Oct. 4, 1949. W. J. HOOPER 2,483,542

STATIC ELIMINATOR FOR PRINTING PRESSES

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Fig. 1.

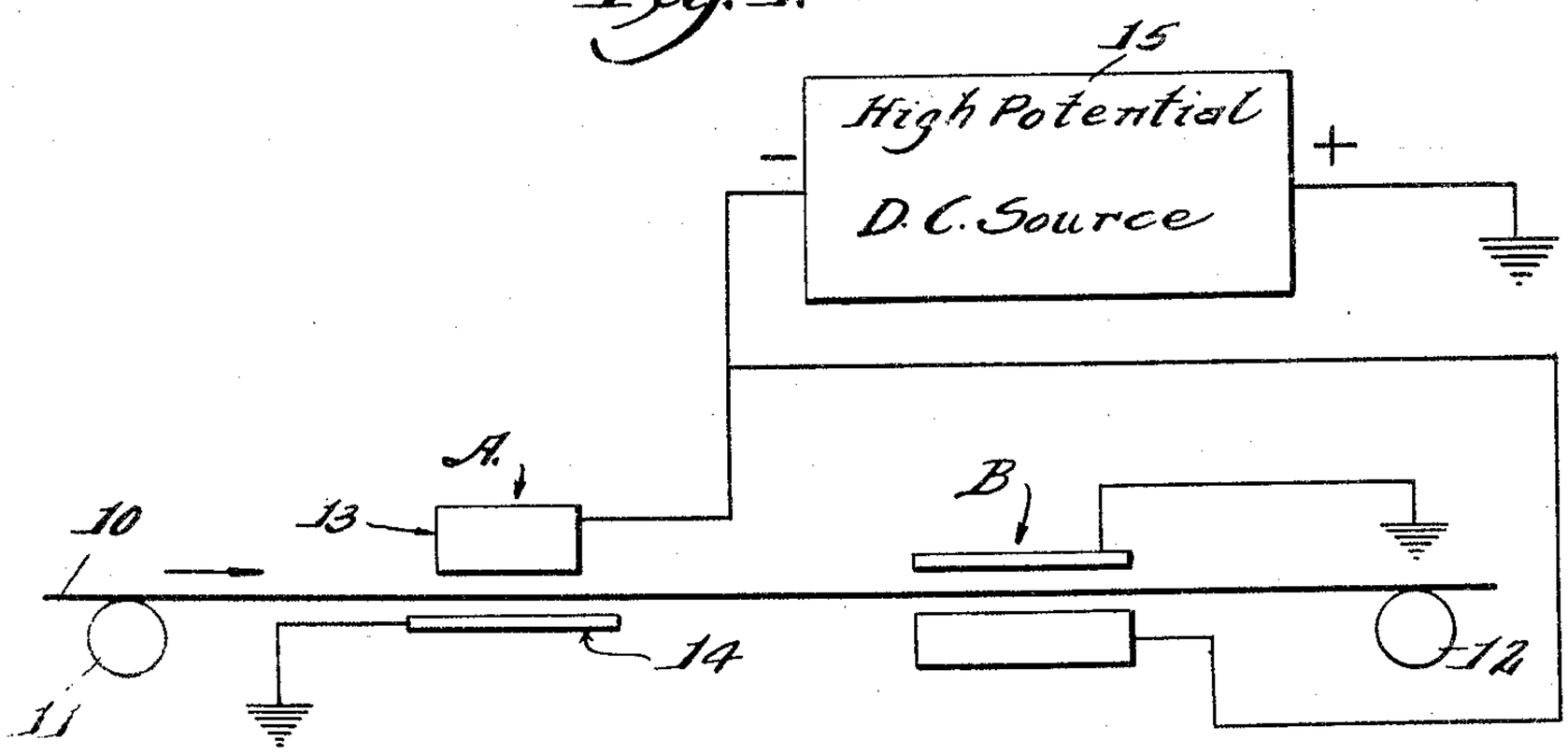
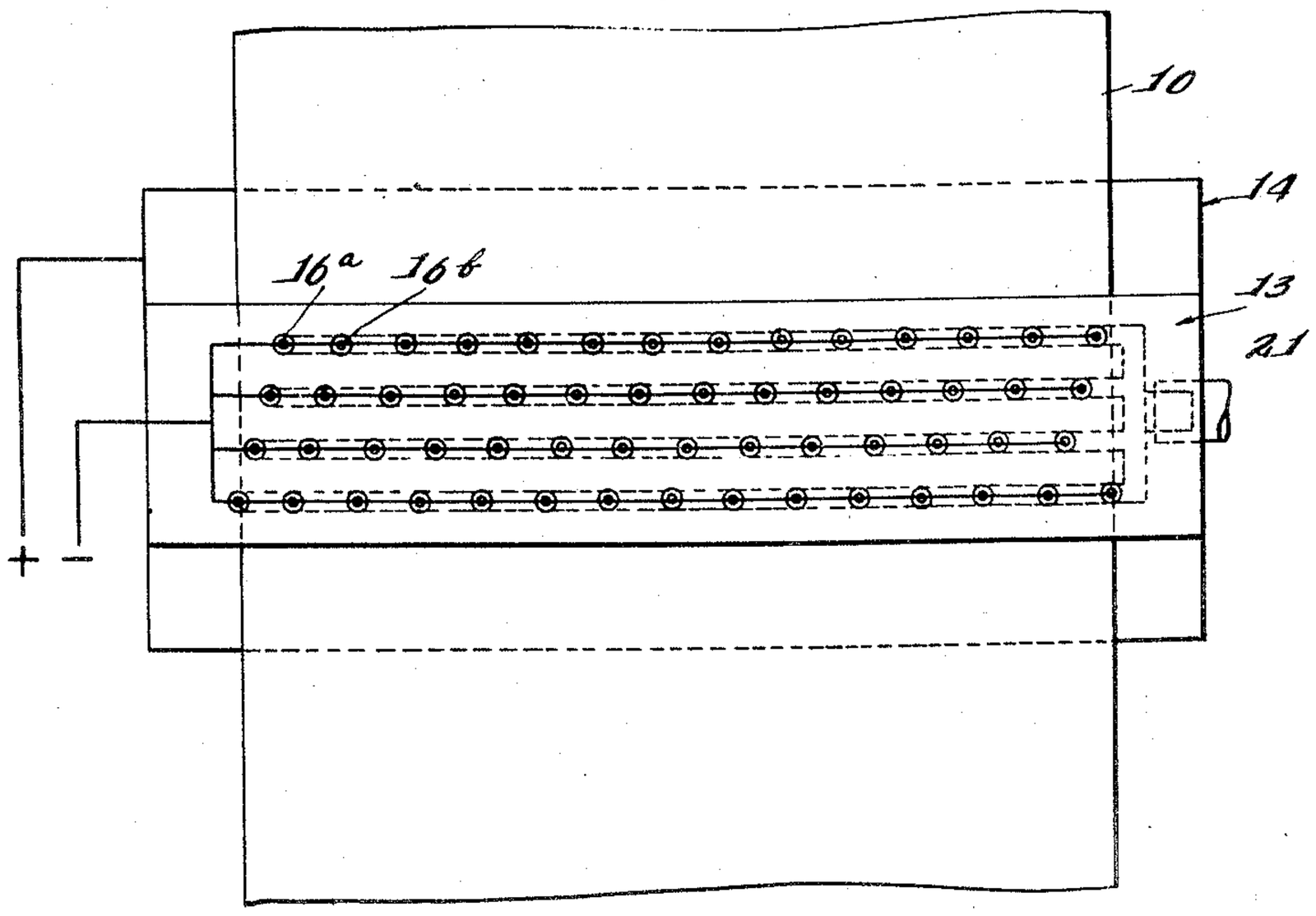


