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SWORDS: THEIR MAKE, WEAR, AND CAUSES OF FAILURE.

BY JOHN C. KING.

We must first ask and answer the question —What is a sword? A steel weapon to cut, pierce, and parry. This triple action requires exceptional potency in the form and the temper of the blade, so that it is to these two last-named material conditions of a sword we must look for efficiency, or the cause is failure. The best of swords will yield to excessive strain; but if they fail upon slight impact with any substance they should cleave or pierce, they may be regarded as weapons made to look like swords: for sale, etc. etc.

A sword we select for consideration is the ordinary cavalry sabre of the British service. Besides the blade, we shall have to consider the form and materials of handle, guard, and scabbard.

The Blade.—The main consideration is the blade, its length, shape, sectional form, and temper. As any sharp weapon will pierce, but without proper sectional form it will not cut effectively, and cutting being the prime factor in sword effect, we make the sectional form the first matter to investigate.

The accompanying illustrations of cross sections of sword blades show the best, the indifferent, and the worst forms for cutting;

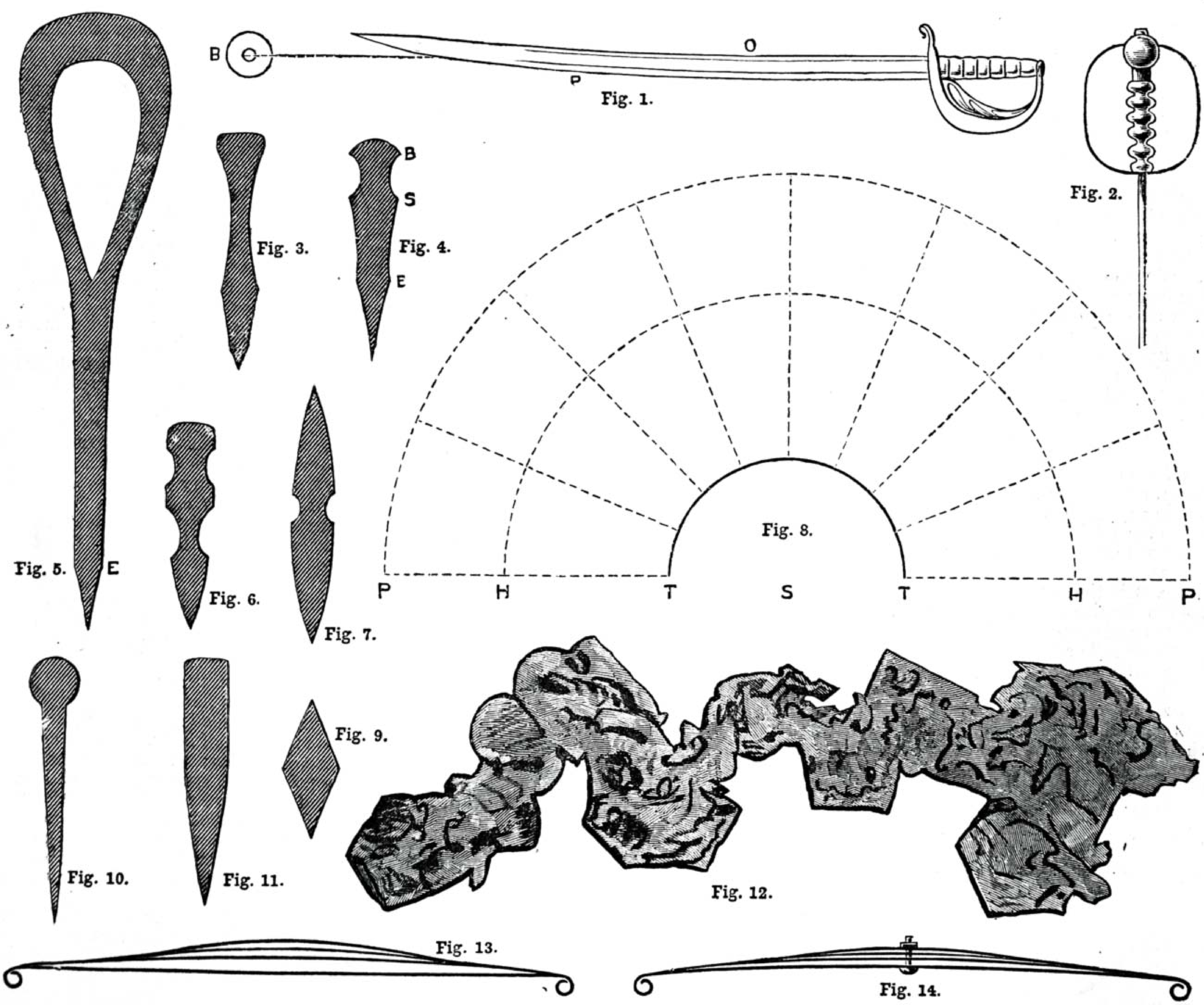


Fig. 1.—Form of Sword generally used by Cavalry. Fig. 2.—Hilt of Oliver Cromwell's Sword. Fig. 3.—Section of Cavalry Sabre in Use in the British Army. Fig. 4.—Cavalry Sabre best adapted for work. Fig. 5.—Section of English Woodman's Axe. Fig. 6.—Infantry Officer's Sword. Fig. 7.—Presentation Sword. Fig. 8.—Radiating Power of Sabre from Horseback. Fig. 9.—Toledo Rapier of Sixteenth Century. Fig. 10.—Sword or Cutlass often seen in Armouries. Fig. 11.—Blade, heavy but devoid of strength. Fig. 12.—Piece of Machine-made Steel magnified at its fracture 550 times. Fig. 13.—Main and Second Plates of Elliptic Spring before bolting. Fig. 14.—Ditto, when bolted together.

which will be explained in detail. The cuts effected by a sword on any yielding substance are either chopping or drawing cuts. As we are now considering straight blades with points only curved about the width of the blade, we may compare the force of the blows of an axe with that of a sword; the one, expending a thousand or more blows on a massive tree butt, without needing to be freshly ground, and rarely failing in the true temper and keenness of its edge; and the other, having to give a few desultory blows, mostly upon a yielding body, and too often failing. A sword may be regarded as an elongated axe, as an axe may be viewed as a section of a sword blade, with the addition of an "eye" for the handle fixing.

The section of an English woodman's axe (Fig. 5) shows a form for effective work on hard wood. This illustration of an axe is described in "Technics of Forestry" in the "Journal of Forestry," by the present writer. It will be noticed that the sharpness of this axe, shown by the part ground to an edge, to the angle E, is keener than four of the six sword edges shown by the illustrated cross sections of swords. The sharpening shows the hollow formed by the grindstone to E, producing a faint angle; this is technically known by woodmen as the "eth" of an axe; this is left prominent for a special purpose, causing the chips to flick out of the cleft of the tree being felled.

The blacksmith who "lays an axe," as steeling it is termed, mostly has a technical mastery of his craft; he does not blame the steel or the coal if failure sometimes results, but adapts his coal, and works his steel to suit his purpose. Why, we may ask, are not swords as reliable as axes?

The use of a sword is more exigent. Much may depend upon a sword parrying without bending or breaking; for a thrust to pierce, or a stroke to cut; life, command, even a nation's destiny may be involved by failure. We have dwelt on this comparison as our experience extends to the making and using of both tool and weapon, and it enables us to point out explicitly that the sectional shape of many sword blades do not fulfil the purpose of this weapon in warfare.

Of the many varieties of sword blades in use, we select for illustration seven of the leading types of swords, to indicate their value for cutting and resistance to strain by drawings of sections at the middles of the blades.

No. 3 is the cavalry sabre in general use in the British army. The "fullers" to lighten and strengthen the sword are worked by "swages," or "top and bottom tools," at the anvil, and by being generally too wide and too deep leave only a thin shell of steel between them. This destroys the rigidity and mars the stability of the blade, causing the sword to yield to a curve at a hard thrust, and breakage to follow; for it must not be lost sight of that this bending easily is insipient breakage, more surely so in a hard tempered blade than a soft blade. This will be made obvious to the reader when tempering is referred to.

The inclination of the bevels of the cutting edge is less acute than the woodman's axe, and would not cut through the collar of a coat or the head piece of a bridle. In fact, the edge is thicker than a new plough "coulter," which has to cleave through stony ground in the front of the ploughshare.

No. 6 is an officer's sword (infantry). The two fullers, narrow and deep, with a ridge between on each side, make a rigid blade, but worse for cutting than No. 3. "It would be ground sharp before going into action," is said in answer to the objection to the obtuse edge, which would make a soft sword that would bend if much of the surface steel were ground away. This will be demonstrated when tempering is explained.

No. 7 is a section of a blade which may be seen used for presentation swords, but mostly without the middle fullers, so that the writing and devices may more easily be displayed on the blade. It is not suited for actual warfare; very few presentation swords are.

No. 10, with a beaded back, is met with in armouries, and, with two fullers at the back of the blade instead of the beaded back, is the sort of hanger or cutlass used by seamen in the old wars of this century. There has been nothing better devised for the navy.

No. 11 is a section of a blade sometimes seen in use where price determines form and finish. It is heavy, and not so strong as if it were to be properly fullered. Its obtuse edge would have little penetration in cutting. No. 9 is a sectional view of a sixteenth century Toledo rapier. It is introduced here, as reference will be made to it under the head of tempering.

No. 4 shows section of a cavalry sabre best adapted for work. From the edge to the "eth" E is more acute than any except the cutlass, No. 10; from E to S, forming about three-eighths of the total width, is only slightly hollow; the "fullers" are narrow from S to B. This is a reliable form for rigidity for piercing and strength for cutting penetration, with least risk of breaking or bending.

Fullering.—It seems paradoxical to lessen the bulk of a thing, making it lighter, yet making it stronger. But it becomes plain upon reflection that it is the surface form which decides the strength. A form which presents portions of its surface edgeways has edgeway strength. A gun barrel will serve for illustration. Regard the inside of this as two deep fullers as of a sword blade, joined, making a circle, the strength of surface shape becomes obvious. Compare the strength of a gun barrel with the strength of the same weight of a rod of solid iron; thus it will be understood that narrow channels fullered into the blade at the back edge of the blade are the best. Old Scotch claymores sometimes show four or five narrow fullers in the strong or wide part of the blade. The fullering of most blades extends only for three-fourths of their length, the back of the blades being sharpened the other fourth of the length.

The Springing of a Sword Blade.—The springing of a blade and its resilience is a merit to a limited extent only. The less a sword yields from straight to curve under strain, the better for the user of the sword. It must be obvious that a blade which bends to slight pressure, however perfect its resilience, is a defective form of blade for a cavalry sabre. A pliant blade, if struck on a hard substance, with its surface nearly in the same plane as the orbit of the stroke, would glance from it, and in the attempt to pierce a moderately hard or tough substance, the pliant blade would bend instead of piercing. The blade shown in section No. 4 best fulfils all the requirements for piercing, cutting, and parrying.

The Shape and Length of a Sword Blade.—We assumed at starting that a straight blade is best suited for modern requirements for cavalry; the length should be proportioned to the stature of the soldier, and the height of the horse on which he is mounted. The service patterns for cavalry are too short to reach a crouching foe a yard away from the course of the horse on the near side. For cavalry a sword half a foot longer would make a more effective weapon. Its power is augmented in the charge and need not be diminished in defence, at which the better soldier would not long accommodate an antagonist by parries. Fig. 1 shows the form of sword now generally used by cavalry; it will be seen that it is not quite straight along the back to the point, which is a defect, more especially for a long sword. The diagrams of the relative circles formed by the turning the wrist in presenting the back of the sword to guard a cut will show that the adverse cut has no axial leverage offered to its force in a straight sword; but on the curved blade the user offers a leverage out of the straight line at the point just as much as the circle, B, shows is the curve deviation of this sword. The wrist has to sustain this strain in guarding a cut on the blade near the point. It has been urged that a slightly curved blade produces an oblique entering cut into any object, but angles of cuts are always determined by the angle of surface presented to the sword.

The business part of a sword may be reckoned from the point to P, the centre of percussion, both for cuts and thrusts. If the point in cutting meets an unyielding substance, the breaking strain is thrown on the cutting edge at P, and by gradations of points of concussion back to P, the strain on the edge is thrown on the blade back to O; but the concussions of edge of blade, back from P to O, create a cantaliver strain along the back of the blade from P to O, due to the momentum of the weight of the blade from those contact points. Now, breakage, apart from faults in tempering, results from the sudden inertia after sudden motion; that inertia is increased by the edge *not being able to cleave through the objects it strikes*, hence the necessity of a keenness of edge to diminish risk of breaking. For thrusting, a curved blade springs under the impact more than a straight one, and lessens the force of penetration. The diagram (Fig. 8) illustrates the radiating power of the sabre from horseback. S is the saddle centre from which the stirrups should hang vertical, as the cavalry man works standing, his seat being only a contingent support. This steady level foot-bearing on stirrups is best attained by the stirrup being hung to the saddle by V-shaped stirrup-leathers from pommel and cantle. As the neutral axis of the animal's movements is nearly central between the fore and hind legs at junction of the body, the soldier is less affected by the horse's motions than if the stirrups are hung forwarder on the saddle. From S to T may be viewed as the extent of body, arms, and legs to be guarded; from T to H, the range of arm and reach of body, also the orbit of guards and parries; H to P, the sword from hilt to point in its sweep at cuts and effective thrusts. A weapon six inches shorter diminishes the radiating power and range of cuts and thrusts and far-reaching parries. Every horse soldier knows that a cut or thrust short of the mark is perilous in combat.

Steel of which Swords are Made.—We have not yet spoken of the sort of steel of which swords should be made, assuming that good steel would be used in the manufacture of sword blades; nor is it of so much consideration to a sword-smith, as is the shape, section, and length of blade, properly tempered, to the soldier. We therefore combine the matter of consideration of steel and tempering, in the hands of a skilful smith, under one heading. Here arises the talent of the forger, who can make and temper the blade which will either cleave iron or silken floss; for this, the man who forges the blade should temper the blade to ensure success. If ignorant of steel working and tempering, a smith may make a good weapon to look at of the best shear steel, yet it might not be so serviceable a weapon as a better smith would forge out of old iron barrel hoops, that process being simply making your steel out of iron, welding, hardening, and tempering. As this is a matter of the technology of iron working, we may treat of it some future time; it would take up too much time to detail its processes in this essay. A volume might be written on steel for swords; after all, it would be what sort of steel the smith converts it into—good or bad; for every heat he takes, every blow he strikes, every chill he gives, modifies the molecular structure of the metal, making it better or worse than when he began the job. We must not forget that smiths of old had to make their steel out of iron during the process of making the weapon. How few smiths—especially where machinery supplements labour—forge and temper a weapon throughout; the division of labour is too often the blight of earnest skill and the bane of enterprising talent. The contractor, perhaps technically ignorant of the proper manufacture of a sword, and assuredly practically incompetent to know what it should be for efficiency as a soldier's weapon, does not simply want to grind his workmen's "bones to make his bread," but perils the nation's welfare by producing worthless weapons, and, forsooth, something worse sometimes — a parliamentary committee which manages to screen the culprits and start the grinding game afresh. Wrong begets other evils; the wasteful process of bad sword making finds its way into the "dunces' dustholes," as the Encyclopedias are not inaptly termed, when they assume to describe the humble technics of toil. For instance, they say swords are forged, tempered, set true, ground, etc. Contractors' swords may, and no doubt are, ground after they are tempered—it comes cheap; but a sword-smith who knows his work would grind his sword before he attempted to temper it, and so ensure the temper being secure from injury by grinding.

Forging Sword Blades.—This may be well done by smiths without any other adventitious aids than the common forge and a suitable muffle for beating, for getting perfect granulation and fibre into the texture of the steel. A hollow fire is made, which is a culvert of banked-up small coal and ashes, at right angles to the nozzle of the "tew iron." This is mostly done over pieces of wood which form the core; these, when burned out, leave the culvert for the steel, called a "hollow fire."

"Drawing down" the Steel.—This is a very elementary matter for a smith who has worked in steel. The proper heats, and the rapid, regular blows of the hammers and sledge, start the jobs; then avoid any hammering while the steel is only black hot, except light taps that do not jar the grain of the steel violently. This is well understood by steel-smiths. For straight blades, the bending of the steel to a concave curve on the cutting edge is necessary, to counteract the action of thinning the cutting edge, and swageing the "fullers," which bring the blade straight; all is the plainest of work, yet requiring experience and judgment. It is while doing this that the smith learns what sort of steel he is working, and how its tempering should be modified. Here we can appreciate the critical mental power of the worker, which is lacking in the action of machinery which aids his work, and too often is made to do imperfectly, though cheaply, what hand labour can do better. The illustration of a piece of machine-worked steel, Fig. 12, magnified at its fracture, shows a grain quite unfit for sword blades, yet it is good steel spoilt by bad working, and is made into blades for swords, hence their defectiveness in too many instances.

Tempering Sword Blades.—We may here at once demonstrate that two distinct principles of tempering have to be adopted with steel tools or weapons to adapt them to the requisite power for resistance to strain required of them. For some purposes, the outside of the steel tool or implement consists of a tough layer protecting a more brittle-grained core. "Springs" for road and railway carriages, for instance, have the brittle resilient steel protected by a sheath of tough steel, which does not impair the resiliency desired in such springs. This is done by tempering. Railway "springs" are about semicircular in shape before the weight of the carriage is put on them, when they are made to yield to a faint curve, nearly straight. Compare the work done by each of these many plates to a "spring," with the idle existence of a flashing sabre—

> "That sometimes plays at havoc with the work of God
> To drink the stain called Glory!"

