PROGRESS OF KOMORI PSS - PLATE SCANNING SYSTEM

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Abstract: As the printing presses become faster and more productive, the reduction of the press idling time is greatly demanded throughout the industry. To build a printing press which can be operated by anyone, is also becoming necessary. Komori as a manufacturer of printing presses, have been developing and supplying numbers of equipment to meet the industry's demands. The PSS is just one of these equipments.

Background of development of PSS

Komori Printing Machinery Co., Ltd. has positively made development of printing press and peripheral devices in the past decade for improving the productivity. The largest background which necessitated such development was requests from customers to shorten the make ready time for printing and to take measures against drop in the capacity and ability of operators of lower age levels. But Komori has been wrestling with such development also as a step toward evolution to fully automated printing presses through application of mechatronics, which is the fusion of mechanism and electronic technology, to printing presses as needed by the age.

In this period Komori announced Komorimatic, PQC, Lithrone Series, high speed web offset press series, PSS, CARS, KPS-3, PDC, PAC, KMS and so forth and constructed Komori Printing Total System (see Fig. 1) which is a comprehensive system which incorporates these achievements. (Komorimatic: Komori continuous dampening system, PQC: Print Quality Control system, PSS: Plate Scanning System, CARS: Computerized Auto Register System, KPS-3: Komori Pin Register System, PDC: Print Density controller, PAC: Print Aqua Controller, KMS: Komori Monitoring System)

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In the announcement of this time, PSS, which was developed with sortening of the make ready time and simplification of color matching, is focused in this total system.

Planning for development of PSS was commenced for utilization of various remote control functions (ink key set, ink feed set, water feed set, etc.) obtained with PQC and the function of conditions recording, reproduction and preset using a magnetic card to automation. Then, operatability, contents of functions, etc., were determined with application to Komori's printing presses only as a precondition. As a result, such a configuration that permits use of PSS without alternation to PQC or printing press and without addition of ancillary equipment.

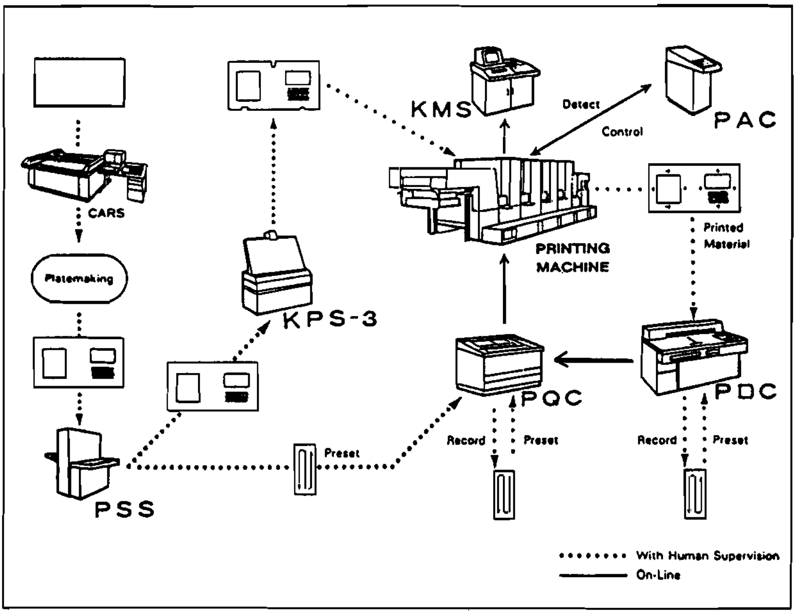

Fig. 1 Komori's Total Printing System

Outline of mechanisms and functions of PSS

The mechanism of PSS is as shown in Fig. 2. It can be roughly divided into camera unit that reads the pattern, illumination unit for the plate surface, drive unit that causes the PS plate to move, control unit which controls these functions and the operation unit for manual setup of conditions, etc. by the operator.

