Specification of Arthur Woolf : steam and other boilers.

Contributors

Woolf, Arthur.

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A.D. 1803 . . . . . N° 2726.

SPECIFICATION

OF

ARTHUR WOOLF.

STEAM AND OTHER BOILERS.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
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Price 1*s.* 5*d.*

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A.D. 1803 . . . . . N° 2726.

Steam and other Boilers.

WOOLF'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, ARTHUR WOOLF, of Wood Street, Spa Fields, in the County of Middlesex, Engineer, send greeting.

WHEREAS His present most Excellent Majesty King George the Third, in and by His Letters Patent under His Great Seal of the United Kingdom of Great Britain and Ireland, bearing date at Westminster, the Twenty-ninth day of July, in the forty-third year of His reign, for Himself, His heirs, and successors, did give and grant unto me, the said Arthur Woolf, my executors, administrators, and assigns, His especial licence, full power, sole privilege and authority that I, the said Arthur Woolf, my executors, administrators, and assigns, and every of them, by myself and themselves, or by my and their deputy or deputies, servants or agents, or such others as I, the said Arthur Woolf, my executors, administrators, or assigns, should at any time agree with, and no others, from time to time, and at all times thereafter during the term of years therein expressed, should and lawfully might make, use, exercise, and vend, within that part of His said Majesty's United Kingdom called England, His Dominion of Wales, and the Town of Berwick upon Tweed, my Invention of "AN IMPROVED APPARATUS FOR CONVERTING WATER OR OTHER LIQUIDS INTO VAPOUR OR STEAM FOR THE WORKING STEAM ENGINES, FOR THE HEATING OF WATER OR OTHER LIQUIDS EMPLOYED IN BREWING, DISTILLING, DYING, BLEACHING, TANNING AND OTHER PROCESSES CONNECTED WITH ARTS AND MANUFACTURES; CALCULATED ALSO TO MAKE A STRONGER EXTRACT THAN CAN BE OBTAINED BY THE PROCESSES COMMONLY

IN USE FROM A GIVEN QUANTINY OF ANY VEGETABLE OR OTHER SUBSTANCE FROM WHICH EXTRACTS ARE OR MAY BE MADE, WITHOUT THE DANGER OF BURNING, SCORCHING, OR SINGEING SUCH VEGETABLE OR OTHER SUBSTANCES, AND APPLICABLE TO VARIOUS OTHER PROCESSES;" in which said Letters Patent there is contained a proviso obliging me, the said Arthur Woolf, by an instrument in writing under my hand and seal, particularly to describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, and to cause the same to be inrolled in His said Majesty's High Court of Chancery within one calendar month next and immediately after the date of the said recited Letters Patent, as in and by the same, relation being thereunto had, will more fully and at large appear.

NOW KNOW YE, that in compliance with the said proviso, I, the said Arthur Woolf, do hereby declare that the nature of my said Invention, and the manner in which the same is to be performed, are described and ascertained in manner and form following, and in the Drawings hereunto annexed, that is to say :—

My new or improved apparatus doth consist, first, of two or more cylindrical vessels properly connected together, and so disposed as to constitute a strong and fit receptacle for water or any other fluid intended to be converted into steam, whether at the usual heats or at temperatures and under pressures uncommonly high, and also to present an extensive portion of convex surface to the current of the flame or heated air or vapor from a fire. Secondly, of certain other cylindrical parts or receptacles placed above the said first-mentioned cylinders, and properly connected therewith for the purposes of containing water and steam, and for the reception, transmission, and useful application of the steam generated from the heated water or other fluid. And, thirdly, of a furnace so adapted to the cylindrical parts just mentioned as to expose the greater part of the surface of all and each of them, or as much of the said surface as may be convenient or desirable, to the direct action of the fire or heated air and vapour. And in order that the construction, disposition, application, and advantages of this my said apparatus may be more fully and clearly understood, I do proceed to exhibit by Drawings and descriptions some of the precise methods of carrying the same into practice and effect. Fig. 1 represents a boiler, made of cast iron or any other fit material, consisting of eight tubes marked *a*, which have a communication with each other and with the cylinder A placed above them, by means of connecting cylinders or tubes attached to the respective parts in a good and workmanlike manner: see *b*, Fig. 2, which exhibits an end view of the apparatus. Fig. 3 shews a side view, and exhibits the manner in which the fire is made to act upon it; A being the main cylinder,

