

Feb. 17, 1942.

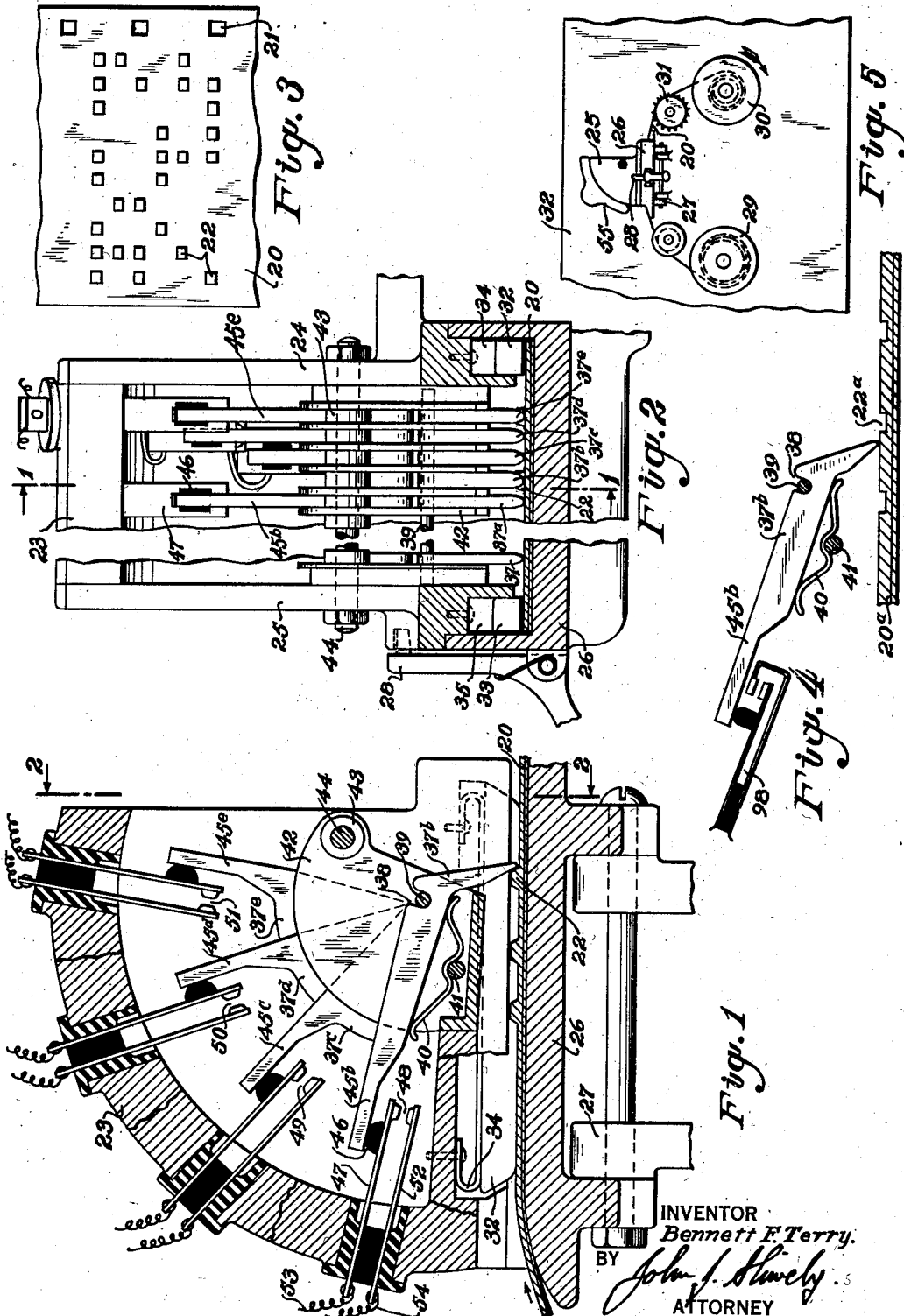
B. F. TERRY

2,273,740

PRINTING PROCESS

Filed Feb. 15, 1939

3 Sheets-Sheet 1



INVENTOR
Bennett F. Terry.
BY *John J. Stively*
ATTORNEY

Feb. 17, 1942.

