BULLETIN 215B

TECHNICAL MANUAL

HIGH SPEED TAPE PUNCH SET
(BRPE)

TELETYPE®
CORPORATION
5555 TOUHY AVENUE, SKOKIE, ILLINOIS
BULLETIN 215B

TECHNICAL MANUAL

HIGH SPEED TAPE PUNCH SET
(BRPE)

SECTIONS

1. DESCRIPTION
2. INSTALLATION
3. ADJUSTMENTS
4. DISASSEMBLY
5. LUBRICATION
6. PRINCIPLES OF OPERATION
LIST OF EFFECTIVE PAGES

MARCH, 1965

(Supersedes Issue of January, 1965)

<table>
<thead>
<tr>
<th>PAGE NUMBER</th>
<th>CHANGE IN EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Change 6</td>
</tr>
<tr>
<td>B to D</td>
<td>Change 4</td>
</tr>
<tr>
<td>1-1 to 1-6</td>
<td>Change 4</td>
</tr>
<tr>
<td>1-7</td>
<td>Change 6</td>
</tr>
<tr>
<td>1-8 to 1-10</td>
<td>Change 4</td>
</tr>
<tr>
<td>2-1 to 2-3</td>
<td>Change 4</td>
</tr>
<tr>
<td>3-1 to 3-39</td>
<td>Change 4</td>
</tr>
<tr>
<td>4-1 to 4-2</td>
<td>Change 4</td>
</tr>
<tr>
<td>5-1 to 5-8</td>
<td>Change 4</td>
</tr>
<tr>
<td>6-1 to 6-13</td>
<td>Change 4</td>
</tr>
</tbody>
</table>

The above list indicates the effective pages as of the date of issue. Upon receipt of change pages, insert them numerically and discard any superseded pages.
HIGH SPEED TAPE PUNCH SET (Late Design)
Consists of
Base (BRPEB), Punch Unit (BRPE)
Motor Unit (LMU) and Cover (BRPEC)
HIGH SPEED TAPE PUNCH SET (Early Design)
Consists of
Base (BRPEB), Punch Unit (BRPE) and Motor Unit (LMU)
### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRONT MATTER</strong></td>
<td></td>
</tr>
<tr>
<td>List of Effective Pages</td>
<td>A</td>
</tr>
<tr>
<td>High Speed Tape Punch Set (Late Design) - Photograph</td>
<td>B</td>
</tr>
<tr>
<td>High Speed Tape Punch Set (Early Design) - Photograph</td>
<td>C</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>D</td>
</tr>
</tbody>
</table>

**SECTION 1 - DESCRIPTION**

1-1. Introduction | 1-1 |
1-2. General | 1-2 |
1-3. Base | 1-3 |
1-4. Motor Unit | 1-4 |
1-5. Tape Punch Unit | 1-4 |
1-6. Motor Mounting and Drive Parts | 1-5 |
1-7. Technical Data | 1-7 |
   a. General | 1-7 |
   b. Standard Speeds | 1-7 |
   c. Magnet Specifications | 1-7 |
   d. Magnetic Pickup Specifications | 1-7 |
   e. Tape Specifications | 1-8 |
   f. Motor Unit | 1-8 |
   g. Weights and Dimensions | 1-8 |

**SECTION 2 - INSTALLATION**

2-1. General | 2-1 |
2-2. Assembled Set - Unpacking | 2-1 |
2-3. Disassembled Set | 2-1 |
   a. Unpacking | 2-1 |
      (1) Base | 2-1 |
      (2) Punch Unit | 2-1 |
      (3) Motor Unit | 2-1 |
   b. Assembly | 2-1 |
2-4. Mounting | 2-2 |
2-5. Electrical Connections | 2-2 |
2-6. Preparation for Operation | 2-2 |
   a. Adjustments | 2-2 |
   b. Lubrication | 2-2 |
   c. Tape Roll | 2-2 |
   d. Tape Threading | 2-3 |
   e. Starting Tape | 2-3 |

**SECTION 3 - ADJUSTMENTS AND SPRING TENSIONS**

3-1. General Maintenance | 3-1 |
3-2. General Adjusting Information | 3-1 |
3-3. Alphabetical Index: Adjustments and Spring Tensions | 3-2 |
3-4. Late Design | 3-3 |
   a. Punch Unit | 3-3 |
   b. Base | 3-24 |
   c. Motor Mounting and Drive Parts | 3-28 |
3-5. Early Design | 3-30 |

