

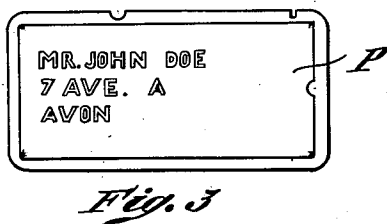
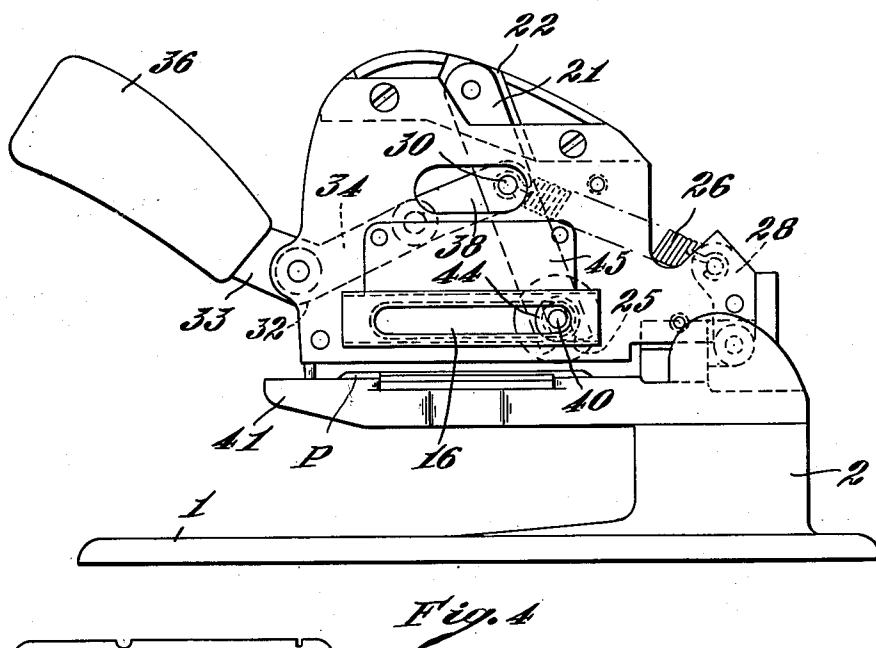
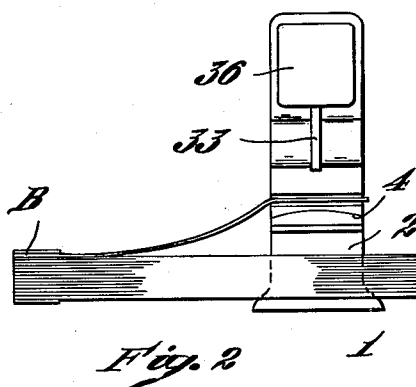
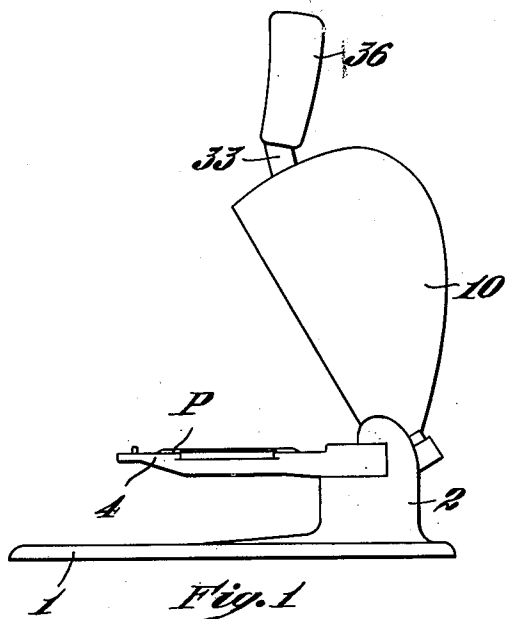
Dec. 9, 1952

