A.D. 1850 . . . . . N° 13,238.

Supplying Steam Boilers with Water, &c.

PROSSER'S SPECIFICATION.

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

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent under the Great Seal of Great Britain, bearing date at Westminster, the Twenty-second day of August One thousand eight hundred and fifty, did give and grant unto me, the said Richard Prosser, my exors, admors, and assigns, Her especial license, full power, sole privilege and authority, that I, the said Richard Prosser, my exors, admors, and assigns, and such others as I, the said Richard Prosser, my exors, admors, and assigns, should at any time agree with, and no others, from time to time and at all times hereafter during the term of years therein mentioned, should and lawfully might make, use, exercise, and vend, within England, Wales, and the Town of Berwick-upon-Tweed, in Her Islands of Jersey, Guernsey, Alderney, Sark, and Man, and in all Her Colonies and Plantations abroad, my Invention for "CERTAIN IMPROVEMENTS IN SUPPLYING STEAM BOILERS WITH WATER, AND IN CLEARING OUT THE TUBES OF STEAM BOILERS;" in which said Letters Patent there is contained a proviso, that I, the said Richard Prosser, should cause a particular description of 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, to be enrolled in Her said Majesty's High Court of Chancery within six calendar months next and immediately after the date of the now reciting Letters Patent, reference being thereunto had, will more fully and at large appear.

NOW KNOW YE, that in compliance with the said proviso, I, the said Richard Prosser, do hereby declare the nature of my Invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following statement thereof, reference being had to the Drawings hereunto annexed, and to the figures and letters marked thereon (that is to say):—

First, respecting that part of my improvements which relates to supplying steam boilers with water (commonly called feed water). Those improvements are in the means frequently used for continually changing the water used in steam boilers, with a view to diminish or prevent depositions of salt or other impurities which the water may contain. In the ordinary operation of steam boilers the evolution of steam from such water will consist of pure water or nearly pure, rarefied by heat into the elastic state of steam. The impurities which were originally contained in the water so rarefied into steam are left behind in the water remaining in the boiler; consequently, as the production of steam goes on, the impurities accumulate in the water contained in the boiler, until the redundant impurities begin to deposit themselves and form incrustations within the boiler. A partial remedy, as commonly practised, is, to blow out a portion of the water in the boiler when it has become very impure, and replace the water blown out by new water, containing only its usual or natural proportion of impurities.

A Patent was granted to Messieurs Maudslay and Field, Fourteenth of October, One thousand eight hundred and twenty-four, for a method and apparatus for continually changing the water used in steam boilers, particularly applicable to the boilers of steam vessels making long voyages, by preventing the deposition of salt or other impurities contained in the water, at the same time retaining the heat, saving fuel, and rendering the boilers more lasting. A small force pump (called a brine pump) worked by the engine, and provided with a loaded escape valve to restrain the escape from the force pipe of the brine pump, had its suction pipe drawing impure water out of the boiler. And in such case the quantity of new water supplied to the boiler by the ordinary feeding pump exceeded what was requisite for replacing the evaporation into steam by as much as the quantity of impure water discharged in waste from the boiler, through the loaded discharge valve, by the action of the said small brine pump. The ordinary operation of producing steam will, as already mentioned, cause an accumulation of the impurities originally contained in the new water. And after such accumulation has proceeded as far as the limits intended to be prescribed to the accumulation of impurities, then the brine pump being set to work every stroke of the engine will take as much of impurities out of the

boiler by one stroke of the brine pump as the impurities left in the boiler by separating themselves from the steam used in the cylinder for that stroke. The engine working quick or slow, the quantity of impure water discharged from the boiler by the brine pump will be proportionate, and will prevent further accumulation of impurities in the boiler; and therefore, however long the engine may be worked, the water in the boiler can never become much more impure or salt, thus avoiding the evils and inconveniences to which steam vessels would otherwise be subject on long voyages, in being obliged to stop to empty and refill the boilers every fifty or sixty hours, or incur the risk of severe injury to the boilers from the deposition of salt within them, and a great waste of fuel the latter part of the fifty or sixty hours, when the water, from the quantity of impurities or salt it contains, is become very unfit for raising steam.

By another part of Messieurs Maudslay's and Field's apparatus, the heat contained in the discharged brine was in part transferred to the new water which was passing through the feed pipe when forced by the feed pump into the boiler. This was effected by forcing the hot brine through the force pipe of the brine pump into a close vessel, through which the feed pipe of the feeding pump was conducted with zigzag folds of great length and extended surface of thin metal, so that the hot brine surrounded the feed pipe or pipes through which the supply of feed water was passing. By these means the heat contained in the waste brine discharged from the boiler was in part absorbed by the supply of new water as it proceeded through the feeding pipe or pipes in its way from the feeding pump to the boiler; thus compensating in a great degree for the loss of heat which would otherwise be sustained by discharging a portion of the hot brine and introducing other water, which at first is only of the temperature of the hot well; but, by flowing through the feeding pipe or pipes surrounded by the hot brine, the water becomes more heated by the time it enters the boiler.

