April 9, 1946. H. E. COLLINS 2,398,288

METHOD OF DUPLICATING AND APPARATUS THEREFOR

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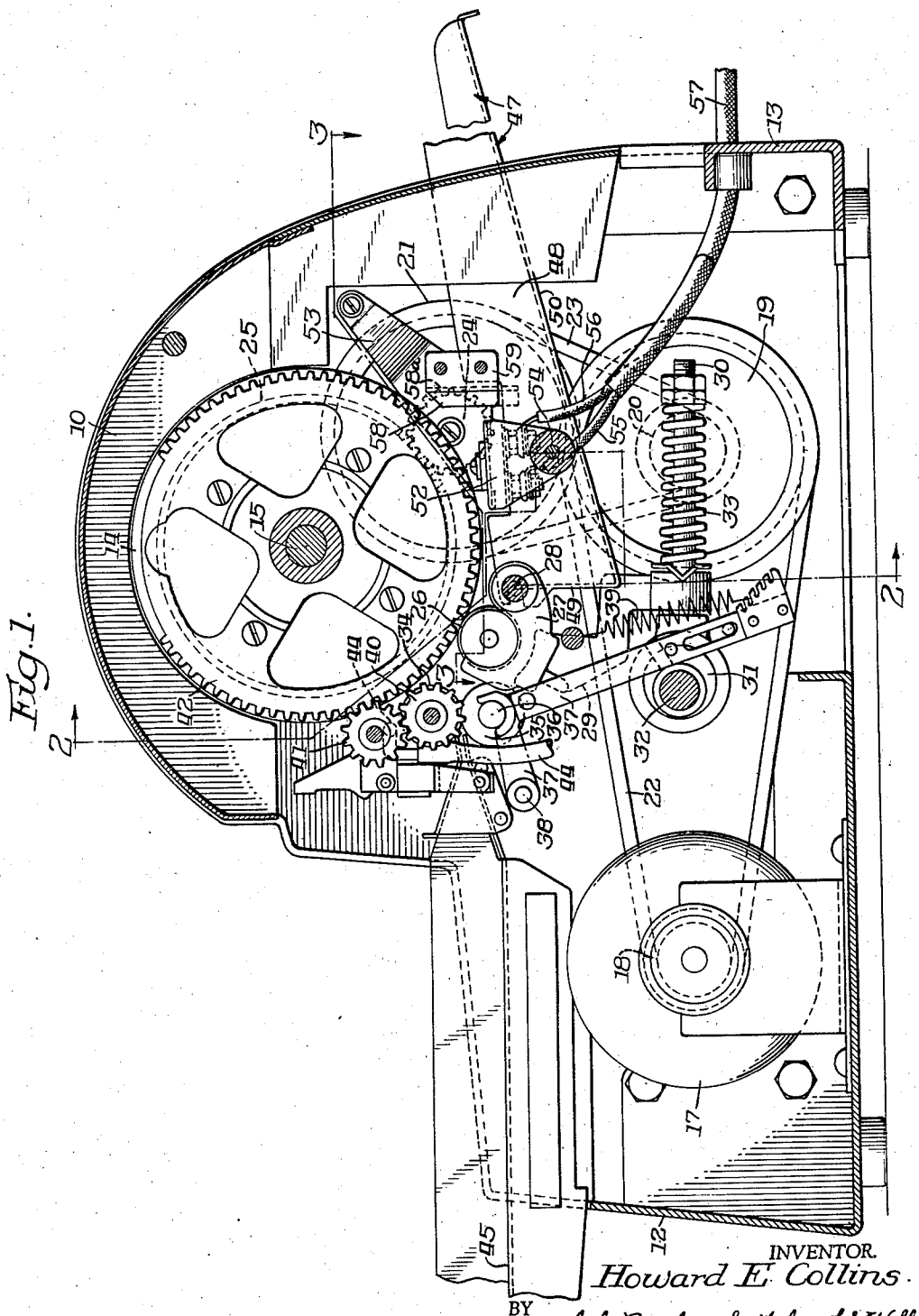


Fig. 1.

