(No Model.) 3 Sheets—Sheet 1.

J. H. MITCHELL.

MACHINE FOR THE MANUFACTURE OF MATCHES.

No. 304,018. Patented Aug. 26, 1884.

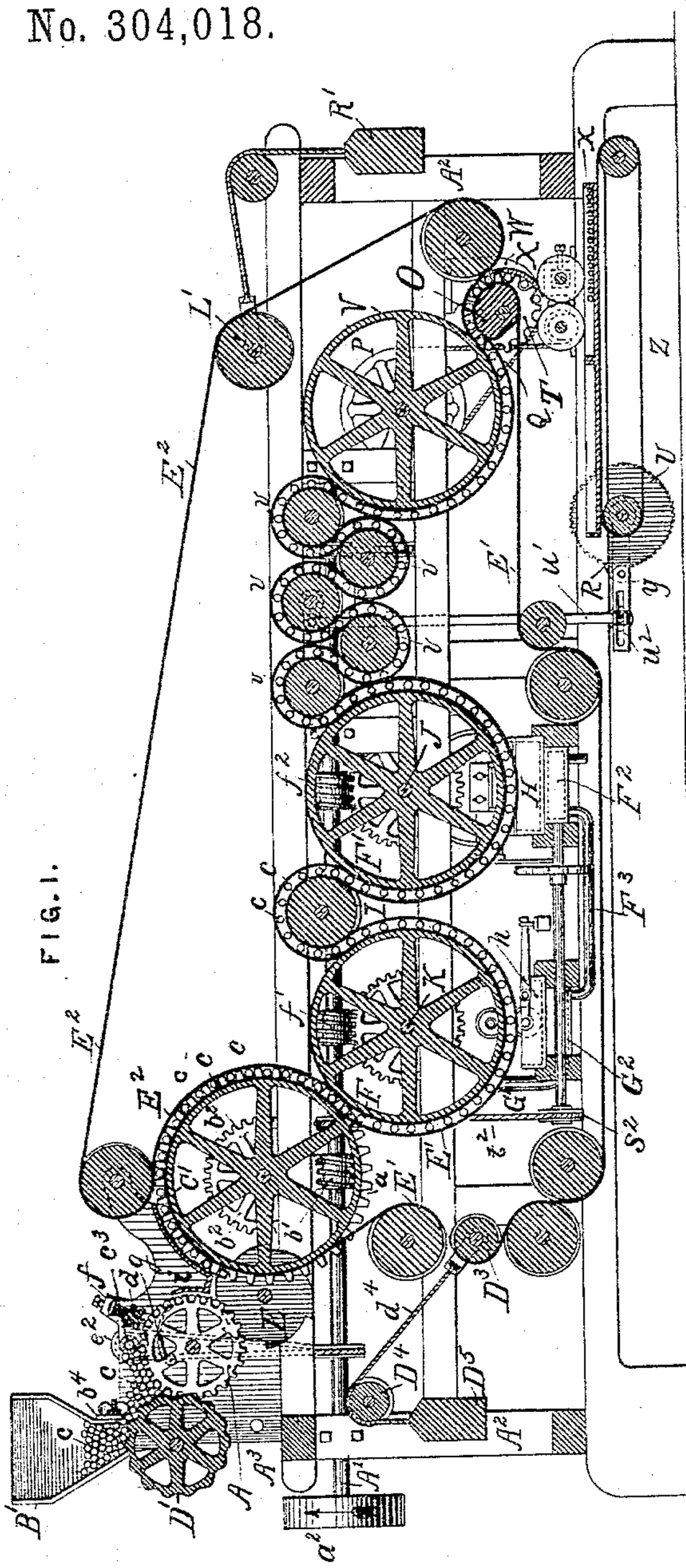

FIG. 1.

