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Machinery for Manufacturing Pipes.

PROSSER'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, RICHARD PROSSER, of Cherry Street, Birmingham, in the County of Warwick, Civil Engineer, send greeting.

WHEREAS I did by petition humbly represent unto Her present
5 Most Excellent Majesty Queen Victoria, that after considerable applica-
tion and expense I had invented "CERTAIN IMPROVEMENTS IN MACHINERY
OR APPARATUS FOR MANUFACTURING PIPES," and Her said Majesty, being
willing to give encouragement to all arts and inventions which may be
for the public good, was graciously pleased, by Her Royal Letters
10 Patent under the great seal of the United Kingdom of Great
Britain and Ireland, bearing date at Westminster, the Twenty-
seventh day of March One thousand eight hundred and forty, in
the third year of Her reign, for Herself, Her heirs and successors,
to give and grant unto me the said Richard Prosser, my execu-
15 tors, administrators, and assigns, Her especial licence, full power,
sole privilege, and authority, that I or they, by myself or themselves
or by my or their deputies, servants, or agents, or such others as I or they
should agree with (and no others), during the term of fourteen years
from the date of the said Letters Patent, should and lawfully might
20 make, use, exercise, and vend my said Invention within that part of Her
said Majesty's dominions called England, Her dominion of Wales,

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and town of Berwick upon Tweed, and also in all Her Majesty's colonies and plantations abroad, in such manner as to me, my executors, administrators, and assigns, shall seem meet, and as that I or they shall enjoy the whole profit and advantage arising by reason of the said Invention, during the said term of fourteen years; and for that end Her said Majesty requires and strictly commands all Her subjects whatsoever within England, Wales, and Berwick upon Tweed, and also in the colonies and plantations aforesaid, that they shall not, neither directly nor indirectly, make, use, or put in practice my said Invention, or any part thereof, nor in anywise counterfeit, imitate, or resemble the same, nor make any addition thereto or subtraction therefrom, whereby to pretend himself or themselves to be the Inventor or Inventors thereof. 10

AND WHEREAS the said Letters Patent also contain a proviso, obliging me the said Richard Prosser particularly to describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, by an instrument in writing under my hand and seal, and to cause the same to be enrolled in Her Majesty's High Court of Chancery within six calendar months next and immediately after the date of the said in part recited Letters Patent, as in and by the same (reference being thereunto had) will more fully and at large appear. 20

NOW KNOW YE, that, in compliance with the said proviso, I, the said Richard Prosser, do hereby declare that my said invention is described and ascertained in manner following and by the aid of the six sheets of drawings hereunto annexed; (that is to say) my said improvements relate to that kind of machinery or apparatus for manufacturing pipes of metal which operates by means of a pair of revolving rollers, that is, two such rollers having concave grooves around their circumferences, and the said grooves around one roller corresponding to those around the other roller, so as be adapted to receive and take in the metal pipe between the two rollers within two of the said corresponding concave grooves, in order that by the revolving motion of the pair of rollers the metal may be passed through between them in the said two corresponding concave grooves, and that the metal may be compressed and elongated in so passing suitably for giving the required external form and extension to the pipe at several repetitions 35

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of the rolling thereof between the rollers; and the mode of manufacturing pipes of metal by rolling as aforesaid between a pair of revolving grooved rollers was, as regards pipes of lead, invented by Mr. Wilkinson, who had a patent for the same in or about the year One thousand seven hundred and ninety, and as regards pipes which are bended or turned up out of strips of wrought iron plate and welded at the meeting edges of such strips, was the subject of a patent granted to Henry Osborne, on or about the first of March One thousand eight hundred and seventeen. But whereas in such machinery or apparatus for

10 manufacturing pipes of metal only one pair of revolving grooved rollers is used (that is, two such rollers disposed one above the other) to roll the metal between them, it follows that the compression which can be thereby exerted upon the metal of the pipe at each time of rolling, it must be chiefly operative at the upper and lower side of

15 the pipe, and only slightly, if at all, laterally or at each side of the pipe, part of my said Improvements is to combine two pair of revolving grooved rollers in one combination of machinery or apparatus for manufacturing pipes in such manner as that, whilst one pair are operating to compress the metal of the pipe at the upper and lower

20 side thereof, the other pair shall be operating to so compress the same metal laterally at each side of the pipe. Machinery of this kind may be constructed in various ways, but the construction which I prefer is represented in sheets I., II., III. of the drawings herewith annexed; sheet I. being a vertical elevation in front, sheet II. a horizontal

25 plan, and sheet III. a vertical section corresponding to sheet II.; the same letters of reference denote the same parts wherever they appear in all the said drawings. A, and B, are two horizontal axes, disposed one above the other in the same vertical plane; one of them is turned round by the power of mill-work, and a corresponding revolving motion

30 is communicated to the other axes by the two equal spur cog wheels C, D, which are fastened upon the axes A, B, and their teeth gear together. E, and F, are two circular wheels fastened upon the axes A, B, respectively, and having a concave groove around the circumference of each. The two wheels, E, F, being one above the other in the

35 same vertical plane, and forming a pair with their grooves corresponding, and operating, when turned round by their axes A, B, and spur

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wheels C, D, as a pair of revolving grooved rollers, in order to receive and take in the pipe between them in the manner shown at *a*, their operation being to compress the metal at the upper and under sides of the pipe *a*. I, J, are two other revolving circular wheels, each having a concave groove around its circumference, exactly the same as 5 the wheels E, F, except that the two wheels I, J, are disposed one on each side of the pipe *a*, both wheels being in the same horizontal plane, with their concave grooves in correspondence, so as to form a second or additional pair of revolving grooved rollers for receiving and taking in the pipe between them, as shown at *a*, their operation being 10 to compress the metal laterally at the opposite sides of the pipe *a*, at the same time that the said metal is undergoing compression at the upper and under sides of the pipe *a*, in manner already described, by the other first-mentioned pair of wheels or rollers, E, and F. The requisite motion is communicated to the two wheels or rollers I, and J, 15 by means of bevil or mitre cog wheels H, and L, which are fastened to each of the wheels or rollers I, and J, and the teeth of which gear with those of similar bevil or mitre cog wheels, G, and K, which are fastened to each of the wheels or rollers E, and F; and the said mitre wheels G, H, and K, L, being all four of equal size one to the other, and the 20 wheels I, J, and E, F, being also all four of equal size one to the other, the motion of the grooved circumferences of all the said four wheels E, F, and I, J, which receive the pipe *a*, between them, will be exactly alike, and suitable for passing the pipe *a*, through between them, and compressing the metal of the pipe above and below, and also at each of 25 its sides, at the same time. The edges of the circumference of each wheel or roller I, J, and E, F, at each side of the concave groove therein is formed to a bevil or mitre, whereby the circumference of all four wheels are adapted to apply one to the other with contact around the pipe *a*, as represented in sheet I., and the concave groove in each wheel 30 being formed to one fourth part of a circle of the same diameter that the outside of the pipe is to be, then all the four grooves will, between them, leave a circular space or passage *a*, which is adapted to receive and take in the pipe, so as, by rolling it through between the four wheels or rollers I, J, and E, F, to compress the metal of the pipe *a*, on all 35