C. H. GILBERT
PRINTING APPARATUS

2,620,730

Filed Feb. 10, 1951

2 SHEETS—SHEET 1



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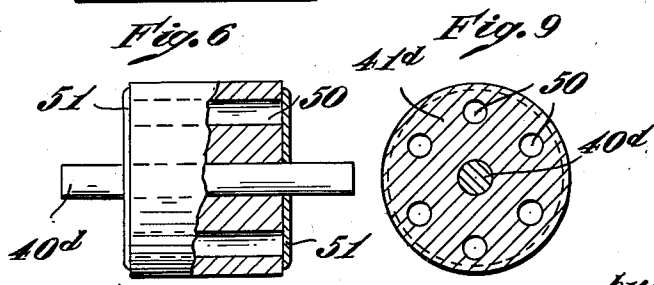
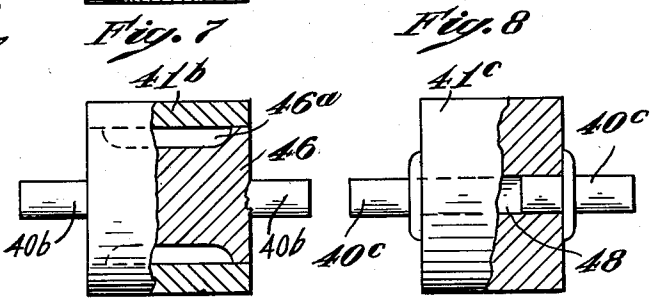
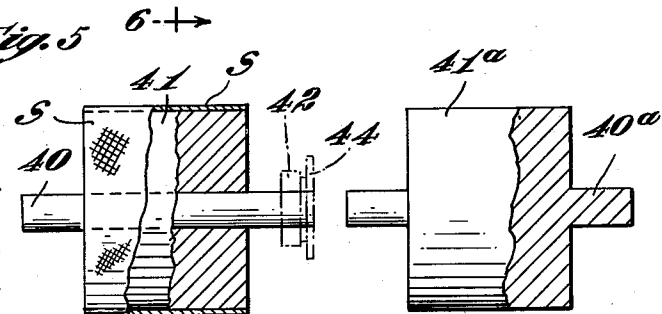
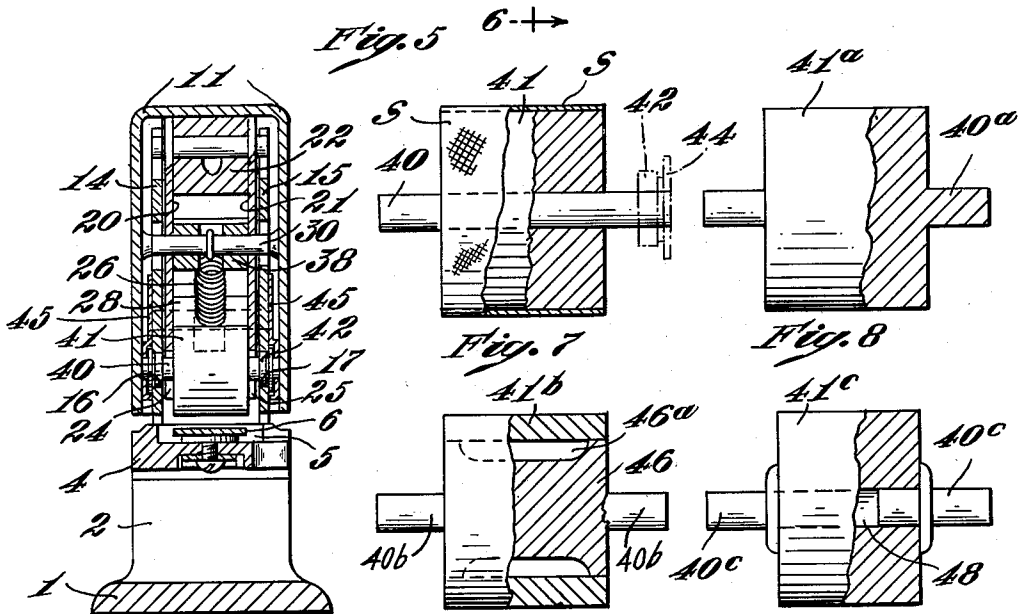
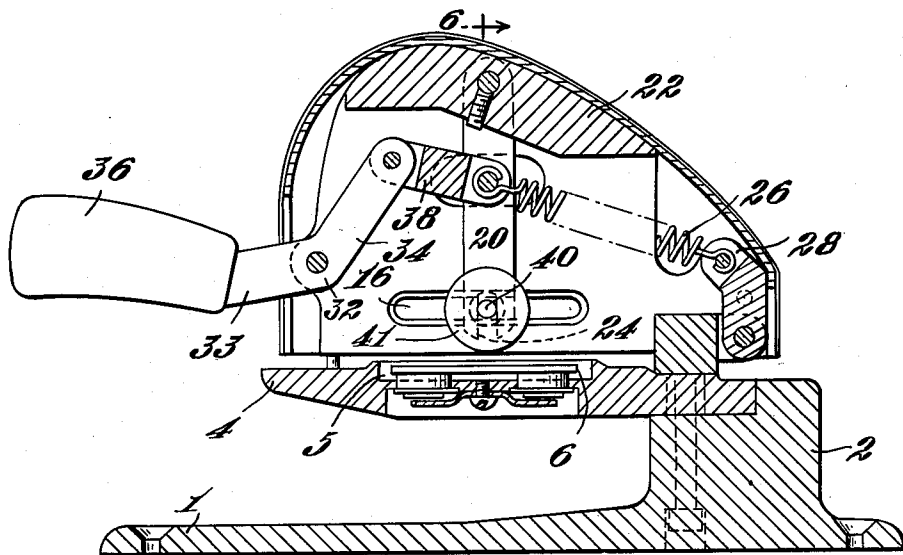
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2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE

2,620,730

PRINTING APPARATUS.

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Application February 10, 1951, Serial No. 210,407

31 Claims. (Cl. 101—269)

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This invention relates to a device such as is shown in Patent 1,801,592, granted April 21, 1931, for printing names and addresses or other indicia on sales slips or the like.

Heretofore such devices have employed an inked typewriter ribbon for printing on the uppermost sales slip and mechanism for advancing the ribbon between successive impressions, and periodically reversing the direction of travel. Although such devices have proved satisfactory, the necessary use of an inking ribbon and associated winding mechanism substantially increases the cost of manufacture, and periodically the inking ribbon must be changed, requiring an inconvenient and somewhat irksome procedure.

The principal objects of the present invention are to provide a simplified device which dispenses with the necessity of using an inking ribbon and winding mechanism, but which possesses all the advantageous features of the prior devices, and to provide a device wherein the inking member may be readily removed and replaced.

