

Mechanized Billing of AMA Toll Messages

FRANK D. SLADE
NONMEMBER AIEE

THE billing of 140,000,000 toll messages a month to 17,000,000 toll using customers, representing about 60 per cent of the total telephone customers, is a major operation involving approximately 15,000 Bell System clerical employees. Toll message volumes have more than doubled in the past 10 years, and further growth seems likely. While many important improvements have been made in the billing processes in order to handle the increased volume more effectively, the mechanization of this work continues to remain a challenge.

The introduction of automatic message accounting (AMA) in the Bell System in 1948 presented an opportunity to mechanize some of the operations involved in toll billing, especially the sorting of AMA toll messages into telephone number order and the timing of such messages. The initial AMA system was described in 1950,¹ and a new development in the AMA system, the tape-to-card converter which produces a punched card for each toll message, is described in a companion paper.²

Although the number of toll messages now recorded on AMA tapes represents only about 3 per cent of the total toll messages, this percentage is expected to double by the end of 1953 and continued rapid expansion of AMA toll message recording is anticipated.

This paper describes the operations followed by the New Jersey Bell Tele-

phone Company in billing toll messages recorded on AMA equipment. The operations involved in billing long-distance toll messages dialed on a trial basis by customers in Englewood and Teaneck, N. J., are not covered, although the same card is used for billing regular AMA toll messages and long-distance messages. The New Jersey Company at present accounts for about 80 per cent of the total AMA recorded toll messages and is the only Bell System company currently using punched cards for toll message billing. The Illinois Bell Telephone Company and the New York Telephone Company are scheduled to adopt punched card toll billing for AMA messages early this year, and three other Bell companies are planning to introduce this type of billing later in 1953. AMA toll messages billed manually are handled in about the same manner as operator-ticketed toll messages.

For many years experiments have been conducted in an effort to find a mechanical method of rating, sorting, and billing toll messages which would provide economies over the highly efficient manual procedures that had been developed over a period of many years. In the fall of 1948, the New York Telephone Company began a trial of punched card toll billing in its Lexington Accounting office in New York City wherein the significant data shown on toll tickets, prepared in the usual manner by operators, were

transferred to punched cards, using a specially designed key punch with an automatic ticket feed. While more than 20,000,000 toll messages were billed by means of punched cards during the period of the trial, the plan was discontinued in December 1950 after much experimentation, when it was concluded that the manual transcription of information from toll tickets to punched cards was uneconomical. One of the principal factors affecting the outcome of the trial was the difficulty encountered in getting the data for each message (generally of low billing value) punched into the cards accurately and at high speed.

With the introduction of the AMA tape-to-card converter, the accurate and rapid preparation of punched cards from original records became a reality, and mechanical billing of AMA toll messages became an economical operation where the volume of toll messages to be billed was at least 200,000 messages per month. While the procedures followed by the New Jersey Company are producing satisfactory results, the many machine and card handling operations involved create a complicated process, which, it is believed, will eventually evolve into a more efficient and simplified procedure.

Preparation of Toll Message Card

The punched card, Figure 1, as it emerges from the tape-to-card converter contains all of the basic information required for rating and billing. The follow-

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FRANK D. SLADE is with the American Telephone and Telegraph Company, New York, N. Y.

NEW JERSEY BELL TELEPHONE CO.—TOLL BILLING—AMA

CONNECT TIME
20481290

NO.	DAY	CLG. C.O.	CLG. LINE NO.	FULL PLACE CALLED	AREA	OFFICE	BR CODE	CLASS	DUR	BASE RATE	CHARGE	MONTH												TERM	OVERTIME																																																		
0	0	0	0	000000000000000000	0	0	0	0	0	0	0	000000000000000000												0	0																																																		
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
1	1	1	1	111111111111111111	1	1	1	1	1	1	1	111111111111111111												1	1																																																		
2	2	2	2	222222222222222222	2	2	2	2	2	2	2	222222222222222222												2	2																																																		
3	3	3	3	333333333333333333	3	3	3	3	3	3	3	333333333333333333												3	3																																																		
4	4	4	4	444444444444444444	4	4	4	4	4	4	4	444444444444444444												4	4																																																		
5	5	5	5	555555555555555555	5	5	5	5	5	5	5	555555555555555555												5	5																																																		
6	6	6	6	666666666666666666	6	6	6	6	6	6	6	666666666666666666												6	6																																																		
7	7	7	7	777777777777777777	7	7	7	7	7	7	7	777777777777777777												7	7																																																		

