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Automated Documentation

by
Robert A. Magnuson



RESEARCH ANALYSIS CORPORATION

MCLEAN, VIRGINIA

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FOREWORD

Realizing that RAC's only tangible products are technical papers and that the present manual methods of draft and document production are impediments to the swift preparation of a large technical document, the author designed and implemented the computer-assisted system herein described.

The system design embodies a number of brand-new ideas—ideas not contained within any other known system, program, or device whose purpose is to compose or typeset documents. These innovations include free-form keypunching, the concept of the voided area, and the freely commingled English-like editing instructions and text.

As a result the keypunching of a draft is actually easier than either typing (onto paper) or traditional keypunching (into cards). Corrections (i.e., changes, insertions, deletions, and rearranging) of a draft are made at the key punch; there is no need to count pages, lines, words, or characters and then to keypunch these counts into special change-instruction cards that must later be processed and interpreted by the computer.

The system, considered to be a working prototype, is now undergoing an extensive operational test and development. It has, for example, produced the body of this very technical paper. Soon the system will be expanded to include new capabilities, some of them described in this paper.

Nicholas M. Smith
Chief, Advanced Research Division

CONTENTS

- Foreword	iii
Keypunching Your Document	1
The Editing Instructions	2
The System in Use	4
The Breakpoint Technique	10
The Squeeze Program	22
Other Techniques	25
Automated Production of Status-Displaying Documents	26
Putting a Program Listing into the Document	30
Causing the Document to Punch the Program Deck	30
By-Product Applications	32
System Modification under Consideration	32
Preliminary Cost Considerations	34
Conclusions, Recommendations, and Summary	35
Appendixes	
A. Card and Deck Formats	38
B. Detailed Descriptions of the Editing Instruction	40
C. The Document Machine, Coded in 1401 Autocoder	54
D. Squeeze, Coded in 1401 Autocoder	66

Figures

1. Double-Spaced Verbatim Listing of the First Twelve Cards (with Errors) Punched to Produce This Document	5
2. Listing Produced Using Cards Shown in Figure 1	7
3. Double-Spaced Verbatim Listing of New Deck Resulting from Correcting Cards of Figure 1	9
4. An Example of a Portion of an Early Draft	11
5. Double-Spaced Verbatim Listing of the Cards That Produce the Draft Shown in Figure 4	12
6. The Draft Marked for Insertion	13
7. Double-Spaced Verbatim Listing of the Document Deck "Broken" at the Point Where the Insertions Are Desired	15
8. Double-Spaced Verbatim Listing of the Three Sets of Insertion Cards	17
9. The Document Produced by Feeding the Cards of Figure 8 to the Document Machine Program	18
10. Double-Spaced Verbatim Listing of the "Broken" Document Deck with the Insertion in Place	20
11. The New Draft (with the Three Insertions) Produced by Cards of Figure 10	21
12. Double-Spaced Verbatim Listing of Squeezed Cards of Figure 10	24
13. Sample of RAC Publication List Produced by the Document Machine Program	28
14. Single-Spaced Verbatim Listing of Cards That Produced Figure 13	29

AUTOMATED DOCUMENTATION

A NEW SYSTEM HAS BEEN DESIGNED BY THE AUTHOR IN WHICH MUCH OF REPETITIVE WORK ASSOCIATED WITH PREPARING THE FINAL DRAFT OF A TECHNICAL DOCUMENT HAS BEEN ELIMINATED. IT IS FELT THAT MUCH OF THE FIRST DRAFT OF A DOCUMENT SURVIVES THE VARIOUS RETYPING OF SUBSEQUENT DRAFTS RIGHT THROUGH TO THE FINAL DOCUMENT. CHANGES ARE MADE HERE AND THERE, PORTIONS ARE ADDED AND DELETED. IF ONLY THE 'GOOD' PORTIONS COULD BE RETAINED WHILE ADDING AND DELETING, THE PROCESS OF OBTAINING THE FINAL DOCUMENT (OR, AT LEAST, FINAL DRAFT) WOULD BE ENORMOUSLY SPEEDED UP. THIS IS EXACTLY WHAT HAS BEEN DESIGNED INTO THE SYSTEM WHICH THIS DOCUMENT DESCRIBES. THE SYSTEM IS LARGELY 'MANUAL', WITH A (1401) COMPUTER RUN REQUIRED ONLY OCCASIONALLY IN THE PROCEDURE.

KEYPUNCHING YOUR DOCUMENT

INSTEAD OF UTILIZING A MANUAL OR ELECTRIC TYPEWRITER FOR THE TRANSCRIPTION OF THE FIRST DRAFT, WE USE A KEY PUNCH. ONE NORMALLY THINKS OF KEYPUNCHING INVOLVING VARIOUS CARD FIELDS, WITH THE DATA BEING CAREFULLY ENTERED INTO THE PROPER PARTS OF THE CARD. NOT SO WITH THIS SYSTEM. THE TYPIST (OR KEYPUNCH OPERATOR) TAKES NO NOTICE OF CARD FIELDS AT ALL. SHE IGNORES THE END OF A CARD. THE FIRST COLUMN OF A CARD FOLLOWS IMMEDIATELY THE LAST COLUMN OF THE PRECEDING CARD. FURTHERMORE, SHE IGNORES ANY 'ACCIDENTAL' RETURNING-OF-THE-CARRIAGE OR GOING-TO-A-NEW-PAGE WHOSE OCCURRENCE DEPENDS ON THE SIZE OF THE PAPER AT HAND, THE PARTICULAR MARGIN STOPS CHOSEN, ETC. SIGNIFICANTLY, WE NOTE THAT THE PLACES WHERE LINES AND PAGES TERMINATE ON THIS DRAFT WILL BE QUITE DIFFERENT ON FUTURE DRAFTS DUE TO INSERTIONS AND DELETIONS

(R TO DECIDING THAT WE WOULD LIKE DIFFERENT MARGIN SETTINGS. WHAT IS KEYPUNCHED IS 'TEXT' AND 'EDITING INSTRUCTIONS'. THE TEXT IS THE MATERIAL WHICH IS TO APPEAR ON THE PRINTED PAGE. THE EDITING INSTRUCTIONS CORRESPOND IN PART TO THE USUAL NON-PRINTING TYPEWRITER KEYS SUCH AS RETURNING THE CARRIAGE, TABBING TO THE NEXT STOP, ETC. ALSO INCLUDED IN THE EDITING INSTRUCTIONS ARE INDICATIONS AS TO WHAT THE TAB STOPS ARE, HOW WIDE A LINE ON A PAGE SHOULD BE, HOW LONG A PAGE SHOULD BE, THE FACT THAT A NEW PAGE IS DESIRED NO MATTER WHERE ON THE PAGE WE ARE, THAT SOME LINES ARE TO BE SKIPPED, PLUS TWO SPECIAL INSTRUCTIONS TO ALLOW FOR INSERTION AND DELETION IN THE MIDDLE OF A CARD. A (1401) COMPUTER PROGRAM, KNOWN AS 'THE DOCUMENT MACHINE', READS, AS DATA, THE DECK OF CARDS CONTAINING THE COMMINGLED TEXT AND EDITING INSTRUCTIONS. IT PRINTS THE TEXT ACCORDING TO BOTH THE EDITING INSTRUCTIONS AND ITS OWN LOGIC. THAT LOGIC INCLUDES AUTOMATICALLY TERMINATING LINES AND PAGES. WHEN A LINE IS AUTOMATICALLY TERMINATED A 'WORD' IS NOT SPLIT. A WORD IS DEFINED TO BE A CONTIGUOUS SET OF NON-SPACE CHARACTERS. WHENEVER A WORD TO BE ADDED TO THE PRINT LINE WOULD EXCEED THE ALLOWABLE (MAXIMUM) LINE SIZE, AUTOMATIC SEGMENTATION OF THE LINE OCCURS. SPACES KEYPUNCHED TO THE RIGHT OF THE LAST WORD APPEARING ON AN AUTOMATICALLY TERMINATED LINE ARE DISCARDED. WHENEVER A LINE TO BE ADDED TO THE PAGE WOULD EXCEED THE ALLOWABLE (MAXIMUM) PAGE SIZE, AUTOMATIC SEGMENTATION OF THE PAGE OCCURS.

THE EDITING INSTRUCTIONS
.....

LET US EXAMINE THE FOURTEEN EDITING INSTRUCTIONS.

- TAB•E•
- SKIP•S•
- PARA•
- NEW•PAGE•
- SET•E•052•
- LEFT•MARGIN•B•
- RIGHT•MARGIN•Q•
- PAGE•SIZE•038•
- SPEC•
- START•PARA•G•
- PUNCH•A•
- END•DOC•
- VCID•
- OK•

THERE ARE EXACTLY TWENTY-SIX 'SYMBOLIC' (OR VARIABLE) TABULATING STOPS, 'A', 'B', ... 'Z'. AN INSTRUCTION SUCH AS '*TAB*D*' TELLS THE PROCESSING 1401 PROGRAM TO TAB TO D. SINCE EACH OF THE TAB STOPS HAS BEEN ASSIGNED A POSITION ON THE PRINT LINE, TABBING TO (SAY) D MEANS MOVING OVER TO THAT PRINT POSITION CURRENTLY ASSIGNED TO D. ANY MISPELLING OF THE TAB INSTRUCTION, E.G., '*TAB*5*', IS SIMPLY NOT A TAB INSTRUCTION BUT IS TEXT. (THE SAME IS TRUE FOR ANY MISPELLED INSTRUCTION.) WHEN THE PROCESSING PROGRAM ENCOUNTERS A SKIP-SOME-LINES INSTRUCTION SUCH AS '*SKIP*0*' IT ENDS AND PRINTS THE CURRENT LINE SKIPPING DOWN AS MANY AS TOLD TO (FROM 0 TO 9 ONLY). THE NEW LINE STARTS AT THE TAB STOP SPECIFIED BY THE MOST RECENT LEFT-MARGIN INSTRUCTION. THE PARAGRAPH INSTRUCTION, '*PARA*', WHICH HAS NO PARAMETERS, ENDS AND PRINTS THE CURRENT LINE, SKIPS A LINE AND STARTS THE NEXT LINE AT THE TAB STOP ASSIGNED BY THE MOST RECENTLY EXECUTED START-PARAGRAPH INSTRUCTION. '*NEW*PAGE*' ENDS BOTH THE CURRENT LINE AND PAGE, STARTING THE NEXT LINE ON THE NEXT PAGE AT THE LEFT MARGIN TAB STOP. THE TAB STOPS ARE SET (AS MANY TIMES AS ONE WANTS) BY MEANS OF THE SET INSTRUCTION. THEY MAY BE SET TO ANY PRINT POSITION BETWEEN 001 AND 131 INCLUSIVE. THE POINT AT WHICH A LINE IS AUTOMATICALLY TERMINATED MAY BE SET BY THE RIGHT-MARGIN INSTRUCTION. SIMILARLY, THE POINT AT WHICH A NEW LINE STARTS MAY BE SET BY THE LEFT-MARGIN INSTRUCTION. THUS THE MARGINS MAY BE SET TO ANY OF THE TWENTY-SIX TAB STOPS, FROM A TO Z. THE PAGE-SIZE INSTRUCTION SETS THE MAXIMUM ALLOWABLE NUMBER OF LINES PER PAGE (EXCLUDING PAGE HEADINGS AND CLASSIFICATION). WE HANDLE ANY CHARACTERS WHICH ARE NOT AVAILABLE ON THE PRINTER BY MEANS OF THE SPECIAL INSTRUCTION, '*SPEC*'. THE PROCESSING PROGRAM REPLACES THIS INSTRUCTION BY A SPACE BUT DOES NOT CONSIDER IT A SPACE FOR THE PURPOSE OF DIVIDING WORDS. IN ADDITION, AFTER THE ENTIRE DOCUMENT IS PRINTED A 'REMINDER' LIST IS PRINTED. THIS LIST CONTAINS THE LINE NUMBER, PAGE NUMBER AND THE NUMBER OF SPECIAL OCCURRENCES ON THAT LINE. THUS YOU HAVE A CHECK LIST TO BE USED WHEN FILLING IN THOSE SPECIAL CHARACTERS. THE PUNCH INSTRUCTION CAUSES A PORTION OF THE CURRENT PRINT LINE TO BE PUNCHED INTO A CARD. THE '*END*DOC*' INSTRUCTION IS TO BE USED ONCE AND ENDS THE DOCUMENT. THE REMAINING TWO INSTRUCTIONS, '*VOID*' AND '*OK*', ARE USED FOR MAKING CORRECTIONS AT A LATER TIME.

ANY TIME '*VOID*' IS ENCOUNTERED BY THE PROCESSING PROGRAM, IT NEITHER PRINTS IT NOR ANYTHING ELSE ENCOUNTERED UNTIL THE '*OK*' INSTRUCTION IS ENCOUNTERED. THE '*OK*' INSTRUCTION IS THE ONLY ONE RECOGNIZED INSIDE A VOID AREA AND IS NOT RECOGNIZED OUTSIDE (EXCEPT AS TEXT). THE COMBINATION OF THESE TWO INSTRUCTIONS ALLOWS FOR INSERTION AND DELETION OF TEXT OR INSTRUCTIONS WITHOUT REPUNCHING SUBSEQUENT CARDS.

THE FOURTEEN EDITING INSTRUCTIONS WERE CHOSEN IN ORDER THAT THEY MIGHT BE EASILY RECOGNIZED BY HUMANS, NOT BE LIKELY TO APPEAR

IN MOST DOCUMENTS AND BE SHORT ENOUGH TO KEYPUNCH READILY. IT IS FELT THAT MOST DOCUMENTS CAN BE HANDLED WITH A COMBINATION OF TEXT AND EDITING INSTRUCTIONS. SEE APPENDIX B BELOW FOR DETAILED DESCRIPTIONS OF THE EDITING INSTRUCTIONS. THIS VERY DOCUMENT YOU ARE READING WAS PREPARED BY MEANS OF THE SYSTEM IT DESCRIBES.

THERE SHOULD BE NO CONFUSION ABOUT EXACTLY WHICH STRINGS CONSTITUTE EDITING INSTRUCTIONS AND WHICH DO NOT. THE SCAN PROCEEDS FROM LEFT TO RIGHT. HENCE, THE INTERPRETATION OF STRINGS AS EDITING INSTRUCTIONS, LOGICALLY SPEAKING, IS LEFT-ASSOCIATIVE. WHETHER A STRING THAT LOOKS LIKE AN EDITING INSTRUCTION IS THAT EDITING INSTRUCTION DEPENDS UPON CONTEXT, E.G., AN OCCURRENCE OF '*PARA*' MAY BE A SUBSTRING OF AN OCCURRENCE OF '*START*PARA*J*'. THE STRING

*NEW*PAGE*NEW*PAGE*NEW*PAGE*

SHOULD PRODUCE A NEW PAGE WITH

NEW*PAGE

AS THE ONLY TEXT IN THE BODY OF THAT PAGE (I.E., ASSUMING NOTHING OF CONSEQUENCE TO THE LEFT OF THE STRING IN QUESTION). ONCE YOU SEE THE LEFT-ASSOCIATIVE RULE, AMBIGUITIES ARE CLEARED UP. FURTHERMORE, THERE IS NO NEED TO GO CLEAR BACK TO THE BEGINNING OF THE DOCUMENT DECK. ONE MUST LOOK, AT MOST, TWENTY CHARACTERS TO THE LEFT OF THE STRING IN QUESTION.

THE SYSTEM IN USE
.....

LET US EXAMINE A DETAILED EXAMPLE OF HOW THIS SYSTEM WAS USED TO PREPARE ITS OWN DOCUMENTATION. WE SEE BELOW IN FIGURE 1 THE DOUBLE-SPACED VERBATIM LISTING OF THE FIRST TWELVE CARDS TYPED (I.E., KEYPUNCHED) FOR THIS DOCUMENT. (NOTE THAT ONLY SEVENTY-TWO COLUMNS ARE USED. COLUMNS 73 - 80 ARE RESERVED FOR IDENTIFICATION AND SEQUENCING TO BE ADDED AUTOMATICALLY LATER.)

*SKIP*6**TAB*D*AUTOMATED DOCUMENTATION*SKIP*6**PARA*A NEW SYSTEM HAS BEEN DESIGNED BY THE AUTHOR IN WHICH MUCH OF REPETITIVE WORK ASSOCIATED WITH PREPARING THE FINAL DRAFT OF A TECHNICAL DOCUMENT HAS BEEN ELIMINATED. IT IS FELT THAT MUCH OF THE FIRST DRAFT OF A DOCUMENT SURVIVES THE VARIOUS RETYPING OF SUBSEQUENT DRAFTS RIGHT THROUGH TO THE FINAL DOCUMENT. CHANGES ARE MADE HERE AND THERE, PORTIONS ARE ADDED AND DELETED. IF ONLY THE 'GOOD' PORTIONS COULD BE RETAINED WHILE ADDING AND DELETING, THE PROCESS OF OBTAINING THE FINAL DOCUMENT (OR, AT LEAST, FINAL DRAFT) WOULD BE ENORMOUSLY SPEEDED UP. THIS IS EXACTLY WHAT HAS BEEN DESIGNED INTO THE SYSTEM WHICH THIS DOCUMENT DESCRIBES. THE SYSTEM IS LARGELY 'MANUAL', WITH A (11401) COMPUTER RUN REQUIRED ONLY OCCASSIONALLY AS THE FINAL STEP IN THE PROCEDURE.*PARA*INSTEAD OF UTILIZING A MANUAL OR ELECTRIC TYPEWR

FIGURE 1

DOUBLE-SPACED VERBATIM LISTING OF THE FIRST TWELVE CARDS (WITH ERRORS) PUNCHED TO PRODUCE THIS DOCUMENT.