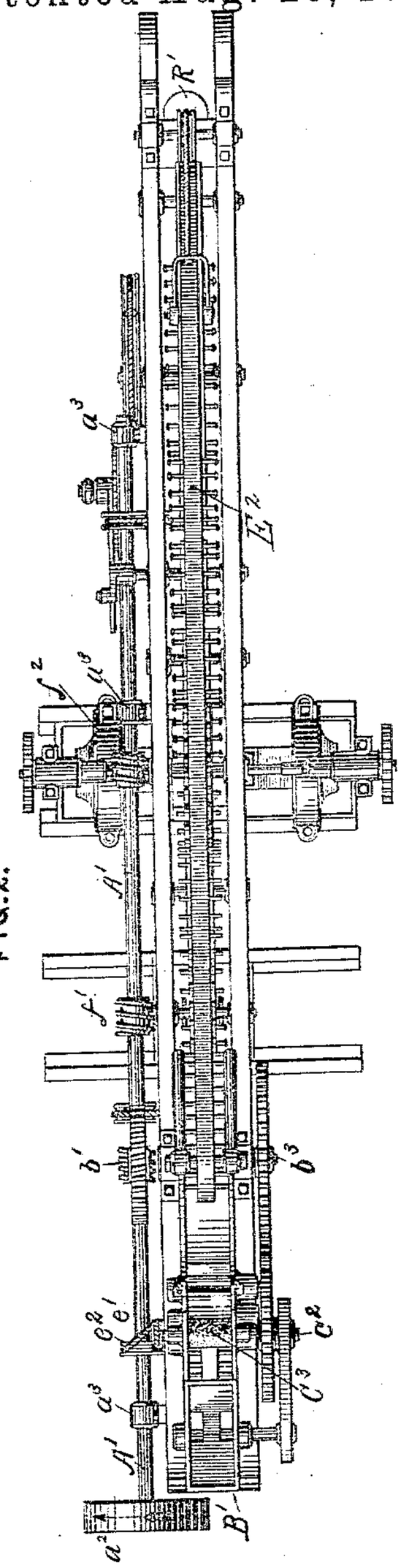

FIG. 2.

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FIG. 3.

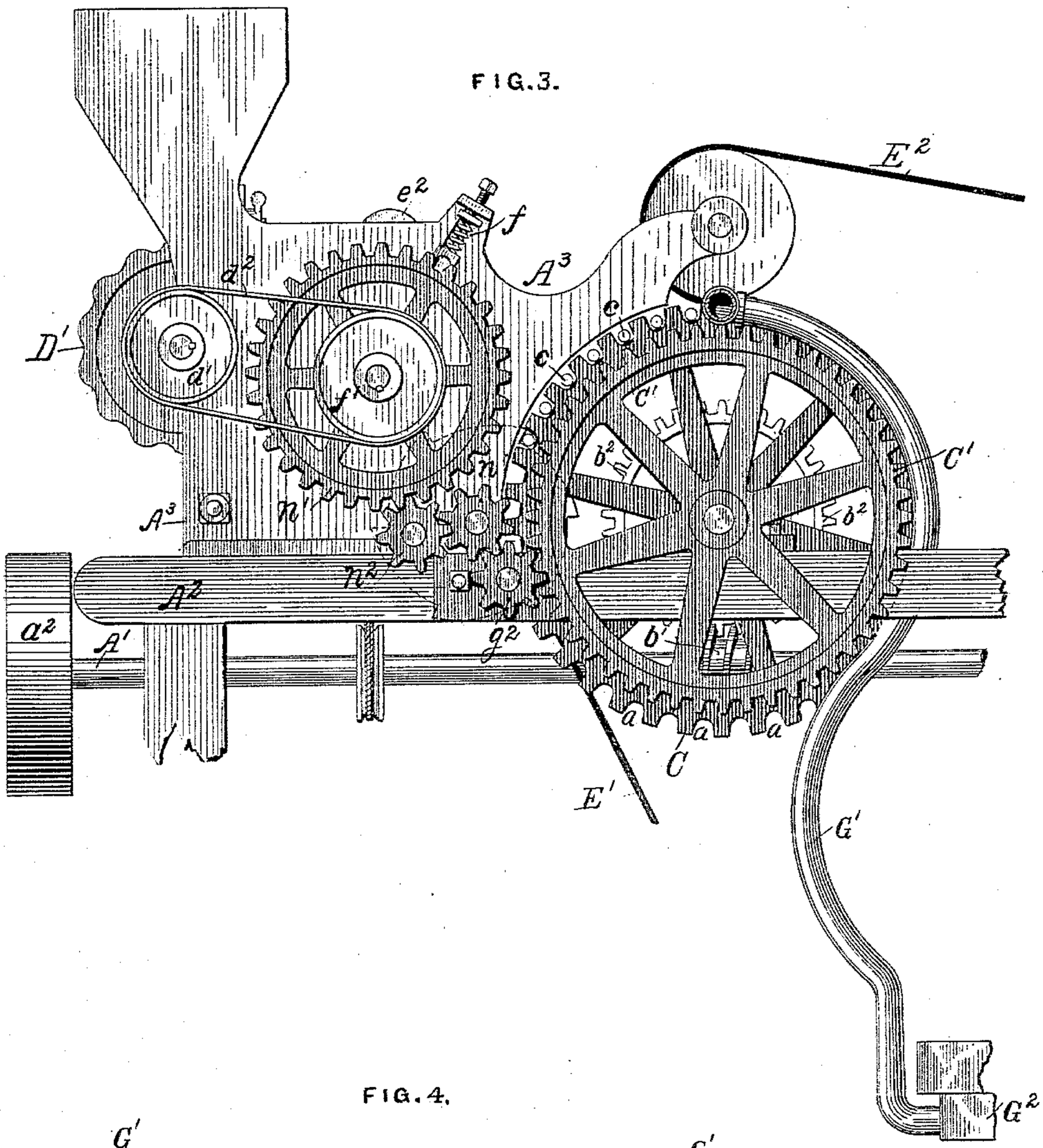

FIG. 4.

