TECHNIQUES OF FLOW-CHARTING

Louis A. Schultheiss

INTRODUCTION, by Edward Heiliger

Automation of libraries must come about through close cooperation between librarians and "machine people." Each must understand something of the other's specialty. For a starter, a good common language is provided by flow charts, which are simple work-flow charts written in yes-no terms. They can be quickly understood by the "machine people," and the technique of making them can be learned by a librarian in a very short time.

Because each member of the library staff knows his own work better than does anyone else, he is, therefore, better qualified to do the flow charting of his work. In flow charting the library's work, all of the staff take part and contribute to the process of preparing for automation. Staff members lose some of their fears in the process and take pride in their contribution to the joint effort. This grass-roots approach develops interest in the whole problem and makes the next step easier. The staff member benefits by learning to think of his work in terms of logical alternatives. He discovers that the old routines were illogical in many ways and that many changes are needed, automation or no. Reasons for work conflict are uncovered and outmoded routines left over from previous changes are discovered.

One by-product has been a new kind of staff manual, consisting of flow charts. An uninitiated staff member seems to be able to understand the workings of a new department much more quickly by reading flow charts than by reading text. It is also easier to see each department's relation to the whole library by studying the whole library's charting.

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It is evident that data processing will be most effective when all of the library's work is tied into one system and when that system is planned before the implementation of any part of the work is begun. Flow charting is an essential part of planning the system and is the first step that must be taken. The paper by Mr. Schultheiss includes a description of the flow charting method and this can be a guide for those interested in using this approach. A complete set of the charts developed in the University of Illinois study can be found in the book published on the project.[1] --E. H.

"Flow-charting" is a very broad term used to describe a number of charting and diagramming operations, many of them not peculiar to data processing. Decision flow charting and work flow charting and diagramming have been used in other fields for many years, although the concept seems to be a relatively new one among librarians.

Since this conference is made up primarily of librarians, I will concentrate on decision flow charting, with a few examples of other types, and will show samples of both early and recent work at the University of Illinois Undergraduate Division Library at Navy Pier, Chicago, during the past three years.

All librarians know about procedure manuals, instruction sheets, and other means of maintaining uniformity of procedures and of instructing new personnel. The primary difficulty with these (other than the fact that they always seem to be out of date) is that they give only broad steps, on an action basis, and cannot show HOW to make the value judgments and decisions that must be made if the procedure is to be carried out intelligently.

Flow charts, on the other hand, combine both physical actions and decision making in one logical flow. The type of operation (action, decision requirement, hold, etc.) is indicated by the shape of the box surrounding the written inscription. The choice of box shapes and sizes may become very elaborate and representational, and may be transcribed in a variety of formats; the Head of our Data Processing Department has often jokingly remarked that by using flow charts and magnetic tape reels we have rediscovered the pictogram and the scroll and are calling this progress.

For work at Navy Pier, however, choices were limited to a small number of the shapes provided by the IBM Diagramming Template:

1. Circles are used to indicate the start or the end of a complete process.

2. Diamonds are used to indicate the entrance of material from another flow sequence, or its exit to another sequence.
3. Rectangles are used to indicate some sort of action.
4. Hexagons are used to indicate holding operations of all kinds.
5. Round-ended boxes are used to indicate questions and decision requirements.

The size chosen at any particular time depends entirely on the length of the inscription to be contained, and the aesthetic whim of the person doing the diagramming.

Decision flow charts are so constructed that all questions are answerable by a "yes" or a "no," and there must be both a "yes" and a "no" answer to each question. If there is not, there is no question because there is no choice. And there can be no "maybe" answers in flow charting. If there are several choices possible at a particular point, the most likely choice is posed as the first question; if the answer to that question is "no," the next most likely choice is posed, and so on down the line until a "yes" answer is reached or until only one choice remains and is no longer a matter of question.

Before going on to the actual techniques of decision flow charting or to an examination of samples of actual working charts, here are a few basic rules:

1. Flows cannot come to a dead end. It is important that no procedure be left dangling; material must either exit to another flow or come to a complete and indicated stop without further requirement for action.
2. There must be two alternatives at each decision point. As already indicated, one must be a "yes" and the other a "no." Two of one kind or a total of more than two are logical impossibilities.
3. Wording must be sufficiently precise for both questions and actions to be clearly understood. It is entirely possible that the wording of inscriptions will be more difficult in some cases than the delineation of the procedural flow itself.
4. The flow chart, to be valuable, must be an accurate picture of the way the work is really done, rather than of the way the supervisor would like to have it done:
   (1) Decisions must be made at the points indicated on the charts.
   (2) Actions must be charted in the sequence in which they are actually performed.
   (3) Actions and decisions must be indicated as being performed by the persons actually doing them.

