Oct. 7, 1958 C. A. RIEGER 2,855,190

APPARATUS FOR DRYING PRINTING INKS

Filed March 2, 1956 4 Sheets-Sheet 1

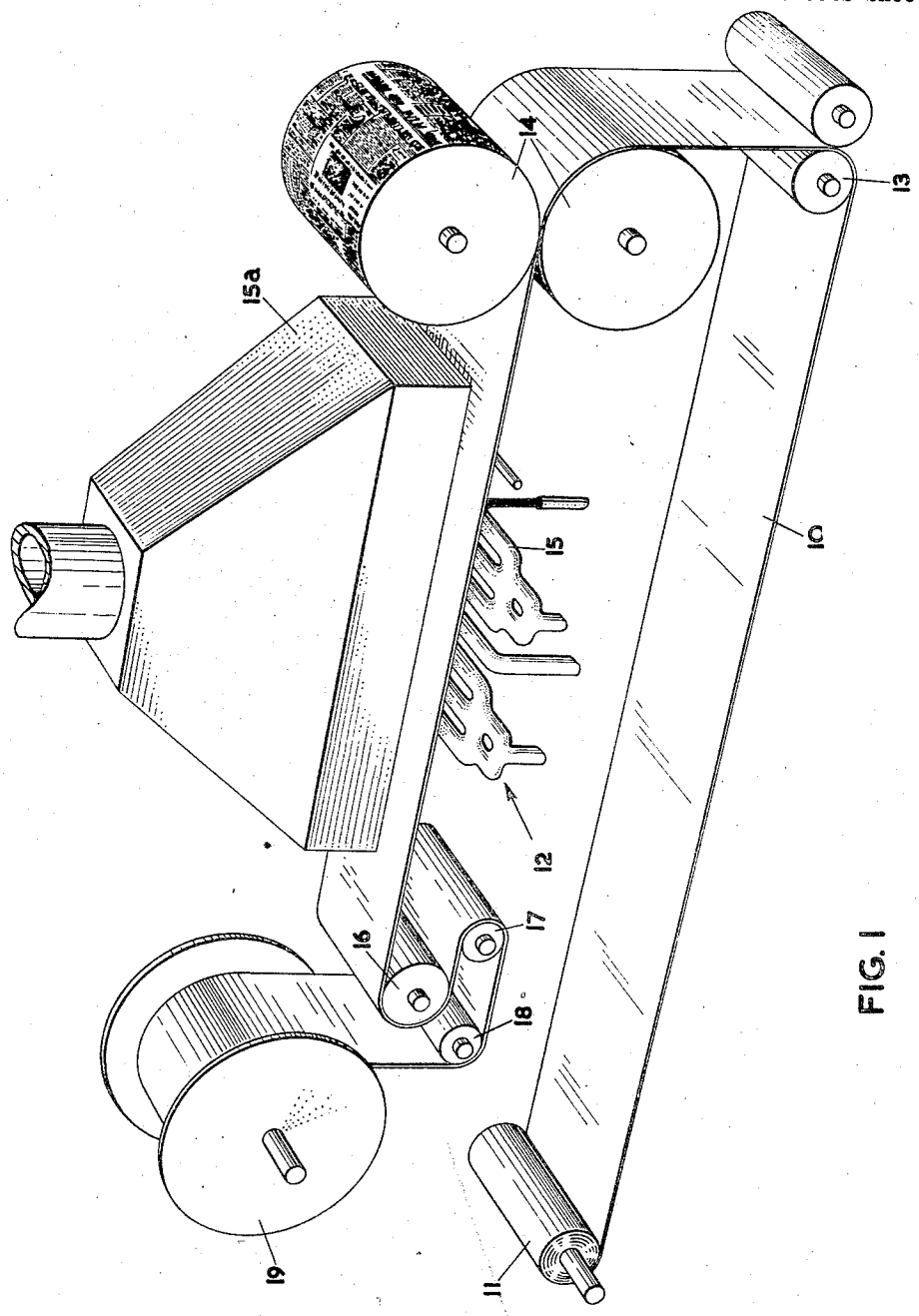


FIG. 1

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APPARATUS FOR DRYING PRINTING INKS