Another object is to provide a relatively inexpensive inking member which is capable not only of absorbing a quantity of ink sufficient to make a substantial number of impressions but also of releasing ink in response to pressure applied during the printing operation in just sufficient quantity to insure a clearly legible impression, and which is capable of withstanding indefinitely the shocks and wear incident to the printing operation.

For the purpose of illustration typical embodiments of the invention are shown in the accompanying drawings in which:

Fig. 1 is a side elevation of a printing device constructed in accordance with the present invention, the head being shown in raised position to receive sales slips;

Fig. 2 is an end elevation showing the head in lowered position with a set of sales slips interposed between the head and base;

Fig. 3 is an enlarged top plan view of the printing plate;

Fig. 4 is an enlarged side elevation with the casing removed;

Fig. 5 is an enlarged longitudinal vertical section showing the inking roller and associated parts in mid-position;

Fig. 6 is a section on the line 6—6 of Fig. 5;

Fig. 7 to 11 are enlarged elevations with parts shown in section of different types of inking rollers; and

Fig. 12 is a transverse section through the inking roller shown in Fig. 11.

The embodiment herein shown for the purpose of illustration comprises a base 1 formed at one end with an upstanding block 2 to which a plate holder 4 is rigidly secured in spaced relation to the base 1 so as to permit the body of a sales book

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B to be inserted beneath the plate holder, as illustrated in Fig. 2. The plate holder is recessed as indicated at 5 (Figs. 5 and 6) and is provided with a yieldable plate-centering member 6 adapted to support a printing plate P (Fig. 3) within the recess 5. The printing plate P may be of the construction shown in Patent 1,912,437, granted June 6, 1933, being formed with raised characters in non-reversed order.

A head 10 is pivotally mounted at the rear of the plate holder so as to swing upwardly, as shown in Fig. 1, to permit a sales slip or the like to be positioned on the printing plate P, the head 10 comprising a split casing or housing 11 (Fig. 6) within which are spaced side walls 14 and 15 formed with aligned elongate guide slots 16 and 17 defining a path parallel to the plane of the characters of the printing plate P.

Spaced depending arms 20 and 21 are pivoted at their upper ends to a spacer block 22 (Figs. 4-6) and the lower ends of these arms terminate in bifurcated portions 24 and 25 aligned with the guide slots 16 and 17. One end of a tension spring 26 is connected with a spacer block 28 at the rear of the housing and its other end is connected with a pin 30 extending between the central portions of the arms 20 and 21, the tension spring 26 being operative to retract and hold the arms in retracted position (Fig. 4).

An actuating member 32 in the form of a bell crank is pivotally mounted between the side walls 14 and 15 with one arm 33 projecting outwardly through an opening in the front of the casing 6 and its other arm 34 extending inwardly. The arm 33 is provided with an operating handle 36 and the inner end of the arm 34 is pivotally connected by a link 38 with the pin 30, the construction and arrangement of parts being such that by depressing the handle 36 the arms 20, 21 are swung forwardly and upon releasing the handle, the spring 26 retracts the arms and restores the handle to elevated position.

The bifurcated ends 24 and 25 of the arms 20 and 21 embrace the end portion of an axle or shaft 40 associated with an ink-carrying roller arranged to travel along a path parallel to and substantially continuous with the plane of the characters of a printing plate P carried by plate holder 4. As shown in Figs. 4, 6 and 7, the shaft 40 has a sliding fit within a porous ink-carrying roller 41 having minute internal cavities which collectively constitute a storage reservoir for ink, the roller, or at least the peripheral portion thereof, preferably having the physical characteristics hereinafter specified. The ends of the shaft 40 carry disc-like flanged rolls 42 fitting within the slots 16 and 17 with their flanges 44 contiguous to the other faces of side walls 14 and 15.

Retainers 45 are riveted or otherwise secured to the outer faces of side walls 14 and 15 to pre-

vent displacement of the flanged rolls 42 and these retainers are formed with slots corresponding to but slightly smaller than the slots 16 and 17, so as to permit the shaft 40 to be slid outwardly therethrough and the inking roller 41 removed without displacing the flanged rolls 42. With this construction and arrangement, the roller 41 may be quickly removed simply by withdrawing the shaft 40 and replaced by holding the roller aligned with the flanged rolls and then inserting the shaft. As shown in Fig. 6, the lower edges of the retaining plates 45 are turned inwardly to extend under the bearing rollers 42.

Although the use of an inking roller having a removable shaft, as illustrated in Fig. 7, is preferable, various other types of rollers such as illustrated in Figs. 8 to 10 may be used. The roller shown in Fig. 8 consists of a porous ink-absorbent body 41^a formed with integral shafts or hubs 40^a. The roller of Fig. 9 consists of a solid core 46 formed with ink-receiving grooves 46^a and integral hubs 40^b, and a porous ink-absorbent sheathing 41^b providing an ink reservoir of the same type as constituted by the entire roll 41. This absorbent sheathing 41^b should be of substantial thickness, sufficient to avoid distortion and to insure delivery of ink in substantially the same way as ink roller 41. As here illustrated, the radial thickness of the sheathing approximates one-third the radius of the roller.

