July 8, 1947. W. S. COCHRAN 2,423,553

PROCESS OF PRINTING FROM A COMPOSITE HECTOGRAPHIC FORM

Filed April 1, 1943 5 Sheets-Sheet 1

FIG. 1.

JOB NO. 6-1034	
PART NO. 17298	
QUANTITY 400	
ORD. 1/29	WTD. 2/10

FIG. 2.

10

MODELS USED ON

PART NAME & MATERIAL Hub and Plate S.A. Chg. Acct. No. 611

PART NO. 17298

SHOP ORDER Mfg.

ADDITIONAL MATERIAL SPECIFICATIONS

ADDITIONAL SHOP INSTRUCTIONS

OPERATION NO.	MACHINE	OPERATION DESCRIPTION	STD. HRS. ALLOW.	TOLERANCES (+) (-)
A-10	Punch Press	Assemble and Swedge	.0025	
A-20	Drill Press	Ream Hub after Swedging	.0042	

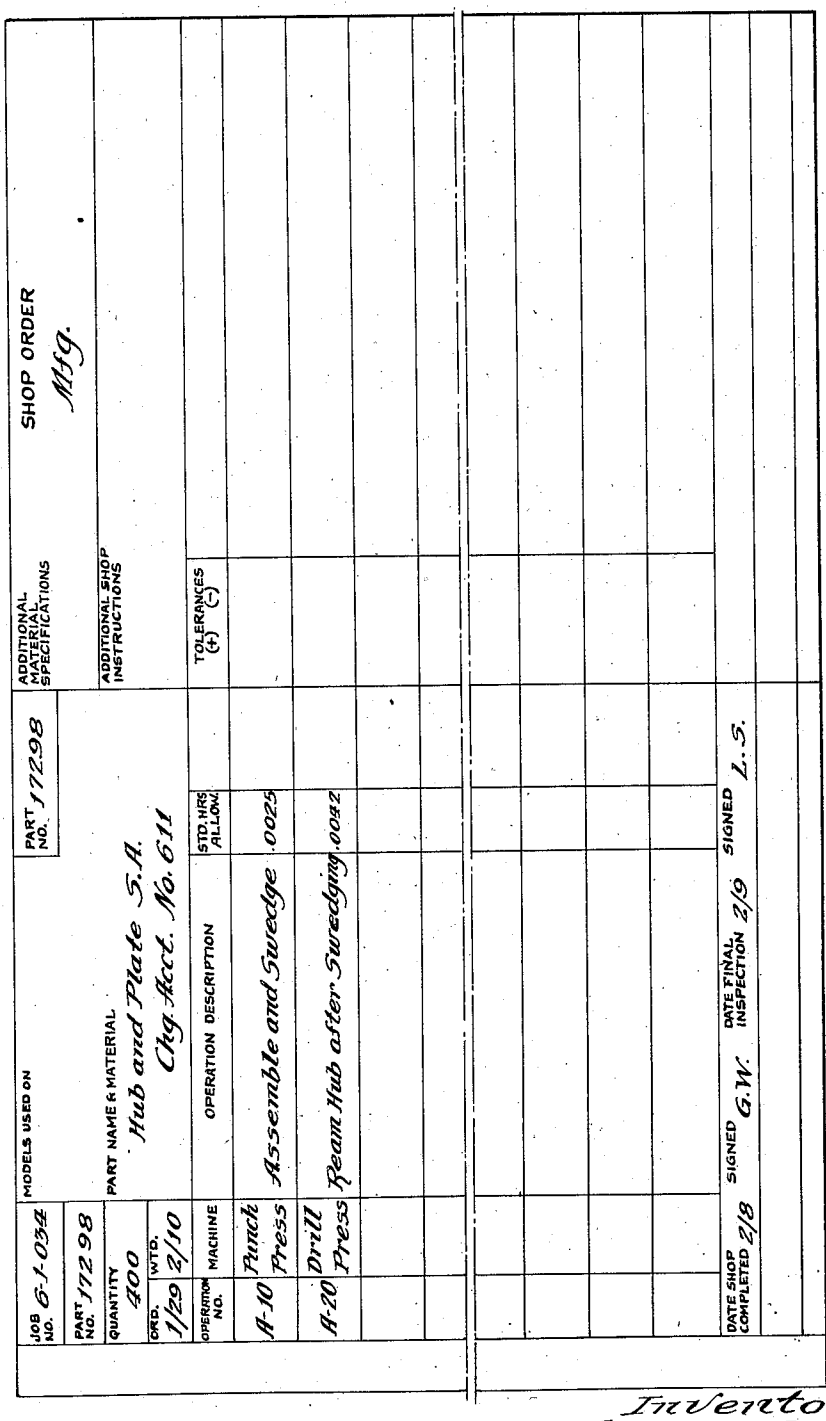
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PROCESS OF PRINTING FROM A COMPOSITE HECTOGRAPHIC FORM

Filed April 1, 1943 5 Sheets-Sheet 2

FIG. 3.



