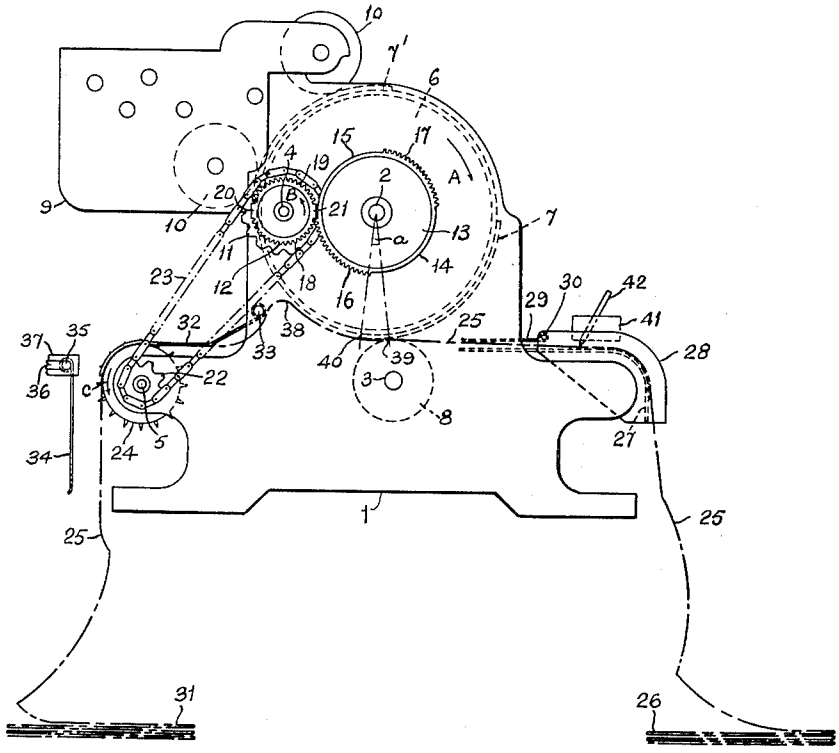
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PRINTING MACHINE FOR PUNCHED PAPER

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PRINTING MACHINE FOR PUNCHED PAPER

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The present invention relates to a machine for printing paper in the form of a long parallel-sided web having a series of holes punched at regular intervals adjacent to each edge of the web. This type of paper, which is commonly known in the printing trade as marginally punched continuous stationery, will be referred to hereinafter, for the sake of simplicity, as punched paper.

Punched paper is often perforated transversely at intervals throughout its length, and the machine according to the invention is particularly suitable for printing this type of punched paper, which will be referred to hereinafter as punched perforated paper.

At present printed punched perforated paper is produced in a machine which performs the operations of printing, punching and perforating the paper contemporaneously. These machines are expensive and of a complicated nature and have to be operated by highly skilled labour.

The object of the present invention is to provide a simple, inexpensive and easily-operated printing machine which can be used to print plain punched paper or plain punched perforated paper.

In office machinery employing punched paper the latter is usually handled by means of a pin wheel drive. The latter comprises two pin wheels fixedly mounted in spaced relationship on a substantially horizontal driving shaft arranged at right angles to the longitudinal axis of the punched paper. The pin wheels engage the holes in the punched paper so that the paper is caused to advance when the pin wheels rotate. Preferably the pin wheels are adjustable in position along the driving shaft so that the pin wheel drive can be adapted to handle punched paper of different widths. The present invention makes use of such a pin wheel drive in association with a rotary printing machine.

According to the invention a rotary printing machine for printing punched paper comprises a printing roller, means adapted to rotate the printing roller continuously, a pressure-applying means adapted to nip punched paper entering the machine against the printing roller to cause the punched paper to be advanced through the machine and the printing roller to print a pattern on the punched paper at intervals along the latter, a pin wheel drive adapted to draw the printed punched paper away from the printing roller, and means for driving the pin wheel drive intermittently, said printing roller and pressure-applying means being adapted to release the punched paper at least once in each revolution of the printing roller and the rotary movements of the printing roller and the intermittently driven pin wheel drive being synchronised in such a way that the pin wheels are at rest at the commencement of each printing operation at the printing roller but start to rotate immediately thereafter so that at the commencement of each printing operation the punched paper at the printing roller is caused to advance slightly relative to the punched paper at the pin wheel drive whereby the portion of punched paper between the printing roller and the pin wheel drive is in a slack condition.