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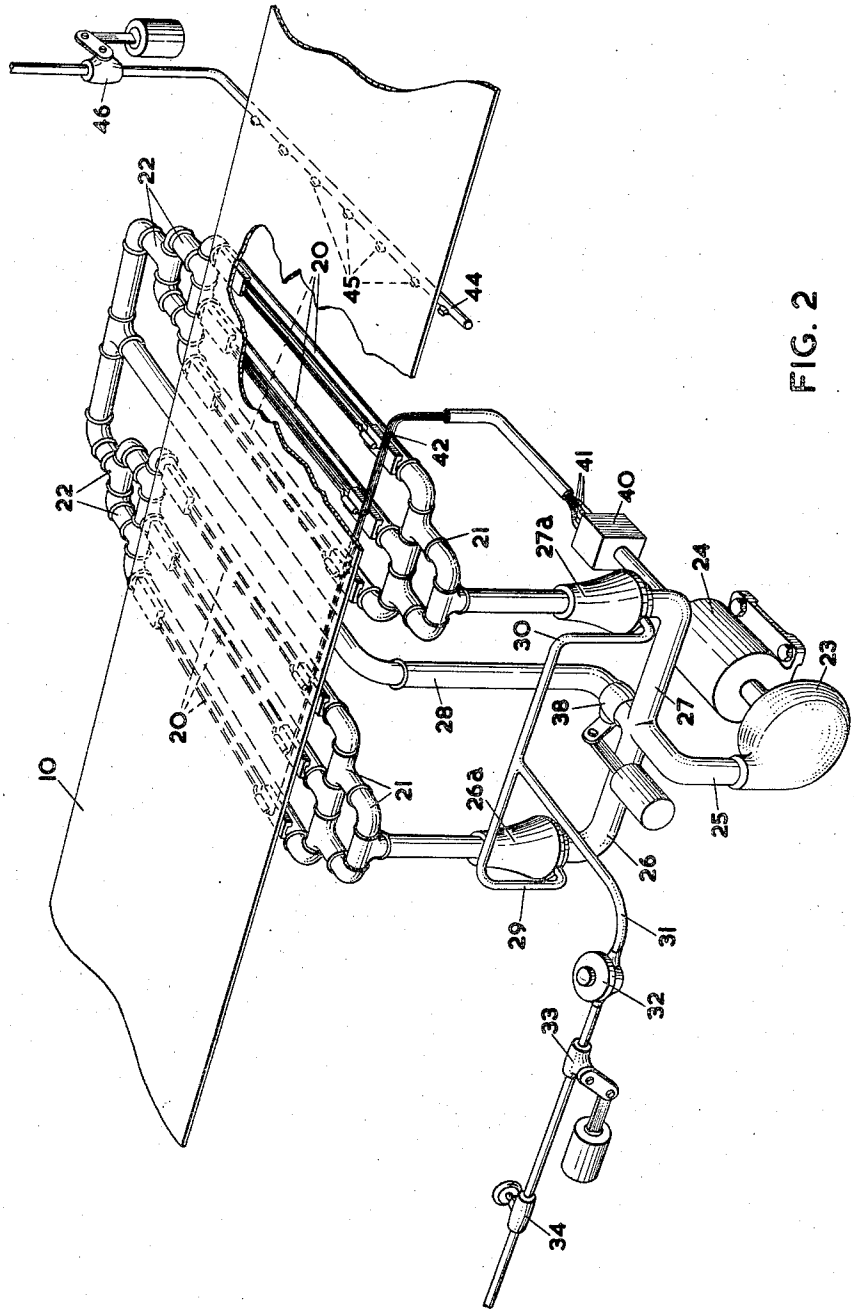


FIG. 2

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APPARATUS FOR DRYING PRINTING INKS

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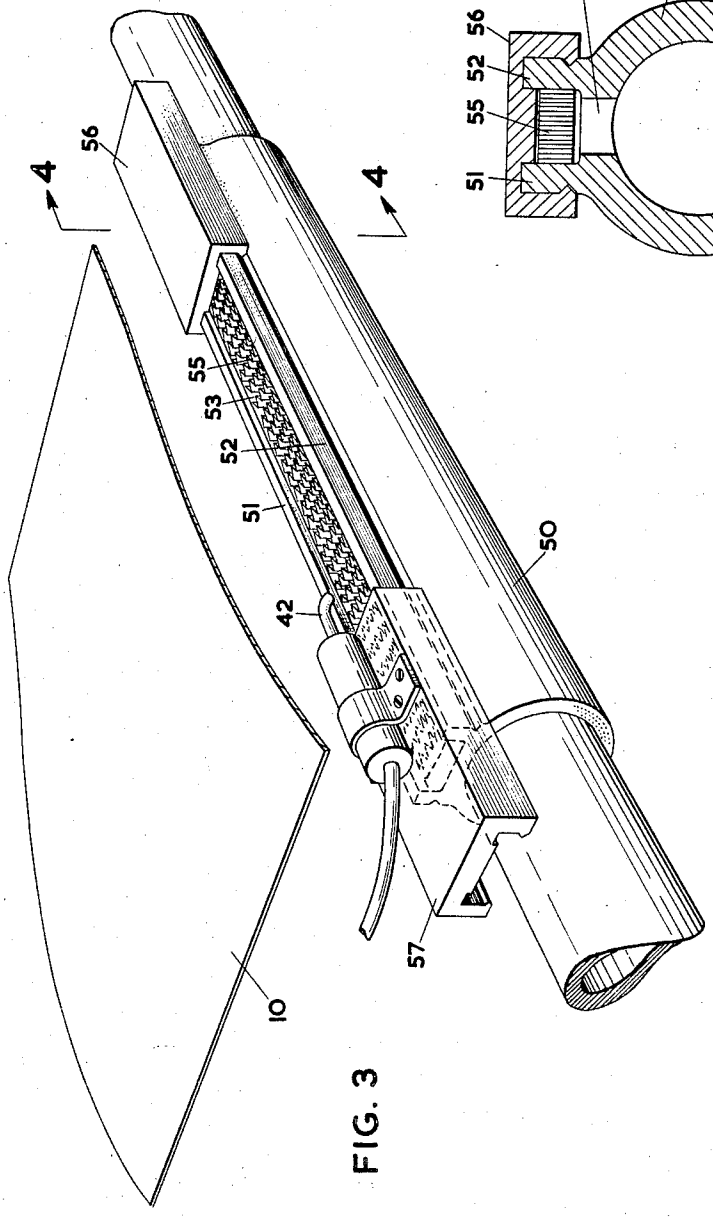


