Specification of William Church : steam boilers and propellers for vessels.

A.D. 1829 . . . . . N° 5857.

SPECIFICATION

OF

WILLIAM CHURCH.

STEAM BOILERS AND PROPELLERS FOR VESSELS.

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Steam Boilers and Propellers for Vessels.

CHURCH'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, WILLIAM CHURCH, of Heywood House, near Birmingham, in the County of Warwick, Esquire, send greeting.

WHEREAS His present most Excellent Majesty King George the Fourth, by His Letters Patent under the Great Seal of Great Britain, bearing date at Westminster, the Fifteenth day of October, One thousand eight hundred and twenty-nine, in the tenth year of His reign, did, for Himself, His heirs and successors, give and grant unto me, the said William Church, His especial licence that I, the said William Church, my executors, administrators, and assigns, or such others as I, the said William Church, my executors, administrators, 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 mentioned, should and lawfully might make, use, exercise, and vend, within England, Wales, and the Town of Berwick upon Tweed, my Invention of "CERTAIN IMPROVEMENTS IN MACHINERY FOR PROPELLING VESSELS AND OTHER MACHINES CAPABLE OF BEING PROPELLED BY STEAM, AND IN BOILERS APPLICABLE TO THE SAME AND ALSO TO OTHER PURPOSES;" in which said Letters Patent is contained a proviso, obliging me, the said William Church, 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 enrolled in His 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.

NOW KNOW YE, that in compliance with the said proviso, I, the said William Church, 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 and by the Drawings hereunto annexed, and the following description thereof (that is to say) :—

My improvements in "Machinery for Propelling Vessels and other Machines capable of being Propelled by Steam" consist in the peculiar construction and arrangement of several of the parts and appendages necessary to the constructing and working of a steam engine, which are designed for the purpose of rendering the engine as a whole more compact, less ponderous, and at the same time capable of exerting a greater effective power than any other engine hitherto made, in proportion to the quantity of steam employed under a given pressure; and also in the construction and arrangement of the paddles or wheels for propelling ships, boats, and other vessels by the agency of steam.

And my improvements in "boilers applicable to the same, and also to other purposes, consist in a peculiar mode of connecting a series of vessels to constitute a boiler for generating steam, and of forming the passages for the flow of the water and steam, and of the flues by which the fire and heated vapour is conducted and made to act upon the water with better effect than has been heretofore done in any other construction of boiler; and also in a new contrivance adapted to the apparatus for supplying the furnace with fuel, and in an appendage to the safety valve; all which said improvements are fully set out in the accompanying Drawings, and will be perfectly understood by reference thereto with the assistance of the following description, that is to say:—

Fig. 1 is an elevation of the steam engine complete, designed for propelling vessels, as it would appear when seen on the side; Fig. 2 is an elevation of the same, taken on the right hand of Fig. 1; Fig. 3 is a representation of the engine as seen from above; Fig. 4 is a section taken through the engine in a horizontal direction at the line A, B, in Figures 1 and 2; Fig. 5 is a vertical section taken through the cylinder in the line C, D, in Fig. 4; Fig. 6 is a section taken vertically through the air pump, hot water cistern, and force pump; in all which several Figures the corresponding letters refer to similar parts of the engine. The cylinder is enclosed within a jacket *á*, *a*, and receives its supply of steam from the boiler through the pipe *b*, which leads into the passage *c*, *c*, extending up one side between the jacket and the cylinder, and over the ends between the end plates *d*, *d*, and the outer caps. The end plates *d*, *d*, of the cylinder are perforated, for the purpose of performing passages for the induction and eduction of the steam, which passages are opened and closed

