Oct. 27, 1936. J. HORN 2,058,983

APPARATUS FOR THE DEVELOPMENT OF PHOTOGRAPHIC PRINTING PAPERS BY MEANS OF GASEOUS DEVELOPING AGENTS

Filed Oct. 20, 1934 3 Sheets-Sheet 1

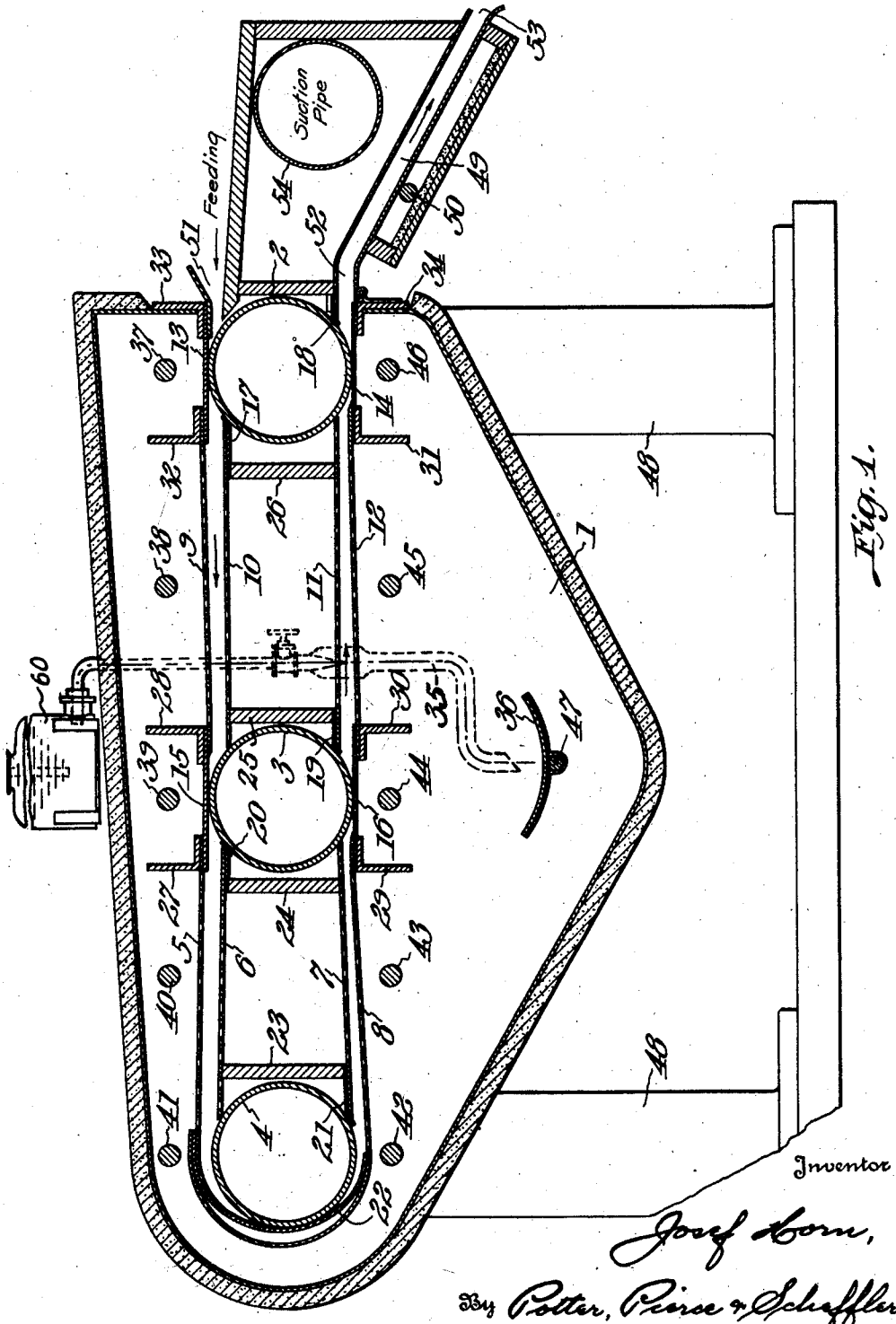


Fig. 1.

