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WEB-FEEDING DEVICES

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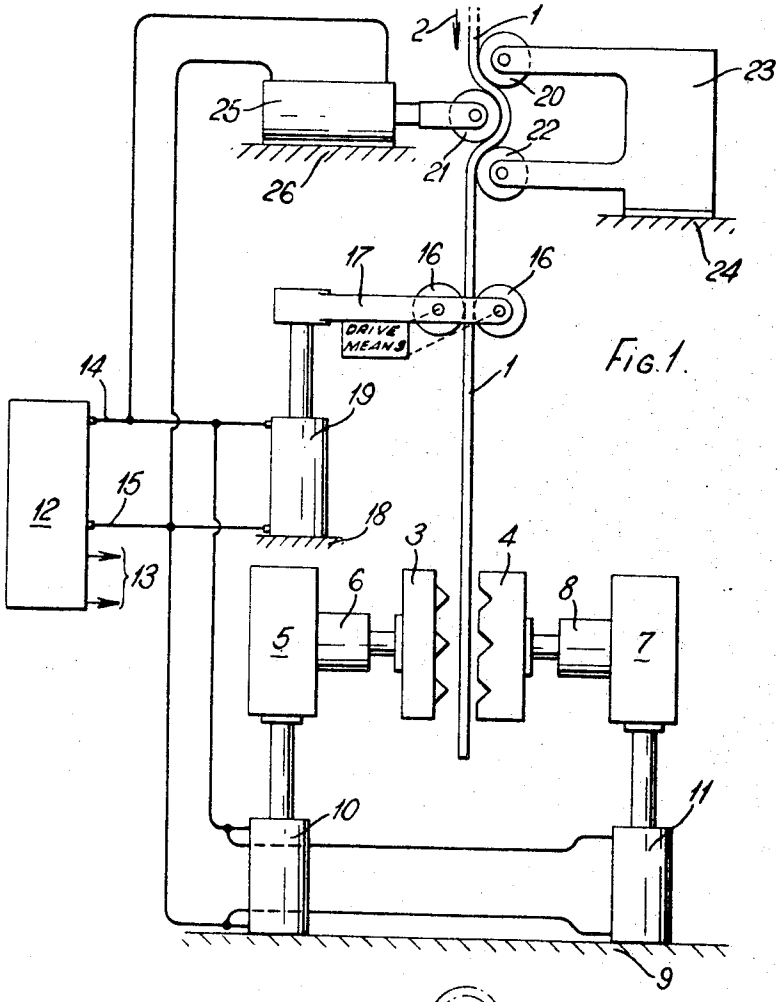


Fig. 1.

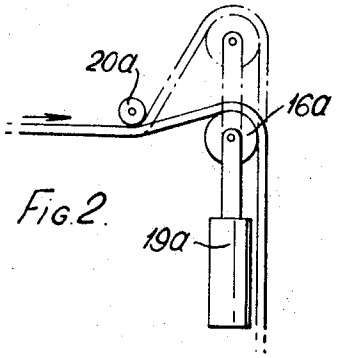


Fig. 2.

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# WEB-FEEDING DEVICES

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## ABSTRACT OF THE DISCLOSURE

A device for feeding a continuously-moving web into an intermittently-operating apparatus, comprising drive rollers giving a continuous drive to the web and means for reciprocating the drive rollers so as to alternately increase and reduce the speed of the web in synchronism with operation of the apparatus.

This invention relates to apparatus for operating on continuously-fed webs of sheet material.

More specifically, the type of apparatus to which the invention is applicable is that type in which a continuously-fed web is subjected to the action of tool means whose operation is intermittent. Such tool means may, during an operating stroke, travel with the web, (either in engagement with an area of the web or in proximity thereto) and upon completion of a desired operation be withdrawn from the web to execute a return stroke in which the tool means is moved in the opposite direction to the movement of the web so that such tool means may be brought into engagement with or proximity to a succeeding area of the web to repeat the desired operation thereon. Such apparatus will hereinafter be termed "apparatus of the type defined."

A convenient example of apparatus of the type defined is a machine for producing moulded articles by drawing from plastic sheet; in such a machine, the tool means comprises male and female dies which are brought into engagement with opposite faces of the sheet and by the application of mechanical and/or fluid pressure draw the sheet into a form determined by the configuration of said dies.