alternately by a sliding valve *e*, *e*, fitted to each end plate and working between it and the top or bottom cap or casing, the lower slider *e* being held up to the lower plate *d* by springs. I shall proceed to describe the construction of these end plates *d*, *d*, and the sliding valves *e*, *e*, with the method of actuating them. Fig. 7 is a horizontal view of one of the end plates as it would appear on its outer surface; Fig. 8 is a section of the same, that is, about an inch of the thickness of the plate on the outside being removed, for the purpose of exhibiting the eduction apertures and recesses within the said plates; Fig. 9 is one of the sliding valves detached, as it would appear on that side which acts against the outer surface of the end plate. Let it now be supposed that the steam from the passage *c*, *c*, is in the act of entering the cylinder through the upper end plate (as in Fig. 5) in order to depress the piston: the upper sliding valve *e*, *e*, must be in such an advanced situation as shall leave the induction appertures open, when the steam, passing freely round the upper slide valve, will enter the cylinder at the appertures *f*, *f*; at the same time the lower slide valve *e*, *e*, will have receded, shutting off the steam at the lower part of the cylinder and opening the apertures *f*, *f*, in the lower end plate *d* to the recesses in the slide valve, and through them to the cavity and eduction passages of the end plate, from whence the volume of steam that had previously acted in raising the piston will now pass off into the chamber *g*, *g*, *g*, within the jacket surrounding the cylinder, as shewn in Figures 5 and 8, and from thence through square passages *j*, *j*, Fig. 2 & 4, to the condensor, which is formed by the pedestals of the framework. The sliding valves *e*, *e*, are connected by rods *h*, *h*, to cranks at the ends of the vertical shaft *i*, *i*, which shaft, being driven round, works the sliding valves to and fro, and produces the induction and eduction of the steam, which puts the piston in action, as above described. The shaft *i* is put in motion by means of a peculiarly formed cross or star-wheel *k*, fixed upon the shaft, as seen in Fig. 1, 3, 4, & 5. This cross or star-wheel has four grooves cut in it, in radial directions, at equal distances apart, which grooves are intended to receive the tappets that are to drive it round each one-fourth of a revolution; and between the grooves the periphery of the star-wheel is cut into as many concave segments, which are designed to work against the circular part of the rotary tappet wheel *l*, seen best in the horizontal view, Fig. 4. This tappet wheel consists of two segment plates; the one fixed upon a vertical shaft *m*, the other adjustable thereon, and both are driven round by bevel gear above, connected to the rotatory horizontal shaft which works the air pump. Upon the tappet wheel segments there are two pins or tappets *n*, *n*, one of which at about every half revolution of the wheel strikes into one of the radial grooves of the star-wheel *k*, and turns it one

quarter of a revolution; thus it will be seen that in every quarter of a revolution of the star-wheel the cranks on the shaft *i* will be moved one quarter round, which by means of the connecting rods will at every such movement shift the sliding valve *e*, *e*. Now, supposing that the sliding valves stand in the situation shown in Fig. 5, that is, the upper one projected forward, leaving the passages *f*, *f*, open for the induction of the steam into the upper part of the cylinder, and the lower one drawn back, shutting off the steam and opening the eduction for the discharge of the steam from the lower part of the cylinder, the first movement of the star-wheel will draw the upper slide valve back a short distance and push the lower one foward; this will merely have the effect of shutting off the supply of steam at the upper part of the cylinder, allowing that steam which is within the cylinder to expand and force the piston through the remainder of its stroke. The second movement of the star-wheel will cause the upper slide valve to open the eduction passages from the upper part of the cylinder, and at the same time the lower slide valve will be so situate as to admit the steam into the lower part of the cylinder in order to raise the piston. The third movement of the star-wheel will place the parts in the same relative situations as the second, and the fourth movement will bring them to the situation from which we started, as shewn in Fig. 5; thus a continued rotation of the tappet, which will, through the intervention of the star-wheel, put the valves in action, and cause the engine to perform its functions. Here it should be observed that the tappet on the fixed segment above described is that which is employed for opening the induction, and for opening and closing the eduction passages, and the adjustable tappet for closing the induction only. The jet of water for condensation being injected into the condensor in the ordinary way, flows with the condensed stream along the passage *n**, Fig. 6 and 4, to the foot valve *o*. The construction of the air and hot water pumps will be best seen in the section Fig. 6, where the water, having washed the foot valve *o*, passes through it into the cylinder of the air pump *p*. The depression of the bucket *q* will cause the water to flow through the clack valves *r*, *r*, and by the rising of the bucket the water will be lifted into the cistern, and made to flow away at the waste pipe *s*. The bucket is made tight by sacking *t*, *t*, which is confined by a circular gland, capable of being tightened up by nuts on the outside. The piston rod of the air pump constitutes the plunger of the hot water pump, which is a hollow cylindrical tube or rod *u*, with a valve at top opening upwards; on the descent of the plunger a vacuum is produced in the barrel *v* of the hot water pump, into which the water from the cistern flows by small apertures through the hollow rod into the pump barrel *v*, and on the ascent of