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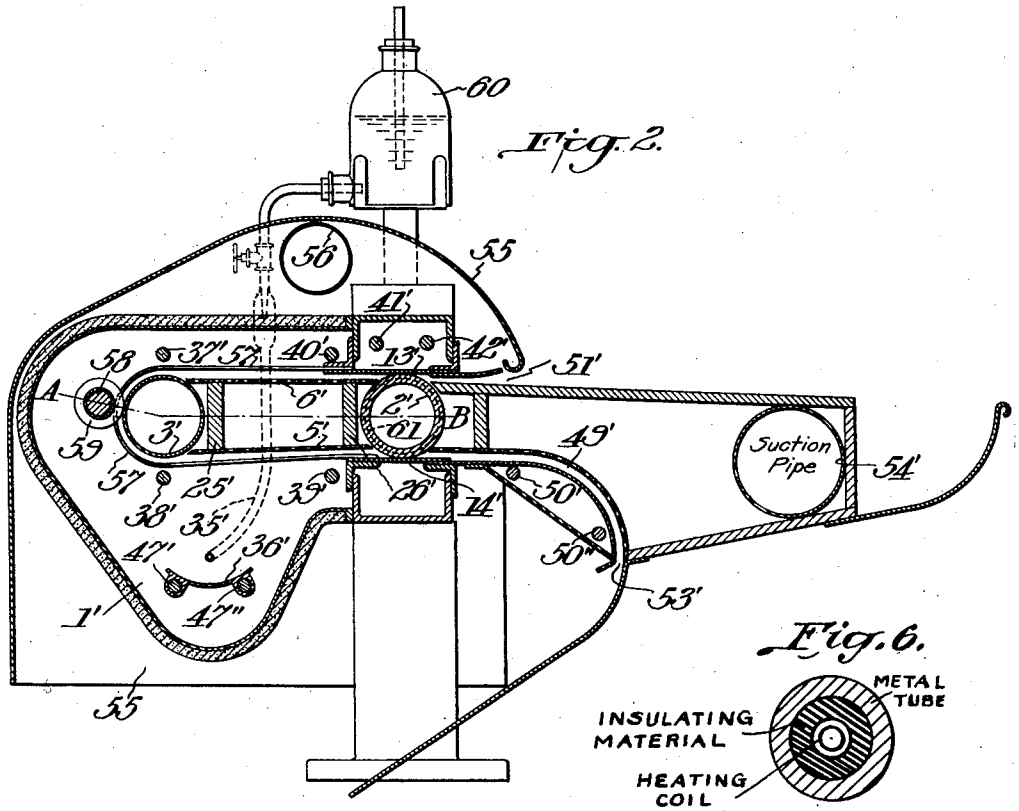


Fig. 2.

Fig. 6.

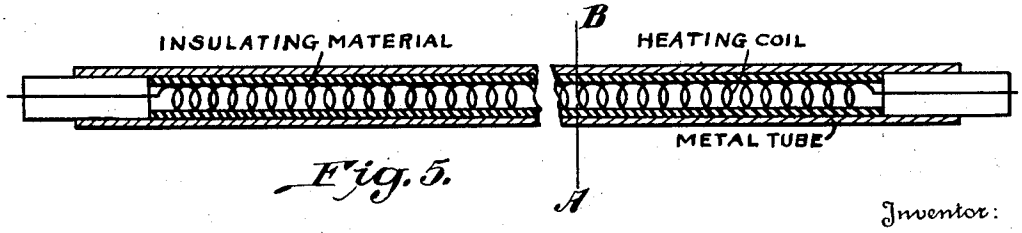


Fig. 5.

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Fig. 3.