Fig. 2.



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STATIC ELIMINATOR FOR PRINTING PRESSES

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Fig. 3.

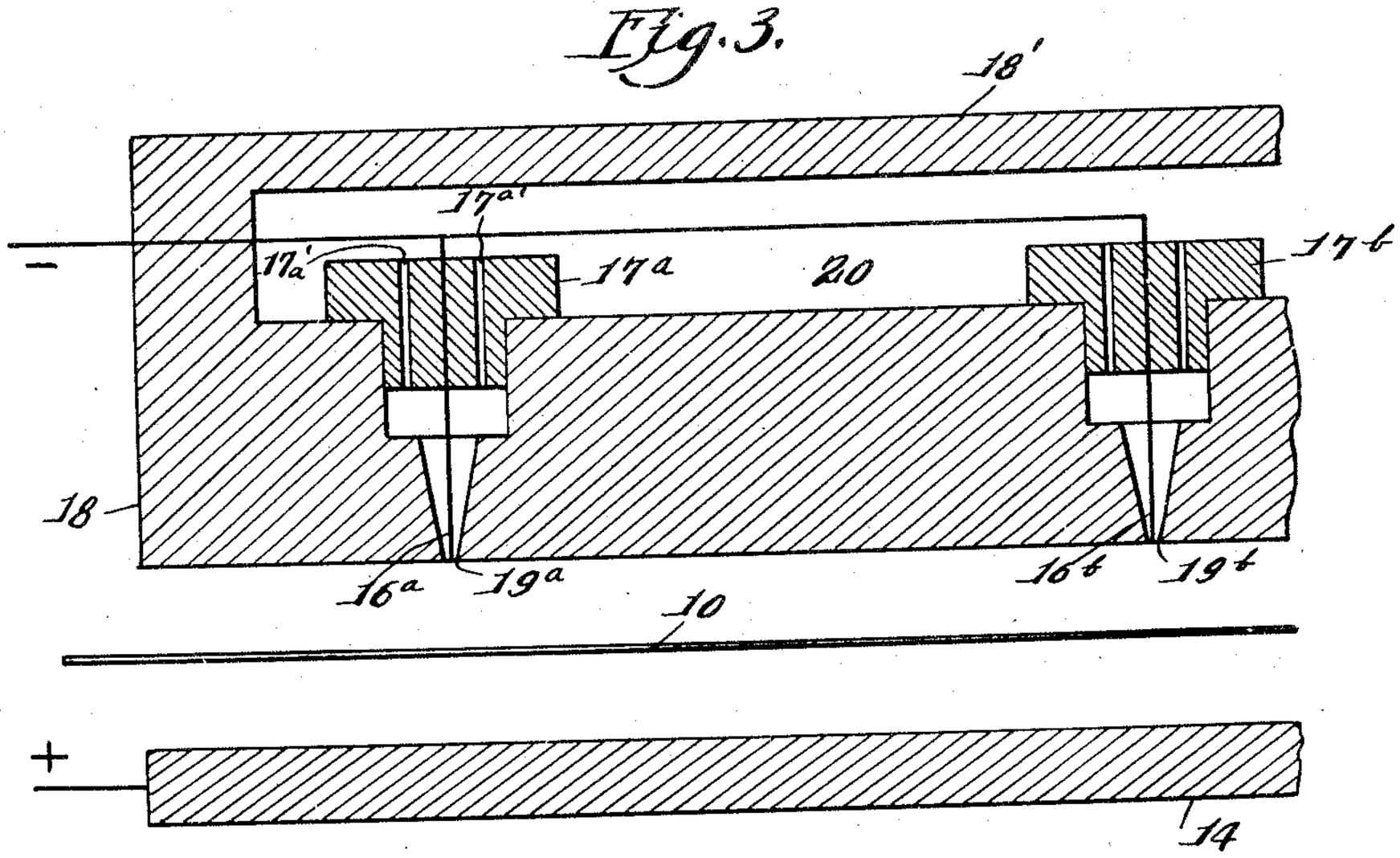
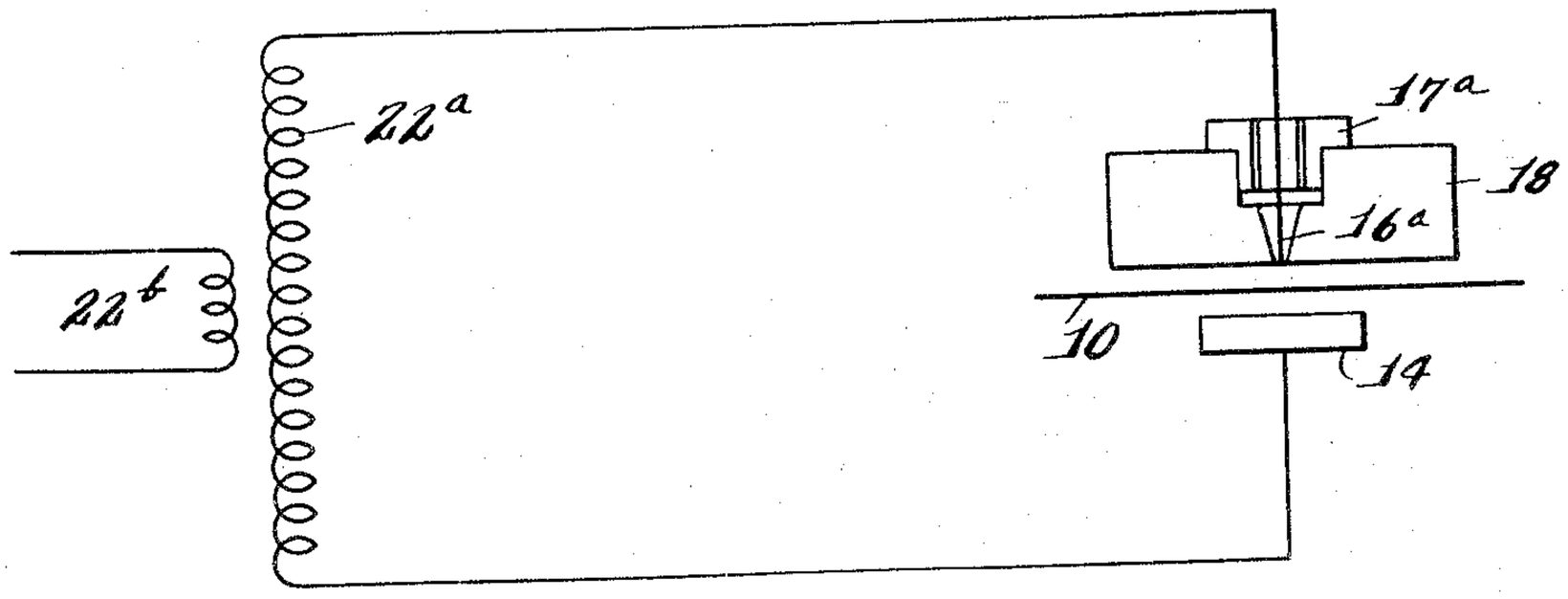


