

REPERTORY
OF
ARTS AND MANUFACTURES.
NUMBER IX.

XX. Specification of the Patent granted to Mr. JOHN DANIEL BELFOUR, of Elfineur, in the Kingdom of Denmark; for his new-invented Machine for making and manufacturing Ropes and Cordage.

Dated March 16, 1793.

WITH THREE PLATES.

TO all to whom these presents shall come, &c.
Now THEREFORE KNOW YE, that I the said John Daniel Belfour do by this instrument under my hand and seal, in pursuance of such proviso in the said recited letters patent contained, and in

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compliance

compliance therewith, declare that the plans or drawings annexed to this instrument, and the description and references herein after contained, do particularly describe and ascertain the nature of my said invention, for which such letters patent were granted to me as aforesaid, and in what manner the same is to be performed; premising, and wishing it to be particularly understood, that the size and dimensions of the machines, and their component parts, which are herein described, are taken from those which I myself have used, and from which the annexed drawings are made, but that the machines may be made of different sizes if required. The effect intended to be produced by the machine invented by me, and for which this patent is taken out, is to improve the manufacture of ropes and cordage, by making every yarn employed in the composition thereof bear its proper and equal proportion of the stress: in order to do this it is necessary that every yarn should, at the time of its being twisted into the rope, be kept tight, to prevent its being squeezed or puckered up into the inside of the strand, as is too much the case in ropes made upon the old principle


principle; and to keep them thus tight, in the operation intended by this machinery, every yarn is to be wound upon a separate reel, which reel is so constructed as not to yield or render out the yarn wound upon it until such yarn is, in the operation of twisting, called forth to contribute its assistance and proportion in forming the strand. This is the end proposed to be answered by all the machinery mentioned in this specification, in which all the other parts are subordinate to the great machine represented in the drawing annexed, and marked with the letter A, (Plate IX. Fig. 1. and Plate X.) which letter is fixed upon the upper rail of the great frame of the machine. A great part of the effect intended to be produced consists in winding the yarns regularly upon the reels, and to that end a considerable part of the machinery hereafter described is particularly applied, because, when the yarns are so wound on the reels, those reels will yield or deliver the yarns off the great machine A then standing still. This machine or frame contains the reels, marked B, on one of which reels a part of every rope yarn is to be wound, the other ends of such yarn being fastened

to the winch or handle that twists the strands. This frame may be made larger or smaller, according to the quantity of reels intended to be placed in it, which quantity of reels depends on the will of the manufacturer, agreeable to the size of the rope intended to be made, as each rope yarn must have a separate reel for itself. I have found it necessary, in making one strand of a twenty-two inch cable, to have the frame made very strong, of oak timber six inches square, to enable it to counteract the great strain it has to bear during the twisting of such a strand; and, for the convenience of moving the frame, four rollers should be inserted, two under each side of the bottom of the frame, for it to move on; which rollers may be made of wood or metal, and should be proportionate in size and strength to the dimensions of the frame itself. On the fore part of that frame there is to be placed, as appears in the drawing, a grate-work of wood and iron, marked C, which moves from side to side on two rollers, marked D, which are fixed in the lower part of the great frame A; and the grate-work is guided on the top by two rollers, also marked D, fixed in the upper part

part of the great frame A. The use of this grate-work is to lead or guide the yarns to the separate reels, on which they are to be wound, and to prevent the yarns from getting between the reels, and also to fill the reels with yarns properly from side to side. To produce these effects this grate-work is moved backwards and forwards, by a great wheel fixed on the right side of the great frame A, reckoning when a person stands with his back to the frame, and which wheel is marked E. This wheel is of a singular construction, and may be made of brass, iron, or any other hard metal, as is hereafter more fully described. This wheel is turned by one of the spindles on which the reels are fixed; in the model from which the annexed drawing is made, the wheel is turned by the seventh spindle from the bottom, marked F, and that spindle is also turned by the general handle G, which handle, at the same time, turns all or as many of the spindles hereafter described as the manufacturer chooses to set in motion, according to the size of the rope he intends to make. The number of reels which I have used in making one strand, or one ninth part, of a twenty-two-inch

inch cable, has been two hundred and ninety-seven; which I have placed in the great frame A on eleven spindles, each spindle containing twenty-seven reels, and the height of the great frame A, thus filled with two hundred and ninety-seven reels, will be seven feet six inches, and the breadth eleven feet: where a great number of spindles are introduced the size of the frame must be increased in proportion. The spindles on which the reels are fixed (four of which spindles are marked H) are made of round iron bars, of an inch and a quarter in diameter, and in length according to the size of the great frame A. They are inserted, at the farthest or right-hand end, into the great frame A, and pass through the frame at the other or left-hand, reckoning as aforesaid, into a plate of iron as represented in the drawing, and marked I; to each spindle is fixed a small handle, marked K, which handle serves to turn the spindles round, for the purpose of turning the reels on which the yarns are wound. These spindles should be made of iron; the reels upon which the yarns are wound may be made of wood, iron, brass, or other metal, but I have

