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[54] **CLUTCH, BRAKE AND KNIFE ARRANGEMENT FOR COPYING MACHINE**

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[51] **Int. Cl.** **B65h 35/06**

[58] **Field of Search**.....83/203–205, 230, 83/610; 355/28, 29

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[57] **ABSTRACT**

A clutch, brake and knife arrangement for the copy paper transport system of a copying machine. A link in the knife assembly is attached to a brake band wrapped around a brake drum fixed to an end of a copy paper feed roller. A clutch is provided to couple the roller to a drive chain. During copy paper feed, the clutch is energized and a knife solenoid is de-energized. The brake band sits loosely around the brake drum and thus exerts no braking force on the copy paper feed roller. When the copy paper is to be cut, the knife solenoid is actuated and the clutch is de-energized. As the knife rotates to cut the copy paper, the brake band attached to the link in the knife assembly is tightened around the brake drum of the copy paper feed roller. This causes the roller to come to an abrupt halt before the cut is made.

14 Claims, 2 Drawing Figures

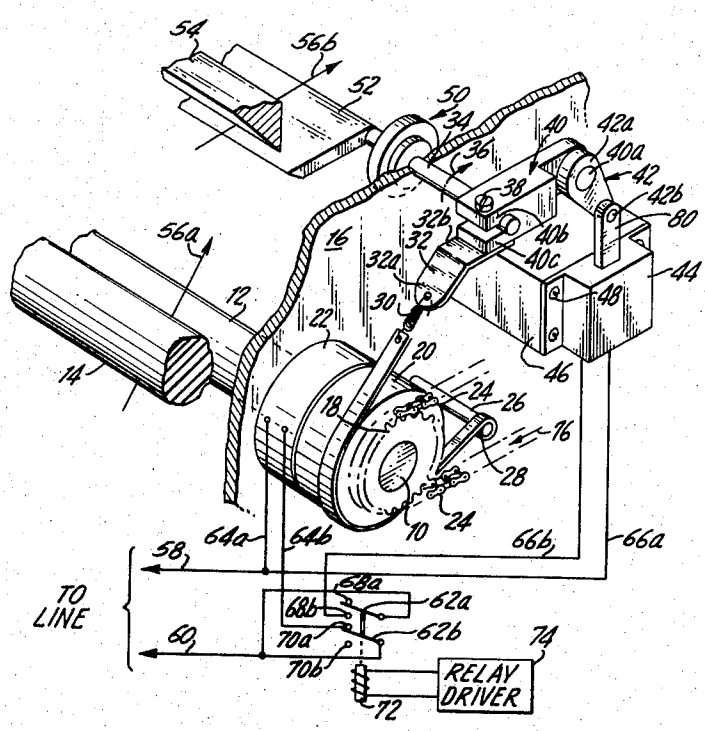
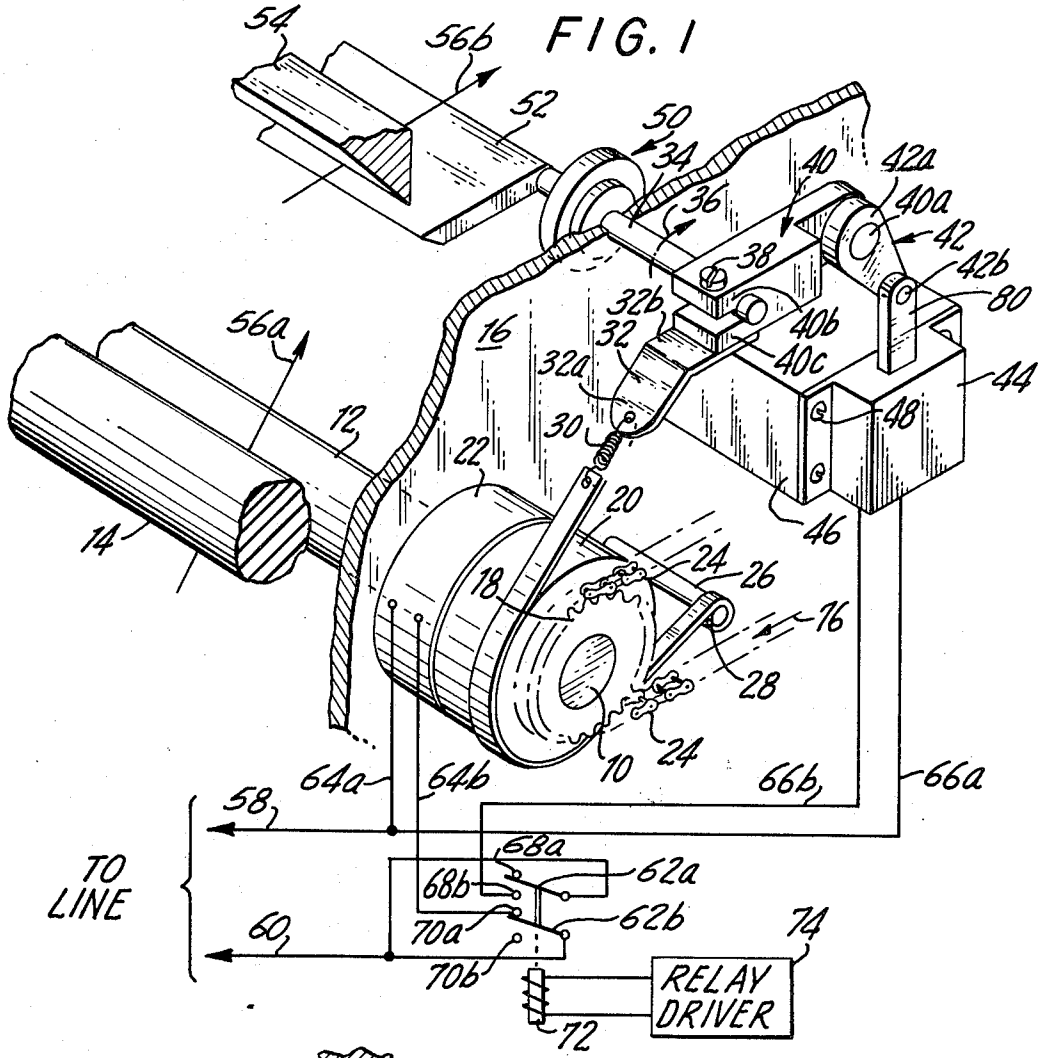