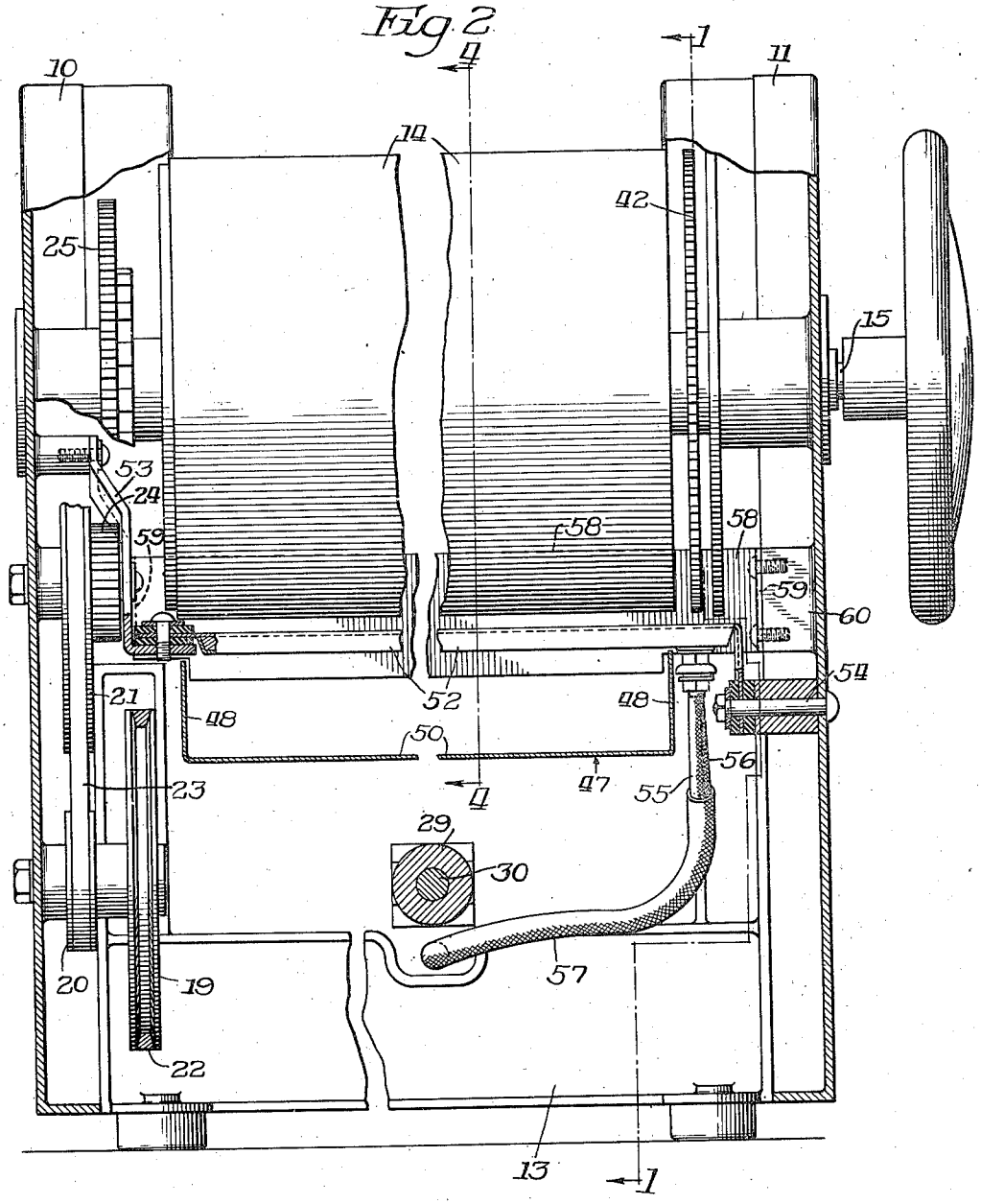
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METHOD OF DUPLICATING AND APPARATUS THEREFOR

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Fig. 2



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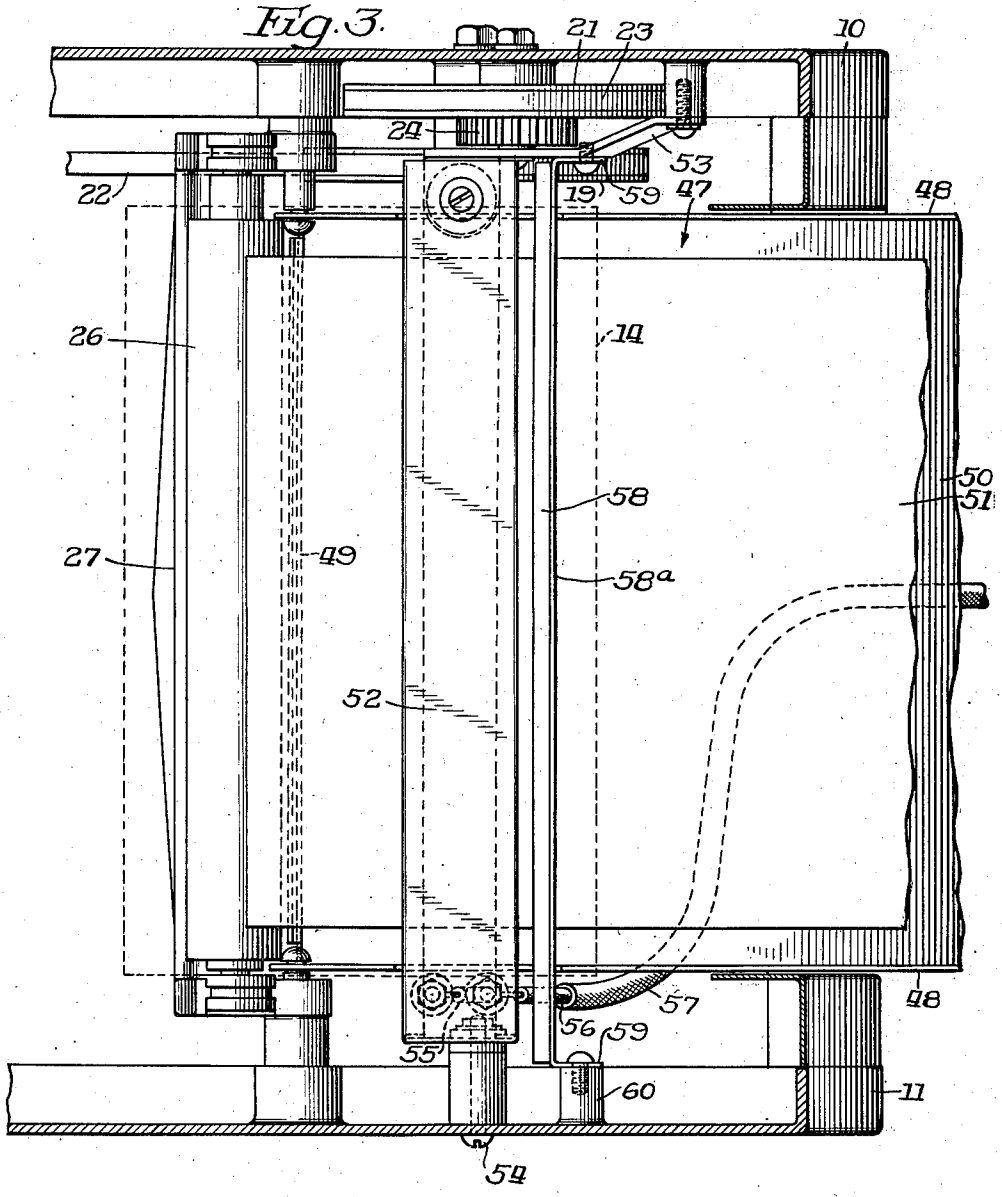
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Fig. 3.