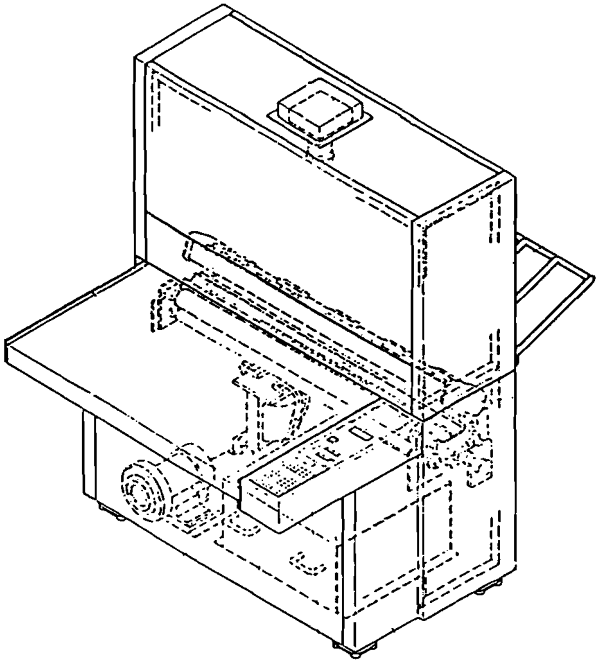

Fig. 2 Illustration of PSS

The PS plate to measure is inserted along the guides from the front side of the equipment. It is then move into the equipment interior by the operation performed by the operator, and measurements are then executed. The PS plate is returned when measurements with all faces are completed. Preparation for output of necessary data is completed when measurements with plates of the necessary number are executed. When a magnetic card is inserted into the card reader in this stage, data is recorded on the card and the card is returned. It is also possible to have the data same as what was recorded on the magnetic card printed on a paper tape, if necessary. Ink preset is completed when the data on this magnetic card is input to the PQC and the required operation is performed by the operator.

The flow of operation and processing with this PSS for measurements and output of data is as follows. (Fig. 3)

Technology which permits measurement at high accuracy and the accuracy in practice

The technological aspects applied to PSS for permitting

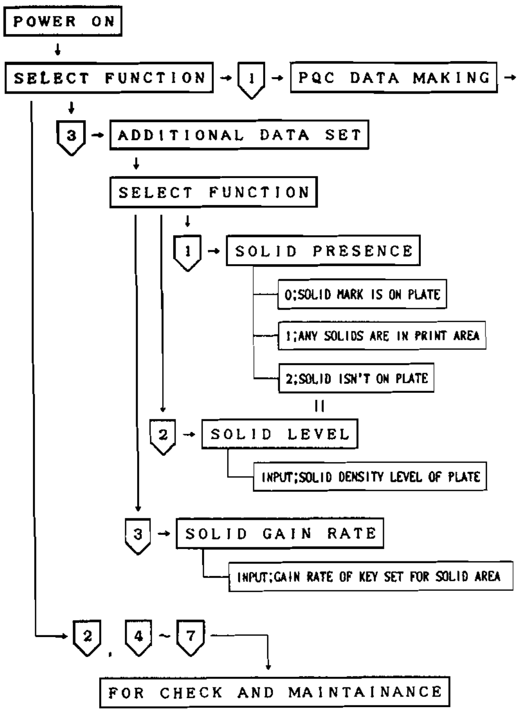

Fig. 3 Flow of Operation

measurements at high accuracy are described in this section.

One of the features of the mechanism of PSS lies in the sensor. A CCD (charge coupled device) Area image sensor (Fig. 4), which was used for portable TV camera and so forth in those days, was used in the early stage of development. It was a sensor of the highest class available in those days and it picked data with the printing area of a PS plate decomposed to 90,000 elements. It made binary coding (into black and white) of the reflected luminous energy per element at a certain level and it produced the area ratio as added by the ink key width for the black portions only.

Even with this method the measured values were of the accuracy of about 5% in the relative error, and results which are almost satisfactory were obtained with patterns of area ratio over 10%. It was confirmed that the results of measurements at solid areas are of extremely high accuracy. With this resolution, however, the measuring accuracy could not be increased for patterns, characters, etc. of extremely small areas. Accordingly, the currently sold type was deve-

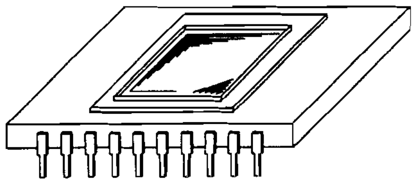

Fig. 4 CCD Area Image Sensor

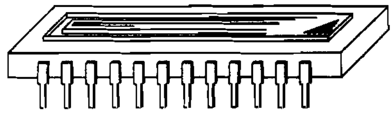

Fig. 5 CCD Linear Array Image Sensor

loped. This type makes use of a most updated CCD linear array image sensor (Fig. 5), and measurement is taken with one line in the lateral direction as divided into about 2,000 elements. In the circumferential direction, measurement is taken with one line at a time sequentially as divided into about 1,000 times as the PS plate moves. As a result a pattern is divided into about two million elements. In addition, it is possible to measure the reflected luminous energy as divided into a number of levels for each one of these elements. We presume you will understand the value of the area ratio obtained as a result is of high accuracy because measurements are taken precisely to a high accuracy. Typical measured data indicating high accuracy are shown below. (Fig. 6 - 9)

