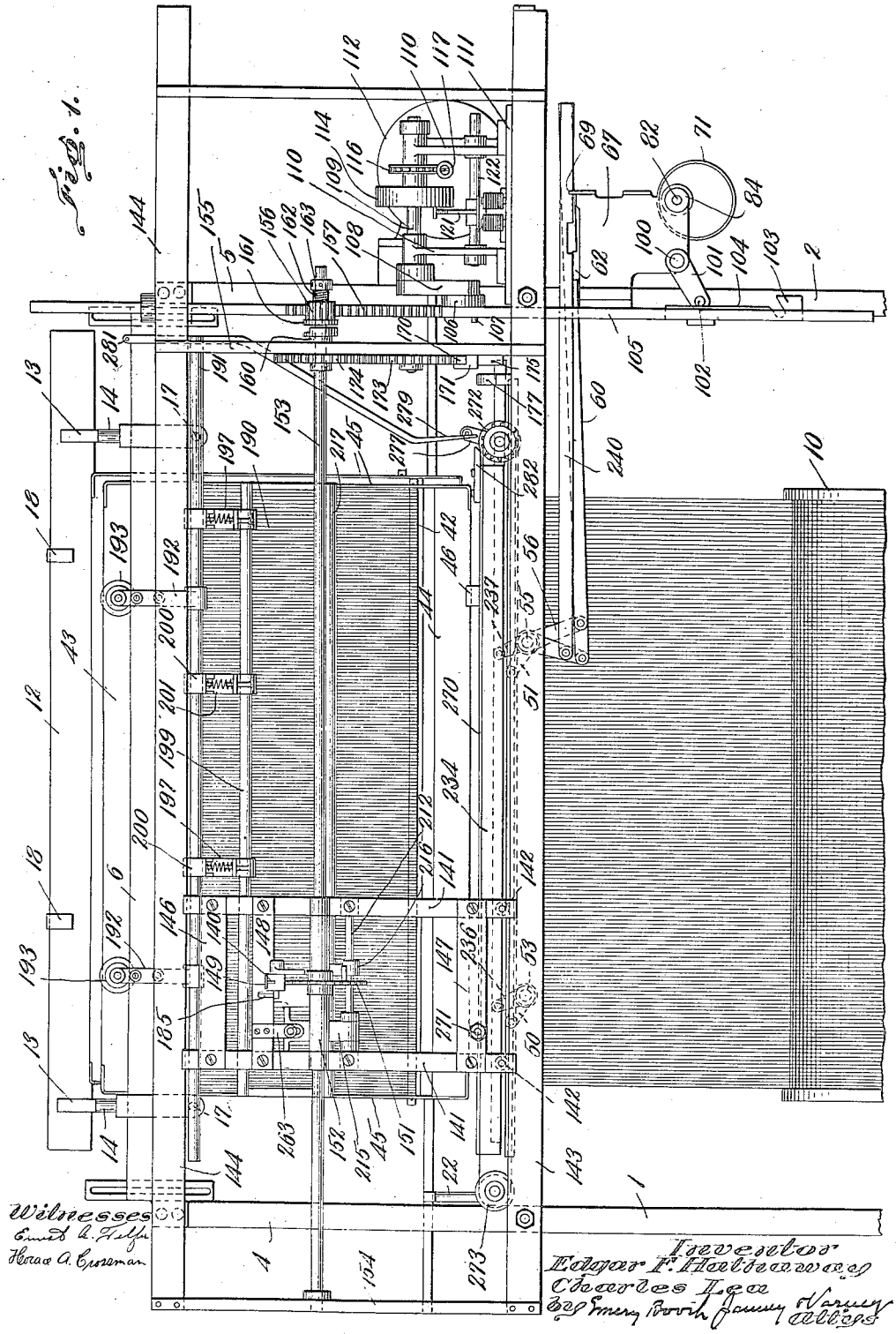
Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 1



Witnesses
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Horace A. Eastman

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Charles Ega
by Emery Booth Janney & Varney
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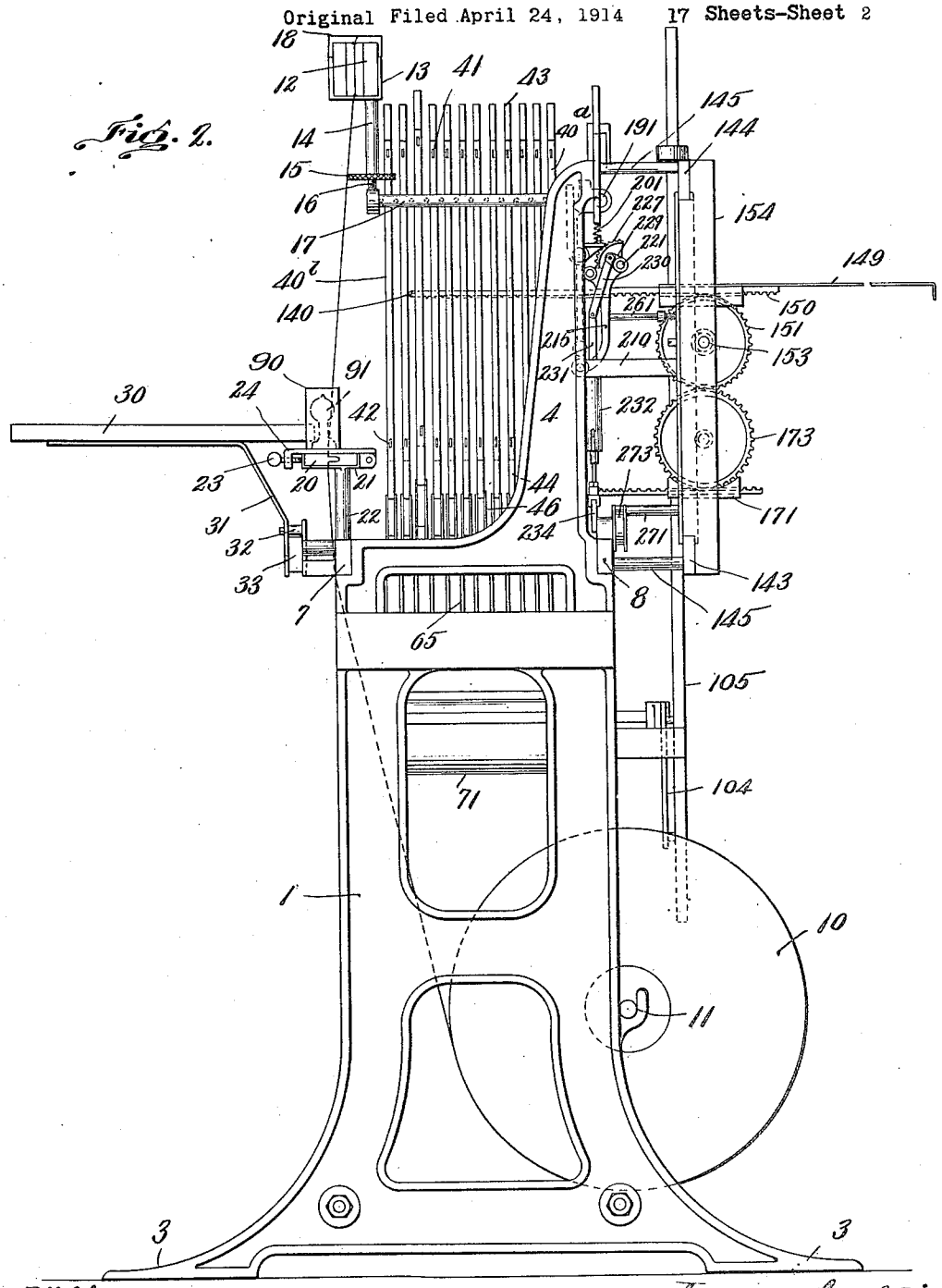
Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL.

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 2

Fig. 2.



Witnesses:
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL.

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 3

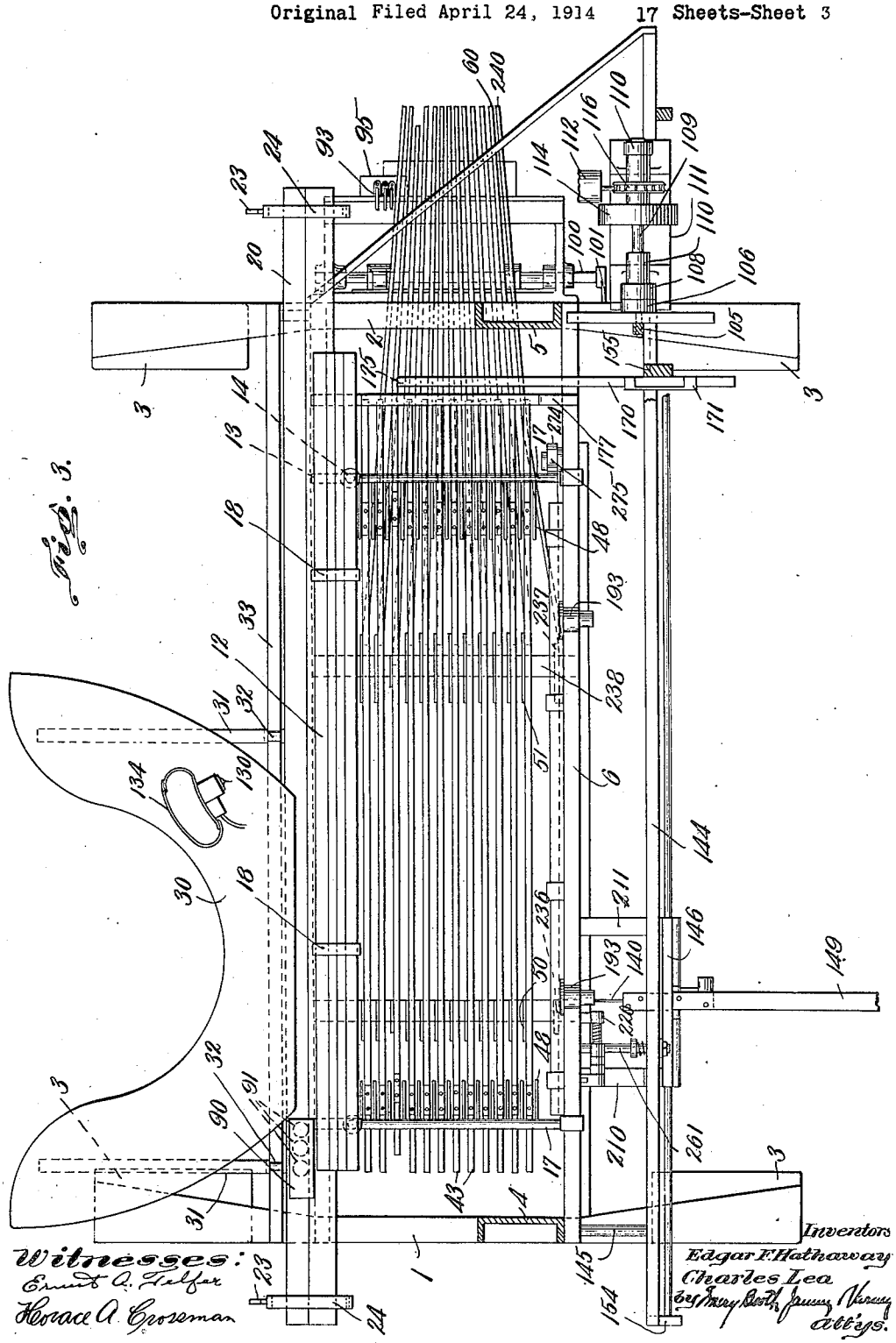


Fig. 3.

Witnesses:
Ernest A. Telfer
Horace A. Croseman

Inventors
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Charles Lea
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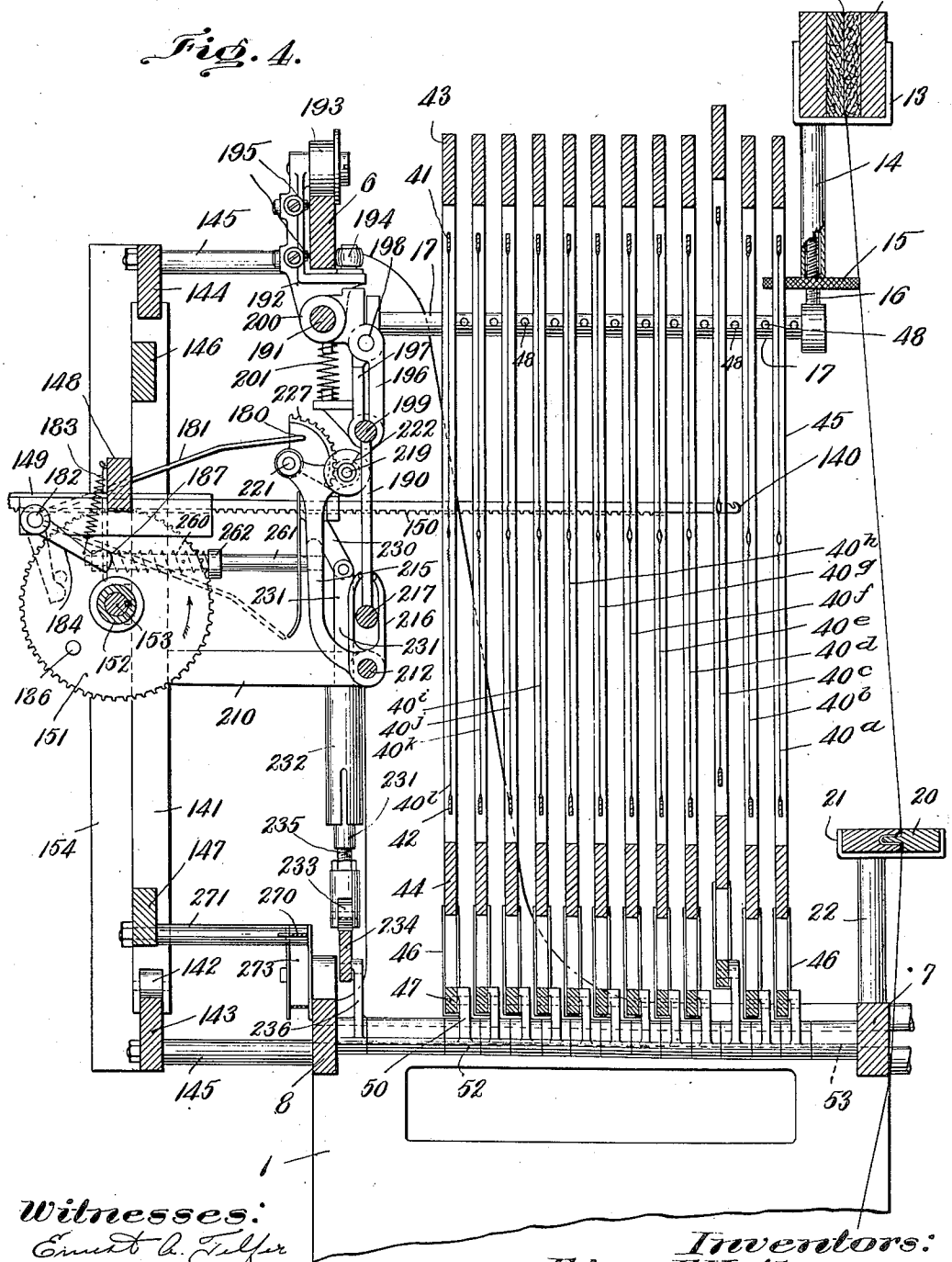
Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 4/12

Fig. 4.



Witnesses:
Ernest A. Fulper
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Charles Lea
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Attys.

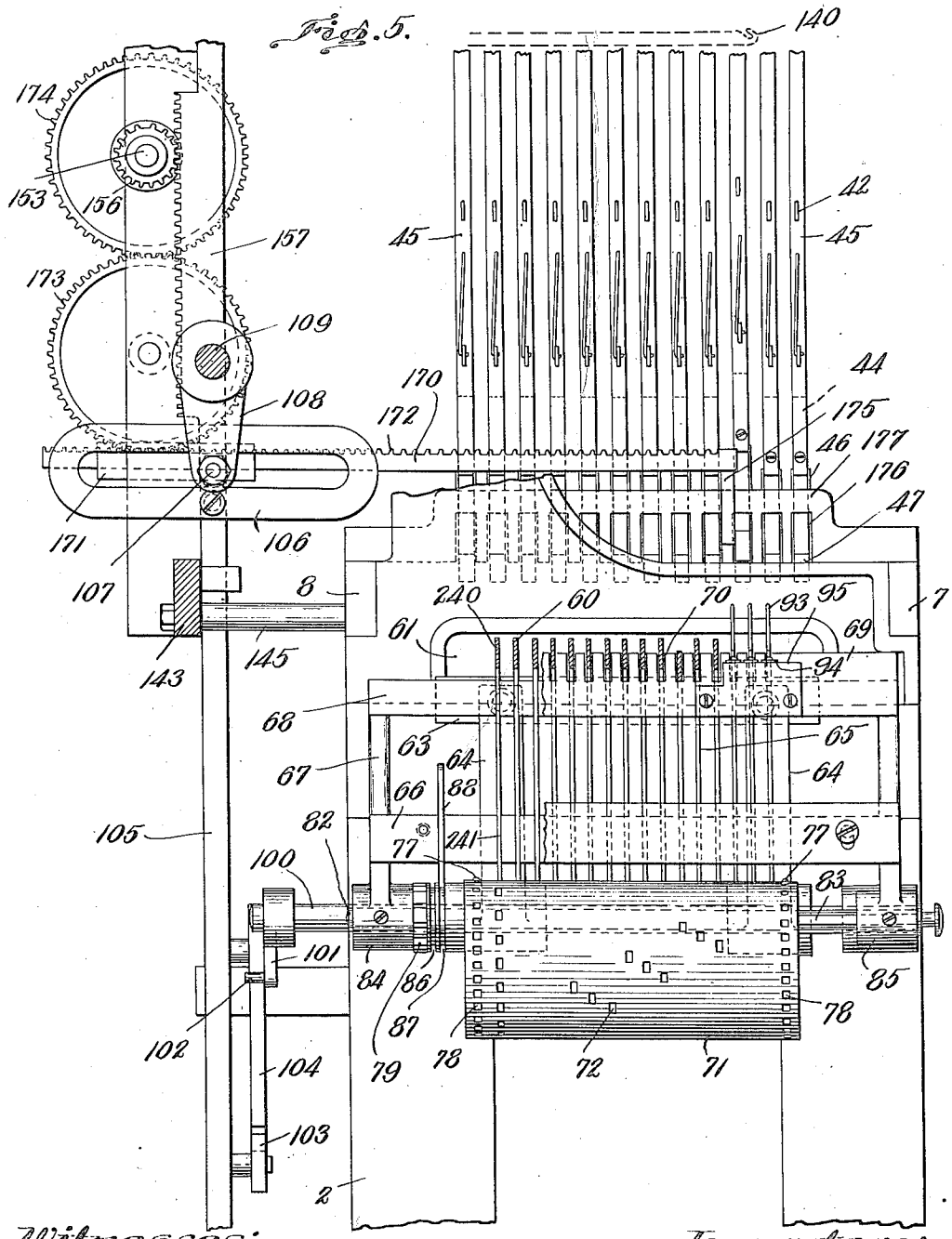
Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 5

Fig. 5.



