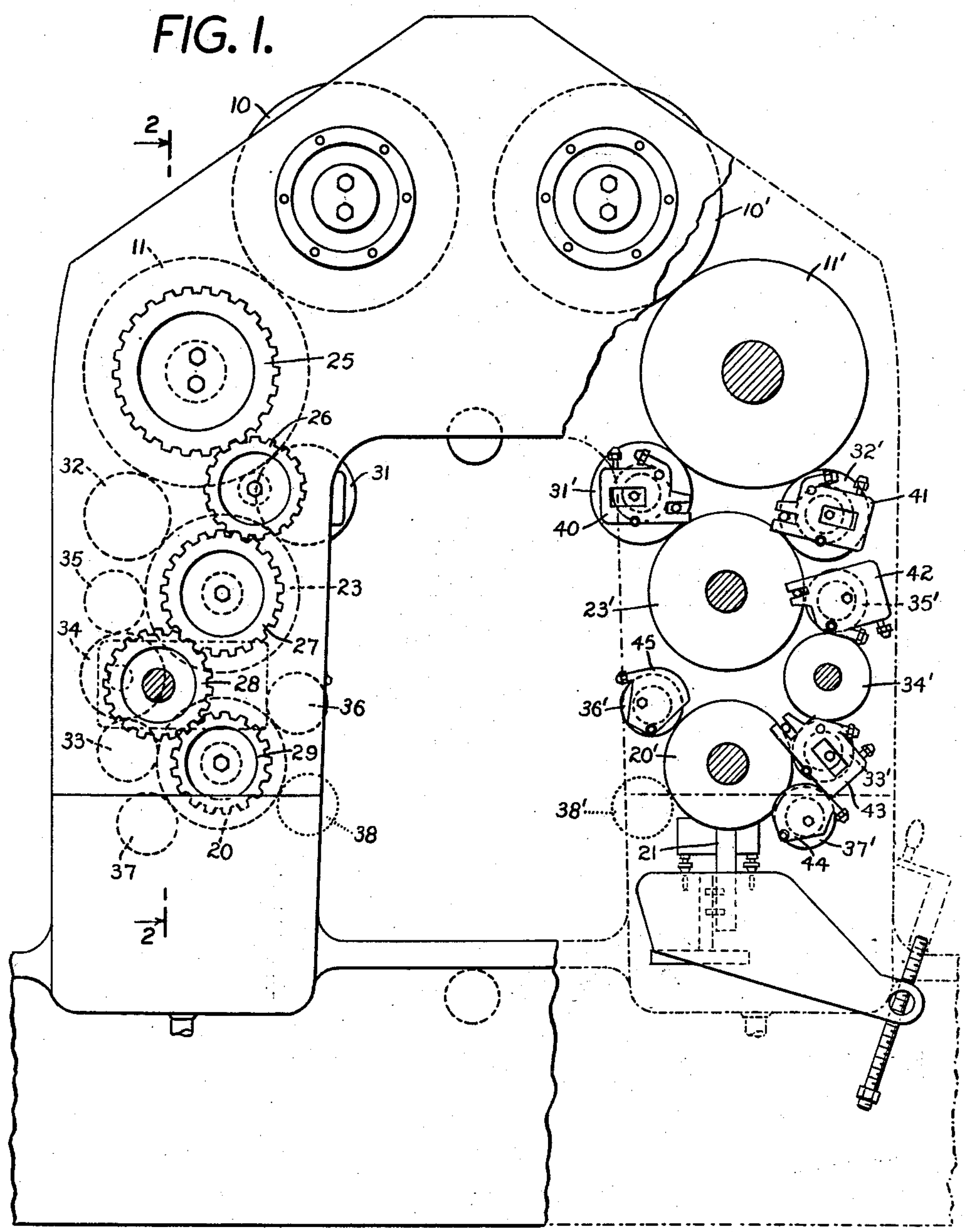
May 6, 1958 C. A. HARLESS 2,833,212

INK MOTIONS FOR PRINTING MACHINES

Filed Feb. 21, 1955 2 Sheets-Sheet 1

FIG. 1.



