Aug. 12, 1924. 1,504,409

J. C. YETTER ET AL

PRINTING MACHINE

Filed Sept. 23, 1920 4 Sheets-Sheet 1

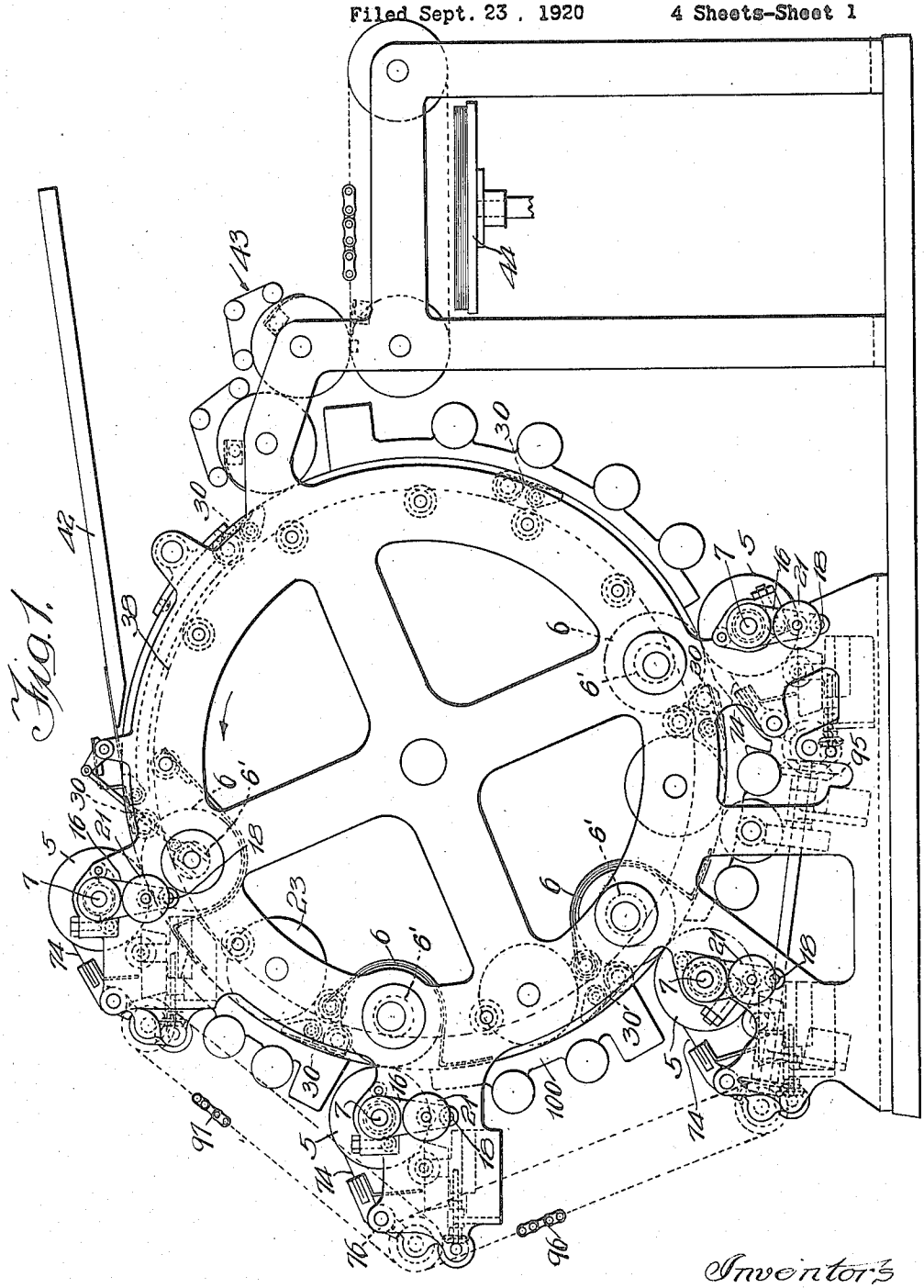

Fig. 1.