FIG. 1



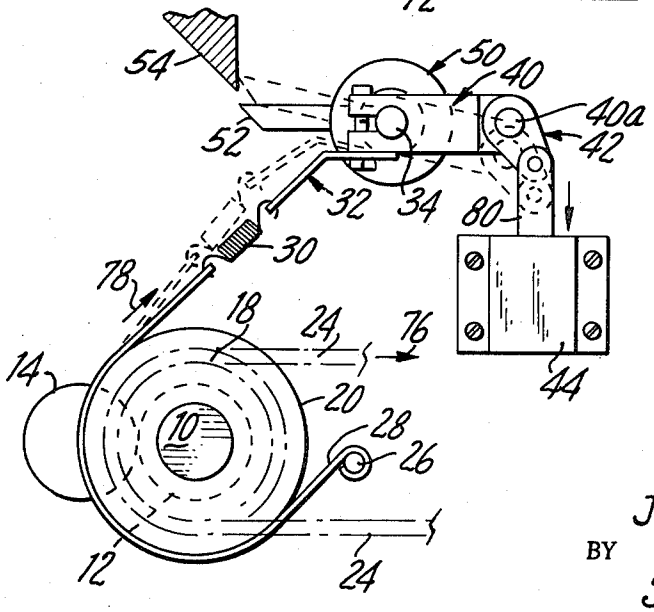


FIG. 2

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CLUTCH, BRAKE AND KNIFE ARRANGEMENT FOR COPYING MACHINE

This invention relates to copying machines in which copy sheets are cut from a roll of copy paper, and more particularly to a clutch, brake and knife assembly for use therein.

