Sept. 22, 1964 R. A. DAVIS 3,149,766

WEB FEEDING APPARATUS

Filed Sept. 5, 1961 3 Sheets-Sheet 1

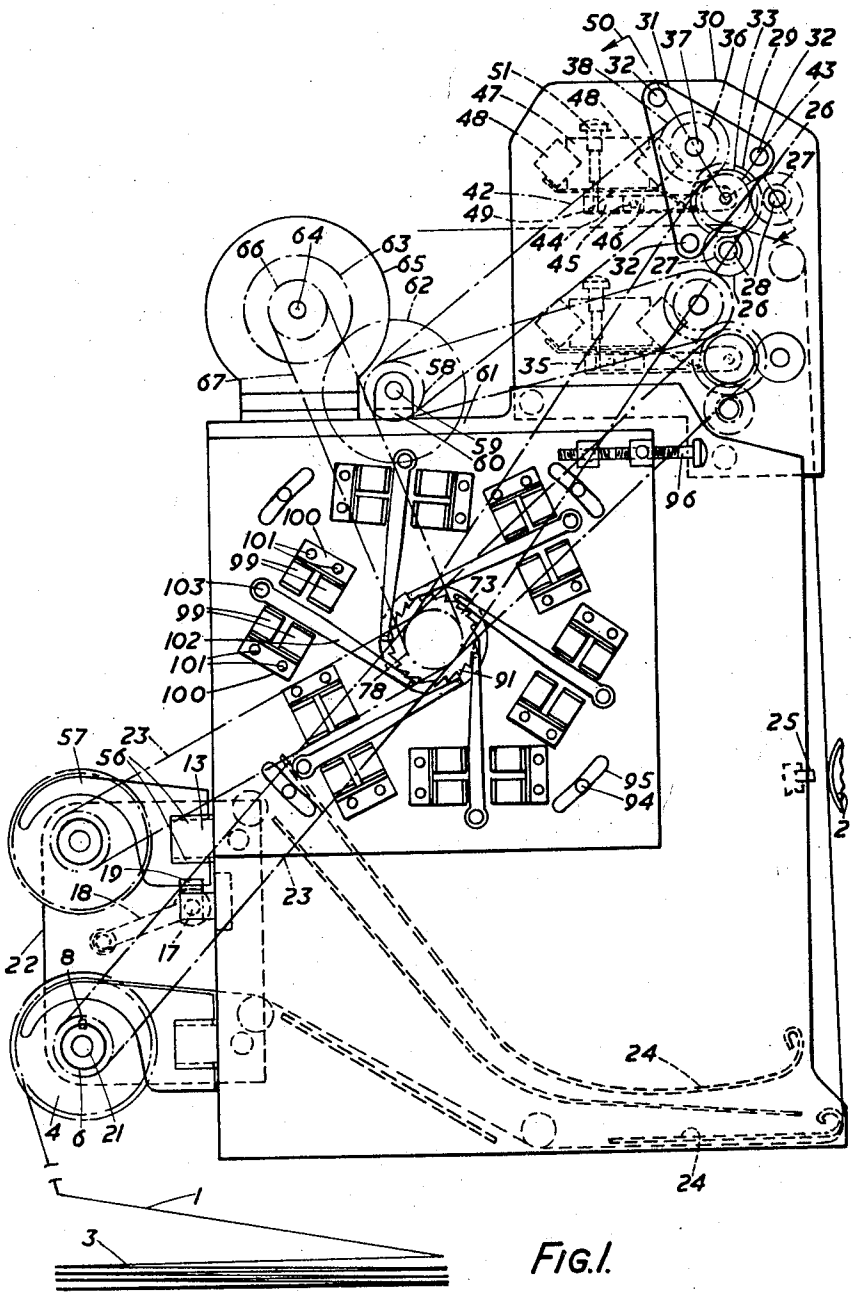


FIG. 1.

INVENTOR
ROGER ARTHUR DAVIS
BY Hane and Nydick
ATTORNEYS

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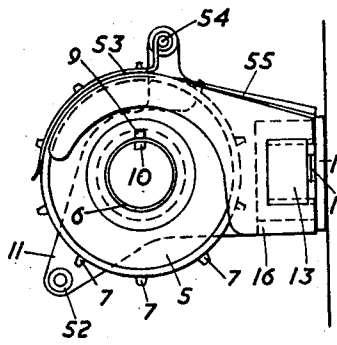


FIG. 2.

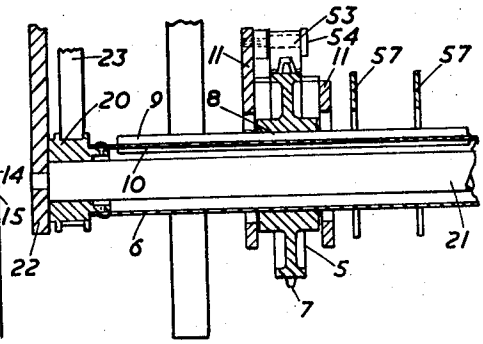


FIG. 3.