the plunger, the volume of water occupying the barrel is carried forward through the valve at top by a pipe to supply the boiler. It is to be observed, that by the general arrangement of the several parts of the engine above described, the weight of the piston with its rod and other appendages is balanced by the atmospheric pressure on the bucket of the air pump, and the weight of the parts appended thereto. In order to effect this important advantage, the action of the two crank shafts may be conveniently connected together by spur wheels *w*, *w*, fixed respectively on the ends of the crank shafts of the piston and of the air pump, in such positions, that when the piston of the engine is ascending, that of the air pump is descending, and vice versâ. The power of the engine is communicated by the piston rod to the cross head, to which the perpendicular rods *x*, *x*, are affixed, extending down on both sides of the cylinder. To the lower ends of these perpendicular rods the connecting rods *y*, *y*, leading from the cranks on the main shaft, are attached by pins, which pins are the axles of antifriction rollers *z*, *z*, working between guides affixed to the inside of the framework. The main shaft having thus obtained its rotary motion, the power may be communicated from either extremity of the shafts to propel or drive other machinery. In constructing a steam engine with my improvements to be used for raising water or other stationary purposes, I propose to place the cold water pump immediately under the center of the steam cylinder in such a way that the axes shall coincide in the manner shewn in Fig. 10, which is a front view of the engine, and Fig. 11, a side view of the same. The perpendicular side rods *x*, *x*, as described above, are extended downward below the base of the cylinder, and their extremites attached to a cross beam A; and the connecting rods Y, Y, leading from the main cranks are also attached to the end of cross beams, as sweep rods are usually connected to cross heads. To the center of the beam the plunger or piston rod B of the cold water pump C is attached, and which extends downwards into the working barrell, forming a parallel motion for both the steam piston and pump rod. When this pump is used simply for the supply of the engine, I sometimes construct it in such a manner as to produce a double action, raising the water in the first place from the well, and then, after it has passed through a filterer, carrying it foward to the engine. The rising main D is a tube, fixed by a flange in the bottom of the cistern E, having a valve at top opening upwards. On the outside of the tube D the plunger B is intended to slide, being made tight by a stuffing box, which plunger B works in the barrel C, also made tight by a stuffing box, both of them being at top. The ascent of the plunger B produces a vacuum within it, and also within the barrel of the pump, causing the water to rise through the main D into the plunger,

and on the descent of the plunger the water so raised becomes displaced from the plunger, and is caused to flow through the valve at top over into the cistern. In the lower part of the cistern there is a false bottom, supporting a filterer through which the water descends, and from the lower compartment is forced forward through the tube F into the column of the framework by the second action of the pump in the descent of the plunger B, from whence it passes into the condensor. It is obvious that the order of the pumps may be reversed, that is, instead of water being discharged from the well into the upper compartment of the cistern, it may be delivered into the lower compartment and filtered upwards. In situations where it may be desirable to employ a governor, I adapt the following contrivance for cutting off the steam at an earlier or later period of the stroke, as may be required. In Fig. 10, the ordinary construction of governor for regulating the throttle valve will be seen at G, having a sliding tube H upon and feathered to the perpendicular shaft *m*, extending down toward the tappet wheel, where it is enlarged, to receive the collar appended to the adjustable tappet above described. From this collar there extends a small pin, which acts in an oblique slot in the enlarged part of the tube H, and when by the centrifugal force of the balls the tube H is drawn up, the oblique slot, through the medium of the pin, causes the adjustable tappet to be shifted from its relative position to the other tappet, and to follow it sooner in its rotation, thereby cutting off the steam at an earlier period of the stroke. In order to enable the engine to work the slides by hand, it is necessary to withdraw the clutch I, from the star-wheel; this is done by pressing the foot upon the lever K, which holds up the clutch by a garter and spring; the shaft *i* can then be turned round, which moves the slide valves and effects the induction and eduction. In high pressure steam engines, I propose to employ the same constructions and arrangement of the parts as already described, dispensing of course with such appendages as are required for effecting condensation, and allowing the steam to pass direct from the jacket through a hot water cistern to the open air. In high pressure condensing engines it is necessary to let nearly all the steam which is above the pressure of the atmosphere escape until it descends to the point of pressure commonly used in condensing engines. I effect this by a peculiar arrangement of valves, which will be fully understood by reference to Figs. 12 and 13. *a* is the eduction passage; *b*, the passage open to the air; *c*, the passage to the condensor. In these passages are placed the valves *d* and *e*, which are connected together by a link and joints *f*; steam entering from the cylinder by the eduction passage will exert its force against the upper valve *d*, which is much larger than the lower one *e*,

and consequently *d* will be thrown open at the same time the lower valve closing, when all the steam above the pressure of the atmosphere will escape by the passage *b*. But on the pressure of the atmosphere and the steam becoming nearly equalized, the valve *d* will fall and close by its gravity, the connecting link at the same time opening the lower valve *e*, when the remaining part of the steam will be free to pass off by the passage *e* to the condensor, where it may be acted upon by the jet of water in the usual way.

My improvement in the construction and arrangement of the paddles or wheels for propelling ships, boats, and other vessels consists in the following combination:—I employ two wheels, each having a series of bent paddles, revolving on a common axle but in opposite directions. These wheels are surrounded each by a cylindrical rim, to which the peripheries of the paddles are attached. Fig. 14 is a front view of one of the paddle wheels, with the cylindrical rim *a*, *a*, *a*, surrounding it; Fig. 15 is a longitudinal representation of the two paddle wheels, the rims being cut in section perpendicularly through their diameters, for the purpose of shewing the construction of the wheels within. I sometimes employ the two wheels with bent paddles, as represented in the two last-mentioned Figures, revolving in opposite directions within a fixed cylinder. It is only necessary to observe that the axis of the wheels is intended to be placed paralled to the keel of the vessel, and they may be driven by any of the ordinary modes of driving two wheels upon the same axle in opposite directions.

