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REPERTORY  
OF  
ARTS AND MANUFACTURES.  
NUMBER XLIX.

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I. *Specification of the Patent granted to Mr.  
WILLIAM CHAPMAN, of Newcastle-upon-Tyne,  
Gentleman; for a Method of laying, twisting, or  
making Ropes or Cordage\*.*

WITH FOUR PLATES:

Dated Jan. 12, 1798.

TO all to whom these presents shall come, &c.  
NOW KNOW YE, that in compliance with the  
said proviso, I the said William Chapman do  
hereby declare, that my said new-invented me-  
thod or methods of laying, twisting, or making  
ropes or cordage, of any number of yarns or  
strands, or any number of threads, tarred or un-  
tarred, from the size of a cable down to the

\* This specification (for Scotland) contains the substance  
of two English patents, one granted September 13, 1797, the  
other March 6, 1798.

VOL. IX.

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smallest

smallest line composed of more than one thread, is described in the several plans or drawings hereto annexed, and the following description thereof. It may occasionally dispense with the use of any or all of the following things or apparatus, made use of in the common method of laying ropes; that is to say, a rope-ground, or space sufficiently long to stretch out the yarn to make the rope or strand of the rope required, in which the yarns, thus extended, are twisted from one or both ends, by hooks to which they are attached, and which, being turned round their axes, twist the yarns in the mass through their whole extent, and form what the rope-makers call a strand; and so many of these strands as are requisite to form a rope, which are usually three, being joined at one end to the same hook, and this being turned the contrary way round to what the hooks at that end were before, the three parts are thus twisted together, and form a rope; which is kept regular in its number of twists, proportionate to its diameter and length, by a movable block of wood, called a *top*, with as many grooves in it as there are strands. This top is held from turning round by a cross bar of iron, or of wood, and prevented from advancing too rapidly by pieces of rope, usually called *tails*, which are lapped round the rope that is making; and as, by the twisting of the yarns and of the rope,

rope, the length becomes shorter, the hooks to which the strands are fastened, (or that to which the rope is fastened,) being fixed upon an upright frame, on a movable platform, commonly called a *sledge*, advance forward accordingly.

This is the outline of the process usually pursued in making what is called a shroud-laid rope, each strand of which consists of a number of yarns twisted together; and if a cable or cable-laid rope is to be made, the common process is, to stretch out so many shroud-laid ropes as there are to be strands in the cable, (usually three,) and to pursue the same manner, in forming them into one rope, as in the preceding instance.

In the principal method which I pursue, those parts that separately twist the strands and rope (in place of being at the extreme ends of the rope and strands, and approaching each other as the rope shortens,) are at any determinate convenient distance.

The process of twisting, consequently, does not go forward through the whole length at once, but only in the intermediate space; and, in this instance, my invention consists in combining with that circumstance a mode of twisting the rope or cord itself by an arbor or shaft, perforated or open, through the whole, or a portion of its extent, and revolving round its own axis; and, at the same time, twisting its several strands or

parts by separate arbors or shafts, either perforated or otherwise; each shaft revolving round its own axis; and, by the aid of such other machinery as will be described, performing not solely the operation of twisting the rope or cord, but also that of coiling it up by the motion of the machine.

The process of twisting the rope, and that of coiling it up by the motion of the machine, necessarily keep pace with each other, and are performed by the same shaft; or, the coiling may, when more convenient, receive its motion from any other part of the machine. Each strand occupies another shaft, revolving *only* round its own axis, and containing, on one end of it, the yarns or threads, wound upon a reel or reels, or in any other manner.

This relates to the making of shroud-laid ropes; and, in the making of cable-laid ropes, the difference consists principally in giving the described twisting-shafts contrary directions to what they had before, and different proportionate velocities; and in coils of shroud-laid rope being substituted for coils or reels of yarn, for the forming of the strands.

On each of the shafts that turn the strands, these coils of rope are progressively uncoiling; and, at the shaft forming the rope, the other end is progressively coiling in fakes, or tiers of cable,

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on a rotative platform; or, otherwise, round a reel moving round with the axis, twisting the rope or cable, but with a distinct axis of motion; or upon a reel that has the same axis of motion with the hollow tube or shaft that twists the rope; of each of which methods, one example is given in the plans. Besides which, my invention includes, as a principle, every other method of coiling up the rope or cord, or strand of a rope or cord, progressively, as it is made, by any motion from the machine or its moving power.

My invention consists also in making a strand or cord, by treating each yarn or thread as a separate strand, in the manner already described; and consequently having as many yarn shafts as threads, all of which may be turned by a belt.

Left the principles I have described, which admit of considerable variety in the execution, should not be sufficiently plain to enable any mechanic to construct a proper machine, I have annexed plans of one of the methods of application, both for shroud and cable-laid ropes, of which the following is an explanation.

In Fig. 1. (Plate I.) *a*, is a table or platform, with or without, as occasion may require, so many stanchions *b, b*, as may be necessary to support the requisite number of reels of yarn; each reel turning round its own axis, as in *c, c*, in Figs. 1 and 2; and all the yarn centred at the head

of the shaft. The reels may also be placed in any other convenient manner, according to their number; and, if requisite, may be two or more tiers in height.

Of these tables, there are to be as many as there are designed to be strands in the rope: these tables or platforms I call *strand tables*; and each of them is to be fixed on a hollow shaft, capable of revolving round its own axis; which shaft I call a *strand-shaft* or an *upper-shaft*, and which is shewn by D, in Figs. 1 and 3.

The yarns composing a strand, or, in the case of cables, a strand itself, passes through this shaft, in which there is a transverse opening of sufficient width, which, in its best form, will be rather more than that of the longitudinal orifice. In the transverse opening, *viz.* between  $d$  and  $d$ , are to be inserted two blocks,  $d$  and  $d$ , (one on each side,) of hard wood, or any other matter, with their opposing faces, as circumstances may require, either longitudinally grooved, or flat, or concave, or otherwise; so as, when forced together by springs, as shewn in Fig. 1, or in any other manner, or by weights, as in Fig. 3, (Plate II.) or by any other means, they may sufficiently resist the passage and twisting of the yarn or strand. These blocks should have their inside-faces rather bevelled towards the upper and lower ends: I call them *press-blocks* or *compressors*. Their  
use,

use, in the making of shroud-laid ropes, is principally to give a resistance equal to the stress that would draw the sledge along, in the common method of making ropes; and, in cable-laid ropes, both to retard the passage of the strands, and prevent their turning round, and thus perform the part of the sledge itself, in the common method, and of the hook on its face-board, or upright frame.