Witnesses:
Ernest A. Telfer
Horace A. Grosman

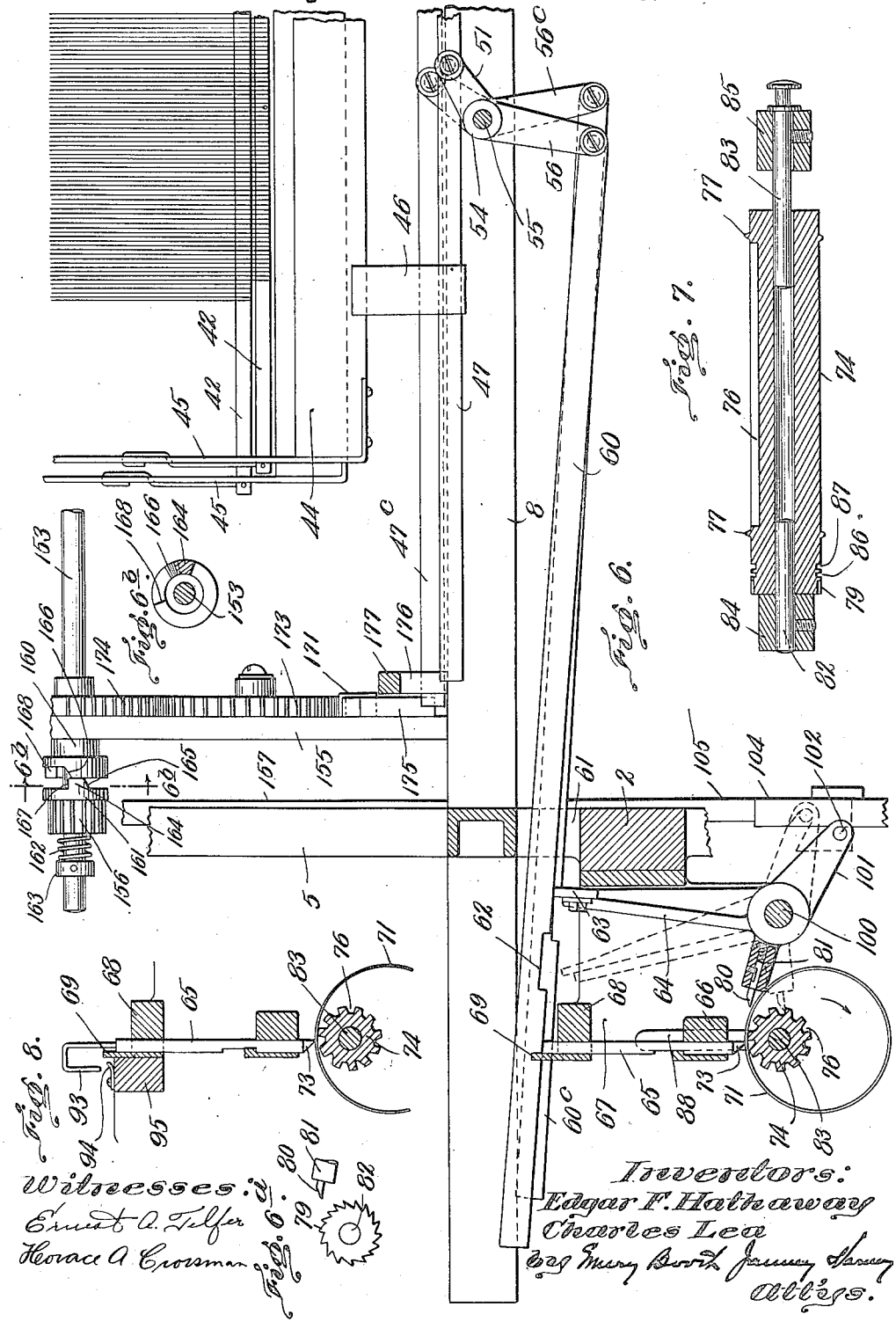
Inventors:
Edgar F. Hathaway
Charles Lea
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

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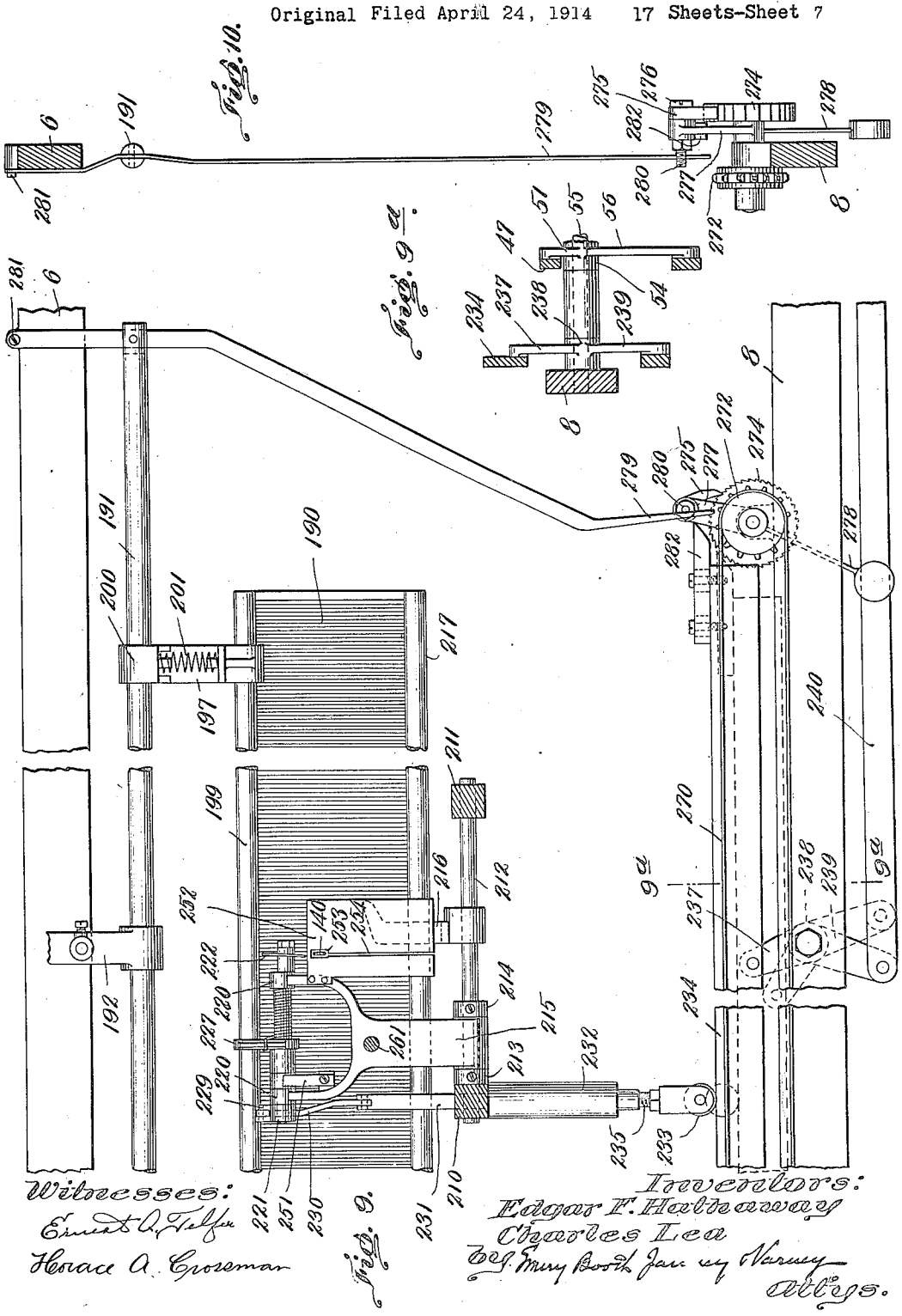


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E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 7



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E. F. HATHAWAY ET AL

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Original Filed April 24, 1914 17 Sheets-Sheet 8

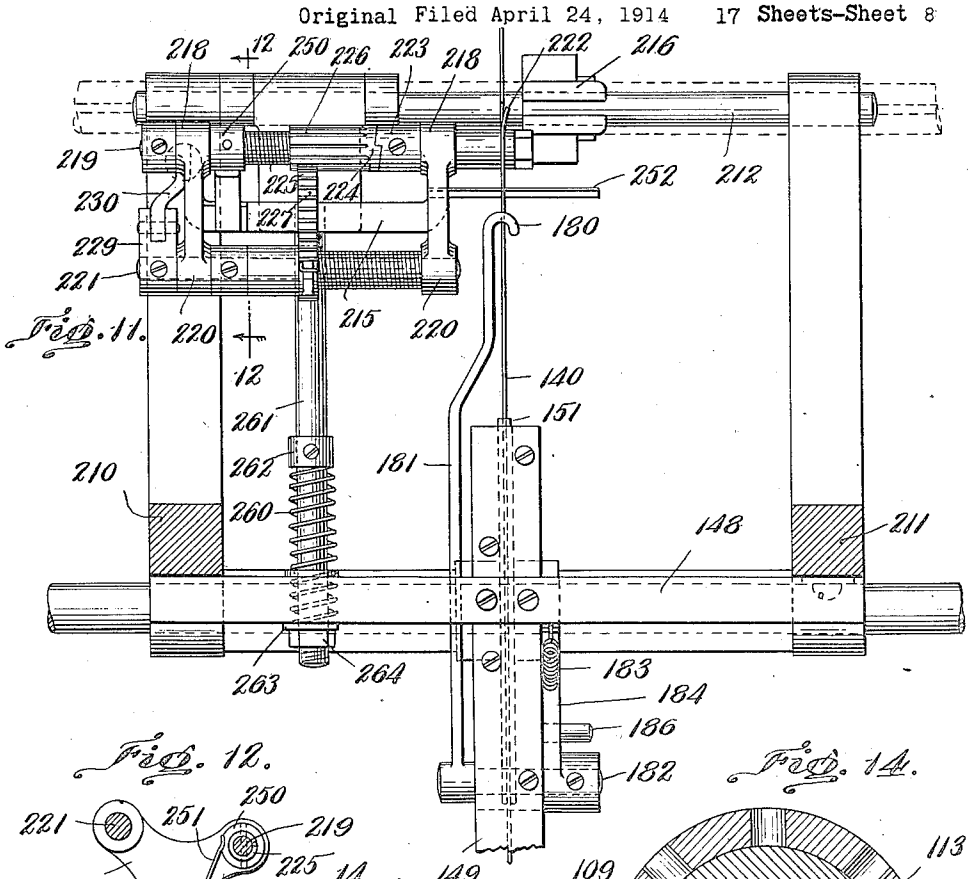


Fig. 11.

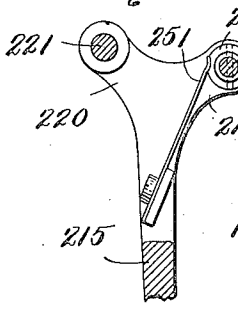


Fig. 12.

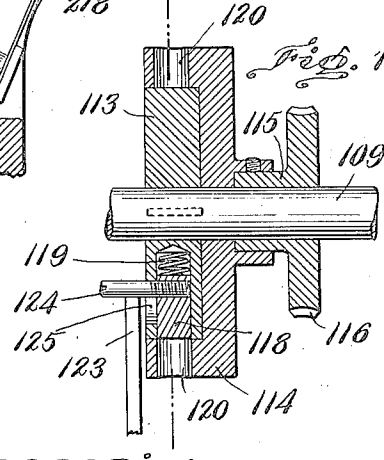


Fig. 13.

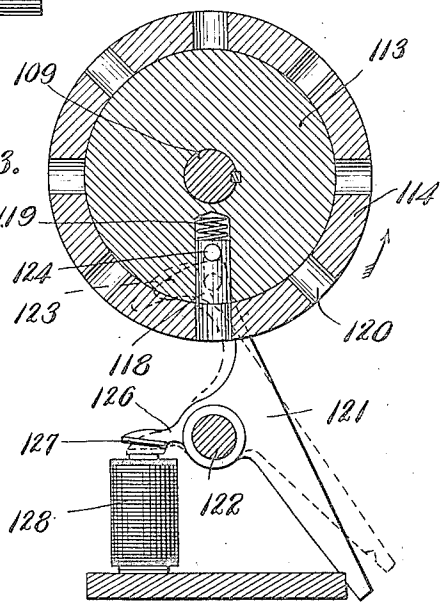


Fig. 14.

Witnesses:
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Horace A. Crossman

Inventors:
Edgar F. Hathaway
Charles Lea
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 9

Fig. 15.

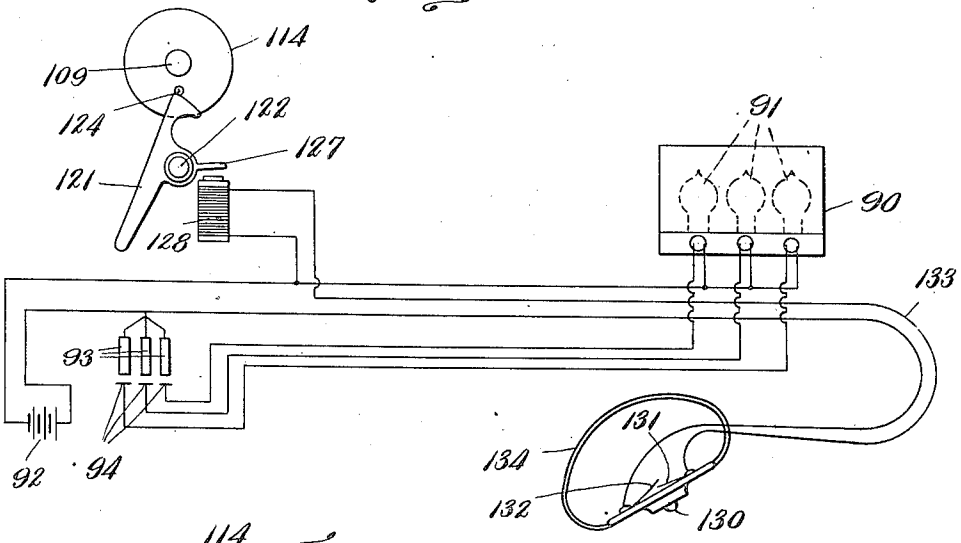
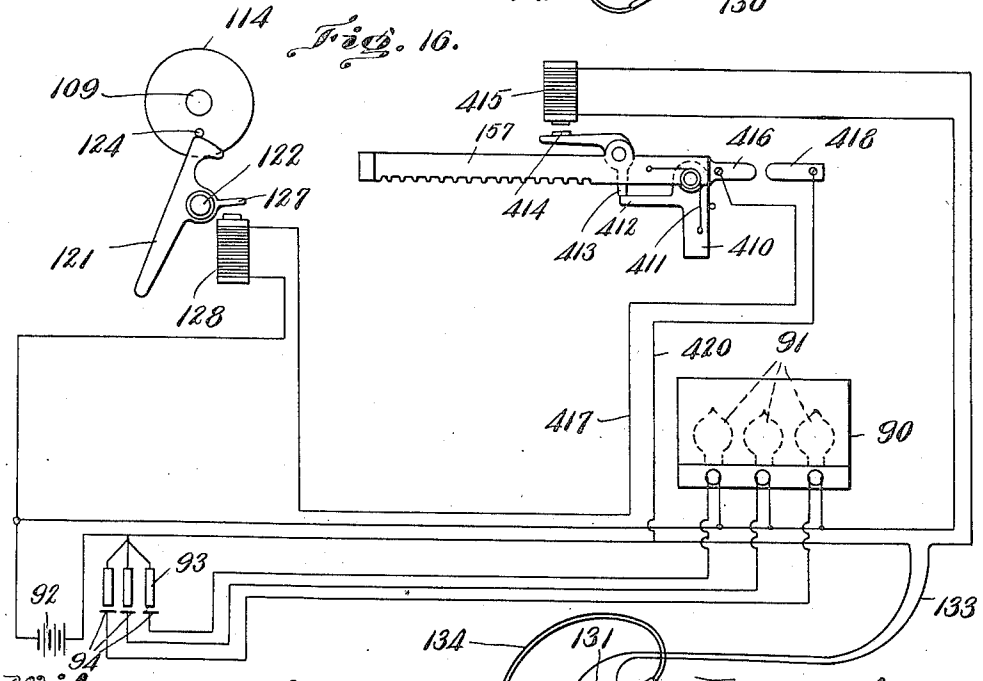


Fig. 16.



Witnesses:
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Inventors
Edgar F. Hathaway
130 Charles Lea
by Emery Booth Janney & Varney
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL.

TEXTILE MACHINE

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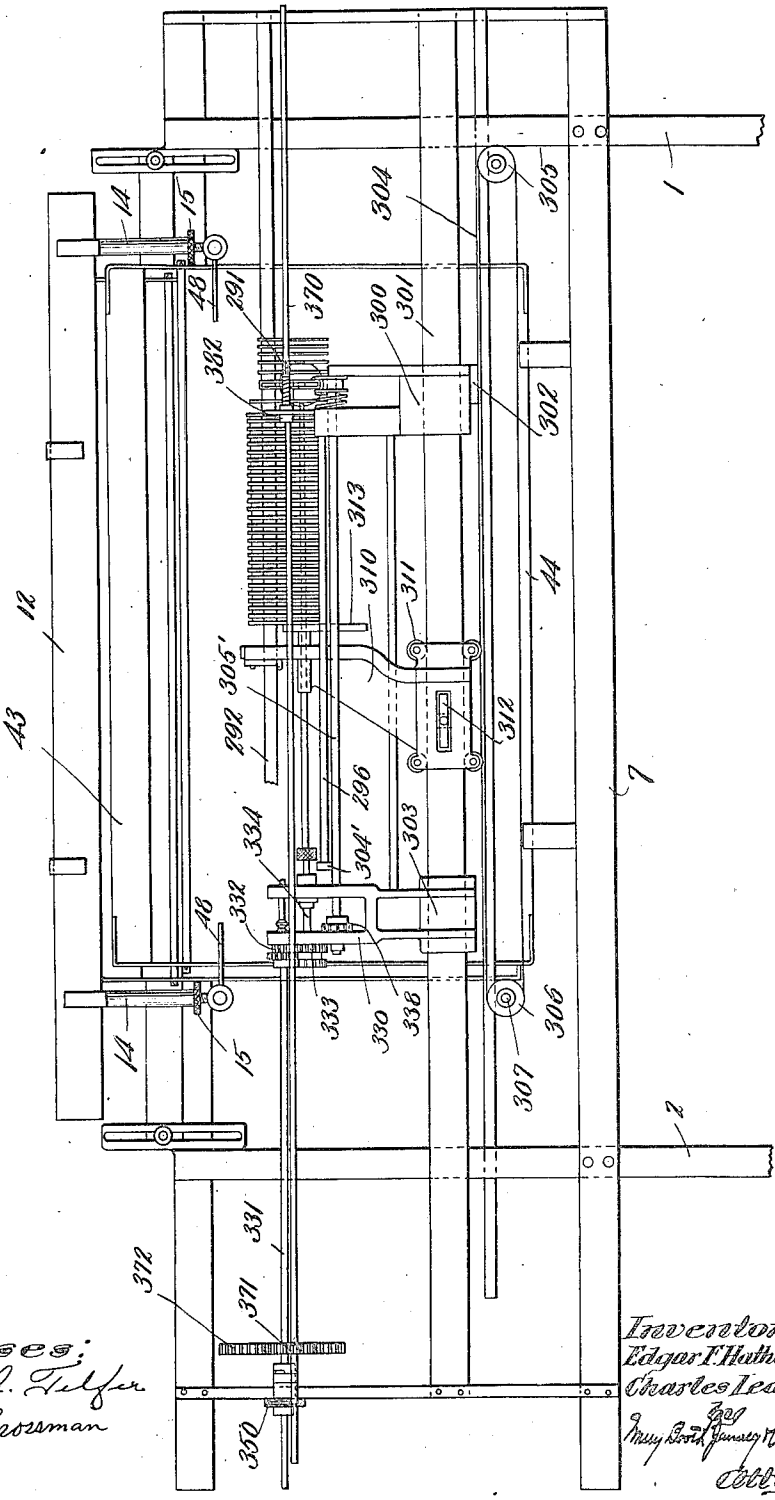


Fig. 17.