In such a rotary printing machine it is possible to adjust the speed of rotation of the printing roller and the speed of rotation of the pin wheels so that, over a period of time, the length of punched paper advanced by the nip at the printing roller is substantially the same as that

drawn along by the pin wheel drive. It is impossible, however, to arrange for the speed of advance of the punched paper nipped at the printing roller to be the same, at every instant of the said period, as the speed of advance of the punched paper at the pin wheel drive. This is due to variations in the height of the printing surface of the printing roller and to variations in the physical properties of the punched paper. Consequently, at some instants the pin wheel drive advances the punched paper at a slightly greater speed than the printing roller. The above mentioned slack condition of the portion of the punched paper between the printing roller and the pin wheel drive allows these slight variations in the speed of advance of the punched paper to occur without the pin wheel drive tearing the punched edges of the paper.

Preferably, the means for driving the pin wheel drive comprises a toothed pinion driven by an interrupted toothed pinion mounted on the shaft of the printing roller, the motion of the toothed pinion being transmitted to the pin wheel shaft by a suitable chain and sprocket drive or a gear drive. The interrupted toothed pinion is arranged to mesh with the toothed pinion a very short instant after the printing roller commences to advance the punched paper at the commencement of a printing operation, and the speeds of rotation of the printing roller and the pin wheels are so arranged that the printing roller advances the punched paper at substantially the same speed as the pin wheel drive.

Preferably the printing surface of the printing roller is provided by one or more removable segmental printing plates carrying the impression of the pattern it is desired to print on the punched paper. If the printing roller comprises one such printing plate it must extend around the printing roller by an amount less than 360° so that there is a gap between its two ends. The passage of this gap past the pressure-applying means, at each revolution of the printing roller, causes the punched paper to be released by the printing roller as mentioned above. If the printing roller comprises two such printing plates they would normally be arranged with their leading edges at diametrically opposite points of the printing roller and with each plate extending around the printing roller by an amount less than 180°. A printing roller comprising two printing plates arranged in this manner will release the punched paper twice in each revolution of the printing roller. Each printing plate preferably is mounted on the printing roller so that its position relative to the above mentioned interrupted toothed pinion may be adjusted.

In the case of printing rollers comprising more than one printing plate the roller is arranged to advance the punched paper as described above as each printing plate, in turn, commences a printing operation. In such cases the pin wheel drive advances the punched paper intermittently, during each revolution of the printing roller, a number of times equal to the number of printing plates provided on the printing roller.

Advancement of the punched paper by the printing roller to produce the slack condition of the portion of punched paper between the printing roller and the pin wheel drive may be brought about by the leading edge of the printing plate, or the leading edge of each printing plate, nipping the punched paper against said pressure-applying means. Alternatively, a raised portion on the printing roller arranged immediately in advance of the leading edge of the printing plate, or a separate raised portion arranged immediately in advance of the leading edge of each printing plate, may serve to nip the punched paper against the pressure-applying means.

As an alternative to forming the printing surface of the printing roller by means of removable segmental printing plates, the surface of the roller itself may be employed to print the punched paper. Here again the

printing surface must extend for less than 360° around the roller so that a gap is produced between the ends of the printing surface. The printing surface may also be divided into a number of separate surfaces equally spaced around the roller and separated from each other by a gap.

The pin wheel drive preferably is provided with a brake so that it is brought to rest rapidly upon disengagement of the intermittent drive. This is to ensure that the patterns printed on the punched paper are spaced at regular intervals.

The pressure-applying means preferably takes the form of a simple pressure roller adapted to rotate freely beneath the printing roller, the axes of rotation of the pressure roller and the printing roller being parallel to one another.

One form of rotary printing machine in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing, which shows a schematic side view of the machine.