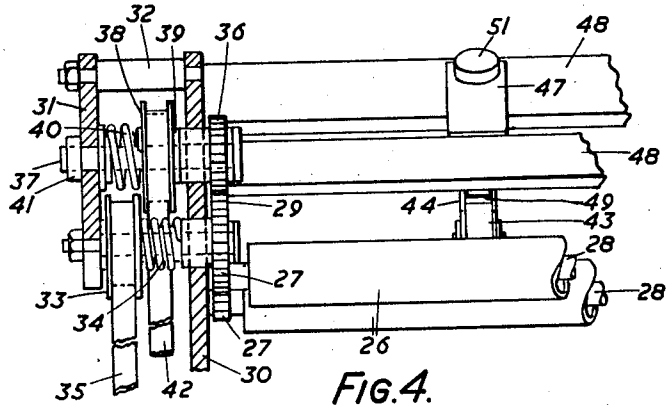


FIG. 4.

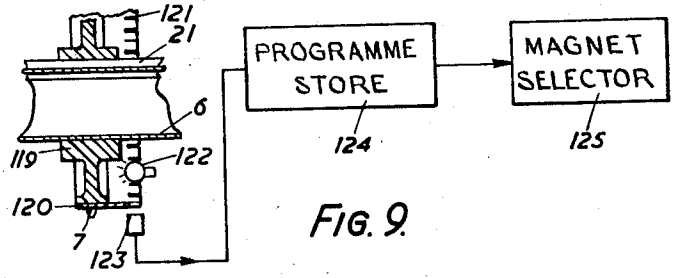


FIG. 9.

INVENTOR
ROGER ARTHUR DAVIS
BY Hane and Nydick
ATTORNEYS

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WEB FEEDING APPARATUS

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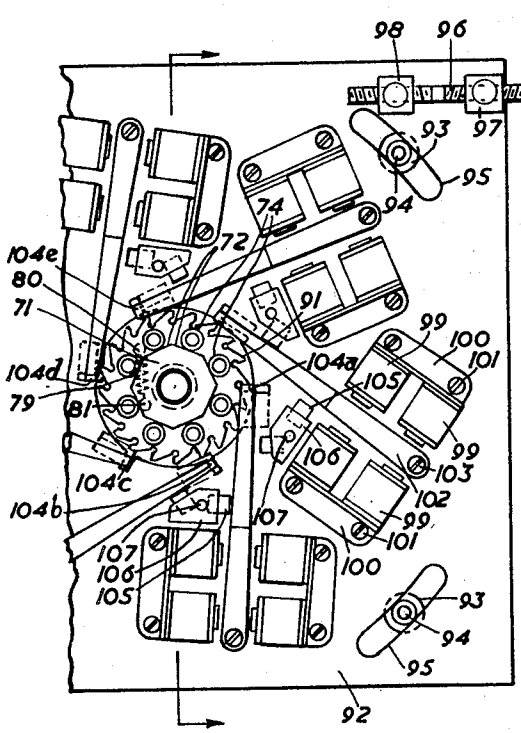


FIG. 5.

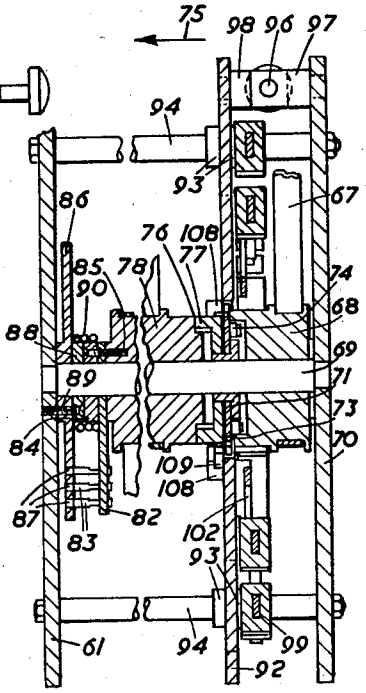


FIG. 6.

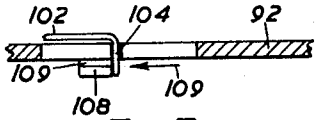


FIG. 7.

FIG. 8.

INVENTOR
ROGER ARTHUR DAVIS

BY Hane and Nydick

ATTORNEY

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WEB FEEDING APPARATUS

Roger Arthur Davis, Letchworth, England, assignor to International Computers and Tabulators Limited, London, England

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Claims priority, application Great Britain Sept. 13, 1960
5 Claims. (Cl. 226—76)

The present invention relates to web feeding apparatus.

It has previously been proposed to provide apparatus for feeding a paper web, for example, through a printing apparatus to allow the printing of lines of characters thereon. Such apparatus commonly requires the web to be arrested with a required printing line at the printing position and then requires the web to be advanced to bring the next required printing line to the printing position. In order to maintain a regular line spacing on the printed web it is obviously necessary to feed and arrest the web accurately at each line position. Conventional apparatus uses relatively heavy tractor or pinwheel feeding mechanisms to ensure accurate alignment of the web and it will be appreciated that these mechanisms have considerable inertia which leads to inaccuracies in alignment caused by the tendency of the mechanisms to overthrow. This tendency is obviously greater as speed of feeding of the web is increased. Moreover, in a great many cases the printing format on the web does not require a constant single line spacing but rather requires that specific printed lines shell occur at predetermined irregularly spaced line positions on the sheet. In order to perform the printing operation as rapidly as possible it is desirable to allow feeding of distances greater than one line space in a single movement rather than in a series of discrete line spacing steps. This preferred operation, however, increases the tendency for misalignment to occur.

It is an object of the present invention to provide improved apparatus for feeding a paper web at high speed and for arresting the feeding of the web at predetermined positions.

