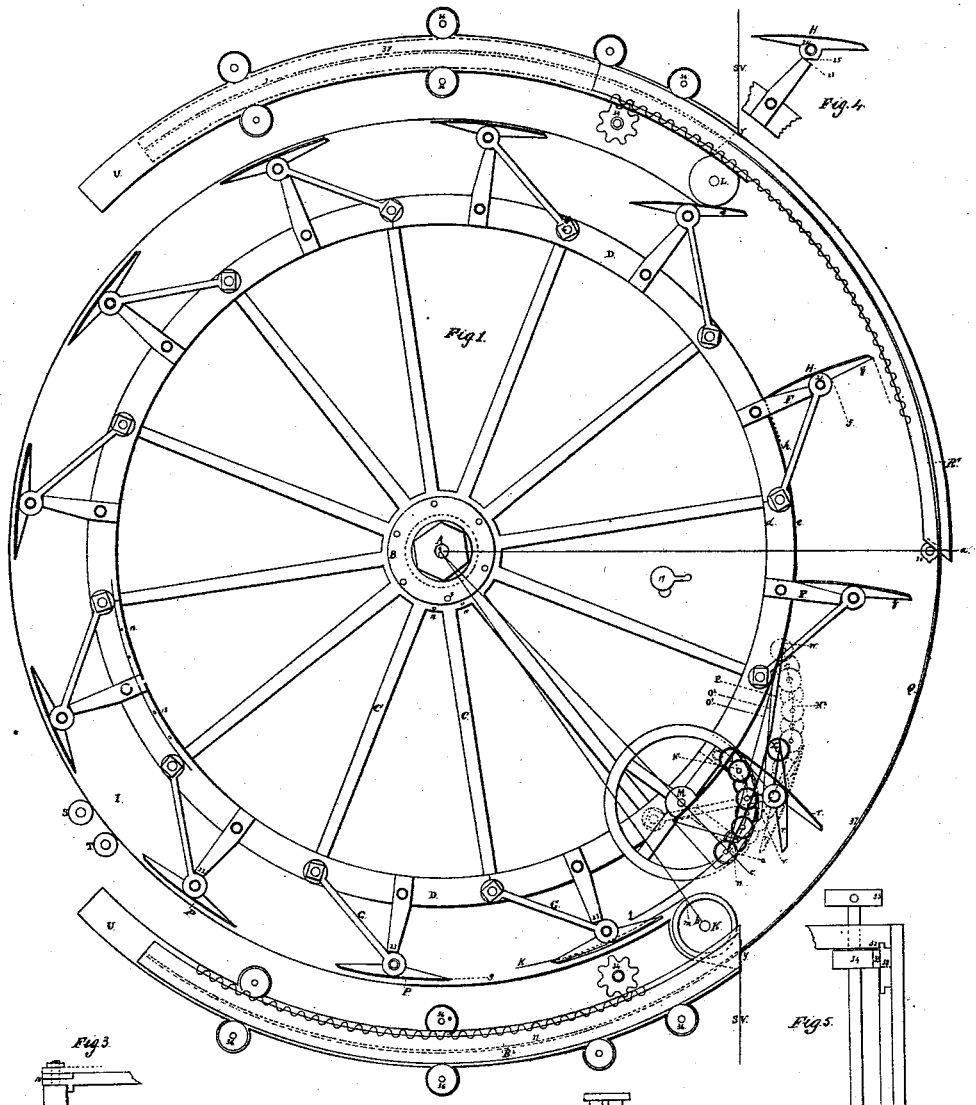
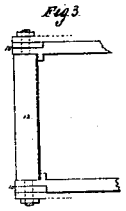
H. Everett,
Paddle Wheel.

No. 3,129.

Patented June 9, 1843.





UNITED STATES PATENT OFFICE.

HORACE EVERETT, OF WINDSOR, VERMONT.

IMPROVEMENT IN SUBMERGED PROPELLERS.

Specification forming part of Letters Patent No. **3,129**, dated June 9, 1843.

To all whom it may concern:

Be it known that I, HORACE EVERETT, of Windsor, in the county of Windsor and State of Vermont, have invented a new and useful Improvement for Propelling Vessels by Steam, called "The Horizontal Shifting Paddle-Wheel," with or without its guards or caisson; and I do declare that the following is a true and exact description of the construction and operation of the same.