In a popular type of copying machine, a roll of copy paper is provided from which a copy sheet is cut to have the same length as the original document to be copied. A typical machine of this type is disclosed in Van Auken et al. U.S. Pat. No. 3,575,503, issued Apr. 20, 1971. The original document to be copied in transported past a scanning window. At the same time, copy paper is fed from a roll through a corona unit and then past an exposure window. The copy paper moves in optical synchronization with the original document to be copied. It is exposed at the exposure station by light reflected from the original document at the scanning window, and is then developed.

A photocell in the original transport system detects the leading and trailing edges of the original document to be copied. Initially, the edge of the copy paper roll is adjacent to a pair of knife blades. As soon as the leading edge of the original document is detected, a copy paper feed roller clutch is energized to start the feed of copy paper from the roll. When the trailing edge of the original is detected, the copy paper clutch is de-energized and at the same time one of the knife blades is rotated to cut the copy paper. No more copy paper is fed from the roll since the copy paper clutch is de-energized, although the cut copy sheet continues to be transported to the corona and past the exposure window by other rollers in the copy paper transport system. Because the copy paper feed begins when the leading edge of the original is detected and terminates with the knife operation when the trailing edge of the original is detected, and because the original and copy paper speeds are the same, it is apparent that the length of the cut sheet is the same as the length of the original document to be copied.

In machines of this type, it is very important that the copy paper feed stop abruptly when the trailing edge of the original is detected. If the copy paper overtravels slightly, it is apparent that the cut copy sheets will be too long. Furthermore, if the copy paper feed does not cease before the knife operates, it is possible for a copy paper "jam" to arise.

An approach which has been taken in the past is to clutch the copy paper feed roller to a drive chain, the chain causing the roller to rotate as long as copy paper feed is necessary. Although the chain moves continuously, it drives the copy paper feed roller only when the clutch is energized. As soon as the leading edge of the original is detected, the clutch is energized and the drive chain causes the copy paper feed roller to rotate and to feed copy paper. As soon as the trailing edge of the original document is detected, the clutch is de-energized and, while the drive chain continues to move, the copy paper feed roller stops turning. In order to insure that the copy paper feed roller does not overtravel, the roller is continuously braked. When the clutch is energized, the drive chain causes the roller to move against the force of the brake. As soon as the clutch is de-energized, the brake causes the roller to stop abruptly.

The major problem with this prior art approach is that at all times when the copy paper feed roller is turned, it must be rotated against the force of the brake. It is thus more difficult to drive the copy paper feed roller and considerable power is wasted. Moreover, there is unnecessary wear on the brake lining whenever the copy paper roller is rotated, and relatively frequent replacements are necessary.

It is a general object of our invention to provide a clutch and brake arrangement by which the copy paper feed roller is clutched to the drive chain when paper is to be fed from the copy paper roll, and the copy paper feed roller is braked only when the clutch is de-energized.

It is another object of our invention to couple the knife assembly to the brake so that operation of the knife (which occurs together with de-energization of the clutch) automatically results in braking of the copy paper feed roller.

In accordance with the principles of our invention, the copy paper feed roller is coupled to the drive chain through a clutch mechanism. Only when the clutch is energized does the copy paper feed roller turn. A brake band is wrapped around a brake drum attached to the roller. One end of the brake band is anchored and the other is connected to one of the links in the knife assembly. When the knife is in its rest position, the brake band is wrapped loosely around the copy paper feed roller brake drum. As long as the clutch is energized and the knife is de-energized, no braking force is applied to the roller. When it is necessary to cut the copy paper, a knife solenoid is operated at the same time that the clutch is de-energized. As the knife solenoid operates to move one of the knife blades, the link in the knife assembly to which the brake band is attached moves in a direction to tighten the brake band around the copy paper feed roller brake drum. At this time the copy paper feed roller comes to an abrupt halt. Thus, the braking force is applied to the copy paper feed roller only when the knife solenoid is operated, this, only when the roller is not turned.

