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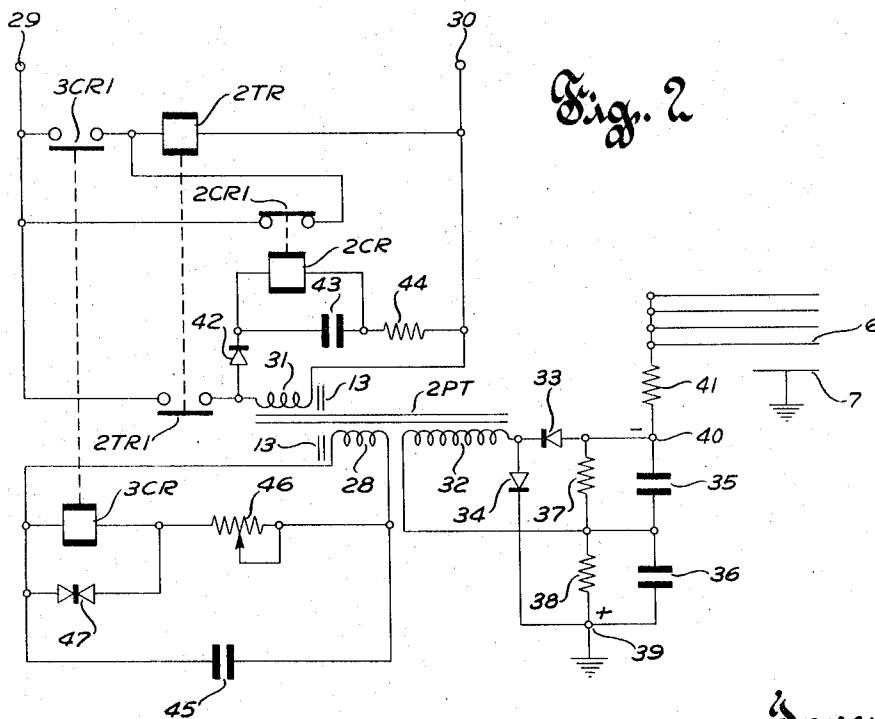
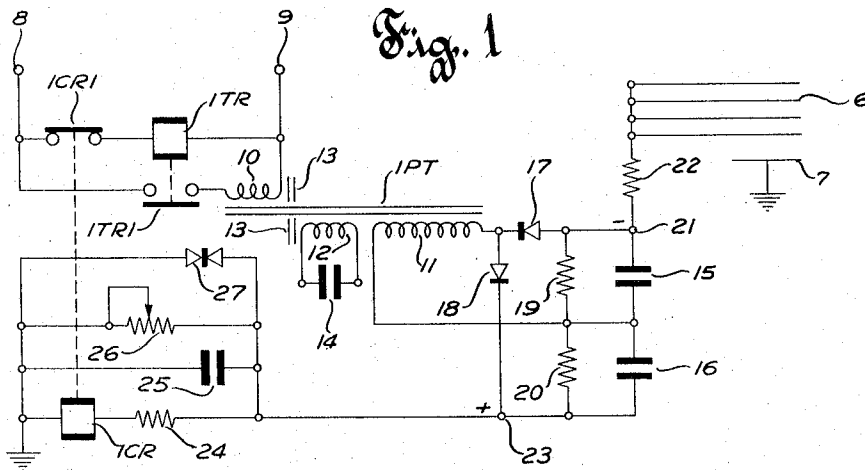
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3,295,441

