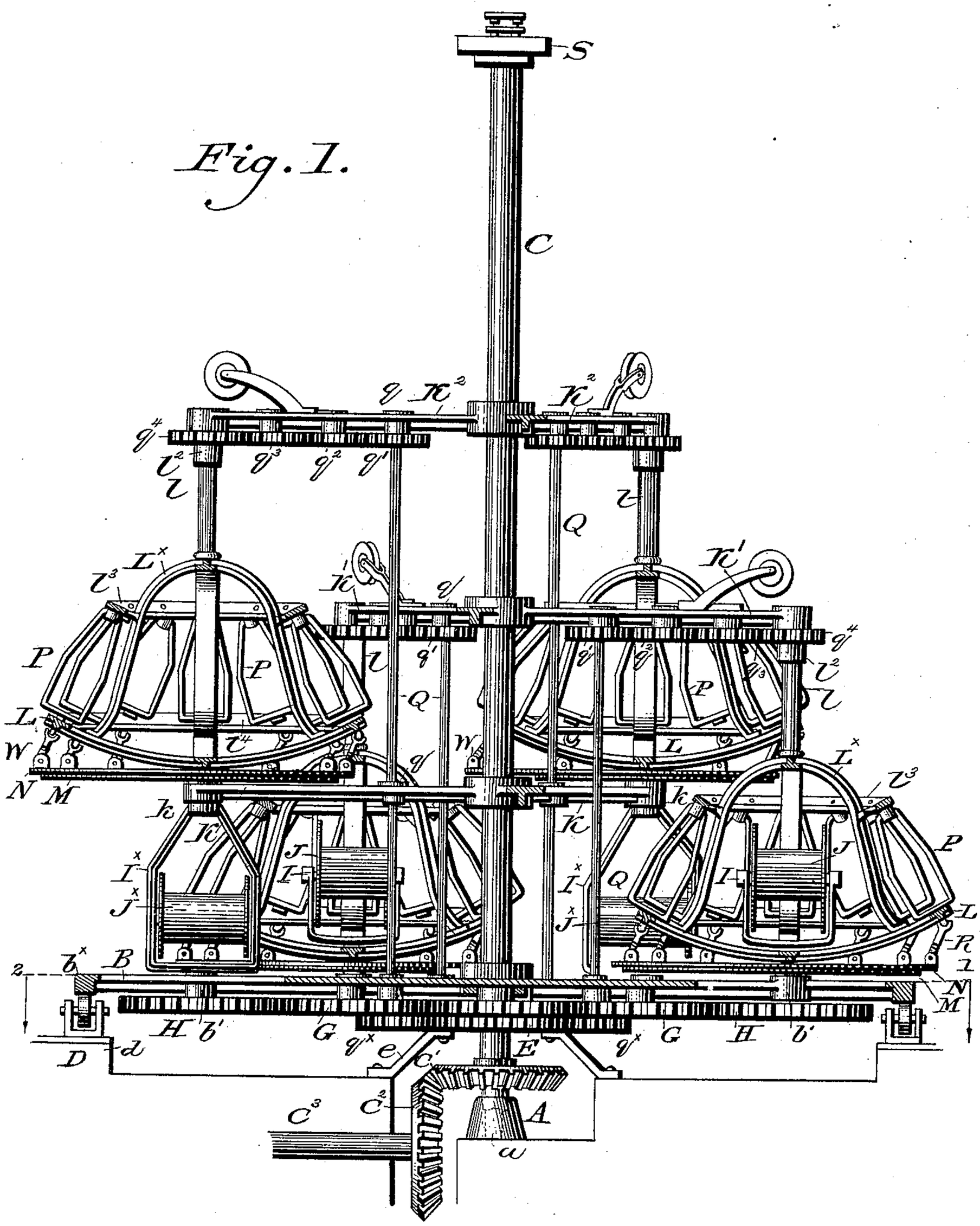
(No Model.) 4 Sheets—Sheet 1

W. HEWITT.

MACHINE FOR MAKING WIRE ROPE.

No. 390,967. Patented Oct. 9, 1888.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

W. HEWITT.

MACHINE FOR MAKING WIRE ROPE.