The major advantage of the arrangement is that when the clutch is energized, no braking force is applied to the copy paper feed roller which must be overcome by the drive chain. An added advantage of the arrangement is that the brake band is tightened by the link to which it is attached before the knife cut is actually made. (The same link which tightens the brake band also turns one of the knife blades, the link tightening the brade band to stop the copy paper feed roller before the knife blade cuts the paper.) This insures that the copy paper feed stops before the knife cut is made.

It is a feature of our invention to provide a brake band around a copy paper feed roller brake drum which is attached to a link in the knife assembly such that the brake band is tightened to halt the copy paper feed roller only when the knife is actuated and prior to the cutting of the copy paper.

Further objects, features and advantages of our invention will become apparent upon consideration of the following detailed description in conjunction with the drawing, in which:

FIG. 1 is a perspective view of the illustrative embodiment of the invention; and

FIG. 2 is a partial end view of the system shown in FIG. 1 and shows the various elements both when the knife is in its normal (rest) position and when it is actuated.

Copy paper feed roller **12** is journalled in vertical bracket **16** and terminates in brake drum **20** which rotates with it. The feed roller bears against roller **14** and, when roller **12** is turned, copy paper, represented by arrow **56***a*, which is fed into the nip of the rollers is transported in the direction shown. The copy paper, farther along its path, passes through knife blades **54**, **52**, as symbolized by arrow **56***b*. Blade **54** is fixed while blade **52**, when actuated, rotates in the clockwise direction to cut the copy paper. It is to be understood that only those parts of a copying machine are shown which are necessary for an understanding of the present invention.

Clutch **22** is mounted on vertical bracket **16**. Shaft **10** extends through drum **20** into the clutch assembly, and when the clutch is energized shaft **10** is clutched to roller **12**. At the end of shaft **10** there is mounted a gear **18**, driven by chain **24**. The chain moves in the direction shown by arrow **76** to cause gear **18** to rotate in the clockwise direction. When conductors **64***a*, **64***b* are extended to line conductors **58**,**60**, the clutch is energized and roller **12** rotates with gear **18** and shaft **10**. When the clutch is de-energized, gear **18** and shaft **10** rotate but are not clutched to roller **12**; roller **12** remains stationary and copy paper is not transported by rollers **12**, **14**.

Bearing **50** is contained within vertical bracket **16**, and shaft **34** extends through it. One end of the shaft is attached to blade **52**. The other end of the shaft is gripped by fingers **40***b*, **40***c* of link element **40**. Screw **38** is extended through the two fingers and lug **32***b* of bracket **32**, the screw serving not only to attach the bracket to link **40**, but also to tighten fingers **40***b*, **40***c* around shaft **34** so that clockwise rotation of link **40** around the axis of shaft **34** causes the shaft to rotate with it in the direction shown by arrow **36**.

Solenoid **44** is mounted to vertical bracket **16** by screws **48**. Link **42** serves to couple link **40** to solenoid shaft **80**. At the rear end of link **40** there is a stud **40***a* around which one end of link **42** is mounted. At the other end of link **42** there is another stud **42***b*, around which the end of solenoid shaft **80** is mounted. When the solenoid is actuated, the solenoid shaft is pulled into the solenoid resulting in a clockwise rotation of link **40** around the axis of shaft **34**. This in turn causes knife blade **52** to rotate in the clockwise direction and a sheet to be cut from the copy paper roll.