In apparatus of the type defined wherein the tool means travels with the web, it is generally necessary for the return stroke to be much faster than the operating stroke if waste is to be avoided (assuming as is usual that any area of the web which is not subjected to the action of the tool means will become waste). In some instances it is possible to allow time for the return stroke by intermittent web feed but the present invention is concerned with those cases (probably the majority) where continuous feed of the web to the apparatus cannot be interrupted, e.g. where the web is of plastic sheet material received directly from an extruder.

According to the invention, there is provided apparatus of the type defined, in which a feed device such as a pair of coacting rollers is arranged to propel the web continuously towards a zone in which the tool means operates, said feed device being mounted for reciprocating movement towards and away from said zone and connected to drive means arranged to produce such reciprocating movement in synchronism with operating and return strokes of the tool means.

The operation of the feed device accordingly provides a continuous forward feed of the web (e.g. where the feed device comprise coacting rollers, by rotation thereof) upon which is superimposed a reciprocating movement. The speed at which the web moves into the zone thus varies between the sum of the speeds of the continuous forward feed and of the reciprocating movement and the difference of those speeds.



Where the tool means is arranged to travel with the web while the tool means is operating or the web, the drive means may be arranged to advance the feed device towards said zone during each operating stroke of the tool means and to retract the feed device during each return stroke of the tool means. Alternatively where the tool means does not travel with the web, the drive means may be arranged to retract the feed device during engagement of the tool means with the web, retraction being effected at such a speed as to reduce the speed of the web through the zone to zero.

While the speed of movement of the web into the zone is less than that of the continuous forward feed, slack necessarily appears in the web upstream of the feed device. Where the respective speeds are such that this slack is substantial, and/or where the web is of material liable to damage, e.g. heated plastic sheet, guide means may be provided to control the position of the web while the slack is present. Such guide means may for example comprise one or more guide rollers arranged or movable mountings so that the web may be allowed to follow a short (e.g. a straight) path when no slack is present but is guided along a longer path when slack tends to appear, the guide means being so coupled to the drive means that the guide means takes up the slack whenever the operation of the feed device tends to produce it.

In order that the invention may be well understood a preferred embodiment thereof will now be described with reference to the accompanying diagrammatic drawing, in which:

FIGURE 1 shows a possible embodiment of the invention, and

FIGURE 2 shows a modification.

Referring first to FIGURE 1 of the drawing, a web **1** of hot plastic sheet is continuously feed as indicated at **2** towards a zone in which a pair of embossing dies **3, 4** operate on said web. The die **3** is connected to a supporting frame **5** via a hydraulic actuator **6** capable of producing horizontal movements of said die **3**. The die **4** is similarly connected to a supporting frame **7** via a hydraulic actuator **8**. The frames **5, 7** are carried on a baseplate **9** by further hydraulic actuators **10, 11** capable of producing vertical movements of the frames **5, 7** (and hence of dies **3, 4**). For simplicity no hydraulic fluid connections to the actuators **6, 8** are shown but such connections will of course be provided from a hydraulic supply unit **12** having a pair of output connections **13** for the said actuators **6, 8**.

The hydraulic supply unit **12** has a further pair of output connections **14, 15** connected to the actuators **10, 11** so that whenever unit **12** is so operated that connection **14** provides a supply of fluid under pressure while connection **15** provides a fluid return, actuators **10, 11** will lower frames **5, 7** and dies **3, 4** but when the function of connections **14, 15** are reversed said frames and dies will be raised. The operation of actuators **6, 8** via connections **13** is such that, while dies **3, 4** are descending, they are held together to emboss web **1**, while when said dies are ascending they are held apart to clear web **1**, and it will therefore be undertsood that unit **12** contains means for generating pressure in hydraulic fluid and for controlling valves connecting such pressure generating means to the connections **13, 14, 15** to obtain such movement of the dies **3, 4**.

Above the zone in which the dies **3, 4** move and operate on the web **1** are mounted a pair of rollers **16** arranged to grip the web **1** and feed it downward; the rollers **16** are driven by any convenient means (as diagrammatically indicated in FIGURE 1) to feed the web, and are car-

ried by a frame **17** which in turn is supported on a base-plate **18** by a hydraulic actuator **19**. The actuator **19** is also connected to the connections **14, 15** of unit **12** so that the frame **17** and rollers **16** move up and down in synchronism with dies **3, 4**.