The nature of my invention consists in providing a horizontal paddle-wheel, placed partly within and partly without the vessel, the paddles of which shall, when without the vessel, act as propellers, and before entering within it shall, by fixtures in the vessel, be turned edgewise, and in that position pass round within the vessel, and on passing out shall resume their position as propellers; and in providing guards to protect the part of the wheel without the vessel against external injury, and in providing a caisson to inclose the wheel when the vessel shall be propelled by sails, and to render repairs of the wheel practicable without having the vessel put into dock or laid down.

The description has reference to the accompanying drawings, making a part of this specification, made on a scale of one inch to a foot, and noted decimally in figures on the unit of a foot.

There are five figures in the drawings, to which the references are noted in the margin, and have relation to the small capital or italicized type, viz:

Figure I is a horizontal section of the paddle-wheel, on the starboard side of the vessel, taken at the top of the upper arms. Fig. II is a vertical section of the same, drawn through the upper paddle-arms on the transverse line, exhibiting also the main arms. Fig. III is a vertical section of the main arms and rims, and of the supports between the rims. Fig. IV is a horizontal section of a paddle-arm and paddle through the shackle. Fig. V is a vertical section of the guards and caisson and the cog-wheel out of place.

The principle lines and circles referred to in the description are: the transverse line 1^a, drawn from the center of the paddle-wheel at a right angle with the side of the vessel; the roller-line 1^b, drawn from the center of the paddle-wheel to the center of the receiving-roller K; the center line 1^c, drawn from the center of the paddle-wheel through a point *n* in the paddle-circle, without the vessel, distant from the intersection *m* of the roller-line and paddle-circle a space about an inch (0.1) less than half or the whole length of a paddle *v*, and the inner and outer rim-circles *d e*.

The paddle-circle *g*, the inner and outer paddle-circles *h i*, and the paddle-arm circle *f*, respectively, are described by the motion of the outside of the paddle when shifted, by the inner and outer ends of the paddles when acting as propellers, and by the end of the paddle-arms.

The drawings are not made in reference to a necessary size of the wheel or of its parts, but merely for the illustration of the description. The dimensions of the parts will necessarily have relation to the size of the wheel, the depth of its immersion, and the velocity required. The space within (from the outside of) the vessel occupied by the wheel will be about six-sevenths (85-100 on the diameter) of the paddle circle, affording sufficient space between the shaft and inside of the vessel for the crank. The wheel may be immersed to any depth that the construction of the vessel will permit. The position of the wheel is no part of the invention claimed. The wheel is made entirely of iron, (unless where otherwise noted.) The shaft A, of cast or hammered iron of sufficient diameter (1.0) for strength, is made round above the upper hub and six or eight square where it passes through the hubs, having a shoulder (which may project an inch or two) to rest on the surface of the upper hub. It extends downward to within an inch (0.1) of the bottom of the lower hub and upward so far as is necessary to connect its crank with the steam-engine. It is supported by clamps above the covering of the wheel-pit and at the bottom rests on a gudgeon 2, fitted into a socket 3, placed in the frame of the vessel. Above the gudgeon is a projection 4, of greater (0.4) diameter than the shaft, having its upper surface turned level, and above that is a section 5, of about an inch (0.1) high, corresponding with the square of the shaft and fitted to enter the lower hub up to the projection, all cast solid and in one piece. The object of the section is to prevent the unscrewing of the fastening-rod on reversing the motion of the wheel. The shaft

has a bore 6 through its center of sufficient caliber (0.2) to admit a fastening-rod of sufficient strength to sustain the whole weight (0.19) of the wheel. A bore smaller than that in the shaft by the depth (0.02) of the cut of its screw is made in the center of the gudgeon nearly to the bottom, in which the screw is cut. The fastening-rod 7 is made to fit the bore of the shaft and of a length to reach from the top of the shaft nearly (0.1) to the bottom of the screw in the gudgeon, having on one end a strong square head, (which is let down on the top of the shaft by a cut in the top of the crank,) by which it is turned, and a screw at the other end, which connects it with that in the gudgeon. The shaft is fastened in the hubs in this manner: The inner cylinder of the drum is placed between the hubs, (in the manner hereinafter described,) which are firmly secured on it by bolts with nuts. The gudgeon being put in place in its sockets, the hubs are placed upon it, and (the squared section entering the lower hub) are brought to a firm rest upon the surface of the projection. The shaft is then inserted in the hubs and the shoulder brought to a firm rest upon the upper hub. The fastening-rod is inserted in the bore and screwed into the gudgeon, bringing the head home upon the top of the shaft. By this the shoulder and projection are brought firm against the upper and lower hubs and the shaft firmly secured to the wheel. The shaft thus placed can be taken out, reinserted, or replaced when necessary.