Messieurs Maudsley and Field applied their said patent brine pump and apparatus in many steam vessels for removing supersaturated brine from the boiler.

This first part of my improvements consists in a new kind of feeding pump, adapted to perform the office of the ordinary feeding pump, namely, of forcing feed water into the boiler, and also for performing the office of the aforesaid brine pump, namely, for removing a proportion of supersaturated brine from the boiler, and discharging such portion into the open air, but without any loaded discharge valve for restraining such discharge. The two operations aforesaid are distinct one from another, and are performed in such manner as

that the escape of the supersaturated brine from the boiler into the open air, without any loaded discharge valve, will cause some mechanical power to be exerted by the brine pump, tending to assist the motion of the feeding pump; (that is to say) as the feeding pump must supply the boiler with a larger quantity of new water than is requisite to replace the evaporation in steam, by a quantity equal to the supersaturated brine which is permitted to escape from the boiler, the mechanical power required for forcing in the said excess of new water will be compensated for (or very nearly so) by an impelling action of the escaping brine upon the brine pump. A feeding and brine pump combined together, so as to fulfil the above conditions, may be constructed in various forms, one of which is represented by way of example in Figure 1, Sheet I., of the Drawings hereunto annexed, which Figure is a vertical section through the centre line of the compound pump. A, A, is the working barrel of the feed pump; B, the solid piston fitted into the barrel, and moved up and down therein by the rod C; D is the suction valve at the bottom of the barrel A, A; and E is the suction pipe bringing water from the hot well of the steam engine to the suction valve D; F is the force valve; and G, the feeding pipe proceeding therefrom to the boiler. The parts thus far described (marked with the capital letters) are similar to the parts of an ordinary feeding pump. The parts performing the office of a brine pump are marked in the same Figure by small letters, namely, *h* is the cover of the working barrel A, A, with a stuffing box formed in that cover to make close fitting around a solid plunger *j*, *j*, to the lower end of which the solid piston B of the pump is attached, and to the upper end the pump rod C. When that pump rod is moved up and down by the engine, it actuates both the plunger *j*, *j*, and piston B with equal length of motion within the barrel A, A, and through the stuffing box. That solid plunger *j*, *j*, is as much less in its exterior diameter than the interior of the working barrel A, A, as to leave an annular space all around the plunger *j*, *j*, within the barrel A, A, and that annular space around A, A, and *j*, *j*, is the capacity of the working barrel of the brine pump. The supersaturated brine is brought from the boiler through the pipe *k*, and passing beneath the lowest part of the hollow slide valve *l*, *m* (that valve being then raised up), the said brine passes under the valve into and through the horizontal passage *n* to the upper part of the annular space between A, A, and *j*, *j*, which forms the brine pump. The Figure represents the piston B and plunger *j*, *j*, at the lowest position of their motion, and the slide valve shut down, which was done on arriving at that lowest position by a short arm *o*, fastened to and projecting horizontally out from the rods C, and acting upon stops affixed to the rod *p* of the slide valve, which rod *p* passes through a stuffing box *q* into the open air.

When the piston B and plunger *j*, *j*, arrive near their lowest position, the slide valve is moved downwards as in the Figure, so as that the hollow through the valve will connect the passage *n* with a waste passage *r*, through which (and such waste pipe *s* as may be requisite) the waste brine will be conveyed away to the open air without resistance from any loaded discharge valve. When the plunger *j*, *j*, and piston B are moved up by their rod C, the slide valve will remain motionless, and the waste brine in the annular space between A, A, and *j*, *j*, will be at liberty to escape freely through *s* without resistance. The same ascending motion of the plunger *j*, *j*, and piston B, will cause water to be drawn into the lower part of the barrel A, A, beneath the piston B, from the hot well through the suction pipe E, so as to fill the barrel A, A, with that water below the piston B. When the piston B and plunger *j*, *j*, arrive near their highest position, then the arm *o* will raise the slide valve so as to disconnect the hollow through the valve from the passage *n*, and connect that passage *n* with the pipe *k* from the boiler, thereby permitting the brine to enter the annular space between A, A, and *j*, *j*, so as to exert hydrostatic pressure upon the area of that annular space. When the piston and plunger begin to descend, the suction valve D will close to prevent the water returning to the hot well, the force valve F will open and the water will pass to the boiler along the feed pipe G. The force and mechanical power required to urge the piston B and plunger *j*, *j*, downwards in the barrel A, A, will be so much assisted by the pressure of the hot brine acting upon the upper side of the annular space between A, A, and *j*, *j*, as that no more power will be required in consequence of the use of a brine pump, that is to say, for working the compound pump, Figure 1, than if the boiler were fed by a smaller feeding pump with just water enough out of the hot well to supply the evaporation into steam. The transfer of heat from the impure brine discharged as waste may be effected in the usual manner by causing that waste brine to surround the feeding pipe G, and flow around the outside of the pipe in a contrary direction to the flow of feed water through the interior of the feed pipe G. The usual close vessel wherein the feed pipe G is to be included, in order that the hot brine may flow around that feeding pipe in close proximity with the outside thereof, is to be supplied with that hot brine, either by open connection with the pipe *k*, or else by connection with the waste pipe *s*, whichever mode of connection may be preferred; the free escape of the waste brine is not to be impeded by any loaded valve or similar impediment.