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sides, as already explained, that is the case if the pipe is required to be of a cylindrical form; but by excavating or turning the concave grooves to any other required form, they may be adapted to give that form to the pipe *a*. The axes of all the four wheels or rollers I, J, and E, F, are situated in the same vertical plane; and by means of suitable fixed framing W, and bearings, 1, 1, 1, for the pivots or gudgeons of those axes, they are sustained in their respective places, and at such distances apart, as that the mitred edges of the circumferences of the four wheels or rollers I, J, and E, F, will be in due contact one with another in manner aforesaid. The bearings 1, 1, 1, for the pivots or gudgeons of each axes may be forked, as represented in sheet L., to conclude each wheel or roller E, F, and I, J, between two of the said bearings; and each forked piece may be fastened by three or more screws against the flat surface of the fixed framing W, but with a small liberty of adjustment by means of wedges 2, inserted between the ends of the several forked pieces and prominent parts *b, b*, of the frame W, so as to adjust the bearings to their proper positions, and to retain them therein. And when machinery or apparatus of this kind is to be used for manufacturing welded pipes of wrought iron, then the iron is to be prepared by rolling the same into thin narrow plates, bars, or strips of suitable length, breadth, and thickness, in the usual manner of what are called skelps (see figure X, sheet III.), and about eight or ten inches at one end of such a plate or strip is bended or turned up, as shown by figures Y, and Z, into an approximation towards the form of a pipe with the edges of the iron meeting each other, or nearly so, by way of a commencement for the intended pipe, the remainder of the length of the iron continuing a flat plate or strip. The iron so prepared is then heated in a reverberatory or other suitable furnace to a welding heat, and on being withdrawn from the furnace in that state, that end Z, which has been previously turned up, is presented end foremost to the passage *a*, between the concave grooves of the four revolving wheels or rollers E, F, and I, J, sheet L., and by their motion they take in the heated iron between them, and compress the iron so much as to bring the meeting edges of the iron together into accurate and close contact whilst the iron is at a welding heat, and thereby those edges become welded together, that action

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being begun at the end Z; but as the iron is taken in and moves forwards through between the four revolving wheels or rollers, the remainder of the length of the iron becomes bended or turned up by their action from a flat plate into the form of a pipe, with the edges meeting in the same manner as was previously commenced at the 5 end Z; that bending and turning up by action of the four revolving wheels or rollers taking place just before the iron actually gets in between them to their gripe or place of mutual contact *a*; but as fast as the iron that is so turned up arrives at that said gripe or place of contact, it is compressed so as to bring the meeting edges into close 10 contact whilst the iron is at a welding heat, and thereby the edges become welded together throughout the length of the iron, and it is converted or manufactured into a welded pipe. But note, although the action of the four revolving wheels or rollers will thus perform the continuance and completion of the turning up of the skelp or plate in 15 manner aforesaid, without previously preparing more than a short portion Z, of one end thereof, nevertheless the whole length of the iron skelp or plate may be previously bended or turned up, if that mode is preferred, or the whole length of the plate or skelp may be previously bended into the form of a concave gutter (that is, it may be 20 partly turned up), and one end of that gutter completely turned up in manner represented at Z, and that end being presented when the whole of the iron is at a welding heat between the four revolving wheels or rollers, they will, as they take the iron in between them, complete the bending and turning up of the remainder of the length from a con- 25 cave gutter into the form of a pipe, with the edges meeting, and the action of the four rollers will compress those edges together, so as to effect the welding as already stated. A mandrel or piston of a suitable size is disposed in the manner shown at R, *r*, sheets II. and III., within the interior of the pipe, whilst it is passing through between the four 30 revolving wheels or rollers, and whilst the iron is receiving compression from them, the mandrel R, *r*, remaining stationary within the interior of the pipe whilst the pipe is moved forwards through between the gripe of the rollers. For this purpose the said mandrel or piston *r*, is formed on the foremost end of a long rod R, of a smaller size than the interior 35

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bore of the pipe, or than the mandril or piston *r*; which is, in fact, an enlargement of the foremost end of the said rod *R*; and that rod *R*, is applied in a horizontal position behind the machine, with its hindermost end supported in a socket at the end of an adjusting screw 3, which

5 screw is borne by a fixed standard *S*, situated at the end of a long horizontal table or platform *T*, fixed behind the rollers, and which table receives the pipe after it has passed through between the rollers. The screw 3, serves to adjust the mandrel rod *R*, *r*, endways, so that its enlarged end, or piston *r*, may be retained in a proper position between

10 the gripe of the four rollers *E*, *F*, and *I*, *J*, as shown in the section sheet III.; and when the turned up end *Z*, of the heated iron is first presented, as already mentioned, to the passage *a*, sheet I., in order to be taken in and passed through between the gripe of the four revolving rollers, then the opening of the turned up end *Z*, is inserted upon the

15 foremost end of the piston or mandrel *r*, which end is made pointed for the purpose of readily entering such open end *Z*; and then, by the further motion that is given to the heated iron by action of the rollers taking it in and passing it through between them, the pipe, as fast as it is formed, is moved along over the stationary mandrel or piston *r*, and

20 the mandrel rod *R*, until the whole length of the pipe has so moved and passed, the said rod *R*, and table or platform *T*, being long enough for thof purpose. The effect of the piston or mandrel *r*, when so applied, is to render the pipe smooth withinside by the said motion of the iron over the piston or mandrel, which in reality passes through all the length at

25 the pipe, although it is the pipe which moves and the mandrel which stands still. The mandrel *r*, also supports the iron internally, where it is compressed between the four revolving rollers in passing through the gripe thereof, preventing the iron from closing in and encroaching upon the intended interior capacity or bore of the pipe; the piston or

30 real mandrel, being the enlarged end *r*, of the rod *R*, *r*, is for that purpose of nearly the same diameter as the said interior capacity or bore of the pipe is intended to be. And note, the aforesaid mode of applying a mandrel *R*, *r*, is no part of my Invention, the same having been heretofore used, but with an ordinary pair of revolving grooved

