

J. A. E. CRISWELL.
MANUFACTURE OF MATCHES.
APPLICATION FILED JULY 8, 1905.

988,253.

Patented Mar. 28, 1911.

4 SHEETS—SHEET 1.

Fig. 1.

Witnesses
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A. Clements

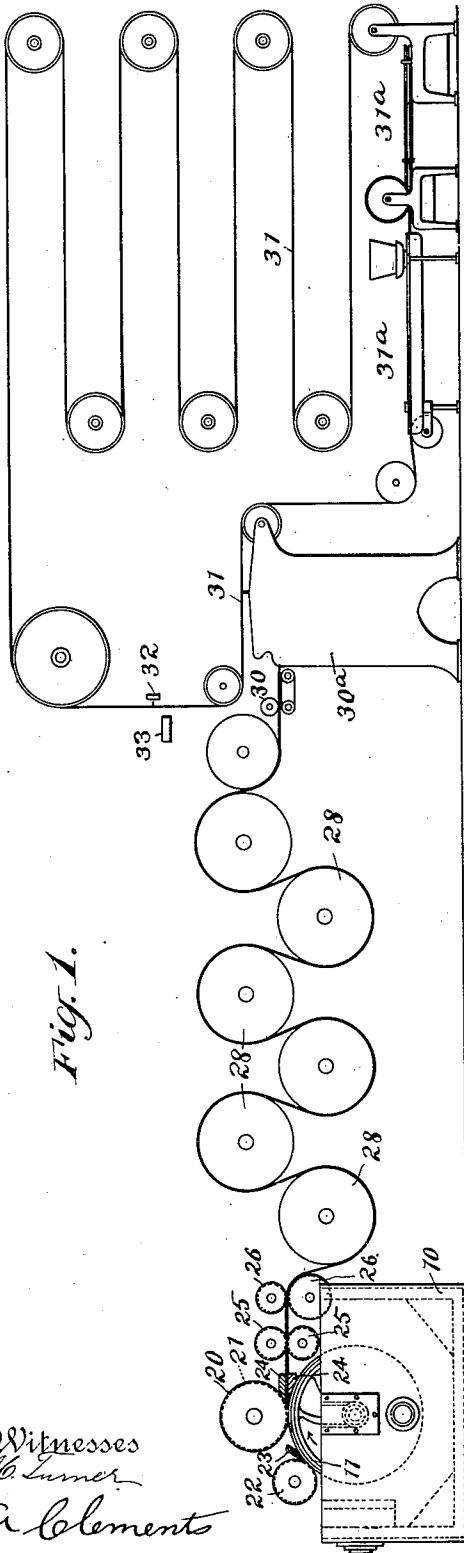


Fig. 3.

Fig. 2.

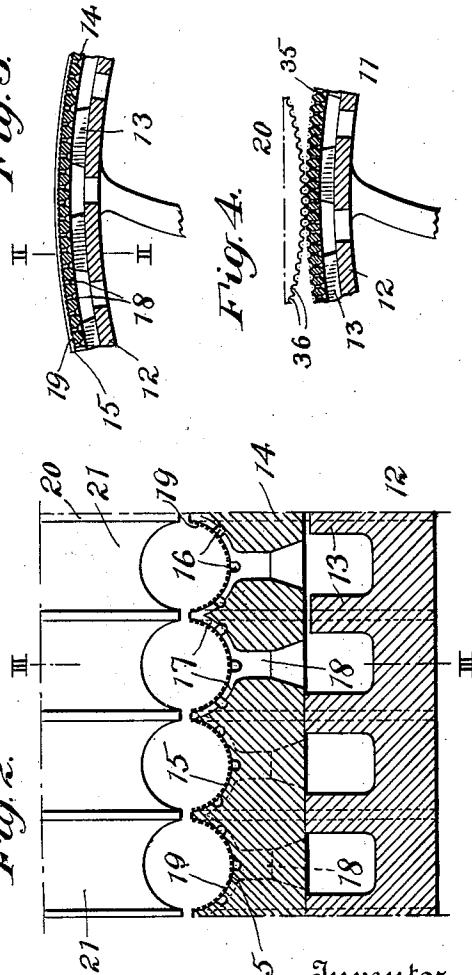


Fig. 5.

Fig. 6.

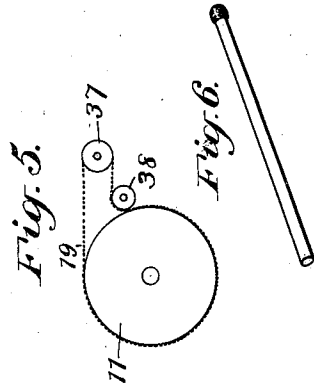
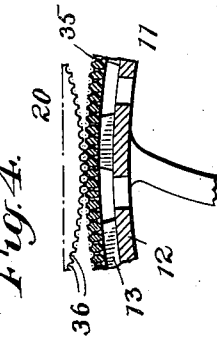


Fig. 4.