Witnesses:
Ernest A. Tolfer
Horace A. Crossman

Inventors:
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Charles Lea
by Mary Brock Janney Varney
Attys

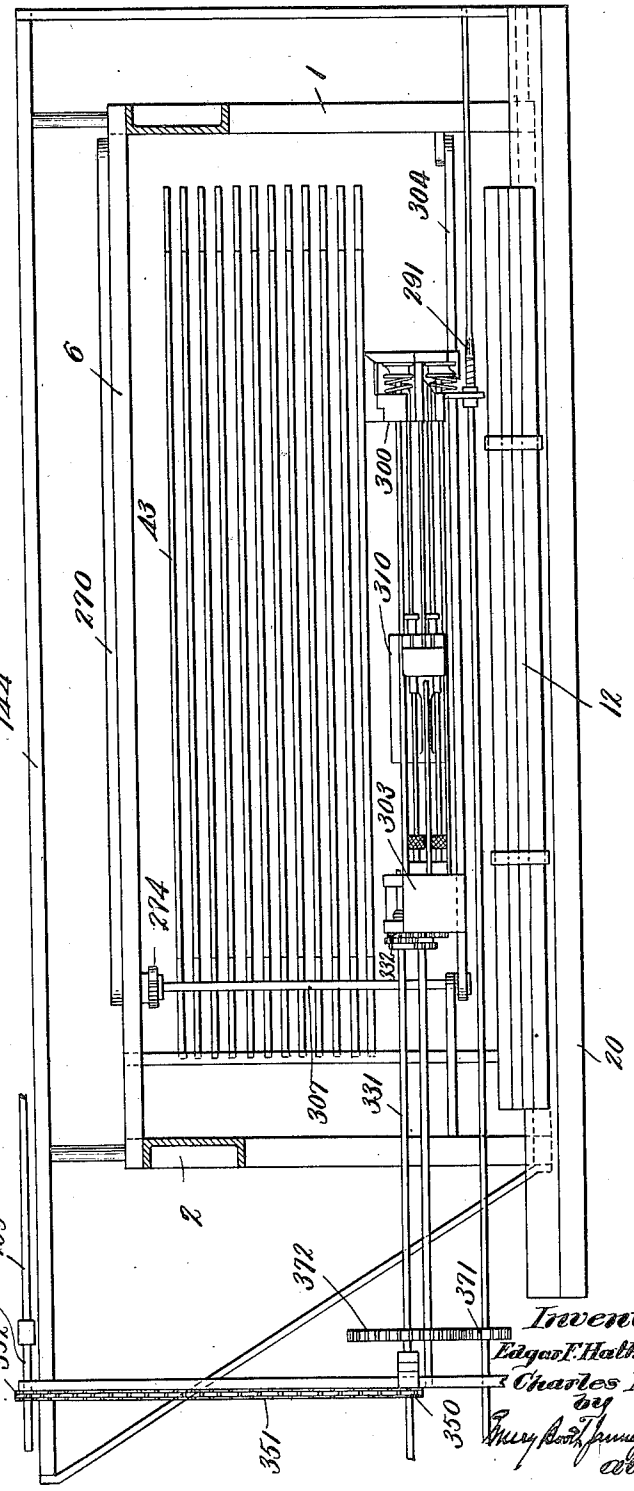
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E. F. HATHAWAY ET AL

TEXTILE MACHINE

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Fig. 16.



Witnesses:
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Horace A. Grossman

Inventors:
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Emery Booth Emery Harris
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

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Fig. 19.

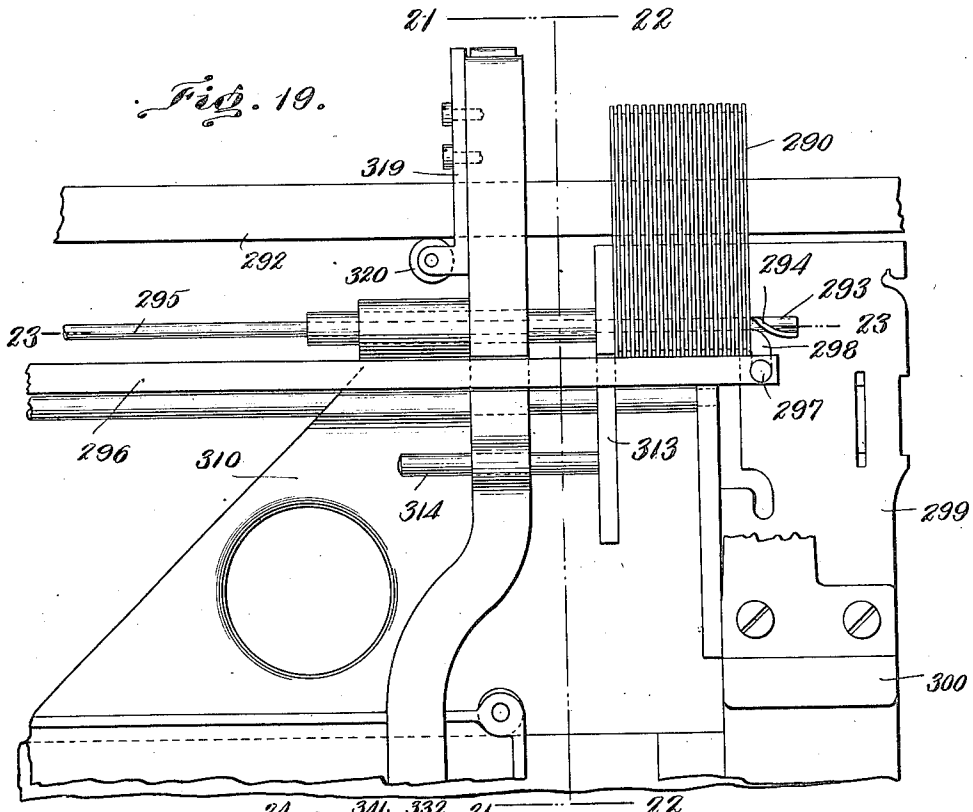
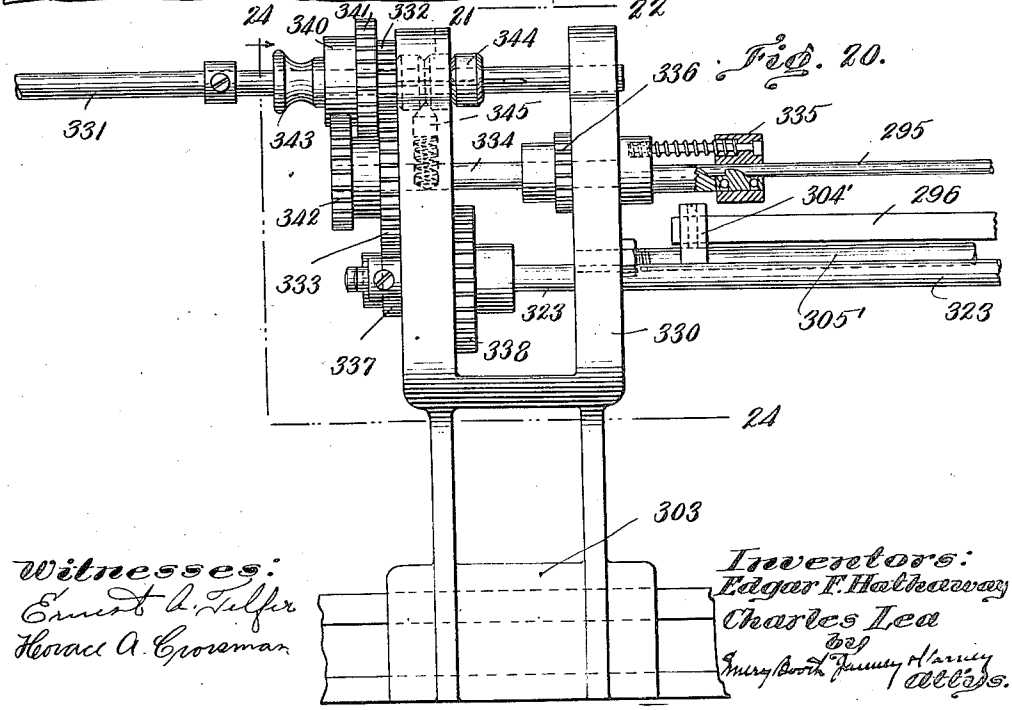


Fig. 20.



Witnesses:
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Edgar F. Hathaway
Charles Lea
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

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Fig. 21.

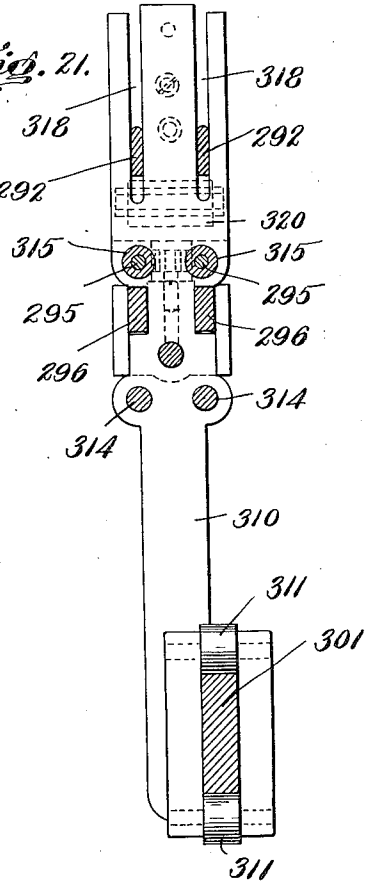


Fig. 22.

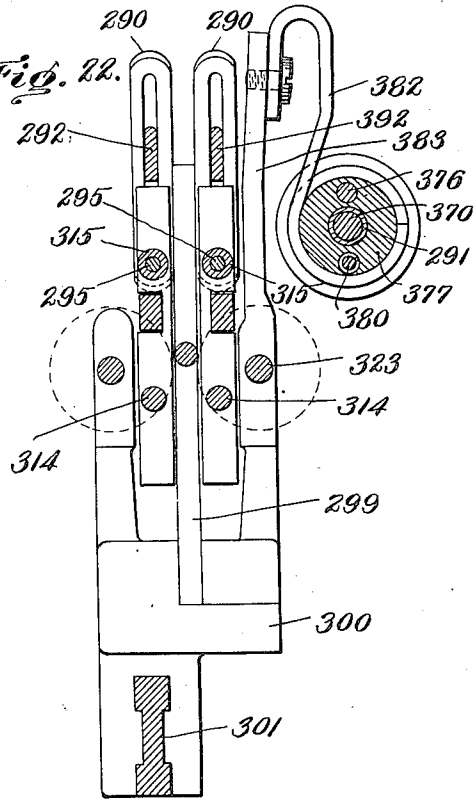


Fig. 23.

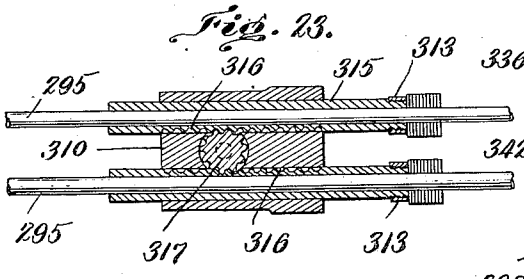
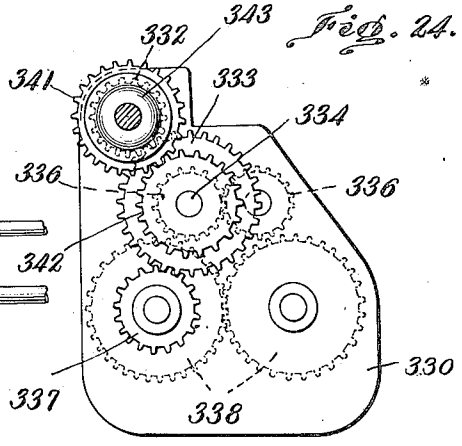


Fig. 24.



Witnesses:
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

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Fig. 25.

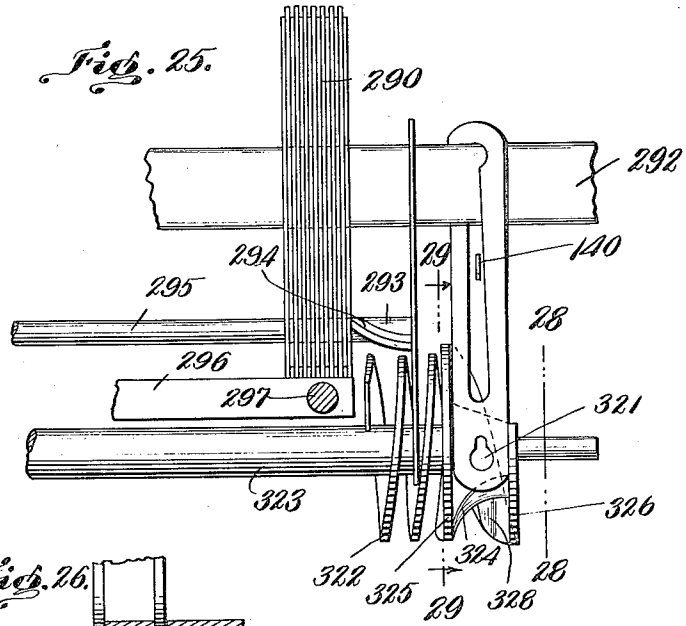


Fig. 26.

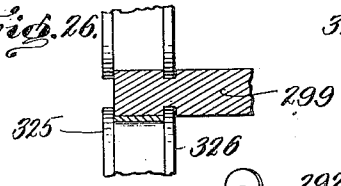


Fig. 29.

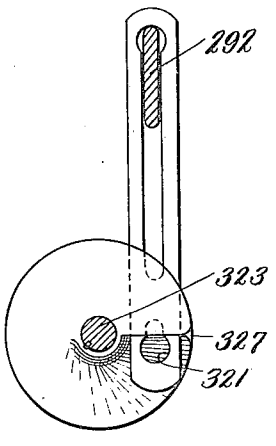


Fig. 27.

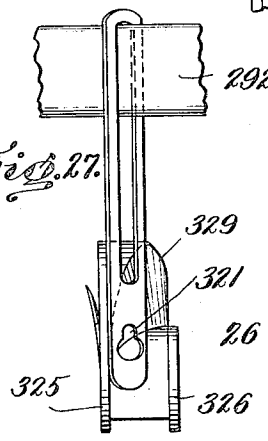
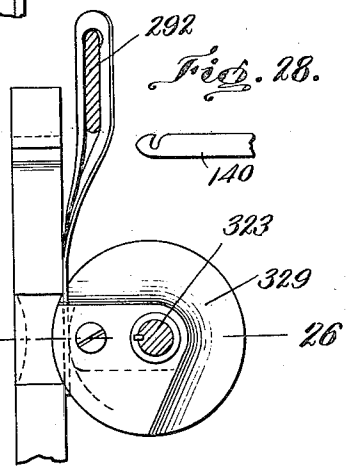


Fig. 28.



Witnesses:
Ernest A. Helfer
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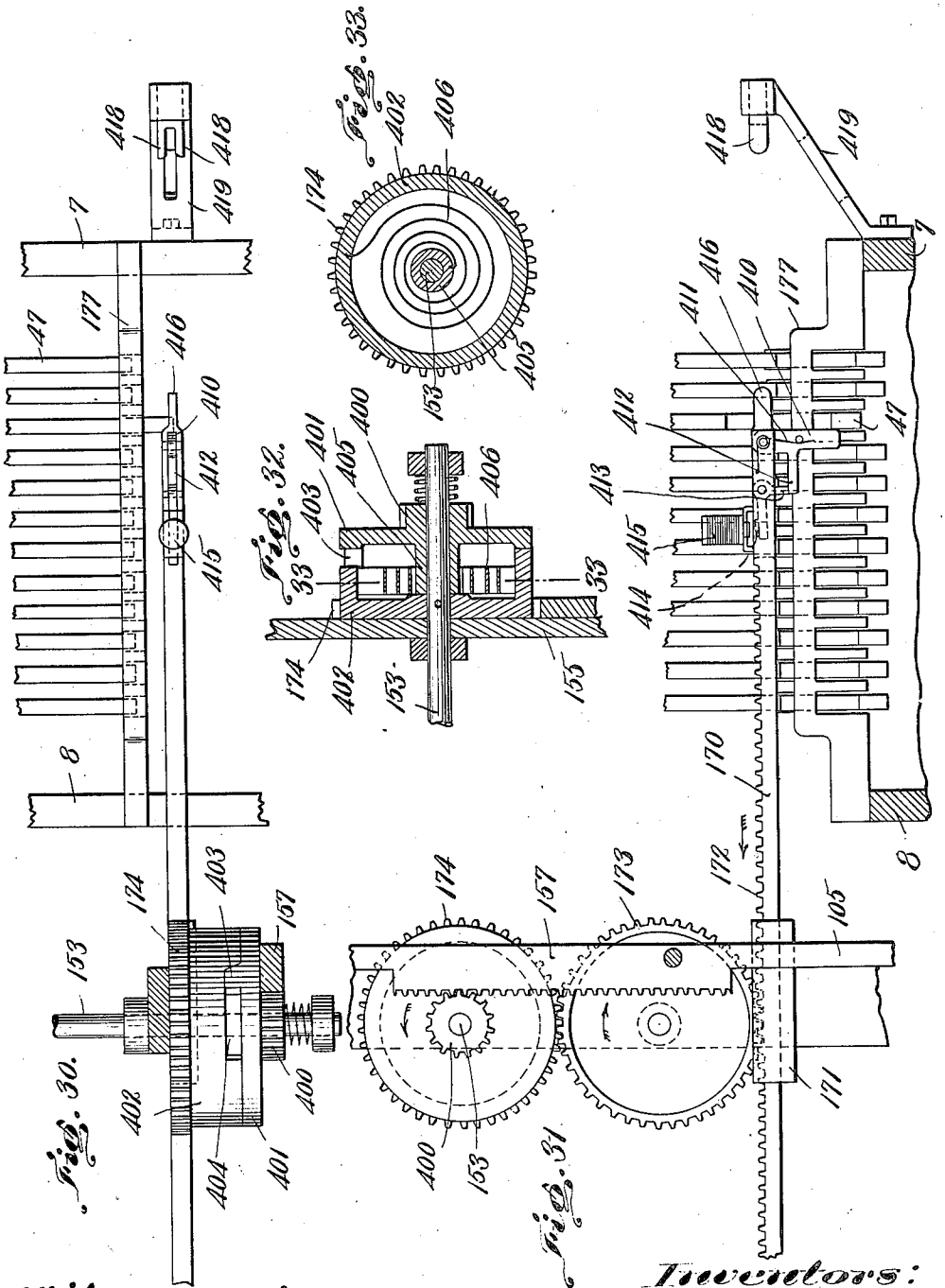
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 15



