

## **Specification of Goldsworthy Gurney : apparatus for raising or generating steam.**

### **Contributors**

Gurney, Goldsworthy, Sir, 1793-1875.

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A.D. 1825 . . . . . N<sup>o</sup> 5270.

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S P E C I F I C A T I O N

OF

GOLDSWORTHY GURNEY.

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APPARATUS FOR RAISING OR GENERATING  
STEAM.

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L O N D O N :

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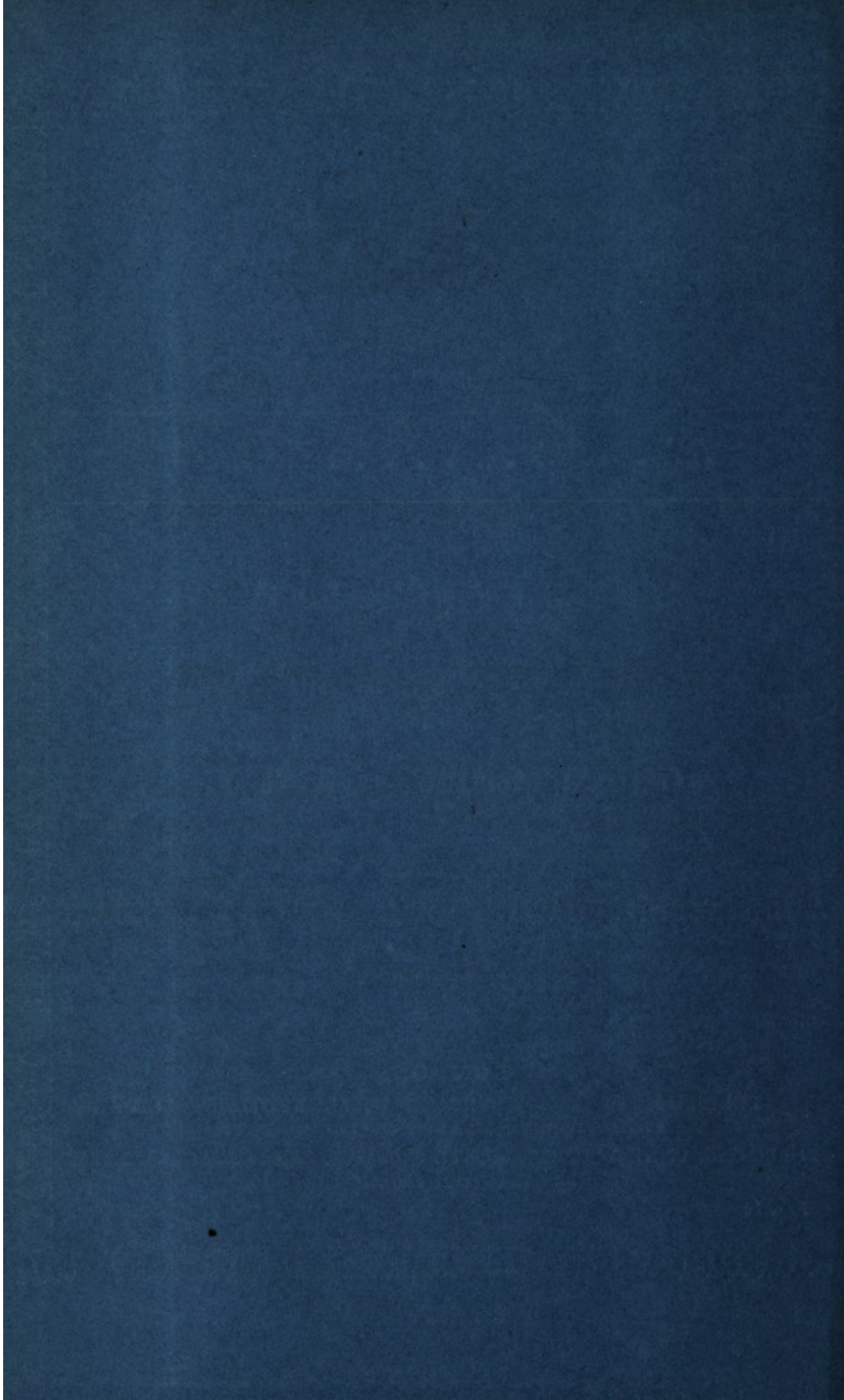
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1854.