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Figure 1. Toll message card as produced by converter

ing data are punched into the cards:

- Column Punched Data**
- 1-4....connect time of message (using 24-hour clock)
 - 4.....special X punch to indicate an AMA message
 - 5-7.....called area code (column 7 only for a regular AMA message)
 - 8, 9, 20...called central office code
 - 22, 23...duration of conversation in chargeable minutes
 - 55-57....calling central office code
 - 58.....month code (for collator date sequence check)
 - 59-61....month and date of message
 - 62-66....called telephone number
 - 67.....party letter of called telephone number
 - 69-72....calling telephone number

- 74.....AMA check ("9" punch); indicates all data were received by punch unit of converter from the input tape
- 74.....billing X indicates a billable message

After verifying the count of message cards punched by the converter with the number of messages recorded on the AMA computer registers, the cards are replaced in the regular cardboard boxes used for shipping and are forwarded three times a day to the punched card accounting offices in Newark and Elizabeth, which are, respectively, 1 and 6 miles from the AMA Accounting Center.

The Newark punched card accounting

office processes about 1,700,000 toll messages per month and prepares toll service statements for 73,000 customers whose telephone bills are prepared at Newark and Paterson. The Elizabeth punched card accounting office processes about 1,400,000 toll messages per month and prepares toll service statements for 75,000 customers whose telephone bills are prepared at Elizabeth and Pennsauken, near Camden. As a temporary arrangement, in order to produce a more even work load at the two punched card accounting offices, toll statements are also prepared at Elizabeth for a small number of customers billed at Paterson.

NEW JERSEY BELL TELEPHONE CO.—TOLL BILLING—AMA

102150 134 0016 1F 18 001348 020 0300 2

DECK	ZONE	C'L'G C.O.	MILEAGE	FULL PLACE CALLED	AREA	OFF. & DIG.	B.R. CODE	BASE RATE	TAX	MILLS	INIT.	TYPE	SILENT	TOLL CTR. CODE
0	0	0	0	000000000000000000	0	0	0	0	0	0	0	0	0	0
1	1	1	1	111111111111111111	1	1	1	1	1	1	1	1	1	1
2	2	2	2	222222222222222222	2	2	2	2	2	2	2	2	2	2
3	3	3	3	333333333333333333	3	3	3	3	3	3	3	3	3	3
4	4	4	4	444444444444444444	4	4	4	4	4	4	4	4	4	4
5	5	5	5	555555555555555555	5	5	5	5	5	5	5	5	5	5
6	6	6	6	666666666666666666	6	6	6	6	6	6	6	6	6	6
7	7	7	7	777777777777777777	7	7	7	7	7	7	7	7	7	7

1. SOLID YELLOW — STA. TO STA. DAY BASE RATE
 2. YELLOW, BLUE STRIPE — STA. TO STA. DAY EXCEPTION POINT
 3. SOLID BLUE — STA. TO STA. NITE EXCEPTION POINT

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Figure 2. Terminating point rating master card

DECK NO.		TAX RATE		00045		001125		1		09		020		BASE RATE		BASE RATE C	
DATE		TAX RATE		CHARGE		TAX		MILLS		CLASS		DURATION		BASE RATE		BASE RATE C	
MO.	DAY	YR.	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Figure 3. Duration rating master card

Punched Card Machines

The four principal types of punched card machines used in billing AMA toll messages are as follows:

Sorters

Sort cards, one column at a time, into one of 12 numbered pockets or a reject pocket.
 Count number of cards sorted.
 Rated speed is 650 cards per minute.

Collators

Compare cards for ascending numerical sequence, selecting those out of numeric order.
 Compare up to 16 columns in one card with matching columns in following cards, rejecting nonmatching cards.