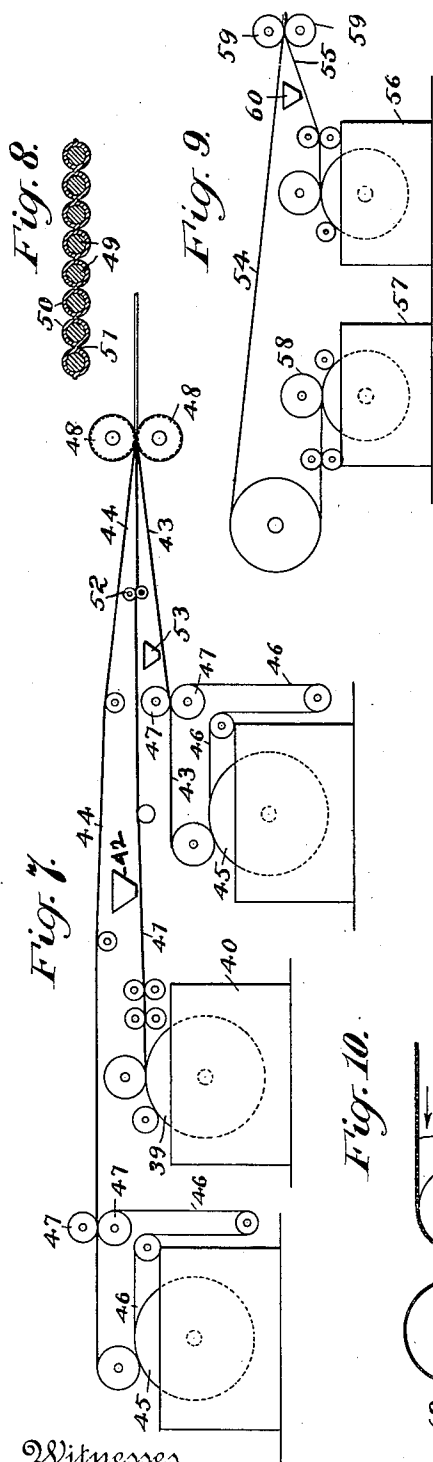
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4 SHEETS—SHEET 2.



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Fig. 10.

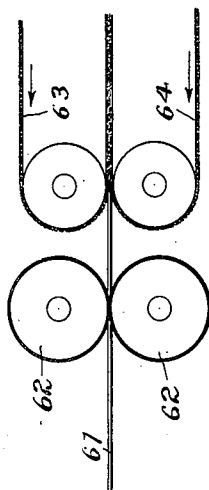


Fig. 12.

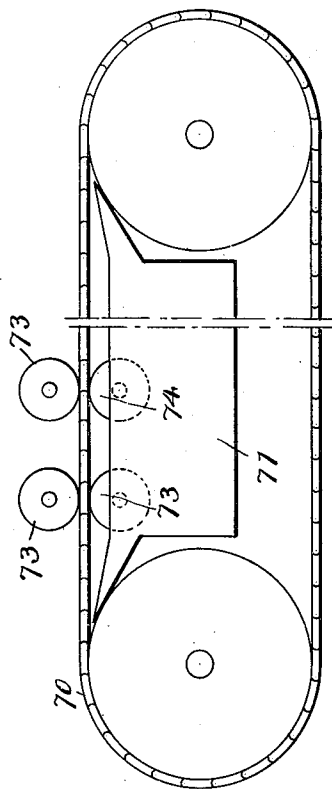
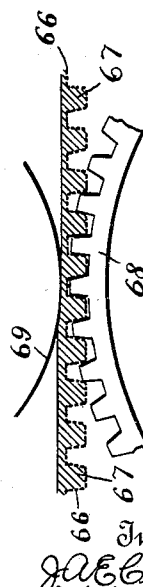


Fig. 11.



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4 SHEETS—SHEET 3.