found them best and most durable as follows: the barrel of the reel should be of wood turned, and should be in length four inches, and in diameter three inches; a hole must be bored through the centre sufficiently large for the spindles, marked **F**, to go through, so that the reel may turn round easily upon the spindle; and on each end of the barrel of the reel, to form the two ends of each reel, an iron plate should be fixed, about one eighth of an inch thick, and six inches in diameter, so as to make the height of the ends of the reels six inches. In order that the reels, after a sufficient quantity of yarn is wound upon them, may be confined to their own spindles, so as neither to be fixed too fast nor moved too easily, I have introduced four springs into each reel, which springs are marked **L**, (Plate IX. Fig. 2.) and should be made of iron or steel, about two inches and a half in length, one quarter of an inch in breadth, and one eighth of an inch thick in the middle, and smaller towards each end: two of these springs are fixed into each end of the barrel of the said reel in the inside; one end of each spring is fixed fast into the barrel of the reel, the other

other end is movable, and is governed by a screw marked M, which, by being turned towards the right, closes the two ends, and thereby fixes the reel faster to the spindle, or, being turned the other way, opens the two ends, thereby allowing the reel to move more freely; a drawing of the inside of one of the ends of one of the reels is included among the drawings annexed. At the distance of four inches from the right-hand end of each spindle, reckoning as aforefaid, and of nine inches from the left, upon each spindle is placed a screw-nut, for the purpose of screwing all the reels on their spindles close together, or giving them greater liberty, and also for keeping the reels in their proper places; and, to give effect to these nuts, each end of each spindle must be made wormed, so as to articulate with the screw or worm in the inside of each nut. The nuts are described by the letter O, and may be made of iron, brass, or other hard metal, but I have found those of brass the best; they should be made in the shape of a  and about four inches diameter, so as to be moved by the hand, without a key, or any other instrument. To prevent the spindles
from

from bending, or breaking, or giving way, during the operation of twisting the strand, I have fixed the standard P, which should stand perpendicularly, and as near as possible in the middle of the great frame A, and be fastened into the upper and lower parts of the great frame A. This standard should have holes in it, at proper distances, sufficiently large for each spindle to go through, which standard I recommend to be made of iron, three inches broad and half an inch thick, placed edgeways as near in the centre of the machine as can be; its height of course must depend on the height of the great frame A. It should be inserted into the top and bottom rails of the great frame, or fixed by nails or screws, or in any other manner the manufacturer chuses, so as to make it fast. To prevent the wheels from carrying each other round, there should be placed between every two reels, upon the spindle, a round piece of brass with a hole through it, so large as to let it pass freely round the spindle without being confined to it, three inches in diameter, one eighth of an inch thick at that part which is nearest the spindle, and reduced gradually smaller,

to about half its thickness, at the outer edges; this piece may be made of iron, or any other hard metal, but I am of opinion brass will answer the purpose best. The handles described by the letter K, which are fixed on those ends of the spindles that come through the great frame A, for the purpose of turning the spindles round, are made of iron, about ten inches long, and a little curved outwards, that they may pass each other; and each handle may be turned separately, or all together by the iron plate I, through which plate are holes, sufficiently large to receive the end of each handle, and which plate may be taken off or kept on at pleasure, by removing the screws which fix it to the upper and lower of the smaller handles K, which screws may be made of iron or any other hard metal. The handles K should be about half an inch in diameter, and may be made either round or square; and, at that end of the handle where the spindle is introduced, a square or other hole must be made, for the spindle to go through, which may be fastened by a pin or screw, or riveted. The plate I, through which the ends of all the small handles K pass, should be

made of iron, and be about one inch and an half broad, and a quarter of an inch thick; its length must depend upon the number of spindles there are to be turned by it: the smaller handles, marked K, may be made in the form of the handle of a corn or coffee mill. The size of the frame, in which the grate-work of wood and iron marked C is fixed, must depend on the size of the great frame A; it should stand perpendicular, and its breadth and height must be less than the breadth and height of the frame A, because it must move backwards and forwards in the front of the frame A, and it should be less in breadth than the breadth of the inside, or clear of the frame A, by the length of one of the reels; and lower than the clear of the height of the frame A, so as to work freely upon and under the four rollers before described. The frame of the grate-work C should be made of oak wood, about three inches square; from the top to the bottom of this frame, in a perpendicular direction, should be fixed as many upright bars of iron as there are reels on each spindle. These upright bars are marked Q, and should be distant from each other about three inches; they