By detailing the simple process of hardening and tempering of "springs" of the sort made up of leaves of steel for ordinary carriages, it will explain what was advanced of two principles of hardening and tempering steel, and further elucidate some features of sword-blade tempering which may be new to the sword-smith as well as the general reader, and interesting to the swordsman. Carriage spring plates are drawn out as thin as a knife blade at their extreme ends, and they are fitted together so that each successive shorter plate in the series of layers is more curved than the next longer one it fits against, as will be seen by the sketch of a bow, or half of an ellipting spring, before it is bolted in the middle to close the plates to a dead fit one against the other. Fig. 13 shows the long main plate, which is about 1½ in. fainter curve than the second plate; this again is 1 in. less curve than the next, and so on to the shortest plate, which is only about half an inch more curve than its longer fellow plate. These diminishing gradations of spaces between plates increase resiliency. Fig. 14 shows the "spring" when bolted together. Here we have a tension on each plate permanently as long as the spring lasts, and when in use it is often bent to a reverse curve, and yet it springs back to its true shape. Plenty of such springs have been in regular wear on vehicles for more than fifty years, and are still good. This success is attained by first hardening the curved plates, separately, by plunging them, when cherry-red hot, into water till cool, then passing each plate into a "hollow fire," so that the plate becomes black hot, and yields the following tests: either to flare grease if rubbed on it, or to make a piece of dry, soft wood give out sparks when rubbed hard against the edge of the heated plate, which is then allowed to cool. This process sheaths the diamond grain of the plate in an envelope of tougher steel, which prevents fracture of the plate, even under excessive strain and concussion over rough roadways. With sword blades, the reverse principle of hardening and tempering is necessary; for though a sword may spring, that action is only incidental to occasional strain; the less a sword yields to a curve the more efficient it is both for cutting and thrusting, as has been previously explained. Here it is necessary to get the diamond grain steel on the outside of the blade.

Hardening and Tempering Sword Blades.—There are other ways of forging sword blades besides drawing them out of steel bars; as a bar of iron for the core, and two thin bars of steel for the cutting edge and surfaces welded together, was a common plan of old. In the United Service Museum, Whitehall, London, is the sword used by Oliver Cromwell (Fig. 2) at the siege of Drogheda. It has the marks on it as if it had been struck by bullets in two places, fracturing the shell of outside steel and dinting the softer iron core under it, which is seen where the outer steel surface is broken away; this makes it appear as if thus made. The perfection to which steel is wrought ready for working into sword blades dispenses with this form of making a tough blade, and the process of tempering is as simple as can be, bearing in mind that steel needs the thoughtful study of how to prevent sudden atmospheric action on its constituent fibres from injuring them during the cooling processes, after making and while tempering. Such highly wrought matter as heated steel requires adequate time for the expansion and compacting of its fibres. We know sudden chill will make it brittle as glass; slow cooling soft as iron; so proportional heat or cold will modify its texture, and throwing a hot sword blade to cool on the floor will do harm to the steel by producing unequal tension of fibre in the sides of the blade. A forged blade should, as soon as done, be thrust into charcoal dust or dry sawdust, or the ashes on the forge, to get cool gradually, by which its fibrous grain obtains better form throughout; grinding should follow. In preparing for tempering, two baths may be used for cooling, or only one. We will describe both plans. One is a brine bath, 1lb. of salt to a gallon of water, with three or four inches of oil on the top—linseed oil is suitable—and the brine water should be at 100° temperature. The blade, with others, is put into a "muffle" or pipe packed with charcoal, so that they do not touch each other; six blades, or eight at most, is enough in the muffle, and this is put in a furnace and heated slowly till the blades are a bright cherry-red colour; one at a time the blades are immediately drawn out of the muffle, and plunged straight down through the oil into the brine bath, and held immovable till the tremor of the bubbling of the water almost ceases. This is known by the tremor of the blade ceasing to be felt by the hand that holds the tongs. The blade has been in a sheath of vapour, and the oxygen of the water, it is assumed, has been drawn to the steel, or the carbon on the steel, and has crystallised the grain, making it very hard; the sword blade is drawn slowly out of its bath and laid horizontally in the oil on the top of the water, resting there till quite cool; when seemingly cool it must not be thrown in a very cold place, but should for some little time longer be kept at the same temperature in charcoal, sawdust, or ashes. This is hardening a sword blade. The final tempering is done by heating to 560° Fahr., which produces a blue colour, and cooling the blade in water. This heating should be in a lead bath, so that the thin parts of the blade are not made hotter than the thick parts. The other plan of hardening is to have two baths, one of brine water, the other of liquid resin and oil, three gallons of lard oil to one of liquid resin, well mixed. The blade is operated the same way; first, straight down into the brine water bath till the tremor imparted by its sheath of vapour has nearly ceased, and then drawn out and plunged straight down into the oil and resin bath till cool. Then heated in the lead bath as before described till surfaced with dark blue colouring, then cooling in water, then packed in charcoal or dry sawdust. The smith who has made the blade can tell if the hardening should be at dark or bright cherry-red, and the tempering light blue, or dark, or purple, according to the nature of the steel. Referring to the Toledo rapier (Fig. 9), quite three centuries old, a perfect weapon, the owner desired it to be made six inches shorter, without drawing down and re-tempering; the writer of this essay warned him that it would produce a soft steel point, as it would bring the core of the blade to the point by the process of grinding. It did so, and the weapon was soft pointed, though the grinding was done slowly in very cold water.

The Sword Handle.—It may be a tang, or a flat haft, to have the handle riveted on to it. The tang admits of a better formed handle for grip and plug in the hand. The regulation pattern handle is bad in form and in roughing of the hand-piece, which roughness is not perceptible through the leather glove. We again have to turn to Oliver Cromwell's sword; the handle and guard, or hilt, are unique. The sketch (Fig. 2) shows the handle and outline of hilt. The power to grip this sort of handle is manifest; the ball end ensures the hold of the sword at a swinging cut. The hilt shows the same common-sense application of a light impenetrable metal cover for the hand, the basket part being pierced with small oblong oval holes, smaller than a grain of corn. It looks more serviceable than ornamental, but a soldier's weapon withal.

The Sheath.—The steel scabbard is an absurdity for real service by its weight, trouble of keeping bright, and annoyance in striking the next horseman when flying about like the sweeps of a mill. It is a minor matter, but experience has shown the great service of leather metalled at the mouth; the sling-rings and points to take the wear of the spur and the ground. The soldier with this sheath is not so distressed by the weight of his sword.

Sword Belts.—The present double strings are a makeshift, and a bad one; a belt-frog, eight inches long, with a metal loop to take a spring clip at the back edge of the scabbard near the mouth, answers admirably. When dismounted, the spring clip is fastened on to a loop of the waist-belt to admit walking without clanking the scabbard. Shorter swords for cavalry, fastened to the saddle, are spoken of. The carbine is now fastened to the saddle, so that in a skirmish a dismounted rider has perhaps a broken sword and his ammunition only. A soldier should carry his tools with him, as his horse carries him. With good belts they would ride easy, and be with him on or off his horse.

The sword is a weapon that is attracting considerable attention at the present time, and it is hoped that the above remarks on the sword itself and its appurtenances will not be found uninteresting or devoid of value.

HOW I MADE A DRILL CHUCK.

BY ELECTRON.

Soon after I became the possessor of a lathe, I found a want of an appliance for drilling holes above ¼ in. in diameter. I had a few drills with square shanks, which had been made for use with a brace, but I had no brace, and the lathe had no drill chuck, nor had I in my possession any taps, or chasers wherewith to make a screw to fit the nose of mandrel.

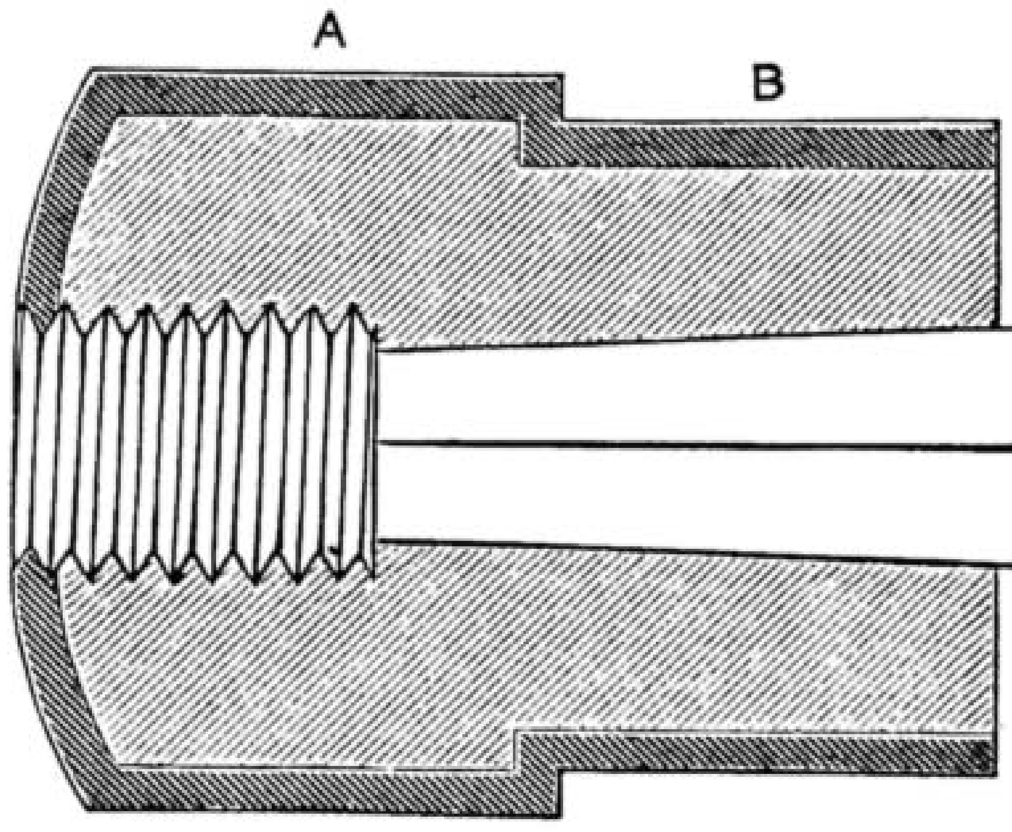


Fig. 1.—Section of Chuck.

I began to consider how I could overcome this difficulty, and in looking round, I found a brass cup, about 2 in. diameter, with a small hole in the end; this was carefully enlarged till it would just fit on the nose of mandrel, but when pushed up to the end it was only ½ in. in front of the end of mandrel. I then got a piece of brass tube, that fitted inside the cup, and cut a piece off, about 1½ in. long; the headstock was then taken off, and set on its end, with the nose of mandrel upwards, and the cup and tube fixed on; one of the drills was then driven into a piece of wood which was fixed on two supports, so that the end of drill rested on the end of mandrel, and was fixed as nearly in line with the mandrel as it could be; the shanks of drill and mandrel were covered with grease, and the tube and cup filled with melted lead. Fig. 1 is the representation of a section of chuck, A being the brass cup, and B the tube.

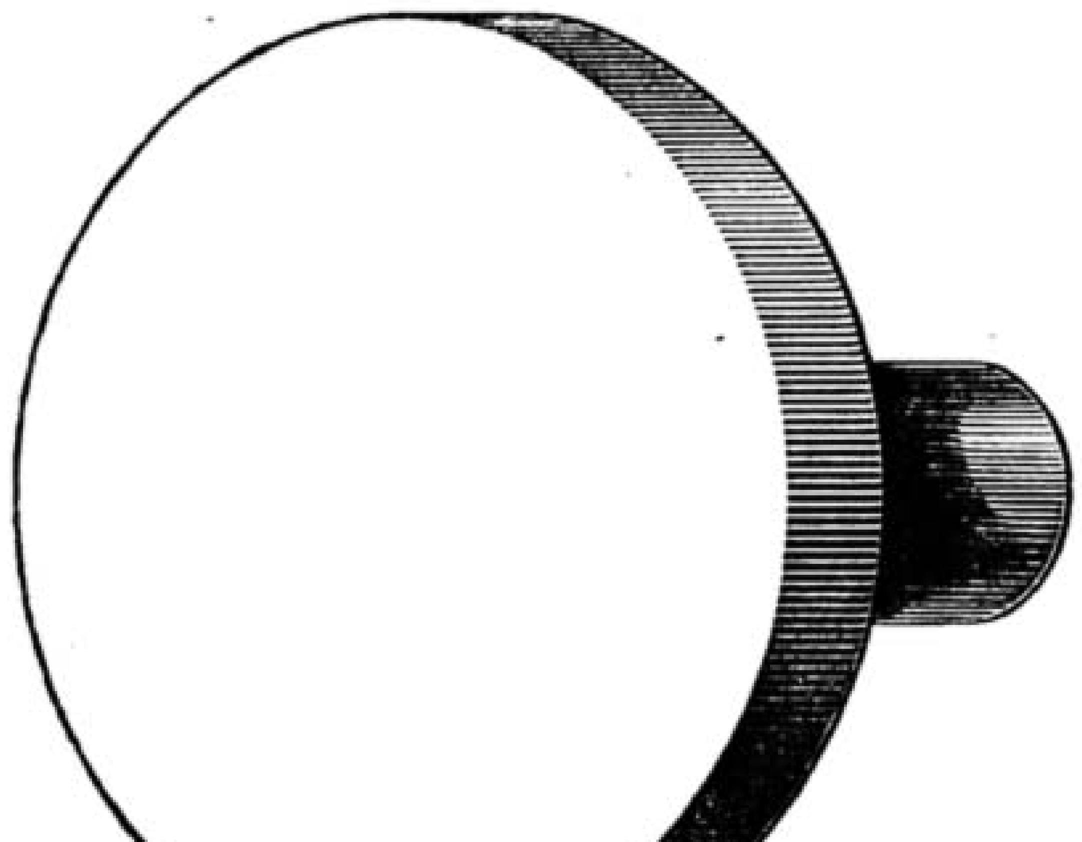


Fig. 2.—Face Plate for Drilling in Lathe.

On fixing the headstock, and revolving the drill, I found it a little out of truth, but by taking a little off one side, and punching the lead on the opposite side, I got it as true as such a drill could be got. I have drilled holes in steel, cast and wrought iron, and brass, and although it has been in use for a long time, it is very little worse. Of course, I don't recommend such a drill chuck where a proper one can be got, as for good work good tools are required; but there may be many a beginner, who may be in the same position as I was, to whom the hint may be useful.

An improvement in making a chuck of this kind would be to have the shanks of drills turned, and drill a hole in the lead when fixed in position. This would ensure it being central; and a set screw put through one side, and bearing on a flat, filed on one side of drill shank, would hold the drill fast.

A cup for holding the lead might be made as follows:—Get a brass tube about 2 in. diameter and 3 in. long, turn the ends true on a wood mandrel, then make a circular plate of brass, with a hole in centre to pass over screw of mandrel; tin the edge of plate and inside of one end of tube with a soldering bit, making the plate a tight fit in the end of tube, and drive it in till level, then solder round the outside of joint, and clean off with a file.

If the tube can be got ⅛ in. thick, it will prevent the set screw in side of chuck wearing the lead. In drilling with the lathe, a face plate should be made to fix on the end of the screw of loose headstock, to keep the work square. Fig. 2 shows this face plate; it should be covered with wood, to prevent damaging the points of drills.

SIGN WRITING AND LETTERING.

BY HENRY L. BENWELL.

(*Continued from page* 260.)

Roman Small Letters—Old English Capitals and Small Letters—Script Capitals and Small Letters.

I promised in my last paper to give a set of Roman small letters or lower case, as a necessary pendant to the complete alphabet of Roman capitals. These will be found in Fig. 34. Any special comment on them seems to be unnecessary.

The student should, as soon as possible, commence working on the Old English letters, proceeding in the same way as before, viz., outlining the letters first and afterwards filling them in. He should first of all take up the capitals only, Fig. 35, and when fairly successful turning his attention to the small letters, Fig. 36. Of course he will find these the most difficult work of all he has yet attempted, but he need only practise their formation in leisure moments, and not force his hand or his patience. It will not do to neglect these Old English characters altogether though, as once they can be drawn with precision, it is a comparatively easy task to learn how to form any of the ornamental and fancy alphabets and church text letters which he will eventually be called upon to paint.

These lessons on forming the alphabet may appropriately conclude with a few remarks on "script," or hand-writing letters, which are illustrated in Figs. 37 and 38. This is the ordinary writing we are all taught when at school, and is known in the copy books as "round-hand." It is much harder, however, to execute this writing with the camel-hair pencil than it is with the pen, but it must, nevertheless, be thoroughly practised, as it is in great demand in the sign-writing business, and must be done well or not attempted at all. It is best to use a sable writer for practising "script" writing, and no previous outline should be allowed, excepting a straight line to work upon. The wrist must also rest comfortably on the mahl-stick, and the work done in a quick, bold, unhesitating manner. I should mention that Old English and "script" letters may for some considerable time be practised with much advantage in pen and ink on some good glazed writing paper, and afterwards on an

Fig. 34.—Roman Small Letters.

enlarged scale on Whatman's or Rowney's hot pressed drawing paper. Of course in cases where this has been previously learnt at school, such a preliminary canter is not requisite.