35 rollers, but is equally applicable to be used along with the machinery or

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apparatus constructed according to this part of my improvements, with four revolving rollers instead of two such. The piston or enlarged end r , of the mandrel rod, R, r , should be made of steel, in order to resist wearing by the friction wherewith the iron passes over it. When the pipe has passed all its length through between the rollers and over the 5 rod R , and is completed, the pipe with the mandrel in it is then removed from the table or platform T , on which it rests, and the mandrel is withdrawn from the pipe; whilst the pipe remains very hot the piston or enlarged end r , is cooled, if necessary, and the rod R, r , may then be restored to its position in the machine, as shown in 10 sheet III., ready for rolling another pipe; but several such mandrels R, r , should be provided, to be used in succession one after another, without waiting for withdrawing each mandrel from the pipe and cooling it. The circumferences of the revolving grooved rollers E, F , and I, J , which effect the welding of the pipes, may move at the rate of 15 three hundred and twenty feet per minute, or even quicker than that, in order to diminish the time during which a pipe is passing through between the rollers and undergoing the operation of welding, which time will, at the aforesaid rate of motion, be about two seconds for a pipe ten feet in length. But note, for welding pipes of that length, it is necessary to 20 support the mandrel rod R , at or near to the middle of its length by a bracket Q , sheets II. and III., which is fixed upon the table or platform T , and the rod R , resting in the inside of the bracket Q , is prevented from bending materially away from its proper straight line. The interior of the bracket Q , is formed with a bell mouth 25 at the side which presents itself towards the four revolving rollers, in order that the foremost end of the iron of the pipe when it is moving rapidly forwards along the rod R , of the mandrel may have no difficulty in entering into the interior of the bracket Q . The rod R , being rather smaller than the interior capacity or bore of 30 the pipe, the iron will advance very easily along the rod. And note, the whole of the rod R , may be made of steel if required, in order to be stiffer and less liable to bend than an iron rod, but an iron rod hammered very hard between swages will in general be stiff enough. Note, a vertical covering plate of iron is applied over the front side 35

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of the fixed frame W, sheet I, to enclose the wheelwork there represented and prevent accidents; and through the middle of that plate is an aperture exactly opposite to the passage α , through between the four revolving wheels or rollers E, F, and J, J, that aperture serving
5 as a guide for the introduction of the heated iron into the said passage in a correct manner. The said covering plate is omitted in the drawings to avoid concealing the wheelwork and framing. Sheet IV. of the drawings hereunto annexed represents the reverberatory air furnace for heating the plates or skelps of iron to a welding heat, and although
10 such furnace forms no part of my present invention, yet being an important part of the apparatus for manufacturing welded iron pipes, it is proper to be described here. Figure 1, is a horizontal plan showing the bed of the furnace, the long fire place, and fire bars across it, the holes B, B, B, through which coal is introduced to the fire place,
15 and the tunnel leading to the chimney. Figure 2, is a side elevation of the furnace at the fire grate side, showing the aforesaid holes B, B, B, also the fire grate and the ash holes beneath the same, also showing by dotted lines the arch of the reverberating roof of the furnace. Figure 3, is a front elevation of the furnace, corresponding to figure 2,
20 and showing by dotted lines the situation of the fire place, the fire bars, the ash hole, and the fire bridge over which the flame from the fire place passes and is reverberated downwards by the arched roof of the body of the furnace to strike upon the iron which is lying upon the flat bed of the furnace. Figure 4, is a side section through the fire place,
25 answering to figure 2; and figure 5, is a longitudinal section answering to figure 3. When the furnace is become properly heated, the skelps or plates of iron bended and turned up at one end, as shown at figure Z, sheet III., are introduced with that end foremost, one by one, through the opening C, figure 1, sheet IV., into the body of
30 the furnace, and are laid along the bed of the furnace side by side with their length crossways to the direction of the current of flame which is passing over the fire bridge, so as by the reverberation of that flame downwards upon the arched roof and striking upon the iron, it shall be heated uniformly and steadily along all its length until it
35 acquires a proper welding heat, the iron lying in the furnace nearly in a

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direction corresponding with that of the rod R, r, of the mandrel, if the same were prolonged, and then the workman with a pair of tongs takes hold of one of the heated plates or skelps which has just acquired the proper heat, by introducing the tongs through the opening A, and drawing out the heated iron by its end Z. Through that opening A, he 5 presents that end Z, to the aforesaid aperture which corresponds to the passage a, between the four revolving rollers, which are situated at about six feet distance from the opening A, of the furnace opposite thereto, and the rollers instantly take in the iron between them, the open end of the part Z, which is turned up applying over the pointed 10 end of the piston or mandrel r, which remains stationary, as already explained, so that by the motion of the four rollers carrying the heated iron through between them, they pass the iron forwards all its length over the rod R, of the mandrel. The compression exerted on the heated iron by the four revolving rollers at the moment when the iron 15 is passing through their gripe or place of contact, gathers the meeting edges of the iron so closely together, that the iron being at a welding heat they become welded together in their said passage, and the piston or mandrel r, gives internal support to the iron at the moment of the compression, and keeps open the internal capacity or bore of the pipe to its 20 full intended diameter, as already explained. A skelp or plate of iron for making welded pipe, 1 inch internal diameter, being eleven feet long, will become twelve feet long when it has passed once through between the four revolving rollers at a welding heat, and has been manufactured by their operation into a welded pipe. The breadth of the skelp or plate of 25 iron must be correctly suited to the circumference of the pipe, so that when the skelp or plate is bended or turned up, with its edges meeting, there will be a proper quantity of metal to reach around that circumference, with just so much excess as that by the compressing action of passing the iron between the four revolving rollers when it is at a good 30 welding heat, the meeting edges thereof will be so firmly pressed together, so as to become securely welded at their junction. Also the thickness of the skelp or plate of iron is to be correctly suited to the intended thickness of the pipe, and the size of the piston or mandrel r, must be adapted accordingly, so as that it will, by the internal 35