Apparatus embodying the present invention will now be described, by way of example, with reference to the accompanying drawings in which,

FIGURE 1 shows a general schematic side view of web feeding apparatus,

FIGURE 2 is a side view of a web feeding device,

FIGURE 3 is a partial sectional view of the web feeding device of FIGURE 2,

FIGURE 4 shows part of a second web feeding device,

FIGURE 5 shows in greater detail the main driving arrangement of the apparatus,

FIGURE 6 is a sectional view of the main driving arrangement,

FIGURE 7 is a detail of a detent supporting arrangement,

FIGURE 8 shows, schematically, a printing programming arrangement, and

FIGURE 9 is a schematic diagram of an alternative programming arrangement.

Referring now to FIGURE 1, the present apparatus is arranged to feed a web of paper 1 past a printing station, represented schematically by a part of a type-carrying wheel 2. The printing station has a row of type carrying wheels arranged in line across the web 1 and the web feeding arrangement to be described allows the feeding of the web to be arrested in order to print lines of characters from the typewheels 2 in predetermined line positions on the web. It will be appreciated that the printing station would, in practice, also include a hammer mechanism for each type wheel and an inked ribbon similar to a typewriter ribbon between the typewheels 2 and

the web 1. Since the printing of characters forms no part of the present invention, the additional apparatus required has been omitted, for the sake of clarity, from the figure. However, it will be appreciated that any suitable known form of character printing apparatus may be used for this purpose. The paper web 1, when used in printing of apparatus of this kind, is usually termed "continuous stationery." Such stationery, in its simplest form, consists of a single layer of paper having perforations, or sprocket holes, punched along both edges to facilitate feeding. Other forms of continuous stationery may also be used, for example, the stationery known as "multi-part sets," in which a number of layers of stationery are used to form a composite web. The layers of paper are laid over one another and interleaved with carbon paper or the composite webs may simply comprise layers of carbon backed paper. In these cases it is preferred that the separate layers should be gummed or fixed together along at least one edge to form the single composite web. Such stationery is usually supplied folded in zig-zag or concertina fashion so that the web may be continuously withdrawn from the pack in which it is supplied.

In the present case, the supply pack 3 is arranged beneath the apparatus and is drawn upwards into the apparatus by means of a first feeding station 4, which is a form of pinwheel feed. The feed 4 is shown in greater detail in FIGURES 2 and 3, and consists of a pair of pinwheels 5 mounted on a common carrier 6 and spaced apart so that the pins 7 of the wheels engage with the sprocket holes in the sides of the web.

In order to reduce the stopping and starting times of the web to obtain maximum effective feeding speed it has been found necessary to reduce the inertia, and consequently the weight, of the feeding devices to a minimum.

For this purpose the pinwheels 5 are preferably moulded in skeleton or shell form in one of the so-called synthetic plastic materials, such as nylon. The pinwheels 7 are slidably mounted on a light weight thin-walled tube 6 of, for example, fibreglass. The hub of each pinwheel is provided with a keyway 8 and a spline 9, again of a synthetic plastic material, is longitudinally fixed to the tube 6 by means of screws (not shown) passing through the tube wall into a backing bar 10 inside the tube.

Each pinwheel 7 is contained in a cage comprising two side plates 11 spaced apart by posts 52 and secured to a block 12, indicated by a dotted outline in FIGURE 2. The block 12 is slidable along a bar 13 extending parallel to the tube 6. The block 12 is retained in position on the bar 13 by means of a retaining plate 14 having a spring strip 15 frictionally engaged with the bar 13. The block 12 also has a recess 16 in its underside.

The recess 16 is provided for lateral adjustment of the pinwheel cage and, consequently, of the pinwheel. This adjustment arrangement is shown in FIGURE 1. A screwed rod 17 extends parallel to the tube 6 and is rotatable by means of a removable handle 18. A conventional split nut having a projection 19 is engaged by the recess 16 of the pinwheel cage block 12. For the sake of clarity the pinwheel cage is omitted from FIGURE 1. Thus, in order to position the pinwheels for engagement with the sprocket holes in the web 1, the split nuts are first disengaged from the rod 17 and the pinwheel cages are positioned at the appropriate spacing. The split nuts are then re-engaged and fine adjustment of the lateral position of the web is obtained by means of the handle 18.

Each pinwheel cage has a conventional slotted guide 53 pivoted about a pin 54 projecting from one side plate 11 to retain the web in engagement with the pins and a stripper blade 55 is also provided for each pinwheel.

The bar 13 is provided with slots 56 and web supports 57 are inserted into the slots 56 between each pair

of pinwheels to prevent sagging of the web between the pinwheels. The supports 57 are generally indicated in FIGURE 1 but are omitted, for the sake of clarity from FIGURE 2.

It will be realized that when it is required to feed more than one superimposed web, a corresponding number of pinwheel pairs are provided at first feeding station. For example, two pairs are indicated in FIGURE 1 and it is to be understood that similar arrangements are provided for each pair. For the sake of clarity, however, only a single web 1 is shown and similarly only a single adjusting handle 18 is indicated. In an alternative form of apparatus the lateral screw adjustments may be omitted and the pinwheels or pinwheel cages may then be secured, for example, by means of set screws.