and *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, the smaller ones. The fire, which rests upon the bars at B, being reverberated from the arch which passes over the two first smaller cylinders, goes under the third, over the fourth, under the fifth, over the sixth, under the seventh, and partly over, partly under, the eighth smaller cylindric tube. The direction of the flame, till it reaches the last-mentioned tube, is shewn by the dotted curved line and arrows. When it has reached that end of the furnace, it is carried by the flue C to the other side of a wall built under and in the direction of the main cylinder A, and then returns under the seventh smaller cylinder, over the sixth, under the fifth, over the fourth, under the third, over the second, and partly over, partly under, the first, when it passes into the chimney. The wall before mentioned, which divides the furnace longitudinally, answers the double purpose of lengthening the course which the flame and heated air have to traverse, giving off heat to the boiler in their passage, and of securing from being destroyed by the fire the flanges or other joinings employed to unite the smaller tubes to the main cylinder. The ends of the smaller cylindric tubes rest on the brickwork which forms the sides of the furnace, and one end of each of them is furnished with a cover, secured in its place by screws or any other adequate means, but which can be taken off at pleasure, to allow the tubes to be freed from time to time from any incrustation or sediment which may be deposited in them. To any convenient part of the main cylinder a steam tube or steam tubes are affixed, to convey the steam to the steam engine or to any vessel intended to be heated by means of steam. Fig. 4 is a view and cross section of two such boilers as I have been describing and their furnaces, in which A, A, represent the two main cylinders, *a*, *a*, two of the smaller cylinders, having the joining between them and the main cylinders built into the walls W, W, which divide the furnaces F, F, F, F, longitudinally, as before mentioned. From A, A, rise the steam tubes S, S, which convey the steam to any part desired by means of the tubes T, T, T. The fuel is introduced into the fire-places P, P, at the mouth-pieces M, M, which I have here represented of the form adopted by Mr. John Roberton, of Glasgow, and for which he has obtained His Majesty's Royal Letters Patent. Of course this method cannot be employed by any person without the license of the Patentee, nor do I claim any other right to it than what any one may purchase, nor is it essential to my apparatus, as any of the doors in common use for furnaces will answer; but I prefer his for reasons not necessary to be detailed in this place. B, B, are the bars of the furnaces, and Z, Z, the ash pits. The brick or mason work is represented in yellow. Fig^{s} 5, 6, 7, and 8, are sections of another boiler, constructed on principles similar to the one just described, but having the cylindric tubes of which it is composed arranged and combined

in a manner somewhat different from the former. In Fig. 5, A is the main cylinder, crossing the smaller cylinders *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, half way between their middles and the ends marked *a*, but not joined to them at the points at which it crosses them. It is put in this place that it may come over that part of the furnace S, S, S, S, S, S, S, S, through which the flame first passes and receives its direct action, which it does over nearly a half of its surface, as may be seen by looking at the vertical section A, S, S, Fig. 8. The smaller cylinders have a communication with the main cylinder in the following manner. Three small cylinders C, C, C, are placed parallel to the main cylinder A, over the smaller cylinders *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, in such a manner that each of the cylinders C, C, C, take in three of the smaller cylinders *a*, *a*, *a*, being united to and connected with them by nicks and flanges (or other fit joining), as shewn in Fig. 6, which is a longitudinal vertical section of that part of the apparatus. The cylinders C, C, C, have a direct communication with the main cylinder A by the pipes or tubes P, P, P, as may be better seen by the cross vertical section, Fig. 8, in which the same parts are marked with the same letters as in Figs 5 and 6. The three tubes C, C, C, are preferred to one long tube, to prevent any derangement taking place in the furnace or in the tubes, by the expansion and contraction occasioned by changes of temperature, which would be much more considerable in one tube of the whole length of the furnace than when divided into three portions; and it is for the same reason that the tube A is not made to communicate directly with the smaller tubes *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, but mediately by means of the tubes marked C and P. N.B.—The two outermost of the tubes marked P may be carried from C to A, from the parts of the tube C marked with the letter *m*, and instead of going parallel to the middle tube P, may be inclined towards it so as to join the cylinder A near the middle, or any other direction may be given to them to prevent derangement by expansion. (Fig. 15 shews another way of establishing a communication between the different parts of such a boiler. A and C are sections of the cylindric tubes, marked with the same letters in Figs 5 and 6, and the openings *c*, *d*, *e*, *f*, are the places by which they communicate with the lower tubes *a*, *a*, *a*. When this way of making a communication between the different tubes which compose the prime boiler is adopted, the tube C may be placed directly over the middle of that half of the furnace, and closed in with brickwork, exactly in the same manner as the tube A, Fig. 8, which is placed over the other half of the furnace.) Fig. 7 is a longitudinal vertical section of the boiler and furnace through the center of the axis of the main cylinder, shewing the course which the flame and heated air are forced to take. The first three smaller cylinders are completely surrounded

