HYDRAULIC MEANS FOR ADJUSTING EMBOSsing CYLINDERS IN A ROTARY EMBOSSER

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ABSTRACT

A roll-type embossing machine in which a pair of material processing rolls are supported on a machine frame. One of the rolls is movable relative to the other and relative to the machine frame by a hydraulic-pneumatic power lift device connected to opposite ends of the movable roll supporting shaft. The other roll is fixed in relation to the machine frame and is provided with an engraved material processing sleeve which can be readily removed and replaced on the machine by means of a swingable bearing support means connected to the roll shaft at one end of the roll and a support bracket or fixture attached to the machine frame adjacent the opposite end of the fixed roll and positioned in close proximity to the roll shaft.

3 Claims, 5 Drawing Figures
HYDRAULIC MEANS FOR ADJUSTING EMBOSsing CYLINDERS IN A ROTARY EMBosser

The present invention concerns a roll-type conveying and material processing machine for embossing a pattern on the surface of paper, or similar materials, and relates particularly to the mechanisms for (1) supporting the embossing roll and the backup roll on the machine frame, (2) adjusting the backup roll relative to the embossing roll, and (3) facilitating the changing of the engraved sleeve which is mounted and secured to the embossing roll.

BACKGROUND OF THE INVENTION

Embossing machines for converting the surface of paper, or similar materials, are commonly constructed with a pair of driven rolls mounted on a machine frame in a parallel relationship and connected to run in a timed relationship. One of the rolls is provided with an engraved pattern on its outer periphery which is impressed onto the paper surface in order to decorate it with the engraved pattern. The other roll, known as the backup roll, supports the paper in relation to the embossing roll surface and applies a predetermined pressure therebetween to insure an accurate reproduction of the embossing pattern on the paper surface.

In the past, it has been necessary to run in the machine prior to production in order to impose the embossing pattern or engraved surface on the outer periphery of the backup roll. In this type of machine, it was essential to drive the rolls in a timed relationship to insure the operating relationship of the roll surfaces remains unchanged in order to obtain a proper reproduction of the engraved pattern on the material surface being processed.

The rolls are usually supported on the frame with the embossing roll fixed in relation to the machine frame and the backup roll adjustable toward and away from the outer periphery of the embossing roll. Various types of power lift and adjustment devices have been utilized to adjust the movable roll in relation to the fixed roll. For example, a common expedient has been the use of a pneumatic lift device, or air pressure bags known commercially as "Firestone Air Rides," connected to oppose ends of the supporting shaft of the movable roll. By such means and suitable controls, the embossing roll and the backup roll can be separated for machine setup, and for determining the operating pressure between the rolls during the embossing operation. The fixed roll is rotatably supported on the machine frame by conventional bearing brackets, while the movable roll has been supported in various ways on the machine, such as slide or pivoted bearing brackets conventionally mounted to allow for limited movement.

In such a machine, it is necessary to remove and replace the entire embossing roll in order to change the engraved patterns on the outer periphery of the roll. After this has been accomplished, the rolls are brought into contact and run together for a limited period of time to insure that the engraved pattern is imposed on the outer periphery of the backup roll prior to actually processing material and producing an imposed pattern on the outer surface of such material. After the run in period is completed, the movable roll is lowered and the material being processed is threaded through the machine and then the movable roll is raised back into contact with the paper and the fixed roll and brought to a predetermined pressure therebetween. Such an arrangement is costly, time-consuming, and limits the overall use and versatility of a relatively expensive piece of machinery.