Those purposes, of holding the strand from turning round in the strand-shaft, and giving sufficient resistance to its passage through, I occasionally answer, by placing in the transverse opening two grooved rollers or sheaves *d, d*, Fig. 3, with axes large enough to occasion sufficient friction, and held together in the same way as the press-blocks: these I call the *holding-rollers*, because of the office they are to perform. The holding-rollers may either move round their own fixed axes, or upon axes inserted through them, of sufficient diameter to occasion the necessary friction.

I also produce the effect of preventing the yarns from twisting round in the strand-shafts, by placing within, upon, or below each shaft, an attached block of wood, or plate of metal, or other substance, with a number of notches or grooves round it, or perforated with a number of holes, through each of which, one or any number of yarns may be put: this implement I call a *yarn-guide*.

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In small ropes, the yarn-guide, the holding-rollers, and prefs-blocks, may be dispensed with, and a pressure applied according to Fig. 10, (Plate IV.) or in any other manner, either upon the yarn itself, or upon the rim of the reel; the former being preferable only because it affords an uniform resistance, notwithstanding the decrease of the diameter of the yarn on the reel.

The prefs-blocks and rollers may also be dispensed with, by a pressure upon the yarn or strand, at its entrance into the hollow-shaft, (or any where in its passage to it;) of which one example, out of the variety that may be adopted, is given in Figs. 11 and 12.

In Fig. 11, the yarn is stopped from going out too fast, by a pressure applied at *u*, which is farther explained by Fig. 12, which shews the plan of the table or frame supporting the reel or reels. *a, a, a, a*, are the feet of the stanchions sustaining the reel. *u*, one side of the shaft rising above the platform, over which the threads pass, as at *u*, in Fig. 11, and are duly compressed by the closing of the bar *b b*, the forks of which pass under the ends of *u*, in the opening shewn in Fig. 11: this bar is brought to its due pressure, by connecting it with the end of the spring *s s*, and bringing it to its necessary degree of tension. *n*, shews the hole down the shaft, through which the threads pass. If the number of yarns be very few,



few, or divided into several parcels, it will be necessary to place, between the bar and the part it presses against, a kind of collar, (round the thread or threads,) of coarse woollen cloth, leather, felt, or other substance, which may also be applied various ways in the longitudinal grooves of the press-blocks, so as to occasion an equable resistance to the yarns in each groove.

These methods may also be used for as many individual yarns as form a strand; and motion may be given to any number of reels, by a belt round the wheels *g, g*, Figs. 10 and 11.

It is perhaps barely necessary to say, that one press-block, or one holding-roller, may be made to answer the proposed end, by making the transverse opening to pass through only one side of the tube in the strand-shafts of Figs. 1 and 3; and that the tables or frames containing the reels, &c. may be placed or fixed to any part of the strand-shafts, and even on their bottom; in which case, these shafts need neither be perforated, nor open on one side, as the strands or yarns would neither have to pass through or along them, but only to be compressed, so as to prevent their either twisting, or passing off faster than requisite.

The strand-shafts all turn uniformly the same way with each other, by means of an upright shaft *C*, and wheel 6, communicating with a

wheel *g* on every strand-shaft, as described in Figs. 1 and 3, or by any other means. These shafts are placed as close to each other as they conveniently can; and the strands from the ends of each are all concentrated to a proper point, and brought to a fixed unrevolving block of wood, or other substance, of a conic or other form, and with as many grooves, holes, notches, or guides, as strands in the rope, to answer the end of the top in the common method of laying ropes, which end also may be produced by pulleys, sheaves, or any other guides.

This block *b*, I call the *laying-block*. Between it and the yarn-guide, the holding-rollers, or the press-blocks, (according as they are used,) all the strands receive their proper twist; and below it (the same as between the top and the single hook, in the common method of laying ropes) they unite, and become a complete shroud-laid or common rope, by the turning of the shaft immediately below the laying-block, *viz.* *E*, which I call the *rope-shaft* or *lower-shaft*, and which, by its apparatus, performs the part of the single hook at the end of the rope, in the usual method.

Between the rope-shaft and the laying-block, I occasionally place a short hollow cylinder of wood, or metal, *viz.* *i*, of the size of the rope to be made; the head of this may be trumpet-mouthed, to receive the lower end of the laying-block.

block. In this cylinder (which, for ease of placing, may be composed of two parts) the strands first unite, and become a rope.

The rope-shaft is perforated, or open in its upper part, and has no press-blocks or holding-rollers to retard the progress of the rope, but, on the contrary, a pair of sheaves or wheels moving easily on their axes, to admit the rope a free passage, and, at the same time, compel it to twist equally round with the shaft. These sheaves or wheels, which ought, like the holding-rollers, to be grooved in such a manner as to hold the rope from turning sideways, I call the *twisting-sheaves*. Between these and the hollow cylinder, I occasionally insert, in the head of the rope-shaft, hollow tubes of metal, or other substance, suited to the size of the rope, which I call *gauge-tubes*. When proper gauge-tubes fill up the space between the cylinder and the twisting-sheaves, the latter may be forced round, by the action of the rope pushing from the laying-block, in the same manner as the top in the common method is forced onwards, notwithstanding the great resistance made by the tails or tail-ropes. But, in other instances, these twisting-sheaves may receive such a progressive motion as, in every revolution of the rope-shaft, (which makes one turn of the rope,) the groove of the sheave shall move such a space as may be equivalent to the length of rope that is

designed to be made by every turn, which will be in proportion to its diameter; and also accordingly as the rope is designed to have more or less twist, or, in the usual phrase, be long or short laid. A method of performing this will be seen by Fig. 3, and is described in the explanation of the rope-shaft of that plan, and its appendages. The rope, from below these twisting-sheaves, passes out so far made, and, amongst other methods, is disposed of in the following ways. If not too unwieldy, I coil it up on a reel, as at *m*, in the rope-shaft E of Fig. 1, which is more particularly described in Figs. 4 and 5, (Plate III.) and in their explanation; where it is shewn, that ropes of different sizes may be made to coil up on the reel, so closely as to require tying up only, and thus supersede the necessity of any farther operation.

For the making of all ropes thus coiled upon a reel, either weights or springs may be made use of to tighten the twisting-sheaves, and the press-blocks or holding-rollers; and consequently the position of the shafts may be in any direction at will, whether horizontal, vertical, or oblique, the axes all pointing the same way, or nearly so; the best position being for the strand-shafts to concentrate a little towards the head of the rope-shaft. The strand-shafts and tables may either stand round one common centre, as in Fig. 2,  
which

which will in general be the most convenient for ropes; or they may stand side by side, in a right line, or with such a degree of curvature as may accord with the number of sets that may be moved by one great wheel or belt; which latter mode will be the most convenient for small lines and cords, and also for small ropes. The ropes that are too large to coil upon a reel, I coil upon a rotative platform, as in Fig. 3. FF, which is fully described in the explanation of the rope-shaft of that figure, and its appendages.