Secondly, the improvement shewn on Sheet II. is to free the feed water of steam-engine boilers from air, and thereby prevent the corrosion of iron boilers or iron boiler tubes. The feed water is taken as usual from the hot well.

But by my improvement, instead of the feed water being pumped out of the hot well it flows by the pressure of the atmosphere through the pipe A, and in the direction of the arrows, until it gets to the warmer or heater; it then flows as shewn by the arrows into a vessel B, in which there is a force pump and a float E. The pump has a grated hole at C in the side of the working barrel, and when the piston gets below that grated hole the water flows through it and fills the pump barrel; on the ascent of the piston, that water is forced through the valve D in the direction of the arrows into the boiler. The upper part of the vessel B communicates by a pipe with the condenser, and the air which is separated from the water (by the joint action of the air pump, and by heating the water above the temperature of the water in the hot well) passes through that pipe and so gets to the air pump through the condenser. E is a float which, as it sinks, opens a passage in the pipe leading from the heater, and allows more water to flow into the vessel B until the float reaches the proper height, when the water is shut off by the plug F, which thus prevents the water flowing into the vessel B and also into the condenser. The air is extracted by heating the water to such a temperature that the air will readily leave it, when the water is exposed to the vacuum in the condenser, and the higher the temperature to which the water is heated the quicker will the air escape from the water. The heater may be placed in any convenient part of the flue, away from the immediate action of the fire, and the water therein heated to boiling or thereabouts. All water contains atmospheric air, and when iron is immersed in such water it speedily rusts; but when the air which water naturally contains has been extracted, then iron may be immersed in such water for any length of time without rusting. The rusting of iron in ordinary water appears to be owing to the presence of the oxygen gas contained in the atmospheric air absorbed by water. On account of the steam which will flow through the pipe leading from the reheated feed water into the condenser, a refrigerator should be placed between the vessel B and the condenser, so as to return the condensed steam back into the vessel B to save the heat which would otherwise be lost.

The Drawing, Sheet II., merely shews the parts so connected as to explain the improvement, but the position of the parts may be varied to suit any particular steam engine.

Although my improved pump is described as a brine pump to a marine steam boiler, yet it is applicable to all steam boilers using impure or hard water; and in order to ascertain the quantity of water (and from that the area of the annual space round the plunger *j*, *j*, Sheet I.) which must be withdrawn from the boiler so as to prevent the formation of scale or deposit therein, I take any quantity

of the water which is to be used for supplying the boiler to which my brine pump is to be applied, and I boil it in a clean glass vessel until a deposit begins to take place therein. I then measure the quantity of water which remains, and compare it with the quantity originally put into the glass vessel for the purpose of being boiled. For example, suppose I take sea water, and find that when seven tenths of the original quantity has been evaporated that a deposit has just began to take place, then the water to be withdrawn from the steam boiler must be three tenths of the quantity forced in by the feed pump; therefore, the annular space between the plunger and the pump barrel must be equal to three tenths of the quantity forced into the boiler at each down stroke of the feed pump will be discharged out of the boiler by each up stroke of the feed pump; in fact, the quantity withdrawn should be rather more than three-tenths, if no deposit is to take place in the steam boiler, otherwise the same amount of deposit will take place in the boiler which took place in the glass vessel. The area of the annular space round the plunger *j, j*, Sheet I., will have to be varied so as to let out of the boiler the proper quantity of impure water, which impurities, if not removed, will form in the boiler the deposit commonly called boiler scale. If a deposit does not take place when the water has been boiled away in the experimental trial (for boilers), such water may be considered pure, therefore no brine pump need be used. Although on Sheet II., for the sake of clearness and simplicity, I have shewn the feed pump with a common piston, yet, when impure water is used, such feed pump may be constructed as shewn on Sheet I. In locomotive engine boilers, the ordinary pump plunger may have a smaller plunger at the opposite end to withdraw the requisite quantity of impure water, and so avoid the formation of boiler scale therein and the consequential loss of heat, when boiler scale is allowed to take place in any steam boiler, whether locomotive, stationary, or marine.

Thirdly, respecting that part of my said improvements which is applicable to clearing out the tubes of steam boilers, this said part is only applicable to that kind or class of boilers wherein metal tubes are used for the flue passages through such boilers, that is to say, the interiors of the tubes form the passages for currents of flame, fire, heated gas, and smoke, which proceed from the fire place in their way towards the chimney. The object of this part of my improvements is to clear out the interiors of the tubes from soot, ashes, and loose dirt, by blowing a jet or blast of steam in at one of the open ends of each tube in the boiler, so that the current of steam of such jet or blast will pass through all the length of the interior of each tube, with a sufficient velocity to clear out soot, ashes, and loose dirt from that interior, by action of such blast.

of steam. The mode of constructing and applying the requisite apparatus for producing and operating with such jets or blasts of steam must be varied to suit the arrangement of the tubes in the boiler as to their number, size, and other circumstances.

