The United States of America,

To all to whom these Letters Patent shall come:

Whereas Robert Fulton a Citizen of the United States, hath alleged that he has invented a new and useful improvement

in Steam Boats

which improvement he states has not been known or used before his application; has made oath that he does verily believe that he is the true inventor or discoverer of the said improvement,

has paid into the treasury of the United States, the sum of thirty dollars, delivered a receipt for the same, and presented a petition to the Secretary of State, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: **These are therefore** to grant, according to law, to the said Robert Fulton his heirs, administrators, or assigns, for the term of fourteen years, from the eleventh day of February 1809 the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Robert Fulton himself, in the schedule hereto annexed, and is made a part of these presents.

In testimony whereof, I have caused these Letters to be made Patent, and the Seal of the United States to be hereunto affixed.

GIVEN under my hand, at the city of Washington, this eleventh day of February in the year of our Lord, one thousand eight hundred and nine and of the independence of the United States of America, the thirty third.

J. Madison

BY THE PRESIDENT.

James Madison Secretary of State.

City of Washington, To wit:

I DO HEREBY CERTIFY, That the foregoing Letters Patent, were delivered to me on the eleventh day of February in the year of our Lord, one thousand eight hundred and nine to be examined, that I have examined the same, and find them conformable to law. And I do hereby return the same to the Secretary of State, within fifteen days from the date aforesaid, to wit:—On this eleventh day of February in the year aforesaid.

R. Rodney Attorney general of the United States.

The Schedule referred to in these Letters Patent Containing part of the same containing a Description in the Words of the said Robert Fulton himself of his Discoveries Inventions and Improvements in Steam Boats. —

It is then the Same for driving the Boat I make use of a Mr. Boulton & Watts Steam Engine but instead of a Beam above the Cylinder I have a triangular cast Iron Beam on each side of it, and near the bottom of the Boat; the base of the triangle is nine feet long: in the centre of the Beam a perpendicular is raised three feet six Inches high, which is the centre of the triangle: the two triangles are fixed on one strong Iron shaft, so that they play together. On the top of the piston rod there is a Beam of strong Iron Bars which moves in guides at each side of the Cylinder: from each end of this Beam two strong Iron Bars reach down by the sides of the Cylinder to a strong Bar of forged Iron, the two pinions and playing down by the sides of the Cylinder is a strong Bar of forged Iron called a Shackle which is connected by a shackle pin to the end of the Beam, then the end of the Beam moves through a Curve in a perpendicular direction, and its centre moves thro' a curve in a horizontal direction, the other end of the triangle is cast with a weight of iron sufficient to balance the weight of the Piston, and all the weight on the opposite side of the fulcrum or centre of the base line. From the centre of each triangle a Shackle from eight to eight Feet long is connected with a crank which is fixed on each shaft of the Paddle wheels: close to each crank is a cast iron wheel about four feet six Inches Diameter, each having a pinion two feet three Inches diameter. These two pinions are on one shaft, in the centre of which is a fly wheel two feet Diameter. The movement for the air pump is taken from the base line of the Beam, and twenty one Inches from the fulcrum. The condensing water comes through the sides or bottom of the Boat by a Pipe which enters the condenser, and is regulated by a cock or valve. The hot well, the pressing Pump to replenish the Boiler, the Steam gage, the safety Valve, the float in the Boiler to regulate the quantity of water, the foot & hand gear &c &c are in precisely the same manner as those acquainted with the Steam Engine, & may be arranged in such a variety of manners as suit to require a Description. I prefer a paddling wheel or wheels to take the purchase on the water; they may be from eight to twenty feet diameter & divided into any number of equal parts from three to twenty; each wheel may have from three to twelve paddles, but a wheel or wheels from twelve to fifteen feet diameter each with from eight to twelve paddles

a position will be found to apply the power of the Engine to great advantage. Mr Stevens has placed a propelling wheel on each side of the Boat, with a wheel guard or frame, outside of each of them for protection, a propelling wheel or wheels may however be placed behind the Boat or in the centre between two connected Boats. To give them in the steering, preserve or merchandize I build my Boats from or more times as long within extreme Breadth at the water line. The extreme may be one third from the bow or in the middle, in which case the water line will form two equal segments of a circle united at the ends. To diminish the false and minus pressure I make the Bow and Stern sharp, to angles of at least sixty Degrees, and that the Boat may draw as little water as possible, I build it flat or nearly so on the bottom. Having mentioned the essential component parts of a steam boat and its mechanism, its successful construction & velocity will depend First on an accurate knowledge of her total resistance while running 1. 2. 3. 4. 5. or 6 miles an hour in still water — Second on a knowledge of the diameter of the Cylinder, strength of the steam and velocity of the Piston to overcome the resistance of a given Boat while running 1. 2. 3. 4. 5 or 6 miles an hour in still water. Third on a knowledge of the square feet or inches to each propeller should have, & the velocity it should move to drive a given Boat 1. 2. 3. 4. 5 or 6 miles an hour through still water. It is a knowledge of these Proportions and velocities, which is the most important part of my discovery on the improvement of steam Boats. ——

The following Definitions, Tables and Calculations will lead to a clear Idea of them —