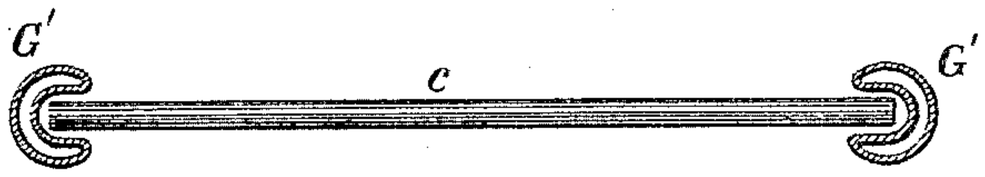

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FIG. 5.

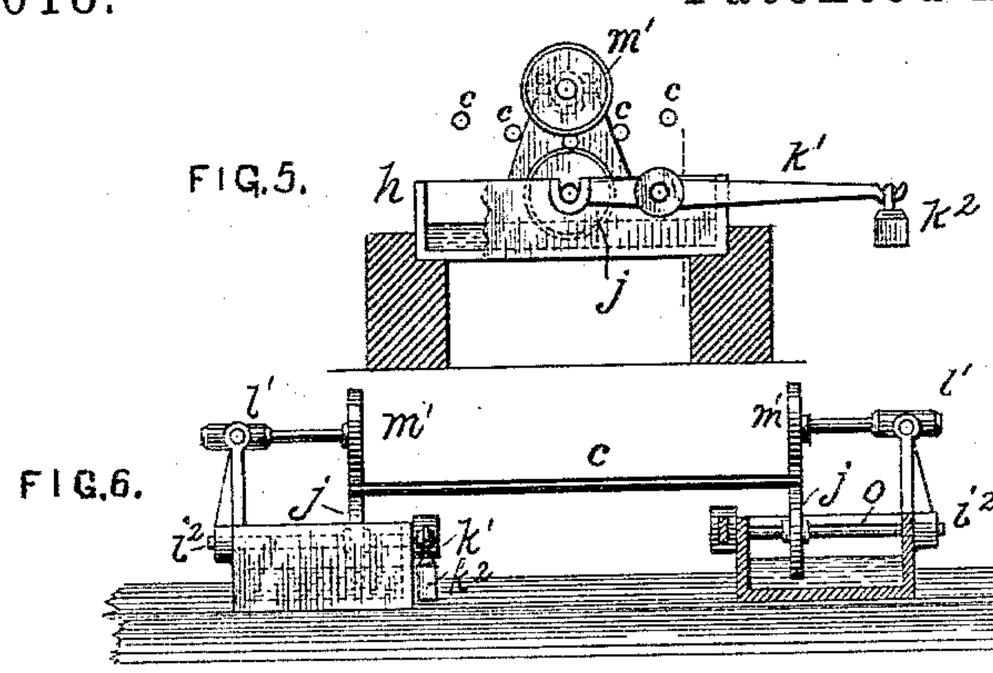


FIG. 6.

FIG. 7.