Each tube 6 carrying a pair of pinwheels is supported by a light weight hub 20 again, for example, of synthetic plastic material, at each end and these hubs carry free running bearings running about a supporting shaft 21 (FIGURE 3) extending between side plates 22 which carry the entire lower feeding station. For the sake of clarity one of the side plates 22 is omitted from the view shown in FIGURE 1. One of the tube carrying hubs 20 of a tube 21 is arranged to be driven by means of a belt 23 from a main clutch. It will be appreciated that each tube 21 is separately driven by its own belt 23 as indicated in FIGURE 1. It is desirable to use a conventional toothed timing belt for this purpose to prevent slip occurring between the clutch and the pinwheels.

As will be seen from FIGURE 1, the web 1, or, where more than one web is fed, each web 1, is advanced from the pack 3 into the feeding and positioning apparatus under control of these timing belts 23. As will be explained, the belts 23 are controlled by the engagement of the main clutch which is controlled electromagnetically to allow advancing of the webs. Only a single clutch is shown in FIGURE 1, but it will be appreciated that it is commonly required to advance two superimposed webs through the apparatus at different rates. For example, in an accounting operation one web may be required for the preparation of invoices while the second web serves as a tally sheet and is moved by one line space at a time irrespective of the movement of the first web. Hence, for this type of operation a separate main clutch would be required for controlling the movement of each web individually. However, since both webs are fed in the same way only a single main clutch will be described herein for the sake of clarity.

Furthermore, although the pinwheels are described as integrally moulded, it will be apparent that the pins may be carried by a separate band secured to the periphery of a single wheel. In a further example each band may form a flexible plastic tractor band with integrally moulded pins and supported by a number of wheels, one of the wheels being a driving wheel carried by a lightweight tube and driven, as described above, by a timing belt.

Each web is fed from the pinwheels at the first or lower feeding station to a paper guide 24 which passes across the bottom of the apparatus. The end of the guide 24 remote from the pinwheels is curved upwards and the web 1 is then guided through a substantial angle to pass a second or upper feeding station at the top of the apparatus. During the passage of the web to this second feeding station, it passes between the line of typewheels and an anvil arrangement 25 which co-act to print a single line of characters at each printing operation.

Each paper guide 24 ensures that a web is correctly positioned in relation to the typewheels 2, that it passes freely between the typewheels 2 and the anvil 25 and, by introducing the substantial bend in the web, also ensures that the web 1 is taut and rigid as it passes the printing position. As shown in FIGURE 1 the path of the web 1 is turned through approximately 90° by the bend in the guide 24. However, it will be realized that this degree of bend in the path is convenient in the present case due to the relative dispositions of the first and second feeding stations in the apparatus. It is not necessary that the stations should be at different levels, nor is it necessary that the web should pass vertically through the printing station as in the present case. Rather the dispositions of the feeding stations relative to the printing station are dictated by convenience in overall design having regard to the printing position of the line of printing elements. In order to reduce the drag on the web or webs to permit high feeding rates it is desirable that the two feeding stations are disposed one on each side of the printing station and that the web is passed as directly as possible between the stations, the guide between the stations producing a bend in the path such that the rigidity of the web as it passes the printing station is improved.

As in the case of the first feeding station the second feeding station has a separate feeding device for each web. These devices are the same, however, so that only one device will be described in detail. The general arrangement of the second feeding station is shown in FIGURE 1, while FIGURE 4 shows a partial sectional view of one of the feeding devices taken along a line 50 as indicated in FIGURE 1.

Each of the second feeding devices is arranged in the following way. Two lightweight tubes 26, generally similar to the tubes used in the first feeding station but without the spline are supported by means of hubs 27 on a pair of parallel shafts 28. The hub at one end of each of the tubes 26 carries gear teeth and an intermediate gear 29 is provided, meshing with both hubs. The intermediate gear 29 is supported on a stub shaft supported between one side plate 30 of the feeding station and an auxiliary plate 31 spaced away from this side plate by supporting posts 32. The hub of the intermediate gear 29 extends into the space between the auxiliary plate 31 and the side plate 30 and abuts the hub of a driving pulley 33. A coil spring 34 is wound about the two abutting hubs and thus forms a unidirectional spring clutch. The pulley 33 is driven by a belt 35 from the main clutch and the coil spring is wound in such a manner that as the pulley 33 is driven, the spring 34 tightens on both hubs and the drive is transmitted to the intermediate gear 29 and so to the parallel tubes 26.

A further gear 36 is provided meshing with the intermediate gear 29 and the hub of the gear 36 also extends into the space between the two plates 30 and 31. A stub shaft 37 supports the gear 36 and this stub shaft is supported at one end by a bush 41 screwed into the auxiliary side plate 31 and carries a further pulley 38. A friction disc 39 is interposed between the pulley and the hub of the gear 36. A compression spring 40 is mounted about the stub shaft 37 on the opposite side of the pulley 38, between the pulley and screwed bush 41. Thus, since both tubes 26 are coupled by the intermediate gear 29, they are frictionally driven by means of the further pulley 38 and the degree of friction is controllable by adjusting the compression of the spring 40 by means of the screwed bush 41. The pulley 38 is continuously driven by means of a bolt 42 from an idler pulley 58. The idler pulley is secured to a shaft 59 supported in a bracket 60 carried by one of the main side plates 61 of the apparatus. Suitable gearing 62, 63 is provided between the shaft 59 and the driving shaft 64 of a main driving motor 65.

The lowermost of the two tubes 26, as shown in FIGURE 1, provides a drive for the underside of the paper web 1, and the upper tube 26 is used to drive a pair of resilient tyred rollers 43 which then provide a drive for the upper face of the web 1. The rollers 43 are preferably of slightly smaller diameter than the two tubes 26 and are so positioned relative to the tubes that the resistance of the web 1 to movement tends to force the rollers 43 into contact with the lower tube 26 so that the web is more tightly gripped between the rollers 43 and the lower tube 26.