Witnesses:
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 16

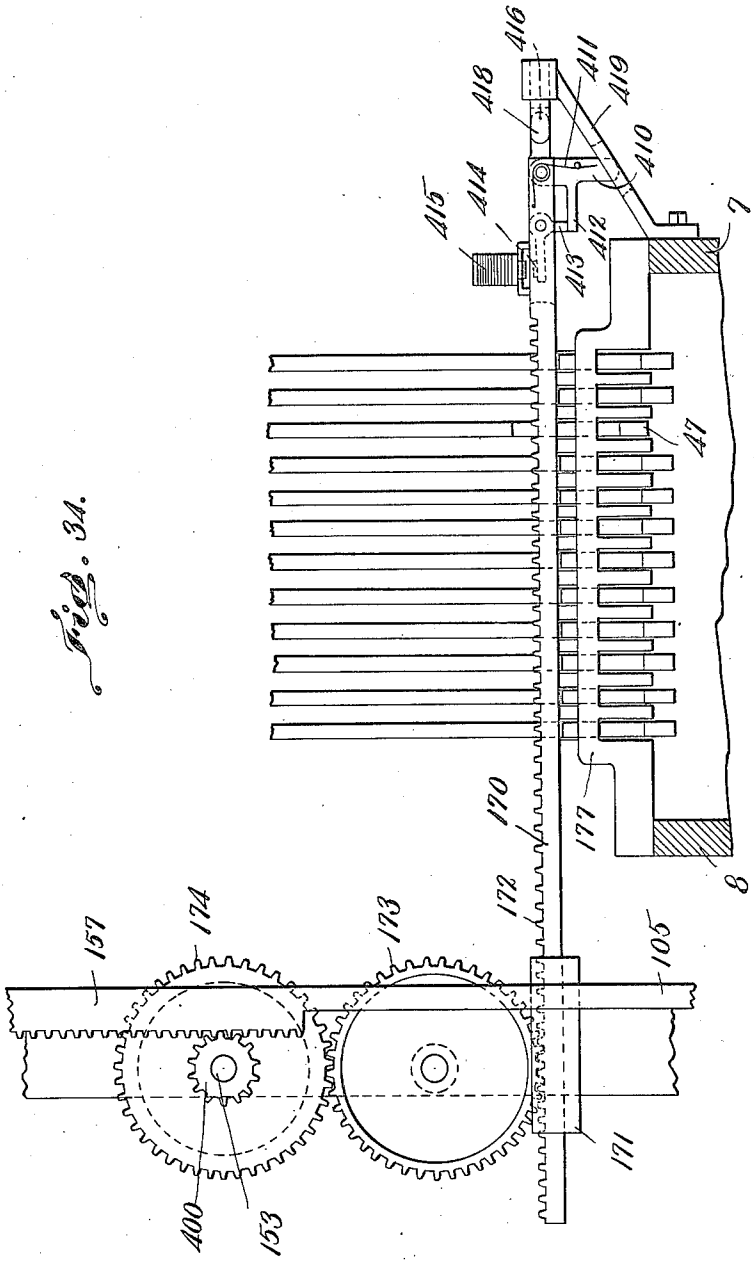


Fig. 34.

Witnesses:
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Inventors:
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Charles Lee
by Murray Booth Jamieson Varney
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Feb. 5, 1924. 1,482,648

E. F. HATHAWAY ET AL

TEXTILE MACHINE

Original Filed April 24, 1914 17 Sheets-Sheet 17

Fig. 35.

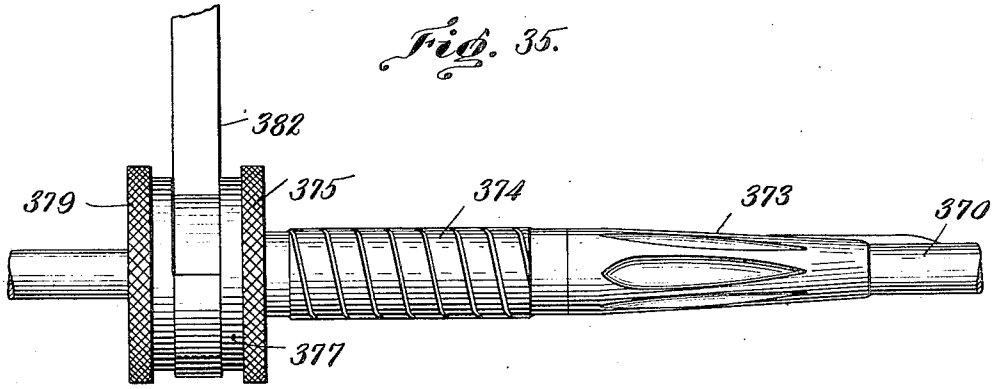


Fig. 36.

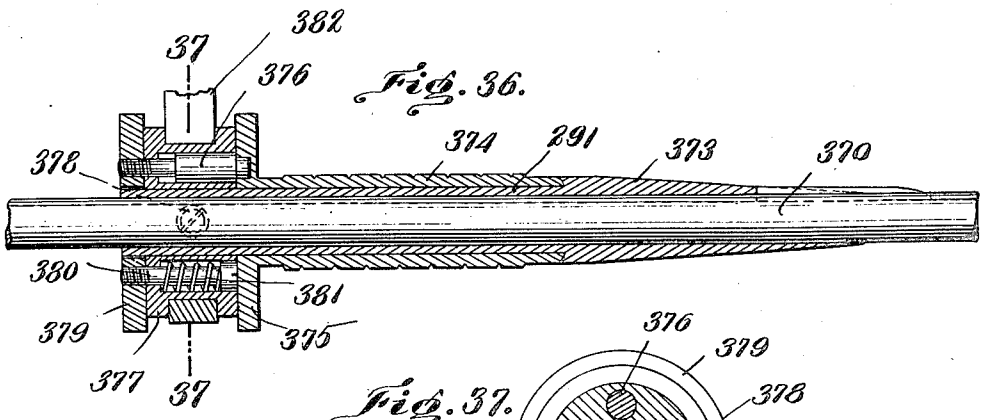
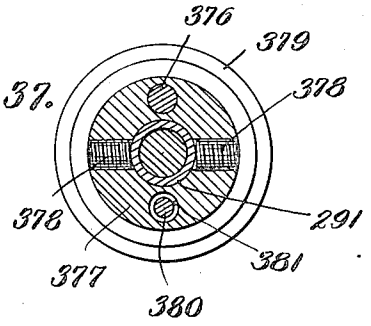


Fig. 37.



Witnesses:
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Horace A. Grosman

Inventors:
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Charles Lea
by Mary Booth Janney Harvey
Attys.

Patented Feb. 5, 1924. 1,482,648

UNITED STATES PATENT OFFICE.

EDGAR F. HATHAWAY AND CHARLES LEA, OF DORCHESTER, MASSACHUSETTS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO BARBER-COLMAN COMPANY, OF ROCKFORD, ILLINOIS, A CORPORATION OF ILLINOIS.

TEXTILE MACHINE.

Application filed April 24, 1914, Serial No. 834,238. Renewed March 17, 1922. Serial No. 544,954.

To all whom it may concern:

Be it known that we, EDGAR F. HATHAWAY and CHARLES LEA, both citizens of the United States, and residents of Dorchester, county of Suffolk, Commonwealth of Massachusetts (whose post-office addresses are 195 Freeport Street, Dorchester, Massachusetts), have invented an Improvement in Textile Machines, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to textile machines, the described embodiment thereof being in a warp drawing machine of a semi-automatic type. Certain features of the invention, however, are broadly applicable to wholly automatic warp drawing machines, as well as to textile machines intended for other purposes.

In the case of simple patterns, automatic machines for drawing in the warp ends have been found not only greatly to cheapen the cost but to add materially to the accuracy of the drawing in. Where complicated patterns are employed, requiring a very large number of harnesses, a point is finally reached where the complication required in the automatic machine for handling this large number of harnesses more than offsets the added advantage of lessened labor cost. The principal complication in an automatic machine for handling a large number of harnesses results from the multiplication of parts required for automatically selecting and facing the required heddle eye in the path of the thread-placing device at each thread-placing movement thereof.

In the described form of machine, we have provided mechanisms whereby a number of steps of the drawing-in operation are performed mechanically and automatically, combined, however, with means whereby the selection and positioning of the heddle eye is performed by hand, the machine being intermittently operated preferably under the control of the operator to provide a pause or interval during which the operator may perform such hand operation or operations as are required to complete the thread-placing operation.

In the hand drawing-in of warps having complicated patterns, the operation was subject to frequent and serious errors. This was due to the inability of the operative correctly to memorize and follow the pattern of the draw, or accurately to select the heddle at all times called for by the pattern. It has been sought to correct the error due to these conditions by the provision of a harness-finding machine such as is shown in Patent No. 732,229, granted June 30, 1903, to C. E. Smith, wherein there is provided a pattern mechanism intermittently set in motion by the operative and adapted to designate at each step the harness required for that particular stage of the pattern. Such designation takes place by the automatic lifting of the selected harness to a level slightly above the level of the harnesses of the other series, the harness which had been previously lifted being simultaneously dropped to its normal level. This leaves to the operative the mechanical operation only of placing the hand threading implement through the eye of the designated heddle, inserting the thread in the hook thereof and drawing it through the eye. The drawing-in operation, therefore, with the aid of such apparatus differed from the hand operation only in the automatic designation of the harness having the eye to be threaded, the threading with the hand implement being performed as before in the hand operation, and the reeding operation being separately and subsequently performed by hand as before.

In the present machine, there is sought to combine with the automatic designation of the harness and the manual selection of the heddle eye automatic features of the wholly automatic machine covering other steps of the thread-placing operation whereby the complication of an old automatic machine is avoided while at the same time the utmost accuracy may be secured in the case of complicated patterns, and a greatly increased output may be had as compared with the hand operation. In other words, the machine has the advantage of accuracy and speed which are characteristic of the automatic machine, but without the mechanical complication thereof.

In one embodiment herein, an automatically operated drawing member is employed, combined with automatic and simultaneously acting reeding mechanism and a pattern-controlled harness designator. In this machine, the needle is brought to rest at or

about the position of the designated harness, the operative thereupon placing the foremost unthreaded eye thereof over the needle and laying a warp thread into the bight thereof. Another operative mechanical cycle is then performed by the machine, that is followed by a similar hand operation, and so on. In another embodiment herein described, all operations except the manual one of selecting and presenting the heddle eye to the needle are automatically performed, including the automatic seizure of the thread by the needle and the automatic presentation and threading of a drop wire.

The elements above referred to are combined in the hereindescribed form of machine in many novel and useful relations, and the machine presents features of novelty and utility, many of which are novel and useful in and of themselves, apart from their combination and purpose in the machine, all of which will more fully appear from the description which follows.

The invention will be best understood by reference to the following description, when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a rear elevation of a machine embodying one form of the invention;

Fig. 2 is an end elevation thereof looking from the left of the machine as viewed in Fig. 1;

Fig. 3 is a plan view of the machine, certain parts being shown in section;

Fig. 4 is a central, transverse section showing the principal working parts of the threading and reeding mechanism on an enlarged scale;

Fig. 5 is an end view of a portion of the machine showing the pattern mechanism on the same scale as Fig. 4;

Fig. 6 is a longitudinal section through the end of the machine showing the pattern and heddle designating mechanism on the same scale as shown in Fig. 5;

Fig. 6^a is a detail in elevation, showing the feeding pawl for the pattern driving member and its relation to its ratchet;

Fig. 6^b is a detail in elevation and partial section taken on the line 6^b—6^b of Fig. 6, showing the yielding driving device for the needle shaft;

Fig. 7 is a longitudinal section taken through the pattern driving member;

Fig. 8 is a detail in sectional elevation showing one of the pattern-controlled signal contacts;

Fig. 9 shows in rear elevation the reeding mechanism and reed-controlled traversing mechanism for the needle carriage on the same scale as shown in Fig. 4;

Fig. 9^a is a detail in sectional end elevation on the line 9^a—9^a in Fig. 9, showing the support for one end of the reed opener-actuating bar;

Fig. 10 is an end elevation of the traverse-controlling mechanism for the needle carriage shown in Fig. 9;

Fig. 11 is a sectional plan showing the reeding mechanism shown in Fig. 4, but on a larger scale;

Fig. 12 is a sectional elevation on the line 12—12 in Fig. 11, showing the spring positioning device for the reed opener;

Fig. 13 is a sectional elevation taken on the main drive shaft showing the clutch mechanism;

Fig. 14 is a transverse sectional elevation taken on the line 14—14 of Fig. 13;

Fig. 15 shows in diagrammatic arrangement the circuits for the control of the starting and stopping mechanism and the pattern controlled signals;

Fig. 16 is a view showing the corresponding circuit arrangements for the modified form of machine shown in Figs. 17 to 37, inclusive;

Fig. 17 is a front elevation of a similar but modified form of machine showing the application thereto of drop wire handling mechanism;

Fig. 18 is a plan view of the machine shown in Fig. 17;

Fig. 19 is an enlarged front elevation of the drop wire separating and selecting devices shown in Fig. 17;

Fig. 20 is a detail of the power-transmitting gearing for the drop wire selecting devices;

Fig. 21 is a sectional elevation taken on the line 21—21 of Fig. 19, looking to the left in said figure;

Fig. 22 is a similar sectional elevation taken on the line 22—22 in Fig. 19, and looking to the right in said figure;

Fig. 23 is a section in plan taken on the line 23—23 in Fig. 19;

Fig. 24 is an end elevation in partial section on the line 24—24 in Fig. 20 of the transmitting gearing;

Fig. 25 is an enlarged front elevation showing the construction and action of the releasing and turning devices for the drop wires;

Fig. 26 is a section in plan taken on the line 26—26 in Fig. 28;

Fig. 27 is a front elevation showing a drop wire in a slightly different position from that shown in Fig. 25;

Fig. 28 is a section in end elevation taken on the line 28—28 in Fig. 25, showing the drop wire completely faced;

Fig. 29 is a section on the line 29—29 of Fig. 5, showing the drop wire as it enters the facing worm;

Fig. 30 is a plan view of the needle limit-

ing mechanism employed in the modified form of machine;

Fig. 31 is a side elevation of the same;

Fig. 32 is a longitudinal, central elevation taken through the driving clutch shown in Fig. 30;

Fig. 33 is a transverse, sectional elevation taken on the line 33—33 in Fig. 32;

Fig. 34 is a view similar to Fig. 31 showing the limiting bar in a different position;

Fig. 35 is a rear elevation of the warp separating and selecting worm;

Fig. 36 is a sectional elevation taken through the same; and

Fig. 37 is a transverse, sectional elevation taken on the line 37—37 in Fig. 36.

Referring to the drawings and to the embodiment of the invention shown in Figs. 1 to 14 thereof, the machine comprises upright end frame supports 1 and 2 joined together by suitably disposed brace members (Figs. 1, 2 and 3). The lower portions of the end supports are provided with supporting feet 3. The upper portions are formed into the pedestals 4 and 5, respectively, connected at their top by the overhead cross piece 6 which serves as a support as well as a trackway for a number of the working parts of the machine. At the base of the pedestals the frame members are connected together by the front cross piece 7 and the rear cross piece 8. (Fig. 4.)

Means are provided for supporting the warp threads in convenient parallel clamped relation. Herein (Fig. 2) provision is shown for supporting one warp in position for drawing in, but, if desired, two or more warps may be similarly held should the pattern require it. Herein the warp beam 10 is disposed beneath the machine between the end frame members, the trunnions of the beam resting in pockets 11 carried by the frame members and the warp ends passing upward therefrom in a generally vertical direction shown in Fig. 2.

Near the top of the machine the thread ends are clamped loosely in a clamp 12 carried in the clamping brackets 13, the latter supported near opposite ends of the machine on the upright, adjustable sleeves 14. The sleeves are interiorly threaded (Fig. 4) and are each provided with a hand wheel 15 by which they may be vertically adjusted on the threaded upright 16 carried by the horizontal arms 17, the latter supported by the upper cross member 6. The threads are yieldably or loosely clamped in the clamping member 12 so that they may be readily withdrawn therefrom. U-shaped grips 18 embrace the portions of the clamps to keep them from unduly spreading.

At a lower point between the upper clamp 12 and the warp beam 10 an intermediate clamp 20 is provided (Figs. 2 and 4), the latter supported on brackets 21 carried by the uprights 22 attached to the front cross member 7. The intermediate clamp 20 consists of two tongued-and-grooved members between which the threads may be tightly held, the clamps being adjusted by means of set screws 23 in the gripping members 24 which overlie the ends of the clamp (Figs. 2 and 3).

As a convenience for the operative we have herein provided an adjustable shelf 30 (Figs. 2 and 3) at the front of the machine which serves both as a work bench and as a rest or support for the operative. The shelf is supported by the brackets 31, the latter carrying rollers 32 on which it is adapted to slide along the track rod 33 supported by and parallel to the front cross member 7. The shelf is appropriately shaped so that the operative may stand close to the machine, but has at each side of him and in front of him a support upon which he may place any required tools or appliances, the shelf being readily moved lengthwise the machine as the drawing in operation progresses from one edge of the warp to the other.

In the illustrated form of machine we have shown means for supporting twelve harnesses designated as 40^a, 40^b, 40^c, etc., (see Fig. 4). It will be obvious, however, that the same principles of operation and construction may be applied to a machine for supporting any number of harnesses. Although cotton harnesses or harnesses of various other types may be employed, herein we have shown harnesses of the so-called wire heddle type (Figs. 2, 4, 5 and 6) consisting each of wire heddles loosely strung on the upper and lower stringer bars 41 and 42, respectively, and carried in rigid, rectangular frames consisting of the wooden upper and lower cross bars 43 and 44, respectively, and the vertical end connections 45.

These frames are each supported vertically in parallel spaced relation by the bottom frame bar 44 in a pair of rigid U-shaped holders 46, each holder carrying one end of the bar 44, the holders 46 being in turn carried by the longitudinal lifting bars 47 (Figs. 4 and 6). At their upper ends the heddle frames are kept in a spaced, separated relation by the parallel separating pins 48 (Fig. 3) projecting from the forwardly extending transverse supporting bars 17 between the successive upright heddle frame members 45.

In order to designate the heddle frame having the heddle next to be threaded, the heddle frames are adapted to be individually and selectively elevated by a slight amount through a vertical movement of its lifting bar 47. This, as will be more fully explained, brings the line of heddle eyes of that particular heddle into prominence before the operative, and also lifts them to

the same level in which lies the path of the drawing in implement.

To raise and lower the heddle frames each lifting bar 47 is mounted for vertical movement and, as required, is moved vertically by an actuating device which is brought into operative relation thereto by means of a pattern mechanism.