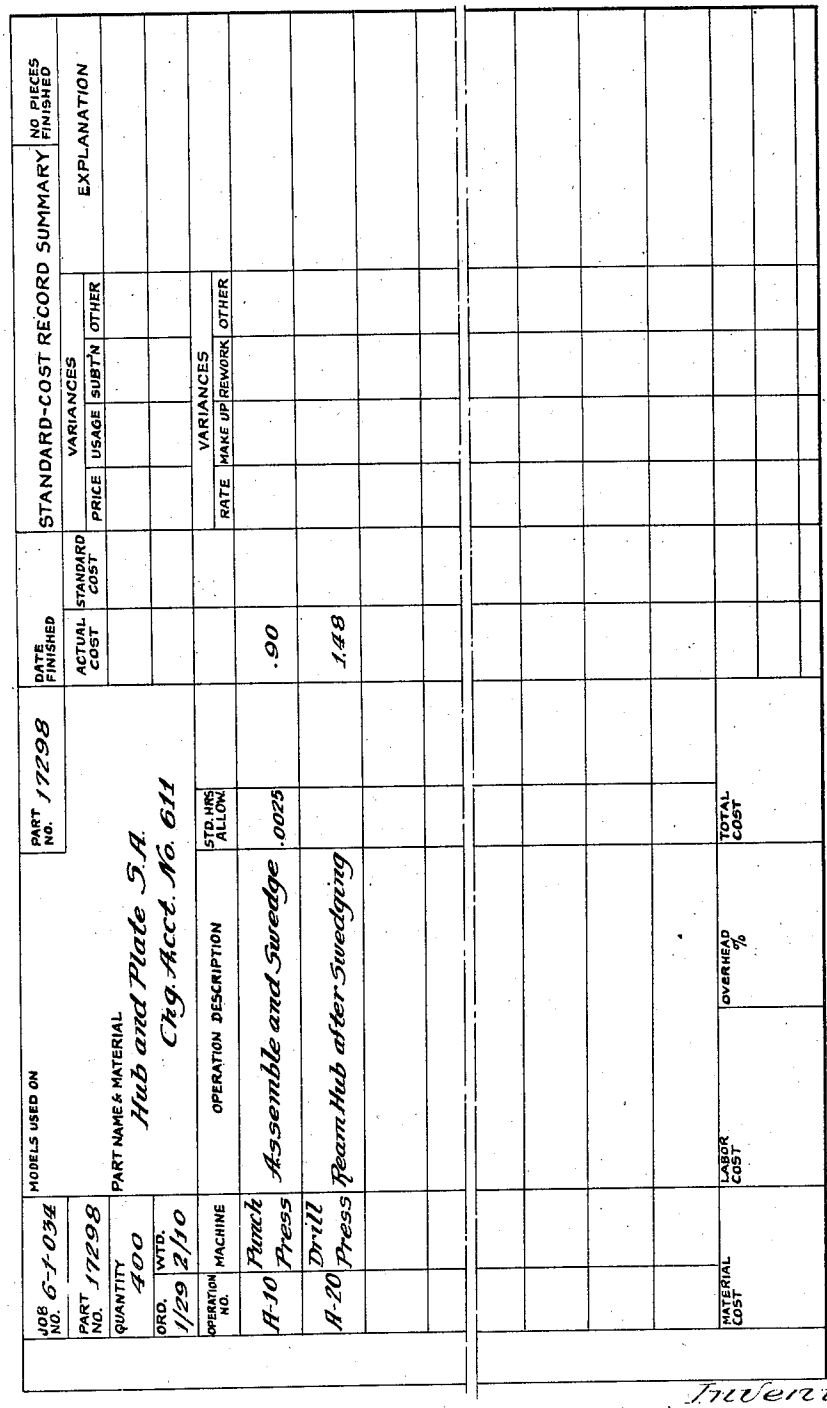
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PROCESS OF PRINTING FROM A COMPOSITE HECTOGRAPHIC FORM

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FIG. 4.



