A.D. 1804 . . . . . N° 2769.

Tambouring Fabrics.

DUNCAN'S SPECIFICATION.

TO ALL AND SUNDRY TO WHOM THESE PRESENTS SHALL COME, JOHN DUNCAN, Manufacturer, in Glasgow, sends greeting.

WHEREAS the King's most Excellent Majesty, by Letters Patent under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date the Thirtieth day of May, in the forty-fourth year of his reign, gave and granted unto the said John Duncan, his executors, administrators, and assigns, and every of them, by himself and themselves, or by his and their deputy or deputies, servants or agents, or such others as might make use of, exercise, and vend his Invention of "**A NEW AND IMPROVED METHOD OR MEANS OF TAMBOURING OR RAISING FLOWERS, FIGURES, OR OTHER ORNAMENTS UPON MUSLINS, LAWNS, AND OTHER COTTONS, CLOTHS, OR STUFFS, OR UPON SILK, LINEN, OR WOOLLEN CLOTHS OR STUFFS, OR UPON CLOTHS OR STUFFS COMPOSED PARTLY OF SILK, FLAX, COTTON, OR WOOLEN,**" within that part of the United Kingdom of Great Britain and Ireland called England, the Dominion of Wales, and Town of Berwick-upon-Tweed, in such manner as to him, the said John Duncan, his executors, administrators, and assigns, should, in his and their discretion, seem meet; and that the said John Duncan, his executors, administrators, and assigns, should and lawfully might have and enjoy the whole profit, benefit, commodity, and advantage, from time to time coming, growing, accruing, and arising by reason of the said Invention, for and during the term of years therein mentioned; to have, hold, exercise, and enjoy the said licence, powers, privileges, and advantages therein granted or mentioned to be granted to the said John Duncan, his executors, administrators, and assigns, for and during and unto the full end and term of fourteen years from the date of the said Letters

Patent, and immediately ensuing, and fully to be complete and ended, according to the Statute in such case made and provided; in which said Letters Patent is contained a proviso that if the said John Duncan should not particularly describe and ascertain the nature of his said Invention, and in what manner the same is to be performed, by an instrument in writing under his hand and seal, and cause the same to be inrolled in His Majesty's High Court of Chancery within one calendar month next and immediately after the date of the said Letters Patent, that then the said Letters Patent, and all liberties and advantages whatsoever thereby granted, should utterly cease, determine, and become void, as by the said Letters Patent, relation being thereunto had, will more fully and at large appear.

NOW KNOW YE, that I, the said John Duncan, in compliance with the said proviso in the said Letters Patent contained, and the purport and true intent and meaning thereof, and of His Majesty's said most gracious intentions, do by this instrument in writing under my hand and seal, duly executed, describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, as follows, that is to say:—

The Tambouring upon cloth has hitherto been performed solely by manual labour, but as by this mode the operator can employ only one needle or hook, the operation is tedious. To enable one person to work with a number of needles or hooks at the same time, and, consequently, to perform a much greater quantity of work within a given period, is the object of the present Invention. In order to produce work of good quality of the various patterns required, the operator is enabled by this Invention, first, to vary the form of his pattern at pleasure in every direction required; secondly, to perforate the cloth with the needles or hooks, and bring them back, without injuring the fabric; thirdly, when the needles have perforated the cloth, to supply them with the thread or yarn which composes the pattern previously to their being brought back; and, fourthly, when a pattern is completed, to make fast the ends of the yarn. To shew the machinery necessary for effecting these operations, Drawings have been made of the different parts composing the machine by which they are accomplished, to which reference being made the machinery used for each of the four purposes stated above will appear, and from thence it will be evident how the whole are connected so as to produce the effect required.

First, to form any pattern, and to vary the same at pleasure in every direction required. If every needle can be brought opposite to every point in the cloth meant to be perforated, the object will be attained, for the needles being made to perforate successively every point required, any given pattern

may be produced. Now, as in this Invention it is only proposed at one and the same time to work a number of figures similar to each other, if the needles or hooks are placed parallel to each other, and at right angles with the superficies of the cloth, at any fixed distance from each other, so that the whole may move together, while the cloth remains stationary, then, if one needle or hook, by perforating in the successive points required, makes any given figure, every other needle will make one similar, or, if the whole needles or hooks remain relatively stationary, and the motion is communicated to the cloth, the same effect will be produced. I have tried both these plans, but I prefer the last, because the effect is the same, and the machinery is much more simple in construction and easier to work, for if the needles or hooks move, the machinery which supplies them with thread must also move in the same direction, and it is much easier to move the cloth than these two parts of the machinery, which, for the sake of steadiness, must be stout and heavy. I shall therefore describe the mode of producing patterns by moving the cloth.

The mechanical theorem upon which this motion depends is thus expressed in the first and second corollaries to Sir Isaac Newton's Third Law of Motion, as given in Motte's translation of Newton's Principia, in the edition published in the year One thousand eight hundred and three, pages 15 and 16, which corollaries are as follows:—Corollary 1st. "A body by two "forces conjoined will describe the diagonal parrallellogram in the same time "that it would describe the sides by these forces apart." Corollary 2d. "And hence is explained the composition of any one direct force out of any "two oblique forces, and, on the contrary, the resolution of any one direct "force into any two oblique forces, which composition and resolution are "abundantly confirmed from mechanics." Which theorem I have applied to the purposes of this machine in the following manner:—The cloth to be tambboured is stretched in a vertical position between two cylinders placed parallel to each other in an oblong frame of cast-iron or other convenient substance, which slides freely up or down at pleasure in another frame. This last frame slides freely from right to left, or vice versa, carrying the other frame along with it, so that either a vertical or horizontal motion may at pleasure be communicated to the cloth, and when both are communicated at the same time the cloth moves in an oblique direction, the obliquity of which varies in proportion to the quantity of motion given to each of the two direct forces. By these means every rectilineal or curvilineal figure may be produced, and, consequently, every pattern required. The construction of these frames which produce this effect will appear from the Drawings Nos. 1 and 2 hereunto

annexed, which are transverse vertical sections of the machine; and in order to make these and the succeeding Drawings more intelligible, I have hereunto annexed two Drawings, marked A and B, which are representations of the wood-work which supports and connects the whole machine, to which I have referred in describing the different parts of the machine, in order to shew in what directions the sections are made. The one of these Drawings, viz^{t}. A, is an elevation of the wood-work as viewed from one side of the machine; and in speaking of the sides of the machine I refer to the situation in which the operator is placed at work, which is in front of the machine. Upon this Drawing are marked and enumerated the different parts of which one side frame is composed. On the opposite side of the machine is another side frame, exactly similar. Drawing B is an elevation of the wood-work as viewed from the front of the machine, or place where the operator sits at work. The different section lines in these two Drawings refer to the different Drawings to be afterwards described, and shew in what direction the machine is supposed to be cut for the purpose of illustration.

I now proceed to describe the cloth frames and their motions, which are illustrated by Drawings No. 1 and 2, hereunto annexed. Drawing 1st. Fig. 1st is an elevated transverse section of the machine, cut perpendicularly across in front of the cloth frames. The four A^{s} in Figure 1st shew the outer or horizontally moving frame, at each of the four corners of which there are projections from the upper and lower bars in an horizontal line, distinguished by four B^{s}, so that the frame may be moved from side to side, as after mentioned. These projections pass through eyes or bushes in or attached to the second and third side rails of the wood-work. By these means the frame, which is distinguished by four A^{s}, is supported at each corner, and slides freely from side to side when required. It is moved from side to side by turning the male screw E, which turns in the female screw F, fixed to the lower bar of the frame. This gives the horizontal motion. What is represented in this frame by K, at opposite corners, is the inner or vertically moving cloth frame, which slides freely up or down within the horizontally moving frame above described. The vertical motion of this vertically moving cloth frame is produced by the piece of metal M, passing through two grooves in the pillars N, N, fixed to the lower bar of this inner or vertically moving frame. In the centre of the said piece of metal M, which is swelled for the purpose, is a female screw, worked by the male screw L, by which the said piece of metal M is elevated or depressed at pleasure, and carries the inner or vertically moving frame K along with it. The ends of the said piece of metal M slide freely in the grooves in the said

pillars N, N, so as not to impede the lateral motion of the outer or horizontally moving frame above described, when acted upon by the screw E. Q is a cylinder resting on the pivots R, R, at each end thereof, which pass through grooves made to receive them in the upper part of the two side bars of the outer or horizontally moving frame. Round this cylinder pass two cords S, S, near to each extremity thereof, and one end of each chord is fixed to the upper bar of the said inner or vertically moving frame, and the other end of each of the said cords, after passing over a pully fixed near to either extremity of the lower bar of the said outer or horizontally moving frame, is made fast to the lower bar near to either extremity of the said inner or vertically moving frame. These chords serve the purpose of what some mechanics call bridles, their use being to regulate the motion of the said inner or vertically moving frame so that the same may rise or sink equally. T, T, are two counterpoises, suspended by cords from the cylinder Q, to balance the weight of the said inner or vertically moving frame, so that it may be moved with equal ease, whether ascending or descending. U, U, are two cylinders parallel to each other, turning, when required, upon pivots in the said inner or vertically moving frame. Between these the cloth is stretched, and is rolled from the one upon the other as often as is necessary, so as to roll round upon one cylinder the cloth upon which the pattern required has been worked, and to present to the needles or hooks the cloth upon which the pattern remains to be worked. On the end of each cylinder is a ratchet wheel V, with a catch, to keep the cloth to a proper degree of tension. These cylinders must be very true; and to prevent warping, to which all wood is more or less liable, I generally make them of block tin, and hollow in the middle. They have each a longitudinal groove, to admit a small wooden shaft, to which is fixed a piece of stout cloth. To the other end of this cloth is fixed the fabric upon which the pattern required is to be worked. The selvedges or edges of the cloth are stretched laterally by the plates or stretchers W, W, in which are a number of sharp pins represented by dotts, on which the selvedges of the cloth are fixed. The ends of the plates or stretchers W, W, slide in the boxes X, X, in which are a number of holes to admit pins to prevent the plates or stretchers from yielding when the cloth is drawn sufficiently tight. Y, Y, are two strong bars across the machine, fixed firmly to the outer or horizontally moving frame at each side thereof. Between these bars is another bar Z, in which is a hole opposite to the point of each needle or hook. This bar Z is fixed to the second side rails of the wood-work described above by the supporters D, D. The use of these three bars is to prevent the cloth from yielding by its own elasticity when pierced by the needles or hooks. The cloth is stretched between the two

cylinders passing in front of these three bars. By these means the two motions, horizontal and vertical, are communicated to the cloth, and the combination of these two motions, by means of the said screws, in different proportions, produces every other motion required. In said Drawing No. 1 are given supplementary figures, which shew more clearly the shape and construction of some of the different parts. Figure 2nd and 3rd are front views of the eyes or bushes C, as constructed by me, but which admit of various modes of construction. Fig. 4th is a plan of the male horizontal screw E, and female screw F, as they will appear when the eye is perpendicular over them, the box which contains the female screw F being fixed to A, the lower bar of the outer cloth frame. The screw E revolves upon its own axis in the pieces G, G, which are screwed fast to the breast beam *a*, which does not appear in Figure 1st, being there supposed to be cut away, but which will appear clearly in Drawing 2d, Fig. 9. In Fig. 4 it is represented as transparent, to shew the shape of G, G, which are screwed to its lowest edge. On the end of the screw E is a bevel wheel H, of thirty-two teeth, worked by a bevel pinion I of sixteen teeth, which is turned by means of a small handle by the operator's right hand, when a lateral motion of the frame is required. The pinion is fixed on a perpendicular spindle, the supporters of which are also fixed to the upper and lower sides of the breast beam *a*, next to the cloth. Fig. 5 is an elevation of this spindle, seen from the back of the machine. Fig. 6 is a profile section of the breast beam *a*, with the upright screw L and its supporters, shewing how they are fixed to the beam *a*. M also appears here in profile. On the screw L is fixed the spur wheel O of thirty-two teeth, turned by the pinion P of sixteen teeth. This pinion is worked by the operator's left hand, where a vertical motion of the frame is required. Fig. 7 is a profile section of the two frames shewn in Fig. 1, cut nearly in the middle, to the different parts of which I have attached the same reference letters as in Fig. 1st, as the one merely shews the same machinery in profile, which the other does in front. The shape of all the parts is clearly shewn in the Drawings, so as to be obvious to a good mechanic from a careful inspection of the Drawings. Fig. 8 is a plan of one of the four stretcher boxes mentioned in Fig. 1st, as seen from above, with the screws which connect them with the upper and lower bars of the inner frame.

I next proceed to describe Drawing 2, Fig. 9, hereunto annexed. Fig. 9 is a vertical transverse section of the machine cut perpendicularly across behind the cloth frames in the direction of the reference section line mentioned in Drawing A. It is chiefly intended to shew how the horizontal screw E and the vertical screw L appear when viewed from behind, and as a further illustration of the way in which they and their supporters are fixed to the breast

beam *a*, which is here visible. A small part of the lower bar of the outer frame, distinguished by four A^s, is represented as transparent, to shew the horizontal screw E, and box with female screw, behind it, which would otherwise be hid. All the reference letters in this Drawing are the same as in the former No. 1; this being merely a view of the same machinery behind which Fig. 1. represents as seen in front and Fig. 7 in profile section. In Fig. 10 in this Drawing the screws E and L, and machinery connected with them, are again shewn as they would appear to an eye placed perpendicularly over them. Fig. 11 shews part of the outer and inner cloth frames, and how the grooves which connect them are constructed. Here, too, the eye is placed immediately above the object. K is part of the upper or under bar of the inner frame (for both have the same shape). A is the side bar of the outer frame, seen in section. Fig. 13 shews how the end of the cross bar Y is fixed to A, the side bar of the outer frame, which appears in section, the eye being still above it. K is the side bar of the inner frame, also seen in section.

These Drawings 1 and 2 contain all the machinery necessary for stretching the cloth, and also for shifting it, so as to produce any pattern. This, as already described, is done by the operator's hands (by turning the screws) in the interval between working every loop or stitch of which the tambouring is composed. The vertical screw L gives the motion up or down. The horizontal screw E gives the motion right or left, as required. When both screws are turned at the same time they produce an oblique motion, varied at pleasure by giving more or less motion to either screw; and as this obliquity may be varied every stitch, all right or curved lines can be produced, and any pattern formed. Most of the remaining motions required in working are produced by the feet pressing down alternately three treddles, as will be afterwards described. The second operation is to perforate the cloth with the needles or hooks, and bring them back without injuring the fabric. To perforate the cloth with the needles, only one motion is necessary. As the cloth is stretched across the machine in a vertical position, the needles, in order to be at right angles to the superficies of the cloth, must also be placed in a frame extending across the machine, and must lye in an horizontal position. The motion communicated to this frame must be from the front towards the back of the machine, and the same motion reversed will bring it again to its former place. This motion is effected in the following manner:—The four c^s in Drawing 3, Fig. 14, represent a rectangular frame of cast-iron, with projecting arms towards the front of the machine, which I call the needle carriage, and which is parallel to the horizon. Upon its cross bar *e*, *e*, is placed the frame which contains the needles, which will afterwards be described. This

needle carriage gives the perforating and returning motion to the needles. To the back bar of this carriage V are attached two double-jointed pieces of iron *q*, *q*, which connect V with two studs *r*, *r*, fixed perpendicularly in the the roller *s*. In the roller are also fixed two horizontal studs *t*, *t*, from which iron rods pass to the treddles below, to continue the connection to the moving power which works these treddles. In Drawing 8, Fig. 35, this carriage and the roller *s* appear in profile section. C, C, is one side of the needle carriage, resting upon friction wheels in the bearer U, U, which are screwed to the second side rails of the wood-work. *q* is one of the double-jointed pieces connected at one end with the back bar of the carriage V, and at the other end with the perpendicular stud *r*, fixed in the roller S. From the horizontal back stud the iron rod W continues the connection to the treddle Y, and from the front stud *t* the rod X continues the connection to the treddle X, Y, when pressed down by the operator's right foot, by depressing the horizontal back stud *t*, draws the carriage *c*, *c*, towards the back of the machine, and the needle frame being fixed upon the cross bar *e*, *e*, of this carriage, the needles consequently perforate the cloth; X, when pressed by the left foot, operates in an opposite direction, and brings the carriage to its former position. But as all tambouring consists of loops drawn successively through the cloth, and also as each loop is drawn through that which preceded it, the instrument used in the operation, altho' commonly called a needle, is (more properly speaking) a hook. Now as this hook, after having perforated the cloth, must be open for the purpose of receiving the thread which forms the tambouring, means must be used to shut it after it is supplied, and before it returns, otherwise it would catch not only the thread but also part of the cloth and also the preceding loop, through the centre of which it passes in perforating.

To explain the means which I have used to effect this purpose, it will be proper, in the first place, to explain the construction of the needle; and to avoid obscurity I shall hereafter always use the term needle, altho', as before stated, it might more properly be called a hook. The needle is a straight piece of steel wire, near the point of which a barb is cut, similar to that of a fish hook; under this barb a groove is struck longitudinally into the stem of the needle, by a screw engine, with a chisel and bolster, much in the way practised by makers of stocking-frame needles; the needle and barb are then pointed sharp. The barb is set straight, and not too high, much in the same shape as it appears at N, in Drawing 3, Fig. 16. The needle is then tempered, and is ready for use. The needle when to be used is put into the handle or case *i*, in Figure 16, in the end of which a small hole is drilled, about an inch deep, to receive it. I fix the needle into the handle with a cement composed of

common sealing-wax mixed with fine powdered brick-dust. This cement when heated melts, but when cold holds very fast, so that a needle may easily be taken out when requisite, by heating the handle in which it is fixed sufficiently to dissolve the wax. In the longitudinal groove is placed a small piece of wire, also grooved quite to the point, but without any barb, and which I shall call the wire slider, for which see Figure 15. When this wire slider, resting in the groove of the needle, is pushed towards the needle point, it slides under the barb of the needle, when the groove in the wire slider receives the barb, and the needle is shut. When the wire slider is drawn back it quits the barb of the needle, and the needle is then open. The wire slider is fixed with silk thread to a piece of brass *k*, as in Figure 15, and this is screwed to a round hollow piece of brass 1, which is fitted upon the handle *i*, so as to slide easily backward and forward. The whole may be seen, Fig. 20. In that part of 1 which is opposite to where *k* is fixed is a long slott through which a screw passes into the handle *i* (see Fig. 20 and 21), so as to allow 1 to slide backward and forward, but to prevent it from turning round on the handle, except when the handle also is turned, in which case it goes along with it. Fig. 22 and 23 are end views of 1, to shew the bore through which the handle *i* passes.

The middle frame is next to be described. On the cross bar of the carriage *e*, *e*, is erected the needle frame, consisting of two bars *f*, *f*, and *g*, *g*, placed on edge, parrallel to each other and to the cloth, with their lower edges screwed fast to pieces on the cross bar *e*, *e*, at *h*, *h*, *h*, *h*. The needle handles, of which twelve are represented between *i*, *i*, are of brass, turned round and straight, and they are placed horizontally and parallel to each other in bushes or eyes formed to receive them in the bars *f*, *f*, and *g*, *g*, so that they may revolve freely on their own axes. The end of the handle which receives the needle projects about two inches beyond the bar *g*, *g*, to receive the brass 1 (Fig. 20), and to allow it room to slide. The bushes in the bar *g*, *g*, are triangular notches, as shewn in Figs. 17 and 24, and on the top of the bar are flat plates through which a screw passes to touch the upper part of each handle gently, so that they may be always tight fitted, and at the same time revolve freely when requisite. In the back bar *f*, *f*, the bushes are round holes to receive the small pivot Y (Fig. 16), at the end of the handle *i*. On this pivot a pinion Z, of sixteen or eighteen teeth, is fixed, which is worked by a rack *m*, and thus the rototary motion is given to all the handles when required. See Figs. 18 and 19. The way of placing the rack above the handles appears by Fig. 18. The rack is hung on the bar *f*, *f*, and slides freely from side to side. *b*, *b*, Fig. 14, is a bar fixed to *f*, *f*, through which a

number of screws pass, the end of each of which touches the pivot Y of each needle handle, for the purpose of setting the needle a little towards the cloth, if required. See Fig. 20. On each handle is a collar of brass, with one of wire behind (Fig. 20), and a hole is drilled through the handle, and a pin put thro' to prevent it from shifting. The pin is drawn when it is necessary to take out a handle. Fig. 20 is a profile section of the carriage, the two needle bars, which compose the frame, and a handle, pinion, collars, brasses, slider, and needle, all above described. The top plates on the bar *g*, *g*, move at one end on a joint or hinge, and are fixed with a screw at the other, so that any handle may be taken out when required. I generally make these plates from six to nine inches long each. The machinery necessary for opening and shutting the needles is as follows:—The form of the wire slider, Fig. 15, and its connection with the pieces of brass *k* and 1, having been already described, it is only necessary to shew how they are connected with the machine, so as to move the slider backward and forward in the groove in the needle. When the needle is free from the cloth, the slider is drawn forward below the barb, and the needle is shut. When the needle moves forward to enter the cloth, it becomes open, so that it may receive the thread. When the needle returns, to disengage itself from the cloth, the slider, whose point has also gone a little way through the cloth, remains stationary until the barb of the needle has entered the groove in the slider; they then return together. The mode of effecting this is as follows:—In each piece of brass 1 a hollow is turned at *a*; between the needle frame bar *g*, *g*, and the cloth, hangs a cross bar *n*, *n*, which I shall call the slider bar. This bar appears as looked down upon in Fig. 4; its shape will appear in Fig. 25. This Figure is an elevation of the slider bar *n*, *n*, as viewed from the front of the machine. It is screwed at each end to two upright pieces *o*, *o*, hanging on the round pivots *d*, *d*, screwed to the capes of the wood-work, so that the bar *n*, *n*, may vibrate freely backward and forward. In the upper part of *n*, *n*, is a square notch for each needle, as represented. This notch receives the hollow in the piece of brass 1 at *a*, in Fig. 20, and by these means, when the bar *n*, *n*, vibrates, all the pieces of brass 1, and consequently the sliders, are drawn backward or forward on the handles, and at the same time the motion of the handles on their own axes is not impeded. For the means of giving motion to the bar *n*, *n*, see Drawing 8, Fig. 35. *n* and *o* are the slider bar and one of the arms in profile section. To the arm *o* is fixed one end of the wire *d*, the other end of which is connected with the crank *e*, working on a pin in the back part of the wood-work, and to the other end of this crank is hung a weight. The operation of this weight draws the bar *n* towards the back of

the machine, to shut the needle. When the bar is drawn far enough back, it is stopped by two screws *p*, *p*, appearing in Fig. 14, fixed to each arm *o* of the bar *n*, and pressing against the cross bar *e*, *e*, of the carriage. To the arm *o* is also fixed another wire *f*, connecting it with the lever *g*, which swings freely on the pin or screw nail fixed in the front post. J is another lever working on a pin or nail passing through its centre into the lower side rail. The back end of this lever is connected by a wire *k*, with a horizontal stud 1, fixed in the roller S. The lower part of the lever *g* being stopped by the front end of the lever *i*, prevents *g*, and consequently the bar *n*, from moving along with the carriage, whereupon the needles open. When the needles are about half way through the cloth, the back end of *i*, being raised by the wire *k*, the other end is depressed, and the lower part of the lever *g* disengaged; the bar *n*, and all the apparatus connected with it, is then drawn towards the back of the machine by the weight behind, until the lever *g* is stopped by the screw *o*. This allows the sliders to go a little way through the cloth, but not so far as the needles go, where they remain till, the carriage returning, the screws *p*, *p*, in Fig. 14, are pushed back by the cross bar *e*, *e*, as soon as the needles are shut. The back end of the lever *i* then descends by the weight attached to it, the other end rises, and the machine is in its former position. As both this and the carriage motion formerly described take their motion from the roller S, worked by the treddles Y and X, it is plain that when properly tempered they will move together. An apparatus as above described is connected with each end of the slider bar *n*, *n*. This completes the machinery required to perforate the cloth with the needles and bring them back without injuring the fabric. The next operation required is to supply the needles with the thread or yarn which forms the tambouring. This operation is performed in the interval after the needles have perforated the cloth and before they return. It consists merely of two motions, first, each thread must describe a small circle round its needle; secondly, after having completed the circle round the needle, each thread must be drawn towards the back of the machine, to bring it under the barb into the hook or eye of the needle. I call this operation feeding, and the needle by which it is performed the feeding needle, to distinguish it from the needle formly described, which may be called the tambouring needle; and I shall now describe the requisite machinery. The whole of this machinery is supported by a beam of wood A, A, as in Fig. 14, extending horizontally across the machine, a little behind the cloth to which it is parallel. Its ends rest on the two second side rails; through each of these ends a bolt passes, horizontally, by which the beam A, A, is screwed to the back supporters *u*, *u*,

of the needle carriage, as shewn in section by Fig. 35. The machinery, as seen from above, is represented in Fig. 14. B, B, is a bar of wood screwed to one of iron, in which are fixed the brass feeding needles represented between C, C, each having a small hole drilled through it near the point, through which a thread passes. The cranks F, F, are fitted into the standards L, L, so as to revolve upon their own axes. On the axes of each crank is a bevil pinion of sixteen teeth; these pinions are turned by two bevil wheels of thirty-two teeth, fixed near the ends on the iron spindle E, E, hung at either end on a centre screw, so as also to revolve freely on its own axis. The other or front ends of the cranks F, F, pass through two bushes or round holes below the feeding bar B, B, into which they are fitted easy, so that when the cranks are turned once round by the spindle E, E, performing half a revolution, the bar B, B, is carried along with them, and the point of each feeding needle describes a smalle circle round its corresponding tambouring needles. B, B, must also be fitted to slide easily backward and forward on the cranks F, F. B, B, is connected by two iron rods G, G, with two upright arms H, H, made fast on an horizontal spindle I, I, hung in centre screws so as to vibrate freely on its own axis. Fig. 26 is a profile section of the same machinery. B, the feeding bar; with one needle C; F, one of the cranks; G, one of the iron rods connecting the bar B with one of the upright arms H; K, one of the bearers of the horizontal spindle I, near the ends of which the upright arms H, H, are fixed, and from the middle of which the lever M projects horizontally forward; A is the cross beam in profile. Fig. 27 is an elevation of the same machinery from behind. By a careful inspection of of Figs. 14, 26, and 27, the construction of all the parts of this machinery will be better understood by a mechanic than by any description, it being always recollected that Fig. 14 is a ground plan or view of the machinery from above; Fig. 26, a profile or view from one side; and Fig. 27, a direct elevation or view from behind. On the middle of the spindle E, E, is a pully D, consisting of two pieces. The first, D 1, Fig. 27, is made fast upon the spindle. The edge is cut as a ratchet wheel of sixteen teeth, and on the flat side is cut another ratchet with a number of small teeth, as represented in the small Figure D 1, annexed to Fig. 27. The second piece is a broad pully, to receive a cord passing three or four times round it. One of its flat sides is a little hollowed, and has a spring catch fixed into it, as shewn in the view D 2. This piece is fitted close to D 1, so that the spring catch rests in the ratchet on the flat side of D 1, and when D 2 is turned round it carries D 1 along with it; but D 2, being loose upon the spindle, will turn back without communicating the motion to D 1, which is further stopped by

a catch resting in the ratchet of sixteen teeth upon its edge. This is so similar to the barrel of a clock or common roasting jack that it will be easily understood. The motions of the feeding machinery are as follow:—A cord passes three or four times round the pully D on the middle of the spindle E, E, as shewn in the profile section, Fig. 29. One end of the chord is fixed to the upper end of a piece of iron N, and the other passing over a pully behind has a weight attached to it. The lower end of N is connected by a wire with one end of the lever O, moving at its centre upon a joint in a piece of iron fixed to the middle treddle P; the other end of O is connected by a wire with the breast beam *a*, *a*, as shewn in Figures 34 and 35. When the treddle P is pressed down by the operator's right heel, it pulls the chord, and consequently turns round the pully D, and gives the rotatory motion to the feeding machinery. When the heel is eased or withdrawn, the weight attached to the cord brings back the treddle and loose part of D to their former positions. In the piece of iron N is cut a notch, which, when it is drawn up by the weight, carries up the horizontal lever M along with it. The rising of M makes the two upright arms H, formerly described, move towards the back of the machine, and by the connection rods G, G, draw back the feeding bar B, B, which thus pulls the threads into the hooks or eyes of the tambouring needles. See again Figs. 14, 26, 27. Fig. 30 shews N in front and M endways, as also does Fig. 31. To N, as in Figures 28 and 31, is fixed a wire R, which, going in a horizontal direction to the left side of the machine, connects N with one end of the lever S. From the other end of S a wire T, connects S with a crank U, fixed perpendicularly to the breast beam *a*, *a*. Fig. 28 is a ground plan, the eye being above. From the other end of the crank U a wire V descends perpendicularly to a stud W, fixed in the left treddle X, as is very plainly shewn in Fig. 32, which is an elevation. When the treddle X is pressed down to bring out the needles, as already described, the connecting wires V, T, R, being pulled, draw N towards the left; the notch thus quits its hold of M, which then descends by the weight suspended from it, and the feeding needles resume their former position close behind the cloth. By these means, first, the circular motion of the feeding needles round the tambouring needles is effected; secondly, the feeding needles are drawn back to bring the thread under the barb of the tambouring needles; and, thirdly, when the tambouring needles quit the cloth, the feeding needles return to their former place. The yarn or thread is warped and rolled round a cylinder, as practised by weavers. This cylinder is hung horizontally across the machine above the beam A, A, to which its supporters are screwed. A section of it appears at *y* in Fig. 35, and an end view of *y* in Fig. 34. On

the end of the cylinder *y* is a small pully, to which is fixed one end of a cord, the other end of which passes over another, a small pully, fixed to any convenient part of the wood-work; a small weight is hung to this end, to keep the yarn at a proper tightness. Besides this, a very light piece of wire hangs on each thread behind the feeding bar B, B, to assist in tightening any one which may be slacker than the rest. In Fig. 33 is a ground plan of the treddles. The middle treddle P, which gives motion to the feeding machinery, is longer than the other two, and has a cross-piece Z, extending to the lower side rail, which is pressed by the right heel when the motion is to be given. This saves the trouble of shifting the right foot from Y to P. The end of P is fixed by a cord or chain to the floor at some distance, in order to prevent its rising more than enough. The supplementary Figures in Drawing 6 shew the treddles in different points of view. This description completes the parts necessary for working the tambouring. The fastening the threads, which is the last thing in the operations required, is quite a separate part, and only used when a pattern is completed. I will therefore first describe the connection of all the working parts, as shewn in Figs. 34, 35, and 36, which will be little else than a recapitulation of what has already been described, and afterwards take the fastening machinery by itself. Fig. 34 is a profile elevation of the machine directly viewed from the right sides. Fig. 35 is a profile section of the machine, which is here represented as if cut asunder near the middle. Its chief use is to shew the connection of some parts which are hid by the intervention of the side frame of the wood-work in Fig. 34. Fig. 36 is a perspective view of the machine. The eye of the spectator is supposed to view the machine about four inches higher than the cape of the side frame, about six inches behind the machine, and about eight feet distant to the right side. In the perspective view of the machine is given, in this Figure, the yarn cylinder *y* is omitted, because its situation is sufficiently shewn by Figs. 34 and 35, and it would hide much of the machinery if introduced in Fig. 36. Some small parts shewn in the former Figures are also omitted. To make these three Figures, viz^{t}, Figs. 34, 35, and 36, understood, it appears only necessary to attend to the different parts, the letters referring to which respectively are the same in all the three Figures, and are also the same which have been before used when describing the parts separately. The only part appearing in these three Figures, not described before, is a screw P, to regulate the extent of motion of the carriage *c*, *c*, by touching *u*, when the needles are sufficiently far through the cloth, and another screw *q*, which, by touching or swinging lever *r*, stops the end of the carriage frame *c*, when it has returned after the cloth is perforated by the tambouring needles. If *r*, which swings freely upon its

joint, is pushed to one side, the carriage will come the breadth of *r* farther out, which is necessary when fastening the ends of the threads, as after described. S is a catch, to keep the machine fast when not at work. It hooks on a cross-piece fixed to *c*, and represented in Fig. 14. In order to work the machine, which I now proceed to describe, referring more immediately to Fig. 36, the operator seats himself in front of the breast beam *a*, at the middle, looking towards the machine. His right hand is placed on the handle which turns the horizontal screw E; his left on the handle of the upright screw L; his right foot is placed on the treddle Y; his left foot on the treddle X. A pattern for one needle is printed upon the cloth, which, being traced by that needle, all the others make similar figures. Having turned his screws until the point of the cloth meant to be perforated comes opposite to the needle, he presses down the treddle Y with the ball of his right foot; this carries the needles through the cloth until the carriage *c*, *c*, is stopt by the stop screw P coming in contact with the standard *u*, *u*. The same pressure opens the hooks, to receive the yarn, as formerly described. He then presses down the cross-piece Z with his right heel, and immediately allows it to rise again to its former position. This produces the two motions required for feeding, as formerly described. And, lastly, he presses down the treddle X with his left foot, which shuts the needles, and draws them out of the cloth, each bringing the loop formed by the yarn along with it. When far enough out, the carriage is stopt by coming in contact with *r* and *q* (see Fig. 34). He then, by means of the two screws, shifts the cloth until the next point to be perforated comes opposite to his pattern needle, and proceeds as before. The following general remarks may tend to make some parts of the operation more obvious:—When the yarn has been wound on the yarn cylinder *y*, each thread is put through the small hole drilled near the point of the feeding needle C. It is then put through the cloth by a common sewing needle, and made fast in front. That part of the tambouring needles which forms the hook or eye is always kept in the same line of direction in which that part of the pattern which is working runs; and when the line of direction requires to be changed the relative position of the hooks must also be changed in a correspondent direction. This is done by turning each needle handle on its own axis by means of the rack *m*, which is moved from side to side by the operator's hand. The feeding needles must perform exactly one revolution at each time, and they must stop at that point of the circle which they describe immediately behind the hook or eye of the tambouring needle. Of course, when the tambouring needles are turned to assume a new position by means of the rack *m*, the feeding needles must also be moved round until they correspond.