The roller 41^c of Fig. 10 is similar to that of Fig. 7, except that in place of the single removable shaft 40 a pair of flanged stub shafts 40^c is provided, the inner ends of which terminate in spaced relation with each other to provide an ink-receiving chamber 48 for the reception of a relatively large free body of ink. The roller 41^d of Figs. 11 and 12 is formed with body of porous, ink-absorbent material like the roller 41, but has a plurality of spaced longitudinal bores 50 defining ink-receiving chambers. The ends of the bores 50 are closed by discs 51 which may be cemented or otherwise secured to the ends of the roller, and a removable shaft 40^d slidably fits within the roller and openings in closure plates 51.

Regardless of the particular material selected, the roller should be sensibly hard (that is, hard and unyielding to the touch) with a visually smooth and accurately cylindrical peripheral surface and the peripheral portion, at least, of the roller (whether the roller be of the same material throughout as shown in Fig. 7 or comprise a solid core and ink-absorbent sheeting as shown in Fig. 9) should contain a multitude of minute, generally interconnected cavities forming capillary canals, the majority of those canals which occur close to the peripheral surface of the roller being open at said surface as microscopic pores which are distributed substantially uniformly. The material (which may be likened to a sponge in internal structure) is capable of taking up and normally retaining a substantial body of ink, thus constituting an ink reservoir of a capacity sufficient for making a plurality of impressions, and of exuding ink from its peripheral surface, when subjected to radial pressure, at a rate proper for making a clear impression. The surface layer of the roller from which the ink exudes and which presses the ink against the paper may for convenience be referred to as the ink delivery element.

When a sales slip is positioned on a printing plate carried by the plate holder, as illustrated in Fig. 2, and the handle 36 is depressed, the inking roller 41 is carried across the upper-most

slip or sheet, progressively pressing successive portions of the sheet against the raised characters of the printing plate and simultaneously depositing on the areas corresponding to the raised type a thin film of ink, thus printing on the side of the sheet opposite the printing plate. In this operation pressure is transmitted to the printing roller 41 from the handle through the side walls 14 and 15 of the head, thence from the downwardly facing upper edges of the slots 16 and 17 to the bearing rollers 42 and thence through the shaft 40 to the printing roller.

The printing action of the inking roller is dependent not only upon its porous ink-absorbent character, but also upon its ability to release a thin film of ink for transfer to the sheet to be printed, thereby insuring a well-inked legible impression, but at the same time avoiding "over-inking" which would result in blotting or smearing the sheet and consequently rendering the impression more or less illegible. Such a roller, constituting a reservoir capable of holding ink sufficient for making at least several hundred impressions, must be capable of withstanding wear or injury which would impair legibility; and as the roller must resist the shocks and strains incident to normal use, it should not only possess a predetermined degree of porosity and ink-absorbency, but also resistance to abrasion and crushing, and a degree of resiliency such as will effect the desired ink release. In addition, the roller should be of a thermally stable composition, i. e., a composition which is resistant to cold flow and not thermo-plastic at temperatures of 500° F. and below.

A wide variety of commercially available materials meet or can be treated so as to meet the above requirements, but the most satisfactory are the non-fibrous materials which fall into the following classes:

(a) Carbonaceous materials such as carbons, graphites and graphitic materials.

(b) Metals and alloys made of iron, steel, copper, and iron-copper alloys prepared by pressing and sintering the powdered material of various particle sizes in accordance with known principles of powder metallurgy.

(c) Hydrating and chemical cements, including materials composed of Portland cement, concrete, gypsum and silicate cements, with or without a fine aggregate, etc.

(d) Ceramics, including the various porcelain-like materials composed of oxides of aluminum, silicon and magnesium, as well as clay and shale.

(e) Thermosetting plastics such as phenol-formaldehyde and urea-formaldehyde resins with or without fillers.

Inking rollers may be made from such materials by molding to the desired form; or stock bars or tubes may be made from such materials, for example, by casting, molding or extrusion, and inking rollers may be made from these stock bars or tubes by cutting from such bars pieces of the proper lengths to form the roller—turning down the ends to form the integral shafts when such shafts are employed, and boring the axial journal openings, if necessary, for the reception of separate shafts when such shafts are used. However, in making the rollers, care should be taken to avoid closure of the microscopic pores at the peripheral surface of the roller.

The suitability of any selected material will to some extent depend upon the ink to be used, and the selection of the particular type of ink will depend upon the character of the paper or

sheet material to be printed. In any case the ink must be relatively free from volatile ingredients, drying oils and the substantial amounts of pigment, etc., which result in caking the surface of the roller and/or clogging the pores. In addition, the ink should be relatively viscous, but having some degree of fluidity, so that it neither flows freely from an impregnated roller nor resists flow when the roller is subjected to a slight pressure. As a general rule inks having a viscosity from about 400 centipoises to 10,700 at 20° C. have proved satisfactory, so long as they are free from the above-mentioned ingredients.

A proximate analysis of a typical ink (hereinafter referred to as the "standard ink") which has proved entirely satisfactory when used with a wide range of roller materials for printing on relatively absorbent paper, such as newsprint, etc. is as follows:

	Per cent
Oleic or the like fatty acid	35-40
Light mineral oil, e. g., S. A. E. 10 or 20	45-50
Coloring material, predominantly an organic dye, e. g., methyl violet, with or without slight amounts of ultramarine, oil soluble resin and lecithin	10-20

The above ink has a viscosity of about 600 centipoises at 20° C. However, other inks which were found to be more or less satisfactory, depending upon the characteristics of the ink roller, comprise various non-volatile vehicles such as tricresyl phosphate, diglycol laurate, glyceryl monoricinoleate, Turkey red oil, and mixtures of these materials, and from 10% to 20% of coloring material composed predominately of a soluble organic dye of high coloring power, such as methyl violet.