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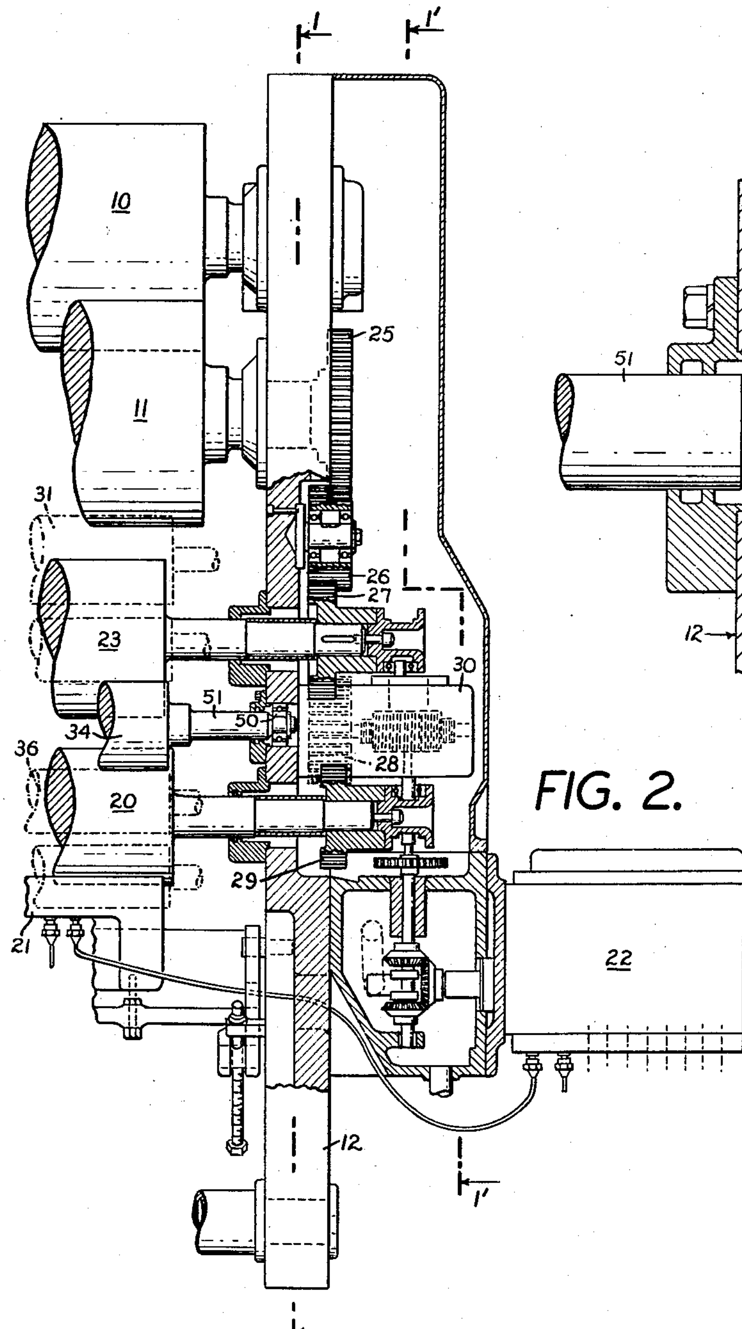
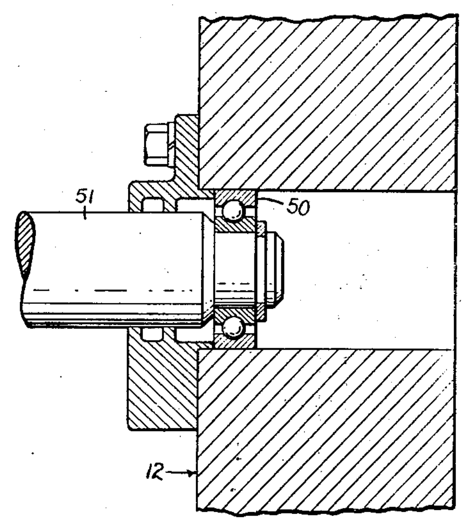


FIG. 2.

FIG. 3.



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INK MOTIONS FOR PRINTING MACHINES

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8 Claims. (Cl. 101—349)

This invention relates to improvements in ink motions for printing machines.

In ink motions of the type with which the present invention is concerned, the ink is supplied initially by an ink pump or ink fountain and ductor roller to the initial ink drum of the ink motion and is conveyed therefrom by way of a train of rollers including alternating hard and soft surfaced rollers, and terminating in the form rollers which apply the ink to the plates on a printing cylinder. A sufficient number of "cuts" or ink transferring contacts between rollers is provided to smooth the ink into a reasonably uniform film circumferentially of the form rollers, and an axially reciprocating movement is provided for some of the rollers so as to distribute the ink axially of the form rollers.