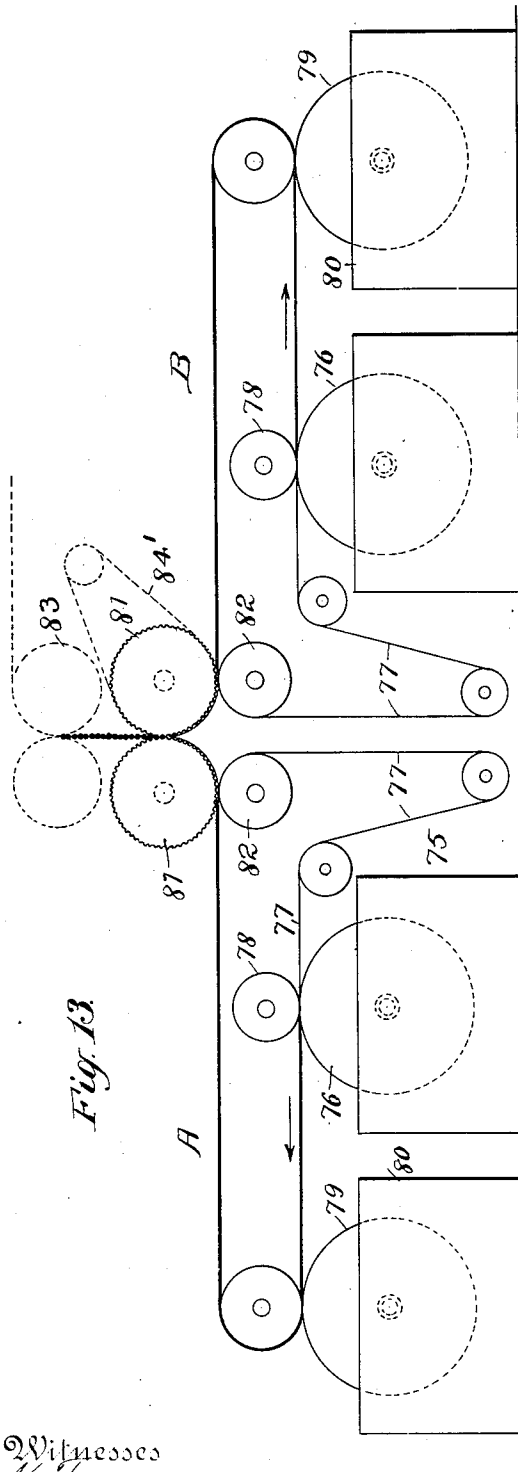


Fig. 13.

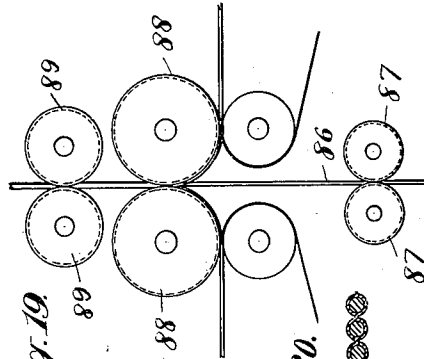


Fig. 19.



Fig. 16.



Fig. 17.



Fig. 20.



Fig. 18.

Fig. 15.

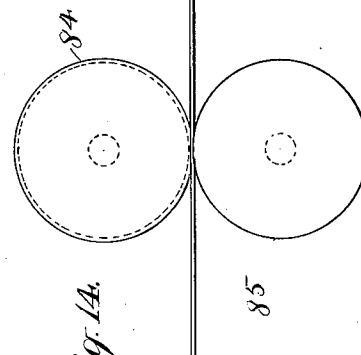
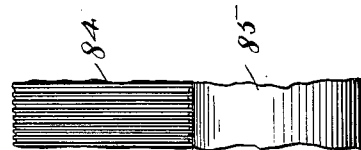


Fig. 14.

