W. L. GREEN.

PRINTING MACHINE.

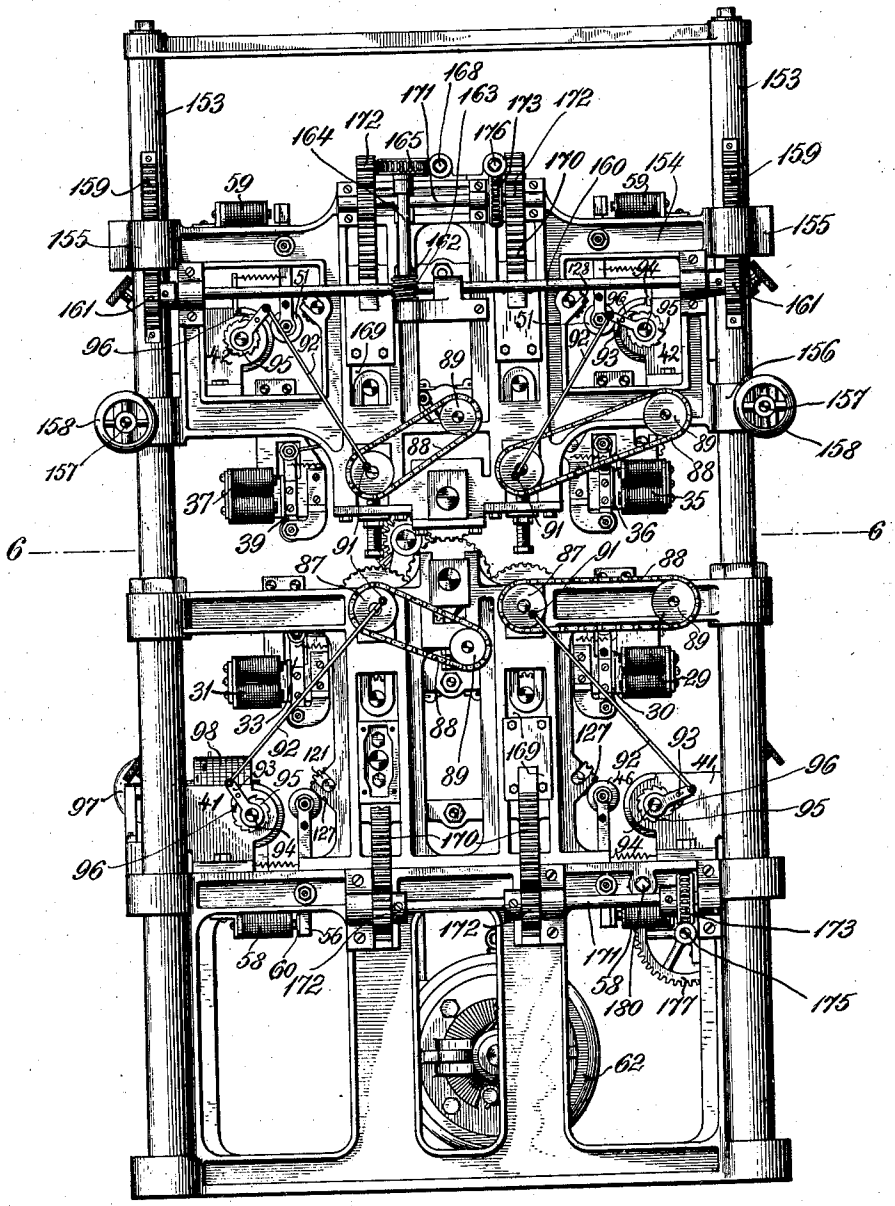
APPLICATION FILED MAY 26, 1905.

1,027,384.

Patented May 21, 1912.

20 SHEETS—SHEET 1.

Fig. 1



Witnesses
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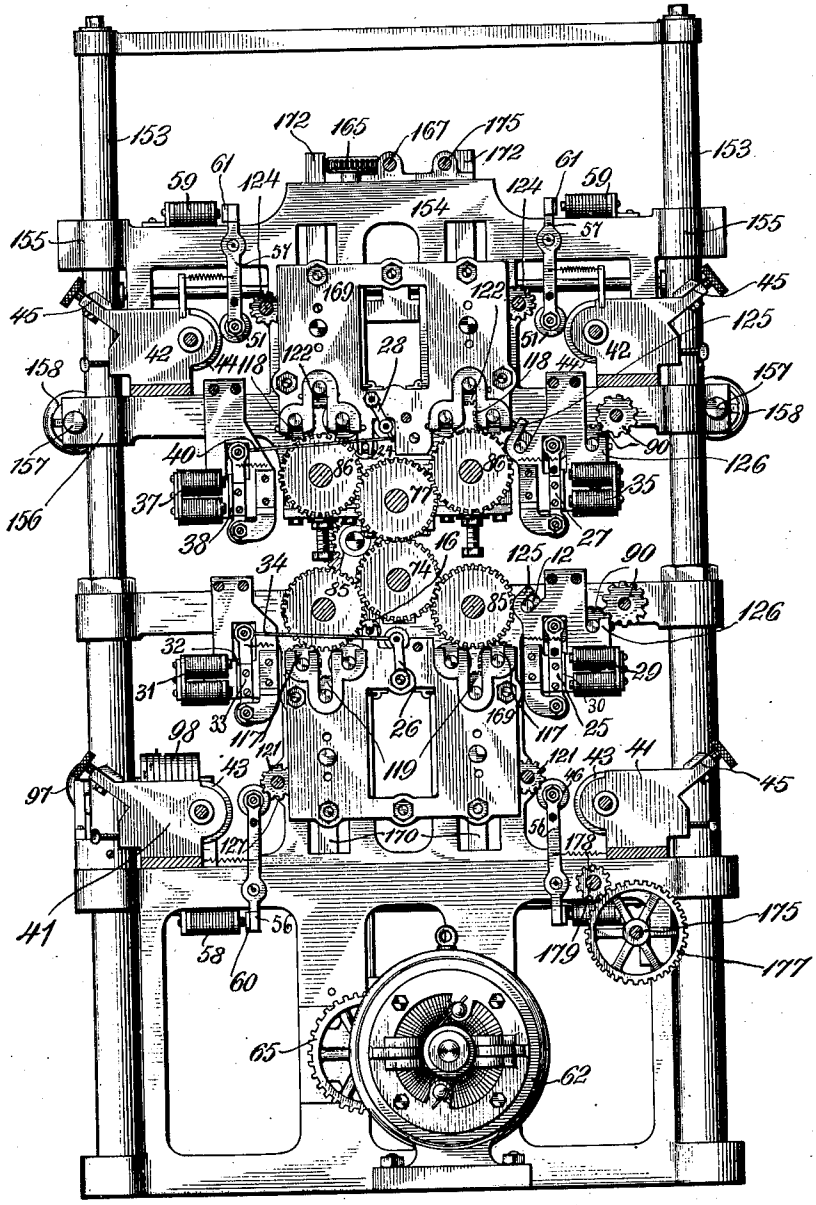
20 SHEETS—SHEET 2.

Fig. 2



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20 SHEETS—SHEET 3.

Fig. 3

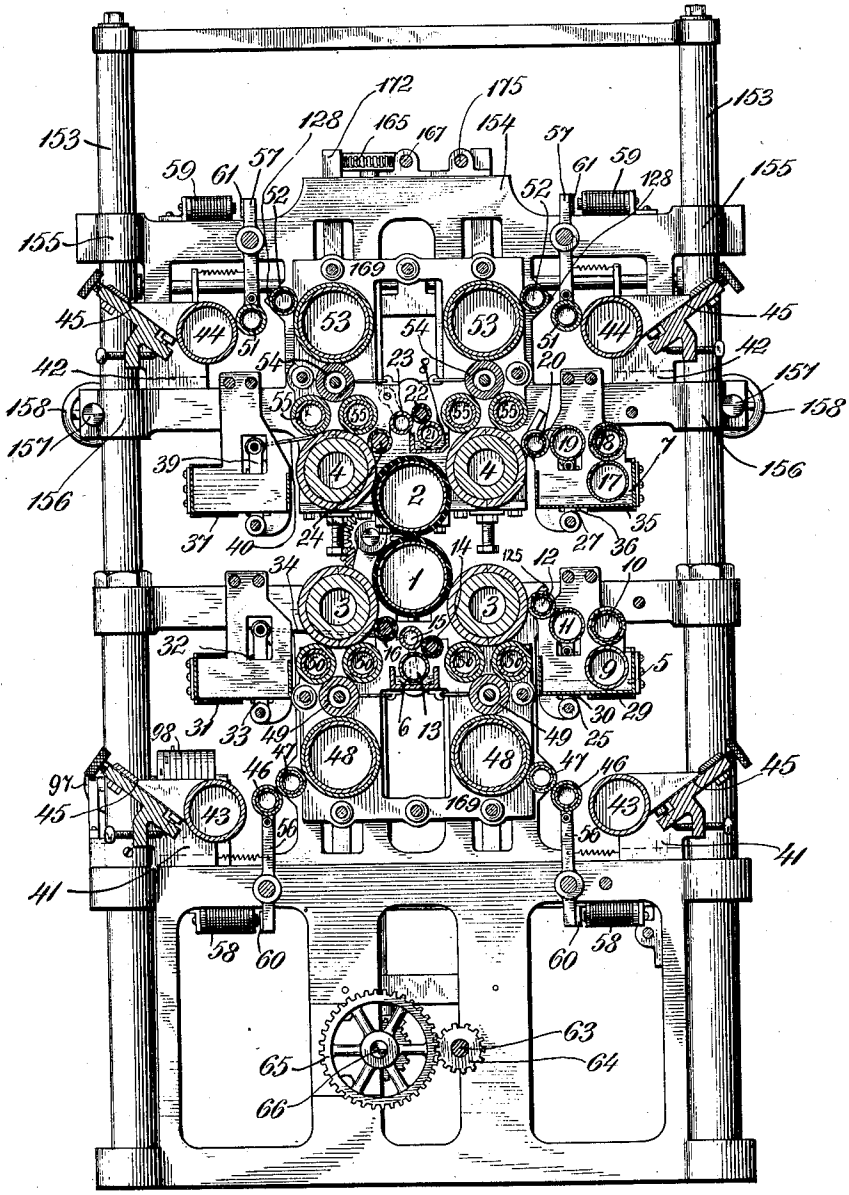

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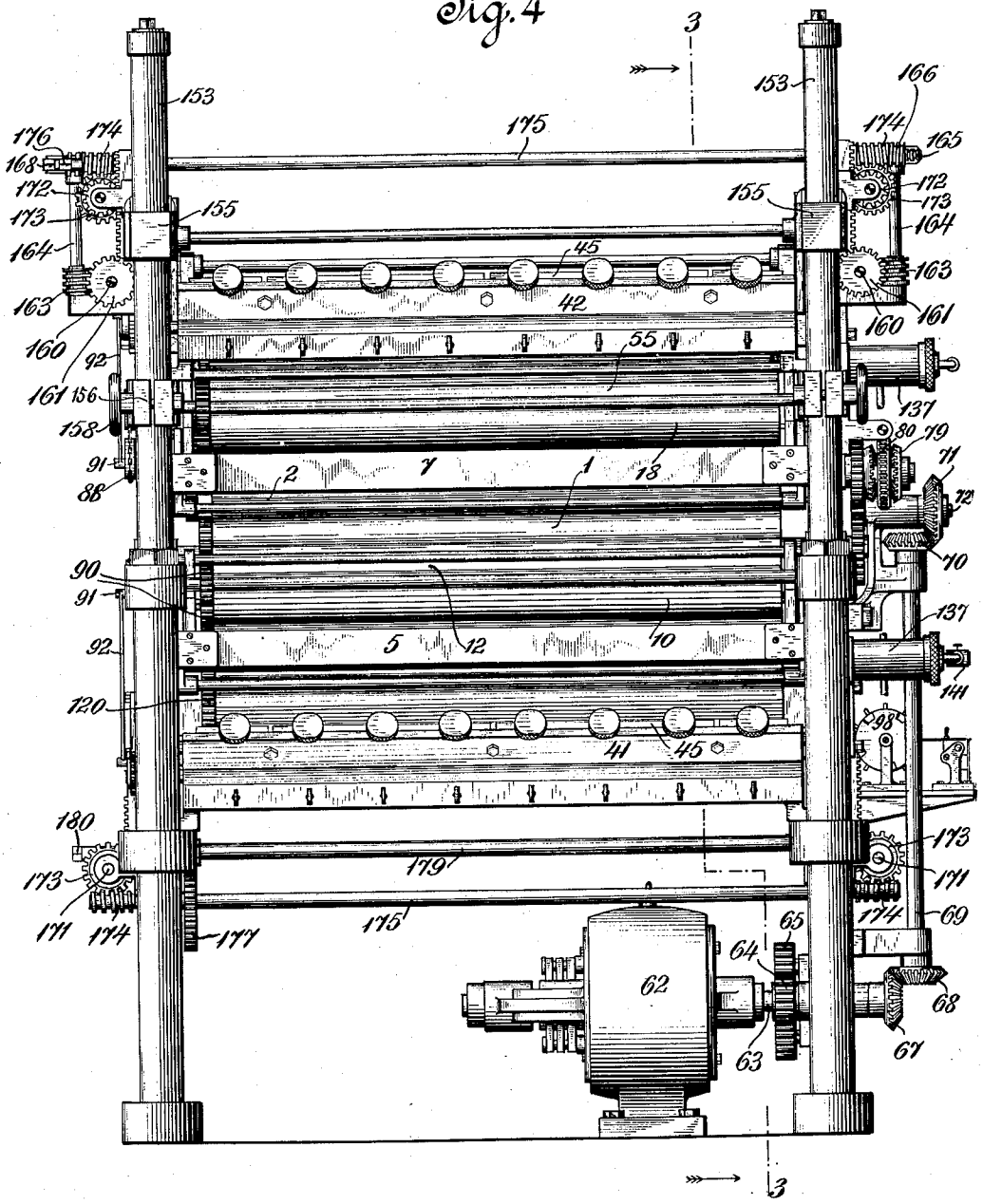
Fig. 4