The outlines of making shroud-laid ropes being now made apparent, there remains to be shewn the process for making cables or ropes of that description. It consists, as above, in strand-shafts and a rope-shaft; the principal difference being, that they are to move contrary ways to what they did before, and make a similar, or nearly similar, number of revolutions, in place of the considerable disparity of twists that are requisite for the strands of the rope itself, when laid as a shroud. This disparity admits of variety, from the causes I shall afterwards mention; but, for the purpose of explanation, I shall at present assume it at two to one in three-strand ropes, (which is nearly the average,) and then the proportionate revolutions of the rope and strand-shafts should be three to one, because every revolution of the rope-shaft takes out one twist from the strands.

If the yarns be so hard twisted as to have more than their due proportion of counterbalance to the untwisting tendency of the strands, then the proportionate twists of the rope may generally be less than I have stated; but, if the yarns be unable to resist the untwisting of the strand, or even be twisted the same way as the strand, which frequently is the case in common ropes of a small number of yarns, then the twists of the ropes to those of the strands should be more than I have stated: what they precisely should be, can be no object of this patent; and I only observe, that a small deviation, on either side of the proportionate number of turns of the rope, will be attended with no inconvenience but what will be remedied on its being stretched and used a short time, when it will assume that proportionate twist which will balance the counteracting power of the strand.

From these circumstances it follows, that cable-laid ropes must either be made on separate machinery, or the shafts must assume contrary turns, and different proportions, to what they had before; means of doing which will be described in the explanation of the rope-shaft of Fig. 1.

If the cable-laid rope be small, so that its strands were made upon reels, as at *m*, in the rope shaft of Fig. 1, then these reels, as they come from the rope-shaft, may be fixed upon  
stanchions,

strands, as the yarn-reels at *c, c*, on the strand-tables of Figs. 1 and 2; or, as must be the case in large ropes, they may be laid on the upper tables in coils, as at *c*, on the strand-table of Fig. 3, and their ends passed through the strand-shafts, and united below the laying-block, and brought down between the twisting sheaves *n, n*: a short piece of rope being then attached to their ends, and brought out of the opening below the sheaves, and passed over the *coiling-wheel p*, and made fast to the coiling-stage *FF*, so as to draw it round, the whole process will go on as described in the explanation of the rope-shaft of Fig. 3.

According to my invention, when the rope is drawn forward by the twisting-sheaves, or other means, the top or laying-block and its appendages may be dispensed with; because, at some given point, according to the proportionate twists of the threads or strands to those of the cord or rope, the rope and its strands, or the cord or line and its threads, will balance themselves. If the strand or yarn shafts be set so as to form a wide angle with the head of the lower-shaft, the point of junction will be at the head of that shaft; but, if the strand-shafts form an acute angle from their feet to the head of the lower-shaft, then the point of concentration will be above the head of the latter; and no very material inconvenience will

will even then arise, provided the pressure retaining the separate strands or threads be quite equal; but, if otherwise, the rope or cord will appear with a strand higher or lower than the rest, accordingly as it may be longer or shorter, by receiving too little or too much resistance in passing from its shaft; which resistance may be regulated, on stopping the machine, by slackening or tightening the springs shewn in the upper shaft of Fig. 1, or by moving inwards or outwards the weights upon the levers, as shewn in the upper-shaft of Fig. 3; and may also, if thought necessary, be regulated, during the going of the machine, by occasional pressure applied on a collar connected with the lever, and capable of sliding up or down any proper part of the shaft.

What I have called shafts, are, under this denomination, principally applicable to the manufacturing of rope; and, when suited to the making of cord, they will be more properly denominated spindles, which of course must be understood through the whole description; and, what I have called upper and lower shafts, will, in the application to cord, be upper and lower spindles.

In the lower-spindles, and even in the lower-shafts for small ropes, there will be no necessity for any part of them being perforated, or open, provided the spindle or shaft be retained in its position, by collars below the reel on which the cord or rope winds up as it is made.

My



My invention likewise consists in making the strands separately, in the following manner: that is to say, I coil or wind up the yarn requisite for a strand on one reel, or any number of reels or bobbins, and fix the reel, or reels or bobbins, on a pin or axis, or pins or axes, round or with which, it or they will revolve, as drawn off. The yarns are then twisted together, and drawn forward by a revolving shaft, similar to E in Fig. 1 or 3, placed in any requisite position, (to which shaft the reels are not fixed :) the yarns are thus made into a strand, which is coiled up, during the process of making, in the modes herein described, or in any other manner, so as to admit of the revolution of the axis or shaft making the strand; which, when thus made, may either be treated similar to a cable-strand, as already described, or it may, with other strands, be laid in a common rope ground, or after the common method, as may also the strands made by any other of my processes, my method being to complete the rope after any of those ways, according to circumstances. In this method, of making the strand by drawing the yarns or threads from off separate reels, that are not fixed to the revolving axis, or shaft that twists the threads together into a strand, I regulate the coming forward, or making of the strand, by apparatus fixed to, or connected with, the shaft, either in a manner similar to

what is explained in the description of the shaft and apparatus for twisting the strands into a rope, or in any other way. I also place above, or leading to, the head of the shaft, a yarn-guide, to separate the yarns to any extent deemed necessary, likewise to enable them to come off in greater or less quantity, as required by the part of the strand they fall into. I regulate the resistance to their coming forward, to any extent wanted to give sufficient compactness to the strand, and, at the same time, not prevent the yarns from any reel, or number of reels, from coming forward as required; for this purpose, that resistance may either be placed on the reels themselves, or in any manner that separates or divides the whole mass of yarns, or in any other way that allows one or more yarns to slip or come forward independently of the rest.

By the method previously described for making a complete rope at one operation, I, during the act of making the strands, unite them into a rope, by means of what I there call a rope-shaft, in which they are all centred, and receive the twist which forms them into a rope: but I also occasionally omit the centring of them, and the subsequent part of the operation, during the making of the strand or strands, and, in place of twisting them into a rope, I only draw the strand forward, as made, and coil it or them in any manner whatsoever;

soever; they, in this instance, having no rotative motion. The apparatus for drawing forward is not fixed to the revolving-shaft, containing the reel or reels, and other necessary appendages, but may be permanent, and receive its motion in any proportion whatever to the revolutions or twists given to the strand by that shaft.