There are many ways of constructing preliminary flow charts. Perhaps one of the easiest is to indicate each action, decision, or other operation on a separate slip of paper and then to arrange the slips on a corkboard or to tape them onto a large surface. This will eliminate a great deal of tearing up and starting over, as few people are able to visualize a flow chart in the beginning or to estimate properly the amount of space it will take. The staff at Navy Pier began with small slips of paper, grease pencils, cellophane tape, and a poster typewriter; the slips were taped to large sheets of jute board, and grease pencil lines were eventually drawn onto the boards to connect the various steps (see Example 1). For purposes of crowding as much as possible onto one 8-1/2"× 11" sheet, the slips used in this example are much smaller than those we actually used. "P" slips are about right, with boards of about 30"× 36" inches.

After steps in a given process have been written on slips, boxed, and arranged on the backing board, flows are traced through to be sure that they are mechanically correct; i.e., have no dead ends, have the proper number and variety of choices, etc. When this has been accomplished, it is usually well to review the work thus far with another staff member who has some knowledge of the procedure under examination. This may not lead to continuing friendships, but it does increase the chances of accuracy. Then, after errors have been corrected and missing steps inserted, the entire chart is ready for transfer to some more permanent and manageable form. Do not be too upset if the first few charts cannot be corrected at all, or if another member of the staff walks up and immediately sees the answer to the problem that has been stumping you for the past half-hour; this is something of a new technique to most librarians, and it also requires the ability to stand off and see a familiar routine as if it were being observed for the first time.

There are at least two common ways of transcribing flow charts to paper: from top to bottom, and from left to right. In the beginning, the staff at Navy Pier were taught to chart from top to bottom. This technique is the one used by IBM and works very well on short flows. The other method of transcribing, from left to right, is used by the Burroughs Company and is the method now used for new work within the Technical Services Division at Navy Pier, though we continue to use the IBM template. The primary reason for the change was simply one of convenience; these charts are used a great deal for training and instructional purposes, and it is easier to connect distant portions of the same routine by lines rather than by exit symbols. Such entrance and exit symbols seem to be difficult for the clerical mind to understand, and they always seem to feel that something else is going on between the point of exit and the point of re-appearance. So we attach additional sheets to the right side of the first page and

accordion-fold the whole thing when we are finished; by doing this, we can keep both the flow chart and the accompanying procedures write-up in the same notebook and both can be consulted without having to turn the notebook at a 90° angle. Examples 2 and 3 are illustrations of transcription. Example 2 is an elaboration of Example 1, reading from top-to-bottom; and Example 3 is the same as Example 2, but is transcribed from left to right.

Examples 4, 5, and 6 indicate three generations in the flow charting of the same procedure. The first operation was done for the Information Systems Section of General Electric in the spring of 1960, and was laid out in very broad steps (Example 4). Example 5 is a portion of the same procedure, as revised in July of 1961. Examples 6-A and 6-B are a revision of the same procedure as it is carried out at the present time.

Example 7 is a bit different. In this case we have a diagram of proposed system flow for a circulation system. If the system outlined in Example 7 is put into operation, the "people flow" or decision flow, will go something like what is shown in Examples 8-A and 8-B.

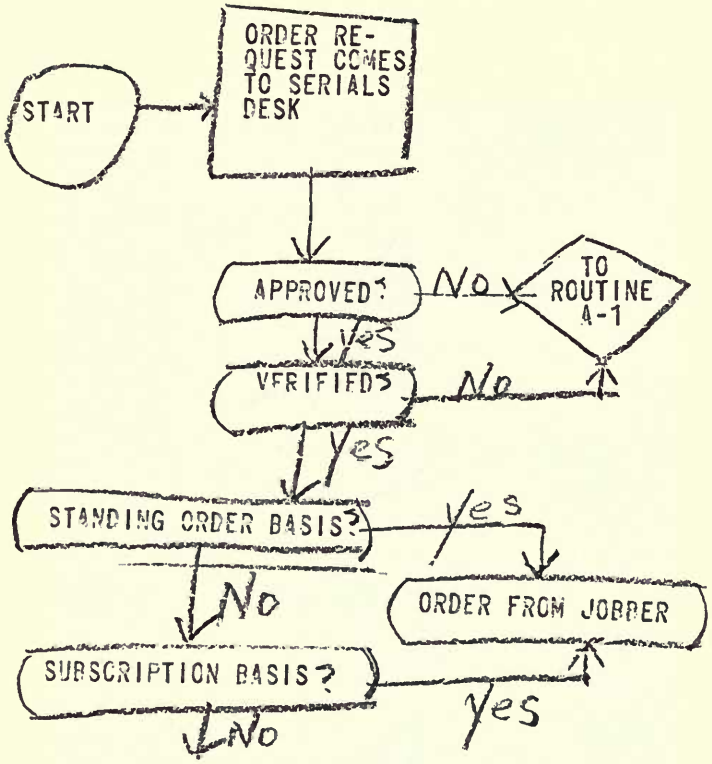
Example 9 is an illustration of the Burroughs Company's flow charting, and shows some differences in symbols and technique.