should be about one inch broad, one quarter of an inch thick, and stand with their flat sides towards the reels, being fixed to the frame C by nails or screws; through which bars must be as many holes proportioned on each bar, according to the whole number of reels on the machine, the lower part of which holes must be level with the upper part of the barrel of the reel, and as large in height as the sides of the reels are from the upper part of the barrel to the edge of the plate at the end of the reel, and sufficiently large in breadth to admit a common rope yarn to pass through them with a rough knot upon it. In order to confine these bars in their proper places, it is necessary to have two or more cross bars of wood or metal, marked R, which may be made stronger or weaker according to the size of the machine; I have found them sufficient when made of oak wood three inches square. The rollers D, on which the frame or grate-work C moves at the bottom, and which keep it in its place at the top, may be made of wood or metal, and should be fixed on pins to the great frame A, having grooves in the centre, which fit on the upper and lower part of the

the

the frame C; and on the right-hand side of the said frame is fixed a connecting iron, marked S, for the purpose of communicating to the frame C the motion given by the wheel E; which iron S must be fastened to the frame of the grate-work C, at about one third of the height from the bottom on the right-hand side, so as to connect it with the wheel E. The length of the iron S, from the side of the frame C on which it is to be fixed, should be about twelve inches, and one inch square, having on the back part of it, towards the wheel E, two projecting arms about three inches in length, one at the end, and the other near the centre; on these two arms the side plates T, which are fixed on the great wheel E, operate as the wheel E goes round, thereby giving the grate-work the necessary motion, to slide the frame C from right to left, and back again, in order to fill the reels with yarns equally, as before mentioned. The plates marked T, on each side of the great wheel E, should be made of iron or steel, and should be fixed upon the great wheel E about one inch within its circumference; their thickness should be about half an inch, their
breadth,

breadth, in the broadest part, should be equal to the length of the body of one of the reels on which the yarns are wound, tapering gradually towards each end till they become level with the surface of the great wheel E, on which they are fixed; their length must depend on the size of the great wheel E, which is to be regulated by the magnitude of the machine. On a machine capable of containing the quantity of reels sufficient for making one strand of a twenty-two inch cable; the great wheel E should be two feet in diameter and about half an inch thick, which wheel should be of iron, and it may be either open or solid on its circumference; it must be divided into teeth, at distances proper for receiving those fixed on the end of the seventh spindle from the bottom before mentioned, which protrudes through the end of the frame A to act upon the great wheel E, so that it may receive motion sufficient to cause the grate-work C to move from side to side a space equal to the thickness of a common rope yarn, each time the reels on which the yarns are wound go once round; by which means the reels can be properly filled, and consequently the reels
need

need not be any larger than to hold the quantity of yarn which is twisted up in making the first strand of a rope; for example, suppose in the common method of making ropes one sixth part of the yarns is twisted up in the operation of making the first strand, (say of yarns one hundred and eighty fathom long,) then on this machine must be wound thirty fathoms of each yarn, so that (instead of a sledge moving forwards, as in the common way, as the strand is twisted) this machine is fixed fast, and, as the strand is twisted from the opposite ends of the yarns, each reel moves round and delivers its yarn faster or slower according to the circle which each yarn occupies in the strand; whereby a very considerable saving in the yarn will be found, by the quantity left on the reels of those yarns which lie in the inside parts of the strand. A rope thus made, by each yarn being kept tight from one end of the strand to the other in the twisting, will not only receive a very considerable degree of additional strength, but will be much less liable to stretch; and it will at the same time, from its compactness, keep the water out much better than a rope made on the old principle;

principle; it will wear longer, and be less subject to what is called *meg*, or to break in the partial manner called by seamen *stranding*, which means one strand giving way before the other; and, from the proofs I have made, all ropes from the circumference of two inches upwards receive more than one fourth part of additional strength from this process; which strength increases as the ropes are made larger, so that I apprehend a twelve-inch cable, made after this manner, will answer all the purposes of one of fifteen inches made in the common way, independent of the saving in the materials. The wheel E, so frequently mentioned, is placed on the side of the great frame A, on a round bolt or spindle of iron, marked V, about eight inches long and one inch in diameter, upon which bolt or spindle the wheel turns round; and, in order to use the wheel E, so as to move the grate-work C from side to side, (in case the seventh spindle should be broke, or not be wanted to be used,) on the outer end of the barrel or nave of the wheel E may be fixed a handle, to turn it without the use of the teeth on the projecting part of the seventh spindle. On the back of the left-hand