PAGE 0006

THESE TWELVE CARDS INCLUDE THE TITLE OF THE DOCUMENT, 'AUTOMATED DOCUMENTATION', THE FIRST PARAGRAPH AND A FRAGMENT OF THE SECOND PARAGRAPH. ALSO INCLUDED ARE THE EDITING INSTRUCTIONS THAT PROVIDE FOR THE PARAGRAPH SPACING AND INDENTATION AS WELL AS FOR THE HORIZONTAL AND VERTICAL PLACEMENT OF THE TITLE. PROOFREADING OF THE COMPUTER-PROGRAM-PRODUCED DOCUMENT INDICATED THREE TYPOGRAPHICAL ERRORS TO BE CORRECTED. THE WORDS 'REPETITIVE' (IN THE SECOND CARD) AND 'OCCASIONALLY' (IN THE ELEVENTH) HAD BEEN MISPELLED. THE SPACE THAT SHOULD FOLLOW THE COMMA IN THE SEVENTH CARD HAD BEEN OMITTED. IT WAS ALSO DECIDED THAT THE PHRASE 'AS THE FINAL STEP' (ALSO IN THE ELEVENTH CARD) WOULD BE ELIMINATED FROM THE LAST SENTENCE OF THE PARAGRAPH. FIGURE 2 SHOWS A COMPUTER-PRODUCED LISTING OBTAINED FROM THE CARDS SHOWN IN FIGURE 1.

AUTOMATED DOCUMENTATION

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INSTEAD OF UTILIZING A MANUAL OR ELECTRIC TYPEWR...

FIGURE 2

LISTING PRODUCED USING CARDS SHOWN IN FIGURE 1.

PAGE 0008

WE NOTE THAT THE SECOND CARD IN FIGURE 1 MUST HAVE THE TWO LETTERS 'TI' INSERTED IN THE MIDDLE IN ORDER TO CORRECT THE MISSPELLING. THIS IS EASILY ACCOMPLISHED BY REPLACING THIS CARD BY TWO OTHERS OBTAINED AS FOLLOWS. ON THE KEY PUNCH MACHINE WE DUPLICATE THE CARD UP TO (BUT NOT INCLUDING) THE 'V' IN THE MISSPELLED 'REPETIVE'. WE THEN PUNCH THE MISSING 'TI' FOLLOWED IMMEDIATELY BY '*VOID*'. THE REMAINDER OF THE COLUMNS MAY BE LEFT BLANK. THE OTHER CARD IS THE COPY OF THE REMAINDER OF THE ERROR CARD (FROM THE 'V' ON) WITH THE EDITING INSTRUCTION '*OK*' IMMEDIATELY PRECEDING IT. THE INITIAL COLUMNS OF THIS CARD (UP TO THE '*OK*') MAY BE LEFT BLANK. THESE TWO REPLACEMENT CARDS EFFECTIVELY INSERT THE MISSING 'TI'. THEY ARE OBTAINED 'ARGELY BY DUPLICATING THE CORRECT PORTIONS OF THE ERROR CARD AND DO NOT REQUIRE THE RETYPING OF THE FOLLOWING CARDS. THE MISSING SPACE IN THE SEVENTH CARD WAS INSERTED BY A SIMILAR PROCEDURE. THE ELEVENTH CARD WAS REPAIRED BY DUPLICATING IT THROUGH THE FIRST 'S' IN 'OCCASSIONALLY', TYPING 'IONALLY' FOLLOWED BY A VOID-OK PAIR OF EDITING INSTRUCTIONS TO FILL OUT THE REST OF THE CARD. THUS BOTH THE SUPERFLUOUS 'S' AS WELL AS THE 'AS THE FINAL STEP' PHRASE WERE DELETED. SEE FIGURE 3 BELOW FOR A DOUBLE-SPACED VERBATIM LISTING OF THE CORRECTED FIRST PARAGRAPH.

*SKIP*6**TAB*D*AUTOMATED DOCUMENTATION*SKIP*6**PARA*A NEW SYSTEM HAS BEEN DESIGNED BY THE AUTHOR IN WHICH MUCH OF REPETITIVE

WORK ASSOCIATED WITH PREPARING THE FINAL DRAFT OF A TECHNICAL DOCUMENT HAS BEEN ELIMINATED. IT IS FELT THAT MUCH OF THE FIRST DRAFT OF A DOCUMENT SURVIVES THE VARIOUS RETYPING OF SUBSEQUENT DRAFTS RIGHT THROUGH TO THE FINAL DOCUMENT. CHANGES ARE MADE HERE AND THERE, PORTIONS ARE ADDED AND DELETED. IF ONLY THE 'GOOD' PORTIONS COULD BE RETAINED WHILE ADDING AND DELETING, VOID

THE PROCESS OF OBTAINING THE FINAL DOCUMENT (OR, AT LEAST, FINAL DRAFT) WOULD BE ENORMOUSLY SPEEDED UP. THIS IS EXACTLY WHAT HAS BEEN DESIGNED INTO THE SYSTEM WHICH THIS DOCUMENT DESCRIBES. THE SYSTEM IS LARGELY 'MANUAL', WITH A (1401) COMPUTER RUN REQUIRED ONLY OCCASIONALLY. OK
IN THE PROCEDURE. PARA INSTEAD OF UTILIZING A MANUAL OR ELECTRIC TYPEWR

FIGURE 3

DOUBLE-SPACED VERBATIM LISTING OF NEW DECK RESULTING FROM CORRECTING CARDS OF FIGURE 1.

PAGE 0010

THE BREAKPOINT TECHNIQUE
.....

WE HAVE SEEN HOW TO INSERT SEVERAL CHARACTERS BETWEEN ADJACENT COLUMNS. THE SAME TECHNIQUE IS USED FOR INSERTING SEVERAL WORDS. HOWEVER, IT IS A FREQUENT OCCURRENCE IN THE BUILDING OF A DOCUMENT THAT SEVERAL SENTENCES ARE TO BE INSERTED. THEN A DIFFERENT PROCEDURE MAY BE FOLLOWED. LET US SUPPOSE THAT WE HAVE ALREADY WRITTEN AND KEYPUNCHED THE MATERIAL SHOWN IN FIGURE 4. THE CARDS THAT PRODUCE THIS MATERIAL ARE SHOWN IN FIGURE 5. WE ASSUME THAT WE ARE SATISFIED WITH THE PARTS THAT CURRENTLY EXIST BUT WISH TO MODIFY IT BY MAKING THREE INSERTIONS. FIGURE 6 SHOWS HOW WE MIGHT MARK THE DRAFT SHOWING WHAT THE INSERTIONS ARE AND WHERE THEY GO.

PAGE 0011

THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE CAN BE FLIPPED OFF IN AN UPRIGHT POSITION.

NOW WE CONSIDER THE PROBLEM OF HOW TO CO...

FIGURE 4

AN EXAMPLE OF A PORTION OF AN EARLY DRAFT.

PAGE 0012

•PARA•THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE CAN BE FLIPPED OFF IN AN UPRIGHT POSITION. •PARA•NOW WE CONSIDER THE PROBLEM OF HOW TO CO

FIGURE 5

DOUBLE-SPACED VERBATIM LISTING OF THE CARDS THAT PRODUCE THE DRAFT SHOWN IN FIGURE 4.

[Insert 1] The occupant(s) will have fallen in
the water and

THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. ① THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. ② YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE CAN BE FLIPPED OFF IN AN UPRIGHT POSITION.

NOW WE CONSIDER THE PROBLEM OF HOW TO CO...

[Insert 2] Then after swimming around to the other side (the side away from the mast), the canoe may be righted by standing on the lower leeboard while pulling on the mast. An alternate procedure is possible and has much to recommend it.

[Insert 3] will be high and dry on top of the inner tube when upon it

FIGURE 6

THE DRAFT MARKED FOR INSERTIONS.

PAGE 0014

WE 'BREAK' THE DOCUMENT AT THE POINTS OF INSERTION AS FOLLOWS. WE DUPLICATE THE CARD UP TO THE POINT OF INSERTION, THEN PUNCH '•VOID•' WITH THE FIRST ASTERISK IN THE POSITION WHERE THE FIRST CHARACTER OF THE INSERTION IS TO GO. WE THEN PUNCH '•OK•' IN COLUMNS 69-72. (IN SOME CASES THIS WILL REQUIRE TWO CARDS.) NOW ON A FRESH CARD WE PUNCH '•VOID•' STARTING IN COLUMN 1 AND PUNCH '•OK•' IMMEDIATELY TO THE LEFT OF THE FIRST COLUMN NOT DUPLICATED ABOVE. THEN THIS CARD IS COMPLETED BY DUPLICATING THE PART OF THE ORIGINAL CARD PAST THE POINT OF INSERTION. NOTE THAT WHILE WE HAVE NOT YET MADE ANY INSERTIONS WE HAVE PREPARED THE DOCUMENT DECK SO THAT ANY INSERTION CARDS CAN BE PLACED BETWEEN TWO CARDS. OF COURSE, THE INSERTION MATERIAL WILL START IN COLUMN 1 AND WILL END WITH A VOIDED AREA THROUGH COLUMN 72 SO THAT NO UNWANTED SPACES ARE INSERTED. IN THE UNLIKELY EVENT THAT A POINT OF INSERTION IS BETWEEN TWO CARDS, THE ABOVE PROCEDURE IS NOT NECESSARY. SEE FIGURE 7 FOR THE REVISED DOCUMENT DECK WHICH, THOUGH CONTAINING THE THREE BREAKPOINTS, WILL STILL PRODUCE THE SAME DOCUMENT AS BEFORE.

•PARA•THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. •VOID• •OK•

•VOID• •OK•THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. •VOID• •OK•

•VOID• •OK•YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE •VOID• •OK•

•VOID• •OK•CAN BE FLIPPED OFF IN AN UPRIGHT POSITION. •PARA•NOW WE CONSIDER THE PROBLEM OF HOW TO CO

FIGURE 7

DOUBLE-SPACED VERRATIM LISTING OF THE DOCUMENT DECK 'BROKEN' AT THE POINTS WHERE THE INSERTIONS ARE DESIRED.

PAGE 0016

WE NOW TYPE THE INSERTIONS MAKING SURE THAT EACH STARTS A CARD IN COLUMN 1 AND, UNLESS IT FINISHES EXACTLY ON COLUMN 72 OF SOME CARD, ENDS WITH A VOIDED AREA THROUGH COLUMN 72. EACH INSERTION CAN BE PRECEDED BY A CARD WHICH DOES SOME VERTICAL SPACING AND TELLS WHAT INSERTION NUMBER FOLLOWS. SEE FIGURE 8 FOR THE VERBATIM LISTING OF THE THREE INSERTIONS AND FIGURE 9 FOR THE RESULTANT PRINTED DOCUMENT WHICH CONSISTS OF ONLY THE INSERTIONS.

•SKIP•2•INSERT 1 •SKIP•2••VOID• •OK•
THE OCCUPANT(S) WILL HAVE FALLEN IN THE WATER AND •VOID• •OK•
•SKIP•2•INSERT 2 •SKIP•2••VOID• •OK•
THEN, AFTER SWIMMING AROUND TO THE OTHER SIDE (THE SIDE AWAY FROM THE MA
ST), THE CANOE MAY BE RIGHTED BY STANDING ON THE LOWER LEEBOARD WHILE PU
LLING ON THE MAST. THEN THE ARDUOUS TASK OF BAILING COMMENCES. AN ALTE
RNATE PROCEDURE IS POSSIBLE AND HAS MUCH TO RECOMMEND IT. •VOID• •OK•
•SKIP•2•INSERT 3 •SKIP•2••VOID• •OK•
WILL BE HIGH AND DRY ON TOP OF THE INNER TUBE WHEREUPON IT •VOID• •OK•

FIGURE 8

DOUBLE-SPACED VERBATIM LISTING OF THE THREE SETS OF INSERTION CARDS.

PAGE 0018

INSERT 1

THE OCCUPANT(S) WILL HAVE FALLEN IN THE WATER AND

INSERT 2

THEN, AFTER SWIMMING AROUND TO THE OTHER SIDE (THE SIDE AWAY FROM THE MAST), THE CANOE MAY BE RIGHTED BY STANDING ON THE LOWER LEEBOARD WHILE PULLING ON THE MAST. THEN THE ARDUOUS TASK OF BAILING COMMENCES. AN ALTERNATE PROCEDURE IS POSSIBLE AND HAS MUCH TO RECOMMEND IT.

INSERT 3

WILL BE HIGH AND DRY ON TOP OF THE INNER TUBE WHEREUPON IT

FIGURE 9

THE DOCUMENT PRODUCED BY FEEDING THE CARDS OF FIGURE 8 TO THE DOCUMENT MACHINE PROGRAM.

PAGE 0019

THE IDEA OF RUNNING THE INSERTIONS SEPARATELY AT FIRST IS TO BE ABLE TO PROOFREAD ONLY THE INSERTIONS. ONCE THEY HAVE BEEN CORRECTED (IF NECESSARY) EACH MAY BE DROPPED IN THE PLACE PREPARED FOR IT IN THE DOCUMENT DECK. WE SEE IN FIGURE 10 THE DOCUMENT DECK AFTER THE THREE INSERTIONS HAVE BEEN PUT IN, AND IN FIGURE 11, WE SEE THE DOCUMENT PRODUCED USING THE FIGURE 10 CARDS AS INPUT TO THE DOCUMENT MACHINE PROGRAM. (OF COURSE, THE CARDS WITH THE IDENTIFYING INSERTION NUMBER ARE DISCARDED.)

•PARA•THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. •VOID• •OK•
THE OCCUPANT(S) WILL HAVE FALLEN IN THE WATER AND •VOID• •OK•
•VOID• •OK•THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. •VOID• •OK•
THEN, AFTER SWIMMING AROUND TO THE OTHER SIDE (THE SIDE AWAY FROM THE MAST), THE CANOE MAY BE RIGHTED BY STANDING ON THE LOWER LEEBOARD WHILE PULLING ON THE MAST. THEN THE ARDUOUS TASK OF BAILING COMMENCES. AN ALTERNATE PROCEDURE IS POSSIBLE AND HAS MUCH TO RECOMMEND IT. •VOID• •OK•
•VOID• •OK•YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE •VOID• •OK•
WILL BE HIGH AND DRY ON TOP OF THE INNER TUBE WHEREUPON IT •VOID• •OK•
•VOID• •OK•CAN BE FLIPPED OFF IN AN UPRIGHT POSITION. •PARA•NOW WE CONSIDER THE PROBLEM OF HOW TO CO

FIGURE 10

DOUBLE-SPACED VERBATIM LISTING OF THE 'BROKEN' DOCUMENT DECK WITH THE INSERTIONS IN PLACE.

THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. THE OCCUPANT(S) WILL HAVE FALLEN IN THE WATER AND THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. THEN, AFTER SWIMMING AROUND TO THE OTHER SIDE (THE SIDE AWAY FROM THE MAST), THE CANOE MAY BE RIGHTED BY STANDING ON THE LOWER LEEBOARD WHILE PULLING ON THE MAST. THEN THE ARDUOUS TASK OF BAILING COMMENCES. AN ALTERNATE PROCEDURE IS POSSIBLE AND HAS MUCH TO RECOMMEND IT. YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE WILL BE HIGH AND DRY ON TOP OF THE INNER TUBE WHEREUPON IT CAN BE FLIPPED OFF IN AN UPRIGHT POSITION.

NOW WE CONSIDER THE PROBLEM OF HOW TO CO...

FIGURE 11

THE NEW DRAFT (WITH THE THREE INSERTIONS) PRODUCED BY CARDS OF FIGURE 10.

YOU WILL NOTE UPON CAREFUL EXAMINATION OF FIGURE 11 THAT THERE ARE THREE SPACES BETWEEN THE SECOND INSERT AND THE NEXT SENTENCE, I.E., BETWEEN THE TERMINAL CHARACTER OF 'TO RECOMMEND IT.' AND THE INITIAL CHARACTER OF 'YOU MUST BE'. HOWEVER, WE SEE IN FIGURE 10 (ON THE NINTH CARD) THAT THERE ARE TWO SPACES BETWEEN 'TO RECOMMEND IT.' AND THE VOID INSTRUCTION AND (ON THE TENTH CARD) THERE ARE NO SPACES BETWEEN THE OK INSTRUCTION AND 'YOU MUST BE'. WHY THEN DID THE DOCUMENT MACHINE PROGRAM PUT IN THE EXTRA SPACE? THIS SITUATION WAS POINTED OUT TO ME BY ONE OF THE REVIEWERS OF AN EARLIER VERSION OF THIS DOCUMENT (A VERSION THAT DID NOT CONTAIN THE PARAGRAPH YOU ARE NOW READING). DESPITE APPEARANCES TO THE CONTRARY, THE DOCUMENT MACHINE PROGRAM MADE NO MISTAKE. THE ERROR WAS MADE BY THE AUTHOR IN KEYPUNCHING AND SHOWS UP MOST CLEARLY IN FIGURE 8. I LEAVE IT AS AN EXERCISE FOR THE READER TO FIND THE EXTRA SPACE.