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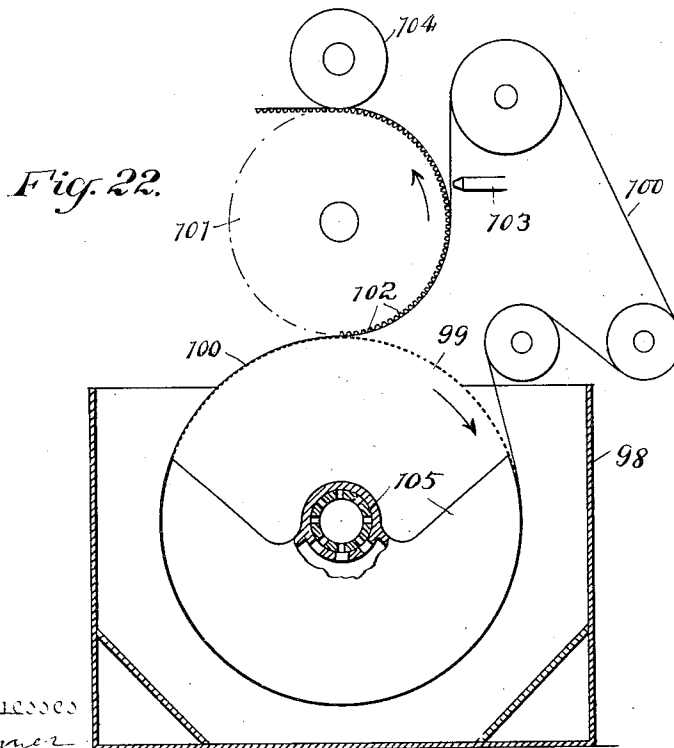
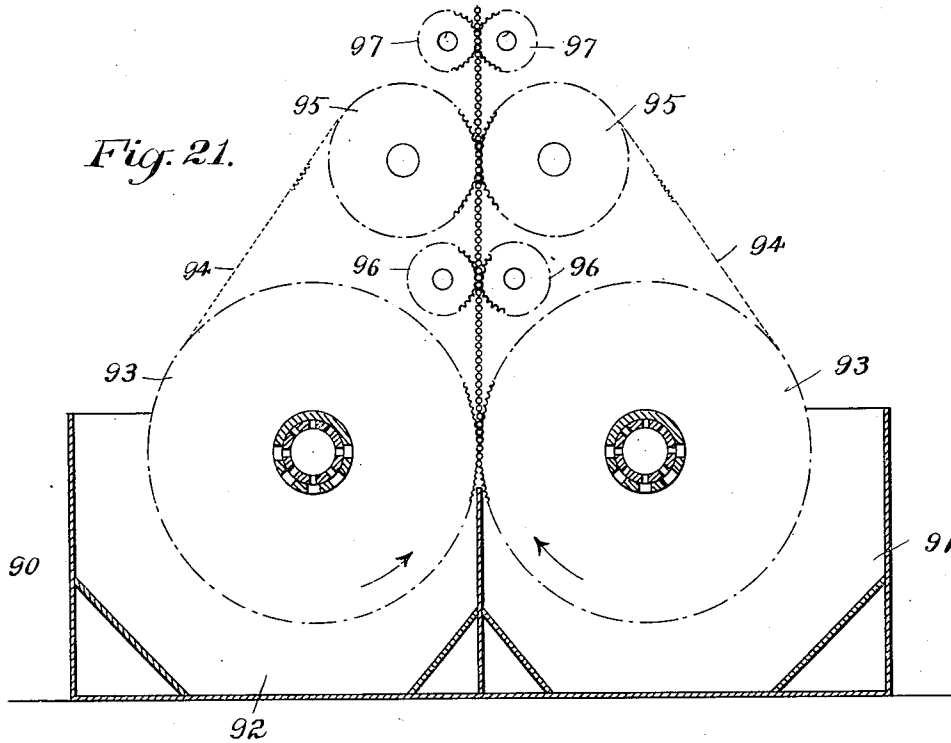
Witnesses
M. Turner
A. Clements

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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

JAMES A. EKin CRISWELL, OF NEW YORK, N. Y.

MANUFACTURE OF MATCHES.

988,253.

Specification of Letters Patent.

Patented Mar. 28, 1911.

Application filed July 8, 1905. Serial No. 268,783.

To all whom it may concern:

Be it known that I, JAMES A. EKIN CRISWELL, of New York, county of Kings, and State of New York, have invented certain new and useful Improvements in the Manufacture of Matches, of which the following is a full, clear, and exact description.

This invention relates to the manufacture of matches, and more particularly to the general character of invention disclosed in my pending application, Sr. No. 40,548, filed December 20th, 1900.

The main object of the invention is to provide a simple and efficient method and apparatus for manufacturing matches, the material for which is first reduced to a pulpy or plastic condition, and to produce them in such a way that the matches may be made automatically and continuously.

A further object of the invention is to utilize cheap material, or material that ordinarily goes to waste in the manufacture of matches, and to so utilize the material that the matches will be strong, of a uniform quality, and will burn longer than the ordinary wood match, and on each of which may be placed matter for advertising purposes.

With these and other objects in view, the invention will be hereinafter more particularly described with reference to the accompanying drawings, which form a part of this specification, and will then be pointed out in the claims at the end of the description.

In the drawings, Figure 1 is a side elevation, partly in section and partly diagrammatic, of one form of apparatus embodying the invention. Fig. 2 is an enlarged fragmentary section of the mold cylinder or drum, taken on the line II—II of Fig. 3. Fig. 3 is a fragmentary transverse section of the drum or cylinder on a smaller scale than Fig. 2, and taken on the line III—III of Fig. 2. Fig. 4 is a view similar to Fig. 3, except that the grooves or molds in the cylinder run lengthwise of the drum and transversely of the machine instead of circumferentially of the drum, as shown in Figs. 1 to 3. Fig. 5 shows a different arrangement of the gauze or wire apron that passes around the drum and collects the material in the tank 10. Fig. 6 is a perspective view of one of the completed matches. Figs. 7 to 10 show different arrangements of apparatus for forming the match bodies. Figs. 11 and 12 show other

means for making match bodies or stems. Figs. 13 to 15 show an apparatus for forming the match bodies from two composite layers of material. Figs. 16 to 18 show webs of different forms of match bodies. Figs. 19 and 20 show means for making match bodies with inner cores, and Figs. 21 and 22 show other means for making the match bodies.

While I have shown several different forms of apparatus for carrying the invention into effect, it is to be understood that the construction and general arrangement of the apparatus may be changed, and where paper-making pulp is employed, or material of a similar character, I may use in connection with the apparatus shown, or separately, any of the features of the machinery used in connection with paper or paper-board making.