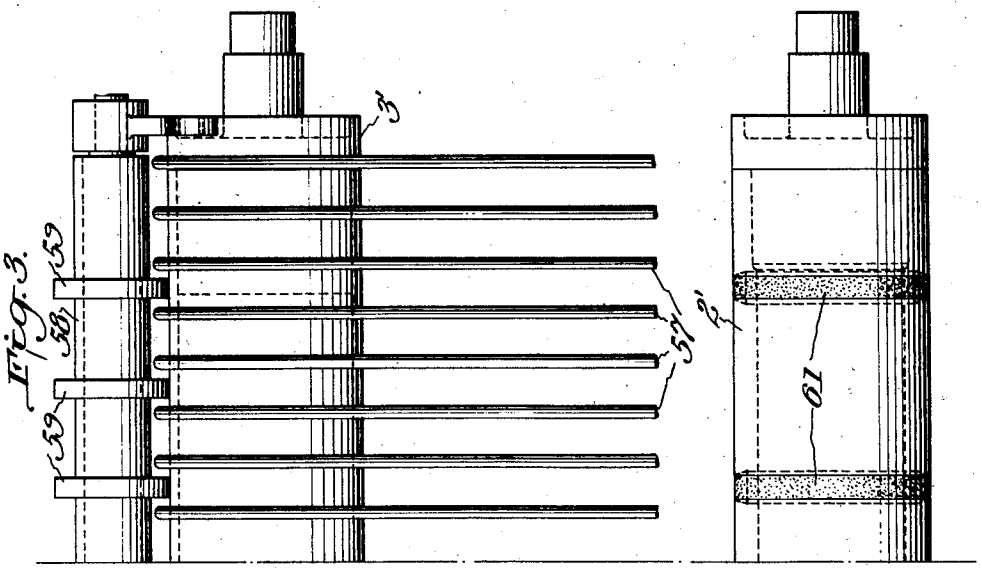
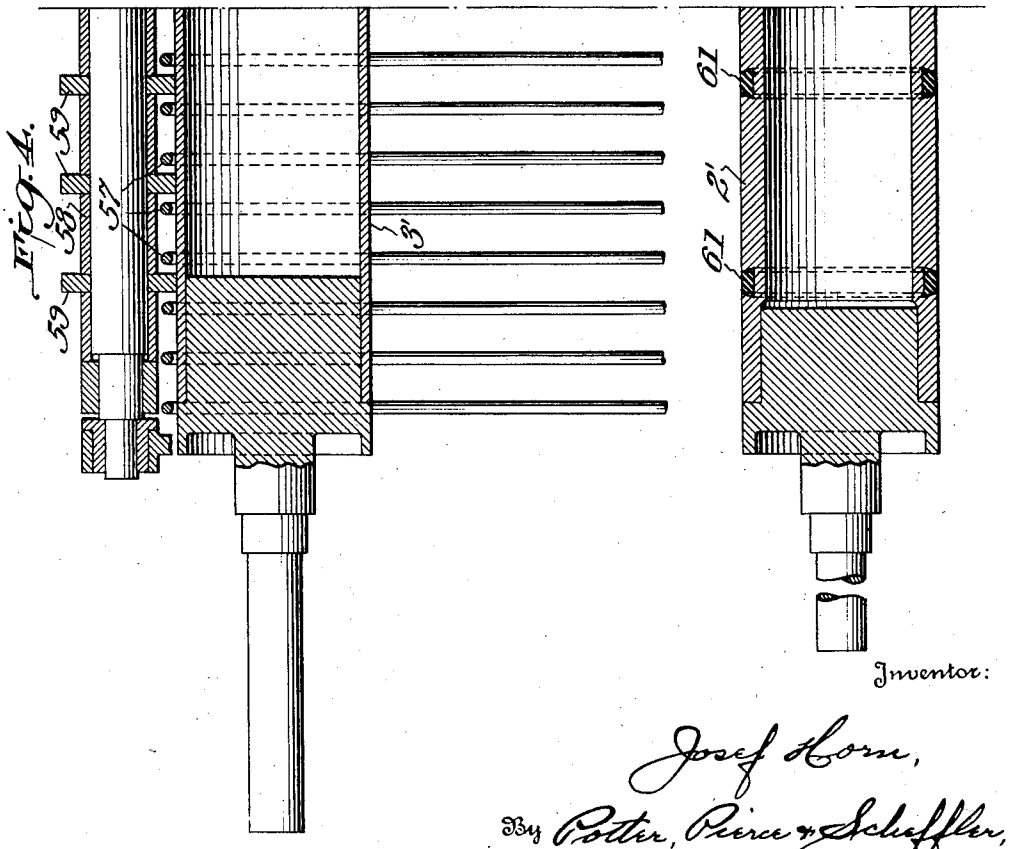