THE SQUEEZE PROGRAM

IT CAN BE EASILY SEEN THAT AFTER SEVERAL ITERATIONS OF CORRECTING THE CARD DECK THAT CONSTITUTES OUR RAW DOCUMENT, THAT DECK MAY ACQUIRE QUITE A FEW VOIDED AREAS. EACH TIME THE DOCUMENT MACHINE PROGRAM READS THE DECK TO PRODUCE THE LATEST DRAFT, IT MUST SCAN THROUGH THESE VOIDED AREAS, SOMEWHAT INCREASING ITS RUNNING TIME. FURTHERMORE, IF AN ORIGINAL CARD HAS BEEN BROKEN UP INTO SEVERAL PIECES BECAUSE OF SEPARATELY MADE CHANGES, IT IS MORE DIFFICULT FOR HUMANS TO READ THIS MATERIAL SHOULD THERE HAVE TO BE FURTHER CHANGES IN THE VICINITY. ALSO WE WOULD LIKE TO MINIMIZE PHYSICAL STORAGE REQUIREMENTS FOR THE DOCUMENT DECKS AND (LATER ON) FOR THE MAGNETIC TAPES STORING THE DOCUMENTS. HENCE, EVERY SO OFTEN WE WOULD LIKE A NEW DOCUMENT DECK WITH THE VOIDED AREAS SQUEEZED OUT. A SECOND (1401) PROGRAM IS INCLUDED IN THE AUTOMATED DOCUMENTATION SYSTEM WHICH DOES THIS. THIS PROGRAM, CALLED 'SQUEEZE', COPIES THE DOCUMENT DECK, SQUEEZING OUT THE VOIDED AREAS. IN ADDITION, THE NEW DECK IS PUNCHED IN COLUMNS 73-75 WITH AN IDENTIFYING SET OF THREE CHARACTERS AND SEQUENTIALLY NUMBERED IN COLUMNS 76-80. THE THREE CHARACTERS ALLOW US TO IDENTIFY OR MARK DECKS OR PORTIONS OF DECKS. THE SEQUENTIAL NUMBERING ALLOWS US TO SORT ANY ACCIDENTALLY DROPPED DECKS.

THERE IS A NEW INSTRUCTION

•END•SECTION•

WHICH IS RECOGNIZED BY THE SQUEEZE PROGRAM. (HOWEVER, THIS SAME STRING IS NOT RECOGNIZED AS AN INSTRUCTION BY THE DOCUMENT MACHINE BUT IS PRINTED AS TEXT.) UPON ENCOUNTERING THIS INSTRUCTION, THE SQUEEZE PROGRAM TERMINATES THE CARD IT IS THEN PUNCHING WITH A VOIDED AREA. THE MATERIAL FOLLOWING THIS INSTRUCTION, THEREFORE, STARTS A NEW CARD. THE INSTRUCTION ITSELF IS NOT COPIED. THUS, 'BREAKPOINTS' IN THE NEWLY PUNCHED DOCUMENT DECK MAY BE CREATED. ONE OF THE USES OF THIS NEW INSTRUCTION IS TO MAINTAIN BREAKPOINTS WHILE REMOVING ALL OTHER VOIDED AREAS. THIS MAY BE ACCOMPLISHED, E.G., BY INSERTING A CARD CONTAINING THE END-SECTION INSTRUCTION ONLY (THE REST IS VOIDED) AT EACH EXISTING BREAKPOINT IN THE DECK TO BE SQUEEZED. IF IT IS DESIRABLE TO HAVE THE SQUEEZE PROGRAM PUNCH AN END-SECTION INSTRUCTION IN THE NEW DECK (ASSUMING YOU EXPECT ANOTHER SET OF CORRECTIONS BEFORE THE DOCUMENT IS FINAL) PLACE THE STRING

•END•SEC•VOID••OK•TION•

IN THE CARD WITH THE END-SECTION INSTRUCTION. WHEN THE VOIDED AREA IS SQUEEZED OUT, AN END-SECTION INSTRUCTION REMAINS TO BE PUNCHED IN THE COMPRESSED DECK. SQUEEZE RECOGNIZES (AND DOES NOT COPY) VOIDED AREAS AS WELL AS THE '•END•DOC•' EDITING INSTRUCTION. THIS LATTER TERMINATES THE PROGRAM. ANY OTHER EDITING INSTRUCTIONS ARE COPIED AS TEXT BY THE SQUEEZE PROGRAM. THE DECK SHOWN IN FIGURE 10 HAS VOIDED AREAS AS A RESULT OF THE CORRECTION PROCEDURES APPLIED. WHEN THESE CARDS ARE FED TO THE SQUEEZE PROGRAM, THEY ARE REPUNCHED AS SHOWN IN FIGURE 12.

•PARA•THE TIME WILL COME WHEN THE SAILING CANOE IS BLOWN OVER FOR ONE REASON OR ANOTHER. THE OCCUPANT(S) WILL HAVE FALLEN IN THE WATER AND THE IMMEDIATE PROBLEM IS TO RIGHT THE CANOE AND BAIL THE WATER OUT. THE FIRST THING TO DO IS TO LOWER THE SAIL. THEN, AFTER SWIMMING AROUND TO THE OTHER SIDE (THE SIDE AWAY FROM THE MAST), THE CANOE MAY BE RIGHTED BY STANDING ON THE LOWER LEEBOARD WHILE PULLING ON THE MAST. THEN THE ARDUOUS TASK OF BAILING COMMENCES. AN ALTERNATE PROCEDURE IS POSSIBLE AND HAS MUCH TO RECOMMEND IT. YOU MUST BE PREPARED BY HAVING AN INFLATED INNER TUBE IN THE CANOE. AFTER LOWERING THE SAIL, THE INFLATED INNER TUBE IS FORCED BENEATH THE UNDERWATER SIDE OF THE CANOE, AMIDSHIPS. THE CANOE WILL SLOWLY RISE, AND, AT THE SAME TIME, THE WATER WITHIN WILL RUN OUT. FINALLY THE CANOE WILL BE HIGH AND DRY ON TOP OF THE INNER TUBE WHEREUPON IT CAN BE FLIPPED OFF IN AN UPRIGHT POSITION. •PARA•NOW WE CONSIDER THE PROBLEM OF HOW TO COPE WITH CURIOUS FOLK WHO MUST LOOK BEYOND THE E

FIGURE 12

DOUBLE-SPACED VERBATIM LISTING OF SQUEEZED CARDS OF FIGURE 10. (NOTE THAT THE IDENTIFICATION AND SEQUENCING, COLS 73-90, HAVE BEEN OMITTED FROM THE FIGURE).

OTHER TECHNIQUES

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TABULAR MATERIAL CAN BE HANDLED BY A VARIETY OF METHODS. FOR TABLES THAT ARE NOT TOO COMPLICATED, I.E., NOT MANY COLUMNS, THE TYPIST CAN SIMPLY TYPE THE APPROPRIATE TAB INSTRUCTION BEFORE TYPING EACH ENTRY. IF THE ENTRIES ARE TO BE RIGHT JUSTIFIED, E.G., NUMERALS, THE TYPIST TYPES ZERO OR MORE SPACES BETWEEN THE TAB INSTRUCTION AND THE ENTRY. AN OCCASIONAL ERROR IN, SAY, THE NUMBER OF SPACES CAN BE EASILY CORRECTED BY THE INSERTION (OR ANALOGOUS DELETION) TECHNIQUE GIVEN ELSEWHERE IN THIS PAPER. SHOULD THE TYPING OF THE SEVEN-CHARACTER TAB EDITING INSTRUCTION PROVE FATIGUING, THE KEYPUNCH DRUM CARD CAN BE USED TO GREAT ADVANTAGE. FOR MATERIAL THAT WILL FIT WITHIN THE SEVENTY-TWO COLUMNS OF A SINGLE CARD, THE DRUM CARD MAY BE SET UP IN FIELDS TO CORRESPOND TO THE TABULAR MATERIAL. THEN THE SKIP KEY ON THE KEY PUNCH IS ACTIVATED TO GO FROM FIELD TO FIELD AS IS USUALLY DONE IN KEYPUNCHING. A BETTER DRUM CARD TECHNIQUE, ORIGINATED AS PART OF THIS AUTOMATED DOCUMENTATION SYSTEM, IS TO PUNCH THE TAB EDITING INSTRUCTIONS IN THE FIRST CARD WITH JUST ENOUGH ROOM BETWEEN FOR THE ENTRIES. THEN, A DRUM CARD IS USED THAT AUTOMATICALLY DUPLICATES THE TAB INSTRUCTIONS AND STOPS FOR THE TYPIST TO FILL IN THE ENTRIES. IF ONE LINE OF THE TABULAR MATERIAL DOES NOT FIT ON A SINGLE CARD, IT MAY BE DIVIDED UP INTO, SAY, TWO HALVES. THE ENTIRE LEFT HALF CAN BE KEYPUNCHED, THEN THE ENTIRE RIGHT HALF. THE TWO HALVES CAN BE COLLATED EITHER MANUALLY OR USING THE EAM COLLATOR.

WHEN TYPING TABULAR MATERIAL USING TAB EDITING INSTRUCTIONS, WE DO NOT HAVE TO DECIDE AT THE TIME OF TYPING EXACTLY WHERE THE COLUMNS ARE TO BE IN THE FINISHED DOCUMENT. SINCE THE TAB STOPS ARE SYMBOLIC (OR VARIABLE) WE CAN PRINT THE MATERIAL (USING THE DOCUMENT MACHINE PROGRAM) WITH SOME APPROXIMATE TAB SETTINGS. THEN, IF THE COLUMNS ARE NOT SPACED TO OUR LIKING, WE RESET THE TAB STOPS BY PLACING A FEW 'SET' EDITING INSTRUCTIONS AT THE BEGINNING OF THE DOCUMENT DECK. THUS, WITHOUT RETYPING THE COMPLICATED TABULAR MATERIAL WE CAN GET THE ENTIRE DOCUMENT REPRINTED WITH DIFFERENT SPACING BETWEEN COLUMNS.

SIMILARLY FOR THE MARGINS, NUMBER-OF-LINES PER PAGE, ETC. NO NEED FOR THE TYPIST TO DO HANDSTANDS AT THE KEYBOARD. ANY CHANGES IN, SAY, MARGIN SETTINGS MAY BE ACCOMPLISHED LATER BY INSERTING THE DESIRED EDITING INSTRUCTIONS AT THE PLACES WANTED IN THE DOCUMENT DECK. THE TEXT MAY APPEAR ON ONE SIDE OF THE PAGE, SAY

ON THE RIGHT,

OR ON THE OTHER
SIDE, SAY ON THE
LEFT. IT MAY BE

IN
SKINNY
SMALL
LINES

OR AS WIDE AS EITHER THE PAPER OR THE PRINT LINE
WILL ALLOW. ALL THIS WITHOUT THE TYPIST'S PUTTING IN CARRIAGE
RETURNS AT THE END OF ANY LINE.

WITHIN THE EAM FIELD ARE USED WHAT ARE KNOWN AS 'TUB CARDS'.
THESE ARE PREPUNCHED CARDS 'PULLED' OR TAKEN FROM 'TUB FILES' AS
NEEDED RATHER THAN KEYPUNCHED AT THAT TIME. THEY ARE USUALLY
PREPARED BY GANG PUNCHING. SUCH A TECHNIQUE IS QUITE USEFUL IN
THE PREPARATION OF DOCUMENTS USING MY SYSTEM. IT IS USEFUL FOR
THOSE PARTS OF DOCUMENTS THAT ARE HIGHLY FORMATTED, THAT HAVE
REPEATED HEADINGS OR SENTENCES. APPENDIX B OF THIS DOCUMENT IS AN
EXAMPLE. MORE THAN HALF OF IT WAS PREPARED BY MEANS OF SUCH TUB
CARDS. IN THE EAM APPLICATIONS, TUB CARDS ARE USUALLY SINGLE
CARDS. HOWEVER, IN THE AUTOMATED DOCUMENT SYSTEM, THE REPEATED
HEADING, SENTENCE OR WHATEVER MAY NOT FIT ON ONE CARD. RATHER, IT
WILL BE ON A SET OF CARDS (ENDING, OF COURSE, WITH A VOIDED AREA).
SINCE A SET OF TWO OR MORE CARDS CANNOT BE DIRECTLY GANG PUNCHED,
THEY ARE MADE ON THE EAM REPRODUCER. AFTER KEY PUNCHING AND
CAREFULLY CHECKING THE PROTOTYPE SET, THE CARDS CONSTITUTING THE
SET ARE REPRODUCED. PUT THE OLD AND NEW DECKS TOGETHER AND
REPRODUCE AGAIN. NOW YOU HAVE FOUR SETS. ONCE AGAIN AND YOU HAVE
EIGHT. THEN SIXTEEN, THIRTY-TWO, ETC., DEPENDING ON HOW MANY SETS
YOU NEED.

AUTOMATED PRODUCTION OF STATUS-DISPLAYING DOCUMENTS

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BESIDES BEING USEFUL FOR THE CONVERGENT PROCESS OF PRODUCING
LARGE TECHNICAL DRAFTS, THE EXISTING SYSTEM CAN BE USED TO PRODUCE
REVISIONS OF THOSE STATUS-DISPLAYING DOCUMENTS THAT MUST BE
REISSUED FROM TIME TO TIME. ONE EXAMPLE IS THE RAC PUBLICATION
LIST, A DOCUMENT THAT LISTS ALL RAC DOCUMENTS. IT MUST BE
REVISED, E.G., EVERY TIME A DOCUMENT'S CLASSIFICATION CHANGES. A
SINGLE CHANGE ON A PAGE NECESSITATES THE ENTIRE PAGE, NOT JUST THE
CHANGE, BEING RETYPED. THEN, OF COURSE, THE ENTIRE PAGE MUST BE
PROOFREAD, THE LATTER REQUIRING TWO PEOPLE. HOWEVER, UNDER THE
AUTOMATED SYSTEM, AS SOON AS THIS (OR ANY) DOCUMENT HAS BEEN
KEYPUNCHED IT CAN BE CONTINUOUSLY MAINTAINED, READY FOR WHOLE OR
PARTIAL REISSUE AT ANY TIME. SEE FIGURE 13 FOR A SAMPLE OF THE
RAC PUBLICATION LIST PREPARED BY THIS SYSTEM. FIGURE 14 SHOWS THE
CARDS. WE SEE FROM THIS EXAMPLE HOW THE LEFT-MARGIN EDITING

PAGE 0027

INSTRUCTION SETS THE POINT AT WHICH NEW PRINT LINES BEGIN. THE EXCEPTION ARISES WHEN WE TAB TO A POINT TO THE LEFT OF WHERE THE CURRENT LINE IS AT THE TIME OF TABBING. SUBSEQUENT TEXT IS PRINTED ON THE NEXT LINE STARTING AT THAT TAB STOP -- EVEN IF IT IS TO THE LEFT OF THE 'LEFT MARGIN'. (HOWEVER, THOUGH NOT SHOWN IN THIS EXAMPLE, THE RIGHT MARGIN CANNOT BE VIOLATED. FOR TABBING TO A POINT TO THE RIGHT OF THE RIGHT MARGIN WILL CAUSE SUBSEQUENT TEXT TO GO ON THE NEXT LINE STARTING AT THE LEFT MARGIN). IT IS INTERESTING TO NOTE THAT, AT PRESENT, THE (EXTERNAL) RAC PUBLICATION LIST DOCUMENT IS ISSUED A YEAR-AND-A-HALF LATE. THERE IS NO ANALOGOUS RAC LIST FOR KEEPING TRACK OF DRAFTS. OF COURSE, OUR CUSTOMER, THE ARMY, HAS MANY SUCH DOCUMENTS THAT WOULD EASILY BE CONTINUOUSLY MAINTAINED UNDER THIS SYSTEM.

TECHNICAL MEMORANDA

- T-419 A PRELIMINARY INVESTIGATION OF FIELD-ARMY-MISSILE
 PENETRABILITY (U)
 JAN 64, SECRET-RESTRICTED DATA, STUDY 17.1, 184 PP
 (GROUP 1)
 WALTER ECKHARDT, RICHARD H. GRAMANN, SIDNEY T. MATHEWS,
 W. BRUCE TAYLOR, CHARLES W. HUMAN
- T-420 SPIKE WOUNDS IN THE VIETNAMESE GUERRILLA WAR (U)
(SEA) FEB 64, CONFIDENTIAL, STUDY 62.4.3, 33 PP, AD 349593,
 (GROUP 1)
 MARK J. EISNER AND SAM BUU SON
- T-421 EAST GERMANY'S ECONOMIC DEPENDENCE ON THE WEST) A
 POTENTIAL FOR STRATEGY (U)
 FEB 64, SECRET, STUDY RP-121, 46 PP, (GROUP 3)
 HEINZ C. KRAUSE
- T-422 RAC AIR ASSAULT CONCEPT STUDIES -- 1963 (U)
MAIN FEB 64, SECRET, STUDY C-511, 64 PP, (GROUP 4)
BODY MAJ GEN JAMES G. CHRISTIANSEN AND WILLIAM H. SUTHERLAND
- APP A, RAC AIR ASSAULT CONCEPT STUDIES -- 1963 (U)
 (OPERATIONAL PROBLEMS OF AIR ASSAULT FORCES EMPLOYED IN
 MIDDLE EAST (U))
 FEB 64, SECRET, STUDY C-511, 250 PP
 THE THEATRESPIEL GROUP
- VOL I APP B, CODEC I. A WAR GAME CONDUCTED FOR THE COMBAT
 DEVELOPMENTS COMMAND (U) (RAC AIR ASSAULT CONCEPT
 STUDIES -- 1963 (U))
 FEB 64, CONFIDENTIAL, STUDY C-511, 143 PP
 THE THEATRESPIEL GROUP

FIGURE 13

SAMPLE OF RAC PUBLICATION LIST PRODUCED BY THE DOCUMENT MACHINE
PROGRAM.