Rated speed is 240 cards per minute for single-feed, or 480 per minute for double-feed.

Reproducing Punches

Gang punch data from one card into another card.
 Detect a double punch or a blank column where one punch should be present.
 Compare all columns of one card with the following cards.
 Duplicate punches in one card to another card.
 Rated speed is 100 cards per minute.

Accountings Machines

Print up to 88 characters on one horizontal line simultaneously.
 Accumulate totals into counters and print totals upon recognizing a control punch.
 Automatically position new pages of forms

to be printed.

Rated speed is 100 cards per minute.

The uses made of these machines in the rating and billing of AMA toll messages are described in succeeding paragraphs.

Primary Rating Operation

The boxes of message cards, upon being received in the punched card accounting office, are examined to insure that all of the boxes for the recorder groups involved have been received, it being the established practice for the AMA accounting office to release all of the cards for a

MO.	DAY	CL.	CLG. LINE NO.	FULL PLACE CALLED	AREA	OFFICE	BR CODE	CLASS	DUR.	BASE RATE	CHARGE	NON BILL	CALLED LINE NO.
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7

Figure 4. Toll message card ready for billing

Statement

B

C A 6 2 6 6 9

NEW JERSEY BELL TELEPHONE COMPANY
TOLL SERVICE STATEMENT

DATE	PLACE CALLED	AMOUNT
4-14	UN 2	.1 0
4-15	HU 2	.1 0
4-17	NYRE 7	.2 0
4-17	MI 2	.1 0
4-23	HU 2	.1 0
4-26	HU 7	.2 5
5-4	NU 2	.1 0
5-9	NYRE 7	.2 0
5-9	NYPL 3	.2 0
5-9	NYRE 7	.2 0
5-9	MI 2	.1 0
TOTAL U. S. TAX		.2 7
TOTAL CARRIED TO BILL		1.9 2

PLEASE SEE YOUR
DIRECTORY FOR
CENTRAL OFFICE NAMES
AND ABBREVIATIONS
OF NEARBY POINTS

U. S. TAX SCHEDULE
TOLL CALLS
UNDER 25¢ . . . 15%
25¢ and over . . . 25%

Figure 5. Customer's portion of toll service statement

recorder group at one time. The individual boxes are marked to show the number of the box and the total number of boxes for the recorder group.

A recorder group may consist of a single central office, such as Cranford 6, or it may comprise two or more offices, such as Leonia 4 and Fort Lee 8, calls for which are perforated on common recorders. The central offices in a recorder group may or may not be in the same originating rate center. Since the messages in a recorder group are not separated by central office when being processed through the tape-to-card converter, the first step in the rating operation is to sort the cards on column 57 by originating central office code, if the recorder group includes offices in two or more originating rate centers. In this sorting operation a card count is obtained to verify the number of toll messages recorded by the AMA computer. All cards having the same originating rate center are then assembled manually in order that the maximum number of cards of a common type may be accumulated for the next operation.

The second step is to sort the message cards on columns 20, 9, 8, and 7 by place called, during which operation the message cards are associated with the appropriate terminating point rating master cards. Each originating rate center has a deck of terminating point rating master cards which consists of a card for each central office that can be dialed by customers of the originating rate center. Since all AMA central offices, with the exception of those around Camden, in the southern part of the state, have the same dialing

area, the number of cards in the terminating point rating master deck for each originating rate center is approximately the same. The offices in and around Camden have a much smaller calling range and therefore the terminating point rating master decks consist of fewer cards. Currently, the rating decks for northern New Jersey offices consist of about 450 cards and for offices in the southern part of the state, about 125 cards.

The terminating point rating master cards, Figure 2, which are yellow in color, show the following information which is punched into the message cards:

1. The initial period station-to-station day rate (commonly referred to as the base rate), columns 36-38.
2. The related Federal tax in cents and mills applicable to the base rate, columns 39-42.
3. The punching for the established abbreviation of the terminating point, columns 10-13.
4. A code to indicate that the message terminates at an interstate or intrastate point, column 43.
5. The class code, "1" for messages not subject to reduced rates, and "2" for messages to be charged at reduced rates, column 24.
6. The number of the rating deck used, column 54.
7. The area and office code of the place called for checking purposes only, columns 47-50.