Fig. 4.



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STATIC ELIMINATOR FOR PRINTING PRESSES

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Fig. 5.

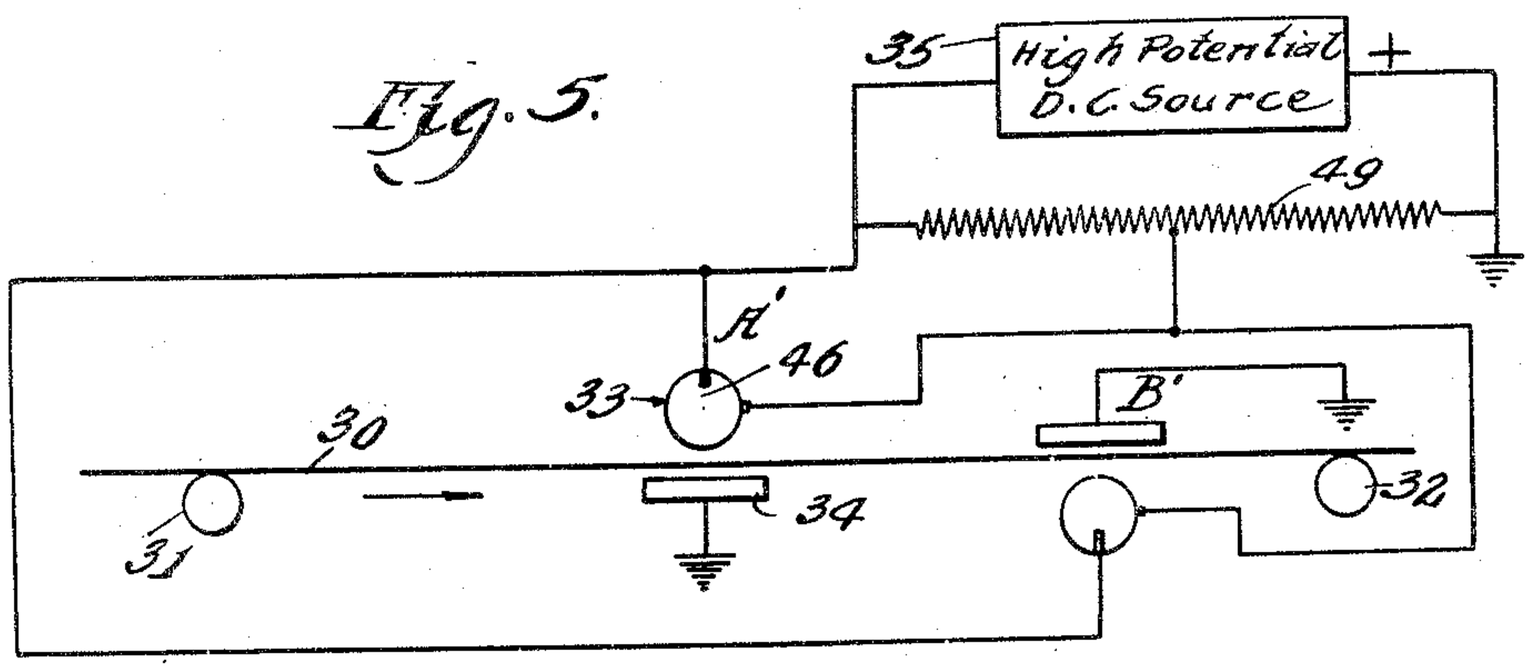
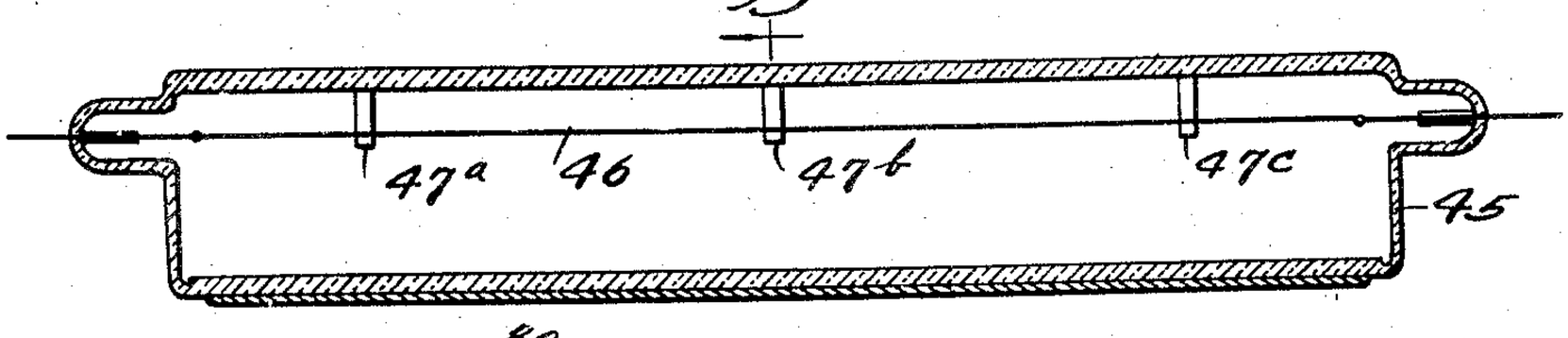