My improvements in boilers applicable to steam engines consist, in the first place, in adapting a series of vessels arranged as shewn in the Drawings, of which Fig. 16 is a front view, exhibiting the caps of the several vessels, and also the fire door, ash pit, and the several doors for clearing the flues; Fig. 17 is a top view of the same, the roof of the casing being removed, in order to shew the three upper vessels, and the manner of uniting them together, that is, by bolting them to flanges. Fig. 18 is a horizontal section, taken through the center of the lower vessels on a line with the furnace; and Fig. 19 is a vertical section, taken transversely through the series of vessels; *a* being the furnace; *b* 1, *b* 2, *b* 3, *b* 4, *b* 5, *b* 6, and *b* 7, the several vessels occupied with water and steam; and *c* 1, *c* 2, and *c* 3, the flues leading from the furnace to the chimney. Fig. 20 is a section of the boiler, taken through the front plate, parallel to its plain, shewing the passages of communication *d*, *d*, *d*, for water and steam from one vessel to another. These connecting passages lead through the flanges *e*, *e*, *e*, surrounding the ends of the vessels, as above said, the passages as well as the flanges being east with the front plate *f*, *f*, *f*, seen in Fig. 17 & 18. The water is introduced into the boiler

at the lower part of the two upper side vessels *b* 5 and *b* 6, through the feed pipe *g*, from whence it flows by the side passages *d*, *d*, into the vessels *b* 1 and *b* 2, and from thence upwards through the oblique passages *d*, *d*, to the vessels *b* 3 and *b* 4. The height of the water in the vessels *b* 3 and *b* 4 will be regulated by a long cylindrical float *h*, acting on a wire with a crank much in the usual way, which shuts off the supply of water when it has risen to the proper level. It will now be obvious that the steam generated in the vessels containing water will pass through the several passages to the upper vessel *b* 7, and from thence through the steam pipe to the engine. It will be perceived by the section, Fig. 19, that the space between the several vessels are divided into longitudinal compartments which constitute flues. The flame and heated vapour from the furnace on reaching the further end divides, and, passing under the lower side vessels *b* 1 and *b* 2, returns to the front of the flues *c* 1 and *c* 2, formed under each, then rising upwards it surrounds the necks of those vessels and proceeds into the flues *c* 3 and *c* 4, under the vessels *b* 5 and *b* 6, and ultimately escapes into the chimney. These vessels and flues are enclosed by a casing of thin sheet iron, which is lined with a stratum of pulverized charcoal or other imperfect conductor of heat, for the purpose of preventing its escape by radiation. I do not intend to confine myself to the precise number of steam generating vessels shewn and described above, as the arrangement exhibited at Fig. 21 would be equally eligible, when a larger capacity of boiler may be required.

My new contrivance, adapted to an apparatus for supplying the furnace with fuel, consists in a mode of projecting small quantities of coal into the furnace at different periods over the entire surface of the fire. Fig. 22 is a front view of a boiler with the improved apparatus adapted thereto; Fig. 23 is the side view of the same, as it would appear at the right hand of Fig. 22; and Fig. 24 is the opposite side, Fig. 25 being a vertical section taken in the same direction. *a* is a hopper, containing coal broken into small pieces, the mouth of which is covered with a grating *b*, designed to prevent large pieces of coal being passed into the hopper; *c* is a feeding roller, which as it revolves deposits small quantities of coal upon shelf *d*. Upon this shelf the pusher *e* is intended to act, for the purpose of projecting the coal into the furnace; *f* is a pinion shaft, which is to be driven by any convenient connection to the engine; *g* is the pinion at the end of the shaft, which takes into and drives the wheel *h* affixed to the feeding roller; *i*, *i*, are levers on the shaft *j*, which are connected by joints to the rods of the pushers; *k* is a bent lever, fixed on the end of the shaft *j*; *l* is an excentric wheel on the pinion shaft; *m* is a roller or pin, projecting from the side of the bent

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CHURCH'S Specification.

4 SHEETS
SHEET 1

FIG. 11.