The principles of making the strand in these two different ways are obviously portions of the process that would, as has been described, make the whole rope at one operation; and those two methods of making the strand, independently of making the complete rope, are reducible to the following principle; that, in making a strand simply, one end only need to be twisted, and the other held from turning, but that both be permitted to pass forward, and progressively change place; and that the yarns be, if deemed necessary, so regulated as to come off their reels in such a manner as the part of the strand they come into may require.

There is also a third method of making a strand, compounded of the two preceding, which may be followed, *viz.* that of using two revolving shafts in place of one; the reels being placed on one of them, and the strand coiling upon the other: these two shafts ought to turn in contrary directions to each other, in place of going the same way about, as they do in making the strands and rope at the same process.

The making of an individual strand is particularly useful, when the rope-machine, explained in Figs. 1 and 2, is not sufficiently large to make the rope required; under which, or in any other predicament, I occasionally fix the requisite number of reels on the strand-tables, shewn in Fig. 2, and, passing the yarns through the upper-shafts, in the same manner as if a rope were going to be made, I unite them at the head of the lower-shaft E; and then, in place of the fixed laying-block *b*, which is used in the making of ropes, I fix a yarn-guide, with any number of grooves or openings, suited to the number of yarns, or any division of that number, and then the process goes forward as in the making of a rope, with this difference, that the upper tables stand still: this method differing in nothing, from one of those afore-described, but in the saving of the distinct apparatus that would be requisite, to resist the passing off of the yarns, and to give the necessary hardening or compactness to the strand.

Besides these methods of separately making strands in such a manner as to give every yarn, or determinate number of yarns, their fair bearing in the strand, so as to give it a degree of strength unattainable by the common process, I have invented a further method, which requires little more apparatus than is used in common roperies or laying-grounds, *viz.* at the head of the ropery,

or

or in any other part, I fix, upon pins, so many reels as will contain all the yarns requisite for a strand, or the given number of strands determined to be made at one time, each reel containing one or more yarns; then, in the instance of making three strands, I fix to three different hooks, on the breast or fore-board of a sledge, so many yarns, separately concentrating to each other, as are requisite; the yarns being previously passed through the openings of three separate fixed tops or yarn-guides, one opposite to, or correspondent with, each hook. Before, or on the face of each top, towards the sledge, there may or may not be fixed a cylinder, such as I have described below the laying-block at the head of the rope-shaft. The yarns are then to be prevented from passing too easily off their reels, either by a pressure on the reels themselves, or on the yarns, in their passage to, or upon, their separate tops, or in any manner that will permit them to come off as wanted.

The men are then to heave upon, or turn round, the hooks of the sledge in the usual way; and the only remaining difference consists in the sledge being drawn progressively backward, as the strand is making, until the whole, or any determinate length of strand be made. The process of drawing backward may be done various ways; amongst others, by a rope to a capstan, moved either by a horse or men, according to the strength

strength requisite, which will not be considerable, on account of the slowness of the motion of the sledge, which, although called technically by this name, I propose to move on wheels. The strands being now made, and all joined at one end by a single hook, the wheels of this sledge may either be locked, and itself laden with a proper weight, or it may have attached to it a common sledge, with its requisite load, and then the completion of the rope may go forward in the usual way.

By the described process of drawing the sledge backward, and by a single hook on the fore-board of the sledge, and a fixed top, or any thing equivalent to it, a rope may be made, during the process of making the strands, after that manner which I have described as admitting the strands to be coiled up in any manner whatever. The other method is, to wind up these strands during their making, and afterwards to stretch them on the rope-ground, previously to the commencement of forming them into a rope, and in this manner one large strand-machine would be sufficient.

I shall here observe, that, in place of reels of yarn, I occasionally substitute balls of yarn in canisters, or other vessels in which they may unwind.

The described shafts, machinery, and apparatus, are not limited to the form or position of which

which I have given, or shall give, descriptions, but obviously admit of great variety; and they may receive their motion from steam-engines, from water, from wind, or from the power of animals, which may communicate the respective direction and velocity to the separate parts, by means of upright and lying shafts with cog-wheels, or by belts or chains, or any other methods practised by mill-wrights or others; my invention not consisting in any particular or limited mode of giving motion to the machine, but in all or any of the following things, *viz.* the application of a fixed unrevolving top or laying-block, of perforated or open-strand-shafts, and of a rope-shaft; and in the use of hollow tubes or cylinders at the lower end of the top, and of gauge-tubes; and in using press-blocks or rollers, and sheaves or wheels pressed against the strand, or the rope, by weights, or by springs, or any thing elastic or otherwise; the giving any determinate regular motion to the strand, or the rope, or cord or line, so as to give it any number of turns that may be desired in a given length; and in coiling up the strand, rope, cord or line, in any way, during the process of making it, by means of any machinery connected with that employed in making the strand, rope, cord or line, or with its moving-power; also in giving the contrary and differently proportioned motion to the same machine,

so

so as to adapt it either to shroud-laid or cable-laid ropes or lines; and in such other particulars as will be more clearly described in the following explanations, or have been previously noticed, in which I include the placing of more reels or balls than one upon any single shaft, or revolving platform, used in the making of the strand of a rope.

In fine, my invention goes to the described methods or principles of twisting or laying; and (as a constituent part in the process of making,) that of coiling or winding up strands, ropes, and cords or lines.

And I likewise claim, as my invention, the application of rollers, which I call *regulating-rollers*, to the manufacturing of twine made of hemp, flax, or tow, the use of which rollers is to give any determinate number of twists, in any given length of twine; for which purpose, they are to be intervening between the reels containing the separate threads of which the twine is composed; and the spindles making the twine, which (like the spindles used in the making of thread) must have belonging to each a flyer and a bobbin, the former twisting, and the latter reeling up, the twine as it is made; which it may do by its resistance to motion, from the friction of weights drawing or pressing against it, or other similar causes, and, by the effect of that friction,  
it



it would draw the threads from off their reels, but it would be in a manner materially irregular, without constant attention in increasing the weights, as the twine increased in thickness on its reel or bobbin. The use of the regulating-rollers therefore is, that the separate threads shall pass from their reels between rollers that have some given determinate motion to any number of turns in the spindle, and consequently be delivered precisely as wanted; for instance, if the twine be to have fifty turns in the length of one foot, then the faces of the rollers, between which the threads pass, must move one foot during fifty revolutions of the spindle; the mode of giving which proportionate velocity is unnecessary to be explained, as being known to every mechanic.

The reels containing the separate threads composing the twine are put upon pins, or other axes, round or with which they separately turn, as required, to unwind. Their position is fixed, and their threads lead off to a conductor or opening, to guide them to the rollers; between which and the spindle, they receive their twist, and are formed into twine. I also claim, as my invention, the use of the regulating-rollers for the manufacturing of worsted, and likewise of cotton, yarns or threads, of any denomination, composed of more than one thread.