*LEFT*MARGIN*C**TAB*A*TECHNICAL MEMORANDA*SKIP*1**TAB*A*T-419*TAB*C*A PRELIMINARY INVESTIGATION OF FIELD-ARMY-MISSILE PENETRABILITY (U)*TAB*C*JAN 64, SECRET-RESTRICTED DATA, STUDY 17.1, 184 PP (GROUP 1)*TAB*C*WALTER ECKHARDT, RICHARD H. GRAMANN, SIDNEY I. MATHEWS, W. BRUCE TAYLOR, CHARLES W. WUMAN*SKIP*1**TAB*A*T-420*TAB*C*SPIKE WOUNDS IN THE VIETNAMESE GUERRILLA WAR (U)*TAB*A*(SEA)*TAB*C*FEB 64, CONFIDENTIAL, STUDY 62.4.3, 33 PP, AD 349593, (GROUP 1)*TAB*C*MARK J. EISNER AND SAM BUU SON*SKIP*1**TAB*A*T-421*TAB*C*EAST GERMANY'S ECONOMIC DEPENDENCE ON THE WEST) A POTENTIAL FOR STRATEGY (U)*TAB*C*FEB 64, SECRET, STUDY RP-121, 46 PP, (GROUP 3)*TAB*C*HEINZ C. KRAUSE*SKIP*1**TAB*A*T-422*TAB*C*RAC AIR ASSAULT CONCEPT STUDIES -- 1963 (U)*TAB*A*MAIN*TAB*C*FEB 64, SECRET, STUDY C-511, 64 PP, (GROUP 4)*TAB*A*BODY*TAB*C*MAJ GEN JAMES G. CHRISTIANSEN AND WILLIAM H. SUTHERLAND*SKIP*2*APP A, RAC AIR ASSAULT CONCEPT STUDIES -- 1963 (U)*TAB*C*(OPERATIONAL PROBLEMS OF AIR ASSAULT FORCES EMPLOYED IN MIDDLE EAST (U))*TAB*C*FEB 64, SECRET, STUDY C-511, 250 PP*TAB*C*THE THEATRESPIEL GROUP*SKIP*1**TAB*A*VOL I*TAB*C*APP B, CODEC I. A WAR GAME CONDUCTED FOR THE COMBAT DEVELOPMENTS COMMAND (U) (RAC AIR ASSAULT CONCEPT STUDIES -- 1963 (U))*TAB*C*FEB 64, CONFIDENTIAL, STUDY C-511, 143 PP*TAB*C*THE THEATRESPIEL GROUP*VOID*
OK

FIGURE 14

SINGLE-SPACED VERBATIM LISTING OF CARDS THAT PRODUCED FIGURE 13.

PUTTING A PROGRAM LISTING INTO THE DOCUMENT

FREQUENTLY A TECHNICAL DOCUMENT DESCRIBES A COMPUTER SYSTEM. PART OF THE DOCUMENT -- SOMETIMES A PRINCIPAL PART, SOMETIMES AN APPENDIX -- WILL CONTAIN A SOURCE PROGRAM LISTING. THE PROGRAM MAY HAVE BEEN WRITTEN IN FORTRAN, COBOL OR SOME ASSEMBLY LANGUAGE. IF THE TECHNICAL DOCUMENT IS PRODUCED BY MEANS OF THE PUNCHED-CARD, EAM, SMALL-COMPUTER SYSTEM HEREIN DESCRIBED, IT IS VERY EASY TO MAKE THE SOURCE PROGRAM A PART OF THE DOCUMENT. FIRST MAKE A DECK OF IDENTICAL CARDS BY GANG PUNCHING (USING THE EAM REPRODUCER). EACH OF THE CARDS CONTAINS '*SKIP*0*' AND A VOIDED AREA TO FILL IT OUT. THIS DECK IS THEN INTERSPERSED WITH THE SOURCE PROGRAM DECK SO THAT EACH SOURCE PROGRAM CARD IS BOTH PRECEDED AND FOLLOWED BY A SKIP EDITING INSTRUCTION. WHEN THE RESULTANT DECK IS PROCESSED BY THE DOCUMENT MACHINE PROGRAM, A SINGLE-SPACED LISTING OF THE SOURCE PROGRAM DECK IS PRODUCED. (BE SURE TO SET THE MARGINS SO AS TO MAKE THE PRINT LINE WIDE ENOUGH.) IF A DOUBLE-SPACED LISTING IS DESIRED, USE '*SKIP*1*' INSTEAD OF '*SKIP*0*', ETC. THE INTERSPERSED SKIP EDITING INSTRUCTIONS HAVE THE EFFECT OF FORCING EACH SOURCE PROGRAM CARD TO BE LISTED ON A SEPARATE PRINT LINE. OTHERWISE, THE DOCUMENT MACHINE PROGRAM WOULD PAY NO ATTENTION TO BEGINNING AND ENDING OF DATA CARDS. WE NOTE THAT THE SOURCE PROGRAM DECK BEING INCORPORATED INTO THE DOCUMENT IS READ FROM COLUMN 1 THROUGH COLUMN 72 ONLY WHICH AGREES WITH THE CARD FORMATS USED FOR SUCH SOURCE LANGUAGES AS FORTRAN, COBOL, MAP, FAP, SAP, AUTOCODER AND SPS.

CAUSING THE DOCUMENT TO PUNCH THE PROGRAM DECK

WE SAW ABOVE HOW TO INSERT A PROGRAM LISTING INTO A DOCUMENT. BY MEANS OF THE PUNCH EDITING INSTRUCTION WE CAN DO THE INVERSE, I.E., MAKE THE DOCUMENT PRODUCE THE SOURCE PROGRAM DECK READY FOR COMPILING OR ASSEMBLING. WE MAY FOLLOW NEARLY THE SAME PROCEDURE AS WE DO FOR INSERTING THE SOURCE PROGRAM DECK. EACH CARD IN THE GANG-PUNCHED DECK THAT IS INTERSPERSED WITH THE PROGRAM DECK CONTAINS A PUNCH EDITING INSTRUCTION IN ADDITION TO THE SKIP EDITING INSTRUCTION (WITH THE REST VOIDED). THUS EACH SOURCE PROGRAM CARD IS PRECEDED BY A PUNCH AND A SKIP EDITING INSTRUCTION. THE VERY LAST SOURCE PROGRAM CARD SHOULD BE FOLLOWED BY A SKIP CARD FOR A PUNCH INSTRUCTION HERE WILL MAKE THE NEXT LINE OF TEXT ALSO BE PUNCHED. COPIOUS COMMENTS MAY BE

INTERSPERSED BETWEEN THE SOURCE PROGRAM CARDS. (BE SURE TO BEGIN EACH COMMENT WITH A SKIP EDITING INSTRUCTION SO THAT THE ABOVE SOURCE PROGRAM CARD IS PROPERLY ENDED ON THE PRINT LINE.) SINCE THESE COMMENTS NEED NOT BE PRECEDED BY PUNCH EDITING INSTRUCTIONS, THEY MAY BE IN ANY FORMAT DESIRABLE AND NEED NOT BE COMPATIBLE WITH THE CARD FORMAT REQUIRED BY THE SOURCE PROGRAM ASSEMBLER OR COMPILER. THE MOST LIKELY CARD FORMAT IS THE FIELD-FREE ONE USED FOR ANY TEXTUAL MATERIAL WITH THIS AUTOMATED SYSTEM. LET THE DOCUMENT MACHINE PROGRAM DO THE COMPOSING OF THE LINES OF THE COMMENTS. OF COURSE, THE ENTIRE DECK CAN BE COMPRESSED BY PROCESSING IT THROUGH THE SQUEEZE PROGRAM AND, THUS, THE VOIDED AREAS ARE REMOVED. SINCE NORMAL DOCUMENT DECK CORRECTION PROCEDURES APPLY, WE MAY CORRECT EITHER SOURCE PROGRAM, INTERSPERSED COMMENTS OR OTHER TEXT WITH EQUAL FACILITY. THUS, E.G., IF A COMPLICATED INSTRUCTION (SAY, A FORTRAN FORMAT STATEMENT) IS ALMOST CORRECT BUT REQUIRES THE INSERTION OF SEVERAL CHARACTERS BETWEEN ADJACENT COLUMNS, THIS CAN BE EASILY ACCOMPLISHED WITHOUT HAVING TO REPUNCH THE ENTIRE REMAINDER OF THE INSTRUCTION (WHICH WHEN DONE IS FREQUENTLY ACCOMPANIED BY NEW KEY PUNCH ERRORS WASTING MORE RUNS ON A LARGE, EXPENSIVE COMPUTER). OF COURSE SHOULD THE EXPANDED SOURCE PROGRAM STATEMENT BECOME LARGE ENOUGH TO SPILL OVER ONTO ANOTHER LINE AND, HENCE, ANOTHER CARD, THE PRESENT SYSTEM WOULD NEITHER SUPPLY THE CONTINUATION PUNCH (IN THE CASE OF FORTRAN) NOR THE 'ETC' OP CODE (IN THE CASE OF MAP OR FAP) NOR WOULD THAT SECOND LINE EVEN BE PUNCHED (SINCE THE PUNCH EDITING INSTRUCTION IS EFFECTIVE FOR ONLY THE NEXT LINE). HOWEVER, SUCH A FACILITY COULD EASILY BE INCLUDED IN AN EXPANDED SYSTEM.

UNTIL THE ADVENT OF THIS AUTOMATED DOCUMENTATION SYSTEM, A PROGRAM AND ITS DOCUMENTATION WERE ENTIRELY DISTINCT WITH THE LATTER EITHER NOT EXISTING OR LAGGING BEHIND THE FORMER BY AS MUCH AS SEVERAL YEARS. NOW THE TWO CAN BE COMBINED. A CHANGE TO THE PROGRAM DECK, BESIDES BEING MUCH EASIER TO ACCOMPLISH THAN FORMERLY, NECESSARILY CHANGES THE DOCUMENTATION. FURTHERMORE, THE INCORPORATION OF EXISTING SOURCE PROGRAM DECKS INTO THE DOCUMENT DECK (AS DESCRIBED ABOVE) MAY BE REGARDED AS AN INTERIM PROCEDURE DURING CHANGEOVER TO THIS AUTOMATED DOCUMENTATION SYSTEM. IN MANY CASES IT WOULD BE MUCH MORE CONVENIENT TO PUNCH THE SOURCE PROGRAM IN THE SAME MANNER AS ANY DOCUMENT, I.E., WITHOUT REGARD TO CARD COLUMNS OR BEGINNING OR END OF CARDS USING TAB INSTRUCTIONS WHERE NECESSARY.

BY-PRODUCT APPLICATIONS
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THERE ARE SOME RATHER INTERESTING APPLICATIONS THAT THE EXISTING SYSTEM MAKES POSSIBLE AS A BY-PRODUCT OF ITS USE. THESE APPLICATIONS BECOME POSSIBLE BECAUSE DOCUMENTS ARE SUDDENLY IN COMPUTER READABLE FORM WHEREAS THEY WOULD NOT BE OTHERWISE. FOR EXAMPLE, ONCE THE RAC PUBLICATION LIST IS ON CARDS IT WILL BE EASY TO WRITE A RETRIEVAL PROGRAM (TO OPERATE EITHER ON THE 7040 OR 1401) TO YIELD INFORMATION ABOUT OUR DOCUMENTS. TITLES, AUTHORS, DOCUMENT NUMBERS AND CLASSIFICATIONS WILL BE IDENTIFIABLE BECAUSE OF THE TAB INSTRUCTIONS THAT PUNCTUATE THEM. (SEE FIGURES 13 AND 14.) YOU COULD, E.G., ASK FOR A LIST OF ALL DOCUMENTS WITH THE PHRASE 'WAR GAME' IN THE TITLE, ETC. ANOTHER APPLICATION IS AUTOMATIC ABSTRACTING OF THE CONTENTS OF DOCUMENTS. MANY GOOD TECHNIQUES ARE KNOWN BUT THEIR MAIN IMPEDIMENT IS GETTING THE DOCUMENTS INTO COMPUTER READABLE FORM. WHEN THIS SYSTEM COMES INTO GENERAL USE, ALL DOCUMENTS PRODUCED UNDER IT WILL BE COMPUTER READABLE.

AN EXAMPLE OF AN EASILY IMPLEMENTED ABSTRACTING PROGRAM IS ONE THAT TAKES THE ENTIRE FIRST PARAGRAPH, THE FIRST SENTENCES FROM SUBSEQUENT PARAGRAPHS AND THE ENTIRE LAST PARAGRAPH FROM A GIVEN DOCUMENT. SUCH A PROGRAM WOULD BE PARTIALLY MADE OF PIECES OF THE DOCUMENT MACHINE PROGRAM AND COULD BE WRITTEN AND OPERATIVE WITHIN SEVERAL HOURS. THIS ABSTRACTING PROGRAM WOULD DO DOUBLE DUTY. FOR, IF THE GENERATED ABSTRACT DID NOT READ CLEARLY, WE WOULD KNOW THE ORIGINAL DOCUMENT WAS POORLY CONSTRUCTED, DID NOT HAVE TOPIC SENTENCES BEGINNING PARAGRAPHS, ETC.

SYSTEM MODIFICATIONS UNDER CONSIDERATION
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SO FAR I HAVE BEEN DISCUSSING APPLICATIONS OF THE EXISTING SYSTEM. IT MAY BE OF INTEREST TO THE READER TO KNOW THAT THIS SYSTEM WAS DESIGNED, PROGRAMMED, CODED, DEBUGGED AND WAS OPERATIVE WITHIN A TWO-WEEK PERIOD. (I MUST ADMIT I HAD BEEN THINKING ABOUT SUCH A SYSTEM FOR SEVERAL YEARS BUT HAD NOT DONE ANY DETAILED PLANNING.) THIS TWO-WEEK SYSTEM DID NOT YET HAVE THE SQUEEZE PROGRAM AND THE DOCUMENT MACHINE PROGRAM HAD SOMEWHAT LESSER CAPABILITIES. DURING THE SUCCEEDING TWO WEEKS THE DOCUMENT MACHINE PROGRAM WAS IMPROVED. IT WENT FROM EIGHT TO TWENTY-SIX TAB STOPS, FROM TWELVE TO FOURTEEN EDITING INSTRUCTIONS. THE

SPELLING AND OPERATION OF SOME OF THE EDITING INSTRUCTIONS WERE CHANGED. DURING THE SAME SUCCEEDING TWO WEEKS THE SQUEEZE PROGRAM WAS IMPLEMENTED AND MADE OPERATIONAL. HENCE, THE SYSTEM CERTAINLY CAN BE EXPANDED TO INCLUDE MANY OTHER FEATURES WITHIN A REASONABLY SHORT PERIOD OF TIME. THE LIST OF FEATURES THAT MAY BE INCORPORATED INTO THIS SYSTEM IS MUCH TOO LARGE FOR ADEQUATE DISCUSSION WITHIN THE SPACE OF THIS DOCUMENT. LET ME MENTION A FEW.

THE STRUCTURE OF THE DOCUMENTATION MACHINE PROGRAM (SEE APPENDIX C.) IS SUCH THAT NEW EDITING INSTRUCTIONS CAN EASILY BE ADDED. FURTHERMORE, IF ANY OF THE CURRENT INSTRUCTIONS TURNS OUT TO BE CLUMSILY SPELLED, THE SPELLING CAN BE CHANGED. BUT WHAT OF THE OLD DOCUMENT DECKS THAT EXIST WITH THE NOW MISPELLED INSTRUCTIONS? IT IS VERY EASY TO CONSTRUCT A PROGRAM FROM ELEMENTS OF THE DOCUMENT MACHINE AND SQUEEZE PROGRAMS (SEE APPENDIX D FOR THE LATTER) WHICH WILL CONVERT, I.E., REPUNCH, THE OLD DECKS INTO NEW ONES WITH THE MODERNIZED SPELLING. SO WE ARE FLEXIBLE. ONE INSTRUCTION TYPE THAT WOULD COME IN HANDY IS A CONTINGENT INSTRUCTION. FOR EXAMPLE, IF THE REMAINING NUMBER OF LINES ON THIS PAGE IS LESS THAN SUCH AND SUCH A NUMBER, GO TO A NEW PAGE, OTHERWISE NOT. THIS WOULD BE USED FOR FIGURES, INDENTED DISPLAYED MATERIAL, ETC., WHICH WE WOULD LIKE TO APPEAR ALL ON ONE PAGE WITHOUT THE NECESSITY OF ALWAYS STARTING A NEW PAGE. BEAR IN MIND THAT WE DO NOT KNOW WHERE THE MATERIAL WILL APPEAR IN THE DOCUMENT AS WE PREPARE IT. IT WOULD BE QUITE USEFUL TO BE ABLE TO USE 'ADDRESS ARITHMETIC' IN, SAY, THE TAB INSTRUCTIONS. FOR EXAMPLE, WE COULD THEN TAB TO A-5 OR TO Q+2, I.E., TO FIVE POSITIONS TO THE LEFT OF TAB STOP A OR TO TWO POSITIONS TO THE RIGHT OF TAB STOP Q. ANOTHER POSSIBILITY IS RIGHT JUSTIFIED TABBING (THE PRESENT IS LEFT JUSTIFIED) FOR NUMERALS. WE MIGHT WANT TO ADD THE ABILITY OF SYMBOLIC REFERENCES TO FIGURES. THE PRINTING PROGRAM WOULD 'ASSEMBLE' THE DOCUMENT AT PRINTING TIME, AT THAT TIME ASSIGNING NUMBERS TO FIGURES AND FILLING IN PAGE REFERENCES IN THE TEXT. THUS, ONE COULD INSERT NEW FIGURE BETWEEN TWO OTHERS WITHOUT HAVING TO RENUMBER THE WHOLE SEQUENCE OF FIGURES BEYOND. ANOTHER DESIRABLE SET OF EDITING INSTRUCTIONS WOULD ALLOW FOR STORING THE CURRENT VALUE OF ALL TAB STOPS, MARGINS, ETC., AND FOR THE LATER RESTORING OF THESE VALUES. WITH THIS ABILITY THE DECK WHICH PRODUCED A FIGURE COULD CONTAIN THE EDITING INSTRUCTIONS THAT PROGRAM IT TO RESTORE WHATEVER TABS, MARGINS, ETC., WERE IN EFFECT WHENEVER IT BEGAN AND HAD TO SET THESE PARAMETERS FOR ITSELF. THUS, FIGURES COULD BE MOVED ABOUT AT WILL IN A DOCUMENT WITHOUT HAVING TO REMEMBER TO FIX THE SETTINGS AFTER IT. I MENTIONED ABOVE THAT 'TUB CARDS' ARE USEFUL IN PUTTING TOGETHER PARTS OF DOCUMENTS, E.G., FOR RECURRING HEADINGS IN APPENDICES. WITH THE PRESENT SYSTEM ONE MUST PHYSICALLY REPRODUCE AND INTERPRET SUCH CARDS USING EAM EQUIPMENT. IT WOULD BE NICE TO BE ABLE TO SPECIFY THAT THE NEXT STRING OF CHARACTERS IS TO BE STORED AS TUB CARD SET SO AND SO. THEN