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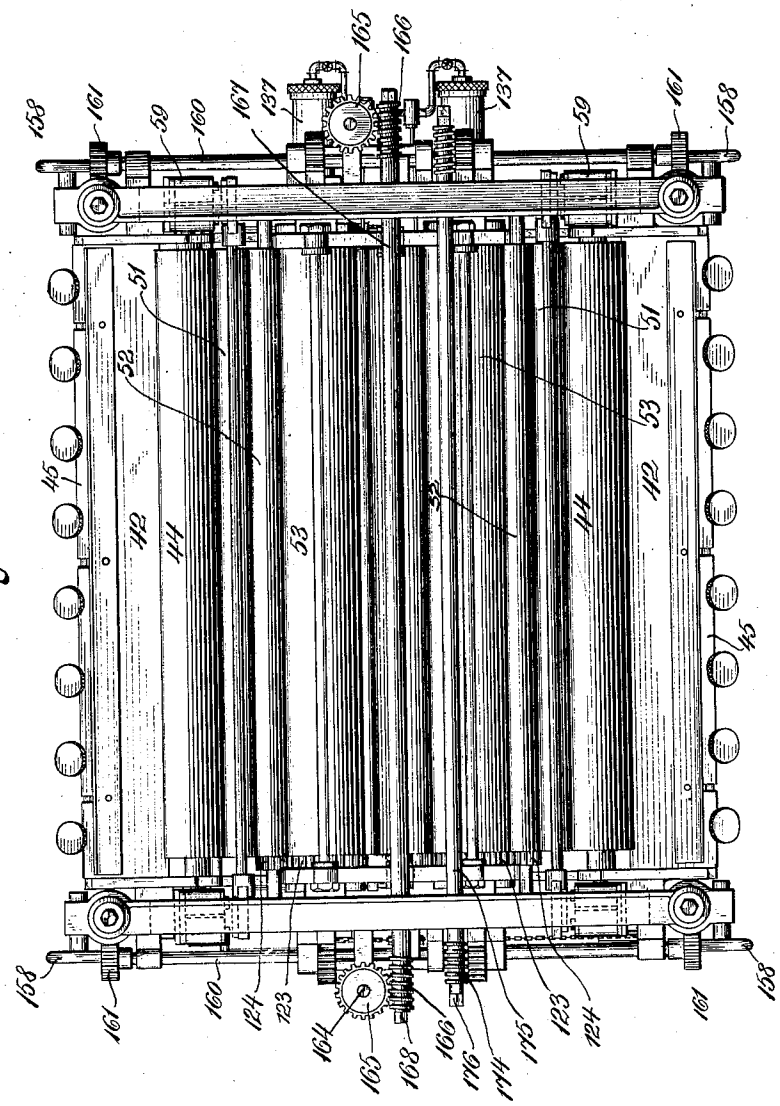
20 SHEETS—SHEET 5.

Fig. 5



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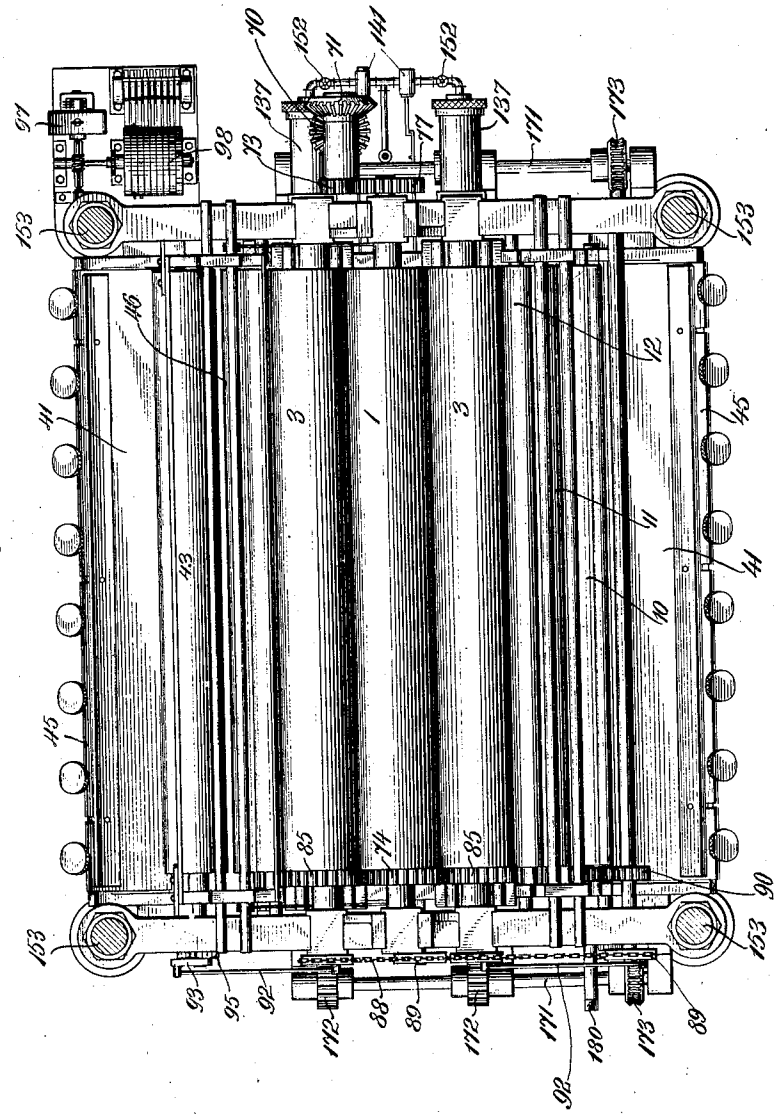

Fig. 6

Witnesses
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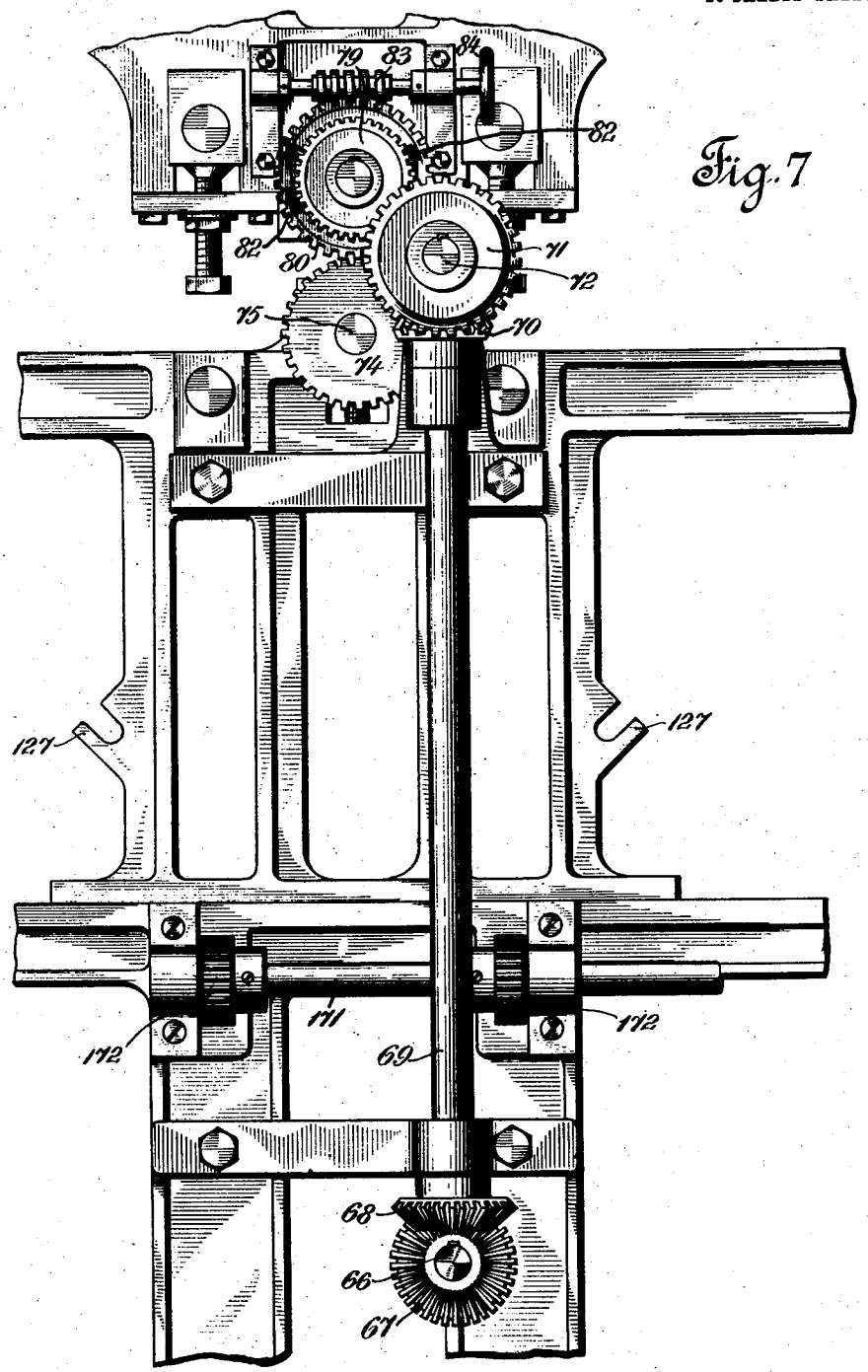

Fig. 7

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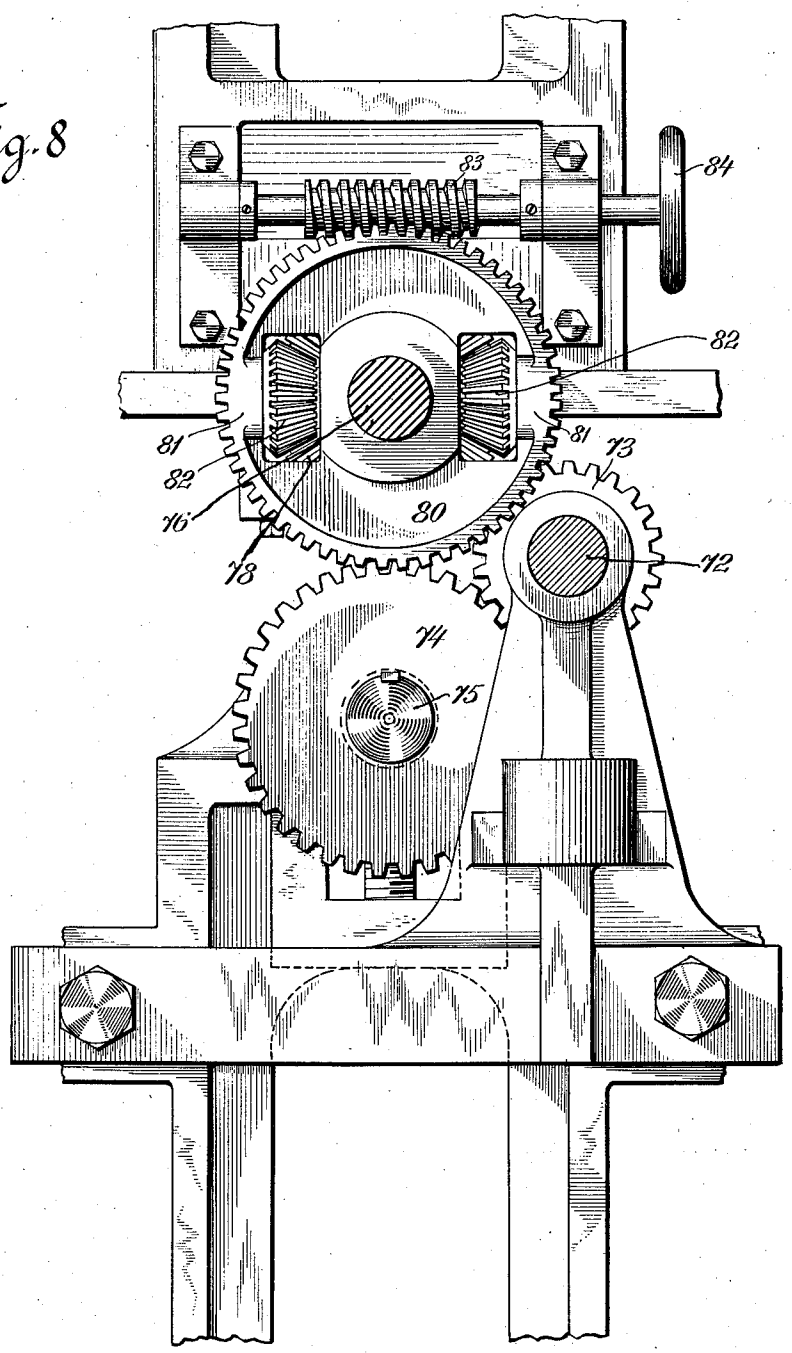
Fig. 8



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20 SHEETS—SHEET 9.