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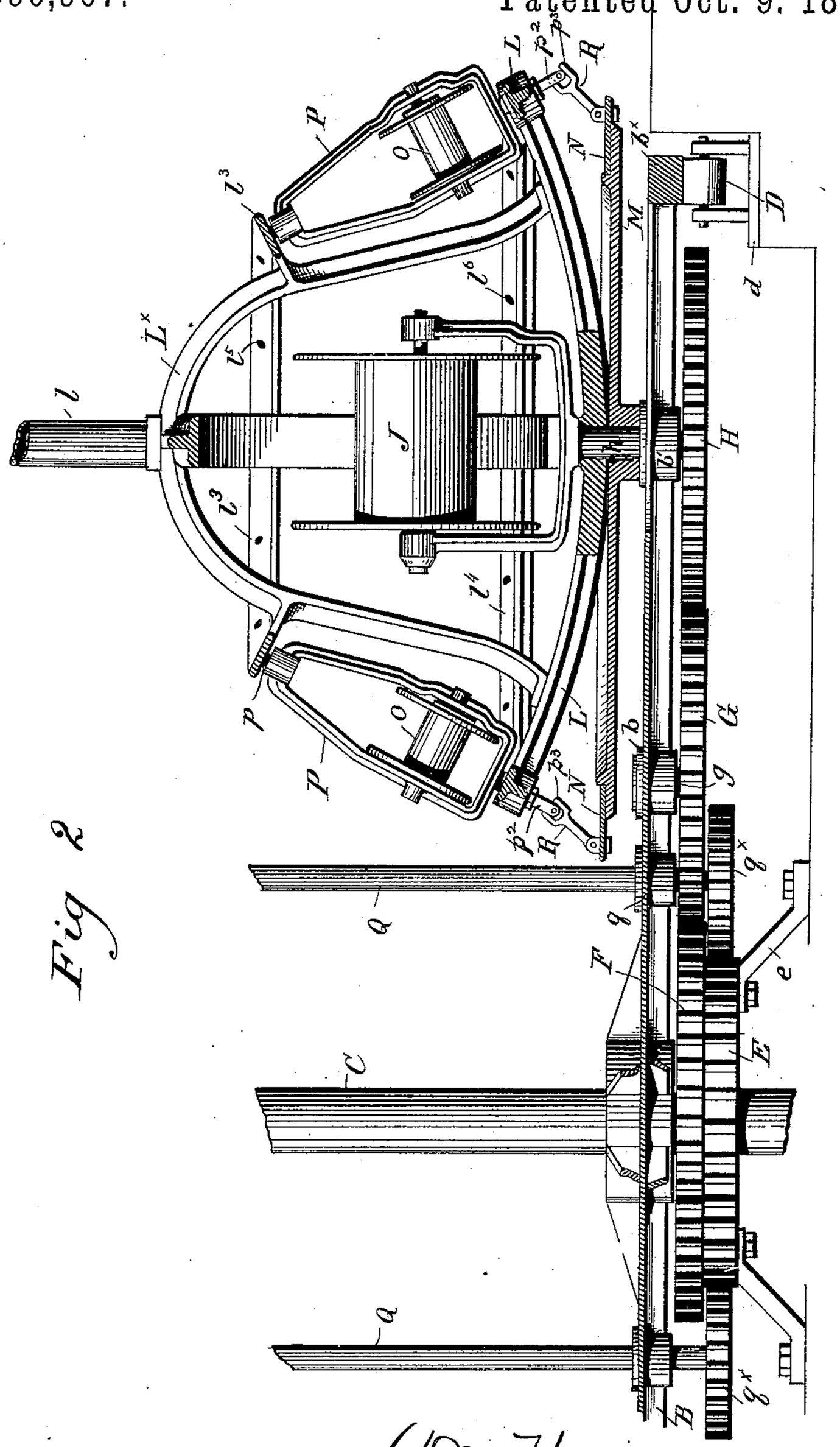

Fig 2

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(No Model.) 4 Sheets—Sheet 3.

W. HEWITT.

MACHINE FOR MAKING WIRE ROPE.

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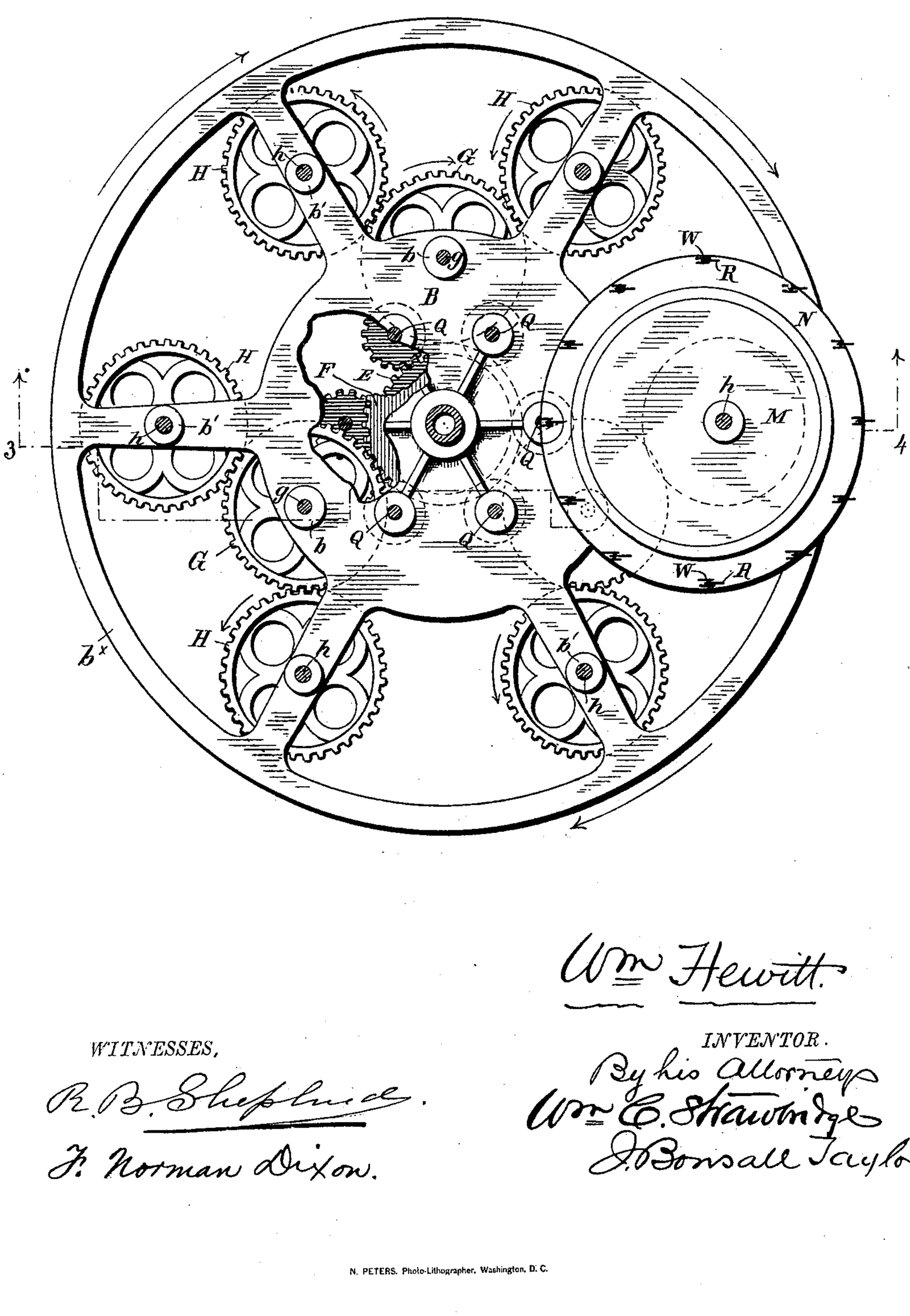
Fig 3



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(No Model.) 4 Sheets—Sheet 4.