Fig. 35.—Old English Capitals.

The hardest part of the work, as far as the writer is concerned, is now over. Specimens of five different forms of letters (those most commonly in use) have been given with the accompanying instructions. They are, so to speak, the root and foundation of all other styles and varieties (German text possibly excepted) in use at the present day, and once let the student become complete master of them, together with the freehand drawing lessons given at first, and he may at once style himself a sign writer. He has nothing more to learn beyond what experience will dictate to him, such as spacing his letters and the proper display of his words. This I will, however, endeavour to assist him in, and also in succeeding chapters point out the necessary tools for a complete outfit, their treatment and care, the colours, with hints on using them, together with directions for painting coats of arms and a pictorial sign; also give a few

Fig. 36.—Old English Small Letters.

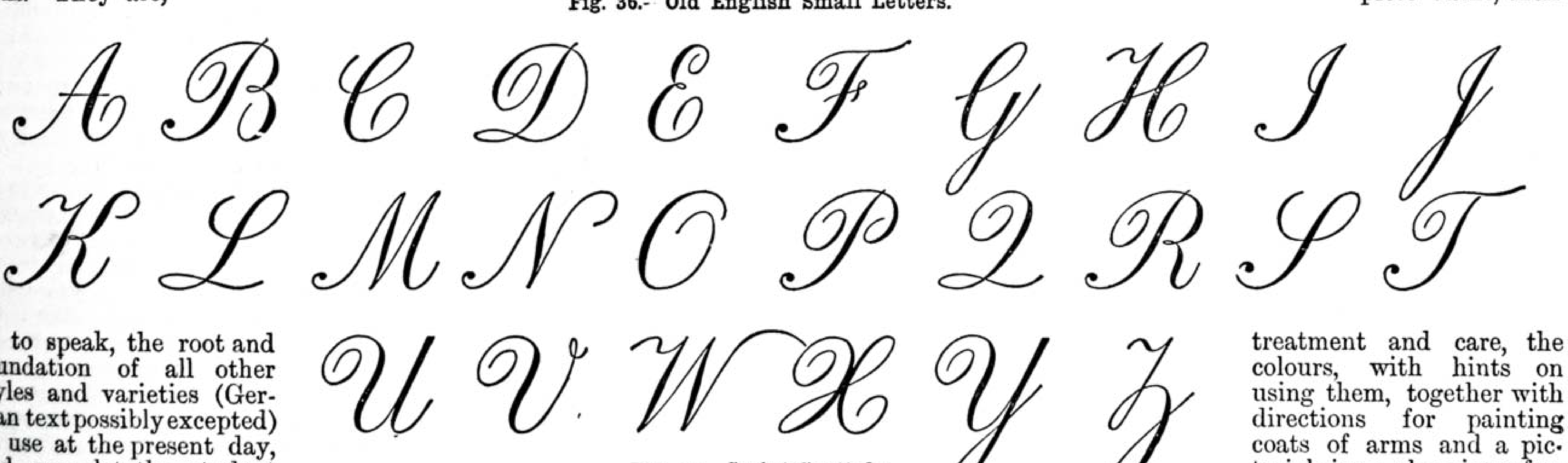


Fig. 37.—Script Capitals.

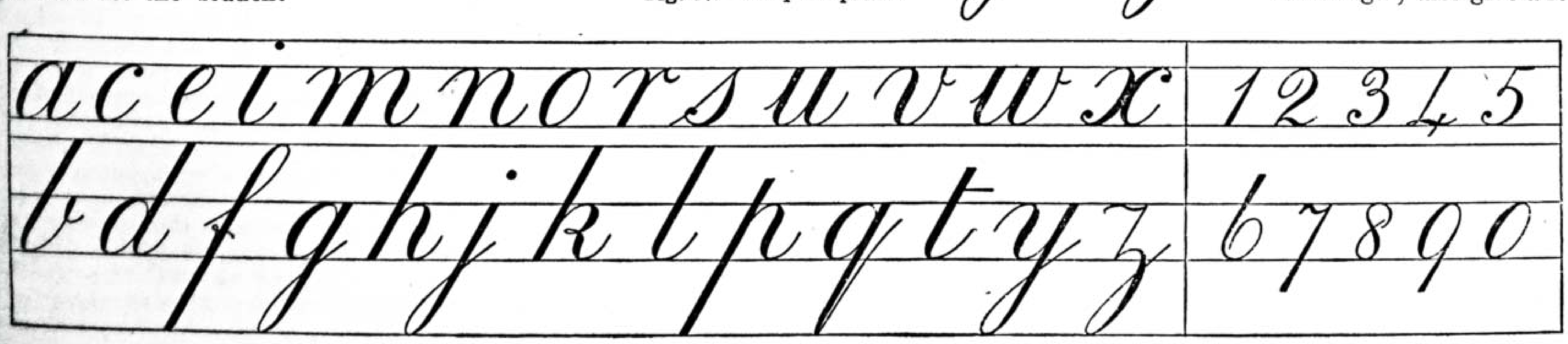


Fig. 38.—Small Letters.

illustrations of specimen signboards and alphabets of ornamental letters and church texts, and concluding with some dodges and receipts of English, Continental, and American origin. There is nothing, therefore, in what has to follow, but pleasurable and interesting reading for the aspirant to sign-writing honours, and in perusing which he will be adding to his knowledge without any apparent effort on his own part. And, moreover, he will always have in these latter chapters a handy book of reference, which he may fly to in any moment of uncertainty or doubt. Every nerve has been strained to exert and encourage the learner and keep him up to his task, and this branch of the painting art has been placed before him in as popular light as it could be, and it now rests with him and his indomitable pluck and energy whether he fails in his attempt, or blossoms forth into a respectable member of the sign-writing profession, and pocketing, as his weekly and easily earned salary, a £10 note.

SMITHS' WORK.

BY J. H.

(*Continued from page 226.*)

The "Pig-Boiling" Process—Dry Puddling Process—Mr. Hall's Experiments—Bessemer's Process—Mushet's Bath of Decarbonised Pig—Siemens and Siemens-Martin Open Hearth Processes—Present Demand for Steel.

In my last, I intended to commence an account in this third article of the work of the mediæval smiths. My readers will permit me to postpone the commencement of this subject until the fourth article, in order that I may make a few remarks on certain processes for the manufacture of iron and steel, which were briefly touched on in my first paper.

Since that was printed, I have received, through the Editor, a communication from a gentleman relating to the "pig-boiling" process, a process to which I made a passing allusion in the first article. It appears to me desirable to notice this communication somewhat fully, in order to give publicity to a chapter in the history of iron making which is not generally known, and at the same time I will point out a few of the essential differences in the wrought iron and mild steels made at the present time. In taking this course, I shall not lay myself open to the charge of digressing from the subject of smiths' work, since most readers will probably like to know what constitutes the essential differences between the iron and steel in their various grades which they use in daily work.

The communication referred to is as follows:—The writer has received a small volume* from Mr. William Hall, of 14, Broad Street Corner, Birmingham, who claims for his late father the merit of having invented the "pig-boiling" process and the patent cinder, or "bull dog," a refractory oxide, by which the increased temperature required in the "boiling" process was successfully resisted; and as this is a fact not generally known, a brief account of the history of this process may be of interest. Since it is probable that some of the readers of Work who may be interested in these articles of mine do not know the essential method of operation of the process termed "pig boiling," I will first very briefly note the difference between it and the original puddling process.

In the original, or dry puddling process, grey pig iron is first refined on the hearth of a rectangular furnace, or "refinery." Coke or charcoal is the fuel used. By means of oxidising agents, as basic slags, cinders, and hammer scale, and a strong blast of air directed down upon the hearth from inclined twyeres, the metal is decarbonised, and white iron, in which the carbon is in the combined condition, results. The refined iron is then puddled on the hearth of a reverberatory furnace, whose bottom is lined with oxide of iron. The metal being white, does not melt, but becomes pasty, and when in this condition it is rabbled over the hearth in order to mix it with the oxide of iron, and also with the hammer scale which is added to the charge, both basic materials, by means of which, and by the action of the atmosphere, the impurities are oxidised out from the metal. Finally it is worked up into balls, and hammered or squeezed, in readiness for rolling into bars and rods. In the later, or "pig-boiling" process, the preliminary and costly refining into white iron is not necessary; grey pig iron, or a mixture of grey with white, being used. The furnace lining consists of broken slags, tap cinder, hammer scale, and old hearth bottoms broken up; while the fettling consists of "puddlers' mine," which is a pure red hæmatite, and of roasted tap cinder, or "bull dog." In these substances when fused, all rich in oxygen, the grey pig is immersed, and the carbon is thereby oxidised out, the period of the boil coinciding with the complete oxidation of the carbon to carbonic oxide, and with the oxidation of the sulphur, phosphorus, and other ingredients. Soon after, the metal drops quietly upon the hearth, and it is then "balled up" in readiness for the hammer.

This is a very brief account of the process, and many details are omitted, but it will suffice to furnish a comparative idea of the two methods.

Somewhere about the year 1820, Mr. Hall's father was engaged in an iron-works, in which, according to the universal practice up to that period, the older dry puddling process was carried on. At about that time, or a little earlier, about 1816, iron bottoms for puddling furnaces, coated with oxide of iron, or cinder, were substituted for those of sand, originally used by Cort. Now Mr. Hall had been in the habit of saving and puddling up odds and ends of scrap metal, apparently as a perquisite, making use of the ordinary furnaces with cinder bottoms for the purpose. When he first charged a puddling furnace of the new type, the scrap mixed with the bosh slag produced in the cinder bottom a surprising result. The contents of the furnace literally boiled over, running over the fire and flue bridges, through the stopper hole, and down upon the plate where the puddler stands. The experimenter was alarmed at first, and resolved to abandon the work. But this resolution was quickly changed, when on the following week the quality of the bloom of iron thus produced was found to be superior to any made by the intermediate refinery methods. The question naturally arose in Mr. Hall's mind, "If such a fine specimen of iron can be produced from the refuse of the puddlers' boshes, what will not good pig iron yield, with equally good fluxes?"

Three years of experiments followed, with the ultimate result that any grade of iron could be produced either from the bosh slag or from pig iron direct. Then follows an account of the difficulties met with by Mr. Hall in the search for materials of a sufficiently refractory character to withstand the corroding effect of the flux. Finally after thirty years of search, cast-iron plates backed with air spaces, with burnt tap cinder or bull dog for a lining, were employed, and a patent was taken out for the latter in 1839. During the whole period of Mr. Hall's connection with the trade, "bull dog" only was used for "fettling," and at Bloomfield I believe it is still continued. Mr. Hall's experiments cost him not less than three thousand pounds. The roasting of tap cinder to make "bull dog" was patented by Mr. Hall, who, from various reasons (foreign to the object of this paper), did not follow up the legal advantages that he had in this respect.

It is satisfactory to know that Dr. Percy, the ablest and most scientific and accurate writer on the metallurgy of iron and steel, accords Mr. Hall credit for his invention. He says, "The merit of introducing 'wet' puddling or 'pig boiling' is ascribed, and, as I believe, with reason, to the late Mr. Joseph Hall, of the Bloomfield Iron Works, Tipton, Staffordshire; but that merit has been disputed, and in this respect Mr. Hall has only met with the fate which seems especially to have befallen the authors of every other improvement of importance in the smelting and manufacture of iron. Mr. Hall, whom I knew personally, was, undoubtedly, one of the most experienced and skilful producers of wrought iron in South Staffordshire, and no firm in that county has enjoyed a higher reputation for the quality of its manufactured iron, for example, boiler plates and horse-nail iron, than Bradley, Barrows, and Hall. As far as I have been able to ascertain the truth, I believe that Mr. Hall was fairly entitled to much of the credit which he claimed for himself."—"Iron and Steel," p. 670.

A tone of evident disappointment pervades Mr. Hall's book.* He smarts under a sense of unrequited merit. We can well understand this when he says, that "the pig-boiling principle, with its furnace, had they been patented, would have realised by this time perhaps a million of money, and the trade has received the full benefit of them without any remuneration to the inventor."

Self-made men are apt to be somewhat egotistic. A successful business permitted him to be independent of the necessity of realising on his own inventions, but he, nevertheless, had a pardonable desire to see his endeavours recognised. They were to some extent acknowledged by one or two.

Mr. Hall's account was written at the period when Bessemer's process was under a cloud, and his early failures afforded a ground at that time for Mr. Hall's unfavourable comparisons of the pneumatic with the pig-boiling process. Mr. Bessemer met with ill-success during three years, and spent thousands of pounds before he could perfect his converters, or produce sound steel. And even then, justice compels us to acknowledge that but for another inventor, David Mushet, whose lack of means alone prevented him from deriving benefit from his discovery, Mr. Bessemer's process could never have been a success. Mr. Mushet had patented the addition of spiegeleisen or ferro-manganese to decarbonised iron, and it is this which has rendered the Bessemer and open hearth processes practicable. Mushet allowed his patent to lapse for want of funds, and others reaped the advantage of it.

* "The Iron Question," by Joseph Hall. Hamilton, Adams, & Co., 1857.

* See *ante*.

To those not acquainted with the practical difficulties of steel making, it may seem the simplest thing in the world to decarbonise a bath of pig iron to that precise stage required for mild steel. But it is not so in fact; and more than that, the iron becomes rotten and "cold short," and worthless in the process. Hence, in the manufacture of all mild steels, the process invariably is, to first burn out *all* the carbon, and then to *add* the measured quantity required in the form of "spiegel" or "ferro." Besides, it so happens that manganese is as essential to the production of mild steel as it is to that of crucible steel. Steel, which before the addition of manganese would be absolutely rotten, is rendered malleable by such addition. It is not that all the manganese remains in the metal, but that it reduces the oxide which is the cause of rottenness. But for the addition of carbon and manganese, therefore, in the form of "spiegel" or "ferro" to the bath of decarbonised pig as originally patented by Mushet, Mr. Bessemer's invention might have been unknown except to students. Mr. Nasmyth's invention, for example (patent No. 1001, May 4th, 1854), was in its essential method very similar thereto, consisting of discharging a current of steam from a nozzle bent downwards to the bottom of a bath of molten metal. For a discussion on the claims of Mr. Mushet, see several letters in *Engineering*, 1884, vol. 37.

It follows as a necessary consequence of the method of dry puddling, that iron so produced cannot be homogeneous, but that it will consist of iron with scale and cinder mechanically intermixed therewith. The processes of piling, squeezing, tilting, hammering, and rolling, expel the major portion, but not all of the scale and cinder. The larger the number of reheatings to which the iron is subjected, and the greater the amount of work done upon it, the more free, other things being equal, will it be from these impurities which are mechanically intermixed. B B B iron has more work done upon it than B B, and this again than B, or merchant iron. But the best iron cannot be wholly freed from scale, and every reheating costs more money for fuel and labour. Herein consists the superiority of mild steel that it is *fused*, and, therefore, freed from scale.

Another point is, that it is more difficult to obtain large masses of iron sound than masses of smaller size, because the amount of scale present is a cumulative quantity, and the difficulty of sound welding increases. No such difficulty exists in steel, ingots of which can be made of 100 tons weight.

The Siemens and Siemens-Martin open hearth processes are growing in public favour more rapidly than the Bessemer. The reason is this, that immediately the Bessemer blow is finished and the spiegeleisen has united with the decarbonised metal, the product must be emptied at once into the ladles for casting. But the metal may be allowed to lie in a molten condition for an indefinite period on the open hearth. The Bessemer process is completed in about twenty minutes, and must not exceed that period; the open hearth process is not completed for seven or eight hours, and may be allowed to continue longer. If on testing, therefore, the chemical and mechanical properties of the metal are not precisely what are required, there is time in the latter case for making such modifications as are deemed desirable. Besides this very valuable power of control over the ultimate product, it is considered better to deoxidise the metal by means of metallic oxide, as is done on the open hearth, than by means of atmospheric air as in the Bessemer process. Bessemer steel is more agitated, and occludes bubbles of gas much more readily than the Siemens open hearth and the crucible processes. Still, there are many things for which the Bessemer process will always hold its own, as tyres, rails, and heavy forgings for cranks and shafts.

In the early days of Bessemer steel making, many manufacturers abandoned its use after trial, as being untrustworthy and treacherous. The fault lay partly in the material, largely, however, in the method of treatment adopted, because the treatment that secures good results in the working of iron does not invariably answer with steel. Iron plates fail, and have failed over and over again. Yet such was the suspicion with which, until very recently, steel was regarded, that the fracture of a single steel plate was invested with far greater importance than that of many plates of iron. So great has been this prejudice that steel has been sold under disguised names—as homogeneous iron or homogeneous metal, and thus found a market, where, as steel simply, it might have failed to do so.

Every branch of manufacture demands its own special grade of steel, and the readiness with which steel of any required grade can be manufactured is one of the chief reasons why its use has become so general. The grade of steel suitable for ship plates and bridges will not serve for ships' boilers, nor for cannon, nor shells, nor for rails, nor tyres, nor tools.