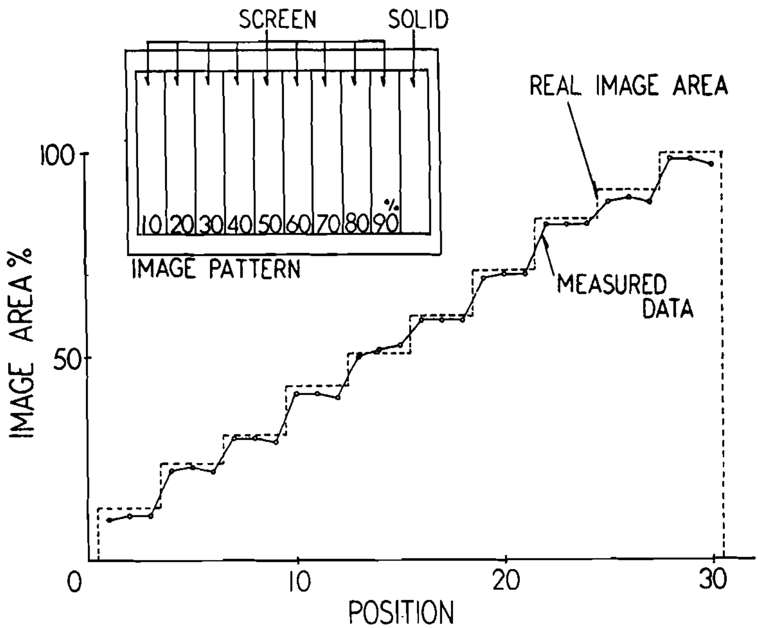

Fig. 6 Measured Data of Screen Image

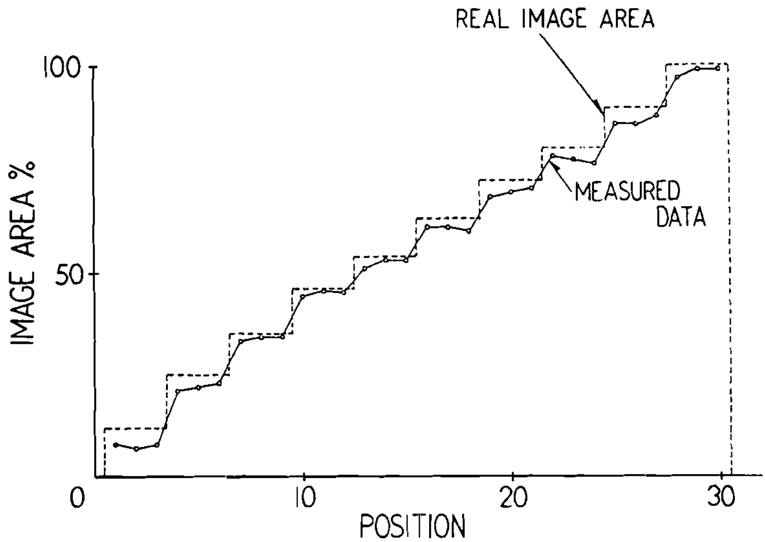

Fig. 9 Measured Data of Solid Image
(Pink Plate-II)

As these data indicate, the measuring accuracy is extremely high. To this accuracy, however, the technologies described below also makes major contribution in addition to the sensor itself.

One is method for calibration. This calibration is for recording in advance irregularity of illumination, irregularity in sensitivity with each element of the camera and so forth and for minimizing the errors caused by irregularity in the practical measurements. A PS plate, from which photosensitive material was completely removed, was used in the early stage of development. (Fig. 10) In other words, this PS plate was set in the measuring position, measurement identical to usual measurement is taken with it and this state was used as the blank. The problems of calibration using this method or using an always set reference plate are surface contamination and variation of concentration. As the reflected concentration with a blank varies as a result, many errors are included in the finally measured values. Particularly in the case where the reflected concentration with the blank is high, almost all areas of low percentage levels become zero in the area measurement in practice. In the case where the reflected concentration of the blank is low, on the other hand, percentage of a certain extent is measured even at the area without any pattern. All of them become errors. (Fig. 11)