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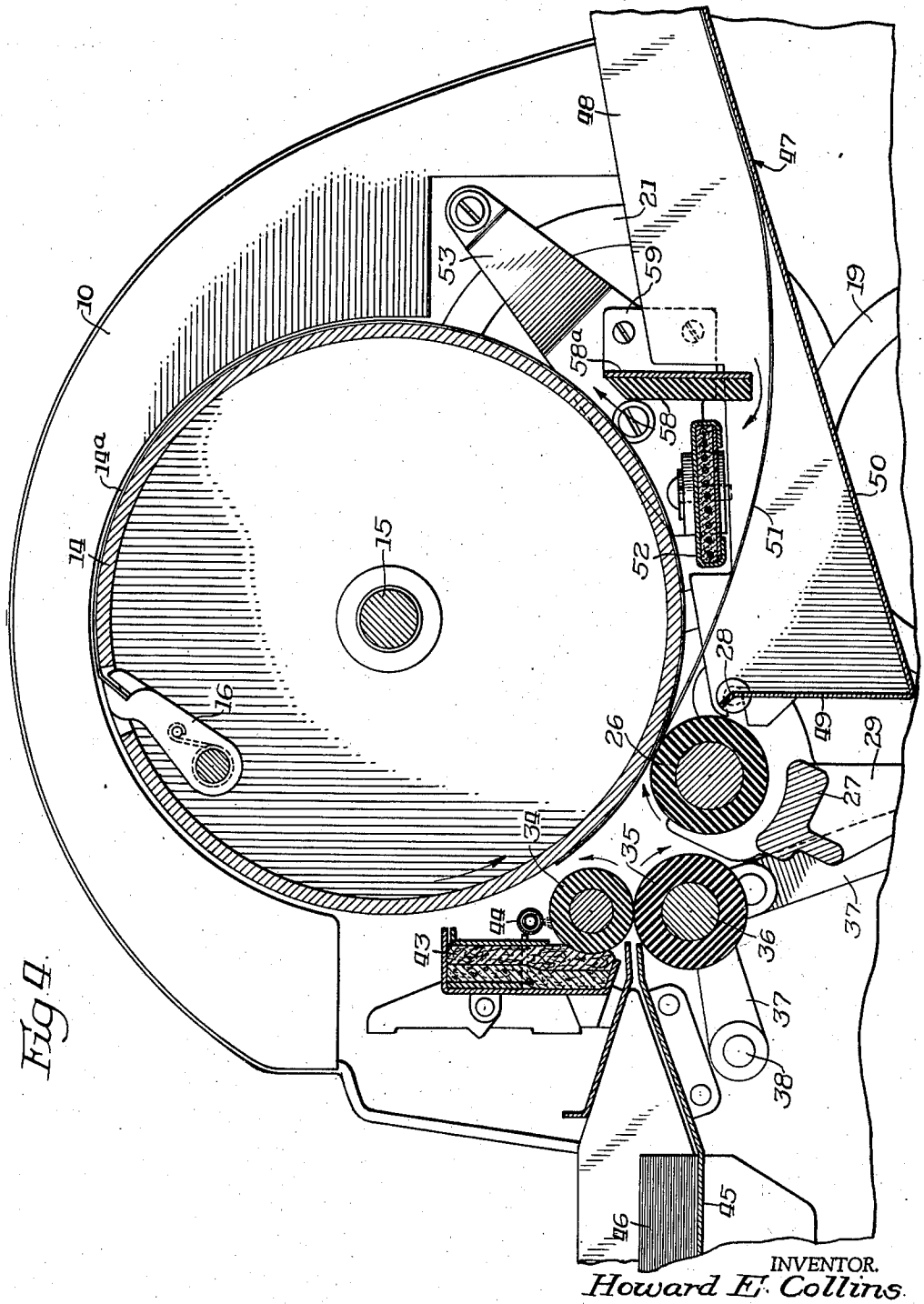


Fig 4.

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Fig. 5.