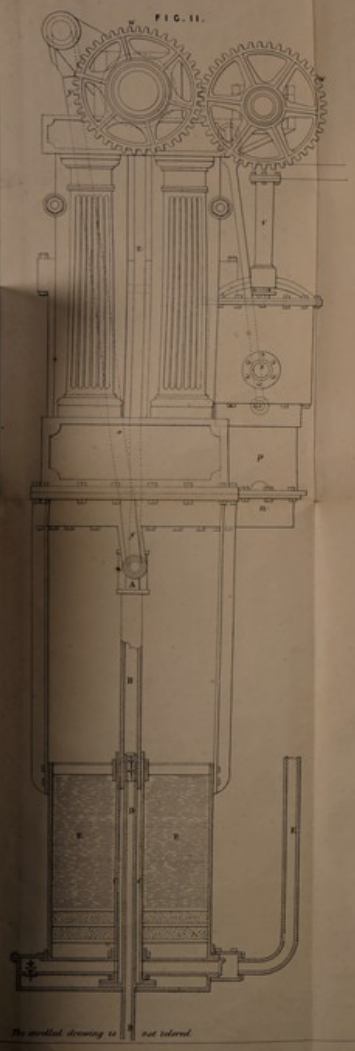


FIG. 10.

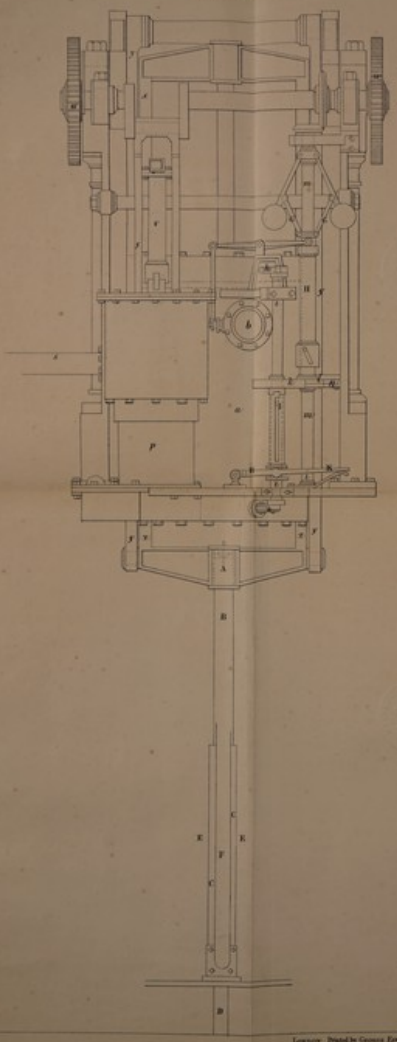


FIG. 2.

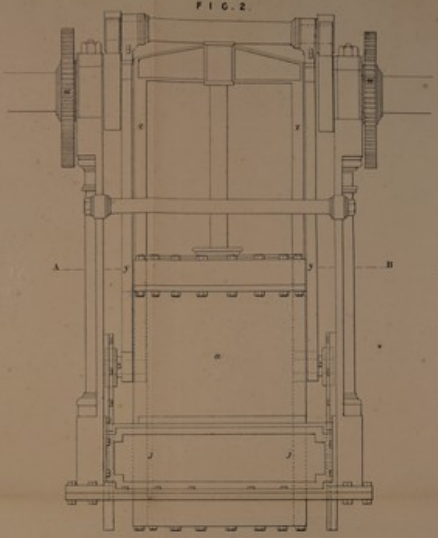


FIG. 1.

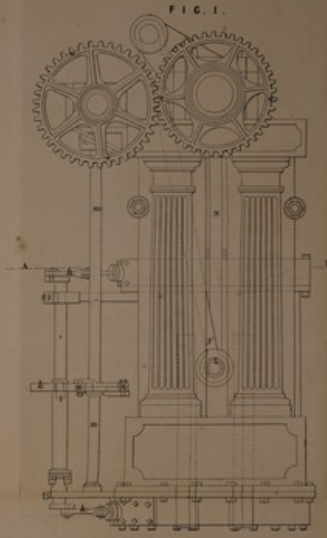


FIG. 3.

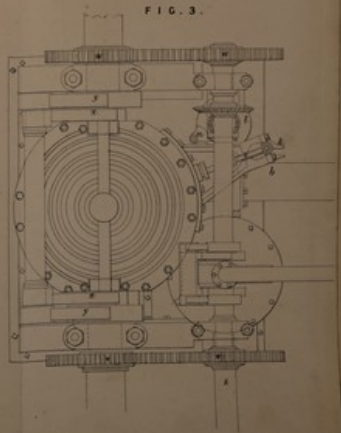
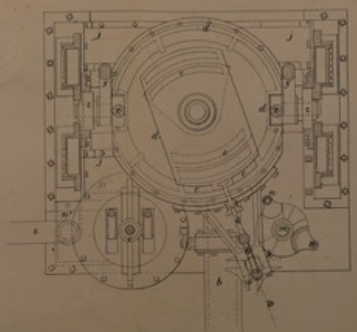


FIG. 4.



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CHURCH'S SPECIFICATION.

4 SHEETS
SHEET 2

FIG. 19.