Having thus described, as shortly and at the same time as clearly as I am able, the construction and use of the various parts of this machine, I have only to express an earnest wish that any mechanic who studies this Specification will bear constantly in mind that in all the Drawings annexed the same letter constantly refers to the same part of the machine, in whatever point of view or in whatever Figure it is represented. By attending to this he will find every part in all its different points of view in one or other of the Drawings, and this will probably assist him more in forming a correct idea of their shapes and construction than any description which can be given. The Drawings were taken, with very great care and attention, from a machine which has been for some time actually at work, and are in general upon a scale of two inches to a foot. It only remains to describe the manner of fastening the ends of the threads. To fasten the end of every thread when a pattern is compleated it is only necessary to draw its end through the last loop. If the operator passes a common sewing needle, with a thread attached to it, through every loop, it will keep the figures sufficiently fast until the whole piece of cloth is tamboured, when the piece is finished, and taken out of the machine. The threads which cross behind between the flowers are clipped away; the threads drawn through the loops, as above described, are pulled away. The end of each thread which composed the tambouring then comes through the last loop, and every figure is made fast. When this mode is pursued, no fastening machinery is required, the whole being done by the operator's hand. The following plan, however, is quicker, for which I shall first describe the machinery used, and then the manner of using it. Fig. 37 represents a transverse vertical section of the machine cut in front of the breast beam *a*. All the machinery, except that used for fastening, is omitted in this Figure. The frame, distinguished by four A's placed at its corner, hangs perpendicularly in front of the cloth, and as near to it as possible without touching it. This frame is supported at the top by two centre screws passing through the ends of the side bars of a horizontally placed frame, above seen as from the front N, N. The real shape of this frame is represented in Fig. 43, where it is viewed from above, and is distinguished by four N's placed at its corners. This frame is supported by two centre screws at T, T, which are fixed to the front cross rail of the wood-work. The frames move on the center screws at A and T as joints, so that the frame pointed out by four A's, in Fig. 37, slides up and down freely. The levers E, E, and weights attached to them, serve as counterpoises. The lower part of the upright bars of the frame pointed out by four A's pass at M, M, through two eyes fixed to the breast beam *a*, to keep the frame steady at bottom. Within this frame is another, distinguished by four B's, which is hung from the

cylinder D, D, which turns on gudgeons in its ends, which pass through eyes supported by the capes of the wood-work C, C, C, C. Four pieces fixed to this frame pass through four eyes in the frame marked by the four A's, and to the back of the cylinder D, D, a weight may be hung as a counterpoise. By these means either of the frames A or B will slide up or down independant of the other. The frame distinguished by four A's carries a horizontal bar F, F, supported by two centre screws passing through the sides of the frame into sockets in the ends of the bar F, F. On these sockets the bar turns as on a joint, backwards or forwards. The frame distinguished by four B's carries the horizontal bar G in front of the bar F, F, from the ends of which projecting round pieces of metal pass through eyes in the sides of the frame B. By these means the bar G also slides from side to side when required. The horizontal bar F, F, part of which is shewn in Fig. 41, carries a set of double wires H, H, shaped as in the Figure. These wires are pointed sharp, and are of unequal length. In the side of the longest is a small longitudinal groove, in which the point of the shortest rests by being bent a little inwards. These wires are placed at the same distance as the tambouring needles formerly described, so that the point of each of the longest wires may rest exactly below the corresponding needle. K, K, are temper screws, to elevate or depress any wire which may require it, independantly of the rest. The bar G, G, part of which is shewn in Figure 42, carries a set of wires I, I, the ends of which are sharp, and turned horizontally towards the operator's left hand at right angles to their stems. These wires are also below their corresponding needles, and in front of the double wires H, H, as shewn in Figs. 37 and 40. L, L, are temper screws, to elevate or depress them when necessary. These wires H, H, and I, I, are cast in plates of tin, in moulds made for the purpose, and these plates are fixed to the bars which carry them, as shewn in Figs. 41 and 42. In order to work this machinery, when a pattern is completed the tambouring needles are turned by the rack, as formerly described, until their barbs are straight upwards. The needles are brought a little further than usual from the cloth by the means formerly explained. The frame distinguished by four A's is then pushed upwards by the operator's hand till the long points of the double wires H, H, pass through each loop of the tambouring. The tambouring needles then are made to perforate the cloth, their points passing between the two wires of H, H, and another loop is wrought in the usual way. The bar G, G, is then drawn a little to the right hand. The frame distinguished by four B's is raised up. The bar G, G, is next brought again towards the left, until the cross point of each of the wires I, I, is above the corresponding loop. By depressing the

bar G, G, a little, till they are rather under the tambouring needles, each loop is caught hold of by the cross points of the wires I, I. The sliders which shut the tambouring needles, already described, are then drawn back until the needles are open. The last-wrought loops are then drawn out of the barbs or hooks of the tambouring needles by means of the wires I, I. The rack is then turned until the barbs point downwards to the floor. The tambour needles then approach the cloth until their points touch it. The bar F, F, is again elevated a little. The square shoulders of the double wires H, H, carry up the loops preceeding the last, and which have rested on them since they divided them at the beginning of the fastening operation, as formerly described. The hooks of the tambour needles receive these loops. The slides are again brought forward, and the needles shut. The needles have now quitted the last loop, and caught the preceding one. The bar F; F, carrying the double wires H, H, is then sunk down to its former place, the bar G, G, pulled again towards the right, to disengage the cross points of the wires I, I, from the loops; the bar G, G, is then also sunk to its former place; the needles are then pushed again through the cloth, but are immediately returned without being fed; the second last loop is by these means drawn through the last, and forms a kind of knot, and the operation is compleated. The operator shifts to another figure, and goes on as before. On one end of the cylinder D, D, is a ratchet wheel O, with a catch P, which falls into it, when the frame distinguished by four B's is raised to a proper height, as before described. The use of this is to keep the said frame steady until the operation of fastening is performed. When the frame is to be pulled down to its former position, the catch is lifted up by pulling down the handle V, as in Fig. 44, suspended to the crank S, which turns upon a pin in the upper cross rail of the woodwork. The crank S is connected with the crank Q by the wire R, and the crank Q is connected with the catch P by the wire U. In Figure 43 this appears as seen from above, in Fig. 44 as seen in front, and in Fig. 45 as seen from one side. Fig. 38 is a profile section of the frames distinguished by four A's and four B's. Fig. 39 shews one of the eyes M from above. The machine described above may be made to perform all its operations by the application of any mechanical power, in the following manner:—It will appear from the above description that, as the formation of any pattern is effected by turning the two screws formerly described, the correctness of the figure will depend upon the skill and attention of the operator; but if the machinery should be so constructed that these effects are produced by a regular uniform motion of the machine itself, it is evident that more regularity will be obtained than can be expected from the operation of any person, how-

over steady and attentive. This will be particularly useful when a large quantity of cloth is to be tamboured of one pattern.

I shall now describe the machinery which I have invented for effecting this purpose, and which may be added to any machine constructed according to the plans and descriptions given above. The wooden framework for carrying and connecting this additional machinery with the former at the right side of the machine consists of a side frame, exactly the same as that shewn in Drawing A, and its connection with the former wood-work is shewn in Drawing B. The Nos. 11, 12, distinguish the additional side frame, as seen from the front of the machine. Nos. 13, 13, are two horizontal beams or rails which connect the side frame 11, 12, with the right side frame of the machine, as formerly described. Two cross rails, exactly the same, form the connection behind. It has been formerly observed and explained, that the whole formation of figures depends upon the application of two forces; the one in an horizontal and the other in a vertical direction. I shall describe the machinery which gives these motions by this plan. As the different parts of the machine in the former Drawings have been distinguished by letters, I shall in these use numbers to avoid confusion. In Figure 46 is represented a horizontal section of the machine, with the additional machinery. Those parts formerly described are again distinguished by the same letters formerly used; the additional parts by numbers. The following description refers to Drawings No. 12, 13, 14, and 15, in all of which the numeral references constantly denote the same part of the machine. The horizontal spindle 15 is supported by centre screws 46, 46, fixed to the cross beams or rails 13, 13, so as to revolve freely on its own axis. On it are fixed four wheels, distinguished by Nos. 16, 17, 18, and 20. No. 20 is a ratchet wheel, in which are cut just so many teeth as there are to be stitches or loops in the figure intended to be tamboured. This wheel is moved one tooth in the interval between every stitch or loop, by means of the catch 21 and lever 38, shewn in Figure 47, which is an elevation viewed from the front. The lever 38 being pulled towards the left side of the machine by the operator, or person attending the machine if working by power, draws the catch 21 along with it, and consequently turns the wheel 20 and spindle 15 a little round. The lower part of the lever 38 works in a box 39, with a stop screw in each end, so as, by stopping the lever when drawn from side to side, to confine the quantum of motion to a single tooth of the ratchet wheel 20, and neither more nor less. The horizontal motion of the frame is produced by means of the wheel 18 turning on the spindle 15 along with the ratchet wheel 20. To the right side

of the outer or horizontally moving frame A, formerly described, is fixed a piece of metal distinguished by No. 19, the end of which presses upon the edge of the wheel 18. To the said outer or horizontally moving frame is also fixed one end of a cord 47 (see Fig. 47), passing over a pully 48, fixed to any convenient part of the right side frame of the wood-work, by the other end of which cord is suspended a weight 49. This weight pulls the outer horizontally-moving frame towards the right side of the machine, and keeps the piece 19 always pressing on the edge of the wheel 18. The horizontal screw, formerly described, and female screw, are taken of. Now, if the circumference of this wheel were a circle, no motion could be generated by its revolution on the spindle 15, because, every line drawn from its centre to any point in its circumference being equal, the horizontally-moving frame would always remain stationary. To construct a wheel which will produce the horizontal motions required, the mechanic, having first turned his wheel into a circular form, must consider the figure he has to produce, and what horizontal motions of the frame are necessary for that purpose. Let him then divide the circumference of the wheel 8 into as many equal parts as he has formerly cut teeth in the ratchet wheel 20, which, as before remarked, correspond with the number of stitches or loops in his figure. From these divisions he will draw lines to the centre of the wheel as radii of the circle. Beginning, then, at the point where his horizontally-moving frame will be nearest the left side of the frame, he must then go round the divisions in the circumference of his wheel, and consider what motion, if any, is required in each. When a motion of the frame towards the right is required, that division of the circumference of the wheel 18 which is then to come in contact with the piece 19 must be brought so much nearer the centre, by cutting away part of the circumference; then the horizontally-moving frame, being always pulled towards the right by the weight 49, will move in that direction until the piece 19 is stopped by that point in the circumference of the wheel 18 which is then in contact with it. When an opposite motion of the frame A is required, the point in the circumference of the wheel 18, which comes in contact with 19, must be left farther from the centre of the wheel. The wheel in revolving will then push the frame towards the left. When no horizontal motion is required, that part of the wheel 18 is made perfectly circular. Fig. 50 and 51 represent two wheels of this kind. The mode of forming their circumferences is there represented. Wheels of this description are known by many mechanics by the name of traverse wheels. The wheel 17 operates upon the vertically-moving or inner frame formerly described, and distinguished by four K's, in a

similar manner to that in which the wheel 18, just now described, acts upon the outer or horizontally-moving frame. Its circumference is cut upon the same principle, approaching to or receding from the centre, as the figure may require, and is made circular when no motion is to be produced.

I shall now describe the machinery which connects this wheel 17 with the vertically-moving frame upon which it operates. So much of the counterpoise weights T, T, formerly described, are taken off, as will allow the vertically-moving or inner frame to descend by its own weight. On the centre of the upper bar of this frame, distinguished by four K's in Figure 47, are fixed two projecting studs, 45, the front one only of which can here be visible; a full view is given in Fig. 48. These studs rests in any of the notches in the hanging piece 44, as required. The upper end of this hanging piece 44 is connected by a joint with one end of the horizontal lever 43, supported at the centre by a strong beam of wood 50, resting on the front and back rails of the wood-work. To the other end of the horizontal lever 43 is joined a hanging piece 42. To the cross tail of this hanging piece 42 are attached two strong wires 41, 41, which, passing on either side of the spindle 15 (in Fig. 46), continue the connection to a lever 40, extending from the back to the front of the machine, the end of which lever only appears in Fig. 47, confined between the sheers 52, fixed to the front cross rail 13. This lever 40 appears very fully in Fig. 49, which is an end elevation. The hanging piece 42, and one of the connecting wires 41, attached below to the lever 40, is appears in profile. The inner or vertically-moving frame, being so balanced as to descend by its own weight, the lever 40 is consequently pressed against the edge of the wheel 17 directly under its centre; and when any point in the circumference of which 17 is farther from its centre than the preceding, it pushes down the lever 40, which by the connection raises the frame upon which it operates; and when any point in the circumference of the wheel 17 is nearer to its centre than the point preceding, the lever 40 is permitted to use, and the frame connected with it descends by its own weight. The vertical screw is now taken off, or the cross piece M may rest below the pillars N, N, formerly described, to raise the vertical frame by the screw. When shifting from any row of Figures to the next, the notches in 44 are for this purpose. M must be clear of N, N, in working on the spindle, another wheel, 16, which, like the former, acts as a traverse. It gives the rotatory motion to the needle handles which were, as formerly described, moved by the operator's hand. The motion is produced as follows:—A lever 22, as in Figs. 49 and 46, moves horizontally on a joint near the back of

the machine, and extends to the front. From this lever a strong wire 24, as in Fig. 46, connects with the slider 25, moveable from side to side in grooves, formed in the supporters 37, 37, in Fig. 47. To this slider 25 is fixed a piece of metal 51, as in Fig. 46, placed at right angles from the slider towards the cloth in an horizontal direction. In this piece 51 is an oblong hole or slott through which passes a vertical pin fixed to the rack *m*, formerly described. By these means the slider 25 carries the rack *m* along with it, when moved from side to side; but the hole or slot in the piece 51, being oblong, does not impede the motion of the rack *m*, when carried by the needle frame (to which it is attached, as described before,) backwards or forwards, to perforate or return from the cloth. The next thing to be described is the connection between the slider 25, above described, and the spindle E, for turning the feeding needles, for it will be recollected that they must correspond. In the former description the change of position of the tambouring needles was produced by the operator's hand; the change of the feeding needles by his right heel; but when all the parts are to be worked by machinery all must be connected. Upon the slider 25 is a rack 26, fixed to its upper edge. This rack communicates motion to a pinion 27, on one end of the horizontal spindle 28, on the other end of which is a bevel wheel 29, turning another bevel wheel 30, on one end of another horizontal spindle 31, on the other end of which a spur wheel 32, working another spur wheel 33, on the spindle E, compleats the connection. The rack 26 on the slider 25 gives only half a revolution to the spindle 22 for every revolution which the rack *m* gives to the tambouring needles. The remaining wheels, 29, 30, 32, and 33, have all an equal number of teeth. By these means the tambouring and feeding needles revolve together; for it was formerly explained that half a revolution of the spindle E gives a whole revolution to the cranks F, and consequently to the feeding needles. A cord from the pully 36, which is fixed on the spindle 28, suspends a weight, the operation of which makes the lever 22; supported at its end by 23, constantly press the edge of the wheel 16. 53 is a small bell, the hammer of which, when acted on by a pin in the wheel 20, rings, to give notice when a pattern is finished. The piece which supports the end of the spindle 31, where the spur wheel 32 is fixed, is jointed at bottom, to allow the said supporter to move a little backward or forward at the top, this carrying along with it the end of 31, where 32 is fixed; the wheels 32 and 33 are thus engaged or disengaged as required. Both parts of the pully D, formerly described, are in this plan loose upon the spindle E; but in one side of D are fixed a number of pins, as represented. When D is pulled towards

the right hand, these pins lay hold of a catch 54 in the spindle E. D, when turned by the treddle P, as formerly described, will then carry E along with it. When D returns towards the left, the pins quit their hold of the catch 54, and D or E will then move independent of each other. In D there is a groove resting in a vertical piece of iron 34, open like a fork at top, and jointed at bottom, so that the top, may move a little from side to side, and carry D along with it, in order to engage or disengage the pins, as above mentioned. From the right treddle Y, formerly described, is a wire 58, in the supplementary outline passing through a vertical hole in the beam A, to a crank 57, placed in a vertical position on the said beam, and moveable on its centre. From the other end of the crank 57 the wire 56 continues the connection to 34, above described, as moving the pully D from side to side. From 34 in Fig. 46 another wire 55, connects it with one end of the crank 53, similar to 57, but placed horizontally. The other end of this crank operates on the jointed supporter of 31, formerly described. When the treddle Y is depressed to perforate the cloth, D, by the above connection, is drawn to the right, and the pins lay hold of the catch 54 on the spindle E. At the same time, one end of the crank being also pulled towards the right of the wire 55, the supporter of 31 is pressed towards the back of the machine, and the wheels 32 and 33 are disengaged from each other. A spring 35, resting behind the supporter of 31, brings the machinery last described to its former position as soon as the treddle rises again; thus the spindle E is alternately connected with the parts of the machine from which it must receive its motions. The connection of every part being now compleated, all will receive the necessary motions from the three treddles, and it only remains to apply the power to these treddles. If it be wished to move by a rotatory motion, it is only necessary to erect a horizontal spindle or shaft across the machine. On this shaft fix two pullies, the one pressing the right treddle Y, and the other the middle treddle P, at the same points where the operator's feet would be in the former plan. Then, if the circumference of these pullies be cut or shaped upon a similar plan to that mentioned when describing the traverse wheels 16, 17, 18, one revolution of the shaft will act in the same way as the alternate pressure of the operator's feet, a sufficient weight attached to the left treddle will produce the returning motion, and supersede the use of the third pully. Some mechanics distinguish rotatory pieces acting in this way by the name of wipers, and they are so generally known as to render any further description or Drawings superfluous. Any power capable of turning this may be applied, at discretion. The person who attends the machine has then only to turn the wheel 20 one notch in the

interval between every stitch, by the means formerly described, and to stop the machine when necessary.

In witness whereof, I, the said John Duncan, have set my hand and seal to these presents, at London, this Twenty-seventh day of June, in the year of our Lord One thousand eight hundred and four.

JOHN (L.S.) DUNCAN.

Signed, sealed, and delivered (being first duly stamped) in the presence of

ALEX. MUNDELL,
Fludyer Street,
H. WINCHESTER,
Strand.

N. RIDLEY.

AND BE IT REMEMBERED, that on the same Twenty-seventh day of June, in the year above mentioned, the aforesaid John Duncan came before our Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute in that case made and provided.

Inrolled the same Twenty-seventh day of June, in the year above written.

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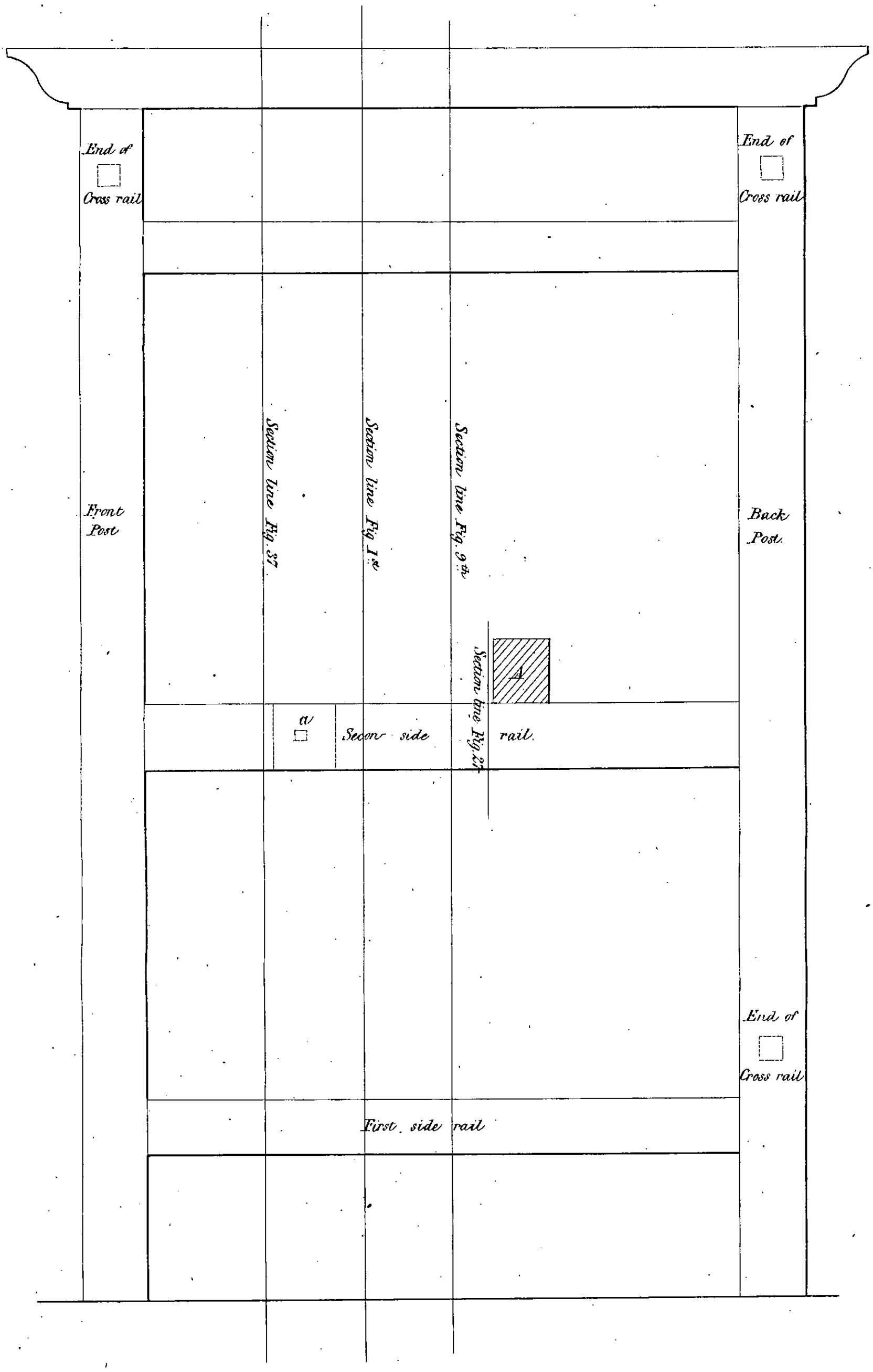
A.D 1804. May. 30. N°. 2769.

DUNCAN'S Specification.

(17 SHEETS.)
DRAWING A.



The enrolled drawing is not colored.

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A.D.1804, May 30. Nº 2769.
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(17 SHEETS)
DRAWING Nº B.

Upper Front Cross Rail

Section Line Fig. 46.

Section Line Fig. 14.

Left Front Post

Line Fig. 35.

Right Front Post

Section Line Fig. 28.

A

Beam which carries Feeding Machinery

a

Breast Beam

Section

Section Line Fig. 33.

The enrolled drawing is not colored.

Floor Line

13

11

13

12

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DUNCAN'S Specification.

(17 SHEETS).
DRAWING N°1.

FIG. 1ST.

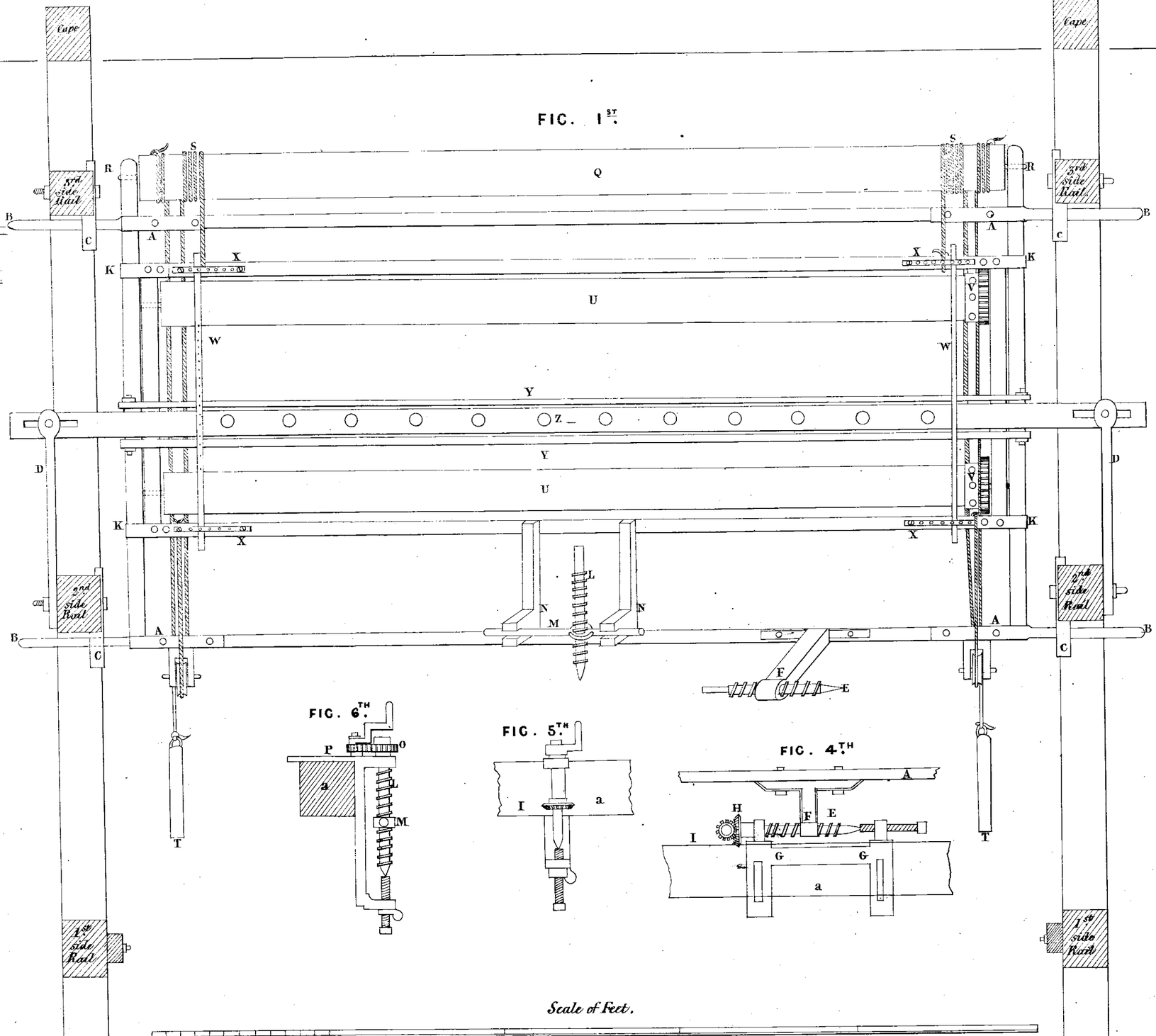
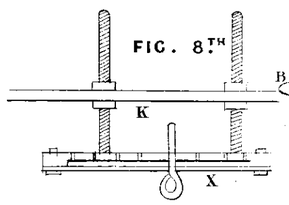


FIG. 8TH.



FIGS. 2D & 3D.

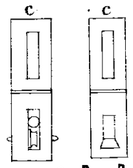
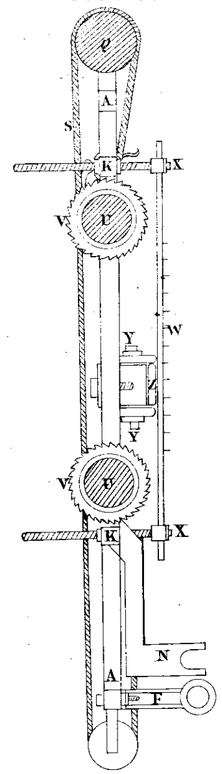


FIG. 6TH.

FIG. 5TH.

FIG. 4TH.

FIG. 7TH.



Scale of Feet.