The tank 10, Figs. 1 to 3, contains the material from which the match bodies are to be made. This material may be of pulp from old waste, scraps, old printed newspapers, wood pulp, alone or in combination, and which may be in a pulpy condition similar to that from which paper or paper board is made. A mold cylinder 11 is rotatably held within the tank 10 and is adapted to collect the material on its outer surface as is usual, though instead of collecting the material so as to form a layer of wet pulp, the said cylinder is especially constructed for making a web of match bodies. Each match body or stem is distinctive and is substantially complete, and the web forms a series of long match splints or bodies which are united together by part of the material which is much thinner in cross-section than the match bodies themselves. The cylinder 11 has a drum 12 provided with projections 13. These projections are spaced apart and form peripheral ribs around the drum, in order to provide as much open work between the ribs as possible, consistent with obtaining the desired strength, and in the drum 12 are apertures or openings providing a ready means for the escape of the water with which the pulp is combined. On the outside of the ribs or projections 13 is a band or cylinder 14 which is secured to, or formed integrally with the projections 13 of the drum 12. This band or cylinder 14 is provided with circumferential grooves or molds 15, which are spaced apart according to the spacing it is desired to have the match

bodies, and which conform to the shape it is desired to have said bodies. These molds or depressions 15 have smaller grooves 16 which extend around the cylinder and at the bottom of the molds or depressed portions, and said grooves 16 are made to communicate with each other by means of grooves 17 which extend transversely of the grooves 16. The band or cylinder 14 is perforated or provided with apertures 18 which communicate with the molds or depressed portions 15 for the match bodies, and which also communicate with the open space between the projections 13 of the drum 12, so that any water or other liquid which passes into the grooves or molds 15 will find ready means for escape through the cylinder mold. A band 19 of wire gauze, woven wire, or a thin perforated plate, corresponding in shape to the depressed portions or molds 15, extends around the outer surface of the cylinder and lies close against the surface of the circumferential molds and forms a substantially smooth surface over the grooves 16 and 17 and openings 18. This band or covering of gauze or woven wire 19 receives the deposit of material in substantially the same manner as is usual with the cylinder of a paper-making machine. The open work of the band or cover 19 forms an outer surface for the molds of the match bodies and permits the water to pass through the cover, grooves 16 and 17, openings 18, and the openings between the projections 13, but retains the material within the depressed portions, so that during the rotation of the cylinder 11 a thick layer of the material will be deposited on the periphery of the cylinder with its under surface conforming to the contour of the circumferential depressed portions or molds 15. The purpose of constructing the cylinder as shown and described, is to make it as strong and light as possible, consistent with giving free egress to the water combined with the pulp which is removed from the material during the process of making the match bodies. By constructing the cylinder according to the method disclosed, the match bodies are partially formed by the cylinder device during its rotation, and the cylinder permits pressure to be applied thereto, to partially or wholly complete the match bodies.

The form and shape of the match bodies may vary and may be round, square, triangular, or any other shape, and where said bodies are square or triangular, for example, the cylinder 11 may be made to form substantially the whole of the match bodies, while in making round match bodies, for example, the mold cylinder only forms substantially one-half of the bodies, as shown best in Fig. 2. In this latter case the upper half of the match bodies are formed by rollers which press directly against the cyl-

inder 11, and are preferably grooved to form the upper half of the match bodies, the material being sufficiently plastic to permit the said rolls while pressing against the cylinder 11 to cause the material to enter the depressed portions or grooves of the rolls, and thereby form match bodies united together by a film or connection of less thickness than the cross-section of the match bodies.

As shown in Fig. 1, there are two pressure rolls, a roll 20 having circumferential grooves 21 forming molds for the upper half of the match bodies, and a roll 22 in advance of the roll 20. The roll 22 presses the match bodies preliminarily, while the roll 20 exerts a greater pressure on the match bodies. Adjacent to the roll 22 is a scraper 23, and against the roll 22 and cylinder 15 are similar devices 24 which enter the depressed portions or molds of said rolls, to prevent the match from adhering to said rolls and to guide and cause them to pass between the pressure rolls 25 and 26. There may be any number of sets of pressure rolls such as shown at 25 and 26 for the purpose of giving the proper compactness to the match bodies or stems. The match bodies after passing to the rolls 26 are sufficiently compressed and from there pass around the usual form of hollow steam drying rolls 28, or through any other form of drier to dry the match bodies and to prepare them for completing the matches. As a means for completing the matches, various forms of apparatus may be employed, whether of the usual form, or such as disclosed in my Patent No. 716,822, dated December 23, 1902, or any other of my patents of the same date. The web of match bodies before being cut may have advertising or other matter printed upon the surface thereof as indicated by the printing roll 30, and from the printing roll the web passes to an assembling machine 30^a, which cuts the web lengthwise of the match bodies and between the same to form long match bodies, and these bodies are cut transversely to form complete splints or stems. If the match bodies lie close together they may be further separated as in the patents referred to, and are forced into a carrier 31 of the usual or any preferred construction. The carrier 31 is of the endless type, and after receiving the splints the latter pass to the heating, paraffining and composition devices 31^a of the usual or of any preferred form, and are then held a sufficient length of time for the match heads to dry, as is usual. Before the matches again reach the assembling machine they are ejected by a device 32 into the boxes or on to a traveling apron 33 for boxing. It will thus be seen that material reduced to a pulp or pulpy state may be made into match bodies, and the matches completed automatically and continuously.