ARC SUPPRESSOR SYSTEM FOR INK MIST CONTROL

Filed March 30, 1964

3 Sheets-Sheet 1



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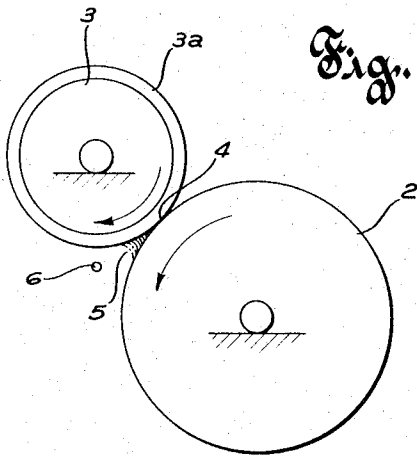
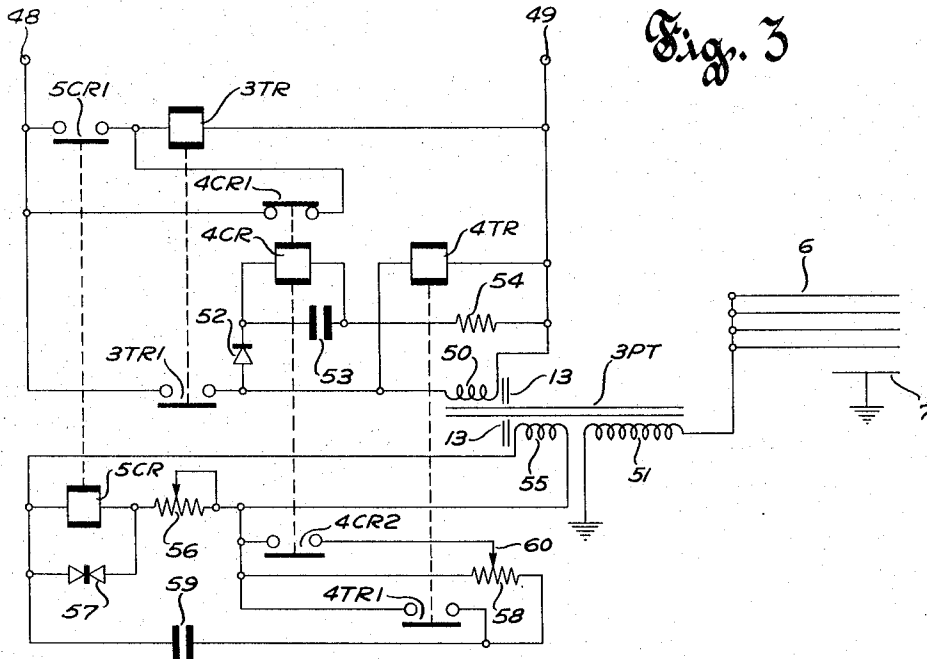
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ARC SUPPRESSOR SYSTEM FOR INK MIST CONTROL

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3 Sheets-Sheet 2



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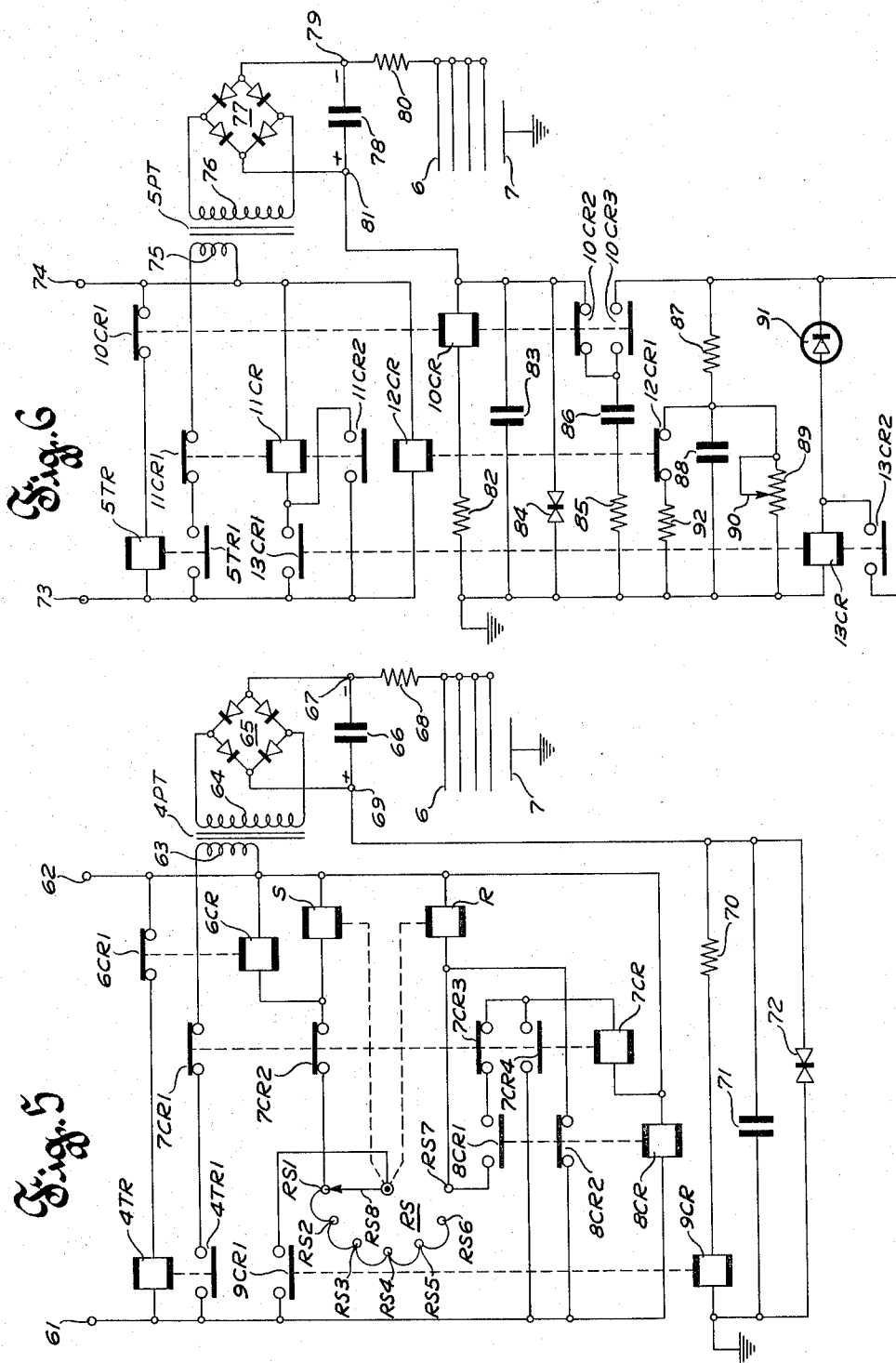
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3 Sheets-Sheet 3