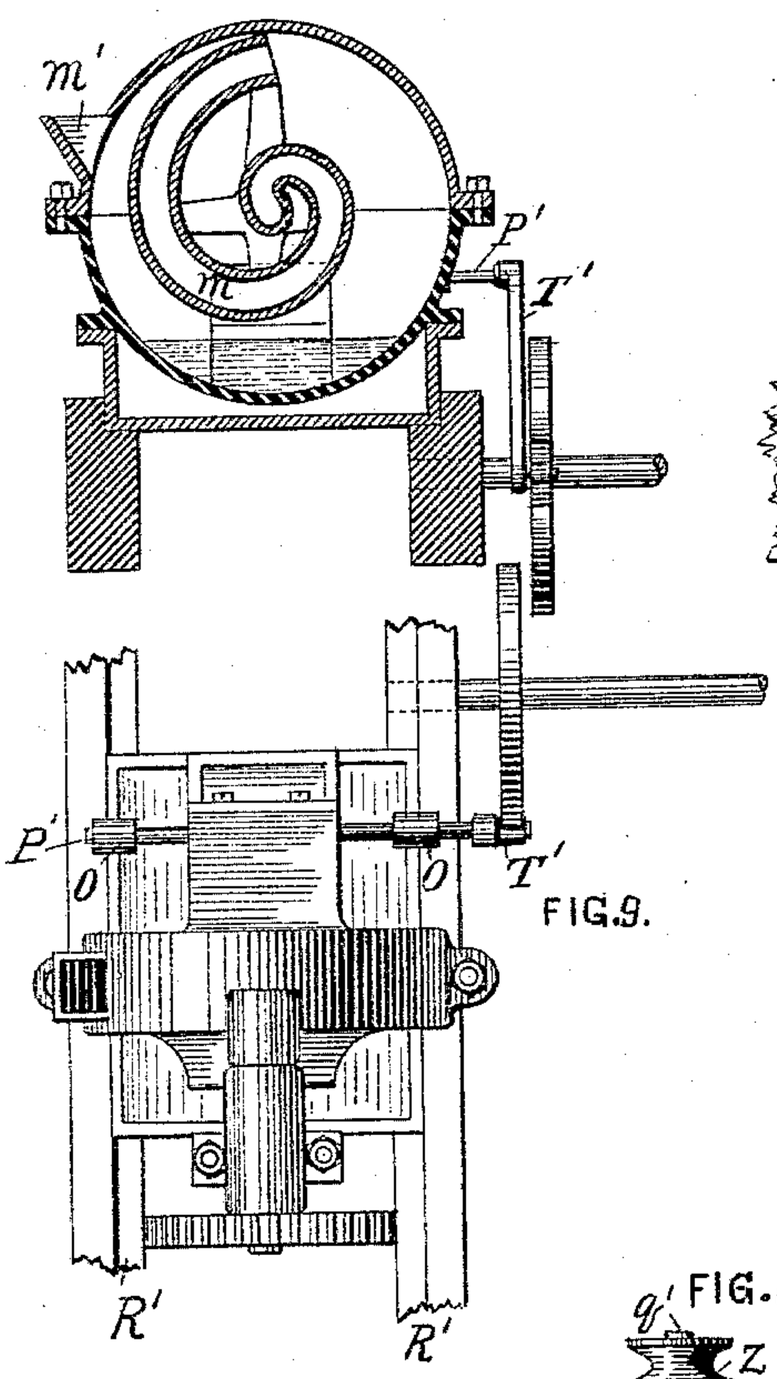


FIG. 8.

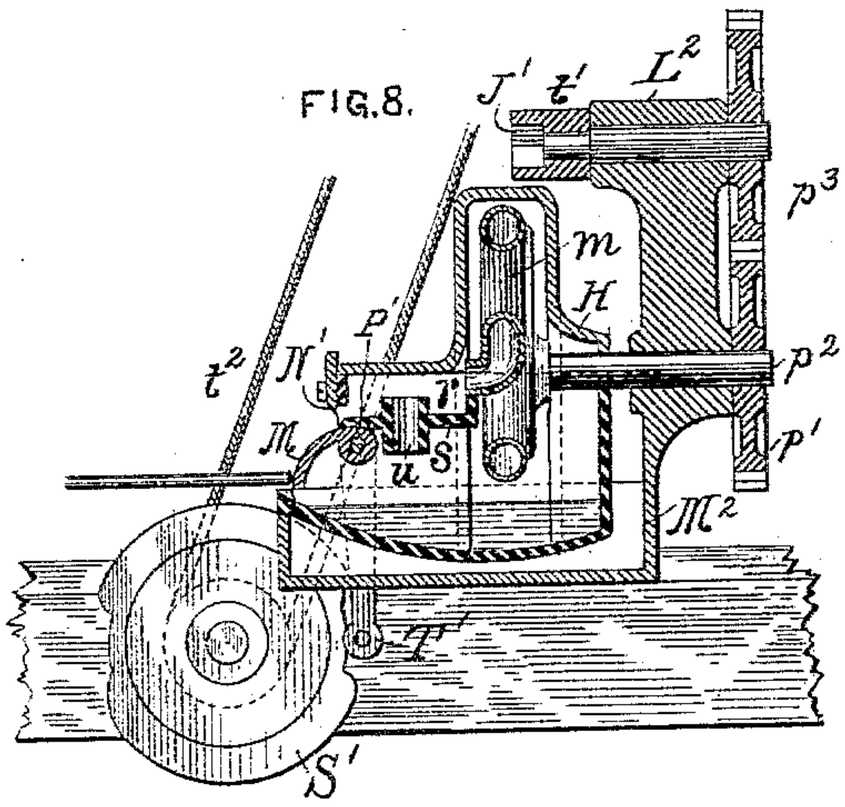


FIG. 9.

FIG. 10.