Fig. 6.



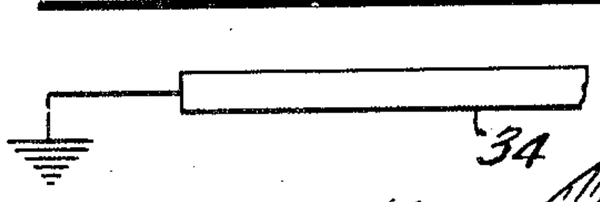
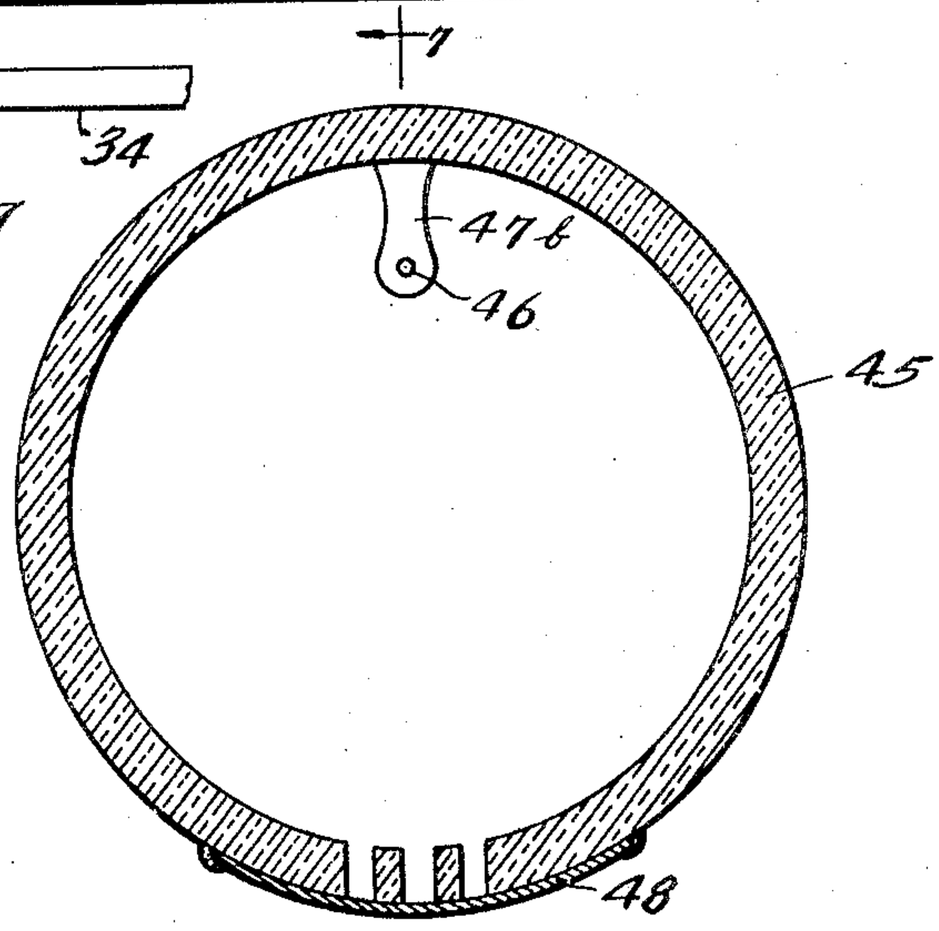
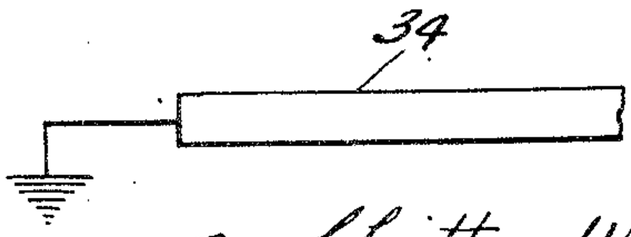


Fig. 7





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STATIC ELIMINATOR FOR PRINTING PRESSES

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Fig. 8.