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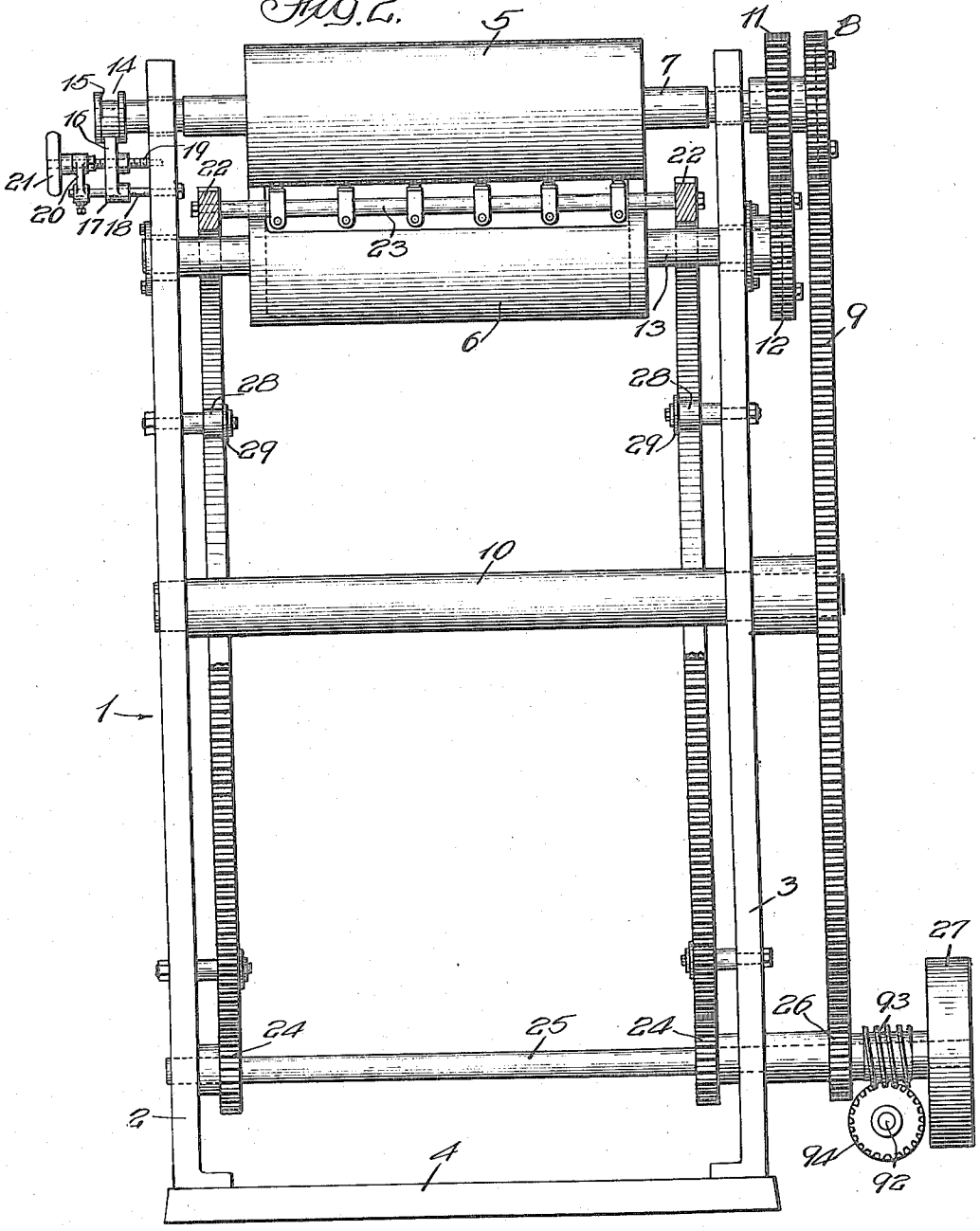
Fig. 2.



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Filed Sept. 23, 1920 4 Sheets-Sheet 3