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support which it affords to the metal when it is passing through between the gripe of the four revolving rollers, cause a due degree of compressure without causing too great a compressure, and for this purpose a considerable number of mandrel rods *R, r*, should be provided
5 for use with the machine; but as they wear away by use, they will become less in diameter at their piston or mandrel ends *r*. And the mandrels should be kept sorted in sets of mandrels of a like size; and one set or another of such mandrels may be used as is found by trial to suit best for effecting the welding of each lot of skelps or plates; and the
10 greatest care should in all cases be taken in making the skelps or plates of iron, by the usual process of rolling iron, to render them of very uniform breadth and thickness from end to end of each one; and that being attained, every large lot of such skelps or plates is to be carefully sorted into smaller lots, consisting of skelps or plates of precisely
15 similar breadth and thickness, and each such small lot is to be manufactured into pipes by itself, using a set of mandrels of such a size as is found best suited to each particular lot of skelps or plates for giving the iron that exact degree of compression when it is passing through between the four revolving rollers at a welding heat, as will effect the
20 welding in a perfect and sound manner; and very much will depend upon the due heating of the skelps or plates to a proper welding heat without over-heating, and with the greatest uniformity of that heat from end to end, which depends solely upon the care of the workmen in managing the fire on the fire-grate and regulating the draft by managing
25 the damper in the tunnel leading from the furnace to its chimney, so that the fire shall burn at all parts of the length of the fireplace with such force as to cause the utmost possible uniformity of heat within the body of the furnace, and also uniformity of flame to strike down upon the iron lying on the bed of the furnace, in order to impart equal heat
30 to all parts of the length of each skelp; and about three or four skelps or plates are in the furnace together, and are introduced one after another to lay side by side on the bed of the furnace, and each one, as it acquires the proper heat, is withdrawn, and passed through between the four revolving rollers. And note, the entrance to the ash-hole of the
35 furnace may be hung with a row of several doors or hanging

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flaps, which, upon hanging down, will impede the free entrance of air beneath the fire-grate, but when turned up will admit the air freely,—or any other known registers for ash-pit draft; and by due regulation of such doors, letting down some and turning up others, or opening or shutting registers, the admission of air to each portion of the length of 5 the long fire may be regulated so as to cause each part to burn with suitable force for heating the iron with regularity at every part of the length of each skelp or plate, all which precautions are so well known for heating iron for rolling, and also for manufacturing iron pipes by welding, as to require no further explanation. And instead of an air 10 furnace, such as is shown in sheet IV., a furnace blown by blast is in common use for that purpose, and may be used to heat the iron for the rolling by the machinery herein described, if preferred. And, as already mentioned, it is not necessary that the bending or turning up of the skelp or plate of iron into the form of a pipe should be previously per- 15 formed, except at one end thereof, for about eight or ten inches of its length, as represented at figures Y, and Z, sheet III., because the action of the four revolving rollers will, of themselves, perform the requisite bending and turning up of the remainder of the length of the skelp or plate of iron (which remainder is a flat plate), as fast as the 20 same is taken in by the motion of the four revolving rollers, and subjected to their gripe or compressure, the bending and turning up beginning to take place on the edges of the flat plate at a small distance in advance of the gripe of the four revolving rollers, that is to say, the bending or turning up begins before the iron in its motion 25 forward through between the said rollers has arrived at their gripe. And as to the mode of bending and turning up a portion Z, at one end of each skelp of plate, in order to prepare the same in manner represented at figures Y, and Z, sheet III., the said bending and turning up may be per- 30 formed by heating the end of the skelp or plate and operating thereon by hand-hammering with smiths' tools called swages, in the usual mode of bending and turning up skelps or plates in preparation for making welded iron pipes therefrom by hand labour without machinery, excepting that only a portion of one end, and only as much as

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can be conveniently done at one heat, is so turned up instead of the whole length; but if preferred, the whole length may be so bended or turned up in preparation for welding into a pipe by operation of the four revolving rollers, as herein-before explained; and in case of so bending
5 or turning up the whole length, it will be best to heat the whole length of the skelp or plate to a moderate working or forging heat in the furnace, sheet IV., and then the bending or turning up may be done by hand hammering and swaging, employing two or more men to work at the same time on different portions of the length, as may be
10 requisite; or otherwise the bending and turning up of the whole length may be performed by machinery commonly used for such purpose in manufacturing iron pipes, called a crocodile, and which is well known. It operates by biting or pinching the skelp or plate between a pair of
15 strong jaws, which are opened and shut alternately by the power of millwork, and the skelp or plate, being duly heated in the furnace to a moderate working or forging heat, is introduced between the opened jaws of the crocodile, which take in all the length of the iron; and it is laid exactly over a concave gutter or channel formed in the under fixed jaw, and then, when the upper moving jaw closes, it brings down upon
20 the hot iron a convex corresponding to the said concave gutter beneath the iron, and pinches the same all its length at once into a gutter form; which being done, and the upper moving jaw having opened again, the iron in its said gutter form being still hot is removed to another concave gutter of suitable form at one side of the former, and parallel thereto,
25 the edges of the iron being suitably placed in the concave, and when the upper moving jaw closes again, it brings down a suitable concave gutter over the hot iron in such manner as that, by being pinched between the two concaves, it becomes turned up, with its edges meeting, or nearly so, and ready, when heated in the furnace to a welding heat,
30 to be passed through between the four revolving rollers, in order to become welded, as herein-before described. And note, it has been already stated that the vertical covering plate which is fixed in front of the wheelwork, sheet I., as an aperture through the middle of it exactly opposite to the passage *a*, through between the four revolving

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rollers, in order to conduct the heated iron correctly into that passage. It should be remarked that the smallest part of such aperture should be about one inch and three quarters diameter for making a pipe of one inch diameter inside, and which will usually be one inch and one fifth diameter outside, the large or front end 5 of the said aperture being of an ample size, as eight or ten inches diameter, and projecting forwards a length of twelve or fourteen inches. And in case of the skelp or plate being only bended or turned up at a portion of one end Z, figures X, and V, sheet III., by way of preparation for passing such iron (when heated to a welding 10 heat) through between the gripe of the four revolving rollers as hereinbefore described, then it is the interior sides of the said aperture which, as fast as the heated iron passes through the same, commences the requisite bending and turning up of the remainder of the length of the heated iron from the state of a flat plate to such a concave or gutter 15 form as would be suitable for entering and being taken in between the gripe of the four revolving rollers, in order by their action, as fast as the iron arrives at their said gripe, to be completely turned up and the edges brought to meet and compressed together so as to become welded together. And note, if the said welding is performed at once passing through 20 between the four revolving rollers, it will require great care and precision in preparing the skelps or plate of very uniform breadth and thickness, and with that breadth accurately adapted to suit the size of the pipe, that the four revolving rollers are at the time adapted to make (for note, as their grooves wear away wider the passage *a*, sheet I., 25 between them will become somewhat larger). Also the size of the piston *r*. of the mandrel R, *r*, is to be judiciously adapted to suit the thickness of the particular skelps or plates that are at the time to be passed through the four revolving rollers; all which precautions have been already mentioned, are required in all the modes heretofore practised of 30 manufacturing welded iron pipes by rolling, but are still more necessary in performing the operation by the machinery herein described, because the heated iron is only to be passed through once for performing the welding, instead of passing several times between two revolving grooved