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PROCESS OF PRINTING FROM A COMPOSITE HECTOGRAPHIC FORM

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FIG. 5.

OPERATORS CARD

JOB NO.	MODELS USED ON	PART NO.	CLOCK NO.	DATE	NO. PIECES FINISHED
6-1-034		17298	614	2/5	220
PART NO. 17298			685	2/6	180
QUANTITY 400	PART NAME & MATERIAL Hub and Plate S.A. Chg. Acct. No. 611				
ORD. 1/29	WTD. 2/10				

OPERATION NO.	MACHINE	OPERATION DESCRIPTION	STD. HRS. ALLOW.
A-20	Drill Press	Ream Hub after Swedging	.0042

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FIG. 6.

JOB LABOR CARD

JOB NO.	MODELS USED ON	PART NO.	ELAPSED TIME	CLOCK NO.
6-1-034		17298	.75	614
PART NO. 17298				OUT 4:50
QUANTITY 400	PART NAME & MATERIAL Hub and Plate S.A. Chg. Acct. No. 611.			IN 3:75
ORD. 1/29	WTD. 2/10			OUT

OPERATION NO.	MACHINE	OPERATION DESCRIPTION	STD. HRS ALLOW.	PIECES FINSH'D	HRS. EARNED		
A-20	Drill Press	Ream Hub after Swedging	.0042	220	.924	IN	
						OUT	
						IN	

RATE	EARNED TIME	OPER. NAME
.90	.92	Wm Thoman

CLOCK NO.	AMT. OF PAY	STD. COST	% PERFORM	RATE	MAKE UP	REWORK	OTHER	EXPLANATION	PART NO.	OPER. NO.
614	.83	.83	123	.90					17298	A-20

11

FIG. 7.

ALLOWED TIME	ALLOWED AMOUNT	ACTUAL TIME	ACTUAL AMOUNT	% BONUS	ALLOWED TIME	ALLOWED AMOUNT	ACTUAL TIME	ACTUAL AMOUNT	% BONUS
.92	.83	.75	.68	25					
2.97	2.67	2.38	2.14	25					
6.22	5.50	4.87	4.38	25					

DAILY SUMMARY ATTENDANCE CARD

8	OUT	5:00 Feb. 5
	IN	8:30 Feb. 5
	OUT	
	IN	
	OUT	
	IN	
TOTAL ELAPSED TIME		

15

TOTAL TIME	BASE RATE	EARNINGS HOURLY	BONUS	OVERTIME	TOTAL GROSS	% BONUS	CLOCK NO.	NAME
10	.90	7.20	1.80		9.00	25	614	322-01-0875 F.L.S.A. Wm Thoman

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PROCESS OF PRINTING FROM A COMPOSITE HECTOGRAPHIC FORM

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FIG. 10.

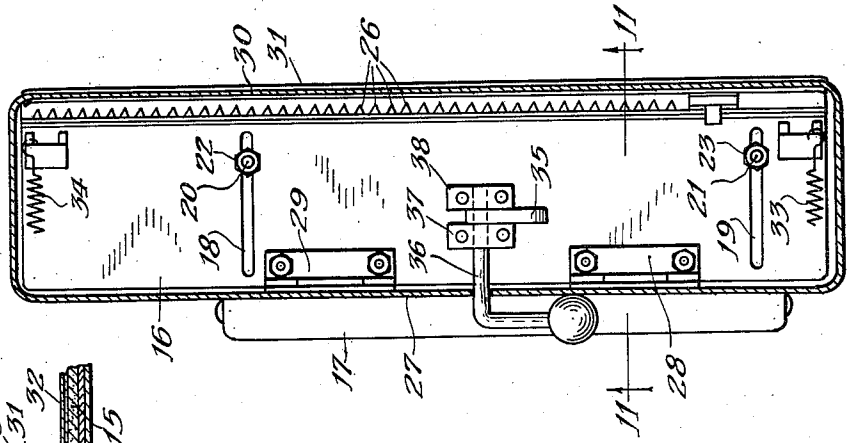


FIG. 11.

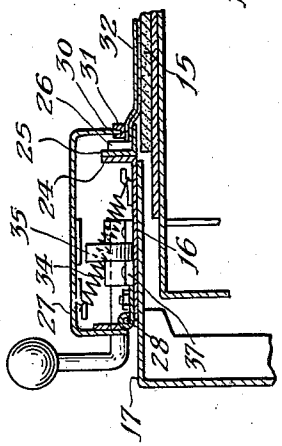


FIG. 9.