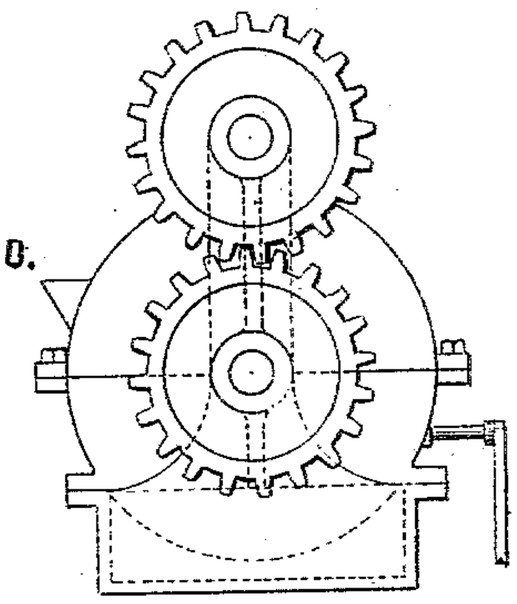
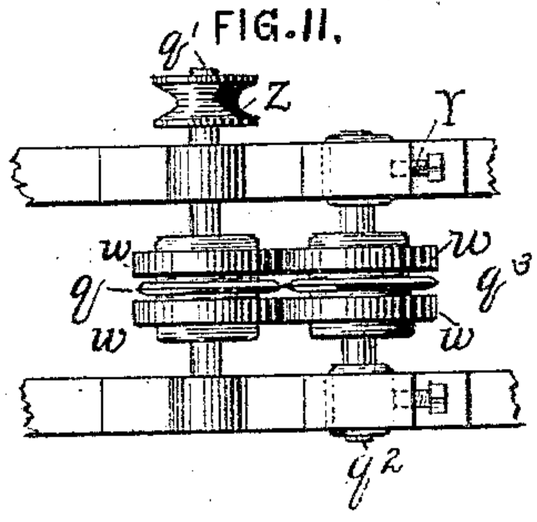


FIG. 11.



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MACHINE FOR THE MANUFACTURE OF MATCHES.

SPECIFICATION forming part of Letters Patent No. 304,018, dated August 26, 1884.

Application filed January 8, 1884. (No model.)

To all whom it may concern:

Be it known that I, J. HENRY MITCHELL, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Machines for the Manufacture of Matches, of which the following is a specification.

The object of my invention is to provide a machine for the continuous carrying on of said manufacture; all the steps thereof, from the picking up of the splints to the final deposit of the matches in the drying-trays, being effected in a single passage through the machine.

In the accompanying drawings, Figure 1 represents a vertical longitudinal section through the center of the machine. Fig. 2 is a top or plan view thereof. Fig. 3 is a side elevation, on an enlarged scale, of the hopper which contains the splints, and the adjacent mechanism. Fig. 4 is a cross-section through the steam-channels, by means of which the ends of the splints are heated before the application of the sulphur thereto. Figs. 5 and 6 are respectively side and end elevations of the sulphuring devices. Fig. 7 is a central longitudinal section, and Fig. 8 a central transverse section, through the devices for applying the phosphorus heading. Fig. 9 is a top or plan view, and Fig. 10 a side elevation, of said devices; and Fig. 11 is a top or plan view of the cutting devices, by means of which the splints are divided at the conclusion of their passage through the machine.

The scale of all these figures from 5 to 11, both inclusive, though less than that of Figs. 3 and 4, is somewhat enlarged from the scale of Figs. 1 and 2.

For convenience of description, it may be well to consider the machine as divided into a series of subsidiary devices, and to describe the mechanical construction and operation of each of these devices separately. Briefly speaking, they may be classified by the successive stages of treatment, as follows: first, the picking-up mechanism, by which the splints are delivered from the hopper into which they are in the first instance fed; second, the transferring devices, which convey the splints to the belt by which they are carried through the machine; third, the apparatus for sulphuring the ends of the splints; fourth, the apparatus for applying the heads thereto; fifth, the devices for shaping and finishing the heads; and, sixth, the cutting and discharging mechanism.

In the drawings, A^2 represents the main frame of the machine, and A^3 the frame of the picking-up mechanism mounted upon the frame A^2 at one end.

A′ represents the main driving-shaft, from which all the motions of the machine are taken. This shaft A′ rotates in bearings a^3, fastened to the frame A^2, and power is supplied to it by the driving-pulley a^2, the direction of whose motion is indicated by the arrow. Upon this driving-shaft A′ is keyed a worm, b', which connects with a worm-wheel, b^2, fastened or keyed to a shaft, b^3, rotating in bearings upon the frame A′. At the center of this shaft b^3 is fastened a large flanged pulley, C, whose flanges are cut into parallel notches *a*, as shown, slightly wider than the thickness of a match-splint.

On the extreme end of the shaft b^3 is keyed a gear-wheel, C′, (see Fig. 3,) which supplies power to the picking-up devices. These, as before stated, are supported upon a secondary frame, A^3, and consist of a hopper, B′, whose interior diameter is as nearly as possible equal to the length of a splint, which, as is well known, is double the length of the finished match. The discharge-opening of this hopper is situated at one side, as shown, and an adjustable gate, b^4, is provided to regulate the size of the opening. The bottom of the hopper is also open to permit the entrance of the periphery of a fluted wheel, D′, upon which the splints *c* within the hopper rest. This fluted wheel D′ is rotated in the direction of the arrow by means of the pulley d', driven by a belt, d^2.