with flame, being directly over the fire; the flame is stopped by the brick-work W over the fifth, and forced to pass under it, and then over the sixth, where it again meets with an interruption which forces it to go under the seventh, over the eighth, and partly over, partly under the ninth. It then turns round the end of the longitudinal wall which divides the furnace, and passes over the eighth smaller cylinder, under the seventh, and so on, alternately over and under the other tubes till it reaches the chimney B. The wall that divides the furnace may be seen in Fig. 5, N, N, and at N, Fig. 8. In these boilers, as in the common boilers for steam engines, the water evaporated by the heat must be replaced by water forced in by the usual means; but to insure its reaching the smaller tubes with certainty, the supply is sent directly into them by the pipe *o*, *o*, which has a communication with each of them by a short branch, as shewn in the Drawing, Fig. 5; the other ends of the smaller cylinders *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, are fitted with caps, or any proper contrivance that can be taken off occasionally to clean out the boiler. Fig. 9 is another section on a larger scale of one of the tubes, marked C in Figs 5 and 6, shewing a different way of joining it to the lower tubes *a*, *a*, *a*. Here, instead of employing flanges, the branches from the tubes or cylinders *a*, *a*, *a*, are adapted, but not to fit close to parts made to correspond in the tube C, and the space between them is filled with any proper cement, as a mixture of iron filings, flowers of sulphur, and sal ammoniac, and the tubes *a*, *a*, *a*, and C, are kept secure by the bolts *b*, *b*, *b*, and the screws and nuts *d*, *d*, *d*. To facilitate the introduction of the cement before mentioned into the joinings of the tubes C and *a*, holes are made in the cylinder C, opposite the parts to which the tubes *a*, *a*, *a*, are to be joined, large enough to admit a man's hand; to these holes are adapted covers, which are secured in their places by the same bolts and nuts that secure the tubes C and *a* from separating. A very secure and convenient way for closing the end of the cylindric tubes is shewn in this Figure at *f*, which is the cover of the tube C. It is made of an eliptical form, as is also the opening in the tube C, so that its shortest diameter can enter by the longest diameter of the opening C. When introduced, it is then turned in such a manner as to make the longest diameter of *f* coincide with the longest diameter of the opening in C, to which it is fitted. It is then brought home to its place, and secured there by the bolt, the nut, and cross bar, shewn in the Drawing. Fig. 10 is an end view of the tube C, shewing the opening. This method of closing vessels which are to sustain a great internal pressure, is one of the best that can be employed, as the cover fits the closer the greater the pressure; but I do not claim it as new or as any part of my Invention, nor is it material to my Invention in what way the tubes are closed, provided they are

made sufficiently close to resist the great expansive force of the steam, and provided they can be opened when necessary for the purpose of cleaning. In cases where it may be wished to increase the power or production of steam without employing the very high degrees of heat which boilers constructed on the principles before described are capable of sustaining, my Invention may be applied to boilers already in use, as in the case of the common oblong boiler, now in very common use for steam engines. To increase very considerably the quantity of steam produceable by such a boiler, my Invention may be applied in the following or any analogous manner. Fig. 11 represents a common oblong boiler of a steam engine, and Fig. 12, an end view of the same. The flame is made to pass through the body of the boiler by a channel, pipe, or flue F, F, Figs 11 and 12; the bottom *m* is arched, as shewn in Fig. 12, and marked by the line *m*, *m*, in Fig. 11. Below such a boiler, place the tubes *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, connecting each of them with the body of the main boiler by a pipe P, Fig. 12, and let the ends of the tubes at C, Fig. 12, be furnished with moveable covers, to be taken off at pleasure, for the purpose of cleaning out the tubes when that may be necessary; the arrows in the Drawing shew the course of the flame from the fire-place A till it enters the flue F, which passes through the body of the boiler. Another very powerful boiler, on similar principles, may be made by constructing an oblong boiler in two main parts A and B, Fig. 13, and connecting the two by vertical tubes, as shewn in that Figure and in the horizontal section through the line *a*, *b*, Fig. 13, represented in Fig. 14, in which the arrows shew the direction of the flame. To give any further illustration of the great variety of modifications of which my Invention is susceptible is unnecessary, as in the foregoing descriptions I have endeavoured to be as clear and explicit as possible, that the public may fully enjoy the benefit of my Invention when the term of my Patent is expired; and from the examples I have given, no person acquainted with the nature and uses of boilers can be at a loss to apply my said Invention, modified according to circumstances, to any case that may present itself. It may not be improper, however, to call the attention of those who may hereafter wish to construct such apparatus to one circumstance, which, indeed, can hardly escape notice from the description which I have given, namely, that in every case the tubes composing the boiler should be so combined and arranged, and the furnace so constructed as to make the fire, the flame, and heated air to act around, over, and among the tubes, embracing the largest possible quantity of their surface. It must be obvious to any one that the tubes may be made of any kind of metal, but I prefer cast iron as the most convenient. The size of the tubes may be varied, but in every case care should be taken not to make their