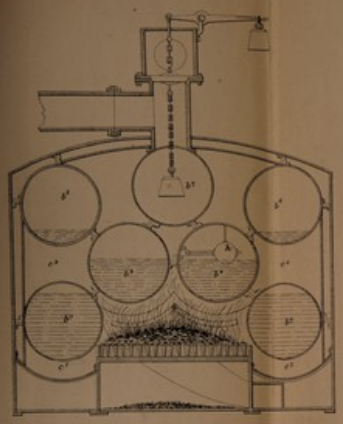

FIG. 20.

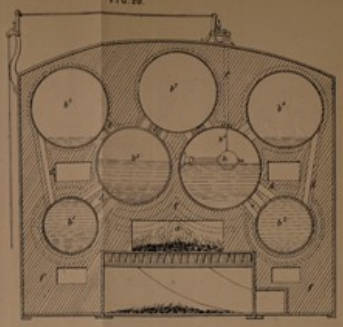

FIG. 21.

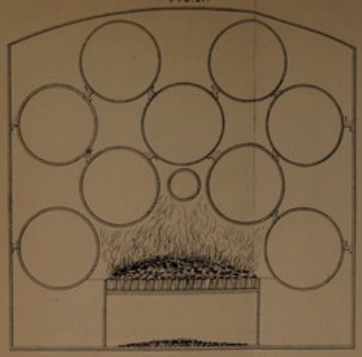

FIG. 18.

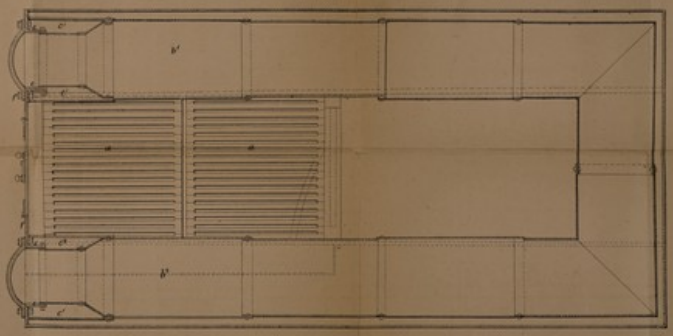

FIG. 16.

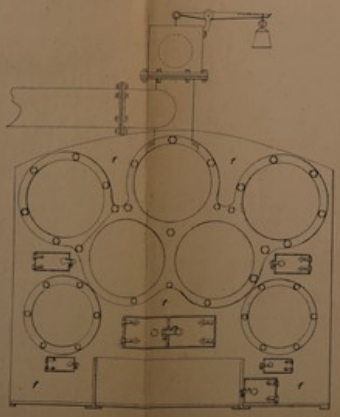

FIG. 17.

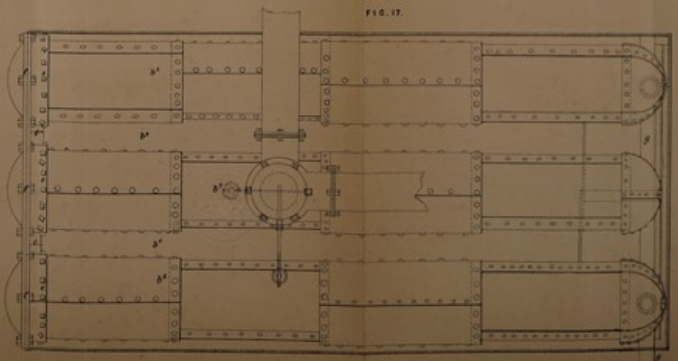

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FIG. 8.

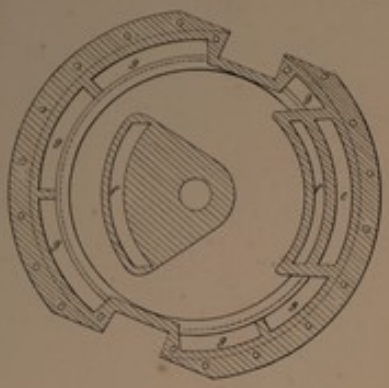


FIG. 12.

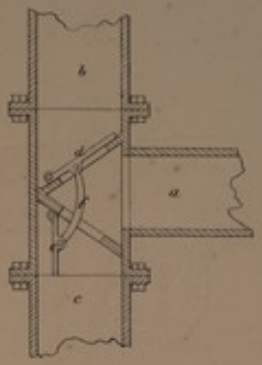


FIG. 9.

FIG. 13.

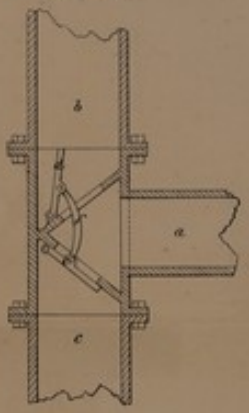


FIG. 7.