The punching of the area and office code of the place called into the message cards from the terminating point rating master cards is done so that a check can be made by comparing the newly punched data in columns 47-50 with the punching in

columns 7-9 and 20. Any message cards associated with the wrong master cards will cause the reproducer to stop.

There are only a few AMA central offices which can originate messages to points where reduced rates for night, Sunday, and holiday messages apply. The terminating point rating master cards for these points have a distinctive marking (blue stripe across the top of an otherwise yellow card) and these cards are followed immediately by a second rating master card (all blue in color) for the same terminating point, which carries the reduced rate for night, Sunday, and holiday messages. All of the message cards associated with the all-blue or blue-striped terminating point rating master cards in the sorting operation are manually examined to determine if the connect time which is printed near the left end of the card by the tape-to-card converter is later than 1759 and earlier than 0430, in which case reduced rates are applicable. Those cards subject to reduced rates are filed behind the all-blue master card and the others are filed behind the blue-striped master card.

After the message cards have been associated with their respective terminating point rating master cards, they are gang punched with the pertinent data carried in the master cards. During the punching operation, the machine verifies the accuracy of part of the punching. However, to insure that all columns of the message cards have been accurately punched, the cards are placed in the comparing side of the reproducer, which completes the verification.

The message cards are next sorted by duration (length of conversation), during which operation the terminating point rating master cards are eliminated. The separation by duration is accomplished by sorting the duration rating master cards and the message cards on columns 23 and 22. Message cards of 1-, 2-, and 3-minute duration are, of course completely rated and taxed following the gang punching of data carried in the terminating point rating master cards. Cards completely rated in this manner cover about 60 per cent of the total message cards.

Adjustment for Overtime

The next step in the rating process (for the remaining 40 per cent of the cards) is to sort by base rate so that messages having the same base rate and duration are together immediately behind the appropriate duration rating master cards. In this rating operation, all message

cards having the same base rate may be processed at the same time regardless of the originating or terminating central office, since it is the base rate charge, length of conversation, and class of message only that determine the amount to be billed. The duration rating master decks include cards for each minute of duration from 4 to 99 minutes for each base rate charge of 10, 15, and so forth, to 45 cents, inclusive; see Figure 3. In addition, there are special cards in file for rating messages to time and weather service. Messages of more than 99 minutes' duration are rare and are specially handled in the AMA computer, which records the pertinent data for such messages on a "straddle" tape which is processed through the AMA printer and then manually handled.

Following these sorting operations and before gang punching the charge data into the message cards, the duration rating master cards and message cards are processed through the collator to verify that the message cards have been correctly associated with the duration rating master cards. In this operation, a comparison is made of the punching in columns 22 and 23 (duration) 36, 37, and 38 (base rate) of the duration master and message cards. At the same time, any improperly associated message cards are mechanically ejected and after being examined are associated with their proper duration rating master cards.

After the association check has been completed, the charge and tax amounts are gang punched into the message cards in columns 25-35. In addition, an X punch is made in column 29, which con-

trols the tabulator selection of the charge to be billed. In the absence of an X punch, the accounting machine selects for billing the base rate and related tax amounts punched in columns 36-42. During the punching operation, the machine verifies the accuracy of part of the punching. However, to insure that all columns of the message cards have been accurately punched, a complete verification of the gang punching operation is made by processing the master cards and message cards through the comparing side of the reproducer.

Storing Cards Prior to Billing

The message cards for rate centers having more than one central office are then sorted by originating central office code (column 57), at which time the duration rating master cards are eliminated. The cards for each central office are then sorted by the thousands digit of telephone number (column 69). During this sort, the duration master cards for single office rate centers are withdrawn. In both of these operations the message cards of 1-minute duration are kept separate for subsequent handling in the application of credit tickets.