W. HEWITT.

MACHINE FOR MAKING WIRE ROPE.

No. 390,967. Patented Oct. 9, 1888.

Fig. 7.

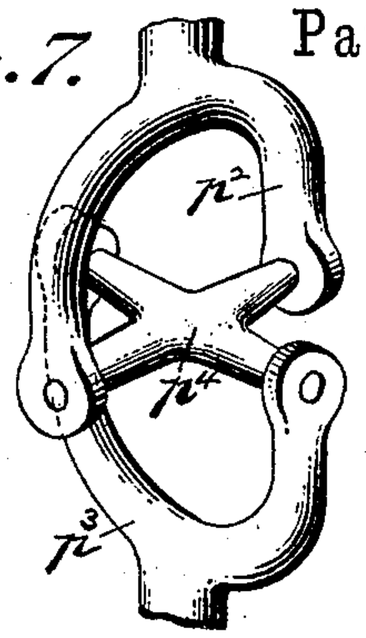


Fig. 5.

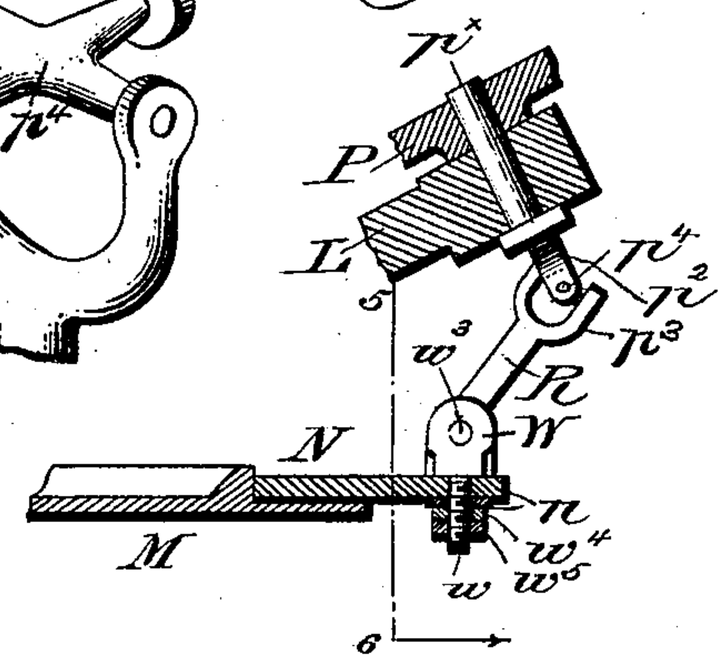


Fig. 6.

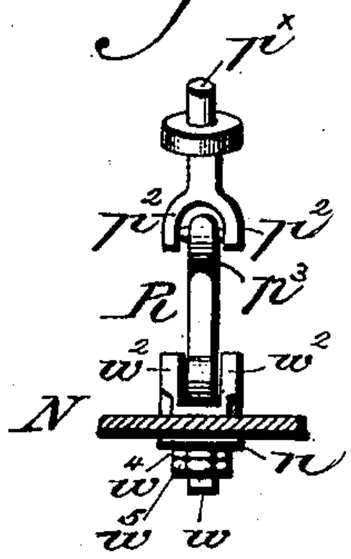
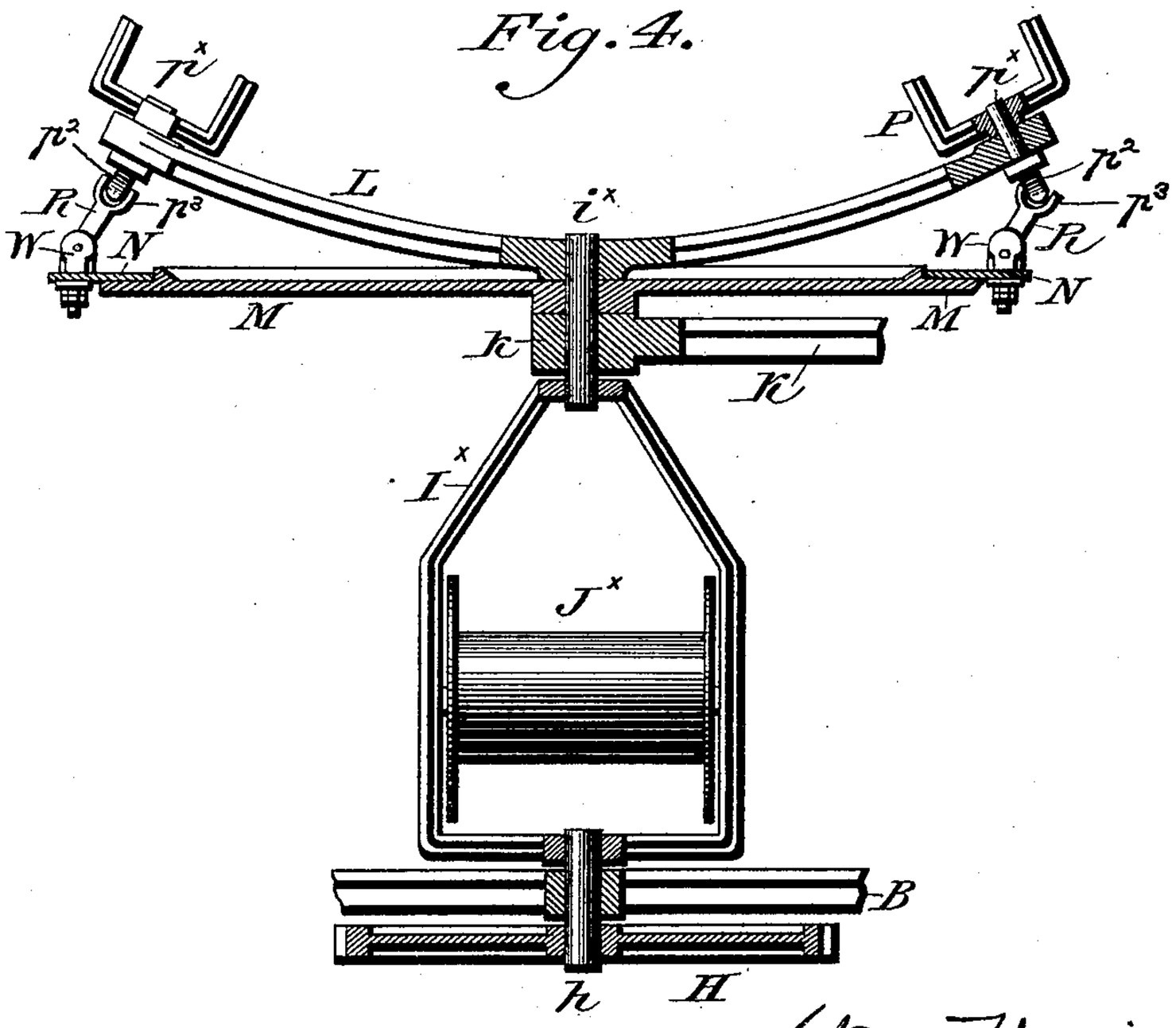