Inking rollers, preferably after forming to proper dimension, may be impregnated with an ink of the above type by immersing the roller in a suitable container of ink heated to a temperature of about 150° F. for a period of about one hour, after which the immersed roller is permitted to cool in the ink for a period of at least four hours. The roller is then removed and excess ink is wiped off with a cloth.

Other methods of inking are permissible and in some cases desirable. For example, a highly porous material may be satisfactorily treated simply by immersing the roller in ink at room temperature for a period of about twenty-four hours. Materials having a low porosity or which tend to repel ink may require vacuum impregnation either at room or elevated temperatures or a combination of vacuum and pressure impregnation. Vacuum impregnation may be accomplished in the same manner as above described except that a vacuum is maintained over the ink for about one hour, followed by atmospheric pressure for four hours. Vacuum-pressure impregnation is similarly accomplished, except that a pressure of about 200 lbs. per square inch is substituted for atmospheric pressure in the procedure above outlined. After inking, the impregnated roller is ready for use in the machine above described.

When using inks of the above type and having the specified viscosity range, a satisfactory inking roller should have the following basic or essential characteristics:

(1) Inking factor (the ratio of porosity in per cent multiplied by 10^6 , to the modulus of elasticity in pounds per square inch) of at least two;

(2) Blow pressure (the pressure necessary to force air through approximately 0.29 inch thick-

ness of the impregnated roller material)—between one and one-quarter and one hundred inches of mercury;

(3) An R^2M factor (the square of the surface roughness in micro-inches multiplied by the modulus of elasticity times 10^{-11}) not exceeding five;

(4) A crushing strength of at least three-quarter ton per square inch.

In addition to these basic requirements, it is desirable that the inking roller should have the following characteristics:

(5) An ink absorption factor (the fraction of the total volume of the pores which can be filled with ink)—not less than fifteen-hundredths;

(6) A porosity (percentage of voids to total volume)—less than seventy per cent;

(7) A pore factor (the ratio of surface porosity in per cent to total porosity in per cent)—of at least one-half in the case of metallic compositions.

It will be noted that the first three basic requirements are interrelated with the desirable requirements, and it has been found that if an inking roller satisfies the above four basic requirements, it will, as a general rule, be satisfactory when used with inks of the above type, although optimum results are obtained if, in addition to observing the basic requirements, the remaining requirements are satisfied.

The porosity of the material is defined as that portion of the total volume, expressed as a percentage, which can be impregnated with a light petroleum oil in the following manner: A test piece, preferably having the dimensions of a roller (for example—Length=0.854-0.864"; Hole diameter=0.188-0.190" and O. D.=0.769-0.771") and free of any substance which will dissolve in the oil, or which will later dissolve in the ink, is first weighed and then immersed in oil in a closed container which is then subjected to a vacuum, the oil being at a temperature of approximately 70° F. A suitable oil is S. A. E. Grade No. 10-W. Air bubbles will be liberated from the test piece for several hours, depending upon the particular material. After air bubbles cease, and in no case less than two hours, the vacuum is released and the test piece is allowed to stand submerged in oil at atmospheric pressure for at least eight hours, following which it is wiped dry with a cloth and again weighed. The difference in weights before and after impregnation is the weight of the oil absorbed, which is then divided by the specific gravity of the oil to give the volume of oil absorbed.

If the test piece is a regular geometric solid, such as a cylindrical roller, its volume may be calculated with sufficient accuracy from its dimensions; but, if not, the volume may be determined by observing the loss of weight when the oil-filled test piece is submerged in water. If the test piece contains substances soluble in the ink, they should be extracted with a suitable solvent in a Soxhlet extractor before measuring the porosity factor. In all cases the porosity is expressed as the percentage of the volume of oil absorbed to the volume of the test piece.

The modulus of elasticity is the ratio of stress to strain expressed in pounds per square inch of cross-section and may be measured as follows. A test piece, preferably in the form of a cylinder having the above-noted dimensions, is first prepared, care being taken to have the ends flat and parallel and the sides perpendicular to the ends. The cross-sectional area of the test piece is meas-

ured and recorded. Two resistance strain gauges are cemented to the opposite side portions of the test piece and so oriented that a change in the length of the test piece will cause a change in electrical resistance of the fine wire grid of the strain gauge. The two gauges are connected in series in order to cancel out the effects of unsymmetrical loading. Suitable gauges for test pieces having the dimensions above noted are Baldwin-Southward SR-4, Type A-7 which should be applied in accordance with the manufacturer's instruction. The test piece with properly attached gauges is placed in a press testing machine, or other means for applying a steady accurately-known force and then subjected to compression loading. The value of strain for each of several values of stress is measured by means of a strain indicator calibrated to read strain directly as a function of the resistance of the strain gauges attached to the test piece. From this data the stress/strain diagram may be plotted and the modulus of elasticity or stress/strain ratio obtained. For the purpose of this test, the modulus is taken as the stress/strain ratio over the straight or nearly straight portion of the curve near the origin.

The surface roughness is a measurement of the character of the surface of a specimen of the material as determined on the Profilometer using the Type J tracer, measurements being made on the surface of a cylindrical roller along a line parallel to its axis. This measurement is expressed in micro-inches, root mean square. The R²M factor is the square of the roughness measurement, so determined, multiplied by the modulus of elasticity in pounds per square inch as above determined, multiplied by 10⁻¹¹.