FIG. 3

FIG. 4

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Filed March 2, 1956 4 Sheets-Sheet 4

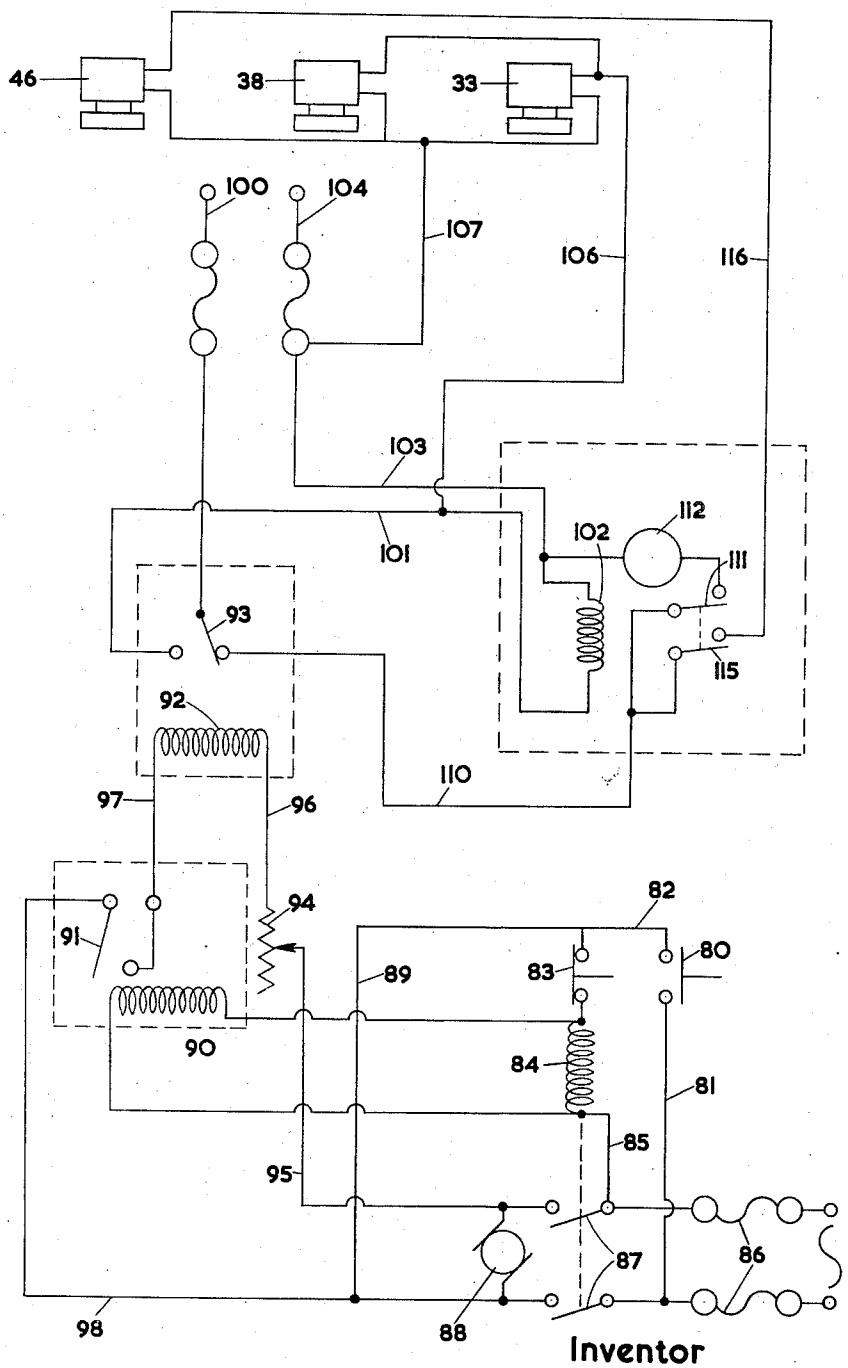


FIG. 5

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United States Patent Office 2,855,190 Patented Oct. 7, 1958