Fig. 4.



WITNESSES:

P. F. Eagle.

F. Norman Dixon.

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UNITED STATES PATENT OFFICE.

WILLIAM HEWITT, OF TRENTON, NEW JERSEY, ASSIGNOR TO THE TRENTON IRON COMPANY, OF SAME PLACE.

MACHINE FOR MAKING WIRE ROPE.

SPECIFICATION forming part of Letters Patent No. 390,967, dated October 9, 1888.

Application filed July 5, 1888. Serial No. 278,999. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HEWITT, a citizen of the United States, residing at Trenton, Mercer county, New Jersey, have invented certain Improvements in Machines for Making Wire Rope, of which the following is a specification.

My invention relates, in general, to a class of devices employed for making continuous ropes or cables of any desired length,—a machine embodying my invention being capable, in a single continuous operation, of laying or twisting a number of wires around a strand core to form a strand, and of laying or twisting a number of strands, similarly and as above formed, around a main core to form a completed rope or cable. The machine is, moreover, equally applicable for the manufacture of continuous ropes or cables from other material than wires.

My invention relates, in particular, to a machine for making wire rope invented by me and patented to me, as assignor to the Trenton Iron Company of Trenton, in and by Letters Patent No. 358,663, dated March 1, 1887.

The principal object of this improvement, as well as that of the machine upon which it is an improvement, is the construction of a simple, inexpensive, and automatically-operating machine in which wire rope or cable can be made from strands laid or twisted about a main core and composed of individual strand-wires laid or twisted about strand-cores, without either the strand wires or the strand-cores being in the act of laying or twisting subjected to any torsion or twisting with respect to their respective or individual longitudinal axes, and in which a large number of strand-formers can, by reason of their disposition with respect to each other and to the strand-core bobbins in connection with which they operate, be brought within a small diametric or cylindriform compass, in order to permit of the rapid revolution of the machine as an entirety.

A further object of this improvement is the provision of improved means for preserving in the flier frames which carry the strand wire bobbins of the strand formers, a given directional relationship throughout their revolution about the axes of the strand former of which they are members, the said improved means being of a character especially applicable to such flier frames of a strand former as are represented and described in my patent referred to, and as are, axially considered, disposed in a conically convergent series, so to speak, that is to say, in a series the flier frames of which are all inclined inward at their upper extremities toward the axis of the strand former of which they are members, so that the upper extremity of each flier frame is nearer to said axis than the lower extremity.

Machinery embodying a good form of my present improvements is represented in the accompanying drawings and described in this specification, the particular subject matter claimed as novel being hereinafter definitely specified.

In the accompanying drawings, Figure 1 is a front elevational view of the entire machine, sectional however in the plane of the dotted line 3–4 of Fig. 3, and sight being taken in the direction of the arrows upon said line. By the foregoing section one of the strand formers of the lower series and one of the strand formers of the upper series are removed, as are also the two strand core bobbins which operate in connection with said strand formers. For greater simplicity of illustration, each of the strand formers is shown in section, the rear portion only of each being shown; and all of the bobbins for the strand wires, the strand wires themselves, the strand cores, and the main core, are omitted. Fig. 2 is a fragmentary, elevational view, partially sectional, of a portion of the carrying and driving spider, of one of the strand formers of the lower series, and of a portion of the gearing for preserving in the carriers for the strand core bobbins a given directional relationship. In this view, for greater simplicity, but two of the flier frames of the strand former are represented. Fig. 3 is a plan of the carrying and driving spider and of the gearing for preserving in the carriers for the strand core bobbins a given directional relationship, the section being supposed in the plane of the dotted line 1–2 of Fig. 1. Fig. 4 is a fragmentary, central, sectional detail of one of the carriers for the independent strand core bobbins, and of the eccentric step, directing disk, and flier spider of the strand former which is in alignment

above said carrier, and which operates in connection therewith. Fig. 5 is a fragmentary elevational view, partly sectional, of one of the hinged links for connecting a flier frame with its directing disk. Fig. 6 is a fragmentary elevational view of the said hinged link, taken in planes of the dotted lines 5–6 of Fig. 5. Fig. 7 is a perspective detail of a convenient construction of universal joint between the flier shaft of a flier frame and the hinged link in connection with which said shaft operates.

Similar letters of reference indicate corresponding parts.

Inasmuch as my present improvements are applicable to the machine described in my patent No. 358,663, referred to, and inasmuch, moreover, as the machine represented in the drawings accompanying this application is not only such a machine as is represented in the said patent, but such a one also as embodies certain other features of construction represented and described in an application for patent for an improvement in machines for making wire rope, filed by me July 5, 1888; Serial No. 279,000,—it will be necessary, for the better understanding of the constructions in which my present improvements reside, to first describe herein, as briefly as may be, the machine represented in the accompanying drawings in which my improvements are embodied.