It does not follow, however, that because steel is so widely used for purposes to which wrought iron was formerly applied that there is no longer any demand for the latter. It was only in May that Sir James Kitson told the members of the Iron and Steel Institute, that with the enormous expansion of the purposes to which steel is applied, there has followed a multiplication of the many special purposes for which iron is needed. Iron will never replace steel for rails and tyres, hardly for ship plates or for bridges, or for guns; but for chains, cranks, boilers, and for the innumerable purposes of the smith, in the form of rods and bars, it will hold its own for an indefinite period.

THE "BATTLESDEN" CART.

BY OPIFEX.

Good Qualities of "Battlesden" Cart—Body—Sides and Front Board—Floor—Alternative Method of Fixing Floor—"Fixing up" Body—Stays—Materials for Floor and Sheckle Stays—Painting and Jointing—Pieces to Extend Seatage—Angle Pieces—Supplementary Sides—Falling Footboard—Method of Fastening Board—Shafts—Cross Bar or Transom—Fixing of Shafts—Sockets—Springs—Iron Sheckles—Springs—Axle—Wheels—Wings—Fixing Wings—Dashboard—Mountings—Lamps—Painting—Varnishing—Treatment of Wheels—Treatment of Ironwork—Painting Inside of Body—Upholstering Back Rest—Cushions—Holes in Floor—Perforated Rubber Mat—Linoleum on Inside of Falling Footboard.

For a good, useful, commodious, and light-running trap, I know no better than the "Battlesden" cart; the family to which it belongs came first from Croydon, from which town they took their name. But the old "Croydons" multiplied so fast that many of their descendants changed their patronymic, and during the process of evolution they have in a great measure altered their appearance also, the "Battlesden" amongst the number.

The construction of this trap is simple, and well within the reach of any fairly skilful amateur, while in the hands of a good workman every item will be "plain-sailing."

The writer has built many vehicles which, upon inspection by his friends, have drawn forth such questions as "Did you really build it yourself?" "Did you make the wheels?" "How did you make these springs?" etc. etc.; and when the reply was "No, I made none of these things," it is to be feared that in some cases he fell considerably in the estimation of the questioner in his character of coach-builder.

But no builder ever does make all these, or turn out a vehicle all of which has been his own unaided work.

In the professionals' manufactory there are many hands employed in the construction of the simplest form of vehicle.

The "body maker" is distinct from the "wheeler," the smith quite a different individual from the painter, the painter from the "trimmer," and so on through the long list of hands.

But we are going to do the work of most of these men ourselves. We shall buy our wheels and springs ready made, and, having procured these, hope to have to call in the aid of the local blacksmith only in the case of a part of our ironwork, and some workers may even dispense with his assistance.

To my mind coach-building possesses a peculiar charm for this very reason: that there is so much variety, and one has to fill so many *rôles*, being, alternately, carpenter, smith, painter, upholsterer, and saddler.

But we must get to work without further delay, and the character we shall first assume is that of "body maker."

The sketch is perspective. Fig. 4 gives the reader a fair idea of what we are about to construct.

It represents the body proper, and consists of two sides (Fig. 9), front board (Fig. 11), and flooring.

To save space, we shall assume that the worker is supplied with the necessary materials, merely describing them in the directions for building.

The two sides and front board are of elm or walnut, and the shape and dimensions are indicated in the drawings, these, of course, referring to finished work, so that allowance must be made accordingly when selecting the timber and sawing it out. If the wood is of even thickness it should be chosen about $1\frac{1}{8}$ in. thick, which, when cleaned up, will be of the right substance.

The upper and lower edges of the sides are bevelled to suit the angle at which the sides are pitched, so that when in position they may be horizontal.

The front board (Fig. 11) is of the same scantling as the sides, and is secured to them by four long screws at each end, the screwheads being countersunk below the surface, the countersinkings to be afterwards filled with putty coloured to suit shade of wood.

The floor is fixed to the sides by means of screws inserted at the proper angle, at least four to each board and heads countersunk, an overlength of about half an inch being allowed at each end to form a small bead along the edge of the bottom and front board of the trap.

An alternative method of fixing the floor consists of placing a "slip" in the internal angle, to which the boards of the floor are screwed; for detail, see Fig. 19.

If this mode be adopted the floor of the cart will be flush with the lower edge of the sides; thus the body will lose a little more than an inch in depth. It will also lack the finish furnished by the bead before mentioned; this might, however, be regarded by some as an improvement.

In "fixing up" the body in the first instance great care will be called for in order to pitch the sides at the proper angle with the floor, and also that the boards of the latter may be quite square to the sides.

To ensure success in this matter it will be well to "tack" the several portions together by means of temporary stays, or light battens across the top and bottom, or by having the body stay, Fig. 14, first made; this is of best quality, half-round iron, $1\frac{1}{4}$ in. wide, $\frac{1}{2}$ in. thick, and of the shape indicated at Figs. 14 and 4, the former showing the dimensions and angles, the latter indicating the position; this stay is secured to the body by three bolts through each side, and by five bolts through the floor, two of which serve also to secure the hind step, and two the block and back spring. See Fig. 1.

The first, third, and last board in the floor, counting from the front, should be of sound ash, the sheckle stays, etc., being bolted through those portions; the other boards should be of well-seasoned red deal; and all, with one exception, being 1 in. thick, finished work; the exception referred to is in the case of the board at the extreme back, to which the hind step, stay, spring, etc., are secured; this should be of ash $1\frac{3}{4}$ in. thick finished work.

Now, an important part of our labour is before us. Great attention must be paid to painting, jointing, etc., as so much depends upon following them, especially at this point in our work.

The next items are the pieces which give additional width to the "seatage" of the trap, and to which the supplementary sides (Fig. 12) are fixed. These are of ash; the dimensions are indicated at Fig. 17, and the shape, position, and method of securing are represented in detail at Fig. 23. They are secured to the body by strong $2\frac{1}{2}$-in. screws, well countersunk in the sides, and placed about 6 in. apart.

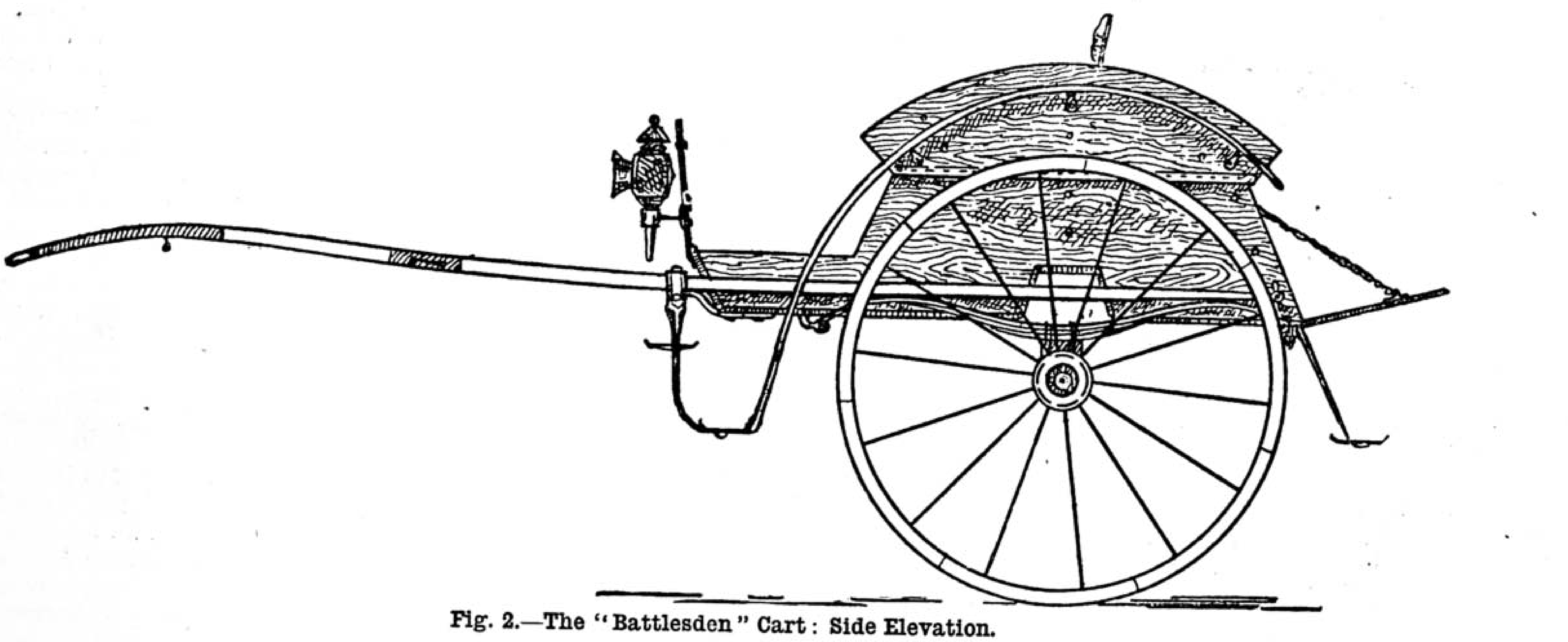


Fig. 2.—The "Battlesden" Cart: Side Elevation.

To further strengthen the attachment of these pieces to the body, it will be necessary to place small angle plates of iron, 3 in. wide by $\frac{1}{8}$ in. thick, at points about 6 in. from each end, and which shall extend across the 3-in. pieces, and down the sides about 6 in.; these are to be fixed with stout inch screws (see sketch and Fig. 18).

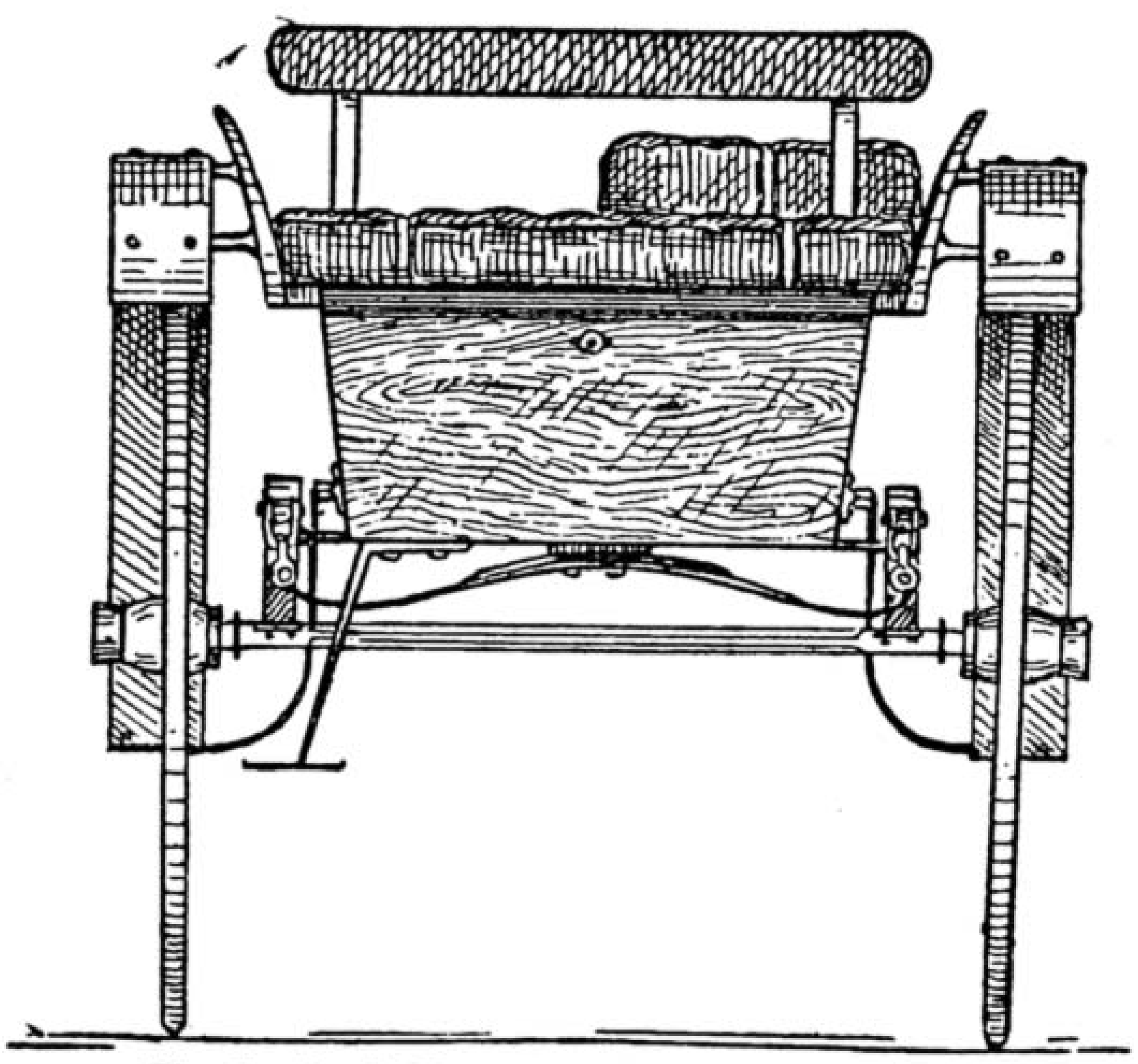


Fig. 1.—Back Elevation of "Battlesden" Cart.

The supplementary sides, Fig. 12, are of $\frac{3}{4}$-in. walnut, etc., slightly tapered toward the curved and upper portion, and are made to assume the slight outward bend by means of four stays (Fig. 13) which are of half-round iron, 1 in. wide, $\frac{3}{8}$ in. thick, and tapered in width and thickness towards the upper ends; these are secured to the horizontal 3-in. piece at points about 9 in. from back and front by two small bolts, and to the supplementary sides by four stout inch screws through each stay—heads countersunk—which, upon being screwed home, will cause the wood to assume the required outward bend.

The supplementary sides are also secured to the 3-in. pieces along their lower edges by $1\frac{1}{2}$-in. screws about 6 in. apart; the heads countersunk, to be covered eventually by a brass bead, etc.

The falling footboard (Fig. 21) at back should be cut sufficiently large to allow of a projection of about $\frac{1}{2}$ in. at each side, which is to be treated in the same way as the ends of the floor and front board, so as to continue the bead; or if the alternative method suggested at Fig. 19 be adopted, then the side edges of the backboard may be merely rounded, or left square, and projecting beyond the sides about $\frac{1}{2}$ in. or $\frac{1}{4}$ in., the lower edges to be flush with the under surface of the floor, and bevelled to suit the angle; the upper edge should coincide with the upper edge of the 3-in. pieces.

The spring hooks used in fastening this board are to be attached to the inside of body at points about 2 in. from the top of the sides. "How," the reader may ask, "is this to be done?" This falling board is attached to the body by a pair of strong "butt" hinges, and when open is secured in position by chains, which may be covered with leather. It is fastened by spring hooks, which are attached to the body on the inside of the sides, and which pass through square mortise holes in the falling board; but there are various methods employed, among which we leave the reader to choose.

Having completed the body we next turn our attention to the shafts, which may be of lancewood, hickory, American elm, or ash. They are obtained from the timber merchant ready bent, and are usually 12 ft. long; and as in this instance there is no plate or other strengthening resorted to, they should be selected free from knots or shakes of any kind.

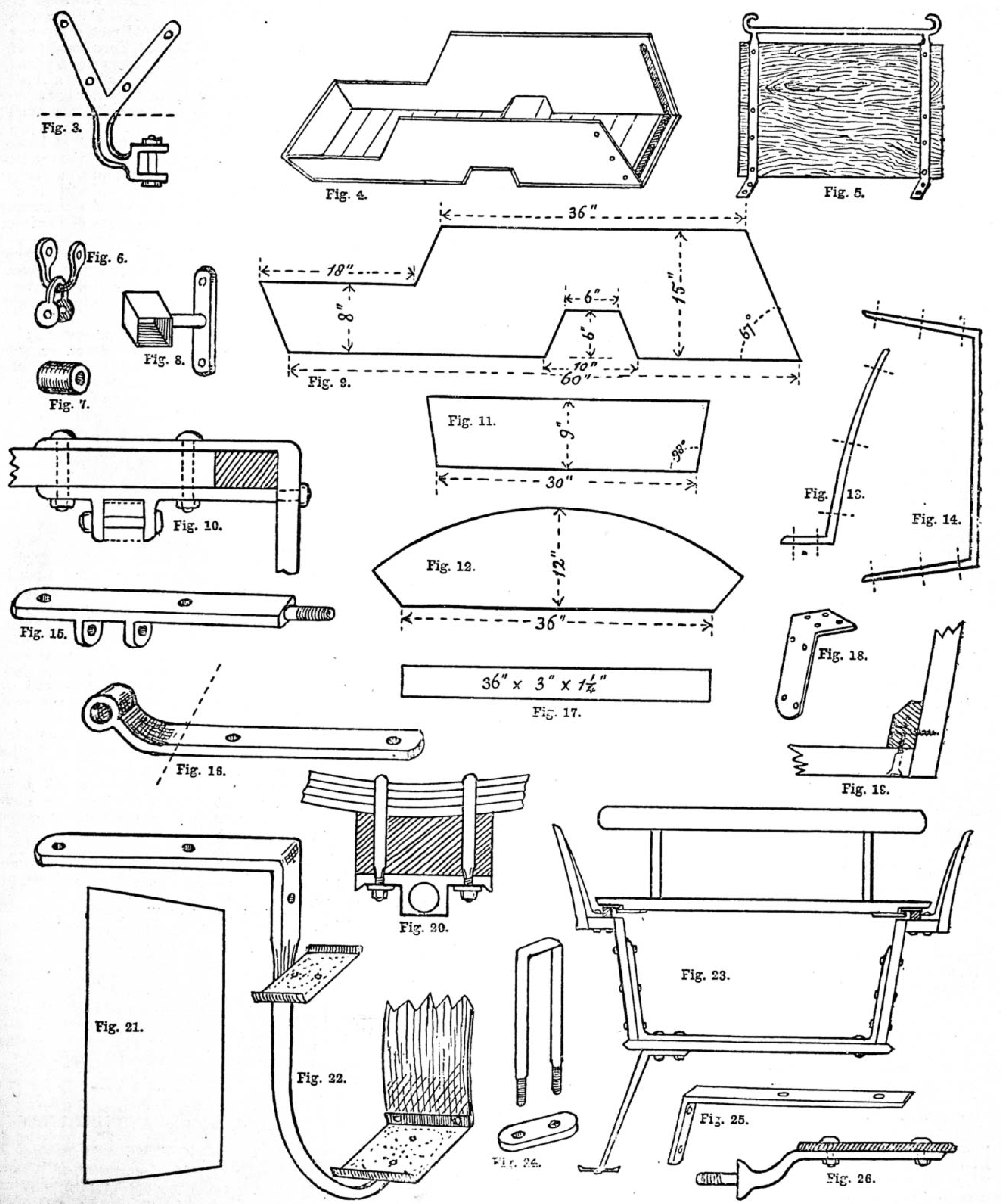
For this cart the extreme length of the shafts is 11 ft., 6 ft. from the point to the cross-bar or "transom," and from the point to the end socket 5 ft.