Considering the relative speeds of the parts of the device in a simple case first, if it is desired that, whenever the dies **3, 4** descend, the web **1** shall be descending at the same speed so that there is no relative vertical movement between the dies and the web, then the speed of descent of the frame **17** plus the speed of web feed due to rotation of the rollers **16** must be equal to the speed of descent of dies **3, 4**. Whenever the dies **3, 4** ascend, it desired that the web **1** (below rollers **16**) shall be stationary, hence during such ascent the frame **17** must be rising at a speed equal to the speed of web feed due to rotation of rollers **16**. Over a complete cycle (i.e. from the start of a descending movement of the dies to the start of the next descending movement thereof) the length of web passing any fixed point below rollers **16** must be equal to the length of web arriving at **2**. From these requirements, it can be deduced that the speeds of descent and ascent of frame **17** and the speed of web feed due to rotation of rollers **16** must each be equal to the speed of web travel at **2**, while the speed of descent of dies **3, 4** must be twice the speed of web travel at **2**, if the speeds of ascent and descent of the dies are equal.

In a more usual case, the dies have a quick-return action, i.e. they ascend more quickly than they descend, and then the ratio of the descending speed of the dies to the speed of web travel at **2** must equal the ratio of the time for a complete cycle to the time for a descending stroke of the dies. The speeds of descent and ascent of the frame **17** and rollers **16** will of course be dependent on those of the dies.

The required speeds for any particular circumstances can readily be obtained by suitable design of the hydraulic system and the drive to rollers **16**, using expedients well known in the art and unrelated to the present invention. If, for example, it is desired to omit the hydraulic actuators **10, 11** so that the dies **3, 4** do not move vertically, then the relative timings are arranged so that while the dies are in engagement with the web, frame **17** and rollers **16** move up at a speed equal to the speed of feed of the web through rollers **16**, thus causing the web to be stationary while engaged by the dies.

During ascent of the frame **17** and rollers **16**, the web **1** will become slack above rollers **16**. To avoid uncontrolled movement of, and possible damage to, the web **1**, above rollers **16** are mounted a group of three guide rollers **20, 21, 22** between which the web **1** travels. Rollers **20, 22** are carried by a stationary frame **23** secured to a base-plate **24**, while roller **21** is carried by a horizontally-arranged hydraulic actuator **25** secured to a base-plate **26**. Actuator **25** is connected to output connections **14, 15** of the unit **12** so that whenever the dies **3, 4** move up, guide roller **21** is moved to the right between and past rollers **20, 22**; as it does so, it will be apparent that the web **1** is guided into an increasingly tortuous path, thus avoiding the slack which tends to appear in the web **1** at this time (due to upward movement of frame **17** and rollers **16**) from becoming manifest in the form of an uncontrolled loop in the web **1** above rollers **16**. Rollers **20, 21, 22** will in general be idler rollers, but if desired (e.g. with very flimsy webs) advantage may be found in driving these rollers at web speed.

While the apparatus which has been described has hydraulic actuation, it will be apparent that mechanical actuation of the several parts is possible, e.g. the various reciprocating movements may be derived from cams carried on a common shaft geared to the drive (not shown) for rollers **16**.

It is moreover noted that reference has been made to various base-plates **9, 18, 24, 26**, but it will be appreciated that all these are parts of a main supporting frame for the apparatus, which frame is not shown in its entirety. Such frame may include various other parts such as guides (not shown) to constrain the frames **5, 7, 17** to perform their specified movements as precisely as is desired.

It may be desirable, especially with hot (and therefore soft) plastic sheet, to minimise the bending of the sheet and to avoid the need for subjecting it to mechanical gripping by the rollers **16**. FIGURE 2 shows an alternative arrangement of the upper part of the apparatus of FIGURE 1 in which the sheet **1** is fed to the apparatus horizontally. In place of rollers **16, 20, 21, 22** there is provided a single roller **16*a*** about which the sheet **1** travels through a right-angle so that on leaving the roller **16*a*** the sheet is travelling downwards (as in FIGURE 1). Roller **16*a*** is carried by a hydraulic actuator **19*a*** (connected in place of actuator **19**, FIGURE 1) serving to lift the roller **16*a*** when the downward speed of the sheet is to be reduced and to lower roller **16*a*** when the sheet speed is to be increased. When roller **16*a*** is in a raised position, the sheet **1** will of course be travelling round a loop, as indicated by the dashed lines, and for further control of the path of the sheet an idler roller **20*a*** is provided above the path of the sheet as it travels toward roller **16*a***.