ANYTIME THE SET IS CALLED FOR IN THE DOCUMENT IT WOULD BE INSERTED BY THE PROGRAM. OF COURSE, THESE TAB CARDS ARE ANALOGOUS TO THE PROGRAMMERS' MACRO IN AN ASSEMBLY PROGRAM. WE COULD ALSO INCLUDE SUBSTITUTABLE ARGUMENTS. THUS, FOR EXAMPLE, THE 'INSERT' CARDS OF FIGURE 8 (I.E., FIRST, THIRD AND EIGHTH CARDS) MIGHT BE PRODUCED BY 'MACRO EXPANSION' WITH THE NUMBER AS THE SUBSTITUTABLE ARGUMENT. THE PRESENT DOCUMENT MACHINE PROGRAM NUMBERS PAGES SEQUENTIALLY. IT WOULD BE USEFUL TO BE ABLE TO SPECIFY A CHANGE IN THE NUMBERING BY EDITING INSTRUCTION. LIKEWISE FOR THE PAGE HEADING AND THE CLASSIFICATION WHICH ARE NOW CONSTANT FOR EACH DOCUMENT. A WORD-SYLLABIFICATION SUBROUTINE MIGHT BE INCORPORATED INTO THE SYSTEM ALLOWING FOR AUTOMATIC HYPHENATION. THEN, WITH A FEW MORE ADDITIONS, RIGHT-JUSTIFIED COPY COULD BE PRODUCED. NATURALLY, THE MORE FEATURES ADDED, THE MORE MEMORY REQUIRED AND THE LONGER PROCESSING WILL TAKE. THE PRESENT PROGRAM OCCUPIES SOME 2750 CHARACTERS OF CORE STORAGE AND PRINTS A PAGE IN TEN TO FIFTEEN SECONDS (DEPENDING ON THE NUMBER OF VOIDED AREAS, LINE WIDTHS, SKIPPING, ETC.)

PRELIMINARY COST CONSIDERATIONS

THE QUESTION OF HOW MUCH IT COSTS TO USE THIS SYSTEM MUST BE CONSIDERED. FULLY DEFINITIVE FIGURES WILL NOT BE AVAILABLE FOR SEVERAL MONTHS. HOWEVER, PRELIMINARY INDICATIONS ARE ENCOURAGING. IT COSTS PERHAPS FIFTY TO SEVENTY-FIVE CENTS TO HAVE A PAGE TYPED AT PRESENT. THE SAME PAGE CAN BE PRINTED IN TEN TO FIFTEEN SECONDS UNDER THIS SYSTEM. AT COMMERCIAL 1401 SERVICE BUREAU RATES OF FIFTY DOLLARS AN HOUR, THIS COMES TO APPROXIMATELY EIGHTEEN CENTS. IN BOTH CASES THE FIRST DRAFT MUST BE MANUALLY TYPED (OR KEYPUNCHED), SO THAT PART COMES OUT EVEN. A KEY PUNCH RENTS FOR SIXTY-FIVE DOLLARS PER MONTH WHICH IS GREATER THAN TYPEWRITER RENTAL RATES. I ASSUME THIS WILL BE MORE THAN OFFSET BY THE REDUCED TYPING NEEDS, I.E., ONLY CHANGES AND ADDITIONS NEED BE TYPED, ETC. PRESENTLY IT MAY TAKE TWO WEEKS TO GET A HUNDRED-PAGE DRAFT RETYPED. DURING THIS TIME THE AUTHOR-ANALYST MUST COOL HIS HEELS. UNDER THE AUTOMATED SYSTEM, THE NEW DRAFT SHOULD BE READY IN LESS THAN A DAY. IT IS HARD TO ASSIGN A CASH SAVING TO THAT BUT I FEEL IT IS OF CONSIDERABLE WORTH.

THE AUTHOR PERSONALLY DID THE KEYPUNCHING FOR THIS DOCUMENT. ONE OF THE REVIEWERS OF AN EARLIER VERSION OF THIS DOCUMENT FELT THAT AN ORDINARY TYPIST, WITHOUT EXTENSIVE TRAINING IN THE USE OF THIS SYSTEM AND OF THE KEY PUNCH, MIGHT BE SLOW IN PUNCHING THE INITIAL DECK OF CARDS FOR A DOCUMENT. DURING THE REVIEW PERIOD, I

7

WAS FORTUNATE ENOUGH TO OBTAIN THE SERVICES OF A TYPIST. SHE WAS NOT A KEY-PUNCH OPERATOR NOR, OF COURSE, DID SHE KNOW THIS SYSTEM. AFTER A HALF-HOUR LECTURE ON BOTH THE USE OF THE KEY PUNCH AND THE USE OF THE SYSTEM SHE WENT TO WORK ON HER FIRST DOCUMENT. NATURALLY SHE MADE MORE ERRORS THE FIRST TIME THAN ON SUBSEQUENT DOCUMENTS, BUT THE RESULTS WERE QUITE GOOD. SHE HAS PRODUCED SEVERAL COMPLICATED TECHNICAL DOCUMENTS SO FAR (INCLUDING CORRECTIONS REQUIRED BY THE AUTHORS). I AM HAPPY TO REPORT THAT THE TIME TAKEN TO PUNCH THE INITIAL DECK IS THE SAME AS THE TIME THAT WOULD BE NEEDED TO TYPE THE MATERIAL ON PAPER USING A TYPEWRITER.

CONCLUSIONS, RECOMMENDATIONS AND SUMMARY

.....

DOUBTLESS THE READER, ON FIRST READING THIS DOCUMENT, IS LOST AMONG A WELTER OF DETAILS. THEREFORE, I SHOULD LIKE TO EMPHASIZE WHAT THE IMPORTANT PARTS OF THIS ORIGINAL DEVELOPMENT COMPRISE.

THE COMPUTER-READABLE DOCUMENT AS STORED IS UNFORMATTED. THIS UNFORMATTED DOCUMENT CONSISTING OF AN ADMIXTURE OF TEXT AND ENGLISH-LIKE EDITING INSTRUCTIONS IS WHAT IS CORRECTED. THE PRINTING, OR 'ASSEMBLING', OF THE FORMATTED DOCUMENT CAN OCCUR ONLY WHEN IT IS BROUGHT TOGETHER WITH THE DOCUMENT MACHINE COMPUTER PROGRAM. THE CORRECTION TECHNIQUE USES THE DUPLICATING FEATURE OF THE UBIQUITOUS MODERN KEY PUNCH. BY TAKING ADVANTAGE OF THE UNIQUE EDITING INSTRUCTIONS, THE LOGIC OF THE PROCESSING COMPUTER PROGRAM, AND THE KEY-PUNCH FEATURES, IT BECOMES POSSIBLE TO ACCOMPLISH THE EQUIVALENT OF WHAT ACTUALLY IS IMPOSSIBLE, E.G., TO INSERT MATERIAL BETWEEN ADJACENT CARD COLUMNS.

AN ATTEMPT TO STORE A FORMATTED DOCUMENT -- WITH COMPOSED, DISTINCT LINES AND PAGES -- WILL MEET WITH FAILURE BECAUSE OF THE EXTREME DIFFICULTY INVOLVED IN MAKING CORRECTIONS.

WHEN I FIRST ATTACKED THE PROBLEM (EARLY OCTOBER 1964) I ATTEMPTED TO DESIGN A SYSTEM IN WHICH THE FORMATTED DOCUMENT WOULD BE STORED ON MAGNETIC TAPE. ON BEING DULY IMPRESSED BY THE MAGNITUDE OF THE PROBLEMS INVOLVED IN MODIFYING THE STORED DOCUMENT, I HAPPILY HIT UPON THE ABOVE IDEAS. NOT ONLY WAS THE PROBLEM OF MODIFICATION SOLVED, BUT THE EXTRA COMPUTER RUN INVOLVED IN CORRECTING AND COPYING THE TAPE WAS ELIMINATED. I QUICKLY WROTE THE TWO PROGRAMS PLACING THEM INTO SERVICE TO PRODUCE THIS DOCUMENT DESCRIBING THE SYSTEM. THE ENTIRE BODY OF THE DOCUMENT (FROM PAGE 0001 ON), INCLUDING ALL THE FIGURES AND

APPENDICES, WAS SO PRODUCED. WHEN THE COMPUTER CODE (APPENDICES C AND D) IS PRINTED, THE CARDS ARE ALSO PUNCHED READY FOR 1401 AUTOCODE ASSEMBLY. NO ATTEMPT WAS MADE DURING THIS SHORT TIME TO POLISH THE CODE, WHICH IS PROBABLY SOMEWHAT INEFFICIENT DUE TO MY LACK OF EXPERIENCE ON THE PARTICULAR COMPUTER (USUALLY REGARDED AS A PERIPHERAL SLAVE TO A LARGE COMPUTER).

AS NEAR AS I CAN DETERMINE, NO ONE ELSE IS USING SUCH A SYSTEM. THE COMPUTER MANUFACTURER, (INTERNATIONAL BUSINESS MACHINES CORPORATION), IN A BROCHURE DESCRIBING THE OPTIONAL LOWER-CASE/SPECIAL-CHARACTERS PRINTER CHAIN, INDICATES THIS FEATURE IS USEFUL FOR FORM LETTERS. OF COURSE, THIS WOULD INDICATE THAT THE LINE AND PAGE COMPOSITION WOULD BE DONE ELSEWHERE -- PROBABLY BY THE TYPIST. THAT SAME BROCHURE POINTS OUT THAT THE REGULAR, UPPER-CASE, PRINT CHAIN CAN BE QUICKLY REMOUNTED ON THE PRINTER FOR REGULAR DATA PROCESSING APPLICATIONS. OF COURSE, I CONTEND (AND THE VERY EXISTENCE OF THIS DOCUMENT PROVES) THAT THE COMPOSING AND PRINTING OF DOCUMENTS IS A REGULAR DATA PROCESSING APPLICATION. MY UNDERSTANDING IS THAT ANY COMPUTER-PRODUCED COMPOSING PRECEDING THE PRINTING ON THE SPECIAL UPPER/LOWER CASE 1401 IS DONE ON THE LARGE, EXPENSIVE COMPUTERS SUCH AS THE 7080 OR 7090.

THE PRESENT SYSTEM WAS DESIGNED WITH RAC'S CURRENT EQUIPMENT IN MIND. OUR 1401 DOES NOT HAVE THE OPTIONAL LOWER-CASE PRINTING CHAIN. IN ORDER NOT TO REQUIRE TOO MUCH COMPUTER TIME, ALBEIT INEXPENSIVE TIME, THE DESIGN INCLUDES USE OF EAM EQUIPMENT AND MANY MANUAL OPERATIONS. SINCE OUR EDITORIAL DEPARTMENT RETYPES ALL FINAL TYPEWRITTEN DRAFTS SUBMITTED FOR EXTERNAL PUBLICATION, THE FACT THAT THE UPPER-CASE 1401-PRODUCED DOCUMENT MUST BE RETYPED IS NO DISADVANTAGE. THE PEOPLE WORKING WITH THE DRAFTS PRODUCED BY THIS SYSTEM MUST GET USED TO THE ABSENCE OF LOWER-CASE. (AT LEAST UNTIL, AND UNLESS, WE GET LOWER-CASE PRINTING CAPABILITY.) IT WAS IN ORDER TO DELIBERATELY DISPLAY THE SYSTEM'S SINGLE DISADVANTAGE THAT THIS DOCUMENT DESCRIBING THE SYSTEM WAS NOT RETYPED. INSTEAD, THE MULTILITH MASTERS WERE MADE DIRECTLY ON THE 1401 COMPUTER. BECAUSE THE EXISTING DOCUMENT MACHINE PROGRAM SEQUENTIALLY NUMBERS PAGES STARTING WITH '0001', THE TITLE PAGE, LIST OF ILLUSTRATIONS, TABLE OF CONTENTS, ETC., ALL OF WHICH ARE NUMBERED WITH ROMAN NUMERALS, WERE PREPARED IN THE STANDARD MANNER BY THE EDITORIAL DEPARTMENT.

I VISUALIZE AN EDITING DEPARTMENT WITH ITS OWN SMALL COMPUTER (CAPABLE OF PRINTING BOTH CASES AS WELL AS A REASONABLE SELECTION OF SPECIAL SYMBOLS), A SET OF KEY PUNCHES AND A FEW PIECES OF EAM EQUIPMENT. THE EDITING DEPARTMENT'S TYPING POOL OF GOOD, MANUSCRIPT TYPISTS WILL MAN THE KEY PUNCHES, PRODUCING THE MACHINE-READABLE FIRST DRAFT FOR ALL LARGE TECHNICAL DOCUMENTS OF THE FIRM OR DEPARTMENT IT SERVES. WHEN A DOCUMENT IS ADJUDGED COMPLETE BY ITS AUTHOR AND THE VARIOUS APPROVAL AUTHORITIES, IT IS

PAGE 0037

ONCE AGAIN RUN OFF ON THE SMALL COMPUTER -- THIS TIME ON CONTINUOUS-FORM MULTILITH MASTERS, READY FOR THE PRESSES.

I REGARD THE VERY EXISTENCE OF THIS LARGE, COMPREHENSIVE PAPER ON A DETAILED TECHNICAL SYSTEM -- PRINTED TWO WEEKS AFTER SYSTEM DESIGN -- AS PROOF OF THE EFFICACY OF THIS (PROTOTYPE) SYSTEM. I RECOMMEND, HOWEVER, A SIX-MONTH TRIAL UTILIZING ONE TYPIST AND ONE KEY-PUNCH MACHINE NOT TO PROVE THE SYSTEM BUT TO IMPROVE IT. WE WOULD FIND WHAT ADDITIONAL FEATURES TO ADD, WHETHER ANY PRESENT FEATURES MIGHT BE DELETED, WHAT THE THROUGHPUT RATE PER TYPIST IS, WHAT THE COST ACTUALLY IS, ETC. A STYLE GUIDE WOULD BE WRITTEN DURING THIS PERIOD OF TIME. THE APPEARANCE AND READABILITY OF EVEN AN UPPER-CASE-ONLY DOCUMENT COULD PROBABLY BE GREATLY IMPROVED BY JUDICIOUS USE OF PROPER HORIZONTAL AND VERTICAL SPACING, UNDERLINING BY VARIOUS CHARACTERS, E.G., PERIODS, ASTERISKS, PLUS SIGNS, ETC. SUCH INFORMATION DERIVED DURING THE TRIAL WOULD BE CONTAINED IN THE STYLE GUIDE.

WE IN THE PROGRAMMING FIELD HAVE LONG ENJOYED THE ABILITY TO REVISE OUR PROGRAM DECKS BY MOVING CARDS ABOUT, BY CORRECTING MISPELLINGS THROUGH THE DUPLICATING FEATURE OF THE KEYPUNCH. SIGNIFICANTLY, ONE OF THE PHENOMENA OF THE COMPUTER AGE HAS BEEN THE LAG BETWEEN THE IMPLEMENTATION OF COMPUTER SYSTEMS AND ADEQUATE DOCUMENTATION THEREOF. I BELIEVE THE SYSTEM I AM OFFERING IS A BREAKTHROUGH THAT WILL ENABLE US TO KEEP PACE WITH THE EXPLODING TECHNOLOGICAL PROGRESS OF OUR TIME.

APPENDIX A

CARD AND DECK FORMATS

.....

DOCUMENT CARDS HAVE TEXT AND EDITING INSTRUCTIONS IN COLUMNS 1-72 INCLUSIVE. COLUMNS 73-80 ARE IGNORED BY BOTH PROCESSING PROGRAMS (ALTHOUGH SQUEEZE PUNCHES IDENTIFICATION AND SEQUENCING IN THESE COLUMNS). WHEN KEYPUNCHING THE DOCUMENT A DRUM CARD THAT SKIPS OUT (EJECTS THE CARD) ON COLUMN 73 IS USED. IT IS ALSO CONVENIENT TO HAVE A FIELD STARTING IN COLUMN 69 (LEAVING JUST ENOUGH ROOM FOR THE CARD TO END WITH '*OK*').

