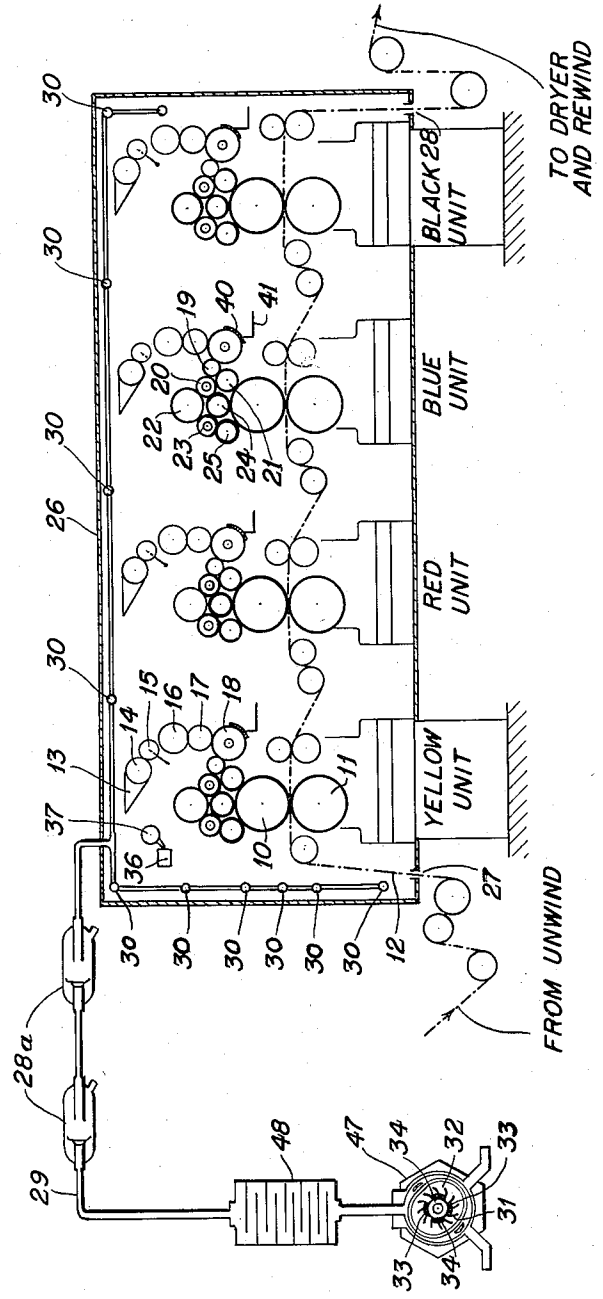
Feb. 21, 1961 A. E. GESSLER ET AL 2,972,301

PRINTING PROCESS AND APPARATUS

Filed April 6, 1954



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United States Patent Office 2,972,301
Patented Feb. 21, 1961

2,972,301

PRINTING PROCESS AND APPARATUS

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Filed Apr. 6, 1954, Ser. No. 421,242

8 Claims. (Cl. 101—426)

This invention relates to printing, in particular high speed printing of magazines and the like, and aims to provide an improved method of printing at high speed with inks which set or dry rapidly. It also aims to provide new inks for use in this process.

Until the early 1930's, typographic or lithographic inks used for printing webs of paper were of two types. For printing of newsprint and similar absorbent stocks, mineral oil inks were used; they dried by absorption of vehicle into the paper. For super-calendered and coated papers which were less absorbent, inks made with oxidizing oil vehicles were used. Because of the slow drying of these inks, printing speeds were low and a traveling tympan was run with the paper to prevent offset and smearing.

The advent of heat drying printing inks (see Gessler U.S. Patent No. 2,087,190) changed this picture radically, most particularly with respect to web typographic printing on papers less absorbent than news-stock (such as the super calendered and coated papers used for magazine printing). Prior to the instant invention, this has been done with heat drying inks, much of it at speeds well over 1,000 feet per minute, and much of it multicolor work. Such inks are characteristically based on solutions of hard thermoplastic resins in petroleum derived solvents which, at usual ambient temperatures, have vapor pressures below 0.05 mm. of mercury so that they evaporate very slowly on the press, but leave the printed films fairly rapidly when the printed paper is passed through one of the heaters with which these presses are equipped and which bring the temperature of the web to about 300° F. to 450° F. These solvent are characteristically paraffinic in nature, with boiling ranges between 450° and 600° F., and with vapor pressures of the order of 0.05 to below 0.005 mm. at 95° F. corresponding to the properties of normal paraffin hydrocarbons in the C_{14} to C_{18} range.