The transom consists of a piece of sound ash about 2 in. square, which extends from shaft to shaft, and is a most important item, as it supports the whole vehicle in front, serves to connect the shafts, and to it also the steps are attached. Figs. 10, 15, and 22 explain the method by which the transom, shafts, and steps are secured, and also the arrangement by which the body is hung. Fig. 22 represents the step. Fig. 15 the under plate, with bolt and nut arrangement at one end, and sheckle socket underneath.

Fig. 16 is the front sheckle, which is secured to the floor of the cart by two bolts, the "eye" being sufficiently large to allow of a rubber tube washer (Fig. 7) being inserted round the bolt which secures it in the socket.

Fig. 10 being a side elevation with section of shaft (diagonal shading), will explain, better than words, the details of this most important part of our work.

The shafts are fixed to the body at the back by means of square sockets (Fig. 8),



Details of Battlesden Cart. Fig. 3.—Front Spring Sheckle (2). Fig. 4.—Perspective View of Body. Fig. 5.—Dashboard and Mounting. Fig. 6.—Spring Couples (2). Fig. 7.—Rubber Sheckle Tube (2). Fig. 8.—Shaft Socket (2). Fig. 9.—Shape and Dimensions of Sides (2). Fig. 10.—Method of Fixing Transom Shaft and Step. Fig. 11.—Shape and Dimensions of Front Board. Fig. 12.—Shape and Dimensions of Supplementary Sides. Fig. 13.—Stay for Supplementary Sides (4). Fig. 14.—Iron Body Stay. Fig. 15.—Under Plate for Front Step (2). Fig. 16.—Front Sheckle (2). Fig. 17.—Shape and Dimensions of 3-in. Piece (2). Fig. 18.—Angle Plates (4). Fig. 19.—Alternative Method of Fixing Floor. Fig. 20.—Method of Clamping Spring and Axle. Fig. 21.—Falling Footboard. Fig. 22.—Front Step (2). Fig. 23.—Back View, showing Details. Fig. 24.—Clamp, etc. (2). Fig. 25.—Wing Bracket (2). Fig. 26.—Alternative ditto. Figs. 1, 2, 4, ½ in. Scale. Figs. 5, 9, 11, 12, 14, 17, 21, and 23, ¾ in. Scale. Figs. 3, 8, 10, 13, 15, 16, 22, 24, and 25, 2 in. Scale. Other Diagrams not to Scale.

having a shank about 2 in. long with T-shaped end provided with two holes, by which it is bolted to the body, at a point about 6 in. from the bottom or floor of the cart.

These sockets should be of best Swedish iron, and must be carefully made, the shanks being at least ⅝ in. thick. The shafts are tapered, and the corners rounded from the transom to the sockets—*i.e.*, reduced from, say, 2¼ in. by 1½ in. at the transom, to 1¾ in. by 1¼ in. at the socket; they should also pass through the sockets and project behind them about 1½ in., the ends being simply rounded, or otherwise finished, according to the fancy of the builder.

From the foregoing directions, it will be seen that the shafts are placed about 2 in. from the body of the cart, and are secured only at two points, viz.: by the sockets and transom, between which points they are parallel; the length of the transom will, therefore, depend upon the distance between the shafts.

That portion of the transom lying between the ironwork which is attached to it at each end should be chamfered, or it may be turned in a lathe, but in the latter case care must be taken not to reduce its thickness to less than 2 in. diameter. The front portions of the shafts from the transom forwards should be "dressed" and tapered at the points, fitted with brass, or japanned metal "tips," and covered with rather thin harness leather for the length of about 22 inches from the points; they are also fitted with "tug" stops, loops for kicking straps, etc., and trace hooks, but I leave these minor details to the worker.

The springs are three in number, the side springs being secured to the body in front by the sheckle (Fig. 3), the V-shaped ends being made to take four stout ⅜-in. by 2-in. bolts, by which the sheckle is secured to the floor.

The side springs are attached at the back to the hind springs by loops or couples (Fig. 6), and the hind spring is fixed to the centre of the piece of ash, described above, at the extreme back of the floor. Between this and the spring, a thin block of hard wood of the width of the spring, and 7 in. long, intervenes, and the whole is firmly secured by two strong bolts about 4 in. apart.

The springs and sheckles may be had of any large ironmonger or dealer in coach-building materials, and are made in different degrees of strength; the width of the plates in the present instance should be 1½ in., length of side spring 4 ft., hind spring about 3 ft., and four leaves in each spring.

Between the springs and axle, blocks of hard wood, 6 in. long, 1½ in. wide, and about 5 in. deep, are placed. These are shaped on the top to suit the curve of the spring, and rest upon the flap of the axle, which should be solid, *i.e.*, forming a part of it; the spring, block, and axle flap are secured by iron clamps (Fig. 24), and details of fixing are shown at Fig. 20.

The best axle is that known as Collinge's patent, which, with boxes, costs about £1 10s. Axles are sold in two pieces, and when the required length is obtained, the axle is "closed" by being welded in the middle. This is a most important matter, and should be done by an experienced hand. The best way is to get the job done at the wheel works where the wheels are procured.

The wheels required for this cart are 4 ft. in diameter, and should be of a light make. When ordering, instructions should be given to have the wheels delivered perfectly clean without paint, and free from any flaws whatever, as although slight imperfections would be of little or no consequence were the work to be painted, in the case of varnished work like the present, they would be very unsightly and cause much trouble.

The sketches, Figs. 1 and 2, will explain to the reader the shape, position, and method of fixing the wings; they are usually of beech 6 in. by ½ in., and are sold ready bent. Fig. 25 shows one form of bracket with section of wing, and Fig. 26 is an alternative and simpler bracket. The front end of the wing is secured to the flange upon the front step as indicated at Fig. 22. When attaching these, allowance must, of course, be made for up and down movement of the vehicle upon the springs, and this will depend upon the strength of the latter. The upper edges of the wings should be bevelled or chamfered on both sides and back end, and the curve should be as nearly semicircular as possible.

The dashboard, Fig. 5, should be of American walnut, or of timber the same as the sides, etc., and is 2 feet long by 18 in. deep.

The mountings, by which it is attached to the front board, Fig. 2, are represented at Fig. 5, and are of half-round inch iron, joined at the top by a round rod; but this is not absolutely necessary, and the upright irons may be rounded off within an inch of the top of the board.

If lamps are required, the sockets, usually sold with them, are welded to a T-shaped bracket, provided with two bolt holes, and shanks to be sufficiently long and curved outwards, to allow the lamp to clear the side of the dashboard, to which they are attached on each side.

The inside of the body and bottom should, on its completion, receive two coats of priming colour; the outside should be kept as clean as possible, and any marks carefully removed with fine sand-paper.

If the body is of walnut, it may be varnished as soon as made, but if of elm, it will be greatly improved by being stained a rich walnut colour; vandyke brown ground in water, with a little washing soda added, makes a good stain; it should be applied warm, with a medium-sized brush, and when dry, the work should have a coat of best carriage varnish; a very little gold size is allowable, but only a very little. All varnishing operations should be carried out in a room which is as free from dust as possible.

The wheels are not stained, but when thoroughly cleaned with fine sand-paper are varnished in, at least, three or four coats. When the first coat is dry, rub down with fine pumice and water, until the surface is perfectly smooth; wash off all trace of pumice, and when the water has dried, give the next coat; when dry, again rub down, and repeat for each coat, until the final one, which should be laid on very evenly, and allowed to dry in a place free from dust, flies, etc. When this first coat is dry, wash well in cold water, and wipe with a chamois leather, as this will help to harden the surface.

The best method of varnishing wheels is to fix a strong bar of round iron in a heavy block or beam, about 3 feet from the ground, and at a slight upward angle. The bar being passed through the box, the wheel may be made to revolve during the process of varnishing, which will be found most satisfactory.

The above remarks as to varnishing apply to all portions of the vehicle, except the ironwork. This should have first two coats of priming colour, and when rubbed down with very fine glass-cloth, should receive an even coat of "quick" black. This consists of ivory, or vegetable black, ground and mixed in turpentine, to which is added a small quantity of black japan to give "body" to the mixture, which will dry quite "flat" and harden very rapidly.

When dry, give an even coat of black japan. At this stage the parts of the vehicle may be put together, and all nuts and bolts screwed up, and touched up with black japan, when the whole of the ironwork should have, at least, two coats of carriage varnish.

The inside of the body should have two coats of some warm brown, or drab colour. The movable seats are japanned and varnished, and the cart is ready for the "trimmer."

The backrest upon the front seat may be upholstered in American leather, or any other suitable material, but much padding is not advisable; in fact, two or three plies of thick baize, or part of an old rug or blanket, placed flat, and covered with the cloth, etc., will be found more comfortable than a cushioned back; besides, it takes up less room, which is a decided advantage in vehicles of this kind when both front and back seats are occupied.

The cushions are three in number, two 18 in. by 16 in. for the front, and one 36 in. by, say, 14 in. for the back seat.

If a higher seat is required for the driver, the right-hand cushion may be made much thicker than the other, and also about twice as thick at the back as in front. Or the front seat may be fitted with a light driving box about 4 in. deep in front and 6 in. at the back; the four sides to be covered with the same material as the cushions. This box is fitted to the seat with four loose dowels or "spuds" which allow of its being removed when required.

Each front cushion is secured in position by one, and the hind cushion by two leather straps (Fig. 1).

Two holes should be bored with a half-inch centrebit through the floor near each corner in front, to allow the water to escape when the cart is being washed.

Do not cover the floor with oilcloth, which holds the water and causes the wood to rot, but use a perforated rubber, or fibre mat.

The inside of the falling footboard at back may be covered with linoleum or oilcloth, cut to fit the opening at the back of the cart, and well tacked down and fastened with the shellac cement used for laying linoleum, etc., on floors.

I now bring this paper to a close, hoping that it may prove useful to any reader who, not knowing how, may wish to attempt the construction of a "Battlesden" cart.

MEANS, MODES, AND METHODS.

In commencing this department of Work, the Editor takes the opportunity to point out that it cannot fail to prove of considerable value to the readers, and to ask them to forward to him *pro bono publico* any "means, modes, and methods" of doing things that have been tried by themselves and found to be reliable and of advantage to the user. Every recipe given will bear the initials of the sender's name, and this ought to form a guarantee for its goodness and reliability.

Waterproof Cement for Glass.

Well mix together, litharge 3 parts; white lead, 3 parts; plaster of Paris, 3 parts; powdered resin, 1 part; each by measure. When about to use the cement, make this mixture into a paste with boiled linseed oil. The consistency of the paste will depend upon the quantity of oil used in making it up. It will set hard in the course of three days, and is an excellent cement for glass aquariums, and for cementing glass to wood where this is liable to be exposed to damp. —G. E. B.

How to Ebonise Door Knobs.

The best woods for ebonising are those white woods which do not show a definite grain marking—such as alder, willow, sycamore, and holly. The bobbins, or knobs, must be first turned smooth, or else glass-papered to the requisite smoothness, as they cannot be glass-papered after they are ebonised. The process requires the use of three separate liquids:—(1) Procure ¼ lb. logwood chips and boil them in ½ gallon of water. Soak the bobbins, or knobs, in this hot liquid for half an hour, then dry. (2) Dissolve 1 oz. of green copperas and 1 oz. of bluestone in 3 pints of hot water, and add a teaspoonful of wood vinegar. Soak the dried knobs in this liquid for a quarter of an hour, then rinse in clean water. (3) Dissolve 2 oz. of common soda or potash in 3 pints of warm water. Immerse the knobs in this liquid for a few minutes, then dry. The first liquid will stain the wood a brownish-yellow tint. The second liquid will change the tint to a blue-black. The third will fix the tint as a dead black. Nutgalls do not improve the first liquid if the logwood is good and the liquid freshly made. Run the knobs or bobbins in a lathe when quite dry, fill in with white wax, and polish with a piece of linen canvas, or duck. They may be varnished, if so desired.—G. E. B.

Writing on Zinc Labels.

Zinc labels are used by gardeners and foresters to label their plants and trees. The names of the plants may be written on the labels with any ordinary black ink, but this is liable to be injured by the weather. A more permanent ink for this purpose is made by dissolving platinum bichloride in rain water, and adding to this a few drops of muriatic acid. The ink may also be made direct from platinum foil. Procure a wineglassful of muriatic acid and half a wineglassful of nitric acid, and mix them in a porcelain dish or saucer. Place this on the hob of the stove in a chimney corner, with a good draught to carry off the noxious fumes. Place in the warm acid mixture from five to six grains of platinum foil or fine platinum wire. The platinum will dissolve in the warm acid, and when this is completed, keep up the heat until all the free acid has evaporated, leaving a thick liquid similar in colour to treacle. This, when cool, will crystallise to a red mass. Dissolve this in a wineglassful of rain water, when it will form the amber-coloured writing fluid. Clean the labels bright, and write on them with a quill or gold pen. The writing will become a deep black as it dries, and then cannot be easily washed off. A cheap substitute may be found in a strong solution of copper sulphate, but the writing from this is not so black or so permanent as that from platinum.—G. E. B.

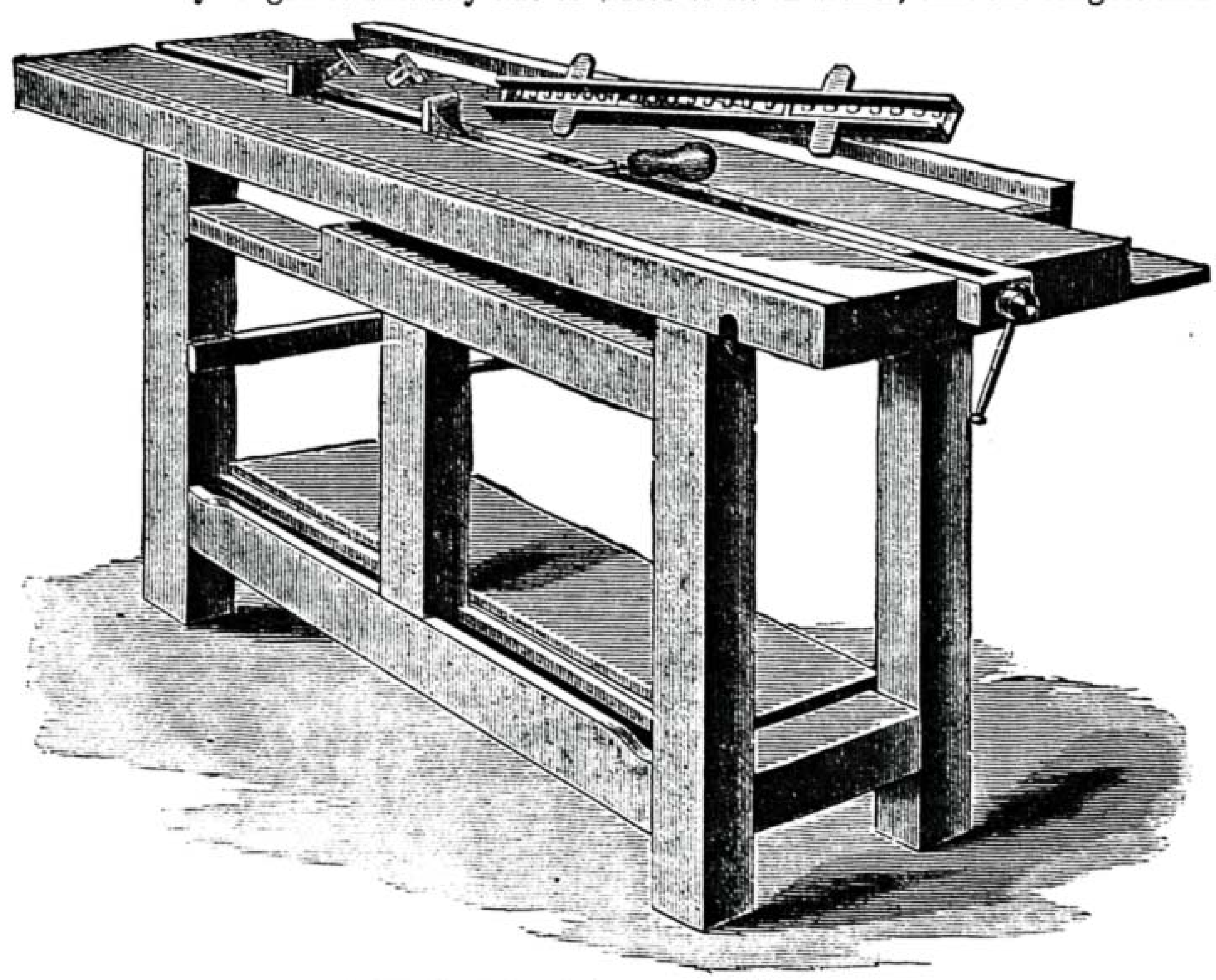
OUR GUIDE TO GOOD THINGS.