Roller **16*a*** is rotationally driven and it is advantageous to make the roller **16*a*** a suction roller, i.e. to have drillings in the roller through which suction is applied to the face of the sheet in contact with said roller so that atmospheric pressure assists in obtaining sufficient frictional grip between the roller and the sheet to allow the roller to drive the sheet. Such suction rollers are well-known in a variety of applications, e.g. in feeding cigarettes.

It will be appreciated that, in the modified arrangement of FIGURE 2, no movement of roller **16*a*** produced by actuator **19*a*** will produce slack in the web, the speeds of the various parts of the apparatus being properly related and the reciprocation of roller **16*a*** properly synchronised with that of the dies **3, 4**.

What I claim as my invention and desire to secure by Letters Patent is:

**1.** In apparatus of the type in which a continuously fed web of sheet material is subjected to the action of tool means the operation of which is intermittent and comprises operating and return strokes, said tool means being arranged to travel with the web while operating thereon, the improvement comprising a feed device arranged to propel the web continuously towards a zone in which the tool means operates, reciprocating means carrying said feed device for reciprocating movement towards and away from said zone, and drive means connected to said reciprocating means, said drive means being arranged to advance the feed device towards the zone during each operating stroke of the tool means and to retract the feed device during each return stroke of the tool means.

**2.** The improvement as claimed in claim **1** including guide means arranged to control the position of the web upstream of the feed device when slack appears therein.

**3.** The improvement as claimed in claim **2**, which said guide means comprises at least one guide roller arranged on a movable mounting so that the web may be allowed to follow a short path when no slack is present but is guided along a longer path when slack tends to appear.

**4.** The improvement as claimed in claim **2**, which the guide means is so coupled to the drive means that the guide means takes up the slack whenever the operation of the feed device tends to produce it.

**5.** The improvement as claimed in claim **1** wherein said feed device comprises a pair of co-acting rollers between which said web is propelled.

**6.** The improvement as claimed in claim **1** wherein said continuously fed web of sheet material approaches said feed device at substantially a right angle to the direction said web of sheet material leaves said feed device towards said tool means and said feed device comprises a single roller.

7. In apparatus of the type in which a continuously fed web of sheet material is subjected to the action of tool means the operation of which is intermittent and comprises operating and return strokes, the improvement comprising a feed device including a single roller arranged to propel the web continuously towards a zone in which the tool means operates, said continuously fed web of sheet material approaching said feed device at substantially a right angle to the direction said web of sheet material leaves said feed device toward said tool means, said feed device being mounted upon reciprocating means capable of moving said feed device towards and away from said zone, and drive means connected to said reciprocating means and arranged to produce such reciprocating movement in synchronism with operating and return strokes of the tool means.

8. The improvement as claimed in claim 7 in which the tool means is arranged to operate on a stationary web, wherein said reciprocating means moves said feed device away from said zone during the operating stroke of said tool means while the latter is in engagement with the web, such movement away from said zone being effected at such a speed as to reduce the speed of the web through said zone to zero.

9. In apparatus of the type in which a continuously fed web of sheet material is subjected to the action of tool means the operation of which is intermittent and comprises operating and return strokes, the improvement comprising a feed device arranged to propel the web continuously towards a zone in which the tool means operates, said feed device being mounted upon reciprocating means capable of moving said feed device towards and away from said zone, drive means connected to asid reciprocating means and arranged to produce such reciprocating movement in synchronium with operating and return strokes of the tool means, and guide means arranged to control the position of the web upstream of the feed device when slack tends to appear therein.

10. The improvement as claimed in claim 9 in which the tool means is arranged to travel with the web while the tool means is operating on the web, wherein said drive means is arranged to advance the feed device towards the zone during each operating stroke of the tool means and to retract the feed device during each return stroke of the tool means.



11. The improvement as claimed in claim 9, in which said guide means comprises at least one guide roller arranged on a movable mounting so that the web may be allowed to follow a short path when no slack is present but is guided along a longer path when slack tends to appear.

12. The improvement as claimed in claim 11, in which the guide means is so coupled to the drive means that the guide means moves to guide the web along a longer path whenever the operation of the feed device tends to produce slack.

13. The improvement as claimed in claim 9 wherein said continuously fed web of sheet material approaches said feed device at substantially a right angle to the direction said web of sheet material leaves said feed device towards said tool means and said feed device comprises a single roller.

14. The improvement as claimed in claim 9 wherein said feed device comprises a pair of coacting rollers petween which said web is propelled.


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