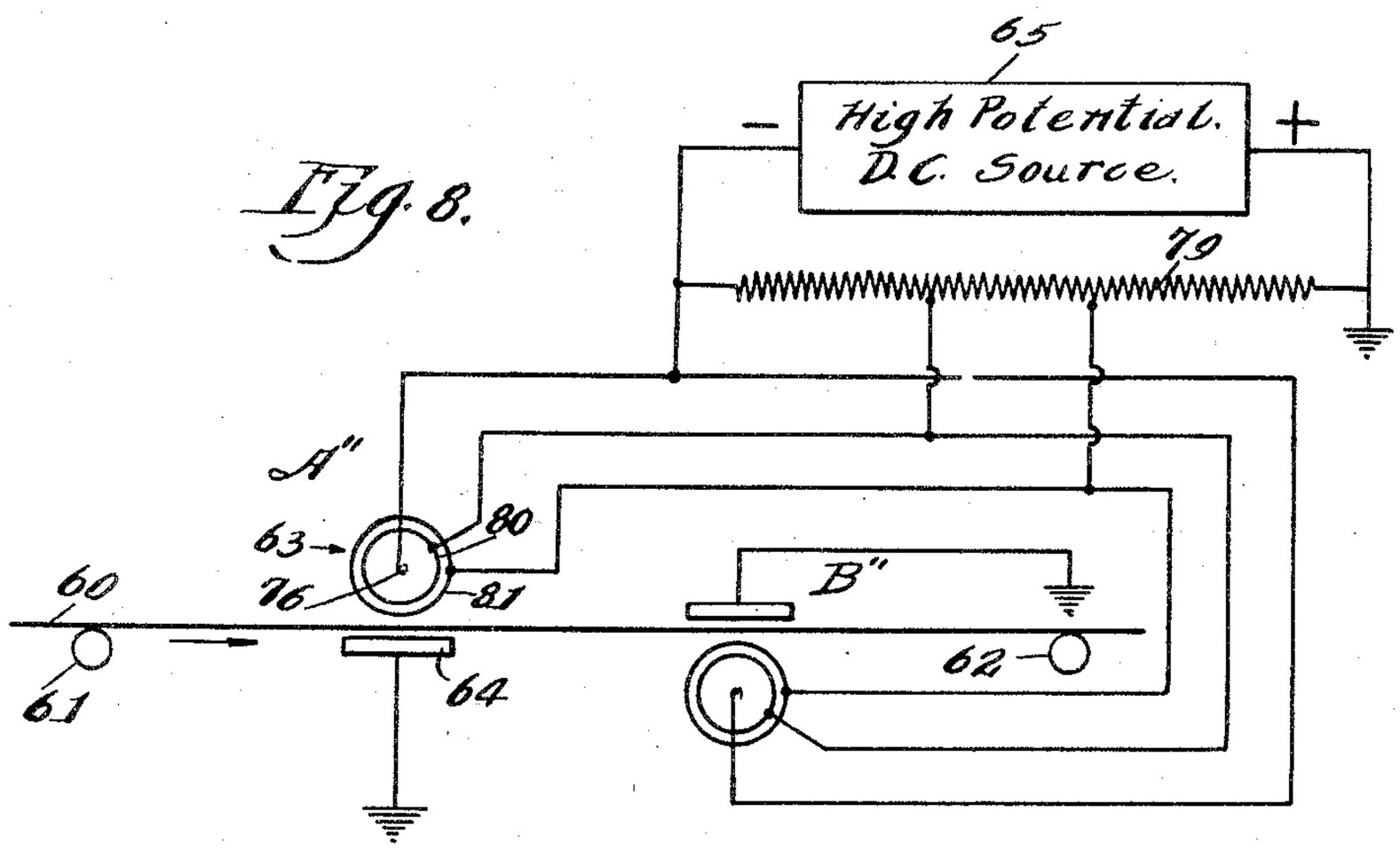
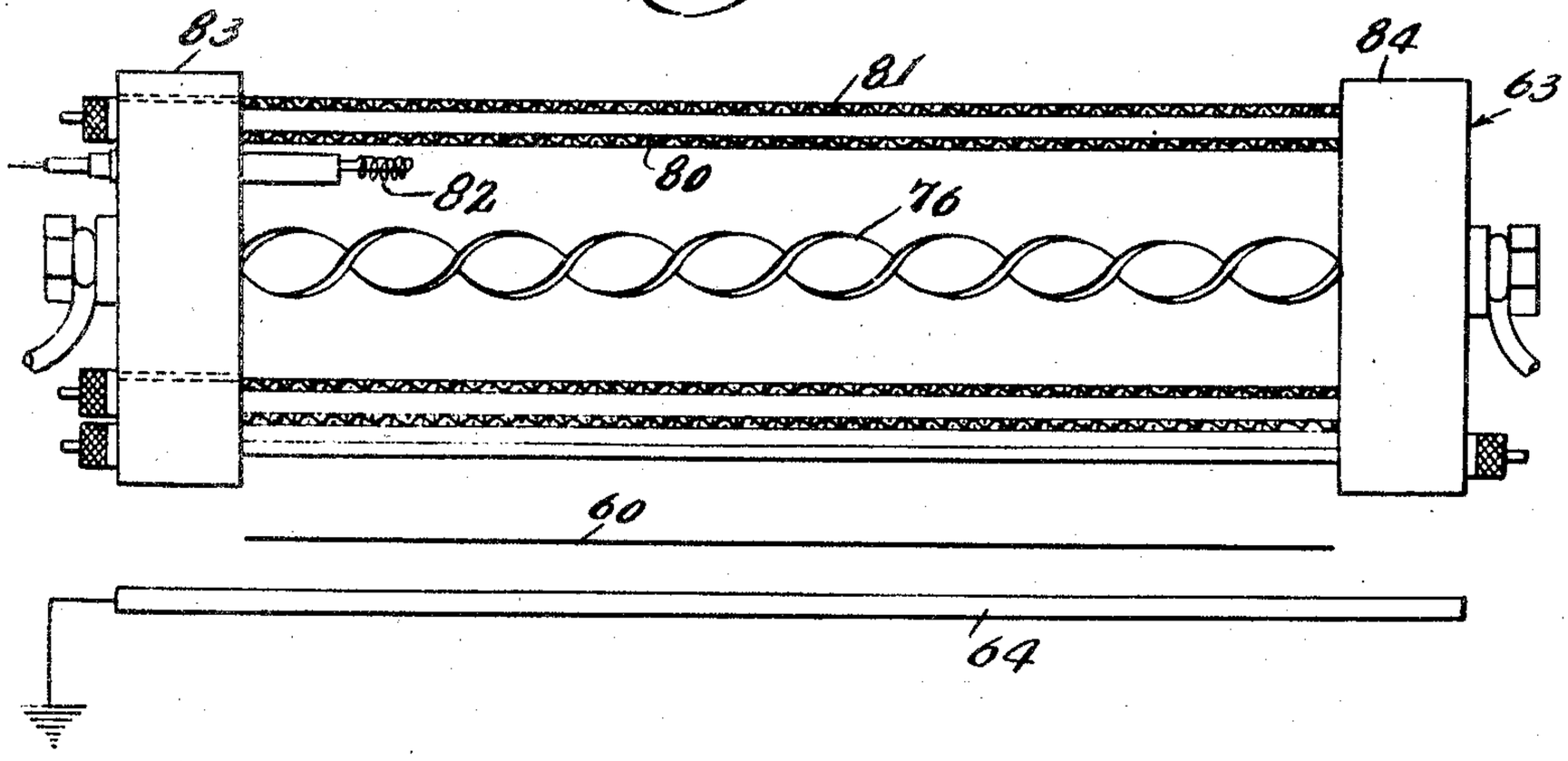


Fig. 9.