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A.D. 1825 . . . . . N° 5270.

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**Apparatus for Raising or Generating Steam.**

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**GURNEY'S SPECIFICATION.**

**TO ALL TO WHOM THESE PRESENTS SHALL COME, I, GOLDS-**  
**WORTHY GURNEY, of Argyle Street, Hanover Square, in the County of Mid-**  
**dlesex, Surgeon, send greeting.**

**WHEREAS** His present most Excellent Majesty King George the Fourth,  
5 by His Letters Patent under the Great Seal of Great Britain and Ireland,  
bearing date at Westminster, the Twenty-first day of October, One thousand  
eight hundred and twenty-five, in the sixth year of His reign, did, for Himself,  
His heirs and successors, give and grant unto me, the said Goldsworthy Gurney,  
His especial licence, that I, the said Goldsworthy Gurney, my exors, adñors,  
10 and assigns, or such others as I, the said Goldsworthy Gurney, my exors.  
adñors, or assigns, should at any time agree with, and no others, from time  
to time and at all times during the term of years therein expressed, should and  
lawfully might make, use, exercise, and vend, within England, Wales, and  
the Town of Berwick upon Tweed, my Invention of "**CERTAIN IMPROVEMENTS**  
15 **IN THE APPARATUS FOR RAISING OR GENERATING STEAM;**" in which said Letters  
Patent is contained a proviso obliging me, the said Goldsworthy Gurney, 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 Majesty's High  
20 Court of Chancery within six calendar months next and immediately after the  
date of the said recited Letters Patent, as in and by the same, reference  
being thereunto had, will more fully and at large appear.



*Gurney's Improvements in Apparatus for Raising or Generating Steam.*

NOW KNOW YE, that in compliance with the said proviso, I, the said Goldsworthy Gurney, do hereby declare that the nature of my said Invention, and the manner in which the same is to be performed, are particularly described and ascertained in the following description thereof (that is to say):—

My improvements are for the most part applicable to, or are improvements in, the construction of such boilers or vessels for raising or generating steam as contain but small quantities of water compared with the surface exposed to the heat.

My first improvement is more particularly applicable to such boilers as are composed of a series of small cylindrical tubes or pipes so combined and united together as to form a close vessel or receptacle to contain the water from which steam is to be raised or generated by the heat of the fire and flame applied against the external surfaces of such pipes or tubes; and my said improvement consists in the application of wire, or of wire gauze or cloth woven of metallic wires and cut into narrow bands or slips, or fillets, which are to be wrapped around or interwoven amongst the said tubes, in such manner as to increase the surface exposed to the heat, and also to present to the fire as many as possible of those ends or points which are formed in cutting and dividing the wire cloth into slips as aforesaid, in order that such wires and metallic points may collect and conduct the heat of the fire through the metal to the water contained in the said tubes, so as to increase the effect of raising or generating steam therefrom.

My second improvement is a mode of arranging and combining the pipes or small cylindrical tubes which are to form a steam boiler, in the manner represented in the Drawing N° 1 hereunto annexed, wherein Figure 1 is a longitudinical section or elevation, and Figure 2 a transverse or end section of a boiler constructed with tubes arranged according to my improvements. A, A, B, B, are the small cylindrical tubes which are bended so as to cross each other, and form double loops in the manner of a figure of 8, as shewn in Figure 2; a number of such curved tubes are arranged one behind the other, in parallel vertical planes, being all united to two large horizontal tubes D and E, one at the bottom, and the other at the top of the boiler; so that the internal capacities of all the tubes are combined to form one vessel or receptacle for the water from which steam is to be raised or regenerated. The contained water communicates freely within all the small tubes A, A, B, B, by means of the large horizontal tube D, which is common to them all; and the steam which is generated within the small tubes rises up therein and collects in the top of the