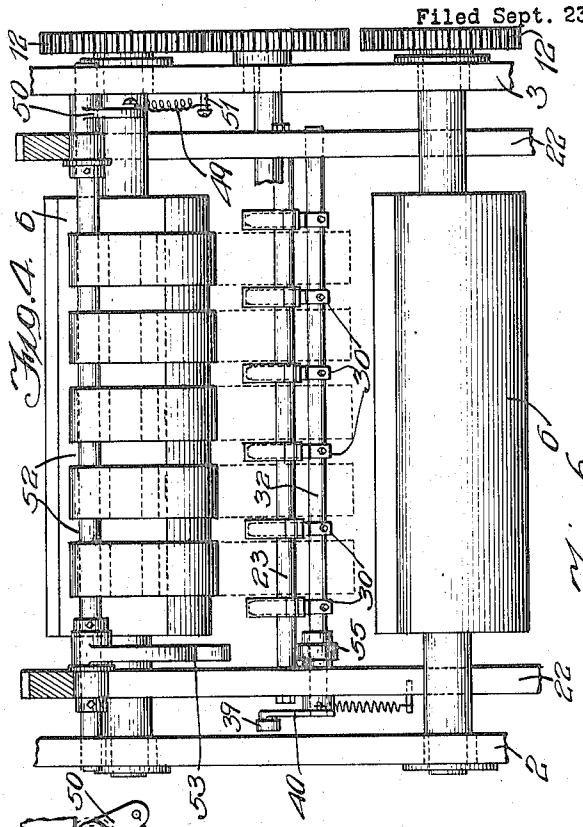

Fig. 4.

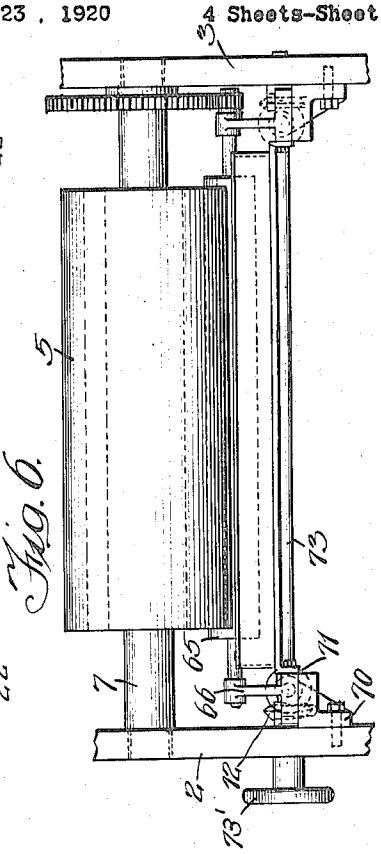

Fig. 6.

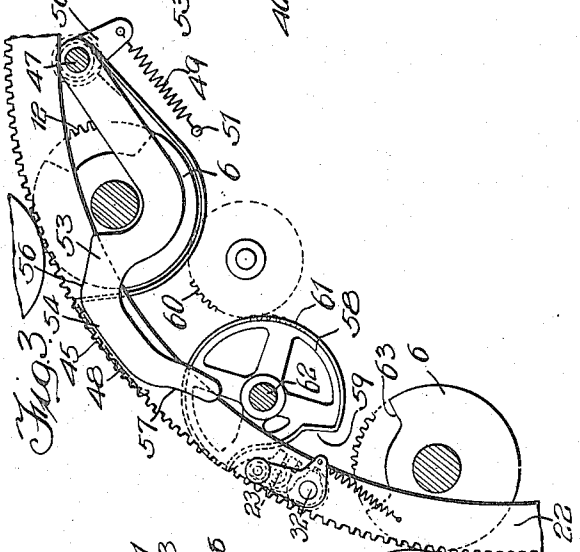

Fig. 3.

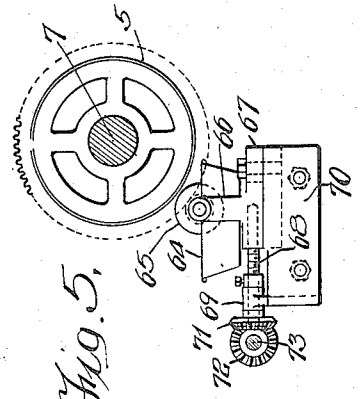

Fig. 5.

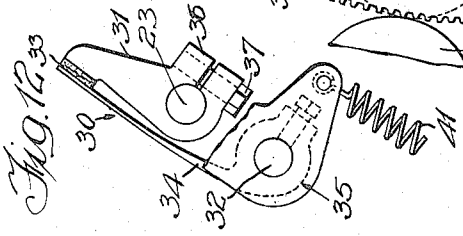

Fig. 12.