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ARC SUPPRESSOR SYSTEM FOR INK MIST CONTROL

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Filed Mar. 30, 1964, Ser. No. 355,735
8 Claims. (Cl. 101—335)

This invention relates to apparatus for suppressing arcing on the high voltage corona wires of ink mist controlling devices.

In the printing industry, a serious problem has been the formation of ink mist in printing presses. This ink mist is formed as the ink film splits at the exit side of the line of contact between ink train rollers. This line of contact is referred to as the "nip" of the rollers, and adjacent pair of rollers are called roller couples. As the ink film splits, filaments of ink are formed which quickly rupture into extremely small ink particles which eventually become diffused in the surrounding atmosphere in the form of mist.

A solution to the problem of ink mist formation in pressrooms has been disclosed in Patent No. 3,011,435 issued December 5, 1961 to Rexford W. Jones, Robert B. Rief and Lewis E. Walkup. The apparatus there shown comprises a highly electrically charged conductor disposed adjacent and parallel to the roller nip and at the exit side thereof. The applied electrical potential is such that a corona discharge surrounds the conductor, and an accompanying electrostatic field exists between the conductive member and the grounded rollers of the ink train. The ink mist particles generated at the exit side of the nip are given an electrical charge in the area of intense ionization surrounding the conductor. The charged ink particles are thereupon driven back to the rollers by the electrostatic field and are absorbed by the ink film on the rollers.

Since the charged conductor or corona wire is located fairly close to the rollers, the chance for damage to either the rollers or the corona wire is present. Originally it was thought that the only way in which damage to the rollers from the corona wire could occur would be from the result of accidental breaks in the newsprint webs. Since breakage of the newsprint web is an obvious event, the press could be quickly shut down by the operating personnel upon such an occurrence. The broken newsprint web would cause the newsprint to bunch up against the corona wire and push it into the moving but decelerating rollers. The corona wire assembly is releasably constructed to allow the wires to be then pulled loose by the rollers to thereby prevent serious damage to other parts of the mechanism. After the complete stoppage of the press, the press operating personnel would remove the broken wires. This approach was quite successful in contending with corona wire failures caused by web breaks. However, in the occasional event a wire broke for some less apparent cause, the continued operation of the press before discovery of the failure could result in damage to the rollers. Originally, it was thought that the principal cause of failure of the taut corona wire other than web breakage was fatigue induced by vibration. It was later discovered that such failures were due primarily to electrical arcing between the corona wire and the grounded rollers.

It is therefore an object of this invention to provide an arc suppressing system for an ink mist controlling apparatus of the type heretofore described.

It is a further object of this invention to provide such an arc suppressing system which shuts down the ink mist control apparatus for an interval following the occurrence

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of an arc to extinguish the arc and is subsequently effective to reenergize the apparatus.

It is another object of this invention to provide an arc suppressing system which is effective to shut down the ink mist control apparatus following the occurrence of a fixed number of arcs.

It is still another object of this invention to provide an arc suppressing system which is sensitive to the frequency of the occurrence of arcs.

Other objects and advantages of this invention will hereinafter appear.

While the system hereinafter described is effective to fulfill the stated objects it is not intended that the invention be confined to the particular preferred embodiments disclosed since they are susceptible of various modifications without departing from the scope of the appended claims.

In the drawings:

FIGURE 1 is a diagrammatic representation of an arc suppressing system suitable for use where a D.C. voltage is applied to the corona wires of an ink mist control apparatus;

FIG. 2 is a diagram of a second variation of the arc suppressing system;

FIG. 3 is a diagrammatic showing of a variation of the invention which, as illustrated, is adapted for an ink mist control apparatus with an A.C. voltage applied to the corona wires;

FIG. 4 is an end view of two rollers of a printing press ink train showing the location of a corona wire with respect thereto;

FIG. 5 diagrammatically illustrates a further variation of the invention which includes arc counting means; and

FIG. 6 is a diagram representing another variation of the invention which includes means sensitive to the number and frequency of arcs.