Referring to the drawing, the machine illustrated comprises two vertically arranged substantially identical side plates 1 (only one of which is shown) arranged in spaced parallel relationship. Four horizontal shafts 2, 3, 4 and 5 are journalled at their ends in the side plates 1, the four shafts being parallel to one another and at right angles to the side plates 1. A printing roller 6 is secured to the shaft 2. The surface of this printing roller is adapted to receive two segmental printing plates 7 and 7', each of which subtends an angle of less than 180° at the centre of the printing roller. A pressure-applying means in the form of an impression roller 8 is secured to the shaft 3. This impression roller provides the necessary nip for the printing process and it is arranged, in the usual way, to be lowered away from the printing roller 6 for the purpose of facilitating setting up of the machine. A full inking unit 9 of known type is mounted on the side plates 1, this inking unit comprising final inking rollers 10 for applying ink to the printing plates 7 and 7' once during every revolution of the printing roller 6.

A sprocket wheel 11 and an interrupted toothed pinion 12 are secured to the shaft 4. The pinion 12 is adapted to engage an interrupted toothed pinion 13 secured to the printing roller shaft 2. The pinion 13 has two cut-away portions 14, 15 leaving two diametrically opposed toothed portions 16, 17 each having the same number of gear teeth. The pinion 12 also comprises two diametrically opposed toothed portions 18, 19, these portions having the same number of gear teeth as portions 16, 17 of the pinion 13. The toothed portions 18, 19 are separated by non-toothed portions 20 and 21.

A sprocket wheel 22 is secured to the shaft 5, which sprocket wheel is driven from the sprocket wheel 11 by a chain 23. A standard pin wheel drive of the kind employed with punched paper is mounted on the shaft 5 between the side plates 1. This pin wheel drive consists of two pin wheels 24 (only one of which is shown) secured to the shaft 5 in spaced relationship. Preferably the two pin wheels are adjustably mounted on the shaft 5 so that the pin wheel drive is capable of handling punched paper of different widths.

In operation of the machine the shaft 2 is rotated, either manually or by means of an electric motor (not shown) so that the printing roller 6 rotates in the direction of the arrow A.

The chain line 25 designates a web of punched perforated paper passing through the machine. This web passes from a stack 26 of the punched paper over a supporting plate 27 between the side plates 1. The web is located transversely by plates 28 which are individually adjustable between the side plates 1 in the transverse direction to suit the width of the web 25. A plate 29 pivotally mounted on a rod 30 bears on the web 25 prior to its passage between the printing roller 6 and the impression roller 8. From the printing roller the web 25 passes over the pin wheels 24 and is delivered in a stack 31. The web 25 is maintained in engagement with the pin wheels 24 in known manner by means of plates 32 pivotally mounted on a rod 33 extending between the side plates 1. There is one plate 32 associated with each pin wheel 24. A plate 34 pivoted along its upper edge on a horizontal rod 35 prevents any tendency for the web 25 to travel other than substantially vertically downwards on leaving the pin wheels 24. The rod 35 is adjustably mounted in slots 36 in frame members 37 (only one of which is shown) so that the distance between the plate 34 and the pin wheels 24 may be adjusted.