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(17 SHEETS)
DRAWING N°2

FIG. A. 11TH

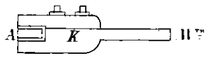


FIG. 12TH

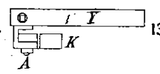


FIG. 9TH

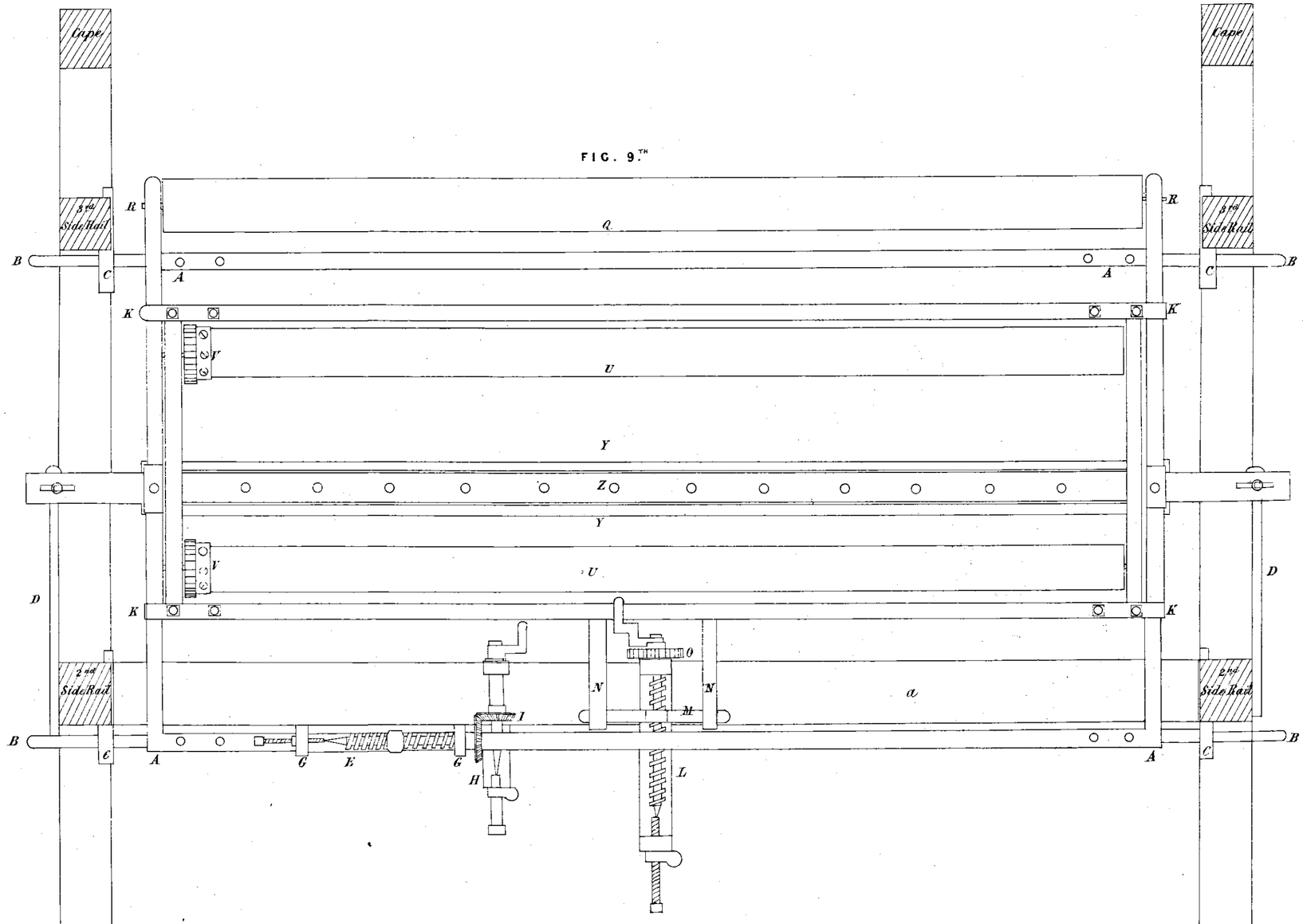
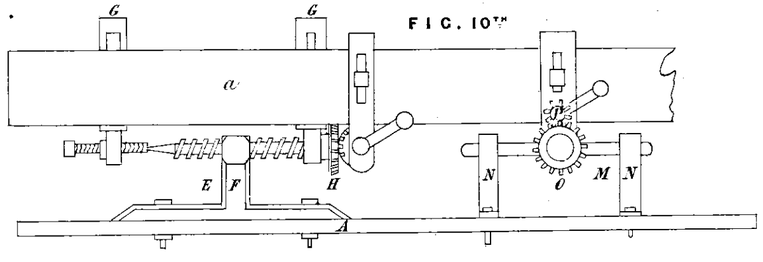


FIG. 10TH



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(11 SHEETS)
DRAWING № 3.

FIG. 24.

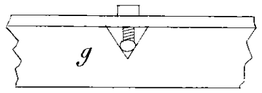
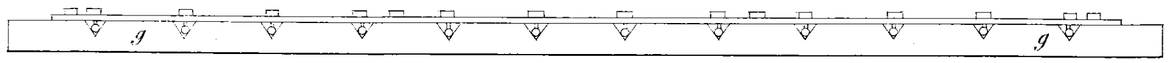


FIG. 17.



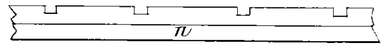


FIG. 22.

FIG. 21.

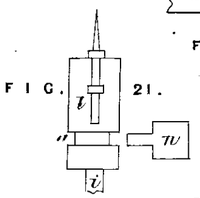


FIG. 23.

FIG. 15.

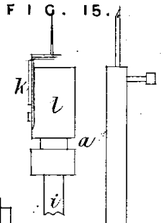


FIG. 16.

FIG. 20

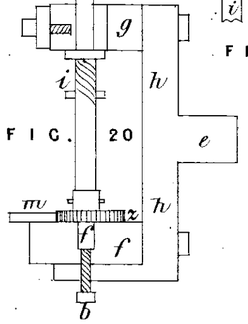


FIG. 14.

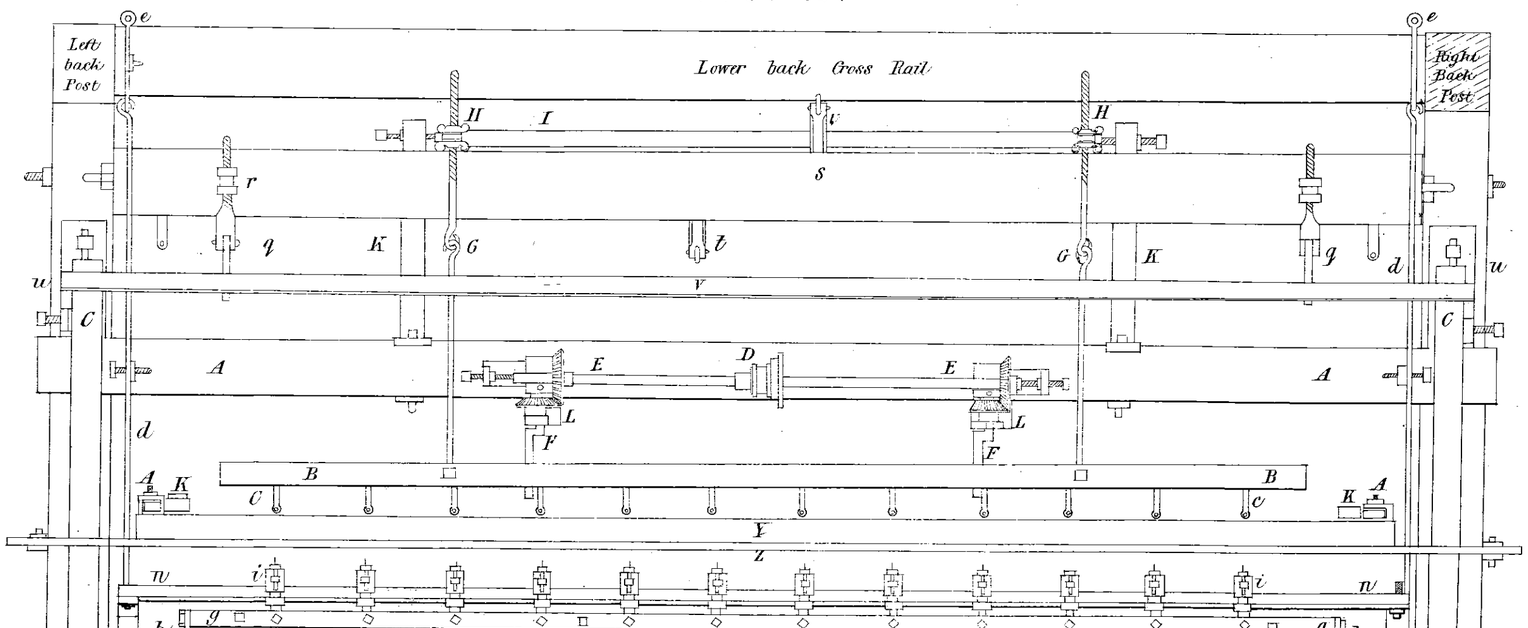


FIG. 19.

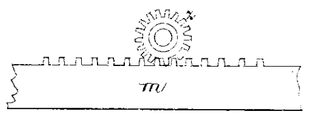
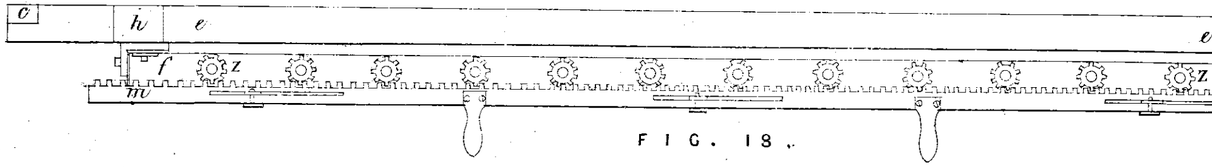


FIG. 18.



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(17 SHEETS)
DRAWING N° 4

FIG. 27.

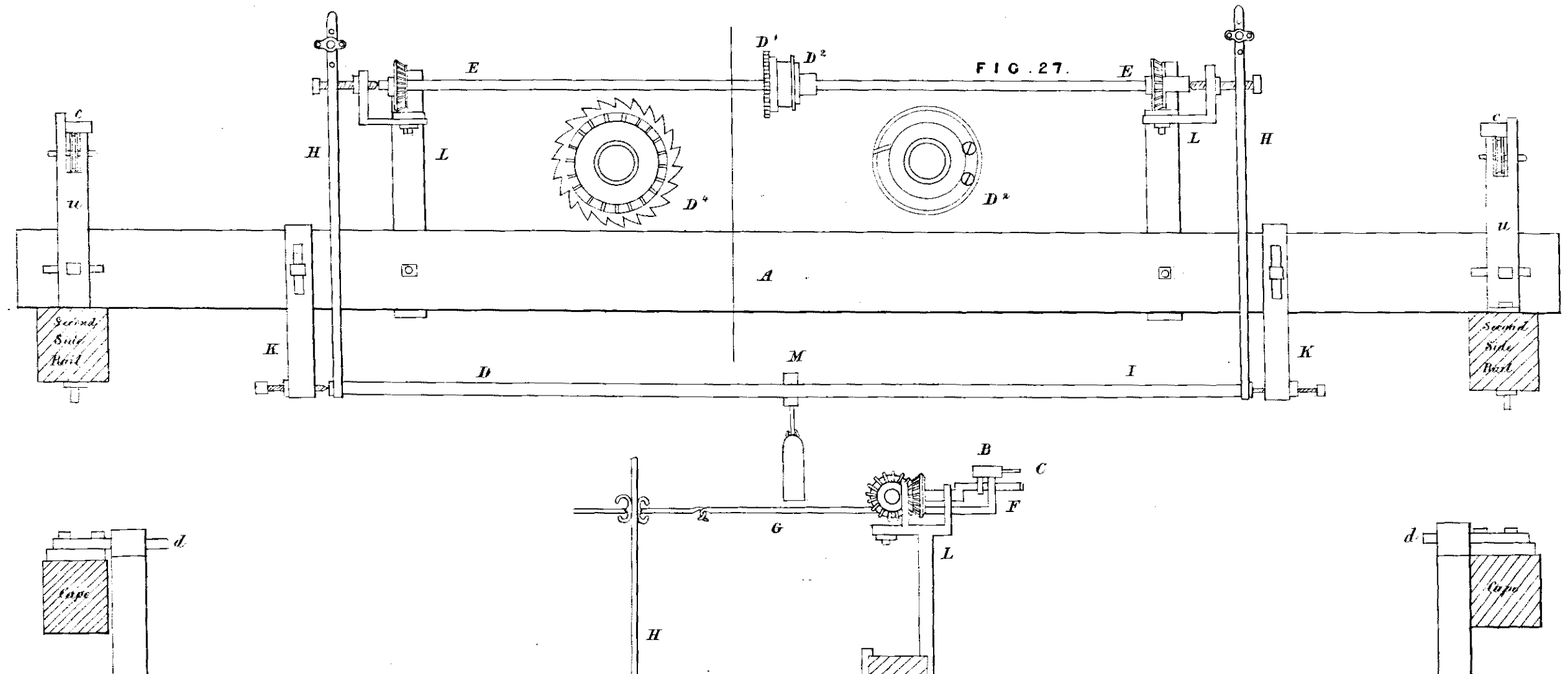

FIG. 26.

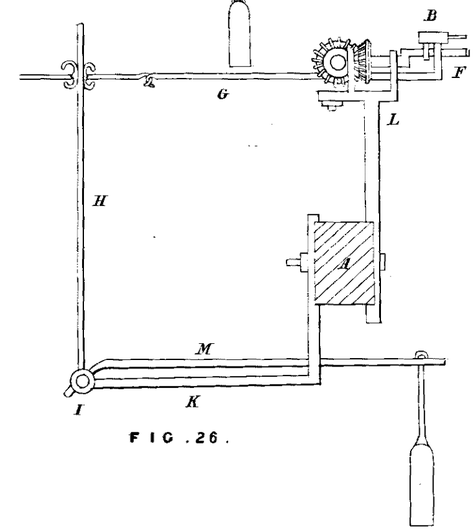

FIG. 25.

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17 SHEETS/
DRAWING N°5.

FIG. 28.

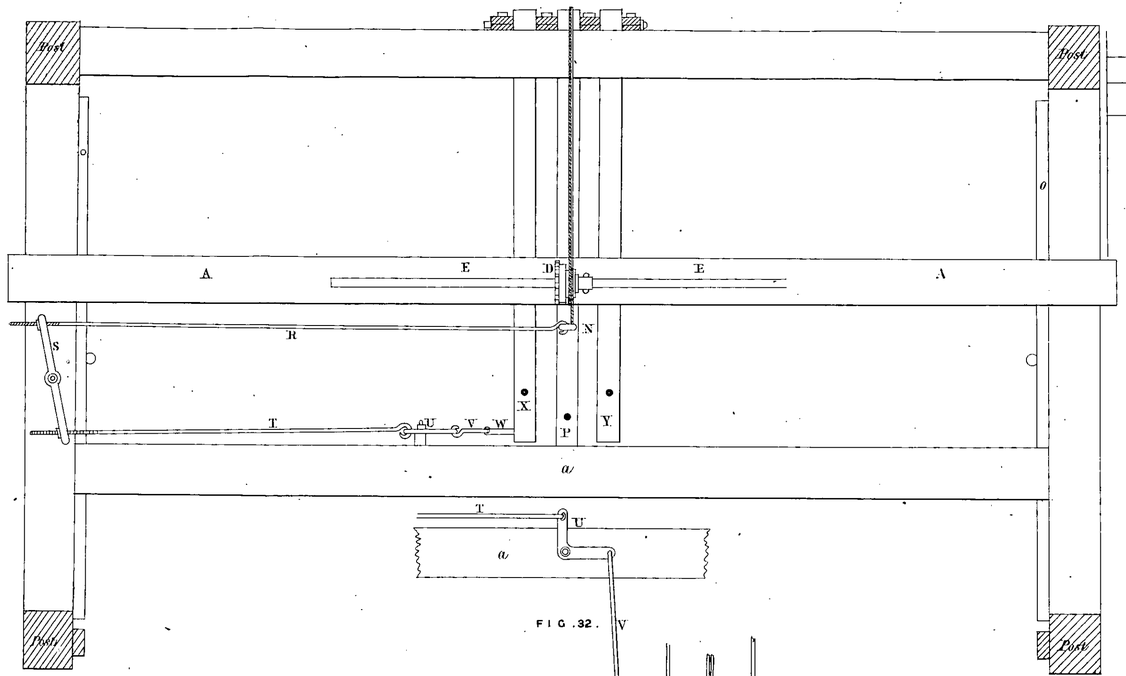

FIG. 32.

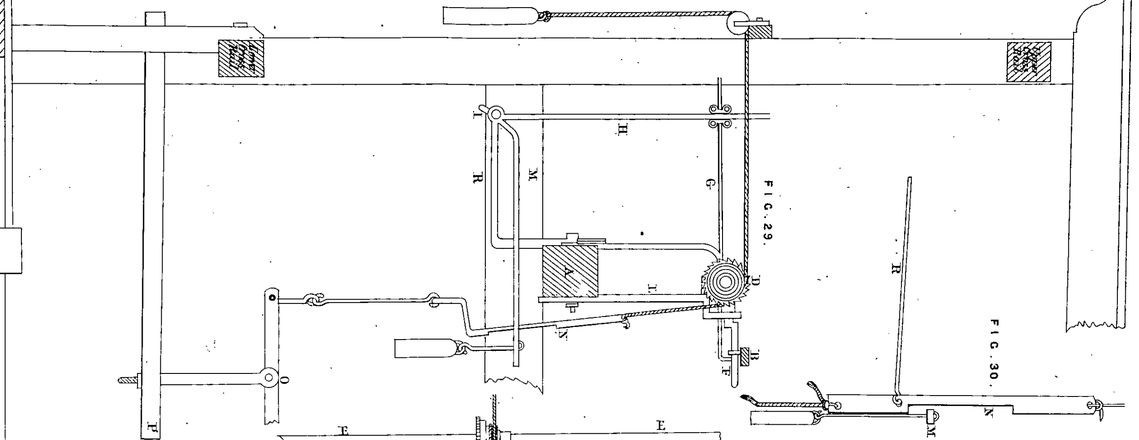

FIG. 29.

FIG. 30.

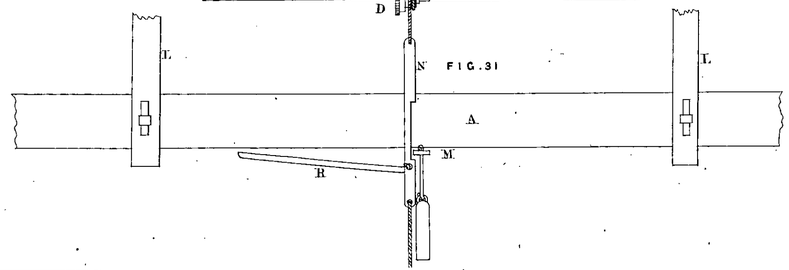

FIG. 31.

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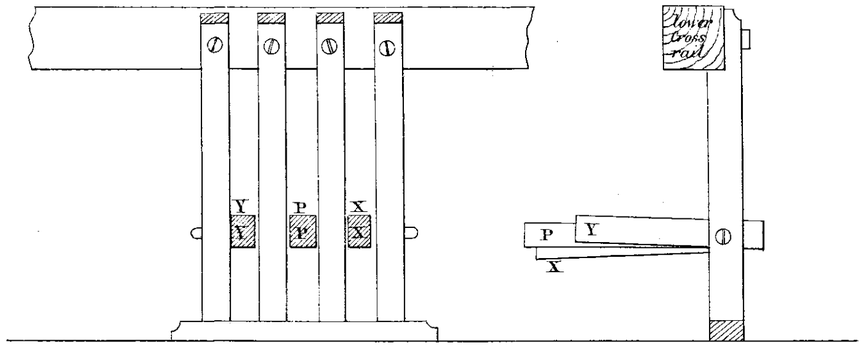

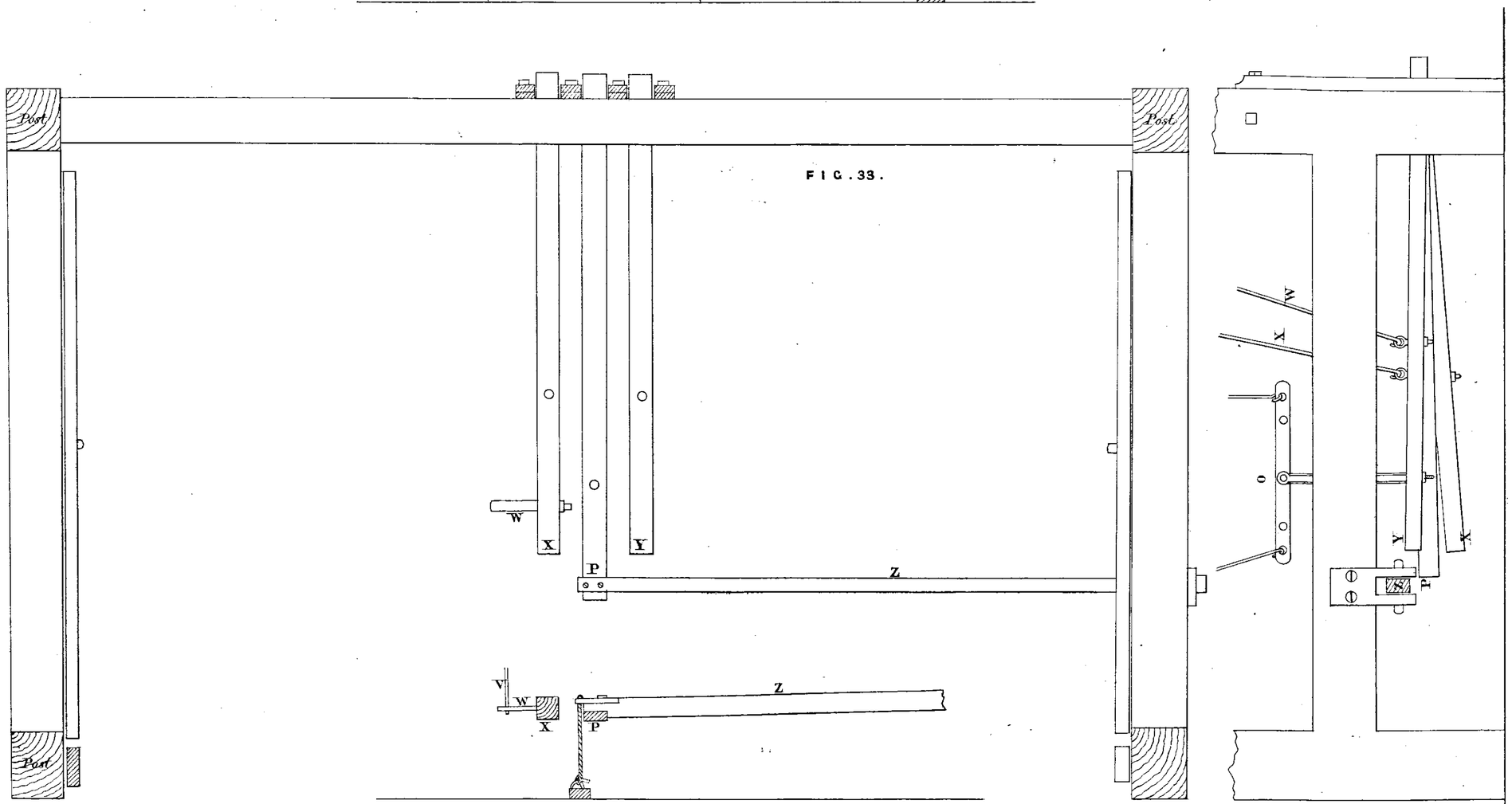

FIG. 33.

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FIG. 34.

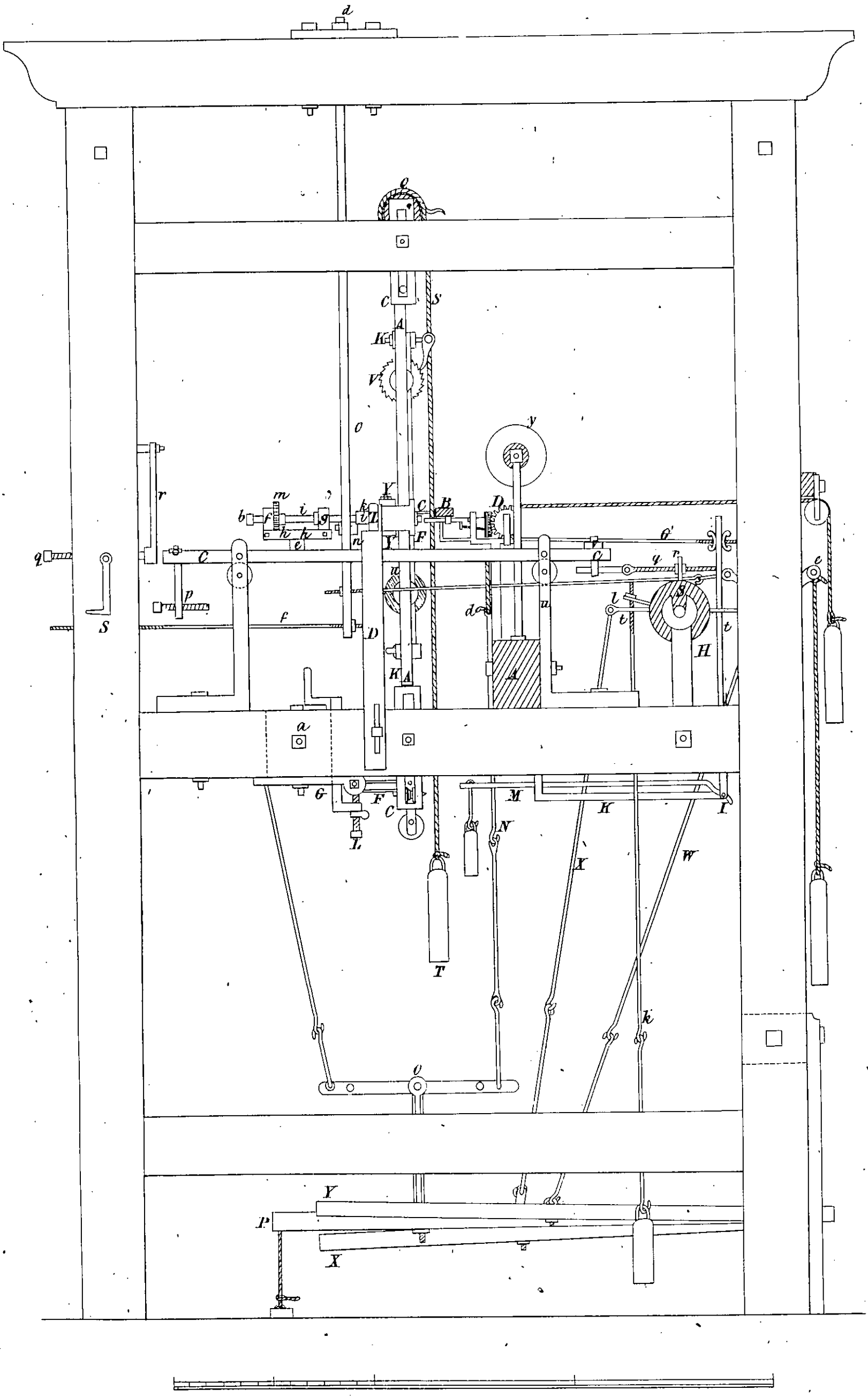

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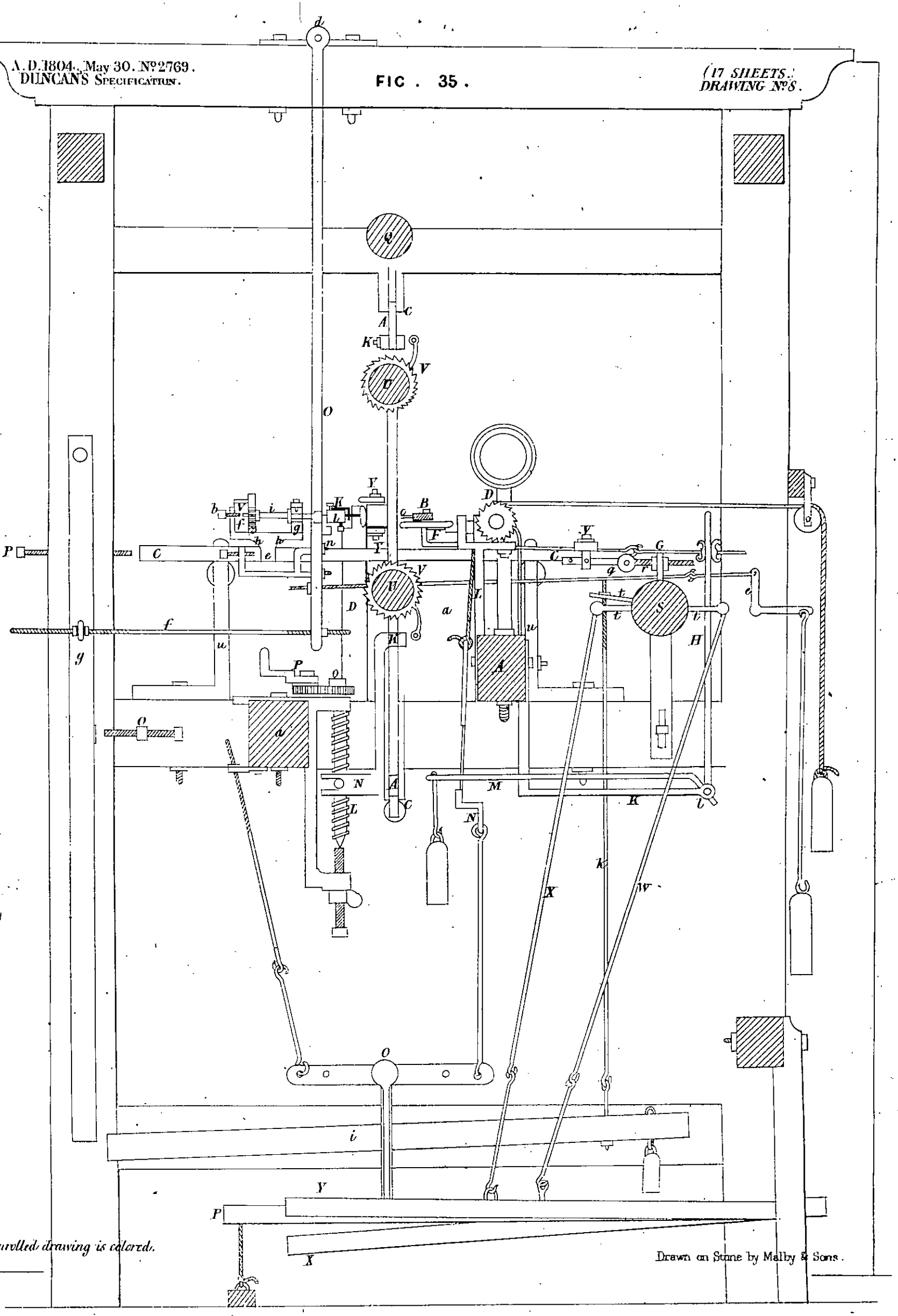
FIG. 35.

(17 SHEETS.)
DRAWING Nº8.



The enrolled drawing is colored.