Referring to Figs. 1, 3, 4, 6 and 9[a], each harness lifting bar 47 is secured near its opposite ends to separate individual supporting levers 50 and 51 (Fig. 1). The levers 50 (Fig. 4) are each carried by a hub 52 journaled on a transverse rod 53 connecting the cross bars 7 and 8. The levers 51 (Fig. 6) are each connected to a hub 54 journaled on the rod 55 connecting the cross bars 7 and 8. Each hub 54, however, has also a depending lever 56 so that by moving the latter the lever 51 may be swung upwardly into the position shown by 56[c] in Fig. 6, the lifting bar 47 moved vertically and to the left as therein shown, the companion lever 50 swinging up as indicated in Fig. 1 to keep the lifting bar 47 always in a horizontal position. Movement, therefore, of any one of the levers 56 will give a combined vertical and longitudinal movement to the corresponding lifting bar and to the heddle frame. as is represented in Fig. 6, lifting the line of heddle eyes of the designated harness higher than that of the eyes of the remaining harnesses, as will be seen from Fig. 4.

To lift the heddle frames each lever 56 is connected to an actuator bar 60 (Figs. 5 and 6), each actuator bar extending laterally through an opening 61 in the frame member 2 and presenting at the opposite side thereof a notched lower side 62 adapted to be engaged by a reciprocatory actuator 63. The actuator 63 comprises a bar or plate extending transversely beneath the series of actuator bars (see Fig. 5) and carried by the two upright arms 64 to which there is imparted one complete swinging reciprocatory movement through the path indicated in dotted lines in Fig. 6 once for each threading cycle of the machine.

The actuator bars 60 are normally held out of operative engagement with the actuator 63 by means of the pattern controlled supporting pins or feelers 65, the under side of each actuator bar resting against the top of one of the pins. The supporting pins are spaced and guided in the lower transverse bar 66 carried by the pattern box or frame 67 and at their upper ends they are guided in a similar transverse bar 68, the latter having an outer, upturned flange 69 (Figs. 5 and 6) which is provided with a series of equally spaced slots 70 adapted to receive and guide the ends of the actuator bars 60 in their vertical pattern-controlled movement.

The lower ends of the pattern-controlled supporting fingers normally rest upon the surface of a pattern member 71 herein in the form of an endless sheet metal strip or belt with perforations 72 at appropriate intervals to provide the required pattern. The perforations are located on the pattern sheet in such locations that a progressive movement of the pattern sheet brings individual perforations into registration with the lower ends of the supporting bars 65. The latter act as feeler members to feel for the said perforations and when a perforation is brought beneath any given feeler the latter drops by gravity, its beveled lower end 73 passing through the pattern sheet into the backing roller 74 on the under side thereof. The backing roller (Figs. 6 and 7) is provided with a series of longitudinal grooves 76 shaped to correspond to the lower end of the feeler bars so that the latter when dropped through the pattern sheet rest therein. The roller 74 turns with the pattern sheet in the direction of the arrow, shown in Fig. 6, so that on the next movement thereof the inclined side of the groove 76 engaging the beveled tip of the feeler rod forces the same out of the grooved roller and through the pattern sheet into its previous normal position. To drive the pattern sheet the roller at opposite sides thereof is provided with teeth 77 which engage with regularly spaced perforations 78 in the pattern sheet whereby the latter is turned intermittently with the roller.

To turn the roller the latter is provided at one end and beyond the pattern sheet with ratchet teeth 79 (Figs. 6, 6[a] and 7) adapted to be engaged by a spring-pressed pawl 80, the latter projecting from and longitudinally slidable in the end of the lateral lug 81 carried on the same piece with the adjacent upright actuating lever 64 so that (see Figs. 6 and 6[a]) with each reciprocation of the actuating bar 63 the pattern roller 74 and the pattern sheet are shifted one step to bring the next pattern opening into the vertical plane of the feeler supporting rods.

The pattern roller 74 is journaled upon pintles 82 and 83 (Figs. 5 and 7) secured to brackets 84 and 85, respectively, carried by the pattern box 67. In order to make one pattern sheet answer for two patterns a plurality (herein two) of sets of longitudinal rows of pattern perforations may be employed and the pattern roller 75 with its pattern sheet shifted longitudinally on the pintles 82 and 83 to bring either one or the other set of pattern perforations in line with the feelers. To correctly position the pattern sheet for one or the other set of pattern perforations the roller 75 is provided near the ratchet 79 with a pair of adjacent circumferential grooves 86 and 87 with either one of which there may be engaged the vertically sliding key 88 (Figs. 5 and 6)

carried in the cross bar 66. By lifting the key the pattern sheet may be longitudinally shifted from one position to the other, one position bringing one set of pattern perforations into operative position and the other position the second set.

As the pattern sheet is shifted step by step different feelers are allowed to drop one by one, each one serving to lower the notched portion 62 of its sustained lifter bar 60 into the arc-shaped path of the actuator bar 63 to be engaged by the latter on its forward movement. On its forward or lifting movement, which starts immediately after the bar 60 is lowered, the actuator bar 63 engages the notch 62 of the bar which is dropped, as for instance the bar 60^c in Fig. 6, advancing it ahead of the others and moving its actuator lever 56^c to lift the corresponding harness as explained. The actuator lever 64 is oscillated once for each threading operation by means hereinafter described. Its first or outward movement serves to turn the pattern sheet through its pawl 80 while its reverse or inward movement acts to designate and lift that harness which corresponds to the feeler member allowed to drop through the pattern sheet in the new position of the latter.

Any desired pattern arrangement may be had. In the pattern indicated in Fig. 5 the harnesses are designated in groups of three, that is to say, the pattern is so arranged that the harness 40^c will first be lifted, then 40^b, and then 40^a; next harness 40^f, then 40^e, and then 40^d, and so on. This, it will be understood is merely illustrative and any required pattern can be had.

It is frequently required to depart from the regular pattern, as by the drawing of two threads through a given eye at some particular stage thereof, or the omission of threads, a change of color or a change of draw from one beam to another where more than two warps are employed, or a combination of these. We have herein provided means whereby deviations of this kind or any other special pattern requirement may be indicated to the operative through the medium of the pattern mechanism and without the necessity of charging his memory with the same.

For this purpose there is provided at or adjacent the operative's position (see Fig. 3) an indicating device 90. This may be a visual, audible or any other desired kind of indicator. Herein we have shown as illustrative of a conventional indicator one or more electric lamps 91, herein three in number, distinguishable from each other as by differently colored glass, these lamps being connected through circuit controlling devices with the pattern mechanism. These lamps (Figs. 8 and 15) are each in an electric circuit which contains the battery 92 and a normally open circuit-closing member 93, one circuit closer being provided for each lamp. The circuit closer (Fig. 8) is in the form of a bent wire carried by the upper end of one of the feeler members 65 and projecting above the cross bar 69 so as to overlie a stationary contact member 94. The contact 94 is carried by an insulated support 95 fast to the cross bar 68. One terminal of the lamp being connected directly to the contact 94 and the other being connected through the battery to the frame of the machine, the circuit-closing member 93 will close its circuit and light the corresponding lamp whenever its feeler member 65 is allowed to drop through the pattern sheet. There is thus provided at a point where it can be readily detected, an easily understood signal controlled by the pattern mechanism of the machine and adapted to indicate any special condition which is required to be fulfilled by the operative in the drawing-in operation.

To actuate the pattern devices once for each cycle of operation of the machine the actuating levers 64 are fixedly secured to a rock shaft 100 (Figs. 1, 5 and 6) carried in bearings on the pattern box 67 and having at its rear end the lever arm 101, the end of which has the laterally projecting pin 102. The latter lies within the path of a vertically moving notched or hook-shaped member 103 (Fig. 1) carried by the plate 104 fastened at the side of the vertically moving driver rod 105. The latter is mounted to slide vertically in the frame and carries the horizontally arranged slotted cross head 106 cooperating with the pin 107 carried by the crank arm 108. The latter is secured to the intermittently operated driving shaft 109 which is given one complete revolution for each cycle of operation of the machine. This causes the vertical driver rod 105 to be given one complete vertical reciprocation with each cycle of machine movement, lifting the hook-shaped member 103 into engagement with the pin 102 of the pattern actuating lever 101 near the end of its upward movement. Having engaged the pin 102 it swings the lever 101 and moves the actuating levers 64 and pawl 80, as heretofore described. On its descending movement it swings the actuating lever back, releases the pin 102 and then drops to its normal position shown in Figs. 1 and 5.

Referring now to the devices for giving the controlled intermittent movement to the machine, the intermittently operated driving shaft 109 (Figs. 1 and 3) is supported in bearings carried by the uprights 110 on the shelf or platform 111 at one end of the machine and above the pattern box 67. The shaft 109 is driven by the electric motor 112, but through an intermediate,

controlled clutch which the operative may throw in at will. The clutch device (see Figs. 13 and 14) is composed of an inner driven disk 113 keyed or otherwise secured to the driven shaft 109 and an outer cylindrical shell or casing 114 fixedly secured to a driving sleeve 115, the latter loosely mounted on the shaft 109. The driving sleeve has attached to it a driving worm 116, the latter adapted to engage with the worm gear 117 (see Fig. 1) carried by the end of the driving shaft of the motor 112.

The motor 112 being constantly driven during the period when drawing-in takes place, the driving shell 114 of the clutch is applied at will to drive the driven disk 113 and is kept in engagement therewith for one complete revolution by the following mechanism. Seated in a radial pocket formed in the periphery of the disk 113 is a clutch pin 118, a coil spring 119 seated against the inner end of the pin tending to force the same radially outward to enter one of the several radial openings 120 circumferentially distributed about the shell 114 and adapted to be brought into successive registration with the pin 118 as the shell is revolved. Normally the clutch pin is held out of operative engagement with the driving shell by means of the swinging stop lever 121 pivoted at 122 and presenting a curved edge 123 within the path of a pin 124, which latter is fastened to the clutch pin 118 and projects laterally therefrom through a slot 125 in the side of the disk 113. The weight of the stop lever and the tendency of the disk 113 to rotate with the shell 114 in the direction of the arrow shown in Fig. 14 tends normally to hold the stop lever in the position shown in said figure where it holds the clutch pin out of engagement with the driving shell 114. The stop lever, however, is provided with the laterally extending bell-crank arm 126 carrying the armature 127 in operative relation to the magnet 128 so that by the energization of the magnet the armature will be attracted and the stop lever drawn down away from the pin 124, allowing the clutch pin to snap into that opening 120 in the driving shell which is next presented in registration therewith. When this occurs the disk 113 and driven shaft 109 will turn with the driving sleeve 115 until the latter has made one complete revolution. Thereupon if the magnet 128 has meantime been de-energized the stop lever will be again presented in the position shown in Fig. 14 where it presents an obstruction to the further movement of the pin 124; causing the same to ride up on the rounded edge of the stop lever and withdraw the clutch pin from engagement with the driving shell 114.

To energize the magnet 128 an appropriate circuit-closing device is preferably arranged closely adjacent the operator's position. Herein (see Figs. 3 and 15) the same consists of a push button 130 adapted to close the contacts 131 and 132 which are contained in a circuit 133, the latter including the magnet 128 and the battery 92. The push button 130 may be located upon the operative's shelf 30 if desired, but preferably to increase the speed of manipulation it is attached to and carried by a portable strap or band 134, the latter being of a size and shape suitable to slip over the palm of the hand of the operative, whereon the push button 130 can be pressed at will by the thumb or fingers of the hand without interfering with the manipulation of the threads or the heddles by the same hand. By having the circuit wires 133 arranged in a flexible connection to the palm-carried push button, the operative is thereby enabled to reach into the machine, adjust the heddles, threads, or other parts requiring manipulation, and immediately upon completion of such manipulation cause the parts of the machine to perform their intended cycle of movement, all without withdrawing his hands from the appropriate position where they will be required for the next manipulation. This leaves the fingers of both hands always available to the operator for the rapid handling of the heddles, warp threads, etc., and provides a very certain but rapid means for ensuring the quick, successive startings of the machine without loss of time or change of position by the operative.

In the embodiment of the invention herein shown a mechanical or automatically actuated thread-placing device is employed, herein in the form of a drawing-in needle 140 (Figs. 1, 2, 4 and 11). Preferably this needle is so positioned as to its path of movement that it is operative only with reference to the heddle eyes of the harness which has been designated through the pattern-controlling mechanism by being lifted to a higher level than the remaining harnesses of the series. This is secured by having the needle travel in a horizontal path (see Fig. 4) at a level above the level normally occupied by the harness eyes and at the same level to which they are selectively elevated by the lifting mechanism.

In the illustrated form of the invention, furthermore, the movement of the needle is not only automatic, taking place with the other intermittent operations of the machine, but it is so controlled by the pattern mechanism conjointly with the harness elevating devices that the needle is brought to rest at the close of a given thread-placing action with reference to the harness designated for the next threading action and in an appropriate position which best enables the operative to place the leading hed-

dle eye from that harness over the point of the needle. Herein the needle is brought to rest with its point just beyond the line of heddles carried by the designated harness. The devices for repicrocating and controlling the needle are as follows:

The needle 140 with its driving parts is mounted upon a traversing carriage adapted to move lengthwise the machine and across the warp. This carriage is composed of the upright supports 141 (Fig. 1) carrying the rollers 142 (Fig. 4) running upon the underlying track support 143 and having upper grooved ends which engage and are guided by the overhead tracking or guide rod 144. The needle carriage guide rods 143 and 144 are supported from the front frame piece 8 and the upper frame piece 6, respectively, by means of the lateral supporting rods 145 (Fig. 4). The needle carriage uprights 141 are connected by upper and lower transverse members 146 and 147, respectively. A third transverse member 148 supports the guide box 149 through which the needle 140 is guided and reciprocated. To reciprocate the needle the under side thereof is provided with rack teeth 150 which engage with the teeth of a gear 151, the latter carried by a sleeve 152 splined to the needle drive shaft 153 to turn therewith, but confined between the needle carriage frame members 141 so as to travel therewith along the shaft. The needle drive shaft 153 is journaled at its ends in upright bars 154 and 155, the latter uniting the lower and upper guide bars 143 and 144. At that end of the shaft 153 which is adjacent the vertically moving driver rod 105 (Fig. 1) it is provided with a pinion 156 meshing with rack teeth 157 on the said driver rod, so that the said pinion is reciprocatively rotated for each vertical reciprocation of driver rod.

Referring now to the mechanism for limiting the movement of the needle, this is accomplished by the provision of certain stop devices cooperating with the pattern mechanism, which stop the further turning movement of the needle drive shaft 153 when the needle has reached the required point in its travel, a yielding driving device being interposed between the pinion 156 and the driving shaft 153 to permit the pinion to continue its rotative movement without further movement of the driving shaft. This may be accomplished by various means, but herein (Figs. 1, 6 and 6b), the yieldable driving device comprises a driven clutch member 160 fixed on the shaft 153 and having clutch teeth interlocking with the driving clutch member 161. The latter is secured to or is a part of the pinion 156 which is freely rotatable on the shaft 153 and capable of a limited sliding movement thereon. The driving member 161 is constantly pressed toward the driven member by means of the spring 162 interposed between the pinion 156 and a collar 163 secured to the shaft 153. The driving member 161 has its face abutting against the face of the driven member 160 with its driving tooth 164 adapted to fit a notch or recess in the face of the driven member 160, the notch being preferably somewhat wider or of greater circumferential extent than the tooth. The side 165 of the tooth which is used to drive the shaft in the forward movement of the needle is beveled or inclined as shown in Fig. 6 and the end of the notch or recess 166 in the driven member 160 is similarly shaped. The opposing faces of the tooth and notch 167 and 168, respectively, which are relied upon in driving the shaft in the retractile movement of the needle, are preferably formed without this bevel or inclination.

When the rack bar 157 starts on its upward movement the pinion 156 has imparted to it a contra-clockwise movement (as viewed in Fig. 5). This turns the driving teeth 164 until the straight faces 167 and 168 are in engagement, whereupon further movement of the pinion is accompanied by a retractile movement of the needle. The vertical movement of the rack and the dimensions of the gearing is such that this draws the head of the needle back through the entire bank of heddles, through the reed and back of the thread stripper which thereupon acts to strip the drawn in thread. When the crank arm 108 has moved through one hundred and eighty degrees from the position shown in Fig. 5 the needle has reached its extreme rearward limit. Further movement of the crank arm causes downward movement of the rack bar 157 and a clockwise rotation of the driving pinion 156. The driving tooth 164 on the driving clutch member 161 thereupon rotates clockwise until the beveled faces 165 and 166 are in abutment, whereupon it starts to impart the advancing movement to the needle. The advancing movement of the needle continues until through the interposition of stop devices hereinafter referred to, further movement is prevented and the driven clutch member 160 is brought to rest. This automatically throws out the driving clutch member 161 by causing the driving tooth 164 to ride out of the recess of the driven member on the beveled face 166 into the position shown in Fig. 6, the spring 162 yielding to permit such sliding movement. The further downward movement of the rack bar 157, if any, is accompanied by rotation of the driving clutch member with the driven clutch member at rest. If the needle movement is stopped before completion of the movement of the pinion 156, the machine will be stopped with the head of

the needle at or just beyond the row of heddles from which the required heddle is to be selected and with the two clutch members out of engagement as represented in Fig. 6. When the machine is next started into operation and the rack bar begins its upward movement, the driving tooth 164 will be turned contra-clockwise until it slips into the notch or recess in the driven clutch member 160, whereupon it will engage and turn the latter by engagement of the clutch faces 167 and 168 to provide the thread drawing movement of the needle. The result is that when the machine is started into operation the needle is first retracted always to the same rearward limit of movement and is then advanced to a variable point determined by the pattern control stop mechanism.

Referring now to the needle stop mechanism, while any suitable device may be employed for controlling the movement of the needle, herein the pattern-controlled movement of the harness is itself utilized for limiting the movement of the needle to cause the latter to stop at or about the plane of the heddles carried by the designated harness. To this end a stop bar 170 (Fig. 5) is employed which is given a reciprocatory movement parallel with and similar to that imparted to the needle. The stop bar is guided for movement in a horizontal plane in the guide box 171 (Figs. 2, 3 and 5) carried by the upright 155. The upper side of the bar 170 is provided with rack teeth 172 which mesh with the teeth of a gear 173 also journaled on the upright 155, the gear 173 in turn meshing with a gear 174 fixed on the needle drive shaft 153. The gears 173 and 174 are so dimensioned that the stop bar 170 is given a reciprocatory movement similar in extent to that of the needle 140. At its forward end the stop bar carries a depending stop lug or finger 175 (Figs. 5 and 6) which has its forward movement limited by striking the end of that harness lifting bar 47 which has been raised under the control of the pattern mechanism.

As will be seen from Figs. 1, 5 and 6, the harness lifting bar 47 has a combined vertical and endwise movement, the endwise movement bringing the end of the lifting bar into the path of the stop finger 175 and stopping further movement thereof. As the machine starts up, the needle is first retracted, the pattern sheet being then moved near the close of the retractile movement of the needle. Immediately after the commencement of the forward needle movement the actuator lever 64 is moved and this lifts and moves the designated harness bar so that it limits the forward movement of the stop lug 175 and brings the hook of the needle to rest just in front of the line of elevated heddles. This condition is represented in Figs. 3, 4 and 5 by the position of the needle and stop lug with reference to the harness designated as 40^c.