One difficulty with conventional high speed printing methods is that the high temperatures necessary to dry the ink are so close to the char point of the paper as to cause a reduction of the tensile strength of the paper. Where poorer grades of paper are used, or where the paper varies in quality from place to place in the web, this reduction of strength is sometimes sufficient to cause the web to break, with consequent loss of production time, and additional substantial paper waste. Furthermore, the paper may become so brittle that trouble is encountered in folding, stapling and binding the signatures. Hence, reduction of heat has been a prime need of the industry.

Another disadvantage of heat drying inks has been that as press speeds have gone up, it has been necessary to approach their lower limit of stability on the press by using solvents near the low end of range. As a result, on shut downs, when the ink is not being replaced continuously by fresh ink feeding down from the fountain, solvent evaporates, and the ink becomes tacky and unprintable. It has been necessary to spray the rollers with solvent after shut downs, so the press can be started

without breaking the web due to excessive ink tack. This produces large quantities of paper waste, since the mixture of solvent and old ink must be removed by the paper until fresh ink works its way down from the fountain. In web offset printing, where plate scumming and stripping may occur when the ink is too thin, this necessity for spraying is a major hazard.

When heat drying inks were first introduced, press speeds of 500 feet per minute were conventional. As press builders stepped up press speeds, the necessary faster ink drying was accomplished partially by improving the ink drying ovens, and partially by changes in ink formulation. The attainment of present day speeds of 1200 to 1500 feet per minute has brought ink formulation to the practical lower limit of ink stability on the press so that mechanical progress in increasing press speeds has been held up by the problem of ink stability.

Many attempts have been made to overcome the above difficulties, including using lower boiling solvents that would evaporate faster so that the ink could be dried faster. Although such inks do dry faster, it has been impossible to use them heretofore because they evaporate too rapidly on the distribution system of the press and cause prohibitive tacking up of the ink.

The expedient of enclosing the distribution system of the press has been suggested by a number of workers, both to reduce solvent loss by evaporation and to prevent contamination of the atmosphere surrounding the printing press by the evaporating solvent. It has been tried with both resin-solvent based inks, and with water emulsion inks. While the enclosed system has been highly successful in gravure printing where the printing roller revolves directly in the ink fountain, it has not proved satisfactory for conventional typographic or lithographic printing.

In such printing, the ink is picked up from a fountain by a roller, and is transferred to other rollers, alternately metal and rubber, to produce eventually on the plate an even film a few ten thousandths of an inch in thickness. Generally, between ten and twenty rollers are used. In each transfer of ink, the thin ink film is literally torn in two, part remaining on the original roller, part transferring to the next roller. The work done in splitting the film produces heat—temperatures up to 140° F. have been observed on uncooled presses, and temperatures of 90 to 100° F. can be observed on some presses even where the metal rollers are water cooled. During the splitting, the film is pulled into innumerable thin filaments of less than 1 mil diameter, and in this form is exposed, ten to twenty times, to the atmosphere around the distributing system, with a relative movement at press speeds equivalent to 15 to 20 miles per hour. This extreme exposure of the film has limited conventional typographic ink vehicles to very slowly evaporating solvents, even in closed systems.

We have discovered that it is possible to print on presses having extended distributing systems with solvent based inks which dry so much more rapidly than present day inks that even single impressions cannot be taken from an ordinary proof press. Our method permits the use of super fast inks whose vehicles comprise resin solutions in organic solvents with boiling ranges much below those of previous heat drying ink solvents, and, at ordinary ambient temperatures, whose vapor pressures and rates of evaporation may be 10 to 40 times that of the solvents in previous heat drying inks. Our inks preferably employ petroleum derived solvents with boiling ranges between 350° and 425° F., corresponding to commercial paraffinic fractions whose principal constituents can be ideally represented as n-hendecane and n-dodecane.