2,855,190

APPARATUS FOR DRYING PRINTING INKS

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Application March 2, 1956, Serial No. 569,208

8 Claims. (Cl. 263—3)

This invention relates to an apparatus for drying printing ink which has been applied to a length of sheet material, and has particular application in the drying of printing inks which have been applied to sheet material (for example, paper, waxed paper, and some synthetic films) in a horizontal-roll printing press, although the invention also has application to the drying of ink applied to sheet material in other types of printing presses.

The invention is specifically concerned with a drying apparatus of the type in which the inked sheet material is traversed in a horizontal plane across a heating device which includes a burner for a combustible gas, the burner having an exposed flame.

With previously proposed constructions of drying apparatus of the above-mentioned type, there has been a great risk of igniting the sheet material in the event that the traversing of the sheet material through the apparatus is discontinued or retarded, the risk arising from the time lag in extinguishing the flame at the burners, and the tendency of the sheet material to sag and contact the burners, which may be at a temperature sufficient to ignite or char it. This risk is particularly great in previously proposed constructions, as previously it has been found necessary to use a single high-pressure burner, which burner reaches a very high temperature when in use.

An object of the invention is to provide an apparatus of the kind set forth in which the risk of igniting the sheet material in the event that the traversing of the material through the apparatus is discontinued or retarded is mitigated, or completely eliminated.

Another object of the invention is to provide a drying apparatus of the kind set forth, in which the flame at the burners is almost instantaneously extinguished in the event that a drive for the traversing means is discontinued or retarded.

A further object is to provide a drying apparatus of the kind set forth, in which the sheet material is rapidly cooled, and is restrained from contacting the burners until such time as they have been adequately cooled, in the event that the drive to the traversing means is discontinued or retarded.

A still further object is to provide a drying apparatus of the kind set forth, which is of simple construction, and less costly to manufacture than previously proposed constructions.

According to the invention, the sheet material is traversed in a horizontal plane over a plurality of burners which are arranged transversely of, and below, the horizontal portion of the sheet, and means are provided which, on the discontinuance or retarding of a drive to the traversing means, will interrupt the supply of gas and increase the supply of air to the burners so that the flame at the burners will be almost instantaneously blown

out and the burners will be subjected to a blast of cooling air.

According to a further feature of the invention, a plurality of the jets are provided beneath the sheets of material, the jets being directed upwardly toward the bottom surface thereof and connected through the intermediary of a normally closed control valve with a supply of compressed air, the valve being operated to its open position in the event that the drive to the traversing means is discontinued, or retarded, the compressed air issuing from the jets serving to cool the sheet material and to lift it away from the burners.

According to a still further feature of the invention, the compressed air is supplied to the jets for a limited predetermined period only after the actuation of the valve to the open position, the valve then closing to discontinue the supply of air.

Other objects and advantages of the invention will become apparent from a study of the following specification when taken in conjunction with the accompanying drawings, in which like reference characters indicate corresponding parts throughout several views, and in which:

Figure 1 is a diagrammatic perspective view of the drying apparatus, the printing rollers of an adjacent horizontal-roll printing press being indicated in the figure;

Figure 2 is a fragmentary perspective view, to a larger scale than Figure 1, showing the construction of the apparatus in greater detail than in Figure 1;

Figure 3 is a fragmentary perspective view to a larger scale than Figure 2, showing one of the burners of the apparatus;

Figure 4 is a section on the line 4—4 of Figure 3; and,

Figure 5 is a circuit diagram of the electrical wiring of the apparatus.

Referring firstly to Figure 1, the sheet material **10**, is stored on a reel **11** and passes under the drying apparatus (indicated generally at **12**), between pinch rollers **13**, and between the printing rollers **14** of the press. The sheet material then passes over burners **15** of the apparatus, after which it is passed over a water cooled roller **16**, guide rollers **17** and **18**, and is then wound onto a roll **19**, driven through the intermediary of a slipping clutch (not shown) from the press, or from an auxiliary motor (not shown).

The drive to the roll **19** is arranged to apply a slight tension to the sheet material **10** so that it is supported in a horizontal plane after it leaves the printing rollers **14** and before it passes over the water cooled roller **15**.

A canopy **15***a* is provided over the burners **15** to carry away the fumes from the burner and from the drying inks.