There are two hubs B, each with its arms cast or made in one piece, and are of the same pattern, having their corresponding faces toward and opposite to each other. The hubs are of a diameter (2.0) sufficient to receive the inner cylinder of the drum, the bolts by which they are fastened together, and the heads of the drum, and of sufficient thickness (0.25) to sustain the action of the shaft and to support the arms, (the increase of thickness over that of the arms being on the inner sides.) They have an aperture in the center corresponding with the squaring of the shaft. A flange 8 projects inward from the inner side of the hubs next to the shaft about an inch, (0.125,) squared inside to the shaft. The outside of the flange is a circle of as much greater diameter (0.2) than that in which the square for the shaft is inscribed as shall be necessary for their proper strength. The outside of the flanges and the inner side of the hubs are turned smooth to receive the inner cylinder of the drum. The outer surfaces of the hubs and arms are turned to a level, and when in place those surfaces are parallel to each other. The hubs are secured by bolts 9, (outside of the inner cylinder,) and are placed at such distance apart (2.5) as is proposed for the depth of the wheel, having a head on the one end and a nut on the other; (or, if shouldered to meet the inside of the hubs, by a nut at both ends.)

The number of arms C depends on the size of the wheel and the number of paddles. The number should be such that the paddle-arms may be placed between them, and that each arm have the same distance on each side from the paddles. A wheel with twelve arms (the one described in the drawings) will admit of only one paddle between them. A wheel of the same size with eight arms will admit of two paddles between the arms. The width (0.25) of the arms where they proceed from the hub is wider than where they connect (0.2) with the rim. They are of the same thickness (0.2) of the rims, or may be square at both ends. They are connected with the rims by halvings 10, made on the outer side of the arms and inner side of the rims. There are flanges on the inner side of the ends of the arms corresponding with those on the rims. The rims D are made in four sections, of the same thickness (0.2) as the arms, and as wide as is necessary (0.5) to give firmness to their connection with the main and paddle arms. Their outer surfaces are turned down to a level with the arms. Their edges are turned in circles. Their inner sides are turned level up to the flanges and parallel to the outer surfaces. The flanges 11 of the rims project inward from the inner side of the rims at the inner rim-circle so far (0.125) and are so thick (0.075) as is necessary to keep the outer cylinder of the drum in place. They are turned round to receive that cylinder. The rims are halved (10) on the outer (or on the upper) side at the center between the main arms to receive the paddle-arms. A plate of copper or other metal is fastened on the inner edge of the rims against the halvings to secure the perfect tightness of the drum, especially when a paddle-arm is taken out for repair. The rims are secured in place by pillars 12, round or flat—if flat, about half an inch thick (0.05) and about five inches wide (0.425)—placed between them where the arms connect, shouldered at both ends, the whole width between the drum and the outer edge of the rim, for the purpose of keeping them parallel. They have bolts at each end, which pass through the rim and stays and are secured by nuts.

The drum E of the wheel is made as large (11.15) as is necessary to sustain the whole weight of the wheel (and incumbent weight) when immersed in water, (2.72,) and made perfectly air-tight (by its accurate construction, secured by paint or proper cement.) When the drum is found too buoyant, the equilibrium is restored by letting in water through an aperture in the top, secured by a sliding valve 19. The inner cylinder 13 of the drum is made of cast-iron, of the length (2.0) necessary to the depth of the wheel, and of sufficient thickness (0.075) for strength. The outer cylinder 14 of the drum is made of sheet copper or iron of sufficient thickness (0.015) for strength, of the same diameter inside as the outside of the rim-flanges, of the depth (2.1) of the distance of the inner sides

of the rims, turned at each end to a uniform depth, and accurately fitted to the rim-flanges. The cylinders being in place, the hubs, arms, and rims are brought home on the cylinders and shoulders of the pillars and secured by nuts on the pillar-bolts.