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rollers, and that through passages or grooves of smaller size at the later times of passing than the former or preceding times of passing; and although I have succeeded in making sound welded pipes at once passing through between four revolving grooved rollers by taking great
5 care in the preparation of the skelps and the heating of them, and in the several precautions herein-before explained, nevertheless if any difficulty is found in doing that, the pipes which have been so welded may be re-heated in the furnace to a moderate welding heat and re-passed through another set of four revolving grooved rollers, exactly like those in
10 sheet I., but with the passage α , between them a very little smaller, and a piston or mandrel r , also a little smaller; and if twice passing in such manner is not found sufficient for effectual welding, then the pipes may be again re-heated in the furnace, and passed a third time through another such machine as sheet I., but with a still smaller passage α ,
15 and if requisite more such machines may be used in succession. But what I prefer is to employ the said two or three or more machines in combination as one machine, so that the iron, in being passed once through the first machine, sheet I., as already described, will also pass through both or all three or more machines, the iron being subjected
20 by their several sets of rollers to as many succeeding gripes or pressures, and that so quickly one after the other that the iron will retain its original welding heat. The said two, three, or more machines must be fixed up in parallel vertical planes, one beyond another, with their several passages α , in one horizontal straight line; and by toothed
25 wheelwork or millwork the four revolving rollers of each set must be turned round with corresponding motions, so as to take in the pipe forwards by each one as fast as the preceding one delivers or passes the pipe through, which may be either to give an exact equality of velocity to the grooved circumference of the rollers of each succeeding set, or
30 else the velocity of the second set may be greater than the first, so as to effect a slight degree of drawing in the pipe while it is in both machines, by communicating a faster motion to the second machine than to the first, and so on. And in case of large pipes of iron and pipes for the rollers of printing machines, &c. it will be desirable that a

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reciprocating or backward and forward motion be communicated to the machine, so as to roll and re-roll each pipe, instead of rolling it only once.

Sheet V. shows an arrangement of machinery for rolling pipes turning up flat plates or skelps into pipes. The wheels G, and H, gear into a wheel D, (see note on drawing, sheet V.), and this provides for the revolution of the wheels I, through the medium of the shaft *i*, and for the motion of the wheel E, through the shaft A. Similar toothed wheels, L, C, K, give motion to the wheels F, and J, through the medium of the shafts *j*, and B; *z*, are the adjusting wedges, and *b*, blocks, which resist the pressure and prevent the wheels F, J, E, I, receding from each other. Figure 1, shows a method of construction which allows the wheel I, to be removed with greater facility, and B, is part of the shaft upon which such wheel I, is mounted, upon a square part of the end of such shaft B, by means of two or more keys.

Sheet VI. shows an arrangement of three wheels or rollers I, F, E. The wheel I, is moved through the medium of the shaft *i*, and the wheel E, through the medium of shaft A, by bevil toothed wheels G, D, H; and the wheel F, is moved through the medium of the shaft B, by suitable power applied to the wheels C, D. All these three wheels, I, F, E, are mounted upon their axes in the manner shown by figure 1, on sheet V.

By the word pipes, I designate any hollow, cylindrical, elliptical, or other form, of whatever metal or mixture of metals the pipe may be composed, and without any limitation as to internal or external diameter or length; and the machinery on drawings, sheets I., II., III., V., and VI., shows my methods of applying my invention to the manufacturing of welded iron pipes, whether such pipes are afterwards used for the conveyance of gas or fluids, or used for railway bars in the form of hollow cylinders or pipes. I also claim the employment of such machinery as shown in drawings, sheets I., II., III., V., and VI., and for turning up flat strips of metal into pipes; and also the application of such machinery to the rolling of pipes of metal or mixtures of metal, such as pipes employed in locomotive engines with tubular boilers, and pipes of copper

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or brass to be employed as rollers for printing calicoes or other substances.

Having now described my said Improvements in machinery and apparatus for manufacturing pipes, I the said Richard Prosser do hereby
5 declare, that the new Invention, whereby the exclusive use is granted to me by the said Letters Patent, consists partly in the combination herein-before described of four or three revolving grooved rollers so disposed that they will all four (or all three) act in concert to compress the metal of the pipe which is passed through between them at all the four,
10 or all the three sides of the circumference of the pipe, at the same time such four (or three) revolving grooved rollers being connected together by toothed wheelwork, according to either of the two modes herein-before described, or else in any other suitable mode, so as to ensure that their several circumferences which operate upon the pipe shall move in the
15 same direction, and either with equal velocities of motion or else with such regulated difference of velocity between the velocity of the said circumference or circumferences one or more of such rollers and the velocity of the circumferences or circumference of the others or the other of the said four (or three) revolving rollers as may best suit for forming the
20 particular kind of pipes upon which the said machinery or apparatus is intended to operate; and such two or three combined revolving rollers to revolve either continuously in the same direction, or else to turn alternately forwards and backwards, that is to say, first forwards in one direction, in order to pass the pipe through between them,
25 and then backwards, or in a contrary direction, in order to repass the pipe back again between them, according as one or other of those modes of rolling may best suit for forming the particular form of pipes upon which the said machinery or apparatus is intended to operate: And partly in the further combination herein-before described of two, three,
30 or more sets or systems of such combined revolving grooved rollers as aforesaid, through or between the gripes of which sets of rollers the same pipe will pass in close and quick succession from one such gripe to the next, so as to be compressed first by passing through between the combined revolving rollers of one set, and then the same pipe, as it passes a

B

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little further onwards, being compressed again by passing through between the combined revolving rollers of a second set; and then the same pipe may be again compressed by passing through between the combined revolving rollers of another succeeding set,—a third set be provided,—and so on, through as many sets as may be combined together, the several sets of rollers being disposed at such distances apart one from another as will best suit; that is, they may be either as close together as the construction of their wheel-work and framing will admit, so that the pipe will begin to enter into between the revolving rollers of a succeeding set immediately after having passed through between those of a preceding set, and therefore the pipe will be undergoing compression at different parts of its length at the same time, or the said sets of rollers may be situated as far apart one from another as the greater part of or nearly the whole length of the pipe that is to be operated upon, so that the foremost end of the pipe will only just arrive at and begin to be taken in by or between one succeeding set a little before the whole length has completely passed through and escaped from the preceding set; and such successive sets of rollers as aforesaid may be set slightly out of parallelism one with another, that is, with the central lines of their several passages *a*, sheet I., arranged in a curved line instead of in a straight line, in order that the pipe in passing through such a set may become curved to an inch of a circle, in case of curved pipes being required: And partly in the further combination which such machinery, containing, as aforesaid, four or three revolving grooved rollers, of a trumpet-mouth aperture to receive and conduct the metal into the gripe of or passage through between the rollers, whereby, together with the action of those rollers, the bending and turning up of the plate of metal from a flat state or from a gutter state to the form of a pipe, with the edges meeting or nearly meeting, as may be required, a portion of one end only of such plate having been previously bended or turned up by way of commencement for entering in between the gripe of the rollers; and such bending or turning up of plates into the form of pipe, by this action of the said machinery, being performed either on iron skelps or plates heated to a working red heat, and turned up, with the edges

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meeting or nearly so in the form of pipes, as a preparation for being afterwards welded together either by action of the said or like machinery, or by any other means, or else for bending and turning up plates with the edges meeting close, in the manner of pipes, to be
5 united by soldering, or to be merely united by close contact, without adhesion.