The rollers 43 are each supported in a carrier 44 and the carrier 44 is pivoted about a pin 45 supported by lugs 46 depending from a block 47. The block 47 slides between two square section bars 48 and may therefore be laterally adjusted to position the rollers relative to the width of the web 1. The underside of the block 47 carries a leaf spring 49 one end of which is applied to the carrier 44 to bias the roller 43 towards the lower roller 26. A plunger 51 is also provided in the block 47 and its lower end engages the carrier 44. Depression of the plunger releases the roller 43 from the lower tube 26 to allow the insertion of the web 1 when initially loading the web into the apparatus.

It will be seen, therefore, that the arrangement of the feeding devices at the second feeding station provides a tube and roller combination to provide a drive to both faces of a web. The main drive is provided by the belt 35 from the main clutch which also controls the driving of the pinwheels at the first feeding station. The operation of the main clutch will be described in detail hereinafter but it will be appreciated that when the clutch is engaged, the web is drawn from the stack 3 and is passed towards the printing arrangement by the first feeding station. At the same time the main drive to the second feeding station is also engaged and the web is drawn through the apparatus by this second station. Since it is not possible, owing to the various tolerances on dimensions required for manufacturing purposes, to ensure that precisely the same web movement is occasioned by both feeding stations it is preferred to slightly underdrive the feeding devices at the second station relative to the pinwheels at the first station and the pulley and gearing proportions are such that this condition is fulfilled. This of course, would normally produce a slack loop of web between the two feeding devices and, since this condition is cumulative in effect, it would appear that the loop gets larger as feeding progresses.

However, since the feeding of the web normally takes place by a series of short feeding movements (e.g. line-by-line spacing or paper throws of only a few line spaces each) and each feeding movement causes a tendency of the second feeding station to overthrow, advantage can be taken of this tendency to take up any slack as it develops. For example, the provision of a positive acting unidirectional coupling between the main clutch and the second feeding station will allow the devices at the second feeding station to jump forward with respect to the main clutch at each overthrow, the unidirectional coupling ensuring that no backward movement of the second feeding station is possible. In this case the friction drive applied continuouously as described to the second feeding station merely assists in the rapid take-up of drive by tensioning that part of the web between the feeding stations and in effect, biassing the web to move forward as soon as the main drive is applied.

In practice, however, the lightweight construction described not only reduces the inertia of the feeding stations upon the application of the main drive but also reduces the tendency of the feeding stations to overthrow and it has been found that the friction drive alone is sufficient to counter the development of a slack loop between the feeding stations by the tensioning effect referred to. Since this friction drive is continuously applied, any slack developing is taken up until the web is again taut, at which point the friction drive slips. Since the friction drive is applied directly to the tubes 26 of the second feeding station the spring clutch 34 in the main drive to the tubes slips to allow the slack to be taken up. On the other hand at the time when the main clutch is engaged, the tubes 26 would tend to drive through the friction clutch to the continuously running friction drive pulley 38 and the load on the main drive would be increased by the load imparted by the friction clutch. Since it is undesirable to increase the main drive load in this way, the pulley ratios in the friction drive are such that the friction clutch tends to drive the tubes 26 at the same speed as the main drive. In this way the friction drive is used to assist the main drive and is thus useful in keeping the starting time for the web to a minimum.

To summarize the foregoing description it will be seen that the movement of the web is controlled by the main clutch, the web being positively driven by the first and second feeding station when the main clutch is engaged.

Further, the web between the station is maintained under tension by an impositive drive applied directly to the second feeding station and this further drive also assists in the rapid movement of the web when the main clutch is engaged. The construction of the feeding devices at both stations are such that all those members which are moved by the drive in feeding the web are as light in weight as possible to reduce the inertia of the moving parts to a minimum and thus allow acceleration from rest to full speed to take place as rapidly as possible. At the same time, because the inertia of these parts is minimised in this way the deceleration is also accomplished rapidly with minimum shock and overshoot, these factors being of importance in aligning the web accurately in predetermined line positions after each feeding movement. In order to reduce the weight in this way, the gears are in shell or skeleton form and the so-called synthetic plastics, such as nylon, are used wherever metal parts are not necessary for correct operation. The main clutch is indicated schematically in FIGURE 1 and is shown in greater detail in FIGURES 5 to 7. The construction and operation of the main clutch will now be described with reference to these figures.

The driving shaft 64 of the motor 65 (FIGURE 1) carries a pulley 66, and a belt 67 (FIGURES 1 and 6) transmits the drive from the pulley 66 to a main driving pulley 68 of the clutch (FIGURE 6). The pulley 68 forms the main driving hub of a conventional roller clutch and runs freely on a shaft 69 supported between the side plate 61 of the apparatus and an auxiliary side plate 70. The driving hub 68 is recessed and this recess houses a cam member 71 also supported freely on the shaft 69 and having a number of cam faces 72. A ratchet wheel 73 is mounted freely on the hub of the cam member 71 and carries a number of rollers 74, one roller 74 for each cam face 72. These arrangements are shown in FIGURE 5, which represents a view in the direction of arrow 75 (FIGURE 6) with the auxiliary plate 70 and the driving hub 68 removed.