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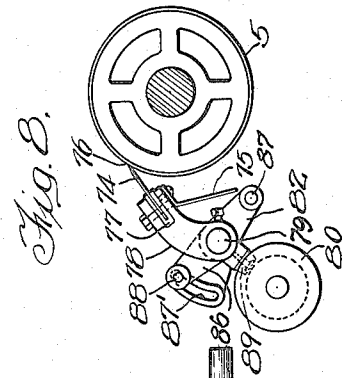
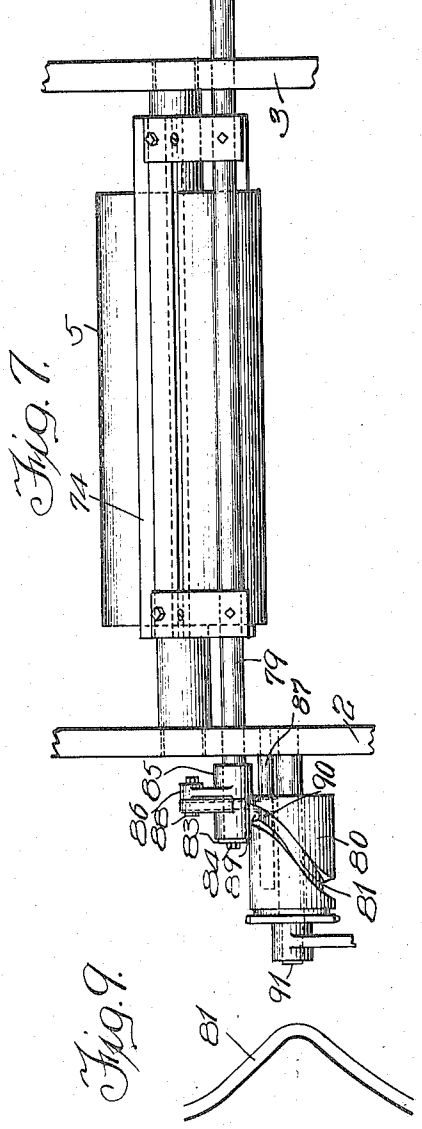


Fig. 8.

Fig. 7.



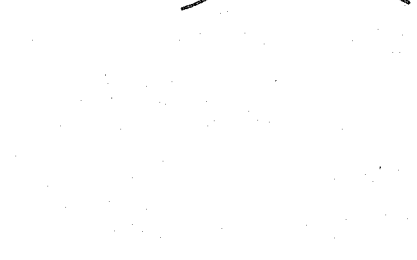


Fig. 9.

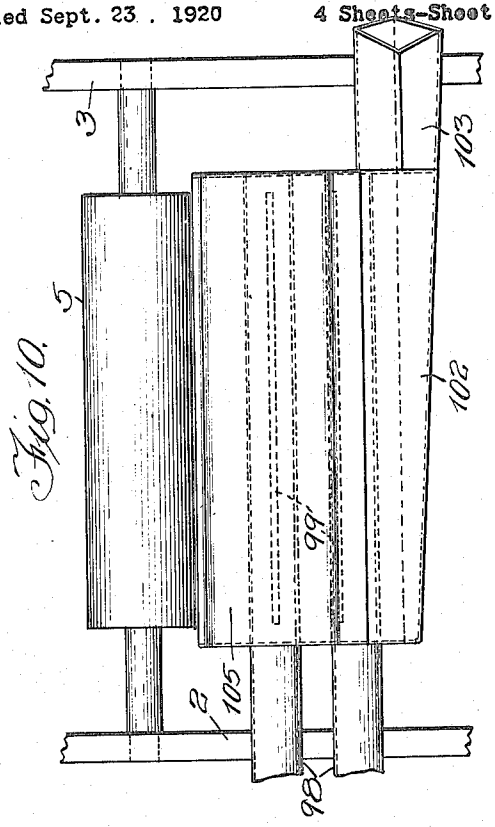


Fig. 10.

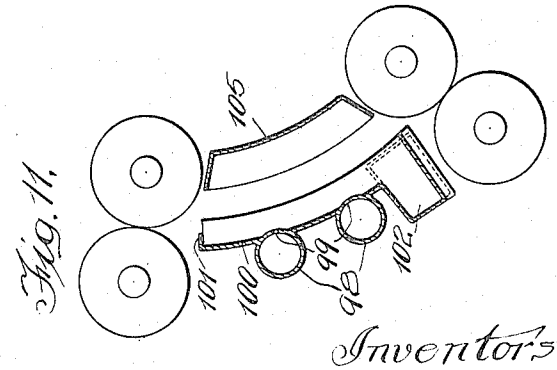


Fig. 11.

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Patented Aug. 12, 1924. 1,504,409

UNITED STATES PATENT OFFICE.

JOHN C. YETTER, OF CHICAGO, AND OTTO R. WOLF, OF RIVER FOREST, ILLINOIS.