Our inks are not printable under ordinary ambient con-

ditions on typographic presses. According to our invention they are printable on such presses when the atmosphere surrounding the distributing system of the press contains a concentration of ink-solvent-vapor which is maintained in such relationship to the temperature of the ink film on the distributing system that the average ink film temperature does not exceed the dew point temperature of the solvent vapor of that atmosphere by more than a few degrees Fahrenheit, and preferably approximates that dew point temperature. We have discovered that we can maintain this relationship by feeding into the vicinity of the press distributing system air or other gas, free of suspended droplets, and containing such a concentration of solvent vapor that there is a tendency toward condensation on the distributing system rather than evaporation from the ink film. The distributing system is preferably enclosed, to conserve the atmosphere.

The atmosphere employed over the distributing system must be free of suspended droplets of solvent for two reasons. First of all, the explosion hazard must be considered. According to the recognized authority, the U.S. Bureau of Mines (see Bulletin 503, pub. 1952, page 68), the C_{10} to C_{12} hydrocarbons will not support combustion below 0.60 to 0.67% in air. The normal C_{11} hydrocarbon (n-hendecane) yields a concentration of 0.4% in air saturated with it at 120° F., 0.66% at 140° F. While we work at temperatures of 105° F. and lower, there is the danger that the concentration would increase to a point above the flammable limit if solvent droplets were permitted to be suspended in the air. Hence, it is necessary, in the interest of safety, to remove by filtration or baffling the suspended solvent droplets invariably present when saturating a gas with solvent vapor.

These solvent droplets would present a second hazard—if they would deposit on the ink, particularly on the form rollers or the plate, they would not become sufficiently incorporated into the ink and would cause uneven printing.

While it is most desirable to keep condensation at a minimum on the press in general, limited condensation on the traveling ink film is not objectionable since the ultrafine initial condensate combines smoothly with the ink film. Such condensation is minute in quantity and does not adversely influence the ink. However, condensation which produces droplets of solvent would cause the same hazards as droplets entrained in the air fed into the enclosure. Hence, we prefer to maintain the distribution system at a temperature lower than those of the press frame and the enclosure, so that condensation will not occur except where it is immediately absorbed into the ink film before droplet formation occurs by coalescence.

The process of our invention is useful with organic solvent inks wherever evaporation is a problem. For example, it will solve the problem of drying on shut down occurring with the more volatile previous heat drying inks. But to get optimum benefit from our invention, we prefer to employ solvents with evaporation characteristics essentially similar to normal paraffin hydrocarbons of 11 to 12 carbon atoms. If slower evaporating solvents are used, excessive heat must still be employed, while faster solvents introduce explosion hazards.

As indicated above, n-hendecane is a safe solvent, in the absence of suspended droplets. N-decane, however, crowds the explosive limits too close for safety—air saturated with n-decane at 100° F. contains 0.475% of decane, at 120° F. 0.855% and at 140° F. 1.58%.

The mixed paraffinic hydrocarbons commercially available in the C_{11}–C_{12} range contain, of course, some decanes, as well as some higher hydrocarbons. But they show practically no demixing when gasified under the conditions of use. As a result, we can use any paraffinic cut in the 350° to 425° F. boiling range, and get essentially the results obtainable with n-hendecane and n-dodecane.

While we prefer to use these petroleum distillates, our invention is applicable to other organic solvents, bearing in mind the problems of volatility explosion hazard, and resistance of the press rollers to the action of such solvents. For example, somewhat more volatile oxygenated solvents can be used, such as 2 ethyl hexyl acetate, since they have higher flash points with respect to their volatility, provided they do not attack the rubber compositions used in the rollers of present day high-speed presses.

Other solvents, such as naphthenic, aromatic and terpenic hydrocarbons, esters, ketones and the like, cannot be used on present day high-speed presses, only because they attack the rubber compositions used on the distributing rollers; they can be used with glue-glycerine composition rollers, with which some slower presses are equipped, provided they have the appropriate evaporation characteristics.

Our invention can be practiced with advantage in all of those printing processes, such as typography or lithography, in which the inks are of such character as to require distribution on an extended system of distributing rollers. It is useful in sheet fed presses, producing prints which will dry as they emerge from the press. But the greatest utility of the invention is in connection with high speed web printing, since it is in this field that it opens really new horizons. The invention can be used both for single and for multicolor printing.

To explain the invention more fully, reference should be had to the drawing, which discloses schematically a four color press set up for the practice of our invention.

The press comprises 4 separate units of substantially identical design, identified in the drawing by the color which is ordinarily printed by the unit. Each unit consists of a printing cylinder **10** having a printing plate mounted on it, and an impression cylinder **11**. A web **12** of paper is fed through the press by appropriate rollers.