The cam member 71 is secured to an output drive member 76, comprising two members 77 and 78 keyed together to form a hollow drum. A tension spring 79 (FIGURE 5) is contained within this hollow and is secured to two posts 80 and 81 respectively supported by ratchet wheel 73 and the cam member 71. The spring 79 is effective to load the ratchet wheel 73 so that it tends to turn relative to the cam member, and thus to the output member 76. This turning movement causes the rollers 74 each to ride up the cam surface 72 with which it is associated and in consequence the rollers 74 are displaced outwards to grip the inner face of the recess in the driving hub 68.

The direction of the drive is such that the rollers 74 tend to ride still further up the cam surfaces causing both members to become locked as the drive is transmitted to the composite output member 76, one part 78 of which carries the driving belts 23 and 35 which drive the first and second feeding stations respectively.

An arm 82 carrying contact brushes 83 is provided and is secured to the part 78 by means of a collar 84 and fixing screws 85. A commutator disc 86 carries contacts 87 which are swept by the brushes 83 as the arm 82 rotates. The disc 86 is secured by means of a second collar 88 and fixing screws 89. The two collars 84 and 88 abut to form a smooth drum and a spring 90 is wound about the drum thus formed to provide an anti-reverse lock in known manner. The action of the spring 90 depends

upon the fact that it is so wound and secured to the stationary collar 88 that it tightens on the collar 84 if the collar 84 tends to move in the reverse direction, thus locking the collar 84 and hence the output drive member 76.

The foregoing description assumes that the ratchet wheel 73 is free to rotate and shows the transmission of the main drive to the feeding stations while the main clutch is engaged. If, now, the rotation of the ratchet wheel 73 is arrested, the forward motion of the output member 76 continues against the loading spring 79 until the relative movement between the ratchet wheel 73 and the cam member 71 is such that the rollers 74 no longer grip both the cam faces 72 and the inner face of the recess in the driving hub 68.

The clutch is therefore disengaged. The coil spring 90, since it prevents reverse rotation of the output member 76, also prevents the relative turning motion between the now stationary ratchet wheel 73 and the cam member 71 with the result that once disengaged, the roller clutch remains in this condition until the ratchet wheel 73 is again released.

Hence, the drive to the web feeding members at the feeding stations is disengaged simply by arresting the ratchet wheel 73. The periphery of this wheel 73 is divided into a number of equally spaced teeth 91, and the pulley diameters and the drive gearing are such that in the present case each tooth 91 on the ratchet passing a given point corresponds to the passage of half an inch of web through the feeding devices. It is usual, however, in printing devices of this general kind to require that successive lines of printing are spaced apart by one sixth or one eighth of an inch, so that to move the web a distance equal to one line space requires that the ratchet disc is arrested after travelling a distance equal to one third or one quarter of a tooth length, respectively.

In order to allow single line spacing on the web for both these spacing conditions, a number of stop members are provided around the periphery of the ratchet disc. In the present case six members are provided and these are supported on an intermediate supporting plate 92. The plate 92 is positioned relative to the ratchet wheel 73 by means of collars 93 secured to supporting posts 94 which space the auxiliary plate 70 away from the side plate 61. The posts 94 project through slots 95 in the plate 92, so that the plate 92 is free to swing about the axis of the shaft 69. The plate 92 is held in a predetermined position by means of an adjusting screw 96. The screw 96 has left- and right-hand threaded portions cooperating respectively with nuts 96 and 97. The nuts 97 and 98 are respectively attached to plates 70 and 92. Six electromagnets assemblies are supported by the plate 92 and each assembly comprises two pairs of electromagnet coils 99 mounted on a yoke 100. The yoke 100 is secured by fixing screws 101 to the plate 92. The two pairs of coils are mounted on opposite sides of an armature 102 pivoted about a pin 103. The end 104 of the armature is bent through a right angle as shown in FIGURE 7 to form a stop member and this end then projects through the mounting plate 92 into the plane of the ratchet wheel 73. Movements of the armature 102 (FIGURES 6 and 7) are controlled by the two pairs of electromagnet coils, one pair being energized to move the stop member 104 into engagement with the ratchet teeth 9, the other pair being energized to move the stop member 104 out of engagement. The armature 102 is retained in the position into which it was last moved by small permanent magnets 105 (FIGURE 6) clamped to the mounting plate 92 by means of a clamping plate 106 and a fixing screw 107.

It is desirable to make the armature and therefore the stop member as light in weight as possible in order that it may be moved rapidly from one position to the other. At the same time, since the shock of engagement of the stop member 104 with a tooth of the ratchet wheel is considerable it is desirable that the end of the armature forming the stop member should be reinforced. Accordingly a block 108 is mounted on the mounting plate 92 in association with each stop member. This reinforcement is shown in detail in FIGURE 7. The block 108 has a channel 109 to allow the ratchet teeth 91 to pass and the stop member 104 projecting through the plate 92 slides over the end face of the block 108. The direction of motion of the ratchet teeth 91 is indicated by arrow 109 in FIGURE 7 and when the stop member is moved into engagement with a tooth, the shock of the engagement is transmitted to the block 108. Hence the armature 102 is made sufficiently light to ensure that it may be moved rapidly and the block 108 reinforces the stop member 104 to provide the necessary solidity to ensure accurate positioning of the ratchet wheel after repeated engagements.