B. F. TERRY

2,273,740

PRINTING PROCESS

Filed Feb. 15, 1939

3 Sheets-Sheet 2

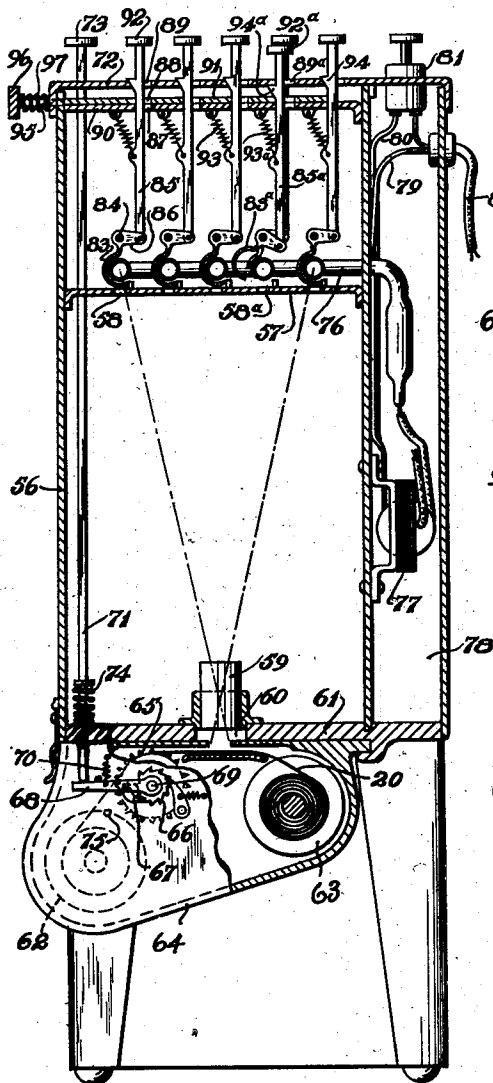


Fig. 6

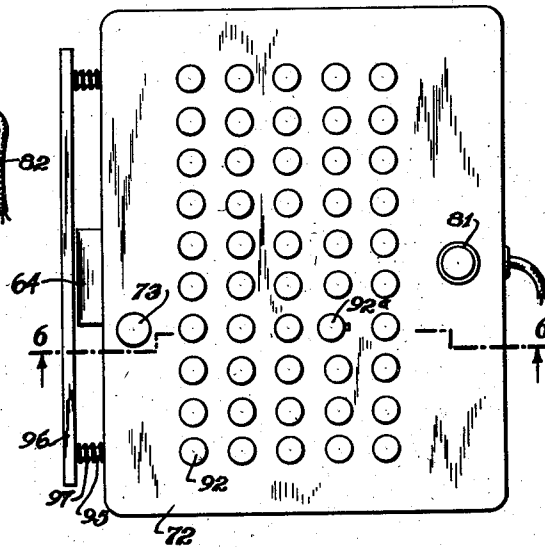


Fig. 7

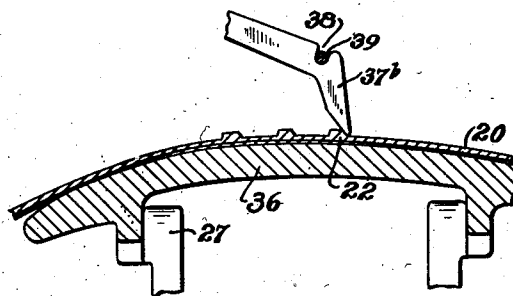


Fig. 8

INVENTOR
Bennett F. Terry.
BY *John F. Shively*
ATTORNEY

Feb. 17, 1942.