Arranged in a parallel series below the horizontal portion of the sheet, as will be seen more clearly in Figure 2, is a plurality of burners **20**, which, for convenience, are arranged in two banks of three. The ends of the burners at near side of the apparatus are connected to manifolds **21**, and the ends of the burners at the other side of the apparatus are connected to manifolds **22**. The manifolds **21** and **22** can be of any desired form, the ones shown in the drawings being fabricated, for convenience of manufacture, from standard plumbers bends and junctions.

Air is supplied to each of the manifolds by a blower **23** driven by a motor **24**, the air from the blower being passed to the manifolds through a main conduit **25** and branch conduits **26**, **27** and **28**. The conduits **26**, **27**

are connected to the manifolds **21**, and the conduit **28** is connected to the manifold **22**. A metering device **26***a*, **27***a* of any known construction, is provided in each of the branch conduits **26**, **27**, the metering devices being supplied with a combustible gas through pipe lines **29**, **30**.

If desired, metering devices can be included in each of the pipe lines **29**, **30**, so that one of the banks of burners can be arranged to have a heat output which is different to that of the other bank. In this case each of the metering devices **26***a*, **27***a* would be independently adjustable to insure the correct air to gas ratios, but preferably the metering devices are of the "venturi" type in which the ratio of gas to air is automatically determined.

The pipe lines **29** and **30** are connected to a common pipe line **31** which is provided with a metering device **32**, a solenoid operated cut-off valve **33**, and a shut-off cock **34**. The valve **33** is normally closed and is opened when its solenoid winding is activated.

The air supply conduit **28** is provided with a solenoid operated cut-off valve **38** which is normally open and is moved to its closed position when its solenoid winding is activated.

Driven by the motor **24** is a magneto **40**, which is connected by wires **41** to a sparking device **42** associated with each of the burners **20**, the devices providing a means for igniting the mixture of air and gas issuing from the burners.

Downstream of the burners **20** is a conduit **44**, which is provided with jets **45** directed towards the bottom of the sheet **10** and towards the burners **20**. A solenoid-operated cut-off valve **46** is provided in the conduit **44**, the valve controlling a supply of compressed air to the conduit.

Referring now to Figures 3 and 4, which show in greater detail the construction of one of the burners, the other burners being of identical construction, the burner includes a tubular member **50** having upwardly directed ribs **51**, **52** formed longitudinally on its outer surface. The ribs **51**, **52** define a channel **53** which is in communication with the interior of the tube **50** through apertures **54**, the channel being filled with a screen **55**, formed by a length of crimped metallic foil which is packed into the groove in a random manner with the crests of the crimps extending parallel to the side walls formed by the ribs **51** and **52**. In this way a very large number of small orifices are provided through which the mixture of air and gas can escape, the mixure as it emerges from the orifices being ignited by the devices **42** as hereinbefore stated.

Mounted on the ribs **51** and **52** is a slide **56** and a slide **57**, the slide **57** carrying the device **42**, and the slides being located on the ribs by dovetails **58** so that they can be slid longitudinally of the burner and screen off predetermined portions of the channel **53**. In this way the width of the flame produced by the burner can be confined to that of the width of the paper which is being passed through the apparatus, thus economizing in the amount of gas used in the apparatus.

It will be seen that the burners are of very simple construction, and in consequence inexpensive to manufacture. Also, by using a series of burners arranged transversely of the sheet material and spaced longitudinally thereof, the burners can each have a relatively low heat output in view of the fact that the sheet material is subjected to the heat for a relatively long time as compared with the duration of heating of the sheet material in an apparatus utilizing a single high pressure burner, and, in consequence, the burners can be operated at a relatively low pressure.

The functioning of the apparatus will now be described in conjunction with Figure 5, which, as previously described, is a circuit diagram showing one form of electrical control for the apparatus, the various switches and relays being shown in the position to which they are actuated when the press and apparatus are not in use.

The sheet material **10** is installed in the press and passed through the apparatus as previously described with reference to Figure 1.

A master "start" switch **80** is then depressed to establish a circuit, through lines **81**, **82**, a normally closed master "stop" switch **83**, solenoid winding **84**, and line **85**, the lines **81** and **85** being connected across the power supply of the press above the conventional fuses **86** thereof. When the solenoid **84** is energized it closes contacts **87** of a master relay in the circuit of the winding of the motor of the press, indicated at **88**, and, in so doing, establishes a hold in circuit for the solenoid winding **84** through line **89**, switch **83**, solenoid winding **84**, and line **85**.

Connected in parallel with the solenoid **84** is the solenoid winding **90** of a relay **91**, the relay **91** being in series with a solenoid winding **92** of a relay **93**, and a potentiometer **94**. The circuit for the solenoid winding **92** includes line **95**, potentiometer **94**, line **96**, solenoid winding **92**, line **97**, relay **91**, and line **98**, the circuit being in parallel with the winding of the motor **88**.