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large horizontal tube E, and passes away through the steam pipe *e*. The openings or spaces F and G, within the loops of the tubes A, A, and B, B, receive the fire and flame by which the tubes are to be heated; thus the lower space F forms the furnace where the fire is made, and  
 5 the upper space G serves as a flue to conduct the flame, heated air, and smoke to the chimney H. The bars *a, a*, Figure 2, for the fire grate, are laid upon the curved tubes A, A, B, B, at the bottom of the loops, and the fire also rests upon the horizontal tube D, by which means the said tubes, and the water within them, receives the direct radiant heat of the fire.  
 10 A plate of metal *b, b*, is placed upon the tubes A, A, and B, B, at the part where they cross each other, so as to separate the lower space F from the upper space G, and prevent the flame and smoke and heated air rising up between the small tubes, but to cause the flame to pass in contact with or against every tube, from one end of the fire-place F to the other, and where  
 15 it rises up as shewn by the arrow in Figure 1, beyond the end of the plate *b, b*, and enters into the upper space G, along which the flame, smoke, and heated air passes or returns in contact with every tube, till it escapes into the chimney H. The whole boiler is enclosed within metal plates, which form a complete case I, I, K, to the outside of the curved tubes A, A, B, B, and to  
 20 cover the horizontal tube E, and also to close the ends of the spaces F and G; and in order to retain the heat the casing I, I, K, is composed of two thicknesses of plate, leaving between them a narrow space, which is filled with pumicestone or other similar non-conducting substance which will endure heat without change. L, Fig. 1, is the fire door at the end of the fire-place F,  
 25 to introduce the fuel. Note.—My second improvement does consist in arranging the tubes for the aforesaid boiler in looped curves, so as to form the spaces F and G for the fire-place and for the flue, and separating those spaces from each other by the plate *b, b*; and the tubes may be bent and applied across each other, so as to form three or more loops, in order  
 30 that the flue or passage for the flame, heated air, and smoke may be prolonged, by causing it to return through more of those loops.

My third improvement is a mode of arranging and combining plates of metal to form a boiler in the manner represented in the Drawing, N° 2, hereunto annexed, wherein Figure 1 is a transverse or end section, and  
 35 Figure 2 a longitudinal section of a boiler constructed according to my improvements. A, A, is an elliptical cylinder or vessel, within which the fire is made upon the fire grate B, B. The vessel A, A, is composed of two elliptical cylinders made of metal plate, and fixed one within the other, and joined together at the ends, but leaving a narrow space or interval all round



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between the two to contain the water from which steam is to be raised or generated by the heat of the fire which is made within the fire-place. A, A, C, C, and D, D, are two semi-cylindrical vessels placed over one another and over the cylinder A, A. They are composed in like manner of two thicknesses of metal plates united together, leaving narrow spaces between them to contain 5 water, the edges of the plates being joined at all parts, so that the said spaces are close on all sides. *a, a*, Fig. 1, are connecting pipes, which proceed from the top or highest part of the cylinder A to the lowest parts of the vessels C, C; and *b, b*, are similar pipes communicating from the highest part of the vessel C, C, to the lowest parts of the upper vessel D, D; 10 by means of these pipes the water and steam has free communication through all the spaces between the vessels A, A, C, C, and D, D. The three vessels are placed one over the other, as shewn in the Drawing, so as to leave spaces between them for the passage of the flame, heated air, and smoke from the fire at B, B, to the chimney E; the course of the draft or current 15 is shewn by the arrows in Figure 2. The spaces to contain water between the two plates or thicknesses, of which the vessels A, A, C, C, and D, D, are composed, is divided by internal partitions into ascending channells, within which the steam which is generated from the water ascends to the top of the vessels; the said internal partitions are curved bars of metal of 20 a sufficient breadth to occupy the space between the two plates, and they are fixed in between the plates by rivets, which pass through the both plates and also through the partitions, so as to unite the whole together, and give strength to the vessel; these partitions are shewn in the section Fig. 2, at *d*; they do not reach quite to the lowest parts of the vessels, nor quite to 25 the highest parts, but fall short of both, so as to allow a free passage horizontally all the length of the vessel at the top and at the bottom thereof, in order to establish a free communication between all the different ascending channells, and permit the water to enter into the same from below, and to allow the steam which is generated therein to pass out from above. Near the lower part 30 of the vessels C, C, and D, D, horizontal partitions are fixed between the plates, so as to form complete horizontal passages *f, f*, along all the length of each vessel, in order to convey the water and steam beneath all the ascending channels, and there horizontal partitions are perforated with small holes, through which the water and steam will ascend into the said channels, so as to 35 be equally distributed amongst the same. Note.—This my third improvement consists in fixing partitions between the plates of which the boiler is formed, in order to form ascending channels, as aforesaid, in which the water is contained and the steam generated, the said ascending channels being disposed