Before the message cards are placed in file by central offices, they are needle-checked to detect possible discrepancies in date order resulting from (a) the fact that the AMA business day ends at 3 a.m. or (b) any mishandling of cards. At this point, the punching of the message cards has been completed and they are ready for listing on toll service statements. The cards, Figure 4, are filed by thousands

in upright storage racks with separators between each day's business.

Handling Claims for Credit

Some errors and claims for credit do, of course, require adjustment and every reasonable effort is made to prevent the billing of erroneous amounts. Customers are requested to notify operators when wrong numbers are reached or when poor transmission or cutoffs are encountered in order that credit tickets may be prepared and adjustments made. The application of credit tickets, which involve less than 0.005 per cent of the total number of messages, is made daily while the message cards are grouped by the thousands digit of telephone number. About 90 per cent of all messages requiring adjustment are located in the cards of 1-minute duration. The message cards involving credits are withdrawn from the billing process and are associated with the credit tickets for subsequent clerical handling.

Message cards involving credits are located by a block sorting process which requires the minimum handling of cards. The identification of a particular card is, of course, facilitated by the presence of the telephone number and connect time which are printed on the cards by the tape-to-card converter.

Most wrong number credit tickets result from incorrect dialing by customers, although some are caused by incorrect handling at terminating manual switchboards. No attempt is made to locate message cards for wrong number credit tickets in the 2-minute and longer

A-2486 (12-51)		▼		CALLED		CONNECT	MINUTES	CLASS
PLACE CALLED	DATE	AMOUNT	AREA	C.O.	TELEPHONE NO.	TIME		
UN 2	4 -14	1 0		8 6 2	7 2 7 5	1 3 2 8	1 1	C A 6 2 6 6 9
HU 2	4 -15	1 0		4 8 2	4 9 5 7	1 4 1 8	1 1	
NYRE 7	4 -17	2 0	1	7 3 7	1 6 8 1	1 8 1 7	1 1	
MI 2	4 -17	1 0		6 4 2	3 7 5 8	1 0 1 3	2 1	
HU 2	4 -23	1 0		4 8 2	4 9 5 7	1 4 3 1	3 1	
HU 7	4 -26	2 5		4 8 7	5 2 9 3	1 2 5 0	8 1	
NU 2	5 - 4	1 0		6 8 2	6 0 8 1	1 4 2 5	1 1	
NYRE 7	5 - 9	2 0	1	7 3 7	1 6 8 1	1 0 3 9	4 1	
NYPL 3	5 - 9	2 0	1	7 5 3	6 3 8 6	1 5 1 1	4 1	
NYRE 7	5 - 9	2 0	1	7 3 7	1 6 8 1	0 6 5 5	2 1	
MI 2	5 - 9	1 0		6 4 2	8 1 0 0	1 0 3 4	4 1	
CODE		TOTAL U. S. TAX	2 7	EXPLANATION CLASS CODES				
LL - LONG LINES	TOTAL CARRIED TO BILL	1 9 2		1. Station Day	3. Person Day	5. Mobile	7. Telegram	
				2. Station Night	4. Person Night	6. Collect	9. Report Charge	

Figure 6. Business office portion of toll service statement

duration cards, since it is assumed that a message of more than 1-minute duration did not involve a wrong number. In rare cases, messages of 2 minutes or more may involve valid wrong number claims and the adjustments are handled by the business office.

Message cards of 2-minute and longer duration are searched, however, in connection with the application of credit tickets for cutoffs or poor transmission. Message cards involved in such claims are removed and associated with the related credit tickets. In allowing credit for cutoffs, the combined time of the AMA message and the reconnection is examined. An allowance of 1 minute is made, and where adjustment is proper, a new card is prepared showing the correct duration and charge. Adjustment of charges on messages involving poor transmission is made in accordance with the agreement reached by the customer and the operator who handled the claim.

All credit tickets properly noted as to disposition are sorted into telephone number order at the close of the billing period and are forwarded to the business office for reference purposes.

Preparation of Toll Statement

To spread the work load as evenly as possible throughout the month, all Bell System companies use rotation or cycle billing. Under this plan, customers are

billed once a month, with different groups of customers being billed at different fixed dates during the month. Since toll service statements are issued on the same basis, their preparation is an almost continuous process.