In typical previously used ink motions, the soft surfaced rollers are free running, while the hard surfaced rollers are gear driven, and the required gearing for driving the cylinders rotatably, and the mechanism for axially reciprocating some of them, places rather definite limitations upon the size of rollers and also upon the location of their axes. A succession of hard surfaced rollers or ink drums must, by reason of the interposition between them of soft surfaced transfer rollers, rotate in the same direction, requiring the use of intermediate idle gears, and, these gear centers must be located properly with reference to the axially reciprocating mechanism. Typical heavy letterpress equipment may include two or three gear driven and axially reciprocated cylinders, the number of these cylinders found necessary depending upon the type of ink used and the type of printing being done. The limitation of available space where three axially reciprocated elements are used, frequently limits the possible location of the ink rail or other element supplying ink to the first cylinder of the ink motion.

The general object of the present invention is to provide an ink motion having improved ink distributing capacity, while at the same time providing a more compact installation as well as a simplified and easily accessible arrangement of rollers.

It has been found that by utilizing a set of three rollers for transferring ink from one vibrator or axially reciprocating cylinder to the next, a very definite improvement in ink distribution may be obtained. At the same time, the construction is simplified and it becomes possible to relocate the ink pump or ink rail in a position for maximum efficiency and ease of adjustment.

In the drawings:

Fig. 1 is an end elevation, partly broken away, on the section planes indicated generally at 1—1 and 1'—1' in Fig. 2;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Fig. 3 is an enlargement of a part of Fig. 2.

The printing unit shown is of the familiar arch type, having two printing couples **10, 11** and **10', 11'**. The frame structure **12** is indicated in phantom. The right and left hand sides of the unit differ only in that the rollers and cylinders are positioned in transposed horizontal relation, so corresponding rollers in each side of the unit are accessible from the outside of the frame. For completeness of illustration, the parts are shown on two different section planes, so that the roller sockets or mountings are shown in the right hand half of the unit and the gearing on the left. It will be understood that roller sockets and gearing as shown are provided for both halves of the unit, and corresponding parts are identified by corresponding reference numerals, with the reference numerals applying to the right hand side of the unit having prime superscripts.

The frame and gearing arrangement is generally the same as shown in prior Harless application Serial No. 421,379, filed April 6, 1954 for Inking Mechanism for Printing Machines, and the roller socket mountings are of the type shown in prior Harless application Serial No. 344,444, filed March 24, 1953 for Ink Roller Mounting.

Each ink motion includes a first ink drum **20** to which the ink is applied by an ink rail **21**, connected to a pump **22**, the ink pump and ink rail arrangement being of the type shown in prior Worthington application Serial No. 440,690, filed July 1, 1954, for Inking Mechanisms. The ink drum **20** as well as the second ink drum **23** is driven by gearing including a gear **25** fixed to the shaft of the plate cylinder **11**, an idle intermediate gear **26**, a gear **27** fixed to the shaft of the ink drum **23**, an idle gear **28** and a gear **29** fixed to the shaft of ink drum **20**. The drums **20** and **23** are reciprocated axially by means of a drive mechanism **30**, the specific form of which forms no part of the present invention and the details of which are shown in prior Harless application Serial No. 421,379, mentioned above. The peripheral speeds of drums **20** and **23** are equal and are the same as the peripheral speed of the plate cylinder **11**.

The ink motion also includes form rollers **31** and **32** for transferring ink from the ink drum **23** to the plate cylinder **11**, and a train of rollers **33, 34** and **35** for transferring ink from the drum **20** to the drum **23**, as well as rider or distributing rollers **36** and **37** cooperating with the drum **20**. An additional rider **38** may be provided where indicated in dotted lines, when the direction of rotation of the ink motion is reversed.

The various roller socket mountings **40—45** are arranged to permit adjustment of the position of the rollers with reference to their cooperating ink drums and the plate cylinder, as usual. The rollers **31, 32, 33, 35, 36, 37** and **38** are all soft surfaced rollers, rubber surfaced rollers being preferred, but rollers surfaced with other compositions being useable as well. The roller **34**, however, is a hard surfaced steel drum having a shaft **51** mounted in bearings **50** held in the frame **12**. These are thrust bearings and hold the drum so as to prevent its motion axially.

The soft surfaced rollers **33** and **35** are adjusted with reference to the hard surfaced drums **20, 23** and **34** for a flat of about ⅜ inch to ½ inch, the precise flat being selected by the pressman according to the ink and operation conditions so as to obtain the best ink distribution.