PRINTING MACHINE.

Application filed September 23, 1920. Serial No. 412,263.

To all whom it may concern:

Be it known that we, JOHN C. YETTER and OTTO R. WOLF, citizens of the United States, and residents of Chicago and River Forest, respectively, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in a Printing Machine, of which the following is a specification.

Our invention relates to improvements in intaglio or photogravure printing machines and has special reference to an improved printing method and machine by means of which separate sheets can be printed in several colors properly registered while passing through the machine from the entrance point to the delivery point.

There have been many difficulties present in the proper production of satisfactory multi-color pictures, in the processes heretofore used. One of the greatest has been the difficulty of registration of the several impressions as they necessarily were made at different times which were separated by sufficient time at least to afford the possibility for the completion and drying of one impression or color upon the whole number of sheets before the next impression or color could be applied. The application of the different colors at different times subjects the sheets to the possibility of expansion or contraction between the several impressions owing to changes in the sheet as to moisture, etc., and as the several plates in a set are exactly the same size, it is substantially impossible to secure exact registration of the several impressions.

The object of our invention is to provide means and methods by which a sheet of paper can be gripped or grasped and carried into position to be impressed with one color, preferably yellow first, and while still gripped carried successively to second, third or more positions where it is successively impressed with several other or additional colors, the sheets not being released from the engaging means until the last impression has been made.

While many features of our invention may broadly relate to different ways of applying the printing pressure to the paper, there are many points which relate particularly to a means which includes a revolving shell or cylinder surrounded with properly positioned impression rolls, novel ink distributing devices and ink drying means and novel paper engaging, carrying and releasing means.

A fundamental object of our invention is to provide means and methods by which intaglio or photogravure printing in colors can be done at a very much higher speed and with much less difficulty than heretofore, the substantially perfect registration of the several impressions being automatic once the machine is set up.

Our invention will be more readily understood from the following detail description, taken in conjunction with the accompanying drawings forming part of this specification, and in which:—

Figure 1 is a fragmentary, diagrammatic side elevation of a machine embodying our invention in a preferred form;

Figure 2 is an end elevation of the machine;

Figure 3 is a fragmentary end elevation of the machine particularly illustrating the gripping and sheet carrying mechanism;

Figure 4 is a fragmentary side elevation of the gripping and sheet carrying mechanism;

Figure 5 is a detail end elevation of one of the intaglio rolls and the inking mechanism;

Figure 6 is a side elevation of the mechanism shown in Figure 5;

Figure 7 is a fragmentary side elevation of one of the intaglio cylinders showing the ink scraping member and means of moving this member back and forth;

Figure 8 is a detail end elevation of the mechanism shown in Figure 7;

Figure 9 is a developed view of one of the novel cam slots which we employ to effect the movement of the scraper;

Figure 10 is a side elevation particularly illustrating the means provided for rapidly drying the ink impressions;

Figure 11 is a fragmentary end elevation of the mechanism shown in Figure 10; and

Figure 12 is a fragmentary detail sectional view particularly illustrating the gripping devices.

In the drawings, 1 represents a frame which carries the several operating mechanisms. This frame consists of two side frames 2 and 3 mounted rigidly upon a base 4 and arranged parallel with each other. Between these sides and within the frame are arranged the several impression cylinders 5 and 6.

There are several pairs of the impression cylinders 5 and 6, there being as many pairs of these cylinders as it is desired to impress colors, as, for instance, yellow, red, blue and black. In the machine shown there are four of these pairs.

The outer cylinder 5 in each pair is the intaglio cylinder; that is the one which applies the ink to the paper and the inner cylinder is the one against which the paper is pressed to produce the impression. The cylinder 5 is mounted on a shaft 7 which is rotatably supported in suitable bearings in the side frames 2 and 3 and is provided on one end with a toothed pinion 8 which meshes with a large gear 9 carried on a central rotatable shaft 10. All of the pinions 8 mesh with the gear 9 and are all of the same size so that the several cylinders 5 are driven in unison. The shaft 7 also carries a second pinion 11 which meshes with a similar pinion 12 carried on a shaft 13 on which the inner or supporting roll 6 is mounted. These shafts 13 are also mounted in suitable bearings carried in the side frames 2 and 3.