Each plate is inked by a distributing system which comprises a series of rollers operating between the fountain **13** and the plate. The metal fountain roller **14** takes ink from the fountain, and transfers it to a rubber ductor roller **15**, to a metal roller **16**, to a rubber roller **17**, thence to the oscillating metal ink storage roller **18** which can be water cooled. A rubber idler roller **19**, takes the ink to the final stages of the distributing system, contacting both the cooled metal roller **20** and the form roller **21** which inks the plate; roller **20** is in contact with distributing roller **22** and form roller **24**; the water cooled metal roller **23** inks both the form rollers **24** and **25**.

The entire press structure is surrounded by an enclosure **26**, preferably of some material such as glass, "Lucite," or other transparent material; this enclosure is complete except for a slit **27** through which the web enters the enclosure, and a slit **28** through which the web leaves the enclosure. The enclosure is provided with appropriate hatches and doors so that, for example, a pressman can get at any fountain from the top of the press, or so that the press can be entered from the side for the purpose of changing plates and so on.

Means are provided for running air or other gas containing solvent vapor into the press. This may comprise, for example, a saturator **47**, in which solvent vapor is mixed with air or other gas. The solvent laden air, containing droplets, is passed through a baffle chamber **48** to remove the bulk of the droplets and then through a pair of mist eliminators **28A** of the centrifugal baffle type. The solvent-vapor-containing air, free of droplets and mist, passes through a line **29** into the chamber through ports **30**, so disposed as to distribute the solvent-vapor-laden air so that dilution from fresh air, carried into the enclosure by web **12**, will be kept at a minimum. To do this, the bulk of the ports are preferably placed near the point where the web enters the enclosure, providing at

such point the greatest possible amount of solvent-vapor-saturated atmosphere.

We have obtained solvent-vapor-containing air by bubbling air through a column of solvent, and by evaporating solvent into air; but a simpler way to get solvent into the airs is by using as the saturator **47** a liquid sealed compressor consisting of a vaned rotor **31**, operating in a liquid seal **32** of solvent. To pass from the inlet ports **33** to the outlet ports **34**, any gas fed into the compressor must pass through the liquid solvent, and thus it becomes substantially completely saturated with solvent vapor at the temperature and pressure in the pump chamber.

We provide means for determining the dew point of the solvent in the enclosure. For example, a water cooled etched or ground mirror **36**, with a temperature indicator **37**, can be observed. As soon as its reflectivity increases on account of condensed vapor, the mirror loses its frosted appearance and the dew point temperature can then be read off on the temperature indicator. Most preferably, a photoelectric system for indicating the first increase in reflectivity (the dew point) is used in combination with a resistance thermometer or a sensitive thermocouple, attached to the surface of the mirror. All readings can be made on instruments outside the enclosure.

We also provide temperature measuring devices **40** at one or more strategic points in the distributing system. These are connected, by electrical leads **41**, to registering devices outside of the press enclosure where the temperature can be read accurately. The registering devices are also, preferably, connected to controls which automatically keep the temperature of the rollers within a predetermined range. As shown in the drawings, these devices **40** may be mounted on the large oscillated water cooled roller **18**, known in this particular distributing system as the ink storage roller.

In the operation of the press, make-ready is preferably done with slow drying inks, with the press enclosure open. When the plates are properly adjusted and the make ready ink is removed the enclosure is closed, and air containing solvent vapor is blown into the press until the dew point indicator and the roller temperature indicators show the proper relationship. This may be accomplished by maintaining a temperature in the saturating compressor similar to that of the rollers. However, by cooling the rollers below the temperature of the atmosphere in the saturating compressor equilibrium can be obtained more rapidly, since complete saturation within the enclosure, at the higher temperature, is not necessary to establish the necessary dew point temperature-ink film temperature relationship. Printing is started when equilibrium is indicated.

During printing, solvent-vapor-saturated air is continuously fed into the enclosure to replace atmosphere which leaks out or is carried out by the moving web. A slight positive pressure is desirable in the enclosure. In the particular press enclosure shown, where the enclosure contains about 120 cubic feet of air, we supply solvent-vapor-saturated air from the compressor at the rate of one cubic foot per second, so that the atmosphere in the press is completely replaced about every two minutes. This constant sweep of atmosphere through the press has the added advantage that neither occasional mist, nor the often occurring minute droplets of ink which are thrown out by the rollers rotating at high speed, can accumulate in the enclosure to the point where they will produce a hazard.