68.—Lister's Patent Screw Holdfast and Cramp Combined.

The accompanying illustration affords a representation of a New Patent Screw Holdfast and Cramp combined, invented and manufactured by Mr. F. Lister, 40, Beckett Street, Leeds, which is used in connection with, and forms an adjunct to, the ordinary carpenter's bench. I have not seen the actual appliance at work, and therefore I cannot speak of the invention from actual experience; but from a small wood model before me, which shows fairly well its construction and action, I am inclined to think that it will be found a most useful and serviceable means of carrying out the purposes which it is intended to serve.

The general relation of the Patent Screw Holdfast to the carpenter's bench, and the manner in which it is fitted to it, will be seen from the illustration given herewith. It is composed of various parts, fixed and movable, the fixed portion being a hollow casting of malleable iron, which traverses the whole length of the bench from end to end, and can be made of any length to suit any size or kind of bench that is used by joiners and cabinet makers. The casing is hollow, being formed of a bottom and two sides, each side being rebated, so as to leave a projecting flange along the top of each side on its inner surface, within which the parts about to be described can work backwards and forwards as desired. The upper end, or end most distant from the operator, is open in the model to admit of the entrance of the fittings. The lower end is closed and pierced to receive a screw, which is worked to tighten or release the grip of the jaws of the appliance when brought into play. The bottom is pierced with two rows of square recesses or holes, so placed as not to be precisely opposite each other, but in alternation, so that each hole is partly opposite the hole in the other row, and partly against the solid material which intervenes in each row between each pair of holes. This casing, it may be said, is placed in and along the centre of the top of the bench in such a manner that the top of the casing may be flush with the surface of the bench. Within the casing, work up and down two carriages furnished with jaws, to grip anything that may be placed between them. The top of each carriage is flush with the top of the casing itself and the surface of the bench; but the jaws project above casing, carriage, and bench for obvious reasons. The carriages are both movable along the casing, and that which is placed at the top of the bench is furnished with a catch which can be depressed or raised at pleasure, and is used in order to secure the carriage and the jaw it carries in any part of the casing by pressing the catch into the recess or hole nearest to that part of the recess at which it is desired to fix it. The action of the catch, it may be said, is such as to hold the jaw immovable. The second carriage intervening between the bottom of the bench, or end nearest the operator, and the carriage at the upper or more distant end, is in itself longer than the carriage at the top end, and is capable of being lengthened still further, the extension being regulated by means of a suitable screw. This carriage is also provided with a catch that is raised and depressed in the same way as the catch attached to the carriage at the top. "It can also be provided with as many stops as may be desired, according to the work required." I am now quoting from the maker's description. "These stops are placed into grooves, and they can be made to slide and stop at will, when they lock the moment you cease to slide."

The invention is certainly remarkable for its great simplicity, and the ease with which it can be worked. It is claimed for it that it completely supersedes the German bench screw, and provides a substitute for this which is in every way superior to it. Further, that the longest and heaviest pieces of work can be cramped and held in it with as much readiness as the smallest pieces, and that you can work and bevel short or long lengths of wood with the greatest ease when held in the cramp. The quickness and facility with which the cramp is applied, tend, moreover, to lessen the time and labour generally employed in cramping up; thus rendering it of value and importance to all who work by piecework or contract. For this reason employers will find it a most useful adjunct to the benches in their workshops, and amateurs who are without such an appliance will find it to their advantage to adopt it. It should be said that there is a centre jaw which can be introduced between the top and bottom jaws as may be required when dealing with short lengths of wood, or taken out and put at the lower end of the bench when cramping large work. Every particle of the Patent Screw Holdfast and Cramp is of malleable iron, except the screws, which are, of course, made of steel, and have square turned threads.



Lister's Patent Screw and Cramp.

The price of this useful article complete, with three sets of jaws adapted for different kinds of work, is 35s., carriage paid. To save inquiries, I had better add that, at present, it is to be had of the inventor and maker only. Every one, without dispute, knows his own business best, but it seems a pity that he keeps the sale of this bench appliance in his own hands, and does not, as far as I can see, push its sale among dealers in tools.

The Editor.

SHOP:

A Corner for Those who Want to Talk It.

*** *All Communications will be acknowledged, but Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Log and Deal Frames, and their Advantages.—A. R. (*Scorrier*) writes:—"As I have written a little on the working of circular saws, perhaps a few remarks on frame saws will be acceptable by those who have little or no experience in the working of them. The frame saw has been in use a great number of years, and no doubt many men understood the working of it even before the circular saw was introduced. Yet though there is not near the practice or skill required to work the frame saw satisfactorily, many are ignorant as to the proper working of it. Some are of opinion that the timber should be fed to the saw when it is making the down stroke, which is a mistake: others think that the saws should be perfectly upright, which is a much greater mistake. All timber, whether it be a log or deal fed in log or deal frame, should be fed just after the saw or saws commence to make the up stroke, so that the timber may be stationary, to take the thrust of saws when making their down stroke. Again, should the saws be perfectly upright in making the up stroke, they will bring up the sawdust and choke the saws, consequently they become heated, and will run out of truth. All frame saws should have a lead—that is to say, the top of saw should overhang the bottom; the amount of lead should be governed by the length of saw. A good lead for saws in cutting soft wood is about $\frac{3}{16}$ in to the foot in length of saw; a much less lead will do for hard wood; this lead will allow the dust to fall freely instead of being brought back into the cut. Again, the keying of the saws is of importance. Some men when they have a hammer in their hand, and commence to hammer, are like children, they don't know when to stop, and keep rapping away until they do some mischief. When a frame saw is strained enough it will give a sharp sound, when the hammering should at once cease. Many are not content with this sound, and keep rapping away until the saw, if soft, gives away in the rivet holes, and if it is hard or rash it breaks. Again, the saws should not be overfed; the feed should vary with the depth of timber and the number of saws at work; the deeper the timber and more the number of saws, the slower should be the feed. There are many advantages that the circular saw has over the frame saw, yet the frame has its advantages. We will suppose we have a large round and crooked log of timber to be sawn into 1 in., 2 in., and 3 in. planks; if sawn with circular saw on the rack bench, the diameter of saw has to be great and the plate thick, consequently a lot of power is required to drive it, and after every cut the log has to be brought back and moved, and so set as to cut the plank its proper thickness; and at the same time perhaps the log is far from being steady, which is very annoying. But it is not so when sawn in the log frame; the log is so clamped that it cannot move, and should there be six, eight, or more cuts to be made, the number of saws can be put into the frame and the log sawn to the number of planks required by passing through the machine once. The same with the deal frame: the number of cuts required is made at one and the same time, and if deals are very deep can be sawn with less power than could be done with circular saw, therefore you will see that where one saw could be worked to an advantage the other would be to a disadvantage. I hope these remarks, though brief, may benefit some of our readers; and I hope in a future issue to write a little on band saws, of which I have had some little experience."

About Work.—R. B. R. writes:—"After taking Work from the first, and reading it carefully, I am shocked to see what subjects you are taking up. It would just be fair on your part to give a lease of half the space that you take up with wood and devote to iron and steel. What I say is for the welfare of Work, as I hear lots grumbling about the space you are taking up with burglars' alarms, papier-mâché, and "Monarch" Play Chair, etc. It looks very like as if it was an advertisement paper. I hope you will see the errors that I point out, and get a paper on something that is useful to practical men."—[I am sorry you are so easily shocked. It takes something of an entirely different character to shock me, and even then the shock is never very severe, as I have given up being surprised even at the letters I get from men like yourself. Perhaps you will be almost annihilated to hear that some men in a large upholstery establishment were wishing the other day for more cabinet making. "Every man for his trade, you know;" and "What is one man's meat is another man's poison." Scores and hundreds of practical men pat me on the back, and the patting amply makes up for the scratching. I cannot please everybody, unfortunately, so I rest content with pleasing the majority and—myself.—Ed.]

The Scratch or Bead Router.—C. E. F. (*Boro', S.E.*) writes:—"Every man who tinkers at a bit of amateur work now and then will be glad of your present publication, Work, and if he does not see anything in any particular number which may bear on the particular hobby of the time, still his general knowledge of mechanics must surely be considerably increased, and widened by a carefully conducted course of reading in your new technical journal; but quite apart from his wider ideas of general construction, I feel sure that we shall all, sooner or later, find the exact thing that we want, and have, or fancy we have, been looking for for some time, as the following will show. Some years ago I bought a large and handsome bookcase, from which, however, the sides of the cornice had been cut away to enable it to be placed in a recess. I tried in vain to match the moulding, but except at what I considered a very outrageous price could not get any one to undertake the job, so gave it up in despair. However, about three weeks ago I was sitting at tea, when I spied a short article about 'Scratch Moulding Tools' in your Magazine, and immediately jumped up crying 'I've got it.' The result was that I got a piece of 19 gauge sheet steel, and with three cutters which I made with files, and mounted, as your correspondent suggested, I succeeded in about six hours (three evenings) in producing 8 ft. of moulding, of which I enclose you a section as an example. I may say that the section is just as the cutters or scratchers have left it, and has not been touched up in any way. You can imagine my delight in selling my bookcase, finished at so small a cost. You are quite at liberty to publish this if you think fit."—[I publish your letter with pleasure, and heartily congratulate you on your success with the scratch. The bit of cornice sent shows that you have done a very creditable piece of work. The writer of the article was with me when your letter reached me, and was much pleased when he read it to think that he had rendered one reader at least good service. I trust you will find much in Work from time to time that will be useful to you, and that your letter will enlighten some of those who appear to think that Work is purposeless and hopeless, because it is not exactly in accord with their own peculiar notions on the general fitness of things.—Ed.]

Home-made Planes.—Bert writes:—"Having been interested in the article on home-made planes and E. P. W.'s remarks, I think that he is quite right in his idea in having a piece over the mouth of the pattern. I have made two or three dozen of them myself. I am an iron moulder, and I find that to cast them with the mouth left open not only causes them to get hard but causes them to warp, being weak in the middle. And another thing I notice, the writer is very scanty with the taper, as most pattern makers are. He says the merest trifle will do. Now, I say it is not enough; if he wants a clean casting he should give a little more taper, then a moulder has a better chance to get his pattern out without shaking any of what we call the cod down—that is, the inside of the pattern—and if that is left intact he can depend on a good clean casting. I have taken Work since the beginning, and I am very pleased with it. I see you mean to go in for all trades, but I have been wondering if you will go in for ours. I have taken in two or three journals, but none reached as far as that. If you could give a little about the working of a cupola, it would be very welcome to not only me, but some friends in the trade who take in Work every week. I may add here that I succeeded in making a table of Mr. Adamson's design in No. 1 of Work. I hope that my suggestions will not be considered offensive."

A Wood Worker's Eulogy.—C. N. (*Sherburn-in-Elmet*) writes:—"I will briefly introduce myself to you as a practical wood carver and fret cutter, it being seventeen years since I commenced to learn that art. I am a regular subscriber to Work, and intend taking it weekly until some unlooked-for cause should deprive me of the necessary copper for its purchase. I have read all the articles on wood working, and I conclude they are a credit to the writers, and will considerably help great numbers of wood workers, both practical and amateur. Work has not come out a day too soon. There has been great need of a paper of this kind. The papers I have taken before on wood working, etc., have not been as clear as they should have been; their articles have been too short, and as a result of this many men have been unable to understand them, more so the amateurs. Better far have one long and continued article, and that article understood and useful, rather than a lot of short useless articles, which are really a puzzle to the amateurs. How different are the articles in Work. When I read them I can almost imagine the practical hand is executing the work before my eyes, they are so clear. No wonder, Mr. Editor, so many thank you for and wish Work success. I have been going to write to you several times, but have held back, so that others might air their views. But after reading the article by F. Miller on wood carving in No. 13, I can refrain no longer. The designs are very good, and I take this opportunity of thanking F. M. for the pains he has taken to instruct in the art of designing. I shall benefit by the instructions, and I shall eagerly look for more. I am a poor designer, owing to my parents being unable to afford sending me to a school of art, and I thus missed tuition in drawing, which I now feel the need of. In the course of time I hope F. M. will contribute some designs for antique carving, such as panels, pilasters, and mouldings. I am afraid I have encroached too far on your space. Therefore I will conclude by saying I recommend Work to all wood workers I come in contact with, and I wish Work unbounded success, and may health, happiness, and God's blessing rest on all its staff."

Utility of Work.—D. C. (*Marsden*) writes:—"Allow me to add my testimony to the value and worth of Work. I anticipate for it a very useful career in future, and am expecting to cull from its pages much useful information and pleasure; it is just such a paper as I have been looking for a long time. I cannot tell you how delighted I was when I came across Work accidentally at a newspaper stall when I was hunting for some such books or papers as would give me the information I was then seeking. I am very pleased to find that Work is likely to supply all needed information. I am anxiously looking forward to the promised articles dealing with camera making, joinery, and cabinet making for beginners. I hope these last-named articles will deal with and show how to make good strong kitchen chairs, square tables with leaves or without, bookcase, and other useful articles of household furniture for a working man's home. I can assure you that I have been very much encouraged to write to you because of your cheerful and encouraging replies to your various correspondents, and especially for your very feeling reply to H. D.'s (*Bury, Lanc.*) queries, because my own circumstances are very much akin to his. My means are limited: I want to use them to the best advantage to myself in purchasing tools, etc., hoping to receive the same consideration at your hands as other correspondents. I wish every prosperity to Work."—[A very good bookcase has been given, and others will follow. Everything mentioned in your letter will be touched on as speedily as possible, and good strong furniture of a plain character will not be neglected. Any special information that you require will be supplied whenever you may ask for it; but I do not notice anything in the above letter that requires more than a general answer.—Ed.]

About Work.—W. H. H. (*Bradford*) writes:—"I write to support the views held by T. J. H. (*Trowbridge*) and J. P. A., and expressed in your issue of June 8. (1) I quite agree with all T. J. H. has written, especially about the cover. I cannot imagine why you refuse to put Work in a cover, unless it is that you think that if we got a cover we should want it made into an insurance policy. (2) I thought when Work was first published it would form a good companion to the 'New Popular Educator.' I do not think so now; I do not consider it worth a more valuable binding (in its present form) than I could make myself from reading 'Binding made Easy.' One page out of every eight being advertisements, the other seven so amateurish, one has scarcely patience to read them. (3) I am a painter. The sign writing articles are very good, and well written, but far too elementary. I ask you, do you think there is any one who would buy Work and be interested in its pages but what has got past the elementary stage? (4) I do hope, with a new volume, you will alter Work considerably, taking for your model the 'Popular Educator,' and inserting in it good articles that would be of some use to others than amateurs. 'Or (to quote J. P. A.) before long you will not be able to number a practical man in your subscribers.' (5) I think you printed Fig. 27, border in dead gold for papier-mâché work, upside down. If so, perhaps you will correct the mistake.—[(1) Unfortunately you altogether mistake the functions of an editor, who is responsible only for the matter supplied in a magazine, and not for the form in which it appears. Curious as it may seem to you, I have really no more to do with putting or not putting Work in a wrapper than you have. (2) Of course you must please yourself about the binding, and if you please yourself you will please me. Work and the "New Popular Educator" are not modelled on the same lines, and there never was, and never will be, any thought or intention of doing so. They are as different in their constitution, aim, scope, and purpose as chalk is to cheese. Again, if fourteen pages were advertisements, and two text and illustrations, the arrangement would be altogether beyond my control, but with the fourteen pages of text and cuts you get value, and very good value too, for your penny. As to the "amateurish" tone, kindly remember that Work is not a trade organ, but is intended for "all workmen, professional and amateur." (3) Yes; you are a painter, and find Mr. Benwell's papers on sign writing "very good and well written, but far too elementary." The great mistake made by many who know their own trade thoroughly is that because they themselves do not require elementary instruction nobody else does. As a painter you often have to climb a ladder, but I do not think you would be satisfied with a ladder that had a few rungs at the top only, the rest being all left out. We must all begin at the bottom, and even you would begin to recognise the value of the elementary rounds in such a case as that which I have just mentioned. As to the question you put to me with regard to the readers of Work, let me tell you that I *know* that the magazine is largely bought by lads and young men just beginning practical life in the workshop. More than this, I have been told by a workman who takes an active part in Sunday teaching that sixteen lads in one school, with which he is concerned, and nearly as many in another, are buyers and readers of Work. (4) I am afraid your hope will not be realised as far as considerable alteration, such as you contemplate, is concerned. When the second volume is reached I confidently expect that there will be even more practical men among its readers than there are now. (5) You are perfectly right in supposing that Fig. 27, in page 185, is presented upside down, and in accordance with your request I "correct the mistake," which will sometimes happen in dealing with cuts of this kind.—Ed.]