It is proper again to mention that, for greater clearness of illustration, I have omitted from the flier frames of the strand formers of the machine as represented in Fig. 1, the bobbins which carry the strand wires as well as the strand wires themselves, and have also omitted to represent either the main core or the strand cores, it not being necessary for a clear understanding of my improvements that such representation should be made.

In the drawings, A represents a main step or hub which is fixedly erected from a bed plate or upon the ground. Upon this main step is concentrically mounted for revolution a hollow or tubular vertically erected main shaft C, with which is fixedly connected for revolution (concentric with that of the shaft) a horizontally disposed combined carrying and driving spider B.

a is an aperture or passage through the main step, which communicates with the hollow interior of the main shaft. Through this aperture the main core is led to within the hollow interior of the main shaft.

The carrying and driving spider B is a radially-armed or wheel-like contrivance formed or provided with a peripheral carrying rim $b^{\times}$ which rests upon a series of circumferentially disposed carrying rolls D mounted upon fixed pillow blocks *d*. As in the case of the machine patented to me, this carrying and driving spider rests upon and revolves with respect to both the main step and the carrying rolls.

c' is a beveled pinion on the shaft, C, conveniently in proximity to the step upon which the said shaft rests, which is engaged with a driving beveled wheel c^2 mounted upon a shaft c^3 the rotation of which is, through the bevel gear c' c^2, imparted to the main shaft C.

E is an annular toothed rack, conveniently supported upon brackets *e* so as to be fixed with respect to the earth or the bed plate. The said rack encircles the main shaft and is concentric thereto. This rack is employed to drive the vertical shafts Q, as hereinafter explained.

F is what I term an "idler rack," supported upon or formed in connection with the fixed annular rack E. The said idler rack also encircles the main shaft and is concentric with said shaft and said fixed annular rack.

G are three idler pinions the shafts *g* of which are respectively contained in tubular bearings *b* formed in the carrying and driving spider. Each of these idler pinions is on the side thereof next the center of the machine in engagement with the idler rack F, so that all of the said pinions receive from said rack, in the revolution of the machine, a common movement of rotation.

The machine represented being one organized to possess six strand formers, each of the foregoing idler pinions is also on the outer side thereof in engagement with two adjacent carrier pinions H, six of which in all are employed, which are respectively affixed to the lower extremities of carrier spindles *h*, which respectively extend up through tubular bearings b' formed in the arms of the carrying and driving spider and the upper extremities of which are alternately provided with the yokes or carriers I and $I^{\times}$ for the strand core bobbins J and $J^{\times}$ respectively.

It will now be understood that, in the revolution of the machine, all of the carrier pinions, and consequently all of the carriers with which said spindles are equipped, receive from the idler pinion rotation in the same direction, or such a direction as is represented by the arrows applied to said pinions in Fig. 3, and that, therefore, the diameters of the idler rack, idler pinions, and carrier pinions being preferably all equal, the carriers for the strand core bobbins are in the revolution of the machine maintained in a given directional relationship with respect to each other and the points of the compass. Inasmuch as in the mounting of the machine all of the carriers for the strand core bobbins are preferably set with respect to their carrier pinions so as to present or trend in the same direction, it is obvious that by reason of the application of the above described gearing the said carriers will continue so to trend, and maintain their parallel disposition throughout the revolution of the carrying and driving spider. As, therefore, the strand core bobbins which are carried by said carriers or yokes, must of necessity maintain the position of their respective carriers, it is obvious that the several strand core bobbins will all trend in the same direction and maintain their parallel disposi-

tion throughout the said revolution of the said spider. This maintained disposition of the bobbins, therefore, insures against torsion in the strand cores which are wound upon said bobbins.

It is proper here to state that the idler rack, idler pinions, and carrier pinions, above described as a means for preserving a given directional relationship in the carriers of the strand core bobbins, are also shown and described in my pending application above referred to for a machine of a different organization from this.

It will now be understood in what manner the carrying and driving spider and the main shaft are together rotated, and also in what manner the directional relationship of the carriers to the strand core bobbins is preserved throughout the revolution of said carriers with the machine.

Fixedly connected with and rotated by the main shaft are a series of, in the form of machine represented, triarmed horizontally-disposed spiders, which I, for convenience of nomenclature, term the "minor spiders," and of which I designate the lowermost K, the middle K′, and the upper K^2,—the said letters, to avoid unnecessary enumeration, being respectively applied to the several arms which, in fact, compose the said respective spiders. The three arms composing the middle minor spider, K′, are disposed in line above three alternate arms of the six-armed carrying and driving spider B; and between the said three alternate arms of the carrying and driving spider and the three arms of the middle minor spider, K′, are supported, both for revolution about the main shaft and for rotation about their own axes, a series of three strand formers, which I term the "lower" series, and which contain, surround, or inclose, the strand core bobbins J, and are provided with a series of flier frames for strand wire bobbins, hereinafter described.

The three arms of the upper minor spider, K^2, and the three arms of the lower minor spider, K, are disposed in line above each other, and are, moreover, so disposed that each of the said three arms of each of the said minor spiders, K and K^2, are staggered with respect to, or interdisposed as regards radial disposition, between the three arms of the middle minor spider, K′. Between the arms of the upper and lower minor spiders are supported and sustained, both for revolution about the main shaft and for rotation about their own axes, a series of three additional strand-formers, which I term the upper series, and which are provided with a series of flier frames for strand wire bobbins, hereinafter referred to.

The strand core bobbins $J^\times$, which operate in connection with said upper series of strand formers, are not placed within the circle of the strand-wire bobbins of said strand formers, but are independently supported below the said strand formers upon the three arms of the carrying spider, which, in the mounting of the machine, are in line below the arms of the lower minor spider K, and which alternate with the other three arms of said carrying-spider, which, as already explained, support the three strand-formers of the lower series.