As printing progresses, the press temperatures rise. The work done in splitting the ink film to distribute it manifests itself as heat. This work is proportional to the tack of the ink. In four color printing, the first ink printed must necessarily be tackiest, and the other inks become progressively less tacky. Hence, the temperature rise due to this effect is greatest on the yellow rollers in the press shown, least on the black.

At the same time, friction in the bearings produces heat, and causes the press frame to heat up. This effect may be less or greater than the effect due to the work done in ink distribution. In the specific experimental four-in-line press shown, frictional heat produced frame temperatures higher than roller temperatures on black and blue units, but lower than roller temperatures on red and yellow units.

As the temperature of the distributing systems rises, the dew point-press temperature relationship varies. Increase of the temperature in the saturating pump can maintain the relationship where only a single color is being printed, or even where two color work is being done with inks of not too dissimilar body. But in four color process work, the tack relationship is such that each distribution system will operate at a different temperature. For example, over a period of several hours in one experimental run with uncooled rollers, the black unit went up to 109° F., the blue to 112, the red to 113 and the yellow went to 119° F. Hence, it is necessary, in order to maintain the desired relationship, either to provide a separate enclosure and saturating unit for each distributing system, or, preferably, to cool the individual distributing systems at different rates.

In actual practice, we prefer to regulate the temperature of both the saturated atmosphere and the ink film in attaining our results. Maintenance of temperatures near or above body heat (98° F.) makes for uncomfortable working conditions. Similarly, cooling of the ink film even down to 60° F. poses real problems to a cooling system. Additionally, ink loses flow properties with decreasing temperatures, and flow can be obtained for low temperature work only by changes in formulation which may hurt the film properties. Hence, we stay in the working range by both cooling the distribution system and raising the temperature in the saturator, depending on the status of the system. With signals from the dew point indicator and the cooled rollers being fed into a control center, an operator can make his adjustments as indicated. The control center could be made automatic by connecting the necessary servomechanisms to the indicators, and to the temperature controls for the distributing system and the saturating compressor.

Instead of the temperature indicating device on the distributing system, it is possible to mount a tack indicating device on the distributing system, and arrange for a signal to indicate when the ink on the rollers begins to tack up—showing a change in equilibrium conditions. We find this type of device workable, but more cumbersome than the temperature indicating device, and slower in providing the desired controls.

In determining the controlling temperatures, which are those of the ink films, it must be borne in mind that available devices for measuring under dynamic conditions indicate roller temperatures, which are not identical with ink film temperatures. This difference is due to the heat developed by the work done in tearing the ink apart in distributing it; the heat is removed from the ink by the refrigerant in the cooled metal rollers, which must be cooler than the ink film.

In our control mechanism, we measure the temperature of the outer surface of a water cooled roller, and comparative tests made with a surface pyrometer immediately after shutting down the press indicate that the temperatures we measure while the press is in operation vary from the actual ink film temperatures. For instance, the ink film on the black unit may be from 2° to 5° F. warmer than the surface of the cooled steel rollers while the yellow unit may be from 10° to 15° F. higher, depending on time and speed of run, and tacks of the ink.

This greater tendency to heat up during printing, plus the fact that the tackiest ink has the greatest tendency to pick the paper, makes the first down yellow unit the most sensitive one in the operation of the press.

In order that our invention will be completely available to those skilled in the art, we will briefly describe a specific example of the practice of our new method.

The press was made ready, and the frame temperature determined to be 85° F. The temperature of the solvent entering the saturating compressor was maintained at 94° F.; the solvent-vapor containing atmosphere entering the enclosure, at six inches of water pressure, was 95° F. After ten minutes, the dew point temperature in the enclosure, as read at the yellow unit, was at 80° F. The inks of Example 1, infra, were placed in their respective fountains; cooling water was started through the rollers, and printing was started.

During printing, the surface temperature of the cooled rollers 18 was kept at 15° F. below the dew point temperature on the yellow unit, at 10° F. below the dew point temperature on the red and blue units, and at 5° F. below the dew point temperature on the black unit.