FOR PRINTING THE DOCUMENT THE DECK IS MADE UP OF THREE PARTS. FIRST, THERE IS THE SELF-LOADING OBJECT DECK OF THE DOCUMENT MACHINE PROGRAM. IMMEDIATELY FOLLOWING THE OBJECT DECK IS A CONTROL CARD. THIS CARD IS IDENTIFIABLE ONLY BY POSITION (I.E., IT IS THE FIRST DATA CARD). IT CONTAINS NO TEXT OR EDITING INSTRUCTIONS BUT DOES CONTAIN, IN FIXED FIELDS, THE PAGE HEADING (COLUMNS 1-50) AND THE CLASSIFICATION (COLUMNS 51-70). THESE FIELDS MAY CONTAIN ANY LEGAL CHARACTERS (INCLUDING ONE OR BOTH BEING LEFT BLANK). THE NEXT CARD BEGINS THE DOCUMENT DECK. THE DOCUMENT MACHINE WILL READ UNTIL IT REACHES THE FIRST '*END*DOC*' EDITING INSTRUCTION. IT IS CONVENIENT TO HAVE THIS INSTRUCTION ON A CARD BY ITSELF AT THE END OF THE DOCUMENT DECK SO THAT SPLITTING OF THE LAST CARD WILL NOT BE REQUIRED TO ADD MATERIAL AT THE END OF THE DOCUMENT.

FOR SQUEEZING (AND SEQUENCING) THE DOCUMENT DECK, THE DECK TO BE LOADED IS ALSO MADE UP OF THREE PARTS. FIRST, THERE IS THE SELF-LOADING OBJECT DECK OF THE SQUEEZE PROGRAM. IMMEDIATELY FOLLOWING THE OBJECT DECK IS A CONTROL CARD. THIS CARD, IDENTIFIABLE BY POSITION ONLY, IS THE FIRST DATA CARD. IT CONTAINS NO TEXT OR EDITING INSTRUCTIONS BUT DOES CONTAIN, IN A FIXED FIELD (COLUMNS 73-75), THE THREE-CHARACTER IDENTIFIER STRING WHICH SQUEEZE PUNCHES IN THE SAME COLUMNS OF EACH CARD OF THE OUTPUT DECK. THE NEXT CARD BEGINS THE DOCUMENT DECK. READING CONTINUES UNTIL THE FIRST '*END*DOC*' EDITING INSTRUCTION IS REACHED.

THE DECK PUNCHED BY THE SQUEEZE PROGRAM BEGINS WITH A COPY (COLUMNS 1-75 ONLY) OF THE CONTROL CARD. THIS IS DONE SO THAT THE

PAGE 0039

NEW DECK CAN BE USED AS INPUT TO THE DOCUMENT MACHINE WITHOUT HAVING TO REMEMBER TO PUT IN A NEW CONTROL CARD. HENCE THE CONTROL CARDS FOR BOTH PROGRAMS CAN BE COMBINED INTO ONE CONTAINING HEADING, CLASSIFICATION AND IDENTIFICATION. AFTER THE CONTROL CARD IS PUNCHED, THE COMPRESSED DOCUMENT DECK, CONTAINING THE DOCUMENT IN COLUMNS 1-72, THE IDENTIFIER IN 73-75 AND THE SEQUENCE NUMBERS IN 76-80, IS PUNCHED. THE DECK IS ENDED BY FOUR CARDS CONTAINING THE END-DOCUMENT EDITING INSTRUCTION.

APPENDIX B

DETAILED DESCRIPTIONS OF THE EDITING INSTRUCTIONS
.....

IN THIS APPENDIX I SHALL USE THE STRING OF EXACTLY N 'V'S, E.G., 'V' OR 'VVV', AS A SYNTACTICAL VARIABLE WHOSE RANGE CONSISTS OF STRINGS OF EXACTLY N CHARACTERS FURTHER LIMITED FOR EACH EDITING INSTRUCTION AS SPECIFIED UNDER THAT INSTRUCTION'S 'RANGE OF PARAMETERS' ENTRY. EACH INSTRUCTION TYPE APPEARS BELOW ON A PAGE BY ITSELF. ALONG WITH THE FORMAT OF THE INSTRUCTION IS SHOWN THE RANGE OF PARAMETERS (FOR THOSE INSTRUCTIONS THAT HAVE ANY), THE INITIAL SETTING OF PARAMETERS (WHERE MEANINGFUL) AND THE ACTION TAKEN BY THE PROGRAM UPON ENCOUNTERING THAT INSTRUCTION.

PAGE 0041

VOID

OK

ACTION TAKEN BY PROGRAM

.....

WHEN '*VOID*' IS ENCOUNTERED BY THE SCANNING PROGRAM, THE COLUMNS AND CARDS TO THE RIGHT ARE SCANNED FOR THE FIRST OCCURRENCE OF '*OK*'. DURING THIS MODE OF SCANNING OPERATION NO EDITING INSTRUCTION OTHER THAN '*OK*' IS RECOGNIZED. TEXT OF THE DOCUMENT BEING PROCESSED MAY BE INTERRUPTED AT ANY POINT BY A '*VOID* ... *OK*' SEQUENCE OF CARD COLUMNS. THE CHARACTER IMMEDIATELY PRECEDING THE '*VOID*' IS TREATED AS IF IT IMMEDIATELY PRECEDED THE CHARACTER FOLLOWING THE '*OK*'. HOWEVER, EDITING INSTRUCTIONS WILL NOT BE RECOGNIZED IF THEY ARE SPLIT BY A VOIDED AREA.

PAGE 0042

SPEC

ACTION TAKEN BY PROGRAM
.....

IN THE PLACE OF THIS EDITING INSTRUCTION THE PROGRAM
PRINTS A SINGLE SPACE. HOWEVER, IT IS CONSIDERED NOT TO BE A
SPACE FOR THE PURPOSES OF WORD SEGMENTATION. THE NUMBER OF
SPECIALS APPEARING ON THIS LINE TOGETHER WITH THE LINE AND PAGE
NUMBERS ARE STORED ON TAPE UNIT 2. AFTER THE END OF THE DOCUMENT
A REMINDER LIST IS PRINTED SO THAT ALL SPECIAL CHARACTERS CAN BE
FILLED IN WITHOUT OVERLOOKING ANY.

•SKIP•V•

RANGE OF PARAMETERS

.....

'V' MAY BE ANY OF THE TEN DIGITS '0' THROUGH '9'.

ACTION TAKEN BY PROGRAM

.....

THE CURRENT WORD OR SET OF SPACES BEING ASSEMBLED (IF ANY) IS TERMINATED AND SENT TO THE PRINTER LINE. THIS MAY RESULT IN THE LINE BEING PRINTED AND THE CURRENT WORD (IF ANY) STARTING THE NEXT LINE. THE LINE BEING PRINTED MAY, IN TURN, CAUSE THIS PAGE TO BE TERMINATED. THEN, THE (NOW) CURRENT LINE IS PRINTED. AFTER THAT THE NUMBER V IS STORED TO BE READ BY THE PRINT SUBROUTINE WHEN THE NEXT PRINTING OCCURS. BEFORE THAT NEXT LINE IS PRINTED V LINES ARE SKIPPED UNLESS THAT WOULD CAUSE THAT LINE TO FALL BELOW THE LIMIT SET BY THE MOST RECENTLY EXECUTED PAGE-SIZE INSTRUCTION. IN THE LATTER CASE THE LINE MERELY STARTS A NEW PAGE REGARDLESS OF HOW MANY LINES WERE TO BE SKIPPED.

*TAB*V*

RANGE OF PARAMETERS

.....

'V' MAY BE ANY OF THE TWENTY-SIX LETTERS 'A' THROUGH
'Z'.

ACTION TAKEN BY PROGRAM

.....

THE CURRENT WORD OR SET OF SPACES BEING ASSEMBLED (IF ANY) IS TERMINATED AND SENT TO THE PRINTER LINE. THIS MAY RESULT IN THE LINE BEING PRINTED AND THE CURRENT WORD (IF ANY) STARTING THE NEXT LINE. THE LINE BEING PRINTED MAY, IN TURN, CAUSE THIS PAGE TO BE TERMINATED. THEN, IF THE POINTER WHICH INDICATES THE NEXT PRINT POSITION IS PAST (TO THE RIGHT OF) THE CURRENT VALUE OF TAB STOP 'V' THE PRINT LINE IS PRINTED. FINALLY, THE PRINT LINE POINTER IS SET TO THE CURRENT VALUE OF TAB 'V'.

PAGE 0045

•PARA•

ACTION TAKEN BY PROGRAM

.....

THE CURRENT WORD OR SET OF SPACES BEING ASSEMBLED (IF ANY) IS TERMINATED AND SENT TO THE PRINTER LINE. THIS MAY RESULT IN THE LINE BEING PRINTED AND THE CURRENT WORD (IF ANY) STARTING THE NEXT LINE. THE LINE BEING PRINTED MAY, IN TURN, CAUSE THIS PAGE TO BE TERMINATED. THEN, THE (NOW) CURRENT LINE IS PRINTED. AFTER THAT THE NUMBER 1 IS STORED TO BE READ BY THE PRINT SUBROUTINE. UNLESS AT THE BOTTOM OF A PAGE THIS WILL HAVE THE EFFECT OF SKIPPING A LINE. THEN THE NEXT LINE TO BE PRINTED WILL START, INDENTED TO THE CURRENT VALUE OF ONE OF THE TAB STOPS. THE TAB STOP USED IS DETERMINED BY THE MOST RECENT '•START•PARA•V•' INSTRUCTION. TAB STOP B IS USED IF NO SUCH SETTING INSTRUCTIONS HAVE PRECEDED.

PAGE 0046

•NEW•PAGE•

ACTION TAKEN BY PROGRAM
.....

THE CURRENT WORD OR SET OF SPACES BEING ASSEMBLED (IF ANY) IS TERMINATED AND SENT TO THE PRINTER LINE. THIS MAY RESULT IN THE LINE BEING PRINTED AND THE CURRENT WORD (IF ANY) STARTING THE NEXT LINE. THE LINE BEING PRINTED MAY, IN TURN, CAUSE THIS PAGE TO BE TERMINATED. THEN, THE (NOW) CURRENT LINE IS PRINTED WHICH MAY RESULT IN GOING TO A NEW PAGE. THEN, THE PAPER IS SKIPPED TO THE BOTTOM OF THE (NOW) CURRENT PAGE WHERE THE CLASSIFICATION IS PRINTED, SKIPPED TO THE TOP OF THE NEXT PAGE WHERE THE CLASSIFICATION IS REPEATED, THE HEADING IS PRINTED TWO LINES BELOW THE CLASSIFICATION, AND FINALLY, A SKIP OF TWO MORE LINES OCCURS TO BRING US TO THE FIRST BODY LINE OF THE NEXT PAGE.

•SET•V•VVV•

RANGE OF PARAMETERS

.....

'V' MAY BE ANY OF THE TWENTY-SIX LETTERS 'A' THROUGH 'Z'. 'VVV' IS A THREE-DIGIT NUMBER FROM '001' THROUGH '131'.

INITIAL SETTING OF PARAMETERS

.....

TAB STOP	A SET TO	001, TAB STOP	N SET TO	066.
	B	006	O	071
	C	011	P	076
	D	016	Q	081
	E	021	R	086
	F	026	S	091
	G	031	T	096
	H	036	U	101
	I	041	V	106
	J	045	W	111
	K	051	X	116
	L	056	Y	121
	M	061	Z	126

ACTION TAKEN BY PROGRAM

.....

TAB STOP 'V' IS SET TO THE NEW VALUE VVV. THUS, SUBSEQUENT TAB-TO-'V' INSTRUCTIONS WILL CAUSE THE PRINT LINE POINTER TO BE SET TO VVV. IF THERE IS A WORD BEING ASSEMBLED, IT IS NOT INTERRUPTED BY THIS EDITING INSTRUCTION. THUS, A NON-SPACE CHARACTER IMMEDIATELY PRECEDING THIS EDITING INSTRUCTION WILL BE IMMEDIATELY FOLLOWED BY THE NON-SPACE CHARACTER IMMEDIATELY FOLLOWING THIS EDITING INSTRUCTION.

•LEFT•MARGIN•V•

RANGE OF PARAMETERS
.....

'V' MAY BE ANY OF THE TWENTY-SIX LETTERS 'A' THROUGH
'Z'.

INITIAL SETTING OF PARAMETERS
.....

THE LEFT MARGIN IS SET TO TAB STOP A.

ACTION TAKEN BY PROGRAM
.....

THE LEFT MARGIN IS SET TO TAB STOP 'V'. THIS MEANS THAT
AFTER PRINTING, EACH NEW LINE STARTS AT THE (THEN) CURRENT VALUE OF
TAB STOP 'V'. IF THERE IS A WORD BEING ASSEMBLED, IT IS NOT
INTERRUPTED BY THIS EDITING INSTRUCTION. THUS, A NON-SPACE
CHARACTER IMMEDIATELY PRECEDING THIS EDITING INSTRUCTION WILL BE
IMMEDIATELY FOLLOWED BY THE NON-SPACE CHARACTER IMMEDIATELY
FOLLOWING THIS EDITING INSTRUCTION.

•RIGHT•MARGIN•V•

RANGE OF PARAMETERS

.....

'V' MAY BE ANY OF THE TWENTY-SIX LETTERS 'A' THROUGH
'Z'.

INITIAL SETTING OF PARAMETERS

.....

THE RIGHT MARGIN IS SET TO TAB STOP P.

ACTION TAKEN BY PROGRAM

.....

THE RIGHT MARGIN IS SET TO TAB STOP 'V'. THIS MEANS
THAT ANY WORD LATER ADDED TO THE PRINT LINE BEING FORMED THAT
WOULD BRING THE LINE OUT BEYOND THE (THEN) CURRENT VALUE OF TAB
STOP 'V' TERMINATES THAT LINE (WITH THE TERMINATING WORD STARTING
THE NEW LINE). IF THERE IS A WORD BEING ASSEMBLED, IT IS NOT
INTERRUPTED BY THIS EDITING INSTRUCTION. THUS, A NON-SPACE
CHARACTER IMMEDIATELY PRECEDING THIS EDITING INSTRUCTION WILL BE
IMMEDIATELY FOLLOWED BY THE NON-SPACE CHARACTER IMMEDIATELY
FOLLOWING THIS EDITING INSTRUCTION.

•START•PARA•V•

RANGE OF PARAMETERS
.....

'V' MAY BE ANY OF THE TWENTY-SIX LETTERS 'A' THROUGH
'Z'.

INITIAL SETTING OF PARAMETERS
.....

PARAGRAPHS INITIALLY START AT TAB STOP B.

ACTION TAKEN BY PROGRAM
.....

IF THERE IS A WORD BEING ASSEMBLED, IT IS NOT
INTERRUPTED BY THIS EDITING INSTRUCTION. THUS, A NON-SPACE
CHARACTER IMMEDIATELY PRECEDING THIS EDITING INSTRUCTION WILL BE
IMMEDIATELY FOLLOWED BY THE NON-SPACE CHARACTER IMMEDIATELY
FOLLOWING THIS EDITING INSTRUCTION. WHEN SUBSEQUENT '•PARA•'
INSTRUCTIONS ARE ENCOUNTERED, THE NEW PARAGRAPH WILL START AT THE
(THEN) CURRENT VALUE OF TAB STOP 'V'.

PUNCH=V

RANGE OF PARAMETERS

.....

'V' MAY BE ANY OF THE TWENTY-SIX LETTERS 'A' THROUGH
'Z'.

ACTION TAKEN BY PROGRAM

.....

THE PRINT SUBROUTINE IS SET TO PUNCH THE PRINT LINE FROM
THE VALUE (AT THE TIME OF PRINTING) OF TAB STOP 'V' FOR EIGHTY
CHARACTERS. SHOULD TAB STOP 'V' BE SET SUCH THAT EIGHTY
CHARACTERS WOULD GO BEYOND THE RIGHT END OF THE 131-CHARACTER
PRINT LINE, NO CARD IS PUNCHED. IF THERE IS A WORD BEING
ASSEMBLED, IT IS NOT INTERRUPTED BY THIS EDITING INSTRUCTION.
THUS, A NON-SPACE CHARACTER IMMEDIATELY PRECEDING THIS EDITING
INSTRUCTION WILL BE IMMEDIATELY FOLLOWED BY THE NON-SPACE
CHARACTER IMMEDIATELY FOLLOWING THIS EDITING INSTRUCTION.

*PAGE*SIZE*VVV*

RANGE OF PARAMETERS
.....

'VVV' MAY BE ANY THREE-DIGIT NUMBER FROM '001' THROUGH
'250'.

INITIAL SETTING OF PARAMETERS
.....

'VVV' IS SET TO '050'.

ACTION TAKEN BY PROGRAM
.....

IF THERE IS A WORD BEING ASSEMBLED, IT IS NOT
INTERRUPTED BY THIS EDITING INSTRUCTION. THUS, A NON-SPACE
CHARACTER IMMEDIATELY PRECEDING THIS EDITING INSTRUCTION WILL BE
IMMEDIATELY FOLLOWED BY THE NON-SPACE CHARACTER IMMEDIATELY
FOLLOWING THIS EDITING INSTRUCTION. VVV IS STORED FOR SUBSEQUENT
SCANNING BY THE PRINT SUBROUTINE AS THE NEW NUMBER OF (BODY)
LINES PER PAGE ALLOWED.

•END•DOC•

ACTION TAKEN BY PROGRAM

.....