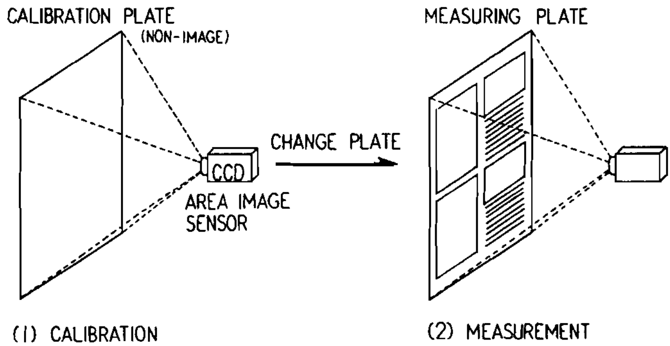

Fig. 10 Calibration of The Past PSS

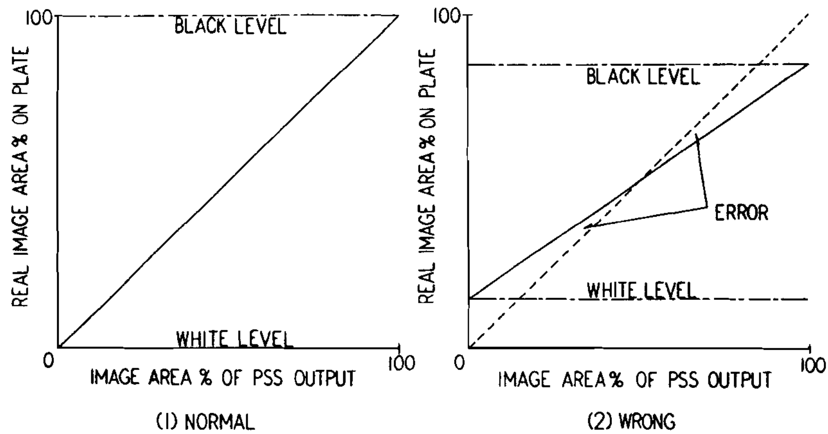

Fig. 11 Error Data

In order to minimize these errors, Komori considered implementation of calibration by the PS plate, which is used for printing in practice, itself. The contents are described below.

Even with a PS plate on which a pattern was exposed, spaces for clamping and spaces in the areas outside of printable area are always remaining, and usually these spaces are not coated with photosensitive resin. Further, since plate ends are clamped, they do not touch the ink roller, and even if there may be a pattern of a certain extent at plate ends, they will not exert adverse effect. Komori, therefore, decided to use the tail end of the PS plate for calibration. PSS sequentially measures lines of width about 1 mm from the tail end of the PS plate toward the gripper end. A solid area is produced at a specified position at the tail end of the PS plate (Fig. 12) and a reference value for 100% solid is obtained in this area. An area without pattern will appear as measurement advances, and the reference value for 0% blank is obtained here. The mean value of values measured at a number of elements is adopted for the data naturally. In addition, data is obtained for the irregularity of illumination in the lateral direction for the 0% blank area. Calibration is completed with these data, and practical measurement begins in this state. (Fig. 13) As a result of employment of this method, calibration is made each time before measurement is taken, and accordingly, it has become possible to take measurement at an extremely high accuracy level without being affected by contamination of PS plate or by the dispersion among production lots.