In Fig. 4 the molds or depressed portions 35 of the cylinder 11, instead of extending circumferentially around the cylinder, extend in a direction parallel with the shaft 5 of the cylinder, so that the match bodies when completed will extend transversely instead of longitudinally of the web as in Fig. 1. When the molds 35 are arranged as shown in Fig. 4, the depressed portions or molds 36 or the pressure roll 20 are similarly formed to make the other half of the match bodies. When, however, the match bodies are square, triangular or of like shape, the roll 20 may be made entirely smooth, and the entire match bodies formed on the cylinder 11, with or without the film, according to the spacing of the molds or depressed portions 35. The match bodies, whether formed in a web or not by reason of the spacing of the molds, may be made into complete matches in the usual or in any preferred way, and in any case may be made in continuous machines, or the match stems made and matches completed by independent means.

The construction shown in Fig. 5 differs from that of Fig. 11, in that the band of woven wire or other material 19, which surrounds the cylinder 11, instead of being secured to the outer surface thereof, is made to pass around the rolls 37 and 38, then around the cylinder to collect the material for the match bodies. The material may be compressed while on the cylinder 11 or while on the flexible band or other material 19 as desired.

Fig. 6 shows a complete match with a round body, though the form of the stem or body will vary according to the shape of the mold or the means for producing the bodies.

The apparatus in Fig. 7 shows how the match bodies may be made from separate or independent webs, so that the inner part may be of one material and the outer covering of the same or of different material. The inner parts may be called cores of the match bodies and may be made on a cylinder 39 substantially the same as shown in Figs. 1 and 2. The material in a pulpy condition in the tank 40, in which the cylinder 39 rotates, may be of a cheap class such as old newspapers, scraps, etc., which may be compressed on the cylinder sufficiently to make the match bodies stiff and rigid, though there may be mixed with the material any suitable substance for assisting in hardening the material whether in the tank 40 or on the cylinder as found most desirable. The web of cores formed by the cylinder 39 and the pressure rolls connected therewith, has material such as flour, starch, or the like, supplied to the surface thereof when needed, by a receptacle 42, and on the opposite sides of the web of cores 41, are the webs 43 and 44. These webs 43 and 44 may be made by

the usual form of paper-making machines, and from any of the materials from which paper may or can be made, so as to be collected on the cylinders 45 and couched on to the felts 46, and then formed into webs by means of sets of rolls 47. These rolls compress the material while on each felt 46 just enough to form a web, and both webs are then caused to pass forward and are united together and to the cores 41 by means of the grooved or fluted rolls 48, to form a web of match bodies having inner cores 49 and an outer cover 50, connected together by film or portion 51, as shown in Fig. 8. The web of match bodies in this case is separated into complete cores by means of the cutters 52, and over the web 43 is a receptacle 53 from which flour or starch may be spread over the web 43 in order to assist in causing the webs to more readily unite together. Instead of the flour or starch covering the surface, the cores may have any suitable hardening substance applied thereto, as paste, copperas, or other material, to assist in stiffening the match bodies when the match bodies are dried; and instead of the webs 43 and 44 being smooth they may conform to the shape of the cores 49. The webs may be passed through a drying apparatus to partially or wholly dry them before being united together, or they may be in any other condition most convenient for forming or uniting the webs together.

In Fig. 9, the match bodies are formed from two webs 54 and 55 by devices 56 and 57 similar to that shown in Figs. 1 and 2, except that one surface of the web is made smooth by reason of the shape of the pressure rolls 58. The webs 54 and 55 are made to pass in such a way that the smooth surface of the two webs will be opposed to each other, so that when brought together and passed between the rolls 59 they will be united together. If desired or necessary a receptacle 60 may be provided for discharging a glutinous substance over the surface of web 55, in order to cause the two webs to unite, and the material may be of such a character that when the webs are united the match bodies will be stiff and rigid.