Definitions

By total pressure is meant the total pressure against the Bow when the Boat is at rest.
By steam pressure is meant the total pressure against the steam when the Boat is at rest.
Plus pressure is additional pressure against the Bow while the Boat moves forward it is received by the fluid being displaced and is an addition to head pressure —
Minus pressure is a diminution of steam pressure received by the fluid not striking so strongly against the steam when the Boat moves forward as when at rest.
Friction arises either from the adhesion of the particles of the fluid to the surface of the Body

Body or from the roughness of the Body, or from both these Causes united. —
Bow resistance is minus pressure, and the friction of the water against the Bow united. —
Stern resistance is minus pressure & the friction of the water against the Stern united. —

Table of Friction of Plus & Minus pressure and of the Resistance of one Square foot of Propeller. —

Nautical Miles an Hour		1	2	3	4	5	6
When a Boat is smooth & clean the friction on every 50 sq. feet will be —	lb	.70	2.36	4.74	7.75	11.32	15.43
The plus and minus pressure on each foot of Bow of 60 degrees, the Stern being also 60 Degrees is —	lb	0.88	3.31	7.15	12.37	18.93	26.78
The plus and minus pressure on each foot of Bow of 20 degrees the Stern being also twenty Degrees is —	lb	0.68	2.29	4.97	8.64	13.30	18.90
The resistance of one Square foot of propeller is —	lb	3.25	13.00	29.36	51.95	80.76	115.71

By this Table the total resistance of all lengths width and Draft of water of all Boats with Bows and Sterns on angles of twenty or sixty Degrees may be calculated. The resistance of one square foot of propeller is also shewn; hence when any particular sized boat, and the number of miles which she is to run in still water has been decided. First find her total resistance for that velocity; then by the Table find the number of square feet or Inches of a Propeller, which, while running a velocity equal to the Boat will make a resistance equal to the Boat: it will consequently follow that the resistance of the Boat and propeller being equal they will pass through equal spaces in equal times, and while the Boat advances one mile the propeller will strike through the water one mile backwards, therefore if the Boat is to run 1, 2, 3, 4, 5 or 6 miles an hour the speed of the propeller in the water must be 2, 4, 6, 8, 10, or 12 miles an hour, one half of each of these velocities is spent in striking Water back to create a resistance equal to the resistance of the Boat, the other half is to overtake as she advances. For Example when a Boat moves one miles an hour the water runs along her sides with a speed of one mile an hour; were the propellers only to run one mile an hour they would not touch the water which was running from them with any forces, but if they ran two miles an hour they would strike the water with the forces of one mile & create a resistance equal to the resistance of the Boat. —

The

The following is the method of finding the total resistance of a Boat, and of calculating the power and proportions of the machinery to the speed which she is to run. — For these Calculations, say Boat 154 feet long 18 feet wide drawing 2 feet of water, Bow and Stern on Angles of 60 Degrees, Steam Engine making a four foot stroke & 15 double strokes a minute, equal 2 feet a Second, the Boat to run four miles an hour. —

Plus and Minus pressures on one foot 12.37 ℔ multiplied by 36 feet the Boats Bow	445.32 ℔
Friction on 848 feet of Bow and Stern at 7,75 ℔ for every 50 Square feet —	131.75
Friction on 2200 Square feet of the Body of the Boat - - - - - - - - - - - -	341.00
Total resistance of the Boat - - - - - - - -	918.07
A like power for the Propellers - - - - - -	918.07
Total power - - - - - - -	1836.14 ℔

be felt at the end of the propellers running four miles an hour or six feet a second: this is three times as fast as the piston moves, hence 1836,14 must be multiplied by 3 equal to 5508,42 ℔ or the power of the Engine. A Cylinder 27 Inches diameter equal 729 round Inches and eight pounds to the Inch gives 5832 ℔ the periphery of the propeller wheel must run eight miles an hour or 12 feet a second equal to 720 feet a minute; wheels 14 feet diameter 44 round & 16 revolutions a minute will give 704 feet a minute which is sufficiently near. — The total resistance of the Boat is - - - - - - - - 918,07 ℔

The resistance of one square foot of propeller, running 4 miles an hour is

51,95 ℔ -- 17½ square feet give resistance - - - - - 909.12 this is 8 3/4 feet in each propeller; by this Example all necessary calculations may be made. —

I make use of sails and take advantage of the wind to aid the Engine, or when the Wind is sufficient I stop the Engine throw the wheels out of gear, and move by the power of the wind only. — To prevent the Boat making lee way she has lee boards or boards which are let down into the water while she is sailing; hitherto there have been two lee boards on each side of the Boat, one on each side near the Bow, and one on each side near the Stern. That the Helms-man may steer to advantage I place the Wheel for steering and lead the tiller Ropes so near the middle of the Boat as to enable him to have an uninterrupted view forward. In any Case where a current against the Boat is superior to the power of the Engine to pass it, I propose to cast Anchors in such waters or obtain any other fastening which will enable me to warp the Boat by the power of the Steam Engine, from Station to Station until the rapid be past. —

Such

Such Steam Boats are for Passengers I build with Berths, good Sophas & Beds, Kitchen Bar & Gas magazine with every convenience for giving Breakfasts, Dinners, Tea & Suppers, either in the Cabbins or under an Awning or Awnings on Deck.

Witnesses.

John R. Livingston

Natl Livingston

Robert Fulton