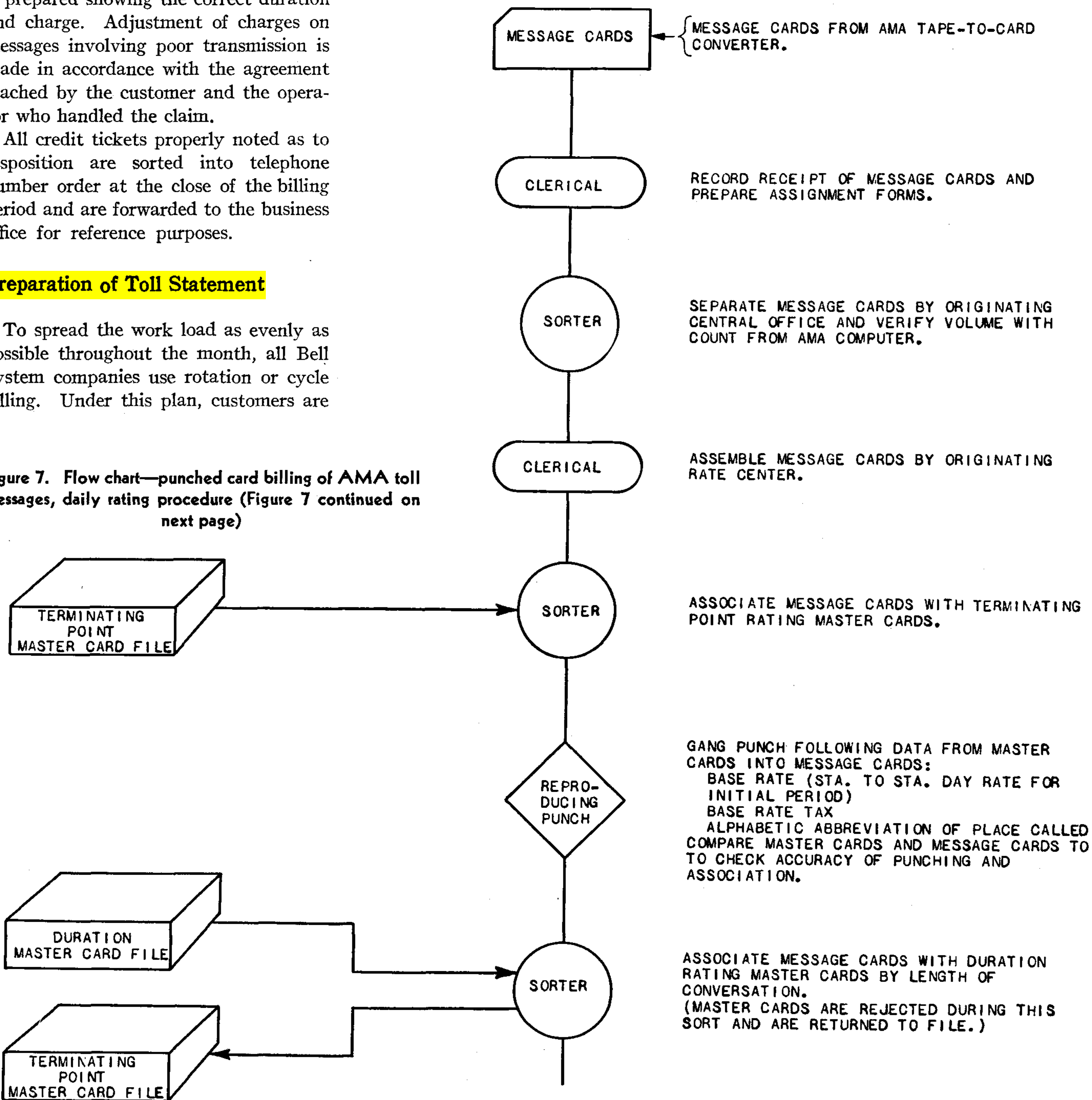
When the message cards for the last date of the billing cycle have been completed, the cards are removed from file and are sorted into telephone number order with date sequence being maintained. In this operation, billing book control cards are mechanically interfiled with the message cards at selected points so that control totals may be established by units. These unit totals are used in balancing the amounts subsequently

entered on customers' bills. The telephone number sequence of all message cards is verified in the collator before the cards are listed on toll service statements.