In witness whereof, I the said Richard Prosser have hereunto set my hand and seal, this Twenty-sixth day of September, in the year of our Lord One thousand eight hundred and
10 forty.

RICHARD PROSSER. (L. S.)

Signed, sealed, and delivered by the within-named Richard Prosser, in the presence of

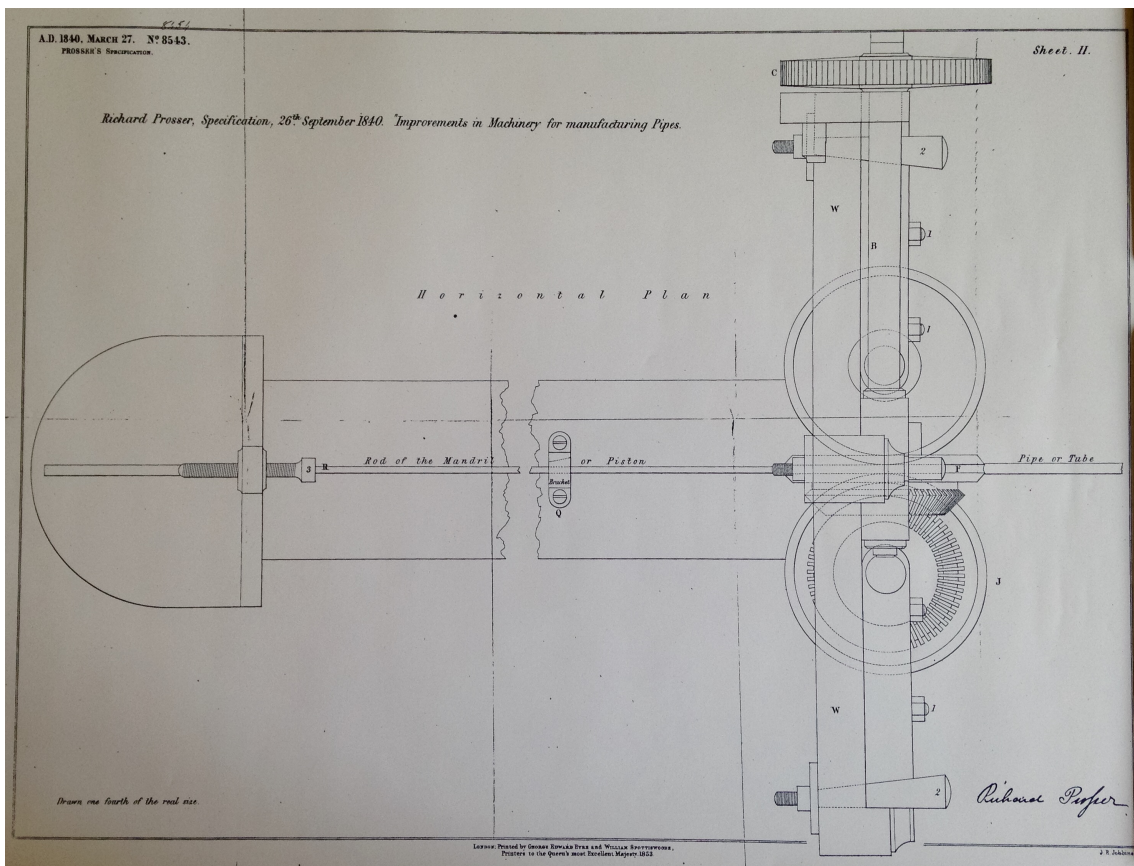
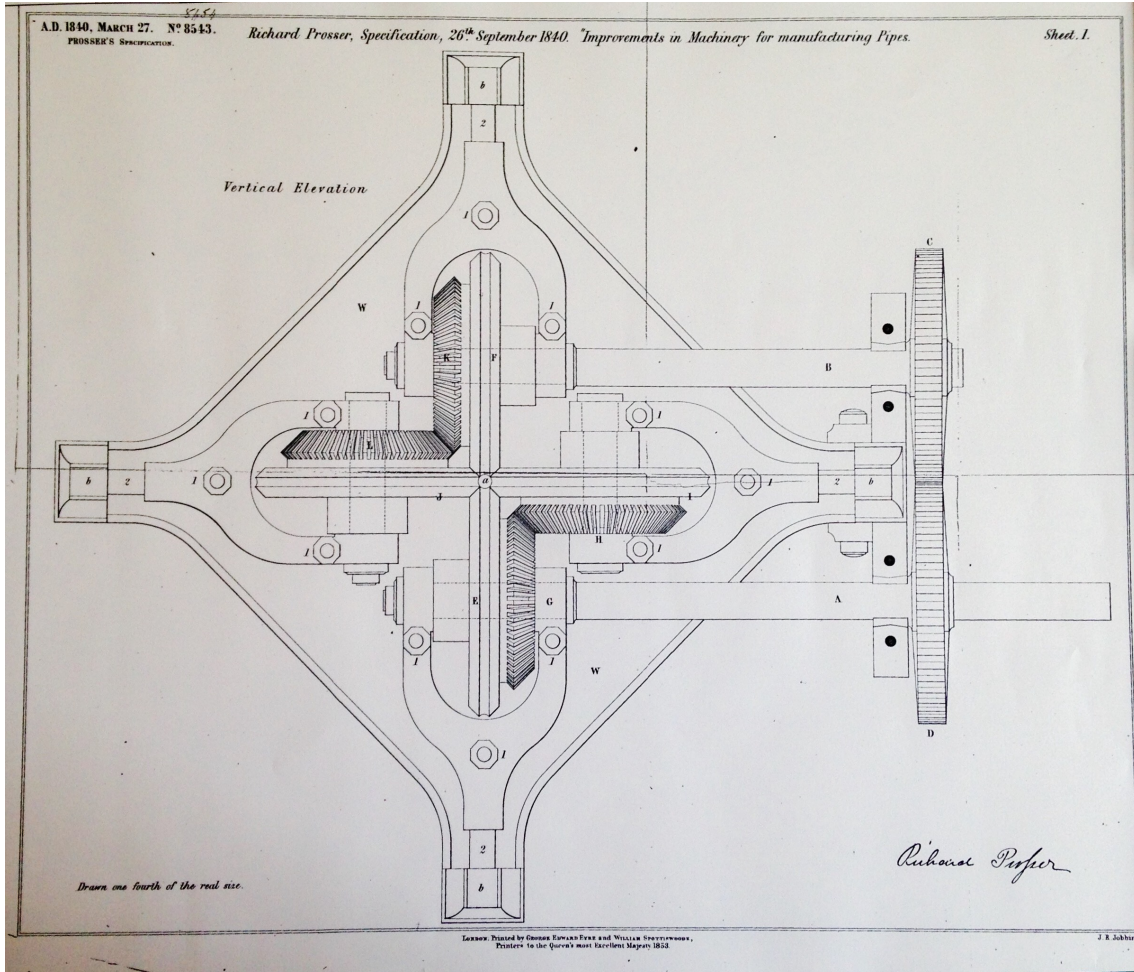
15 J. WOODCOCK,
20, Lin^s Inn Fields.