Sheet III. represents part of a boiler with tubular flues fitted with this part of my improvements by way of an example of the mode of applying my improvements in other cases. The boiler is of a cylindrical form with tubes disposed within it through all its length, to form flue passages through the the boiler. Each end of each tube is inserted into a hole through the flat end of the cylindrical boiler, and well fastened into that hole. Figure 2 is a longitudinal section of one end of the boiler; Figure 3, an end elevation, shewing the apparatus for applying the jets of steam at that end of the boiler. In Figure 2 only four rows of the said seven rows in height can be seen. M is the steam pipe, proceeding from the upper part of the cylinder of the boiler to the destination of the steam, where it is to be used for clearing out the tubes. The preceding description of the parts marked in capital letters affords a sufficient explanation of the kind of tubular boiler which I have selected by way of example, to explain the manner of applying this part of my improvements. It will be apparent that the same improvement can be equally applied to any other form of tubular flue boiler which is in ordinary use, provided that the current of fire and heat is conducted through the interior of each tube whilst the water is applied around the tube in contact with the convex surface thereof. The new parts for the application of jets or blasts of steam are marked with small letters of reference, namely, *n* is a valve fitted within a valve box communicating with the interior passage of the steam pipe M, so that when the valve *n* is opened steam will pass out of the steam pipe M into the valve box, and thence, through the pipe *o*, into the jet box *p*, which box sustains the jet tubes for the several tubes of the boiler. Those jets are fixed horizontally across the box *p*, so that there will be one such jet opposite and near to the open end of each one of the tubes of the boiler, as is shewn in the section, Figure 2. The valve *n* being opened, steam will rush from the steam pipe M through *o* into the box *p*, and therefrom in jets or blasts into the open ends of the tubes of the boiler, in order to clear out those tubes by the effluent blasts of steam. The internal capacity of the box *p* is, by internal partitions, divided into three distinct boxes, each box being supplied with steam by a separate valve and pipe. This division of the apparatus into three is for the purpose of clearing out one third of the number of tubes at a time, leaving the remaining tubes to be cleared out at succeeding operations. By this arrangement the boiler will be able to supply a

sufficient quantity of steam for clearing out the tubes effectually. In different boilers different divisions of the whole number of tubes may be adopted, so as to attain the object of effectually clearing out such number of tubes as may be subjected to that operation at once. Much will depend upon the pressure to which the steam is raised in the boiler. If it be high-pressure steam, a great force of velocity of the jets of such steam will very soon effect the required clearing; jets of low-pressure steam, having less velocity, will require to be used in larger quantities. Figure 4 is a vertical section through a portion of the box *p*, shewing how one of the jets *q* may be constructed and fastened into the box *p*. The tube *q* Figure 4, is represented to be inserted and securely fastened into a hole through the remote side of the box *p*, the length of the tube *q*, passing horizontally across all the width of the box *p*, and entering into a hole through that side of the box *p* which is nearest to the end of the boiler. The end of the tube *q* does not fill that hole, but leaves an annular crevice all around, and it is through that crevice that the jet of steam issues in the form of an annular jet or hollow current. The external bulk of the jet is greatly increased by thus rendering it hollow, and it therefore is better adapted for acting along the interior circumference of the tube K than a solid jet would be, unless more steam were used. The interior of the tube *q* being left open across the box *p*, permits of seeing into and through the interior of the tube K of the boiler, or, if requisite, inserting a rod into that interior. Instead of the jet being made hollow, as at *q*, Figure 4, the jet may be a short piece of tube fastened into a hole through that side of the box *p* which is nearest to the boiler. In such case there will be no perforation through the opposite side of the box *p*, and the whole bore of the jet pipe will be filled with effluent steam issuing in the central line of the tube K of the boiler. That side of the box *p* which is nearest to the end of the boiler must be fixed at such distance as to leave ample passage for the draught or current of smoke to pass up between the box *p* and the end G, H, of the boiler. The box *p* may be made of cast iron with internal partitions for dividing the interior capacity of the box into three (or more) divisions, as already mentioned, the two halves of each portion may be united back and front by screw pins, one of which is shewn at *r*, Figure 4, the whole box *p* being united together like one large box *p*, and applied temporarily in its true intended place opposite the end of the boiler. Then the vertical side of the box may be correctly marked by inserting a long marker through all the length of each of the tubes K of the boiler in succession to shew the exact places where holes should be bored in the box *p* for each jet. It is not essential that the jets of steam should be supplied from a steam box, such as

p, although that is a convenient mode of applying and fixing jet pipes in cases where there is room for such a box at the end of the boiler. In boilers where such a box as *p* would occupy too much space at the open ends of the tubes of the boiler the steam may be conveyed to each jet by small pipes and branches; and still further, to avoid unnecessary apparatus, the jet pipes (for such a portion of the tubes through the boiler as are appointed to be cleared at one operation) may be made moveable, in order that after having operated upon one portion of the tubes the same jet pipes may be moved opposite the open ends of another set of tubes. The steam can be conveyed to such moveable jet pipes through jointed conveyance pipes of a somewhat similar construction to those commonly used for conveying gas to lights which are required to be moveable.