When the circuit for the motor **88** is initially established through the contacts **87**, the armature of the motor is stationary and thus is not generating any back E. M. F., resulting in a drop in the line voltage. The potentiometer **94** is so adjusted that the line voltage applied across the solenoid winding **92** at this time is insufficient for the solenoid to actuate the relay **93**. As the speed of the motor **88** rises, the back E. M. F. generated by the motor rises, and, in consequence, the line voltage is restored to its original value, at which time the voltage applied across the solenoid **92** is sufficient for it to actuate the relay **93**. At this time the motor **88** has reached a predetermined speed, and the sheet material is passing through the press and the apparatus at a speed at which it would not be raised to a dangerous temperature in the event that the burners were put into operation.

When relay **93** is actuated, it establishes a circuit from a power line **100**, through the contacts of the relay **93**, line **101**, solenoid winding **102**, line **103**, and supply line **104**, for a purpose hereinafter referred to, and additionally establishes a circuit through line **106**, the solenoid windings of the valves **33** and **38** in parallel, and line **107** back to the power line **104**. This results in the opening of valve **33** to supply gas to the burners, and the closing of the valve **38** to discontinue the additional supply of air for purging the burners. It will be noted that neither of the valves **33**, **38** can be operated until such time as the motor **88** has reached the predetermined speed selected by adjustment of the potentiometer **94**.

The solenoid winding **102** forms part of a pre-set timing relay of any known construction, in which the contacts of the relay are closed by the solenoid **102** when its winding is energized, and are opened after a predetermined time delay by a motor unit **112** of the relay.

Should now the switch **83** be actuated to stop the press, the circuit for the solenoid winding **84** is interrupted at the switch, as is the circuit for the solenoid winding **90**. This allows the relay **91** to return to its unactuated position in which the circuit of the solenoid winding **92** is interrupted which in turn allows the relay **93** to return to its unactuated position.

When in its unactuated position, the relay **93** establishes a circuit from the power line **100**, through the contacts of the relay **93**, line **110**, relay contact **111**, motor **112**, line **113**, and line **103** back to the power line **104**. The motor **112** is thus energized and proceeds to move the contact **111** to an open position, the contact **111** opening, for example, after a time delay of five seconds. A circuit is also established from the line **110**, through a relay contact **115** which is ganged with the contact **111**, line **116**, the solenoid winding of valve **46**, and line **107** back to the power line **104**. Thus, the solenoid winding of the valve **46** is actuated to open the valve and to allow compressed air to

pass into the conduit **44**, where it is directed by the jets **45** onto the under side of the sheet material to rapidly cool the sheet and also to hold it out of contact with the burners.

Simultaneously with the return of the relay **93** to its unactuated position, the circuit for the solenoid windings of the valves **33** and **38** is broken, thus allowing the valves to move to a position in which the supply of gas to the apparatus is discontinued and the supply of air to the manifolds **22** is established, this occurring simultaneously with the establishment of the supply of compressed air to the jets **45**. Due to the opposed flows of air in the tubular members of the burners, any remaining gas is quickly purged and the flame at the burners is almost instantaneously extinguished, while at the same time the interior of the tubular members is scoured by the increased flow of air and the burners are very rapidly cooled to a temperature at which there is very little danger of them igniting the sheet material, should it come into contact with them.

Thus, the sheet material will come to rest in the apparatus on the closing down of the press, with both the burners and the sheet material at a temperature at which there is little hazard of igniting the sheet material.

Should the switch **80** now be operated to re-start the press, there will again be a time delay in the opening of the gas valve **33** and closing of the air valve **38**, for the reasons previously described, and also the solenoid winding **102** will be energized to re-set the timing relay.

Should an overload develop in the apparatus or the press, so that the longitudinal movement of the sheet material is retarded due to the speed of the motor **88** dropping, a drop in line voltage will occur across the motor for the reason previously mentioned, and in consequence the relay **93** will move to its unactuated position to discontinue the supply of gas, establish the supply of air to manifolds **22**, and establish the supply of compressed air to the jets **45**, again removing the hazard of igniting the sheet material.

Should the sheet material break some time after it has passed through the printing rollers **14**, there is little danger of igniting the sheet material, as it has been found in practice that the portion of the sheet material adjacent to the printing rollers immediately wraps itself around the rollers, and the portion of the sheet material adjacent to the water cooled roller **15** is immediately withdrawn from the apparatus onto the roll **18**. It will thus be seen that it is of little consequence whether the drying apparatus is operating or not, should the sheet material break. If desired a web sensing device of any known construction can be provided, the device operating a switch in series with the solenoid winding **84** and the solenoid winding **90**, to open the circuit in the event of the web breaking.