It is, of course, to be understood that this description is directed to the specific apparatus represented in the drawings, which, as stated, happens to be an apparatus employing six strand formers and capable of producing six strands only, but that it is perfectly possible to organize a machine operating upon the principle invented by me which shall be provided with a greater or a less number of strand formers than six.

It will now be apparent that there are in the machine under discussion three lower strand formers, which, for convenience, I designate the lower series, and three upper strand formers, which I similarly designate the upper series, and that by reason of the fact that all of the arms of the several minor spiders are of the same length and the arms of the carrying and driving spider, in effect, of the same length, each of the said strand-formers (which, as already explained, are supported between the said spiders) is, as will be understood by reference to Fig. 3, at the same radial distance from the main shaft, although with regard to circumferential disposition the said three strand formers of the lower series alternate with the three strand formers of the upper series.

Inasmuch as the three minor spiders are fixedly connected with the main shaft and the main shaft fixedly connected with the carrying and driving spider, the revolution imparted to the main shaft, in the manner hereinbefore explained, will occasion the revolution of all the strand formers with respect to the vertical axis of the main shaft, the said revolution being that necessary to bring to pass the laying or twisting of the strands, formed, as hereinafter explained, in the respective strand formers, about the main core, which is carried up through the main shaft.

As all of the strand formers are of the same construction, a description of one will suffice for all.

The strand formers represented are each provided with twelve strand-wire bobbins, so as to be adapted to lay twelve strand wires, about a strand core, to form a strand.

Each strand former is composed, essentially, of a rotatable housing or frame-work provided with a series of strand wire bobbins. I prefer to construct these housings each of a flier spider L connected with and supporting what I term a "tripod-frame," $L^\times$, which sustains a hollow vertical strand former shaft, l, the upper extremity of which is journaled in an arm of a minor spider and provided with a strand-laying head, l^2. In the machine represented I employ twelve strand wire bobbins.

There being, as will now be understood, six

strand core bobbins in all, one operative in connection with each strand former, all upon practically the same level, it will be apparent that, inasmuch as three of these strand core bobbins are operative with the three strand formers which constitute the upper series, these three strand core bobbins must be carried by the three yokes or carriers $I^{\times}$, which are each independent carriers and not like the other three yokes or carriers I inclosed within housings and encircled by the flier frames of the strand formers of the lower series. These three independent yokes or carriers $I^{\times}$ are continued up above the gudgeons of their strand core bobbins $J^{\times}$, and provided each with a hollow carrier shaft $i^{\times}$, Fig. 4, which passes through a bearing k formed in an arm of the lower minor spider K, upon which arm one of the strand formers of the upper series rests or has bearing. The three independent strand core bobbins $J^{\times}$, therefore, operate respectively in conjunction with the three strand formers of the upper series of strand formers, which, as already stated, are intermediate between the strand formers of the lower series.

The strand cores which are carried upon the independent strand core bobbins $J^{\times}$ are led up through the axial apertures of the carrier shaft $i^{\times}$, and thence up through the strand former shafts l of the strand formers in alignment above said shafts to the strand laying heads l^2, each of which, as is usual, contains a die.

M are horizontally disposed eccentric steps, which respectively operate in connection with the respective strand formers, the three steps which operate in connection with the lower series of strand formers resting or being stepped upon the bearings b' in the carrying and driving spider, as shown in Fig. 2, and being keyed to the carrier spindles h of the carriers I which operate in connection with said lower series of strand formers, and the three disks which operate in connection with the strand formers of the upper set resting or being stepped upon the bearings k of the lower minor spider K, as shown in Fig. 4, and being keyed to the carrier shafts $i^{\times}$ which project upwardly from the carriers $I^{\times}$ of the independent strand core bobbins $J^{\times}$.

Each of the foregoing eccentric steps M is eccentric with respect to the spindle h or shaft $i^{\times}$, as the case may be, to which it happens to be keyed, and each is equipped with an annular ring N, which I term a "directing disk," and which floats, rides, or rotates upon it.

The flier spiders of the lower series of strand formers which are stepped upon the eccentric steps of said strand formers, are free to rotate with respect to the carrier spindles h as gudgeons with respect to which they are concencentrically mounted. The flier spiders of the upper series of strand formers are similarly disposed and free to rotate with respect to the carrier-shafts $i^{\times}$.

It having been explained that the carriers of the strand core bobbins maintain a given trend and directional relationship throughout their revolution about the main shaft, it will be readily understood that the eccentric steps, which, as stated, are, through the carrier spindles and carrier shafts, respectively connected with said carriers, are maintained in a similar given trend and directional relationship throughout their revolution about the main shaft.

The tripod frame of each strand former housing is conveniently equipped with an upper circular bearing ring l^3 and with a lower circular bearing ring l^4, the said two rings being preferably disposed in parallel horizontal planes at a distance apart about equal to the length of the flier frames. The upper ring l^3 is provided with a series of holes or perforations l^5, and the lower ring l^4 with other holes or perforations l^6 in alignment with those of the upper ring, and the said two series of perforations serve as or constitute bearings, respectively, the upper for the tubular gudgeons p which extend upwardly from the flier frames P, and the lower for the flier shafts $p^{\times}$ which extend downwardly from said flier frames. As will be apparent, therefore, the flier frames rest solidly upon the lower ring l^4 of their flier spider, being preferably formed with a broad bearing base, as shown in Fig. 5. By virtue of this construction the entire weight of the fliers and their contained bobbins and strand wires is superimposed direct upon and borne by the flier spider and its lower ring, a construction insuring both stability and durability.

The tripod frame of each strand former is, as stated, conveniently equipped to maintain a series of radially disposed flier frames, carriers, or revoluble housings, P, for carrying the strand wire bobbins O, shown in Fig. 2. Each of the flier frames of said strand-wire bobbins is preferably inclined inwardly from the vertical, as represented in the drawings, so that the various strand-wires led from the strand-wire bobbins will pass in a direct line through the upper tubular journals, p, of the flier frames up to the strand-laying heads l^2, with which the strand formers are, as stated, respectively provided.