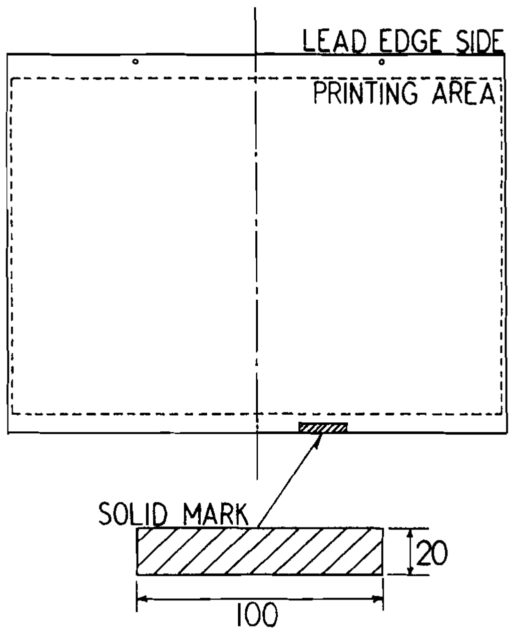

Fig. 12 Solid Mark Position and Size on Plate

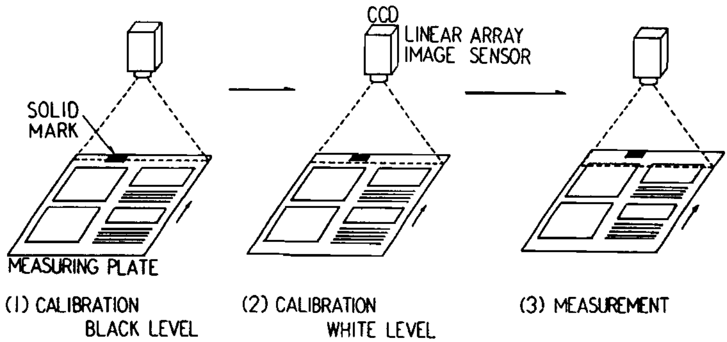

Fig. 13 Calibration of The Latest PSS

Illumination equipment is also one of the factors having strong relation with the measuring accuracy. Komori adopted a halogen lamp for illumination because of the following reasons.

1. High illumination intensity is obtained. (about 7,000 lux)
2. The service life is long (about 2,000 hours) and the brightness remains unchanged until about the time when the service life matures.
3. There is no case where it exerts adverse effect over the PS plate at the time of measurement because it has the main wavelength (about 1,000 nm) besides the photosensitive wavelength area (200 - 450 nm) of the photosensitive resin on the PS plate.
4. Small size and light weight.

Particularly in the measurement of low percentage areas, the level of luminous energy and the accuracy of measured data have a close relation, and the reliability of the measured data is low with low luminous intensity. PSS permits measurement to high accuracy with a halogen lamp of high brightness.

The accuracy of movement of the PS plate in the circumferential direction also exerts influence over the measured data. Komori's PSS is of such a system that the camera is kept fixed and the PS plate moves, and unless the PS plate moves with stability, troubles such as double measurement and variation of measured length will occur. Further, if the PS plate moves in the radial direction, focusing is not suitably made and the accuracy of the measured data drops as a result. PSS adopts a conveying means using a special roller (Fig. 14) in order to cope with this problem. The

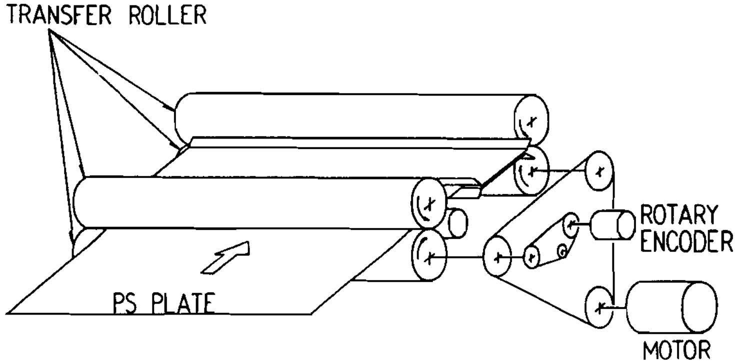

Fig. 14 Mechanism of Plate Loading

plate travel is detected with a rotary encoder attached to the roller, and timing of measurement and so forth are controlled in accordance with the data from this rotary encoder. Measurement at high accuracy with every line is taken with this mechanism.

Area ratio to ink fountain key opening conversion tables

One of the features of PSS is that data can be fed directly to PQC using a magnetic card, to which data was loaded from the PSS, without using a converter. It is because PSS has built-in tables of relation between the area ratio and the ink fountain key opening. These tables are what was obtained through many tests, and tables are provided for every different press model incorporating PQC. We would like to lay particular emphasis on that conversion tables of two types, i.e., a table for screen and a table for solid.

Komori, through tests, found that ink of a fixed volume is required for printing solid of an area ratio of a low level and it is considerably larger than the ink volume required for printing screen of the same area ratio. From this result Komori felt the necessity of measurement of a solid area in the measurement of area ratio the pattern on a PS plate, and accordingly, developed the equipment providing the function to measure a solid area. Furthermore, Komori prepared tables of two types for conversion into the ink fountain key opening in order to permit output of values of ink fountain key opening which correspond to a pattern of mixture of screen and solid through special arithmetic operation. The following graph is an example. (Fig. 15)