Whereas the apparatus described is of particular application where it is desired to use low pressure burners, with which there is a tendency for the flame to linger at the burners, it is also of application where it is desired to use a high-pressure burner, as, in this case, although the flame at the burner would almost instantaneously be blown out on the interruption of the gas supply it is still necessary to quickly cool the burner.

If the apparatus is to be made as a unit separate from the press, the motor **88** would be used for driving the roll **19**, and the motor would be interlocked in any known manner with the motor of the associated press.

What I claim as my invention is:

1. Apparatus for drying printing ink which has been applied to a length of sheet material, including in combination, means for traversing said sheet in a substantially horizontal plane, burners arranged below and transversely of the said sheet, and having orifices directed towards and substantially perpendicular to the underside of the sheet material, means for supplying a combustible gas and a supply of air to said burners, means disconnecting said supply of gas and increasing said supply of air in the event that the drive to said traversing means is discontinued or retarded, a plurality of jets arranged beneath said sheet material, said jets being directed towards the bottom surface of said sheet, a supply of compressed air to said jets, a normally closed electrically-operated valve controlling the supply of compressed air to said jets, means for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said traversing means is discontinued or retarded, and means for automatically de-energizing the operating mechanism of said valve after a predetermined time delay.

2. Apparatus for drying printing ink which has been applied to a length of sheet material, including in combination, means for traversing said sheet in a substantially horizontal plane, burners arranged below and transversely of said sheet, and having orifices directed towards and substantially perpendicular to the underside of the sheet material, means for supplying a combustible gas and a supply of air to said burners, means disconnecting said supply of gas and increasing said supply of air in the event that the drive to said traversing means is discontinued or retarded, a plurality of jets arranged beneath the said sheet material, said jets being directed towards the bottom surface of said sheet, a supply of compressed air to said jets, a normally closed electrically-operated valve controlling the supply of compressed air to the said jets, means for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said traversing means is discontinued or retarded, and an electrically-operated time delay switch in the circuit of the operating mechanism of said valve, said switch de-energizing the operating mechanism of said valve after a pre-determined time delay to permit said valve to move to its closed position and cut off said supply of compressed air to said jets.

3. Apparatus for drying printing ink which has been applied to a length of sheet material, including in combination, means for traversing said sheet in a substantially horizontal plane, a plurality of burners arranged below the horizontal portion of said sheet, and having orifices directed towards and substantially perpendicular to the underside of the sheet material, each of said burners including a tubular member extending in a direction transverse to the direction of movement of said sheet, said tubular member having a perforate upper surface, means for supplying a combustible gas and a supply of air to the interior of each of said tubular members at one end thereof, means for supplying air to the interior of each of said tubular members at the other end thereof, a first valve controlling said supply of gas to said one end, a second valve controlling the supply of air to said other end, and means for closing said first valve to discontinue said supply of gas to said one end and for opening said second valve to establish said supply of air to said other end in the event that the drive to said traversing means is discontinued or retarded.

4. Apparatus for drying printing ink which has been applied to a length of sheet material, including in combination, means for traversing said sheet in a substantially horizontal plane, a plurality of burners arranged below the horizontal portion of said sheet, and having orifices directed towards and substantially perpendicular to the underside of the sheet material, each of said burners including a tubular member extending in a direction transverse to the direction of movement of said sheet, said tubular member having a perforate upper surface, means for supplying a combustible gas and a supply of air to the interior of each of said tubular members at one end thereof, means for supplying air to the interior of said tubular members at the other end thereof, a first valve controlling said supply of gas to said one end, a second valve controlling the supply of air to said other end, and means for closing said first valve to discontinue said supply of gas to said one end and for opening said second valve to es-

tablish said supply of air to said second end in the event that the drive to said traversing means is discontinued or retarded, a plurality of jets arranged beneath said sheet material, said jets being directed towards the bottom surface of said sheet, a supply of compressed air to said jets, a normally closed electrically-operated valve controlling the supply of said compressed air to said jets, means for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said traversing means is discontinued or retarded, and an electrically-operated time delay switch in the circuit of the operating mechanism of said valve, said switch de-energizing the operating mechanism of said valve after a pre-determined time delay to permit said valve to move to its closed position and cut off said supply of compressed air to said jets.