Fig. 4.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR THE DEVELOPMENT OF PHOTOGRAPHIC PRINTING PAPERS BY MEANS OF GASEOUS DEVELOPING AGENTS

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13 Claims. (Cl. 95—94)

The present invention relates to apparatus for the development of photographic printing papers by means of gaseous developing agents.

Various photographic developing apparatus employing gaseous developing agents, for instance ammonia, are known. In nearly all of these apparatus the copies to be developed are passed through the developing chamber by means of tapes or cords. The employment of such conveying or guiding means has not stood the test of practice, particularly because tapes or cords are subjected to very considerable wear and tear and consequently have a comparatively short life. Moreover, tapes, bands or cords hinder complete development owing to the fact that they become moist and frequently leave upon the copies marks, particularly longitudinal stripes.

The subject of the present invention is a photographic developing apparatus employing a gaseous developer, in which the mentioned drawbacks are avoided by passing the copies to be developed by means of at least two driven rollers through a slit like channel arranged in the developing chamber and formed by fixed members, the walls of said channel being interrupted to permit the developing gas to act on the material to be developed. The channel consists of two parts, one being above the other a certain distance, one of which parts is connected with an inlet slit provided in the wall of the developing chamber, which slit serves for feeding the material to be developed, and the other part being connected with an outlet slit provided in the same wall of the chamber, which outlet slit serves for discharging the developed material. The other or free ends of the two parts of the channel are connected with one another by means of a curved passage. For feeding and discharging the material to be developed and also for moving it through the channel, driving rollers are so arranged in gaps provided in the walls of the channels that they project into the channel to such an extent that they touch the opposite walls which may be formed at these points by pressing members, for instance resilient pressing bands or pressing rollers, serving to ensure the passage of the copies from the transporting rollers into the slot-like channel and vice versa. The material to be developed enters into the inlet slit of the machine, passes through one part of the channel, is deflected behind the last roller, and passes with reversed direction through the other part of the channel and back to the outlet slit, where it is discharged. The action of the developing gases on the copies takes place mainly during the passage of the copies through the said channel ports, which are preferably made of perforated sheet iron or in the form of grids or wire nettings. The improved apparatus has the advantage that it may be built for any desired capacity without any difficulty by lengthening the transport path, for instance by arranging in series a considerable number of transport rollers and guiding channels. Moreover, the efficiency of the machine and particularly the speed of transport of the copies may be increased by increasing the length of the path of the copies in the gas space. The distance between two consecutive driven rollers depends upon the minimum length of the sheets to be developed by means of the apparatus. If, for instance, size (21 x 29.7 cm.) is the smallest size treated, the distance between two consecutive cooperative transport rollers may be about 270 mm.

A constructional form of apparatus is shown by way of example in cross-section in Fig. 1 of the accompanying drawings but no limitation should be understood by this construction. Another constructional form is shown by Fig. 2. Fig. 3 shows a plan view of the transporting device of Fig. 2. Fig. 4 shows a section along line A—B of Fig. 2. Fig. 5 shows a constructional form of the heaters shown in Figs. 1 and 2. Fig 6 is a cross-section on the line A—B of Fig. 5.