The toll service statements used for listing AMA toll messages are continuous forms consisting of two parts, the customer's portion and the business office portion. The customer's portion, Figure 5, of the toll service statement shows the central office designation and telephone number, date, place called, charge (excluding tax) for each message, and the total tax and total amount (including tax) to be entered on the customer's bill.

The business office portion, Figure

Figure 7. Flow chart—punched card billing of AMA toll messages, daily rating procedure (Figure 7 continued on next page)



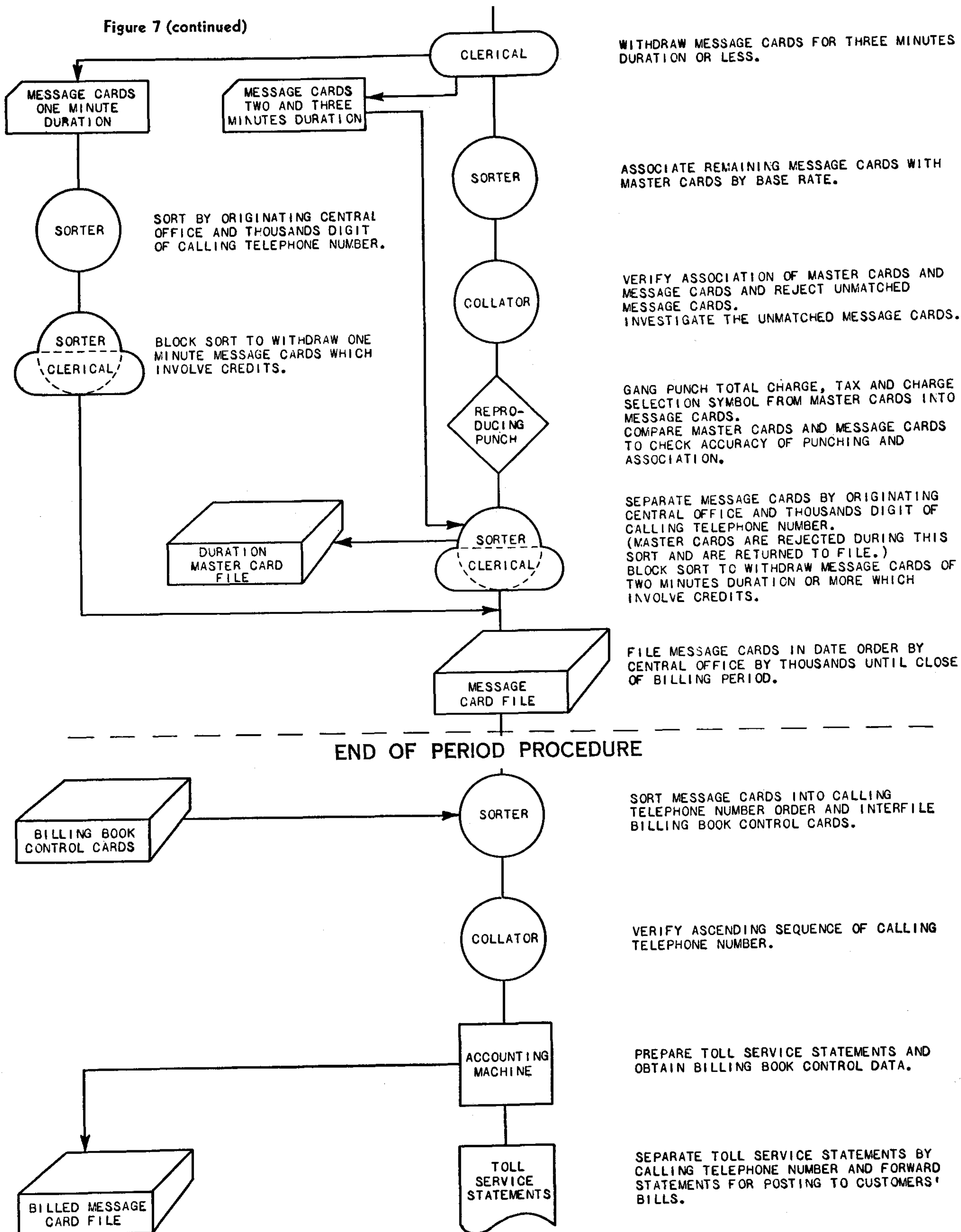
6, of the toll statement, in addition to containing the same information as the customer's portion, also shows the called area, called central office (numerical dial pulls), called telephone number, connect time, duration in minutes, and class of message.