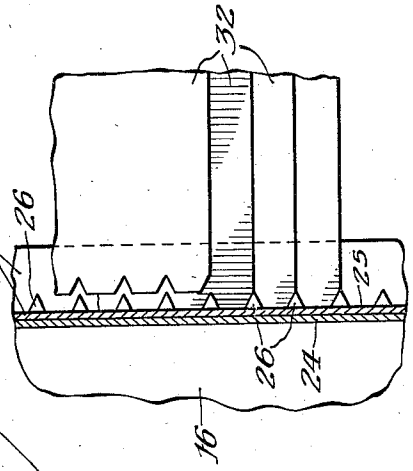
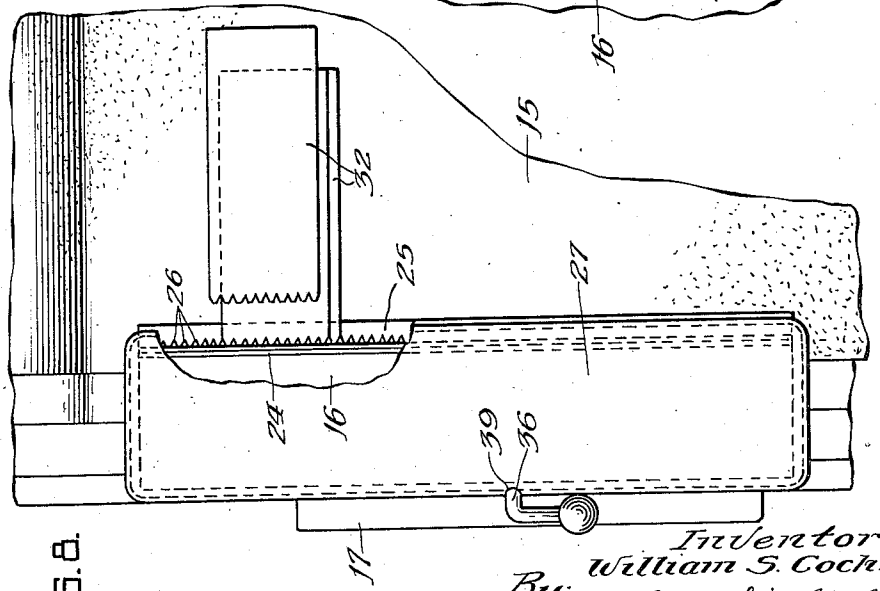


FIG. 8.



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Patented July 8, 1947 2,423,553

UNITED STATES PATENT OFFICE

2,423,553

PROCESS OF PRINTING FROM A COMPOSITE HECTOGRAPHIC FORM

William S. Cochran, Evanston, Ill., assignor to Ditto, Incorporated, Chicago, Ill., a corporation of West Virginia

Application April 1, 1943, Serial No. 481,463

2 Claims. (Cl. 101—149.4)

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The present invention relates particularly to the scheduling and control of production in a manufacturing plant. It has for its principal purpose the provision of a system of record keeping devices that are particularly applicable to facilitating accurate and continuous control of scheduled orders as they progress through the various manufacturing steps.

The invention contemplates, as a specific and important feature of the system, a provision of means whereby detailed records of the activities of operators on a particular machine are maintained. These records are maintained in such fashion that operators of more than ordinary ability or less than ordinary ability can be readily located and arrangements can be made to give adequate recognition for good work as well as to find the work for which a particular operator is best fitted.

The system in its entirety is so arranged that the calculation of individual performance records in no way upsets the maintenance of the standard system. In any production control system it is necessary, of course, to set up standards for the making of a particular part, and these standards must be in such simple form as to enable them to be broken down into machine or bench operations on which individual records of progress can be maintained. The record keeping must be of such nature as not to involve too much paper work on the part of the production force, but it must also be adequate to supply the necessary information to enable an order for a definite number of manufactured devices to be carried through the manufacturing process with full information at any time as to its progress and with full records to establish the cost of the manufacturing operations when the job is completed.

In order that the system may be more clearly understood, the accompanying drawings show the working devices or forms that are used at the various stages. In connection with these drawings a complete detailed description will be hereinafter given to illustrate their utility in scheduling of production and control of production throughout the manufacturing process.