Fig. 9

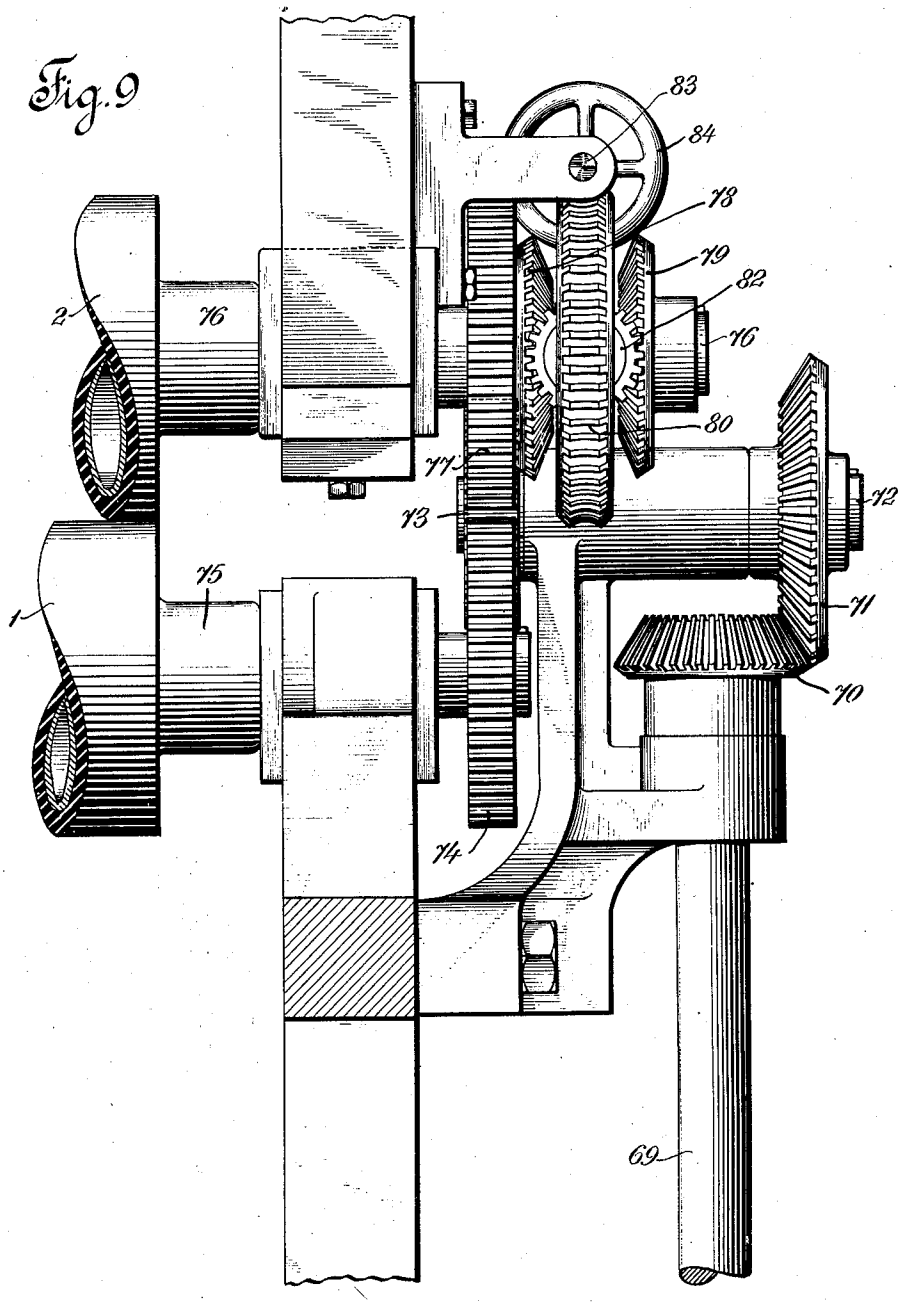

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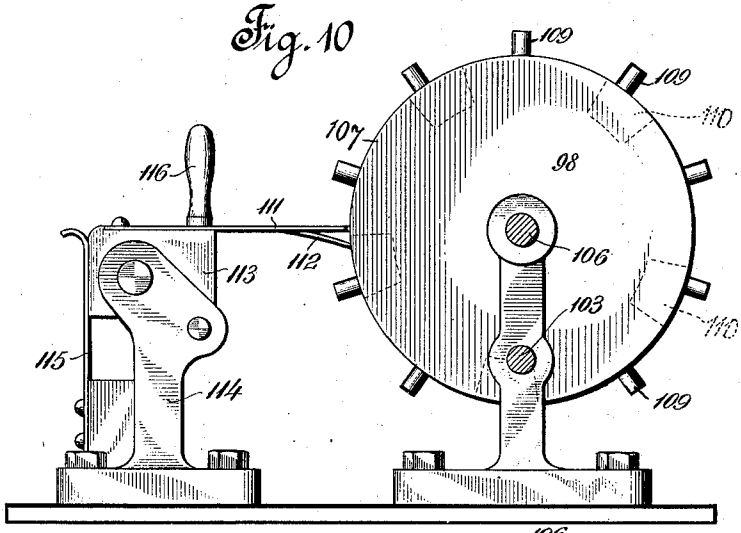
Fig. 10



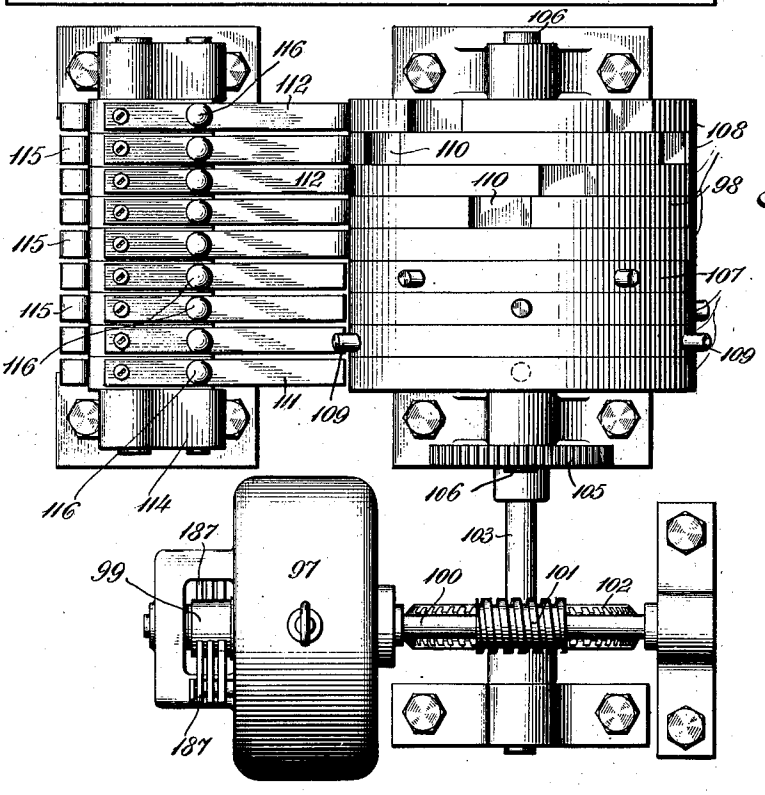


Fig. 11

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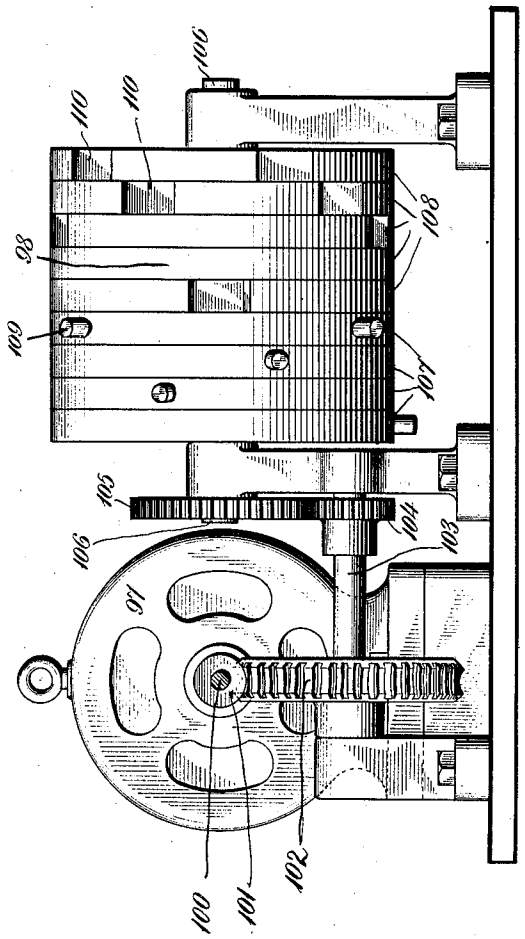
20 SHEETS—SHEET 11.

Fig. 12.



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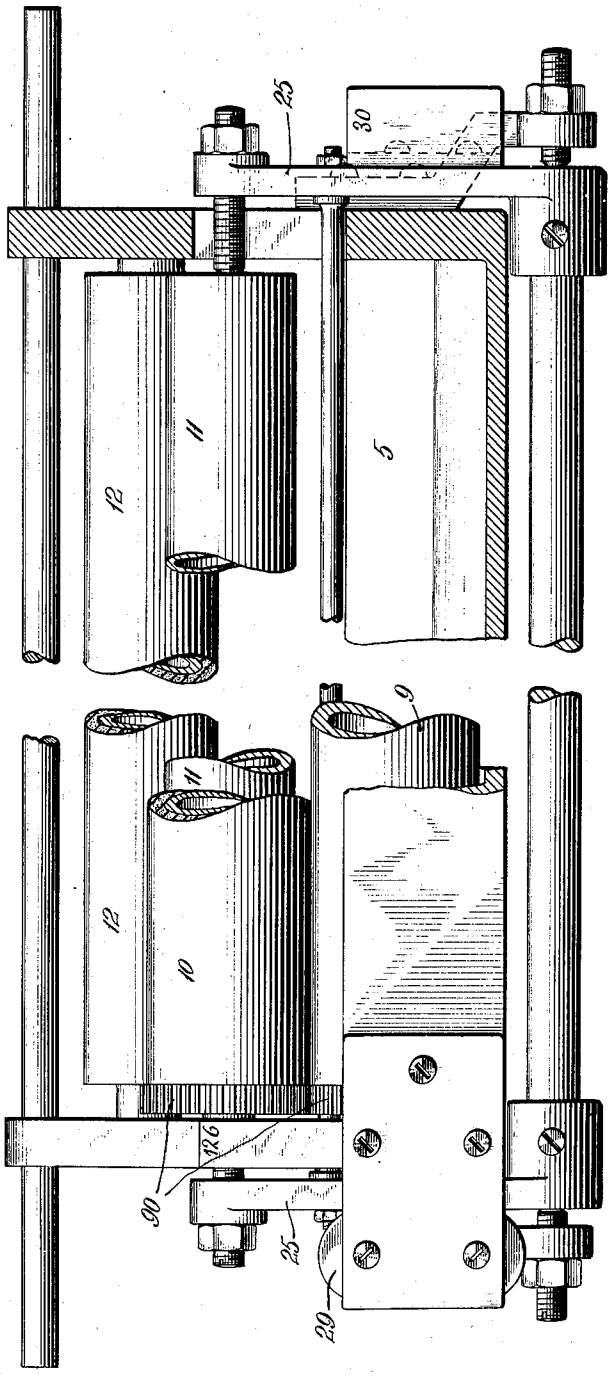

Fig. 13

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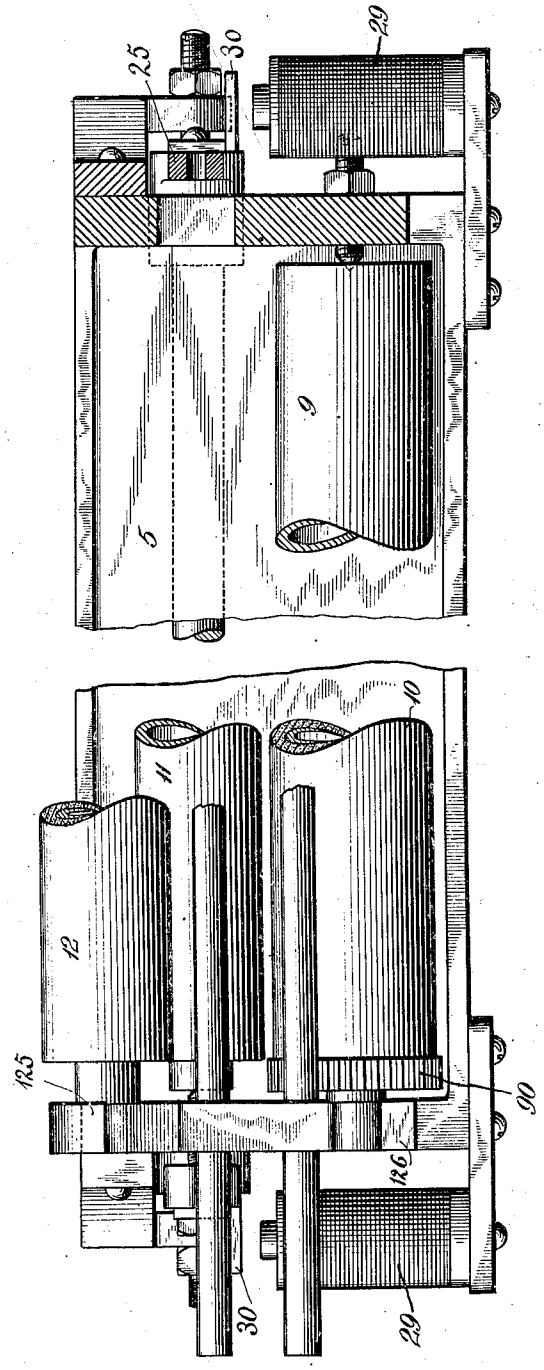
20 SHEETS—SHEET 13.