diameter too great; and it must be remembered that the larger the diameter of any single tube of such a boiler, the stronger must it be made in proportion to enable it to bear the same expansive force as the smaller cylinders. It is not essential however to my Invention, that the tubes should be of different sizes; but I prefer that the upper cylinders, especially the one which I call the main cylinder, should be larger than the lower ones, it being the reservoir, as it were, into which the lower ones send the steam to be thence conveyed away by the steam pipe or pipes. The following general direction may be given respecting the quantity of water to be kept in a boiler on my construction; it ought always to fill, not only the lower tubes, but the main cylinder A and the cylinders C to about half their diameter, that is, as high as the fire is allowed to reach, and in no case ought it to be allowed to get so low as not to keep full the necks or branches which join the smaller cylinders marked with the letter *a* to the cylinders A or C, for the fire is only beneficially employed when applied, through the medium of the interposed metal, to water to convert it into steam; that is, the purpose of my boiler would in some measure be defeated if any of the parts of the tubes exposed to the direct action of the fire should present in their interior a surface of steam instead of water, to receive the transmitted heat, which must more or less be the case if the lower tubes, and even a part of the upper, be not kept filled with the liquid. Though I have only mentioned such arrangements of tubes as present them in an horizontal or in a vertical direction, yet they may be put in other positions, at the pleasure of the workman, without destroying the effect intended to be produced, if the instructions I have given in this Specification be properly attended to. As to the construction of the furnaces, though that must be obvious from the Drawings, it may not be improper here to remark, that they should always be so built as to give a long and waving course to the flame and heated air or vapour, forcing them the more effectually to strike against the sides of the tubes which compose the boiler, and so to give out a large portion of their heat before they reach the chimney; unless this be attended to, there will be a much greater waste of fuel than necessary, and the heat communicated to the contents of the boiler will be less from a given quantity of fuel. My Invention is not only applicable to all the uses to which the boilers in common use are generally applied, but to all of them, with much better effects than the latter, and can besides be applied to purposes on which boilers constructed as they have hitherto been would be of little or no use. The working of all kinds of steam engines is one important application of my Invention; for the steam may be raised in a boiler constructed in the manner before described to such a temperature, and consequently to such an expansive force, as to work any engine,

even without condensing the steam, but by simply allowing it to escape into the atmosphere after it has done its office, as proposed by Mr. James Watt, in the Specification of his Patent, dated January Fifth, One thousand seven hundred and sixty-nine, where he says, engines may be worked by the force of steam only, by discharging the steam into the open air. In all cases where it is desireable to heat or boil water or other fluids and substances without the direct application of fire to the vessel or vessels containing them, which in such cases become secondary boilers, the use of my apparatus will produce effects superior to any obtainable by other means, no more being necessary than to make the vessel or secondary boiler, containing the water or other fluids and the substances immersed or dissolved in or blended or mixed with the water or other fluid, to communicate by means of a tube or tubes with the prime boiler constructed in the manner before described. In such cases, as in making extracts of every kind for the various purposes of arts and manufactures, and for the simple boiling of water or watery fluids, the steam should go directly into the vessel or secondary boiler, whose contents are to be heated or boiled, and the orifice or orifices of the pipe or pipes through which the steam is conveyed should go to a considerable depth in the fluid, that the steam may be the better able to give off its heat and be condensed before it can reach the surface; and in every such case an allowance should be made for the increase which will be made to the quantity of liquid in the vessel to be heated, by the quantity of steam which will be condensed in the same before the process be ended. The vessels into which the steam is thrown may be either open or close as the nature of circumstances may require, but where extracts are to be made from vegetable or other matters from which extracts are or may be made, as from hops, bark, drugs, and dye stuffs, for brewing, tanning, dying, and other processes, the material will be much more completely exhausted of all their valuable parts, and in many instances they will be completely dissolved, by employing close vessels, which in that case must be made very strong, a thing not difficult to be accomplished, when it is recollected that they may be at a distance from, and consequently out of the power of being deranged by, the fire, and that they may be surrounded with, and as it were buried in, massy stone or brick work, in addition to other and obvious means of securing them. My apparatus so employed becomes in fact an improved Papins digester on a small scale. I do not wish to be understood as claiming the merit of having been the first who applied steam in the manner just described to boil water and other fluids, but merely as pointing out an important use to which my apparatus is applicable, and in which the effect obtained will be much greater than by any other means.