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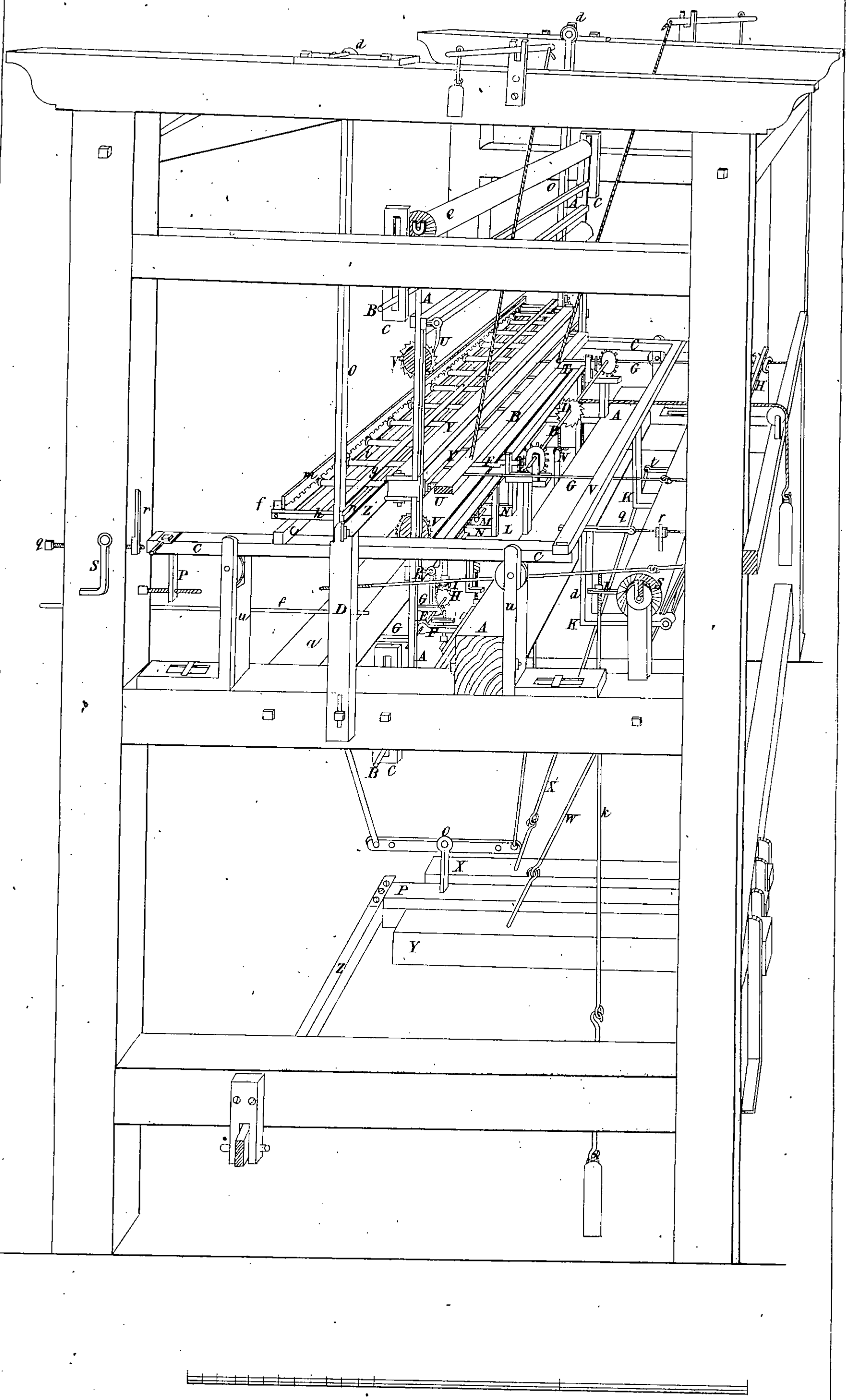
FIG. 36.



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(17 SHEETS)
DRAWING N° 10

FIG. 41.

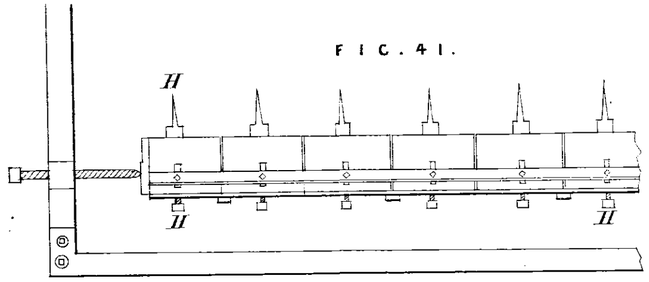
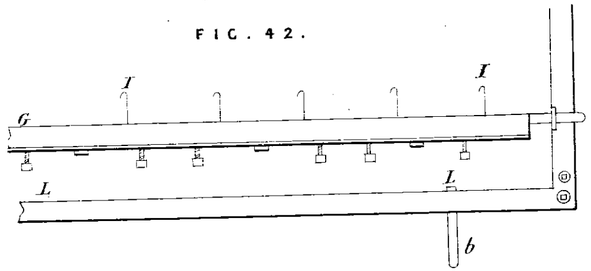


FIG. 42.



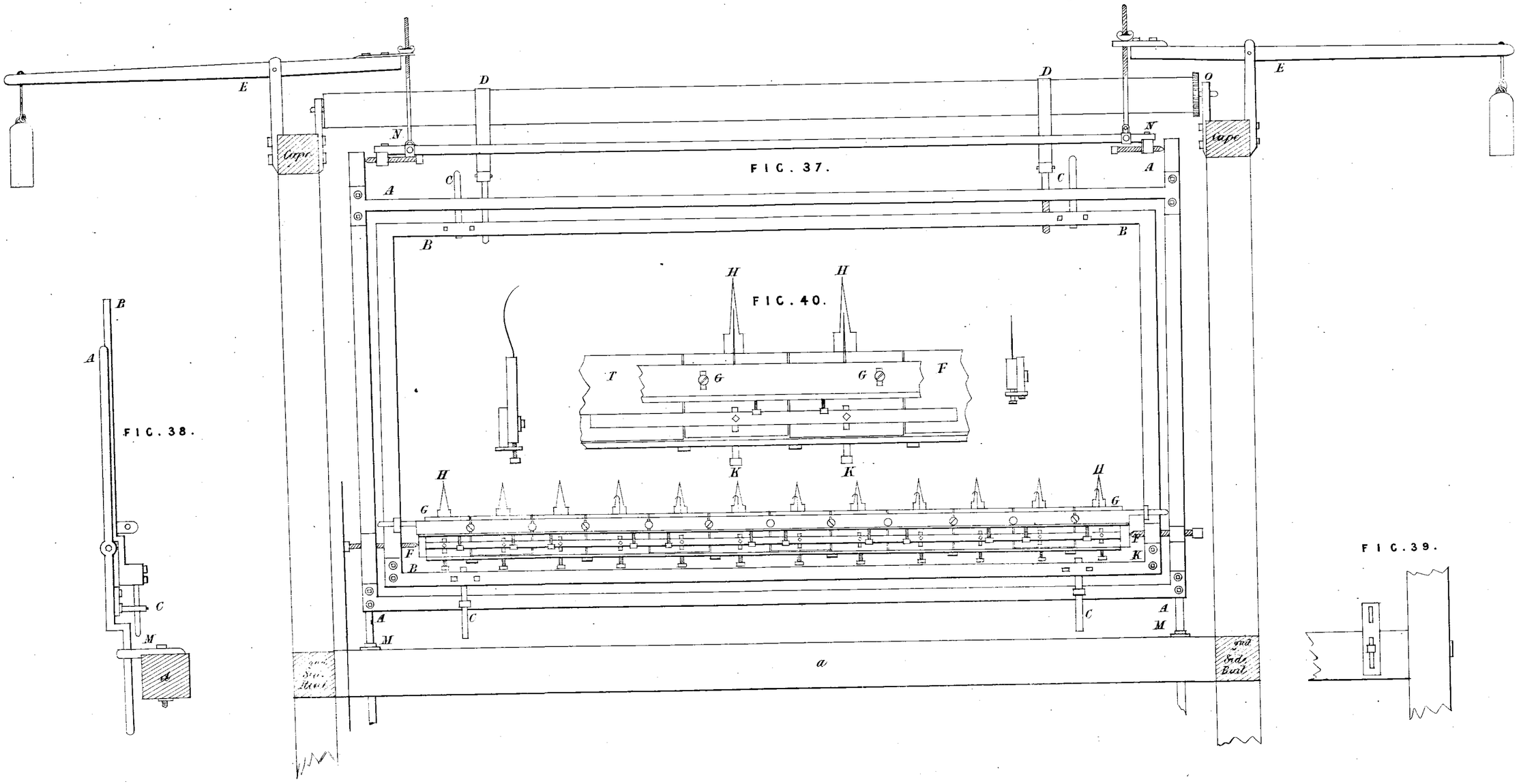


FIG. 37.

FIG. 40.

FIG. 38.

FIG. 39.

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(17 SHEETS.)

DRAWING N° 11.

FIG. 43.

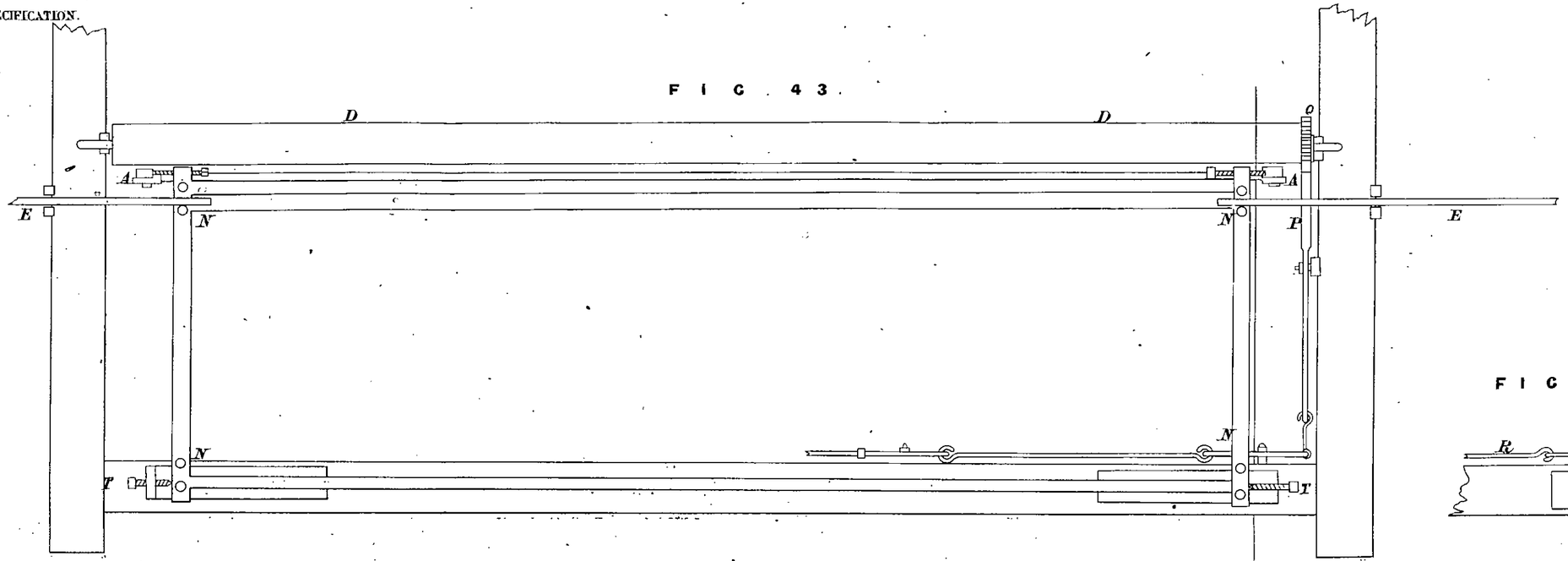


FIG. 45.

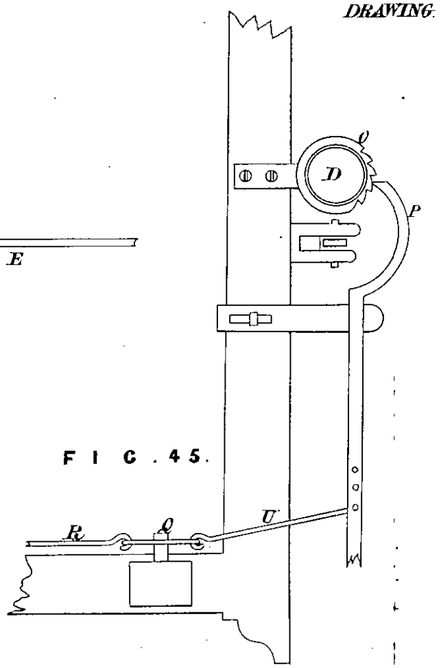
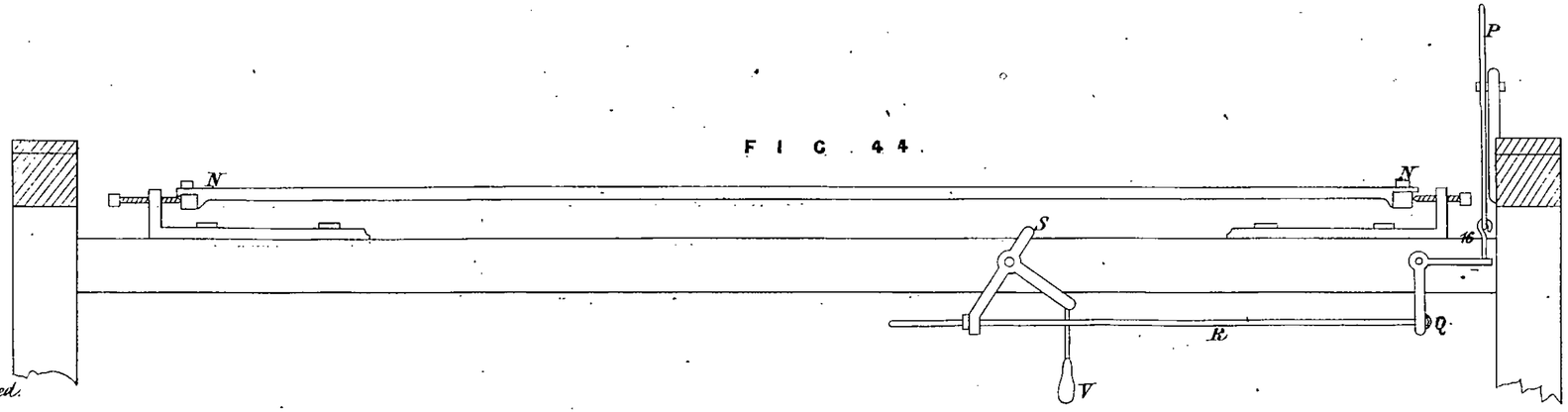


FIG. 44.



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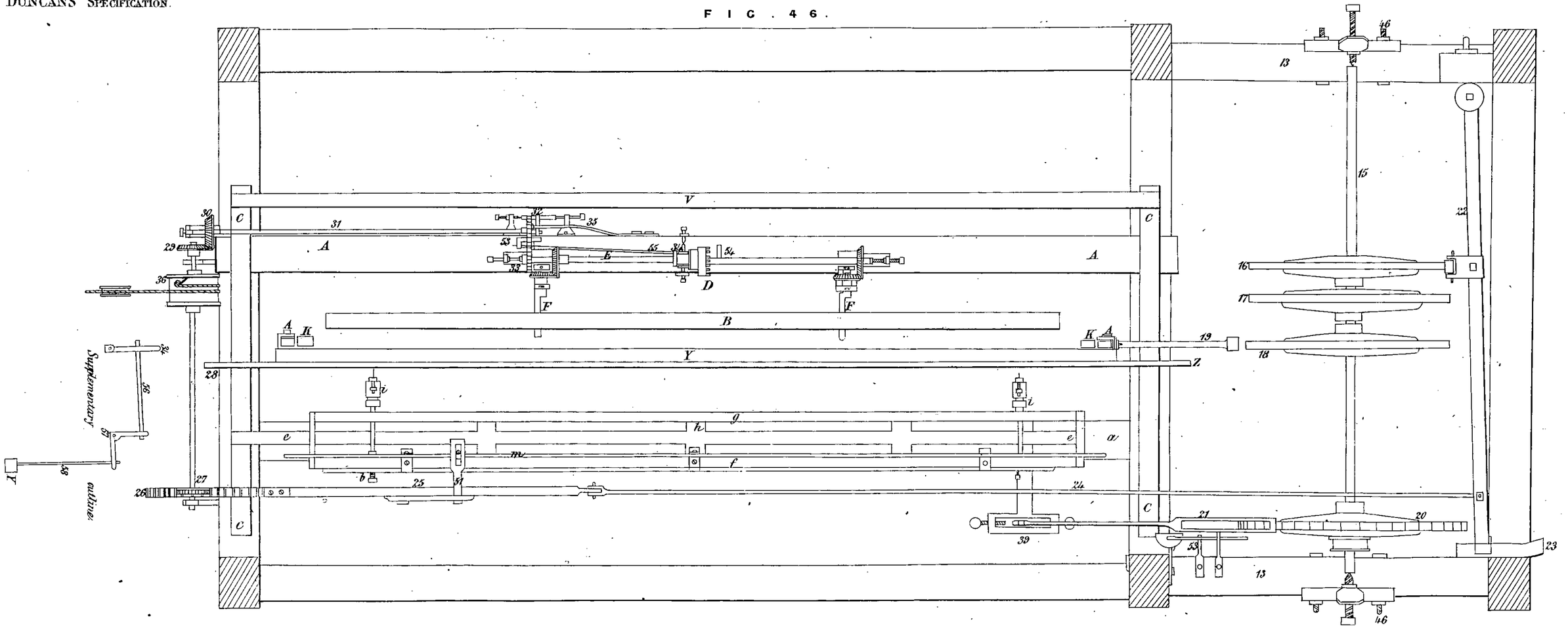
DUNCAN'S Specification.

[17 SHEETS]
DRAWING 12.

FIG. 46.



The enrolled drawing is partly colored.

Drawn on Stone by Malby & Sons.

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Printers to the Queen's most Excellent Majesty. 1856.

FIG. 47.

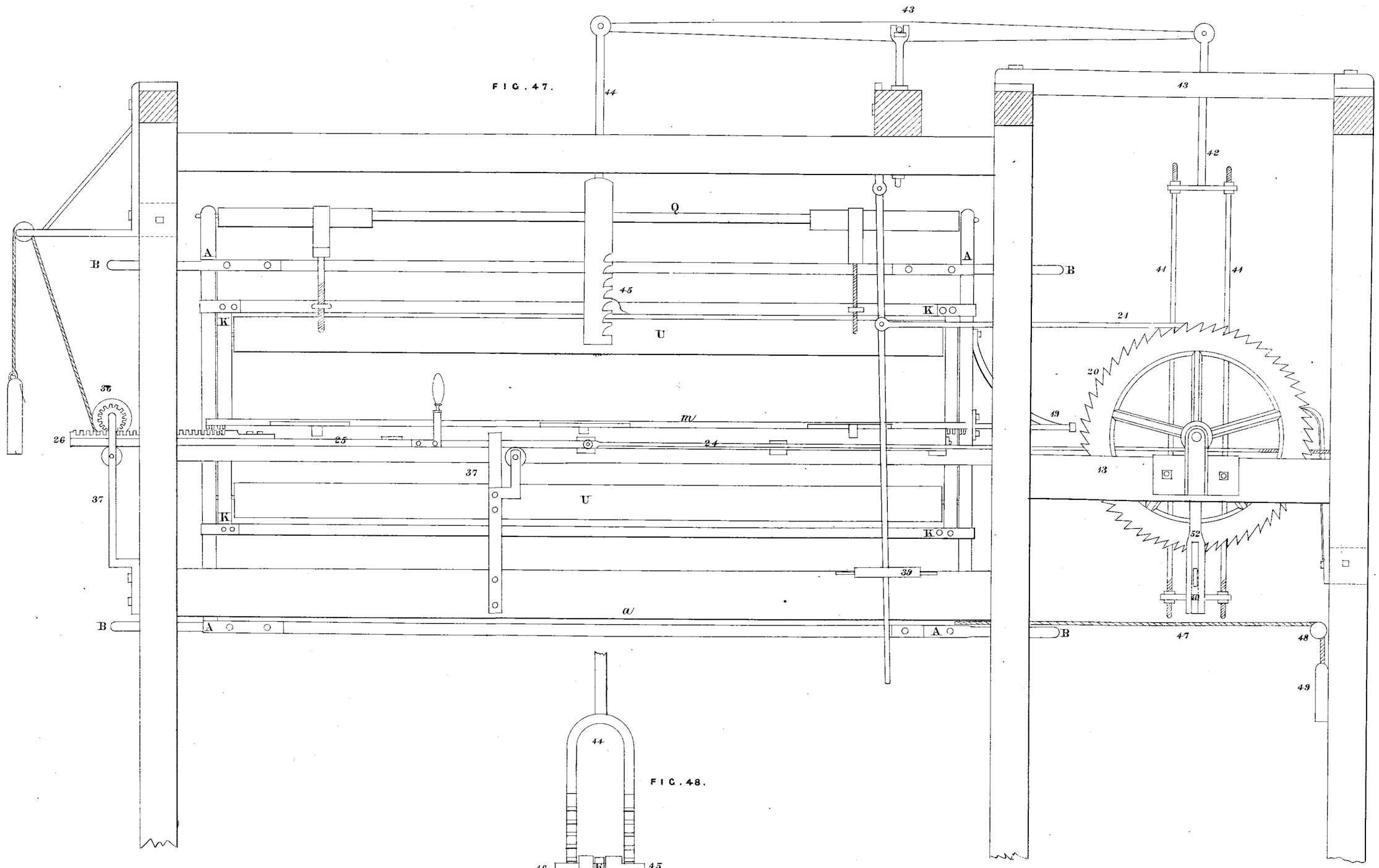

FIG. 48.

The enrolled drawing is colored

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FIG. 49.

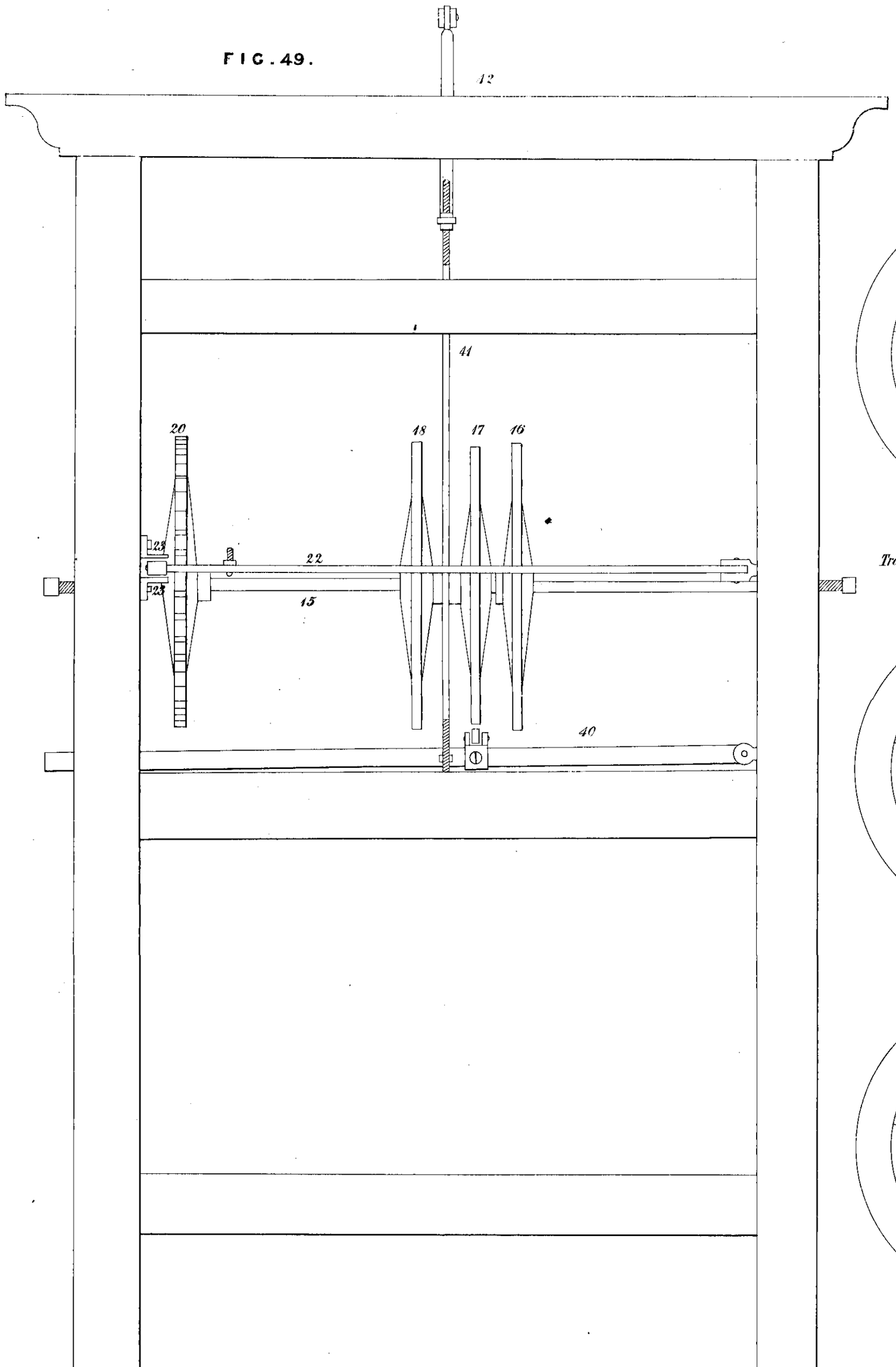
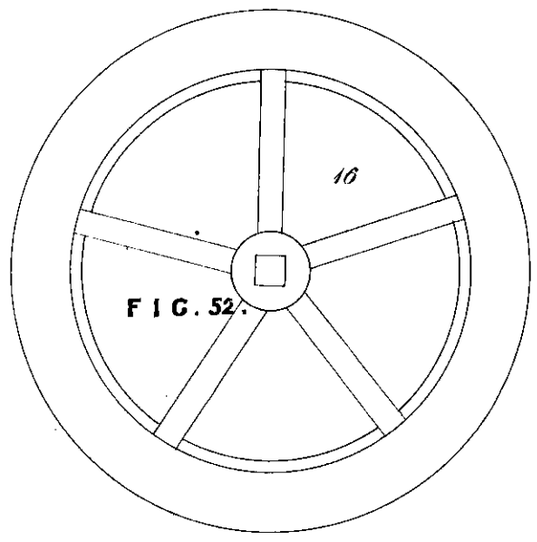
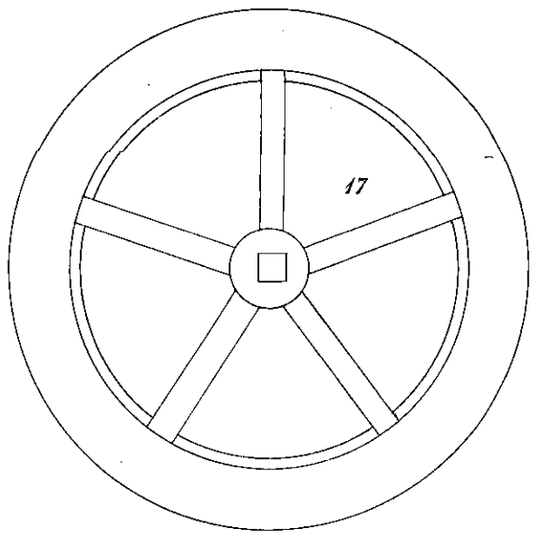
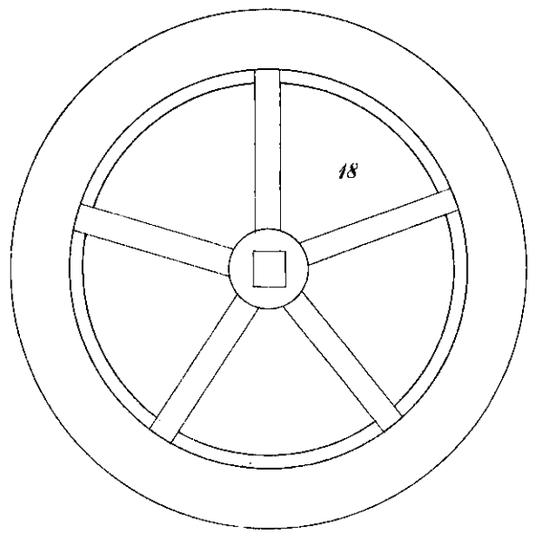


FIG. 52.



Traverse Wheel before being Cut.





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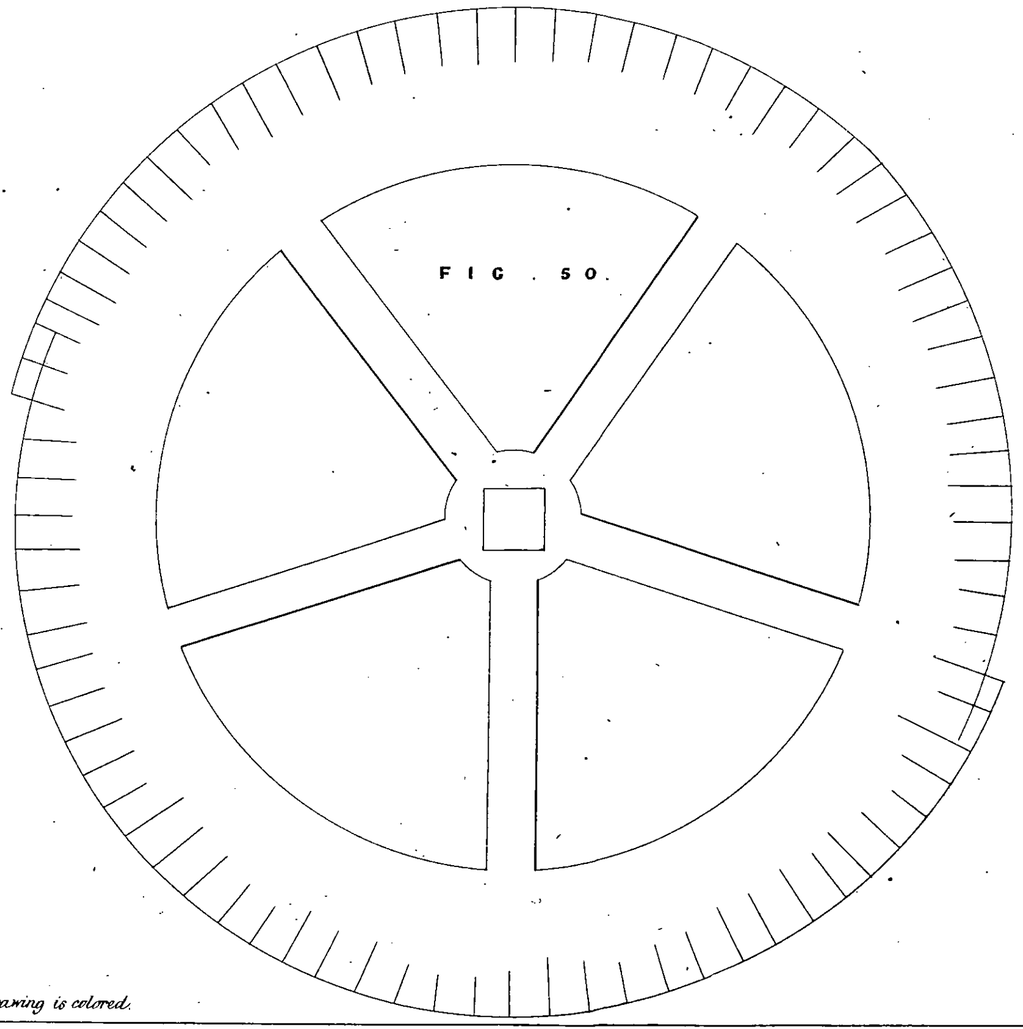

FIG. 50.