In order to effectuate the laying or twisting of the strand-wires about the strand cores, it is, of course, essential to revolve the strand-formers about their respective axes, and this I accomplish by providing a series of vertical shafts, Q, preferably corresponding in number with the number of strand formers, and journaled in boxings q, respectively formed in the minor and in the carrying and driving spiders which shafts are below said last named spider equipped with driving pinions $q^{\times}$ which engage with the fixed annular toothed rack E. It is obvious that, as the said carrying and driving spider is revolved, the said driving pinions $q^{\times}$ will be rotated by their revolutionary engagement with the said fixed rack E, which latter, as stated, is concentric with the axis of rotation of the carrying and driving

spider, and that therefore all of the said shafts Q will be simultaneously rotated.

Three of the shafts Q have vertical extension to the upper minor spider K^2, and three of them but to the middle minor spider K'. The three longer shafts are employed to occasion the revolution about their own axes of the three upper strand formers. The three shorter shafts are employed for a similar purpose in connection with the three lower strand formers.

Each vertical shaft Q is at its upper extremity provided with a driving toothed wheel, q', which, through the intervention of idler toothed wheels q^2 and q^3 journaled upon the minor spiders, occasions the rotation of a driven toothed wheel, q^4, conveniently mounted upon the strand former shaft l of the particular strand-former in connection with which said train of toothed wheels operates, and thereby occasions the revolution of said strand-former about its own axis.

It will now be understood in what manner the strand formers are revolved about the main shaft, and also, in such revolution, rotated about their own axes.

I have heretofore mentioned the importance of avoiding torsion in the strand-wires. In order to such avoidance it is essential that the strand-wire bobbins, which, as stated, are grouped radially and revoluble about or with respect to the strand core bobbins, should be so controlled that they shall always, throughout their revolution about the axis of the strand-formers which contain them, bear a predetermined directional relationship to said strand core bobbins, and consequently also to the points of the compass. This result I accomplish by prolonging the flier shaft $p^\times$ of each flier frame below its bearing l^6 in the lower bearing ring l^4 of the flier spider which carries it, and by connecting, by means of a universal joint of any preferred character, the lower extremity of said prolonged shaft to the upper extremity of a hinged or jointed link R, the lower extremity of which latter is, for convenience in its application and removal, hinged or pivoted to a link hub W, the depending stem w of which passes through a bearing n formed for it in the directing disk N which operates in connection with the strand former with a flier frame of which said hub and link connection operates. The gist of this portion of my invention residing in the provision of substantially such jointed, hinged, or pivoted directing links as the foregoing, for the maintenance of a predetermined directional relationship in the flier frames of a series of convergently inclined flier frames,—it is apparent that it is immaterial how said hinged links as such are formed and applied. A good way of forming and of conveniently applying them is that shown in Figs. 5, 6 and 7 of the drawings, in which the lower prolonged extremity of the flier shaft $p^\times$ is shown as terminating in a fork p^2, and in which the upper extremity of the hinged link R is shown as similarly terminating in a fork p^3 which is connected with the fork p^2 by means of the journal-ended cross-shaped bar p^4 being in effect a double pivot pin with respect to which both forks are journaled and serving to establish between said forks, and consequently between the flier shaft and the hinged link, a universal joint or connection,—and in which also the hub W is also provided with check pieces w^2 through which a pivot pin w^3 passes, and which are formed to present a basal bearing surface or shoulder by the aid of which the hub proper rests upon the directing disk, the stem w of said hub being, below said disk, retained and journaled with respect thereto by the application of a washer w^4 retained by lock nuts w^5 applied to threads formed upon said stem. Other forms of jointed links formally different from those set forth, but adapted to secure the result of a jointed connection between the flier frames and the directing disk may, however, be resorted to.

It is obvious that through the operation of the directing disks and the hinged links aforesaid, the eccentric steps serve to maintain throughout the revolution of the strand formers upon their own axes, a given trend or relation in all of the hinged links and, consequently, in all of the flier frames of the strand wire bobbins with which said links are, as stated, through their flier shafts, connected, and with which said strand formers are provided.

From the foregoing relationship of parts it results that each strand wire is presented to its strand laying head without torsion.

It is of course obvious that it is inconsequential in what position the flier frames and their contained bobbins are originally set, as they must necessarily maintain their individual directional relationship to the points of the compass throughout their individual revolutions about the axis of the strand former of which they are members. Thus, therefore, torsion of the strand-wires is completely avoided, whether the said strand wire bobbins of given strand formers be all, as represented in Figs. 1 and 3, originally set parallel, or whether the several strand wire bobbins of a given strand former are originally set at varying angles.

As already mentioned, the three strand formers constituting the lower set are provided with strand core bobbins which are housed within the frame-work, frame, or housing of said strand formers, as a reference to Figs. 1 and 2 will make clear; while the three strand formers which constitute the upper set, operate in conjunction with independent strand-core bobbins which are supported direct upon the carrying and driving spider and axially below the said strand formers. All of the said strand-core bobbins are, however, connected with the carrier spindles h of the carrier pinions H in the manner already fully explained.

The object of the foregoing arrangement of the carriers is to avoid lifting the heavily laden strand core bobbins higher than is actu-

ally necessary, and to translate the weight of such strand core bobbins directly to the carrying and driving spider, and as low down as possible in the machine. Incidentally, moreover, this arrangement permits of the bringing of the entire machine within a smaller compass, so that a greater number of revolutions per minute can be obtained.

S is a head boxing of any preferred character and conveniently of the construction represented and described in my patent referred to.

Traction is, of course, exerted upon the main core and the various strands to draw them, when laid together as a completed cable, through the die of the head boxing, the rapidity of traction measurably determining the amount of twist both in the rope and in the strands. The strand-laying heads are conveniently made of substantially the same construction as the rope-laying head.