Another important use to which my Invention can be applied with better effect than the means now in use, is that of distillation on the large scale, and that by either sending the steam directly into and among the contents of the still or alembic, or by inclosing the still in another vessel, and making the steam of a high temperature to circulate in and to occupy the space beween the exterior surface of the still and the interior surface of the containing vessel. In either case all danger of burning or singeing the materials operated upon is done away, and a much more pleasant and pure spirit will be obtained than by the methods now in common use. I need not stop here to shew the reason why even in the case of throwing the steam directly into the still, the spirituous part will be the first to rise and pass over into the receiver. I might mention many other useful applications that may be made of my Invention, but I shall only state one more; namely, to the drying of gunpowder, and lessening the danger of explosions in the manufacture of that article. By means of my Invention, any desired temperature necessary for that purpose may be produced where the powder is to be dried, without the necessity of having fire in or so near the place as to endanger its safety; for by employing steam only, conveyed through pipes and properly applied and directed, without allowing any of it to escape into the room or apartment where the powder is, any competent workman can produce a heat equal to that found necessary for drying gunpowder, or much higher if required. Nor is the lessening of the danger of explosions the only advantage which this way of drying gunpowder holds out; it presents another, and an essential one for the goodness of the article; the heat can be completely regulated so as to prevent or at least lessen the partial decomposition of the powder by the sublimation of the sulphur, which is found to take place by the methods at present in use. In every case, I use one or more safety valves in my apparatus, to prevent the danger of explosions from the force of the contained steam, and when necessary to regulate its temperature. Besides such valves as I have just mentioned, when the steam is intended to be passed into a secondary boiler, I sometimes introduce another valve, which I shall now describe, to regulate the degree of elastic force which the steam must acquire before it can escape from the primary boiler. Fig. 16 represents a section of the main cylinder of one of my boilers, and the valve which with its appendages regulates the elastic force of the steam. A is the main cylinder; B, B, the neck or outlet for the steam, surmounted by the steam box C, which is joined with the neck B, B, by flanges *a*, *a*, or in any other workmanlike manner. The top or cover of C, marked with the letter D, which is also made secure by a flange or by any other proper means, has a hole through it,

for the rod of the valve, so contrived as to answer the purpose of a stuffing box, to make the rod work up and down steam-tight, the stuffing being kept in its place by means of the male screw which works in the female screw that forms the stuffing box, as shewn in the section. By means of a pin or nail *b*, and the two vertical pieces *e*, *e*, or by any other convenient means, the piston rod is made fast to *m*, which is a cover of and joined to the hollow cylinder *n*, *n*. The cover *m* fits steam-tight into the collar *o*, *o*, which is made fast in C by cement or otherwise. The cylinder *n*, *n*, is open at the bottom, having a free communication with A, the main cylinder of one of my boilers, and has two, three, or more vertical slits, one of which, S, is shewn in the Drawing. The sum of the surface of all these slits or openings should be equal to the area of the opening of the collar *o*, *o*, in which the cylinder *n*, *n*, works. When the steam acquires a sufficient degree of elastic force to raise the valve (that is, the cylinder *n*, *n*, with its cover *m*, and the rod R, R), and whatever weight it may be loaded with, then the openings S, getting above the steam-tight collar *o*, *o*, allows the steam to pass into the steam box C, and the quantity of steam that passes will be proportioned to the elastic force it has acquired, and the weight with which the valve is loaded, and the rise of the openings S above the collar *o*, *o*, will be in the same proportion. This valve may be loaded in any of the usual methods, but I prefer the one shewn in the Drawing, in which the upper part of the rod R, R, is made in the form of a rack, working in a segment of a wheel W, which carries an arm the axis of which is represented by the line L, W, which carries a weight Z, that may be moved near to or farther from the centre of the wheel W, according as the pressure of the valve is wished to be increased or diminished. As the valve rises, the weight moves upwards in the arch *n*, *n*, giving an increased resistance to the farther rising of the valve proportioned to the greater horizontal distance from the centre W, which the weight attains by its rise in the said arch, the said distance being measured in the line W, *p*, by a perpendicular from the said line W, *p*, passing through the centre of the weight. Thus, if the weight Z press with a force equal to twenty pounds on the square inch of the aperture in *o*, *o*, in its present position in the line W, L, it will, when it rises to the position at *i*, press with a force equal to thirty pounds, and at *p*, with a force equal to forty pounds on the square inch; so that the rod L, W, may be made to serve at the same time as an index to the person who attends the fire, nothing more being necessary for this purpose than to graduate the arch described by the end L of the rod W, L. In the side of the steam box C, there is an opening N, to allow the steam to pass from it by a pipe