5. Apparatus for drying printing ink which has been applied to a length of sheet material, including in combination, means for traversing said sheet in a substantially horizontal plane, a plurality of burners arranged below the horizontal portion of said sheet, and having orifices directed towards and substantially perpendicular to the underside of the sheet material, each of said burners including a tubular member extending in a direction transverse to the direction of movement of said sheet, said tubular member having a perforate upper surface, slides associated with said upper surface by which said perforations can be selectively masked, a manifold at each end of said tubular members, means for supplying a combustible gas and a supply of air to one of said manifolds, means for igniting the mixture of said gas and air emerging from said perforations, means for supplying air to the other of said manifolds, a first valve controlling said supply of gas, a second valve controlling the supply of air to said other manifold, and means for closing said first valve to discontinue said supply of gas to said one manifold and for opening said second valve to establish said supply of air to said second manifold in the event that the drive to said traversing means is discontinued or retarded, a plurality of jets arranged beneath said sheet material, said jets being directed towards the bottom surface of said sheet, a supply of compressed air to said jets, a normally closed electrically-operated valve controlling the supply of said compressed air to said jets, means for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said traversing means is discontinued or retarded, and an electrically-operated time delay switch in the circuit of the operating mechanism of said valve, said switch de-energizing the operating mechanism of said valve after a pre-determined time delay to permit said valve to move to its closed position and cut off said supply of compressed air to said jets.

6. Apparatus for drying printing ink which has been applied to a length of sheet material by a printing press, including in combination with an electrically-driven printing press, means for traversing said sheet in a substantially horizontal plane after it has been passed through the printing mechanism of said press, burners arranged transversely of, and below the horizontal portion of said sheet, each burner having orifices directed towards and substantially perpendicular to the underside of the sheet material, means for supplying a combustible gas and a supply of air to said burners, a first valve controlling said supply of gas, a second valve controlling a conduit through which a further supply of air can be fed to said burners, means for closing said first valve to discontinue said supply of gas and for opening said second valve to establish said further supply of air to said burners in the event that the drive to said press is discontinued or retarded, a plurality of jets arranged beneath said sheet material, said jets being directed towards the bottom surface of said sheet, a supply of compressed air to said jets, a normally closed electrically-operated valve controlling the supply of said compressed air to said jets, means for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said press is discontinued or retarded, and an electrically-operated time delay switch in the circuit of said operating mechanism of said valve, said switch de-energizing the operating mechanism of said valve after a predetermined time delay to permit said valve to move to its closed position and to cut off said supply to said jets.

7. Apparatus for drying printing ink which has been applied to a length of sheet material by a printing press, including in combination with an electrically-driven printing press, means for traversing said sheet in a substantially horizontal plane after it has been passed through the printing mechanism of said press, a plurality of burners arranged below the horizontal portion of said sheet, each burner having orifices directed towards and substantially perpendicular to the underside of the sheet material, each of said burners including a tubular member extending in a direction transverse to the direction of movement of said sheet, said tubular members having a perforate upper surface, means for supplying a combustible gas and a supply of air to the interior of said tubular members at one end thereof, means for supplying air to the interior of said tubular member at the other end thereof, a first valve controlling said supply of gas to said one end, a second valve controlling the supply of air to said other end, means associated with said press for closing said first valve to discontinue said supply of gas to said one end and for opening said second valve to establish said supply of air to said other end in the event that the drive to said press is discontinued or retarded, a plurality of jets arranged beneath said sheet material, and directed towards the bottom surface of said sheet, a supply of compressed air to said jets, a normally closed electrically-operated valve controlling the supply of compressed air to said jets, means for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said press is discontinued or retarded, and an electrically-operated time delay switch in the circuit of the operating mechanism of said valve, said switch de-energizing the operating mechanism of said valve after a pre-determined time delay to permit said valve to move to its closed position and cut off said supply of compressed air to said jets.

8. Apparatus for drying printing ink which has been applied to a length of sheet material by a printing press, including in combination with an electrically-driven printing press, means for traversing said sheet in a substantially horizontal plane after it has been passed through the printing mechanism of said press, a plurality of burners arranged below the horizontal portion of said sheet, and having orifices directed towards and substantially perpendicular to the underside of the sheet material, each of said burners including a tubular member extending in a direction transverse to the direction of movement of said sheet, each of said tubular members having a perforate upper surface, slides associated with said upper surfaces by which said perforations can be selectively masked, a manifold at each end of said tubular members, means for supplying a combustible gas and a supply of air to one of said manifolds, means in proximity to said perforations of said tubular members for igniting said supply of gas and air, means for supplying air to the other of said manifolds, a first valve controlling said supply of gas, a second valve controlling the supply of air to said other manifold, means for closing said first valve to discontinue said supply of gas to said one manifold and for opening said second valve to establish a supply of air to said second manifold in the event that the drive to said press is discontinued or retarded, a plurality of jets arranged beneath said sheet material, said jets being directed towards the bottom surface of said sheet, a supply of compressed air to said jets, means

for energizing the operating mechanism of said valve to establish said supply to said jets in the event that the drive to said press is discontinued or retarded, and an electrically-operated time delay switch in the circuit of the operating mechanism of said valve, said switch de-energizing the operating mechanism of said valve after a predetermined time delay to permit said valve to move to its closed position and cut off the supply of said air to said jets.

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