THE CURRENT WORD OR SET OF SPACES BEING ASSEMBLED (IF ANY) IS TERMINATED AND SENT TO THE PRINTER LINE. THIS MAY RESULT IN THE LINE BEING PRINTED AND THE CURRENT WORD (IF ANY) STARTING THE NEXT LINE. THE LINE BEING PRINTED MAY, IN TURN, CAUSE THIS PAGE TO BE TERMINATED. THEN, THE REMAINING LINE IS PRINTED. ON A NEW PAGE THE REMINDER LIST IS PRINTED. THE COMPUTER PROGRAM THEN HALTS. NOTHING FURTHER IS SCANNED. OBVIOUSLY, THIS COMMAND CAN APPEAR ONLY ONCE IN A DOCUMENT. AND IT MUST APPEAR IN ORDER TO TERMINATE THE PROCEDURE.

APPENDIX C

THE DOCUMENT MACHINE -- CODED IN 1401
 AUTOCODER

```

      LABEL      OP      OPERAND

                JOB  R A MAGNUSON  DOCUMENT MACHINE
                CTL  335
                ORG  87
XR1            DCW  '071'
                DC   =2
XR2            DCW  '000'
                DC   =2
XR3            DCW  '000'
                ORG  101
                DA   1X80
                ORG  333
HEDING         DCW  =50
CLASSI         DCW  =20
PREV           DCW  '2'
PAGLIN         DCW  '050'
  
```

WD ADDS 1 TO XR2, WHICH COUNTS
 THE NUMBER OF CHARACTERS IN THE CURRENT WORD BEING ASSEMBLED.
 THEN IT MOVES CHAR INTO THE NEXT POSITION OF WORD, THE AREA
 WHERE THE WORD IS ASSEMBLED. THEN PREV IS SET TO 1 IN ORDER TO
 REMEMBER THAT A WORD IS IN THE PROCESS OF BEING ASSEMBLED.
 CONTROL PASSES TO GN.

```

WD          SBR  XR2,1+X2
           MCW  CHAR,WORD-1+X2
           MCW  '1',PREV
  
```

GN GETS THE NEXT CHARACTER. IF
 THAT NEXT CHARACTER IS AN ASTERISK, CONTROL IS TRANSFERRED TO
 GN1 IN CASE THIS IS THE START OF AN EDITING INSTRUCTION. IF
 THE NEXT CHARACTER DOES NOT BEGIN AN EDITING INSTRUCTION,
 ASTERISK OR NOT, IT IS MOVED TO CHAR, THEN GN4 IS EXECUTED IN
 ORDER TO MOVE THE NEXT-CHARACTER POINTER, XR1, OVER TO THE NEXT
 ONE YET. AFTER THAT, CONTROL IS GIVEN TO EITHER SP (IF CHAR IS
 A SPACE) OR TO WC (IF CHAR IS NOT A SPACE).

```

GN      BCE GN1,CARD+X1,*
GN2     MCH CARD+X1,CHAR
        B   GN4
        BCE SP,CHAR,
        B   WD
    
```

GN1 LOOKS TO SEE IF THE STRING TO THE RIGHT OF THE ASTERISK UNDER CONSIDERATION RESEMBLES ANY OF THE EDITING INSTRUCTIONS. IF SO, CONTROL IS SENT TO THE APPROPRIATE EDITING INSTRUCTION SUBROUTINE. IF NOT, CONTROL GOES BACK WITHIN GN (TO GN2).

```

GN1      C   CARD+5+X1,'VOID*'
        BE   VOID
        C   CARD+5+X1,'SPEC*'
        BE   SPEC
        C   CARD+5+X1,'SKIP*'
        BE   .SKIP
        C   CARD+4+X1,'TAB*'
        BE   TAB
        C   CARD+5+X1,'PARA*'
        BE   PARA
        C   CARD+9+X1,'NEW*PAGE*'
        BE   PAGE
        C   CARD+4+X1,'SET*'
        BE   SETTAB
        C   CARD+12+X1,'LEFT*MARGIN*'
        BE   SETRET
        C   CARD+13+X1,'RIGHT*MARGIN*'
        BE   LINSIZ
        C   CARD+11+X1,'START*PARA*'
        BE   SETPAR
        C   CARD+10+X1,'PAGE*SIZE*'
        BE   PAGESIZ
        C   CARD+6+X1,'PUNCH*'
        BE   PUNEXT
        C   CARD+8+X1,'END*DOC*'
        BE   ENDDOC
        B   GN2
    
```

VOID STAYS IN A TIGHT LOOP, EXECUTING GN4 TO MOVE TO THE NEXT CHARACTER AND LOOKING TO SEE IF THAT NEXT CHARACTER BEGINS THE STRING, 'OK'. WHEN THE FIRST 'OK' HAS BEEN FOUND, THE NEXT-CHARACTER POINTER IS ADJUSTED TO THE CHARACTER IMMEDIATELY TO THE RIGHT OF THE 'OK'. CONTROL IS THEN SENT TO GN.

```

VOID     SBR XR1,5+X1
GN3      B   GN4
    
```

```

C   CARD+3+X1,'*OK*'
BU   GN3
SBR  XR1,3+X1
B     GN4
B     GN

```

GN4 ADDS 1 TO XR1, THE NEXT CHARACTER POINTER. IF XR1 IS THEN WITHIN THE 72 CHARACTERS CORRESPONDING TO THE 72 COLUMNS OF A DOCUMENT CARD, CONTROL IS RETURNED TO THE INSTRUCTION AFTER THE CALLER. IF XR1 POINTS TO A CHARACTER BEYOND THE 72, THE 72 CHARACTERS FROM THE LAST CARD READ ARE MOVED TO CARD THROUGH CARD+71. THEN A NEW CARD IS READ. THE FIRST 20 CHARACTERS OF THIS CARD ARE MOVED TO CARD+72 THROUGH CARD+91. THIS LAST AREA IS CALLED 'NEXT' AND IS USED SO THAT THE SCAN FOR AN EDITING INSTRUCTION STRING CAN BE CARRIED OUT BEYOND THE RIGHT END OF THE 72 CHARACTERS. XR1 HAS 72 SUBTRACTED FROM IT SO IT WILL POINT CORRECTLY TO THE NEXT CHARACTER IN CARD. CONTROL IS RETURNED TO THE NEXT INSTRUCTION AFTER THE CALLER.

```

GN4   SBR  GN5+3
      SBR  XR1,1+X1
      C    '072',XR1
      BL   GN5
      S    '072',XR1
      MZ   *-4,XR1
      MCW  72,CARD+71
      R
      MCW  20,NEXT+19
GN5   B    0
CARD  DA   1X92
NEXT  EQU  CARD+72
CHAR  DA   1X1

```

SP EXECUTES ENDWD JUST IN CASE PREV = 1, I.E., WHEN THE LAST CHARACTER BEFORE THE PRESENT SPACE WAS NOT A SPACE. THEN THE PRINT LINE POINTER, XR3, IS ADVANCED BY 1. CONTROL PASSES TO GN.

```

SP   BCE  ENDWD,PREV,1
      SBR  XR3,1+X3
      MCW  '2',PREV
      B    GN

```

ENDWD DETERMINES WHETHER THE WORD THAT HAS JUST BEEN ASSEMBLED WILL FIT ON THE PRINT LINE, I.E., WITHOUT EXTENDING BEYOND THE PRESENT RIGHT MARGIN. PRINT IS EXECUTED JUST IN CASE THE WORD DOES NOT FIT. THE WORD IS MOVED TO THE PRINT LINE TO THE RIGHT OF WHERE XR3, THE PRINT-LINE POINTER, WAS SET AFTER THE POSSIBLE PRINTING. WHEN

('WORD REMINDER'), A COUNTER INDICATING HOW MANY SPECIALS THERE ARE IN THIS WORD, IS ADDED TO LREM ('LINE REMINDER'), A COUNTER INDICATING HOW MANY SPECIALS THERE ARE ON THIS LINE. XR3 IS ADJUSTED TO POINT TO THE RIGHT-MOST CHARACTER OF THE WORD JUST PLACED ON THE PRINT LINE. WREM IS SET TO ZERO AND PREV IS SET TO 2 TO INDICATE THAT NO WORD IS IN PROCESS OF BEING ASSEMBLED. XR2, WHICH COUNTS THE NUMBER OF CHARACTERS IN THE CURRENT WORD, IS SET TO ZERO. CONTROL IS RETURNED TO THE NEXT INSTRUCTION AFTER THE CALLER.

```
ENDWD   SBR  WDXIT+3
        A   XR2,XR3
EW3     C   TABA+45,XR3
        BH  EW1
        B   EW2
EW1     B   PRINT
        A   XR2,XR3
EW2     MCH  WORD-1+X2,20)+X3
        SBR  XR2,0
        A   WREM,LREM
        MCH  '000',WREM
        MCH  '2',PREV
WDXIT   B    0
```

SPEC MOVES A SPACE INTO CHAR, ADDS 1 TO WREM AND ADJUSTS XR1 TO POINT TO THE NEXT CHARACTER IN CARD. CONTROL PASSES TO WD.

```
SPEC     MCH  ' ',CHAR
        SBR  XR1,5+X1
        A   '1',WREM
        B   GN4
        B   WD
WREM     DCW  '000'
LREM     DCW  '000'
LNR      DCW  '100'
PNR      DCW  '0000'
        DCW  ' '
```

SKIP CHECKS WHETHER THIS STRING IS A VALID SKIP EDITING INSTRUCTION. (IT CHECKS FOR THE 3RD ASTERISK IN THE RIGHT SPOT AND THAT THE NUMBER OF LINES TO BE SKIPPED LIES BETWEEN 0 AND 9, INCL.) CONTROL GOES TO GN2 IF THIS STRING IS NOT A VALID SKIP INSTRUCTION. ENDWD IS EXECUTED JUST IN CASE PREV = 1. THEN PRINT IS EXECUTED. THIS DISPOSES OF THE CURRENT WORD AND LINE. AFTER THAT, THE NUMBER OF LINES TO BE SKIPPED (BEFORE PRINTING THE NEXT LINE) IS MOVED INTO SKNR. XR1 IS ADJUSTED TO POINT TO THE NEXT CHARACTER IN CARD. CONTROL PASSES TO GN.


```

SKIP    BCE SK10,CARD+7+X1,*
        B   GN2
SK10    C   CARD+6+X1,'0'
        BH  GN2
        BCE ENDWD,PREV,1
        B   PRINT
        MLNS CARD+6+X1,SKNR
        SBR XR1,7+X1
        B   GN4
        B   GN

```

TAB CHECKS WHETHER THIS STRING IS A VALID TAB EDITING INSTRUCTION. IF NOT, CONTROL IS SENT TO GN2. ENDWD IS EXECUTED JUST IN CASE A WORD WAS IN PROCESS OF BEING ASSEMBLED. THEN IT LOOKS TO SEE IF THE PRINT-LINE POINTER, XR3, IS PAST THE INDICATED TAB STOP. IF SO PRINT IS EXECUTED. THEN XR3 IS SET TO THE INDICATED TAB STOP. XR1 IS ADJUSTED AND CONTROL PASSES TO GN.

```

TAB      BCE T1,CARD+6+X1,*
        B   GN2
T1       MCW CARD+5+X1,COMP
        B   ATOZ
        MCW TABA-3+X3,TSTOP
        S   '1',TSTOP
        MZ  *-4,TSTOP
        MCW SAVXR3,XR3
        BCE ENDWD,PREV,1
        C   XR3,TSTOP
        BL  T3
        B   T4
T3       B   PRINT
T4       MCW TSTOP,XR3
        SBR XR1,6+X1
        B   GN4
        B   GN
TABA     DCW '001'
        DCW '006'
        DCW '011'
        DCW '016'
        DCW '021'
        DCW '026'
        DCW '031'
        DCW '036'
        DCW '041'
        DCW '046'
        DCW '051'
        DCW '056'
        DCW '061'
        DCW '066'

```

```

DCW '071'
DCW '076'
DCW '081'
DCW '086'
DCW '091'
DCW '096'
DCW '101'
DCW '106'
DCW '111'
DCW '116'
DCW '121'
DCW '126'
TSTOP DCW =3

```

ATOZ IS EXECUTED BY SEVERAL OF THE EDITING INSTRUCTION SUBROUTINES TO CHECK FOR A LETTER OF THE ALPHABET. COMP IS EXAMINED. IF COMP DOES NOT CONTAIN ANY OF THE 26 LETTERS, CONTROL PASSES TO GN2. IF COMP CONTAINS THE K(TH) LETTER OF THE ALPHABET, XR3 IS SAVED IN SAVXR3 AND SET TO THREE TIMES K. CONTROL IS RETURNED TO THE INSTRUCTION AFTER THE CALLER.

```

ATOZ   SBR  AZXIT+3
        C    COMP,'A'
        BH   GN2
        C    COMP,'I'
        BL   A22
        MCW  '000',A21
        B    A24
ATOZ   C    COMP,'J'
        BH   GN2
        C    COMP,'R'
        BL   A23
        MCW  '027',A21
        B    A24
ATOZ   C    COMP,'S'
        BH   GN2
        C    COMP,'Z'
        BL   GN2
        MCW  '051',A21
ATOZ   MCW  XR3,SAVXR3
        MLNS COMP,A25
        MCW  A25,XR3
        A    XR3
        A    A25,XR3
        A    A21,XR3
AZXIT  B    0
A21    DCW  =3
A25    DCW  =3
SAVXR3 DCW  =3

```

PAGE 0060

COMP DCW -1

PARA EXECUTES ENDWD JUST IN CASE A WORD HAD BEEN FORMED, THEN, EXECUTES PRINT. A 1 IS MOVED INTO SKNR. THE CURRENT VALUE OF THE PARAGRAPH TAB STOP (DETERMINED BY THE LAST START-PARA EDITING INSTRUCTION EXECUTED) IS MOVED INTO XR3, THE PRINT-LINE POINTER. XR1 IS ADJUSTED. CONTROL PASSES TO GN.

```
PARA    BCE  ENWD,PREV,1
        B    PRINT
        MCW  '1',SKNR
PARA1    MCW  TABA+3,XR3
        S    '1',XR3
        MZ   0-4,XR3
        SBR  XR1,5+X1
        B    GN4
        B    GN
```

PAGE EXECUTES ENDWD JUST IN CASE A WORD HAD BEEN FORMED. PRINT AND THEN HEAD ARE EXECUTED. THE PRINT LINE IS CLEARED. XR1 IS ADJUSTED AND CONTROL PASSES TO GN.

```
PAGE    BCE  ENCD,PREV,1
        B    PRINT
        B    HEAD
        CS   332
        CS
        SBR  XR1,9+X1
        B    GN4
        B    GN
```

SETTAB DETERMINES WHETHER THIS STRING IS A VALID SET-TAB EDITING INSTRUCTION. IF NOT, CONTROL PASSES TO GN2. IF SO, THE INDICATED TAB STOP IS SET ACCORDING TO THE PARAMETER IN THE EDITING INSTRUCTION. XR1 IS ADJUSTED. CONTROL PASSES TO GN.

```
SETTAB  BCE  ST1,CARD+6+X1,0
        B    GN2
ST1      BCE  ST2,CARD+10+X1,0
        B    GN2
ST2      MCW  CARD+9+X1,TSTOP
        C    TSTOP,'001'
        BH   GN2
        C    TSTOP,'131'
        BL   GN2
        MCW  CARD+5+X1,COMP
        B    ATCZ
```

```

          MCW TSTOP,TABA-3+X3
          MCW SAVXR3,XR3
          SBR XR1,10+X1
ST4      B    GN4
          B    GN

```

SETRET DETERMINES WHETHER THIS STRING IS A VALID LEFT-MARGIN EDITING INSTRUCTION. IF NOT, CONTROL PASSES TO GN2. IF SO, A PARAMETER IN PRINT IS SET SO PRINT WILL USE THE NEW STOP AS THE LEFT MARGIN AFTER PRINTING. XR1 IS ADJUSTED AND CONTROL PASSES TO GN.

```

SETRET   PCE  SR1,CARD+14+X1,*
          B    GN2
SR1      MCW  CARD+13+X1,COMP
          B    ATOZ
          A    STOPS,XR3
          MCW  XR3,P5+3
          MCW  SAVXR3,XR3
          SBR  XR1,14+X1
          B    ST4

```

LINSIZ DETERMINES WHETHER THIS STRING IS A VALID RIGHT-MARGIN EDITING INSTRUCTION. IF NOT, CONTROL PASSES TO GN2. IF SO, ENDWD HAS A PARAMETER WITHIN SET SO THAT IT CAN LOOK FOR THE NEW RIGHT MARGIN.

```

LINSIZ   BCE  LS1,CARD+15+X1,*
          B    GN2
LS1      MCW  CARD+14+X1,COMP
          B    ATOZ
          A    STOPS,XR3
          MCW  XR3,EW3+3
          MCW  SAVXR3,XR3
          SBR  XR1,15+X1
          B    ST4

```

SETPAR DETERMINES WHETHER THIS STRING IS A VALID SET-PARA EDITING INSTRUCTION. IF NOT, CONTROL PASSES TO GN2. IF SO, A PARAMETER WITHIN PARA IS SET SO PARA MAY USE THE NEW TAB STOP.

```

SETPAR   BCE  SP1,CARD+13+X1,*
          B    GN2
SP1      MCW  CARD+12+X1,COMP
          B    ATOZ
          A    STOPS,XR3
          MCW  XR3,PARA1+3
          MCW  SAVXR3,XR3
          SBR  XR1,13+X1

```

PAGE 0062

STOPS B ST4
 DCW +TABA-3

PAGSIZ DETERMINES WHETHER THIS
STRING IS A VALID PAGE-SIZE EDITING INSTRUCTION. IF NOT,
CONTROL IS PASSED TO GN2. IF SO, PAGLIM IS SET TO THE NEW
LIMIT. XR1 IS ADJUSTED AND CONTROL PASSES TO GN.