Adjacent to the fluted wheel D′ are two picking-up wheels, A, arranged upon a shaft, c^2, so as to rotate together, and at such a distance apart as to overlap the sides of the fluted wheel D′. As the fluted wheel D′ rotates, it draws out the splints from the hopper through the side gate, and as it travels toward the picking-up wheels A it holds the splints squarely but loosely between the flutes, and thus presents them into the picking-up wheels. These wheels A are provided with wedge-shaped pe-

ripheral notches, whose openings are large enough to freely receive the splints, but converge at bottom to a diameter less than that of the splints, and the notches upon one wheel are parallel to those upon the other.

Immediately above and in like contact with the periphery of the picking-up wheels A is a rotating brush, C^3, actuated by means of the belt e' and pulley e^2 from the main driving-shaft A'. The function of this brush is to throw back the surplus splints, only permitting those to pass which are in the openings of the picking-up wheels A.

Adjacent to the brush C^3, and likewise above the picking-up wheels A, is a tread-roller, *d*, mounted in sliding bearings upon the frame A^3, which are provided with adjustable spring-pressure attachments *f*, so that the degree of pressure of the tread-roller may be regulated. The function of this tread-roller *d* is to firmly pack the splints into the wedge-shaped openings of the picking-up wheel A. A pair of light curved springs, *g*, attached to the frame A^3, press lightly against the under surfaces of the splints during a certain portion of their travel in the picking-up wheels A, and those serve to discard or throw out any splints which, by reason of imperfect shape or small size, do not become fastened firmly in the openings of the picking-up wheels A by the pressure of the tread-roller *d*. These discarded splints fall into a waste-hopper, *i*, arranged in proximity to the periphery of the picking-up wheels A.

Adjacent to the picking-up wheels A are the transfer-wheels E, keyed to a common shaft and rotating as one. These wheels E are provided with parallel teeth, somewhat like ratchet-teeth, as shown, and their purpose is to transfer the splints from the picking-up wheels A to the large flanged pulley C, before referred to, and which will be termed the "locating-wheel." The gearing by which these several wheels are rotated must of course bear a definite relation to the number of match-receptacles upon each of the wheels, and also to certain other features which will now be described. Thus, if the locating-wheel C has (as is the preferred construction) thirty-six receptacles in the flanges and the transfer-wheels E six teeth, it is obvious that the latter must make six revolutions for every one revolution of the locating-wheel; and if the picking-up wheels A have twenty-four match-receptacles they must make one rotation for every four of the transfer-wheels E. Furthermore, all these wheels must travel in the same direction, and the gears are therefore arranged as follows. (See Fig. 3.) Upon the end of the shaft c^2 of the locating-wheel C is a large gear, C', having forty-eight teeth. This meshes with the pinion g^2, having eight teeth, which in turn meshes with the driving-pinion *n* of the transfer-wheels E, having also eight teeth. This driving-pinion *n* meshes with a second pinion, n^2, having eight teeth, which in turn drives the large gear *n'*, having thirty-two teeth, and secured to the shaft of the picking-up wheel A. The pulley *d'* upon the shaft of the fluted wheel D' is also somewhat smaller than the pulley *f'*, by which its belt d^2 is driven, so that the travel of the fluted wheel is faster than that of the picking-up wheels. This relation of speed tends to crowd the match-splints forward on the picking-up wheels A and pack them properly in the notches thereof; and I so arrange the tension of the belt d^2 that if the splints become crowded too much between the peripheries of the fluted wheel D' and picking-up wheels A the pulley *d'* will slip until the crowding is relieved by the travel of the picking-up wheels. The teeth of the transfer-wheels E are so arranged in relation to the teeth of the picking-up wheels A and locating-wheel C as that the splints are struck squarely out of the one and into the other, thus avoiding any danger of breakage.

Upon the periphery of the locating-wheel C, and between the flanges thereof, travels an endless belt, E', somewhat narrower than the length of the splints. The passage of this belt through the remaining portions of the machine can readily be traced. It is provided with a tightening-roller, D^3, the strain upon which is effected by the weight D^5, connected with the journals of the roller D^3 by means of the rope d^4, passing over pulley D^4. As the splints are received in the openings of the locating-wheel C, this belt E' is of course beneath them. By the travel of the locating-wheels the splints are carried forward a short distance, and their upper surfaces come in contact with a second endless belt, E^2, whose travel with the remaining portions of the machine can also be readily traced, and which is provided with a similar tightening-roller, L', and weight R'. The splints are carried between the surfaces of these two belts from this point until just before their final discharge from the machine, and hence the two belts will hereinafter be considered as if constituting a single element, and referred to by the name of "the duplex belt."

In order to hold the splints firmly during the sulphuring and heading, I pass the duplex belt over the pulleys F F', which are provided with flanges just high enough to receive the inner belt, E^2. These pulleys, which I term "holding-wheels," are mounted, respectively, upon shafts K J and driven by worm-gearing *f' f²* from the main shaft A'.