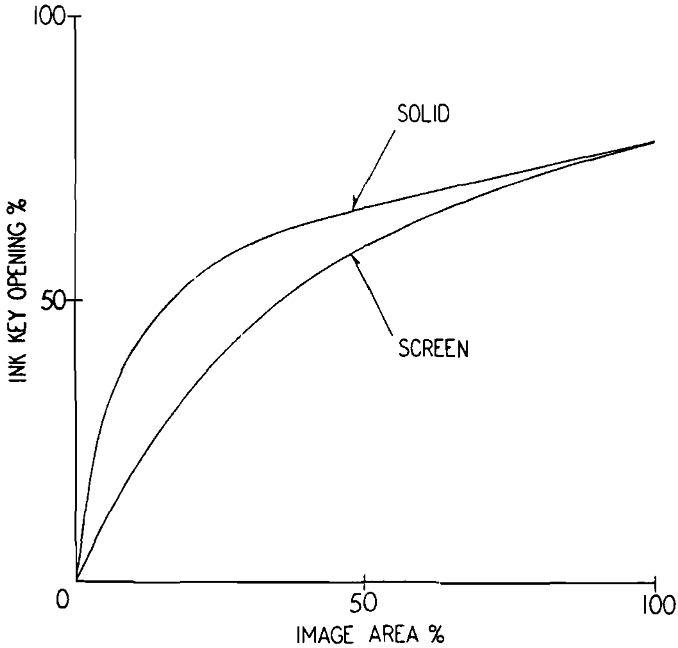

Fig. 15 Table: Screen and Solid

Furthermore, tables are prepared for each color because the optimum ink volume varies by the color. A graph shown above is an example. (Fig. 16) Komori also discovered that the number of times of application of printing pressure varies by the printing sequence of colors and that the table vary accordingly. Such tables are also incorporated. (Fig. 17) It is understood that the relation between the area ratio and the ink fountain key opening becomes linear as the number of times of application of the printing pressure increases. Tables produced out of the relation between the ink volume and the printing concentration by the paper type are also prepared in addition. (Fig. 18) With non-coated paper the ink foundation key opening is larger compared to coated paper because it absorbs ink of a larger volume and also because ink concentration hardly increases on non-coated paper.

Ink preset of high accuracy is permitted in the practical use because arithmetic operation is performed in a number of stages using these tables, for conversion of the area ratio into the ink foundation key opening. Furthermore, such a table that causes automatic increase of the ink fountain feed and decrease of the ink fountain key opening when the