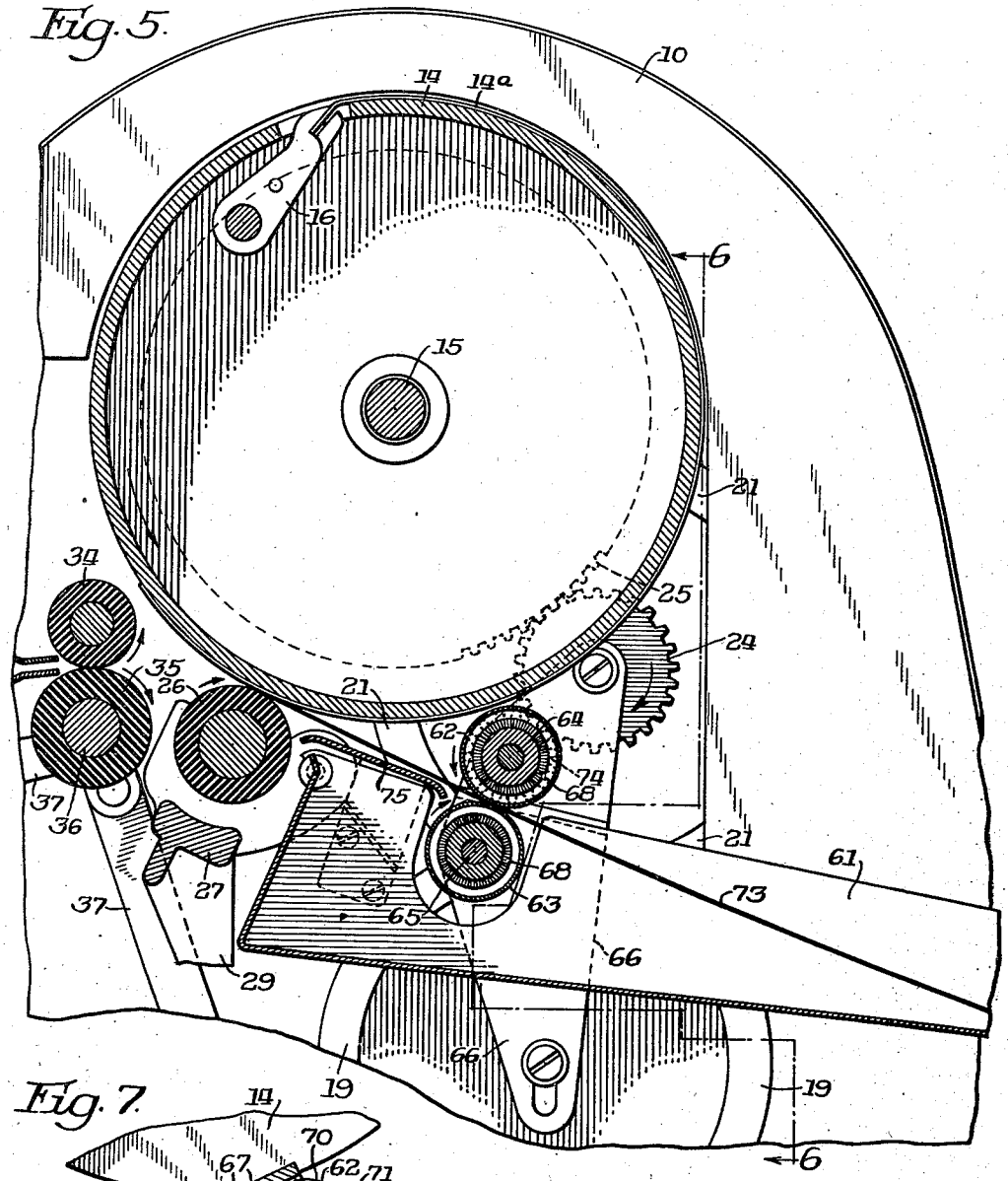
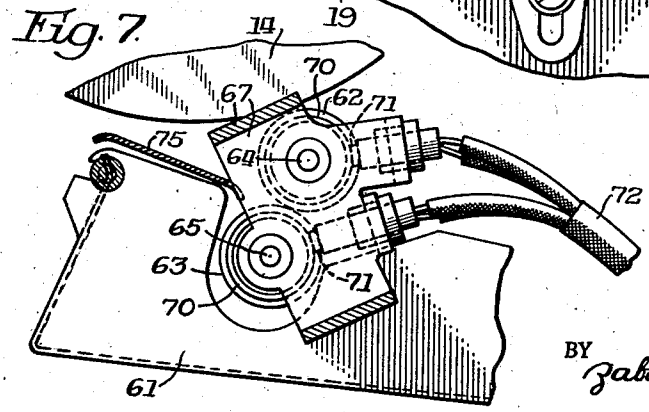


Fig. 7.