hand

hand side of the great frame A, through which the ends of each spindle come, it is necessary to have a hook or stop, for the purpose of fastening each handle, after a sufficient quantity of yarn is wound on the reels, so that the spindles may remain immovable during the operation of twisting the strands, while the reels work perfectly free and independent of each other round the spindle. It is also necessary to fix on each reel a piece of line or leather, fast at both ends, the bite of which is to be put through the holes of the grate-work in the uprights marked Q, for the convenience and dispatch of fastening the yarns thereto; which line or leather should be of such a length as to be conveniently reached; (say from two to three feet;) and, in order to have them always handy after the spare yarn is taken from them, a bolt, or piece of wood, may be put through the bites of those which the size of the rope may not require to be used, to prevent them from being drawn through the grate-work, and thereby creating confusion among the reels. At the back ends of the lower parts of the great frame A should be fixed straps or bolts, for the purpose of fastening it, to prevent its moving

forwards during the operation of twisting the strands; and, if it should be thought necessary, for the better strengthening and securing the spindles, more than one of the upright standards P may be used; but, if that is done, it will render a proportionably greater number of the nuts O necessary for regulating the situation of the reels on the spindles.

The above is the explanation of the construction and effects of the principal parts of the machinery used in this operation; what follows relates to the detached parts of the machinery which are necessary, according to my plan, to complete the whole. The machine which I call the separating machine, (see Plate XI. Fig. 1 and 2,) is for the purpose of keeping each yarn free and separate from the others, during the operation of twisting the strands; and there may be one of these separating machines for every fifteen or twenty fathoms of yarn to be twisted, at the option of the manufacturer. It is to stand loose, for the convenience of being moved when necessary, and its size must depend on the size of the great machine A; but, for the strand of a twenty-two inch cable, I found

it

it necessary to have its breadth three feet, and its height four feet six inches. The standards or fides, marked *a*, may be made of wood, four inches broad and two inches thick; the rest of the frame in due proportion. In the inside of both the standards or fides *a* must be a groove, two inches broad and three quarters of an inch deep, from the top to within two inches of the bottom of the standard, to admit the frame *b* to be slid up and down if thought necessary; and the two standards *a* may also, if thought proper, be connected, at half their height from the bottom, by a hinge, so that they may fall down outwards, in order to give more room in the rope walk; and, when in use, these fides may be kept fast by a small hook, bolt, or pin, at each side. The frame *b* must be made to fit the groove in the standard *a*, and be half its height; into the bottom of which frame should be inserted, and fixed, bars of wood or metal, marked *c*, but I prefer wood on account of its being lighter. Each of these bars should be as high as the frame *b*, and about one inch square, having a space betwixt each, of about one quarter of an inch. The frame *b* should be open at the top, like the teeth of a

Y 2

comb,

comb, for the convenience of admitting the yarns to be dropped in, without the trouble of receiving them through; and, to facilitate the doing of this, on one side of the bars there should be as many small bolts or rods, made of round iron, about one eighth of an inch diameter, marked *d*, as there are spindles in the great machine *A*, so that each yarn may be separated from the other; and these rods are to be put through holes bored in the three upright parts of the frame *b*, marked *e*. On the end of each rod should be a small knob or head, and upon the rods, immediately within their knobs or heads, must be placed a plate *f*, with as many holes in it as there are rods, through one of which holes each rod is to pass, which plate I find best made of iron; it should be so long as to take in the ends of each rod, and of sufficient strength to bear the rods being all drawn out at once if required; upon which plate may be placed handles, large enough to receive a man's hand, in order to draw out the plate and rods all at once. These rods should be at equal distances, according to the size of the frame, as they are intended to keep the yarns from falling upon or mingling with each other;

other; if they are at the distance of one inch it will be found sufficient to prevent confusion. The reason why these rods should be thus loose is for dispatch; for example, before the rope-maker begins to work, all the rods are to be drawn out of the machine, and as the men or boys employed carry the yarn along they are to drop the yarns between the bars *c*; as soon as a yarn is put between every bar, the lowermost rod is to be put into its place, after which the next row of yarns is to be put in, then the second rod, and so on till the whole number of yarns required to be used shall be dropped in. The use of the plate *f* is as follows; when the twisting of the strand is begun, and the top minor (an instrument used in twisting, the nature and use of which is herein after described) approaches towards the machine, fig. 1, one of the workmen is to draw all the rods out at once, by which means the yarns are entirely free of the machine, and no impediment is occasioned in the operation; he is then to draw out the pin *g*, which keeps the frame *b* in its place, whereby that frame falls to the bottom, in the grooves, as before described, and, if occasion requires, he is to unhook or loosen the
hooks