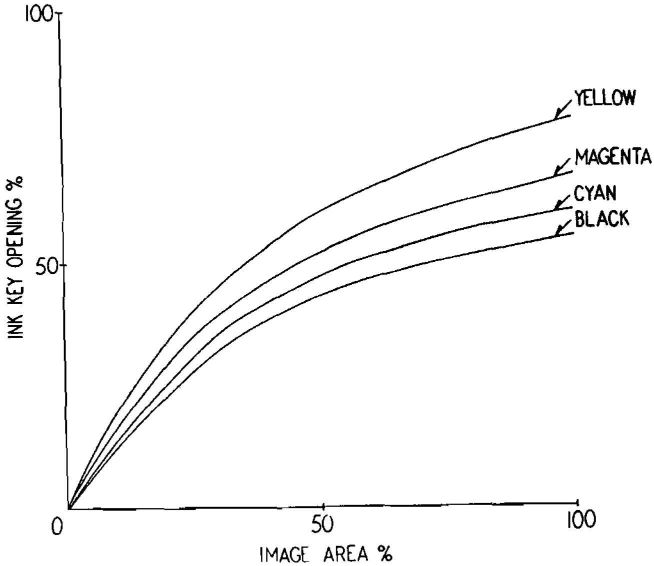

Fig. 16 Table: Ink

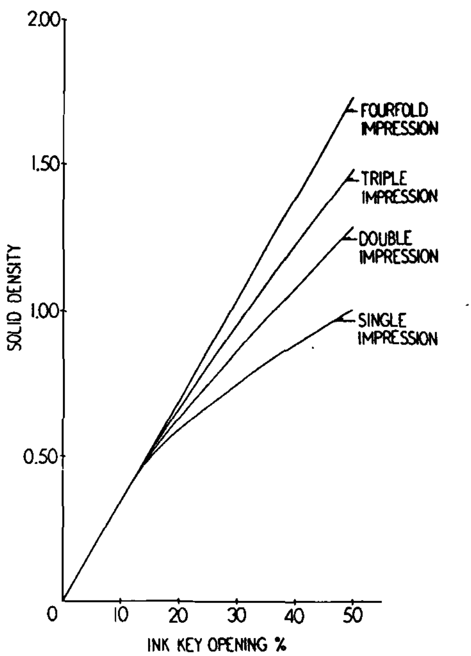

Fig. 17 Table: Number of Impression

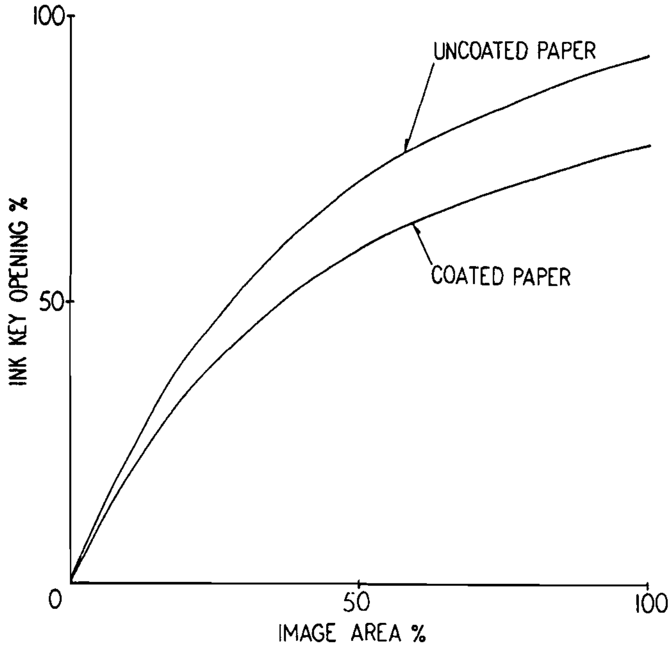

Fig. 18 Table: Paper

ink fountain key opening exceeds a certain level is also provided so as to match various printing conditions.

Factors which make ink preset unstable

Even if the accuracy of PSS has been improved many different aspects, there are cases where PSS is not capable of exhibiting its performance in the practical use because of various factors which make ink preset unstable. The factors of instability located outside of the PSS are described below.

Since PSS is an ink presetting equipment, its evaluation is naturally made by the concentration of the printed ink. However, it is known that this concentration involves extremely many varying factors. These factors are shown in the following table. (Table 1)

The data produced out of PSS is what has been set under specific standard conditions, and the desired accuracy cannot be obtained when deviation from the setting occurs. What are particularly important for obtaining high accuracy are, normal conditions as a printing press first of all,

- DENSITY VARIATION
  - CIRCUMSTANCE
    - TEMPERATURE
    - HUMIDITY
    - AIR BLOW DIRECTION
    - ETC.
  - PRESS CONDITION
    - ROLLER SETTING
    - PRESSURE SETTING
    - PRINTING UNIT
    - OSCILLATION SETTING
    - ETC.
  - PRINTING
    - PRINTING SPEED
    - MAKE-READY TIME
    - PRINTING SEQUENCE
    - ETC.
  - PRE-PRINTING
    - SCREEN RULING
    - UCR
    - EXPOSURE TIME
    - ETC.
  - MATERIAL
    - PLATE
    - INK
    - BLANKET
    - PAPER
    - FOUNTAIN ADDIVE
    - ROLLER
    - ETC.
  - OPERATOR
    - SKILL
    - FATIGUE
    - ETC.
  - PROBLEM
    - DOUBLING
    - GHOSTING
    - DOT GAIN OR LOSS
    - BAD TRAPPING
    - COLOR VARIATION
    - ETC.

Table 1 Factors of Density Variation

stable environmental conditions, fixed materials conditions and fixed printing conditions. A number of these conditions are described below.

As a printing press, it is required that setting of rollers of the inking units and dampening devices is correct and that setting of the printing pressure is normal. The reason is that, if setting of rollers and so forth is wild, normal transfer of ink and dampening water is not accomplished. Furthermore, if there is despersion in the setting of rollers between the right-hand side and the lefthand side, the ink that is fed out of the ink fountain is not correctly delivered to the specified position on the printing face.

Environmental conditions include variation of conditions of ink and variation of conditions of dampening water caused by temperature. The preset accuracy drops when delivery of ink and dampening water to the plate surface varies. In addition, when temperature and humidity change, the evaporation rate of dampening water on the plate surface varies, and as a result, changes occur in the supply of dampening water and in the degree of emulsification, and the accuracy drops.

Among the materials, the problem of the ink itself is the largest. When ink of varied concentration level with the same volume is used by a number of types, the preset values change at each occasion. Further, with ink of different physical property values such as tack value, it is not favorable becuuse the ink transferability varies. Changes in the ink transferability caused by secular changes to blankets and rollers also cause a drop in the preset accuracy. If the exposure time to the PS plate is unsuitable, the area ratio with the proof is not matched with the area ratio measured with PSS, and the preset accuracy drops as a result.

Printing conditions involves the problems with the operator in the preparation for printing. The preset accuracy will drop to a major extent when ink is unnecessarily emulsified because of use of excessive length of time for register adjustment or when the dampening water supply rate is unnecessarily increased.