A major feature of the present invention consists in the combination with the two successive gear driven and axially reciprocated cylinders or ink drums **20, 23** (commonly called "vibrators"), of an ink transferring train **33—34—35**, instead of the usual single roller or pair of rollers, each of which makes contact with both vibrators. It is found, not only that the parts may be simplified and relocated to advantage, but also that an improved ink distribution is obtained by comparison with ink motions in which a third gear driven vibrator is interposed between vibrators **20, 23**.

The drive of roller or drum **34** involves both roller

33 (driven by drum **20**) and roller **35** (driven by drum **23**), so that the system of rollers **20—33—34—35—23** and gears **27—28—29** taken in the cyclical order stated form a closed system in which it is conceivable that at any of the contacts or cuts **20—33, 33—34, 34—35** or **35—23** the driving torque may be from either one of the pair in question to the other and may, hence, with respect to a given roller, be either an accelerating torque or a decelerating torque. The torque transmission at any given contact will be a function of the flat end of the ink thickness as well as any other factors influencing the friction or viscous drag between rollers.

The precise speed relationships between hard and soft surfaced rollers in driving contact under ink motion conditions are not fully understood. High speed photography shows, however, that the condition at a cut in an ink motion is of an oscillating or variable character as distinguished from a smooth and steady rotation and transfer of ink film, as the ink can be seen to well out between rollers adjacent the flat, creating a body of ink which disappears and then reforms. It is probable that the drive conditions and, hence, speed of the various rollers which are not gear driven are unstable and variable, it being likely that there is a tendency for slip at a given cut to reduce the thickness of ink film in the flat, thereby giving the driving roller a better grip on the driven roller so as to accelerate the latter and reduce the slip, permitting a thicker ink film to pass, which, again, reduces the grip of the driving roller on the driven roller, permitting the slip to increase, creating a cycle of unknown period and producing an average drive speed ratio which is extremely unstable and sensitive to variations in the various conditions.

Tests of the ink motion of the invention have led to the surprising result that the ink distribution obtained is not only as good as, but is better than that obtained with an ink motion with comparable number of cuts but differing in that the roller **34**, or corresponding roller, is gear driven instead of running free. While there is considerable question as to the precise reasons for this improvement, there is no question as to the fact of the improvement, since the ink distribution characteristics have been tested by printing a uniform half tone screen formation and then observing the variation in tone density in the printing. The elimination of periodic waves of greater and less density printing, when using the ink motion of the invention, is very striking.

Observations of the roller speeds have produced some very interesting results. In the installation tested, the driven rollers or drums operated without gain, so that the peripheral speeds of drums **20** and **23** were equal. The peripheral speed of these rollers and speed of the idle hard surfaced roller **34** were measured under a variety of ink conditions and over a range of about 300–900 feet per minute peripheral speed. Under actual printing conditions, a slippage of about 9% was observed, the relationship between roller speeds being apparently linear. The results obtained are summarized in the following table:

First series

	Ft./Min. 34	Ft./Min. 20	Ft./Min. Slippage	Percent Slippage
1	240	258	−18	6.9
2	506	570	−64	11.2
3	765	839	−74	8.8
4	508	564	−56	9.9
5	245	265	−20	7.5

In the above table, identified as "First Series," the first column states surface speeds of cylinder **34** as measured with an accurately calibrated tachometer, the second column states speeds similarly measured and at the same time, of the driven drum **20**, the speeds in each case being given in feet per minute. The third column is the slippage in feet per minute, this being the difference between column 2 and column 1, and the fourth column expresses this slippage as a percentage figure. It will be observed that the slippage appears to increase as the speed of roller **34** is increased from 240–245 feet per minute to 506–508 feet per minute and then decreases at the higher speed of 765 feet per minute. It will also be observed that the percentage of slip varies significantly between observations No. 1 and No. 5 at approximately the same speeds and also between observations No. 2 and No. 4 at substantially the same speed. The average percentage of slip was about 9%. It is apparent that there is an automatic adjustment of slippage, which is not a simple function of drive speed and which varies markedly even though the ink feed and other operating conditions are maintained constant so far as possible. In view of the demonstrated improvement in ink distribution which was obtained, and in view of the demonstrated slippage and variation in slippage which were observed, it has been concluded that the floating drive of the intermediate hard roller **34** produces automatic variation in speed of this roller with corresponding variation in the slippage at the cuts, which variation works in such a direction as to compensate automatically for fluctuations in thickness of ink film and to vary the slippage in a manner to reduce such fluctuations.