Fig. 14



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20 SHEETS—SHEET 14.

Fig. 15

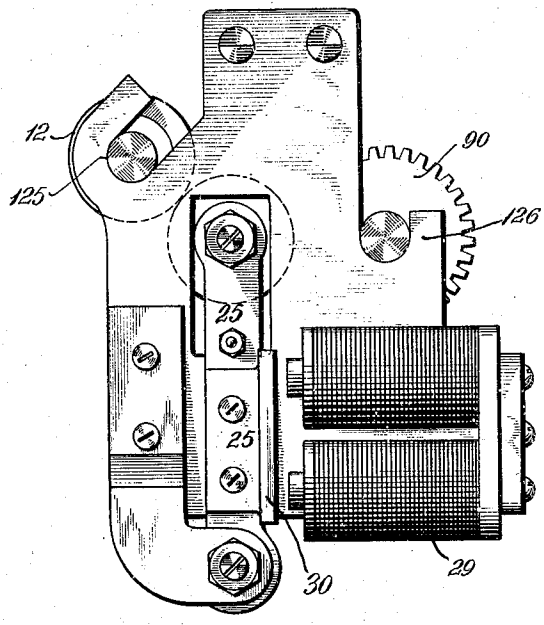
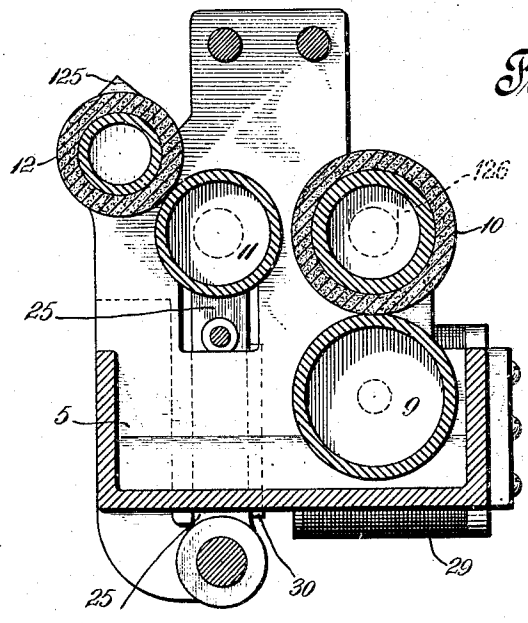


Fig. 16



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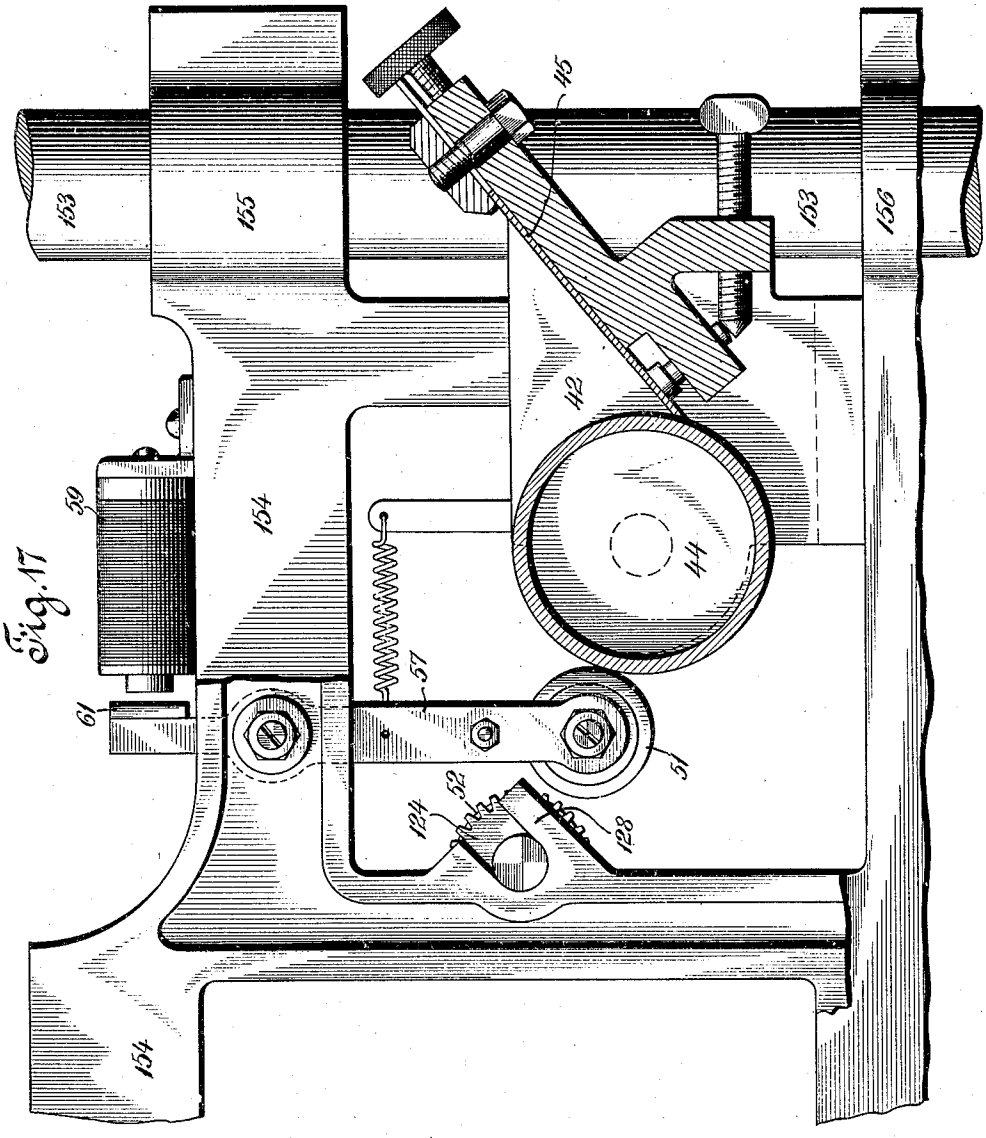

Fig. 17

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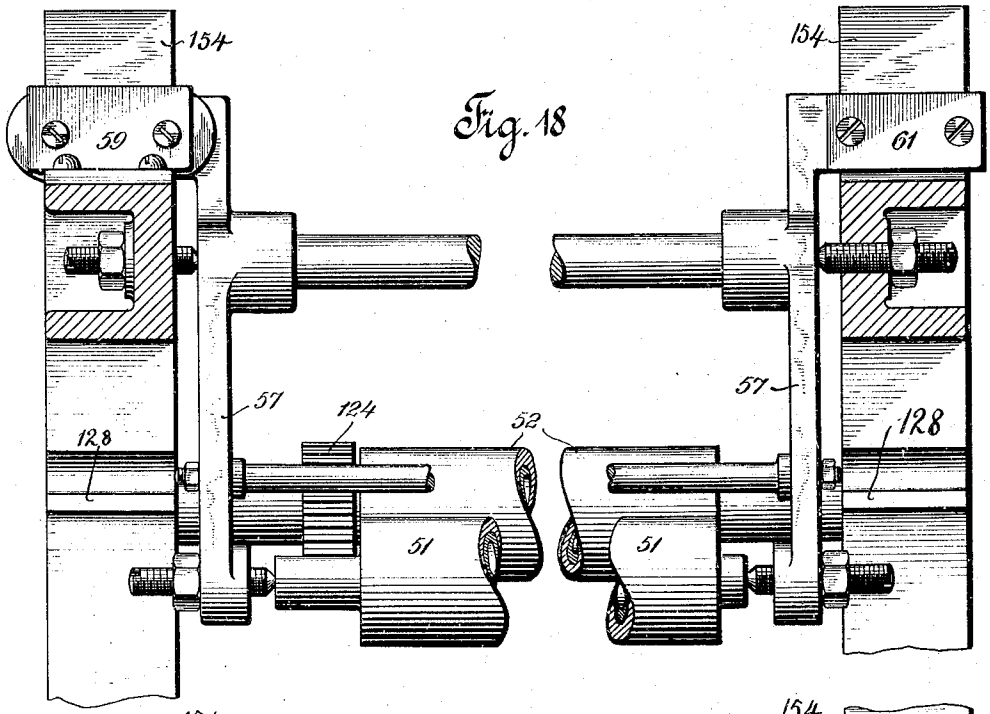