It is necessary to accurately register the several rolls 5 with each other transversely of the machine so that the several successive impressions will be accurately transversely registered. For this purpose we provide a fine screw adjustment comprising a collar 14 on each shaft 7 at the end opposite to the pinion and provided with a circumferential groove 15 in which the inner end of an arm 16 accurately fits longitudinally of the shaft 7. The outer end 17 of the arm 16 is slidably mounted on a stationary guide pin 18 parallel with the shaft 13 and between its ends it is provided with a threaded opening for receiving an adjusting screw 19. This screw is also parallel with the shaft 7 and is carried in the free end of an arm 20 rigidly mounted on the outer end of the guide pin 18 and is held against longitiudinal movement by suitable collars. The screw 19 is provided on its outer end with a suitable hand wheel 21 by which the shaft 7 can be readily adjusted and accurately held longitudinally.

Within the frame 1 is arranged a skeleton cylinder frame comprising side rings 22 just within the side frames and joined by transverse rods or shafts 23. The rings 22 are provided with gear teeth on their outer peripheries adapted to mesh with pinions 24 mounted on a drive shaft 25. This shaft also carries a similar pinion 26 meshing with the large gear 9 for driving the shaft 10. This shaft 25 is driven at a suitable speed by any suitable means such as a belt pulley 27. The skeleton cylinder is mounted for rotation on anti-friction rollers 28 which act as concentric bearings within the rings 22 and are carried by the side frames of the machine, they are held against endwise movement by collars 29 mounted upon the studs upon which the anti-friction rollers 28 are mounted. The relation of the several gears is such that the skeleton cylinder revolves in synchronism with the revolution of the large gear 9; in other words they revolve together. The use of the gear rings 22 permits the mounting of the shafts 13 in fixed positions upon the side frame.

We provide several series of clamps 30 for engaging the forward edges of the sheets of paper and carrying them around with the main cylinder. These clamps, as best shown in Figure 12, each consists of a relatively fixed though adjustable anvil member 31 mounted upon and carried by the fixed shaft 23. There are a number of these anvil members spaced across the machine on each shaft 23 and each is provided with a substantially flat outer surface 33 upon which the paper is adapted to be clamped by a spring finger 34 carried by a hub 35 rigidly mounted on a shaft 32 which is close to and parallel with the shaft 23. The several anvil members 31 are each provided with a split hub 36 adapted to be clamped tightly upon the shaft 23 by clamping bolts 37. By means of this arrangement the surfaces 33 upon which the paper is clamped can be adjusted radially to correspond with the slightly varying diameters of the impression cylinders, which are gradually reduced in diameter by being ground off for new etchings.

While it would be possible to adjust the intaglio cylinders 5 inwardly, as they are reduced in diameter, to properly contact them with the cylinders 6, we prefer to adjust the cylinders outwardly and for this purpose we mount the cylinders 6 in eccentric bearings 6′ shown in dotted lines in Figure 1. The peripheral speeds of the rollers 5 and 6 are adjusted in the old and well known manner by the use of more or less packings of paper sheets on the roller 6, it being understood that the two rolls are thereby equalized as to peripheries.

The fingers 33 are raised by a cam 38, Figure 1, which engages a cam roller 39 on the free end of a crank arm 40 mounted on one end of each shaft 32. This cam raises the fingers to release the paper at the delivery point and permits the fingers to descend and clamp the next sheet at the feeding point. These fingers are pressed down by tension springs 41 which connect an arm 42 extending inwardly from each shaft 32 to the rotating cylinder. The feeding point is just at the edge of a feed table 42 and adjacent to the first or upper pair of impression rolls, and the delivery point is arranged just below the feed table and adjacent to suitable take off mechanism 43 which is arranged to deliver the sheets face

up on a receiving table 44. But as the take off mechanism does not form part of this present invention, no specific explanation thereof is thought to be necessary.

One important feature of our invention is the support of the sheets in the periphery of the skeleton or operating cylinder as they pass from one pair of impression rolls to the next. For this purpose we provide suitable paper or sheet supports 45 between the pairs of impression cylinders. These supports are made of sheet metal and are formed to extend around beneath the inner impression roll 6 in each instance, having one end secured to a hub 46 clamped upon a transverse shaft 47 mounted at its ends in the side frame within the ring 22. Each support 45 has an outer inclined supporting surface 48 extending beyond the roll 6 around which the support extends and the several supports on each shaft 47 are adapted to be held in their sheet supporting position by extension springs 49 connecting the free end of an arm 50, rigidly mounted on the shaft 47, to a fixed pin 51 carried by one of the side frames of the machine.