Example 10 is somewhat more pictorial than the ones we have seen so far, and is a very sweeping description of the conversion of catalog data contained on punched cards to magnetic tape and to a book catalog.

The final example, Example 11, is of a completely different sort. This one is an example of a block diagram, and contains one block for each computer operation. After completion, diagrams of this type are coded into the language of the computer, punched into cards, and are put into the computer itself.

REFERENCES

1. Schultheiss, Louis A., et. al. Advanced Data Processing in the University Library. New York, Scarecrow Press, 1962.


START
ORDER REQUEST COMES TO SERIALS DESK
APPROVED?
No
TO ROUTINE 4-1
Yes
VERIFIED?
No
Yes
STANDING ORDER BASIS?
Yes
ORDER FROM JOBBER
No
SUBSCRIPTION BASIS?
Yes
No

EXAMPLE 1

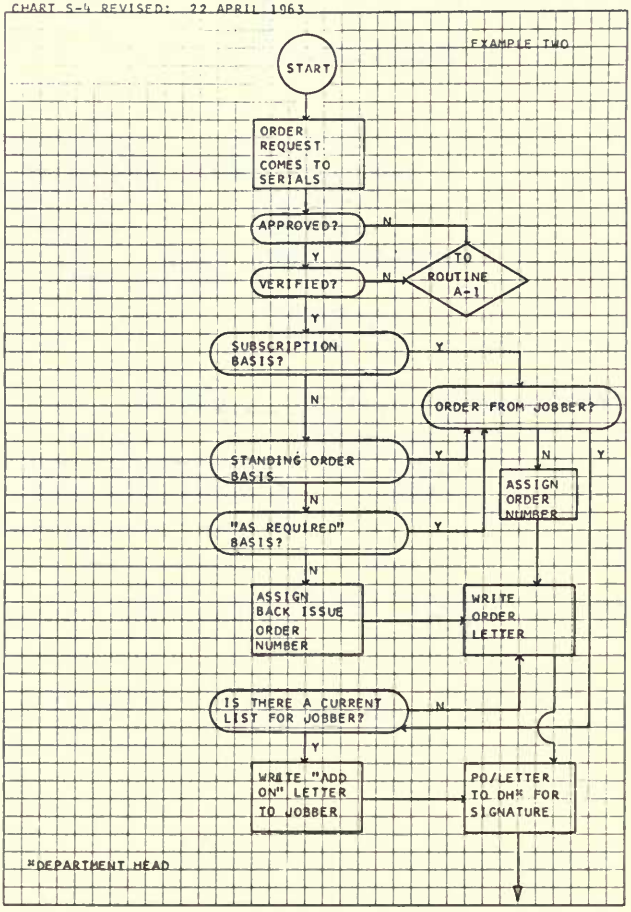


CHART S-4 REVISED: 22 APRIL 1963
EXAMPLE TWO
START
ORDER REQUEST COMES TO SERIALS
APPROVED?
N
Y
TO ROUTINE A-1
VERIFIED?
N
Y
SUBSCRIPTION BASIS?
Y
N
ORDER FROM JOBBER?
STANDING ORDER BASIS
Y
N
Y
ASSIGN ORDER NUMBER
"AS REQUIRED" BASIS?
Y
N
ASSIGN BACK ISSUE ORDER NUMBER
WRITE ORDER LETTER
IS THERE A CURRENT LIST FOR JOBBER?
N
Y
WRITE "ADD ON" LETTER TO JOBBER
PO/LETTER TO DH* FOR SIGNATURE
*DEPARTMENT HEAD