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Patented Oct. 4, 1949 2,483,542

UNITED STATES PATENT OFFICE

2,483,542

STATIC ELIMINATOR FOR PRINTING PRESSES

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Application October 24, 1945, Serial No. 624,191

3 Claims. (Cl. 175—264)

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This invention relates to a static eliminator for printing presses, and more particularly to means for varying the electrical charge on the surface of a web of moving sheet material, as paper, by means not making mechanical contact with such web.

In forms of printing operations where the sheet material moves in frictional engagement with guide rolls, guide bars, and the like, undesirable static electric charges develop. This phenomenon becomes particularly objectionable in presses of the kind operating on a continuous moving web, and under conditions where the humidity is relatively low, as in the winter. The frictional engagement between the web and a different material causes the creation of static electric charges on the surface of the web, generally positive, which may run up into thousands of volts. This situation is a direct danger to workers who can be startled into an incautious and disastrous move around the running presses by shocks from this static electricity; and presents a fire hazard in connection with the inflammable volatile constituents of the conventional oil base ink, for example.

In order to obviate this difficulty and keep the web at some desired electrical condition, as at ground potential, various forms of static eliminators have been developed. The majority of these operate by virtue of actual mechanical contact with the paper, creating still further sets of conditions conducive to static electric charges, or by endeavoring to render the air adjacent the surface of the sheet material sufficiently conductive to cause any substantial charge to leak off, as by use of gas flames. Previous attempts in this regard have also involved considerable disadvantages. The open gas flame will, of course, instantly set fire to the web if its movement should be stopped for any reason without first turning off the gas supply. Static eliminators in the form of grounded metal rolls frequently create more static electricity by virtue of their engagement with the web than the charge they succeed in draining off to ground as the web passes over them. Static eliminators which have not heretofore touched the web have generally been ineffective.

I have devised and am here disclosing and claiming a static eliminator or charge varying arrangement which makes no mechanical contact with the moving sheet material, which has no tendency to ignite the web, and which is very effective in bringing the electrical condition of the web to a desired value, whether that be ground potential or a potential somewhat positive or negative with respect to ground. In general, I accomplish this by generating charged gas particles, normally negatively charged air particles,

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and causing these to move against the surface of the web and give up their charge to the web to bring its electrical condition to the desired state.

While the problem of static electricity may be encountered in connection with any type of press work, as mentioned above, it constitutes a particularly difficult problem in presses using rubber impression blankets or offset rolls and operating at high speed, as for example in newspaper presses of the rotogravure type. The general construction and arrangement of a newspaper press where the problem of static electricity becomes particularly difficult are well known, and accordingly I will not go into a description of such a press here. If desired, Crafts Patent 2,085,185, issued June 29, 1937, may be referred to to supplement this disclosure as to one commercial form of such a press.

Another place where the electrical condition of the web is of considerable importance is in connection with electric printing, where electric forces are used to effect or assist the transfer of ink from the ink source, as a type roll, to the moving web. Methods and apparatus for electric printing form the subject matter of Huebner Patent 1,820,194 and of certain copending applications of mine. In such printing the electrical condition of the web is of considerable importance, as it must not have electrical charges opposing the fields of force associated with the transfer of ink, and preferably should have charges assisting such field.

In any event, the accompanying drawings and the following description are limited to means for varying the electrical condition of moving sheet material, as the web used in newspaper printing, and for the purpose of this application it will be assumed that the web, and particularly the surfaces thereof, is at some electrical condition which it is desired to vary. Normally, of course, the web will have positive electrical charges which it is desired to eliminate; but it will be understood that my invention is broader than merely eliminating positive charges.

Various features and advantages of my invention will be apparent from the following specification and the drawings, in which:

Figure 1 is a schematic diagram of one embodiment of my invention; Figure 2 is a plan view of one of the charge varying units adapted to be associated with the moving web, with the upper part of the air chamber removed; Figure 3 is a fragmentary transverse sectional view of the device shown in Figure 2; Figure 4 is a diagram illustrating a modified electrical circuit arrangement for the apparatus shown in Figures 1–3; Figure 5 is a schematic diagram of another form of my invention; Figure 6 is a vertical sectional view of one of the charge varying units shown in

Figure 5: Figure 7 is a transverse sectional view along the line 7—7 of Figure 6; Figure 8 is a schematic diagram of still another embodiment of my invention; and Figure 9 is an enlarged vertical sectional view of one of the charge varying units shown in Figure 8.

In the particular embodiment of my invention illustrated in Figures 1–3, a moving web of paper 10 is illustrated as passing over guide rolls 11 and 12 and as moving to the right as illustrated in Figure 1. This web may, for example, be a web of the type used in newspaper printing and comprises a portion of the web passing at high speed through a press of the type known in Crafts Patent 2,085,185, merely as one representative example. The web is illustrated as passing between portions of charge varying units here identified in general as A and B, the first being designed particularly to vary the charges on the upper surface of the web 10 (speaking with respect to the position as shown in Figure 1) and the second being designed primarily to operate on the lower surface of the web. Since static electric charges on a web are generally cumulative, the fact that the web passes over the guide roll 12 after being brought to ground potential or having its electrical condition brought to some other predetermined value is not too critical; although, if desired, the second guide roll 12 may be eliminated and the web may enter directly into a printing zone or the like after it leaves the second conditioning unit B.

Inasmuch as the two conditioning or charge varying units A and B are identical, merely being reversed in their relationship to the web, only the unit A will be described in detail. This comprises an upper section or portion identified in general as 13 and including first electrode means and means for causing a stream of air to move thereby and toward and against the upper surface of the web; and another portion 14, this comprising the second electrode member and being, in this particular embodiment, a plate of metal extending across the entire width of the web, as may be best seen in Figure 2, and electrically grounded. A relatively high direct current potential, preferably of the order of 5,000 or 10,000 volts, is developed between the two electrode members by a high potential D. C. source 15 having its positive terminal grounded and its negative terminal connected to the electrode in the upper surface 13 of the conditioning units, where the web is to have its electrical condition rendered more negative, as to remove or neutralize positive static electric charges.