Conditions for skillfully using PSS

The factors of instability described earlier are tolerated to a certain extent. The best conditions are basically desirable, but PSS and PQC are provided with functions which are capable of compensating for variation as the case may be.

One of these functions is "SOLID GAIN RATE" provided for PSS. This is the function to automatically perform arithmetic operation of increase/decrease in the range of 20% to the ink fountain keys including solid portions. It is used in the case where it is wanted to further increase the concentration of solid portions.

The second is the "M-1 MODE" with PQC. This function is to increase or decrease the overall concentration by multiplying a certain coefficient to the ink fountain key opening data produced out of PSS. It is the function provided in order to cope with all of the variation of concentration resulting from printing materials and standard concentration setup unique to each individual printing company.

The ink preset capacity and accuracy of PSS obtained in practice at printing companies by the use of these functions are highly evaluated.

In the aspect of measurement, basically it is necessary for improving the accuracy that a solid mark is provided at the tail end of the PS plate. Because it permits accurate setup of a reference for 100%. However, measurement is permitted without a solid mark as the case may be. In such a case it is satisfactory if the level of concentration of the solid of the used PS plate, and depending on its accuracy, it is possible to take measurement identical to that with a solid mark. In order to make accurate measurement with stability, however, it is the best to provide a solid mark.

As for the conditions of the printing press, it is necessary that setup of reference 0% of ink fountain keys, setting of roller nip and setting of printing pressure between cylinders are of standard levels.

Conditions which cause a drop in the measuring accuracy

PSS is a system which permits measurement to an extremely high accuracy level. However, it does have a limit because it takes measurement through specific optical and electronic processing. This point is described below.

The majority of photosensitive resin layers on the PS plates used in Japan are of green color. Outside of Japan, however, there are photosensitive resin layers of many different colors. In the process of development of PSS, therefore, Komori gathered PS plates produced by a number of companies having high share levels in the world market and examined these PS plates. Komori also made examination of these PS plates subjected to burning treatment, waterless plates, wipe-on plates, trimetal plates, etc. Their colors were diversified as blue, green, pink, orange, brown, red, etc.

Illumination, sensor, filter, etc. were selected for PSS as most universal devices. As a result, it has been varified that the measuring accuracy drops with the following PS plates.

As for the problem of color, the measuring accuracy drops and the error increases with colors in which red is predominant, that is, orange and pink for instance. The accuracy also drops with waterless plates. In the case of waterless plates it is considered that the fact that their nonprinting areas is not grained aluminium also affects drop in the measuring accuracy.

As for the problems in the plate producing method, the measuring accuracy drops with home-made plates of unstable quality such as wipe-on plates and trimetal plates. Irregularity in the resin color and coating in the printing area and irregularity in the grain of the plate materials can be raised as the reasons for it. Even with a PS plate, if it has been exposed and local discoloration has occurred, errors will result in the subject area.

The developing ink for storing plates also causes occurrence of printing errors unless coating is equally made. With gum arabic, no problem occurs if coating is made by a machine, but if coating is made manually, errors may occur due to irregularity.

With a burned plate, large errors will occur if the burning irregularity is large.

Even with a PS plate which is free of the conditions stated above and which conforms to the measuring conditions of PSS, if the plate surface is contaminated, the error increases at the contaminated point or area. If the area used for calibration is contaminated, errors occur in the entire measurement. Particular attention, therefore, is required to contamination.

Measurement with PSS is executed to an extremely high accuracy if consideration is made to the points indicated above.

Situation of use of PSS in Japan

The functions and other factors of PSS have been explained. Finally, the situation of use of PSS is described below. PSS of about 250 sets have been shipped to the world market by this time, and their approximately 60% are used in Japan. When use of PSS is observed as the penetration rate to users of Komori printing presses with PQC, the figure of approximately 65% is obtained. It is anticipated that this figure will grow in the future.

Exhaustive rationalization is required at printing companies in Japan because of low unit prices of printing. Shortening of the makeready time has large meaning for rationalization at printing companies, and interests of users are concentrated to this point. An user, who is extremely enthusiastic in the research activities, reached an achievement of completion of makeready with a 44 inch 5-color press in 13 minutes by making use of his own knowhow and Komori's total system. What constitutes the nucleus of this achievement is ink preset with this PSS.

It is considered that such a trend will become stronger in the future, and it is also considered that such a trend is a trend in the world which is not limited to Japan. Under these circumstances Komori intends to continue research and development in order to make further contribution to this trend through seizure of new items to be added to Komori's total system.