The first step in the sulphuring process is to properly heat the ends of the splints, in order that they may not chill the melted sulphur, but may readily absorb it. This is effected by means of the steam-heating channels G', arranged on either side of the machine, and curved to conform to the travel of the belt in passing from the locating-wheel C to the holding-wheel F. The cross-section of these channels is shown in Fig. 4, where it will be seen that they embrace both ends of the match-splints *c*, so as to heat them for a space of about one-half of an inch. The steam-heat-

ing channels G′ communicate with the steam-heating box G², below the sulphur-trough *h*, which in turn is connected by means of the pipe F³ with a second steam-heating box, F², below the receptacle H, for containing the heading composition, thus effecting the heating of the several apparatus by a continuous system.

The sulphuring devices are shown in Figs. 5 and 6. They are arranged on each side of the machine, and, being similar to one another in construction, a description of one will suffice. Each consists of troughs *h*, for containing the melted sulphur, in which there rotates a roll, *j*, whose periphery is covered with soft porous material—such as asbestus-fiber—which will not be injured by the heat of the melted sulphur. The shaft *o* of this roll *j* is arranged in a very loose bearing, *i*², at one end, while the other is supported upon a lever-arm, *k*′, provided with a weight, *k*², which tends to raise the roll *j*. A second roll, *m*′, having its surface similarly covered with soft and porous material, is arranged to rotate above and in contact with the first roll, *j*. This second roll, *m*′, is supported upon a bearing hung in trunnions *l*′, so that the roll is free to rise and fall. These rolls are arranged parallel and in such relation to the holding-wheels F as that the projecting ends of the match-splints *c* shall, in their travel, pass between the adjacent surfaces of the rolls, and thus slowly rotate the latter, whose freely-suspended bearings permit them to rise for the passage of the splint and to fall again after it has passed. Upon falling, the upper roll, *m*′, comes in contact with the surface of the lower roll, *j*, taking up therefrom a portion of the melted sulphur which adheres to the periphery thereof, and thus the surfaces of both rolls are kept coated with the melted sulphur, and their rotation is effected by the movement of the splints themselves, the heated ends of which, in their passage through the rolls, absorb sufficient sulphur. After emerging from the sulphuring apparatus, the duplex belt E′ E², with the splints between its surfaces, travels upward and over the pulley I, and then comes in contact with the surface of the second holding-wheel, F′, in the receptacles of which the match-splints are again held. The travel of this wheel F′ carries the splints downward to the apparatus for applying the heads, which is constructed as shown in Figs. 7, 8, 9, and 10.

As in the case of the sulphuring devices, the heading apparatus is placed on each side of the machine, and only one will be described. A hot-water trough, M², is placed above the steam-heating box F², before referred to, and immersed in the trough M² is the receptacle H, shaped to hold the various working parts, and closed as far as possible to contact with the air. The heading composition is supplied to the receptacle H by the supply-opening *m*′. Within this receptacle H a spirally-coiled pipe, *m*, mounted upon the shaft *p*², is rotated by means of the gears *p*′ and *p*³, having bearings in the upright L², supported upon the end of the trough M². The outer end of this spiral pipe *m* at each revolution dips beneath the surface of the heading composition, which is in the bottom of the receptacle H, and takes up a small quantity, which it transfers through the coil to the central discharge-opening, *r*. It is there poured out upon the plate *s*, provided with an overflow-pipe, *u*, to prevent the accumulation of too much of the composition, and from said plate *s* passes out through the adjustable gate N′ onto the curved surface of the dipping-plate M. This dipping-plate M is fixed upon a shaft, P′, having bearings O outside of the receptacle H, to which is attached a cam-arm, T′, and at its other end is in contact with the revolving cam S′, actuated by means of a belt, *t*², and pulley *s*² from the main driving-shaft. The configuration of this cam S′ is such that its revolution causes the dipping-plate M to alternately approach and recede from the end of the match-splint *c*, and as the fluid heading-composition is poured in a continuous even film over the curved surface of the dipping-plate M, the movements of the latter imitate most closely the operation of vertical hand-dipping, and thus tend to produce an equal distribution of the composition upon the end of the match-splint, instead of crowding it upon one side, as is sometimes the case with mechanical heading devices. The surplus composition flows back from the bottom of the dipping-plate M into the receptacle H.

To render the apparatus for applying the heads and the reservoir of the composition readily detachable from the remainder of the machine, the shaft of the gear *p*³ is provided with a coupling, *t*′, having a square opening, J′, in one end, into which the square projecting end of the shaft J fits. The hot-water trough M² is arranged to slide in ways R′ at right angles to the frame A², and thus in case of accidental ignition of the heading composition the whole apparatus can be at once moved away from the machine and extinguished. The location of all the journals outside the receptacle H avoids the danger of ignition through the friction of the moving parts.