Explanation and Description of the COILING-  
REEL in Figs. 1, 4, and 5.

(See Plate I. and III.)

For ropes not exceeding four inches girt, (or as much more or less as may be found convenient,) I propose the lower shaft to be as in Fig. 1, where the two fides are spread out so as to receive a reel, which may receive its motion in the following manner.

On the end of the axis of one of the twisting sheaves *n*, (Fig. 1.) may be affixed a pulley-wheel *o*, of the same diameter; which, by means of a belt, may communicate with another pulley-wheel *p*, on the end of the axis of the reel on which the rope is to wind, and of the diameter of the part on which the rope begins to wind; consequently, as the twisting-sheaves move with the same velocity as the rope is laid, it will be capable of winding it up in the beginning; and, as the rope increases the thickness of the reel, the belt must slip in the proportion of that increase; or otherwise the pulley *p*, at the end of the axis of the reel, may be composed of two concentric wheels; the one so much less than the other, as to afford only a proper degree of friction to lay the rope tight on the reel.

If

If wanted to wind regularly upon the reel, so as to supersede the necessity of coiling it again, the rope must pass through a collar, as at *a*, Fig. 5; and be guided from side to side, as each layer is completed, moving the width or diameter of the rope on every revolution of the reel; which may be effected in the following manner, as I shall exemplify in the coiling of a four-inch rope.

*b c*, in Fig. 5, is an iron bar, passing through the two sides of the frame holding the reel of the rope-shaft of Fig. 1. The end *b* is square, flat, or angular, and passes through a suitable hole, to prevent it from turning: the end *c* is a continuous screw, with its threads so far distant, that one revolution of the nut *d*, Figs. 4 and 5, or some proportionate revolution of it, shall move the collar *a* the precise diameter of the rope; then, if the reel be suited to take 12 turns of a four-inch rope on the length of its axis, the following explanation will be sufficient.

One revolution of the nut *d*, (which contains a female screw,) moving the collar *a* one diameter of the rope, and 12 diameters being equal to the length of the reel, the nut must reverse its motion at every 12 revolutions; then, if the nut *d* have eight teeth, and be in gear with the wheel *e*, of 32 teeth, which is on the same arbor with the pinion *i*, the latter will make one revolution, whilst the nut *d* makes four. The two wheels *f*

and *g* are constantly in gear with each other, and turn contrary ways; and, besides the teeth working into each other, and with the pinion *b*, they have, on the same axis with them, two half-wheels, (shaded black in the plan,) each of which have 24 teeth, that alternately work into the pinion *i*, of 8 teeth, and thus, giving three revolutions to it, give 12 to the nut *d*, which is the number required. It may be necessary to notice, that the wheels termed half-wheels, must be so much less than semicircles, as to prevent the possibility of both being in contact with the pinion *i* at the same time.

From what has been said, it follows, that the wheel *g* only makes one revolution, during the time that the collar *a* moves backwards and forwards, and lays two complete layers of rope on the reel; which, in the present instance of a four-inch rope, requires 24 revolutions of the reel, which, by the little pinion *l*, on the end of its axis, gives motion to the whole. If this pinion *l* have 16 teeth, and the wheel *k* four times as many, then the pinion *b*, on the same arbor, having 8 teeth, and the wheels *g* and *f* 48 teeth each, the latter must make only one revolution for 24 of the rope reel, which, in the present instance, is the number required.

If the rope, in place of four inches girt, should only be three inches and three quarters, then, in  
place

place of the pinion  $l$  being of 16 teeth, another of 15 teeth is inserted on the end of the axis of the reel; and thus any rope, down to an inch and a half, or a pinion of 6 teeth, may, by the same machinery, be closely coiled on the reel. In lesser ropes, lighter machinery may be used, and all the proportions of reeling be obtained, in a manner similar to that above described.  $m$ , is a screw, raising or depressing a collar in which the axis of the reel and the pinion  $l$  turns; so that, be the diameter of the latter increased or reduced, it may still be in gear with the wheel  $k$ .

Explanation of the ROPE-SHAFT of Fig. 3, with its Appendages, &c. Figs. 6, 7, and 8.

(See Plates II, III, and IV.)

#### E. The rope-shaft.

$nn$ . The twisting-sheaves; one of which (being confined in its position) receives its progressive motion from the endless screw  $o$ , on the axis of the small wheel  $r$ , which receives its motion by revolving against a fixed or stationary concave wheel  $ss$ .

Different velocities may be given to the twisting-sheaves, by having sheaves proportioned to the different ropes, as to the number of teeth in their periphery; having the greater number for the  
the

the smaller ropes, and screw-wheels of a correspondent interval of thread, to fix upon the axis of the wheel  $r$ . I shall exemplify this in the instance of a 16-inch cable, which ought, if very hard laid, to come forward a foot, or a little more or less, in every revolution, and 16 inches, if rather slack laid.

Let the general proportion of the little wheel  $r$  be  $\frac{1}{2}$  of the fixed concave wheel  $ss$ , which it works within, and the teeth of the twisting-sheave as much more than an inch in their pitch, as the extremity of the sheave is beyond its gripping point, then each revolution of the cable-shaft must lay a foot of rope, and so proportionately in all smaller ropes, reducing the pitch or space between the teeth accordingly, *viz.* by increasing their number; and, in ropes of *equal* size, decreasing their number, if designed to be slacker laid. In the making of small lines or cords, both these wheels may be dispensed with; as the twisting-sheaves may then bear such a proportion to the diameter of the line or cord, that one tooth of that sheave may be equal to the length of line or cord made by one revolution of the lower shaft or spindle; and, consequently, a fixed wheel, containing an endless screw of one thread, equal to the space (and vacancy) of a tooth, or to the pitch of the teeth of the sheave-wheel, will answer the purpose required. The wheel  $ss$ , from which  
the

the twisting-sheaves ultimately receive their motion, is not necessarily concave, or fixed in this position. It may be placed at the foot of the shaft; and the axis containing the endless screw *o*, may be horizontal, or in any other position. The twisting-sheaves may also, if necessary, be each of them driven by a separate screw; or one may drive the other, by a cog-wheel on each: they likewise are not confined, either as to the place on the shaft, or relative position to each other.

FF. The cable stage, supported on rollers, and cut through, to shew the tiers and fakes of the cable.