In FIG. 4, there are shown a pair of rollers 2 and 3 exemplary of two of the many such rollers in the ink train of the usual printing press which distribute ink by transfer from one to another. Roller 2 may be assumed to be made of steel whereas roller 3 is made of steel covered with a layer 3a of resilient material. The area of contact 4 between the rollers is referred to as the nip, and the exit of which is the area in which ink filaments 5 and the consequent ink mist are initially formed. A corona wire 6 is arranged parallel and in close proximity to the exit side of the nip 4. The rollers 2 and 3 are connected to ground while a high voltage is applied to corona wire 6 by electrical apparatus as hereinafter described. As previously explained, the corona discharge surrounding wire 6 is effective to charge the ink mist particles and the electrostatic field between wire 6 and rollers 2 and 3 and is effective to drive the charged particles back to rollers 2 and 3 to be absorbed by the ink film thereon. Each of the forms of electrical apparatus hereinafter described is adapted to accomplish the objects of this invention by minimizing and suppressing the harmful effects of arcs which will occasionally occur between corona wire 6 and rollers 2 and 3.

In FIG. 1, there is shown a power supply for applying a D.C. voltage to corona wires 6. The electrical grounded ink train rollers 2 and 3 are represented schematically by grounded element 7. Alternating current power is applied to terminals 8 and 9 usually at the same time the power to the press motors is applied. The line voltage is then applied through normally closed contact 1CR1 of control relay 1CR to energize the coil of timed relay 1TR. After a selected timed interval, the normally open contact 1TR1 closes to energize the primary winding 10 of a power transformer 1PT.

Transformer 1PT is a voltage regulating transformer of a commercially available type with a high voltage

regulated output delivered from secondary winding 11. A third winding 12 is the saturating winding. A magnetic shunt 13 is placed between the primary and saturating windings 10 and 12 and a capacitor 14 is connected across saturating winding 12.

The D.C. output of power transformer 1PT is delivered to a conventional voltage doubling and rectifying circuit comprising capacitors 15 and 16, diodes 17 and 18, and bleeder resistors 19 and 20 to produce a high voltage output, point 21 being the negative terminal and point 23 being the positive terminal. The voltage produced between terminals 21 and 23 is preferably about 15,000 volts D.C. The negative terminal 21 is connected to corona wires 6 through a surge suppressing resistor 22 which is inserted to prevent excessively high rates of discharge of capacitors 15 and 16 through corona wires 6 in case of arcing, shorting or other such occurrence.

Positive terminal 23 is connected to ground through the arc detecting circuit comprising the coil of control relay 1CR, a current limiting resistor 24, a capacitor 25, a variable resistor 26, and a voltage surge suppressing semiconductor device 27. Upon the occurrence of an arc between corona wires 6 and grounded member 7 there is a sudden increase in current flowing through terminal 23 to ground. The current flowing through resistor 24 and the coil of relay 1CR thereupon increases sufficiently to cause actuation of relay 1CR, and the normally closed contact 1CR1 opens to deenergize timed relay 1TR. Contact 1TR1 thereupon immediately opens to deenergize the primary winding 10 and consequently interrupt the high voltage supply to corona wires 6. Coil 1CR is also deenergized to cause contact 1CR1 to close. Timed relay 1TR is thereupon reenergized and after a selected timed interval during which the arc becomes extinguished, contact 1TR1 recloses to again energize the high voltage supply. The same cycle of operation will then repeat when the next arc occurs.

Capacitor 25 serves to insure that coil 1CR is energized for a time sufficient to allow timed relay 1TR to drop out. Variable resistor 26 forms an electrical path in shunt of the coil of relay 1CR and resistor 24, and resistor 26 may therefore be varied to control the level of current through point 23 at which relay 1CR will become actuated. The voltage surge suppressor 27 is of a type known as a "thyrector diode" and limits the voltage across its terminals to protect parallel connected elements from high applied voltage upon the occurrence of an arc.

The system of FIG. 1 is effective to limit the duration of arcs to be very short interval of time required for contact 1TR1 to open in response to the occurrence of the arc. Since the arc is unable to cause substantial damage to the corona wire 6 during this limited interval, the perils to the machinery due to arcing on the corona wires are drastically reduced.

FIG. 2 shows a system for suppressing arcs in which the arc sensing means is placed in circuit with the saturating winding 28 of power transformer 2PT. As power is initially applied to line terminals 29 and 30 current flows through the normally closed contact 2CR1 of control relay 2CR to energize the coil of a timer relay 2TR. After a preset timed interval contact 2TR1 of timer relay 2TR closes to energize the primary winding 31 of a voltage regulating power transformer 2PT. High voltage alternating current is thereupon delivered from a secondary winding 32 to a rectifying and voltage doubling circuit comprising rectifiers 33 and 34, capacitors 35 and 36, and bleeder resistors 37 and 38. The positive terminal 39 is connected to ground while the negative terminal 40 is connected to corona wires 6 through a surge suppressing resistor 41.