hooks *i*, by which means the upper part of the standards *a* falls down outwards, and thereby gives more room in the rope walk. According to the length of the rope intended to be made, more than one of these separating machines are to be used in the same manner; I find by experience, that one separating machine at every fifteen fathom is sufficient, but the number should be proportioned to the distance each yarn is kept from the other, because the farther the yarns are separated from each other the fewer of those separating machines are required. To prevent the strand from being twisted too quick, I have introduced an instrument which I call the top minor, marked U, (Pl. XI. Fig. 3 and 4,) which is inserted between the yarns, and keeps each yarn separate from the rest; it moving along as the strand is twisted. The top minor U should be made of strong tough wood, which I have found best of elm or oak, and its shape and use are as follows. In shape it resembles a sugar-loaf, but is not so picked at the small end, but at the broad end exactly of the same form as per drawing U; round the broad end should be fixed a hoop of iron, which is to be let in level with

with the wood, which hoop must be made according to the size of the top. To this hoop should be fixed small projecting pieces of iron, their length about two inches, their breadth about one inch, and their thickness in the middle about one eighth of an inch, and something smaller towards each edge; they should stand at the distance from each other of one quarter of an inch, or more if possible to be allowed, which must depend on the size of the rope to be made, otherwise in making the strands of a great cable its size will be increased so as to render it cumbersome to use; for example, a top minor of about nine inches diameter, at the broad end, will be of a size sufficient for the twisting a number of yarns to make a strand of a twelve inch cable, whereas to make a twenty-two inch cable it would require one of twenty-four or twenty-six inches diameter; and, when the whole quantity of cavities between the spikes of the top minor are not wanted, the yarns can be placed between every second or third, so as to render but few of these top minors necessary in a rope-walk. Its length should be the same as the diameter at the broad end, and it should decline
away

away towards the small end. At one fifth of its length from the broad end should be fixed, either into or through it, two handles, for the purpose of guiding it as the strand is twisted, by which means it may be impelled forward or kept back, so as to cause the strand to be twisted harder or more open, at the option of the workman, and the reason of its being so stout (as I call it) at the small end is, that it may not jam among the yarns; and, from its shape, and being greased before it is placed among them, it will be found to require very little assistance, but will move forward as the strand is twisted. If, in making the strand of a large rope, it is thought too large or cumbersome to be governed by hand, it may easily be fixed on a small sledge, to relieve the workman, which sledge, if necessary, can have a small winch in it, upon which winch a rope may be used, fastened to the opposite end of the rope walk, to heave the sledge, and the top minor along with it, forward as wanted. Various other methods may be substituted for the purpose of preventing the strand from twisting, until it has received that position the workman wishes; such as pieces of wood with holes bored in them;

small

twisting again, I have found it necessary to have a contrivance which I call *nippers*, marked W, (Pl. XI. Fig. 3.) which are to be screwed fast on that end of each strand which terminates at the great machine A, after the strand has received its proper twist, and before it is loosened from the great machine, and placed on the great winch commonly used for the purpose of twisting the three strands into one; and these will also serve to conduct the strands exactly towards the great winch, so as to prevent one strand being longer than the other; they should be made of iron, sufficiently strong to bear the strain that may be requisite, which is no more than to hold the strands tight after twisting. In the bite of these nippers the strands must be fixed fast by a screw, and the nippers must be properly secured in the frame; as soon as one strand is fixed to the great winch, the sledge with the nippers may be flipped under the next strand; and, when that is fixed, to the third. The thickness of the nippers, in the shank, should be about one inch in diameter, and the hole of the sledge, through which they are fixed, sufficiently large to admit their being turned
round

round with ease; their shape should be as per letter **W**, and they may be fixed into the upper or cross bar of the sledge, on the fore part of the great winch, (at the distance of six, nine, or twelve inches from the shank of the same,) heretofore used in twisting the three strands into one; but, the nearer they are fixed, the shorter the neck need be to convey the strand to the winch. The jaw **X** may be made to open sufficiently to receive one strand of the largest rope, as it may be screwed together so as to confine the smallest, and it may be made either round or square. In order to facilitate the general work, as each yarn must be placed separately on a reel on the great machine **A**, it would be better to have a great number of whole yarns wound on separate reels, distinct from those which are placed on these spindles, always ready for use; the yarns may be wound on those reels by boys, women, or old men, as soon as the yarns have gone through the tar, and are sufficiently dry. The size of these distinct or spare reels must depend on the length of the yarn, and they should be made of light wood, with a hole through each sufficiently large to receive a bolt, on which they