As will be perceived, the machine is adapted to make any of the usual kinds of rope. The strand cores, which are made outside of the machine and wound upon the strand core bobbins, which are then applied to the machine, may be either single wires or cords, about which six wires may be laid to form a seven-wire-strand rope; or the strand cores may be of three wires previously twisted together, about which nine wires may be laid to form a twelve-wire rope, or the strand cores may be of seven wires previously twisted together (six laid around one) about which twelve wires may be laid to form a nineteen-wire-strand rope; or the strand cores may be of seven wires twisted together, about which six seven-wire strands may be laid to form a "strand-rope" as it might be called, six such strand ropes being then laid together to form a larger rope.

It is preferable to drive the strand formers from above rather than from below, the mode represented in the drawings being a good one. Other means, however, of imparting rotation to said strand formers may, if desired, be resorted to.

It is apparent that, so far as my invention is concerned with the jointed or hinged link contrivances described, instead of resorting to the arrangement of carrier pinions, idler pinions, and idler rack, for preserving a given directional relationship in the carriers for the strand core bobbins, which devices are described in my pending application already referred to,—such means as are set forth in my patent referred to may be substituted in their stead. It is also apparent that my jointed or hinged link contrivances referred to are equally applicable in connection with an inclined flier frame itself of a construction different from that shown in the accompanying drawings, or applied in connection with and forming a member of a strand former of a different construction and mode of application from that of the strand formers herein represented and described. It is obvious, moreover, that it is inconsequential by what means the flier frames are maintained in their inclined position. The circular bearing rings represented and described, are perhaps the most convenient devices to secure the inclined maintenance of the flier frames, but the said frames may be otherwise supported or otherwise journaled at will.

Having thus described my invention, I claim:—

1. The combination, of a central and revoluble main shaft;—means for operating said main shaft;—a lower series of strand formers radially disposed at predetermined distances apart around said shaft, supported from said shaft near its base, and each composed of a revoluble open-centered frame containing a series of radially-disposed flier frames for carrying strand-wire bobbins,—a first series of yokes or carriers for a series of strand core bobbins, each disposed within the open center of the revoluble frame of a given former of said aforesaid lower series of strand-formers, and each directly surrounded or encompasssed by the flier frames of said strand former of said lower series;—an upper series of strand-formers radially disposed at predetermined distances apart around said shaft, supported therefrom upon a level higher than that of the lower series, alternating with regard to circumferential distribution with the strand-formers of said lower series, and each composed of a revoluble frame containing a series of radially disposed flier frames for carrying strand-wire bobbins;—a second series of single or separate and independent yokes or carriers for strand-core bobbins corresponding in number with the strand formers of the said upper series, in line below said formers, but not centrally disposed therein, and upon the level of the strand-core bobbin carriers of the first series of carriers which are disposed within the centers of and operate in conjunction with the lower series of strand formers;—means for preserving in said carriers for said strand core bobbins, a given directional relationship throughout their revolution;—an eccentric step connected with each yoke or carrier of both series;—a directing disk operating in connection with each eccentric step;—and jointed links, in series corresponding with the series of the flier frames of each strand former, applied to said directing disks,—substantially as and for the purposes set forth.

2. The combination, with a main shaft,—of two series of strand formers supported from said shaft, grouped around it on different levels, and successively alternating or staggered;—a series of separate and independent carriers for strand core bobbins, corresponding in number and in radial disposition with the several strand formers, together composing the said two series, but all placed upon a common level, being substantially that of the lower of the two series of strand formers;—means, substantially such as set forth, for preserving in said carriers for said strand core bobbins a given directional relationship through-

out their revolution;—an eccentric step connected with each yoke or carrier of both series;—a directing disk operating in connection with each eccentric step;—and jointed links, in series corresponding to the series of the flier frames of each strand former, applied to said directing disks,—substantially as and for the purposes set forth.

3. The combination to form a strand former for a wire rope machine,—of a rotatable housing or frame;—a series of convergently inclined flier frames, for carrying strand wire bobbins, carried by and journaled in said housing, and provided with flier shafts extending through their bearings in said housing;—a carrier for a strand core bobbin the carrying shaft or spindle of which is in alignment with the axis of revolution of said housing;—an eccentric step fixedly connected with the spindle or shaft of said carrier;—a directing disk applied to said step;—pivoted link hubs, corresponding in number with the number of flier frames, applied to said directing disk;—and hinged links pivoted to the flier shafts and connected with the hubs,—substantially as set forth.

4. The combination with a rotary main shaft, of a number of strand formers disposed radially around the said shaft, means for imparting separate rotation upon their axes to the said strand formers as they move around the axis of the said shaft in the revolution of the latter, a series of inclined flier frames disposed radially upon each of the said strand formers, an eccentric step in proximity to each of said strand formers, a directing disk operating in connection with each eccentric step, jointed links, in series corresponding with the series of the flier frames of each strand former, applied to the said flier frames and directing disks, and means for preserving in said eccentric steps a given directional relationship throughout their revolution with the main shaft, substantially as described.

5. The combination with a rotary main shaft, of a number of strand formers disposed radially around the said shaft, means for imparting separate rotation upon their axes to the said strand formers as they move around the axis of the said shaft in the revolution of the latter, a series of inclined flier frames disposed radially upon each of the said strand formers, yokes or carriers for strand core bobbins corresponding in number with the strand formers, means for preserving in said yokes or carriers a given directional relationship throughout their revolution with the main shaft, an eccentric step connected with each yoke or carrier, a directing disk operating in connection with each eccentric step, and jointed links, in series corresponding with the series of the flier frames of each strand former, applied to the said flier frames and directing disks, substantially as described.

In testimony whereof I have hereunto signed my name this 2d day of July, A. D. 1888.

WILLIAM HEWITT.

In presence of—

J. BONSALL TAYLOR,

F. NORMAN DIXON.