Fig. 18

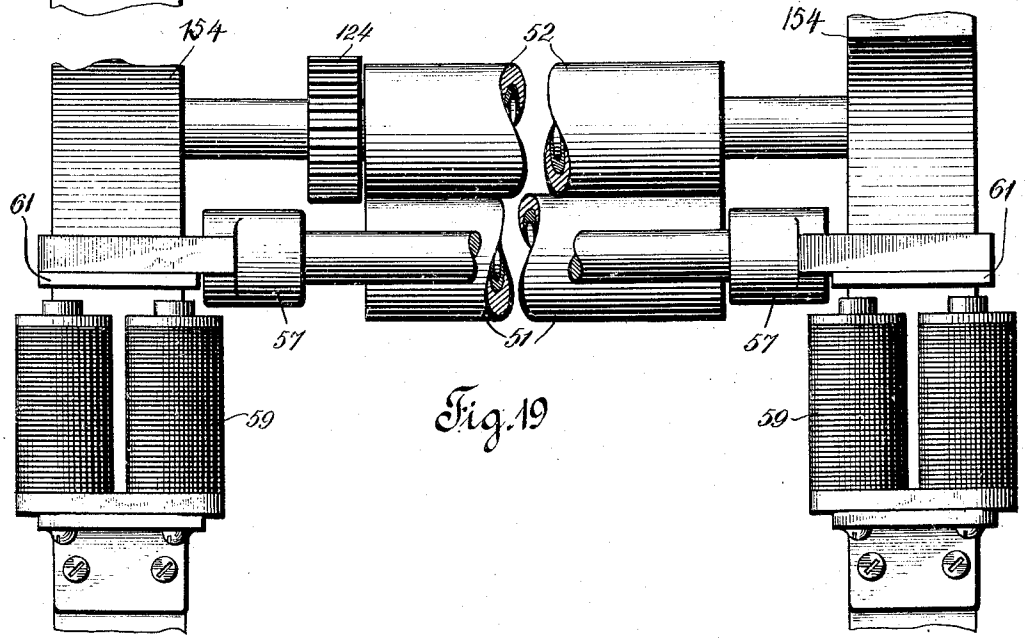

Fig. 19

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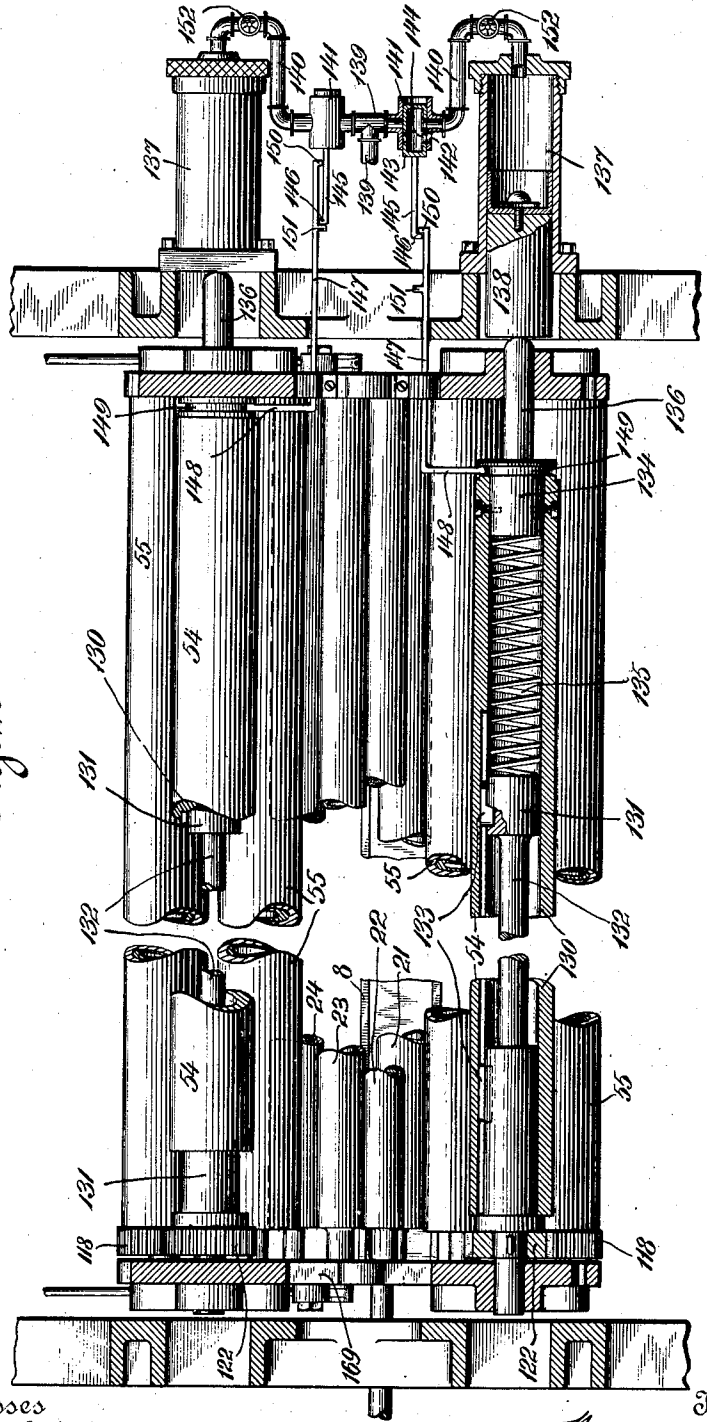

Fig. 20

Witnesses
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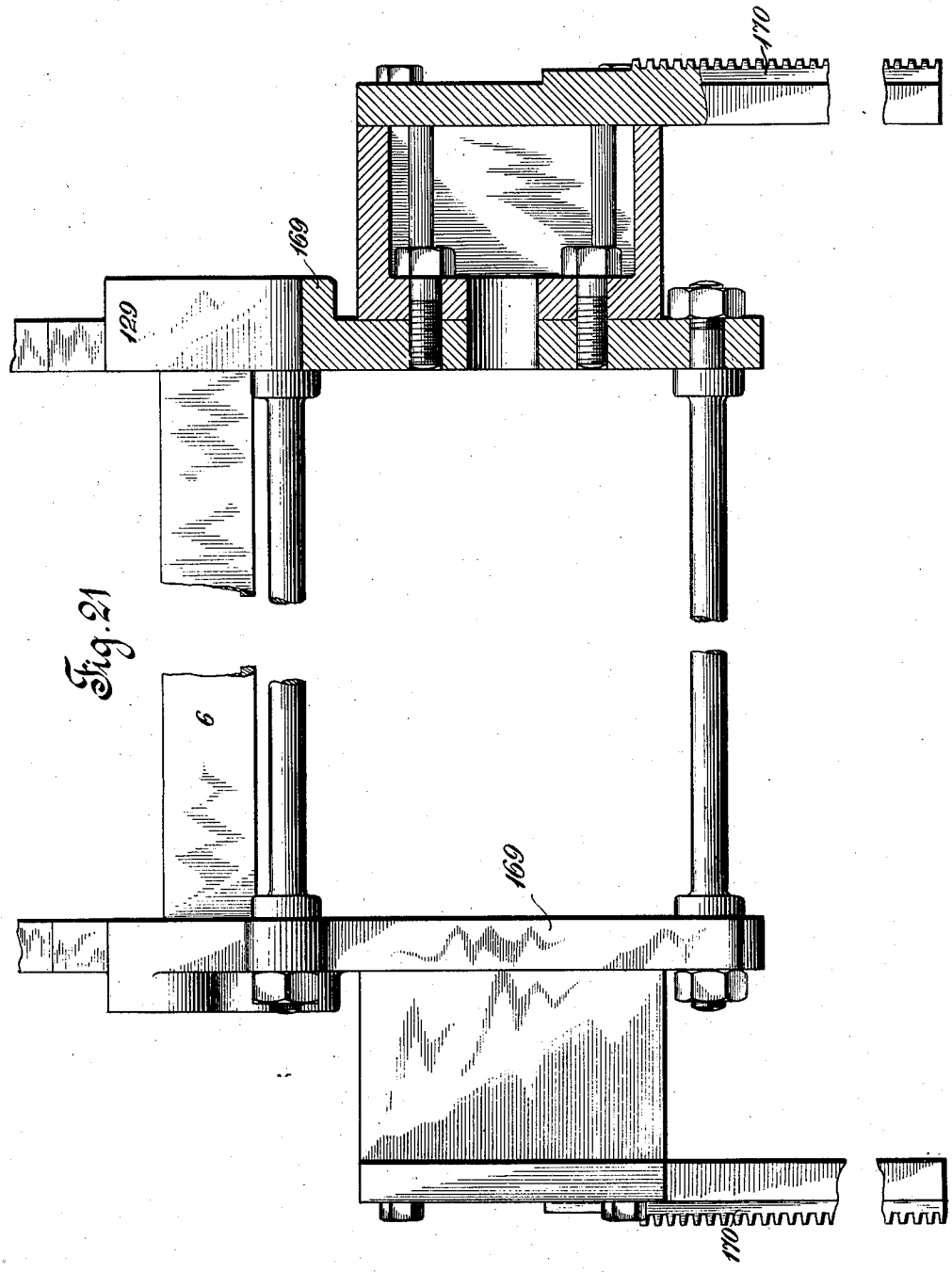

Fig. 21

Witnesses
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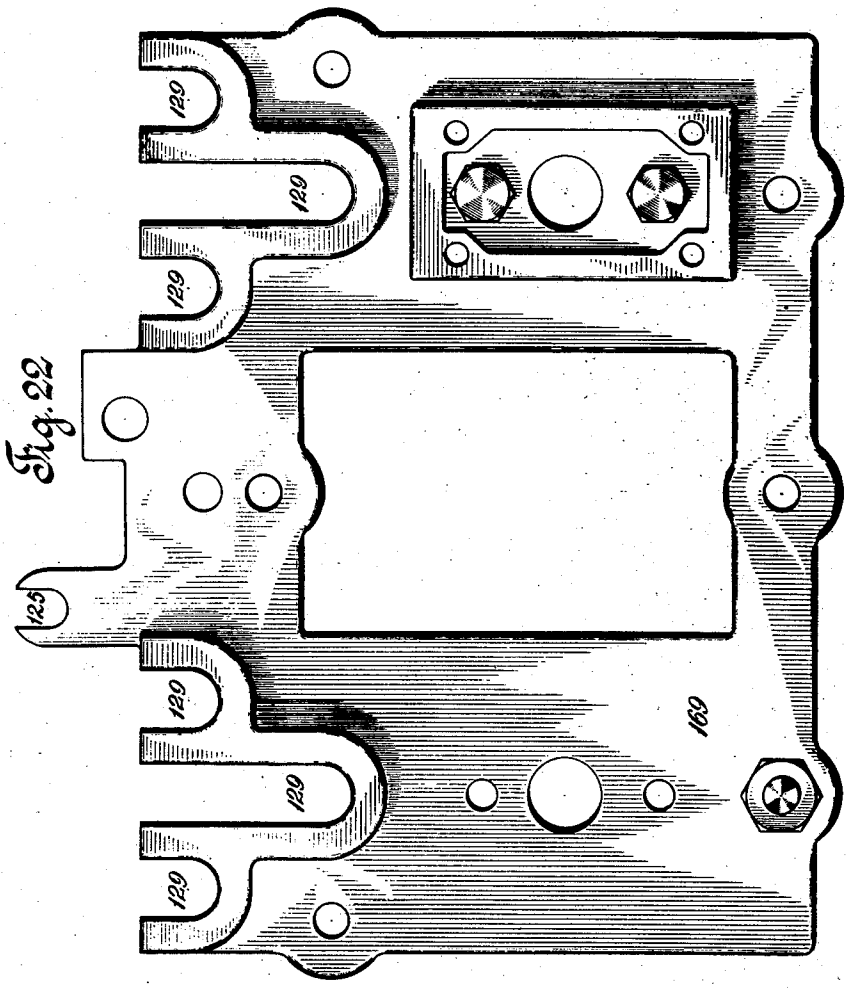

Fig. 22.

Witnesses
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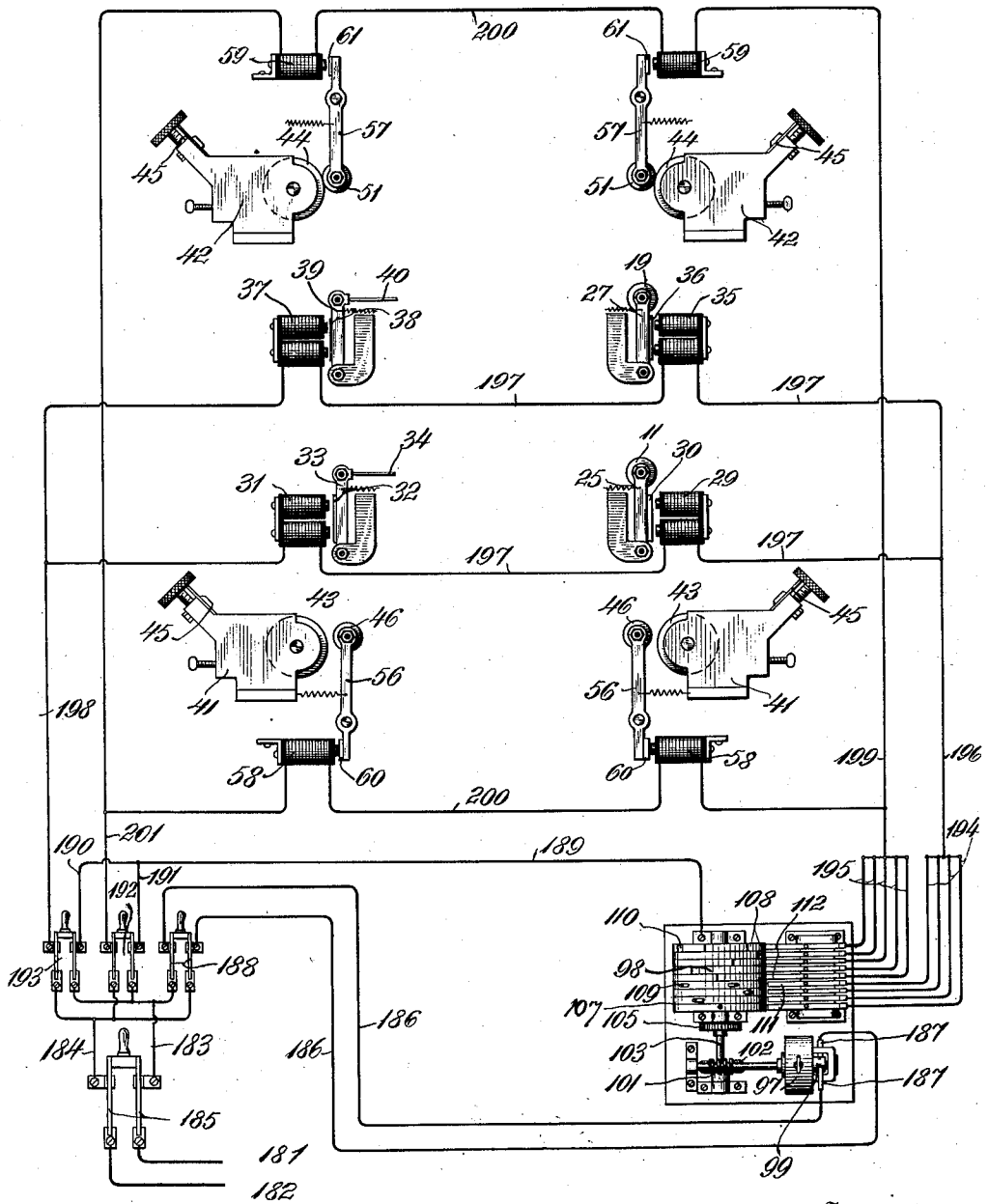
20 SHEETS—SHEET 20.