In recent years, there have been developments in an effort to reduce the operational and pre-production problems experienced by the machines above described. For example, a special resilient roll material has been introduced and utilized for the construction of the backup roll. This material has a resilient quality in relation to prior used materials and has a limited retention of the embossing pattern. Accordingly, it can be used without the necessary pre-production run in operation and thus there is no need for a time drive or interconnection between the rolls to insure a consistent operational relationship between the roll surfaces. This type of roll provides additional cost savings because it can be used with a variety of embossing patterns and does not require removal when the engraved roll surface has been changed on the machine. Another development has been arrangement of a removable sleeve to fit on the engraved roll or embossing roll to replace the formerly used solid engraved rolls. In order to change the roll pattern, one must simply have to remove the outer sleeve surface and replace it with another, thereby reducing the amount of investment in the entire roll structure.

Pneumatic lift devices, or air pressure bags, have provided economical and efficient roll positioning and adjusting devices, but there are inherent drawbacks in the use of such equipment. Air pressure is subject to fast acting speeds and vibrational problems. Accordingly, a direct application of air pressure to the lift devices and directly onto the movable roll shaft can cause problems of overaction and vibration frequency which disturbs the operation and efficiency of the machine and effects the control of the pressure between the rolls.

Accordingly, with the use of these various developments in the state of the art, there has been a need to provide a machine which can combine these various developments with other improvements to provide a versatile, reliable, efficient, and labor saving apparatus.

SUMMARY OF THE INVENTION

The present invention embodies these various features with others to provide a machine in which the engraved roll sleeve can be simply and efficiently removed from the machine and changed without the necessity of taking the entire embossing roll from the machine frame. The backup roll structure can be utilized with a variety of engraved patterns or embossing surfaces and can be efficiently and reliably adjusted relative to the embossing roll by a simple and economical self-contained control system.

More particularly, the present invention includes a pair of horizontally disposed parallel rolls supported on a machine frame in which an engraved or embossing roll is power-driven by any suitable means. The backup roll is constructed of a resilient impressionable material such as pellon and serves to support the paper, or similar material, at a predetermined pressure in relation to the outer periphery or engraved roll surface of the embossing roll to thereby emboss a pattern on the
BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood and its numerous features and advantages will become apparent to those skilled in the art by reference to the accompanying drawings considered in conjunction with the following written specification, in which:

FIG. 1 is a side elevational view of a roll-type embossing machine embodying the present invention;
FIG. 2 is an enlarged fragmentary cross-sectional view of a portion of an embossing machine shown in FIG. 1 and taken in the direction of arrow 2—2 of FIG. 1 to illustrate the hydraulic-pneumatic backing roll lift device and pressure control mechanism and the upper embossing roll support arrangement; backing
FIG. 3 is an enlarged fragmentary side view of the embossing roll bearing support mechanism;
FIG. 4 is a fragmentary plan view of the embossing roll bearing support mechanism shown in FIG. 3; and
FIG. 5 is a schematic illustration of the fluid power circuit that supplies air pressure to the lower roll lift and pressure control mechanism.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, it should be understood that the roll-type embossing machine illustrated is represented by a side view to show the general arrangement of parts that is comprised in the entire material processing machine. Such a machine includes a transversely spaced substantially identical arrangement of parts to complete the machine structure. The embossing machine is provided with suitable drive means (not shown) to operate the various mechanisms required in the paper surface converting operation. A conventional rolled material stand 12 supports the paper or similar rolled material M which is to be processed and embossed. The material stand 12 is provided with conventional brake means (not shown) which limits the speed of unwinding of a roll of material M from the stand 12 during the embossing operation. A similar rolled material stand 14 is located at the opposite end of the embossing machine to rewind by suitable drive and clutch means (not shown) the paper, or similar rolled material M, after the embossing operation. Such support stands and related drive equipment are well known to the art and suitably timed with the embossing machine drives in various ways to facilitate the unwinding, embossing, and rewinding operations.

Transversely extending spaced apart carrying or idler rollers 16 are mounted on the embossing machine frame 18 by conventional bearing means 20. These idler rollers support the web of material M and guide it in a conventional manner through the embossing rolls and onto the stand 14 for the rewind of the material M.