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WOOLF'S SPECIFICATION.

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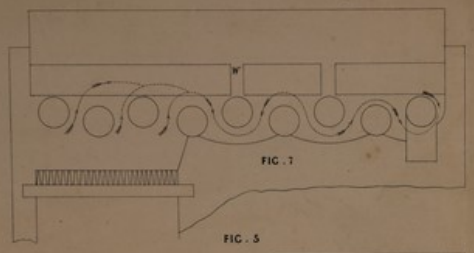


FIG. 8

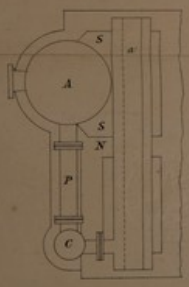
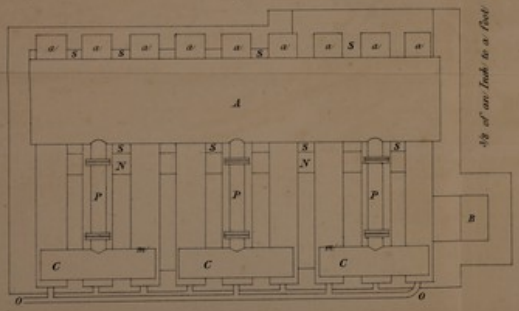


FIG. 5



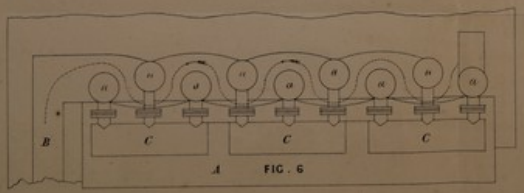


FIG. 6

FIG. 1

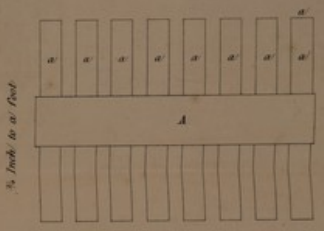


FIG. 2

FIG. 3

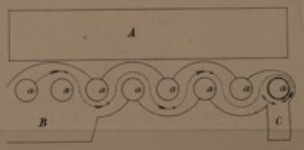


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FIG. 4.