Having now described my said improvements, I, the said Richard Prosser, do hereby declare that the new Invention whereof the exclusive use is granted to me by the herein-before recited Letters Patent of the Twenty-second day of August last consists in the following improvements, namely:—

Firstly, in the compound brine pump herein-before described and represented by way of example in Sheet I., Figure 1. The characteristic quality of such pump (however it may be constructed) being that the piston of the pump will be impelled with some mechanical power in the act of discharging the impure water or supersaturated brine which the pump is appointed to discharge in waste from the boiler. The discharge of that waste water into the open air being free, and unimpeded by any loaded discharge valve, as heretofore used in brine pumps; also the valve of the brine pump, according to this part of my improvements, being a slide valve (or else other suitable valves) opened and shut by machinery when required for admitting brine from the boiler into the brine pump when required, and allowing the same brine to escape therefrom into the open air without resistance when required, and in the method shewn on Sheet II. for extracting air from the feed water so as to prevent the rusting of iron steam boilers or the iron tubes which may be used therein.

Secondly, in the improvement herein-before described and represented by way of example in Sheet III. for clearing out the tube flues in steam boilers by blowing jets or blasts of steam through the interior of each such tube from end to end.

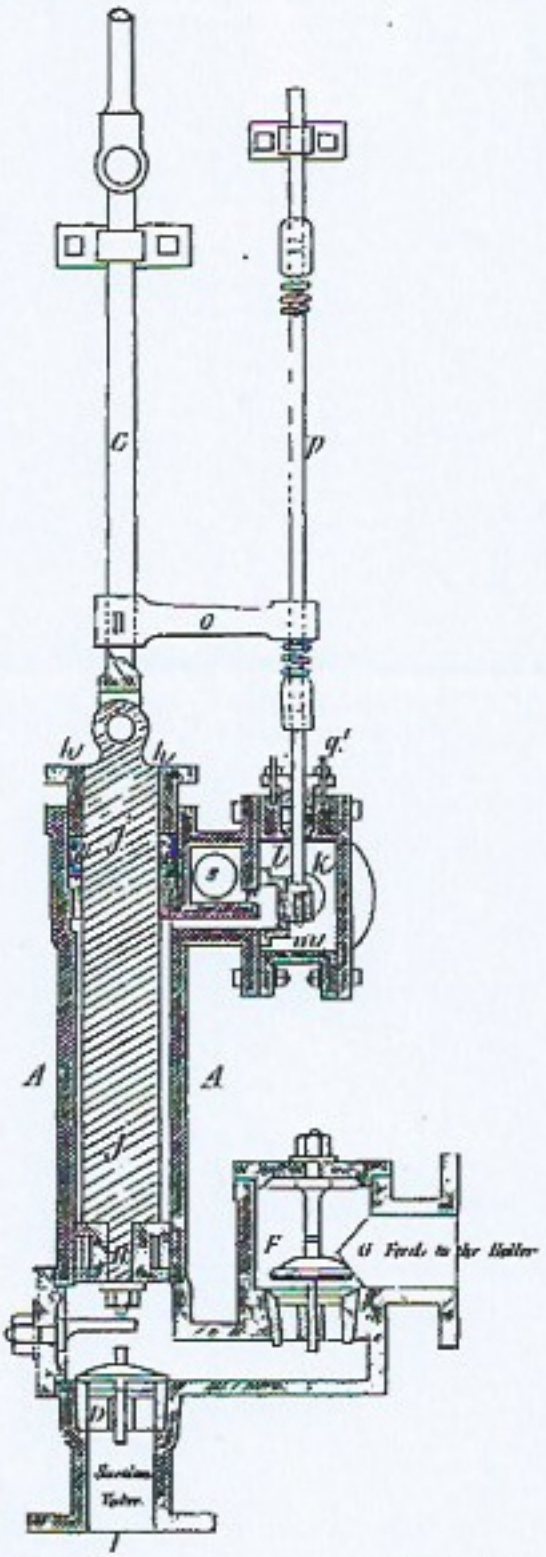
In witness whereof, I, the said Richard Prosser, have hereunto set my hand and seal, this Twenty-first day of February, One thousand eight hundred and fifty-one.

RICHARD PROSSER. (L.S.)

AND BE IT REMEMBERED, that on the Twenty-first day of February, in the year of our Lord 1851, the aforesaid Richard Prosser came before our said Lady the Queen in Her Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained and specified, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose.

Enrolled the Twenty-second day of February, in the year of our Lord One thousand eight hundred and fifty-one.

LONDON:
Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1856.



The accompanying drawing is not colored.

London: Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1850.