The top and bottom (heads) of the drum are made of boards 15, of about an inch thick, (0.1,) closely fitted together and sheathed with copper, (of a less thickness (0.0075) than the outer cylinder 16,) formed between concentric circles, the inner one lapping onto the hubs and the outer one onto the rims a sufficient space (0.1) to be fastened down by screws 18, passing through the heads and circular screw-plate 17, of an inch wide (0.1) and half an inch in thickness, (0.05,) placed on their surface at the edges, into the hubs and rims. The capacity of the drum may be increased or diminished by the thickness or thinness of the boards. They cannot, however, be raised beyond (0.15) the nuts on the wheel without rendering an increase in the depth of the paddles necessary. The board may be halved down to receive the plates and heads of the screws. This mode of regulating the buoyancy of the drum may be of some importance. In the wheel described the drum displaces two hundred and sixty-six and two-tenths cubic feet of water, and the iron-work of the wheel, outside of the drum and in the water, displaces twelve and eight-tenths more, making two hundred and seventy-nine, which, at sixty-two and five-tenths

	Pounds.
pounds per foot, is	17,437
while the iron-work weighs only about.	16,350
	1,087

Reducing the thickness of the board to one-fourth of an inch will reduce the buoyancy nine hundred and sixty-two, or reducing the depth of the drum to two and fifty-five one-hundredths will restore the equilibrium.

The paddle-arms F, of cast or hammered iron, are placed in the center between the wheel-arms, and halved on the inner (or on the under) side 10 into the rims. They are of such width (0.25) at the rim as to afford sufficient strength and tapering on the forward (in relation to the transverse line) side to the head, in a line to the eye of the arm, and of the same thickness (0.2) as the rims. To give additional strength, if necessary, the part of the side not halved may be parallel with the other. Each paddle-arm is fastened to the rim by a separate bolt and nut. The head 21 of the paddle-arm is made by the line of a circle of such radius (0.25) as shall give it sufficient strength drawn (from the center of the eye) from one side of the arm round to the other. The heads of the paddle-arms are halved 22 on the upper side to the neck to receive the paddle-shackle, and the halving across the neck forms a shoulder 23, corresponding to the shoulder on the shackle. The paddle-arms may be cast with the sections of the rim; but in case of accident they cannot be repaired without taking up the wheel. The stays G of the paddle-arms are rods of the best hammered iron, of sufficient width (0.125) and thicknes (0.1) to sustain the strain to which they may be subjected, having circular heads and eyes at each end, like the heads of the arms, to receive the paddle-axle at one end, and at the other the bolt of the pillar at the rim. The outer head forms the outer jaw of the upper paddle-shackle. The cross-stays G^2 pass inside the paddle-arms from the axle at the rim of the one to the axle near the head of the other. Their rods are of round iron of sufficient size (0.06) to bear the strain to which they may be subjected. Their heads and eyes are similar to those of the stays. They are brought home by the nuts at the rims; but at the other end a small space (0.02) is left open between the head and the arm or shackle. They are so bent in the middle as to pass each other. The heads are so made that when in place they are parallel with the arms. The outer head of one of them forms the upper jaw of the lower shackle. Their object is to regulate and preserve the parallelism of the paddle-arms. The paddles H are of the same curve as the paddle-circle. They are made of sheet-iron of sufficient thickness (0.025) for strength, and of such length (2.0) (horizontal) as the construction of the wheel will permit, and in depth (3.5) extending three or four inches above and below the drum. The paddle-shackles 24, of a thickness (0.08) a little less than the halving of the head, of the best hammered iron, are made to correspond with the heads of the arm, and have corresponding shoulders 25 at such point that when in contact with the arm-shoulders the paddle shall rest at right angles to the arm to prevent turning inward when passing within the vessel. The shackle is fastened to the concave side of the paddle by bolts (and nuts) passing through an iron back 24, (made in one piece with the shackle, and of the same thickness,) one side fitted to the concave side of the paddle, and the other shaped to lines (straight or concave) drawn from the ends of the paddle to the shackle in the direction of the center of the eye. The eye of the shackle is of the same diameter (0.15) as that in the arm below it, the lower one being smaller than the upper one by the depth of the cut of the screw on the axle. The eyes of the shackles may have a brass lining secured by a pin through a hole piercing the brass and iron; and as the shackle turns only one-fourth of a circle the lining (as it wears) may be shifted by quarters. The outer end of the paddle (for an inch) is inclined forward (to the line of its motion) at an angle of forty degrees or fifty degrees, for the purpose (by its action against the water) of keeping the paddle in position while passing within the wheel-pit, as well as easing the shift of the paddles, by their being received upon the receiving-roller a little