One end of brake band **28** is secured to anchor **26**, the anchor being mounted on vertical bracket **16**. The brake band extends around brake drum **20** and is attached at its other end to one end of the spring **30**. The other end of the spring is secured to lug **32***a* of bracket **32**. In the position shown in the drawing, the tension of the brake band is insufficient to exert any braking force on brake drum **20**; chain **24** can thus drive roller **12** when clutch **22** is energized without having to overcome any braking force.

Relay driver **74** is normally de-energized. With realy **72** similarly de-energized, ganged contacts **62***a*, **62***b* are in the positions shown. Conductor **64***b*, connected to terminal **70***a*, is extended through contact **62***b* to line **60**. Since conductor **64***a* is connected to line **58**, current flows through conductors **64***a*, **64***b* and the clutch is energized. As long as relay driver **74** remains unoperated, feed roller **12** is clutched to gear **18** and it turns to move copy paper. At the same time, solenoid conductor **66***b*, connected to terminal **68***b*, is not extended through contact **62***a* to line **60**, and the solenoid remains de-energized with knife **52** in the position shown.

When it is determined that the copy paper is to be cut, relay driver **74** is operated (by some mechanism not shown in the drawing). At this time, relay **72** is energized and contact **62***a* moves to terminal **68***b*. Line **60** is thus connected through contact **62***a*, terminal **68***b*, conductor **66***b*, the winding of solenoid **44** and conductor **66a** to line **58**, and the solenoid operates. At the same time, contact **62***b* moves from terminal **70***a* to terminal **70***b*, and the actuating current for the clutch stops flowing.

When the knife solenoid is operated, links **40**, **42**, and solenoid shaft **80** move to the positions shown in phantom in FIG. **2**. At the same time that knife **52** moves upward in FIG. **2** to cut the copy paper, bracket **32** moves to the position shown in phantom. Brake band **28** is tightened in the direction shown by arrow **78** and exerts a braking force on brake drum **20**. Thus the knife solenoid not only causes the copy paper to be cut, it also serves to cause roller **12** to come to an abrupt halt. Spring **30** is provided to insure that when bracket **32** moves to the position shown in phantom in FIG. **2** brake band **28** is wrapped tightly around brake drum **20**. the length of the brake band is such that spring **30** stretches slightly when bracket **32** moves to the position shown in phantom. Without the spring, the brake band would have to be precisely the right length — were it too short knife **52** would not move to its maximum uppermost position shown in phantom in FIG. **2**, and were it too long insufficient tension would be developed in the brake band to halt copy paper feed roller **12**.

As soon as relay driver **74** releases, solenoid shaft **80** moves upward to the positions shown in FIGS. **1** and **2**, knife **52** restores and the brake band loosens around brake drum **20**. At the same time, clutch **22** is energized so that the copy paper feed commences once again.

With the system shown in the drawing, as soon as the knife restores the copy paper feed begins once again. The knife must remain actuated until another copy paper feed is to begin. In some machines, it may be desirable to have the knife restore without immediately commencing a copy paper feed. In such a case, all that is necessary is to provide additional contacts in one of conductors **64***a*, **64***b* which open with the operation of relay driver **74**, but are not closed again after the relay driver de-energizes until the copy paper feed is to commence.

It should be noted that the arrangement of FIGS. **1** and **2** insures that roller **12** stops turning before the actual cut is made. The cut is not made until knife **52** moves upward adjacent to the tip of knife blade **54**. By this time, brake band **28** has been tightened sufficiently to brake roller **12**. Thus the knife cut cannot possibly be made until after the copy paper feed roller comes to a halt.

Although the invention has been described with reference to a particular embodiment, it is to be understood that this embodiment is merely illustrative of the application of the principles of the invention. Numerous modifications may be made therein and other arrangements may be devised without departing from the spirit and scope of the invention.