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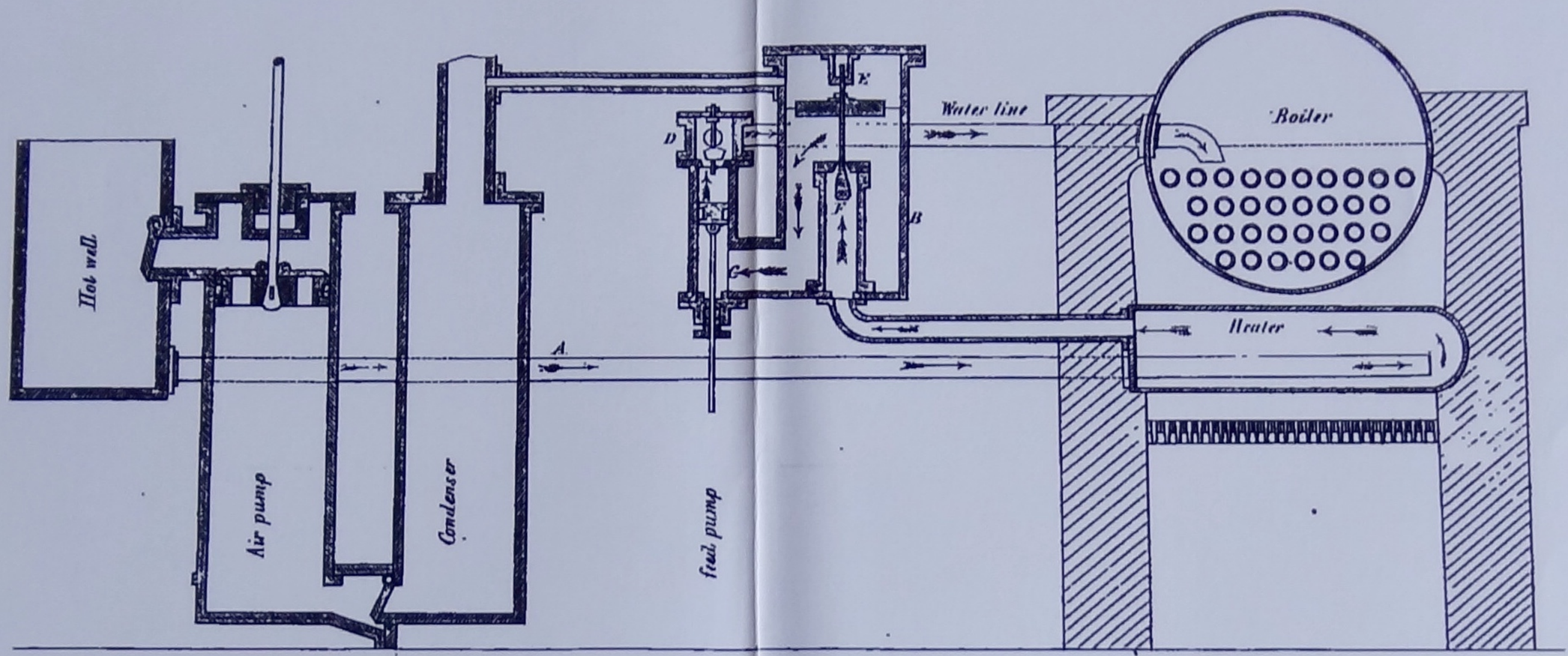
PROSSER'S Specification.



The enrolled drawing is not colored.

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A.D. 1850. Aug. 22. No. 13238.
PROSSER'S Specification.

(3 SHEETS.)
SHEET 3.

FIGURE 2.