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and combined with the horizontal channels aforesaid, so that the water will be equally diffused amongst them, and that the steam may pass freely away, as before stated.

My fourth improvement is a mode of separating the steam from the  
5 water, and is applicable to all boilers which contain but small quantities of water lodged in narrow spaces, whether within tubes or between plates, for the steam which is generated in such boilers is so intermixed with the water that the water is liable to be carried away with the steam. My improvement is represented in Drawing N° 1, at Figure 1. M, M, is a vessel  
10 which I call a separator; the steam pipe *e* from the boiler enters into the vessel M, and turns down, so as to introduce the steam (or steam intermixed with water) into that vessel, where the water separates itself from the steam and falls to the bottom, but the steam rises up into the top of the vessel M, and passes out through the steam pipe *f*, to the engine. The lower  
15 part of the separator communicates by a pipe *g* with the lower part of the boiler, in order that the water which is separated from the steam being reduced in temperature, and consequently increased in specific gravity, may return into the boiler again, so as to keep the tubes or narrow water spaces of the boiler constantly supplied with water from below upwards. *h* is a partition fixed in  
20 the lower part of the separator, with a perforation through the centre, beneath which a piece of wood is applied to stop the same in the manner of an inverted valve opening downwards; this inverted valve allows the water to pass freely downwards out of the separator M through the pipe *g* to the boiler; but in case of a very sudden evolution of steam, which would tend to force the  
25 water out of the tubes or water spaces of the boiler, this valve rises so as to retard the current or stop the passage of the water out of the boiler through the pipe *g*.

My fifth improvement consists in a method of applying a blast or artificial current of air, blown by bellows, in order to excite the fire in the furnaces  
30 or fire-places of boilers for generating steam; and my said improvement consists in turning down the extremity of the air pipe or nozzle through which the air is blown, so that the orifice shall be above the fuel, and thus the blast will be directed downwards upon or into the fire, whereby the coals or fuel will be rapidly distilled, and the gas or smoke arising therefrom being blown  
35 into the fire in mixture with the air of the blast will be effectually ignited and consumed so long as a sufficient intensity of heat is preserved.

My sixth improvement is a method of cleaning the interior surfaces of those steam boilers which are composed of such small tubes or of such narrow spaces between plates as to render it difficult or inconvenient to scrape away or



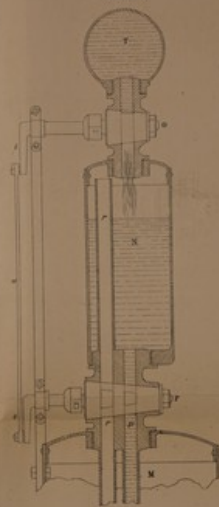
*Gurney's Improvements in Apparatus for Raising or Generating Steam.*