In the drawings:

Fig. 1 is a plan view of one of the control records described hereinafter as the shop order master;

Fig. 2 illustrates another record or form which will be referred to hereinafter as the variable master;

Fig. 3 is a plan view of a third record or form referred to hereinafter as a shop order;

Fig. 4 is a plan view of another record or form referred to hereinafter as the standard cost record summary;

Figs. 5, 6 and 7 illustrate in plan view three additional forms which are referred to hereinafter, respectively, as the operator's card, the job labor card and the daily summary attendance card;

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Fig. 8 is a somewhat diagrammatic view showing the application of a plurality of overlapped job labor cards to a duplicating pad;

Fig. 9 is a fragmentary plan view illustrating how the notched cards are arranged in overlapped relation;

Fig. 10 is a plan view, partly broken away, of the holding device for holding cards in overlapped relation; and

Fig. 11 is a sectional view on line 11—11 of Fig. 10.

With the exception of the daily summary attendance card all of the forms carry related information which is placed upon them by a duplicating operation from the shop order master and the variable master forms.

In the preparation of the shop order master the items entered upon this master in copying ink include the part or assembly number and name, the name of the product on which the part or assembly is to be used, individual operation numbers and descriptions in the sequence in which the operations are to be carried out, the type of machine on which operation is to be performed, a time standard established for each operation, and such other special instructions as may fit each operation, such, for example, as tolerances allowed. It will be noted that the shop order master, in the upper lefthand corner, has a vacant area of the same size and shape as the variable master sheet shown in Fig. 2. It will also be noted that each operation of a part carries a number. For convenience these numbers are arranged in tens when the shop order master is first made up; that is, the first operation is numbered "10," the second "20" and so on. If a new operation has to be inserted between the first and second operation it can then be given a number such as "15." Also, if changes are made in a particular operation such as operation "10" the changed operation can be renumbered, for example, by giving it the number "11."

Assuming that an order is received which requires the making up of a definite number of parts for which a shop order master has been prepared, a variable master is made up by typing upon the variable master form shown in Fig. 2 the production order number, part number, number of pieces in the lot to be made, the date ordered and the date wanted. This typing is done in hectograph or other copying ink. The variable master is then temporarily attached to the shop order master for the purpose of making the rest of the forms that will be needed in following the progress of the order through the shop.

Where the duplicating method used is the

mirror script or reverse printing method the information typed on the shop order master and on the variable master will be printed in copying ink on the back in reverse so that the two masters combined can be used in a liquid process duplication to reproduce copies. Where the reproduction is to be done by the so-called gelatin process the typing is done in copying ink directly upon the face of the forms and for reproduction purposes the form is first impressed upon the gelatin surface after which the copies to be made can be taken from the gelatin surface.

The shop order shown in Fig. 3 is a complete reproduction of the shop order master and variable master when they are combined. In the normal production control one copy of the shop order is all that is necessary although of course more copies may be made if they are desired. In making copies from the combined shop order and variable master unit the form shown in Fig. 4 (standard cost record summary) is filled out in sufficient numbers for its purpose, but in this case only the information on the lefthand half of the shop order master, including the column to the right of that showing standard hours allowed, is reproduced. The rest of the information is blocked out by use of a block-out sheet or eliminated by momentarily folding the master under along a prescored line 10. An operator's card for each operation listed upon the shop order master is also made. A completed operator's card is shown in Fig. 5. It will be noted that this card carries all of the information on the variable master plus the heading of the shop order master and the information relating to one of the numbered operations. One card is prepared for each operation.

The operation information space on the operator's card is immediately below the heading information which is common to all operator's cards for the particular part. The operation information is, however, individual to the card. The heading information is first run on all the operator's cards for the particular part. A block-out sheet is used to cover the operation information while the cards are fed to a duplicating machine to which the master has been applied.

In order to place the individual operation information on each operator's card a window type block-out sheet is used which is of the same size as the operator's card but which has a space cut out of it just big enough to expose a single line of the operation information on the master in the case of direct duplication by the liquid process, or, on the gelatin image in the case of duplication by the gelatin pad method. By the use of an adjustable guide on the feed tray of the duplicating machine and by shifting the block-out sheet to expose the next line of operation information after each operator's card is fed to the machine, each operator's card is provided with its individual operation information.