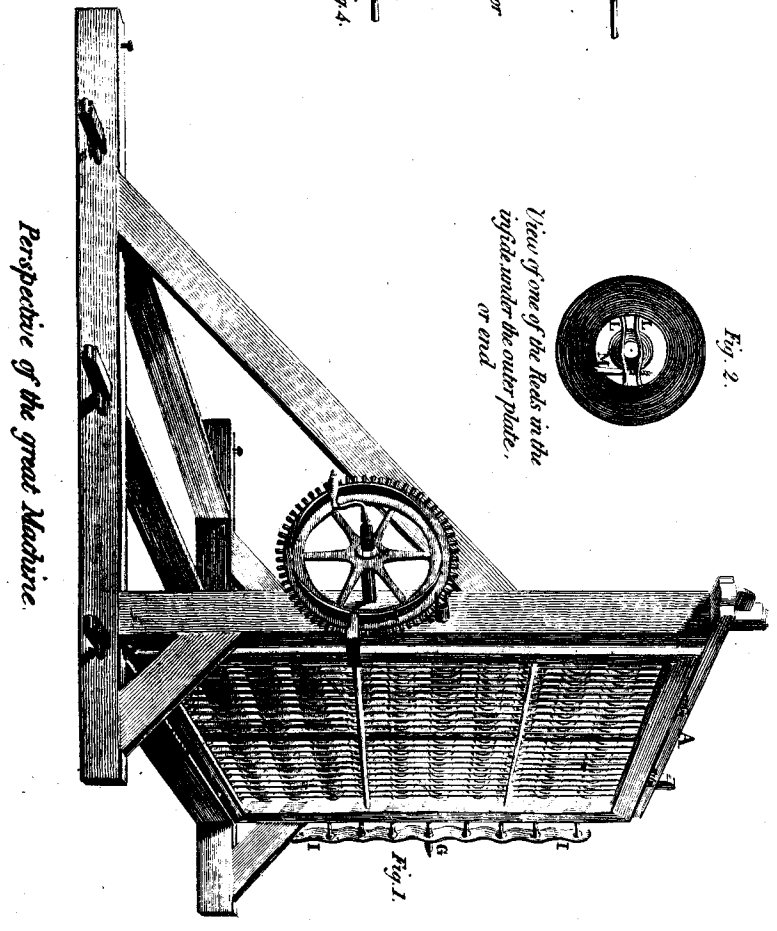
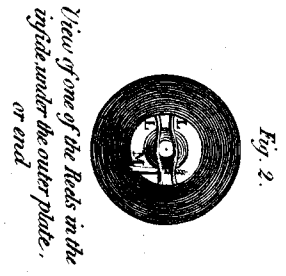
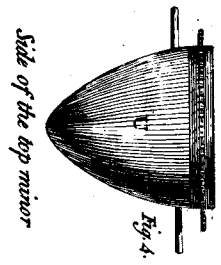
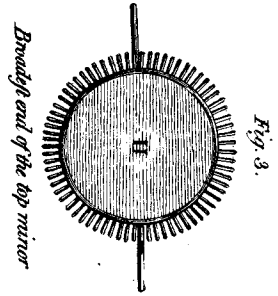
can run round with ease, at one end of which bolt there should be a handle fixed; and, as the reels are put on one by one, there should be a small brass or iron ring put between each, so as to prevent one reel from pulling the other round, similar to those between the reels on the spindles in the great machine A. The use of these reels, with the yarns thus wound, will be easily perceived to be to facilitate the winding the yarns from them, on to the reels on the spindles in A, and the number of them must be proportionate to the size of the rope intended to be made, and the strength of those who are to carry them; and, when the intended quantity of reels is put on the bolt, another handle may be easily put on the other end of it, to keep the reels on, and make it more convenient to carry. When the number of reels is so placed, the end of each yarn must be fastened to the bite of the cords, or leather straps, fixed on the reels in the great machine A; then the intended quantity of yarn, from the other reels on the bolt, must be wound on the reels in the great machine A, while those who bear the reels on the bolt walk on gradually, towards the upper end of the rope