Simultaneously with the energization of primary winding 31, current begins to flow through a parallel wired time delay circuit comprising a rectifier 42, a capacitor 43 and a resistor 44. After capacitor 43 becomes suf-

ficiently charged, the voltage across its terminals becomes sufficient to cause energization of the operating coil of relay 2CR to open contact 2CR1. The time delay in the operation of relay 2CR is introduced to allow sufficient time for a contact 3CR1 to close so that the energizing current to relay 2TR is not interrupted at this point.

A voltage sensing relay 3CR is introduced into the circuit of the saturating coil 28 in parallel with a resonating capacitor 45. The operating coil of relay 3CR is connected in series with a variable resistor 46 by which the operating point of the relay may be adjusted. A voltage surge suppressing device 47 is connected in parallel with the coil of relay 3CR to protect the same from excessive voltage surges and to provide a degree of voltage stabilizing across 3CR at normal power supply loads.

As power transformer 2PT is initially energized, the voltage at the terminals saturating winding 28 increases and, when sufficiently high, causes enough current to flow through resistor 46 and the coil of relay 3CR to cause contact 3CR1 to close. When contact 2CR1 opens after its time delay, contact 3CR1 maintains relay 2TR energized.

The characteristics of power transformer 2PT are such that the increased load current flow in secondary winding 32 resulting from the occurrence of an arc between corona wires 6 and grounded member 7 in turn causes a drop in the voltage across the terminals of saturating winding 28. This drop in voltage is sufficient to cause the current flow through resistor 46 and the coil of relay 3CR to decrease below that value necessary to hold contact 3CR1 closed. Relay 3CR thereupon drops out and contact 3CR1 opens to deenergize the coil of timer relay 2TR. Contact 2TR1 immediately opens and as a result the primary winding 31 of power transformer 2PT is deenergized to turn off the high voltage to corona wires 6 and extinguish the arc.

At the same time winding 31 is deenergized, the current flow to relay 2CR is interrupted and as a result, contact 2CR1 will reclose to reenergize the cooperating coil of timer relay 2TR. After the preset timed interval, contact 2TR1 will again close to reenergize the power transformer and to render the ink mist control operational. As previously explained, contact 3CR1 will then close and contact 2CR1 will open. The arc suppressing system is then ready to repeat the cycle to extinguish the next occurring arc.

FIG. 3 illustrates a variation of arc suppressor which is particularly adapted for use where high voltage alternating current is applied to the corona wires. It has been found that alternating current is especially useful in color printing.

As A.C. power is initially applied to terminals 48 and 49, current flows through normally closed contacts 4CR1 to energize the operating coil of timer relay 3TR. After a preset time interval, contact 3TR1 closes to energize primary winding 50 of a voltage regulating power transformer 3PT which delivers high voltage A.C. to corona wires 6 from its secondary winding 51. The operating coils of two relays 4CR and 4TR are wired in parallel with primary winding 50. The first relay 4CR is a control relay having a time delay circuit associated therewith comprising diode 52, capacitor 53, and resistor 54. The rectified current flowing through diode 52 serves to charge capacitor 53 at a rate determined by the value of resistor 54. After a time sufficient to allow contact 5CR1 to close, capacitor 53 becomes charged to that level where the voltage across its terminals is sufficient to energize control relay 4CR to open contact 4CR1 and close contact 4CR2. At the same time primary winding 50 becomes energized by the closure of contact 3TR1, the operating coil of timer relay 4TR becomes energized. Contact 4TR1 closes after a preset timed interval which is selected to be larger than the time delay of relay 4CR.

As power is applied to primary winding 50, saturating winding 55 becomes energized and a voltage is applied

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to the operating coil of relay 5CR through a variable resistor 56. Contact 5CR1 thereupon closes to maintain relay 3TR energized. A voltage surge suppressing semiconductor device 57 is connected in parallel with the coil of relay 5CR to protect the same from excessive voltage transients and to provide a degree of voltage stabilizing across 5CR at normal power supply loads.

Relays 4CR and 4TR provide means for preventing excessive voltage surges to corona wires 6 upon the initial energization of power transformer 3PT. When contact 3TR1 closes to energize primary winding 50, contacts 4CR2 and 4TR1 open. The full resistance of resistor 58 is therefore initially in series with resonating capacitor 59. Since maximum voltage is delivered from secondary windings when the minimum resistance is in series with saturating winding 55, any voltage surge which might occur upon initial energization of transformer 3PT is substantially reduced by the presence of resistance 58. After the time delay in the operation of relay 4CR, contact 4CR2 closes to shunt a portion of resistance 58 determined by the setting of slider 60. The resistance of the resonating circuit of saturating winding 55 is thereupon reduced and output voltage of transformer increases. Similarly, a further increase to full output voltage results upon the closure of contact 4TR1 after the timed interval of timer relay 4TR. The A.C. output of the ink mist control apparatus therefore increases in two steps upon energization of transformer 3PT to avoid excessive voltage surges at corona wires 6.