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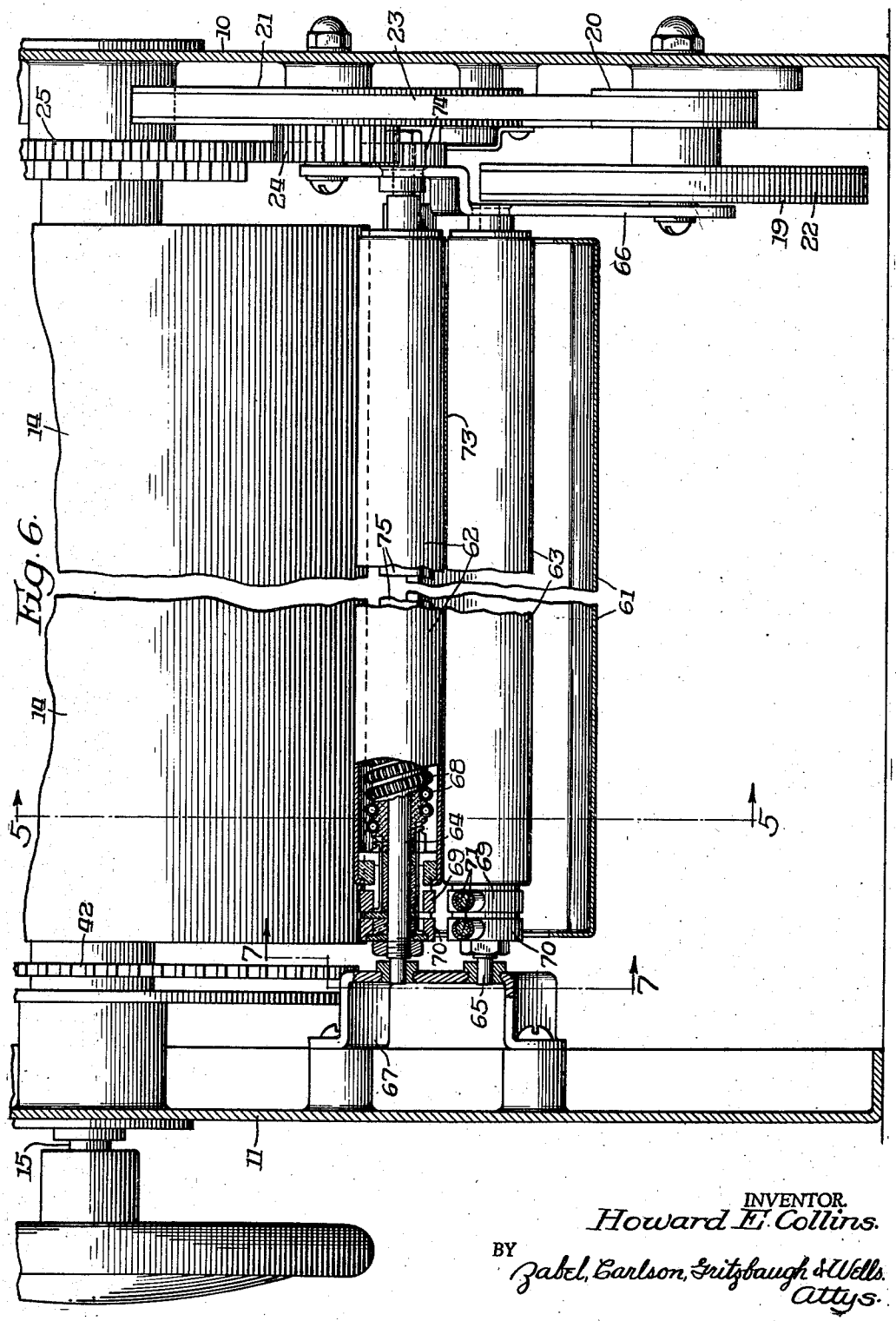


Fig. 6.

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Patented Apr. 9, 1946 2,398,288

UNITED STATES PATENT OFFICE

2,398,288

METHOD OF DUPLICATING AND APPARATUS THEREFOR

Howard E. Collins, La Grange, Ill., assignor to Ditto, Incorporated, Chicago, Ill., a corporation of West Virginia

Application March 2, 1942, Serial No. 433,009

16 Claims. (Cl. 101—132.5)

This invention relates to an improved method of duplicating and to the apparatus for carrying out the improved method, and it has for its object the provision of a new step in liquid process duplicating whereby the master sheet may be preserved so as to lengthen its effective life and to make possible the production of an increased number of copies from a single master sheet, and whereby clearer and better copies may be produced and the appearance of the printed copy sheet may be improved.

In liquid process duplication, in which the master sheet is moistened and subjected to pressure a great number of times in succession, it is important to keep the body of the ink on the master sheet as nearly dry as possible, with the moistening effect limited to the outside face portions of the ink so far as possible. This result is expedited to a considerable degree by the use of a highly volatile solvent which is adapted to evaporate after moistening the outside surface of the ink without penetrating the ink to any substantial depth. Furthermore, I have discovered that if the body of the ink on the master sheet can be kept comparatively dry and firm in the periods between the successive surface moistenings, the copies produced on the copy sheets are much more sharp and clean-cut and the number of copies possible to be made with a single master sheet is substantially increased.

It is important also from the standpoint of the copy sheets that any moisture applied to their faces in a duplicating operation be removed quickly without an opportunity to soak through the sheets, since the sheets are very likely to become wrinkled and otherwise distorted from their flat condition if the sheets are permitted to dry slowly when stacked with a considerable amount of moisture in them. Moreover, the sheets are hard to arrange and do not pile smoothly and evenly if they are too wet, and the print is likely to be blurred slightly in the handling of the sheets.

For overcoming these difficulties so as to make possible the making of a great number of good copies of acceptable appearance, even when the solvent employed is not extremely volatile, I have provided an improved arrangement of parts by which heat may be applied in such manner that both the master sheet and the copy sheet may be dried effectively as they advance beyond the impression point in the duplicating machine, so as to maintain the body of the ink on the master sheet substantially dry and firm except for the temporary surface moistening, and so as to dissipate the moisture from the face of the copy sheet and thus prevent the objectionable diffusion of the solvent through the copy sheet. For expediting the drying effect, the arrangement is made such as to establish the necessary air currents in conjunction with the application of the heat so as to carry away the moisture promptly upon its release from the faces of the sheets.

It is another object of the invention to improve the method of duplicating and the apparatus by which such method may be carried out in sundry details hereinafter pointed out. The preferred means by which the improved method is carried out is illustrated in the accompanying drawings, in which:

Fig. 1 is a longitudinal vertical sectional view through a duplicating machine embodying my improved construction, with parts of the structure broken away for clearness of illustration;

Fig. 2 is a transverse vertical sectional view taken upon an enlarged scale at the line 2—2 of Fig. 1;

Fig. 3 is a horizontal sectional view taken on an enlarged scale at the line 3—3 of Fig. 1;

Fig. 4 is a vertical sectional view taken on an enlarged scale at the line 4—4 of Fig. 2;

Fig. 5 is a view similar to Fig. 4 but showing a modified form of construction, being substantially a section taken at the line 5—5 of Fig. 6;

Fig. 6 is a vertical sectional view taken at the line 6—6 of Fig. 5; and

Fig. 7 is a vertical sectional view taken at the line 7—7 of Fig. 6.