In the developing casing 1 of Fig. 1, which is mounted on the bases 48, there are provided three driven transport rollers 2, 3, 4. Between the rollers are provided slot-like guiding channels which are made of perforated sheet iron plates or grids 5, 6, 7, 8, 9, 10, 11, 12. At the points where the rollers are projecting into the inner wall of the guiding channel the outer wall is replaced by means of resilient pressing members or strips 13, 14, 15, 16, which press the paper to be transported against the rollers and thus ensure proper carrying of the paper by adhesion. In order to ensure passing of the sheets from the rollers into the guiding channels, and vice versa, scrapers 17, 18, 19, 20, 21, made, for instance, of spring steel, are provided at the top rear points of the perforated guide members. The last transport roller, in the example shown the roller 4, is provided with a single bent pressing member 22, which deflects the paper and changes the direction of its movement. Safe passage of the paper from the rollers into the guide channels is also ensured by the fact that the perforated walls of the channel and the pressing members over- or under-lap each other in a suitable manner. The channels and the pressing members are fixed and supported by means of ledges 23, 24, 25,

26, 27, 28, 29, 30, 31, 32, 33, 34 mounted on the walls of the casing.

Feeding of the developing apparatus with ammonia may, for instance, be effected by allowing ammonia water to fall drop by drop from a container 60 and a pipe 35 into a trough 36 heated by means of a heating member 47. The trough 36 has a certain fall or inclination and is fed at the highest point so that the ammonia water running down along the trough gradually evaporates. This ensures the whole developing space being uniformly supplied with gas. Heating bodies 37, 38, 39, 40, 41, 42, 43, 44, 45, 46 are also provided at various points above and below the guide channels, and heat the members guiding the paper to a sufficient extent to avoid any condensation of water existing in the developing space upon the guiding members. After leaving the developing space the sheets enter a discharge chamber 49, the upper walls of which are perforated below which there is provided a heating body 50, which drives out any gases adhering to the sheets. The driven out gases are drawn off by means of a suction pipe 54 arranged above the discharge chute. The operation of the apparatus is as follows: The sheets are fed in at the inlet opening 51, are gripped by the first roller 2 and the resilient pressing member 13 and are transported by the rotation of the roller into the first guide channel constituted by the perforated members 9 and 10, the scaper 17 ensuring a reliable separation of the paper from the roller and a satisfactory entry into the guide channel. At the end of this guide channel the papers are gripped by the roller 3 and the corresponding pressing member 15 and passed into the next following guide channel, the scraper 20 ensuring a reliable separation of the paper from the roller and a satisfactory entry into the guide channel. From the second guide channel the paper passes to the roller 4 and is pressed by the curved pressing member 22 against the roller 4 and reversed. The paper then reaches the lower guide channels, moving first under the roller 3 back to the roller 2 and finally entering at the point 52 the discharge chute 49. In this discharge chute 49 the paper is freed from gas and finally leaves the apparatus at the point 53. During the passage of the paper through the guide channels formed by perforated members 5, 6, 7, 8, 9, 10, 11, 12, ammonia gas produced in the heated trough 36 acts upon the paper, the heating bodies 37, 38, 39, 40, 41, 42, 43, 44, 45, 46 preventing any formation of condensation or any deposition of condensed water, and improving and accelerating the developing process.

Another constructional form of apparatus is shown by Fig. 2. The developing chamber 1' is enclosed by means of a further casing 55 with a suction pipe 56 in said casing in addition to suction pipe 54' for preventing any gas from penetrating to the surrounding air. In the chamber 1' there are provided two driven rollers 2' and 3'. Between these rollers are provided slot-like channels, which are made of the perforated plates 5' and 6' and the wire netting 57, which latter also reaches around the roller 3'. The resilient pressing members 13' and 14' press the material to be developed against the roller 2' and thus ensure proper carrying of the paper by adhesion. The roller 58 is provided with disk like elements 59 which project through the wire netting 57 and touch the roller 3'. The channels are supported by means of the ledges 25' and 26' mounted on the walls of the casing. Feeding of the developing apparatus with ammonia may, for instance, be effected by allowing ammonia water to fall drop by drop from the container 60 and the pipe 35' into a trough 36' heated by means of heating-members 47' and 47''. Heating bodies 37', 38', 39', 40', 41', 42' are provided at various points above and below the guide channels. After leaving the developing space the sheets enter a discharge chamber 49' the upper walls of which are perforated, below which there are provided heating bodies 50' and 50''. The sheets enter at the point 51' and are discharged at the point 53'. Fig. 3 and Fig. 4 show the rolls 2' and 3' of Fig. 2, the wire netting 57 and the disk-roller 58 projecting through the wire netting 57 and touching the roller 3'. In Fig. 4 61 indicates rubber rings serving to ensure the adhesion of the sheets.