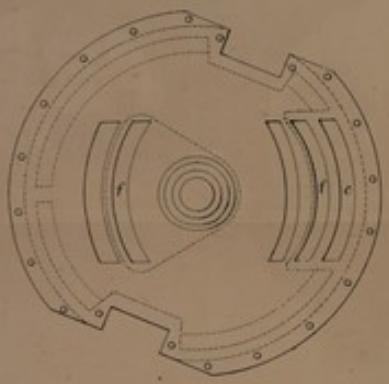


FIG. 6.

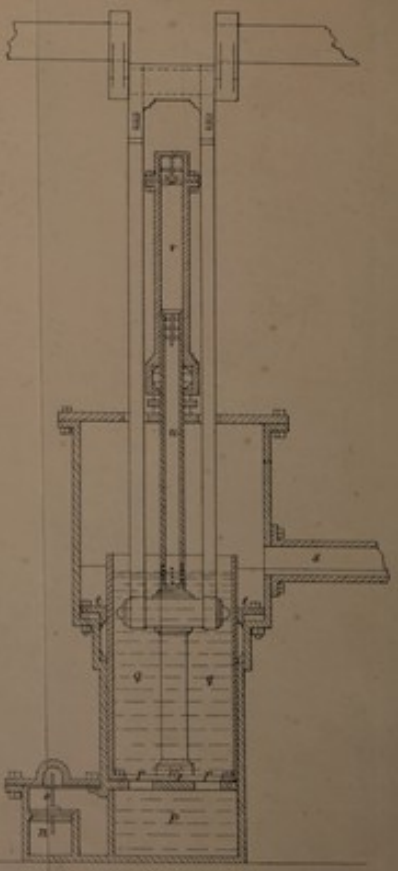
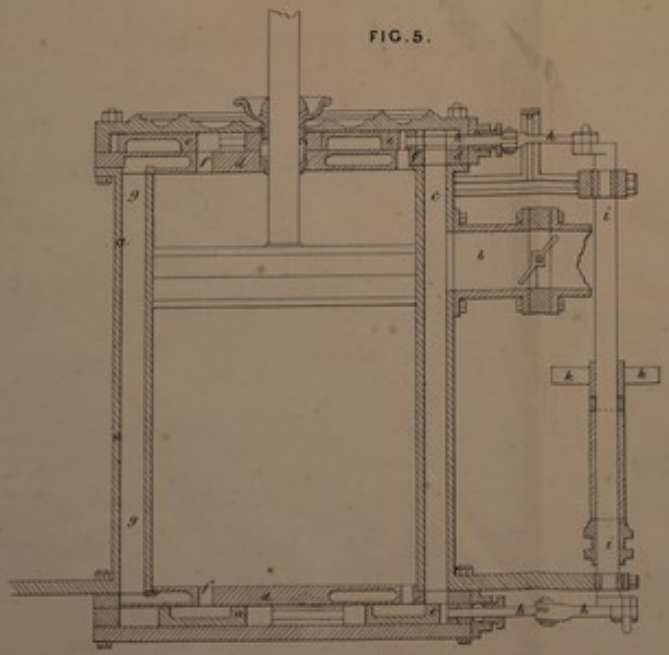


FIG. 5.



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CHURCH'S SPECIFICATION.

(4 SHEETS.)

FIG. 15.

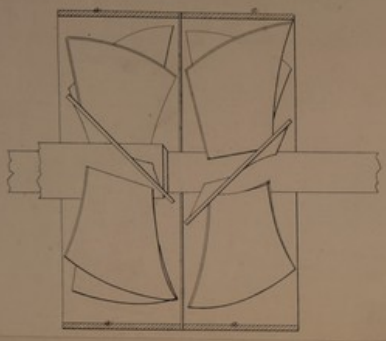


FIG. 14.

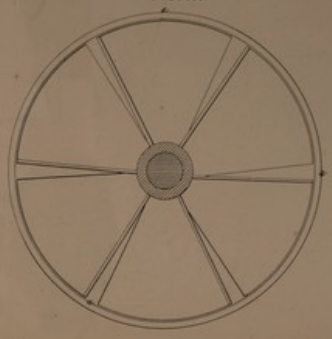


FIG. 24.

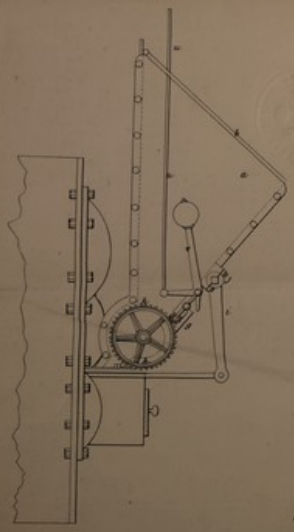


FIG. 25.