The crushing strength of the material is its compressive strength expressed in pounds per square inch and may be measured in the following manner. A test piece, preferably having the above-noted dimensions, is carefully prepared in the same manner as the test piece for use in determining modulus and is then placed in a press, testing machine or other means of applying a measurable compressive force. The load is applied and gradually increased from zero until the test piece breaks or acquires an appreciable permanent distortion, at which time the maximum load sustained is recorded. From this load and the area of the test piece the strength in pounds per square inch can be calculated.

The ink absorption factor is defined as the fraction of the total volume of the pores which can

be filled with ink, and is measured in the following manner. A roller, preferably having the above-noted dimensions and free from substances which will dissolve in the ink is prepared from the desired material, and its volume determined by calculation from its dimensions. The porosity of the material is determined in the manner described above on a second identical sample roller. The first roller is then inked in the manner above described, after which it is weighed. From the gain in weight of the roller and the known specific gravity of the ink, the volume of ink absorbed and the ink absorption factor may be calculated.

The blow pressure is measured as follows: A roller, preferably having the above-noted dimensions, is first inked in the manner described above and is then clamped in a fixture designed to close one end of the hole and to allow air pressure to be introduced into the other end of the hole, the ends of the roller being covered by rubber gaskets. The roller and fixture are immersed in clear water and air pressure is applied and gradually increased until a plurality of bubbles appear on one or more parts of the surface of the roller. The pressure, measured in inches of mercury, is then noted and this pressure is considered the blow pressure factor if a further increase in pressure causes bubbles to appear at other parts on the surface.

If the roller is made of a material which contains a gum or other substance soluble in ink, the gum or other such substance must first be removed by extraction prior to measuring the blow pressure factor, and the factor so obtained applies to the case of the unextracted roller as well as the extracted roller.

The surface porosity is defined as the percentage of surface area occupied by cavities and is determined by microscopic estimation. A recommended method is to form a test piece having a surface which is either flat or only slightly curved so as to be brought into focus in the field of the microscope. A monocular-metallurgical microscope having a magnification of 120X and equipped with a reticule in the eye piece having a 5 mm. square, cross ruled into twenty-five 1 mm. squares, is recommended. In estimating the percentage of voids, each small square in the reticule is examined and the average of twenty-five estimates is noted.

Specific examples of materials representative of the above classes, together with their above-specified characteristics, are set forth in the following table:

Table

Ex.	Material	Porosity, Percent	Modulus $\times 10^{-6}$	Inking Factor	Blow Pressure	Roughness, Micro-inch	R ² M Factor	Crushing Strength, p. s. i.	Ink Absorption Factor	Pore Factor
1.	Graphite.....	19.4	1.7	11	25	70	0.083	>7,000	0.79	
2.	do.....	19.2	1.17	16.5	6	110	0.142	6,000	0.56	
3.	Powder Iron Compact.....	42.2	2.0	21.1	4	160	0.512	13,000	0.72	>.75
4.	do.....	24	11	2.2	>2	55	0.33	>13,000	0.50	>.75
5.	Powder Copper Compact.....	36	4.3	8.35	12	50	0.112	5,200	0.85	>.75
6.	do.....	31	5.0	6.2	30	75	0.282	>5,200	>0.15	>.75
7.	Gypsum.....	46	1.4	32.8	18	160	0.358	5,000	0.94	
8.	do.....	51	1.3	>3	10	120	0.187	>2,200	>0.3	
9.	do.....	39.8	2.0	19.9	3-24	150	0.45	4,300	0.85	
10.	do.....	46	1.35	>3	12	120	0.19	2,600	>0.3	
11.	Silicate Composition.....	42.1	0.27	156	5-10	240	0.37	2,500	0.23	
12.	Ceramic Composition.....	30.8	8.13	3.79	9	215	3.64	29,000	0.74	
13.	Thermosetting Resin.....	43.2	<0.13	>300	2-2.5	310	<0.125	2,300	>0.15	
14.	do.....	30.2	<.4	>8	6	210	<0.176	1,580	0.72	

>= Greater than.
<= Less than.

The graphite of Example 1 is compressed graphite or carbon impregnated with pitch and reheated to carbonize the pitch, thereby producing a more dense material, which is manufactured by U. S. Graphite Co. and sold under the trade name Graphitar #4. The graphite of Example 2 is a commercial electric-furnace graphite made by National Carbon Co. and sold under the trade designation C-15.

The powdered iron compact of Example 3 is made from 100 mesh electrolytic iron (Buel Metals Co.) with added graphite, ferro-manganese and lubricant, pressed at 4.5 tons per square inch pressure, sintered and hardened by quenching. The powdered iron compact of Example 4 was made in a manner substantially the same as that of Example 3, except that the compact was pressed at 18 tons per square inch pressure.

The powdered copper compact of Example 5 was made from 100 mesh copper powder (Metals Disintegrating Co.) with added lubricant and pressed at 9 tons per square inch and then sintered. The powdered copper compact of Example 6 was made in substantially the same way as that of Example 5 except that the compact was pressed at 13.5 tons per square inch pressure.