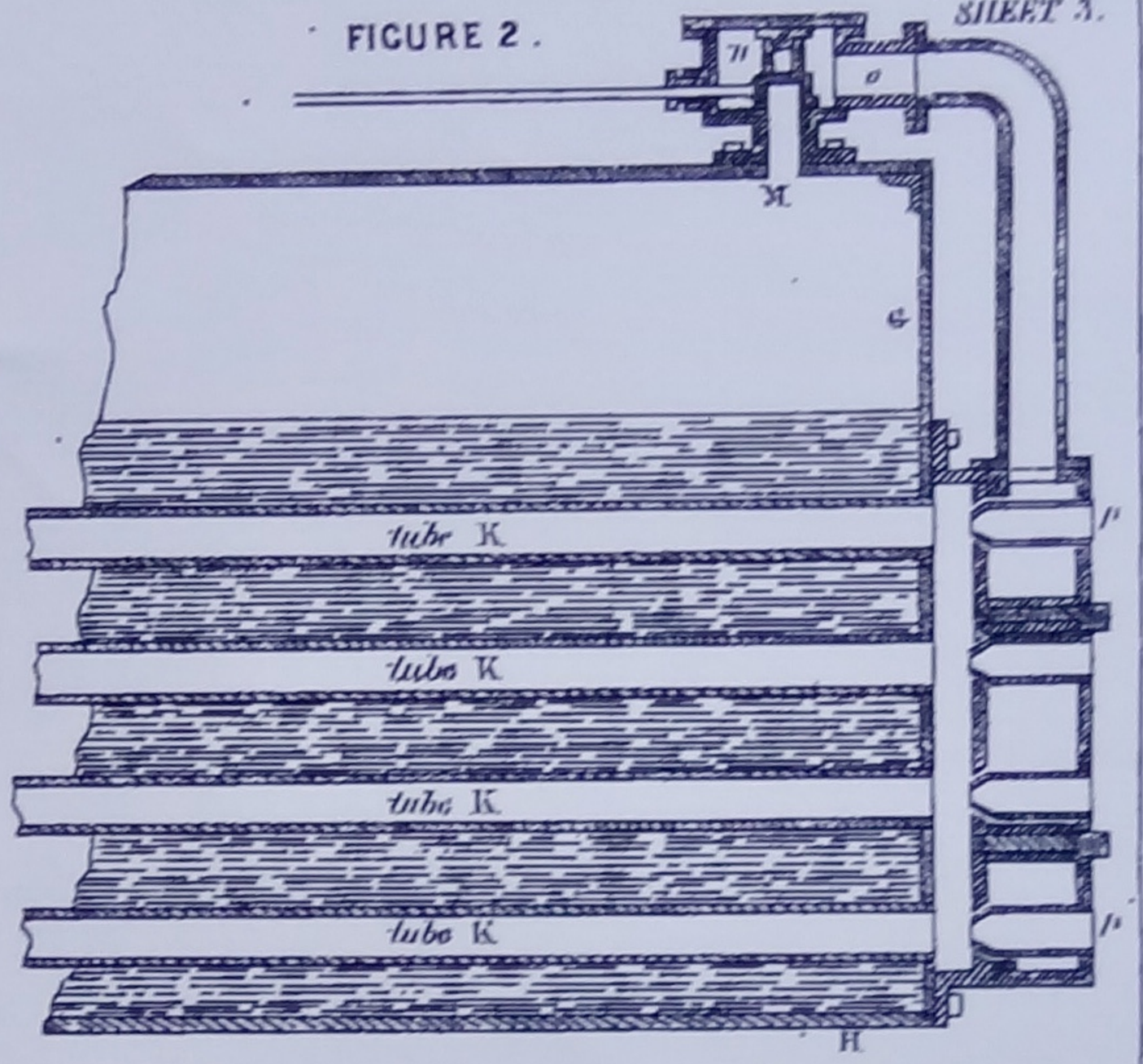


FIGURE 3.