Referring now to Figs. 1 to 4 inclusive of the drawings, in which corresponding parts are indicated by the same reference characters, 10 and 11 indicate side frame members at opposite sides of the drum connected rigidly together by crossbars 12 and 13, as is best shown in Fig. 1. Between the standards 10 and 11, I have mounted a duplicating drum 14 by means of a heavy shaft 15, such drum being provided with grippers 16 of any suitable type movably mounted on the drum for securing a master sheet 14a in position on the face of the drum so as to be carried around thereby (see Fig. 4). In the arrangement shown, the drum 14 is driven by a motor 17 by means of driving pulleys 18, 19, 20 and 21 and cooperating endless belts 22 and 23, the pulley 21 being provided with a gear 24 which meshes with a gear 25 which is suitably connected by any approved means with the drum 14 so as to cause the drum to rotate with the gear. The arrangement is such that the drum 14 is driven in counterclockwise direction in Fig. 1.

Below the drum 14, an impression roller 26 is provided in position for pressing against the face of the drum, such impression roller being rotatably mounted between the arms of a yoke 27 pivotally mounted at opposite sides of the machine so as to swing about an axis at 28. The yoke 27 is provided at about its middle point with a downwardly extending arm 29 which engages a link 30 mounted at its rear end upon an eccentric 31 carried by a transversely positioned shaft 32. At its forward end, the bar 30 is provided with a coiled spring 33 which presses the arm 29 yieldingly toward the shaft 32. The arrangement is such that by rotary movement of the shaft 32 the yielding pressure of the impression roller 26 against the drum may be controlled.

A short distance to the rear of the impression roller 26 (toward the left in Fig. 4), I have provided the usual forwarding rollers 34 and 35, the roller 34 being mounted upon a fixed axis, while the roller 35 is mounted by means of a shaft 36 between bell-crank levers 37 which are pivotally mounted upon the standards 10 and 11 at 38, the downwardly extending arm portions of the levers 37 being adjustably connected with coiled springs 39 which normally hold the levers and the roller 35 upwardly in pressure relationship to the roller 34.

The roller 34 is driven in counter clockwise direction in Fig. 1 by means of a pinion 40 meshing with an idler pinion 41 which in turn is driven intermittently by a mutilated gear 42 adapted to rotate with the drum 14, the arrangement being such that the roller 34 when driven moves at substantially the same surface speed as that of the drum.

Moistening means of any approved form is provided for applying a film of moisture to the face of the roller 34 as the drum 14 revolves in counter clockwise direction in Fig. 4. In the arrangement shown, the moistening means comprises an absorbent pad 43 held in pressure relationship to the roller 34, together with means comprising a tubular member 44 for delivering a suitable supply of solvent upon the face of the roller 34 in position to be spread by the pad 43.

A short distance to the rear of the forwarding rollers 34 and 35, I have provided a table or tray 45 in position for holding a pile 46 of copy sheets to be fed one at a time into the bite of the rollers 34 and 35 for movement forwardly toward the right in Fig. 4. A short distance in front of the impression roller 26, I have provided a tray 47 in position to receive the copy sheets as they move forwardly toward the right in Fig. 4 from the impression roller 26. In the preferred arrangement as illustrated, the tray comprises comparatively deep side walls 48 and a deep rear wall 49, with the bottom wall 50 slanted upwardly, the tray being positioned in fairly close proximity to the drum 14 and the impression roller 26 so as to cooperate with such parts for forming in effect a housing into which the copy sheets are delivered one at a time. In Fig. 4, a copy sheet 51 is shown at about the end of its forward movement with the drum.

Coming now to the means for applying heat to the master sheet and the copy sheet as they separate in the course of a duplication operation, 52 indicates a comparatively thin and broad electrically energized strip heater of any approved type extending across underneath the drum in the space between the master sheet and the copy sheet at a point a short distance in advance of the impression point so as to be in close proximity to the inked faces of both of said sheets, as is best shown in Fig. 4. The heater 52 is supported at one end by a bracket 53 carried by the standard 10 (see Fig. 2) and is supported at its opposite end by a bolt 54 extending through an opening in the standard 11. As is shown in said figure, the heater is preferably insulated from the framework of the machine, and is energized by means of the leads 55 and 56 of an electric cable 57 (see Fig. 1).

The arrangement is such that when suitable electric current is fed to the strip heater 52, the temperature within the housing comprising the drum 14, the impression roller 26, and the tray 47 is raised many degrees, depending of course upon the strength of the current supplied through the cable 57 under the control of any suitable regulating mechanism not shown. This results in an effective application of heat to the inked faces of both the master sheet 14a and the copy sheet 51 so as to cause the solvent to be quickly released from the sheets and so as to prevent any substantial penetration of the solvent into the bodies of the ink on the master sheet. This result is expedited and promoted substantially by the provision of a baffle plate 58 extending across the machine in front of the heater 52 between the path of the master sheet and the path of the copy sheet. This baffle plate is preferably formed of insulation material, being supported by means of a transversely extending metal plate 58a having its end portions bent to provide forwardly extending flanges 59. One of said flanges 59 is connected to the bracket 53, while the other is connected to a lug 60 carried by the standard 11, as is best shown in Fig. 3.

