then nicely hollowed out and finished with a guaged drill of $\frac{3}{4}$ inch equilateral cutting edge: into this capsule or cup we ram whilst hot the nipples, for countersinking the tablets, as seen in the plate machine, fig. 8, pl. 4. which saves turning and fileing, and a great deal of trouble.

Plate 4, fig. 1, is a pair of tongs we found highly useful in holding a shoe while we did anything to the setting it, securing it from swerving or motion, or getting out of place, the two halves of the

shoe, being kept equally in line. We used a small half round wood rasp to form the place for the clip of the shoe to rest against, instead of employing that ruinous tool the clumsy rough scalping rasp of the common smiths.

Sawing the shoes asunder, which I adopted at one time, sometimes before and sometimes after rivetting, being found tedious was discontinued. I next used to cut them between two sharp chissels, the one, viz. the lowest, resting on the face of the anvil, supported by a board, through a slit in which it passed; and this chissel was only raised with its cutting edge just above its surface; the shoe being laid upon it, was easily divided by another chissel, applied as we have stated, above. The shoe before division should be made quite flat and level, which will not be at all disturbed by the cutting. A figure of this apparatus is seen pl. 5, fig. 6. All the cast shoes I divided in this way.

In finishing my present account of these instruments I add one more, which I formerly believed important enough for separate publication, in which state it will sometimes be found, it is the *distender* or *spreader*, used for putting on the expansion shoes, to prevent their collapse during this proceeding. In publishing which I formerly observed, that the refinements of science, in any art, often admit of more abuse than the grosser methods of vulgar practice. The Expansion shoe, the most easy to the feet of any ever invented, may be rendered, by carelessness or abuse, the most oppressive of any; for, being naturally made to open and close, it is forced inwards by the nails in shoeing, and may so compress the foot as to occasion more uneasiness than the common shoe; the nails ever having a greater tendency to the inside and softer parts of the foot. In my early use of this shoe, I entreated the smiths, therefore, to begin with setting it as wide as possible; but this precaution, though it sometimes succeeded, I found uncertain and insufficient, and that some instrument must be resorted to, to remove this difficulty. I therefore contrived the *Distender* or *Spreader*, see letter A, pl. 5, which is only used during the nailing on of the shoes, and afterwards is removed; it consists of a cross-bar of iron notched at the ends so as to embrace the inner edge of the shoe, and tapped in the middle, to receive a stout steel screw which passes through it, and abuts by one end against the front edge of the shoe; and is provided also with a turning socket or swivel, having a forked head to embrace the shoe, so that the screw may be freely turned without the socket moving from it's place. By turning the screw to the left, the cross-bar is forced backwards against the narrowing circle of the inside of the shoe, and distends it to your pleasure; and by the contrary motion of the screw, the bar is sent forwards to the widest parts of the shoe, and admits of it's collapse in any degree required; or if carried still farther forwards quite to the square shoulder of the screw, the instrument can then be taken out and removed with the fingers. It will therefore permit the nicest adjusture of the holes of the shoe to the middle of the wall of the hoof, and will render unnecessary the often vile practice of knocking the shoe about with the hammer after it has been partially nailed on, by which the nails are often brought to press painfully upon the quick. The shoe being nailed and finished, the instrument is removed by turning the screw backwards, and forcing the cross-bar to it's top or shoulder, when it can be twisted round and taken away; and the screw should ever be kept as short as may be, or it's interfering with the sides of the shoe may render it's removal not so easy. The steel screw at the end is simply squared to admit the application of a *turning handle*, having a brass or iron socket with a square hole in it, see figure B.

The cross bar, if it be found too short, can generally be lengthened by being put in the fire and drawn out with the hammer; or if it be too long, it can be reduced at the ends by a file.