Fig. 23



Witnesses

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UNITED STATES PATENT OFFICE.

WARREN L. GREEN, OF NEW YORK, N. Y.

PRINTING-MACHINE.

1,027,384. Specification of Letters Patent. Patented May 21, 1912.

Application filed May 26, 1905. Serial No. 262,390.

To all whom it may concern:

Be it known that I, WARREN L. GREEN, a citizen of the United States, and a resident of New York city, county and State of New York, have invented certain new and useful Improvements in Printing-Machines, of which the following is a specification.

My invention relates to lithographic printing presses, and to methods of printing therefrom.

Heretofore in lithographic printing as commonly practiced, when it was desired to print with two or more colors upon one or both sides of a web or sheet, a separate stone or plate was employed for each color, only one being used at a time. The web or sheet would be printed from said stone or plate, printing on as many sheets as desired. Then another stone or plate with another colored ink upon it, would be substituted for the first, and the additional design in said color would be printed upon the web or all the sheets. This operation would be repeated as many times as there were colors, the design of one color being printed over the design of another color. As such printing is done from hard unyielding surfaces, such as stone and metal, it is necessary that the web or sheets should be damp in order to make them pliable and to receive a proper printing impression from the stones or plates. By the unavoidable evaporation of the moisture on the web, the material of the web will shrink, and thus the risk of improper register of the designs of different colors will be great. If it be desired to print on both sides of the web, the risk of the spoiling of the combined designs will be increased; and this is especially so, for the additional reason that the printing on one side of the web has to take place after that on the other side. As the shrinkage or nonshrinkage of the web is dependent upon the conditions of the temperature and atmosphere, the difficulties of keeping the web in the proper condition and of producing good results, especially fine work, such as the printing of stocks and bonds, will be appreciated.

The principal objects of my invention are to overcome the above difficulties and disadvantages; to print upon a dry web or sheets; print in two or more colors upon one side of the web or sheet at one impression, and with the designs in proper register with each other; to print at one impression from two or more superimposed colors; and to print in two or more colors on both sides of the web or sheet at one impression.

My invention consists of the mechanism, devices, features, and method of printing by lithography hereinafter described.

The accompanying drawings illustrate one embodiment of my invention in which—

Figure 1 is a side elevation. Fig. 2 is a similar view to Fig. 1, except that the parts outside of the gears for operating the impression and form cylinders are removed. Fig. 3 is a vertical section as shown through the line 3—3 of Fig. 4 looking in the direction of the arrows. Fig. 4 is a front elevation. Fig. 5 is a plan. Fig. 6 is a horizontal section as shown through the line 6—6 of Fig. 1. Figs. 7, 8 and 9 are details enlarged of the principal driving gearing for the machine proper. Fig. 10 is a front elevation of the commutator for controlling and regulating the supply and application of moisture and ink to the printing cylinder. Fig. 11 is a plan view of the commutator as shown in Fig. 10 and the connected parts for operating the commutator. Fig. 12 is a side elevation of the commutator, motor and connecting parts shown in Fig. 11, except that the shaft of the motor is broken away or shown in section. Figs. 13, 14, 15 and 16 are details enlarged of one set of damping devices for the form cylinder, Fig. 13 being part elevation part vertical section, Fig. 14 being part plan and part horizontal section, Fig. 15 being a side elevation, and Fig. 16 being a transverse section. Figs. 17, 18 and 19 are details enlarged of one set of devices for supplying the ink to the form cylinder, Fig. 17 being a transverse section, Fig. 18 being a rear elevation partly broken away, and Fig. 19 a plan. Fig. 20 is a part plan and part horizontal section of the means for preventing the streaking of the ink on the form cylinder, and the means for controlling and regulating the movements of said streaking preventing means. Fig. 21 is a side elevation enlarged partly in vertical section partly broken away of one of the vertically adjutable supporting frames for the inking rollers. Fig. 22 is a front elevation of one of the side plates which form the journal

bearings for the inking rollers. Fig. 23 is a diagrammatic view of the means for controlling and regulating the supply and application of the moisture and ink to the printing cylinders.

Similar characters represent like parts in all the figures.

1 is the lower impression and printing cylinder, and 2 is the upper impression and printing cylinder. Each impression and printing cylinder serves as an impression cylinder for the other, the web to be printed upon passing between the cylinders. These cylinders 1 and 2 have unbroken or continuous elastic or yielding surfaces or peripheries, which are preferably in the form of a cover or blanket, and of rubber, although any similar elastic or yielding material may be used.

3—3 are the lower form cylinders, which are shown in the drawings as being on opposite sides of the impression cylinder 1 and in tangential contact therewith.

4—4 are the upper form cylinders, which are on opposite sides of the impression cylinder 2 and in tangential contact therewith. The surfaces or peripheries of the cylinders 3 and 4 are of metal, stone or similar material, and are for the purpose of receiving the designs, one cylinder for each color, and for transferring said designs to the elastic impression cylinders 1 and 2.

5 and 6 are the damping fountains for supplying the moisture to the form cylinders 3—3 respectively, and 7 and 8 are the damping fountains for supplying the moisture to the upper form cylinders 4—4 respectively.

9, 10, 11 and 12 are the damping rollers for taking up the water from the fountain 5 and supplying it to its proper form cylinder 3; 13, 14, 15 and 16 are the damping rollers for applying the moisture from the fountain 6 to the other cylinder 3; 17, 18, 19 and 20 are the damping rollers for taking up the water from the fountain 7 and applying it to the cylinder 4, and 21, 22, 23 and 24 are the damping rollers for taking up the water from fountain 8 and applying it to the other cylinder 4. The rollers 11, 15, 19 and 23 are supported respectively on arms 25, 26, 27 and 28, and each one of said rollers is adapted to have an oscillating movement back and forth from one damping roller to another by reason of its supporting arm being pivoted. The oscillating movements of said arms and consequently of the rollers that they support, are caused by magnets attracting armatures which are secured to said arms, and tension springs for normally drawing the arms away from said magnets.

29 is the magnet which attracts the armature 30 on the arm 25 bearing the roller 11, 31 is the magnet which attracts the armature 32 on the lever 33, and which is connected to the arm 26 that supports the roller 15 by a connecting rod 34.

35 is the magnet for attracting the armature 36 on the arm 27 that supports the roller 19, and 37 is a magnet for attracting the armature 38 on the lever 39, and drawing rod 40 connecting said lever with the arm 28, to cause the said arm and its supported roller 23 to oscillate.

41 and 42 are the lower and upper inking fountains or receptacles respectively, and 43 and 44 are the lower and upper ink feeding rollers respectively.

45 are ordinary adjustable ink scrapers which are substantially tangential to the rollers 43 and 44.

46, 47, 48, 49 and 50 are the ink transferring and ink distributing rollers which feed the ink to the lower cylinders 3, and 51, 52, 53, 54 and 55 are similar ink transferring and distributing rollers that feed the ink to the upper cylinders 4. The rollers 48 and 53 are what would be usually called the lower and upper ink distributing cylinders respectively, and 50 and 55 are what are usually termed the lower and upper form ink rollers. The cylinders 48 distribute the ink that is applied to them from the lower fountain feeding rollers and the cylinders 53 distribute the ink that is fed to them from the upper fountain feeding rollers 44. The rollers 50 transfer the ink directly to the lower form cylinders 3, and the rollers 55 transfer the ink directly to the upper form cylinder 4.

56 and 57 are oscillating levers of the first class that are pivoted to the frame of the machine. The levers 56 support at their upper ends the ink ductor rollers 46 so that said rollers can oscillate between the fountain feed rollers 43 and transferring rollers 47. The levers 57 support at their lower ends the ink ductor rollers 51 so that they can oscillate between the upper ink fountain feed rollers 44 and the transferring rollers 52.

58—58 are electromagnets arranged opposite the arms of the levers 56, that are opposite the arms that support the rollers 46, and 59—59 are similar magnets arranged opposite similar arms of the levers 51, the corresponding arms of said levers 56 and 57 being provided with armatures 60 and 61 respectively to be attracted by the magnets 58 and 59 respectively. The vitalizing and devitalizing of the different magnets will cause the levers 56 and 57 bearing the ductor rollers 46 and 51 respectively, to oscillate back and forth against the fountain feed rollers and the ink transferring rollers 47 or 52, the length of time that the circuit is completed in the magnets and the rapidity with which said magnets may be vitalized and devitalized, causing the regulation of the oscillations of the ductor rollers, and

consequently the regulation and control of the ink distribution upon the transferring and distributing rollers 47 and 52, and consequently the regulation and control of the ink distribution to the form cylinders 3 and 4.

I will now describe the means for driving the printing press so as to cause the impression produced by one elastic printing cylinder to properly register with the impression produced by the other elastic printing cylinder while the printing machine is in operation.

62 is the main driving motor of the machine, and 63 is the shaft of said motor.

64 is a pinion on the shaft 63 engaging with a gear 65. On the shaft 66 of gear 65 is a bevel gear 67 engaging with another gear 68 on shaft 69. A gear 70 on shaft 69 engages with a gear 71 on horizontal shaft 72, and on said shaft 72 is a gear 73 which engages with a gear 74 that is secured to shaft 75 of the impression roller 1. On shaft 76 of the impression roller 2 is a loose gear 77, said gear engaging with gear 73. The rotation of the gear 73 will therefore cause gears 74 and 77 to revolve.

78 is a bevel gear which is secured to gear 77 and also loose upon the shaft 76.

79 is a bevel gear fixed upon the shaft 76 and facing the bevel gear 78 (see Fig. 9).

80 is a worm wheel loose on shaft 76 and supported thereby.

81—81 are inwardly extending studs on the worm wheel 80, and which support planetary bevel pinions 82, 82 which are between the bevel gears 78 and 79 and which engage with said gears.

83 is a worm engaging with the worm wheel 80 and provided with a hand wheel 84 for turning the same. The hand wheel 84 and the worm wheel 83, as illustrated in the drawings, are mounted on the fixed frame of the machine and do not rotate with the printing cylinder 2.

As above stated the rotation of the gear 73 will cause the gears 74 and 77 to revolve. The revolution of the gear 77 will, through the bevel gear 78, pinions 82, bevel gear 79, and shaft 76, cause the impression cylinder 2 to revolve. Said impression cylinder 2 will then revolve at the same time as impression cylinder 1. If, however, the impressions upon said cylinders do not register, they can be made to do so by rotating the worm 83 by means of the handle 84. This will cause the cylinder 2 to revolve slowly an infinitesimal distance if desired, while the cylinder 1 remains stationary and when pinion 73 is not rotated. This regulation of the cylinder 2, so as to cause the impression upon it to properly register with the impression on cylinder 1, is caused by the rotation of the worm wheel 80 and the consequent planetary movements of the pinions 82 to a greater or less degree, causing a slight rotation of the bevel gear 79 and consequently shaft 76 and impression roller 2.

The shafts of the form cylinders 3 and 4 are provided respectively with gears 85 and 86, the gears 85 engaging with and being rotated by the gear 74, and the gears 86 engaging with and being rotated by the gear 77. The rotation, therefore, of the gears 74 and 77, which revolve with the two impression cylinders 1 and 2, will cause the form cylinders 3 and 4 to revolve. The form cylinders 3 and 4 will, therefore, revolve in unison with the impression cylinders 1 and 2 and with about the same velocity, so that they will properly transfer the impressions to the impression or printing cylinders.

Damping mechanism.—87 are sprocket wheels secured to the shafts of the form cylinders 3 and 4, and 88 are sprocket chains connecting said wheels 87 with other wheels 89, which through gears 90 and other gearing, will cause the damping rollers 9, 10, 12, 13, 14, 16, 17, 18, 20, 21, 22, and 24 to revolve, and thereby transfer and distribute the water or dampness from the damping fountains to the form cylinders 3 and 4.

91 are cranks of the shafts of the sprocket wheels 87 and which may be eccentric connections to said wheels. These cranks 91 are connected by rods 92 respectively with rock levers 93 that are loosely journaled on shafts 94 of the ink feeding rollers 43 and 44. Secured to the shafts 94 respectively are ratchets 95, and the levers 93 are provided with pivotal pawls 96 for engaging with said ratchets, (see Fig. 1).

97 is an electric motor for operating the commutator 98 which controls and regulates the electric currents that vitalize the different electromagnets 29, 31, 35 and 37 of the damping mechanism, and 58 and 59 of the inking mechanism. The commutator 98 is rotated through the armature 99, shaft 100, worm 101 on said shaft, worm wheel 102, shaft 103 of said wheel, pinion 104 on shaft 103, gear 105, and the commutator shaft 106 to which said gear is secured. The commutator 98 is composed of a number of disks 107, 108 of conducting material secured to the shaft 106 and placed side by side, (see Figs. 10, 11 and 12). The disks 107 are provided with pins 109 for conducting the electric current, extending outward peripherally from said disks and at predetermined intervals on the same. The disks 108 are provided with segmental blocks of insulation 110 set into said disks at their peripheries and at predetermined intervals of said disks.