The message cards are tabulated by billing books and the accounting machines automatically stop when billing book control cards are encountered. At this point the registers are emptied and the following data are printed on the next blank form:

- Calling central office code
- Billing book number
- Number of messages
- Number of toll users
- Total toll charges
- Total tax
- Total charges including tax

The toll service statements are then

Figure 7 (continued)



separated by telephone number and the customer's portion is severed from the business office portion of the statement. The message cards used to prepare the toll service statements are not forwarded to the business office, since the business office portion of the toll statement contains all of the billing information shown on the cards. The message cards are retained by the punched card accounting office for a period of one month after billing.

Two different practices are in use for showing the total of the toll service statement on the customer's bill. In the Paterson accounting office, the total amount of the mechanically prepared toll statement covering AMA messages is posted on one line of the bill, and the

amount of the manually prepared statement covering operator-handled messages is posted on another line of the bill. In the three other accounting offices, the two toll statements are placed in a jacket. The total of the two statements is entered on the jacket and is posted on a single line of the bill. It is believed that the practice followed by the Paterson accounting office will be generally adopted.

Figure 7 shows the toll billing operations described here, with each step of the procedure in chronological order.

With the introduction of the tape-to-card converter, AMA sorters and printers are no longer required for processing toll messages. The resulting substantial reduction in AMA capital investment

and processing time are important advantages which have helped to make the mechanization program economical. Improvements in the design and functioning of AMA equipment and commercial business machines are under way and continued development can be expected. With these developments and improved operating techniques, the mechanization program should provide economies and advantages not now foreseen.

References

1. FUNDAMENTALS OF THE AUTOMATIC TELEPHONE MESSAGE ACCOUNTING SYSTEM, John Meszar. *AIEE Transactions*, volume 69, part I, 1950, pages 255-69.
2. PRINCIPLES OF TAPE-TO-CARD CONVERSION IN THE AMA SYSTEM, Willard B. Groth. *AIEE Transactions*, volume 72, part I, 1953 (*Paper 53-113*).

Discussion

Arthur Bessey Smith (Automatic Electric Laboratories, Inc., Chicago, Ill.): In the epoch-making movement toward nationwide toll dialing, the person-to-person call will always merit consideration. Every day there occur many situations in which it is essential that person A must contact person B, and no other, because only B knows the answer which A needs to have. Also it occurs that A and B must hold a short conference, in which they and only they must exchange information, ideas, and proposals, and come to a mutual agreement (or final disagreement).

Though the person-to-person calls may be in the order of 8 to 10 per cent of the total number of toll calls, they will always be needed. In some local regions the percentage may be much higher.

Though it may not be possible to forecast how far the subscriber can go in dialing toll connections to destination, it seems certain that ultimately automatic switching of toll lines will enable the toll operator to do it with great efficiency and effectiveness. And this will help the person-to-person service.

The movement toward nationwide toll dialing is part of the general movement toward the mechanization of tools and devices, resulting in increasing application

of electric power to industry. Though the relays and magnets used in automatic switching of telephone lines do not seem to amount to much in terms of horsepower, yet they really are electric motors, and replace manual labor.

The more power drive there is, the greater is the work output of each worker, whether of manual labor in a factory or mill, or of a telephone operator. This makes mankind more efficient and living is raised to a higher level. In America we have more horsepower per worker than in any other part of the world. It is one of the important things which has made our nation great and which will maintain our position.