The position of the printing plate 7 relative to the set of teeth 16 is such that the printing plate 7 commences to print on the web 25 while the pin wheel drive is at rest in the position shown in the drawing. A small loop 38 is therefore formed in the web 25 between the impression roller 8 and the pin wheels 24 as the web is advanced by the nip between the rollers 6 and 8 at point 39. When the leading edge 40 of the printing plate 7 has advanced through an angle a (amounting to about 10°) past the point 39, toothed portion 16 of pinion 13 engages the toothed portion 18 of the pinion 12 to cause rotation of the latter in the direction of the arrow B. This has the effect of rotating the pin wheels 24 in the direction of the arrow C. The dimensions of the pinions 12, 13, the sprockets 11, 22 and the pin wheels 24 are such that the pin wheels advance the web 25 a distance equal to the length of the web between two adjacent transverse perforations each half revolution of the printing roller. Since the printing plate 7 extends around less than half the circumference of the printing roller it will be appreciated that the pin wheels 24 continue to advance the web 25 after the latter is relieved of the nip between the impression roller 8 and the printing plate 7. This means that the loop 38 disappears and the web 25 is taut when the pin wheels 24 come to rest through disengagement of the toothed portions 16 and 18. This disengagement of the toothed portions 16 and 18 takes place when the pinion 12 has been rotated through 180° from the positions shown in the drawing. Preferably the shaft 5 is frictionally braked so that it is brought to rest immediately the toothed portions 16 and 18 disengage. The web 25 now remains stationary until the leading edge of the printing plate 7' reaches the point 39. The web is then advanced again to form the loop 38 and the pin wheels 24 commence to rotate again through engagement of the toothed portion 17 of the pinion 13 with the toothed portion 19 of the pinioin 12. This loop 38 remains in the web 25 until the nip on the web between the impression roller 8 and the printing plate 7' is relieved and then the continued rotation of the pin wheels 24 makes the web taut once more before disengagement of the drive to the pin wheels.

From the above description it will be appreciated that owing to the presence of the slack portion or loop 38 in the web 25 during the printing operations by the plates 7 and 7', the web can advance at slightly different speeds at the pin wheels 24 and the impression roller 8 without the paper web being damaged by tearing at the punched holes therein.

If desired the printing roller 6 may be provided with means for consecutively numbering the patterns printed on the web 25 by the printing plates 7 and 7'. To this end each printing plate comprises a series of rotatable drums (not shown) arranged side by side. These drums carry impressions of the numbers it is desired to print on the punched paper and one or more of the drums are indexed through part of a revolution by suitable cam means (not shown) each revolution of the printing roller 6.

The above described machine is intended to print two impressions on the web 25 during each revolution of the printing roller 6. It will be appreciated, however, that the machine may be adapted to print only one impression, or more than two impressions in each revolu-

tion of the printing roller by arranging the appropriate number of printing plates around the printing roller. In these cases the above described pinions **12** and **13** would be replaced by other interrupted tooth pinions to give the web the correct number of dwell periods during each revolution of the printing roller.

A printing machine in accordance with the present invention may be combined with a simple device for ruling lines on the punched paper in the longitudinal direction of the paper. Referring again to the drawing, such a device may comprise a horizontally disposed slotted bar **41** mounted between the side plates **1** upon which a plurality of ball point pens **42** or other suitable writing implements are mounted. The slot in the bar **41** is disposed substantially at right angles to the direction of advance of the web **25** and extends completely across the web. Each ball point pen **42** is mounted for adjustment along the slot in the bar **41** and each pen is urged against the web **25** by suitable spring means (not shown) at a point where the web is supported on its underside by the plate **27**. Such a ruling device is used by drawing the paper web **25** between the supporting plate **27** and the ball point pens **42** by means of the pin wheels **24**. The number of pens **42**, the colour of the ink in the pens, and the positions of the pens in the slotted bar **41** are so chosen that the required number of lines of the desired colous or colours and at the correct distance apart are produced on the web **25** as the latter passes through the machine. If desired the bar **41** may be provided with two or more parallel slots, there being one or more pens **42** mounted in each slot. With this arrangement it is possible to produce lines closer together on the web **25** than would be possible if all the pens were mounted in a single slot. Instead of the ball point pens **42** the ruling device may comprise other writing implements such as pencils or rotatable wheels fed with a suitable ink or dye. The ruling device may be employed at the same time as the web is being printed by the printing roller **6**. Preferably, however, ruling is effected as a separate operation. In this case the impression roller **8** would be lowered away from the printing roller **6** and the pin wheels **24** would be arranged to be driven continually instead of intermittently.