I.—Questions Answered by Editor and Staff.

Jewellery Colouring, Soldering, etc.—Young Amateur (*Douglas*).—Young Amateur cannot colour his brooch as it is, for the process of (wet) colouring is not used in a general way for any quality less than 15 ct. gold, whereas he has soldered a 9 ct. catch on to a fine gold brooch with silver solder. Colouring is a process in which the surface of the article coloured has its alloy (silver and gold) taken out and the fine gold left. Consequently as silver solder is just the very material that colour acts on, the whole will be eaten away, and the 9 ct. catch will drop off, even if it be not destroyed as well, as it is very likely to be. Perhaps, to save further bother, in this case the brooch had better be electro-gilt. But as it is possible that others may have got into a similar muddle, I will give the method that I should follow, were the brooch put in my hands to do properly. First get rid of all the silver solder—for that we place the brooch in nitric acid; try nitric acid and warm water (1 part each) at first, and add acid until you see it works. This ought to eat all the solder away in an hour or two. But this is only to be done if your brooch is better than 15 ct. gold, and if it has not been soldered together anywhere else with common solder. Yes, I know Young Amateur says his brooch is fine gold; but that title is often given to 12 ct. gold in a jeweller's shop window, and it is just possible that Amateur, being also young, has taken that as his authority. Most "jewellers' materials" shops now keep gold and silver and solders, so you can either send for some from Gray & Son, Clerkenwell Green, E.C.; Calipé, Poland Street, Oxford Street, W.; or King, St. John's Square, Clerkenwell. Now make your catch of 15 or 18 ct. gold, and solder it on, if a plain, solid article, with solder made thus:—15 ct. gold, 1 pennyweight; fine silver, 3 grains; fine copper, 1 grain. Or thus—Fine gold, 13 grains; fine silver, 6 grains; fine copper, 5 grains. If it be rather a light and thin affair you might try this, which is the commonest I use for coloured work:—22 ct. (that is, the same as sovereigns are made of), 1 dwt.; fine copper, 2 grains; easy silver solder, 10 grains. Melt the first two all together, but if you make the last, melt your gold and copper first, and add the silver solder when they are in a fluid state, and don't forget to use a fair amount of borax (to the last one especially), and also remember that it will not stand being melted more than once, as the zinc in the silver solder will go off (become oxidised, I think, is the chemical term). See that your brooch is scraped clean, and the catch too, where you are going to solder them together. After soldering, etc., polish your catch and brooch, then get it clean and quite free from grease. I prefer to anneal the articles when I can, and let them get cold by themselves, and black. Now tie the brooch on to two or three horsehairs (you can use platina or gold wire if you like, but there is no advantage in so doing), and it is ready to colour. I shall simply give the plainest directions to colour a plain article. First we must have ready some boiling water and a basin. Secondly, some colouring mixture well pounded up and thoroughly mixed, and in quantity sufficient to three quarters fill your pot, which for regular work is specially made of black lead, but for only an occasional job the ordinary crucible is good enough, and much cheaper. The ingredients are—Saltpetre, 2 parts; lump alum (not burnt alum), 1 part; salt, 1 part. The quantity you must judge for yourself by the size of the pot, which should be at least ½ in. wider halfway down than your work is. Add a little water to it—don't cover it all up with water—say, until it looks damp all through, and set it on the fire, heat it slowly, and stir it up occasionally with a piece of wood or iron, until it boils up; then put your work in, and keep it there for several minutes, moving it about all the time, in order to give every part of the colour a chance to do a little work; if it boils dry too soon, add just a little hot water, and put your work in again until it gets of a dark colour; this you can see by dipping it in some of your warm water in the basin. When it is dark enough—and only experience will tell you that—you must weaken your colour by adding hot water to it; then when it boils up again redip the brooch until it becomes of the rather pale yellow colour that fine gold has. The whole process from the time of boiling up the colour should not take longer than from ten to twenty minutes. Rinse it well, and it is ready for finishing, either by the scratch brush or burnisher, or if Etruscan work or a coin it may do as it is. One word more, and that is—single articles rarely colour well; a good bunch of them and a good size colour pot is what is preferred by H. S. G. To clean up jet work, a little powdered rottenstone, whiting free from grit or rouge well rubbed over it, will bring up the polish again. If the work is plain, use the ball of the thumb and whiting, and don't be afraid of rubbing hard and rapidly; if it is shaped you will have to use a brush, lap, dolly, bob, or whatever tool will get at the parts, and subject them to the friction required; then wash with soft brush and soap and water.—H. S. G.

Wood for Violin Making.—F. J. C. (*Brockley*). writes for the information of Fiddler (*Highbury*):—"Your correspondent will be able to get this in any quantity, and at a moderate price, at J. Thibouville-Lamy, Musical Instrument Makers, 10, Charterhouse Street, E.C."

Indiarubber Stamps.—C. S. P. (*Greenwich*).—The name or inscription, whatever it may be, is first set in ornamental type or plain type, as may be desired, and a cast of the type is taken in plaster. Vulcanised indiarubber in a state of fusion is then run into the cast, and a facsimile of the type in a yielding material is thus obtained. The stamp is afterwards mounted. Of course, various appliances are required for carrying out the process; but to go into these would require a special paper, and you only ask to be told how they are produced.

Frame for Wardian Case.—W. P. (*Southport*).—The frames or astragals for cases made in wood are similar to window astragals for window sashes, a section of which is shown in Fig. 1. Astragals for corner uprights are made as shown in section in Fig. 2. The glass is set in and bedded with putty, the putty bedding being shown in each figure by dotted lines. An example of each kind of astragal, in which the glass can be set without putty, is shown in Fig. 3. The uprights are made without a cut-out cheek for glass, a saw draught equal in width to the thickness of the glass being sufficient to slip the glass into, the same being removable by unscrewing the vase finials shown at the top of the corner astragals in Fig. 4, which is the front elevation of a plain and simple wardian case in wood. These finials are filled with a double screw, one end of which enters the finial itself, and the other the upright astragal. The framing at the top of the glass is held down by the finials.

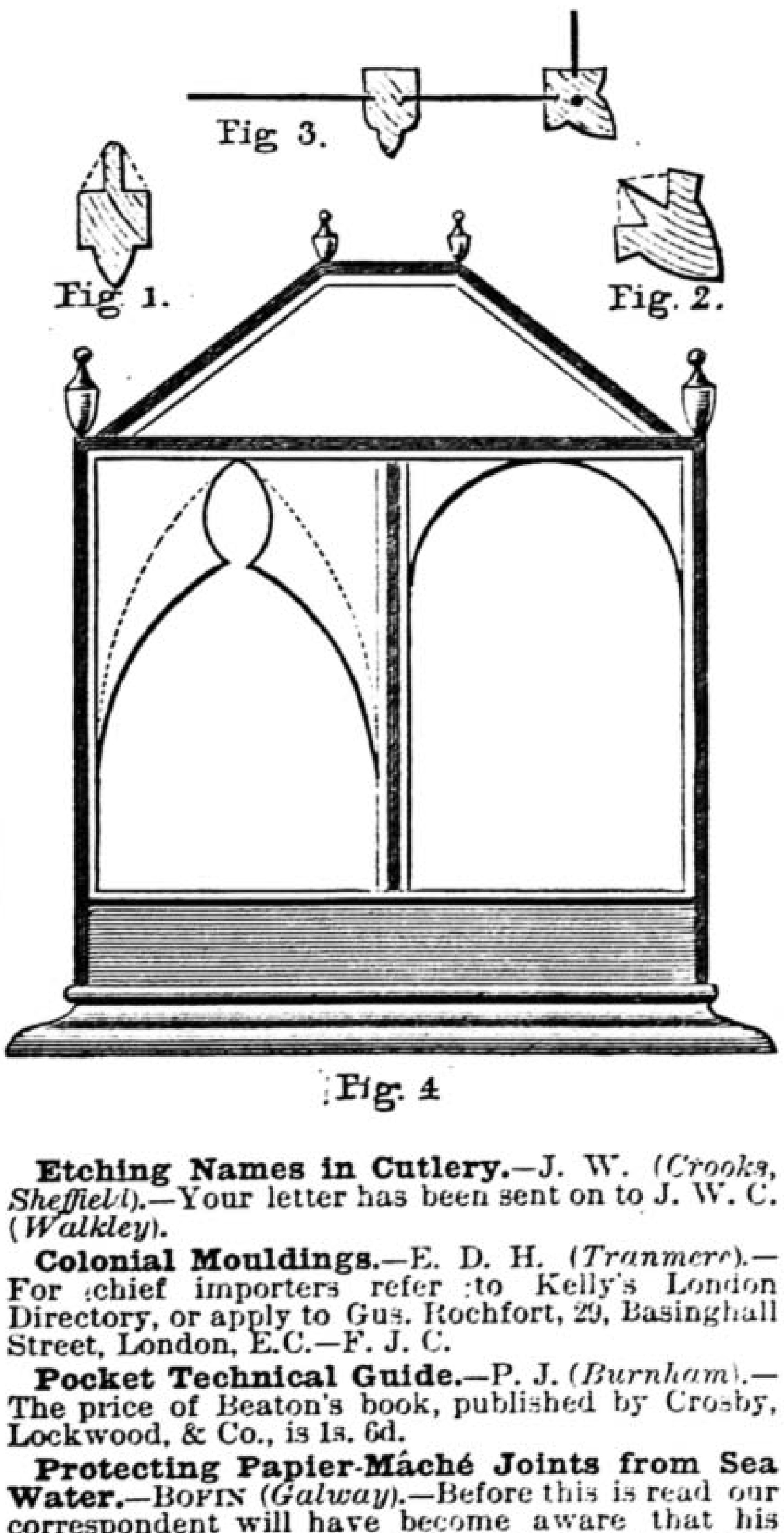


Fig. 4

Etching Names in Cutlery.—J. W. (*Crooks, Sheffield*).—Your letter has been sent on to J. W. C. (*Walkley*).

Colonial Mouldings.—E. D. H. (*Tranmere*).—For chief importers refer to Kelly's London Directory, or apply to Gus. Rochfort, 29, Basinghall Street, London, E.C.—F. J. C.

Pocket Technical Guide.—P. J. (*Burnham*).—The price of Beaton's book, published by Crosby, Lockwood, & Co., is 1s. 6d.

Protecting Papier-Mâché Joints from Sea Water.—Bofin (*Galway*).—Before this is read our correspondent will have become aware that his present question is answered with his former one. If the solution of gutta-percha which we recommended will protect the paper from the action of sea water, it will, of course, protect the glued joints also.—S. W.

Small Casts in Plaster.—W. R. (*Mile End*).—Directions for working even "small casts" must, to be of any use, be longer than could well be given in "Shop," especially as W. R. does not mention the kind of objects from which he wishes to cast; but we shall hope, before long, to give him full information on the subject in the other columns of this paper.—M. M.

Combination Lathe and Fret Saw.—J. H. S. (*Braishfield*).—I take it that you want a machine or tool for real work. The Britannia Company's No. 3 is certainly a useful tool in the hands of a practical man, and the price is low; but as you are an amateur in wood working, I would advise you to go a step further, and try the B. C.'s 4 in., and if so, you will find results more satisfactory, which is the great desire of both amateur and professional. This would also apply to your question respecting the fret and circular saw action, as attached to the lathe for steadiness. The amount of vibration given off and the want of power in roughing down a piece of wood in a 3-in. lathe is often a most discouraging start for an amateur, as also disappointment in the result.—G. E.

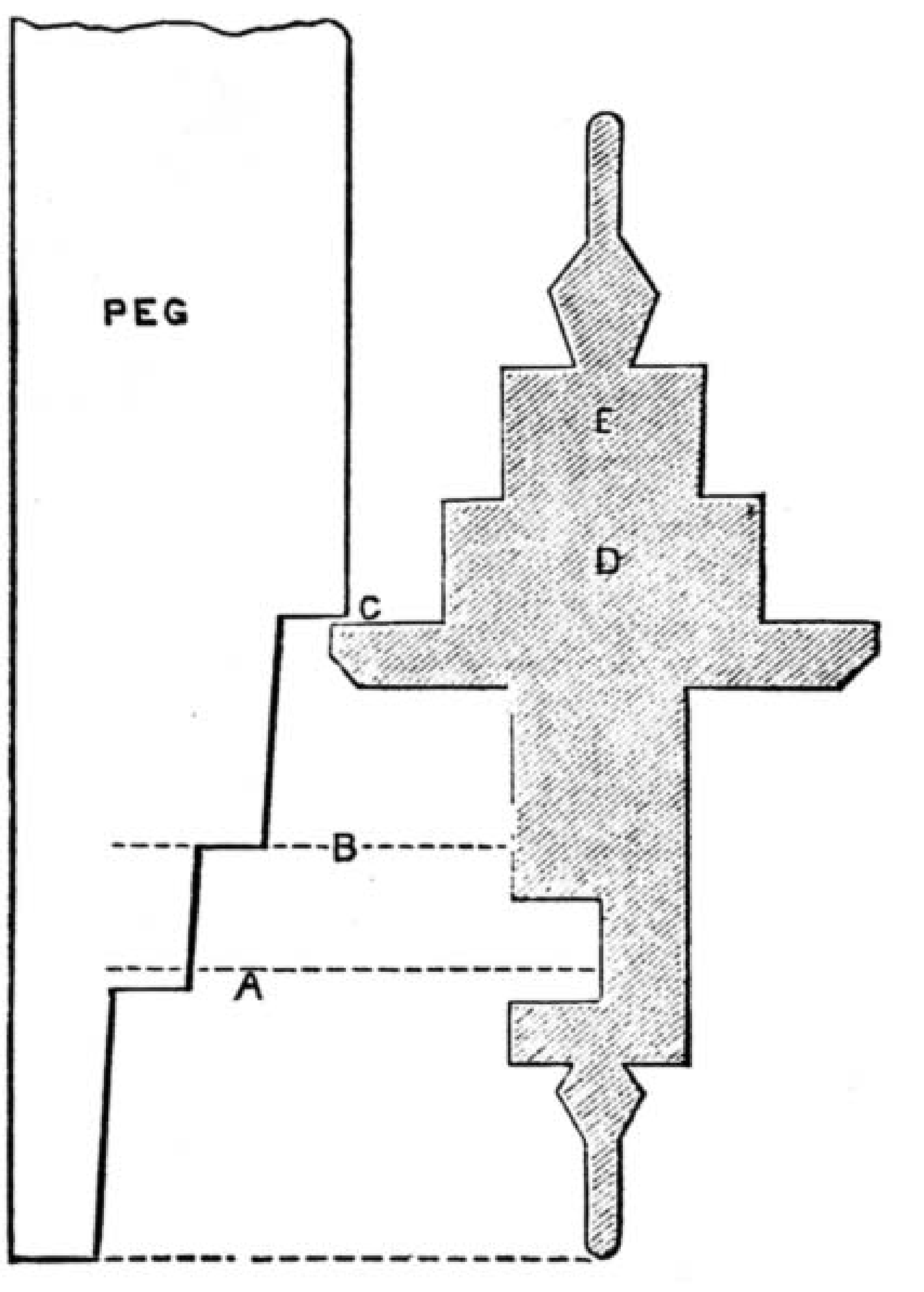
Joints and Cabinet.—R. M. W. (*Burnley*).—Don't apologise for troubling me. Letters such as yours are not regarded in that light. The desire is to make Work useful, so that practicable suggestions and encouragement are always welcome and cheering. I am glad you, among others, have found the friendly hints to amateur wood workers helpful. Mr. Denning, to whom your thanks have been conveyed, has papers on both the joints you name in preparation, as well as other topics of a similar character, all of which, no doubt, you will find of assistance, and your "sincere hope" is cordially re-echoed. The cabinet, by which, if I am right in thinking, you mean the piece of furniture commonly known among cabinet makers as a nest of drawers, will have attention at an early date. In case you do not understand what a nest of drawers is, I may say it is a kind of square-cornered pedestal fitted with drawers only. These run from side to side, and are usually secured by one lock fitted on a hinged style to the right of them. If this is not the kind of thing let me know, and I will see what can be done to meet your wants. In any case I think I may safely promise that sooner or later a description of whatever the piece of furniture you wish to make will appear in Work. Why not send me a rough sketch or diagram of the article? No matter how roughly drawn, a sketch often shows more plainly than any description what is really required, and when the subject seems likely to be of general utility, you may be sure that arrangements will be made for a paper on it. I am pleased to hear you are making one of the tables described in No. 1, and I trust it will come up to your expectations. Thanks for your good wishes.—D. B.