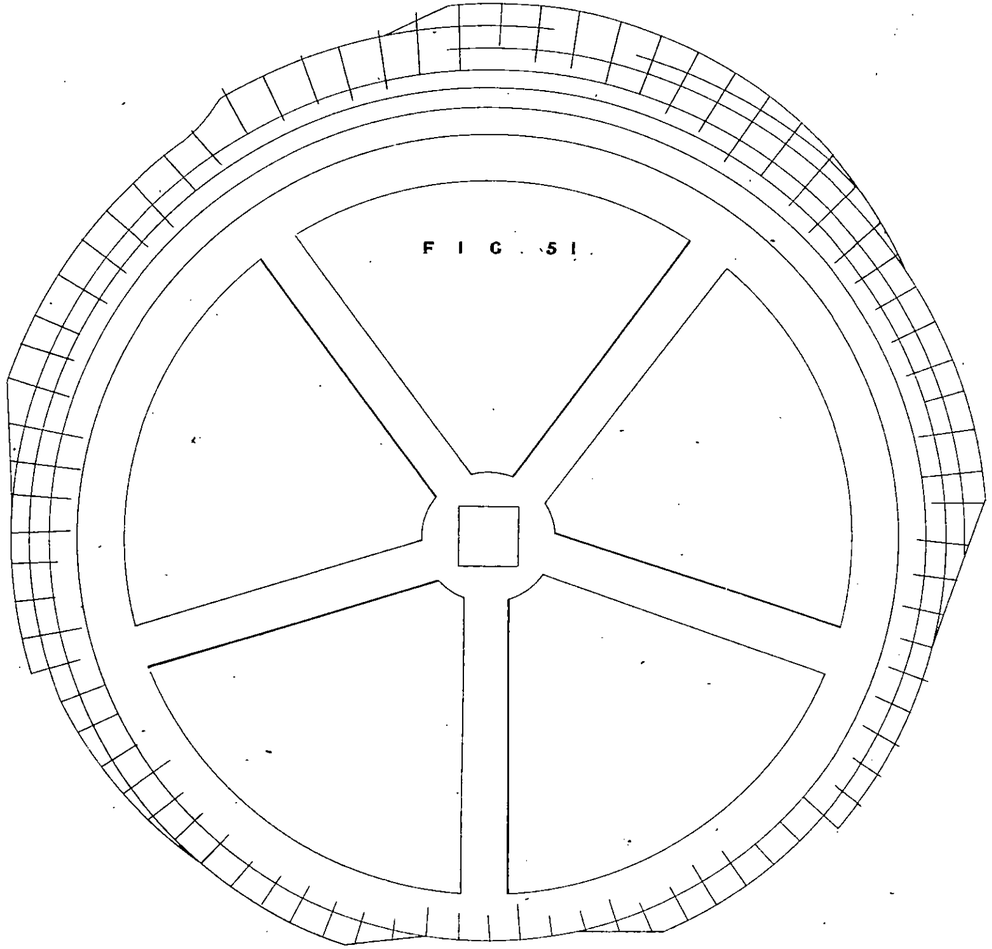

FIG. 51.

The enrolled drawing is colored.

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A.D. 1804 . . . . . N° 2769.

Tambouring Fabrics.

DUNCAN'S SPECIFICATION.

TO ALL AND SUNDRY TO WHOM THESE PRESENTS SHALL COME, JOHN DUNCAN, Manufacturer, in Glasgow, sends greeting.

WHEREAS the King's most Excellent Majesty, by Letters Patent under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date the Thirtieth day of May, in the forty-fourth year of his reign, gave and granted unto the said John Duncan, his executors, administrators, and assigns, and every of them, by himself and themselves, or by his and their deputy or deputies, servants or agents, or such others as might make use of, exercise, and vend his Invention of "**A NEW AND IMPROVED METHOD OR MEANS OF TAMBOURING OR RAISING FLOWERS, FIGURES, OR OTHER ORNAMENTS UPON MUSLINS, LAWNS, AND OTHER COTTONS, CLOTHS, OR STUFFS, OR UPON SILK, LINEN, OR WOOLLEN CLOTHS OR STUFFS, OR UPON CLOTHS OR STUFFS COMPOSED PARTLY OF SILK, FLAX, COTTON, OR WOOLEN**," within that part of the United Kingdom of Great Britain and Ireland called England, the Dominion of Wales, and Town of Berwick-upon-Tweed, in such manner as to him, the said John Duncan, his executors, administrators, and assigns, should, in his and their discretion, seem meet; and that the said John Duncan, his executors, administrators, and assigns, should and lawfully might have and enjoy the whole profit, benefit, commodity, and advantage, from time to time coming, growing, accruing, and arising by reason of the said Invention, for and during the term of years therein mentioned; to have, hold, exercise, and enjoy the said licence, powers, privileges, and advantages therein granted or mentioned to be granted to the said John Duncan, his executors, administrators, and assigns, for and during and unto the full end and term of fourteen years from the date of the said Letters

Patent, and immediately ensuing, and fully to be complete and ended, according to the Statute in such case made and provided; in which said Letters Patent is contained a proviso that if the said John Duncan should not particularly describe and ascertain the nature of his said Invention, and in what manner the same is to be performed, by an instrument in writing under his hand and seal, and cause the same to be inrolled in His Majesty's High Court of Chancery within one calendar month next and immediately after the date of the said Letters Patent, that then the said Letters Patent, and all liberties and advantages whatsoever thereby granted, should utterly cease, determine, and become void, as by the said Letters Patent, relation being thereunto had, will more fully and at large appear.

NOW KNOW YE, that I, the said John Duncan, in compliance with the said proviso in the said Letters Patent contained, and the purport and true intent and meaning thereof, and of His Majesty's said most gracious intentions, do by this instrument in writing under my hand and seal, duly executed, describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, as follows, that is to say:—

Tambouring upon cloth has hitherto been performed solely by manual labour, but as by this mode the operator can employ only one needle or hook, the operation is tedious. To enable one person to work with a number of needles or hooks at the same time, and, consequently, to perform a much greater quantity of work within a given period, is the object of the present Invention. In order to produce work of good quality of the various patterns required, the operator is enabled by this Invention, first, to vary the form of his pattern at pleasure in every direction required; secondly, to perforate the cloth with the needles or hooks, and bring them back, without injuring the fabric; thirdly, when the needles have perforated the cloth, to supply them with the thread or yarn which composes the pattern previously to their being brought back; and, fourthly, when a pattern is completed, to make fast the ends of the yarn. To shew the machinery necessary for effecting these operations, Drawings have been made of the different parts composing the machine by which they are accomplished, to which reference being made the machinery used for each of the four purposes stated above will appear, and from thence it will be evident how the whole are connected so as to produce the effect required.

First, to form any pattern, and to vary the same at pleasure in every direction required. If every needle can be brought opposite to every point in the cloth meant to be perforated, the object will be attained, for the needles being made to perforate successively every point required, any given pattern

may be produced. Now, as in this Invention it is only proposed at one and the same time to work a number of figures similar to each other, if the needles or hooks are placed parallel to each other, and at right angles with the superficies of the cloth, at any fixed distance from each other, so that the whole may move together, while the cloth remains stationary, then, if one needle or hook, by perforating in the successive points required, makes any given figure, every other needle will make one similar, or, if the whole needles or hooks remain relatively stationary, and the motion is communicated to the cloth, the same effect will be produced. I have tried both these plans, but I prefer the last, because the effect is the same, and the machinery is much more simple in construction and easier to work, for if the needles or hooks move, the machinery which supplies them with thread must also move in the same direction, and it is much easier to move the cloth than these two parts of the machinery, which, for the sake of steadiness, must be stout and heavy. I shall therefore describe the mode of producing patterns by moving the cloth.

The mechanical theorem upon which this motion depends is thus expressed in the first and second corollaries to Sir Isaac Newton's Third Law of Motion, as given in Motte's translaation of Newton's Principia, in the edition published in the year One thousand eight hundred and three, pages 15 and 16, which corollaries are as follows:—Corollary 1st. "A body by two "forces conjoined will describe the diagonal parrallellogram in the same time "that it would describe the sides by these forces apart." Corollary 2d. "And hence is explained the composition of any one direct force out of any "two oblique forces, and, on the contrary, the resolution of any one direct "force into any two oblique forces, which composition and resolution are "abundantly confirmed from mechanics." Which theorem I have applied to the purposes of this machine in the following manner:—The cloth to be tamboured is stretched in a vertical position between two cylinders placed parallel to each other in an oblong frame of cast-iron or other convenient substance, which slides freely up or down at pleasure in another frame. This last frame slides freely from right to left, or vice versa, carrying the other frame along with it, so that either a vertical or horizontal motion may at pleasure be communicated to the cloth, and when both are communicated at the same time the cloth moves in an oblique direction, the obliquity of which varies in proportion to the quantity of motion given to each of the two direct forces. By these means every rectilineal or curvilineal figure may be produced, and, consequently, every pattern required. The construction of these frames which produce this effect will appear from the Drawings Nos. 1 and 2 hereunto

annexed, which are transverse vertical sections of the machine; and in order to make these and the succeeding Drawings more intelligible, I have hereunto annexed two Drawings, marked A and B, which are representations of the wood-work which supports and connects the whole machine, to which I have referred in describing the different parts of the machine, in order to shew in what directions the sections are made. The one of these Drawings, viz^{t}. A, is an elevation of the wood-work as viewed from one side of the machine; and in speaking of the sides of the machine I refer to the situation in which the operator is placed at work, which is in front of the machine. Upon this Drawing are marked and enumerated the different parts of which one side frame is composed. On the opposite side of the machine is another side frame, exactly similar. Drawing B is an elevation of the wood-work as viewed from the front of the machine, or place where the operator sits at work. The different section lines in these two Drawings refer to the different Drawings to be afterwards described, and shew in what direction the machine is supposed to be cut for the purpose of illustration.

I now proceed to describe the cloth frames and their motions, which are illustrated by Drawings No. 1 and 2, hereunto annexed. Drawing 1st. Fig. 1st is an elevated transverse section of the machine, cut perpendicularly across in front of the cloth frames. The four A^{a} in Figure 1st shew the outer or horizontally moving frame, at each of the four corners of which there are projections from the upper and lower bars in an horizontal line, distinguished by four B^{a}, so that the frame may be moved from side to side, as after mentioned. These projections pass through eyes or bushes in or attached to the second and third side rails of the wood-work. By these means the frame, which is distinguished by four A^{a}, is supported at each corner, and slides freely from side to side when required. It is moved from side to side by turning the male screw E, which turns in the female screw F, fixed to the lower bar of the frame. This gives the horizontal motion. What is represented in this frame by K, at opposite corners, is the inner or vertically moving cloth frame, which slides freely up or down within the horizontally moving frame above described. The vertical motion of this vertically moving cloth frame is produced by the piece of metal M, passing through two grooves in the pillars N, N, fixed to the lower bar of this inner or vertically moving frame. In the centre of the said piece of metal M, which is swelled for the purpose, is a female screw, worked by the male screw L, by which the said piece of metal M is elevated or depressed at pleasure, and carries the inner or vertically moving frame K along with it. The ends of the said piece of metal M slide freely in the grooves in the said

pillars N, N, so as not to impede the lateral motion of the outer or horizontally moving frame above described, when acted upon by the screw E. Q is a cylinder resting on the pivots R, R, at each end thereof, which pass through grooves made to receive them in the upper part of the two side bars of the outer or horizontally moving frame. Round this cylinder pass two cords S, S, near to each extremity thereof, and one end of each chord is fixed to the upper bar of the said inner or vertically moving frame, and the other end of each of the said cords, after passing over a pully fixed near to either extremity of the lower bar of the said outer or horizontally moving frame, is made fast to the lower bar near to either extremity of the said inner or vertically moving frame. These chords serve the purpose of what some mechanics call bridles, their use being to regulate the motion of the said inner or vertically moving frame so that the same may rise or sink equally. T, T, are two counterpoises, suspended by cords from the cylinder Q, to balance the weight of the said inner or vertically moving frame, so that it may be moved with equal ease, whether ascending or descending. U, U, are two cylinders parallel to each other, turning, when required, upon pivots in the said inner or vertically moving frame. Between these the cloth is stretched, and is rolled from the one upon the other as often as is necessary, so as to roll round upon one cylinder the cloth upon which the pattern required has been worked, and to present to the needles or hooks the cloth upon which the pattern remains to be worked. On the end of each cylinder is a ratchet wheel V, with a catch, to keep the cloth to a proper degree of tension. These cylinders must be very true; and to prevent warping, to which all wood is more or less liable, I generally make them of block tin, and hollow in the middle. They have each a longitudinal groove, to admit a small wooden shaft, to which is fixed a piece of stout cloth. To the other end of this cloth is fixed the fabric upon which the pattern required is to be worked. The selvedges or edges of the cloth are stretched laterally by the plates or stretchers W, W, in which are a number of sharp pins represented by dotts, on which the selvedges of the cloth are fixed. The ends of the plates or stretchers W, W, slide in the boxes X, X, in which are a number of holes to admit pins to prevent the plates or stretchers from yielding when the cloth is drawn sufficiently tight. Y, Y, are two strong bars across the machine, fixed firmly to the outer or horizontally moving frame at each side thereof. Between these bars is another bar Z, in which is a hole opposite to the point of each needle or hook. This bar Z is fixed to the second side rails of the wood-work described above by the supporters D, D. The use of these three bars is to prevent the cloth from yielding by its own elasticity when pierced by the needles or hooks. The cloth is stretched between the two

cylinders passing in front of these three bars. By these means the two motions, horizontal and vertical, are communicated to the cloth, and the combination of these two motions, by means of the said screws, in different proportions, produces every other motion required. In said Drawing No. 1 are given supplementary figures, which shew more clearly the shape and construction of some of the different parts. Figure 2nd and 3rd are front views of the eyes or bushes C, as constructed by me, but which admit of various modes of construction. Fig. 4th is a plan of the male horizontal screw E, and female screw F, as they will appear when the eye is perpendicular over them, the box which contains the female screw F being fixed to A, the lower bar of the outer cloth frame. The screw E revolves upon its own axis in the pieces G, G, which are screwed fast to the breast beam *a*, which does not appear in Figure 1st, being there supposed to be cut away, but which will appear clearly in Drawing 2d, Fig. 9. In Fig. 4 it is represented as transparent, to shew the shape of G, G, which are screwed to its lowest edge. On the end of the screw E is a bevel wheel H, of thirty-two teeth, worked by a bevel pinion I of sixteen teeth, which is turned by means of a small handle by the operator's right hand, when a lateral motion of the frame is required. The pinion is fixed on a perpendicular spindle, the supporters of which are also fixed to the upper and lower sides of the breast beam *a*, next to the cloth. Fig. 5 is an elevation of this spindle, seen from the back of the machine. Fig. 6 is a profile section of the breast beam *a*, with the upright screw L and its supporters, shewing how they are fixed to the beam *a*. M also appears here in profile. On the screw L is fixed the spur wheel O of thirty-two teeth, turned by the pinion P of sixteen teeth. This pinion is worked by the operator's left hand, where a vertical motion of the frame is required. Fig. 7 is a profile section of the two frames shewn in Fig. 1, cut nearly in the middle, to the different parts of which I have attached the same reference letters as in Fig. 1st, as the one merely shews the same machinery in profile, which the other does in front. The shape of all the parts is clearly shewn in the Drawings, so as to be obvious to a good mechanic from a careful inspection of the Drawings. Fig. 8 is a plan of one of the four stretcher boxes mentioned in Fig. 1st, as seen from above, with the screws which connect them with the upper and lower bars of the inner frame.

I next proceed to describe Drawing 2, Fig. 9, hereunto annexed. Fig. 9 is a vertical transverse section of the machine cut perpendicularly across behind the cloth frames in the direction of the reference section line mentioned in Drawing A. It is chiefly intended to shew how the horizontal screw E and the vertical screw L appear when viewed from behind, and as a further illustration of the way in which they and their supporters are fixed to the breast

beam *a*, which is here visible. A small part of the lower bar of the outer frame, distinguished by four A's, is represented as transparent, to shew the horizontal screw E, and box with female screw, behind it, which would otherwise be hid. All the reference letters in this Drawing are the same as in the former No. 1, this being merely a view of the same machinery behind which Fig. 1 represents as seen in front and Fig. 7 in profile section. In Fig. 10 in this Drawing the screws E and L, and machinery connected with them, are again shewn as they would appear to an eye placed perpendicularly over them. Fig. 11 shews part of the outer and inner cloth frames, and how the grooves which connect them are constructed. Here, too, the eye is placed immediately above the object. K is part of the upper or under bar of the inner frame (for both have the same shape). A is the side bar of the outer frame, seen in section. Fig. 13 shews how the end of the cross bar Y is fixed to A, the side bar of the outer frame, which appears in section, the eye being still above it. K is the side bar of the inner frame, also seen in section.

These Drawings 1 and 2 contain all the machinery necessary for stretching the cloth, and also for shifting it, so as to produce any pattern. This, as already described, is done by the operator's hands (by turning the screws) in the interval between working every loop or stitch of which the tambouring is composed. The vertical screw L gives the motion up or down. The horizontal screw E gives the motion right or left, as required. When both screws are turned at the same time they produce an oblique motion, varied at pleasure by giving more or less motion to either screw; and as this obliquity may be varied every stitch, all right or curved lines can be produced, and any pattern formed. Most of the remaining motions required in working are produced by the feet pressing down alternately three treddles, as will be afterwards described. The second operation is to perforate the cloth with the needles or hooks, and bring them back without injuring the fabric. To perforate the cloth with the needles, only one motion is necessary. As the cloth is stretched across the machine in a vertical position, the needles, in order to be at right angles to the superficies of the cloth, must also be placed in a frame extending across the machine, and must lye in an horizontal position. The motion communicated to this frame must be from the front towards the back of the machine, and the same motion reversed will bring it again to its former place. This motion is effected in the following manner:—The four c^3 in Drawing 3, Fig. 14, represent a rectangular frame of cast-iron, with projecting arms towards the front of the machine, which I call the needle carriage, and which is parallel to the horizon. Upon its cross bar *e*, *e*, is placed the frame which contains the needles, which will afterwards be described. This

needle carriage gives the perforating and returning motion to the needles. To the back bar of this carriage V are attached two double-jointed pieces of iron *q*, *q*, which connect V with two studs *r*, *r*, fixed perpendicularly in the the roller *s*. In the roller are also fixed two horizontal studs *t*, *t*, from which iron rods pass to the treddles below, to continue the connection to the moving power which works these treddles. In Drawing 8, Fig. 35, this carriage and the roller *s* appear in profile section. C, C, is one side of the needle carriage, resting upon friction wheels in the bearer U, U, which are screwed to the second side rails of the wood-work. *q* is one of the double-jointed pieces connected at one end with the back bar of the carriage V, and at the other end with the perpendicular stud *r*, fixed in the roller S. From the horizontal back stud the iron rod W continues the connection to the treddle Y, and from the front stud *t* the rod X continues the connection to the treddle X, Y, when pressed down by the operator's right foot, by depressing the horizontal back stud *t*, draws the carriage *c*, *c*, towards the back of the machine, and the needle frame being fixed upon the cross bar *e*, *e*, of this carriage, the needles consequently perforate the cloth; X, when pressed by the left foot, operates in an opposite direction, and brings the carriage to its former position. But as all tambouring consists of loops drawn successively through the cloth, and also as each loop is drawn through that which preceded it, the instrument used in the operation, altho' commonly called a needle, is (more properly speaking) a hook. Now as this hook, after having perforated the cloth, must be open for the purpose of receiving the thread which forms the tambouring, means must be used to shut it after it is supplied, and before it returns, otherwise it would catch not only the thread but also part of the cloth and also the preceding loop, through the centre of which it passes in perforating.

To explain the means which I have used to effect this purpose, it will be proper, in the first place, to explain the construction of the needle; and to avoid obscurity I shall hereafter always use the term needle, altho', as before stated, it might more properly be called a hook. The needle is a straight piece of steel wire, near the point of which a barb is cut, similar to that of a fish hook; under this barb a groove is struck longitudinally into the stem of the needle, by a screw engine, with a chisel and bolster, much in the way practised by makers of stocking-frame needles; the needle and barb are then pointed sharp. The barb is set straight, and not too high, much in the same shape as it appears at N, in Drawing 3, Fig. 16. The needle is then tempered, and is ready for use. The needle when to be used is put into the handle or case *i*, in Figure 16, in the end of which a small hole is drilled, about an inch deep, to receive it. I fix the needle into the handle with a cement composed of

common sealing-wax mixed with fine powdered brick-dust. This cement when heated melts, but when cold holds very fast, so that a needle may easily be taken out when requisite, by heating the handle in which it is fixed sufficiently to dissolve the wax. In the longitudinal groove is placed a small piece of wire, also grooved quite to the point, but without any barb, and which I shall call the wire slider, for which see Figure 15. When this wire slider, resting in the groove of the needle, is pushed towards the needle point, it slides under the barb of the needle, when the groove in the wire slider receives the barb, and the needle is shut. When the wire slider is drawn back it quits the barb of the needle, and the needle is then open. The wire slider is fixed with silk thread to a piece of brass *k*, as in Figure 15, and this is screwed to a round hollow piece of brass 1, which is fitted upon the handle *i*, so as to slide easily backward and forward. The whole may be seen, Fig. 20. In that part of 1 which is opposite to where *k* is fixed is a long slott through which a screw passes into the handle *i* (see Fig. 20 and 21), so as to allow 1 to slide backward and forward, but to prevent it from turning round on the handle, except when the handle also is turned, in which case it goes along with it. Fig. 22 and 23 are end views of 1, to shew the bore through which the handle *i* passes.

The middle frame is next to be described. On the cross bar of the carriage *e*, *e*, is erected the needle frame, consisting of two bars *f*, *f*, and *g*, *g*, placed on edge, parrallel to each other and to the cloth, with their lower edges screwed fast to pieces on the cross bar *e*, *e*, at *h*, *h*, *h*, *h*. The needle handles, of which twelve are represented between *i*, *i*, are of brass, turned round and straight, and they are placed horizontally and parallel to each other in bushes or eyes formed to receive them in the bars *f*, *f*, and *g*, *g*, so that they may revolve freely on their own axes. The end of the handle which receives the needle projects about two inches beyond the bar *g*, *g*, to receive the brass 1 (Fig. 20), and to allow it room to slide. The bushes in the bar *g*, *g*, are triangular notches, as shewn in Figs. 17 and 24, and on the top of the bar are flat plates through which a screw passes to touch the upper part of each handle gently, so that they may be always tight fitted, and at the same time revolve freely when requisite. In the back bar *f*, *f*, the bushes are round holes to receive the small pivot Y (Fig. 16), at the end of the handle *i*. On this pivot a pinion Z, of sixteen or eighteen teeth, is fixed, which is worked by a rack *m*, and thus the rototary motion is given to all the handles when required. See Figs. 18 and 19. The way of placing the rack above the handles appears by Fig. 18. The rack is hung on the bar *f*, *f*, and slides freely from side to side. *b*, *b*, Fig. 14, is a bar fixed to *f*, *f*, through which a

number of screws pass, the end of each of which touches the pivot Y of each needle handle, for the purpose of setting the needle a little towards the cloth, if required. See Fig. 20. On each handle is a collar of brass, with one of wire behind (Fig. 20), and a hole is drilled through the handle, and a pin put thro' to prevent it from shifting. The pin is drawn when it is necessary to take out a handle. Fig. 20 is a profile section of the carriage, the two needle bars, which compose the frame, and a handle, pinion, collars, brasses, slider, and needle, all above described. The top plates on the bar *g*, *g*, move at one end on a joint or hinge, and are fixed with a screw at the other, so that any handle may be taken out when required. I generally make these plates from six to nine inches long each. The machinery necessary for opening and shutting the needles is as follows:—The form of the wire slider, Fig. 15, and its connection with the pieces of brass *k* and 1, having been already described, it is only necessary to shew how they are connected with the machine, so as to move the slider backward and forward in the groove in the needle. When the needle is free from the cloth, the slider is drawn forward below the barb, and the needle is shut. When the needle moves forward to enter the cloth, it becomes open, so that it may receive the thread. When the needle returns, to disengage itself from the cloth, the slider, whose point has also gone a little way through the cloth, remains stationary until the barb of the needle has entered the groove in the slider; they then return together. The mode of effecting this is as follows:—In each piece of brass 1 a hollow is turned at *a*; between the needle frame bar *g*, *g*, and the cloth, hangs a cross bar *n*, *n*, which I shall call the slider bar. This bar appears as looked down upon in Fig. 4; its shape will appear in Fig. 25. This Figure is an elevation of the slider bar *n*, *n*, as viewed from the front of the machine. It is screwed at each end to two upright pieces *o*, *o*, hanging on the round pivots *d*, *d*, screwed to the capes of the wood-work, so that the bar *n*, *n*, may vibrate freely backward and forward. In the upper part of *n*, *n*, is a square notch for each needle, as represented. This notch receives the hollow in the piece of brass 1 at *a*, in Fig. 20, and by these means, when the bar *n*, *n*, vibrates, all the pieces of brass 1, and consequently the sliders, are drawn backward or forward on the handles, and at the same time the motion of the handles on their own axes is not impeded. For the means of giving motion to the bar *n*, *n*, see Drawing 8, Fig. 35. *n* and *o* are the slider bar and one of the arms in profile section. To the arm *o* is fixed one end of the wire *d*, the other end of which is connected with the crank *e*, working on a pin in the back part of the wood-work, and to the other end of this crank is hung a weight. The operation of this weight draws the bar *n* towards the back of

the machine, to shut the needle. When the bar is drawn far enough back, it is stopped by two screws *p*, *p*, appearing in Fig. 14, fixed to each arm *o* of the bar *n*, and pressing against the cross bar *e*, *e*, of the carriage. To the arm *o* is also fixed another wire *f*, connecting it with the lever *g*, which swings freely on the pin or screw nail fixed in the front post. J is another lever working on a pin or nail passing through its centre into the lower side rail. The back end of this lever is connected by a wire *k*, with a horizontal stud 1, fixed in the roller S. The lower part of the lever *g* being stopped by the front end of the lever *i*, prevents *g*, and consequently the bar *n*, from moving along with the carriage, whereupon the needles open. When the needles are about half way through the cloth, the back end of *i*, being raised by the wire *k*, the other end is depressed, and the lower part of the lever *g* disengaged; the bar *n*, and all the apparatus connected with it, is then drawn towards the back of the machine by the weight behind, until the lever *g* is stopped by the screw *o*. This allows the sliders to go a little way through the cloth, but not so far as the needles go, where they remain till, the carriage returning, the screws *p*, *p*, in Fig. 14, are pushed back by the cross bar *e*, *e*, as soon as the needles are shut. The back end of the lever *i* then descends by the weight attached to it, the other end rises, and the machine is in its former position. As both this and the carriage motion formerly described take their motion from the roller S, worked by the treddles Y and X, it is plain that when properly tempered they will move together. An apparatus as above described is connected with each end of the slider bar *n*, *n*. This completes the machinery required to perforate the cloth with the needles and bring them back without injuring the fabric. The next operation required is to supply the needles with the thread or yarn which forms the tambouring. This operation is performed in the interval after the needles have perforated the cloth and before they return. It consists merely of two motions, first, each thread must describe a small circle round its needle; secondly, after having completed the circle round the needle, each thread must be drawn towards the back of the machine, to bring it under the barb into the hook or eye of the needle. I call this operation feeding, and the needle by which it is performed the feeding needle, to distinguish it from the needle formly described, which may be called the tambouring needle; and I shall now describe the requisite machinery. The whole of this machinery is supported by a beam of wood A, A, as in Fig. 14, extending horizontally across the machine, a little behind the cloth to which it is parallel. Its ends rest on the two second side rails; through each of these ends a bolt passes horizontally, by which the beam A, A, is screwed to the back supporters *u*, *u*,

of the needle carriage, as shewn in section by Fig. 35. The machinery, as seen from above, is represented in Fig. 14. B, B, is a bar of wood screwed to one of iron, in which are fixed the brass feeding needles represented between C, C, each having a small hole drilled through it near the point, through which a thread passes. The cranks F, F, are fitted into the standards L, L, so as to revolve upon their own axes. On the axes of each crank is a bevil pinion of sixteen teeth; these pinions are turned by two bevil wheels of thirty-two teeth, fixed near the ends on the iron spindle E, E, hung at either end on a centre screw, so as also to revolve freely on its own axis. The other or front ends of the cranks F, F, pass through two bushes or round holes below the feeding bar B, B, into which they are fitted easy, so that when the cranks are turned once round by the spindle E, E, performing half a revolution, the bar B, B, is carried along with them, and the point of each feeding needle describes a smalle circle round its corresponding tambouring needles. B, B, must also be fitted to slide easily backward and forward on the cranks F, F. B, B, is connected by two iron rods G, G, with two upright arms H, H, made fast on an horizontal spindle I, I, hung in centre screws so as to vibrate freely on its own axis. Fig. 26 is a profile section of the same machinery. B, the feeding bar; with one needle C; F, one of the cranks; G, one of the iron rods connecting the bar B with one of the upright arms H; K, one of the bearers of the horizontal spindle I, near the ends of which the upright arms H, H, are fixed, and from the middle of which the lever M projects horizontally forward; A is the cross beam in profile. Fig. 27 is an elevation of the same machinery from behind. By a careful inspection of of Figs. 14, 26, and 27, the construction of all the parts of this machinery will be better understood by a mechanic than by any description, it being always recollected that Fig. 14 is a ground plan or view of the machinery from above; Fig. 26, a profile or view from one side; and Fig. 27, a direct elevation or view from behind. On the middle of the spindle E, E, is a pully D, consisting of two pieces. The first, D 1, Fig. 27, is made fast upon the spindle. The edge is cut as a ratchet wheel of sixteen teeth, and on the flat side is cut another ratchet with a number of small teeth, as represented in the small Figure D 1, annexed to Fig. 27. The second piece is a broad pully, to receive a cord passing three or four times round it. One of its flat sides is a little hollowed, and has a spring catch fixed into it, as shewn in the view D 2. This piece is fitted close to D 1, so that the spring catch rests in the ratchet on the flat side of D 1, and when D 2 is turned round it carries D 1 along with it; but D 2, being loose upon the spindle, will turn back without communicating the motion to D 1, which is further stopped by