EXAMPLE 2

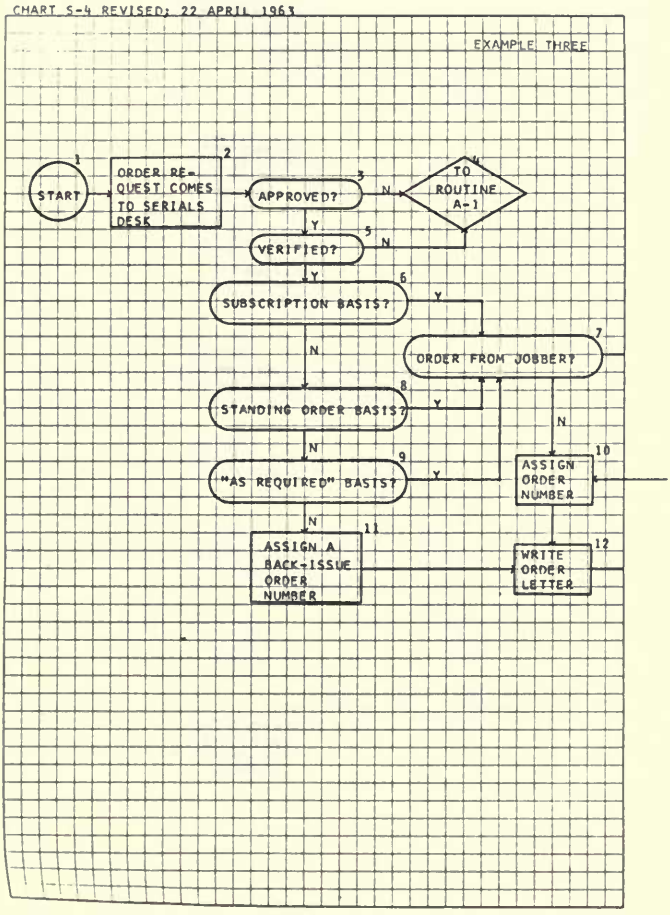
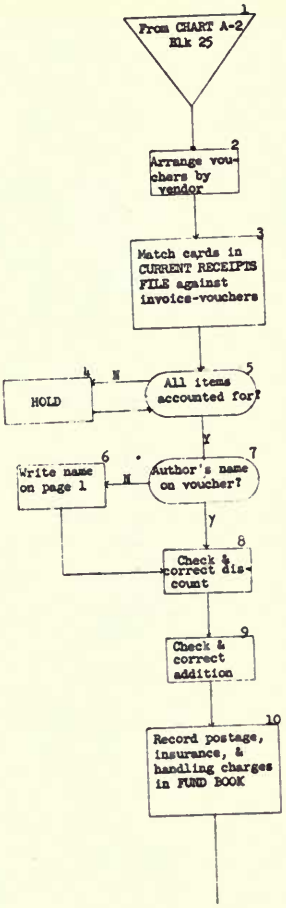


CHART S-4 REVISED: 22 APRIL 1963
EXAMPLE THREE
1
START
2
ORDER RE-QUEST COMES TO SERIALS DESK
3
APPROVED?
N
4
TO ROUTINE A-1
Y
5
VERIFIED?
N
Y
6
SUBSCRIPTION BASIS?
Y
N
7
ORDER FROM JOBBER?
8
STANDING ORDER BASIS?
Y
N
9
"AS REQUIRED" BASIS?
Y
N
10
ASSIGN ORDER NUMBER
11
ASSIGN A BACK-ISSUE ORDER NUMBER
12
WRITE ORDER LETTER

EXAMPLE 3


1
From CHART A-2
Blk 25
2
Arrange vouchers by vendor
3
Match cards in CURRENT RECEIPTS FILE against invoice-vouchers
4
N
HOLD
5
All items accounted for?
Y
6
Write name on page 1
N
7
Author's name on voucher?
Y
8
Check & correct discount
9
Check & correct addition
10
Record postage, insurance, & handling charges in FUND BOOK