G. The cable, passing out of the side of the cable-shaft, and over the coiling-wheel *p*, which, by means of the iron shank *t*, is drawn in and out, so as to lay on the fakes or different turns of the cable, one within or without the other, as it winds in or out, after finishing every tier or layer of rope. In this instance, the utmost diameter of the cable stage is 16 feet, and the innermost part (of where it is proposed to coil) 8 feet: this, in a 16-inch cable, will admit of nine fakes in a tier, and the mean length of each fake will be little above 6 fathoms, and of the whole tier about 56 fathoms; consequently, the coiling-wheel *p* must move inwards or outwards four feet in the time (or in less time) that 56 fathoms of cable are laying; which, according to the standard

of hard twisting already assumed, would be done in 336 revolutions of the cable-shaft; that is, it would move one inch in seven revolutions. Moving inwards or outwards, in less time, will be attended with no further inconvenience than leaving a space between the fakes, and sooner completing a tier. As the length of the fake increases or decreases, the wheel  $p$  ought to be moved slower or faster inwards and outwards; but this would be attended with unnecessary complication of machinery, and therefore the medium motion may be sufficient, as it will only occasion the cable to incline a little inwards or outwards.

One mode, out of many, of giving this motion, is as follows: the shank  $t$  may be formed as a screw, for the necessary length, and have the space of a revolution of thread to be half an inch, and pass through a nut  $u$ , containing a female screw; then, in the instance of a 16-inch cable, the nut would have to make two revolutions, in a period not exceeding seven turns of the cable-shaft, but say in six turns; then, let there be two small wheels  $v v$ , Fig. 6, each with an endless screw  $w$ , or  $x$  upon its axis, and the wheels of the same diameter as the wheel  $y$ , on the foot of the axis of the wheel  $r$ , Fig. 3, and connected with the same wheel  $y$ , Fig. 6, consequently performing similar revolutions. These wheels  $v v$  must be on a frame, capable of moving  
a short



a short space in the curved dotted line  $w x$ , whose centre is in the axis of the wheel  $y$ , therefore never losing their connection with it; and, accordingly as the shank  $t$  is to move inwards or outwards, the endless screw  $w$ , or the endless screw  $x$ , is to be acting on the nut  $u$ , which nut is to be supplied with different numbers of teeth, and fineness of pitch, capable of being easily affixed and taken off; as also must the axes of the wheels  $v v$  be supplied with endless screws of correspondent space of thread. The nut wheel  $u$ , in the instance in question, having to make one revolution in three turns, and the wheel  $r$  making 36 revolutions in that time, it follows, that the nut-wheel should have 36 teeth. In a cable of half the size, to coil it close, it should have twice the number of teeth; but, as no material inconvenience will arise from its loose coiling, the same wheels and screws may be dispensed with. As to the change of motion, I propose to give it in the following, or any other manner, *viz.* that when the coiling-wheel  $p$  has proceeded to its extremities, either inwards or outwards, its axis  $q$  shall then set in motion what in steam-engines is usually called a *spanner*; which, being connected with the frame supporting the wheels  $v v$ , shall put the screw on the axis of one wheel out of gear with the nut  $u$ , and throw the other in, so as to give the contrary motion. Also all, or part, of this

machinery may be dispensed with, because, in large cables, the stage will move so slowly that men may stand in it to coil them away, as in a ship's cable-stage.

By means of the rollers, or by wheels affixed to the coiling-stage, it will move sufficiently easy. Some resistance to motion is necessary, that it may recede as the rope advances.

If 60 fathoms of 16-inch cable be made in one hour, the rope-shaft, according to the above premises, need only make 6 revolutions in a minute, and, if not hard twisted, only 5 turns, or as low as  $4\frac{1}{2}$ .

Smaller ropes, to be laid in the same time, must make a number of revolutions inversely as their sizes.

In Fig. 1, a method of giving motion to the strand-shafts and rope-shaft is shewn, adapted to the contrary and different motions of shroud and cable-laid ropes. In this instance, A, represents (in section) a shaft that may give motion to as many sets of machinery as requisite. 1, is a cogged face-wheel on the lying-shaft, working into the spur-wheel 2; which, by a small movement, must be capable of being disengaged from the wheel 1, and be put into gear with another wheel, (on the same lying-shaft A,) similar to the wheel 1, and with cogs opposite to it, so as to move the spur-wheel 2 the contrary way round.

The

The double bevel-wheel 3, is on the same axis with 2, and works on one face into the wheel 4, on the upright shaft B; and, on the other face, the opposite side of the wheel works into the bevel-wheel 5, on the shaft C: therefore the shafts B and C move the same way round.

The wheels 4 and 6, being of equal diameters, and both faces of the wheel 3 being alike, it follows, that the shafts B and C must move with an equal number of revolutions. As the wheel 6, on the shaft C, works into the wheel 9, at the foot of each strand-shaft, and is of the same diameter with them; and as the wheel 7, on the shaft B, works into the wheel 8, on the rope-shaft, and is but  $\frac{1}{3}$  of its diameter; it follows, that their revolutions will bear the same proportion with each other, as that which has been mentioned to be nearly the medium in shroud-laid ropes. Any other proportion, at the option of the manufacturer, may be obtained as easily.

To adapt the same machinery for making a cable-laid rope, the shafts, in the first instance, must all move the contrary way. This is effected by disengaging the wheel 2 from the wheel 1, and putting it into gear with the opposite face-wheel, already described. The remaining part is, to make the revolutions of the strand-shaft and rope-shaft equal. This will be obtained by lowering the wheel 7 so much, down the shaft B, as

to disengage it from the wheel 8, and bring the wheel 9 into gear with 10; which, being of equal diameters, and having the same proportions to each other as the wheel 6 has to those on the foot of each strand-shaft, will consequently give equal revolutions to the strand-shafts and rope-shaft; which, combined with the contrary motion to what they had, is all that is requisite to form cable-laid ropes with the same machinery.

In Fig. 3, a cable motion only is shewn; and the spur-wheels of the shafts B and C are only half the diameter of the wheels of the strand-shafts and rope-shaft that they work into; and they, of course, move with revolutions equal to each other, as in the preceding instance.

If found necessary to give different proportionate revolutions to the strand and rope shafts, in making shroud-laid ropes of a greater or less number of yarns, the disparity will be trivial; and the effect desired may easily be produced, by having the wheel 7 to take off, in two or more parts, and substituting in its place another wheel, of greater or less diameter, which will be brought into gear with the wheel 8, by shifting the foot of the shaft B a little inwards or outwards.