The gypsum of Example 7 consisted essentially of calcium sulfate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), manufactured by U. S. Gypsum Co. and sold under the trade name Red Top Plaster of Paris, and was made into a paste with water, cast and then dried. The gypsum of Example 8 was made by the same manufacturer and sold under the trade name Superfine Casting Plaster which was mixed with 60% water by weight, cast and dried. The gypsum of Example 9 was also made by U. S. Gypsum Co. and sold under the trade name White Hydrocal, which was mixed with 50% water by weight, cast and dried. The gypsum of Example 10 was the same as that of Example 9 but was mixed with 60% water by weight, cast and dried.

The silicate cement of Example 11 consisted of a conventional mix of sodium silicate, sodium fluosilicate, and fine aggregate, which was made into a paste, then cast and dried. The ceramic material of Example 12 consisted of a magnesium-aluminum silicate, chiefly cordierite crystals, manufactured by American Lava Company and sold under the trade name Alsimag 202.

The thermosetting resin of Example 13 was a phenol-formaldehyde resin, containing no filler, and was made by Bakelite Corp. and sold under the trade name Bakelite Molding Compound XM9131 Stiff Flow; and the resin of Example 14 was a similar product containing a dye or pigment and an asbestos filler, and was sold under the trade designation Bakelite Molding Compound BM261 Stiff Flow.

The blow pressure and ink absorptive values in the above table are those obtained when using the standard ink. As previously noted, these values may vary somewhat, depending upon the particular character of the ink.

Although, as above noted, a satisfactory roller can be produced from any material having the above-specified basic characteristics, the most satisfactory rollers are of inorganic, nonfibrous material such as carbon and graphite, powdered metal compacts, and ceramics such as unglazed porcelain, which are prepared from compressed powdered material so that the final product has the following physical characteristics:

Inking factor—between three and three hundred
R²M factor—less than five

Blow pressure—between three and fifty inches
Porosity—between ten and fifty per cent
Pore factor—at least three-quarters for metallic compositions

5 Minimum ink absorption factor—fifteen-hundredths

Crushing strength—at least one and one-quarter tons per square inch

10 While a freely rotatable roller capable of bodily translation across the surface of the printing plate is desirable and the preferred instrumentality for the purpose, it is to be understood that any equivalent combined ink reservoir and pressure-applying element, for example, a rocker or 15 other form of platen (likewise capable of holding ink for a plurality of impressions and of delivering just sufficient ink to the paper for each impression, and having physical characteristics equivalent to those of the roller herein specifically illustrated and described) is to be regarded as 20 within the scope of the invention.

By making the roller pores of capillary size the ink does not flow out except in response to pressure of the printing type transmitted through the 25 paper being printed and those areas which are thus compressed yield only enough ink to print legibly and not enough to blur.

By covering the inking roller with a fabric sleeve of closely woven fine thread, the life of 30 the roller is considerably increased, particularly if the roller is made of graphite or other material which wears with use. The covering material is preferably woven in the form of a tube having a diameter approximately equal to that of the roller, and each sleeve is then formed by cutting off a length of the tube approximately 35 equal to that of the roller. The tube is woven with the warp extending axially and the weft extending circumferentially and the circumferential threads are preferably formed of material which shrinks when wet and dried. Thus after 40 the sleeve is slipped over the roller and then wet and dried it grips the roller elastically. However, the sleeve may of course be woven somewhat smaller than the roller so that it must be stretched in slipping it over the roller. While the sleeve is shown only at S in Fig. 7, it will be understood of course that it may be used on any 45 of the inking rollers.

50 Not only must the thread be fine and closely woven but the resulting fabric must be thin; otherwise the printing is not sharply defined. The diameter of the thread should not be greater than approximately one-hundredth of an inch and it is preferably of the order of three to four thousandths of an inch. The number of threads per inch should be in the neighborhood of one hundred to two hundred and fifty per inch. 55 While any kind of fine thread may be used, silk, cotton, nylon and rayon, or combinations of these, are preferred. Good results have been secured with warp of 80/2 (cotton system of counts) combed Peeler cotton 125 ends per inch and weft of 70/1 (denier) nylon 150 picks per inch. However best results have been obtained with warp of 14/2 (denier) silk approximately 240 ends per inch and weft of 14/4 (denier) silk approximately 100 picks to the inch.

70 It is to be understood that this disclosure is for the purpose of illustration and that various changes and modifications may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

75 In part this is a continuation of my co-pend-

ing application Sr. No. 47,785, filed September 4, 1948.

The claims of companion applications Serial No. 47,785, filed September 4, 1948 (of which this is in part a continuation), and Serial No. 253,143, filed October 25, 1951 (a division of Serial No. 47,785), having been incorporated herein, those applications have been abandoned.

I claim:

1. A device for printing indicia on a sales slip or the like, comprising two opposed members, one of said members having means for supporting a printing plate having raised characters, and the other of said members having inking means consisting of a porous ink-carrying pressure roller rotatably mounted to move in a path parallel to and substantially contiguous with the raised characters of said plate for progressively pressing successive portions of a sales slip interposed between said opposed members against said plate, the roller comprising hard material whose pores are so fine that ink exudes from the surface of the roller only in response to the pressure of said characters through the sales slip or the like, said material having a crushing strength of at least three-quarters ton per square inch, an R^2M factor less than five, a blow pressure of between approximately one and one-quarter inches and one hundred inches, and an inking factor exceeding approximately two.

2. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of a porous, ink-absorbent, thermally stable material having a crushing strength of at least about three-quarter ton per square inch, an R^2M factor less than five, a blow pressure of between approximately one and one-quarter and one hundred inches, and an inking factor exceeding approximately two.