a catch resting in the ratchet of sixteen teeth upon its edge. This is so similar to the barrel of a clock or common roasting jack that it will be easily understood. The motions of the feeding machinery are as follow:—A cord passes three or four times round the pully D on the middle of the spindle E, E, as shewn in the profile section, Fig. 29. One end of the chord is fixed to the upper end of a piece of iron N, and the other passing over a pully behind has a weight attached to it. The lower end of N is connected by a wire with one end of the lever O, moving at its centre upon a joint in a piece of iron fixed to the middle treddle P; the other end of O is connected by a wire with the breast beam *a*, *a*, as shewn in Figures 34 and 35. When the treddle P is pressed down by the operator's right heel, it pulls the chord, and consequently turns round the pully D, and gives the rotatory motion to the feeding machinery. When the heel is eased or withdrawn, the weight attached to the cord brings back the treddle and loose part of D to their former positions. In the piece of iron N is cut a notch, which, when it is drawn up by the weight, carries up the horizontal lever M along with it. The rising of M makes the two upright arms H, formerly described, move towards the back of the machine, and by the connection rods G, G, draw back the feeding bar B, B, which thus pulls the threads into the hooks or eyes of the tambouring needles. See again Figs. 14, 26, 27. Fig. 30 shews N in front and M endways, as also does Fig. 31. To N, as in Figures 28 and 31, is fixed a wire R, which, going in a horizontal direction to the left side of the machine, connects N with one end of the lever S. From the other end of S a wire T, connects S with a crank U, fixed perpendicularly to the breast beam *a*, *a*. Fig. 28 is a ground plan, the eye being above. From the other end of the crank U a wire V descends perpendicularly to a stud W, fixed in the left treddle X, as is very plainly shewn in Fig. 32, which is an elevation. When the treddle X is pressed down to bring out the needles, as already described, the connecting wires V, T, R, being pulled, draw N towards the left; the notch thus quits its hold of M, which then descends by the weight suspended from it, and the feeding needles resume their former position close behind the cloth. By these means, first, the circular motion of the feeding needles round the tambouring needles is effected; secondly, the feeding needles are drawn back to bring the thread under the barb of the tambouring needles; and, thirdly, when the tambouring needles quit the cloth, the feeding needles return to their former place. The yarn or thread is warped and rolled round a cylinder, as practised by weavers. This cylinder is hung horizontally across the machine above the beam A, A, to which its supporters are screwed. A section of it appears at *y* in Fig. 35, and an end view of *y* in Fig. 34. On

the end of the cylinder *y* is a small pully, to which is fixed one end of a cord, the other end of which passes over another, a small pully, fixed to any convenient part of the wood-work; a small weight is hung to this end, to keep the yarn at a proper tightness. Besides this, a very light piece of wire hangs on each thread behind the feeding bar B, B, to assist in tightening any one which may be slacker than the rest. In Fig. 33 is a ground plan of the treddles. The middle treddle P, which gives motion to the feeding machinery, is longer than the other two, and has a cross-piece Z, extending to the lower side rail, which is pressed by the right heel when the motion is to be given. This saves the trouble of shifting the right foot from Y to P. The end of P is fixed by a cord or chain to the floor at some distance, in order to prevent its rising more than enough. The supplementary Figures in Drawing 6 shew the treddles in different points of view. This description completes the parts necessary for working the tambouring. The fastening the threads, which is the last thing in the operations required, is quite a separate part, and only used when a pattern is completed. I will therefore first describe the connection of all the working parts, as shewn in Figs. 34, 35, and 36, which will be little else than a recapitulation of what has already been described, and afterwards take the fastening machinery by itself. Fig. 34 is a profile elevation of the machine directly viewed from the right sides. Fig. 35 is a profile section of the machine, which is here represented as if cut asunder near the middle. Its chief use is to shew the connection of some parts which are hid by the intervention of the side frame of the wood-work in Fig. 34. Fig. 36 is a perspective view of the machine. The eye of the spectator is supposed to view the machine about four inches higher than the cape of the side frame, about six inches behind the machine, and about eight feet distant to the right side. In the perspective view of the machine is given, in this Figure, the yarn cylinder *y* is omitted, because its situation is sufficiently shewn by Figs. 34 and 35, and it would hide much of the machinery if introduced in Fig. 36. Some small parts shewn in the former Figures are also omitted. To make these three Figures, viz^{t}, Figs. 34, 35, and 36, understood, it appears only necessary to attend to the different parts, the letters referring to which respectively are the same in all the three Figures, and are also the same which have been before used when describing the parts separately. The only part appearing in these three Figures, not described before, is a screw P, to regulate the extent of motion of the carriage *c*, *c*, by touching *u*, when the needles are sufficiently far through the cloth, and another screw *q*, which, by touching or swinging lever *r*, stops the end of the carriage frame *c*, when it has returned after the cloth is perforated by the tambouring needles. If *r*, which swings freely upon its

joint, is pushed to one side, the carriage will come the breadth of *r* farther out, which is necessary when fastening the ends of the threads, as after described. S is a catch, to keep the machine fast when not at work. It hooks on a cross-piece fixed to *c*, and represented in Fig. 14. In order to work the machine, which I now proceed to describe, referring more immediately to Fig. 36, the operator seats himself in front of the breast beam *a*, at the middle, looking towards the machine. His right hand is placed on the handle which turns the horizontal screw E; his left on the handle of the upright screw L; his right foot is placed on the treddle Y; his left foot on the treddle X. A pattern for one needle is printed upon the cloth, which, being traced by that needle, all the others make similar figures. Having turned his screws until the point of the cloth meant to be perforated comes opposite to the needle, he presses down the treddle Y with the ball of his right foot; this carries the needles through the cloth until the carriage *c*, *c*, is stopt by the stop screw P coming in contact with the standard *u*, *u*. The same pressure opens the hooks, to receive the yarn, as formerly described. He then presses down the cross-piece Z with his right heel, and immediately allows it to rise again to its former position. This produces the two motions required for feeding, as formerly described. And, lastly, he presses down the treddle X with his left foot, which shuts the needles, and draws them out of the cloth, each bringing the loop formed by the yarn along with it. When far enough out, the carriage is stopt by coming in contact with *r* and *q* (see Fig. 34). He then, by means of the two screws, shifts the cloth until the next point to be perforated comes opposite to his pattern needle, and proceeds as before. The following general remarks may tend to make some parts of the operation more obvious:—When the yarn has been wound on the yarn cylinder *y*, each thread is put through the small hole drilled near the point of the feeding needle C. It is then put through the cloth by a common sewing needle, and made fast in front. That part of the tambouring needles which forms the hook or eye is always kept in the same line of direction in which that part of the pattern which is working runs; and when the line of direction requires to be changed the relative position of the hooks must also be changed in a correspondent direction. This is done by turning each needle handle on its own axis by means of the rack *m*, which is moved from side to side by the operator's hand. The feeding needles must perform exactly one revolution at each time, and they must stop at that point of the circle which they describe immediately behind the hook or eye of the tambouring needle. Of course, when the tambouring needles are turned to assume a new position by means of the rack *m*, the feeding needles must also be moved round until they correspond.

Having thus described, as shortly and at the same time as clearly as I am able, the construction and use of the various parts of this machine, I have only to express an earnest wish that any mechanic who studies this Specification will bear constantly in mind that in all the Drawings annexed the same letter constantly refers to the same part of the machine, in whatever point of view or in whatever Figure it is represented. By attending to this he will find every part in all its different points of view in one or other of the Drawings, and this will probably assist him more in forming a correct idea of their shapes and construction than any description which can be given. The Drawings were taken, with very great care and attention, from a machine which has been for some time actually at work, and are in general upon a scale of two inches to a foot. It only remains to describe the manner of fastening the ends of the threads. To fasten the end of every thread when a pattern is compleated it is only necessary to draw its end through the last loop. If the operator passes a common sewing needle, with a thread attached to it, through every loop, it will keep the figures sufficiently fast until the whole piece of cloth is tamboured, when the piece is finished, and taken out of the machine. The threads which cross behind between the flowers are clipped away; the threads drawn through the loops, as above described, are pulled away. The end of each thread which composed the tambouring then comes through the last loop, and every figure is made fast. When this mode is pursued, no fastening machinery is required, the whole being done by the operator's hand. The following plan, however, is quicker, for which I shall first describe the machinery used, and then the manner of using it. Fig. 37 represents a transverse vertical section of the machine cut in front of the breast beam *a*. All the machinery, except that used for fastening, is omitted in this Figure. The frame, distinguished by four A's placed at its corner, hangs perpendicularly in front of the cloth, and as near to it as possible without touching it. This frame is supported at the top by two centre screws passing through the ends of the side bars of a horizontally placed frame, above seen as from the front N, N. The real shape of this frame is represented in Fig. 43, where it is viewed from above, and is distinguished by four N's placed at its corners. This frame is supported by two centre screws at T, T, which are fixed to the front cross rail of the wood-work. The frames move on the center screws at A and T as joints, so that the frame pointed out by four A's, in Fig. 37, slides up and down freely. The levers E, E, and weights attached to them, serve as counterpoises. The lower part of the upright bars of the frame pointed out by four A's pass at M, M, through two eyes fixed to the breast beam *a*, to keep the frame steady at bottom. Within this frame is another, distinguished by four B's, which is hung from the

cylinder D, D, which turns on gudgeons in its ends, which pass through eyes supported by the capes of the wood-work C, C, C, C. Four pieces fixed to this frame pass through four eyes in the frame marked by the four A's, and to the back of the cylinder D, D, a weight may be hung as a counterpoise. By these means either of the frames A or B will slide up or down independant of the other. The frame distinguished by four A's carries a horizontal bar F, F, supported by two centre screws passing through the sides of the frame into sockets in the ends of the bar F, F. On these sockets the bar turns as on a joint, backwards or forwards. The frame distinguished by four B's carries the horizontal bar G in front of the bar F, F, from the ends of which projecting round pieces of metal pass through eyes in the sides of the frame B. By these means the bar G also slides from side to side when required. The horizontal bar F, F, part of which is shewn in Fig. 41, carries a set of double wires H, H, shaped as in the Figure. These wires are pointed sharp, and are of unequal length. In the side of the longest is a small longitudinal groove, in which the point of the shortest rests by being bent a little inwards. These wires are placed at the same distance as the tambouring needles formerly described, so that the point of each of the longest wires may rest exactly below the corresponding needle. K, K, are temper screws, to elevate or depress any wire which may require it, independantly of the rest. The bar G, G, part of which is shewn in Figure 42, carries a set of wires I, I, the ends of which are sharp, and turned horizontally towards the operator's left hand at right angles to their stems. These wires are also below their corresponding needles, and in front of the double wires H, H, as shewn in Figs. 37 and 40. L, L, are temper screws, to elevate or depress them when necessary. These wires H, H, and I, I, are cast in plates of tin, in moulds made for the purpose, and these plates are fixed to the bars which carry them, as shewn in Figs. 41 and 42. In order to work this machinery, when a pattern is completed the tambouring needles are turned by the rack, as formerly described, until their barbs are straight upwards. The needles are brought a little further than usual from the cloth by the means formerly explained. The frame distinguished by four A's is then pushed upwards by the operator's hand till the long points of the double wires H, H, pass through each loop of the tambouring. The tambouring needles then are made to perforate the cloth, their points passing between the two wires of H, H, and another loop is wrought in the usual way. The bar G, G, is then drawn a little to the right hand. The frame distinguished by four B's is raised up. The bar G, G, is next brought again towards the left, until the cross point of each of the wires I, I, is above the corresponding loop. By depressing the

bar G, G, a little, till they are rather under the tambouring needles, each loop is caught hold of by the cross points of the wires I, I. The sliders which shut the tambouring needles, already described, are then drawn back until the needles are open. The last-wrought loops are then drawn out of the barbs or hooks of the tambouring needles by means of the wires I, I. The rack is then turned until the barbs point downwards to the floor. The tambour needles then approach the cloth until their points touch it. The bar F, F, is again elevated a little. The square shoulders of the double wires H, H, carry up the loops preceeding the last, and which have rested on them since they divided them at the beginning of the fastening operation, as formerly described. The hooks of the tambour needles receive these loops. The slides are again brought forward, and the needles shut. The needles have now quitted the last loop, and caught the preceding one. The bar F, F, carrying the double wires H, H, is then sunk down to its former place, the bar G, G, pulled again towards the right, to disengage the cross points of the wires I, I, from the loops; the bar G, G, is then also sunk to its former place; the needles are then pushed again through the cloth, but are immediately returned without being fed; the second last loop is by these means drawn through the last, and forms a kind of knot, and the operation is compleated. The operator shifts to another figure, and goes on as before. On one end of the cylinder D, D, is a ratchet wheel O, with a catch P, which falls into it, when the frame distinguished by four B's is raised to a proper height, as before described. The use of this is to keep the said frame steady until the operation of fastening is performed. When the frame is to be pulled down to its former position, the catch is lifted up by pulling down the handle V, as in Fig. 44, suspended to the crank S, which turns upon a pin in the upper cross rail of the woodwork. The crank S is connected with the crank Q by the wire R, and the crank Q is connected with the catch P by the wire U. In Figure 43 this appears as seen from above, in Fig. 44 as seen in front, and in Fig. 45 as seen from one side. Fig. 38 is a profile section of the frames distinguished by four A's and four B's. Fig. 39 shews one of the eyes M from above. The machine described above may be made to perform all its operations by the application of any mechanical power, in the following manner:—It will appear from the above description that, as the formation of any pattern is effected by turning the two screws formerly described, the correctness of the figure will depend upon the skill and attention of the operator; but if the machinery should be so constructed that these effects are produced by a regular uniform motion of the machine itself, it is evident that more regularity will be obtained than can be expected from the operation of any person, how-

ever steady and attentive. This will be particularly useful when a large quantity of cloth is to be tamboured of one pattern.

I shall now describe the machinery which I have invented for effecting this purpose, and which may be added to any machine constructed according to the plans and descriptions given above. The wooden framework for carrying and connecting this additional machinery with the former at the right side of the machine consists of a side frame, exactly the same as that shewn in Drawing A, and its connection with the former wood-work is shewn in Drawing B. The Nos. 11, 12, distinguish the additional side frame, as seen from the front of the machine. Nos. 13, 13, are two horizontal beams or rails which connect the side frame 11, 12, with the right side frame of the machine, as formerly described. Two cross rails, exactly the same, form the connection behind. It has been formerly observed and explained, that the whole formation of figures depends upon the application of two forces; the one in an horizontal and the other in a vertical direction. I shall describe the machinery which gives these motions by this plan. As the different parts of the machine in the former Drawings have been distinguished by letters, I shall in these use numbers to avoid confusion. In Figure 46 is represented a horizontal section of the machine, with the additional machinery. Those parts formerly described are again distinguished by the same letters formerly used; the additional parts by numbers. The following description refers to Drawings No. 12, 13, 14, and 15, in all of which the numeral references constantly denote the same part of the machine. The horizontal spindle 15 is supported by centre screws 46, 46, fixed to the cross beams or rails 13, 13, so as to revolve freely on its own axis. On it are fixed four wheels, distinguished by Nos. 16, 17, 18, and 20. No. 20 is a ratchet wheel, in which are cut just so many teeth as there are to be stitches or loops in the figure intended to be tamboured. This wheel is moved one tooth in the interval between every stitch or loop, by means of the catch 21 and lever 38, shewn in Figure 47, which is an elevation viewed from the front. The lever 38 being pulled towards the left side of the machine by the operator, or person attending the machine if working by power, draws the catch 21 along with it, and consequently turns the wheel 20 and spindle 15 a little round. The lower part of the lever 38 works in a box 39, with a stop screw in each end, so as, by stopping the lever when drawn from side to side, to confine the quantum of motion to a single tooth of the ratchet wheel 20, and neither more nor less. The horizontal motion of the frame is produced by means of the wheel 18 turning on the spindle 15 along with the ratchet wheel 20. To the right side

of the outer or horizontally moving frame A, formerly described, is fixed a piece of metal distinguished by No. 19, the end of which presses upon the edge of the wheel 18. To the said outer or horizontally moving frame is also fixed one end of a cord 47 (see Fig. 47), passing over a pully 48, fixed to any convenient part of the right side frame of the wood-work, by the other end of which cord is suspended a weight 49. This weight pulls the outer horizontally-moving frame towards the right side of the machine, and keeps the piece 19 always pressing on the edge of the wheel 18. The horizontal screw, formerly described, and female screw, are taken of. Now, if the circumference of this wheel were a circle, no motion could be generated by its revolution on the spindle 15, because, every line drawn from its centre to any point in its circumference being equal, the horizontally-moving frame would always remain stationary. To construct a wheel which will produce the horizontal motions required, the mechanic, having first turned his wheel into a circular form, must consider the figure he has to produce, and what horizontal motions of the frame are necessary for that purpose. Let him then divide the circumference of the wheel 8 into as many equal parts as he has formerly cut teeth in the ratchet wheel 20, which, as before remarked, correspond with the number of stitches or loops in his figure. From these divisions he will draw lines to the centre of the wheel as radii of the circle. Beginning, then, at the point where his horizontally-moving frame will be nearest the left side of the frame, he must then go round the divisions in the circumference of his wheel, and consider what motion, if any, is required in each. When a motion of the frame towards the right is required, that division of the circumference of the wheel 18 which is then to come in contact with the piece 19 must be brought so much nearer the centre, by cutting away part of the circumference; then the horizontally-moving frame, being always pulled towards the right by the weight 49, will move in that direction until the piece 19 is stopped by that point in the circumference of the wheel 18 which is then in contact with it. When an opposite motion of the frame A is required, the point in the circumference of the wheel 18, which comes in contact with 19, must be left farther from the centre of the wheel. The wheel in revolving will then push the frame towards the left. When no horizontal motion is required, that part of the wheel 18 is made perfectly circular. Fig. 50 and 51 represent two wheels of this kind. The mode of forming their circumferences is there represented. Wheels of this description are known by many mechanics by the name of traverse wheels. The wheel 17 operates upon the vertically-moving or inner frame formerly described, and distinguished by four K's, in a

similar manner to that in which the wheel 18, just now described, acts upon the outer or horizontally-moving frame. Its circumference is cut upon the same principle, approaching to or receding from the centre, as the figure may require, and is made circular when no motion is to be produced.

I shall now describe the machinery which connects this wheel 17 with the vertically-moving frame upon which it operates. So much of the counterpoise weights T, T, formerly described, are taken off, as will allow the vertically-moving or inner frame to descend by its own weight. On the centre of the upper bar of this frame, distinguished by four K's in Figure 47, are fixed two projecting studs, 45, the front one only of which can here be visible; a full view is given in Fig. 48. These studs rests in any of the notches in the hanging piece 44, as required. The upper end of this hanging piece 44 is connected by a joint with one end of the horizontal lever 43, supported at the centre by a strong beam of wood 50, resting on the front and back rails of the wood-work. To the other end of the horizontal lever 43 is joined a hanging piece 42. To the cross tail of this hanging piece 42 are attached two strong wires 41, 41, which, passing on either side of the spindle 15 (in Fig. 46), continue the connection to a lever 40, extending from the back to the front of the machine, the end of which lever only appears in Fig. 47, confined between the sheers 52, fixed to the front cross rail 13. This lever 40 appears very fully in Fig. 49, which is an end elevation. The hanging piece 42, and one of the connecting wires 41, attached below to the lever 40, is appears in profile. The inner or vertically-moving frame, being so balanced as to descend by its own weight, the lever 40 is consequently pressed against the edge of the wheel 17 directly under its centre; and when any point in the circumference of which 17 is farther from its centre than the preceding, it pushes down the lever 40, which by the connection raises the frame upon which it operates; and when any point in the circumference of the wheel 17 is nearer to its centre than the point preceding, the lever 40 is permitted to use, and the frame connected with it descends by its own weight. The vertical screw is now taken off, or the cross piece M may rest below the pillars N, N, formerly described, to raise the vertical frame by the screw. When shifting from any row of Figures to the next, the notches in 44 are for this purpose. M must be clear of N, N, in working on the spindle, another wheel, 16, which, like the former, acts as a traverse. It gives the rotatory motion to the needle handles which were, as formerly described, moved by the operator's hand. The motion is produced as follows:—A lever 22, as in Figs. 49 and 46, moves horizontally on a joint near the back of

the machine, and extends to the front. From this lever a strong wire 24, as in Fig. 46, connects with the slider 25, moveable from side to side in grooves, formed in the supporters 37, 37, in Fig. 47. To this slider 25 is fixed a piece of metal 51, as in Fig. 46, placed at right angles from the slider towards the cloth in an horizontal direction. In this piece 51 is an oblong hole or slott through which passes a vertical pin fixed to the rack *m*, formerly described. By these means the slider 25 carries the rack *m* along with it, when moved from side to side; but the hole or slot in the piece 51, being oblong, does not impede the motion of the rack *m*, when carried by the needle frame (to which it is attached, as described before,) backwards or forwards, to perforate or return from the cloth. The next thing to be described is the connection between the slider 25, above described, and the spindle E, for turning the feeding needles, for it will be recollected that they must correspond. In the former description the change of position of the tambouring needles was produced by the operator's hand; the change of the feeding needles by his right heel; but when all the parts are to be worked by machinery all must be connected. Upon the slider 25 is a rack 26, fixed to its upper edge. This rack communicates motion to a pinion 27, on one end of the horizontal spindle 28, on the other end of which is a bevel wheel 29, turning another bevel wheel 30, on one end of another horizontal spindle 31, on the other end of which a spur wheel 32, working another spur wheel 33, on the spindle E, compleats the connection. The rack 26 on the slider 25 gives only half a revolution to the spindle 22 for every revolution which the rack *m* gives to the tambouring needles. The remaining wheels, 29, 30, 32, and 33, have all an equal number of teeth. By these means the tambouring and feeding needles revolve together; for it was formerly explained that half a revolution of the spindle E gives a whole revolution to the cranks F, and consequently to the feeding needles. A cord from the pully 36, which is fixed on the spindle 28, suspends a weight, the operation of which makes the lever 22, supported at its end by 23, constantly press the edge of the wheel 16. 53 is a small bell, the hammer of which, when acted on by a pin in the wheel 20, rings, to give notice when a pattern is finished. The piece which supports the end of the spindle 31, where the spur wheel 32 is fixed, is jointed at bottom, to allow the said supporter to move a little backward or forward at the top, this carrying along with it the end of 31, where 32 is fixed; the wheels 32 and 33 are thus engaged or disengaged as required. Both parts of the pully D, formerly described, are in this plan loose upon the spindle E; but in one side of D are fixed a number of pins, as represented. When D is pulled towards

the right hand, these pins lay hold of a catch 54 in the spindle E. D, when turned by the treddle P, as formerly described, will then carry E along with it. When D returns towards the left, the pins quit their hold of the catch 54, and D or E will then move independent of each other. In D there is a groove resting in a vertical piece of iron 34, open like a fork at top, and jointed at bottom, so that the top, may move a little from side to side, and carry D along with it, in order to engage or disengage the pins, as above mentioned. From the right treddle Y, formerly described, is a wire 58, in the supplementary outline passing through a vertical hole in the beam A, to a crank 57, placed in a vertical position on the said beam, and moveable on its centre. From the other end of the crank 57 the wire 56 continues the connection to 34, above described, as moving the pully D from side to side. From 34 in Fig. 46 another wire 55, connects it with one end of the crank 53, similar to 57, but placed horizontally. The other end of this crank operates on the jointed supporter of 31, formerly described. When the treddle Y is depressed to perforate the cloth, D, by the above connection, is drawn to the right, and the pins lay hold of the catch 54 on the spindle E. At the same time, one end of the crank being also pulled towards the right of the wire 55, the supporter of 31 is pressed towards the back of the machine, and the wheels 32 and 33 are disengaged from each other. A spring 35, resting behind the supporter of 31, brings the machinery last described to its former position as soon as the treddle rises again; thus the spindle E is alternately connected with the parts of the machine from which it must receive its motions. The connection of every part being now compleated, all will receive the necessary motions from the three treddles, and it only remains to apply the power to these treddles. If it be wished to move by a rotatory motion, it is only necessary to erect a horizontal spindle or shaft across the machine. On this shaft fix two pullies, the one pressing the right treddle Y, and the other the middle treddle P, at the same points where the operator's feet would be in the former plan. Then, if the circumference of these pullies be cut or shaped upon a similar plan to that mentioned when describing the traverse wheels 16, 17, 18, one revolution of the shaft will act in the same way as the alternate pressure of the operator's feet, a sufficient weight attached to the left treddle will produce the returning motion, and supersede the use of the third pully. Some mechanics distinguish rotatory pieces acting in this way by the name of wipers, and they are so generally known as to render any further description or Drawings superfluous. Any power capable of turning this may be applied, at discretion. The person who attends the machine has then only to turn the wheel 20 one notch in the

interval between every stitch, by the means formerly described, and to stop the machine when necessary.

In witness whereof, I, the said John Duncan, have set my hand and seal to these presents, at London, this Twenty-seventh day of June, in the year of our Lord One thousand eight hundred and four.

JOHN (L.S.) DUNCAN.

Signed, sealed, and delivered (being first duly stamped) in the presence of

ALEX. MUNDELL,
Fludyer Street,
H. WINCHESTER,
Strand.

N. RIDLEY.

AND BE IT REMEMBERED, that on the same Twenty-seventh day of June, in the year above mentioned, the aforesaid John Duncan came before our Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute in that case made and provided.

Inrolled the same Twenty-seventh day of June, in the year above written.

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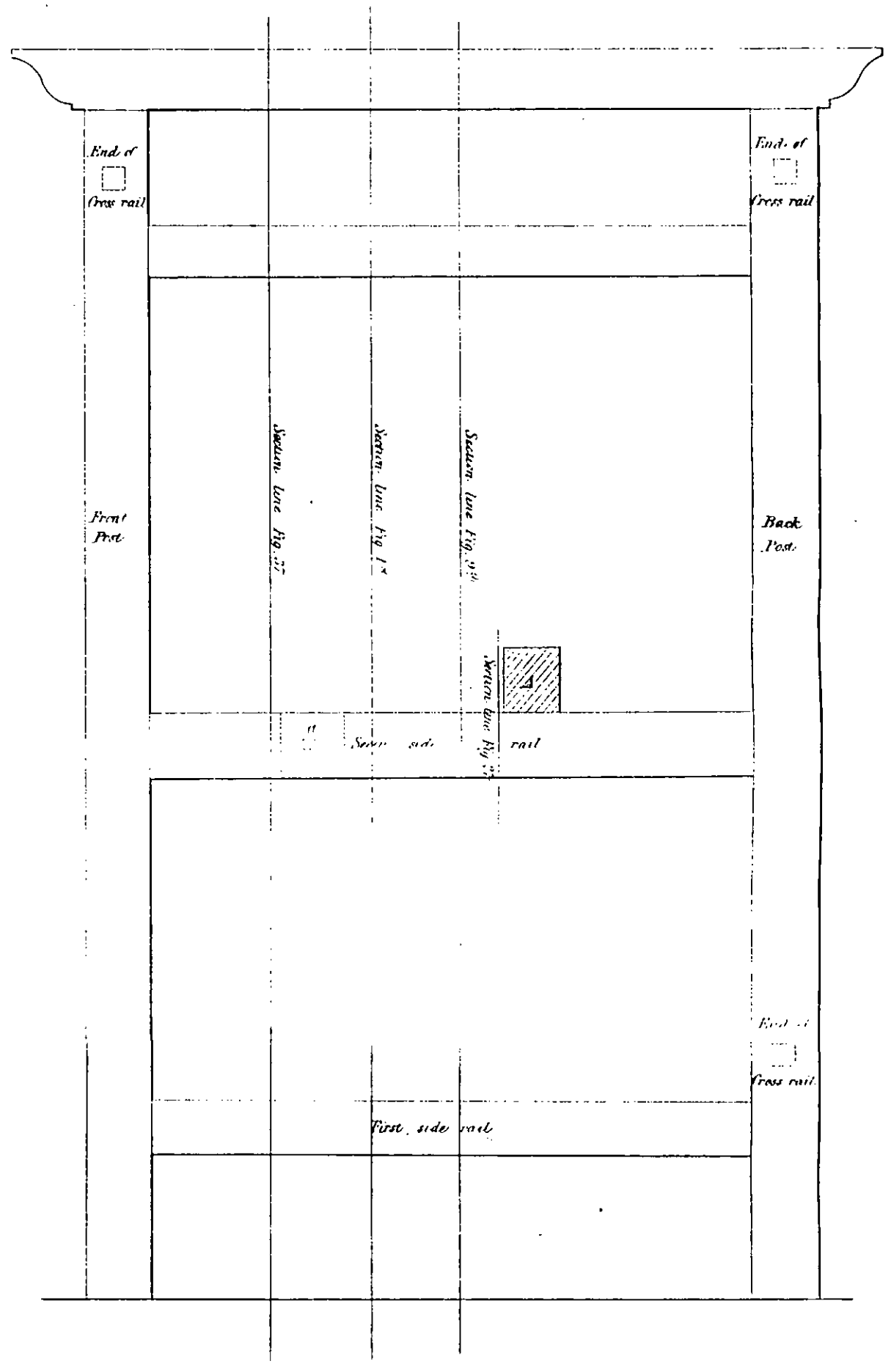
A.D.1804. May. 30. N° 2769.

DUNCAN'S Specification.

17 SHEETS)
DRAWING A.



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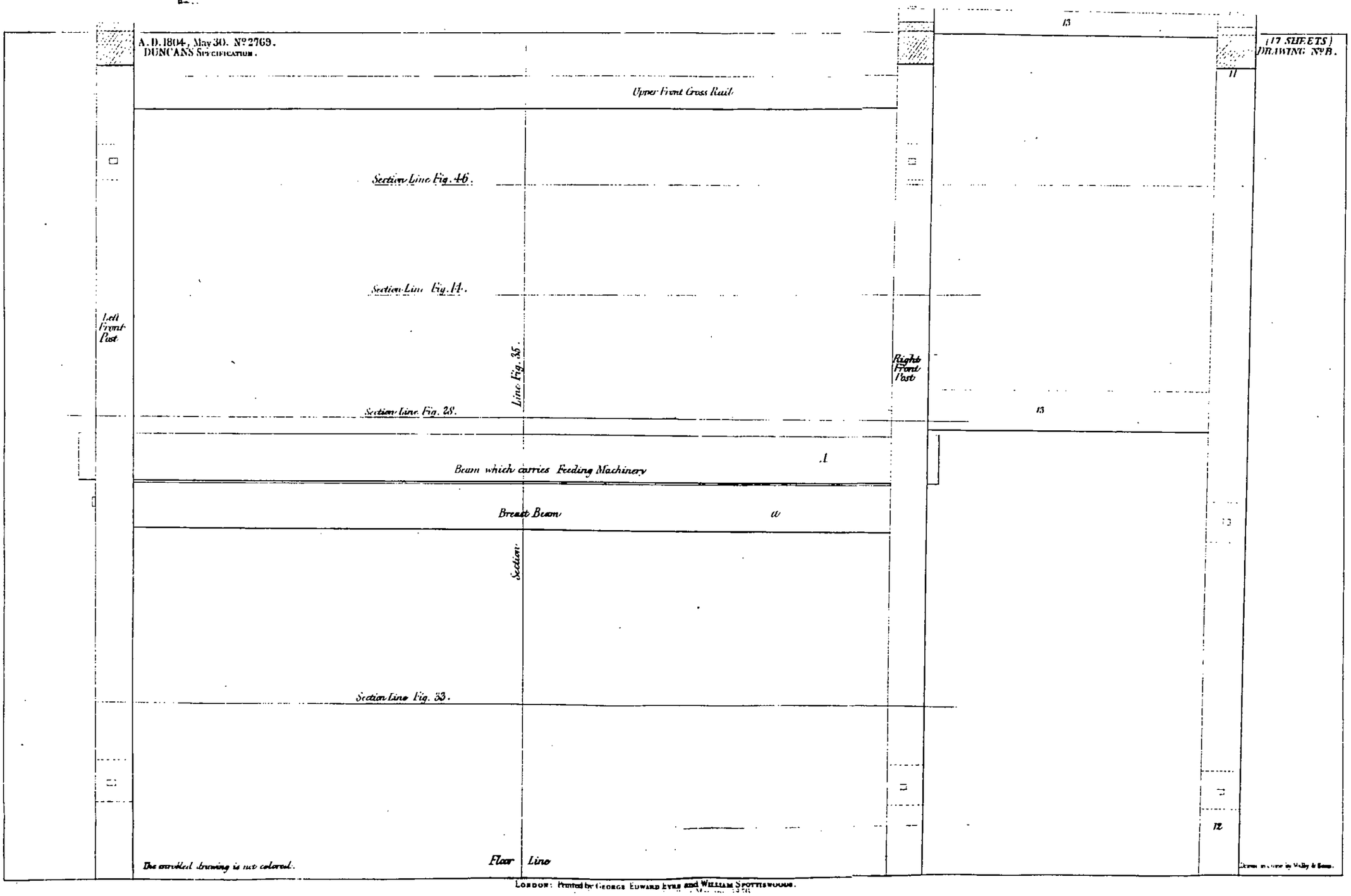
DUNCANS Specification.