Fig. 6, is a horizontal plan, on an enlarged scale, of the coiling-wheel, with its supporting rails, and machinery for reverse of motion, which are shewn

shewn in elevation in Fig. 3. Figs. 7 and 8, are also on an enlarged scale. The former of them shews the above apparatus in elevation, similar to Fig. 3, and the latter is likewise in elevation, but transversely to Figs. 3 and 7. The following letters of reference are common to all those figures, so far as they are to be found in any of them; *viz.* E, the rope-shaft, through which passes *t*, the shank of the coiling-wheel *p*. *z, z*, are the rails on which the coiling-wheel is supported, by the trucks or rollers *a 1, a 1*. *a 2*, is a forked bar of iron, fastened at one end by a pin to the bar *a 3*, which moves on a centre at *a 4*, and is charged with a sufficient weight, at its head, to force the endless screw *w* into gear with the nut *u*, when assuming its present position; or to force the screw *x* into gear with *u*, when acquiring the position of the dotted line, as at *a 5*. *a 6*, is an upright bar, with a pin through it, to support the bar *a 2* at such height as that it will not rest against *q*, the axis of the coiling-wheel. I shall here observe, that the lower limb of the bar *a 2* may be dispensed with. *a 7* and *a 8*, are moveable slides, to be fixed so far short of the innermost and outermost range of the coiling-wheel as nearly the length of the opening in the bar *a 9*, which passes over *b 1*, a shank connected with the moveable frame of the wheels *v, v*.

According

According to the position of the bar *a 3*, the coiling-wheel must be moving outwards: when *g* arrives at *a 7*, it will carry forward with it the bar *a 2*, until it brings the foot of the bar *a 3* past the perpendicular under the centre *a 4*, and the opposite end of the groove on *a 9* near to the shank *b 1*; at which time, the weight on the head of *a 3*, preponderating the contrary way to its former position, begins to assume that of the dotted line *a 5*, and consequently carries along with it the shank *b 1*; which, disengaging the endless ferew *w*, and putting the endless screw *x* into gear with the nut *u*, gives the contrary motion required.

EXPLANATION OF Fig. 9. (See Plate IV.)

The principle of coiling the rope here is nearly the same as in the coiling-stage; the reel making so many revolutions less than the rope-shaft as there are coils of the rope upon it; the difference chiefly consists in this mode admitting the shafts to be horizontal, if that position should be deemed eligible. To enable the rope to be coiled in a sufficiently small space, it is necessary, that either the pulley-wheel *a* should move inwards and outwards, as in the plan for the coiling-stage, or that the reel (or wheel on which the rope is to be wound) should change its relative position with  
the

the wheel *a*, by shifting its place on the axis of the rope-shaft; the latter of which may be done various ways, and, amongst others, by the following method; *viz.* the outer rim of the wheel *b b* should move through the notch of a moveable block *c*, that travels backwards and forwards, for a space nearly equal to the length of the axis of the reel. This block *c* should have such a compressure upon the rim of the wheel *b b*, as to be equal to the pulling it round, as the twisting sheaves give out the rope; and it may be moved backwards and forwards by a crank *d*; the crank being rather shorter than half the length of the axis of the coiling-reel, because of its slower motion towards each extreme. The wheel *e*, upon the same arbor with the crank, should move with different velocities, according to the thickness of the rope to be coiled up; which (as it must receive its slow motion by the intervention of other wheels, to which a belt may be applied in the rapid part of the movement) may be done by having drum-wheels of different diameters; and consequently any velocity may be given, proportionate to the size of the rope. This description, even without the aid of the previous examples I have given, is sufficiently plain to any millwright, or person conversant in mechanics, to whom alone a description of mechanical subjects can be made clearly obvious, even with great prolixity.

Ex-

## EXPLANATION OF Fig. 13. (See Plate IV.)

B, is the transverse section of a shaft, similar to B in Fig. 1. 6 6, is a spur-wheel at the upper end of it, to perform the same operation as the wheel 6, on the shaft C, in Figs. 1 and 2. This wheel 6 6 is connected with as many wheels *g, g*, as may be convenient to place round it; each of them turning a strand-shaft D, the same as in Figs. 1, 3 and 11.

In the present instance, the wheel 6 6 is of 6 feet 6 inches diameter, and the wheels *g, g*, &c. of 2 feet, making 13 revolutions for four of the shaft B; and there are 12 strand-shafts, consequently, applicable to three lower shafts, for four strand-ropes, or four shafts for three strand-ropes: this plan is drawn to correspond with the latter. E, represents one of the four rope-shafts, and 8 the wheel upon it, similar to 8, in Fig 1. 7 7, is a correspondent wheel, on the lower part of the shaft B, and gives motion to all the rope-shafts. The diameter of 7 7 is 3 feet 9  $\frac{1}{2}$ -inches, and that of the wheels 8 8 is 3 feet 6 inches, *viz.* in the proportion of 13 to 12; consequently, as the wheels 6 6 and *g g* are as 13 to 4, the strand-shafts will make three revolutions to one of the rope-shaft. In the same manner as described, any number of machines may be placed round  
the



the same shaft or arbor, and any proportionate velocity given to the strand and rope shafts.

Also, if found necessary (which can only be in ropes of a *small number* of threads) to twist the yarns, during the process of making a strand, it may be done by a number of small shafts, placed as D, D, round the whole, or round a portion of the circle, and giving motion to them by a belt. A reel, with a single yarn may be placed, as in Figs. 10 and 11, on as many of them as there are yarns in the strand; and all these, concentrating about a top or laying-block, may join at a proper distance in one shaft, as at B, similar to the rope-shaft E, Fig. 1. This shaft also, like the small shafts with single threads, may receive its motion from a belt, and move with the same number of revolutions; its use (with yarns properly twisted) being only to prevent the twist from being taken out of the yarns, by the contrary twisting of the rope; which may equally be effected by giving the yarns for small ropes a more than ordinary twist.

#### DESCRIPTION OF THE PROCESS OF TARRING AND WARPING.

In the methods I have described, of making ropes, or strands of ropes, where each yarn, or number of yarns, has to take its proper place, it

is necessary that every yarn, or small number of yarns, should be separately wound up, and the mode of performing this, becomes an essential and constituent part of my method or methods of making ropes.