I have also at times, in order to lengthen or shorten the cross-bar, made a screw at each end of it, on which a socket or swivel also screwed, worked, and shortened or lengthened it, at pleasure, the socket having a forked extremity to embrace the inner edge or margin of the shoe; but this method, though convenient, is not so strong or so simple as the former, and the apparatus must ever bear the weight of the horse if he should chance to tread upon it, or it is useless.

A difficulty often occurred with the cross-bar, if perfectly straight, by its interfering with the frog, if it was at all large or projected; to overcome this, I formed the bar into an arched or curved form, just sufficient to allow of its passing over it, as may be seen in the figure. This instrument I have generally applied to the shoe after the two first nails have been driven; at other times before its application to the foot, leaving it loose and easy; for if put on extended to tightness, there can be no farther extension of the shoe when on: any very considerable distension after nailing is wrong, as it forces the nails on the interior of the hoof, since in distending them below, you close them above.

The size of this screw is a little more than a quarter, but less than three eights of an inch diameter, with a coarse strong thread that a few turns may make it travel a good distance.

On the Brampton Metal Shoes.

Having concluded our account of the making the Expansion Shoe from the bar, I shall add a few words on the nealed cast iron, or Brampton Metal Shoes, as they may perhaps hereafter, in many cases, supersede the others with great advantage.

This metal was first brought into use for horse shoes by Joseph Godwin and Thomas Dudley using it for common and general shoeing; it was however given up and abandoned after a few years, the latter becoming a bankrupt. I have no doubt however, from what I have seen and experienced in the use of this metal, of the perfect practicability of the proposition, and of it's possessing, especially in some situations and circumstances, many great advantages. Any figure however complex, which the shoe may require, is as easily formed as the most simple where cast metal is used; and also the workmanship, time and tools, and wayward conduct of men is saved. The figure also is more perfect than the most skilful hand can give; and we have found them, we have thought, more easy to the horse in using, than those made by hand, which may, perhaps, be attributed to the superior harmony of design throughout in their whole execution.

The expence will be certainly less than by any other mode. The only drawback in their use, for we shall conceal nothing, is, that the metal is subject to some degree of uncertainty, breaking sometimes before they are worn out; it therefore becomes a proper inquiry as to the frequency of this, on which will depend their adoption or otherwise. Now this can only be known by much use of the shoes, which alone will enable us to form a just estimate of their value. We have now seen the use of some hundreds, not to say thousands; and such is the perfection to which they have brought this metal, that we have not known them to break so frequently as to make it an occurrence that we think should forbid their use, for the other shoes will also at times break.

I have also found a means of trying their goodness before they are applied, by which our security is increased: which consists in essaying them upon a block of cast iron. This I have made of an oblong square or cubic form, the sides all arched in different degrees of concavity, into, or over, these inverted arches;—the shoe is put, the shallowest arch, for instance, first, and with a hammer I bend the shoe till it fits that arch; I then go to a deeper, and so on till I have as-

certained exactly what the metal will bear; after this there is pretty good security in their wearing well, and a whole batch of shoes may be tried, or a single shoe.

We may also judge prettly well of this metal by breaking a shoe; if the conversion of the metal has been perfect, the metal generally looks bright and sparkling like wrought metal, at least in degree; but if the quality of cast metal prevails, a black hue or grain is seen with hardly any metallic splendor.

The manner of effecting this change in cast metal has not been commonly divulged, but has been practised with considerable secrecy by those who manufacture it. I have been curious to learn what I could respecting this process, and what I have been able to obtain I shall keep no secret.

I first sought the patent office in order to observe what the original patentee had disclosed, and found he had been pretty free and communicative. His patent is dated June 26th, 1804, and after the usual preamble states, that he uses for this purpose what he calls *The Steel converting Furnace;* and that the cast metal placed in this furnace is to be exposed to the action of iron stone or iron ore, or some metallic oxyd, lime, or any combination of these, reduced to small pieces, or to powder, that they might combine with, or consume, the carbon of the cast iron. That the heat should be applied for a long period, and so intensely as to combine the carbon with the above substances, or effect the decomposition of the carbon.