Upon the occurrence of an arc from corona wire 6 to grounded member 7, a voltage drop occurs in saturating winding 55, as has been previously explained in connection with the apparatus of FIG. 2. The voltage to the coil of relay 5CR will, as a result, decrease sufficiently to allow relay 5CR to drop out and for contact 5CR1 to open. The opening of contact 5CR1 deenergizes the operating coil of relay 3TR and contact 3TR1 immediately opens to deenergize transformer 3PT and extinguish the arc. At the same time the energizing current to relays 4CR and 4TR is interrupted. Contact 4TR1 thereupon reopens. As relay 4CR drops out contact 4CR2 reopens and contact 4CR1 closes to reenergize timer relay 3TR. After a timed interval, contact 3TR1 recloses to again energize the transformer 3PT and relays 4CR and 4TR subsequently pick up to raise corona wires 6 to operating voltage. The system will repeat the aforescribed cycle to extinguish the next arc.

FIG. 5 illustrates a system adapted to extinguish arcs by interrupting the high voltage to corona wires 6 upon the occurrence of each arc and to further count each arc and shut down the ink mist control after a fixed number of arc for the duration of the run of the printing press. The counting is accomplished by an electromagnetically operated resettable stepper switch RS having a stepping coil S, a reset coil R, seven sequentially contacted stationary contacts RS1 through RS7, and a movable contact RS8.

As A.C. power is initially applied to terminals 61 and 62, current flows through normally closed contact 6CR1 of a control relay 6CR to energize the operating coil of a timer relay 4TR. After the elapse of a preset time, contact 5TR1 of timer relay 4TR closes to energize the primary winding 63 of a step-up power transformer 4PT. High voltage from secondary winding 64 is rectified by full wave rectifier bridge 65 and smoothed by a capacitor 66 to provide a negative voltage at a terminal 67. A surge suppressing resistor 68 connects terminal 67 to corona wires 6. The other terminal 69 of the high voltage D.C. supply is connected to ground through a surge detecting circuit comprising the operating coil of a control relay 9CR, a voltage dropping resistor 70 connected in series therewith, a parallel connected capacitor 71, and a parallel connected voltage surge suppressing device 72. Capacitor 71 is an energy storage device for lengthening the period of actuation of relay 9CR upon the occurrence

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of a short surge of current in the high voltage supply. Voltage surge suppressor 72 provides protection for parallel connected elements from excessively high voltage surges. During normal operation of the ink mist control system, the current flow through the operating coil of relay 9CR is insufficient to cause relay 9CR to pick up, and it is only upon the occurrence of an arc between corona wires 6 and grounded member 7 that the current flow to the coil of relay 9CR causes contact 9CR1 to close.

When power is applied to terminals 61 and 62, the reset coil R of stepper switch RS is momentarily energized through the normally closed contact 8CR2 of a control relay 8CR to cause movable contact RS8 to return to contact RS1 if not already there. Since the operating coil of relay 8CR is connected directly across terminals 61 and 62 it is also energized and contact 8CR2 then opens to interrupt the momentary energization of reset coil R and contact 8CR1 closes. The system would at this point be in its normal operating condition, ready to detect and extinguish the first occurring arc.

The first arc causes relay 9CR to pick up to close contact 9CR1. Current then flows through contact 9CR1, movable contact RS8, stationary contact RS1, and normally closed contact 7CR2 of relay 7CR to energize stepper coil S of stepper switch RS and the operating coil of relay 6CR. Consequent to the energization of coil S, the movable contact advances one step to stationary contact RS2. The energization of relay 6CR opens contact 6CR1 to deenergize relay 4TR. Contact 4TR1 immediately opens to interrupt the input to power transformer 4PT and the first occurring arc is as a result extinguished. Relay 9CR consequently drops out after a period determined by the sizes of capacitor 71 and resistor 70. Contact 9CR1 then opens to deenergize coil S and relay 6CR and contact 6CR1 opens to deenergize the coil of timer relay 4TR. After the timed interval of operation of timer relay 4TR, contact 4TR1 recloses to again energize power transformer 4PT. The system is then again operational and is ready to extinguish the second occurring arc.

The aforescribed cycle of operation repeats following each subsequent arc with movable contact RS8 moving one step with each arc to sequentially contact each of contacts RS2 through RS6. Upon the occurrence of the sixth arc in a series of arcs, contact 9CR1 closes to again cause a one-step advance of the stepper switch RS and causes the interruption of power by contact 4TR1. In addition, capacitor 71 causes relay 9CR to hold contact 9CR1 closed until movable contact RS8 makes contact with contact RS7. Thereupon reset coil R is energized to reset movable contact RS8 to its original position at contact RS1, and the coil of relay 7CR is energized. Consequently, contact 7CR1 opens to maintain transformer 4PT deenergized. Contact 7CR2 opens to prevent energization of relay 6CR and the stepper coil S. Contact 7CR4 closes to maintain relay 7CR energized and contact 7CR3 opens. The ink mist control system will remain shut down until the power to terminals 61 and 62 is removed, whereupon relays 7CR and 8CR drop out and the system returns to its original deenergized condition as illustrated in FIG. 5.