remove from the interior surfaces any sediment or incrustations which may have been deposited by the water from which steam has been generated; and my improvement consists in filling the boiler with a solvent which will dissolve the incrustation or sediment without acting sensibly upon the metal of which the boiler is composed. If the boiler is made of iron, then a solution of one 5 part of muriatic acid in one hundred parts of water will answer the purpose of a solvent; or if the boiler be of copper, a solution of sulphuric acid and common salt may be used in the proportion of one pound of salt and half an ounce of sulphuric acid to every three gallons of water; or a boiler may be cleaned by a solution of common vinegar at the rate of one pint to one gallon of water. 10 The exact proportions of the above ingredients is not important, and must be varied at the discretion of the person who is to use my method of cleaning, in order that the incrustation or earthy concretion against the interior surfaces of the metal of boilers may be dissolved and removed therefrom without corroding the metal; and as the strength and exact proportions of the materials of the solu- 15 tion must depend upon the nature of the substance which forms the crust or concretion, no exact rule can be given for the same, but it must be determined by trial. The above solution must be introduced into the boiler when cold, and it should continue therein a sufficient time that it may be dissolve the concretions. A very slight fire of shavings or of wood must be applied to the boiler during 20 the operation of the solvent, in order to heat it just so much as will occasion a slow motion or circulation of the solvent through all the tubes or narrow spaces in which it is contained, in order that every unsaturated part of the solvent may pass slowly over the concretions and be enabled to combine with or dissolve the earthy matter thereof; and when the solvent has performed 25 this effect and become saturated, the fire must be applied so as to raise steam within the boiler to a sufficient elastic pressure that it may, when a cock is opened at the lowest part of the boiler, expel and blow out the solution, which will carry with it the disengaged silica or other insoluble matters of the incrustation; the fire must be removed as soon as the boiler becomes emptied of the solution. 30 This process may be repeated with a fresh solution if the concretions are so abundant as to require it.

My seventh and last improvement is an apparatus for feeding and supplying water to a steam boiler, in order to replace that which is evaporated into steam. It is represented in the Drawing N° 1, Figure 3; and it is 35 also shewn on a smaller scale in Fig. 1, attached to the boiler and apparatus already described; but it may be applied to any other kind of boiler. N is a close vessel adapted to contain water or steam, and receiving the water for the supply of the boiler through a stop cock O, which



FIGURE 3.



Scale of Feet

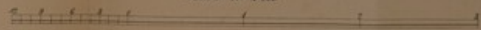


FIGURE 1.

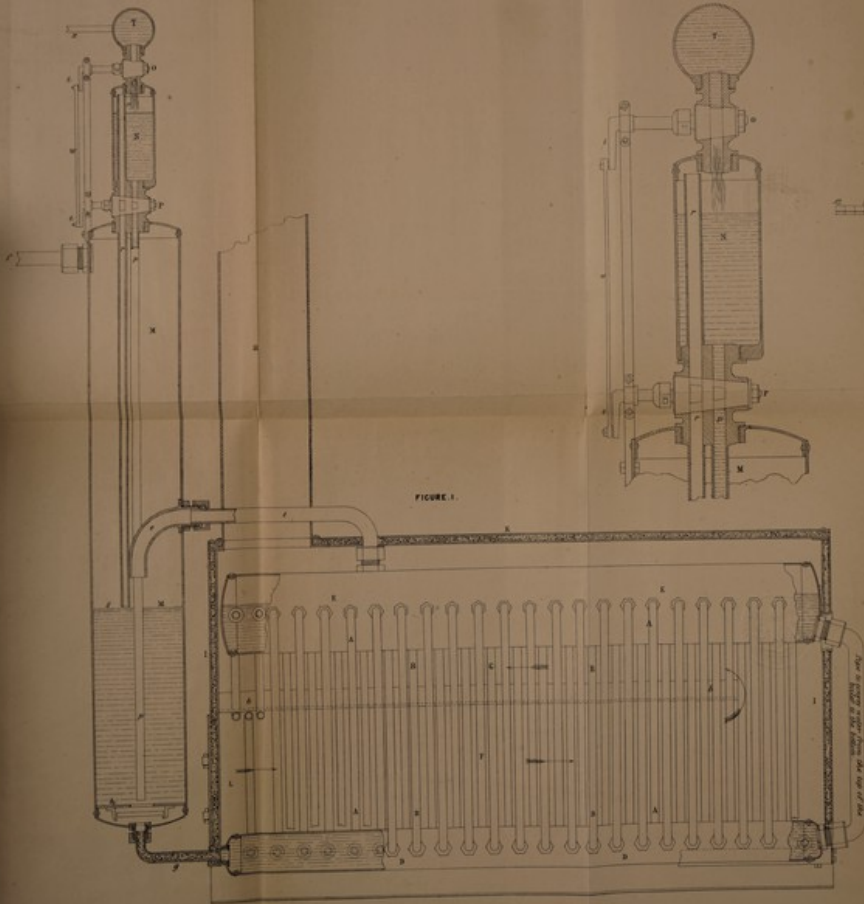
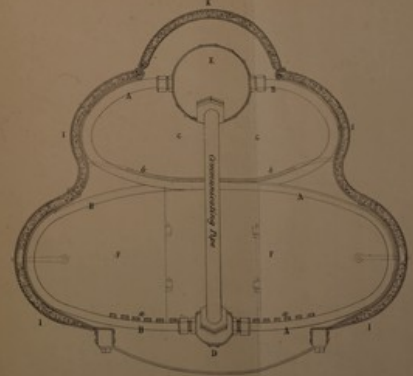