If the iron is to be rendered perfectly malleable, from one-half to two-thirds of it's weight of iron-stone is to be employed; if only partially so, a less quantity will suffice. Five or six days will, in general, be found sufficient to continue the heat, which towards the close of the process cannot be too great short of fusing the iron. The cast iron should not be too thick, as it will much lengthen the process. The length of time for the conversion, will also much depend on the nature of the iron used. The iron to be converted should be placed in alternate layers with the composition; and to prevent the iron ore from adhering to the cast metal, a thin layer of sand should be interposed.

Such is the patentee's setting forth of his process, in which there appears much candour, and of unreserved open communication.

The horse shoe being very solid, compared with the articles they were generally used to convert, it will no doubt require a much longer time of exposure to the fire. The conversion is, however, as perfectly practicable with thick as well as with thin metal; since we have received formerly from Wolverhampton some tablet shoes for cart horses, which wore remarkably well and appeared to be converted quite through their substance.

I have also learnt from conversations with the manufacturers, that it is not all cast iron that will admit of conversion; but that the iron which is found in Cumberland, and is obtained from Lancashire under the name of Ulverstone pig, is by far the best. The Shropshire iron runs when melted, and I think he observed, very fluid and thin, and to convert it required an intense degree of heat; but what is called *Old Park pig* will do better than any other. I have also been told that most of the Swedish pig iron is particularly well suited for this purpose.

A Mr. Shuter of Wolverhampton, a manufacturer of this article, was explicit enough on this art to inform me that iron pots were used in the conversion, standing one over another in tiers; these were closely cemented up with wet sand, so as to be hermetically closed; for the least aperture would cause the flame to rush in, and burn away or scale the metal. The dimensions of one of these ovens was about a cube of seven or eight feet, with intervals between the rows of pots for the passage of the fire. These pots were of a cylindrical form, with lids to them of about a hundred

weight and a half, and were, after being charged with the metal, let down into the furnace by a crane, or by pullies. The iron ore, he observed, was reduced very much by the process, and was almost converted into a metallic state.

In a large factory near him, they used for their oven a truck or frame of iron placed on wheels, and which being loaded with the pots was drawn in by a horse within the walls of the furnace, and the wheels were then covered over to defend them from the action of the fire; and when the process was finished, it was drawn out backwards, and the contents removed.

He observed also, that if the fire was neglected and suffered to go low and the metal to chill, instead of being briskly kept up in rather an increasing heat, the process did not succeed so well, and the metal was not converted; he therefore never ceased to watch it night and day, having a couch near the furnace.

The material for cementation was a red iron stone, got, I believe, in Somersetshire, which was pulverised; but this was found, alone, to stick too much to the metal and to scale it, and it was lowered by the admixture of iron ore that had already been burned and used in the process; as to manganese they never used it. He observed, also, that about the third day of the process, if the heat was a little vigorous, a blue flame was seen to issue from all the sides of the pots, and from any fissure in the sand, and this he considered a good omen; after this had continued two or three days, there was no more issue of this sort.*

I have not hesitated to describe all I knew of this process, as it is impossible where so many men are employed, long to make a secret of it to any one determined to bribe or be curious in getting at it; and I apprehend a very extensive use of it will hereafter be made, especially in complex things or of difficult forging: some of the metal so treated will harden like steel, and knives and razors have often been made with it.

I have also farther improved these cast shoes by sinking a deep groove in them for the fullering, through the bottom of which, as the metal was thin, there was no difficulty in pritching the holes even when the metal was cold, indeed, best so, as the metal is not then exposed to the risk of injury from overheating in the fire, and as it works kindly cold. One further improvement, which it appears to me may be made in these cast shoes is, to bevil the very inside inner edge, or margin of the shoe, in order, when it meets the ground or a stone, that pressure against this oblique surface may have a tendency to expand the shoe, as is in some degree the case with the natural hoof, especially with the internal surface of the bars or inflections.