As best shown in Figure 4 the several supports on each shaft 47 are separated to provide spaces 52 between them through which the paper clamps can freely pass. These supports, however, extend out into the path of the shafts 23 and 32 and for the purpose of depressing the supports to permit the shafts to pass, we provide a cam lever 53 mounted at one end upon one end of the shaft 47 and extending around the shaft of the roller 6, its free end 54 being arranged transversely in alignment with the several paper supporting ends 48 of the supports 45. This free end 54 of the cam lever 53 is adapted to be engaged by a cam roller 55 mounted on the shaft 32 and depress the lever 53 and through the shaft 47, upon which the lever is rigidly mounted, depress or withdraw the supports 45. The outer end 54 of the lever 53 is provided with a depressing cam surface 57 at one end and with a similar cam surface 57 at its free end to permit the lever and the paper supports to return to normal position as soon as the shafts 23 and 32 have passed.

In order that the unsupported portion of the paper sheet may not be too great, we extend these supports only part way from one of the inner cylinders 6 to the next and provide a cylindrical support 58 between the ends of the supports 45 and the next cylinder 6. Each of these cylindrical supports 58 has a cut away portion 59 in its periphery to permit the paper clamps and the shafts upon which they are mounted to pass. These cylindrical supports are arranged with their outer surfaces in the path of the paper sheets as they are carried around the machine and are properly driven in synchronism with the machine by means of an idler gear wheel 60 which meshes with the gears 12 on the shaft 13 of the pressure roll 6 and with a similar gear 61 on the shaft 62 of the support cylinder 58. Each of the pressure cylinders 6 is provided with a depression 63 in its periphery similar to the cut away portion 59 in the periphery of the cylinders 58 to permit the shafts 23 and 32 and the paper gripping devices to pass freely.

For this purpose of applying the ink to the outer or intaglio rollers 5, we provide an ink pan 64 for each printing roller or cylinder 5 in which is arranged an ink feed roller 65 rotatably mounted at its ends in standards 66 rising from a horizontal frame 67. This roller contacts with and is driven by its printing roller 5, it dips into the ink in the pan 64 and applies a superfluity of ink to the roller 5. The frame 67 is adjustable from and towards the printing cylinder to adjust the inking roller 65 for properly delivering the ink. This adjustment consists of two horizontal screw shafts 68 entering suitable threaded openings in the frame 67 and adjacent to each end thereof. These screws are rotatably mounted in bearings 69 rigid with brackets 70 bolted to the side frame in which is mounted a transverse shaft 73 provided on one end with a suitable hand wheel 73′. By the rotation of the shaft 73 the ink rollers 65 can be forced into contact with the printing cylinders 5 or withdrawn out of contact therewith.

The ink is applied to the printing cylinders 5 by the inking roller 65 and the surplus ink is scraped off of the printing cylinder by a scraper 74 mounted above the ink pan and having an apron 75 for returning the surplus ink into the pan. The scraper 74 is made of a flat piece of sheet metal having an edge 76 provided to contact with the surface of the printing cylinder nearly tangential therewith. The edge 76 rests against the cylinder with a light pressure just sufficient to scrape off the surplus ink. This scraper is mounted in slots 77 in the free ends of the arm 78 which are clamped upon a transverse shaft 79 which is mounted in suitable bearings in the side frames 2 and 3. It is necessary to change the position of the edge 76 longitudinally on the intaglio cylinder or the wear would not be even, as the circumferential lines on the cylinder might quickly produce points on the edge 76. For causing this longitudinal movement of the scraping blade we provide a rotating cam cylinder 80 mounted parallel with the shaft 79 and outside of the side frame 2. The cam cylinder is provided in its cylindrical surface with a cam slot 81. On the outer end of the shaft 79 is provided a yoke 82 which is secured between its ends on the shaft 79 between a washer 83 secured on the shaft by a set screw 84 and the hub 85 of an