EXAMPLE 4

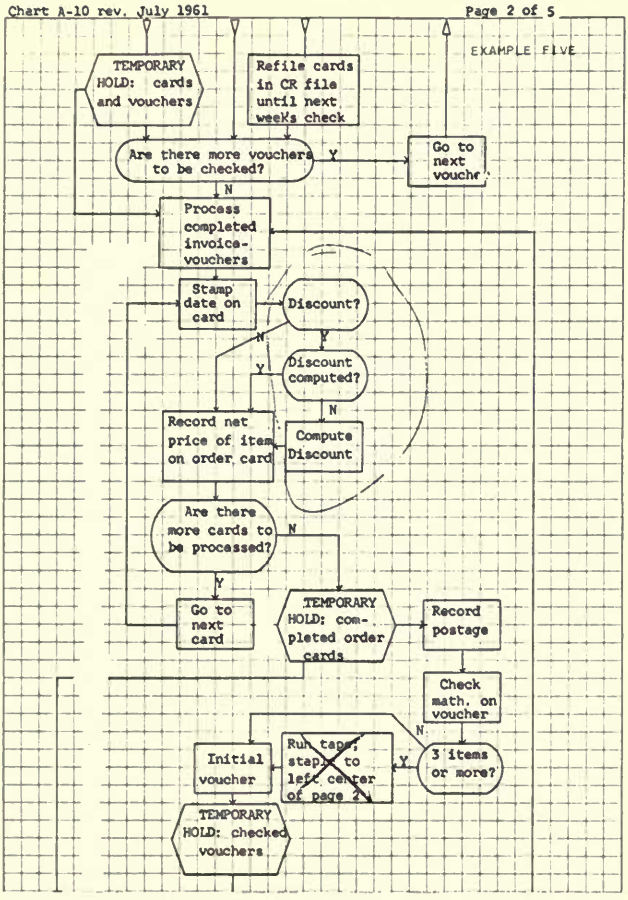
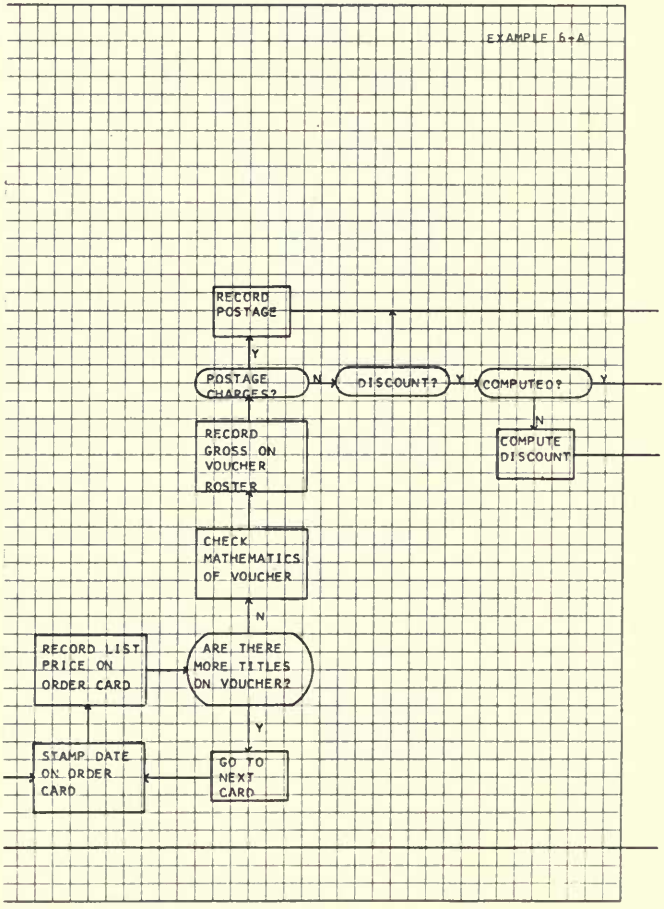
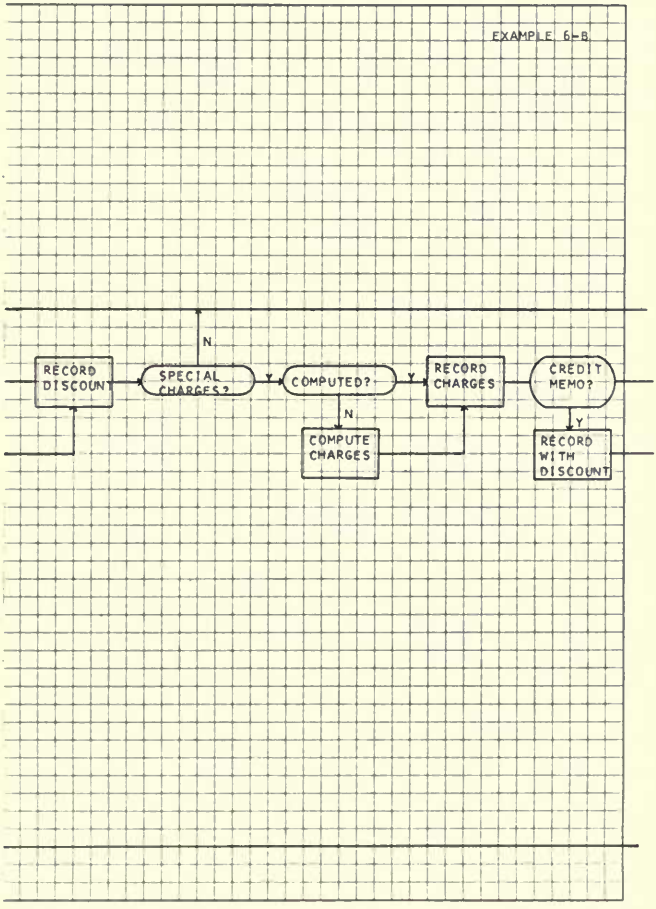


Chart A-10 rev. July 1961
Page 2 of 5
EXAMPLE FIVE
TEMPORARY HOLD: cards and vouchers
Refile cards in CR file until next week's check
Are there more vouchers to be checked?
Y
Go to next voucher
N
Process completed invoice-vouchers
Stamp date on card
Discount?
N
Y
Discount computed?
Y
N
Record net price of item on order card
Compute Discount
Are there more cards to be processed?
N
Y
Go to next card
TEMPORARY HOLD: completed order cards
Record postage
Check math. on voucher
N
3 items or more?
Y
Run tape; staple to left center of page 2
Initial voucher
TEMPORARY HOLD: checked vouchers