When printing started, the dew point temperature dropped a few degrees, due to the entrance of fresh air into the enclosure with the web. This can be compensated for by increasing either the temperature or volume of the solvent-vapor-saturated atmosphere being fed to the enclosure. In this instance, the rate of addition was such that the dew point was permitted to rise a few degrees. For instance, in a 30 minute run at 800 feet per minute, the dew point temperature first dropped from 80° F. to 77° F., and then rose to 82° F. We were able to dry these inks at a web temperature of only 200° F. and our printing results were excellent.

It is a feature of our invention that the balance which is maintained during printing can be preserved during the very different conditions which obtain when the press is temporarily shut down. During printing, the identity of the ink on the distributing system is changing constantly since it flows in a slow but steady stream over the rollers—the atmosphere in the enclosure is being constantly diluted with fresh ink—the ink is being heated by the work done in distributing it—and the multitudinous thin filaments of ink are being constantly exposed to the atmosphere. During shut downs, the ink stands still—no fresh air is being drawn into the enclosure by the web—and the ink is being cooled by the colder rollers, rather than being heated. We compensate for these differences by stopping refrigeration of the rollers, and by reducing the amount of new solvent-vapor-saturated atmosphere fed into the press.

When printing was interrupted in the course of the above-described run, the rate of feed of solvent-vapor-containing atmosphere was reduced to one half of the rate of addition during printing, to prevent undue condensation.

Despite these precautions, some condensation may occur on the water-cooled rollers since residual cold water remains in them after shut down. If the ink film has been maintained at approximately the dew point temperature during printing, this condensation is not objectionable, and we prefer to operate accordingly.

Besides providing means for operating presses more rapidly, for reducing paper waste, and for producing signatures with more desirable mechanical properties, our process has two other marked advantages. First, the finish obtainable with our inks is better than can be obtained by present day practice. This appears to be due to two reasons. One is that the inks with the lower boiling solvents can carry more of the gloss producing resin solids. The other is that far less penetration of the paper occurs with these faster drying inks. This latter characteristic also results in the use of substantially less ink.

The second marked advantage arises from economy in operating costs. Fuel bills for operating the drying units can be cut drastically, while the cost of saturating the air in the enclosure is a minor matter—thus, a typical solvent will require only ⅓ pound to ½ pound of a very inexpensive material per 1000 cubic feet of air for saturation at 90° F.

The foregoing description relates to a four color web press equipped with a single enclosure for all four printing units. It will be appreciated that this is illustrative and that other types of typographic or lithographic printing presses can be used in the practice of our invention. Presses are so dissimilar in design that each type of press must be enclosed with an eye to a maximum economy and utility for the particular press. In some types of web press, for example, it may be simpler and more economical to provide separate enclosures for each distributing system, rather than to enclose the whole press in a single chamber. In other cases, it may be desirable to enclose the distributing system and most of the plate, but to leave the point of impression outside of the enclosure. This eliminates the problem of the web passing through the enclosure, but involves drying of the ink on the exposed plate during shut downs, which may be easily remedied by cleaning the plate before resumption of printing.

As indicated, while our invention can be practiced to advantage with conventional heat-drying inks at the fast evaporating end of the scale, the inks we prefer to use do not, so far as we are aware, have any utility except in the practice of our process. These inks may be described as dispersions of pigments in solutions of hard resins in appropriate organic solvents. Illustrative examples thereof are as follows:

EXAMPLE 1.—SET OF PROCESS INKS

A—Yellow ink

Benzidine yellow	15.50
Pentalyn G (pentaerythritol ester of polymerized rosin)	46.10
Aluminum stearate	0.48
Oleic acid	2.86
Paraffinic petroleum solvent—principally hendecanes and dodecanes, boiling range 365 to 400° F., Kauri butanol value 32	35.06
	100.00

B—Red ink

Eosine red	17.00
Pentalyn G	47.18
Aluminum stearate	0.66
Oleic acid	2.83
Paraffinic Petroleum solvent—principally hendecanes and dodecanes, boiling range 365 to 400° F., Kauri butanol value 32	32.33
	100.00

C—Blue ink

Peacock blue	22.40
Pentalyn G	39.71
Aluminum stearate	0.66
Oleic acid	2.86
Solvent as above	34.37
	100.00

D—Black ink

Carbon black	13.98
Furnace black	3.68
Clay	19.50
Iron blue	3.03
Alkali blue in	0.56
Bodied linseed oil	0.77
Pentalyn G	26.45
Soya lecithin	1.89
Oleic acid	2.83
Solvent as above	27.31
	100.00

These inks had the following rheological properties (determined on a rotational viscometer at 30° C.).