I claim:

1. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of a curved passage, gaps in the walls of said channels and in said gaps transport rollers fitted in projecting into said channels touching the opposite walls of said channels which walls are provided at these points with resilient pressing members, said rollers serving for transporting the material to be developed through said channels.

2. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of a curved passage, gaps in the walls of said channels and in said gaps transport rollers fitted in projecting into said channels touching the opposite walls of said channels, which walls are provided at these points with resilient pressing members, the rollers serving for transporting the material to be developed through said channels and said curved passage, and heating devices in said developing chamber near said channels.

3. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of a curved passage, gaps in the inner walls of both said channels opposite to another and in said gaps transport rollers fitted in having a diameter, which is nearly equal to the distance between the outer walls of both the channels, projecting into both said channels touching the outer walls of said channels and serving for transporting the material to be developed through

said channels, and heating devices in said developing chamber near said channels.

4. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of a curved passage, gaps in the inner walls of both said channels opposite to another and in said gaps transport rollers fitted in having a diameter, which is nearly equal to the distance between the outer walls of both the channels projecting into both said channels and touching the outer walls of said channels, a gap in the inner wall of said curved passage and a roller fitted in touching the outer wall of said passage, the rollers serving for transporting the material to be developed through said channels and said curved passage, and heating devices in said developing chamber near said channels.

5. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of a curved passage, gaps in the inner walls of both said channels opposite to another and in said gaps transport rollers fitted in having a diameter, which is nearly equal to the distance between the outer walls of both the channels, projecting into both said channels touching the outer walls of said channels, which walls are provided at these points with resilient pressing members, one of the rollers tightly fitted in at the beginning of both said channels, the rollers serving for transporting the material to be developed through said channels, and heating devices in said developing chamber near said channels.

6. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of a curved passage, gaps in the inner walls of both said channels opposite to another and in said gaps transport rollers fitted in having a diameter, which is nearly equal to the distance between the outer walls of both the channels, projecting into both said channels and touching the outer walls of said channels, which walls are provided at these points with resilient pressing members, one of the rollers tightly fitted in between the inlet slit and the outlet slit, a gap in the inner wall of said curved passage and a roller fitted in touching the outer wall of said curved passage, which wall is substituted at this point by a resilient pressing member, the rollers serving for transporting the material to be developed through said channels and said curved passage, and heating devices in said developing chamber near said channels.

7. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, arranged one above the other in the same wall of the chamber, two slit like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being connected with another by means of an interrupted curved passage, gaps in the inner walls of both said channels opposite to another and in said gaps transport rollers fitted in projecting into both said channels, having a diameter which is nearly equal to the distance between the outer walls of both the channels and touching the outer walls of said channels, which walls are provided at these points with resilient pressing members, one of the rollers tightly fitted in between the feeding point respectively the discharging point of both said channels, a gap in the inner wall of said curved passage, in said gap a transport roller fitted in, a pressing roller comprising disk-like elements projecting with said elements through interruptions of the outer wall of said passage and touching said transport roller, the rollers serving for transporting the material to be developed through said channels, and heating devices in said developing chamber near said channels.

8. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, said slits being arranged one above the other in the same wall of the developing chamber, two slit-like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of the outer walls of said channels being connected with another by means of a curved resilient pressing band, a roller between the inlet opening and the outlet opening tightly fitted in by means of resilient pressing bands, the roller having a diameter, which is nearly equal to the distance between the inlet opening and the outlet opening, another roller between the free ends of the inner walls of said channels touching said curved resilient pressing band, the distance between this touching point and the inlet respectively the outlet opening being smaller than the length of the material to be developed, and heating devices near said channels.