B. F. TERRY

2,273,740

PRINTING PROCESS

Filed Feb. 15, 1939

3 Sheets-Sheet 3

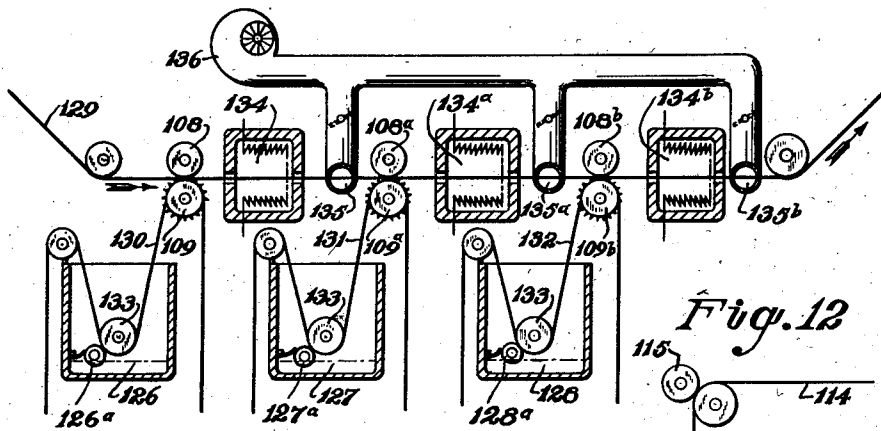


Fig. 12

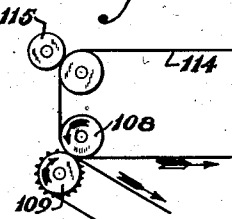


Fig. 11

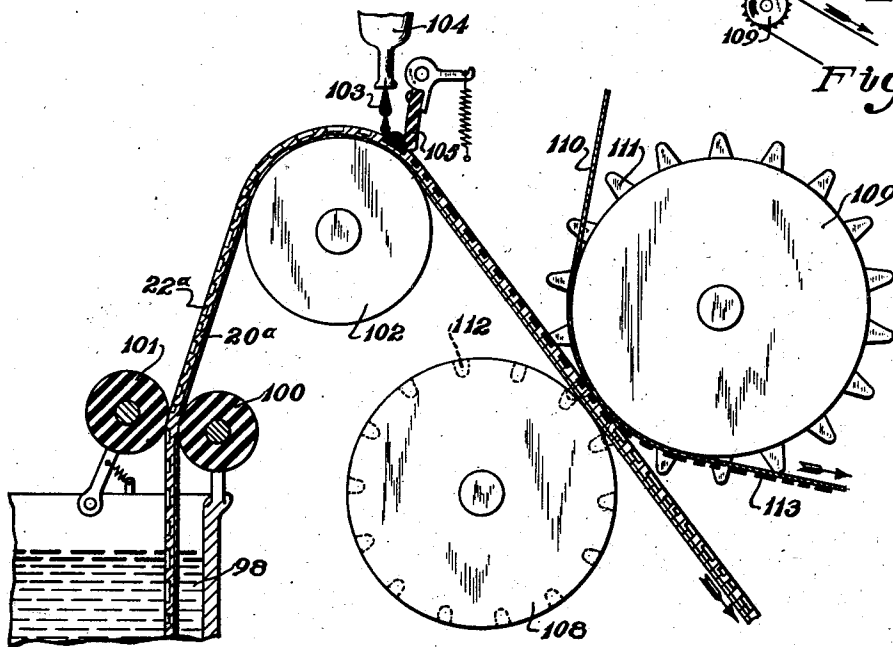


Fig. 9

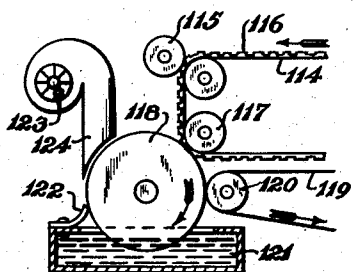


Fig. 10

INVENTOR
Bennett F. Terry.
BY *John J. Shively.*
ATTORNEY

UNITED STATES PATENT OFFICE

2,273,740

PRINTING PROCESS

Bennett F. Terry, New York, N. Y.

Application February 15, 1939, Serial No. 256,608

5 Claims. (Cl. 101—170)

This invention pertains to improvements in records and processes and apparatus for using the same.

An object of the invention is to provide improved means of preserving data in the form of records.

Another object is to provide suitable processes and apparatus for utilizing the improved records.

A further object is to provide records of the above nature in which the data recordings comprise offset areas, depressions or protrusions of the face of a film.

Another object is to provide records of the above type in which the individual recordings may be of minute size.

Another object is to provide means to transfer, duplicate or reproduce recorded data by means of inks and the like.

Another object is to provide records of the above type adapted to control record-controlled devices such as tabulating machines.