The present invention is suitable for use in connection with any type of apparatus in which a web of material is fed through a clutch, brake and knife arrangement of the character described. Accordingly, while the foregoing description relates to copying machines, the invention is also valuable for use in various types of printing apparatus and other equipment wherein a web of material is intermittently advanced.

What I claim is:

1. A clutch, brake and knife assembly for cutting a sheet of paper from a roll and braking paper feed from the roll comprising

feed roller means for feeding paper from said roll,

drive means,

clutch means energizable for clutching said feed roller means to said drive means and de-energizable for releasing said feed roller means from said drive means,

knife means for cutting a sheet of paper from said roll and normally disengaged from paper passed adjacent thereto,

means for energizing said knife means to cut a sheet of paper from said roll,

means for braking said feed roller means,

means for operating said braking means to halt said feed roller means and simultaneously operating said knife energizing means to cut a sheet of paper from said roll,

and means for controlling the simultaneous operation of said knife energizing means and the de-energization of said clutch means,

said braking means including a brake drum attached to said feed roller means,

anchoring means,

and a brake band,

one end of said brake band being coupled to said anchoring means and the other end of said brake band being coupled to said knife means for moving with said knife means to tighten the brake band around said brake drum when said knife energizing means is operated.

2. A clutch, brake and knife assembly in accordance with claim 1 wherein said knife means includes a knife blade and link means for moving said knife blade responsive to the operation of said knife energizing actuating means, said other end of said brake band being coupled to said link means.

3. A clutch, brake and knife assembly in accordance with claim 2 further including spring means connected at one end to one end of said brake band, with the other end of said spring means and the other end of said brake band being coupled to said anchoring means and to said link means respectively.

4. A clutch, brake and knife assembly in accordance with claim 3 wherein said brake band is dimensioned such that upon operation of said knife energizing means the tension developed in said brake band is sufficient to halt said feed roller means before said knife means cuts said paper.

5. A clutch, brake and knife assembly in accordance with claim 1 wherein said braking means includes means coupled between said feed roller means and said knife means for moving and braking said feed roller means responsive to movement of said knife means.

6. A clutch, brake and knife assembly in accordance with claim 5 wherein said braking means is operative to halt movement of said feed roller means prior to the cutting of said paper by said knife means.

7. An assembly for cutting a sheet of paper from a roll and braking paper feed from the roll comprising feed roller means for feeding paper from said roll, means for driving said feed roller means upon energization and not driving said feed roller means upon de-energization, knife means for cutting a sheet of paper from said roll and normally disengaged from paper passed adjacent thereto, normally inoperative means for braking said feed roller means, and means for operating said braking means to brake said feed roller means and said knife means to cut a sheet of paper from said roll simultaneously.

8. An assembly in accordance with claim 7 further including means for controlling the simultaneous operation of of said knife means and the de-energization of said driving means.

9. An assembly in accordance with claim 8 wherein said braking means includes a brake drum attached to said feed roller means, anchoring means, and a brake band, one end of said brake band being coupled to said anchoring means and the other end of said brake band being coupled to said knife means for moving with said knife means to tighten the brake band around said brake drum when said knife means is operated.

10. As assembly in accordance with claim 9 wherein said knife means includes a knife blade and link means for moving said knife blade responsive to the operation of said operating means, said other end of said brake band being coupled to said link means.

11. An assembly in accordance with claim 10 further including spring means connected at one end to one end of said brake band, with the other end of said spring means and the other end of said brake band being coupled to said anchoring means and to said link means respectively.

12. An assembly in accordance with claim 11 wherein said brake band is dimensioned such that upon operation of said knife means the tension developed in said brake band is sufficient to halt said feed roller means before said knife means cuts said paper.

13. An assembly in accordance with claim 8 wherein said braking means includes means coupled between said feed roller means and said knife means for moving and braking said feed roller means responsive to movement of said knife means.

14. An assembly in accordance with claim 13 wherein said braking means is operative to halt movement of said feed roller means prior to the cutting of said paper by said knife means.

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