(17 SHEETS)
DRAWING N°B.



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DUNCAN'S Specification.

(17 SHEETS).
DRAWING N°1.

FIG. 1ST.

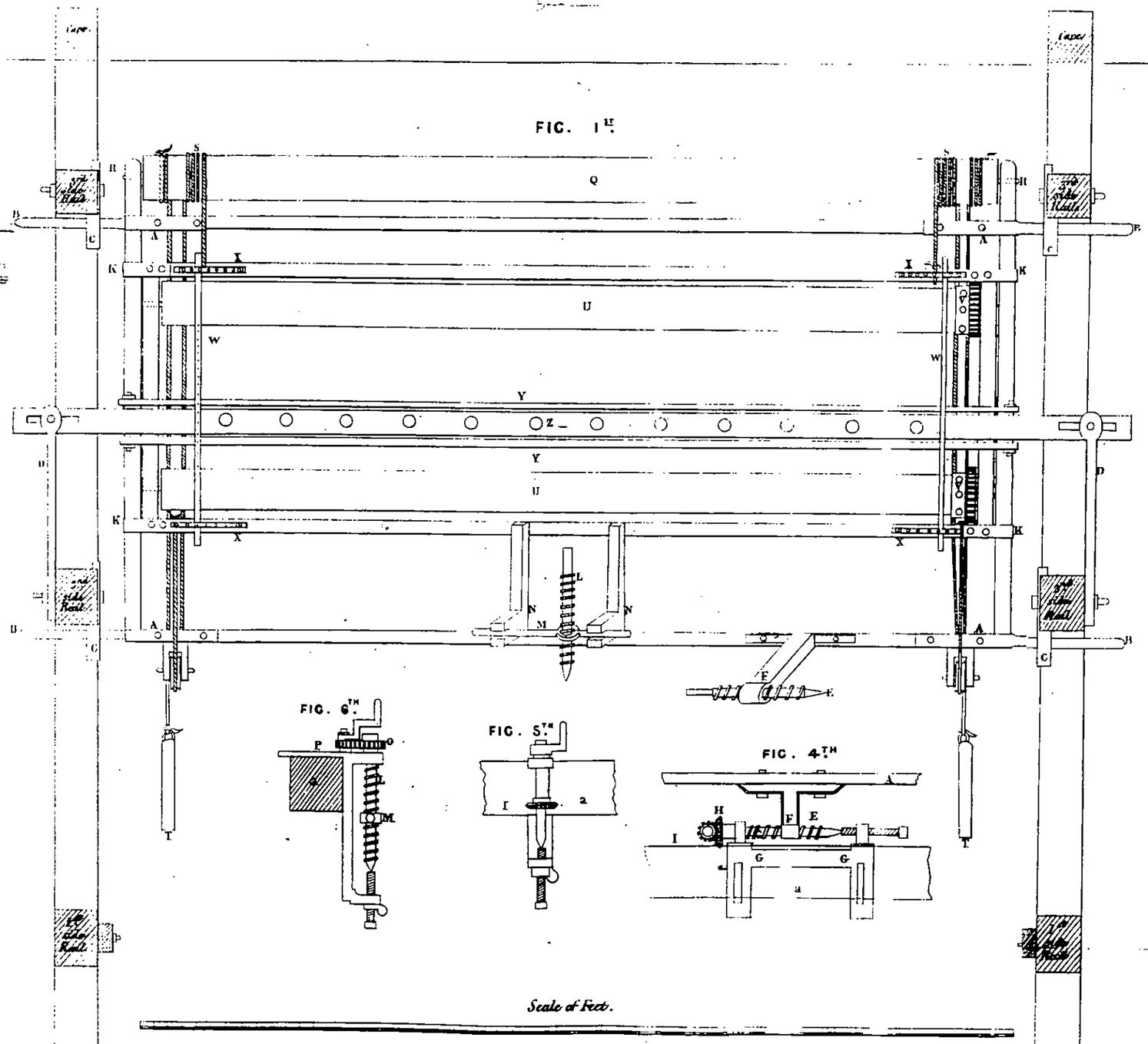


FIG. 2ND & 3RD.

FIG. 8TH.

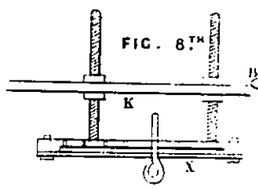
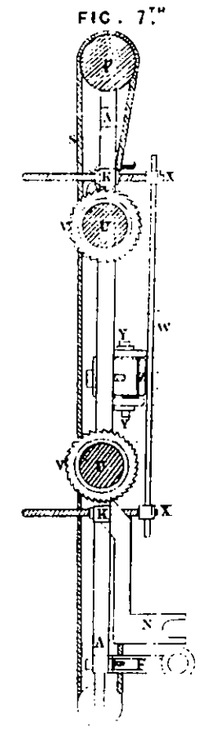


FIG. 6TH.

FIG. 5TH.

FIG. 4TH.

FIG. 7TH.



Scale of Feet.

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(17 SHEETS)
DRAWING N°2

FIG. A.

FIG. B.

FIG. 9.

FIG. 10.

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11 SHEETS:
DRAWING N° 3.

FIG. 24.

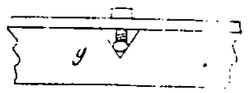
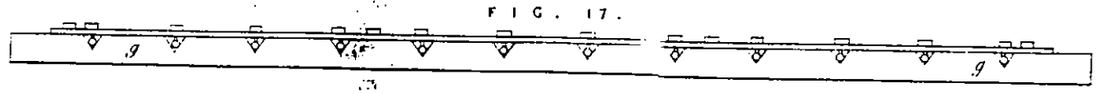


FIG. 17.



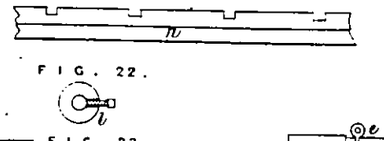


FIG. 22.

FIG. 21.

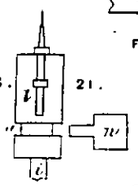


FIG. 23.

FIG. 16.

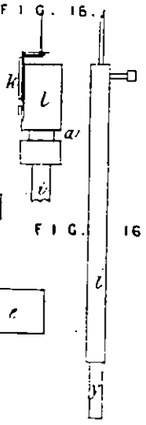


FIG. 20

FIG. 16.

FIG. 14.

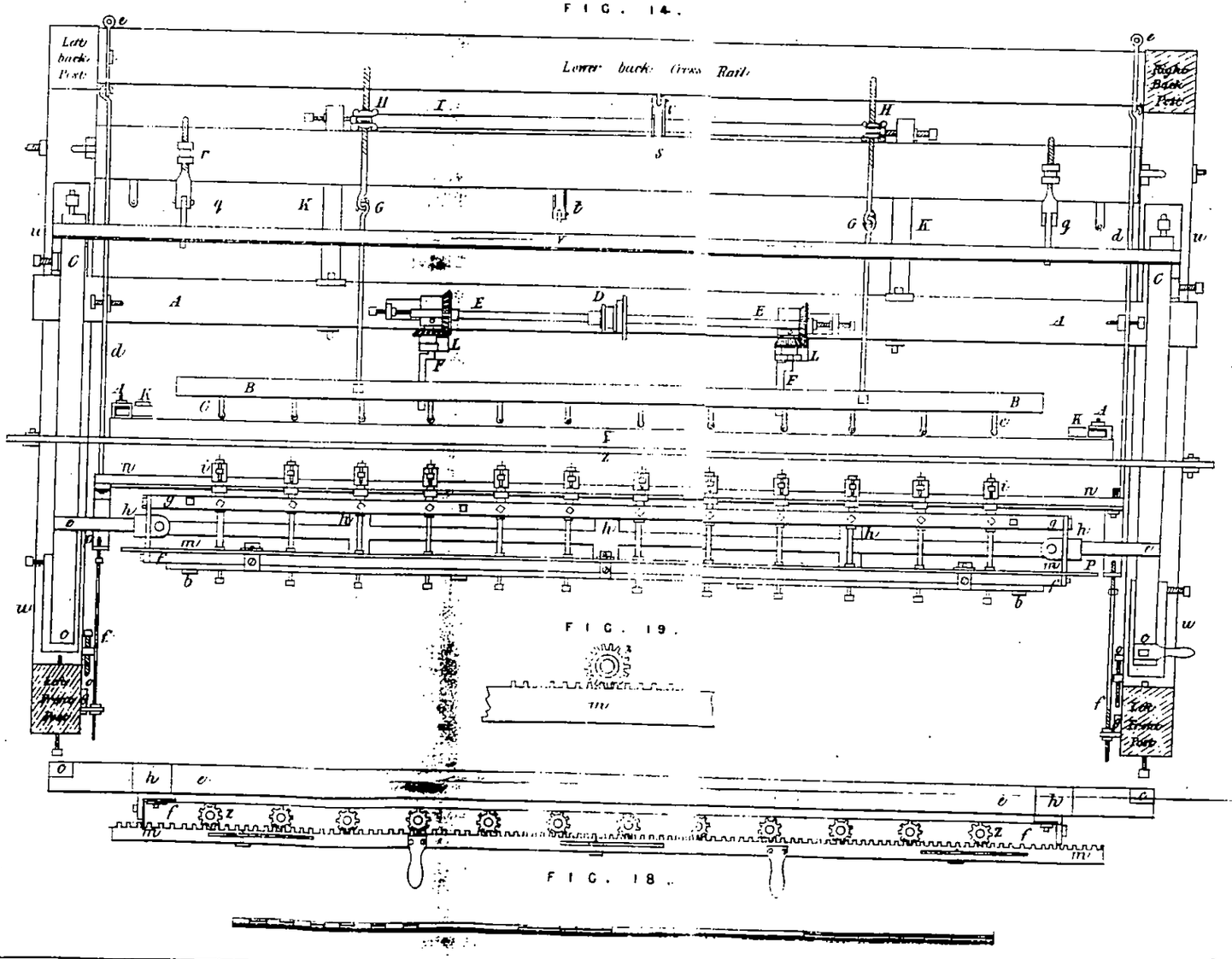


FIG. 19.

FIG. 18.

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DUNCAN'S SPECIFICATION.

17 SHEETS.
DRAWING N° 4.

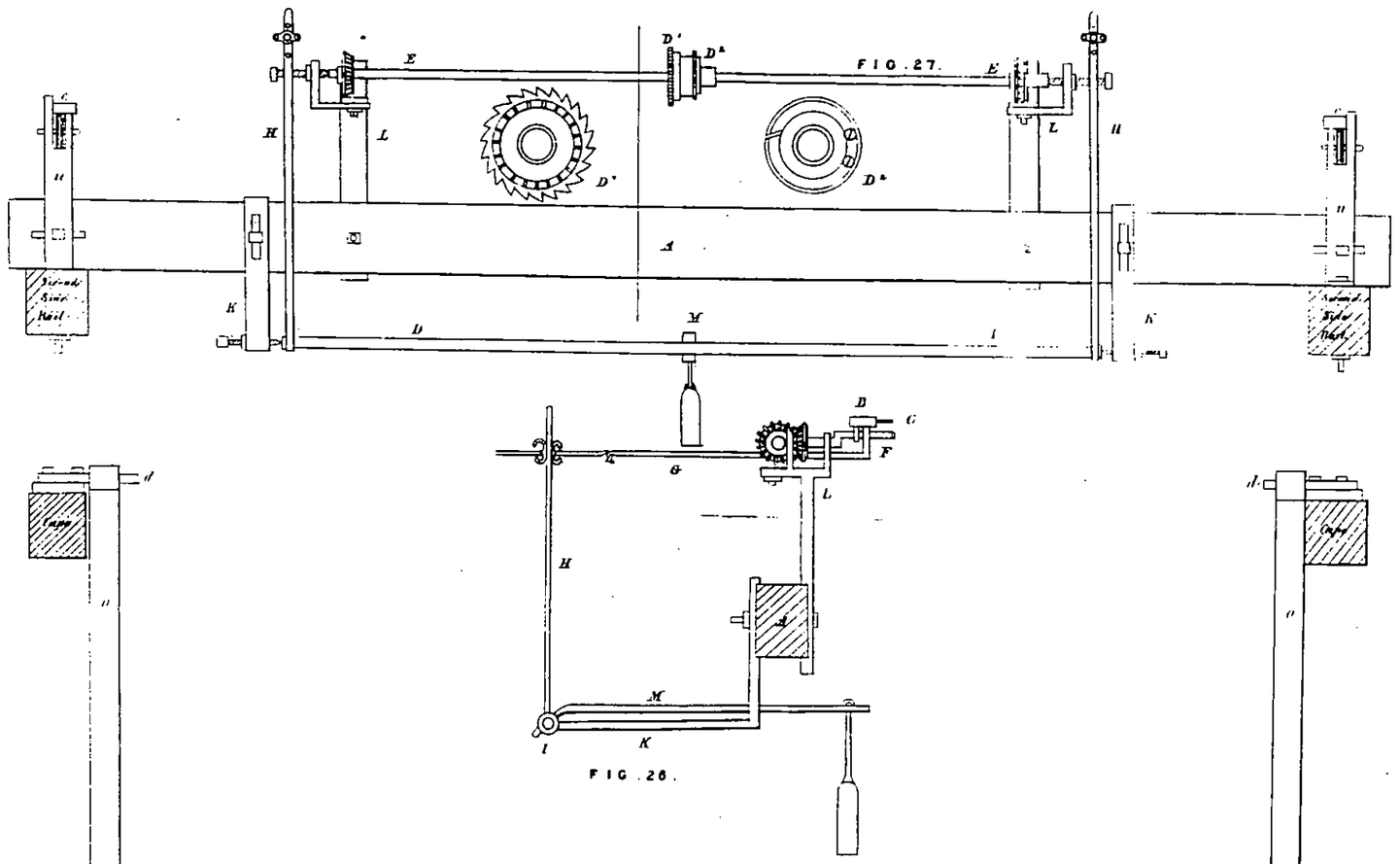

FIG. 27.

FIG. 28.

FIG. 25.

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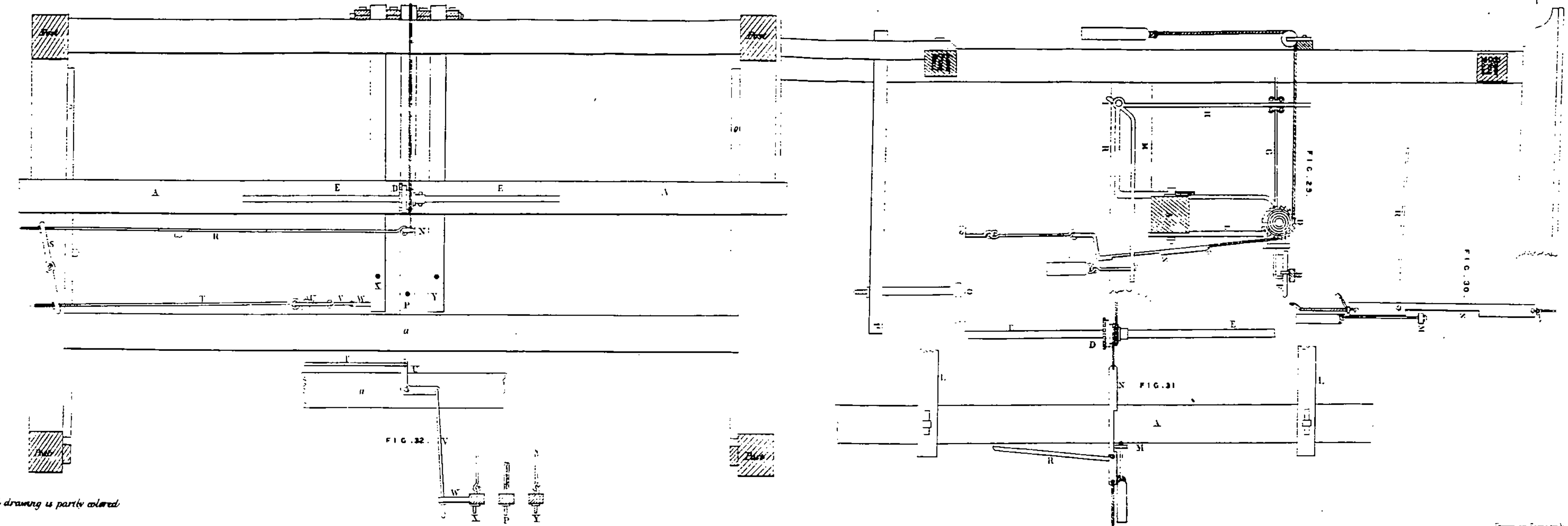

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Drawn on Stone by

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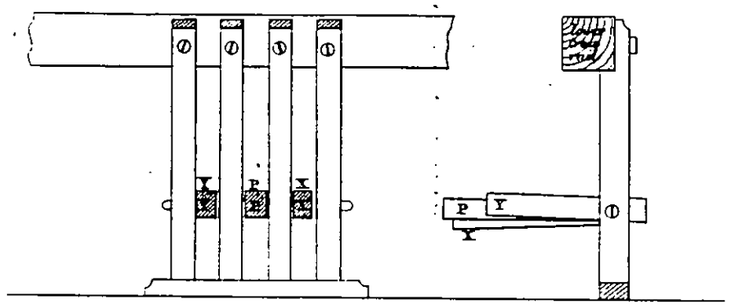
DUNCAN'S SPECIFICATION.

17 SHEETS
DRAWING Nº 6.



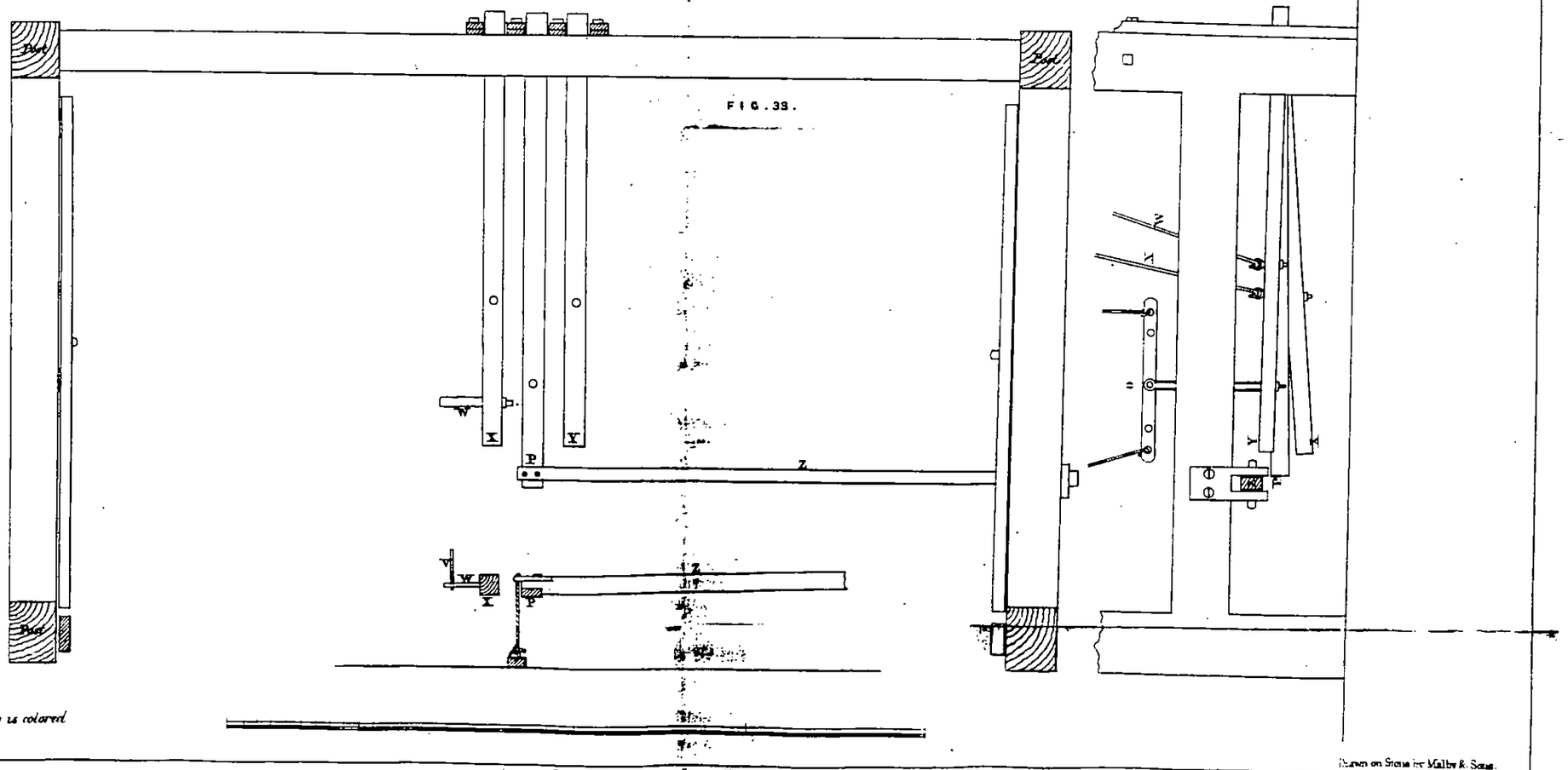


FIG. 33.

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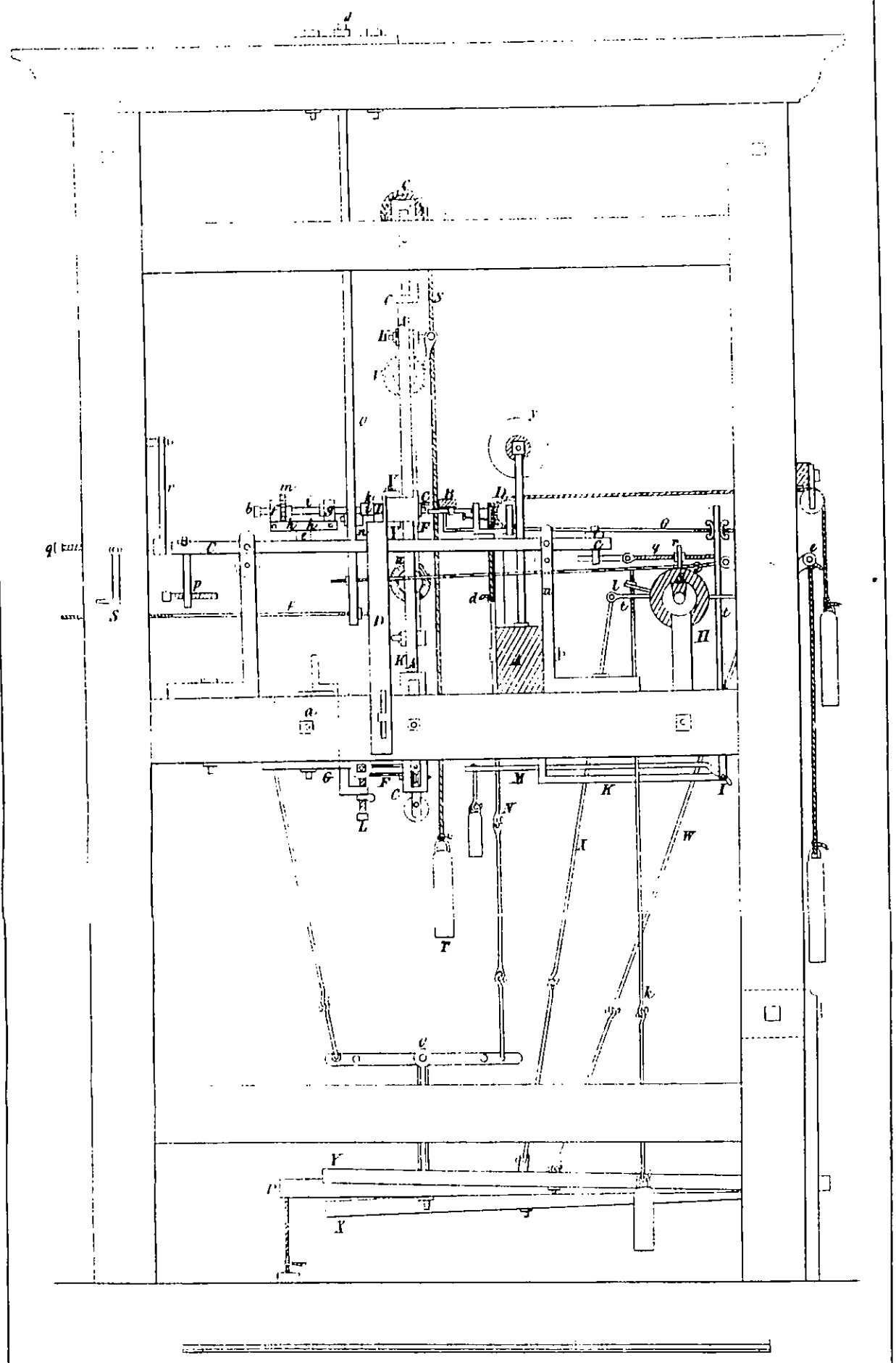
DUNCAN'S Specification

(17 SHEETS)
(DRAWING N°7

FIG. 34.



The enrolled drawing is coloured.

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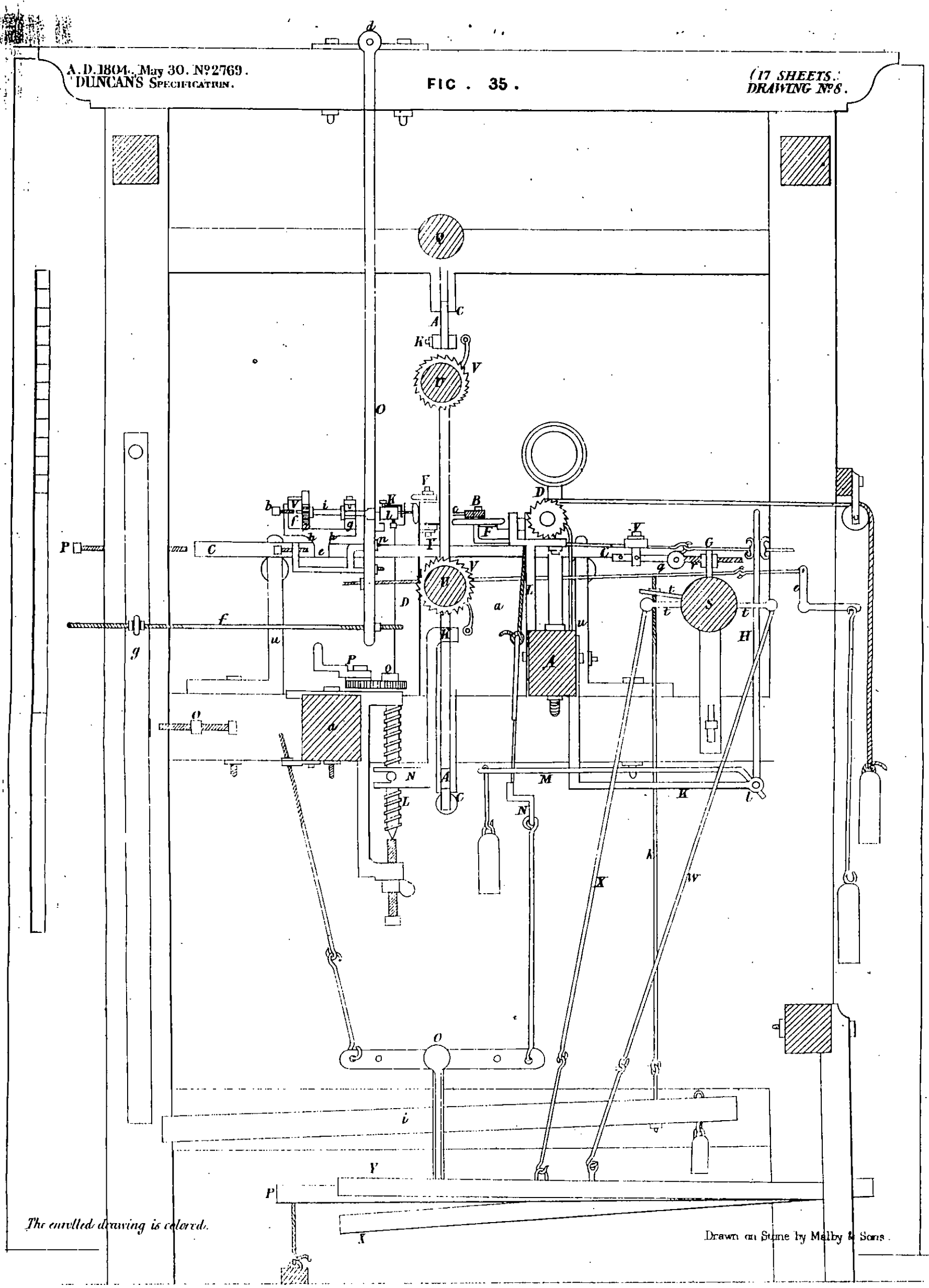
DUNCAN'S SPECIFICATION.

FIG. 35.

(17 SHEETS.)
DRAWING N°8.



The curilled drawing is colored.