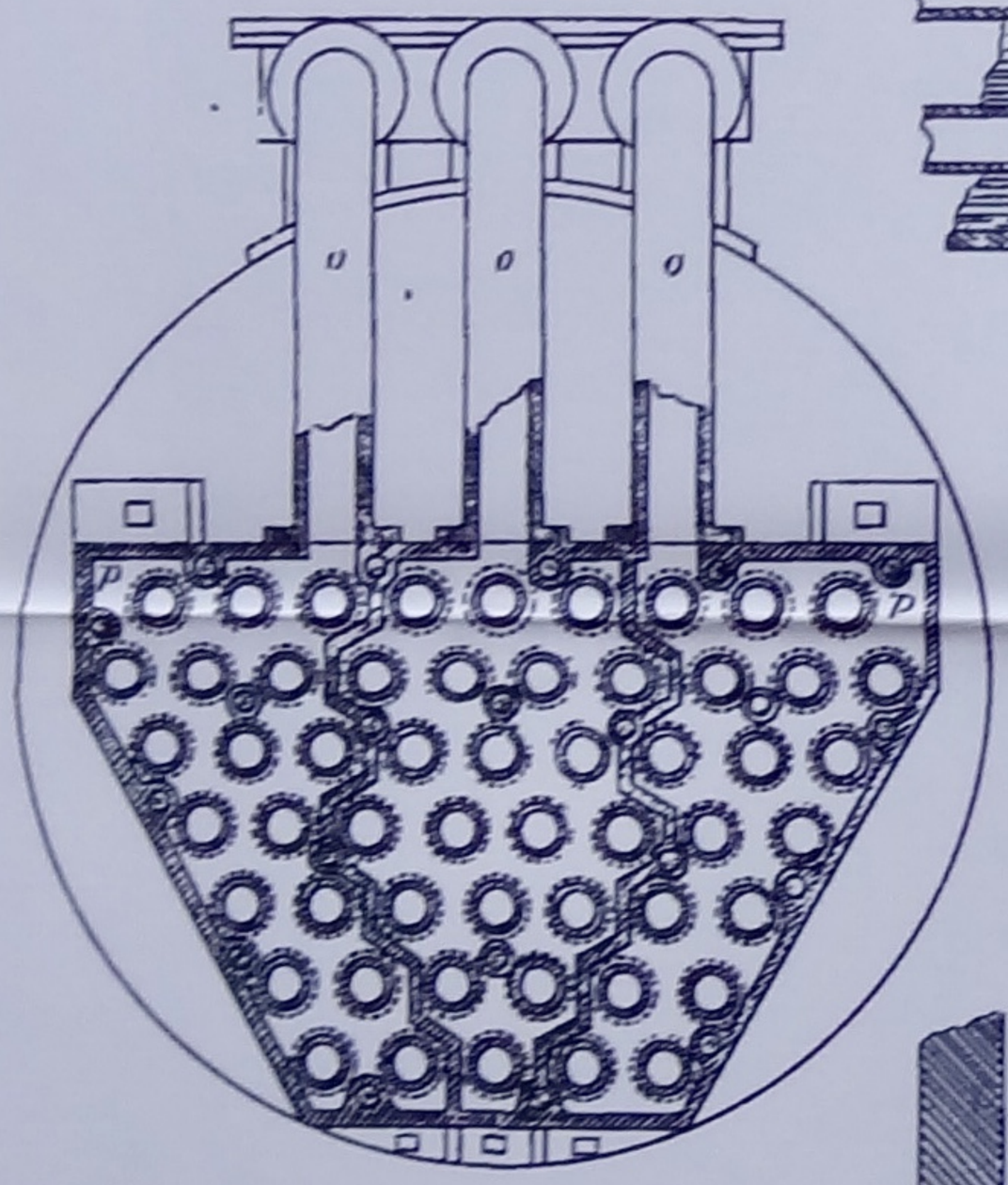
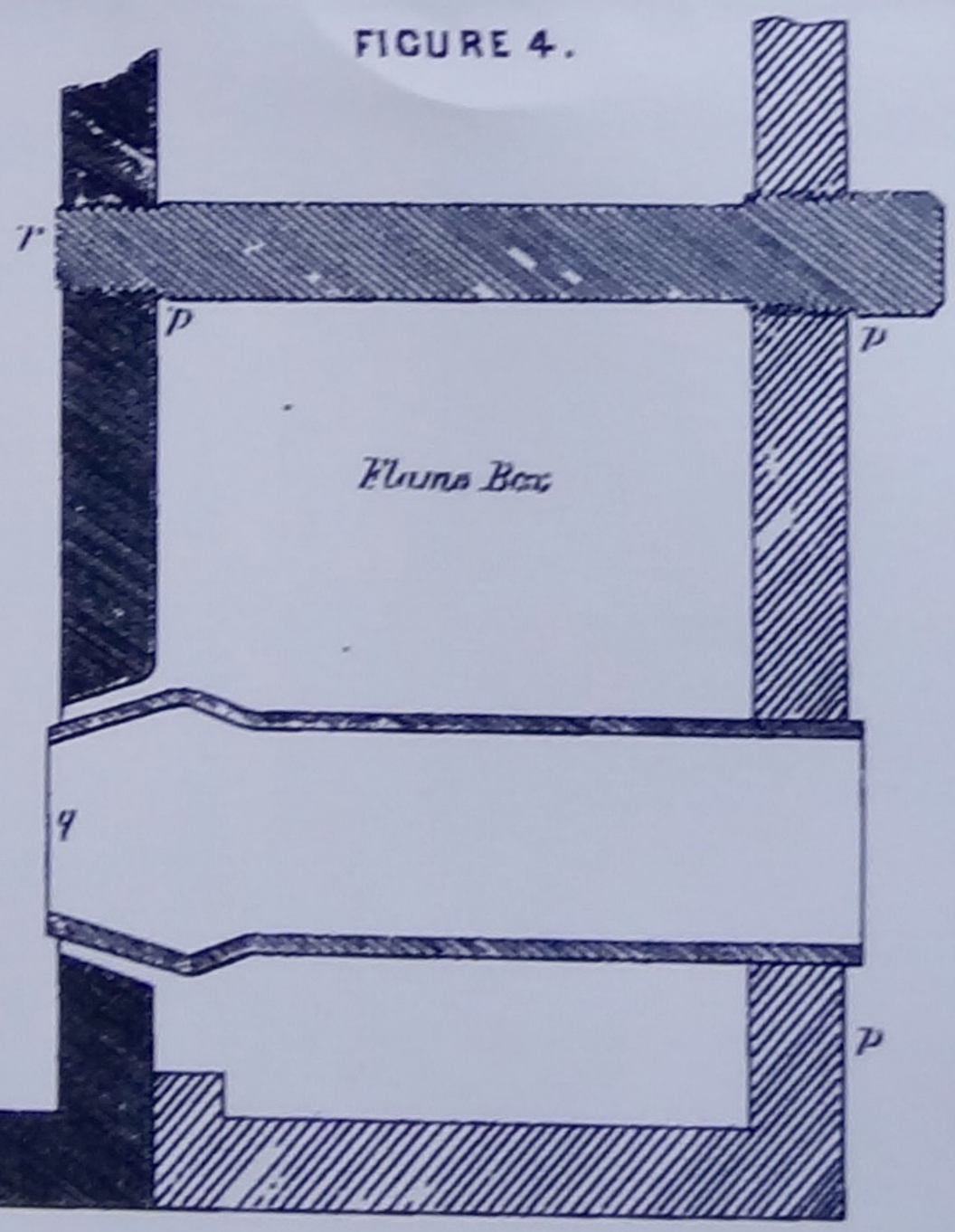


FIGURE 4.



The scrolled drawing is not referred.

Litho on Stone by Malby & Sons.

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Printers to the Queen's most Excellent Majesty. 1856.