PAGSIZ BCE PS1,CARD+14+X1,*
 B GN2
PS1 C CARD+13+X1,'001'
 BH GN2
 C CARD+13+X1,'250'
 BL GN2
 MCW CARD+13+X1,PAGLIM
 SBR XR1,14+X1
 B ST4

PUNEXT DETERMINES WHETHER THIS
STRING IS A VALID PUNCH EDITING INSTRUCTION. IF NOT, CONTROL
PASSES TO GN2. IF SO, A PARAMETER WITHIN PUNCH IS SET SO PUNCH
WILL KNOW WHAT TAB STOP TO PUNCH FROM. ALSO A SWITCH WITHIN
PRINT IS SET SO THAT THE NEXT PRINT LINE CAN BE PUNCHED. XR1
IS ADJUSTED AND CONTROL PASSES TO GN.

PUNEXT BCE PNX1,CARD+8+X1,*
 B GN2
PNX1 MCW CARD+7+X1,COMP
 B ATOZ
 MCW XR3,CH2
 MCW SAVXR3,XR3
 MCW +PUNCH,P6+3
 SBR XR1,8+X1
 B ST4

ENDDOC EXECUTES ENDWD JUST IN
CASE A WORD HAD BEEN FORMED. THEN PRINT IS EXECUTED. AN END
SENTINEL IS WRITTEN ON TAPE 2 TO END THE LIST OF SPECIAL
REMINDERS (IF ANY). TAPE 2 IS REWOUND. THE REMINDER LIST IS
PRINTED, READING TAPE 2 UNTIL THE END SENTINEL IS ENCOUNTERED.
TAPE 2 IS REWOUND. THE PROGRAM HALTS.

ENDDOC BCE ENOWC,PREV,1
 B PRINT
 WT 2,SENTRY
 B HEAD
 CS 332
 CS
 CC T
 MCW 'REMINDER LIST',260

PAGE 0063

```

W
RWD 2
CS 332
CS
MCW ' SPECIALS ON LINE , PAGE ',235
EN1 RT 2,LREM-2
BCE EN2,LREM-2,Z
MCW LREM,203
MCW LNR,224
MCW PNR,235
W EN1
EN2 CS 332
CS
MCW 'END REMINDER LIST',260
W
RWD 2
HALT H HALT
SENTRY DCW 'Z'
DCW ' '

```

PRINT ADDS SKNR, THE SKIP NUMBER, TO LNR, THE LINE NUMBER. IF LNR THEN EXCEEDS PAGLIM, THE PAGE LIMIT, THE CURRENT PRINT LINE IS SAVED IN LINSAY. THEN HEAD IS EXECUTED AND THE PRINT LINE IS RESTORED FROM LINSAY. IF, ON THE OTHER HAND, LNR DOES NOT EXCEED PAGLIM, AS MANY LINES ARE SKIPPED AS SKNR INDICATES. THEN, IN ANY EVENT, SKNR IS SET TO ZERO AND 1 IS ADDED TO LNR. THE LINE IS PRINTED. IF THE PUNCH SWITCH IS SO SET, PUNCH IS EXECUTED. IF LREM, THE LINE REMINDER, IS NOT ZERO, INDICATING ONE OR MORE SPECIALS ON THIS LINE, THE REMINDER IS WRITTEN ON TAPE 2. LREM IS RESET TO ZERO. THE PRINT AREA IS CLEARED. XR3, THE PRINT-LINE POINTER, IS SET TO THE PRESENT VALUE OF THE LEFT MARGIN TAB STOP. CONTROL IS RETURNED TO THE NEXT INSTRUCTION AFTER THE CALLER.

```

PRINT SBR PRXIT+3
A SKNR,LNR
C LNR,PAGLIM
BH P1
MCW 332,LINSAY+131
B HEAD
MCW LINSAY+131,332
B P2
P1 C '001',SKNR
BL P2
S '1',SKNR
MZ *-4,SKNR
CC J
B P1
P2 MCW '000',SKNR

```

PAGE 0064

```

      A   '1',LNR
      W
P6     B   P7
P7     C   LREM,'000'
      BE   P3
      WT   2,LREM-2
      MCW  '000',LREM
P3     CS   332
      CS
P5     MCW  TABA,XR3
      S    '1',XR3
      MZ   *-4,XR3
PRXIT  B    0
LINSAV DA   1X132
SKNR   DCW  '000'

```

PUNCH DETERMINES WHETHER THERE ARE 80 CHARACTERS WITHIN THE PRINT AREA FROM THE CURRENT VALUE OF THE TAB STOP SET BY THE PUNCH EDITING INSTRUCTION LAST EXECUTED. IF NOT, CONTROL IS RETURNED TO THE INSTRUCTION AFTER THE CALLER. IF THERE IS ENOUGH ROOM, THE 80 CHARACTERS ARE MOVED TO THE PUNCH AREA AND THE CARD IS PUNCHED. THE SWITCH IN PRINT THAT SENT CONTROL TO PUNCH IS RESET SO THAT ANOTHER PUNCH EDITING INSTRUCTION IS REQUIRED FOR ANOTHER EXECUTION OF PUNCH.

```

PUNCH  MCW  PCH2,XR3
      MCW  +P7,P6+3
      MCW  '079',PCH2
      A    TABA-3+X3,PCH2
      C    '131',PCH2
      BH   P7
      A    '200',PCH2
      MCW  PCH2,PCH1+3
PCH1   MCW  0,180
      P    P7
PCH2   DCW  =3

```

HEAD SETS LNR TO ZERO AND ADDS 1 TO PNR, THE PAGE NUMBER. THE PRINT AREA IS CLEARED. THE CLASSIFICATION IS MOVED INTO THE PRINT AREA. THE FORM IS SKIPPED TO CHANNEL 12, THE BOTTOM OF THE FORM. THE CLASSIFICATION OF THIS DOCUMENT IS PRINTED (AT THE BOTTOM OF THE PAGE). THE FORM IS SKIPPED TO CHANNEL 1. THE CLASSIFICATION IS PRINTED (AT THE TOP OF THE NEXT PAGE). THE PRINT AREA IS CLEARED, THE PAGE HEADING IS MOVED INTO THE LINE ALONG WITH THE WORD 'PAGE' AND PNR, THE PAGE NUMBER. THE PAGE HEADING IS THEN PRINTED. CONTROL IS RETURNED TO THE NEXT INSTRUCTION AFTER THE CALLER.

```

HEAD   SBR  HDXIT+3

```

PAGE 0065

```

MCW '000',LNR
A '1',PNR
CS 332
CS
MCW CLASSI,250
CC '
CC A
W
CC S
W
CS 332
CS
MCW HEDING,265
MCW 'PAGE',272
MCW PNR,277
CC T
W
HDXIT B 0

```

START READS THE FIRST DATA CARD, BY DEFINITION, THE CONTROL CARD. THE PAGE HEADING IS MOVED FROM COLUMNS 1 THROUGH 50 INTO HEDING. THE CLASSIFICATION IS MOVED FROM COLUMNS 51 THROUGH 70 TO CLASSI. THE FIRST DOCUMENT DECK CARD IS READ AND A WORD MARK IS PLACED IN MEMORY POSITION 1. THEN GN4 IS EXECUTED. THIS ACCOMPLISHES MOVING THE FIRST CARD TO CARD AND THE READING OF THE SECOND CARD, ETC. (BECAUSE XR1 IS ORIGINALLY SET TO 72). TAPE 2 IS REWOUND AND CONTROL PASSES TO GN.

```

START R
MCW 50,HEDING
MCW 70,CLASSI
R
SW 1
B GN4
B HEAD
CS 332
CS
RWD 2
B GN
LTORG*
WCRO DA 1X132
DCW =1
END START

```


APPENDIX D

SQUEEZE -- CODED IN 1401 AUTOCODER

LABEL	OP	OPERAND
	JOB	R A MAGNUSON SQUEEZE/SEQUENCE
	CTL	335
	ORG	87
XR1	DCW	'071'
	DC	=2
XR2	DCW	'000'
	ORG	101
OUTPUT	DA	1X75
COUNT	DCW	=5
CHAR	DA	1X1

GN GETS THE NEXT CHARACTER. IF THAT NEXT CHARACTER IS AN ASTERISK, CONTROL IS TRANSFERRED TO GN1 IN CASE THIS IS THE START OF AN EDITING INSTRUCTION. IF THE NEXT CHARACTER DOES NOT BEGIN AN EDITING INSTRUCTION, ASTERISK OR NOT, IT IS MOVED TO CHAR, THEN GN4 IS EXECUTED IN ORDER TO MOVE THE NEXT-CHARACTER POINTER, XR1, OVER TO THE NEXT ONE YET. AFTER THAT PUNCH IS EXECUTED. THEN CONTROL LOOPS AROUND TO GN.

GN	BCE	GN1,CARD+X1,•
GN2	MCW	CARD+X1,CHAR
	B	GN4
	B	PUNCH
	B	GN

GN1 LOOKS TO SEE IF THE STRING TO THE RIGHT OF THE ASTERISK UNDER CONSIDERATION IS ANY OF THE EDITING INSTRUCTIONS. IF SO, CONTROL IS SENT TO THE APPROPRIATE EDITING INSTRUCTION SUBROUTINE. IF NOT, CONTROL GOES BACK WITHIN GN (TO GN2).

GN1	C	CARD+5+X1,'VOID•'
	BE	VOID
	C	CARD+12+X1,'END•SECTION•'
	BE	ENDSEC

```

C   CARD+8+X1,'END+DOC*'
B   ENDDCC
B   GN2

```

VOID STAYS IN A TIGHT LOOP, EXECUTING GN4 TO MOVE TO THE NEXT CHARACTER AND LOOKING TO SEE IF THAT NEXT CHARACTER BEGINS THE STRING, '*OK*'. WHEN THE FIRST '*OK*' HAS BEEN FOUND, THE NEXT-CHARACTER POINTER IS ADJUSTED TO THE CHARACTER IMMEDIATELY TO THE RIGHT OF THE '*OK*'. CONTROL IS THEN SENT TO GN.

```

VOID   SBR   XR1,5+X1
GN3    B     GN4
        C     CARD+3+X1,'*OK*'
        BU    GN3
        SBR   XR1,3+X1
        B     GN4
        B     GN

```

GN4 ADDS 1 TO XR1, THE NEXT-CHARACTER POINTER. IF XR1 IS THEN WITHIN THE 72 CHARACTERS CORRESPONDING TO THE 72 COLUMNS OF A DOCUMENT CARD, CONTROL IS RETURNED TO THE INSTRUCTION AFTER THE CALLER. IF XR1 POINTS TO A CHARACTER BEYOND THE 72, THE 72 CHARACTERS FROM THE LAST CARD READ ARE MOVED TO CARD THROUGH CARD+71. THEN A NEW CARD IS READ. THE FIRST 20 CHARACTERS OF THIS CARD ARE MOVED TO CARD+72 THROUGH CARD+91. THIS LAST AREA IS CALLED 'NEXT' AND IS USED SO THAT THE SCAN FOR AN EDITING INSTRUCTION STRING CAN BE CARRIED OUT BEYOND THE RIGHT END OF THE 72 CHARACTERS. XR1 HAS 72 SUBTRACTED FROM IT SO IT WILL POINT CORRECTLY TO THE NEXT CHARACTER IN CARD. CONTROL IS RETURNED TO THE NEXT INSTRUCTION AFTER THE CALLER.

```

GN4     SBR   GN5+3
        SBR   XR1,1+X1
        C     '072',XR1
        BL    GN5
        S     '072',XR1
        MZ    *-4,XR1
        MCW   72,CARD+71
        R
        MCW   20,NEXT+19
GN5     B     0
CARD    CA    1X92
NEXT    EQU   CARD+72

```

PUNCH MOVES CHAR TO THE NEXT POSITION IN OUTPUT, THE PUNCH AREA. 1 IS ADDED TO XR2, THE PUNCH-AREA POINTER. IF THE POINTER IS STILL WITHIN THE 72 CHARACTERS PUNCHED ON A CARD, CONTROL IS RETURNED TO THE

PAGE 0068

INSTRUCTION AFTER THE CALLER. IF THE POINTER HAS GONE BEYOND THE RIGHT-MOST ALLOWABLE POSITION, IT IS RESET TO POINT TO THE LEFT-MOST PUNCH POSITION, 1 IS ADDED TO COUNT (THE SEQUENCE NUMBER TO BE PUNCHED), THE CARD IS PUNCHED AND THE PUNCH AREA IS CLEARED. CONTROL RETURNS TO THE INSTRUCTION AFTER THE CALLER.

```

PUNCH    SBR  PXIT+3
          MCW  CHAR,OUTPUT+X2
          SBR  XR2,1+X2
          C    '072',XR2
          BL   PXIT
P1        MCW  '000',XR2
          A    '1',COUNT
          P
          CS   172
PXIT      B    0

```

ENDSEC EXECUTES VOIDOK, THEN ADJUSTS XR1, THE INPUT-CHARACTER POINTER. CONTROL PASSES TO GN.

```

ENDSEC   B    VOIDOK
          SBR  XR1,12+X1
          B    GN4
          B    GN

```

VOIDOK PLACES THE STRING '*VOID*' IN THE CARD(S) BEING PUNCHED. (IT MAY EXTEND OVER THE END OF ONE CARD.) HE THEN LOOKS TO SEE IF '*OK*' WILL FIT ON THE CURRENT CARD IN COLUMNS 69-72. IF SO, IT IS SO PLACED. IF NOT, THE CURRENT CARD IS PUNCHED AND THE '*OK*' IS PLACED IN THE NEXT CARD IN COLUMNS 69-72. CONTROL IS RETURNED TO THE INSTRUCTION AFTER THE CALLER.

```

VOIDOK   SBR  VOXIT+3
          MCW  '* ',CHAR
          B    PUNCH
          MCW  'V ',CHAR
          B    PUNCH
          MCW  'O ',CHAR
          B    PUNCH
          MCW  'I ',CHAR
          B    PUNCH
          MCW  'D ',CHAR
          B    PUNCH
          MCW  '* ',CHAR
          B    PUNCH
          C    '068',XR2
          BH   VO1

```

```

MCH '068',XR2
MCH '•',CHAR
B PUNCH
MCH '0',CHAR
B PUNCH
MCH 'X',CHAR
B PUNCH
MCH '•',CHAR
B PUNCH
VOXIT B 0
VCI SBR PXIT+3
B P1

```

ENDDOC EXECUTES VOIDOK, CLEARS THE PRINT AREA, THEN PLACES THE '•END•DOC•' STRING THRICE IN THE PRINT AREA. THIS IS PUNCHED FOUR TIMES AND THE PROGRAM HALTS.

```

ENDDOC B VOIDOK
CS 180
MCH '•END•DOC•',109
MCH '•END•DOC•',144
MCH '•END•DOC•',172
P
P
P
P
HALT H HALT

```

START READS THE FIRST DATA CARD, THE CONTROL CARD (BY DEFINITION). A WORD MARK IS PLACED IN MEMORY POSITION 1. THE FIRST 75 CHARACTERS OF THAT FIRST CARD ARE MOVED TO THE FIRST 75 CHARACTERS OF THE PUNCH AREA. (THIS LEAVES THE IDENTIFIER, COLS 73-75, IN PLACE.) THIS CARD IS PUNCHED. THE LOWER 72 CHARACTERS OF THE PUNCH AREA ARE CLEARED. THE SECOND CARD IS READ. GN4 IS EXECUTED ACCOMPLISHING THE MOVING OF THE SECOND CARD TO CARD, THE READING OF THE THIRD, ETC., (BECAUSE XR1 IS INITIALLY SET AT 72). CONTROL PASSES TO GN.

```

START R
SW 1
MCH 75,175
P
CS 172
R
B GN4
B GN
END START

```

PAGE 0069

```

MCW '068',XR2
MCW '•',CHAR
B PUNCH
MCW '0',CHAR
B PUNCH
MCW 'K',CHAR
B PUNCH
MCW '•',CHAR
B PUNCH
VOXIT B 0
VCI SBR PXIT+3
B P1

```

ENDOC EXECUTES VOIDOK, CLEARS THE PRINT AREA, THEN PLACES THE '•END•DOC•' STRING THRICE IN THE PRINT AREA. THIS IS PUNCHED FOUR TIMES AND THE PROGRAM HALTS.

```

ENDDOC B VOIDOK
CS 180
MCW '•END•DOC•',109
MCW '•END•DOC•',144
MCW '•END•DOC•',172
P
P
P
P
HALT H HALT

```

START READS THE FIRST DATA CARD, THE CONTROL CARD (BY DEFINITION). A WORD MARK IS PLACED IN MEMORY POSITION 1. THE FIRST 75 CHARACTERS OF THAT FIRST CARD ARE MOVED TO THE FIRST 75 CHARACTERS OF THE PUNCH AREA. (THIS LEAVES THE IDENTIFIER, COLS 73-75, IN PLACE.) THIS CARD IS PUNCHED. THE LOWER 72 CHARACTERS OF THE PUNCH AREA ARE CLEARED. THE SECOND CARD IS READ. GN4 IS EXECUTED ACCOMPLISHING THE MOVING OF THE SECOND CARD TO CARD, THE READING OF THE THIRD, ETC., (BECAUSE XR1 IS INITIALLY SET AT 72). CONTROL PASSES TO GN.

```

START R
SW 1
MCW 75,175
P
CS 172
R
B GN4
B GN
END START

```