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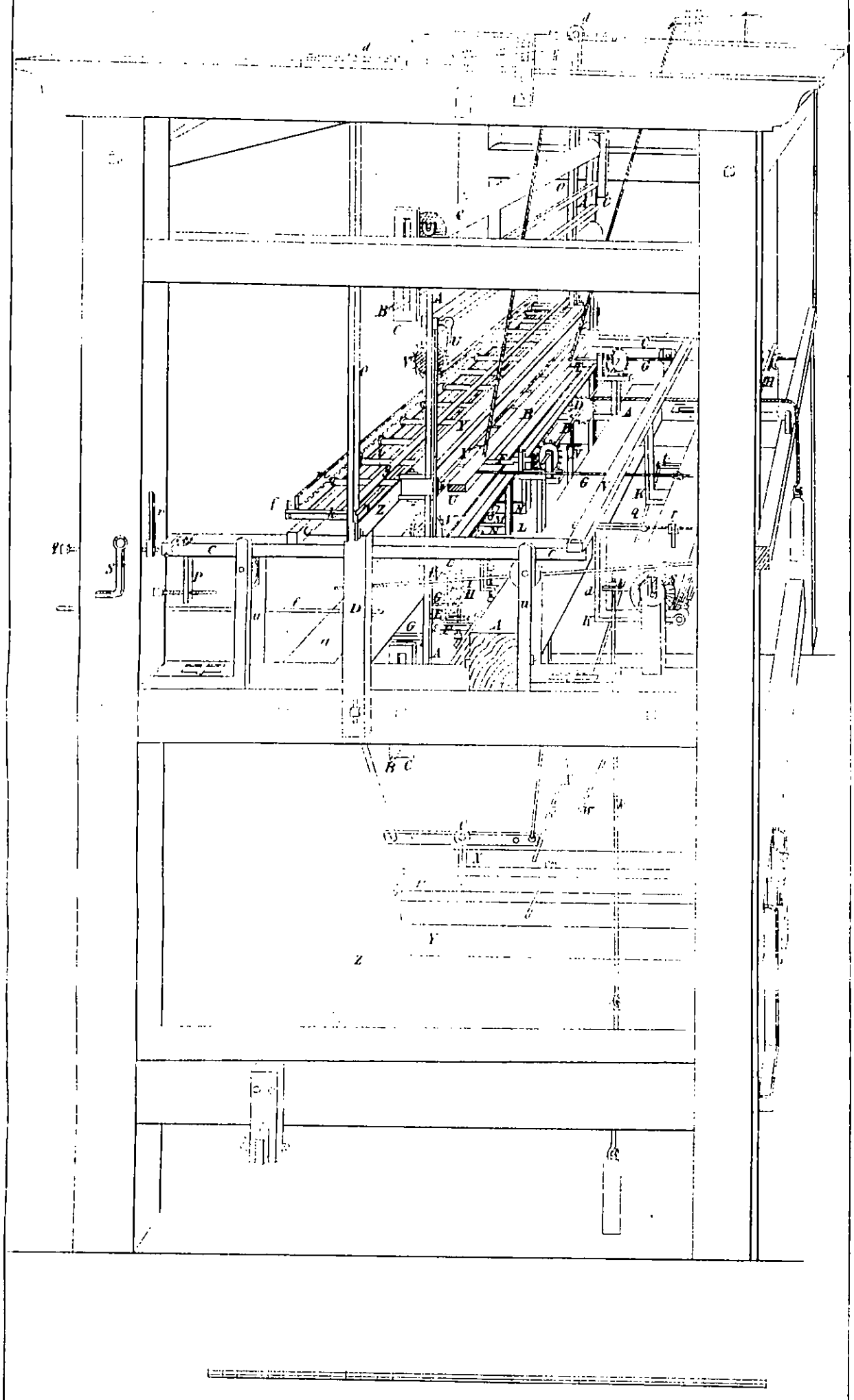
DUNCAN'S Specification.

17 SHEETS.
DRAWING N°9

FIG. 36.



The enrolled drawing is colored.

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(17 SHEETS)
DRAWING N° 10

FIG. 41.

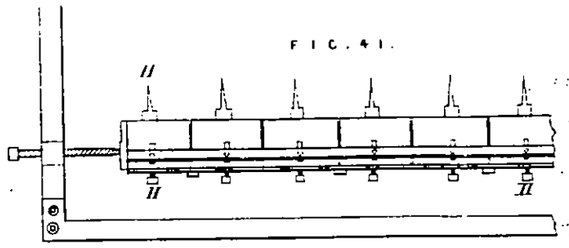

FIG. 42.

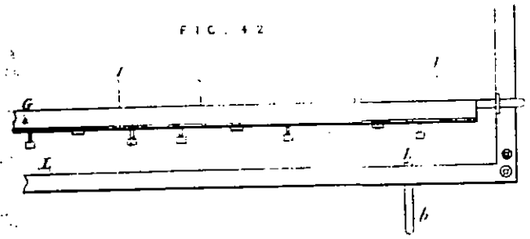

FIG. 37.

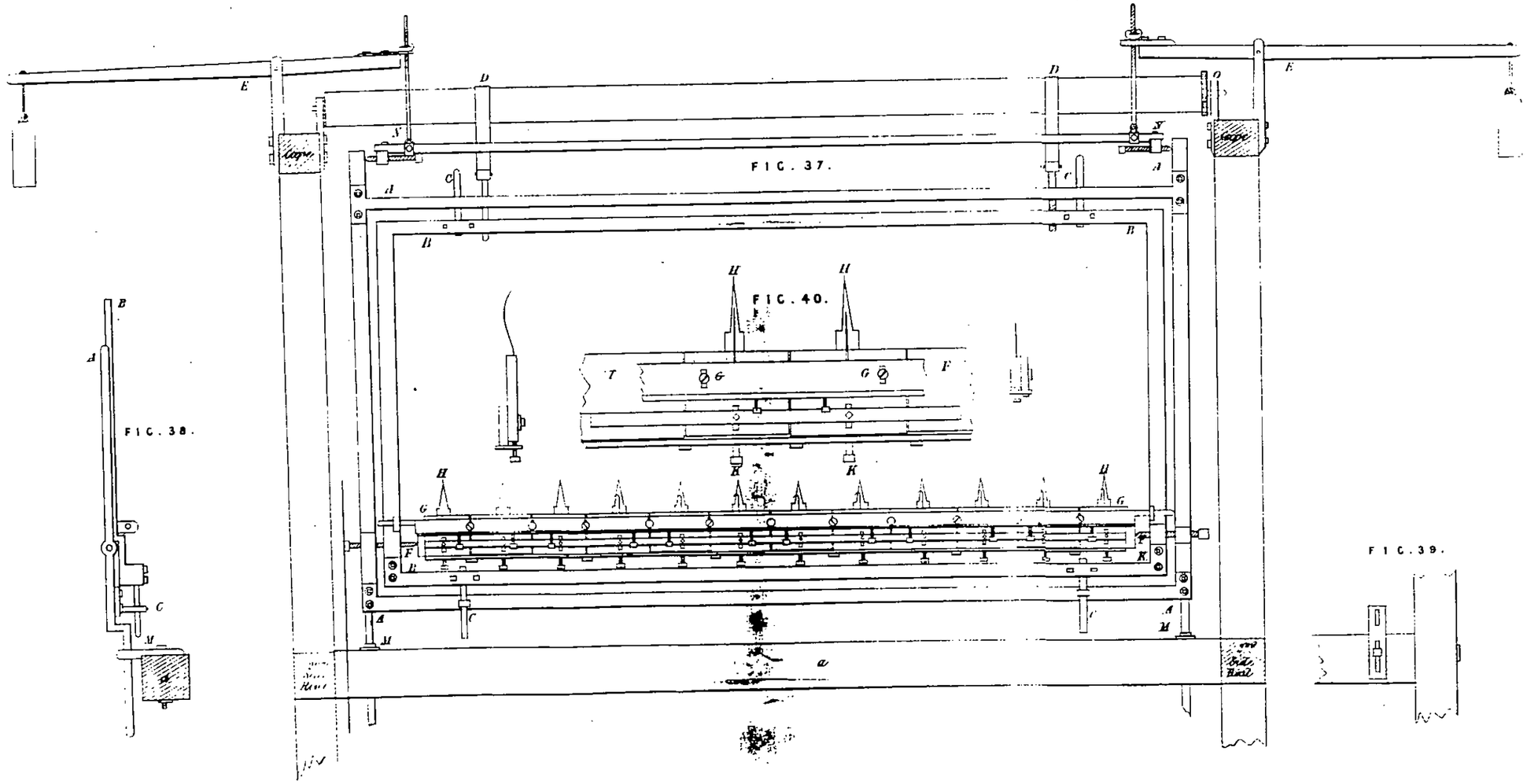

FIG. 40.

FIG. 38.

FIG. 39.

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17 SHEETS.
DRAWING Nº 11.

FIG. 43.

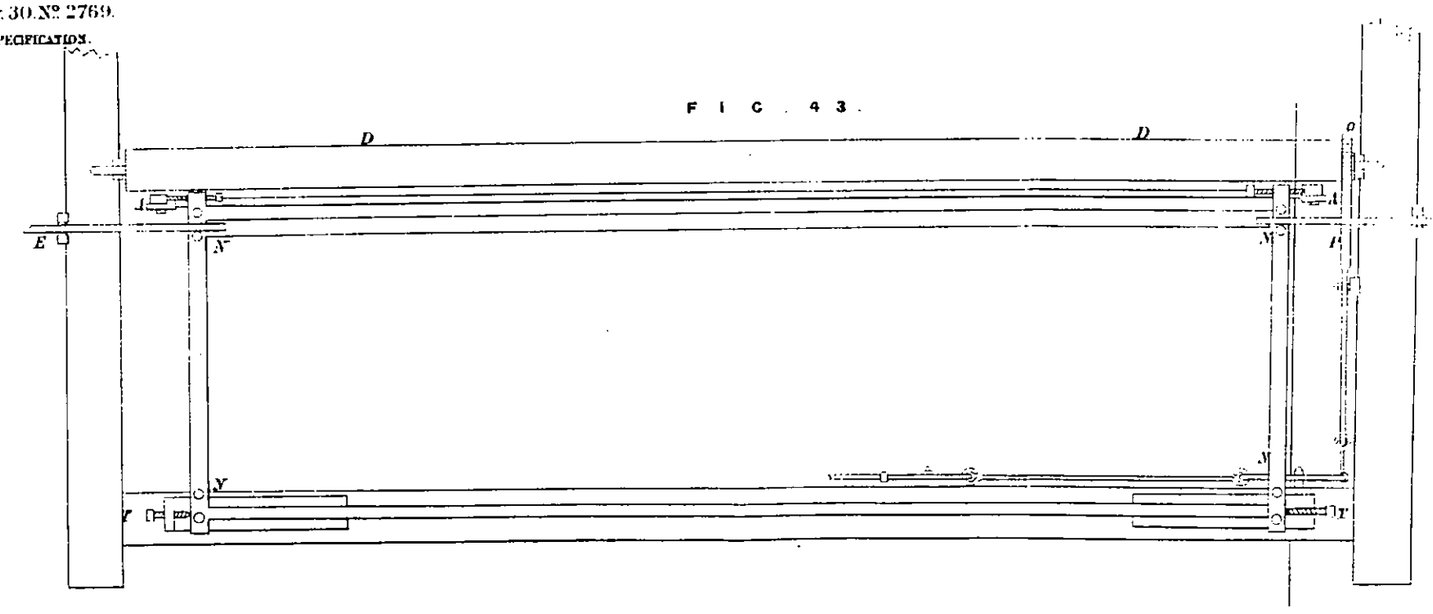


FIG. 45.

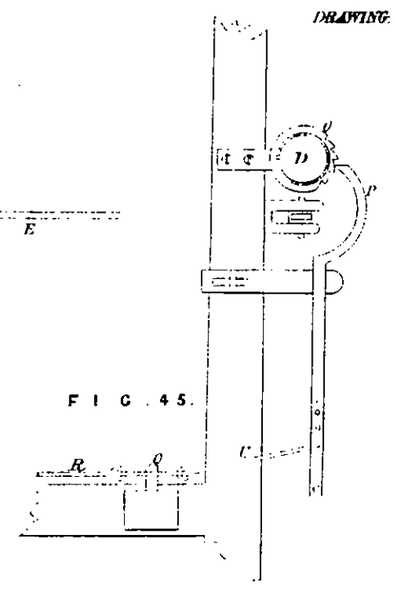
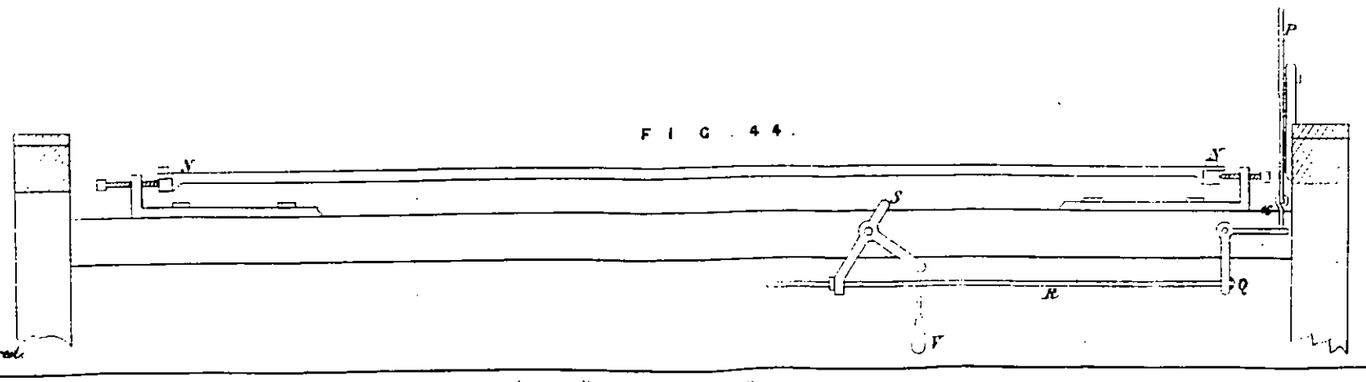


FIG. 44.



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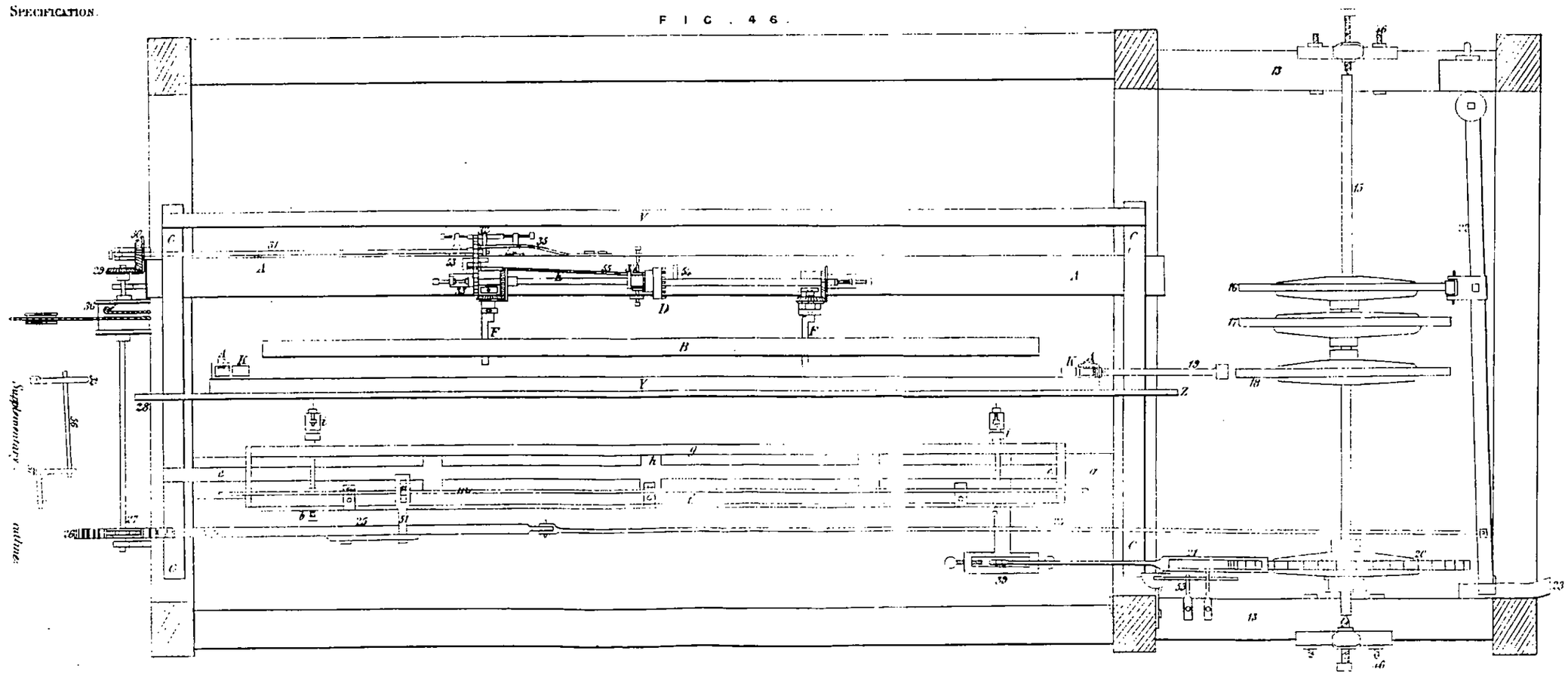
(17 SHEETS)
DRAWING 12.

FIG. 46.



The unrolled drawing is partly colored.

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DUNCAN'S Specification.

17 SHEETS]
DRAWING N°13

FIG. 47.

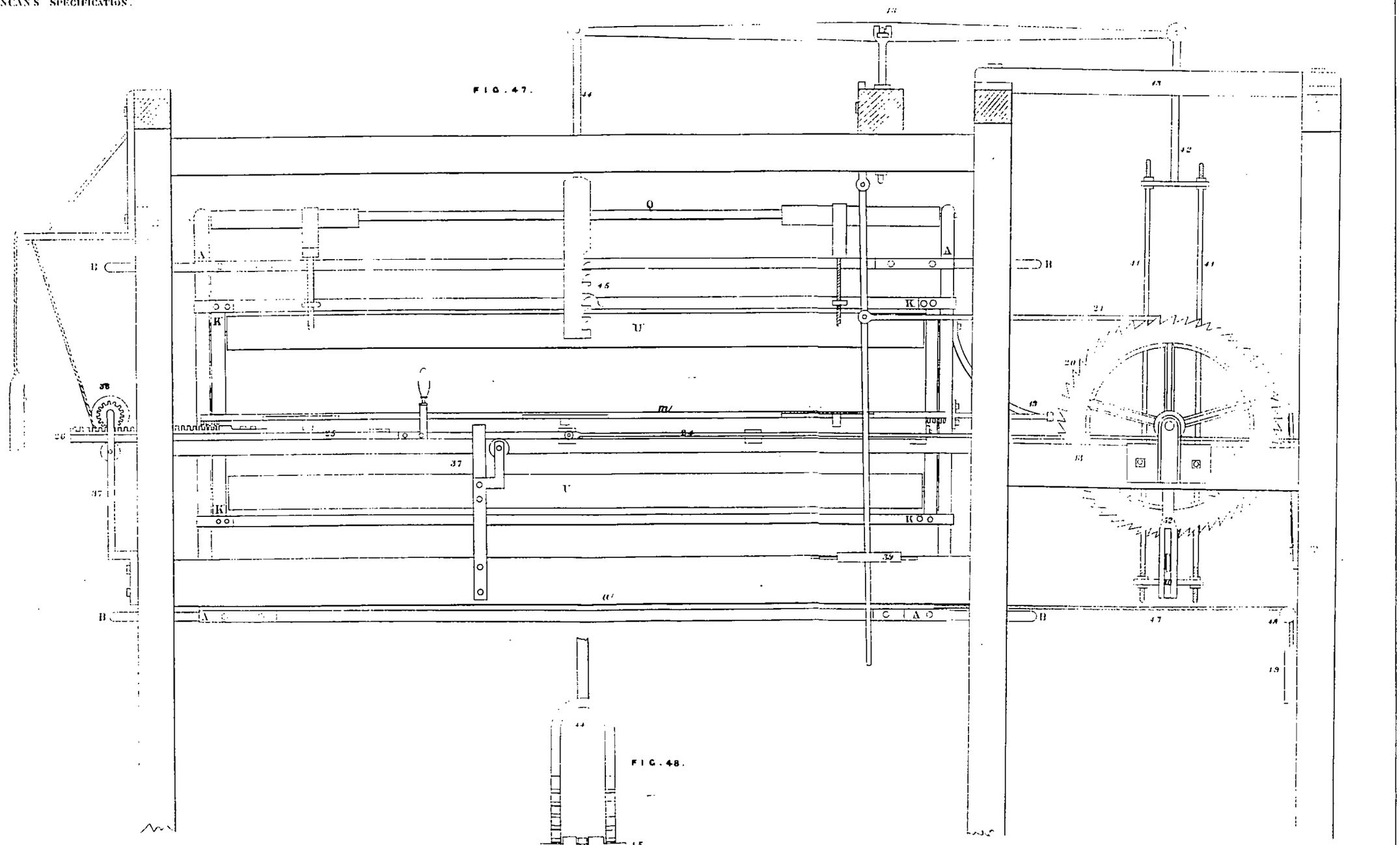

FIG. 48.

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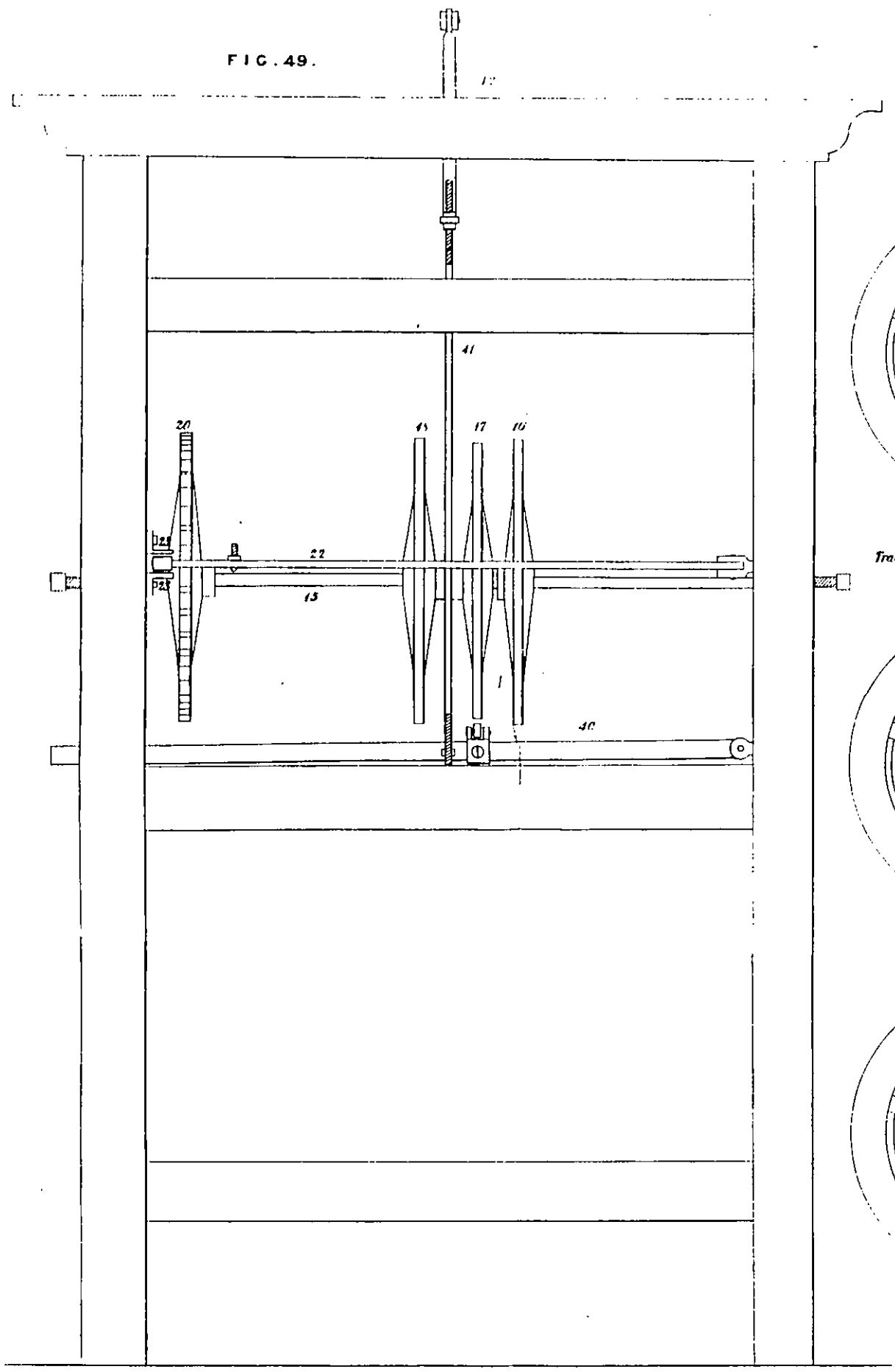
FIG. 49.



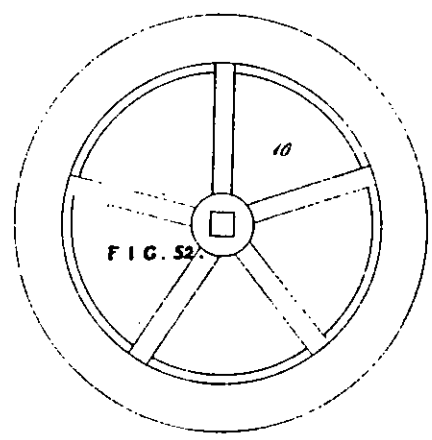
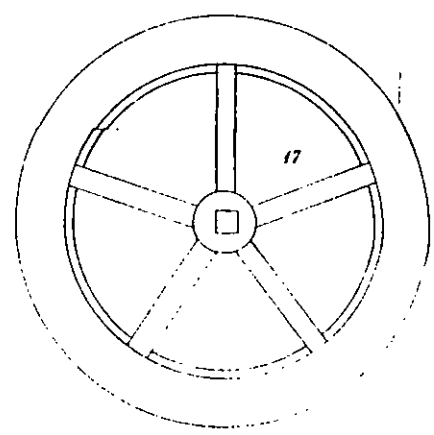
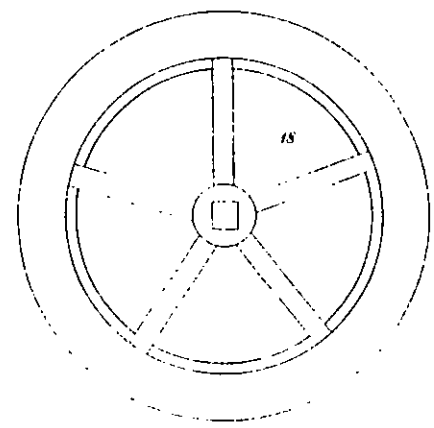


FIG. 52.

Traverse Wheel before being Cut.





The enrolled drawing is partly colored.

Drawn on Stone by Maby & Sons.

LONDON: Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1856.

A.D. 1804. May. 30. N° 2769.
DUNCAN'S Specification.

17 SHEETS.]
DRAWING N°13.

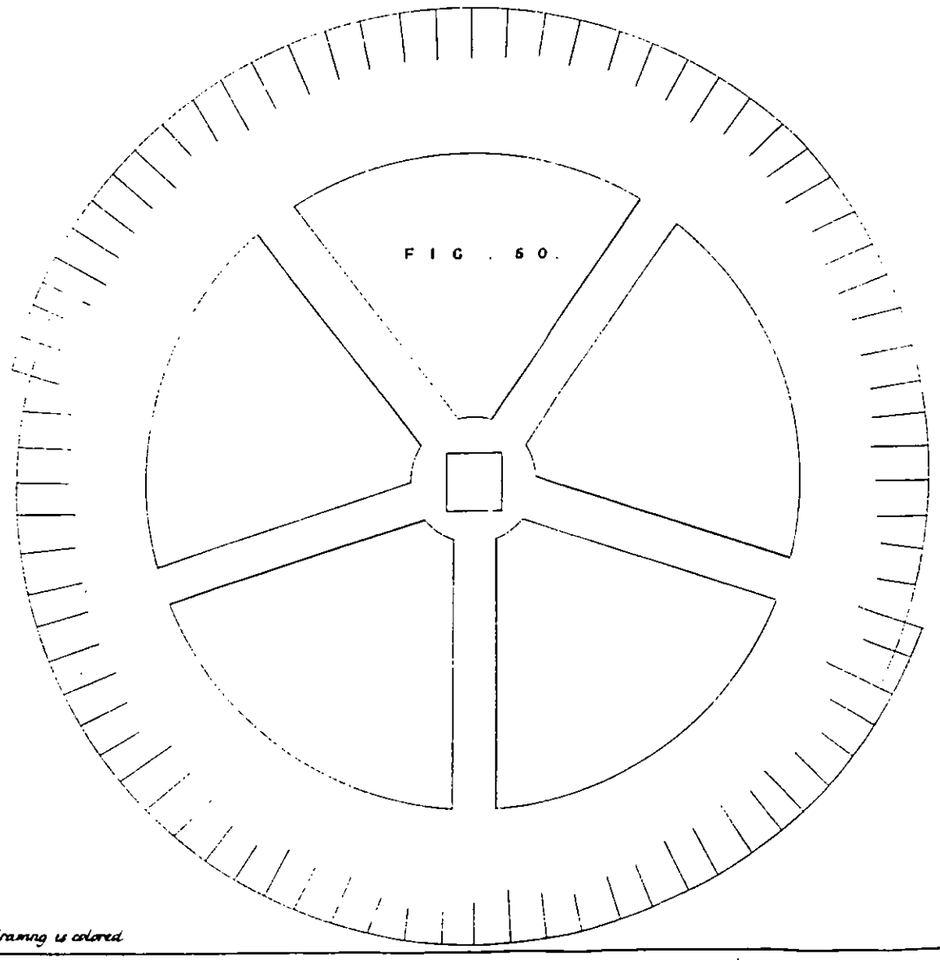


FIG. 50.

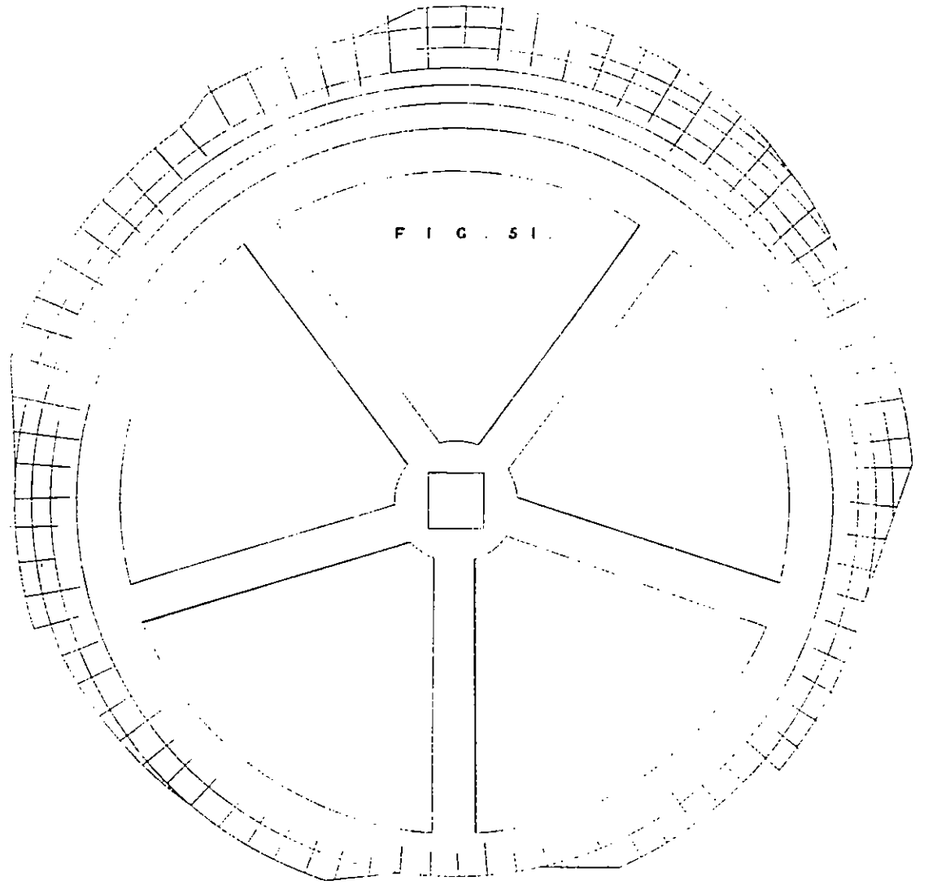


FIG. 51.

The enrolled drawing is colored.

Engraved on Stone by Malby & Sons.

London: Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1876.