In order to provide an unyielding resistance to the stop lug the ends of the lifter bars 47 (Figs. 5 and 6) move in and through the vertical slots 176 in the slotted guide or bridging member 177, which latter lies transversely across the machine, resting upon the cross bars 7 and 8. The end of the designated lifting bar 47 (as is represented by 47^c in Fig. 6) projects into the path of the stop finger 175 from between the walls of the slotted guide so that it presents an unyielding abutment to the further movement of the stop finger.

The drawn-in thread is stripped from the needle by a thread-stripping finger 180 (Figs. 4 and 11) which lies directly over the needle at the rear of the reeding devices and is given a downward stripping movement across the thread after the needle has drawn the latter through the reed. To this end it is carried by the end of a stripping arm 181, the latter mounted on the rock shaft 182 journaled in the lower end of the needle guide box 149. The stripping arm is normally held in the elevated position shown by means of the spring 183, one end of which is secured to the transverse member 148 on the needle carriage and the opposite end to the actuating finger 184 fixed to one end of the stripper shaft 182. In its upward position the stripper arm is seated in a slot 185 (Fig. 1) in the bottom of the transverse member 148. To give the stripper a downward swing the needle actuating gear 151 carries a laterally projecting pin 186 and, as the gear turns (in the direction of the arrow shown in Fig. 4) to retract the needle, the pin is caused to strike the head 187 of the actuator finger 184 and draw the latter down against the tension of the spring 183 giving the stripper finger 180 the necessary downward stripping movement. On the reverse movement of the needle the actuator finger 184 and the stripper arm return to their normal positions.

The drawing-in device is given relative movement with relation to the reed and harnesses so that the drawing-in operation takes place progressively from the left to the right as viewed in Figs. 1 and 3. This relative movement between the drawing-in device and the reed, harnesses and warp threads may be provided in any suitable manner, but herein we have provided mechanism for automatically feeding the needle carriage with reference to the reed so that when relative movement is required between the reed and the needle carriage, the latter will be automatically moved by the required amount, the distance traversed by the needle carriage having no fixed limit but being adaptable to the variable spacings of the

reed dents. This will be best understood by first referring to the reeding devices.

The reed 190 is supported by means of a plurality of clamps which depend from the carrier bar 191 (Figs. 1, 4 and 9). The carrier bar is secured to a plurality of hangers 192, the latter depending from the cross piece or track bar 6, being supported thereon by the rollers 193. Side rollers 194 at the front and other rollers 195 at the rear of the bar 6 maintain the hangers in an upright position and, together with the carrier bar 191, provide a reed carriage capable of a free, endwise movement. The reed clamps comprise jaws 196 and 197 (Fig. 4) pivoted at 198 and having their lower ends tightly gripping the upper reed bar 199. One of the jaws 196 has a sleeved projection 200 fixedly secured to the carrier bar 191 and a spring 201 is employed normally to force the jaws into clamping engagement with the reed bar. The reed carrying devices, so far as described, are substantially the same as those described in our prior copending application Serial No. 537,612.

The reeding devices are best shown in Figs. 9 and 11, also Figs. 1, 2 and 4 and 12, being carried upon the supporting arms 210 and 211 projecting forwardly from the needle carriage supports. At their forward ends the supporting arms 211 sustain the short longitudinal shaft 212 on which, between the fixed collars 213 and 214, is pivoted the upright bracket 215, the latter carrying the reed opener shaft and operating mechanism therefor. The shaft 212 also carries a traveling reed guide or rest 216 for the lower reed rod 217. The reed hangs suspended from the overhead clamps, but is prevented from any oscillatory movement therein by the rest or support 216 which comprises appropriately shaped arms engaging the reed and reed bar on both the front and back of the reed, as represented in Figs. 4, 9 and 11. Since this travels with the needle it is always kept in fixed relation both to the needle and to the reed opener and travels with the latter across the extent of the reed.

The reed opener supporting bracket 215 is bifurcated to provide longitudinally branched supports as shown in Fig. 9 and each branched support is bifurcated transversely the machine as represented in Fig. 12 to provide the forward supporting arms 218 for the reed opener shaft 219 and the rear supporting arms 220 for the countershaft 221. The reed opener shaft 219 carries at one end and directly above the path of the needle a rotary reed opener 222 of the type described in prior Patent 871,680 dated Nov. 19, 1907. This reed opener has a helical blade provided with a thin entering lip or wedge at its advancing edge increasing in thickness toward the end of the helix. The edge engages and enters between the dents of the reed, separating and spreading the splits for the passage of the adjacent needle. When the thickened portion of the spiral withdraws from one dent the advancing edge has already entered the next one. As the opener separates the splits, it acts to screw itself along the reed, enforcing a relative movement between the reed and the opener. One complete revolution of the opener causes it to pass from one dent to the next adjacent one.

To impart a full revolution at each actuation of the reed opener, the shaft 219 has two clutch members, one, the driven member 223, fixed thereon, and the other, the driving member 224, loose on the shaft both as to rotary and a limited longitudinal movement. The two members are provided with clutch teeth beveled as shown in Fig. 11 so that when the driving member 224 is turned clockwise (as viewed in Fig. 4) the reed opener is rotated. When the driving member is turned in the opposite direction the teeth on the driver slip over the beveled teeth on the driven member 223 without moving the latter, the spring 225 which normally presses the driving member against the driven member yielding to permit the necessary longitudinal movement of the former.

The driving member 224 has cut thereon pinion teeth 226 which mesh with the teeth of the segmental gear 227, the latter secured to the rock shaft 221. At the end of the rock shaft 221 there is secured the bifurcated arm 229 (Figs. 2 and 11) which has jointed connection through the link 230 with the vertically movable actuating rod 231 (Figs. 4 and 9) so that as the latter is moved up and down the segmental gear 227 is oscillated and the reed opener intermittently rotated.

The actuating rod 231 passes through a vertical sleeved guide 232 depending from the supporting arm 210 and carries at its lower end a roller 233 which tracks upon the reed opener actuating bar 234. Threaded adjustment of the roller relatively to the rod 231 may be had at 235. The bar 234 like the harness lifter bar 47 is given a combined lifting and endwise movement under the control of the pattern mechanism, the lifting movement serving to lift the roller 233 and therethrough turn the reed opener. For this purpose the bar 234 is supported on swinging arms 236 (Fig. 4) and 237 (Figs. 9 and 9a), the former pivoted on the transverse shaft 53 and the latter secured to a sleeve 238 on the transverse rod 55 (Fig. 9a). The sleeve 238 has depending the arm 239 connected to the actuator bar 240, the latter being similar to the harness lifter bars 60 and, like those bars, having a lower notched end normally held out of the path of the actuator by the feeler or supporting

pin 241, the latter located at the left of the series of feeler rods as viewed in Fig. 5.

Each time that the feeler 241 is dropped through the pattern sheet, the bar 240 is moved by the actuator 63 and the reed opener actuating bar 234 is given a lifting together with an endwise movement to the left, as shown in dotted lines in Fig. 9, this resulting in turning the reed opener and spreading the next adjacent splits of the reed for the passage of the needle. By suitable selection of the pattern the drawing-in may take place in any desired order through the reed. In the pattern illustrated in Fig. 5 the pattern sheet is perforated to allow for an actuating movement of the actuator bar 234 once for each two cycles of operation or thread-drawing movements of the needle. This results in drawing two threads through each reed dent but any other pattern order may be followed since it depends wholly upon the arrangement of perforations in the pattern sheet 71. The dimensions of the parts are such that each lifting movement of the actuator bar 234 causes one complete revolution of the reed opener, the latter always being left in the same final position whereat it acts to hold separated the reed splits for the next needle movement.

In order to prevent the reed opener from overthrowing or turning past its desired position of rest, the reed opener shaft has secured thereto a collar 250 having a notch or groove in which the end of the spring pressed arm 251 (Fig. 12) is caused to seat and stop the shaft always in the same position, the arm, however, readily yielding when further driving effort is applied through the driving member 224. The spring arm 251 is supported by the upright bracket 215 (Fig. 9) and the latter also has secured thereto the shield or apron guard 252 (Figs. 9 and 11) which lies outside of and below the reed opener 222 and is perforated at 253 for the passage of the needle. A slot 254 leads down from the perforation 253 and serves as a thread guide down which the thread passes when stripped by the arm 180.

The upright bracket 215 constituting the reed opener support is yieldingly pressed toward the reed by means of the coil spring 260 (Figs. 4 and 11) encircling the rod 261 and interposed between a fixed collar 262 thereon and a plate 263 depending from the cross member 148 on the needle carriage. One end of the rod is secured to the upright bracket so that the latter with the reed opener is yieldably pressed toward the reed, but the entire support may be swung back about the longitudinal shaft 212 to compress the spring 260 and withdraw the reed opener from engagement with the reed.

Referring now to the automatic means for feeding the needle carriage, the latter is traversed along the guide bars 143 and 144 by means of an endless flexible driving member 270 (Figs. 4, 9 and 10), which is attached to the carriage through a laterally projecting driving pin 271 fast to the cross bar 147 of the needle carriage. The driving member 270 is herein constructed in the form of a sheet metal belt or strip perforated to receive the teeth of a driving sprocket wheel 272 (Figs. 9 and 10) located at the right hand end of the machine, as viewed in Figs. 1 and 9, the said driving belt passing over a guide sheave 273 at the opposite end of the machine. By turning the sprocket 272 the needle carriage can be moved from one end of the machine to the other.

To turn the sprocket wheel 272 the latter is mounted on the same shaft with the ratchet wheel 274 (Figs. 9 and 10) adapted to be moved step by step by the pawl 275 pivoted on a pin 276 carried by an arm 277, the latter adapted to swing about the axis of the ratchet wheel 274. The arm 277 has secured thereto a depending weighted arm 278. The latter is so positioned that it tends to swing the pawl to the left as viewed in Fig. 9. This movement of the pawl, however, is opposed by a lever arm 279 which lies across the path of an extension 280 of the pivot pin 276. The arm 279 which thus limits the backward movement of the pawl 275 is pivoted at 281 on the overhead cross piece 6 but has a jointed connection just below the cross piece to the end of the carrier bar 191 for the reed. The movement of the reed, therefore, and its carrier bar alters the position of the stop arm 279 and changes the limit of backward throw of the pawl. The feeding movement of the pawl is caused by a lug 282 fast to the end of the reed opener actuator bar 234 and in line with the pawl actuating lever 277 so that as the actuating bar is given its combined lifting and endwise movement the lug 282 strikes the lever and tends to move the pawl and turn the ratchet wheel. Whether it does in fact impart a feeding movement to the pawl and the extent of the feeding movement, however, depends upon the position of the stop arm 279 and the position to which that stop arm has allowed the pawl to swing back.

The action of this feeding mechanism is as follows: At each of its movements the reed opener 222 moves the red toward the left as viewed in Fig. 9, withdrawing the stop finger 279 from the path of the pawl pivot pin 280 by an amount dependent on the movement of the reed. With the next actuation of the reed opener the lug 282 strikes the pawl actuating lever 277, imparting to the pawl a feeding movement, turning the sprocket wheel and feeding the needle carriage to the right. The reed car-

riage moves with the needle carriage, due to the maintained engagement of the reed opener with the reed so that the stop finger is thereupon shifted to reduce the feeding movement of the pawl on its next actuation.

It will thus be seen that the reed is given a certain normal position. If displaced from that normal position, signifying the necessity of an incremental feed of the needle carriage, it so controls the stop arm 279 as to throw in or increase the needle carriage feed, but when restored to that normal position it then throws out or reduces the needle carriage feed. This results in a traverse of the needle carriage and sustained parts from one end of the machine to the other, the traverse being automatically controlled by the requirements of the drawing-in as indicated by the tendency of the reed carriage to be displaced from its normal position.

At the commencement of the drawing-in operation the harnesses, the reed and the warp having been installed in the machine, the needle carriage is positioned at the left hand end as viewed in Fig. 1, with the reed opener engaged with the first dent of the reed. The operative takes his position within the curved rest 30 with the palm controlled switch 130 in his hand. The required pattern sheet 71 having been previously placed in the machine and current having been turned on the motor 112, the operative presses the switch 130 so as to close only momentarily the controlling circuit for the clutch magnet 128. This clutches the drive shaft 109 to the driving motor, as heretofore described, so that the former is given one complete rotation and then stopped. During this rotation the pattern sheet is shifted and the actuator bar 63 moved to lift the required harness and to turn the reed opener if the pattern calls for a drawn thread in the next reed dent. Simultaneously, the needle is moved forward and brought to rest slightly beyond the line of heddle eyes carried by the designated harness and at the same level to which the eyes have been automatically raised. With this cycle of operation complete the operative slips the foremost heddle eye over the hook of the needle, inserts the foremost warp thread in the bight of the hook and then again presses the hand carried switch to put the machine through its next cycle. The needle thereupon retracts, drawing the thread through the harness eye and the appropriate reed dent, the threads being stripped by the stripper arm 180. As the needle starts to advance, the pattern is again moved and the next harness called for by the pattern is lifted, the needle being automatically brought to rest as before just behind the line of heddle eyes carried by that harness. This operation is repeated for each threading movement of the machine. The operative is only required to push the heddle eye over the needle hook and insert the thread and momentarily close the switch, the machine performing its required operation practically as quickly as the operative can seize the next thread.

It will be seen that the endwise movement of the heddle frames which is imparted to each frame as it is lifted into position for thread drawing is in the direction of travel of the needle carriage. In pushing the succeeding heddle eye over the needle the operative tends to press back or bunch the adjacent unthreaded heddle eyes. When the harness is restored to its original position its movement is in a reverse direction, i. e., opposite to the travel of the needle carriage, and this movement tends to throw the threaded heddle to one side of the needle path and out of further interference therewith, and at the same time to throw the heddles which have been bunched back into a position where they are more accessible.

In Figs. 16 to 37, inclusive, there is shown a form of machine substantially similar to that shown in Figs. 1 to 15, inclusive, but with the addition of devices for supporting, separating and facing drop wires, other devices for separating and positioning the warp threads and mechanism providing for the automatic seizure of the separated warp thread and its insertion through the eye of the drop wire.

In this machine the only hand operation is the placing of the foremost heddle eye from the designated harness over the head of the needle. When the machine is thereupon set into operation by the closure of the controlling switch 130, the needle is projected forward through the previously positioned drop wire, seizing the also previously positioned warp thread and drawing the same through the drop wire, heddle eye and reed dent. The automatic stoppage of the needle on its forward movement at or in front of the designated heddle is performed as before.

Referring first to the devices for supporting and automatically presenting the drop wires which are designated by the numeral 290, these are substantially the same as those shown in our prior Patent No. 1,227,537, dated May 22, 1917. The drop wires are arranged in two parallel banks on the front or operator's side of the machine (Figs. 17 and 18) between the warp separator 291 and the heddle frames. Previous to installation in the machine the drop wires are strung upon the stringer or hanger bars 292 the ends of which are supported in the frame-work of the machine. In this position they are held in a compacted series and released one by one by means of a releasing key 293 (Fig. 25) the latter consisting of a

head having a helical wing or flange 294 carried by a releasing rod 295 which passes through a series of perforations in the drop wires, the latter being so arranged as to form a channel or passage for the releasing rod. The rod-receiving perforation for one wire is located slightly out of line with the rod-receiving perforation for the next drop wire, so that when installed in the machine with the releasing rod in position the drop wires assume the vertically staggered relation shown in Figs. 19 and 25.

Herein each stringer bar 292 is relieved of the weight of the unthreaded drop wires, the latter resting each alternate one on the underlying supporting bar 296 and the intermediate drop wires upon the releasing rod 295. The bar 296 for each bank is supported at one end by a pin 297 (Figs. 19 and 25) which is removably seated in a slot 298 formed in the upright standard 299 secured to the traveling carriage 300. The latter is adapted to slide along the guide rod 301 extending lengthwise the machine, and has a connection 302 (Fig. 17) to a flexible band or belt 304 similar to the needle carriage driving belt 270. The belt 304 passes over the guide sheave 305 (Figs. 17 and 18) at one end of the machine and over the driving sprocket wheel 306 at the opposite end. The sprocket wheel 306 is fixed on the transverse shaft 307 which constitutes an extension of the shaft carrying the ratchet 274 employed to drive the needle carriage, so that the belt 304 moves with the belt 270 and the carriage 300 moves lengthwise the machine with the needle carriage.

The opposite end of each supporting bar 296 is supported by a second sliding carriage 303 also slidable in the guide rod and fixedly secured to the carriage 300 to move therewith. The ends of the supporting bars 296 are herein secured to a block 304′ (Fig. 20) resting on a tie rod 305′ which joins the carriage 303 and the carriage 300. The drop wires when installed in the machine as described are compacted by means of a packer carriage 310 which (Figs. 17 and 21) is mounted on rollers 311 to travel along the track bar 301. The packer carriage is constantly pressed to the left as viewed in Fig. 17 by the action of the traveling releasing devices and to retard its movement on the track bar there is provided a friction device such as the spring 312 carried by the packer carriage and having frictional contact with the track bar.

To engage and compact the drop wires the carriage is provided with a plurality of followers or packers 313 (Figs. 19 and 23) held in alignment with each bank of drop wires and so arranged as to press against the same. To equalize the pressure where the banks of drop wires are of unequal length, each follower 313 is carried upon a rod 314 slidably mounted in the carriage 310. Each follower is also provided with a rearwardly extending sleeve 315 (Fig. 23) slidable in the packer carriage, each sleeve having gear teeth 316 meshing with an intermediate pinion 317 the latter journaled upon an upright axis within the carriage 310. This provides an equalizing effect of the packers irrespective of any difference in the extent of the two series, that is to say, if one series is longer than the other the pinion will allow the two packers to adapt themselves to the unequal length of the two series of drop wires.

The releasing rods 295 pass through the sleeves 315, securing an extended journaled support therein. The packer carriage is prolonged vertically (Fig. 21) to present a pair of upright slots 318 through which the stringer bars 292 pass, there being fast to the back of the packer carriage (Fig. 19) a vertically adjustable bracket 319 carrying rollers 320 upon which the stringer bars 292 rest.

Referring to the releasing key, the shouldered end of the spiral wing 294 holds back the unthreaded series against the packer. The perforation in each drop wire, however, has a lateral offset indicated at 321 in Fig. 27, these offsets being presented in successive heddles first up and then down. The shape thus given the perforations is such that they pass readily over the head of the releasing key. By means of this alternating formation, when the shaft is turned to bring the shoulder of the spiral wing 294 into alignment with the lateral enlargement of the foremost drop wire, the latter will pass over the releasing head and be released and separated from the remaining members of the series, the helical wing 294 engaging the drop wire and acting as a screw to feed it along and discharge it from the end of the releasing rod into the position indicated in Fig. 25.