before they are fully shifted. The paddles may be made of cast-iron, rendered malleable, and the shackles cast on them. The shackles 26 are secured to the heads of the arms by an axle having a head at the upper end and a nut at the lower end. A screw is cut on the axle for two or three inches (0.2) next (within) the arms, and also in the middle. On the screws next the arms (the cross-stays being in place) nuts 27 are run and brought nearly up against the cross-stays or (if not used) against the arms. Their object is to make and secure a perfect parallelism of the arms. A third or center shackle 28 is fastened at the center of the paddle, with the eye so large as to have no bearing on the axle. A nut 29 of brass is screwed up under it so as to sustain the whole weight of the paddle and relieve the arms of all friction. The nut is to be screwed up from time to time so as to keep the arms relieved. For the purpose of rendering frequent adjustments unnecessary, a fifth of an inch space (0.02) is left between the shackles and the stay and cross-stay; and on each adjustment the shackles may be raised to the top of the space, and thus nearly the whole friction and wear is brought to bear on two parts which can be easily replaced.

The wheel-pit I, within the vessel, extends an inch or two (0.1) beyond the paddle-circle. Outside of that it may be in such form as shall be best adapted to the strength of the vessel. There must be sufficient space (0.2) above the upper end of the drum to permit the gudgeon being raised out of the socket. Below the drum no more space (0.1) is necessary than to permit the wheel to run free. A circular groove *u* is cut in the top and bottom of the wheel-pit about two inches (0.2) wide and of a depth to receive the ends of the paddle, the inner side of which is a little less (0.075) than the paddle-arm circle, and is banded with iron turned true and smooth, for a guide *k* for the paddles while passing within the wheel-pit. The wheel-pit (when the caisson is not used) may be covered permanently, an aperture being left for the insertion of the shaft.

For the purpose of shifting the paddles various means may be used, all, however, depending on the same general principles. Two small rollers K L of the same diameter (1.0) and on the same axle are placed horizontally at each end of the wheel-pit in such position that the periphery shall meet the line on the side of the vessel and also the paddle-circle. They are placed immediately above or below the line of the paddle-shackles, (so as to clear the heads of the bolts of the shackle.) These rollers are common to all the modes of shifting the paddles.

First mode: Two shifting-wheels M of the same size, having the center in the center line and a radius (1.3) that shall extend to the paddle-arm circle and cut the inner paddle-circle twice at points in a line with such center, having their periphery three or four inches thick, (0.3,) banded with iron, and turned smooth, are placed above and below the drum, so as to meet the concave side of the inner ends of the paddle. The object of fixing upon this distance is that the paddles when entering the wheel-pit shall be received upon the receiving-rollers before they leave the shifting-wheels or are fully shifted. The parts of these wheels within the wheel-pit may be countersunk in the frame of the vessel above and below the drum. The upper wheel is suspended by clamps above the covering of the wheel-pit. Its shaft is inserted and fastened in the same manner as the main shaft, having no gudgeon, however, at the bottom, and the projection (formed as a plate) is countersunk in the bottom of the hub, so as to be level with it. The lower wheel is dropped onto a bolt fixed in the frame of the vessel. The shifting-wheels may be enlarged, so that the periphery shall cut the inner paddle-circle at about sixteen and one-half degrees aft the transverse line, at which point the paddles will commence shifting. These two sizes are considered as the extremes between which shifting-wheels should be constructed, and the larger they are the better will be their operation.