The six stop members 104 are so positioned about the periphery of the ratchet wheel that correct line spacing may be obtained by selecting an appropriate stop member 104 to be engaged with the ratchet wheel teeth 91. For example, consider the requirement that single line spacing is required at successive positions one sixth of an inch apart on the web and suppose that the first of the stop members, reference 104*a* in FIGURE 5, is engaged with a ratchet tooth 91. The second member 104*b* is then positioned so that if moved into engagement position at this time it is spaced away from the face of a ratchet tooth 91 by a distance equal to one third of a tooth-length. Under similar conditions the third member 104*c* is spaced away from a tooth face by a distance equal to two-thirds of a tooth length. Thus, if all three members 104*a* to 104*c* are initially in the engagement position and the first member 104*a* is moved out of engagement, the ratchet wheel 73 will move until the second member 104*b* is engaged by the face of the next occurring tooth 91, that is, for a distance equal to one third of a tooth length. If now, the second member 104*b* is withdrawn the ratchet wheel movement will continue for a similar distance until the third member 104*c* is engaged. If the first member 104*a* is once more moved into the engagement position and the third member 104*c* is withdrawn the ratchet wheel will again move for a distance equal to a third of a tooth length. Thus, the selection of an appropriate one of the group including the first, second and third stop members 104*a* to 104*c* controls the movement of the web in line spacing at increments of one sixth of an inch.

The first, fourth, fifth and sixth stop members 104*a*, 104*d*, 104*c* and 104*f* respectively are used as another group in a similar manner to control line spacing of the web at increments of one eighth of an inch, the fourth, fifth and sixth stop members 104*d* to 104*f* being so positioned relative to the first member 104*a* that they are spaced away from engagement with the face of a ratchet tooth 91 by one quarter, one half and three quarters of a tooth length respectively.

It will be appreciated that the paper web may be fed to successive line positions at either a sixth or an eighth of an inch spacing by the successive selection of the stop members in the appropriate group. Further, the paper web may be fed for distances corresponding to multiples of single line spaces by the selection of appropriate stop members to be moved into engagement with the ratchet disc teeth. It will be appreciated that since in the case of one sixth-inch spacing, the length of each tooth on the ratchet represents three line spaces, the movement of the stop member into the path of a tooth may take place up to almost three line positions in advance of the line position at which feeding is to be arrested. Thus, the time available for moving the stop member into position is almost three times as great as would be the case if the length of a ratchet tooth corresponded to a single line position on the web. This in turn, allows greater tolerance in the operating characteristics of the electromagnets and stop members at high feeding speeds. It will be obvious that similar considerations apply in the case of one eighth-inch spacing.

In order to facilitate the alignment of the characters to be printed with pre-printed lines on the web, for example, the mounting plate for the stop members is adjustable by means of the screw **96**. The slots **95** in the plate which allow the plate to be shifted about the axis of the ratchet disc and thus enable the positions of the stop members **104** to be adjusted with respect to the faces of the ratchet teeth **91**.

It is commonly required in the preparation of printed documents on a web of paper to provide a programme of arresting positions which are required to be repeated for each document on the web so that the same printing layout is used for each document. Programme devices for this purpose have previously been proposed and may, for example, require that line spaces are counted or that a predetermined programme of arresting positions is stored, the store being scanned in synchronism with the feeding of the web. The store may take various forms, typical examples being a plugboard, a perforated tape or a shifting register.

In conjunction with such programme devices it is required to provide means for indicating the position of the web relative to the printing station in order that a particular programme step may be identified or to provide means for signalling the passage of each line past the printing position.

In the apparatus previously described the commutator **86** in association with the brushes **83** provide means for identifying the position of the web. In loading the web into the apparatus, the main clutch is first engaged and then disengaged to align the brushes **83** with a predetermined "home" contact **82**. The web **1** is then loaded into the apparatus so that a corresponding starting line position is at the printing station. In an alternative apparatus the drive to the brushes **83** is provided through a unidirectional clutch, such as the spring clutch referred to earlier, in order to allow the brushes to be independently positioned on the commutator after the web has been loaded.

These programming arrangements are shown schematically in FIGURE 8. Three rings of contacts **82** are provided on the commutator. One of these rings **110** is continuous round the commutator to provide a feeder. One of the remaining rings **111** has individual contacts spaced at intervals corresponding to web movement in increments of one sixth of an inch line spacing while the last ring **112** has contacts spaced to correspond to line spacing increments of one eighth of an inch.

Each contact of the ring **111** is connected individually to a one sixth-inch programming device **113** and each contact of the ring **112** is similarly connected to a one eighth-inch programming device **114**. These devices are identical except that there are fewer programme steps in the device **113** than in the device **114**. Both devices consist of plugboards having facilities for connecting any particular contact **82** to an output line to energize a required pair of electromagnet coils **99** and cause the operation of the associated stop member. These output lines are passed through a selecting switch **115** in order to disable that programme device not currently required for operation. From the switch **115** the outputs pass to a magnet selecting arrangement **116**. This arrangement controls the duration of energization of the appropriate magnet. For example, suppose that stop member **104***a* is required to be operated for programme step **7**. Since the coils **99** are required to be energized in advance of this programme step contact **82** associated with programme step **5** will be connected to secure this energization and the magnet selecting arrangement **116** will maintain the required coil energized. Furthermore, the arrangement also receives an input signal from a printing control device **117** in order that the selected programme steps are correctly called in relation to whether or not printing has actually occurred in any step. From the magnet selecting arrangement **116** energizing lines **118** are connected to the individual electromagnet coils **99**.