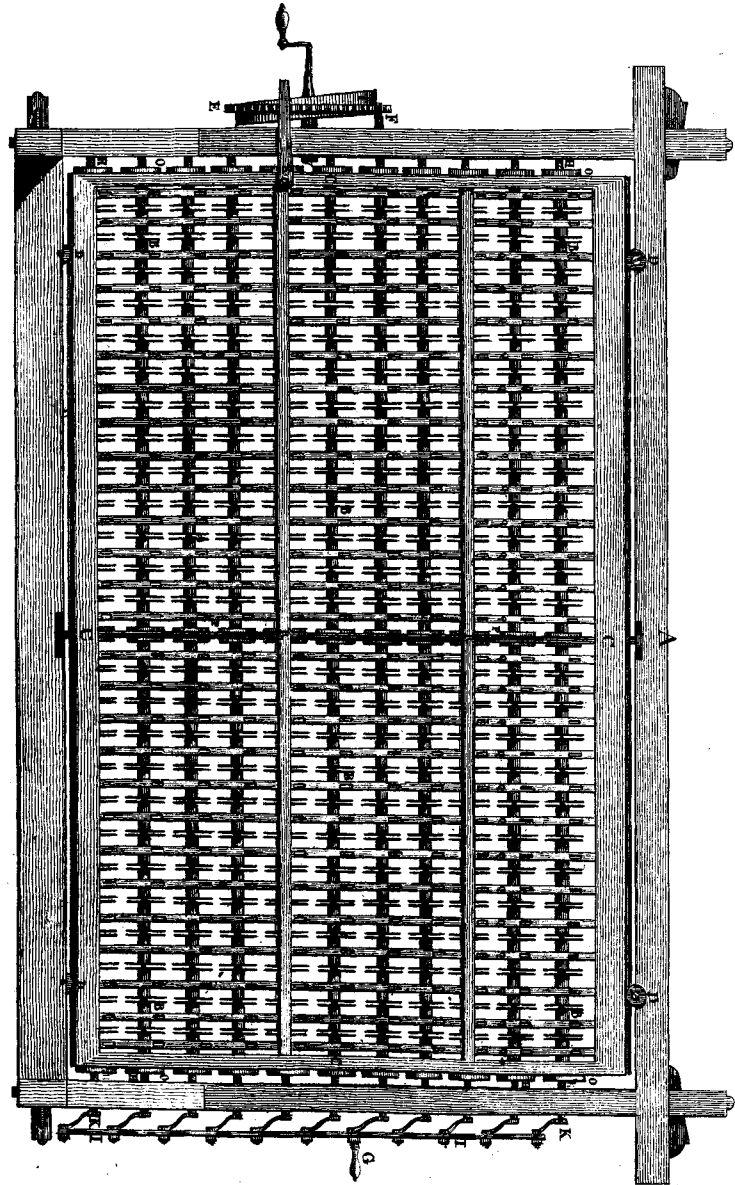
rope walk, permitting the reels to run round and quit the yarns as they go. When the reels, on the great machine A, have received as much yarn as is intended to be put on them, let the other ends of the yarn be fastened to the twisting winch, as usual, at the opposite end of the rope walk. It will always be advisable, in winding the yarns on to the reels, in the machine A, to begin with the lower rows of those reels, on account of placing or dropping the yarns properly into the separating machine; and it will be also advisable to wind on to the reels, in the machine A, as many yarns at one time as there are reels on one spindle, because, a whole spindle of reels being turned by one handle, time and labour will both be saved. In order to place the yarns in the separating machine with the greater ease, the conductor, marked Y, (Pl. XI. Fig. 4.) will be found useful, and it may be made of wood, of a sufficient length to admit small pins to be fixed into it, at the distance of about one quarter of an inch from each other, between which the yarns may be placed, as soon as they are wound on the reels upon the machine A; and two boys can, with the conductor borne between

between them, follow those who carry the yarn along, and by that means the yarns will be placed much sooner, and more regularly, in the separating machine. As few rope-makers have occasion to make cables larger than eighteen inches diameter, the generality of them will, in my opinion, find a machine that will contain two hundred reels, for making one strand, large enough, but this will in some measure depend on the thickness of the yarns. It will be proper to have three of these machines, because then all the three strands of a cable may be twisted at one time, and thereby greater regularity effected. Those who make no larger than a fifteen-inch cable in diameter, will find a machine that contains one hundred and sixty reels large enough, allowing always for the different thickness of yarns; but, when a twenty-two-inch cable is to be made, it will be necessary to have the quantity I have mentioned in the former part of this specification, viz. two hundred and ninety-seven reels; although, by this improved method of laying the yarns together, by which each yarn is made to bear an equal strain, I am fully persuaded that an eighteen-inch cable will