Another object is to provide suitable sensing means for use with the above records.

A further object is to provide suitable apparatus to record the data on the film by means of light.

Another object is to provide a method of ink printing which includes continuous transfer of ink impressions to a receiving material in non-repetitive succession from a strip-like member having thereon a non-repetitive series of ink carrying members.

A still further object is to provide a process using film means of the above type for multi-colored printing.

Other objects and advantages of the invention will appear during the course of the following description in connection with the attached drawings, in which:

Figure 1 is a vertical sectional view of a sensing means for use on tabulating machines and the like;

Figure 2 is an end sectional view of the same in the plane 2—2, Figure 1;

Figure 3 is a plan view of a portion of record film;

Figure 4 is a detail view of an alternative form of sensing switch and lever arrangement;

Figure 5 is a fragmental front view illustrating the sensing device mounted on a tabulating machine;

Figure 6 is a vertical sectional view of a device for recording data;

Figure 7 is a plan view of the keyboard of the same;

Figure 8 is a fragmental view of an alternative shape of platen for the sensing means;

Figure 9 is an enlarged detail view of a preferred form of ink printing roller and related apparatus;

Figure 10 is a diagrammatic illustration of a variation of the ink printing process suitable for reproduction of printed matter from microfilm and the like;

Figure 11 shows a second modification of the ink printing process; and

Figure 12 is a diagrammatic view of means for assembling a plurality of recordings on a single receiving strip or film.

Referring to Figure 3, the numeral 20 indicates a short section of film which may be provided with the usual sprocket perforations 21 either on one or both borders. The film 20 carries data recordings generally denoted by the numeral 22, which recordings may be in the form of protrusions as shown in profile in Figure 1, or may be in the form of depressions 22a as shown in Figure 4.

The arrangement of protrusions 22 as shown in Figure 3 is typical of data recordings suitable for use in a tabulating machine, it being understood that while the record is shown with ten rows of protrusions by way of illustration, any desired number of rows may be provided as in the case of present punched card records. It will be further understood that while the protrusions are shown of substantial size for clarity of description, in practice they may be of minute size, permitting a large amount of recorded data to be placed on a small area of film.

Referring to Figures 1 and 2, which show in detail a sensing means adapted for use with the records on film 20, the numeral 23 indicates an arcuate body or frame which may be mounted on a tabulating machine 32 as illustrated diagrammatically in Figure 5. The body 23 is provided with inner and outer end members 24 and 25. A channeled platen 26 is hinged at 27 below the body 23 and is provided with a latch 28 which normally holds the upturned edges of the platen 26 accurately in engagement with the end members 24 and 25.

The platen 26 is adapted to support and guide the film 20, which may be fed thereover by any suitable mechanism such as the reels 29 and 30 and sprocket 31, Figure 5. Shoes 32 and 33 secured to springs 34 and 35, which in turn are secured to the members 24 and 25, resiliently engage the borders of the film 20 to hold the latter flat on the platen 26. As an alternative ar-

rangement, the platen may be slightly curved as represented by numeral 36, Figure 8, in which case the curvature of the film in tension on the platen ensures lateral flatness of the film and permits the spring-pressed shoes to be dispensed with.

Referring again to Figures 1 and 2, a plurality of contact levers 37, 37a, 37b, 37c, etc., have notches 38 in their upper side, the notches 38 being pressed upward into pivotal engagement with a common cross pin 39 by curved leaf springs 40 backed by a second cross pin 41. Plates 42, clamped between spacer washers 43 on a cross bolt 44, act as separators between the levers 37, 37a, etc., and also retain the springs 40 laterally in position.

The contact lever 37b shown in Figure 1, has a rearwardly extending arm 45 engaging an insulating block 46 on the upper resilient member 47 of a normally open switch or contactor 48. The two sides 47 and 52 of the contactor 48 are provided with leads 53 and 54 for connection in the proper control circuit of the tabulating machine 32, all the other contactors being provided with similar leads. A conduit box or cover 55, Figure 5, may be provided to protect the wiring in place on the machine 32.

It will be seen that the location of the second cross pin 41 to the left of fulcrum pin 39, together with the points of engagement of the spring 40 with the lever 37b, cause the latter to be urged clockwise, clockwise movement however, being prevented by the engagement of the point of lever 37b with the film 20. As the film 20 moves to the right, a protrusion 22 encountering the point of lever 37b raises the point, swinging the lever counter-clockwise and causing the arm 45b to close the contactor 48.