The mode of operation in shifting the paddles is this: The paddle-wheel being in motion, the inner ends of the paddles are brought in contact with the periphery of the shifting-wheels at the point where they cut the inner paddle-circle, and (the paddle-wheel moving on) the inner half of the paddle is carried up on the shifting wheels (without friction, they moving at the same time) until the center of the paddle-eye is in the center line. The paddle is then at right angles with the paddle-arm, and the shoulder of the shackle is brought down upon the shoulder of the arm, and in that position (the paddle moving on) the inner (now the back) end passes on the rolling shifting-wheel until the outer (forward) end is received on the roller, upon which it passes (leaving the shifting-wheel) into the wheel-pit. Within the wheel-pit the forward end is prevented from turning inward by the shoulders. The action of the inclined end against the water tends to keep the paddle down upon the shoulders, and should it incline outward the back end will be stayed by the guide-circle *k*, and it is thus kept in position edgewise to the line of its motion until it comes to the side of wheel-pit, where it is to pass out. When the paddle begins to move out of the wheel-pit, its velocity being greater than that of the vessel, the inside of the outer end of the paddle is resisted by the water and the outside pressed back upon the discharging-roller, against which it turns without friction (the roller turning at the same time) until the inner side of the inner end of the paddle is brought home against the paddle-arms, and the paddle is thus brought into a position to act as a propeller. The spaces passed through by the outer half of the paddle being greater

than those passed through by the inner half, in that proportion the resistance against the outer half is greater than that against the inner half, and that major resistance keeps the paddle in a propelling position until it again meets the shifting-wheels. In the wheel described the axle is placed in the center and the resistance against the outer half compared with that against the inner half is nearly as 47 to 41. The axle should so divide the paddle as to give to the outer half only a sufficient major resistance to secure it in position as a propeller. A greater than this will unnecessarily add to the power required to shift the paddles. The proper line of division depends on the size of the paddle-wheel, the length of the paddle, the depth of immersion, and the velocity required. On reversing the motion of the paddle-wheel the paddles will be kept shifted within the wheel-pit by the guide-circles, and on passing out by the receiving-roller until they are received on the aft side of the shifting-wheels, over which they will pass. On leaving them, the resistance now also being greatest on the outer end of the paddles, they will be kept in the same position (upon the shoulders) and in that position pass into the wheel-pit. Any irregularity in entering will be corrected by the discharging-rollers. It is evident that on the reversed motion the paddles cannot act as propellers. This is an admitted defect; but the great object is to go forward and not backward, yet it is believed that the action of the wheel will still be sufficient to back the vessel for the usual purposes for which that operation is needed, excepting to draw the vessel from a grounding. This is matter of opinion, and the theory of this opinion will now be stated. The drum of the wheel, so far as it is without the vessel, will act as a propelling-power by its action (or centrifugal force) against the water. The transverse section of the arms and paddles will also act as propellers, and thus a back motion will be given to the vessel unless prevented by a reaction within the wheel-pit. The action and reaction within the wheel-pit is (supposed to be) between the paddles and the internal surfaces of the wheel-pit, and not between the paddles and the external water in opposition to the motion of the vessel. The reaction within the wheel-pit, then, has no tendency to retard the motion of the vessel otherwise than as it retards the motion of the wheel. It is therefore merely a loss of power. If these principles be well founded, it may be important to extend the drums nearly to the outer rim-circle and lessen its depth by placing the arms nearer together. The flat pillars 12 between the rims may have the same effect, and if absolutely necessary they might be extended even to the paddle-arm circle, yet they would lessen the forward motion by the waste of power to move them in the wheel-pit. If the drum be extended to the outer rim-circle, the pillars must be placed inside.

The second mode of shifting the paddles is by substituting gangs of rollers N for the shifting-wheels. The rollers are made of iron from four to eight inches diameter (0.5) and about an inch thick (0.1) placed in two alternate lines so near together as to merely leave room between those in one line for the arbors of those in the other. They are set in the segment of a circular block of such a circle that the outside edges of the rollers shall form a similar circle to that of the wheels; and those blocks are firmly fixed in the frame of the vessel, but capable of being taken out for repairs, and are placed in the same relative position as the wheels. One gang and one wheel may be used together, the outward circles being the same. It may be more convenient to use the gang above the drum, where it can be more easily placed than the wheel, and the wheel below it. The circle of the gangs N may be enlarged (see N^2) beyond what can well be done as to the shifting-wheels. They are not confined to the form of a circle, but may be formed on any curve desired.