The specific area of the embossing machine 10 which is improved by the present invention is the embossing mechanism indicated generally by the number 22. This mechanism includes a pair of horizontally disposed parallel rolls 24 and 26 transversely extending and supported on the main frame by bearing means 28 and 30 (see FIGS. 2 and 3). The roll 24 is driven in any suitable manner (not shown) and is locked and secured to the embossing roll 24 by any suitable means. The embossing
roll 24 is provided with a supporting shaft 34 that is rotatably carried on the main frame 18 by bearing means 28 and 30. Located adjacent the bearing 30 is a roll holding fixture or support bracket 36 welded to the frame 18 and having a depending lug 38 positioned in close proximity to one end of the shaft 34. The lug 38 is provided with a semicircular surface 40, which closely proximates the outer surface of the shaft 34.

At the opposite end of the roll 24 and its shaft 34, there is a supporting bearing means 28 which is uniquely mounted on a frame 18 in such a manner so as to be releasably secured and swingable relative thereto. As seen in FIGS. 3 and 4, the bearing means 28 is bolted to a frame member 18c of the frame 18 by bolts 42. Additionally, the frame member 18c is pivotally secured to the frame 18 by a pivot bolt 44 and a lock bolt 46. Accordingly, the loosening of the pivot bolt 44 and the removal of lock bolt 46 allows the swinging or pivoting of the frame member 18c away from the frame 18 adjacent the end of shaft 34. When this occurs, the opposite end of shaft 34 will rest against the semi-circular surface 40 of the depending lug 38 of the holding fixture or bracket 36. In such a manner, embossing roll 24 is supported in a cantilevered fashion on the machine frame 10. The object of such an arrangement is to provide for free access to one end of the embossing roll 24 to allow for the easy removal of the engraved sleeve 32 from the embossing roll 24 without removing the entire embossing roll from the machine.

The lower roll 26 in the preferred embodiment includes a shaft 50 which is supported at opposite ends by duplicate bearing supports and power lift means, as will be hereinafter described. Since such bearing support means and power lift means are substantially identical at each end of the machine, the description of one such arrangement is all that is necessary to fully understand the invention.

Shaft 50 is slidable supported on the machine frame by bearing means 52 and is arranged to be freely rotatable therein (see FIG. 2). The backup roll 26 and the shaft 50 are supported in anti-friction roller bearings 54, which are suitably secured to a bearing support block 56. The bearing support block 56 is vertically slidable on the machine frame 18 in a slot 58. The slot 58 is of a design suitable to guide the bearing block 56 vertically, but permit no lateral movement.

The roll 26 is constructed of a resilient material, such as pellon, or the like, to provide for backup pressure to support the paper, or similar material, in relation to the embossing roll 24, as previously explained. The filler material, such as pellon, provides an outer periphery of correct hardness to receive a definite pattern imposed by the engraved roll surface. However, this pattern will remain imposed on the surface for a relatively short period of time to allow for the desired embossing operation to occur on the surface of the paper. After such is accomplished, the material will return to its original configuration and there will be no retention of the engraved image on the outer periphery of roll 26.

In FIG. 2, it will be seen that the lower end of the bearing block or bearing support 56 is connected through a pinned joint arrangement 60 to the pneumatic power lift device generally indicated by the numeral 62.

The pneumatic power lift device 62 comprises a pneumatic power lift air bag 64 that is secured at its lower end to the frame 18 by a base plate 66. A circular flexible wall structure 68 and a top plate 70 are secured in an air-tight relationship to complete the pneumatic power lift air bag structure 64. Pressurized air is connected by any suitable means (not shown) to a pressure source, such as a pump P, as will be hereinafter described. Also rigidly connected to the machine frame 18 is a two-way, or double-acting hydraulic cylinder assembly 72, which is positioned above and in alignment with the pneumatic power lift 64. A piston and rod assembly 74 is suitably mounted on the hydraulic cylinder assembly 72 and is connected at one end to the top plate 70 of the pneumatic power lift device 64 and at the opposite end to a link 76, which is coupled to bearing block 56 by the pin joint 60. Thus, it will be seen that any vertical movement of the top plate 70 by the inflation of the air bag 64 will be directly transmitted to the bearing block 56 by means of vertical movement of the piston rod 78 of the piston and rod assembly 74.