It will be realized that, since in the present apparatus the ratchet wheel has twenty teeth, the programming arrangement described above is suitable only for documents which are ten inches long and contain sixty line positions at sixth inch increments or eighty positions at eighth-inch increments. An alternative manner of use of the programme control commutator allows the production of documents of other lengths. In this case the programme device includes a programme store and the programme steps are scanned in sequence, one step being scanned at each line position. In this case the commutator and brush arrangements is merely required to produce a signal for each contact scanned by the brushes. Hence, the lines of contact **111** and **112** are commoned and a resultant impulse is derived on the common connection as the appropriate brush **83** passes across each contact **82** in the line.

An alternative way in which these indicating impulses may be derived is shown in FIGURE 9, which shows a part of a modified first web feeding station. A pinwheel is keyed as previously described to a spline **9** on a hollow tube **6**. In this case, however, the pinwheel consists of a wheel **119** which has a separate band **120** about its periphery, the band **120** carrying the web-engaging pins **7**. The band **120** also carries a number of slots **121**, the spacing of the slots corresponding to the line positions on the web. The slots **121** are illuminated by a light source **122** and are scanned by a photoelectric cell **123**. Signals produced by the photoelectric cell **123** indicate the passage of the line positions through the apparatus and are passed to control scanning of the programme store **124**. Resultant programme signals are passed to the magnet selector **125** to control the energization of the electromagnet coils **99** as described. It will be appreciated that this method of deriving indicating signals has the advantage that the indication is derived directly from the pinwheel which is positively coupled to the web and therefore prevents any play which may occur between the main clutch and the pinwheel from affecting the accuracy of the indication. It will also be understood that separate bands **120** are provided for one sixth and one eighth of an inch spacing. The bands may, for example, be provided on each of the pair of pinwheels at a web-feeding station, the output from the required band being selected by switching.

What is claimed is:

1. Web feeding apparatus comprising, first feeding members positively engageable with a web; second feeding members spaced apart from said first feeding members in the direction of feeding of the web; a unidirectional clutch coupled to said second feeding members arranged to transmit a drive applied thereto in a web-feeding direction; a main drive; a main clutch engageable to couple the main drive to said first feeding members and to said unidirectional clutch to produce concurrent feeding of the web by both first and second feeding members; and a friction clutch coupled directly between said second feeding members and said main drive.

2. Web feeding apparatus comprising, first feeding members positively engageable with a web; second feeding members positively engageable with the web and spaced apart from said first feeding members in the direction of feeding of the web; a unidirectional clutch coupled to said second feeding members arranged to transmit a drive applied thereto only in a web-feeding direction; a continuously running main drive; a main clutch having an input and an output; means coupling the input of the main clutch to the main drive; means coupling the output of the main clutch to said first feeding members and to said unidirectional clutch; means for temporarily engaging said main clutch to produce concurrent feeding of the web by both first and second feeding members; and means for impositively coupling

said second feeding members directly to said continuously running main drive.

3. Web feeding apparatus comprising, a first web feeding station including web-engaging pin feeding members; a second web-feeding station spaced apart from the first station in the direction of feeding of the web and having a web-engaging roller feed; a unidirectional clutch at the second feeding station coupled to the roller feed and arranged to transmit a drive thereto only in a web-feeding direction, the roller feed including rollers disposed to firmly grip the web when a drive is applied in said web feeding direction; a continuously-running main drive; a main clutch having an input and an output; means coupling the input of the main clutch to the main drive; means coupling the output of the main clutch to the pin feeding members at the first station and to said unidirectional clutch; means for temporarily engaging said main clutch to produce concurrent feeding of the web at both first and second feeding stations; and a friction clutch coupled directly between said roller feed and the main drive.

4. Web feeding apparatus comprising first feeding members positively engageable with a web; second feeding members positively engageable with the web and spaced apart from said first feeding members in the direction of feeding of the web; a unidirectional spring clutch coupled to said second feeding members arranged to transmit a drive applied thereto only in a web-feeding direction; a continuously running main drive; a ratchet wheel; a detent normally engaged with the ratchet wheel; means for disengaging and re-engaging the detent with the ratchet wheel; a roller clutch coupling the ratchet wheel to the main drive effective only when the detent is disengaged to transmit a positive drive to the ratchet wheel; means positively coupling the ratchet wheel to the first and second feeding members to produce concurrent feeding of the web by both first and second feeding members during the period when the detent is disengaged; and a friction clutch coupling the second feeding members directly to the main drive.

5. Web feeding apparatus comprising first and second feeding members positively engageable with a web, the second feeding members being spaced apart from the first members in the direction of feeding of the web; a unidirectional spring clutch coupled to said second feeding members arranged to transmit a drive applied thereto only in a web-feeding direction; a friction clutch coupled to said second feeding members; a continuously running main drive; means directly coupling said main drive to said friction clutch to tend to drive said second feeding members in the web-feeding direction; a ratchet wheel; a detent normally engaged with the ratchet wheel; electromagnets disposed about the detent responsive to electrical signals to produce movement of the detent effective to disengage and re-engage the detent with the ratchet wheel; a roller clutch coupling the ratchet wheel with the main drive effective only when the detent is disengaged to transmit a positive drive to the ratchet wheel; and means for positively coupling the ratchet wheel to the first and second feeding members to produce concurrent feeding of the web by both first and second feeding members during the period when the detent is disengaged.

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