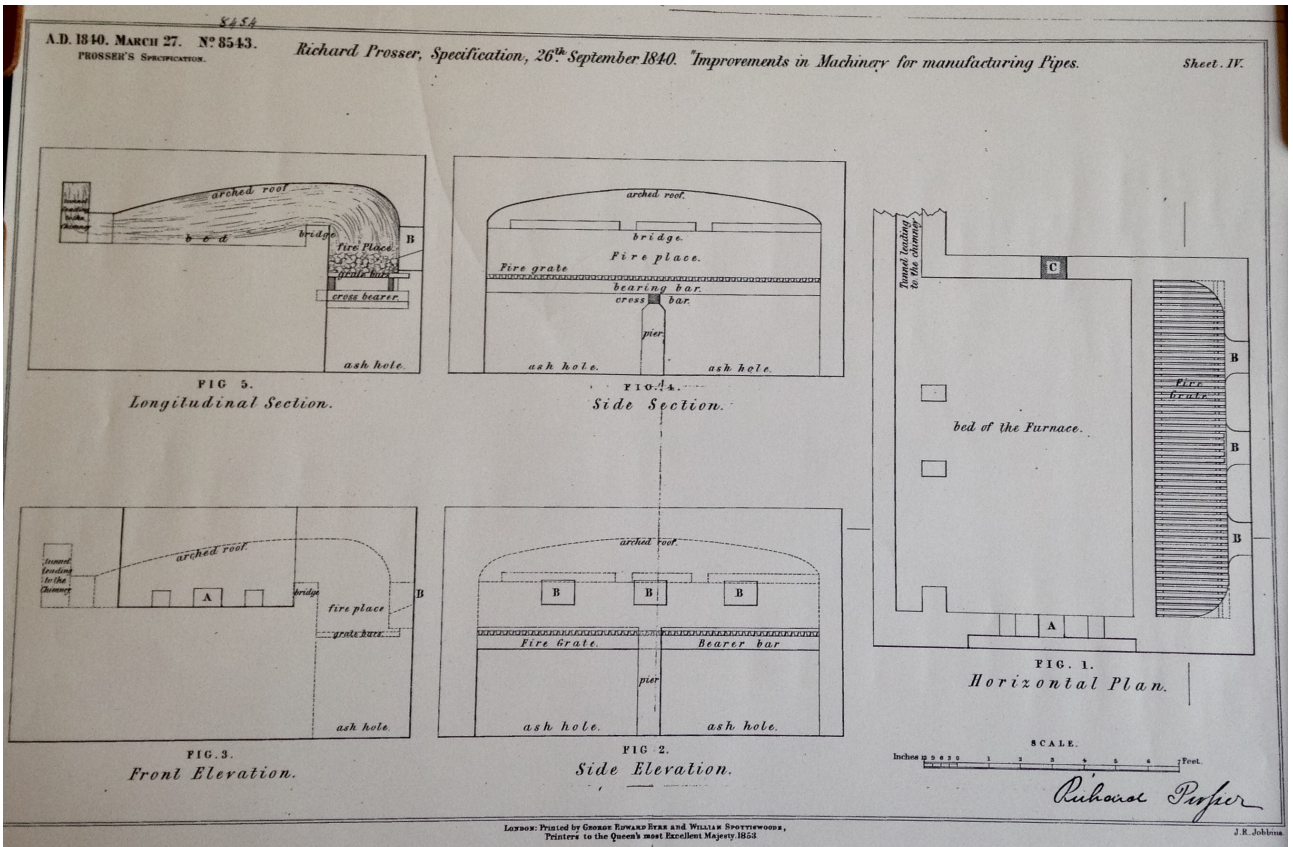
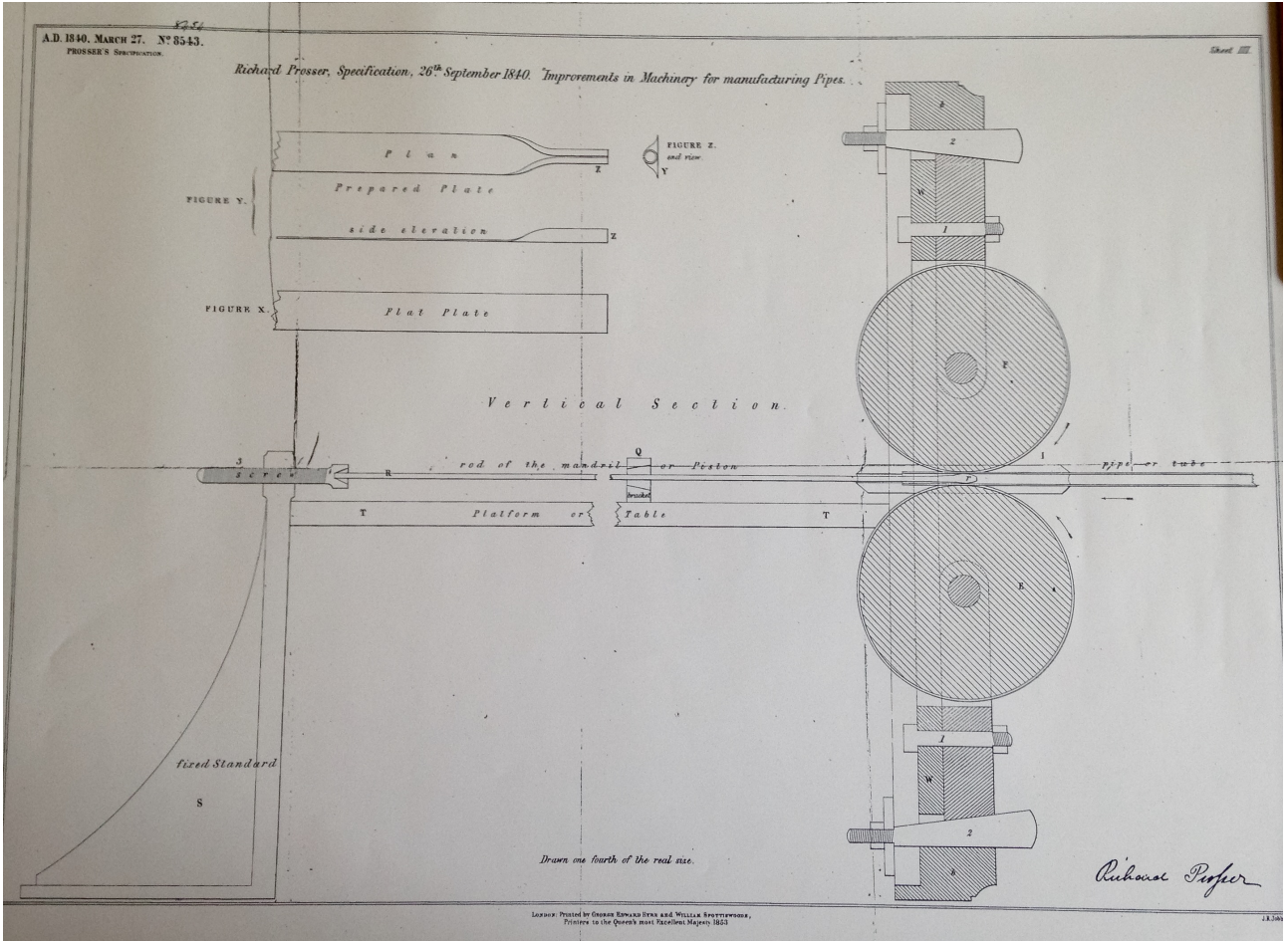
And be it remembered, that on the Twenty-sixth day of September in the year of our Lord One thousand eight hundred and forty, the aforesaid Richard Prosser came before our said Lady the Queen in
20 Her Chancery, and acknowledged the specification aforesaid, and all and everything therein contained and specified in the form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose.