Fig. 10 shows how a central core of long fibrous material not in a pulpy condition may be employed, which is coated on the outside with plastic material whether of paper-making pulp or of any other suitable material in a plastic or semi-plastic condition. The cores may be made from a sheet of wood veneer 61, long strands or filaments of woody material, shredded wood, excelsior, bagasse, straw, dried plants or other material, which may be chemically or mechanically treated if desired and united or not with a suitable binder. The web of material 61 passes between the fluted or grooved rolls 62 so as to form cores for the

match bodies according to the shape the stems or bodies are to have when finished. The material after leaving the rolls 62 may be in the nature of webs, or separate cores as desired, and is fed between felts 63 and 64. These felts may be the parts of a paper-making machine for collecting the pulp or other material as already described, on the outer surface of which the material is couched as usual, so that when the felts are caused to travel in the direction indicated by the arrows, it will cause the material, in a plastic condition, to form a layer on the opposite sides of the cores. The material between the felts may be compressed while supported by the latter, and the entire match web of match bodies may be made into complete matches in the usual or any preferred way.

20 In Fig. 11 the material whether of paper-making pulp, ground plant or plant products as sunflowers or cotton seed refuse combined or alone for the match bodies is collected on to an endless flexible apron 66 which is provided with depressions 67 according to the form it is desired to have the match stems. This endless apron may be a thin metallic plate or plates, woven wire, or combination of materials, and is preferably of such a nature that all moisture may be compressed out of the material. The apron 66 is fed over a roll 68 which has teeth entering between the recessed portions of the apron 66 so as to support the latter on all sides, and above the roll 68 and apron 66 is a pressure roll 69 which compresses the material as the apron passes between the rolls and forms the match bodies. Instead of the bodies extending transversely of the web they may extend longitudinally thereof, or the match bodies in this and the other views shown may be made complete in the first instance without being joined together in the form of a web.

45 In Fig. 12 is shown an endless belt 70 made by a series of distinct sections hinged together so as to form an endless chain. The construction of each link may be substantially the same as the construction of the cylinder 11 of Fig. 1, in order to permit the water or other liquid to readily pass through the chain and into a box or other receptacle 71. The material as any of the grains ground and combined or not with paper-making pulp, or the latter alone may be gathered to the surface of the endless chain, or the material may be collected by passing through the liquid pulp. The material after being collected on the endless chain may be compressed by the pressure rolls 73 and 74 by the passage of the belt 70 therebetween so as to form the match bodies in a manner similar to that described in connection with Fig. 1, and the matches may be then completed in any preferred manner.

The match bodies may be made by a modified form of paper or paper board machine such as shown in Fig. 13. The parts A and B are each intended to make one-half of the web of match bodies, and are identical in construction, and each represent a part of paper-making machine with the felts moving in opposite directions. A description of part A will answer for part B. The pulp tank 75 has the usual cylinder 76 with its fine wire cover for collecting the pulp which is couched on to the felt 77 by the roll 78. A second cylinder mold 79 rotates in a pulp tank 80, and in said tank 80 may be the same quality of material as in tank 75, although the material in tank 75 may be of a better quality by reason of the fact that it will form the coating or outside cover of the match bodies. The layer of pulp while on the felt passes between the pressure rolls 81 and 82, the former being grooved so as to form one-half of the match bodies as shown. The other half of the match bodies from the part B, which have been similarly made and formed as in part A, unite with the half of the match bodies formed by the part A as they move between the rolls 81. Additional pressure and compression may be given the match bodies by means of the set of rolls 83, the match bodies being then taken and the matches completed as already described. To prevent the material from adhering to the rolls 81, an endless wire gauze 84' may be made to pass around said rolls and to enter the grooves thereof to form the bodies properly as shown in dotted lines at 84' in part B of the machine.

In Figs. 14 and 15, the rolls 84 and 85 are similar to rolls 81 and 82 except that the grooves forming the mold for the match bodies are circumferential instead of extending parallel to the shaft of the rolls as in Fig. 13. The rolls 84 will form one-half of the match bodies in a web as in Fig. 16, or as separate match bodies, according to the spacing between the grooves and the distance between the pair of rolls forming the set. Where the bodies are triangular or rectangular as in Figs. 17 and 18, the entire match bodies may be formed by one set of rolls instead of two sets as in Fig. 13.

In Figs. 19 and 20, the match bodies are formed with central cores. The cores 86 may be formed by the rolls 87 of any suitable material, as any of the fruits or vegetables or vegetable matter dried and ground and chemically or mechanically treated and united or not with paper-making pulp, or they may be in the nature of twisted fibrous material, as cotton and the like which are fed as a web or as independent cores between the rolls 88 which are similar to the roll 84 of Fig. 14. Dried and ground bananas, spoiled fruits treated with chemicals, or vegetables, as potatoes likewise treated may

be used in combination with other material as wood pulp for the cores. The match bodies may be further compressed by the rolls 89 and when completed the match bodies will be substantially the same as in Fig. 20, or instead of being joined together as a web, they may be entirely separated, and the matches completed as usual.