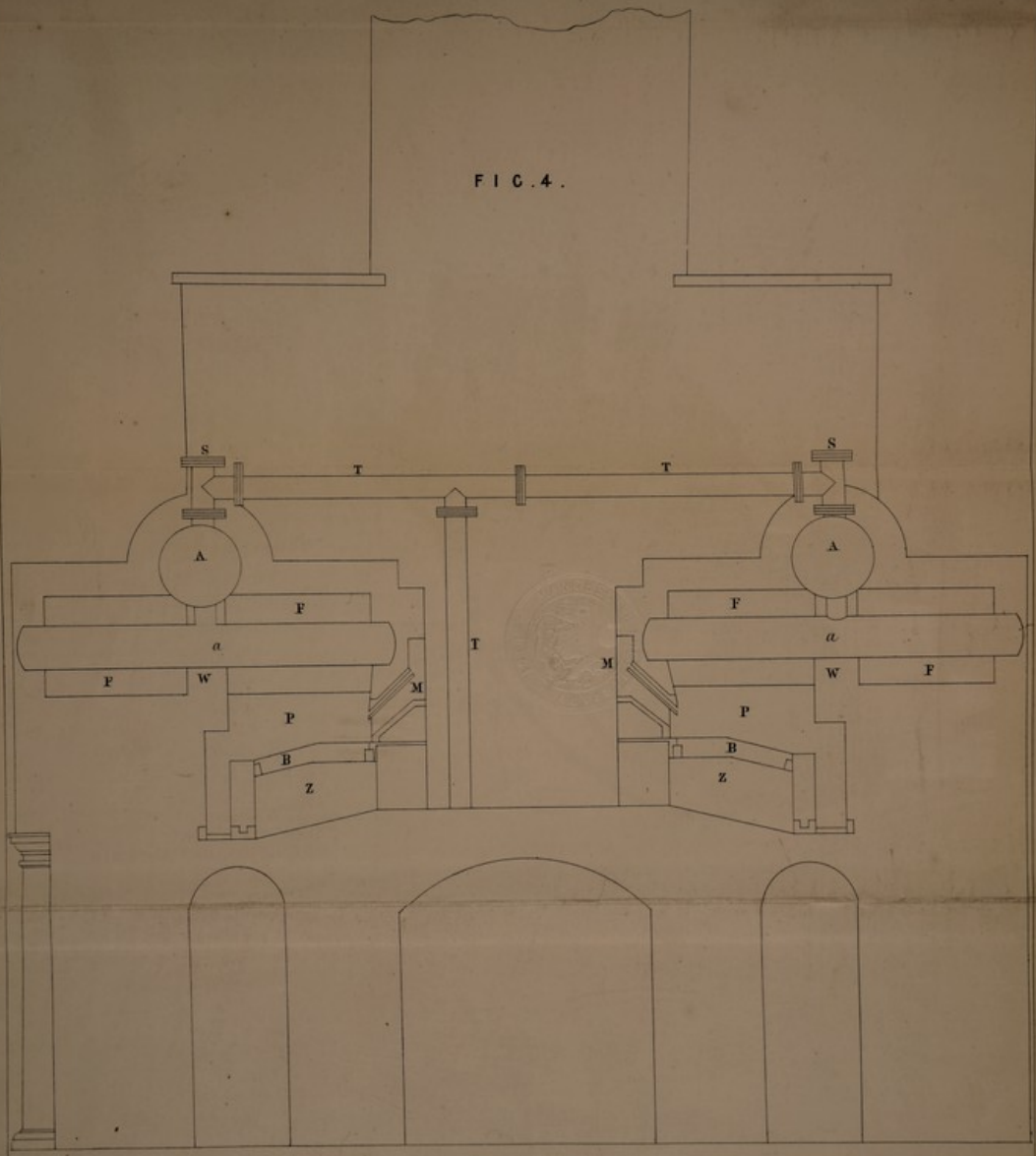

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FIG. 11.

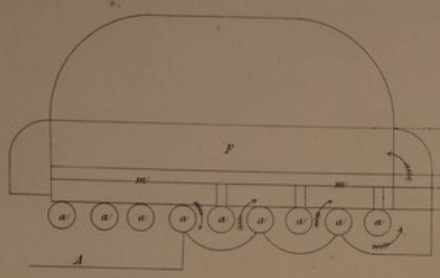

FIG. 12

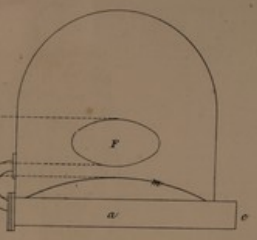

FIG. 13

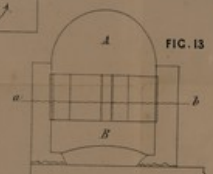

FIG. 14

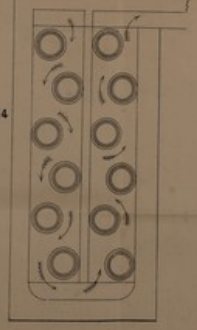

FIG. 9.

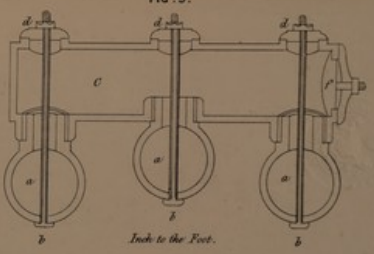

FIG. 10

The Enrolled drawing is partly colored.