The mode that I have invented is applicable to, and a part of, my method of making tarred ropes. The principle of it consists in winding up separately, during the process of tarring, each individual yarn, or small number of yarns, as may be previously determined. In the common method of tarring, which is frequently done to the extent of three or four hundred yarns at one time, they are, as they come from the tar-kettle, passed in the mass through an opening, where they receive such pressure as to force back the superfluous quantity of tar; and they are drawn forward by the mass of yarns being passed any requisite number of turns round an axis, which is moved by a horse, or by any other means; and the whole is progressively coiled up. In place of this, my method is, to draw forward, and wind up, any determinate number of yarns, by their ends being fastened to their respective reels, one or more to each; and, as it is necessary to keep the yarns from entangling, in their passage from the tar-kettle, or other vessel, to their reels, I occasionally press them separately, in such a manner as that each reel shall draw forward its own yarn or  
yarns,

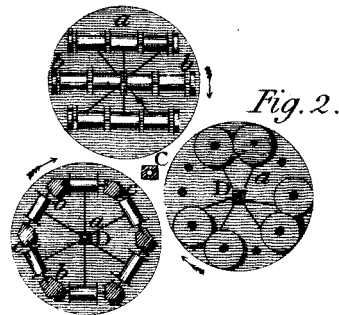
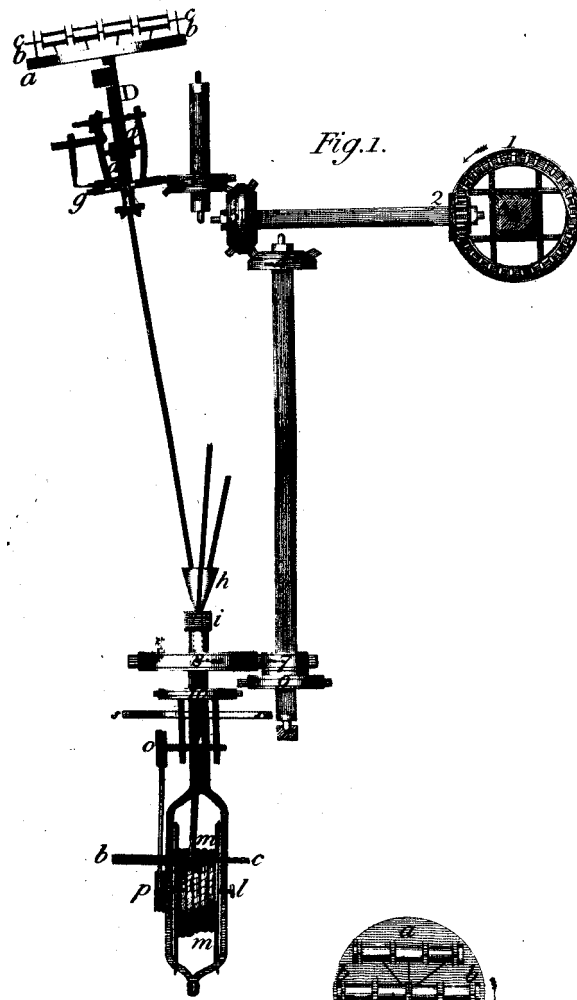
yarns, independently of the rest, similar to what I have described in the passage of the yarns through the strand-shaft; which may be done by one general pressure, the yarns being divided in layers, by the intervention of coarse woollen cloth, felt, or any other elastic or pliable substance, and in the transverse direction to those layers: they may be farther separated by the insertion or intervention of metal or wooden pins, or other divisions, which must have correspondent openings or grooves, either in the press-block, or place pressed against. It is only necessary farther to observe, that not any of the reels on which the white yarns are wound, and from which they unwind as they pass into the tar-kettle, should pass its yarns to two or more reels, as inconveniencies would thereby arise in regulating their manner of winding up; consequently, the white yarn should be on as many separate reels as the tarred yarn is proposed to pass on to at the same time. By these means, during the process of tarring, any requisite length of tarred yarn may be wound up, and cut off, and other reels may be substituted for the continuation of the process, for the residue of the yarn. In the passage of the yarns through the tar, it will be eligible to keep them separate, by passing them through distinct openings in the piece of metal usually called by ropers a *foot*; one or more of which is sometimes used

to keep the yarn under the surface of the tar, in its passage through the kettle. According to this method, much of the trouble requisite in warping, or laying out the desired length and number of yarns for making a strand of a rope, will be saved.

**OBSERVATIONS ON THE SCALE OF THE  
PLANS, &c.**

The figures themselves are not meant to give any decidedly fixed, or relative proportions of the different parts of each machine; but, as they may be carried into execution on the dimensions that are delineated, I shall observe, that all the figures, excepting 4, 5, 6, 7, and 8, are drawn on a scale of  $\frac{1}{8}$  of an inch to a foot; and the figures last mentioned on a scale of half an inch to a foot.

It must likewise be noticed, that the teeth or cogs on the wheels are, in some parts, omitted; the description and figures combined being deemed sufficiently explanatory without them. In Witness thereof, &c.



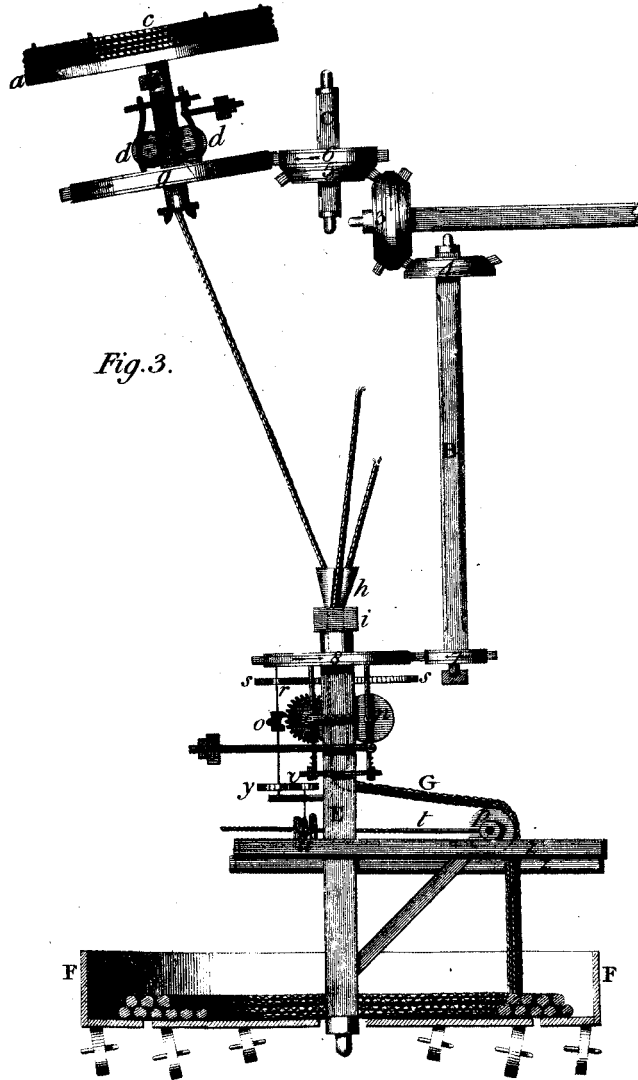


Fig. 3.