The tank 90, Fig. 21, has two divisions, 91 and 92, in each of which may be paper-making pulp of different or the same material, and in each tank rotates a cylinder 93. Around each cylinder 93 and moving therewith is a band or apron of flexible material 94, such as wire gauze, which has depressed portions or molds to form the match bodies, and each collects the material as they move with the cylinder 93 as in paper-making. The bands or aprons 94 pass around wheels or drums 95 and in the direction indicated by the arrows, and are brought in close relation so as to form complete match bodies. The material held by the aprons 94 may pass between the pressure rolls 96 and 97, and the match bodies may be partly formed by the rotation of the cylinder 93 and completed by the pressure rolls and the drums 95. The tank 98 has the usual cylinder 99 rotating therein, and around the cylinder passes a smooth apron or belt of wire 100. The apron will collect the material from the tank 98 in the usual way so as to provide a wet layer, and immediately above the cylinder 99 is a drum 101 which has depressed portions or molds 102 according to the form of the match splints to be made, and into which molds the soft material is forced as said drum 101 moves in the direction indicated. The layer of material will thus be forced into the mold grooves 102 and the latter transferred to said drum, and if desired a steam or air jet 103 may be provided to assist in removing the layer or any material from the apron to the drum 101. As the drum continues to rotate, the material will be compressed into the mold grooves by the rolls 104, so that the match bodies or web of match bodies will be made. The collecting cylinder in this and the other views may have the usual or any preferred form of suction device to assist in causing the layer of material to be collected on the cylinder, apron, or in the molds and to draw off the water as it passes within the cylinder. In this case the water is drawn off centrally of the cylinder by a device 105, which may be connected to a pump or other device.

It will be seen from the foregoing that cheap material, or material that ordinarily goes to waste may be employed in the manufacture of matches: that matches may be made continuously and automatically either in whole or in part of plastic material, and the match bodies properly spaced apart so as to require no further separation for head-

ing and completing the same; that matches of various shapes and of a distinctive character may be made; that various materials whether of themselves inflammable or not may be used; that the matches may be variously colored and on each of which may be placed advertising matter, and that by making the matches as herein described, a strong article of uniform quality is produced, which will burn longer and better than the ordinary form of wood match.

The materials or any of them may be chemically or mechanically treated, and to any of them may be added singly or in combination sulfur, saltpeter, paste, copperas, and the like; and where necessary or desirable, I may employ as a binder, where a long fibrous material is used, glucose, glue, rosin, lime, flour, plaster of Paris, or any suitable glutinous or resinous substance.

The paper-making pulp or other material may be made in a layer and then into match bodies. If paper-making materials are used the layer may be made so that it might be further compressed to form the match bodies. It may be made into a soft layer of paper of the proper thickness which will absorb readily other material and the layer may then be compressed into match bodies. The matches may be completed as usual or entirely automatically or may be coiled as by a machine substantially as shown in my application Sr. No. 37,716, filed Nov. 26, 1900.

Various changes in the apparatus and method may be made without departing from the character of the invention; and instead of using the rolls for compressing the material in the molds, if desired some form of reciprocating devices may be employed.

It will be understood that at any stage of the making of the matches, I may add paraffin, crude petroleum, or other oils; or I may add rosin, saltpeter, or other chemicals independently or mixed with others, when it is desirable to make the match splints burn more readily; and it is further understood that the matches may be made in the form of match cards or in any other suitable form.

The match bodies may be made of several webs of the materials which are soft enough to be compressed into the desired shape to form match stems; or there may be webs of different density in which the inner web may be harder than the outer. If desired cotton in the nature of a web may be incorporated with the other material, and might be used as it comes from the usual carding engine.

By the term "paper" as applied, it is to be understood that it is used in its broadest sense and includes any thickness whether what is technically called paper "board" or not, and that "paper-pulp" is intended to include any of the materials from which paper can or may be made.

Having thus described my invention, what

I claim as new and desire to secure by Letters Patent, is—

1. In the manufacture of matches, the method which consists in collecting a web of
5 wet paper-making pulp in a web like form, and compressing the web while soft and directly forming the match splints.

2. In the manufacture of matches, the method which consists in collecting paper-
10 making pulp, and while soft compressing said material directly into match splints.

3. In the manufacture of matches, the method which consists in taking wet pulp
15 and while soft forming it into a web having solid distinctive match ribs or splints extending lengthwise thereof and in parallel relation with each other and connected together by a part of the same material but of
20 less thickness than the match splints, and then cutting the web to form complete splints.

4. In the manufacture of matches, the method which consists in taking and forming by compression while in a soft condition pulp so as to make a web having distinctive
25 ribs or match splints connected together by the same material but of less thickness, then cutting the web between the splints and transversely thereof to form complete splints.

5. In the manufacture of matches, the
30 method which consists in taking a web of wet paper-making pulp in a web-like form, compressing the web while soft and directly forming distinctive and clearly defined long
35 match splints connected together by a film of the same material but of less thickness, and then cutting the web into complete match splints.

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Witnesses:

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