If the system is shut down by removal of the power to terminals 61 and 62 before the system has been shut down automatically by the sixth arc, relay 8CR will thereupon drop out to return the system to its original state except for the position of the resettable stepper switch RS. If movable contact RS8 is on a contact other than contact RS1, it will remain in such position until the system is again energized. The stepper switch will thereupon immediately reset as previously described.

FIG. 6 illustrates a system for extinguishing each arc as it occurs and for shutting down the ink mist control if a preselected rate of arc occurrence is exceeded.

As power is applied to terminals 73 and 74, current flows through the normally closed contact 10CR1 of a

control relay 10CR to energize the operating coil of timer relay 5TR. After its timed interval of operation, contact 5TR1 closes to complete the circuit through normally closed contact 11CR1 of a relay 11CR to energize the primary winding 75 of a step-up power transformer 5PT. High voltage A.C. from secondary winding 76 is then rectified by a full wave bridge 77 and smoothed by capacitor 78 to provide a high negative voltage at terminal 79. A surge suppressing resistor 80 connects terminal 79 to corona wires 6.

The operating coil of control relay 12CR is also energized upon application of power to terminals 73 and 74 to open contact 12CR1.

The other terminal 81 of the high voltage supply is connected to ground through an arc detecting and counting circuit. The normal operating current flowing through resistor 82 and the operating coil of control relay 10CR is insufficient to cause relay 10CR to pick up. Relay 10CR will, however, become actuated by a surge such as will occur when an arc exists between corona wires 6 and grounded member 7. Connected in parallel with resistor 82 and the coil of relay 10CR is a capacitor 83 for extending the period of actuation of relay 10CR and a voltage surge suppressing device 84 for protection of parallel connected elements.

During normal operation of the ink mist control system current flows through the normally closed contact 10CR2 and a resistor 85 to rapidly charge a capacitor 86.

Upon the occurrence of an arc between corona wire 6 and grounded member 7, the surge of current through the coil of relay 10CR causes relay 10CR to be actuated to open contacts 10CR1 and 10CR2 and close contact 10CR3. The opening of contact 10CR1 deenergizes relay 5TR and the contact 5TR1 immediately opens to deenergize high voltage power transformer 5PT to extinguish the arc. As contact 10CR3 closes a portion of the charge created by the arc then existing in capacitor 86 is carried through resistors 87 and 85 to partially charge a capacitor 88. When contact 5TR1 timer closes, the high voltage supply is reenergized.

With each succeeding arc, capacitor 88 similarly receives additional but reduced increments of charging current. A variable resistor 89 will slowly and continuously discharge capacitor 88 at a rate determined by the setting of a slider 90. If arcs occur at a sufficiently high rate, capacitor 88 will receive charging current faster than resistor 89 drains it off and the breakdown voltage of a voltage level breakdown device 91 will be exceeded. Breakdown device 91 may be, for example, a Zener diode or neon glow tube. The coil of control relay 13CR will thereupon be energized to close contacts 13CR1 and 13CR2. The closure of contact 13CR2 shunts voltage level breakdown device 91 to discharge capacitor 88 through the operating coil of relay 13CR.

The closure of contact 13CR1 energizes the coil of relay 11CR to open contact 11CR1 and close maintaining contact 11CR2. Since relay 11CR will be maintained energized, contact 11CR1 will remain open to prevent energization of the high voltage power transformer 5PT. When the power to terminals 73 and 74 is removed relays 11CR and 12CR drop out to return the system to its original state as illustrated in FIG. 6.

If power to terminals 73 and 74 is removed before the arc rate sensitive circuit shuts down the high voltage supply as described, the closing of contact 12CR1 will discharge the arc counting capacitor 88 through resistor 92 to return arc rate sensing circuit to its original state.

I claim:

1. In a printing press, in combination; a roller couple for transferring printing ink from one roller of the couple to the other, said couple when in operation causing an ink mist to be produced in the atmosphere adjacent the exit side of the nip of said couple; means for suppressing said mist comprising an electrical conductor disposed adjacent said rollers and in relatively short spaced relation to the

exit side of said nip, power supply means for applying a high electrical potential between said conductor and at least one roller of said couple to establish a corona discharge about said conductor and to establish an electrical field between said conductor and said roller of said couple, said corona discharge effecting electrical charging of the particles of said mist and said electrical field acting upon said charged particles to repel the latter back onto said rollers; and means for suppressing electrical arcing between said conductor and said roller comprising means for detecting the surge of current flowing to said conductor resulting from the occurrence of each arc between said conductor and said roller, means responsive to said detecting means for deenergizing said power supply means to interrupt each arc, means for automatically reenergizing said power supply means following each of a fixed number of arcs after an interval of time sufficient to allow each arc to be extinguished, and means for preventing automatic reenergization of said power supply means following the occurrence of one more than said fixed number of arcs.