The lever 37c, adjacent lever 37b, also has a rear arm 45c adapted to close a contactor 49 when a protrusion on the film 20 moves under the point of lever 37c. The arm 45c, however, is directed angularly above the arm 45b. Similarly the levers 37d and 37e have arms 45d and 45e adapted to close contactors 50 and 51 respectively, the arms being directed at different angles above the horizontal.

Thus, the entire bank of levers, while identical in their engaging points, spring and fulcrum arrangement, have their switch closing arms staggered progressively in groups. The present illustration shows the progressive staggering as occurring in groups of four levers, but it is obvious that a group may be made to contain six or other numbers of levers. The purpose of this group staggering is to permit the levers themselves to be very thin and closely spaced while allowing the contactors to be of ample size. While the size of levers and related parts is greatly exaggerated in Figures 1 and 2, as previously noted, it will be evident that by the structure described a large number of levers with engaging points closely spaced may be provided in practice, thereby allowing for operation by minute and closely spaced protrusions on the film but allowing the contactors to be of ample size to transmit the small currents called for in actuating the control mechanisms for instance of tabulating machines.

The positive film is first exposed under the negative, then developed, preferably in a non-tanning developer, fixed and washed in the usual manner. The film is then treated with a solution such as copper sulphate, potassium bromide, potassium bichromate and water, which selec-

tively brings the image into relief. The film is then washed and dried, the unexposed portions remaining as protrusions above the general level of the film surface.

The actual height of the protrusion 22 is dependent on the thickness of the emulsion, and when using the process for record purposes in connection with tabulating machines an emulsion of substantial thickness may be provided in order to avoid the necessity for undue delicacy in the mechanical structure of the sensing means, Figures 1 and 2. It will be noted, however, the arcs of swing of the points of levers 37b, 37c etc., are nearly tangent to the film 20, so that as a protrusion 22 moves to the right and engages the point of lever 37b, for example, the latter is moved a distance much greater than the height of the protrusion. In consequence, a comparatively small height of protrusion produces a comparatively large angular motion of the lever imparting ample motion to the end of the long arm 45b to effectually close the contactor 48.

In order to effect the placing of protrusions 22 on the film 20 in proper relation for use with the sensing means Figures 1 and 2, a device of the type illustrated in Figures 6 and 7 may be used. Referring to Figure 6, a normally light-tight casing 56 has fixed therein a horizontal partition 57 provided with a plurality of apertures 58 arranged in a pattern corresponding to that of the tabulating form. A suitable lens system 59 is mounted above a window 60 in the bottom 61 of casing 56. The lens 59 is adapted to focus a reduced image of the apertures 58 on the film 20 which is disposed on reels 62 and 63 in a suitable magazine 64, the magazine being removably secured to the bottom 61. A drive sprocket 65 is provided with an exterior ratchet 66 operable by a pawl 67 on a lever 68 rotatably mounted on the sprocket shaft 69. A spring 70 normally holds the lever 68 upward. A vertical plunger 71 extending through the bottom 61 and top 72 of the casing 56 and provided with a finger button 73, overlies the lever 68 and is normally held upwardly on interior spring 74. When the button is depressed, the plunger 71 swings the lever 68 downward against a stop 75, thus revolving the ratchet 66 and sprocket 65 through a predetermined angle and feeding the film 20 to the left a corresponding amount.

A tubular illuminating means 76 disposed above the partition 57, is so formed as to overlie all the apertures 58, and is provided with a transformer 77 mounted in a rear chamber 78 of the casing 56. Primary conductors 79 and 80 of the transformer 77 lead through a normally open push button switch 81 to an exterior supply cord 82 adapted to be connected to any suitable source of current.

Individual shutters 83 are pivotally mounted on rods 83 so as to normally block the apertures 58. Vertical rods 85 pivoted to levers 86 on the shutters 83, extend upward through slots 87, 88 and 89 respectively in a support plate 90, a release plate 91, and the top or keyboard 92. The tops of the rods 85 are provided with keys 92.