111 are conducting brushes which extend from a support toward the peripheries of the disks 107, without touching the same,

but so that the pins 109 during the rotation of the disks 97 will overlap and strike against the brushes 111 when the disks 97 revolve. There is a brush 111 for each disk 107.

112 are brushes for each disk 108, said brushes extending in the same direction as the brushes 111 and which bear against the peripheries of the disks 108 there being a brush 112 for each disk 108. Each brush 111 and 112 is secured to an independent support 113 which is pivoted to frame 114, so that any or all of said brushes may be drawn away from the commutator 98, so as to prevent electrical connection between said commutator and brushes.

115 represents a series of springs one for each brush and which bears against the outer surface of the supporting frame 113, and which springs serve the purpose of holding the frame 113 in the position in which they may be swung. For convenience I provide a handle 116 extending upward from each one of the brushes 111 and 112 by which said brushes and their supports 113 may be swung away from the commutator or swung down to be brought into electrical connection with the same.

From the above it will be seen that when the brushes 111, 112 are in position to be brought into electrical connection with the commutator 98, and said commutator is caused to revolve, an electrical connection will be completed through the plates 108 and all of the brushes 112 that are not in contact with the insulation segments 110; an electrical connection will be completed through pins 109 whenever any of said pins come in contact with the brushes 111.

One of each set of the inking form rollers 50 has secured to its shaft a gear 117 and one of each set of inking form rollers 55 is provided with a similar gear 118. Each gear 117 engages with gear 85 on the adjacent form cylinder 3, and each gear 118 engages with gear 86 on the adjacent form cylinder 4. The shafts of rollers 49, 48, 47, 54, 53 and 52 are provided with gears 119, 120, 121, 122, 123 and 124 respectively. The gears 119, 120 and 121 of each group all engage with each other as do also gears 122, 123 and 124, so that when their corresponding form cylinders 3 and 4 revolve, the different rollers 49, 48, 47, 54, 53 and 52 will revolve, so as to properly feed the moisture and ink to said form cylinders.

In order that the rollers 12, 16, 20 and 24 may be easily lifted out of the operating position or replaced, I make the bearings of the journals of said rollers U-shaped as shown at 125, Fig. 22. The bearings for the journals of rollers 10 and 18 are also U-shaped for a similar purpose, as shown at 126, and 127 are similar U-shaped bearings for the journals of rollers 47 each of said bearings however having its loop extending toward its corresponding ink distributing cylinder 48.

128 is a U-shaped bearing similar to 127 for the shaft of each ink transferring roller 52. In order that the inking rollers 49, 50, 54 and 55 may be readily removed or replaced the journals of said rollers are supported in U-shaped bearings 129.

Means for preventing the streaking of the ink upon the form-cylinders.—The ink distributing rollers 49 and 54, which are adjacent and tangential to the inking form rollers 50 and 55 have a longitudinally reciprocating movement, and said movement is caused by the following construction of said rollers 49 and 54 and adjacent mechanism connected therewith. Each of said rollers 49 and 54 is formed of an outer shell or sleeve 130 and a core 131 entering said sleeve and secured to one of the journals of the roller. In order that said roller may not be too heavy, I reduce the core 131 between its ends as shown at 132, see Fig. 20. Said ends are of nearly the same diameter as the inner periphery of sleeve 130, so that said sleeve may readily slide longitudinally upon the ends of said core. These ends are connected to the sleeve 130 by a spline and groove 133, so that the core and sleeve will revolve together, but will have longitudinal movement in relation to each other.

134 is a plug which enters the sleeve 130 at the end opposite the fixed core 131, and which plug may be removably attached to said sleeve by screws or any appropriate means.

135 is a spiral tension spring inclosed within the sleeve 130 between the core 131 and the plug 134, said spring tending constantly to bear said plug and the sleeve 130 to which it is secured in a direction away from the core. The outer end of the plug 134 is provided with a rod 136 extending longitudinally from the plug, and which rod forms the journal bearing for the roller 49 or 54 opposite to the fixed journal bearing.

137 is an engine cylinder secured to the frame of the machine opposite and beyond the rod 136.

138 is a piston in said cylinder, and which bears on the outer end of the rod 136.

139 is the inlet tube to the engine and connecting valves and pipes for an expansible fluid by which the piston 138 is adapted to be operated.

I have shown in the drawings, and as clearly illustrated in Fig. 20, the engines or cylinders of two rollers 54 for a form cylinder, so arranged as to reciprocate the sleeves 130 of said two rollers 54 respectively in opposite directions alternately. The same inlet tube 139 answers the purpose for both cylinders 137. Extending

from said inlet tube 139 are two branch tubes 140 connected to the outlet end of the respective cylinders 137. Each one of these tubes 140 is provided with a bypass valve 141. In Fig. 20 only one of said valves is shown in section, as the other valve is a duplication of said valve. This valve is provided with an exhaust passage 142 and an inclosed hollow reciprocating member 143, said member being also provided with transverse passages 144 which passages are adapted to register with the inlet tube 139 and branch tube 140 respectively, and one of said passages being also adapted to register with the exhaust passage 142 in the casing of the valve.

145 is a rod extending inward from the member 143 and provided with a lateral lug 146.

147 is a longitudinally sliding rod passing through the frame of the machine, and provided with a lateral arm 148 engaging with a groove 149 in the plug 134. Said rod 147 is also provided with two lateral lugs 150, 151 overlapping the lug 146 of the rod 145.

The operation of the above described mechanism is as follows: The expansible fluid, preferably compressed air, being admitted into the tube 139, will pass into the branch tubes 140, and first through the two ports 144 of the valve member 143 that is registering with pipes 139 and 140, and said fluid will then pass into the corresponding or nearest cylinder 137, and will force the piston 138 of said cylinder in a direction away from pipe 140, and consequently will force the rod 136, plug 134, and the sleeve 130 in the same direction, compressing the spring 135. This action of the above parts will cause rod 147 to move in a similar direction so that its lug 150 will pull the rod 145 and valve member 143 so that said member will close the inlets from tube 139 to tube 140 and shut off the admission of the compressed fluid, and will next cause one of the ports in said member 143 to register with the exhaust passage 142 in the valve, so that the expansible fluid may escape into the outside air. The pressure on the cylinder 138 being removed the spring 135 will draw back the sleeve 130 to its former and normal position.

While the above operation on one roller 54 is taking place, the reverse movements are taking place on the other roller 54, the valve 141 nearest to the cylinder 137 of said second roller being arranged so as to have the ports 144 of said valve register with the inlet tubes 139 and 140, when the similar ports of the other valve are out of register with their inlet tubes 139 and 140. Each tube 140 is provided with a regulating cock 152 for regulating the admission of the expansible fluid to the cylinders 137, whereby the reciprocating movements of the sleeve 130 will be regulated.

Means for adjusting the upper impression and form cylinders and their damping and inking rollers in relation to the lower impression and form cylinders and their damping and inking rollers.—153 are vertical columns which support the entire upper portion of the machine.

154 is an upper frame provided with sleeves 155 passing around the columns 153. This frame 154 supports the upper impression cylinder 2, form cylinders 4 and all the damping and inking rollers and mechanism for said cylinders.

156 are clamping split sleeves secured to frame 154 and which surround the columns 153, said sleeves having clamping screws 157, so that after the frame 154 and its supported parts have been adjusted it can be secured in place. Each of said screws 157 is provided with a handle 158 by which they may be turned.

159 are vertical racks upon the columns 153.

160 is a shaft extending across the frame 154, and provided with pinions 161 which engage with the racks 159. Shaft 160 is also provided with a worm wheel 162 which engages with worm 163 on shaft 164, and said shaft is provided with a worm wheel 165, engaging with a worm 166 on a shaft 167, which shaft is provided with a post 168 by which said shaft and worm may be turned by means of a key or crank handle. By the rotation of the shaft 167 its worm rotates the wheel 165, shaft 164 and worm 163, and said worm 163 rotates the worm wheel 162, the shaft 160 and the pinions 161, thus causing said pinions to ride up or down upon the racks 159 and so raise or lower the frame 154 and its supported parts.

It will be noted that reducing gearing is made use of between the crank post 168 and the pinion 161 so that a slight movement of the upper cylinder toward and from the lower cylinder may be produced, and if desired, the printing surfaces of the printing cylinders may be moved out of contact without disengaging the teeth of their driving gears.

Vertical adjustable frames for the damping and inking rollers.—169 represents frame plates on opposite sides of the machine connected by braces, and said plates having bearings as 129, for the journals of all the inking rollers except 43, 44, 46, 47, 51, 52.

170 are vertical racks secured to each plate 169, see Figs. 1, 21 and 22.

171 is a shaft extending across the racks 170 and provided with pinions 172 engaging with said racks. The shaft 171 is provided with a worm wheel 173 engaging with a worm 174 on shaft 175, which shaft is provided either with an angular post or key as shown at 176 on the upper shaft 175, or

which may be rotated by the mechanism like that by means of which the lower shaft 171 is rotated, see Fig. 1. The said lower shaft 175 is provided with a gear 177 engaging with the pinion 178, the shaft 179 of said pinion being provided with a post 180, so that said shaft may be rotated by means of a key, the intermediate gearing between the shaft 175 and the shaft 179 permitting easy adjustment with less power than a post upon the shaft 175 will permit.

From the above it will be seen that the rotation of any of the shafts 175 will rotate the shafts 171, and their pinions 172 will cause them to rise or fall upon the racks 170, so that the frame plates 169 and their supported parts will be raised or lowered and thus vertically adjusted; and said vertical adjustment will cause all the inking rollers except 43, 44, 46, 47, 51 and 52 to be vertically adjusted.

Means for operating and controlling the devices for controlling and regulating the supply of moisture and ink to the form or plate surfaces.—Referring to Fig. 23, 181 and 182 are two lines of the main electric circuit from any generator or source of electric supply. 183 and 184 are two lines each having a contact terminal, and 185 is a switch for connecting the lines 183 and 184 with the main lines 181 and 182. 186 is an electric circuit connected with the brushes 187 of the armature 99, and 188 is a switch in said circuit 186 for connecting it with lines 183 and 184. 189 is an electric line connected with commutator 98 and provided with branches 190 and 191, one branch 190 connected with a contact terminal of switch 193, and the other branch 191 connected with a contact terminal of switch 192. 194 are lines connected with the brushes 111 respectively, and 195 are lines connected with the brushes 112 respectively. 196 is a line connected with the lines 194, which line has branches 197—197 passing through the magnets 29, 31, 35 and 37, and uniting with line 198, which is connected with a contact terminal of switch 193. 199 is a line connected with the lines 195, and which is provided with branches 200—200 that pass through the magnets 58 and 59, these branches 200 uniting with line 201 that connects with a terminal of switch 192. Switches 193 and 192 are for the purpose of connecting the lines 183 and 184 with the lines 198 and 190, and with lines 191 and 201 respectively.

The operation of the above described mechanism, devices and elements is as follows: If all the switches are in the position shown in Fig. 23, all the lines above named will be in circuit, the circuit will be completed through lines 181, 182, switch 185, lines 183, 184, switch 188, line 186, brushes 187 and armature 99, causing said armature to revolve. During the revolution of said armature, the commutator 98 will be caused to revolve, and when one or more of the brushes 111 is in contact with one or more of the pins 109, an electric circuit will be completed through line 183, switch 193, lines 190, 189 and the commutator 98, through said brush or brushes, line or lines 194, line 196, line or lines 197, magnets 29, 31, 35, 37, and line 198 to line 184, thus vitalizing said magnets and attracting their armatures and their supporting levers, and which cause the ductor moistening rollers to oscillate toward the magnets. The breaking of the circuit above specified, will permit the arms to move away from the magnets. The revolution of the commutator 98 will cause one pin 109 after another to come in contact with the brushes 111, every time said contact is made the circuit through the magnets being completed, and thereby vitalizing and causing them to attract and move the operating arms of the ductor rollers; and during the intervals when said pins 109 are not in contact with the brushes 111 the circuit will be broken through said magnets, so that they will be devitalized, and the arms and rollers moved in the opposite direction. The length of time the circuit is completed and the rapidity with which the ductor rollers are oscillated by the making and breaking of the circuit with the magnets, will cause the control and regulation of the moisture to the form surfaces through the transmission of said moisture from the fountain rollers to the rollers that transmit the moisture to the form surfaces. The circuit will also be completed through line 183, switch 192, lines 191, 189, commutator 98, disks 108 and any brush or brushes 112 that are in contact with said plates and not in contact with the insulated segments 110, then through line or lines 195, line 199, branches 200, magnets 58, 59, line 201 to switch 192, thereby vitalizing the magnets 58 and 59. Said magnets will be vitalized as long as one of the brushes 112 is in contact with one disk 108, and not with insulated segments 110. When one of these insulated segments 110 during the revolution of the commutator, comes in contact with the brushes 112, the circuit will be broken at said contact. The making and breaking of the contacts through the brushes 112 and the consequent vitalizing and devitalizing of the magnets 58, 59, will cause a similar movement of the ink ductor rollers to that that was described above in relation to the moistening or damping ductor rollers. The length of time the circuit is completed and the rapidity with which the ink rollers are oscillated by the making and breaking of the circuit through the magnets, will cause the control and regulation of the ink to the form surfaces through the transmission of said ink from the fountain rollers to the rollers that transmit the ink to the form surfaces.