2. A high voltage supply for an ink mist control system comprising a voltage regulating transformer having a primary winding, a saturating winding, and a high voltage secondary winding connected to a load circuit, means for interrupting the energization of said primary winding; and electro-responsive means connected to said saturating winding for operating said deenergizing means; said transformer having operating characteristics such that the voltage across said saturating winding is reduced when the load increases abnormally in said secondary winding as results from arcing in said load circuit; whereby an abnormal increase in current in said secondary winding causes the high voltage supply to be interrupted.

3. A high voltage alternating current supply for an ink mist control comprising a voltage regulating transformer having a primary winding, a saturating winding, and a high voltage secondary winding connected to a load circuit deenergization; means for interrupting the energization of said primary winding; electroresponsive means sensitive to the occurrence of an abnormal increase current in said secondary winding for operating said deenergizing means; whereby an abnormal increase in current in said secondary winding serves to interrupt the high voltage alternating current supply by deenergizing said primary winding; means responsive to the operation of said deenergizing means including timing means for reenergizing said primary winding a timed interval after the occurrence of said abnormal increase in current; and means connected to said saturating winding for, upon reenergization of said primary winding, increasing the high voltage output of said transformer in a plurality of steps to avoid abnormally high output voltage surges.

4. The invention as defined in claim 3, in which said saturating winding has a capacitive load and said means for increasing the high voltage output of said transformer in a plurality of steps comprises resistance means in series with said capacitive load and means for reducing the resistance of said resistive means in sequential steps following energization of said primary winding.

5. The invention as defined in claim 4, in which said electroresponsive means comprises voltage sensitive means connected to said saturating winding, and said transformer has operating characteristics such that the voltage across said saturating winding is reduced when the load increases abnormally in said secondary winding as results from arcing in said circuit.

6. A high voltage supply for an ink mist control system comprising a transformer having a primary winding and a high voltage secondary winding; electroresponsive means for detecting abnormally high surges of current from said secondary winding; means responsive to said electroresponsive means for interrupting the energization of said primary winding upon the occurrence of an abnormally high surge of current from said secondary wind-

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ing and subsequently reestablishing the energization of said primary winding after a timed interval; and second means for interrupting the energization of said primary winding after the occurrence of a variable number of abnormally high current surges from said secondary winding, said number being dependent on the rate of occurrence of said surges.

7. The invention as defined in claim 6, together with rectifier means connected to said secondary winding and having direct current output terminals; and in which said second means for interrupting the energization of said primary winding comprises a first capacitor for being charged by current from said direct current output terminals, a second capacitor for being charged incrementally from said first capacitor upon each operation of said electroresponsive means, a resistor connected in parallel with said second capacitor for discharging said second capacitor at a selectable rate, a voltage level breakdown device connected to said second capacitor, a second electroresponsive device connected to said voltage breakdown device for being energized by the discharge of said second capacitor upon the breakdown of said breakdown device and for interrupting the energization of said primary winding.

8. In a printing press, in combination; a roller couple for transferring printing ink from one roller of the couple to the other, said couple when in operation causing an ink mist to be produced in the atmosphere adjacent the exit side of the nip of said couple; means for suppressing said mist comprising an electrical conductor disposed adjacent said rollers and in relatively short spaced relation to the exit side of said nip, power supply means including a high voltage regulating transformer having a primary winding and a high voltage secondary winding for applying a high electrical potential between said conductor and

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at least one roller of said couple to establish a corona discharge about said conductor and to establish an electrical field between said conductor and said roller of said couple, said corona discharge effecting electrical charging of the particles of said mist and said electrical field acting upon said charged particles to repel the latter back onto said roller; and means responsive to the occurrence of an arc between said conductor and said roller comprising a first relay responsive to the occurrence of said arc having an operating coil connected to said secondary winding, contact means operated by said first relay means, and a timed relay having operating means connected and energizable through said contact means, said timed relay further having timed contact means operated by said operating means and connected in circuit with said primary winding for sequentially deenergizing said primary winding to extinguish said arc and reenergize said primary winding a timed interval after occurrence of said arc.

References Cited by the Examiner

UNITED STATES PATENTS

1,160,844	11/1915	Chernyshoff	317—17
1,751,380	3/1930	Anderson	317—22 X
2,165,015	7/1939	Sohles	200—126
2,180,164	11/1939	Minnci	317—11 X
2,284,794	6/1942	Bedford	317—11 X
2,563,558	8/1951	Schultheiss	200—126
2,765,430	10/1956	Graef	317—22 X
3,011,435	12/1961	Jones	101—350
3,187,225	6/1965	Mayer	317—33 X

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