arm 86. One end of the yoke is guided on a fixed guide pin 87 extending out from the frame 2, parallel with the shaft 79 and the other end is provided with a slot 87′ concentric with the shaft 79 and in which is received a pin 88 carried by the arm 86. This slot permits the shaft 79 to be rotated to shift the scraper 84 back out of contact with the cylinder and the pin 88 is provided with a head which connects the arm 86 to the yoke 82 so that as the yoke is moved longitudinally of the shaft 79 it will carry the arm 86 and the shaft 79 with it. The yoke 82 is provided with a projection 89 carrying an antifriction roller 90 which works in the cam slot 81 and by which the shaft 79 and with it the scraper 74 is moved back and forth. It is desirable to keep the scraper in constant motion at an even or uniform speed, in other words it should never come to rest, and for this purpose we make the reversal point 91 of the cam slot 81 of quite short radius, thus causing the reversal in direction of the scraper to be very quickly accomplished while the intervening part of the cam slot is such as to maintain a substantially uniform rate of motion of the scraper as it moves back and forth. This is much more satisfactory than the old form of crank and connecting rod motion which moves the scraper rapidly in the middle of its stroke and very slowly toward each end, indeed noticeably coming to rest at each end of the stroke. This motion is very noticeable as the motion of the scraper is very slow and any wear in the several bearings tends to hold the scraper at rest at the ends of its stroke.

For applying power to rotate the several cams 80 we provide a substantially horizontal shaft 92 at the lower part of the machine driven at a relatively slow speed by the driving shaft 25 through a screw worm 93 on the shaft 25 and a worm wheel 94 connected therewith mounted on the shaft 92. This shaft drives the cams for the two lower printing cylinders by bevel gearing 95 and the cams for the two upper cylinders are driven from the cam shaft of one of the lower cylinders by drive chains 96 and 97, suitable sprockets being provided on the several shafts.

In order to be able to run the machine at high speed it is necessary to dry one application of ink before the next application is made, and for this purpose we apply hot air to the printed surface between the impressions.

For this purpose we provide means for applying a blast of hot air against the printed sheet as it passes from one printing point to the next and as it passes from the last printing point to the point of delivery. This means consists of hot air delivery pipes 98 extending transversely across the machine, two arranged between adjacent pairs of printing rolls and a plurality arranged between the last printing roll and the point of delivery. Each pipe is provided with a longitudinally extending delivery slot 99 on its inner side to direct a blast of hot air against the exposed printed surface of the paper. Preferably we connect the tubes together by a housing or box 100 having peripheral marginal walls 101 which extend into close proximity to the surface of the paper so as to prevent the escape of the hot air and we provide a suction outlet 102 at the bottom of the box or casing extending across the machine and having a discharge connection 103 at one end for connection to a suction fan or similar device.

Within the skeleton cylinder we provide a closed bottomed open topped box 105 arranged radially within the box or casing 100 for preventing the escape of the hot air within and through the machine.

By means of our system of gripping the sheets and carrying them successively between the several printing rollers in combination with the system of drying the ink between the impressions we are enabled, upon one machine, to print from six thousand to eight thousand sheets per hour, in four colors, and we are enabled to produce and preserve substantially accurate registration of the several impressions.

As many modifications of our invention will readily suggest themselves to one skilled in the art, we do not limit or confine our invention to specific details of construction herein shown and described.

We claim:

1. In a printing machine, an intaglio roll, a corresponding pressure roll, a cylindrical structure having sheet gripping devices and adapted to carry sheets between the two rolls, means for adjusting the sheet gripping devices inwardly, and means for adjusting the pressure rolls outwardly to correspond with the reduced diameters of the intaglio and pressure rolls.

2. In a printing machine, a rotatable cylindrical structure provided with a plurality of sets of sheet gripping devices spaced around the same, a plurality of pairs of impression rolls positioned around said structure in relatively fixed position, one of each pair outside said structure and the other of each pair within the structure, means for rotating the structure and the impression rolls in synchronism, the inner impression rolls having depressions permitting the passing of the gripping devices, the gripping devices being adapted to successively grip successive sheets and carry the same through between the several pairs of impression rolls before the sheets are freed from the gripping devices, supports ar-

ranged between the pairs of printing rolls, and means for forcing the supports inwardly to permit the rotation of the cylindrical structure.

3. In a printing machine, a rotatable cylindrical structure provided with a plurality of sets of sheet gripping devices spaced around same, a plurality of pairs of impression rolls positioned around said structure in relatively fixed positions, one of each pair outside said structure and the other of each pair within the structure, a supporting roller between each pair of printing rollers arranged within the periphery of the cylindrical structure, said supporting roller having a depression permitting the passage of the gripping devices.

Signed this 7th day of Sept. 1920, at Chicago, Ill.

JOHN C. YETTER.
OTTO R. WOLF.