Each end of the stationary hydraulic cylinder 80 of the double-acting hydraulic cylinder assembly 72 is coupled through suitable hydraulic piping 82 to form a closed circuit hydraulic system that includes flow control valves 84 and 86. This closed circuit is initially provided with hydraulic fluid to fill the system and the displacements on either side of the piston and rod assembly 74 within cylinder 80 are equal. Therefore, vertical movement of the piston rod 78 under the influence of the pneumatic lift device 64 will cause fluid to flow from the upper end 80 of the hydraulic cylinder through the flow control valves 86 and 84 and fluid lines 82 into the opposite end of the cylinder 80.

The flow control valves 84 and 86 are constructed to operate at a predetermined rate in one direction and full flow rate in the opposite direction. As will be seen by the arrows shown on the valves, as the fluid flows out of the top end of cylinder 80 through valve 86, it will be controlled at the rate of flow which has been predetermined by the valve structure. As it leaves valve 86 and flows through line 82, it will be unrestricted in its movements through one-way valve 84 into lines 82 and into the bottom end of the cylinder 80. Conversely, as the fluid is moved out of the bottom end of cylinder 80 through line 82, it will be controlled at the rate it can pass through valve 84 thereby controlling the rate of lowering of the entire assembly. In this manner, the speed at which roll 26 can be raised or lowered in relation to roll 24 is controlled. In other words, flow control valves 84 and 86 are constructed to operate at a predetermined rate and will control the speed of fluid flowing from one end of cylinder 80 to the opposite end, thereby controlling the speed at which the roll 26 can be raised or lowered in relation to fixed roll 24. Furthermore, the restriction caused by the flow control valves 84 and 86 will dampen out any vibrations received from the entire machine and will isolate such vibrations from the surfaces of the rolls 24 and 26 during the embossing operation, thereby eliminating the possibility that such vibrations could impair the efficiency of the embossing operation.

FIG. 5 illustrates schematically the pneumatic, or air pressure circuit for controlling the air bag, or pneu-
matic lift device 64. An air pressure line 90 runs from the pressure source, such as pump P, to the manual control valve 92. The valve 92 is connected by pressure lines 94 to a pair of pressure responsive valves 96, each of which serves one air lift device 64. The valves 96 are spring loaded and controlled by a feedback pressure, which is preset and read by conventional gauges 98. Additional lines 100 connect the pressure-responsive valves 96 to their air lift devices 64. An additional line 102 is connected to the line 100 and to a pair of check valves 104, which in turn connect the lines 94 to complete the pneumatic or air pressure circuit. Thus, when pressure is set between the rolls 24 and 26 for the embossing operation, manual valve 92 is opened and pressurized air flows into the air bag 64, and the pressure is maintained by the valves 96 at the preselected setting. When the system is to be exhausted, the manual valve 92 is shifted in the opposite direction, which relieves the lines 94 of the air pressure, check valves 104 open, and the air pressure is exhausted from air bags 64 through lines 100 and 102, through check valves 104, into lines 94, and into the atmosphere by means of an exhaust port in the manual valve 92.