It not being practical to vary the ink supplied under actual printing conditions, further series of tests were run to determine the effect of ink film thickness on the drive conditions at a single cut. The results of one such set of observations are set forth in the following table:

Second series

	Ft./Min. 34	Ft./Min. 20	Ft./Min. Slippage	Percent Slippage
1	220	254	−34	13.4
2	460	560	−100	18
3	704	839	−135	16.1
4	460	547	−87	15.9
5	230	280	−50	17.8

In making the observations summarized in this table, the conditions were the same as described above, with the exception that the rubber roller **35** was removed. The effect of this, of course, was to increase the quantity of ink on the intermediate hard surfaced roller **34**. It will be noted that the percent of slippage increased quite significantly and that the variation of slippage with speed is very much reduced. The indication is that under actual printing conditions, the ink film has a tendency to vary in thickness with speed of operation and also with other factors even though the speed remains constant, to such an extent that the drive torque is markedly affected. It will be noted that the speeds of rotation in the second series of observations are somewhat different from those in the first series, although not significantly so. This results from the fact that the press speed was established according to the reading of the press tachometer, a less accurate instrument than the tachometers used in making the observations.

A third series of readings were taken with the roller **35** replaced and the lower roller **33** removed, the result being that the cylinder **34** and following elements ran substantially dry. The following results were obtained:

Third series

	Ft./Min. 34	Ft./Min. 20	Ft./Min. Slippage	Percent Slippage
1	271	282	−11	3.9
2	554	567	−13	2.3
3	835	839	−4	.5
4	554	564	−10	1.8
5	282	292	−10	3.4

It will be observed that the slippage is markedly reduced, as might be expected, but also that a rather anomalous effect is obtained, in that the percent of slippage at the intermediate speed is decreased by comparison with the slippage at high and low speeds, the reverse of what was found in the observations of the first series. It may be inferred that difference in thickness of ink film at a cut not only affects the percent of slippage at any given speed, but also affects in a very marked way the variation in slippage with variation in speed, going so far as to reverse the curve.

A fourth series of readings were made under the same conditions as the third series, but with the tachometer reading the speed of cylinder **23** instead of cylinder **20**:

Fourth series

	Ft./Min. 34	Ft./Min. 23	Ft./Min. Slippage	Percent Slippage
1	271	282	−11	3.9
2	550	560	−10	1.8
3	845	839	+6	−.7
4	561	570	−9	1.6
5	273	285	−12	4.2

As might be expected, the indicated percentage of slippage at the various speeds was approximately the same as in the third series, in most cases, but exhibited a variation of about the same order of magnitude as observed at corresponding speeds in the other series. It is of interest to note that at the higher speed the slippage is reversed, indicating that the roller or cylinder **34** was travelling at a higher peripheral speed than the driving roller **23**. This result, while apparently anomalous, is not inconsistent with the theory, so far as known, since variation in flat may change the drive ratio between a hard surfaced and soft surfaced roller so that a difference in flat at the cut **34—35** and the flat at the cut **35—23** could well result in negative slip, as indicated.

While a great deal of theorizing has been done on the variation of drive ratio between hard surfaced and soft surfaced rollers, and it is generally accepted that in friction drives the drive must be from soft to hard cylinder instead of vice versa, it is apparent that under actual press operating conditions, where the ink motion rollers are covered with a film of ink there is no simple explanation or formula which accounts for the observed phenomena. It appears, merely, as stated above, that the thickness of ink film influences the slippage and that the slippage variation is in a direction to regularize or even out the distribution of the ink.

The compactness of the structure is quite striking, and permits an advantageous rearrangement of the ink rail with respect to the first drum or cylinder of the train. It will be observed that the ink rail is positioned directly below the first drum **20** and that it is mounted for a generally vertical pivotal movement toward and away from that drum. As a result, ink mist or spray from the various cuts is caught by the drums and rollers themselves, avoiding loss of ink and dirtying of adjacent mechanisms. The "normal" direction of rotation of the printing unit is clockwise as to the right hand plate cylinder and counter clockwise as to the left hand plate cylinder of the unit, and the direction of rotation of the driven ink drums associated with these cylinders is the same. It will be noted that ink mist emerging from the cut **34—20** is boxed in by the remaining rollers and cylinders so that it will not leave the ink motion. If the unit is reversed, the same effect is obtained, and, in fact, a tangent plane through any flat will lead to the surface of one of the rollers or cylinders of the ink motion, except for the cut **34—35**. At this point, however, the ink film has been quite well distributed, so that the tendency toward ink mist formation is very much reduced. Although it would be difficult to demonstrate in any quantitative way, it appears that the ink mist produced at this cut (or at the cut **33—34** when the unit is reversed) is reduced by permitting the cylinder **34** to run free.