Each bank of drop wires has its own releasing key and these act coordinately to release a drop wire first from one bank and then from the other. To present a released drop wire within the path of the needle a conveying worm 322 (Fig. 25) is provided for each bank which engages the released heddle. Each worm is mounted upon a worm shaft 323. The conveying worm 322 conveys the heddle to a position where it can be turned for the passage of the needle by means of the turning device 324. As shown in Figs. 25 to 29, inclusive, the turning worm is provided with flanged faces 325 and 326, the inner or leading one of which has a radial slot or opening 327 to receive edgewise the advancing drop wires as indicated in Fig. 29. The radial slot opens into a recess 328 whi is deepened toward the face 326 so that as the drop wire enters the slot it

is gradually turned by the recess 328 into the position represented in Figs. 25 and 28 where it is faced with the threading opening (herein the elongated slot) presented squarely to the drawing-in needle 140. The two positioning and turning worms work on opposite sides (Figs. 22 and 26) of the upright standard 299, the latter providing an abutment against which the drop wires are pressed by the turning worm and between which and the worm it is held in a flatwise faced condition. The flanges 325 and 326 of the worm are caused, one to overlap the side of the wall 299, and the other to enter a groove therein so that the drop wire is held rigidly between the two flanges, the wall and the face of the worm. After the retraction of the drawing-in needle, continued rotation of the turning worm presents to the face of the drop wire a worm portion 329 which is abruptly deepened and also beveled so that the threaded drop wire is turned back to its normal or edgewise position as shown in Fig. 27, complete movement of the worm giving the threaded drop wire a push to the right as viewed in Fig. 25.

In order to release and face a drop wire from each bank alternately for the action of the needle, the two worm shafts, each facing a drop wire once for each revolution, are timed 180° apart and make each one full revolution for two thread drawings, while the two releasing shafts (which release a drop wire for each full revolution) are timed 90° apart and make one full revolution for every four thread drawings. This provides for the presentation of a drop wire from one series for one thread and a drop wire from another series for the next succeeding thread.

The driving mechanism for the worm and releasing shafts together with speed change mechanism are carried upon the auxiliary head 330 sustained by the sliding carriage 303 (Figs. 20 and 24). Referring more particularly to Figs. 17 to 20, the transmission mechanism on the auxiliary head is operated by means of a common actuating shaft 331 which is turned at intervals by the main driving mechanism of the machine. At the auxiliary head 330 (Figs. 20 and 24) the actuating shaft 331 is provided with a driving pinion 332 which meshes with the gear 333 fastened upon the end of a short connecting shaft 334 for one of the releasing rods 295. The end of each releasing rod is removably connected in relation to its driving shaft by means of a chuck 335 from which it can be readily withdrawn for purposes of removal from the machine. The companion shaft for the remaining releasing rod is driven at the same speed, but in an opposite direction by means of intermeshing gears 336—336 of equal diameter. The gear 333 on the shaft 334 is also caused to mesh with the gear 337 on the end of one of the worm shafts 323, such gear being of half the diameter of the gear 333 so that the worm shaft is driven at twice the speed of the releasing shaft. The remaining worm shaft is driven in an opposite direction, but at the same speed, by means of intermeshing gears 338 of equal diameter.

In order to present an unthreaded drop wire from a single bank for each threading operation where a single bank only is employed, the speed of rotation of the releasing rod and worm shaft is increased by means of speed change mechanism on the auxiliary head. This comprises a sliding sleeve 340 splined to the actuating shaft 331 but movable longitudinally thereon. The sleeve carries the gear 332 and also a gear 341 of greater diameter, the latter on longitudinal movement of the sleeve being adapted to engage the gear 342 which is also fast on the shaft 334 with the gear 333. The proportions of the gears are such that when the sleeve is moved from the position shown in Fig. 20 to a position effecting engagement between parts 341 and 342, the speed of the worm shafts and releasing rods is doubled. The sleeve is provided with a grooved finger piece 343 for seizing and moving the same and a hub or extension 344 is also provided carrying a pair of positioning grooves adapted to engage with a spring-pressed pin 345 seated in the head so that the gear-carrying sleeve will be automatically positioned in either of its working positions.

The common drive shaft 331 has a sprocket wheel 350 driven by the sprocket chain 351, the latter in turn being driven from the sprocket wheel 352 on the driving shaft 353 (see Fig. 18). The latter constitues an extension of the main drive shaft 109 which is turned one complete revolution for each cycle of machine operations so that the drive shaft 331 likewise is turned once for each threading operation.

Driven from the same driving shaft 331 we have also herein provided a thread-separating device adapted to separate and position a thread in the needle path for each thread drawing. Herein such thread-separating device is in the form of a sleeve member 291 splined upon the driving shaft 370, the latter journaled in the frame of the machine and driven from the driving shaft 331 by the intermeshing gears 371 and 372. Referring to Figs. 35 to 37, inclusive, the sleeve member 291 has a corrugated tapered nose 373 which strokes the threads into parallelism, this being succeeded by a spirally grooved portion 374, the advancing lip of which picks off the foremost thread and conveys it along into the path of the needle.

The spirally grooved sleeve 374 can be angularly adjusted upon the sleeve member 291. For this purpose the sleeve 374 termi-

nates in a flanged portion 375, having a recess in which there is adapted to seat the pin 376 slidably mounted in the collar 377, the latter being fast to the sleeve 291 by means of the set screw 378 shown in Fig. 37. The opposite end of the pin 376 is threaded into a disk 379 which latter is normally held close against the face of the collar 377 by the stud 380. The latter has one end threaded into the disk 379, but is provided with a head 381 sliding in a recess in the collar, a spring being interposed between the head and the bottom of the recess yieldingly to force the disk 379 into the position shown. The disk 379, however, may be drawn to the left (as viewed in Fig. 36) withdrawing the pin 376 from the flange of the sleeve 374 whereupon the latter may be turned, thereby to adjust the lip of the screw or helix in different angular positions about the shaft. The flange 375 may be provided with a plurality of recesses distributed circumferentially about the same to permit of different positions of adjustment of the pin 376.

The collar 377 is circumferentially grooved as shown in Figs. 35 and 36, the collar resting by its groove on the hook-shaped bracket 382 (Figs. 22, 35 and 36) which latter is fastened to an upright arm 383 carried by the traveling heddle facing carriage 300 so that the separating worm 291 advances progressively across the machine always in fixed relation to the heddle and the needle carriages.

In the form of machine just described a slight modification in the mechanism for moving the stop bar 170 and the needle permits the entire needle movement to be automatically performed as before, the needle starting from its automatically pattern controlled position at the designated heddle frame, moving quickly forward through the threading perforation of the drop wire to engage a warp thread, then being retracted for its full movement and finally advancing again to its next position of rest.

The controlling mechanism for the needle and stop bar in the modified form of machine is shown more particularly in Figs. 16, and 30 to 34, inclusive. It comprehends a slightly modified form of driving clutch interposed between the rack bar 157 and the needle driving shaft 153 and a modified form of stop bar with controlling devices therefor. Referring to Figs. 30 to 33, inclusive, the needle driving shaft 153 is driven from the rack bar 157 through an intermediate pinion 400 and driving and driven clutch members 401 and 402, the former fixedly secured to the pinion and the latter to the needle driving shaft. The gear 174 which meshes with the stop bar driving gear 173 is carried by the clutch member 402. As in the case of the needle driving device for the machine first described, the driving clutch member has a driving tooth 403 having one side beveled and the opposite side flat, working in a recess 404 in the side of the driven clutch member 402. When the stop bar is brought to rest by the harness bar 47 which has been shifted, the driving member 401 separates longitudinally from the driven member and withdraws the clutch tooth 403 from the recess 404, subsequent movement of the driving member continuing with the clutch teeth resting against the edge of the driven member. The driving member, however, has a hub 405 which enters within the driven member and has one end of a spiral spring 406 attached thereto, the opposite end being secured to the interior of the shell of the driven member. When the needle and its stop bar are brought to rest the driving clutch continues its movement and by so doing winds up the spiral spring 406. This is later relied upon to give a quick initial forward movement to the needle when the machine is first set into operation. This is done by freeing the stop member from its abutment so that the stop member and the needle are urged forward under the power of the spring 406 and move quickly forward to their extreme forward limit of movement. This gives a clockwise rotation to the driven clutch member 402 as viewed in Fig. 33 bringing the tooth of the driver and the notch of the driven member again into registration. The driving member then starts to turn reversely in a contra-clockwise direction and the flat face of the tooth engaging the flat shoulder in the recess turns the driven member contra-clockwise as viewed in Fig. 33 and initiates the retractile movement of the needle.

To provide for the release of the stop bar the latter (Figs. 30 and 31) carries near its forward end a pivoted depending lug 410 which is normally pressed into the right angled position shown in Fig. 31 by a spring 411. The stop lug 410 has a rearwardly projecting finger 412, the end of which normally underlies a pivoted detent 413 so that when the lug meets with the obstruction of the displaced lifting bar 47 it is immovable and brings the stop bar to rest. The detent 413, however, is pivoted upon the stop arm and is provided with the armature 414 adapted to be attracted by the magnet 415, the latter carried by the stop bar. When the armature is lifted by energization of the magnet the detent is moved out of the path of the finger 412 so that the lug no longer acts as a stop but yields readily backward against the spring 411.

The magnet 415 (see Fig. 16) is in direct circuit with the push button 130 and the battery 92 so that when the button is pressed the stop bar is freed and moves quickly forward. The forward end of the stop bar carries a contact piece 416 which is connected

through the circuit wire 417 (Fig. 16) with the magnet 128. When the stop bar has moved to its forward movement the contact 416 engages contacts 418 carried by a bracket 419 fastened to the machine frame, the contacts 418 being included in the circuit wire 420 which connects through the battery 92 with the remaining terminal of the magnet 128. As soon as the stop bar and needle have completed their forward movement, therefore, the magnet 128 is energized, clutching the motor of the driving shaft to the machine and initiating the threading movement of the needle which causes the retraction of the needle and then its advancement to the next pattern-designated position.

It will be obvious that the hand method of inserting the warp threads without the use of the automatic thread separator may be employed in connection with the drop wire facing mechanism, and that various other departures from the illustrated form of machine may be had.

While we have herein shown and described for purposes of illustration one specific form of the invention, it is to be understood that the same is not limited to the details of form or arrangement or the specific construction of parts herein shown, and that various mechanisms and features herein described may be embodied in machines of widely different types and for other purposes than those herein described, all without departing from the spirit of the invention.

Claims:

1. In a harness designating machine, the combination with supports for a plurality of harnesses, means for giving said supports each a combined lifting and substantial endwise movement, pattern controlled means for selectively actuating said moving means, a needle, and means for causing relative movement between the needle and the harnesses transverse the harness support.

2. In a harness designating machine, the combination with supports for a plurality of harnesses, means for giving said supports each a substantial endwise movement, pattern controlled means for selectively actuating said moving means and drawing-in mechanism, with means for causing relative movement between the same and the harnesses transverse the harness supports.

3. In a harness designating machine, the combination with supports for a plurality of harnesses, a power-driven actuator to lift the individual supports, a pattern mechanism for rendering the actuator effective as regards a selected harness, and starting means for applying power to said machine and causing its stoppage after the lifting of a single harness.

4. In a drawing-in apparatus, the combination of a plurality of harness supports having controlled means for selectively designating a given harness, a mechanically actuated thread placing device having a path transverse the harness supports, and means to interrupt the operation of said thread placing device after each thread placing operation, to stop the same in proximity to the designated harness.

5. In a warp drawing apparatus, the combination with a plurality of harness supports, of means for selectively moving one of said supports to designate the same, a mechanically actuated thread placing device having a path transverse the harness supports, and starting means to cause the actuation of the said thread placing device, and also to cause its automatic stoppage in proximity to the designated harness.

6. In a warp drawing apparatus, the combination with a plurality of harness supports of means for individually moving said supports selectively to designate the same, a mechanically actuated thread-placing device, and means for causing the actuation of said device and its automatic stoppage at a point definitely related to the designated harness support.

7. In a warp drawing machine, the combination with a plurality of harness supports, pattern-controlled mechanism for selectively designating said supports, a drawing-in needle, means for giving said needle a thread-placing movement, means controlled by said pattern mechanism for automatically stopping said needle in a position having a definite relation to the designated harness, power-driven means to actuate said machine and starting means for said power-driven means to cause said machine to perform one complete threading cycle followed by its automatic stoppage.

8. In a warp drawing device, the combination with a plurality of harness supports, a needle having a reciprocatory path above the line of heddle eyes, means for selectively raising said harness supports, and means for stopping the needle in a position having a definite relation to the harness of the raised harness support.

9. A warp-drawing machine having, in combination, a plurality of harness supports, variable pattern-controlled mechanism for selectively elevating the same, a mechanically-actuated thread-placing device having a reciprocatory path in line with the heddle eyes of an elevated harness, and means to interrupt the action of the thread-placing device to permit the manual application of the heddle to the thread-placing device.

10. In a warp drawing machine, the combination with a plurality of harness supports, a mechanically actuated needle, a driving member, starting means to move

said driving member through one complete cycle followed by the automatic stoppage thereof, a yielding driving connection between said driving member and the needle, and pattern-controlled stopping means for stopping said needle at different positions.

11. In a drawing-in machine, the combination with a plurality of harness supports, pattern-controlled means for moving said supports automatically to designate a selected harness, a needle, a needle driving member, a yieldable connection between the needle driving member and the needle, and a pattern-controlled stop device automatically to stop the needle in a position having a definite relation to the designated harness.

12. In a drawing-in machine, the combination with a plurality of harness supports, pattern-controlled means for moving said supports automatically to designate a selected harness, a needle, a needle driving member, a yieldable connection between the needle driving member and the needle, a pattern-controlled stop device automatically to stop the needle in a position having a definite relation to the designated harness, power-driven means for actuating said pattern mechanism and needle driving member, and starting means to cause the automatic operation of said machine for one threading movement followed by the automatic stoppage thereof.

13. In a warp drawing machine, the combination with a plurality of harness supporting members, a mechanically actuated needle driving member therefor, a yieldable connection between the driving member and the needle, a stop bar adapted to be moved with the needle also through said driving connection, and pattern controlled means for selectively designating and moving a harness supporting member, the movement thereof bringing the same into the path of the stop bar and causing the automatic stoppage of the needle in a position having a definite relation to said designated harness.

14. A warp drawing machine having a plurality of harness suporting bars, pattern-controlled means for selectively moving the same, a mechanically actuated needle and a stop member for the needle adapted to engage and be stopped by the movement of the supporting bar.

15. A warp drawing machine having a plurality of harness supporting bars, pattern-controlled means for giving them a combined longitudinal and vertical movement, a fixed member having slots through which the ends of said bars work, a mechanically actuated needle and a needle stop member having a reciprocatory path at the side of said fixed member and adapted to engage the harness supporting bar which is projected therefrom.

16. A warp-drawing machine having, in combination, a mechanically-actuated reciprocatory thread-placing device, means for supporting harnesses with the harness eyes at a different level from the path of said thread-placing device, and means for arresting the operation of the thread-placing device when the latter is in a position having a definite relation with a given harness.

17. In a warp drawing machine, the combination with a plurality of harness supports, an actuator for selectively moving said harness supports, pattern-controlled mechanism for placing said actuator in operative engagement with a selected harness support, a driving shaft, a primary driving member, means under the control of the operative for connecting the said driving member to said driving shaft and turning the same for one complete threading movement, and then causing its automatic stoppage, a member to which reciprocatory movement is imparted by said driving shaft, connections whereby said reciprocatory member drives said actuator and pattern mechanism, a needle, a needle driving shaft, a yieldable driving connection between said reciprocatory member and said needle driving shaft, and a stop member geared to said needle shaft to move simultaneously with the needle.

18. In a warp drawing machine, the combination with a reciprocatory needle, of a needle driving gear, a thread-stripping arm and an actuating device mounted on said gear for reciprocating said stripper arm.

19. In a warp drawing machine, the combination with a plurality of harness supports, pattern-controlled means for selectively designating a harness, a reed support, a needle, and mechanism for actuating said needle simultaneously to draw a thread through the eye of a designated harness and the reed, and means for stopping said needle in a position having a definite relation to a designated harness.

20. In a warp drawing apparatus, the combination with a plurality of harness supports, pattern-controlled means for selectively designating a harness, a reed support, a threading device, mechanical means for moving said threading device to draw a thread through the heddle eye of a designated harness and a selected reed dent, and means for automatically bringing the threading device to rest in convenient location to the next designated harness to permit the manual application of the heddle eye thereof to the threading device.

21. In a warp drawing machine, the combination of supporting means for a plurality of harnesses in parallel arrangement; a mechanically actuated thread-placing device facing the plurality of parallel harnesses; means for moving each of said harnesses relatively to the others; and means to cause

said device to stop at or adjacent to the heddle eye of the harness having the heddle next to be threaded, the heddle eyes of the other harnesses automatically remaining out of the path of the thread-placing device.

22. In a warp drawing machine, the combination of supporting means for a plurality of harnesses in parallel arrangement, pattern-controlled means for selectively designating and moving the harness having the eye next to be threaded relatively to the other harnesses, a mechanically actuated needle facing the plurality of parallel harnesses, and means to cause stoppage of the same at or adjacent the eye of the designated harness, the other harnesses automatically remaining out of the path of the needle.

23. In a warp drawing machine, the combination of supporting means for a plurality of harnesses in parallel arrangement, means for moving each of said harnesses relatively to the others, a mechanically actuated thread-placing device facing the plurality of parallel harnesses and pattern-controlled means to cause stoppage of the same at or adjacent the eyes of a selected harness having the eye next to be threaded, the eyes of the other harnesses automatically remaining at a different place and the eyes of the selected harnesses in the same plane as the plane in which the path of the thread-placing device lies.

24. In a warp drawing machine the combination with supporting means for a plurality of harnesses, a thread-placing device, mechanical means for actuating the same, pattern controlled means for moving a given harness having the eye next to be threaded to position its eyes in the plane in which the path of movement of the thread-placing device lies, the eyes of the remaining harnesses being maintained outside of said plane, and means to arrest the thread placing device in a position having a definite relation to said given harness.

25. A warp drawing machine having in combination with supporting means for a plurality of harnesses, a thread-placing device, mechanical means for actuating the same, means for moving a given harness having the eye next to be threaded with its eyes in the plane in which the path of movement of the thread-placing device lies, the eyes of the remaining harnesses being maintained outside said plane and means to arrest the movement of the thread placing device with the latter in a position having a definite relation to said given harness.

26. In a warp drawing machine the combination with a reciprocating thread-placing device, supports for a plurality of harnesses, means for mechanically actuating the thread-placing device, pattern-controlled mechanism for selectively designating the harness having the eye next to be threaded by causing relative movement between the harness suports, driving mechanism for the machine, means controlled by the operator for starting the driving mechanism, automatic means for stopping the driving mechanism at a predetermined stage, stop mechanism also controlled by the pattern mechanism to stop the thread-placing device at a variable point fixed with relation to the designated harness said pattern-controlled mechanism being automatically moved by the driving mechanism to shift the pattern and then relatively to move the harness supports while the thread-placing device is retracted out of interference with the heddles.

27. In a warp drawing machine the combination with supporting means for a plurality of harnesses, pattern-controlled means for selectively designating the harness having the eye next to be threaded, a mechanically driven thread-placing device, power driven means for actuating the machine, means for starting the machine and for automatically stopping the same at a predetermined stage in each threading movement to permit the manual application of the heddle eye to the needle, and means automatically to cause relative feeding movement between the thread-placing device and the harness supporting means.