On passing upward from the heading apparatus the splints are taken off from the holding-wheel F′ between the surfaces of the duplex belt, and are then caused to pass around a series of pulleys, *v v v v*, arranged, as shown in Fig. 1, in close proximity to one another, and so disposed as to cause the belts to take a rapidly-reversed serpentine motion. The object of this is to give to the head a symmetrical form, while at the same time permitting it to travel a sufficient distance to cool and stiffen somewhat, and thus retain its shape. If this travel is effected in a right line, or even in a series of straight lines in alternate directions, the tendency of the still fluid composition is to accumulate on one side, and thus

destroy the symmetrical shape of the head. After this serpentine movement, the duplex belt passes downward around the pulley V and carries the matches between the teeth of the discharging-wheels T, whose openings are sufficiently large to permit the splints to fall out readily on arriving at the lowest point of its rotation. After the separation of the two belts, which takes place by the belt E^2 passing around at the pulley W, while the belt E' turns sharply around the cam-shaped slide O, the splints are prevented from leaving the discharging-wheels T until the proper moment by means of the curved shield X.

Immediately below the center of the discharging-wheel T is the cutting mechanism, constructed as shown in Fig. 11. It consists of two disk-cutters, q q^3, arranged to revolve with their edges in contact, and supported, respectively, upon the shafts q' q^2 on each side of each cutter; and in close proximity thereto are arranged disks w, of vulcanized rubber, whose faces revolve in close contact and with a considerable degree of pressure against one another. The object of these disks w is to grip and hold the splints securely on each side of the point to be cut during the operation of the cutters, and thus prevent the sliding of the splints either upward or sidewise while being cut. They furthermore serve to rotate the cutter q^3 by conveying thereto the motion of the shaft q', which is driven by means of the pulley z and belt Q from the pulley P. The bearings of the shaft q^2 are adjustable by means of the screws Y toward the shaft q'. After passing between the cutters q q^3, the now severed matches drop into trays x, carried upon the endless belt Z, which is caused to travel slowly forward as the matches are fed into the trays by means of a pawl and ratchet, R U. The throw of said pawl R is made adjustable in the ordinary way by means of an arm, y, attached thereto, and having a slot, w^2, in which the connecting-rod w' is adjustable toward and from the center of motion. As the trays are filled with the matches, they are removed from the belt Z, and laid away for the heads to completely harden and dry.

Having thus described my invention, I claim—

1. The combination, with the carrying-belt and the pulleys upon which said belt travels, of the steam-channel G', arranged at the side of the belt and curved to conform to the direction of its travel, substantially in the manner and for the purposes set forth.

2. In an apparatus for sulphuring match-splints, the combination, with a carrying-belt, of a sulphur-pan, a roll revolving therein, and a second roll revolving above and in contact with the first, the journals of said rolls being freely suspended to permit the separation of their surfaces by the passage of the splints, and the rolls being so arranged with relation to said belt as that the ends of the splints thereon shall pass between and rotate them, substantially as set forth.

3. In a continuously-operating match-machine, the combination of the sulphuring and heading apparatus with a duplex belt having its adjacent surfaces smooth, a locating-wheel provided with spaced receptacles which distribute evenly the splints between the smooth adjacent surfaces of the belt, and holding-wheels around which said belt travels in passing said apparatus, whereby said splints are held firmly between said surfaces during the sulphuring and heading operations without the use of clamps or other positive holding devices upon the belts.

4. The combination of a closed receptacle for containing the heading composition, a spiral pipe arranged therein, and having a central discharge-opening, mechanism for rotating said pipe, and an inclined dipping-board adjacent to said opening, the whole operating substantially as set forth.

5. The combination of a carrying-belt, a dipping-board suspended upon hinges parallel to the line of travel thereof, mechanism for moving said board toward and from said belt during the passage of a splint, and apparatus for maintaining a flow of heading composition upon said board, whereby said splints are headed in a manner similar to the operation of vertical dipping.

6. In a continuously-operating match-machine, the combination, with the carrying-belt, of a heading apparatus mounted removably at the side of said belt, and provided with detachable driving mechanism, whereby the immediate removal of said apparatus is permitted, substantially as set forth.

7. In a continuously-operating match-machine, the combination, with the heading apparatus and the carrying-belt, of a series of pulleys around which said belt passes immediately after the heading operation, said pulleys being arranged in different planes, and in such close proximity to one another that said belt is caused to take a continually-reversed serpentine course without traveling in a straight line during the hardening of the heads, substantially in the manner and for the purposes specified.

8. The combination of the carrying-belt with the cam-shaped slide O, discharging-wheels T, shield X, and the cutting apparatus arranged below said discharging-wheels, substantially as set forth.

9. The combination, with the disk-cutters q q^3, of the elastic disks w, arranged on each side thereof, whereby the splints are held during the cutting operation, substantially as set forth.

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