While the operation of the present invention should be apparent from the foregoing description, it will be briefly reviewed in relation to the operation of the entire machine. During the initial setup of the machine to accomplish an embossed pattern on a roll of material M, which may be paper, or the like, prior to threading the web of paper M through the machine, the roll surface is changed in the following manner. The backup roll 26 is lowered by shifting valve 92 to exhaust air pressure from the pneumatic circuit and thereby deflating the air bags 64 to allow the backup roll, its supporting shaft 50, and the bearing means 52 to lower by sliding down the slots 56 in the machine frame and thereby separating the peripheries of rolls 24 and 26. As previously mentioned, the rate at which the rolls 26 can be lowered in relation to roll 24 is governed by the flow rate of the flow control valves 84 and 86 as the fluid passes from the lower end of cylinder 80 through the suitable hydraulic piping 82, through valves 84, 86, into the upper end of the cylinder 80. When the roll 26 has reached its lowermost position, the machine is now in condition for changing the outer periphery or engraved surface of the roll 24 by substituting a different sleeve 32 for the one on the machine. This is accomplished by removing lock bolt 46 of the upper roll bearing structure and loosening pivot bolt 44 in the frame member 18a. With the lock bolt 46 removed and the pivot bolt 44 loosened, the bearing means 28 and the frame member 18a can be swung away from the end of shaft 34, as seen in dotted lines in Fig. 4. When this occurs, the opposite end of shaft 34 will rest on the semi-circular surface 40 of the depending lugs 38 of the holding bracket or support structure 36. The engraved sleeve 32, which is locked on the roll 24, can be removed and changed for another sleeve 32 in order to alter the embossing pattern. When this is accomplished, the frame member 18a and the bearing means 24 are pivoted into the position shown in full lines in Fig. 4, the pivot bolt 44 is tightened, and lock bolt 46 is installed to secure the bearing support mechanism in its fixed relationship with the frame 18. During this entire operation, no adjustments or alterations to the bearing mechanism 30 at the opposite end of roll 24 are required.

As previously mentioned, the backup roll 26 is constructed of resilient material, such as pellon, which has a certain image retention, or memory quality. This memory quality enables the outer periphery, or surface, of roll 26 to hold the pattern received from the engraved surface of roll 24 as the material M passes therebetween during the embossing process. Thereafter, the image disappears because the roll resumes its original shape. Such an arrangement is particularly advantageous because it allows the use of one backup roll with a variety of engraved surfaces and does not require the changing of backup rolls, thereby enhancing the versatility of the machine. Furthermore, as previously explained, it allows for the backup roll to be freely rotating with respect to the rest of the machine and thus it can operate without the requirement of a timed or driving relationship with the embossing or upper roll. After the outer or engraved surface of roll 24 is changed, as previously explained, the sleeve 32 is locked in place and the material M is threaded between rolls 24 and 26 and connected to the rewind stand in a conventional manner. Then the lower or backup roll 26 is returned to the original operating position, as shown in FIGS. 1, 2, and 3.

To reposition the roll 26 to its operating position, the manual valve 92 is shifted to allow for pressurized air to pass through the lines 94, pressure-responsive valves 96, and line 100 to inflate the air bag, or air lift devices 64. The inflation of the air lift device, or pneumatic lift 64 causes the top plate 70 to rise and thereby force piston rod 78 of the piston and rod assembly 74 upwardly. The upward movement of the piston rod 78 pushes the bearing block 56 along the slide 58 in the machine frame 18 and in such manner will raise the roll 26 against the surface of the material and the outer periphery of the engraved roll 24. This lifting operation will continue until the nip pressure or operating pressure between the rolls is reached, at which time the valves 96 will respond to their preset pressure reading and hold the position at the reading set on the gauges 99.

As the pneumatic lift device, or air bag 64 inflates and the top plate 70 raises, fluid in the cylinder 80 and its interconnected flow circuit fluid system will moderate the speed of the lifting operation. Fluid from the upper side of piston and rod assembly 74 will be forced out of the chamber at the top end of cylinder 80, will pass through the fluid line 82, flow control valves 86 and 84, into the second fluid line 82, and into the bottom end of the cylinder 80. This transfer of fluid will be at a predetermined rate as controlled by the setting on the valves 84 and 86. It will, therefore, govern the speed at which the piston and rod assembly may respond to the air pressure being introduced into the pneumatic lift device 64 and thereby control the rate of lift.