3. An inking roller as set forth in claim 2, wherein said portion is covered with a fabric sleeve of a closely woven fine thread.

4. An inking roller as set forth in claim 2, wherein said portion is covered with a fabric sleeve, the fabric having a thread count of at least approximately 100 per inch.

5. An inking roller as set forth in claim 2, wherein said portion is covered with a fabric sleeve of a closely woven fine thread, the circumferential threads being stronger than the axial threads.

6. An inking roller as set forth in claim 2, wherein said portion is covered with a fabric sleeve of a closely woven fine thread, the circumferential threads being more elastic than the axial threads.

7. An inking roller as set forth in claim 2, wherein said portion is covered with a fabric sleeve of a closely woven fine thread, the circumferential threads being of nylon and the axial threads of cellulosic material.

8. An inking roller according to claim 2 further characterized in that the blow pressure of said portion is between three and fifty.

9. An inking roller according to claim 8 further characterized in that the inking factor of said portion is between three and three hundred.

10. An inking roller according to claim 2 further characterized in that the ink absorption factor of said portion is greater than fifteen hundredths.

11. An inking roller according to claim 10 further characterized in that the porosity of said portion is less than seventy per cent.

12. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of a porous, ink-absorbent, thermosetting resin having a crushing strength of at least about three-quarters ton per square inch, an R^2M factor less than approximately 0.176, a blow pressure of between approximately two and six inches, and an inking factor exceeding approximately three.

13. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of a porous ink-absorbent thermosetting resin having a crushing strength of at least three-quarters ton per square inch, an R^2M factor less than approximately 0.176, a porosity between approximately thirty and approximately forty-three per cent, a blow pressure between two and six inches, an inking factor between three and three hundred, and a minimum ink absorption factor of fifteen-hundredths.

14. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of a phenolformaldehyde resin having a crushing strength of at least 1500 pounds per square inch, an R^2M factor less than approximately 0.176, a porosity between approximately 30 and approximately 43 per cent, a blow pressure of at least 2.0, an inking factor greater than 3.0, and an ink absorption factor greater than 0.15.

15. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of a porous ink-absorbent, thermally stable, carbonaceous material having a crushing strength of at least about three-quarters ton per square inch, an R^2M factor less than five, a blow pressure of between approximately one and one-quarter and one hundred inches, and an inking factor exceeding approximately two.

16. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of a thermally-stable carbonaceous material having a crushing strength of at least one and one-quarter tons per square inch, an R^2M factor less than five, a porosity between ten and fifty per cent, a blow pressure between three and fifty inches, an inking factor between three and three hundred, and a minimum ink absorption factor of fifteen-hundredths.

17. An inking roller for printing indicia on a sales slip, comprising a cylindrical member having at least its outer periphery portion composed of carbon and having a crushing strength of at least one and one-quarter tons per square inch, an R^2M factor less than five, a porosity between ten and fifty per cent, a blow pressure between three and fifty inches, an inking factor between three and three hundred, and a minimum ink absorption factor of fifteen-hundredths.

18. An inking roller for printing indicia on a sales slip comprising a cylindrical member having at least its outer peripheral portion composed of graphite and having a crushing strength of at least one and one-quarter tons per square inch, an R^2M factor less than five, a porosity between ten and fifty per cent, a blow pressure between three and fifty inches, an inking factor between three and three hundred, and a minimum ink absorption factor of fifteen-hundredths.

19. An inking roller for printing indicia on a

sales slip, comprising a cylindrical member having at least its outer peripheral portion composed of graphite having a crushing strength of at least three tons per square inch, an R^2M factor not exceeding five, a porosity of about twenty per cent, a blow pressure between six and twenty five inches, an inking factor between ten and twenty, and an ink absorption factor between one half and one.

20. An inking roller as set forth in claim 15, wherein the carbonaceous material is covered with a fabric sleeve of a closely woven fine thread.

21. An inking roller as set forth in claim 15, wherein the carbonaceous material is covered with a fabric sleeve, the fabric having a thread count of at least approximately 100 per inch.

22. An inking roller as set forth in claim 15, wherein the carbonaceous material is covered with a fabric sleeve of a closely woven fine thread, the circumferential threads being stronger than the axial threads.

23. An inking roller as set forth in claim 15, wherein the carbonaceous material is covered with a fabric sleeve of a closely woven fine thread, the circumferential threads being more elastic than the axial threads.

24. An inking roller as set forth in claim 15, wherein the carbonaceous material is covered with a fabric sleeve of a closely woven fine thread, the circumferential threads being of nylon and the axial threads of cellulosic material.

25. An ink roller as set forth in claim 2, further characterized in that said material has a crushing strength of several of tons per square inch.

26. An ink roller according to claim 25, further characterized in that said material is graphite.

27. An ink roller as set forth in claim 25, fur-

there characterized in that the inking factor is within the range of three to three hundred and near the lower end thereof.

28. An ink roller as set forth in claim 27, further characterized in that the porosity is within the range of ten to fifty per cent and near the lower end thereof.

29. An ink roller as set forth in claim 28, further characterized in that the ink absorption factor is at least approximate one-half and does not exceed approximately 0.94.

30. An ink roller as set forth in claim 29, further characterized in that the R^2M factor is at least approximately 0.083.

31. An ink roller according to claim 30, further characterized in that said material is graphite.

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