Tension springs 93, secured to the bottom of the support plate 90, urge the rods 85 forward and upward, normally holding the shutters 83 in closed positions. An angular tooth 94 is provided on each of the rods 85. When a key, for example key 92a, is depressed, the downward movement of the rod 85a swings the shutter 83a clear of the aperture 58a as shown in Figure 6, the other shutters to the rear of 83a having been

cut away in the drawings to clarify the showing. As the tooth 94a falls below the bottom of the keyboard 72, the forward pull of the tension spring 93a swings the rod 95a forward, causing the tooth 94a to move under the forward edge of the slot 89a and hold the shutter locked open when the operator's finger is withdrawn from the key 92a. In other words, depression of any key locks open the corresponding shutter.

Obviously any desired symbols may be assigned to the keys 92, and their number, arrangement and the corresponding pattern of apertures may be varied in any desired manner, depending on the system of recordings used with a particular type of tabulating machine; it will be understood that the form shown is merely for purposes of illustration.

The release plate 91 is slidable on the support plate 90 and has two extensions 95 protruding through the front of the casing 56. A release bar 96 is secured to the extensions 95, and compression springs 97 normally hold the release plate in forward position as shown. When the bar 96 is pushed inward the movement of release plate 91 swings the rods 89 rearwardly so that if any rods are in depressed position their teeth 94 are disengaged from the front edges of the keyboard slots 89, allowing the rods to be drawn upward by their springs to close the corresponding shutters.

In the preferred method of making a record, the operator first depresses the various keys 92 corresponding to the desired pattern, thus locking open the corresponding shutters 83. As soon as the set-up is complete, the switch 81 is closed, energizing the transformer 77 and the tube 76, the latter illuminating only the open apertures. A reduced image of the pattern formed by the illuminated apertures is projected by the lens 59 on the film 20. The switch 81 having been released, extinguishing the tube 76, the release bar 96 is pushed to cause the shutters 83 to close, and the plunger 71 is depressed to feed the film and place the device in condition for making the next record.

Should an error in set-up be detected prior to photographing the pattern, all shutters may be closed by means of the release bar 96 and the desired data reset in corrected form, or if desired, any individual erroneously set key may be released by pushing it rearwardly to disengage its tooth 94.

The foregoing procedure of completing the set-up before exposure is obviously advantageous in avoiding loss of time in making records and waste of film through errors. It will be noted, however, that if for any reason it is desired to impress symbols individually, this can be done by operating the switch 81 and release bar 96 after each single depression of a key.

When a series of record patterns has been completed on the film 20 the latter may be developed, a positive made from it, and treated in the manner previously described to complete the record for use with the sensing means, Figure 1, the protrusions 22 occurring on the film wherever an image of an illuminated aperture 58 has been photographed.

Records made by the described process may be very small in area, the diminution being limited only by the minimum size to which the parts of the sensing means may practically be reduced, which size as previously pointed out, may be brought within very low compass by accurate manufacture. Obviously, the method permits a

large amount of data to be recorded in minimum space, and due to the small movement and low inertia of the sensing members, records can be sensed at much higher speed than is possible with other types of records such as punched cards and the like.

In some cases it may be desired to retain the original film as a master record and to duplicate the data for use in the machine or machines. For this purpose the original film may be simply developed and used as a negative from which positives are made, after which the positives are treated in the manner previously described.

If desired, however, the negative itself may be subjected to the bleaching and tanning process, then used directly to operate the sensing device, in which case the latter is arranged as shown in Figure 4, wherein the contactor 98 is of the self-closing type and is normally held open by the bar 45 as the point of lever 37b rides on the upper surface of the film 20a. When the point of 37b drops into a depression 22a forming part of the record, the contactor 98 closes automatically to energize its control circuit. When the negative is used in this manner the wiring of the sensing means is arranged to compensate for the reversal in relative positions of the data markings from that occurring in the positive. From the above it is evident that the invention comprises controlling a sensing means by differences in thickness of the record, the controlling factors being either protrusions or depressions.