It is well, also, in pritching these cast iron shoes to pritch the two front holes with a pritchel longer and slenderer than is usual at the point, in order to give these two holes a good slope, otherwise the mouth of the hole must be enlarged on the outside, to incline the direction of it enough for conveniently driving these two first nails.

As these cast shoes of Brampton Metal are formed with more truth of figure and harmony of intention from carefully-wrought moulds, so in a general way, we have thought them more easy to the feet of the horses. That it is scarcely doubtful with me whether they will not ultimately supersede the wrought metal, and on other accounts than the above, relating to the habits and conduct of the working smiths in this art. However, whether my apprehensions in this respect be verified or not, I have secured the invention by ample directions for making them from the bar.

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* There is little doubt this proceeded from the combustion of the carbon, and was carburetted hydrogen with the phosphates and other admixtures; this the inventor, Lucas, called the foul part of the cast iron.

A few objects represented on the fifth plate still remain to be exposed, which have been found necessary in prosecuting these researches. Fig. 5 is a convenient instrument for forcing open the shoe at any time after it has been put on the foot; the two extremities *a a* being placed between the two heels of the shoe; by turning the screw *b*, we force them asunder, and consequently distend the shoe, in order to give it play or to introduce a stretcher between the limbs to keep the heels open. The two extremities *a a* on the outside, are roughed like a rasp to make it hold the iron of the shoe more firmly, and are also a little concaved.

Fig. 7 is a sort of wrench made of a shaft of iron with two lateral pieces, which being placed between the limbs of the shoe, force it open, for the same purposes as the former; it must, however, be used with more caution, or it may do harm from over distension. Other stops may be placed along the shaft at different distances to accommodate different shoes, and such may be either rivetted in, or screwed, in which case holes screwed may be formed so as to suit almost any sized shoe.

Fig. 8 is a tablet shoe without rivets, two nipples at the back of the tablet serve to hold the two halves of the shoe: the fullering or channel for the nails is also cast in it, and afterwards pritched through or perforated: also the two notches *a a* are cast in this shoe for receiving the bar or stretcher, see fig. 9. which bar is applied after the shoe has been nailed on the foot. In the wrought shoes we cut this piece out at one stroke by a tool having a bolster and a stamp fixed on a center, fig. 13. These bars may always be used in the stable, and we have often used them out, but they are not so well calculated for this service. The very margin or inner edge of this shoe is bevelled outwards to give it a tendency when it meets the ground or the side of a stone to determine it outwards, to extend the foot in this direction. A shoe with the stretcher applied, is seen fig. 10, which is let in whilst the shoe is distended by the instruments, fig. 5 or 7: it is almost unnecessary to add that no violence should be used with these instruments, but the gentlest measures.

Fig. 11 is a view of the shoe mentioned at page 6, where the rivets or centers of motion are at the very extremity of the two limbs, that the friction of the extra-central piece should be entirely removed, and that the least lateral force may distend them, and this more especially if the tablet be battened out so as to receive the bearing of the immediate front parts of the hoof, and remove any, or at least any very considerable pressure, from these, upon the points of motion. In this shoe the cylindrical nipples are passed through the tablet, and rivetted in front. The stretching bar also is here differently applied, being passed through the web of the shoe, which is extended and hollowed out above to receive it,—the shoe closing upon the notch, prevents its escape. A blunt stamp tool is used for making this hollow in the web, and the metal, by being thus rendered very thin, is easily perforated through into a square hole.

The heels of these shoes have been left more square than the diagram describes, pl. 1, fig. 1, in order to receive the intertortional column, which will take place if the shoe be shorter than would be required when this part is cut away to a more acute angle; care must however be taken that it does not at all interfere with the bar itself, as the least pressure there would infallibly occasion uneasiness.

Fig. 20 is the distender with its cross bar A, and turning handle B, described already.