Third.—Instead of either of the preceding modes the paddles may be shifted on inclined planes O. To fit the paddles for the inclined planes, a square bar *t* of iron of sufficient size (0.1) for strength, of the length of the perpendicular depth of the paddle, having round axles three or four inches (0.3) long at each end, on each of which is placed a brass or iron roller *u x*, of five or six inches diameter, (0.5,) and from one to two inches thick,(0.15,) and from one to two inches (0.15) from the end, is to be fastened by bolts and nuts to the concave side of the perpendicular or edge of the inner side of the paddle, (or so near to the edge that the roller *u* shall come to the edge of the paddle,) places being made in the paddles for the rollers. These places are made by cutting a T in the paddle and in turning the parts each side of the stem inward, (cutting out a part for the bar.) These will form cheeks to keep the rollers on the axles and in a true position and add strength to the paddles. The planes are to be made of wood, faced true with iron and fastened to frame of the vessel, above and below the drum, in such a position that the paddle shall be fully shifted at the center line. The planes will extend from a point *o* in the center line (distant the radius of the paddle-roller and of the axle-bar from and within the paddle-circle) to any point *w* desired in the inner paddle-circle. An arc of a circle P (or any other curve desired) may be substituted for the planes. The arc may be drawn on any radius less than that of the outer paddle-circle and greater than that of the length of the chord of the arc, and the plane and arc may be combined. The planes and arcs may be so extended that the paddle may begin shifting when it has passed half its distance from the next paddle aft the transverse line, which in the wheel described is fifteen de-

grees. In these cases (planes, arcs, and curves) the roller-guide circle is carried round within the wheel-pit on a circle *l*, drawn by a radius from the center of the paddle-wheel to the apex *o* of the plane or arc, (the point where the paddle is fully shifted.) Whether the guards are used or not, the roller-guide circles may commence at that apex, and between that and the side of the vessel will project inward from the guards or from the side of the vessel, in which case the receiving-rollers are not necessary. The paddles will be more gradually and steadily shifted by the planes or arcs than by the wheels or gangs, being capable of being more extended than the wheels and presenting a more even surface than the gangs and being more simple in construction than either; and the paddles may be fully shifted at any point *v* desired between the center and transverse lines. The guards Q are two segments of circles on a radius as much greater (0.4) than that of the outer paddle-circle as shall afford room for the pillar 30 between them. They are made of timber or plank, of sufficient thickness (0.4) for strength, banded on the outer edge by a thick (0.075) bar of iron, which is firmly secured to the guards, and bolted at each end to the side of the vessel. They are fitted and fastened to the vessel about an inch (0.1) above and below the line of the ends of the paddles. The lower guards may be constructed in the frame 31 of the vessel with such supports underneath as the construction of the vessel will permit. The upper guard is supported at its outer edge by a strong iron pillar 30, placed in the transverse line, shouldered at each end, secured by nuts. The wheel may be used without the guards, the sole object of which (if the caisson be not used) is to protect the paddles from injury by collision with external objects. The caisson R R^2 is not necessary to the use of the wheel with or without the guards, but is added as a convenience for inclosing the paddles when the vessel is propelled by sails, and for making repairs, without taking it into dock or laying it down.