Next the form shown in Fig. 6, the job labor card, is prepared by copying upon it by a duplication operation the same information that is copied upon the operator's card. However, with the job labor cards it is necessary to have a card for each shift and each operation. In other words, an operation may extend over two or more shifts in which case there will be two or more job labor cards for each operator's card.

As a matter of convenience all of the headings may be placed on the job labor cards when the master is blocked out to put the headings on the

operator's cards. Then when the window block-out is being used for a particular operator's card the job labor cards for that operation are also fed through the duplicating machine before moving the block-out sheet to expose the next line of operation information on the master sheet.

The job labor cards serve at a later point in the system as masters for certain information that is hand written in hectograph pencil in the last two lines at the bottom of these cards. In order to accomplish this result the job labor cards are made of a paper that will serve this dual purpose: that is, as a copy sheet to receive the copying ink in the duplicating process and to serve as a master copy for the information placed thereon by the hectograph pencil.

When the complete set of forms has been copied from the combined shop order master and variable master, the variable master is removed from the shop order master and destroyed. The shop order master however is usable over and over again for subsequent production orders for the same part. These shop order masters are therefore kept in a master file so that for a succeeding production order it is only necessary to make up a new variable master and proceed as before for the making of the several records.

In the operation of the system, when an operator is ready to carry out a certain operation on his machine he receives from the time keeper the operator's card for that machine. The timekeeper at the same time records the starting time on the corresponding job labor card. The card and the operator fills in his identifying number or identification number on the job labor card and the operator fills in his identifying number and the date on his operator's card and takes the card with him to the machine. This operator's card remains at the machine until all the required pieces called for on the order are finished in that operation. When the last piece is finished the operator then working upon the order returns the operator's card to the timekeeper.

If an operator does not finish all of the pieces on an order by quitting time he then marks up the number of pieces he has finished on the operator's card in the space provided and leaves the card at the machine. He reports to the timekeeper the number of pieces finished and the timekeeper posts this number of pieces on the job labor card for the shift. This job labor card (Fig. 6) is individual to the operator and carries his name and clock number. It forms the direct means by which operators of exceptional performance can be picked out. This part of the function of the job labor card unit will be pointed out more fully hereinafter.

If an operator on a second or third shift takes up where the first operator left off he first goes to the timekeeper who punches his "in" time on the job labor card bearing his name and clock number. The timekeeper tells the incoming operator how many pieces remain to be completed in the lot at the machine. The operator then goes to the machine and enters his clock number and the date on the operator's card at the machine. He checks the count of pieces as indicated by the "number of pieces finished" column entry with the quantity entry at the left on the operator's card. When he finds any discrepancy he can report it to the foreman.

When an operation on a particular lot is finished the last operator returns the operator's

card to the timekeeper who can then see that the next operation, as shown in sequence by the numbers on the operator's cards, gets under way. The timekeeper's activity is repeated, insofar as recording is concerned, for each succeeding operation. The completed operator's cards are kept in an order file by order number so that the file will show at all times how far a lot has progressed.

As job labor cards are completed (punched out) the following calculations will be made. These will be done by the timekeeper if he has time available or by a comptometer operator if he does not have sufficient time. The calculations and postings will be as follows:

1. Pieces finished multiplied by the standard time per piece to determine the standard hours earned.
2. Actual elapsed time from the clock punching.
3. Operator's base rate.

The following calculations are examples of those made by the comptometer operator:

1. If the standard hours earned are more than the actual elapsed time the man has earned full bonus and the time earned is calculated by multiplying the standard hours earned by 120% so that the 20% bonus is added. The resulting figure is the time earned and is entered in the space provided under that caption.
2. If the standard hours earned are less than the actual elapsed time the man may or may not have earned a partial bonus. Therefore the calculation is made by adding the standard hours earned and the actual elapsed time and multiplying by 60%.
   (a) If the resulting figure is more than the actual elapsed time he has earned a partial bonus and this figure is the time earned and is entered in the space provided under that caption.
   (b) If the resulting figure is less than the actual elapsed time he has not earned any bonus and therefore the actual elapsed time is the time earned and is entered in the space provided under that caption.
3. The following calculations are made and posted with hectograph pencil on the job labor card:
   (a) Base rate multiplied by time earned to determine amount of pay.
   (b) Standard cost which is standard per piece multiplied by number of pieces finished.
   (c) Any difference between amount of pay and standard cost is a variance and should be classified under the proper caption.
   (d) Per cent of performance which is the total time earned divided by the actual elapsed time.
   (e) Explanation of the variance, if any.
   (f) Post clock number and operation number on all job labor cards where the percent of performance is more than a predetermined amount above 100% or more than a predetermined amount below 100%.