What is claimed is:

1. In a printing machine ink motion, and in combination, first and second axially reciprocable ink drums, gearing and drive mechanism for rotatably driving and axially reciprocating the said drums, means for supplying ink to the first said drum and means for taking ink from the second said drum for inking a printing cylinder, an ink transfer mechanism between the two said drums comprising first and second soft surfaced rollers contacting the respective drums and a freely rotatable hard surfaced roller contacting the two said soft surfaced rollers.

2. In a printing machine ink motion, and in combination, first and second axially reciprocable ink drums, gearing and drive mechanism for rotatably driving and axially reciprocating the said drums, means for supplying ink to the first said drum and means for taking ink from the second said drum for inking a printing cylinder, an ink transfer mechanism between the two said drums comprising first and second soft surfaced rollers contacting the respective drums and a freely rotatable but axially fixed hard surfaced roller contacting the two said soft surfaced rollers.

3. In a printing machine ink motion, and in combination, first and second axially reciprocable ink drums, gearing and drive mechanism for rotatably driving and axially reciprocating the said drums, means for supplying ink to the first said drum and means for taking ink from the second said drum for inking a printing cylinder, an ink transfer mechanism between the two said drums comprising first and second soft surfaced rollers contacting the respective drums, a freely rotatable but axially fixed hard surfaced roller contacting the two said soft surfaced rollers, and adjustable supports for soft surfaced rollers whereby the axial distance thereof from the drums and intermediate roller may be regulated.

4. In a printing machine ink motion, and in combination, first and second axially reciprocable ink drums, gearing and drive mechanism for rotatably driving and axially reciprocating the said drums, means for supplying ink to the first said drum and means for taking ink from the second said drum for inking a printing cylinder, an ink transfer mechanism between the two said drums comprising first and second soft surfaced rollers contacting the respective drums and a freely rotatable hard surfaced roller contacting the two said soft surfaced rollers, the said rollers being arranged in mutual unstable driving relation for driving the said hard surfaced roller with a substantial and variable slippage.

5. In a printing machine ink motion, and in combination, first and second axially reciprocable ink drums, gearing and drive mechanism for rotatably driving and axially reciprocating the said drums, means for supplying ink to the first said drum and means for taking ink from the second said drum for inking a printing cylinder, an ink transfer mechanism between the two said drums comprising first and second soft surfaced rollers contacting the respective drums and a freely rotatable hard surfaced roller contacting the two said soft surfaced rollers, the said rollers being arranged in mutual unstable driving relation for automatically varying the slippage of the hard surfaced roller, whereby variation in ink film thereon causes compensating variation in slippage.

6. In a printing machine ink motion, and in combination, first and second reciprocable ink drums, drive gearing therefor comprising a drive gear fixed to each drum, an intermediate idle gear in mesh with the said drive gears and mechanism for axially reciprocating the said drums, an axially fixed freely rotatable hard surfaced roller between the said drums and offset from their common axial plane, and soft surfaced rollers in ink trans-

ferring and driving relationship to the said drums and hard surfaced roller.

7. In a printing machine ink motion, and in combination, first and second reciprocable ink drums, drive gearing therefor comprising a drive gear fixed to each drum, an intermediate idle gear in mesh with the said drive gears and to one side thereof, and mechanism for axially reciprocating the said drums, an axially fixed freely rotatable hard surfaced roller between the said drums and also offset from their common axial plane, and soft surfaced rollers in ink transferring and driving relationship to the said drums and hard surfaced roller, the said idle gear being supported with part of it in alignment with the shaft of the said hard surfaced roller.

8. In a printing machine ink motion, and in combination, first and second reciprocable ink drums, drive gearing therefor comprising a drive gear fixed to each drum, an intermediate idle gear in mesh with the said drive gears and to one side thereof, and mechanism for axially reciprocating the said drums, an axially fixed freely rotatable hard surfaced roller between the said drums and offset from their common axial plane on the side toward said idle gear, soft surfaced rollers in ink transferring and driving relationship to the said drums and hard surfaced roller, and an ink rail supplying ink to the first said drum along a line substantially in the common axial plane of the said drums.

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