FIGURE 2.



The vertical drawing is partly colored

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FIGURE 1.

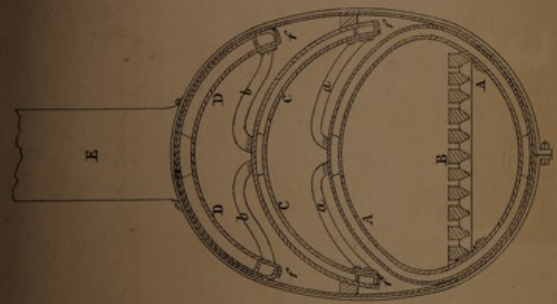
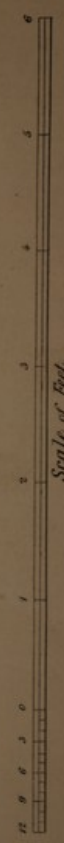
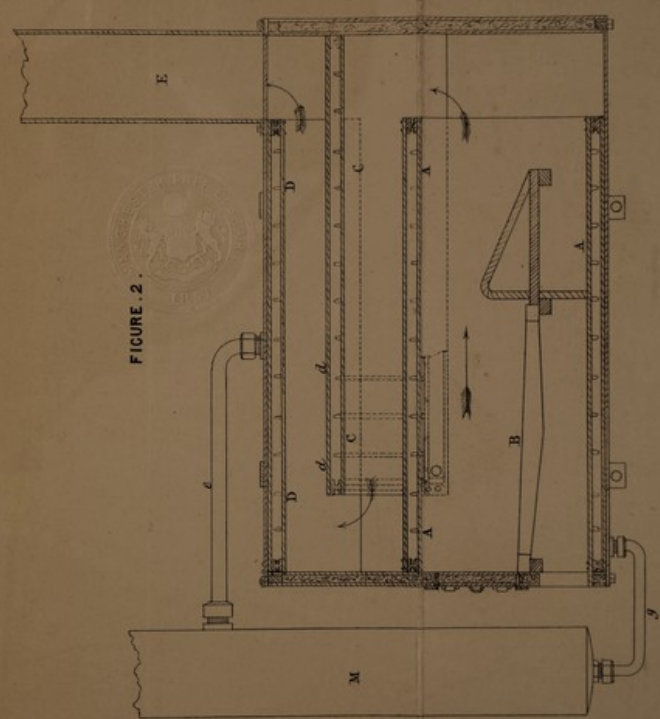
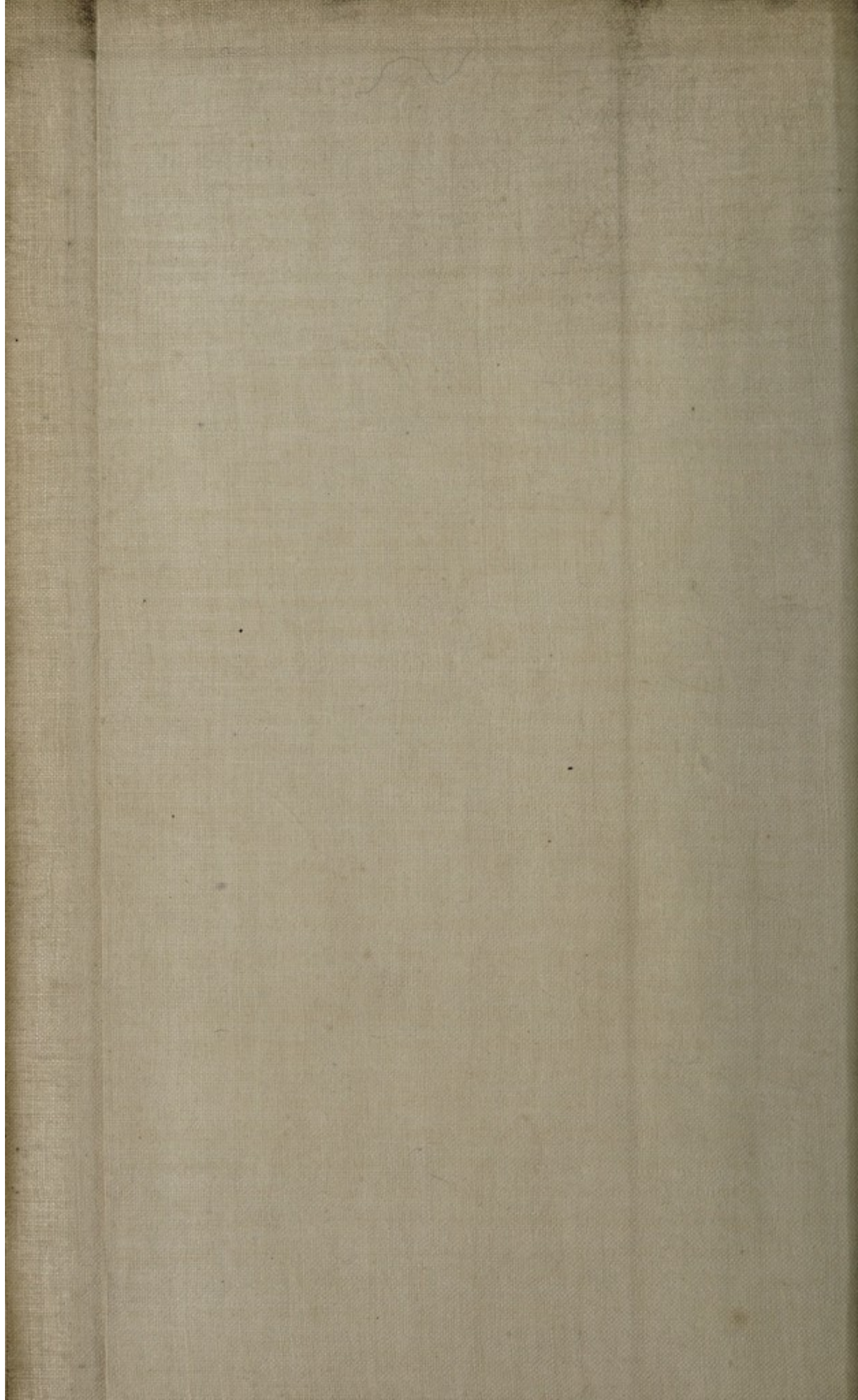


FIGURE 2.