It functions to control the rate of lowering in a similar manner. To summarize the results achieved through the use of the present invention, a conventional roll-type embossing machine can be improved to provide a simple, inexpensive and effective control system for operating an embossing machine at high rates of production and
maintain effective control of the operating pressures. A multiplicity of engraved roll surfaces or sleeves can be utilized without changing the backup roll structure and the engraved roll surfaces can be altered without removing the fixed or embossing roll from the machine. There is no need to run in the machine prior to the embossing operation and there is no requirement for expensive interconnecting drives between the embossing rolls and the backup rolls as required on prior machines.

While the preferred embodiment of the invention has been shown and described, various modifications, alterations, substitutions may be made without departing from the true spirit and scope of the present invention. For example, it is possible to utilize the lift and operating pressure control arrangement on a machine that does not embody the same roll changing structure which supports the embossing roll in its fixed relationship to the machine frame. Conversely, it is possible to utilize the roll support and sleeve changing structure on the embossing roll on a machine that does not include a pneumatic and hydraulic lift arrangement. Accordingly, it is understood that the present invention has been described by way of illustration, rather than limitation. The annexed claims are intended to cover all such modifications and the invention may be practiced otherwise than as specifically illustrated and described.

What is claimed is:

1. A roll-type material processing machine, a machine frame, a first roll having outwardly projecting shaft end portions rotatably supported on the frame by spaced apart bearing means carried by the frame, a second roll disposed parallel to the first roll and being adjustable relative to the first roll, spaced apart bearing means for said second roll movable relative to the frame and guided relative thereto for movement toward and away from the first roll, said bearing guide means being retained in the machine frame, the improvement comprising a hydraulic-pneumatic power lift and adjustment means connected between the machine frame and said movable bearing means for the second roll, including a pair of pneumatic lift devices secured to the frame and connected to the spaced apart second roll shaft bearing means, pressure fluid supply means connected to the pneumatic lift devices, means for operating and controlling the pneumatic lift devices to inflate and thereby extend and deflate and thereby retract said devices by said pressure fluid, a hydraulic cylinder and ram assembly operatively associated with each of said pneumatic lift devices, a cylinder secured to the frame and positioned adjacent each of the pneumatic lift devices, a piston and rod assembly slidably disposed within each of the cylinders and having its oppositely directed rod end portions extending from the cylinder ends, one end of each of the rods connected to the adjacent pneumatic lift device and the opposite ends of said rods connected to said bearing means for said second roll, fluid conveying means connected to each of said hydraulic cylinders to form a closed circuit fluid conveying system between the opposite ends of said cylinders, fluid control means operatively associated with said cylinders and said fluid lines to control the rate of fluid flow from one end of the cylinder to the other in response to the piston sliding within the cylinder, whereby as pressure fluid is introduced into the pneumatic lift devices by said control means the lift devices will inflate and extend thereby actuating the piston and rod assemblies of each of said cylinders causing them to slide within the cylinders and push on the second row of bearing means to move said bearing means within said guide means on the frame and move the second roll toward the first roll and when the control means is operated in the opposite direction, the pressure fluid will be exhausted from the pneumatic lift device allowing the second roll bearing means to slide within the guide means and the piston and rod assemblies to slide within the cylinders, moving the second roll away from the first roll and as the piston and rod assemblies move within their associated cylinder, the passage of fluid from one end of the hydraulic cylinders to the other will be controlled and the rate of speed of movement of the second roll in relation to the first roll will be governed by the fluid control means of each of the cylinders.

2. A machine in accordance with claim 1 in which the fluid control means comprises a pair of restrictor valve means connected in a closed circuit fluid conveying system, each of said valve means allowing full fluid flow in one direction and metered fluid flow in the opposite direction.

3. The combination set forth in claim 1, whereby said guide means comprises a slot formed in the machine frame and said bearing means for the second roll includes a support disposed and retained within said slot and movable longitudinally in the slot but restrained from movement transversely in the slot.

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