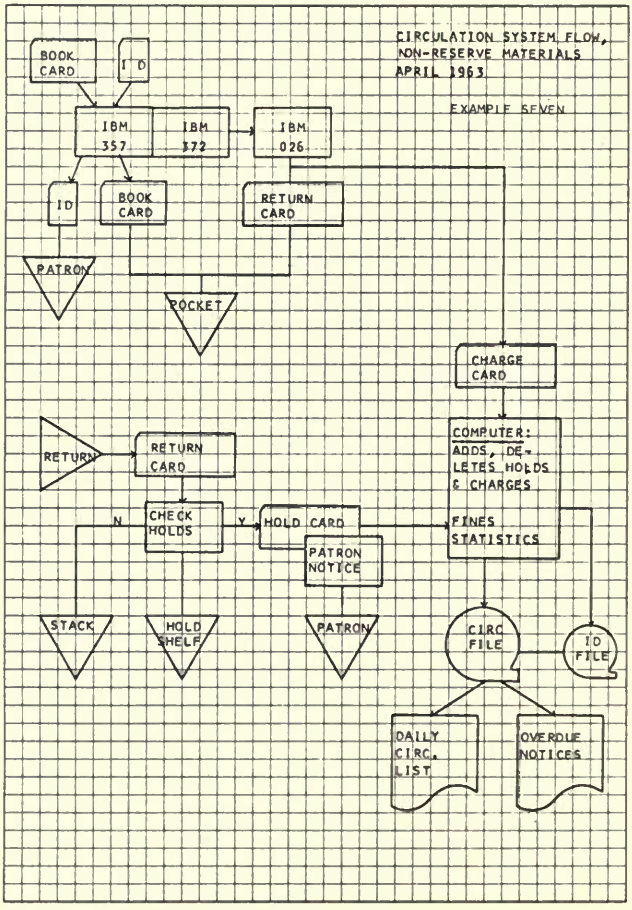
EXAMPLE 5


EXAMPLE 6-A
RECORD POSTAGE
Y
POSTAGE CHARGES?
N
DISCOUNT?
Y
COMPUTE 0?
Y
N
COMPUTE DISCOUNT
RECORD GROSS ON VOUCHER ROSTER
CHECK MATHEMATICS OF VOUCHER
N
RECORD LIST PRICE ON ORDER CARD
ARE THERE MORE TITLES ON VOUCHER?
Y
STAMP DATE ON ORDER CARD
GO TO NEXT CARD

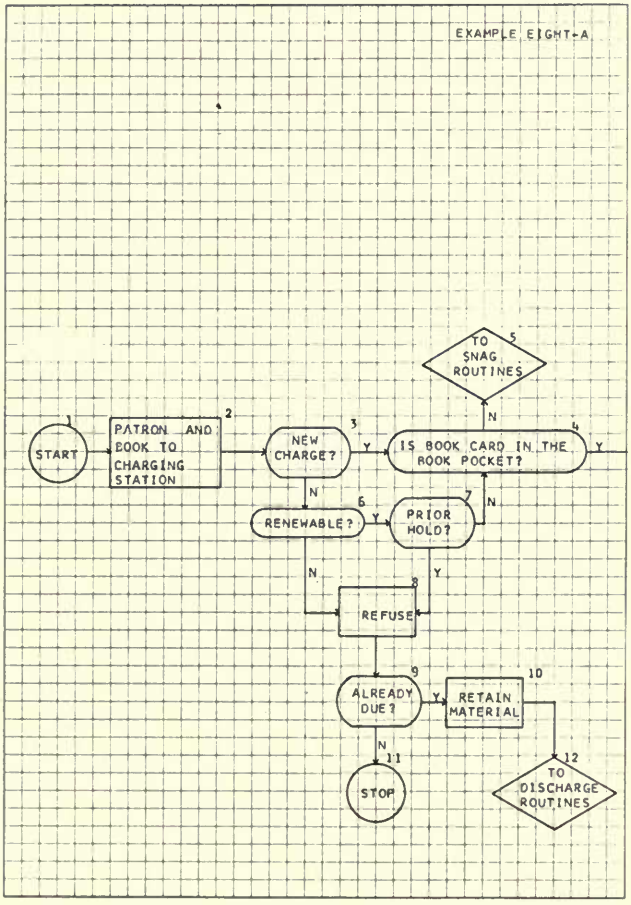
EXAMPLE 6-A


EXAMPLE 6-B
RECORD DISCOUNT
SPECIAL CHARGES?
N
Y
COMPUTED?
N
Y
COMPUTE CHARGES
RECORD CHARGES
CREDIT MEMO?
Y
RECORD WITH DISCOUNT