28. In a warp drawing machine the combination with supporting means for a plurality of harnesses, pattern-controlled means for selectively designating the harness having the eye next to be threaded, a mechanically actuated thread-placing device adapted to be reciprocatively moved and brought to rest in a position having a definite relation to the designated harness to permit the manual application of the heddle eye to the same, and means for automatically causing the relative feeding movement between the thread-placing device and the harness supporting means.

29. The combination of a movable reed support, a thread-placing device, and means controlled by the varying position of the reed support for causing feeding movement of the thread-placing device.

30. In a warp drawing machine, the combination with a thread-placing device, a carriage therefor, mechanism for moving the carriage, a longitudinally movable reed support, reed separating mechanism carried by the thread-placing carriage, means for actuating said mechanism to engage and separate the next adjacent reed splits, said mechanism at each actuation tending to cause relative movement between the same and the reed, and means controlled by the movement of the reed support for setting in operation the carriage feeding mechanism to feed the thread-placing carriage in the opposite direction.

31. In a warp drawing machine, the combination with a thread-placing device, a carriage therefor, mechanism for moving the carriage comprising a feeding ratchet, a sprocket wheel turned thereby, a flexible connection engaging the same and attached to the carriage, a pawl, a reciprocatory pawl carrying arm, a longitudinally movable reed support, reed separating mechanism carried by the thread-placing carriage, means for actuating said mechanism to engage and separate the next adjacent reed splits, said mechanism at each actuation tending to cause relative movement between the same and the reed, means for imparting a controlled feeding movement to the pawl comprising a pawl actuating member, and means controlled by the movement of the reed support for controlling the extent of feeding movement imparted to the ratchet by the pawl.

32. In a warp drawing machine, the combination with a thread-placing device, a carriage therefor, mechanism for moving the carriage comprising a feeding ratchet, a feeding pawl, means for imparting a feeding movement to the pawl, a longitudinally movable reed support, reed separating mechanism carried by the thread-placing carriage, means for actuating said mechanism to engage and separate the next adjacent reed splits, said mechanism at each actuation tending to cause relative movement between the same and the reed, and a member connected to the reed support and moved thereby to limit the movement of the pawl whereby the displacement of the reed support controls the extent of feeding movement imparted by the pawl.

33. In a warp drawing machine, the combination with a longitudinally movable reed support, a thread-placing device, a carriage for the same, progressively operated reed opening mechanism on the carriage tending to cause relative movement between the reed and the carriage, and means to cause feeding movement of the carriage dependent on the displacement of the reed.

34. In a warp drawing machine, the combination with a longitudinally movable reed support, a thread-placing device, a carriage for the same, progressively operated reed opening mechanism on the carriage tending to cause relative movement between the reed and the carriage, and means to cause feeding movement of the carriage dependent on the displacement of the reed, said feeding means including a feeding ratchet and pawl and means connected to the reed support to control the feeding movement imparted by the pawl.

35. In a warp drawing machine, the combination with a thread-placing device, a carriage therefor, a carriage feeding mechanism, a reed support, a reed-opening mechanism and means dependent on the reed-opening mechanism for controlling said feeding mechanism.

36. In a warp drawing machine, the combination with a thread-placing device, a carriage therefor, a carriage feeding mechanism, a reed support, and means dependent on the spacing of the reed for actuating said feeding mechanism.

37. In a warp drawing machine, a movable carriage, an independent and separably movable support for a series of parallel elements, and automatic feed mechanism controlled by the position of the support for said parallel elements for feeding said carriage.

38. In a warp drawing machine, a movable carriage, a thread-engaging device with operating mechanism therefor mounted on said carriage, an independently and separably movable support for a series of parallel elements, and automatic feeding mechanism for the carriage sensitively controlled by the position of said separably movable support.

39. In a warp drawing machine, a traversing thread-engaging device, a separately and longitudinally movable support for a series of parallel elements, a ratchet and pawl mechanism for causing traversing movement of the thread-engaging device, and means adapted to be moved by the said movable support for sensitively controlling the feeding movement imparted by the pawl.

40. In a warp drawing machine, the combination with a reed support, a carriage, a rotary spiral reed opener on said carriage, a shaft therefor, a driving rock shaft on said carriage, connections for converting each oscillatory movement of said shaft into one complete rotation of said reed opener shaft, a vertically movable actuator rod for moving said rock shaft, an actuator bar extending lengthwise of the machine, said rod being in operative relation thereto in all positions of the carriage, and pattern-controlled means for raising and lowering said bar to actuate the reed opener.

41. In a warp drawing machine, the combination with a reed support, a carriage, a reed opener thereon, a vertically movable actuator on the machine, and means on said carriage engaging said actuator to move said reed opener.

42. In a warp drawing machine, the combination with a reed support, a carriage, a spiral reed opener thereon, a driving rock shaft, connections to convert the oscillatory movement of the rock shaft into one complete rotation of the reed opener, and means on the machine to oscillate said rock shaft.

43. In a warp drawing machine, the combination with a carriage of a reed opener thereon, a reed support, an actuator on the

machine having both a vertical and an endwise movement, means on said carriage operated by the vertical movement of said actuator to move said reed opener, and means operated by the endwise movement of said actuator to move said carriage.

44. In a warp drawing machine, in combination, a carriage, feeding mechanism therefor, a reed support, a thread-placing device and reed opener on said carriage, and a pattern-controlled actuator for operating the feeding mechanism and the reed opener.

45. In a warp drawing machine, supporting means for a plurality of harnesses, a thread-placing device, driving mechanism with automatic stopping means to interrupt the movement of the thread-placing device at a point where the eye of the harness next to be threaded may be manually applied thereto, and a starting device adapted to be carried by the hand of the operator.

46. In a warp drawing machine, supporting means for a plurality of harnesses, a thread-placing device, driving mechanism with automatic stopping means to interrupt the movement of the thread-placing device at a point where the eye of the harness next to be threaded may be manually applied thereto, and a starting device adapted to be carried by the hand of the operator, while leaving the fingers available for the manipulation of the heddles.

47. In a warp drawing machine, supporting means for a plurality of harnesses, pattern-controlled means for designating the harness having the eye next to be threaded, driving mechanism, automatic stoppage means to stop the same after the completion of a given movement, and a starting device adapted to be carried by the hand of the operator.

48. In a warp drawing machine, supporting means for a plurality of harnesses, a thread-placing device, driving mechanism, a starting device adapted to be carried by the hand of the operator while leaving the fingers available for the manipulation of the heddles, and automatic stoppage means to stop the movement of the thread-placing device after the completion of a given movement.

49. In a harness-finding machine, means for supporting a plurality of harnesses, pattern-controlled means for moving a selected harness, a driving member and a driven member for said pattern-controlled means with means provided for automatic disengagement of said members on the completion of a predetermined movement, and a starting device controlled by the operator.

50. In a harness finding machine, means for supporting a plurality of harnesses, pattern-controlled means for designating a selected harness, a mechanically actuated needle driving mechanism including a driving member and a driven member with means providing for automatic disengagement on the completion of a predetermined movement, and a starting device controlled by the operator.

51. In a harness-finding machine, means for supporting a plurality of harnesses, pattern-controlled means for moving a selected harness, a driving member and a driven member for said pattern-controlled means with means provided for automatic disengagement of said members on the completion of a predetermined movement, and a starting device controlled by the operator comprising an electrically controlled device provided for the initial engagement of said driving and driven members, and a controlling switch adapted to be carried by the hand of the operator while leaving the fingers available for the manipulation of heddles.

52. In a textile machine, the combination with harness designating means, of a driving member and a driven member therefor, a clutch device for connecting one to the other, a disengaging member for causing disengagement of the clutch device after a given movement of the driven member, electrically-controlled means for rendering said disengaging member inoperative to allow the engagement of the clutch, and a switch at the operator's position to control said device.

53. In a warp drawing apparatus, the combination of means for supporting a plurality of harnesses, pattern-controlled means for selectively designating a harness, a needle, mechanism for actuating said needle, a driving member and a driven member for said mechanism a clutch device for connecting one member to the other, disengaging means for causing disengagement of the clutch device after one threading movement of the needle, electrically controlled means for causing engagement of the clutch device and a manual switch at the operator's position to control the same.

54. A harness-finding machine having supporting means for a plurality of harnesses, pattern-controlled means for selectively designating the same, electrically controlled driving means, and a palm-carried switch for controlling the same.

55. In a harness-finding machine, the combination of supporting means for a plurality of harnesses, pattern-controlled means for selectively designating the harness having the heddle eye next to be threaded to assist the operator in manually placing the eye over the thread-placing device, and a movable work rest for the operator.

56. In a warp drawing machine, the combination of supporting means for a plurality of harnesses, pattern-controlled means for selectively designating the harness having the heddle eye next to be threaded to assist

the operator in manually placing the eye over the thread-placing device, a mechanically actuated thread-placing device to place the thread in said heddle eye, means for stopping the same in a position having a definite relation to a selected harness and a movable work rest for the operator.

57. In a textile machine, the combination of a machine bed, harness supports, a needle carriage arranged to travel along the bed and a work rest also mounted to travel along the bed.

58. In a harness finding apparatus, the combination of supporting means for a plurality of harnesses, pattern means for selectively designating the harness having the eye next to be threaded, and pattern-controlled signal means for indicating a special requirement in the draw.

59. In a warp drawing machine a mechanically actuated threading device, harness supports, pattern-controlled means to designate the harness having the eye next to be threaded, means to start and stop the movement of the threading device, and pattern-controlled signals for indicating special requirements of the drawing.

60. In a warp drawing machine, the combination of supporting means for a plurality of harnesses, pattern controlled means for selectively designating the harness having the eye next to be threaded, and pattern-controlled means for indicating an abnormal characteristic of the regular pattern.

61. In a warp drawing machine, the combination with drawing-in means, of starting and stopping means therefor, pattern devices to control the operation of said drawing-in means, and signals controlled thereby.

62. In a warp drawing machine, the combination with drawing-in means, of starting and stopping means therefor, pattern devices to control the operation of said drawing-in means, and visual signals controlled thereby and observable by the operator.

63. In a drawing-in machine, the combination with drawing-in mechanism, a pattern member, operating devices controlled thereby, electrically controlled signal means to indicate special requirements of the draw, and means for selectively controlling said signals including pattern-controlled contacts.

64. In a drawing-in apparatus, the combination of a plurality of harness supports, a mechanically-actuated thread placing device, a pattern member, pattern-controlled means to designate the harness having the eye next to be threaded, means to start and stop the thread-placing device to perform a designated thread movement, electrically controlled signals to indicate special requirements of the draw, and means for selectively controlling said signals by pattern-controlled contacts.

65. The combination with pattern controlling means, of one or more signals to indicate special conditions relating to the warp-drawing operation to be fulfilled by the operator, and mechanism governing said signals controlled in predetermined arrangement by said pattern controlling means.

66. In a warp drawing machine the combination with harness supports, of a thread-placing device, power-driven mechanism for actuating the same, means to initiate the power-driven movement of the thread-placing device and stop the same for each threading movement, and means to present a drop wire to the said thread-placing device.

67. In a warp drawing machine the combination with harness supports, of a thread-placing device, power-driven mechanism for actuating the same, means to initiate the power-driven movement of the thread-placing device and stop the same for each threading movement, and means automatically to present a warp thread to the said thread-placing device.

68. In a warp drawing machine the combination of harness supports, a thread-placing device, pattern-controlled mechanism to designate the harness for the heddle eye next to be threaded, drop wire presenting mechanism, means to start and stop the thread-placing device for each thread drawing, the said device being automatically stopped in a position having a definite relation to the designated harness and when started being mechanically moved through the presented drop wire and then retracted to place the thread through the drop wire and heddle eye.

69. In a warp drawing machine a drawing-in needle, a plurality of harness supports, drop-wire presenting mechanism, pattern-controlled means for stopping the needle at each thread drawing in proximity to the harness having the eye next to be threaded, and starting means controlled by the operator for moving the needle first through the eye which has been manually placed over the same and through the presented drop-wire and thence retracted for the drawing-in operation and then again advanced to its next stopping position.

70. In a warp drawing machine, a drawing-in needle, a plurality of harness supports, drop-wire presenting mechanism, means for automatically presenting selected warp threads to the needle, pattern-controlled mechanism for stopping the needle at each thread-drawing in proximity to the harness having the eye next to be threaded, and starting means controlled by the operator for moving the needle first through the eye which has been manually placed over the same, thence through the presented

drop-wire to engage the presented warp thread, thence retracted for the drawing-in operation, and then advanced to its next stopping position.

71. In a warp drawing machine the combination of harness supports, drop-wire presenting mechanism, a threading device, pattern-controlled means to stop the same at each thread-drawing in proximity to the harness having the eye next to be threaded, automatic warp thread selecting and presenting means, and starting means to start the threading device to perform a complete threading movement before stopping at the next selected position of rest.

72. In a warp drawing machine, the combination of harness supports, drop-wire presenting mechanism, a threading device, pattern controlled means to stop the same at each thread-drawing in proximity to the harness having the eye next to be threaded, and starting means to start the threading device to perform a complete threading movement before stopping at the next selected position of rest.

73. In a warp drawing machine, a reciprocatory threading device, pattern controlled means to stop the same at each thread-drawing at a variable point, and starting means controlled by the operator to move the same for its complete reciprocatory movement irrespective of its stopping point.

74. In a warp drawing machine, a reciprocatory threading device, driving means therefor, pattern-controlled means to stop said device at varying points in its advancing movement, and a spring device to store up the driving impulse when the threading device is stopped and cause the same to complete its advance movement when started.

75. In a warp drawing apparatus, the combination with harness supports, of pattern-controlled designating mechanism therefor, means for operating the same, drop-wire presenting mechanism actuated by said operating means, and means to interrupt the operation of the machine after a harness support has been designated.

76. In a warp drawing apparatus, the combination with harness supports, of pattern-controlled designating mechanism therefor, means for operating the same, and automatic warp thread presenting mechanism actuated by said operating means, and means to interrupt the operation of the machine after a harness support has been designated.

77. In a warp drawing machine a reciprocatory thread-placing device, a plurality of harness supports, pattern-controlled means to stop the thread-placing device in proximity to a selected harness whereby an eye therefrom may be manually placed over the said device, electrically controlled means for releasing the stopped thread-placing device, impelling means to move the same forward beyond its stop position, and means set in operation by the forward movement thereof to complete the threading movement of the thread-placing device.

78. In a drawing-in machine, the combination of means for supporting a plurality of harnesses, a reciprocatory drawing-in device, pattern-controlled means to stop said device in a position having a definite relation to a selected harness when moving in one direction, means controlled by the operator to release the same and cause the quick completion of the movement of said device, and driving mechanism to complete the thread-placing movement of the said device before stoppage in a position having a definite relation to the next selected harness.

79. In a warp drawing machine, a reciprocatory thread-placing device, a plurality of harness supports, pattern-controlled means to stop the thread-placing device in proximity to a selected harness whereby an eye therefrom may be manually placed over the said device, means controlled by the operative for thereafter causing a quick completion of the movement of the thread-placing device followed by a reverse thread-placing movement and the final stoppage of the same in a position having a definite relation to the next selected harness.

80. In a warp drawing machine, a reciprocatory thread-placing device, a plurality of harness supports having controlled means for stopping the thread-placing device in a position having a definite relation to a selected harness whereby an eye therefrom may be manually placed over the said device, electrically controlled means for releasing the thread-placing device, impelling means to move the same forward, contacts closed by the further movement of the thread-placing device, and starting means for the driving mechanism controlled by the contacts to cause the completion of the movements of the thread-placing device.

81. A warp-drawing machine having, in combination, a support at one side of the machine for holding a sheet of warp threads in a substantially vertical plane, a support at the other side of the machine for a reed, harness supports intermediate the warp support and the reed support, and an operator's shelf adjustable longitudinally of the machine adjacent to the vertical sheet of threads.

82. A warp-drawing machine having, in combination, a support at one side of the machine for holding a sheet of warp threads in a substantially vertical plane, harness supports, and an operator's shelf adjustable longitudinally of the machine adjacent to the vertical sheet of threads.

83. A warp-drawing machine having, in combination, a support at one side of the

machine for a sheet of warp threads, a support at the other side of the machine for a reed, and an operator's shelf adjustable longitudinally of the machine at the warp side of the latter.

84. A warp-drawing machine having, in combination, a support at one side of the machine for a sheet of warp threads, harness supports, and an operator's shelf adjustable longitudinally of the machine at the warp side of the latter.

85. A warp-drawing machine having, in combination, a support at one side of the machine for a sheet of warp threads, a support at the other side of the machine for a reed, harness supports intermediate the warp support and the reed support, and an operator's shelf adjustable longitudinally of the machine at the warp side of the latter, the forward side of said shelf being recessed to accommodate the operator.

86. A warp-drawing machine, having, in combination, a framework, means for movably supporting a loom element therein, a mechanism carriage arranged to travel lengthwise of said element, mechanism on said carriage for operating upon said element, said mechanism serving to connect said element to the carriage for movement therewith, means for causing the mechanism carriage to travel, and means whereby displacement of said element automatically controls the action of said carriage-moving means.

87. A warp-drawing machine having, in combination, a framework, means for supporting a plurality of loom elements therein, a mechanism carriage arranged to travel lengthwise of said elements, mechanism on said carriage for operating upon said elements, means for causing the mechanism carriage to travel, and means whereby one of said elements automatically regulates the action of said carriage-moving means.

88. A warp-drawing machine having, in combination, a framework, means for movably supporting a loom element therein, a mechanism carriage arranged to travel lengthwise of said element, mechanism on said carriage for operating upon said element, means for causing the mechanism carriage to travel, and means whereby said element automatically regulates the action of said carriage-moving means.

89. A warp-drawing machine having, in combination, means for movably supporting a loom reed, a mechanism carriage movable lengthwise of the machine, a reed opener on the mechanism carriage arranged to engage the reed, means to cause the carriage to travel, and means controlled by the position of the reed for regulating the carriage-moving means.

90. A warp-drawing machine having, in combination, means to support a loom reed, a mechanism carriage, means including a pawl and ratchet for moving the carriage, and means automatically controlled by the reed for governing the action of the pawl.

91. A warp-drawing machine having, in combination, means for supporting the work so that it has some freedom to move longitudinally of the machine, a drawing-in mechanism, and means controlled by the varying position of the work for causing feeding movement of said mechanism.

92. A warp-drawing machine having variably-movable harness supports and a drawing needle having a variable stroke.

93. In a warp-drawing machine, a drawing needle having a variable stroke.

94. A warp-drawing machine comprising a drawing needle and intermittenly-acting means to actuate the needle.

95. In a machine for drawing warp threads through a plurality of harnesses, a needle, and means for bringing the needle and a selected harness into operative association with each other.

96. A warp-drawing machine having, in combination, a mechanism carriage, a feed for the carriage, operating mechanism on said carriage, means for movably supporting a series of elements for the engagement of successive elements by said mechanism, said series of elements being free to travel with said carriage, and means sensitive to movement of said series of elements as a whole for controlling the feed for the carriage.

In testimony whereof, we have signed our names to this specification, in the presence of two subscribing witnesses.

EDGAR F. HATHAWAY.
CHARLES LEA.

Witnesses:
EVERETT S. EMERY,
THOMAS B. BOOTH.