These completed cards are than sorted by operator and kept until the end of the day when

they are posted to the daily summary attendance card as explained later. (After they are posted and balanced any cards where men had a percentage of performance of less than or more than the predetermined percentage bracket will be sorted out and also any cards with variances caused by makeup or rework will be sorted out. These will be placed in related, overlapped position on a gelatin machine so the bottom lines show and a report will be run off. This report is exceptionally important to the management, as will be later pointed out, yet no rewriting is necessary to get it.) Then the cards will be filed back with the others and sent to the cost department.

When the job is completed the job labor cards will be sorted by job number by operation, and the following information will be totaled by operation and posted to the standard cost record summary in the cost department:

1. Actual cost (amount of pay).
2. Standard cost.
3. Variances (with amount of each under proper caption).
4. Explanation of variances.

After this information has been posted, the job labor cards will be filed in the sequence in which they are completed, which is by job number and operation.

A supply of daily summary attendance cards (Fig. 7) will be prepared in advance on the addressograph which fills in the man's clock number, name and social security number. There will be one of these used each day by each man and he will punch in, in the morning, and out at night. The timekeeper will place a new card in the clock rack by the attendance card for each man each day so that it will be there for the man when he comes in. If he works any overtime it will be punched in and out on this card too. At the end of the day the timekeeper will remove these cards from the rack and put in a new one for the next day. He will then figure the elapsed time (with one-half hour lunch deducted) and enter this under the clock punchings. This eliminates punching in and out at noon.

Then he will take all the job labor cards for each man each day and will post the following information from each one to the daily summary attendance card:

1. Allowed time earned.
2. Amount of pay earned.
3. Actual time.

After all the job labor cards for that man have been posted the following entries and calculations will be made, using a hectograph pencil to make the entries on the bottom line of the card (see Fig. 7):

1. Total hours earned.
2. Base rate.
3. Total hours earned multiplied by base rate to determine gross earnings which is entered in gross earnings space.
4. Actual hours multiplied by base rate to determine hourly earnings which is entered in hourly earnings space.
5. The difference between hourly earnings and gross earnings is bonus earnings which is entered in proper space.
6. Divide the hourly earnings by the gross earnings to determine the percent bonus earned.
7. Clock number (and name if necessary) in proper spaces.

Then the cards will be sorted by clock number and a report will be prepared in the same fashion

as the report was prepared from the bottom lines of the job labor cards. The manner of arranging the cards for running the copies on a gelatin machine is to place them in overlapped relation and to align them so that only the section at the bottom of the card which carries "total time," "base rate," "earnings," etc. is exposed. This is the section in which the entries have been made in hectograph ink by hectograph pencil or pen. The cards are made of a dual purpose paper capable of serving as a copy sheet and as a master sheet. A group of the cards can be arranged in this staggered relation upon the device shown in Figs. 8 to 11 or merely against a suitable margin bar to hold them in position until they have been brought into contact with the duplicating pad of a gelatin type duplicating machine. Of course other suitable means may be used to position the cards. Since the cards are in part a result of a previous duplicating operation and are in part a duplicating master they perform a very unusual function in the successful operation of the system.

Then the cards will be sent to the payroll department for posting to the payroll records. After posting the cards will be filed by clock number by day.

If a set up is necessary before an operator can start a job on a machine a job labor card marked "Set up" will be punched in for him instead of punching him in on the job labor card for that operation. This set up card will show the same information as the regular job labor card. The operator will be given the operator's card for that operation and will be told to return and be punched out when he has completed the set up. When he does so and reports the set up completed the timekeeper will remove the set up and job labor card and punch him out on the set up card and in on the job labor card. Then the operator will go back to his machine and start to work.

In case of machine trouble, cleanup work, sharpening tools, changing cutters or any other non-productive work it will be necessary for the operator to report to the timekeeper when he starts on such work so that he can be punched out on the job labor card and in on a card for machine trouble, cleanup work or whatever it is. Whenever this work is finished and he goes back on productive work he must report to the timekeeper who will punch him off on the non-productive job and back in on his productive job. It is very important that this be done so that the operator can protect his bonus earnings and to enable the figuring of bonuses daily.