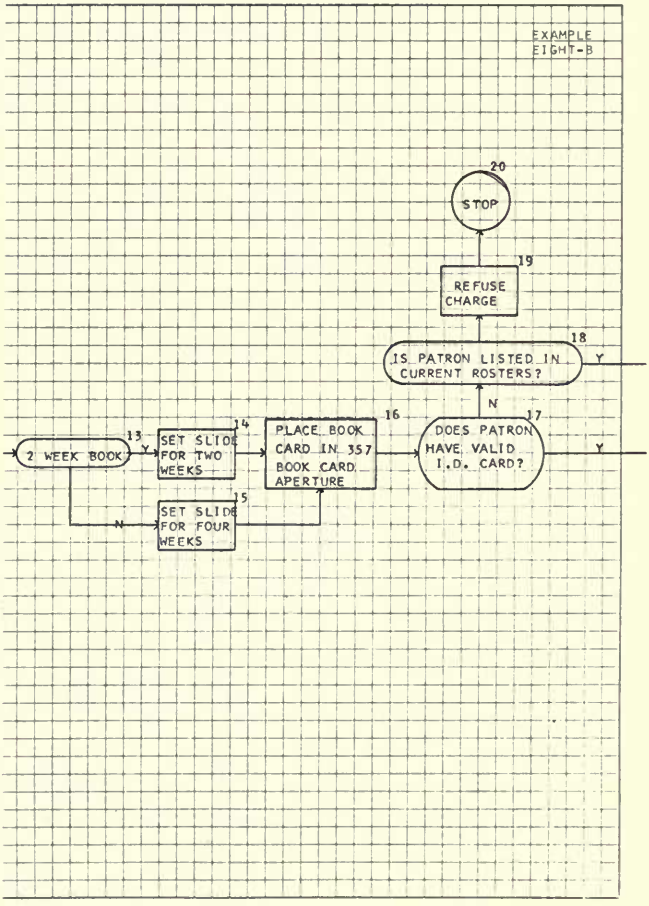
EXAMPLE 6-B


CIRCULATION SYSTEM FLOW,
NON-RESERVE MATERIALS
APRIL 1963
EXAMPLE SEVEN
BOOK CARD
I D
IBM 357
IBM 372
IBM 026
ID
BOOK CARD
RETURN CARD
PATRON
POCKET
CHARGE CARD
RETURN
RETURN CARD
COMPUTER: ADDS, DELETES HOLDS & CHARGES
N
CHECK HOLDS
Y
HOLD CARD
PATRON NOTICE
FINES STATISTICS
STACK
HOLD SHELF
PATRON
CIRC FILE
ID FILE
DAILY CIRC. LIST
OVERDUE NOTICES

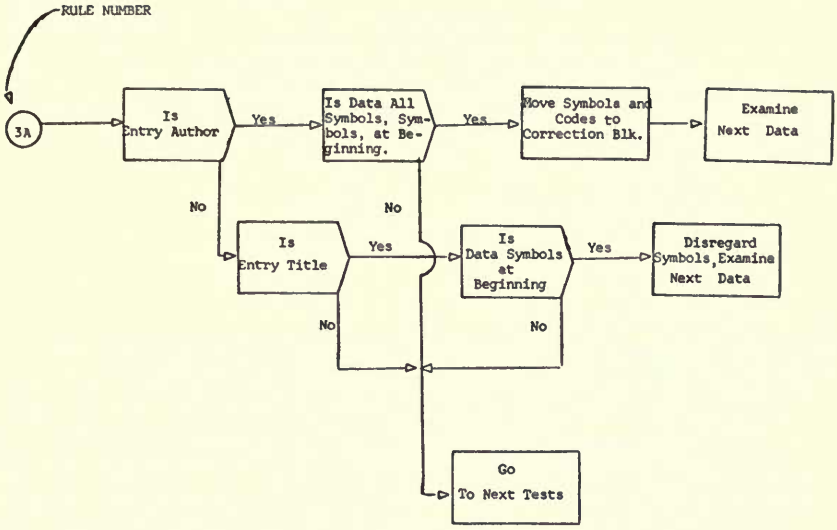
EXAMPLE 7


EXAMPLE EIGHT-A
1
START
2
PATRON AND BOOK TO CHARGING STATION
3
NEW CHARGE?
Y
4
IS BOOK CARD IN THE BOOK POCKET?
Y
5
TO SNAG ROUTINES
N
N
6
RENEWABLE?
Y
7
PRIOR HOLD?
N
N
Y
8
REFUSE
9
ALREADY DUE?
Y
10
RETAIN MATERIAL
12
TO DISCHARGE ROUTINES
N
11
STOP