The guards form a top and bottom for the caisson. The top guard must be strengthened in its fastenings to the vessel by iron knees passing under it and up on the sides of the vessel and firmly bolted, so as to prevent the possibility of collapse by pressure. The inner edges of the bands must be made level, and the outer side of the bands turned to a circle concentric with the paddle-circle. A groove is cut on the inner side of the guards against the inside of the bands, of sufficient depth and thickness (0.1) to receive the flange of the railway-rollers 38. A small space (0.05) is left between the upper shoulder of the pillar and the upper guard. The covering of the wheel-pit and caisson must be so constructed as to be removable at pleasure, and of such strength as shall prevent the possibility of injury by the pressure to which it may be subjected. The caisson R R^2 is made in two sections of a circle concentric with the guard-circles, of timber or plank, closely fitted to, and of the depth (4.5) of the outside of the guards, and of sufficient thickness (0.5) to sustain the pressure of the water from without. The timber or planks of the caisson are halved at each edge, so as to make shoulders 32 to fit between the guards, and so that the inside of the halving shall fit to the edges of the guards. The length between the shoulders at the ship's side will be the distance between the guards, and at the pillar the distance from the top of the lower guard to the top of the upper shoulder of the pillar. The inclination is made on the upper edge of the section. The sections of the caisson R^2, when at rest within the vessel, are placed in spaces U, fore and aft the wheel-pit, concentric with and about one foot without the paddle-circle, being a continuation of the circle of the sections, and of their depth (4.5) and thickness (0.5,) (with a sufficient allowance to permit them to move freely,) and of sufficient length to permit their being put in and taken out within the vessel. The length of a section is the distance from its connection with the cog-wheels 34 to the pillar 30. The bands of the guards are extended on the same circle within the wheel-pit to the length of the sections of the caisson, of which they are the railways 37 and guides. Two sections 33 of cast-iron, on a circle corresponding with the inside of the caisson, having cogs on the inner side, (extending from the cog-wheels as far as is necessary to move the caisson,) are attached to the inside of each section, about two inches (0.2) from their shoulders, leaving a sufficient space between the cog-sections and the top of the shoulders for the play of the guide-rollers. Two cog-wheels 34, fitted to mesh with the cog-sections, having a capstan or crank 35 on the upper end of the axle, are fixed on the same axle, and placed perpendicularly within the vessel at as little distance from its side as will permit the working of the capstan or crank. Sets of rollers 36, two on an axle, are placed within the vessel so as to bear against each side of the caisson in the spaces between the cog-sections and shoulders. In the top and bottom of each section three flange-rollers 38 are fitted (one near each end, the other in the middle) to run on the railways and in the grooves. The places on the bottom railway, under which the outer and middle rollers rest when the sections are (out) in place, are hollowed out, so as to bring the top of the upper shoulder at the pillar on a level with the shoulder of the pillar, (but so fitted as to have an easy rise when moving back.) The object of the wedge form of the sections is to ease their moving out and to secure a water-tight joint on the shoulders, (as well as on the face of the bands) by the collapse of the guards. At the place where the caisson enters the vessel on each side the space (0.025) on the outside is left a little open. Against this open-

ing a strip of thick firm leather *y* is fitted at one edge to the side of the vessel and the other edge passes on to the caisson, against which (the caisson being in place and the water being pumped out of the wheel pit) it is pressed by the external water, and a tight joint secured. The space between the wheel-pit and the caisson may be filled with timber or left open with the wheel-pit, as shall be best adapted to the strength of the vessel. A pump S is fitted near the side of the wheel-pit, connected with it, and also an air-tube T, to supply the wheel-pit with air when the pump is in operation, both rising above the water-line.

When repairs are to be made, the sections of the caisson are run out upon the railways, and brought home against each other at the pillar, (being inclined and fitted at the end to the form of pillar,) so as to secure a close joint. The water is then pumped out of the wheel-pit. The pressure of the water on the outside of the sections brings them home upon the rims of the guards, while the pressure on the outside of the guards will bring them home upon the pillar and upon the shoulders of the caisson. The covering of the wheel-pit may then be taken off for the examination or repair of the wheel; and when closed and the wheel-pit being again filled with water, the sections of the caisson are run back to their places within the vessel.

What I claim as my invention is—

The means and modes of shifting and regulating the motion of the paddles, and the guards and caisson, as herein described, or by any variation of construction that may be deemed more convenient, on the same principles and to the same end; but in this application I claim nothing for the separate parts in the construction, excepting when used in the combination of, or in connection with, a horizontal shifting paddle-wheel.

The advantages of the improvements described are a greater relative speed, (compared with wheels of the same diameter and surface of paddles at the same number of revolutions per minute,) a greater security against external damage, and the practicability of being repaired without being laid down or put into dock; and also, the inclosure of the vessel when propelled by sails, and then increasing its buoyancy by exhausting the wheel-pit.

HORACE EVERETT.

Witnesses:

JAMES YOUNG,

N. YOUNG.