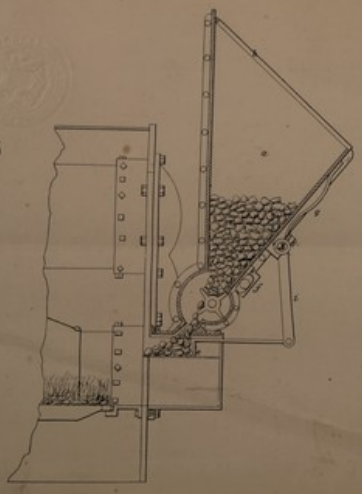


FIG. 22.

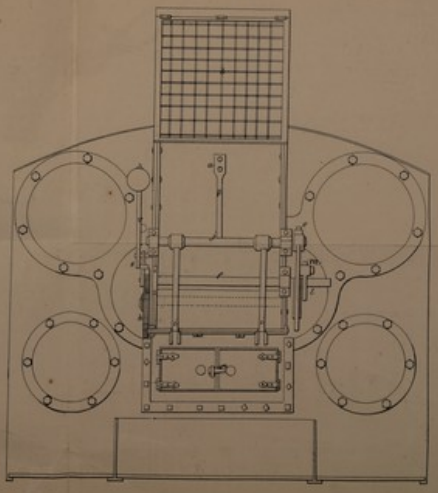
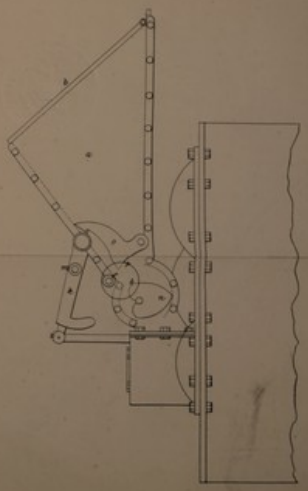


FIG. 23.



The enrolled drawing is colored.

Malby & Sons Lith.

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lever; *n* is a heart wheel, affixed to the end of the axis of the feeding roller. Let it now be supposed that motion is given to the pinion shaft *f* and communicated to the feeding wheel *c*, coals will be deposited in small quantities on the shelf *d*. The pusher being drawn back by the excentric *l* acting against the pin *m* into the position shewn in the Figures, it remains retained in that situation by the catch O until the excentric has arrived at the position where it presents its shortest radius to the pin *m*. At this time a pin *p* in the excentric raises the catch and allows the spring *q* to throw forward the pusher with considerable force, until its further progress is arrested by the toe of the bent lever *k* striking against the heart wheel *n*, when the coals that had been deposited on the shelf are thrown off on to the fire bars. Now it will be seen that the heart wheel as it revolves will stand in various positions in relation to the toe of the bent lever; the force of the strokes will be also varied, and consequently the coals projected to different distances and distributed with considerable regularity over the whole area of the fire bars. By reference to Figs. 22 and 24 it will be seen that the pinion above described is held in geer with the wheel on the axis of the feeding wheel by a pair of jointed bars *s*, *s*, the bearing of the shaft being held in a slot, the intention of which is to allow the pinion to be withdrawn for the purpose of stopping the feed of fuel, in case of the water in the boiler becoming by any means so low as to render it unsafe to continue the fire under it. In order therefore to effect this object, a wire *u* is broat from a float in the boiler and attached to the arm of the lever *v*, and as the float descends the lever *v* is raised towards a vertical position, and ultimately falls over into the opposite enclined position, and by a pin at its lower extremity the jointed levers *s*, *s*, are tripped, and thus the pinion is drawn out of geer when the feeding of the fuel ceases.

The improved appendage to the safety valve is shewn by Fig. 19, and consists in guiding the conical valve to its seat without the intervention of the ordinary guide rod and bridge, by means of a weight suspended from a chain within side the boiler, and a lever and counterweight on the outside of the cap, which covers the valve and secures it against the possibility of its being over-weighted.

In witness whereof, I, the said William Church, have hereunto set my hand and seal, this Fifteenth day of April, in the year of our Lord One thousand eight hundred and thirty.

WILLIAM (L.S.) CHURCH.

Church's Improvements in Steam Boilers and Propelling Machinery.

HARVEY.

AND BE IT REMEMBERED, that on the Fifteenth day of April, in the eleventh year of the reign of His Majesty King George the Fourth, the said William Church came before our said Lord the King in His Chancery, and acknowledged the instrument aforesaid, and all and every thing therein contained and specified, in form above written. And also the instrument aforesaid was stamped according to the tenor of the Statute made in the fifty-fifth year of the reign of His late Majesty King George the Third.

Inrolled the Fifteenth day of April, One thousand eight hundred and thirty.

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