*The enrolled drawing is partly altered.*  
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communicates with the upper part of the vessel N; and the lower part of that vessel communicates by another cock P, and descending pipe *p*, *p*, with the boiler or with the separator M; in order to convey the water into the same for the supply of the boiler, a pipe *r*, *s*, also communicates  
5 from the upper part of the boiler, or from the separator M, to the upper part of the feeding vessel N, to convey steam into the same at *r*; and the cock P is adapted to stop this communication, as well as that of the pipe P. The orifice *s* at the lower end of the steam pipe *s*, *r*, within the boiler or within the separator M, is placed at the height or level  
10 at which the water is required to stand therein, so that the orifice or open end *s* of the pipe *r*, *s*, will be immersed in the water and prevent any steam from entering, except when the water subsides below its intended level, and then the orifice *s* of the steam pipe *r*, *s*, will be exposed, so as to admit steam into that pipe; and if the steam cock P is open, that steam will pass up  
15 through *s*, *r*, into the feeding vessel N at the upper part thereof, above the contained water; the turning plugs of the cocks O and P are so arranged and connected together by the cranks *t*, *t*, and the rod *w*, that the double cock P at the bottom of the feeding vessel shall always open or shut both the passages *p* and *r* for the water and for the steam at the same time or nearly  
20 so, and also that the cock O at the top of the feeding vessel N shall always be shut when the two passages of the cock P are open, and vice versa. The operation of this apparatus is as follows:—If the upper cock O is open the other cock P is shut, and then a supply of water is admitted through O into the feeding vessel N, to fill the same; then the cock O  
25 being closed, and the other cock P opened, so much of the water contained in the feeding vessel as is required to fill up the boiler to its intended level will run down through the pipe *p*, but no more water than is requisite can so run down, because the water will not quit the feeding vessel N, except in as much as steam is introduced from the boiler or from the separator into  
30 the upper part thereof through the steam pipe *s*, *r*, and the cock P; and although the steam passage *r*, *s*, is opened, the steam from the boiler cannot enter into the orifice or open end *s*, of the steam pipe, except when the surface of the water in the boiler or in the separator M is lower than its intended level, and as soon as the proper quantity of water has been introduced, and  
35 that surface is raised to its intended level, the water closes the orifice *s* of the steam pipe so as to prevent any more steam entering into the feeding vessel N, and then no more water will run out of the same. The turning plugs of the cocks O and P are turned backwards and forwards by their cranks *t*, *t*, and connecting rod *w*, which are put in motion by the engine, in order



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to open and shut them alternatively, as before stated; when the steam and water cock P at the bottom of the feeding vessel N is closed, and the water cock O at the top of that vessel is opened, the supply of fresh water which is introduced through O being cool, condenses the steam contained in the upper part of the feeding vessel N, so as to form an exhaus- 5  
tion therein, which facilitates the introduction of the water to fill the same, ready to repeat the feeding of the boiler when the cocks O and P are turned so as to shut the upper one O and open the lower one P, as before described; and this improvement is applicable to any kind of steam boiler as well as those which are composed of tubes or narrow spaces to combine water; and instead 10  
of the double cock P, with two passages for the steam and the water, two distinct cocks may be used, their turning plugs being connected so as to open and shut the two passages *p, p*, and *r, s*, nearly at the same time; the steam passage being in all cases opened a little sooner than the water passage, and kept open a little longer. The vessel T, which is above the cock O, must be kept con- 15  
stantly filled with the water which is to be introduced into the boiler; it may be either an open cistern, into which water is constantly poured, or it may be a close vessel, as represented in the Drawing, and connected with a pipe *x*, to bring the water into it by suction, in consequence of the exhaustion which will take place within the vessel T, as well as in the feeding vessel N, in conse- 20  
quence of the condensation of the steam.

In witness whereof, I, the said Goldsworthy Gurney, have hereunto set my hand and seal, this Twenty-first day of April, in the year of our Lord One thousand eight hundred and twenty-six.

GOLD<sup>y</sup> (L.S.) GURNEY. 25

STEPHEN.  
AND BE IT REMEMBERED, that on the Twenty-first day of April, in the year of our Lord 1826, the aforesaid Goldsworthy Gurney came before our said Lord the King in His 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 30  
the tenor of the Statute made for that purpose.

Inrolled the Twenty-first day of April, in the year of our Lord One thousand eight hundred and twenty-six.

LONDON:

Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,  
Printers to the Queen's most Excellent Majesty. 1854.