The source 15 is preferably of a type permitting variation of its output voltage by manual means, as changing of the rheostat setting. It will not be described or illustrated in detail as it may be of a conventional type which may be secured on the commercial market, as for example those built for high-voltage X-ray tube supply purposes. Such equipment takes power from an ordinary commercial current source, steps its voltage up to the desired value, and rectifies and filters it to provide a high D. C. voltage. The equipment preferably includes manually variable means enabling variation of the output voltage as mentioned above, meters by means of which the output voltage and current may be determined and the like. While the current requirements for this purpose are not heavy in the ordinary sense of the word, a certain current flow is necessary to keep charging the air molecules

negatively, and accordingly the high potential source should preferably be capable of operating at the desired voltages with current drains in the neighborhood of 100 milliamperes, well within the range of commercial X-ray equipment.

Referring now more particularly to Figures 2 and 3, it will be seen that the first electrode means or source of electrons comprises a plurality of electrically interconnected sharp pointed needle members 16*a*, 16*b*, etc., these members having their sharp points adjacent and pointing toward the web but spaced therefrom, as for example one-half inch; and being spaced at suitable intervals across the entire width of the web, a preferred arrangement in the form of staggered rows being shown in Figure 2. The needle members are suitably mounted, as by mounting plugs 17*a*, 17*b*, etc. in openings in a block 18 of insulating material, these openings terminating in nozzles or small orifices 19*a*, 19*b*, etc. surrounding the points of the needle members 16*a*, 16*b*, etc. Inasmuch as all of these individual arrangements are identical, only one will be described in detail, reference now being had more particularly to Figure 3.

The mounting block 17*a* is drilled with openings 17*a*′ communicating with the opening in the block 18 terminating in the orifice 19*a*; and the block 18 has its cover portion 18′ spaced from the main body portion thereof to provide a chamber 20 adapted to be supplied with compressed air from any conventional source through a feed line or hose 21 shown in Figure 2. Compressed air in the chamber 20 passes through the openings 17*a*′ and eventually issues in a stream from the orifice 19*a*′, passing immediately around the sharp needle point of the member 16*a* as it issues from the orifice. Since the needle member 16*a* is several thousand volts negative with respect to the other electrode member 14, movement of air past its sharp point effects transfer of negative electrons or negative units of charge from the metal of the needle member to the molecules of the air passing immediately adjacent it, generating negatively electrically charged gas or air particles or molecules. Since the stream of air is directed toward the upper surface of the web 10, the charged air molecules pass across the space and contact such surface where they give up their excess negative charge to the web, in the particular embodiment here being illustrated, and continually render the surface of the web more negative; i. e., if the web was charged positively, they tend to neutralize such charge and bring the web to ground potential or any other desired less positive electrical condition. In order to maintain the efficiency of the conditioning unit it is preferable that the sharp points of the needle members 16*a*, 16*b*, etc. be gold plated or otherwise made in such manner as to prevent loss of sharpness of the needle point due to corrosion.

The use of a sharp pointed needle-like member as one electrode member, in combination with a stream of air thereby, appears to have inherent rectifying characteristics, and accordingly the conditioning unit can be actuated directly from an alternating current source, as illustrated in Figure 4, if desired. In this modification the needle member 16*a*, illustrated as representative of all of the needle members forming the first electrode means is shown as connected to one end of the secondary 22*a* of a step-up transformer 22, the primary 22*b* of this transformer being connected to a conventional

commercial source of alternating current. The other end of the secondary winding 22*a* is connected to the electrode member 14, so that the member 16*a* is alternately positive and negative with respect to the member 14. With cold needle members and voltages of the order of 5,000 or 10,000 volts, substantially no charge is given to the moving air molecules passing the point of the member 16*a* while this member is positive with respect to the other electrode member 14; but substantial negative charge is given to the moving air molecules when the needle member is negative with respect to the other electrode member. While this form of energization is somewhat simpler and less expensive than that illustrated in Figure 1, it is apparent that it is operative over only half, or less than half, of each cycle, so that I prefer the energizing arrangement illustrated in Figure 1.

Referring now more particularly to Figures 5, 6 and 7, another embodiment of my invention will be described. In order to keep the description brief and enable reference back to earlier portions of this specification if desired, parts shown in these figures, where analogous to parts already described, will be given reference numerals 20 higher than those heretofore used.

Referring first to Figure 5, the moving web 30 is shown as passing over guide rolls 31 and 32 and as passing between oppositely arranged conditioning or charge varying units A' and B'. Each of these units, as before, comprises a source of charged particles on one side of the web, as the means identified as 33, and a grounded electrode member or plate on the other side of the web. Inasmuch as the units are identical, only the unit A' will be described in more detail.

In this particular form of my invention an evacuated tube 45 extends substantially entirely across the width of the web and has its closest portion suitably spaced therefrom, as a half inch. The tube contains a filament 46 adapted to be heated to incandescence by electric current in conventional manner, this filament being of platinum or other suitable material. While this filament is shown as a single wire mounted on suitable spacers 47*a*—*c*, it will be understood that the important thing is a hot filament, as a source of electrons, extending transversely across the width of the web, whether this be in the form of a single wire or a plurality of aligned sections. Opposite the filament 46 and facing toward the web 30, as may be best seen in Figure 7, the envelope is provided with what is being here termed a window, this comprising slots in the material of the tube envelope, as glass, covered by a thin metal foil 48, as aluminum. Application of a positive potential to this aluminum foil 48, if there is suitable potential drop between it and the filament 46, causes the electrons to reach the aluminum foil with such velocity that the majority of them pass straight through the foil and travel on to the web 30, where they operate as free electrons or as charges on air molecules with which they have collided. The terms "charged gas particle" and "ion" are being used herein in a sense intended to cover a molecule of air or other gas which has picked up a charge, as by acquisition of an electron; or a free electron itself, as these particles have electric charges and move in a manner analogous to those of gas particles as distinguished from liquid or solid material. While such a tubing as that illustrated here is not new per se, I believe that I am the first to appreciate and disclose a manner in

which such a tube can be associated with another electrode member (as the plate 34) in such manner as to vary the electrical condition of a moving web of sheet material without physical contact therewith.