9. A device for gaseous development of light sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet and an outlet slit in said chamber, said slits being arranged one above the other in the same wall of the developing chamber, two slit-like channels in said chamber formed by means of an inner perforated plate and an outer wire netting and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of the outer wire netting, a roller between said channels at their beginning tightly fitted in, the diameter of the roller being nearly equal to the distance between the outer walls of both the channels, which walls are substituted by resilient pressing bands at the points where they touch the roller, another roller between the free ends of the inner walls of

the channels forming together with the outer wire netting a curved passage, a pressing roller comprising disk-like elements projecting through the outer wire netting and touching the transport roller, the distance between this touching point and the inlet respectively the outlet opening being smaller than the length of the material to be developed, and heating devices near said channels.

10. A device for gaseous development of light-sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet slit and an outlet slit in said chamber, said slits being arranged one above the other in the same wall of the developing chamber, two slit-like channels in said chamber formed by means of interrupted walls and being in connection with the inlet slit and the outlet slit respectively, the free ends of the outer walls of said channels being connected with another by means of a curved resilient pressing band, a roller between the inlet opening and the outlet opening tightly fitted in by means of resilient pressing bands, the roller having a diameter, which is nearly equal to the distance between the inlet opening and the outlet opening, another roller between the free ends of the inner walls of said channels touching said curved resilient pressing band, the distance between this touching point and the inlet respectively the outlet opening being smaller than the length of the material to be developed, and heating devices near said channels, and a degassing chamber immediately adjacent to the outlet opening for degassing the developed sheets.

11. A device for gaseous development of light sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet and an outlet slit in said chamber, said slits being arranged one above the other in the same wall of the developing chamber, two slit-like channels in said chamber formed by means of an inner perforated plate and an outer wire netting and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of the outer wire netting, a roller between said channels at their beginning tightly fitted in, the diameter of the roller being nearly equal to the distance between the outer walls of both the channels, which walls are substituted by resilient pressing bands at the points where they touch the roller, another roller between the free ends of the inner walls of the channels forming together with the outer wire netting a curved passage, a pressing roller comprising disk-like elements projecting through the outer wire netting and touching the transport roller, the distance between this touching point and the inlet respectively the outlet opening being smaller than the length of the material to be developed, heating devices near said channels, and a degassing chamber immediately adjacent to the outlet opening for degassing the developed sheets.

12. A device for gaseous development of light sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet and an outlet slit in said chamber, said slits being arranged one above the other in the same wall of the developing chamber, two slit-like channels in said chamber formed by means of an inner perforated plate and an outer wire netting and being in connection with the inlet slit and the outlet slit respectively, the free ends of said channels being in connection with another by means of the outer wire netting, a roller between said channels at their beginning tightly fitted in, the diameter of the roller being nearly equal to the distance between the outer walls of both the channels, which walls are substituted by resilient pressing bands at the points where they touch the roller, another roller between the free ends of the inner walls of the channels forming together with the outer wire netting a curved passage, a pressing roller comprising disk-like elements projecting through the outer wire netting and touching the transport roller, the distance between this touching point and the inlet respectively the outlet opening being smaller than the length of the material to be developed, heating devices near said channels and a degassing chamber immediately adjacent to the outlet opening for degassing the developed sheets, the developing chamber surrounded with a protective casing for preventing any gas to penetrate to the arrounding air.

13. A device for gaseous development of light sensitive material comprising a developing chamber, a source of developing gas in said chamber, an inlet and an outlet slit in said chamber, said slits being arranged one above the other in the same wall of the developing chamber, a slit-like channel in said chamber formed by means of two parallel inner perforated plates and an outer wire netting extending around the free ends of said perforated plates, a roller between the inlet slit and the outlet slit tightly fitted in by means of pressing bands, the diameter of the roller being nearly equal to the distance between the inlet opening and the outlet opening, another roller between the free ends of said perforated plates forming together with the outer wire netting a curved passage, a resilient pressing roller comprising disk-like elements projecting through the outer wire netting and touching the transport roller, the distance between this touching point and the inlet respectively the outlet opening being smaller than the length of the material to be developed, heating devices near said channel and a degassing chamber immediately adjacent to the outlet opening for degassing the developed sheets, the developing chamber surrounded with a protective casing for preventing any gas to penetrate to the arrounding air.

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