	Viscosity (poises)		Yield Value (dynes per sq. cm.)	
	100 r.p.m.	200 r.p.m.	100 r.p.m.	200 r.p.m.
Yellow	132	101	1,410	1,920
Red	69	62	135	390
Blue	41	34	80	115
Black	32	23	390	540

EXAMPLE 2

Single color black—Limed rosin type

Carbon black	15.80
Furnace black	4.50
Clay	9.00
Talc	4.50
Wood rosin	29.65
Hydrated lime	1.91
Gilsonite	2.81
Stearine pitch	1.56
Solvent of Example 1	30.27
	100.00

EXAMPLE 3

Heavy-bodied single color black

Carbon black	10.0
Furnace black	8.8
Clay	14.0
Methyl violet	0.1
Oleic acid	0.3
6% limed polypale (polymerized rosin)	30.3
Gilsonite	3.3
Solvent of Example 1	33.2
	100.0

Viscosity 161 poises at 77° F. and 30 r.p.m.

EXAMPLE 4

Single color black

Carbon black	12.8
Furnace black	8.4
Clay	9.0
Methyl violet	0.1
Oleic acid	0.3
Pentalyn G	34.0
Gilsonite	3.7
Paraffin petroleum solvent—boiling range 350 to 375° F.	31.7
	100.0

This ink is at the fast end of our range. A similar ink, at the slow end of the range, would use a similar solvent with a boiling range of 400 to 425° F.

While we have shown only a limited number of inks, all made with petroleum solvents, it is obvious that a wide variety of inks can be used in our process. The binders may obviously be any film former which can be used with the particular solvent employed, and which gives a dry film when the solvent evaporates. It is necessary to use inks which will not swell the presently used rollers—hence, aliphatic petroleum solvents are preferred. But oxygenated solvents can also be used on most rollers; and presses equipped with special rollers, or with glue glycerine rollers, can be used with napthenic, aromatic and terpene hydrocarbons.

We claim:

1. The method of printing on a moving web of paper by a process in which an ink is distributed over an extended distribution system to a printing plate and in which the ink contains a volatile solvent which will cause the ink to dry up on the distribution system under ordinary ambient conditions, which comprises maintaining a concentration of ink solvent vapor in the atmosphere over the ink distribution system in such relationship to the temperature of the ink film on the distribution system that the ink temperautre does not exceed the solvent vapor dew point temperature by more than a few degrees centigrade, by preparing at a point out of contact with the distributing system a gas containing high concentrations of ink solvent vapor, and continuously feeding said gas to the vicinity of the distribution system at such a rate as to replace such gas as is removed from the vicinity of the distribution system by the action of the moving web and other causes.

2. The method of claim 1, in which the atmosphere about the distribution system is maintained by enclosing the distribution system, and the separately prepared gas is continuously fed into the enclosure.

3. The method of claim 1, in which the separately prepared gas is substantially free of suspended solvent droplets when fed into the enclosure.

4. The method of claim 1, in which the relationship is maintained by enclosing the distributing system, and by a combination of feeding into the enclosure gas containing high concentrations of solvent vapor and free of suspended solvent droplets, and by cooling the distributing system.

5. The method of claim 4, in which the distributing system comprises rollers and a frame therefor, and the rollers are cooled below the temperature of the frame.

6. The method of claim 1, in which the volatile organic solvent is an aliphatic petroleum distillate in the 350 to 425° F. boiling range.

7. An apparatus for printing with an ink containing a solvent of such volatility that the ink is unprintable from a press with an extended distribution system under ordinary ambient conditions, comprising a printing press with an extended distribution system, an enclosure for the distribution system of the press, means to mix gas with solvent which produces a mixture substantially saturated with solvent vapor and containing suspended droplets, means to remove suspended solvent droplets from the mixture, means to feed said mixture with suspended solvent droplets removed therefrom into the enclosure, and means to cool the distributing rollers of the press.

8. The apparatus of claim 7, having a dew point indicator in the enclosure, associated with means to determine temperature on the distributing system, to permit of maintenance of the temperature of the ink film in such relationship to the solvent vapor concentration in the enclosure that it never exceeds the solvent vapor dew point by more than a few degrees Fahrenheit.

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