Cement for China Mending.—Jeune Écolier (*Capel*).—We question whether anything short of rivets will mend china, so as to be safe under the rough handling it will have in constant use. White lead will resist boiling water, and make an exceedingly strong joint if sufficient time is given to it to set thoroughly, which will be a matter of weeks. It needs to be used neatly, as any smudge on the face is not easy of removal when hardened. The advertised cements are numerous; we have not tried the "Coaguline" mentioned. For mending china for ornamental purposes only, we know of nothing better, stronger, neater, more cleanly, or easy of application, than isinglass dissolved in acetic acid. Any one can make it himself, or buy it ready prepared at fancy shops. It is sold under different names as "Diamond Cement," and at the Soho Bazaar, London, as the "Soho Cement." The bottle containing it is placed in a cup of boiling water to liquefy it, the broken edges warmed, and the cement applied to both with a camel-hair pencil. It sets in about twelve hours. China thus mended should, however, be washed in cold or moderately warm water only—not boiling.—M. M.

Banjo Making.—R. Y. (*Canning Town*).—The best and most useful size to make your banjo will be one with an 18-in. finger-board and a 12-in. hoop or drum. By making your instrument to this size, if you wish to tune it to and play with piano, or any other instrument tuned to concert pitch, you will be able to do so. If you make the finger-board or neck any longer, you will not be able to tune it up to such a high pitch, and if you were to try to do so, you would find your strings would not stand the strain, and would break, which would make banjo-playing a rather expensive luxury, if you tried to pull it up to pitch very often. The exact measurements are—the hoop 12 in. diameter, 2¼ in. deep, or you could make it deeper if you chose to, but I should not recommend it to be made any shallower than the size I have given. Length of finger-board from the end that fits against hoop to the nut, 18 in. The nut is the small piece of wood or ivory, etc., that is grooved into the finger-board at the end where the peg head falls back, and in which notches are cut to keep the strings at equal distances apart. The distance from nut to thumb-string peg will be 6¼ in., and 6¾ in. to the small piece of wood or ivory that you will put in to carry the thumb-string. Length of peg head from nut, 5½ in.; width of finger-board at nut, 1$\frac{1}{16}$; at thumb-string peg, 2¼; full at end; where neck butts against hoop, 2$\frac{1}{16}$. These are exact measurements taken from an instrument made to be played on, and not merely for show. A great many 7-stringed banjoes sold by music sellers are made with the finger-boards too narrow, making it impossible to finger the strings, and play some of the chords properly, therefore if you are wise you will work to these measurements I have given. Let the bridge stand on vellum about 3 in. or 3½ in. from edge of hoop. If my answer to your query is not sufficiently clear, or if you require any more information, I shall be pleased to put you right on hearing from you again (through Editor).—J. G. W.

Die Stamping.—Bon Fil (*Birmingham*).—You do not state whether you possess apparatus and material for this work or no; if not, you must procure them before you can obtain even a glimpse of success. A press is essential, and cards and gutta-percha to make counterparts cannot be dispensed with, as great pressure has to be exercised, and the simple die cannot do its work unaided. You can obtain of Messrs. Hughes & Kimber, West Harding Street, Fetter Lane, London, E.C., anything that you require for the purpose, and the plant will cost you from £5, and upwards. I do not, however, think that your brass dies will be of much use, as I suspect they were originally cut for seals. If that is the case, don't expect from them more than impressions in which the ground is coloured and the engraving white, technically termed cameo stamping, or perhaps only white impressions called plain stamping. You might colour those impressions, according to the laws of heraldry, by hand, for die stamping in colours necessitates a separate die for each colour, and I imagine you do not contemplate going that length. I would also mention that steel dies are invariably used, which are cut in accordance with the style of stamping required. For plain and cameo stamping the die is cut to give an impression in high relief, and a cameo impression is obtained by passing a colour roller over the face of the die. On the other hand what is called relief stamping is akin to copperplate printing, inasmuch as the engraving is more on the surface, and lines are employed for shading. To obtain an impression from a die so engraved, colour is brushed into the incisions, and the face of the die is wiped clear of ink; the lines are thus left full of ink, and consequently only the parts that are engraved appear impressed upon the paper. Any further information I shall be most happy to give with the editor's permission through the medium of "Shop."—J. H. M.

Watchmaking: How to Pivot a Cylinder.—COUNTRY WATCHJOBBER.—The simplest way I know is as follows:—Take a peg, cut the bottom



flat, and rest on the bottom jewel hole; cut a step or notch, A, where the rim or band of scape wheel comes; another, B, the height of scape teeth; another, C, just free of top of scape cock; place the peg on a new cylinder and see if suitable for length by resting top of notch, C, where the balance is to go, and notch B halfway down pallet, and A in centre of space of cylinder. The bottom of peg shows where the shoulder of bottom pivot should be; cut off the plug, leaving suitable length for pivot; take off both end pieces, screw on cock, and take length by gauge and cut off top plug to it, leaving a little over for rounding off when finished. To gauge the size, if you have no cylinder gauge use the pinion gauges. The plugs are merely fitted tight and driven in. For running in cylinders I fill them with sealing wax or shellac; and for other jobs, half beeswax and half resin make a very useful wax, as it requires but slight heat to put on or off.—A. B. C.

Violin Carving Tools.—I hasten to correct an error which appears, *re* sharpening carving tools, in No. 11; in the last sentence the word *tool* should have been *oil stone*. If the fault be mine, please accept my apology for making such a blunder, and, if possible, insert correction in next issue.—B.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Indiarubber.—PERPLEXED (*London*) writes:—"Will some reader kindly tell me how to make such a thing as a glove of indiarubber, similar but a trifle stouter than the children's common air balls before they are blown out? It must be elastic enough to pull it on and off without tearing."

Cake Firelighters.—J. C. (*Dundee*) writes:—"Would you inform me, through your valuable paper, where a machine can be got for the manufacture of cake firelighters, and the materials employed in the manufacture of the same?"

Tuition in Carpentering.—AMATEUR (*Bayswater*) writes:—"Would you kindly inform me in your issue, whether there is any institution or place where a person desirous of learning carpentering might get some elementary practical knowledge?"

Incubator.—B. F. (*Liverpool*) writes:—"Can any reader give me a plan of a simple incubator, with particulars, for me to make at home? I have a large square tin box, which might come in for it, and can use the soldering iron."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

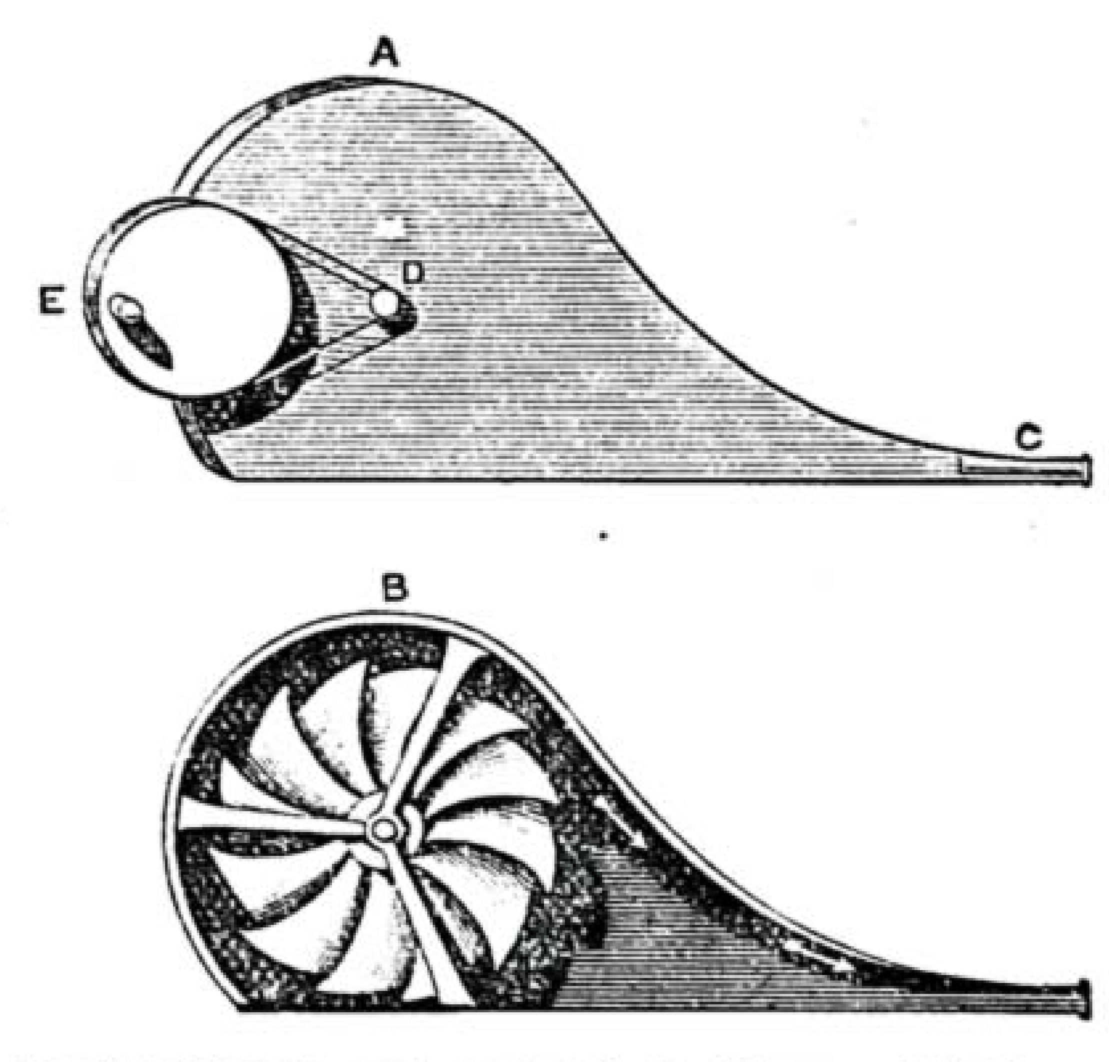
Fretwork Patterns. — MESSRS. CHARLES CHURCHILL & COMPANY, Importers of American Machinery (21, *Cross Street, Finsbury, E.C.*) write:—"*Re* Fretwork Patterns and W. E. M. in your issue dated June 1st. The book is one of our series, No. 4, 2s."

Fretwork Patterns.—W. H. J. C. (*Highbury*) writes:—"In No. 11 of WORK (see page 174), I note that W. E. M. wishes to ascertain the publisher's address of a pattern book on fretwork. I think I can give him that information, as, strange to say, I was at work on the first pattern of the book when I received my last copy of WORK. The book is Part 4 of an American publication, published by John R. Bowman, 40, Beekman Street, New York, at 50 cents (Part 4), and is very cheap, I consider, for the price; the only drawback is that no explanations are given for putting the patterns together, a fault with some English editions. If W. E. M. wishes for some really good and artistic patterns, I should advise him to get No. 10, published at 2 dols. One of the patterns I have forwarded to you out of No. 10 book. I cannot close this without wishing WORK a great success, for I think that it will be the means of brightening many a home by its very plain and intelligible articles on home decoration. I am not a mechanic by trade, but I spend my leisure time in fretwork and picture-frame making, and with the help of your valuable paper I intend starting on some article of furniture. I also hope that you will give us amateur fretworkers a few patterns now and again, something less elaborate than that cabinet issued with the first edition, which was a splendid pattern, only rather too difficult for me at any rate."—[You shall have some simpler fretwork designs.—ED.]

Moulded Indiarubber.—J. writes in reply to OSLEK (see page 190):—"David Moseley & Sons, Chapelfield Works, Ardwick, Manchester, can supply them."

Colouring Photographs.—F. H. Y. (*Kentish Town*) writes in reply to EXPECTANT (see page 174) on how to colour photos with water-colours:—"I think I can help him a little if he carries out the following directions: Rub the photo over with calcined preparation of magnesia, and use gum arabic and water to mix his colours."

Machine for Current of Air.—A. H. (*Wolverhampton*) writes in reply to BELLOWS (*Gloucester*) (see page 190):—"Seeing in 'Shop' an inquiry on how to make a machine for an intermittent current of air, I beg to submit the drawing herewith (if you can understand it). A is the apparatus complete, the sides being of wood, and the point, C, of brass. Inside as seen at B is a fan, which may be made of tin, and is worked by a



small pulley, D, and a wheel, E. If you wish I can, another time, give a fuller description."

A Pronged Ring.—J. writes in reply to E. C. (*Battlemore*) (see page 190):—"Harrison & Co., Malleable Iron Works, Lincoln, is a good firm."

IMPORTANT PRIZE COMPETITION.

THE Editor of WORK has the pleasure of informing his readers that Messrs. CASSELL & COMPANY, LIMITED, have placed at his disposal the sum of

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Trade Notes and Memoranda.

THE citizens of New York are becoming painfully aware of the fact that the complex conveniences of civilised life in a big city are fraught with danger. Not a day passes without a break in the mains of the Steam-heating Company, which supplies both heat and power to the principal buildings in the city. The pipes form a perfect network under the streets, and owing to the enormous pressure of steam, constantly explode with a loud noise, hurling fragments of stone and quantities of mud, mingled with steam, into the air. The steam for that particular quarter of the town in which the explosion occurs has then to be shut off, leaving many of the establishments destitute of motive power. The gas mains also are put together so defectively that there is an enormous escape continually going on, so that the subways of the electric companies become invaded to such an extent that the men have to use great precautions when going underground. Disastrous explosions sometimes result from a break occurring in the electric conduits, which break produces an arc, so igniting the waste gas. In one of these which occurred recently in front of the Fifth Avenue Hotel, 200 feet of the pavement was torn up. Again, the overhead electric light wires which carry a powerful current often break, and have caused the death of several men and horses who have come into contact with the broken circuit. At the present time the relations between the electric light and the telegraph companies and the municipal authorities are somewhat strained, owing to the refusal of the companies to lay their wires underground as demanded by the municipality.

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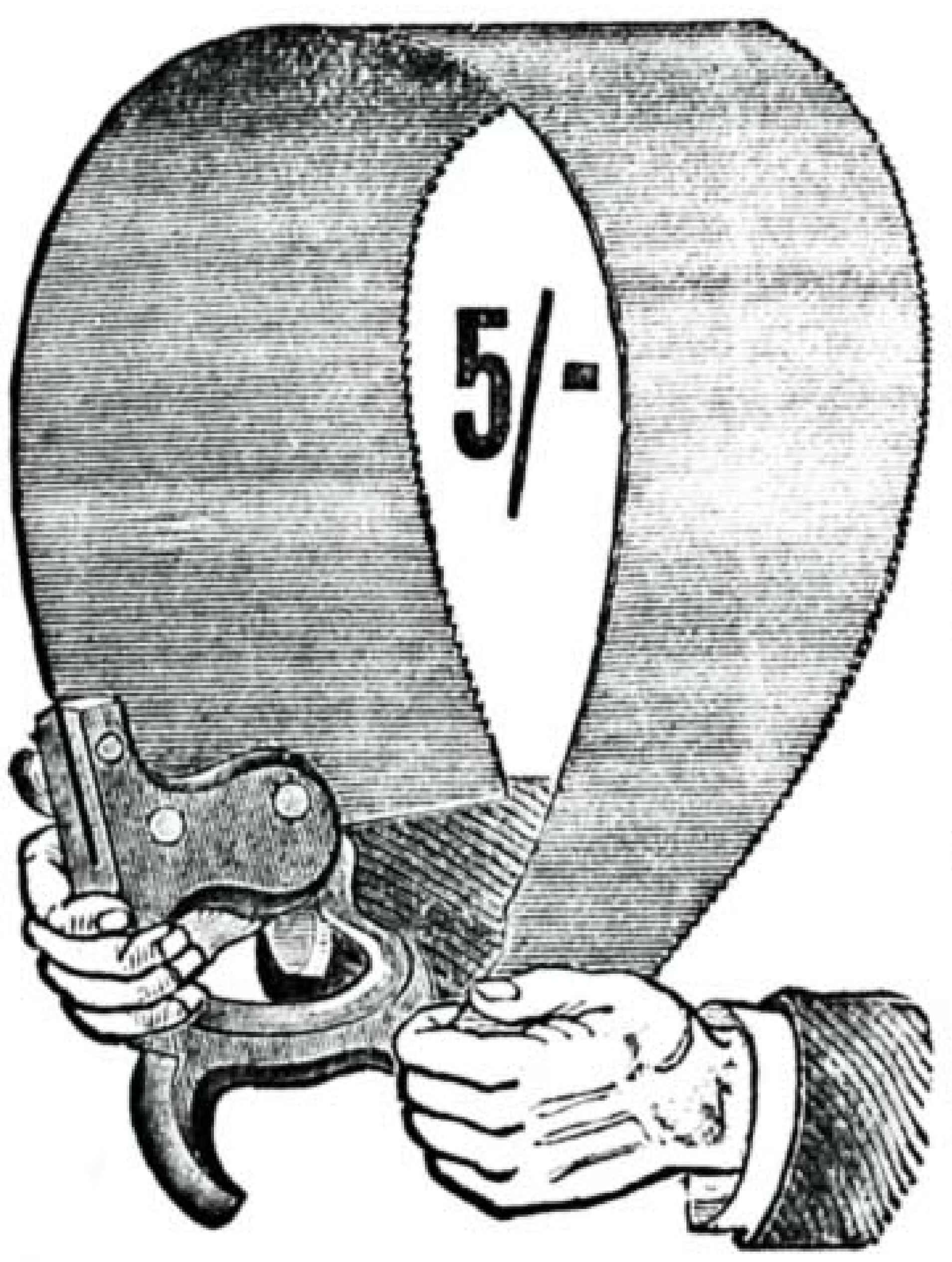

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