The shop order will be kept with the lot of material through all operations in the shop and will go to final inspection with the material. There the inspector will initial and date it and mark down the number of good pieces finished, scrap pieces finished and total pieces finished. Then it will go with the material into the storeroom where the storeroom will acknowledge receipt and then the shop order will be removed and sent back to the planning department. Then it will be filed by order number.

The functioning of the job labor cards as copy receiving units and as masters from which copy can be taken is very important to the system. It is particularly important in making the system useful for investigating and determining the fitness of man for particular work. The information from the job labor cards compared with the information on the bottom lines of the daily summary attendance cards for the same individual will show which jobs the man is best at, what his daily time record is and whether he does better on one type of operation than another. Also to check the standard time allowed for correctness, all of the job labor cards for different individuals doing the same operation can be placed together in overlapped relation and a copy taken to compare the actual time with the allowed time for all operators. There are various other uses to which the dual function of serving as a copy sheet and a master sheet adapts the record cards. It is believed, however, that the examples given are sufficient to indicate the novelty and advantage of the dual function in systems of this character.

Arrangement of the job labor cards in overlapped relation is greatly facilitated if the cards are provided with means at one edge to enable them to be spaced correctly and quickly. It will be noted that the job labor card (Fig. 6) is provided with regularly spaced notches 11 at one end. Similar notches 12 are provided on the operator's card and similar notches 13 are provided on the daily summary attendance card. These notches cooperate with a margin bar 25 (Figs. 8–11) provided as an attachment for a duplicating machine.

Figs. 8 to 11 inclusive, illustrate the method of assembling cards in overlapped relation and applying them to a hectograph pad 15 of a duplicating machine. The attachment referred to above comprises a base plate 16 which is adjustably secured to a side frame 17 of the duplicating machine. Two slots 18—19 are provided in the plate 16, and they receive two bolts 20 and 21 which are provided with nuts 22 and 23. The plate 16 has an upturned flange 24 to which an angle bar 25 is fixed. This bar has vertical V-shaped teeth thereon spaced to match the spacing of the notches 11, 12 and 13 on the cards. The plate 16 is provided with a combined cover and clamp 27, which is hinged at 28 and 29 to the plate 16. At the edge 30 of the cover, a rubber or other yielding material channel 31 is secured to engage cards 32 on the margin bar 25. Two springs 33 and 34 are connected between the cover 27 and the plate 16 to force the cover down. A lifting finger 35 is mounted on a rod 36 that is journalled in two bearings 37 and 38 on the plate 16. The rod 36 is bent upwardly back of the cover 27 to provide a handle. The cover 27 is cut out as indicated at 39 to clear the rod when the cover is swung back on its hinges.

Now in assembling a stack of cards in overlapped relation, the operator can lay one edge of the card on the margin bar and move the cards singly into register with the teeth 26 on the margin bar as the stack is advanced lengthwise of the bar. The series of overlapped cards will then be gripped by the cover 27 and be pressed down on to the duplicating pad 15. As many copies as may be desired can be made from the image on the duplicating pad that is made from the lower lines of the job labor cards and the daily summary attendance cards. Since the other matter on the cards is covered except for the bottom card and since the other matter on the card is either printed in non-duplicating ink or a mere copy taken from the original shop order master, the copying of the information written with hectographic pencil is readily done. A single copy sheet can show the performance records of a large number of men.

It is believed that the foregoing description

will make the nature of my invention and its advantages clear to those skilled in the art.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A duplicating method for job record and like systems which comprises forming a composite master from a permanent reusable master sheet having information thereon in copyable ink and a single use master strip having information thereon in copyable ink by covering a predetermined section of the master sheet with said master strip, producing copies having classifying information thereon from said composite master upon individual composite copy and master sheets, adding new master information comprising information common to a group of like sheets and information differing on the individual sheets of a group, in hectograph ink to a marginal edge of said last named sheets and reproducing on a single copy sheet the master information on the individual sheets of a group by overlapping them to form a composite master exposing the marginal edge master portion of each sheet.

2. A duplicating method for job record and like systems which comprises forming a composite master from a permanent reusable master sheet having information thereon in copyable ink and a single use master strip having information thereon in copyable ink by covering a predetermined section of the master sheet with said master strip, producing copies from said composite master upon individual composite copy and master sheets, adding new master information, comprising information common to a group of like sheets and information differing on the individual sheets of a group in hectograph ink to a marginal edge of said last named sheets and making copies from the combined marginal edges of the individual sheets of a group.

WILLIAM S. COCHRAN.

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The following references are of record in the file of this patent:

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