Duplicate records may also be made from the above described negative by means shown diagrammatically in Figure 9. In this case the film 20a, containing the sunken portions or depressions 22a, is subjected to a suitable bath 98, for example, a solution of glycerine and water, which renders it more pliable and swells the emulsion, increasing the depths of the depressions 22a. The film is pressed or squeezed between the rollers 100 and 101 to remove the excess bath liquid and is conducted over a third roller 102. As the film 20a passes over the roller 102 it receives a charge 103 of pigment such as oil engraving ink from a feeder 104. A resilient wiper 105 spreads the ink evenly into the depressions 22a and removes it from the upper surface of the film, the dampness of the film surface preventing the oily ink from adhering thereto so that the only remaining ink is that mechanically retained in the depressions. The film is then drawn between two rollers 108 and 109 which press it into intimate contact with a second strip 110 which may be of paper or the like or may be a second film having a surface adapted to receive the ink 103. Sprocket teeth 111 on the roller 109 serve to drive the film and receiving strip and to keep them in proper registry, the roller 108 having sockets 112. As the film 20a and strip 110 pass between the rollers the ink leaves the depressions 22a and adheres to the strip 110 in raised portions 113, producing a pattern on the strip which is a reversed duplicate of that impressed on the original negative film. If ink of adequate hardness is used, after drying the newly produced duplicate record may be used to actuate the sensing device, Figure 1, in the manner already described. By the above method any desired number of records may be made on cheap material such as paper, the film 20a being washed in a suitable ink removing bath and preserved for future use. However, while engraving ink is given as an example, obviously

any other suitable material may be employed in the manner described.

It will be obvious to those skilled in the art that the method and apparatus described in connection with diagrammatic Figure 9 may also be used to reproduce other than tabulation data, for example, printed matter and the like photographed on microfilm. For direct reproduction for instance of printed matter in its original values, i. e., black letters on white background or the like, the film used as in Figure 9 may be a positive printed from the original negative. In some of such cases wherein the reproduction is intended for viewing or projection rather than mechanical action by the recorded data, a variation in the process may be made as follows:

The data to be reproduced is photographed on the film by any suitable means. The film is developed, fixed, hardened and washed normally. In the case of material to be printed in the reverse tone relation, a positive film print is made directly from the original negative, and this positive film is also developed, fixed, hardened and washed in the usual manner. The positive is then bleached and tanned during which process the exposed portions of the emulsion recede, leaving the unexposed portions protruding above the general film level with surfaces adapted to retain certain wet inks.

For ink printing the film may be used at once before drying or if stored in dried condition may be redampened for flexibility and additional elevation of the unexposed portions as previously set forth. Referring to diagrammatic Figure 11, which shows a process suitable for use when printing is to be done on opaque media such as paper, the positive film 114 is first passed under a suitable ink roller 115 which deposits ink of a character adapted to adhere to the upraised portions 116. The film is then passed between a pressure roller 117 and a transfer or offset roller 118, preferably of rubber or the like. The wet ink is transferred from the portions 116 to the surface of roller 118. The receiving strip 119 is passed between the surface of offset roller 118 and a second pressure roller 120, by which process the ink image is retransferred from the offset roller 118 to the surface of strip 119 in proper relation for direct viewing. The roller 118 is continuously cleansed of ink in a bath 121 of suitable highly volatile solvent such as carbon-tetrachloride. A resilient scraper 122 removes excess solvent, and the highly volatile character of the solvent causes the latter to evaporate completely from the roller surface prior to the next application of ink. If desired, in order to increase the speed of operation of the apparatus, an air blast furnished by a blower 123 through a nozzle 124 may be employed to assist rapid evaporation.

If transparent ink prints are to be made for projection through the receiving material, for example cellophane or the like, transfer may be made directly from an inked negative strip 114a, to the receiving strip 125 as shown diagrammatically in Figure 11, the inked film 114a being pressed into contact with the strip 125 by pressure rollers 108 and 109 in the manner described in connection with Figure 9.

Figure 12 illustrates diagrammatically the application of the invention to multi-color printing, the process being particularly adapted to rapid and cheap production of natural color motion picture film. Referring to Figure 12, the nu-

merals 126, 127 and 128 indicate baths of suitable transparent inks of the colors it is desired to combine on the strip 129. Tanned negative films 130, 131 and 132 made by any suitable multi-color photographic means are pressed between rollers 133 and inking rollers 126a, 127a and 128a, dipping in the ink baths 126, 127 and 128 of the colors to be produced by their partial images, the various portions of the films retaining ink in inverse proportion to the intensity of the images thereon.