Enrolled the Twenty-sixth day of September, in the year of our Lord
25 One thousand eight hundred and forty.

LONDON:

Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1853.

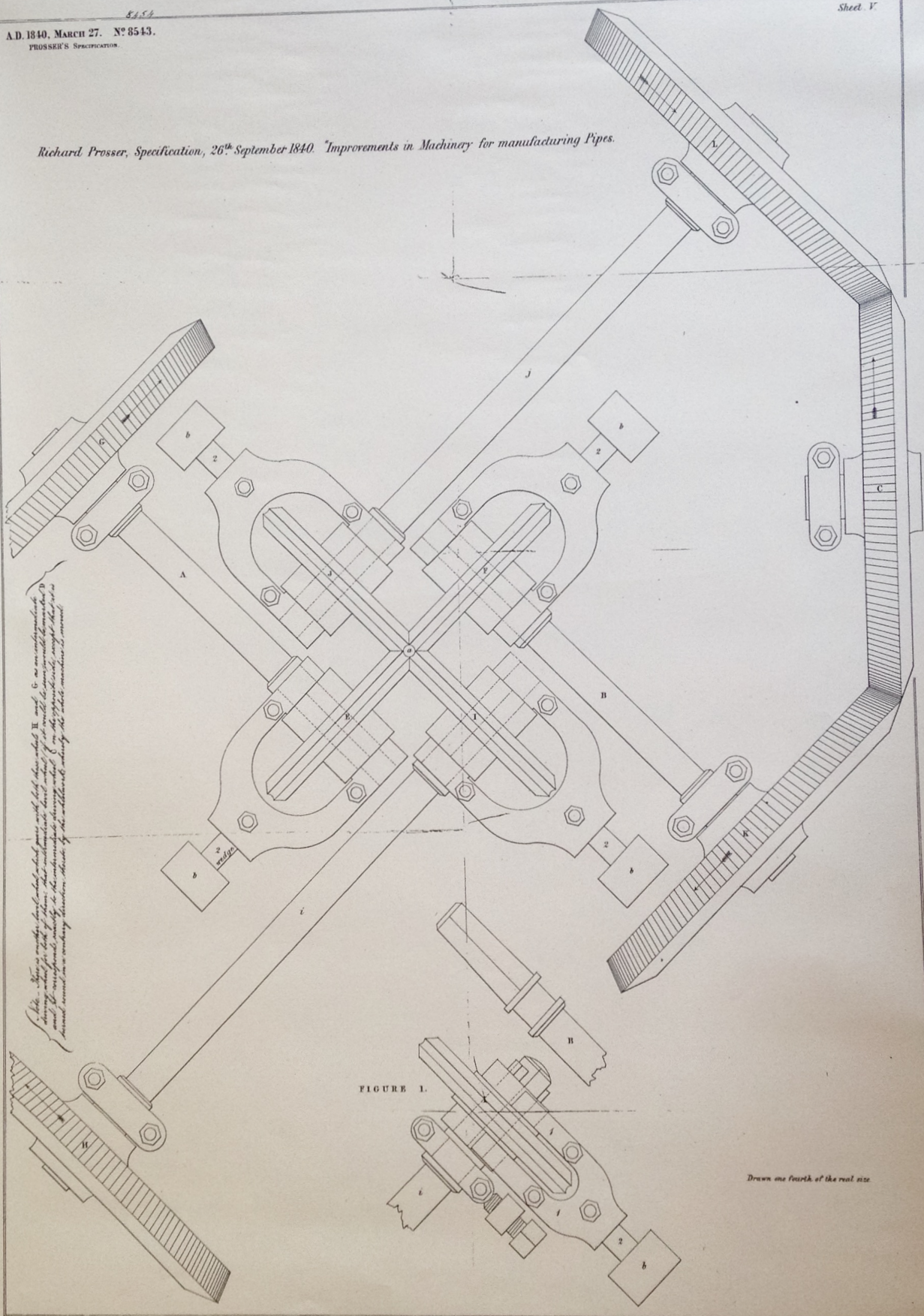




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PROSSER'S SPECIFICATION.

Sheet V

Richard Prosser, Specification, 26th September 1840. *Improvements in Machinery for manufacturing Pipes.*



The rollers on the right are intended to guide the pipe, and the rollers on the left are intended to support the pipe, and the rollers on the bottom are intended to support the pipe, and the rollers on the top are intended to support the pipe.

FIGURE 1.

Drawn one fourth of the real size.

London: Printed by GEORGE ROWLAND FOX and WILLIAM BARNWELL, Printers to the Queen's most Excellent Majesty 1843.

J. R. Lamb