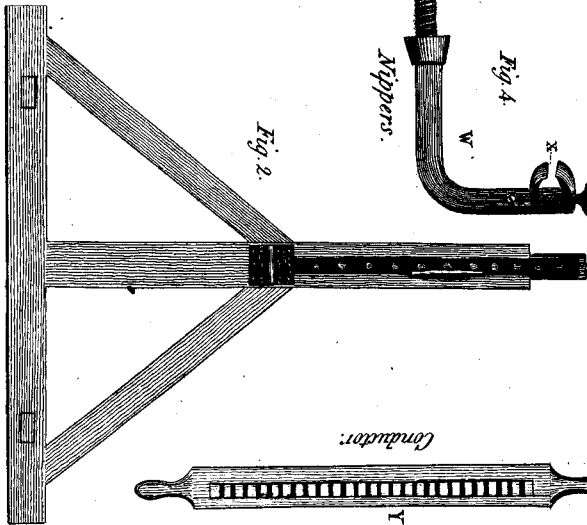
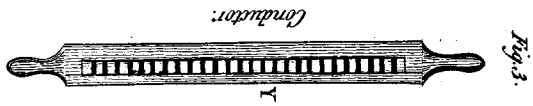
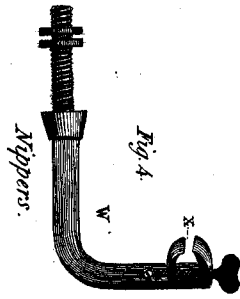
will be found to answer all the purposes of one of twenty-two inches made in the common way; and there will be a saving of a considerable quantity of the yarns, which will be found left on the reels; which, in the usual mode of twisting, would have been all wound up into the strands, and which in a large cable will amount to a very important quantity; or, if it should still be wished to use cables and ropes of the same dimensions as hitherto, a prodigious increase of strength, compactness, and durability, will be found in strands twisted by this machine. The ropes made by this machine should be wrought by steady and well-practised workmen, and, when they come to lay the three strands into one, they should endeavour, by all means in their power, to turn at both ends of the rope-walk with an equal motion, so that no more twist may be taken into the first strands than when the top minor passes through them; for, by any considerable alteration in twisting, either too slow or too quick, part of the improvement intended by this process may be defeated; for, if twisted too quick at the end towards which the top approaches, the outside yarns will receive more strain on them than

they ought to have, and, if too slow, the inside yarns will be affected in a similar manner. Therefore it is necessary to be attentive to this part of the process, and as the sledge, through which they twist the strands, as well as the machine A, both stand fast during the laying the yarns into strands, it may not be amiss to have a small bell over each, with a line fixed to it, and conducted along the top of the rope-walk, within reach, to give notice to the men at the other end when to stop. Every part of the manufacturing of cordage and ropes in general may be executed in the manner hitherto practised, except this of twisting the yarns into the first strands, whether for the purpose of making what are commonly called *water-laid ropes*, or *shroud-laid ropes*; and the hemp may be dressed, and the yarn spun and tarred, in the usual manner. In making smaller ropes three strands can be made on one machine, according to the number of the yarns which may be required. It must also be observed that in twisting the strands there must be a top minor for each, all of which should be carried along at one time, equal to each other, that the three strands may have an equal texture. In witness whereof, &c.

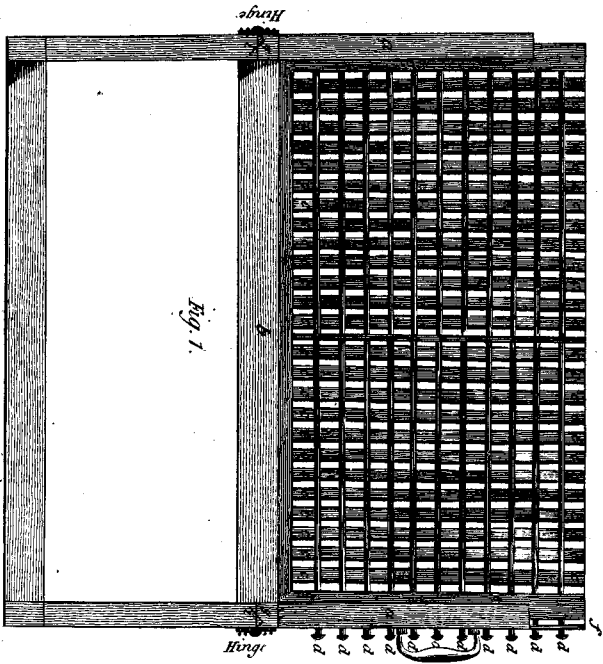




Front view of the great Machine, with the gradework C. Six only of the Rods are marked B, four of the Spiridles are marked H, and four of the Nuts marked O; but all the rest of the above parts are to be considered as described by the same Letters.



End view of the separating Machine.



Front view of the separating Machine.