What I claim is:

1. A rotary printing machine for printing punched paper comprising a printing roller, a printing form on said printing roller, means adapted to rotate the printing roller continuously, a pressure-applying means adapted to nip punched paper entering the machine against the printing roller to cause the punched paper to be advanced through the machine and the printing roller to print a pattern on the punched paper at intervals along the latter, a pin wheel drive adapted to draw the printed punched paper away from the printing roller, means for driving the pin wheel drive intermittently, said printing roller and pressure-applying means being adapted to release the punched paper at least once in each revolution of the printing roller, and means for synchronizing the intermittently driven pin wheel drive with the passage of said printing form through the printing line in such a way that the pin wheel drive is at rest at the commencement of each printing operation at the printing roller but starts to rotate shortly thereafter and continues rotation for a certain time after termination of the printing operation while the punched paper is released so that at the commencement of each printing operation the punched paper at the printing roller is caused to advance slightly relative to the punched paper at the pin wheel drive whereby the portion of paper between the printing roller and the pin wheel drive is in slack condition during the printing operation while the slack is taken up by said pin wheel drive before the next following printing operation.

2. A rotary printing machine as claimed in claim 1, in which the means for driving the pin wheel drive intermittently comprises a toothed pinion, an interrupted toothed pinion driving said pinion and driven in turn by the printing roller, and transmission means for transmitting the motion of the toothed pinion to the pin wheel drive.

3. A rotary printing machine as claimed in claim 1, in which the speeds of rotation of the printing roller and the pin wheel drive are such that the nip at the printing roller advances the paper web at substantially the same speed as the pin wheel drive.

4. A rotary printing machine as claimed in claim 1, in which the printing surface of the printing roller is provided by at least one removable segmental printing plate.

5. A rotary printing machine as claimed in claim 2, in which the printing surface of the printing roller is provided by at least one removable segmental printing plate, and in which the angular position of each printing plate in relation to the angular position of said interrupted toothed pinion may be adjusted.

6. A rotary printing machine as claimed in claim 1 in which means are provided for braking the pin wheel drive.

7. A rotary printing machine as claimed in claim 1, in which said pressure-applying means is in the form of an impression roller.

8. A rotary printing machine as claimed in claim 1, comprising means for consecutively numbering the patterns printed on the punched paper by the printing roller.

9. A rotary printing machine as claimed in claim 1, in combination with means for ruling lines on the punched paper in the longitudinal direction of the paper.

10. A printing machine for printing a longitudinally punched web, comprising, in combination, a printing roller; a printing form on said printing roller; means for continuously rotating said printing roller; pressure-applying means movable to and from an operative printing position cooperating with said printing form along a printing line for printing and transporting the paper web; a pin wheel drive adapted to engage punched holes in the punched web for drawing the web away from said printing roller; drive means for intermittently driving the pin wheel drive and including means operatively connected to said printing roller for synchronizing the intermittent operation of said pin wheel drive with the passage of said printing form through the printing line in such a way that the pin wheel drive is at rest at the commencement of each printing operation but starts to rotate shortly thereafter and continues rotation for a certain time after termination of the printing operation so that at the commencement of each printing operation a slack portion is formed in the web between said printing roller and said pin wheel drive and so that the slack portion is made taut by said pin wheel drive while the web is released by said printing roller and pressure applying means before the next following printing operation.

11. A printing machine for printing a longitudinally punched web, comprising, in combination, a printing roller; a printing form on said printing roller; means for continuously rotating said printing roller; pressure-applying means movable to and from an operative printing position cooperating with said printing form along a printing line for printing and transporting the paper web; a pin wheel drive adapted to engage punched holes in the punched web for drawing the web away from said printing roller; drive means for intermittently driving the pin wheel drive and including a first interrupted toothed pinion connected to said printing roller for turning movement with the same and a second interrupted toothed pinion meshing with said first interrupted toothed pinion and being operatively connected to said pin wheel drive for synchronizing the intermittent operation of said pin wheel drive with the passage of said printing form through the printing line in such a way that the pin wheel drive is at rest at the commencement of each printing op-

eration but starts to rotate shortly thereafter and continues rotation for a certain time after termination of the printing operation so that at the commencement of each printing operation a slack portion is formed in the web between said printing roller and said pin wheel drive and so that the slack portion is made taut by said pin wheel drive while the web is released by said printing roller and pressure applying means before the next following printing operation.

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