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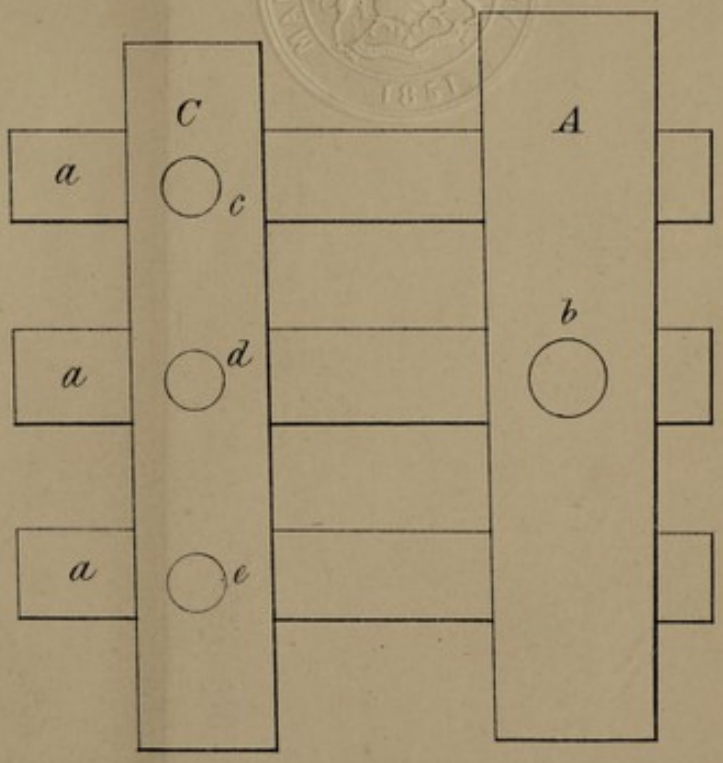
(5 SHEETS)

A.D. 1803. JULY 29. Nº 2,726.

WOOLF'S SPECIFICATION.

FIG. 15.



The enrolled drawing is colored.

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(3 SHEETS)

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WOOLF'S SPECIFICATION.

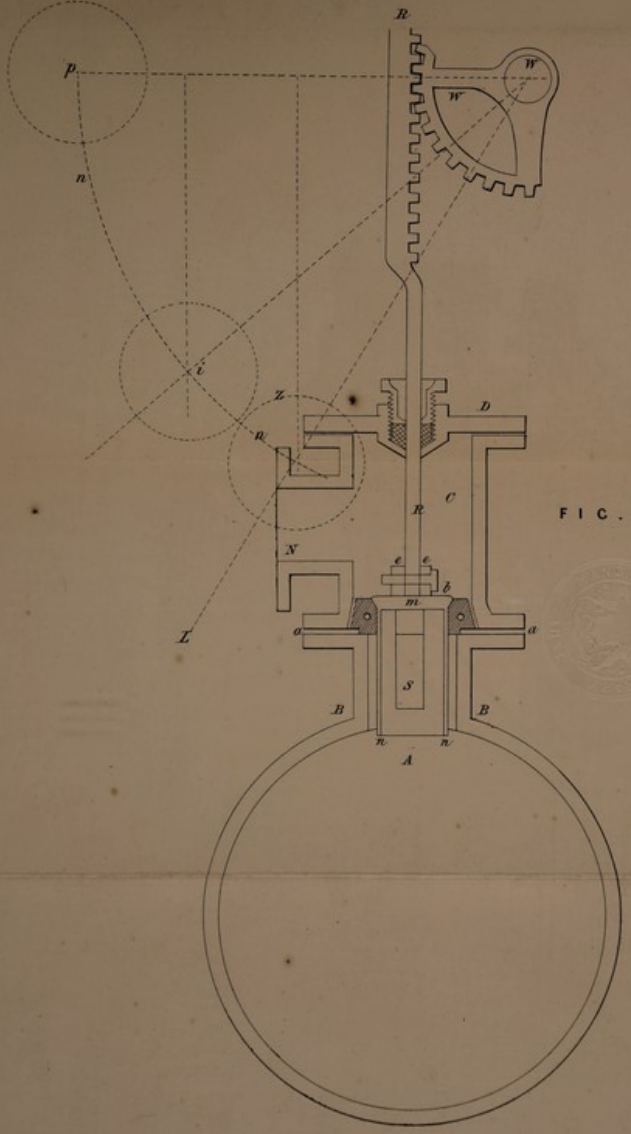

FIG. 16.

The enrolled drawing is not colored.

Malby & Sons, lith.

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or tube to the steam engine or to the secondary boiler, or for the purpose of conveying and applying it to any other vessel or use to which steam is applicable.

In witness whereof, I, the said Arthur Woolf, have hereunto set my hand and seal, this Twenty-seventh day of August, One thousand eight hundred and three.

ARTHUR (L.S.) WOOLF.

AND BE IT REMEMBERED, that on the same Twenty-seventh day of August, in the year above mentioned, the aforesaid Arthur Woolf came before our Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and everything therein contained, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute in that case made and provided.

P. HOLFORD.

Inrolled the same Twenty-seventh day of August, in the year above written.

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