The film 130 is pressed into contact with the receiving strip 129 by a sprocketed roller 109 and registering roller 108 of the type previously described, thereby impressing the one color partial image on the moving strip 129. The latter then may pass through an electric oven 134 providing a mild heat to dry the first application of ink. The second and third color partial images are successively superimposed on the first partial images in the same manner as described; sprocketed rollers 109a and 109b and registering rollers 108a and 108b being initially brought into engagement with the various films in proper relation to provide continuously accurate registration of the partial images. Second and third ovens 134a and 134b serve to dry the ink impressions from films 131 and 132 in the manner described. To cool the strip 129 after each drying and thus promote rapid operation, the strip may be conducted through laterally slotted air conduits 135, 135a and 135b supplied with air blast by a suitable blower 136. If desired, the ink may be only partially dried in the ovens and drying may be completed by the air blasts, this procedure permitting the use of milder heat in the ovens.

It will be seen that the foregoing process, using surface application of inks, for transfer, makes possible the production of color films simply, rapidly and with a minimum of transfer operations. The stock comprising the receiving strip may be of various low cost materials, the principal requirements being a surface capable of receiving the inks and sufficient body to retain its accuracy in production and in the use to which it is to be put after completion.

While the foregoing process has been described as operating with three colors, it is obvious that it may be applied to any number of colors of which partial images may be made. In connection with all varieties of the process described the films if desired may be dampened as described in connection with Figure 9 to render them more flexible and swell the relief, and printing may be carried on either from the positive or the negative, depending on the type of ink used and the nature of the desired reproduction. After printing the ink-carrying films may be washed in any suitable ink solvent.

It will be apparent from the foregoing that the invention makes possible substantially continuous reproduction by printing from strip or ribbon-like supports or carriers having ink carrying patterns or members arranged in non-repetitive succession, and that this process may have a wide variety of applications in addition to the examples described.

While the invention has been set forth in preferred forms, it is not limited to the precise structures and processes described, as various modifications may be made without departing from the scope of the appended claims.

What is claimed is:

1. That method of forming a series of natural colored transparencies from three photographic strip films having supplementary partial images photographically impressed thereon in sunken portions in correspondence respectively to the intensities of three predetermined colors to be selectively combined, which comprises developing said films, treating said films chemically to bring said partial images into relief, applying transparent inks of said three predetermined colors separately to the sunken portions of said respective films, and continuously pressing said three films into registered contact with a moving substantially straight transparent strip at three spaced and aligned stations whereby said inks may be transferred from said sunken portions forming said partial images to the surface of said strip to form partial color images thereon, the spacing of said aligned stations and the registry of said films with said strip being adapted to bring said partial ink images of said three colors into mutually supplementary relation.

2. The method as claimed in claim 1 including the steps of partially drying each of said partial ink images by heat directly after the application thereof to said receiving strip and applying air blast to said strip after each heating to complete said drying and to cool said strip, said heat and said air blast being applied substantially evenly to both sides of said straight strip whereby said strip is maintained in flat condition.

3. In a printing device, in combination, a plu-

rality of ribbon-like supports each carrying a non-repetitive series of ink-carrying members, the ink-carrying members of each of said supports forming sunken portions thereon comprising patterns supplementary to corresponding patterns of the ink-carrying members of said other supports, means to continuously apply inks to the sunken portions of said members, a continuously movable receiving strip, means to maintain a zone of said receiving strip in substantially straight longitudinal alignment, and means to continuously press said ink-carrying members into registered engagement with said receiving strip at different aligned stations in said zone while said receiving strip is in continuous motion whereby said inks may be transferred from said members to said strip.

4. The combination claimed in claim 3 wherein said supports comprise photographic films, wherein said supplementary patterns of ink-carrying members comprise partial images corresponding to the intensities of different supplementary colors of a common photographic subject, and wherein said inks are of said corresponding supplementary colors.

5. The combination claimed in claim 3 including means to apply heat substantially evenly to both sides of said receiving strip subsequently to each of said transfers of ink thereto, and means to apply cold air blast substantially evenly to both sides of said strip subsequently to each of said applications of heat.

BENNETT F. TERRY.