In this particular form of my invention the charged particle leaving the filament 46 is preferably accelerated by field gradients developed both by the foil 48 and the plate 34, so that these latter act as first and second portions, respectively, of the second electrode means, the filament constituting the first electrode means. That is, as may be best seen in Figure 5, the high potential D. C. output of the source 35, while it again has its positive terminal grounded and its negative terminal connected to the first electrode member (the filament 46 in this case), has its voltage developed across a bleeder resistor 49. The plate 34, being grounded, is therefore positive with respect to the filament 46 in an amount corresponding to the full potential drop developed by the source 35; but the foil 48 is connected to some intermediate point on the voltage divider 49, so that while it is positive with respect to the filament 46 it is not as highly so as the plate 34. This results in electrons attracted from the filament 46 and caused to pass through the foil primarily by the voltage differential between the voltage 48 and the filament 46 to continue on toward the web 30 by virtue of the attraction of the even more positive second portion of the positive electrode means, the plate 34. Again it will be apparent that this particular embodiment of my inventions is adapted to render the web less positive; i. e., partially or entirely to neutralize positive static electric charges thereon.

Referring now more particularly to Figures 8 and 9, still another embodiment of my invention will be illustrated. In order to keep the description brief, reference numerals applied to parts analogous to those heretofore described will be employed which are 50 higher than those used in connection with the first-described embodiment of my invention, and 30 higher than those used in connection with the embodiment illustrated in Figures 5–7.

A web 60 of sheet material, as paper, is again illustrated as passing over guide rolls 61 and 62 and as passing between sections of oppositely arranged identical conditioning units here identified in general as A'' and B'', only the first of which will be described in detail. Each unit again comprises two principal sections, the unit A'' being shown as comprising the section 63, which provides the source of charged gas particles above the web, and the section 64, comprising a grounded plate electrode member, below the web.

Referring now more particularly to Figure 9, the upper section 63 will be seen as comprising a central filament 76 adapted to be electrically heated to incandescence in conventional manner, this being here shown as a twisted strip of suitable material, as platinum. Instead of being housed in an air-tight envelope, the filament 76 in this form of my invention lies substantially at the axis of a pair of spaced and electrically insulated cylindrical screen members 80 and 81, of copper mesh screening analogous to that used in a miner's safety lamp. Since the hot filament 76 is in this case exposed to air movements, with different heat losses, a thermostat 82 is provided and associated with the heating circuit for the filament 76 (as by control of a thyratron tube) in such manner as to maintain the temperature of the filament 76 substantially uniform despite

variations in heat loss therefrom. All of the related parts are held in their desired association by end blocks of suitable insulating material, these being here identified as 83 and 84.

In this particular form of my invention electrons "boil off" as it were from the hot filament 76 and are caused to travel toward and pass through the screens 80 and 81 by virtue of positive potentials applied to these screens; and those electrons which travel in the general direction of the web 60 are caused to continue movement toward said web and to strike a surface thereby by virtue of a higher positive potential of the member 64 relative to the filament 76. The high potential D. C. source 65 again has its positive potential grounded and its negative potential connected to the filament 76 as the first electrode member, the potential differential developed by this source being applied across a bleeder resistor 79. In this particular case the screens 80 and 81, and the plate 64 all constitute portions of the second electrode means, and in order to facilitate continued movement of the electrons in the desired direction I prefer to apply the full potential differential between the plate 64 and the filament 76, a somewhat lesser potential differential between the screen 81 and the filament, and a still lesser potential differential between the screen 80 and the filament 76, the reduced but still positive potentials for the screens 80 and 81 preferably being effected by intermediate connections to the bleeder resistor 79, as illustrated in Figure 8. As will be readily apparent this provides another form wherein electrically charged particles originate at a source (here the filament 76) and are caused to move toward and impinge upon a surface of the web 60 to give up their charge thereto and thereby vary the electrical condition of the web. In this particular embodiment of the invention the charged particles are again electrons, and any positive static electric charges on the upper surface of the web 60 would be eliminated or reduced in an amount determined by the number of electrons striking the web, this in turn being a function of the filament temperature and the positive electrode voltages used, and being readily controllable.

While I have shown and described certain embodiments of my invention, it will be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. In a press of the character effecting printing on a moving web of sheet material, as paper, means for neutralizing static electric charges on the web, comprising: first electrode means adjacent the path of movement of the sheet material on one side thereof, this means comprising a hot filament extending across the width of said web; second electrode means having a first portion on the same side of said web as the filament and a second portion on the opposite side of the web; and means for creating a substantial potential differential between said electrode means, both portions of the second electrode means having the same polarity with respect to the filament but the second portion being at a higher potential differential than the first, said potential differential being such as to cause electrically charged gas particles to move toward said second portion

of said second electrode and contact a surface of said sheet material during such movement to vary the charge therein.

2. In a press of the character effecting printing on a moving web of sheet material, as paper, means for neutralizing static electric charges on the web, comprising: first electrode means adjacent the path of movement of the sheet material on one side thereof, this means comprising a hot filament extending across the width of said web; second electrode means having a portion of screen material between the filament and the web and a second portion on the opposite side of the web; and means for creating a substantial potential differential between said electrode means, both portions of the second electrode means having the same polarity with respect to the filament but the second portion being at a higher potential differential than the first, the construction and arrangement being such as to attract electrically charged gas particles to said second portion of said second electrode and cause said particles to move toward said second portion of said second electrode and contact a surface of said web during such movement to vary the charge therein.

3. In a press of the character effecting printing on a moving web of sheet material of substantial width, as paper, means for neutralizing static electric charges on the web, comprising: first electrode means adjacent the path of movement of the sheet material on one side thereof, this means comprising a hot filament extending across the width of said web; second electrode means having first and second portions of screen material between the filament and the web and a third portion on the opposite side of said web; and means for creating a substantial potential differential between said electrode means, all portions of the second electrode means having the same polarity with respect to the filament but the second portion being at a higher potential differential than the first, and the third portion being at a higher potential difference than the second, the construction and arrangement being such as to cause electrically charged gas particles to move toward said third portion of said second electrode and contact a surface of said sheet material during such movement to vary the charge therein.

WILLIAM J. HOOPER.

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