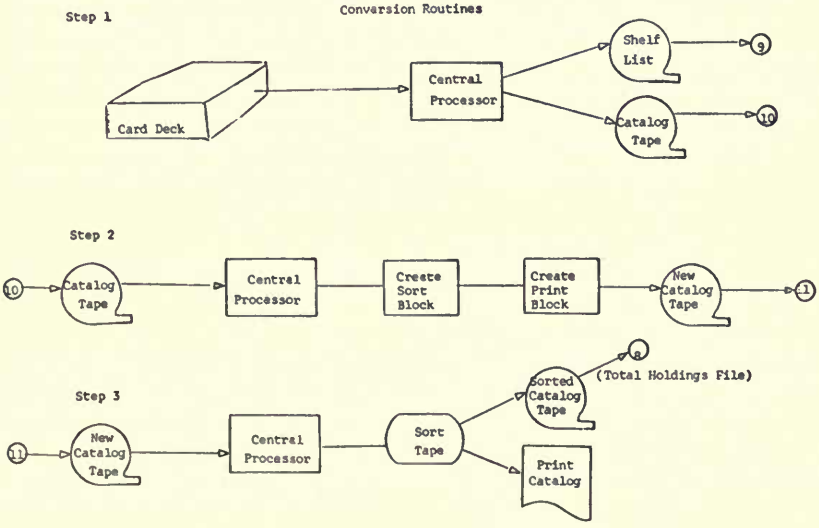
EXAMPLE 8-A


EXAMPLE
EIGHT-B
20
STOP
19
REFUSE
CHARGE
18
IS PATRON LISTED IN
CURRENT ROSTERS?
Y
N
16
17
DOES PATRON
HAVE VALID
I.D. CARD?
Y
13
2 WEEK BOOK
Y
14
SET SLIDE
FOR TWO
WEEKS
PLACE BOOK
CARD IN 357
BOOK CARD
APERTURE
N
15
SET SLIDE
FOR FOUR
WEEKS

EXAMPLE 8-B

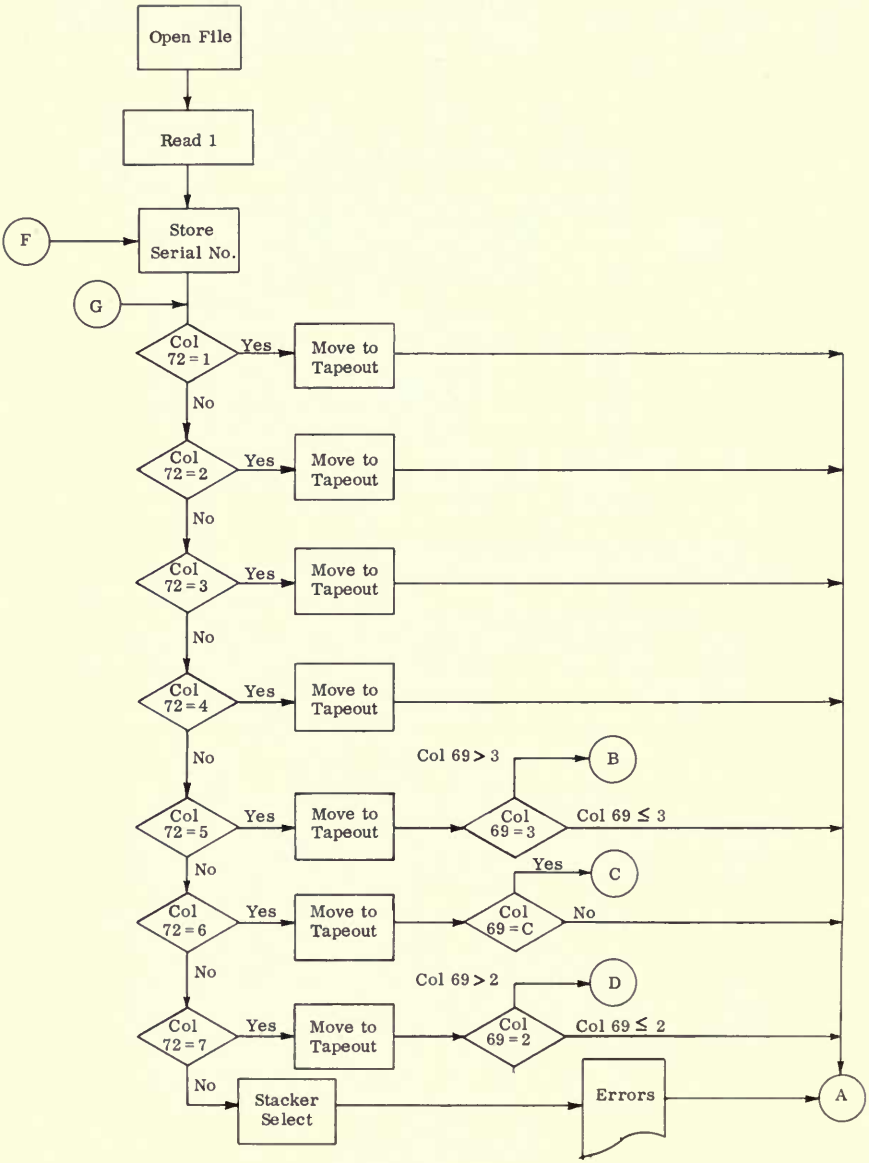


EXAMPLE 9



EXAMPLE 10

File Creation



EXAMPLE 11