With the heater 52 energized by an electric current so as to be heated to a substantially higher temperature than that of the room in which the machine is located, a stream of heated air will be caused to flow upwardly along the front face of the drum in contact with the inked face of the master sheet. The movement of the air upwardly from the heater 52 is substantially encouraged and expedited by the rotation of the drum 14 in its normal counterclockwise direction in Fig. 4. The baffle plate 58 is positioned so as to retard the escape of the heated air but so as to permit a substantial flow of the air upwardly between said plate 58 and the drum. The movement of the air upwardly from the housing in which the heater 52 is positioned serves of course to induce the movement of the air into the housing, a substantial portion of such entering air being drawn in at the bottom edge of the baffle plate 58 which is designed to be spaced a short distance from the face of the copy sheet being delivered. These streams of air serve both to encourage the dissipation of the solvent from the faces of the master sheet and the copy sheet and also to carry away the moisture extracted from the faces of the sheets. The fresh air entering the housing about the heater 52 and the adjacent portions of the master sheet and the copy sheet is normally of much lower temperature than that of the heated and moistened air in the housing whereby such fresh air is enabled effectively to take up the moisture forced out of the sheets.

With the machine in operation under the conditions as above described, with the heater 52 energized and the currents of air flowing as specified above, the copy sheet 51 is effectively dried by the time it reaches its normal piled position in the tray and before it is covered by the next

succeeding copy sheet. The solvent is also dried from the face of the master sheet so as to prevent the solvent from soaking into the body or bodies of ink thereon. This is of great importance, since in this way the ink is kept intact and substantially dry and solid so as to cause the successive moistenings of the ink to be confined almost entirely to the surface portions of the ink whereby the condition of the master sheet is kept satisfactory and any rapid deterioration is prevented.

In the arrangement shown in Figs. 5, 6 and 7, a modified form of construction is provided. Inasmuch as this modified construction corresponds to that already described in many respects, the same reference characters are applied to the parts except so far as a changed construction is employed.

In the modified construction, the receiving tray 61 for the copy sheets extends forwardly and downwardly from the drum 14 and the impression roller 26, as is clearly shown in Fig. 5, providing room for two rollers 62 and 63 in pressure relationship to each other across the tray transversely of the machine. These rollers are supported by means of shafts 64 and 65, respectively, bearing in brackets 66 and 67 mounted on the standards 10 and 11 at opposite sides of the machine, as is best shown in Fig. 6. Each of the rollers 62 and 63 is provided with an electrical heating unit 68 of any approved type therein, with the terminals of the unit connected with contact rings 69 and 70. Suitable brushes 71 connected with the leads of an electric cable 72 supply current to the units for heating the rollers to the desired degree.

Means is provided for driving the rollers 62 and 63 in the direction for carrying a copy sheet 73 forwardly toward the right in Fig. 5. This means comprises a pinion 74 fixedly mounted on the shaft 64 of the upper roller 62 so as to drive such roller at the same surface speed as that of the drum 14. As is best shown in Fig. 5, the rollers 62 and 63 are so positioned with respect to each other as to direct the copy sheet 73 downwardly along the bottom wall of the tray 61. For feeding the copy sheet into the bite of said rollers, a guide plate 75 is provided just to the rear of the rollers.

When a heating current is fed to the rollers 62 and 63 so as to heat such rollers to the desired temperature, heat is applied both to the inked top face of the copy sheet 73 and to the inked face of the master sheet 14a which is carried by the drum into close proximity to the roller 62 following an impression. A stream of heated air is also caused to rise along the front face of the drum (at the right in Fig. 5), such current of air being brought about by reason of the heating of the air below the drum and also by reason of the rotary movement of the drum in counter clockwise direction in said Fig. 5. Such heated air, rising along the face of the master sheet 14a, serves to dry the ink characters on the master sheet so as to keep the bodies of ink firm and hard with the solvent kept from soaking into the body of the ink. Since the rollers 62 and 63 are in pressure relationship to each other, the rollers have an ironing or pressing effect upon the copy sheets so as to dissipate solvent from the top face of the copy sheet and also to press out any wrinkles which may have been formed in the sheet by reason of the moisture applied thereto.

By the use of my improved construction, I am enabled to protect the master sheet against rapid deterioration and also to increase the number of copies produced by the use of a single master sheet. I am also enabled to produce better looking copy sheets, piled much more neatly in the receiving tray, since the dissipation of the moisture from the face of the sheet serves to protect the sheet from being wrinkled or otherwise distorted and also prevents the copy from becoming blurred.

While I prefer to employ the form of mechanism as illustrated in the drawings and as above described, my invention is not limited to such arrangement except so far as the claims may be so limited, it being understood that changes might well be made in the construction and the method without departing from the spirit of the invention.

I claim:

1. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving the copy sheet forwardly in impression relationship to a master sheet on the drum, and means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on to the master sheet, means for applying heat to the face of the master sheet as it moves forwardly free of the copy sheet in advance of the impression point, and baffle means retarding the escape of the heated air from the point of application of the heat so as to dissipate solvent from the face of the master sheet and to reduce to a minimum the penetration of the solvent into the ink carried by the master sheet.

2. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving the copy sheet forwardly in impression relationship to a master sheet on the drum, and means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on to the master sheet, means effective at a short distance ahead of the impression point for applying heat at the bottom portion of the drum below a master sheet on the drum and above a copy sheet advancing with the drum for dissipating solvent from the sheets, and a baffle in advance of said heat-applying means substantially closing the space between the sheets but open sufficiently for permitting a stream of heated air to move upwardly in contact with the inked face of the master sheet.

3. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving the copy sheet forwardly in impression relationship to a master sheet on the drum, and means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on to the master sheet, means effective at a short distance ahead of the impression point for applying heat at the bottom portion of the drum below a master sheet on the drum and above a copy sheet advancing with the drum for dissipating solvent from the sheets, and means comprising a tray in position to receive the copy sheets from the drum adapted to cooperate with the drum for forming in effect a housing about the heat-applying means and portions of said sheets adjacent to the impression point for increasing the heating effect on the sheets and ar-

ranged for permitting a stream of heated air to move upwardly along the front face of the drum in contact with the inked face of the master sheet.

4. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving the copy sheet forwardly in impression relationship to a master sheet on the drum, and means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on to the master sheet, means effective at a short distance ahead of the impression point for applying heat at the bottom portion of the drum below a master sheet on the drum and above a copy sheet advancing with the drum for dissipating solvent from the sheets, a tray in position to receive the copy sheets from the drum and adapted to cooperate with the drum for forming in effect a housing about the heat-applying means and portions of said sheets adjacent to the impression point, and a baffle a short distance in advance of said heat-applying means extending downwardly into the tray so as to increase the heating effect on the sheets but spaced slightly from the drum for permitting a stream of heated air to move upwardly in contact with the face of the master sheet and spaced sufficiently from the bottom of the tray for permitting a stream of air to move backwardly into the tray along the top face of the copy sheet.

5. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving the copy sheet forwardly in impression relationship to a master sheet on the drum, and means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on to the master sheet, and a comparatively thin broad heating unit at a short distance ahead of the impression point at the bottom portion of the drum below a master sheet on the drum and above a copy sheet advancing with the drum and in close proximity to both of said sheets for dissipating solvent from the sheets.

6. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving the copy sheet forwardly in impression relationship to a master sheet on the drum, and means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on to the master sheet, and an electrical heating unit externally of said drum for applying heat to a limited portion of the face of the master sheet as it moves forwardly free of the copy sheet in advance of the impression point for dissipating solvent from the master sheet so as to reduce to a minimum the penetration of the solvent into the body of the ink on the master sheet.

7. In the liquid process method of making a series of duplicate copies in succession by the use of an inked master sheet, the steps of dissolving a portion of the ink of said master sheet, making an impression thereof on a copy sheet, and applying heat to the face of the master sheet after separation of said sheets to dry the ink remaining on said master sheet.

8. In the liquid process method of making a series of duplicate copies in succession by the use of an inked master sheet, the step of applying heat simultaneously to the faces of the master sheet and a copy sheet immediately upon their separation after an impression.

9. In the liquid process method of making a series of duplicate copies in succession by the use of an inked master sheet, the step of applying heat by a single instrumentality to the inked faces of the master sheet and a copy sheet immediately upon their separation after an impression.

10. In the liquid process method of making a series of duplicate copies in succession by the use of an inked master sheet, the steps of dissolving a portion of the ink of said master sheet, making an impression thereof on a copy sheet, and causing a stream of heated air to flow along the inked face of the master sheet immediately upon its becoming exposed after an impression.

11. In the liquid process method of making a series of duplicate copies in succession by the use of an inked master sheet, the steps of applying heat to the faces of the master sheet and a copy sheet immediately upon their separation after an impression for releasing the solvent from the faces of the sheets, and causing a stream of air to flow along the inked faces of the sheets for expediting the release of the solvent and for carrying away the freed moisture.

12. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving a copy sheet forwardly in impression relationship to a master sheet on the drum, means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on the master sheet whereby it may be transferred to the copy sheet, and heating means externally of said drum for applying heat to the engaging faces of the copy sheet and of a limited area of the master sheet immediately after their separation.

13. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving a copy sheet forwardly in impression relationship to a master sheet on the drum, means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on the master sheet whereby it may be transferred to the copy sheet, heating means for applying heat to the engaging faces of the master sheet and the copy sheet immediately after their separation, and a copy sheet receiving tray adjacent said drum positioned for copy sheets to drop thereon from the drum, said heating means being interposed between the copy sheet tray and the drum.

14. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving a copy sheet forwardly into impression relationship to a master sheet on the drum, a receiving tray positioned beneath the drum and adapted to receive copy sheets after they have been pressed against the master sheet on the drum, means for applying a film of solvent on the face of one of said sheets in advance of their engagement for dissolving a portion of the ink on the master sheet, and heat radiating means interposed between the drum and the copy sheet receiving tray adapted to radiate heat against the moistened surfaces of the master sheet and the copy sheet immediately after they separate.

15. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving a copy sheet forwardly in impression relationship to a master sheet on the drum, means for applying a film of solvent on the face of one of said sheets before their engagement for dissolving a portion of ink on the master sheet and causing it to be transferred to the copy sheet when the sheets are engaged, heating means positioned between the drum and the moistened face of the copy sheet after it leaves the drum whereby to evaporate solvent from the engaging faces of the master sheet and the copy sheet immediately after they are separated.

16. A liquid process duplicating mechanism, comprising in combination a drum provided with means for carrying an inked master sheet around therewith, means for moving a copy sheet forwardly in impression relationship to a master sheet on the drum, means for applying a film of solvent on the face of one of said sheets before their engagement for dissolving a portion of ink on the master sheet and causing it to be transferred to the copy sheet when the sheets are engaged, heating means positioned between the drum and the moistened face of the copy sheet after it leaves the drum whereby to evaporate solvent from the engaging faces of the master sheet and the copy sheet immediately after they are separated, said heating means comprising a heated roller engaging the impression receiving surface of the copy sheet.

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