If the switch 185 be disconnected from lines 183, 184, the circuit 186 will be broken and every other circuit will be also broken, and therefore there will be no electric force to operate or control any of the above described parts or elements. The circuit 186 will also be broken if the switch 188 be disconnected from such circuit, and the commutator would not be revolved. If any of the brushes 111, 112 were in contact with a pin or pins 109, or plate or plates 108, the magnets would be vitalized and simply keep their armatures attracted, and keep the ductor rollers in one position preventing oscillation of the same.

If the switch 193 be disconnected from the lines 190 198, the circuit through the magnets 29, 31, 35, 36 would be broken, and the means for oscillating the moistening ductor rollers would be out of operation. If the switch 192 be out of electric connection with the lines 201 and 190, the magnets 58 and 59 would be devitalized, as the circuit through them would be broken, and the means for oscillating the inking ductor rollers would be out of operation.

From the above it will be seen that the control and regulation of the supply and moisture of ink to the form surfaces can be controlled instantly by the operation of the different switches 185, 188, 192 and 193.

If the machine hereinbefore described be put into operation, separate designs may be transferred to the form cylinders 3—3 and 4—4, the designs on the two cylinders 3—3 being of different colors respectively and the designs on the two cylinders 4—4 being of different colors respectively. The designs from said two form cylinders 3—3 will then be transferred to the impression cylinder 1, the design from one cylinder 3 in one color being superimposed onto the cylinder 1 from the other cylinder 3 in another color. A similar proceeding will take place in regard to impression cylinder 2, the designs of different colors from the two form cylinders 4 being transferred to the impression cylinder 2, and the design of one color superimposed over that of another color. If a web of dry paper be fed between the impression cylinders 1 and 2, the designs in two colors on each of said cylinders will be transferred to the web; and on opposite sides of the same, the elastic surface of said cylinders 1 and 2, yielding sufficiently to properly and fully impress the web and thereby impart good impressions upon the same, the operations of the several damping and inking rollers and cylinders as hereinbefore described, insuring good and clear impressions upon the impression cylinders.

From the above it will also be evident that my invention provides a new and useful printing machine that will print both surfaces of the web or paper at the same time, and cause the impression on both sides of the web or paper to properly register in relation to each other; that can print both surfaces on the paper or web of different colors and at the same time; that can make the impression on both printing cylinders to register; that will cause designs in two or more colors to be superimposed one over the other onto the printing surface, and that will thereby cause the web or sheet to be printed upon at one impression by two or more superimposed colors from the same printing surface; that will cause two or more impressions of different colors to be transferred to the web or paper always in the proper position in relation to or register with each other; that can control and regulate the supply and application of moisture or ink or both to the printing cylinders; that will prevent the streaking of the ink on the form or plate cylinders; that has means for adjusting the printing cylinders in relation to each other, and that has a means for adjusting a printing cylinder and its coacting parts in relation to another printing cylinder and its coacting parts, and means for adjusting the ink transferring rollers in relation to the form rollers.

My invention in its broader aspects is not limited to the precise apparatus and method herein described, as many changes other than those suggested may be made without departing from the main principles of my invention or sacrificing its chief advantages.

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

1. A multicolor printing machine comprising a fixed frame, and a movable frame, a cylinder having an elastic printing surface mounted in said fixed frame, a planographic form cylinder adapted to receive a design and transfer it to said cylinder, a cylinder having an elastic printing surface mounted in said movable frame a planographic form cylinder adapted to receive and transfer a design to said last mentioned cylinder, also mounted in said movable frame, means rotating one of said printing cylinders relative to the other whereby the designs on both cylinders may be made to register, and means adjusting said movable frame relative to said fixed frame whereby the pressure of one printing cylinder upon the other may be regulated, and the printing cylinders may be adjusted without adjusting each planographic form cylinder relative to its associated printing cylinder.

2. A multi-color printing machine comprising two cylinders each provided with an elastic printing surface, between which surfaces a web may be fed, a plurality of planographic form cylinders each adapted to receive a planographic design and said

form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, and means for causing the impression on both sides of the web to accurately register with relation to each other.

3. A multi-color printing machine comprising two cylinders each provided with an elastic printing surface, between which surfaces a web may be fed, a plurality of planographic form cylinders each adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, and means for rotating one of said elastic printing cylinders with relation to the other so as to cause the impressions produced by the two cylinders to register one with the other.

4. A multi-color printing machine comprising two cylinders each provided with elastic printing surfaces, between which surfaces a web may be fed, a plurality of planographic form cylinders adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, a handle, reducing gearing between the handle and one of said printing cylinders, whereby one of said elastic printing cylinders may be caused to rotate with relation to the other printing cylinder so as to cause the impressions produced by the two cylinders to register one with the other.

5. A multi-color printing machine comprising two cylinders each provided with an elastic printing surface, between which surfaces a web may be fed, a plurality of planographic form cylinders each adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, a handle, planetary gearing between said handle and one of said printing cylinders whereby one of said elastic printing cylinders may be rotated a minute distance with relation to the other so as to cause the impressions produced by the two cylinders to register one with the other.

6. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a handle, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register.

7. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a handle, reducing gearing including a worm wheel and worm between said handle and one of said cylinders whereby one of said cylinders may be rotated a minute distance with relation to the other, to cause the impressions produced by the two cylinders to register one with the other.

8. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a shaft, a gear loose on said shaft, a bevel gear connected with said gear, a bevel gear fixed to said shaft, a planetary bevel pinion meshing with said bevel gears, a worm wheel for carrying said pinion, a worm and handle for rotating said worm wheel, whereby one of said printing cylinders may be rotated with relation to the other in order to secure accurate register between the impressions produced by said printing cylinders.

9. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a handle mounted on the fixed frame of the machine, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register while the printing machine is in operation.

10. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a handle, reducing gearing comprising a worm and worm wheel between said handle and one of said cylinders, said handle and worm being mounted in the fixed frame of the machine and said worm wheel being normally stationary, whereby one of said cylinders may be rotated a minute distance with relation to the other, to cause the impressions produced by the two cylinders to properly register, while the machine is in operation.

11. In a printing machine, the combination of two printing cylinders each provided with a continuous elastic printing surface and each operating as the impression cylinder for the other, means for adjusting one of said cylinders toward and from the other, gearing for driving said cylinders, a han-

dle, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register.

12. In a printing machine, the combination of two printing cylinders each provided with a continuous elastic printing surface and each operating as the impression cylinder for the other, reducing gearing for adjusting one of said cylinders toward and from the other, gearing for driving said cylinders, a handle, reducing gearing including a worm wheel and worm between said handle and one of said cylinders whereby one of said cylinders may be rotated a minute distance with relation to the other, to cause the impressions produced by the two cylinders to register one with the other.

13. In a printing machine, the combination of two printing cylinders each provided with a continuous elastic printing surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a shaft, a gear loose on said shaft, a bevel gear connected with said gear, a bevel gear fixed to said shaft, a planetary bevel pinion meshing with said bevel gears, a worm wheel for carrying said pinion, a worm and handle for rotating said worm wheel, whereby one of said printing cylinders may be rotated with relation to the other in order to secure accurate register between the impression produced by said printing cylinders.

14. In a printing machine, the combination of two printing cylinders each provided with a continuous elastic printing surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a handle mounted on the fixed frame of the machine, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register while the printing machine is in operation.

15. In a printing machine, the combination of two printing cylinders each provided with a continuous elastic printing surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, a handle, reducing gearing comprising a worm and worm wheel between said handle and one of said cylinders, said handle and worm being mounted in the fixed frame of the machine and said worm wheel being normally stationary, whereby one of said cylinders may be rotated a minute distance with relation to the other, to cause the impressions produced by the two cylinders to properly register, while the machine is in operation.

16. A multi-color printing machine comprising two cylinders each provided with an elastic printing surface, between which surfaces a web may be fed, reducing gearing for adjusting the two cylinders toward and from each other, a plurality of planographic form cylinders each adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, and means for causing the impression on both sides of the web to accurately register with relation to each other.

17. A multi-color printing machine comprising two cylinders each provided with an elastic printing surface, between which surfaces a web may be fed, reducing gearing for adjusting the two cylinders toward and from each other, a plurality of planographic form cylinders each adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, and means for rotating one of said elastic printing cylinders with relation to the other while the printing machine is in operation.

18. A multi-color printing machine comprising two cylinders each provided with elastic printing surfaces, between which surfaces a web may be fed, reducing gearing including a crank shaft, a worm for adjusting said cylinders toward and from each other, a plurality of planographic form cylinders adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, a handle, reducing gearing between the handle and one of said printing cylinders, whereby one of said elastic printing cylinders may be caused to rotate with relation to the other elastic printing cylinder while the machine is in operation.

19. A multi-color printing machine comprising two cylinders each provided with an elastic printing surface, between which surfaces a web may be fed, reducing gearing including a crank shaft and worm for adjusting said cylinders toward and from each other, a plurality of planographic form cylinders each adapted to receive a planographic design and said form cylinders adapted to transfer their designs to their associated printing cylinder, whereby both sides of a web may be printed upon, one side in a plurality of colors, a handle, planet-

ary gearing between said handle and one of said printing cylinders whereby one of said elastic printing cylinders may be rotated a minute distance with relation to the other while said printing machine is in operation.

20. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, means for adjusting said cylinders toward and from each other without disengaging said gearing, means for securing the cylinders in their adjusted positions, a handle, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register.

21. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, reducing gearing including a worm wheel, a worm for adjusting said cylinders toward and from each other without disengaging said driving gearing, a handle, reducing gearing including a worm wheel and worm between said handle and one of said cylinders whereby one of said cylinders may be rotated a minute distance with relation to the other, to cause the impressions produced by the two cylinders to register one with the other.

22. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, reducing gearing for adjusting said cylinders toward and from each other without disengaging the driving gearing, a handle mounted on the fixed frame of the machine, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register while the printing machine is in operation.

23. In a printing machine, the combination of two printing cylinders each provided with an elastic surface and each operating as the impression cylinder for the other, gearing for driving said cylinders, reducing gearing for adjusting said cylinders toward and from each other without disengaging the driving gearing, means for clamping the printing cylinder in its adjusted position, a handle mounted on the fixed frame of the machine, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register while the printing machine is in operation.

24. In a printing machine, the combination of two printing cylinders each provided with an elastic surface, each operating as the impression cylinder for the other, one of said cylinders being mounted in a frame, parallel columns for supporting and guiding said frame, a shaft extending across said frame and provided with a plurality of pinions, racks connected with said columns, reducing gearing for driving said shaft, gearing for driving said cylinders, a handle mounted on the fixed frame of the machine, reducing gearing between said handle and one of said cylinders, whereby one of said cylinders may be rotated a minute distance with relation to the other to cause the impressions produced by the two cylinders to properly register while the printing machine is in operation.

25. In a printing machine, the combination of two oppositely-disposed printing cylinders mounted upon parallel shafts, a driving gear whereby said shafts are rotated, a gear rigidly mounted on the shaft of one of said cylinders in mesh with said driving-gear, an idler gear mounted on the shaft of said other cylinder, also in mesh with said driving gear, differential gearing between said idler gear and its shaft, whereby the rotation of said cylinder is given the proper direction, and means controlling said differential gearing whereby said cylinder may be rotated in either direction independently of said driving gear.

26. In a printing machine, the combination with a fixed frame, a cylinder having an elastic printing surface mounted in said frame, and a planographic form cylinder adapted to receive and transfer a design to said cylinder, of vertical guides carried by said fixed frame, a movable frame adjustably mounted upon said guides, a rack carried on said guides, a plurality of gears cooperating with said rack and mounted upon a worm gear shaft carried by said adjustable frame, a worm shaft mounted in said movable frame and engaging the gear on said worm gear shaft, a worm gear carried by said worm shaft, and a worm shaft actuating said last mentioned worm gear whereby said frame may be vertically adjusted toward or from said printing cylinder, a cylinder mounted in said adjustable frame opposite said first mentioned printing cylinder, a planographic form cylinder and a damping and inking mechanism all mounted in said adjustable frame and adapted to receive and transfer a design to said last mentioned cylinder.

27. In a printing machine, the combination with a plurality of oppositely disposed frames, each having mounted therein a cyl-

inder oppositely disposed as to the other, each having an elastic printing surface and having associated therewith a plurality of planographic form cylinders whereby a plurality of colors may be simultaneously transferred to said elastic printing surfaces, and means whereby a micrometrical adjustment of one of said frames, relative to the other, may be effected to regulate the pressure exerted between said cylinders without disturbing the relation of the printing cylinders and the planographic cylinders, means rotating said printing cylinders in unison, and means whereby one of said cylinders may be rotated independently of the other, to bring the designs upon both of said cylinders into register.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WARREN L. GREEN.

Witnesses:
F. K. JOHNSON,
S. G. GERNED, Jr.