**SECTION 4 - DISASSEMBLY**

4-1. General | 4-1 |
4-2. Cover | 4-1 |
4-3. Motor Unit | 4-2 |
4-4. Punch Unit | 4-2 |
   a. Removal from Base | 4-2 |
   b. Punch Block Mounting Plate Assembly | 4-2 |
   c. Feed and Punch Magnets | 4-2 |

**SECTION 5 - LUBRICATION**

5-1. General | 5-1 |
5-2. Punch Unit | 5-2 |
   a. General Areas | 5-2 |
   b. Feed and Code Magnets | 5-3 |
   c. Perforating Mechanism | 5-3 |
   d. General Areas | 5-4 |
   e. Perforating Mechanism | 5-4 |
   f. Feed Mechanism | 5-5 |
   g. Feed Mechanism | 5-5 |
   h. Drive Mechanism | 5-5 |
5-3. Base and Motor Unit | 5-6 |
   a. General Areas | 5-6 |
   b. Tape Reel and Brake Mechanism | 5-6 |
   c. Motor Unit | 5-7 |
5-4. Early Design | 5-8 |
   a. General | 5-8 |
   b. Punch Unit | 5-8 |
   c. Single Unit Base | 5-8 |
   d. Multiple Unit Base | 5-8 |
   e. Base with Gear Drive | 5-8 |

**SECTION 6 - PRINCIPLES OF OPERATION**

6-1. General | 6-1 |
6-2. Code | 6-1 |
6-3. General Operation | 6-1 |
6-4. Motion | 6-3 |
   a. Motor Unit | 6-3 |
   b. Drive Parts | 6-3 |
   c. Drive Mechanism | 6-3 |
6-5. Synchronization | 6-3 |
   a. General | 6-3 |
   b. Flywheel and Magnetic Pickup System | 6-3 |
6-6. Tape Perforation | 6-5 |
6-7. Tape Feeding | 6-6 |
6-8. Manual Feed Out | 6-7 |
6-9. Tape Reel and Brake Mechanism | 6-7 |
   a. General | 6-7 |
   b. Mechanical | 6-7 |
   c. Electrical | 6-8 |
6-12. Early-Design Punches | 6-9 |
SECTION 1

DESCRIPTION

1-1. INTRODUCTION

a. This manual presents information for the High Speed Tape Punch Set, an electro-mechanical apparatus designed to rapidly perforate intelligence into paper tape. Unless stated otherwise, the material in this publication applies to late-design Punch Sets, the manufacture of which began in 1959. Sets manufactured prior to 1959 are considered early-design Punch Sets, and are so designated.

b. Also included in this manual is certain adjustment information which pertains to Punch Units (see Paragraph 1-1.e) used in applications other than High Speed Tape Punch Sets. For further information concerning these Punch Units and their applications, contact the Teletype Product Sales Department.

c. Section 1 provides a brief physical and functional description of the equipment and a listing of its technical data. Installation instructions are contained in Section 2. Sections 3 through 5 cover maintenance including adjustments, disassembly and lubrication. General maintenance instructions appear in Paragraph 3-1. Section 6 explains the operation of the Punch Set. The purpose of Section 6 is to provide background information and to serve as an aid to training personnel, applying and maintaining the equipment, and locating and correcting troubles. Of special interest to those applying the punch and designing associated equipment is Figure 6-8 which indicates recommended electrical and mechanical timing.

d. The six sections mentioned above are subdivided into numbered paragraphs. The first numeral indicates the section that the paragraph is in. For example, if a reference is to Paragraph 5-1.b, it will be found in Section 5. Similar numbering is applied to the illustrations: For example, Figure 6-8 is in Section 6. References in the text to left or right indicates the viewer's left or right as he faces the front of the equipment. He is facing the front when the tape reel and tape rollers are on his right and the tape cutter is on his left (see Figure 1-2). In the illustrations, unless they are specifically labeled otherwise, it is assumed that the equipment is being viewed from the front. Pivot points are shown in the drawings by circles or ellipses which are solid black to indicate fixed points and cross-hatched to indicate floating points.

e. The terms defined below are used in a special sense throughout the bulletin:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Contained Set</td>
<td>A Punch Set (see Paragraph 1-2) consisting of a Punch Unit, Base, Motor Unit, and drive parts.</td>
</tr>
<tr>
<td>Punch</td>
<td>This term designates the equipment when there is no need to differentiate between the Punch Set (see Paragraph 1-2) and the Punch Unit (see Paragraph 1-5).</td>
</tr>
<tr>
<td>Code</td>
<td>A binary permutation code expressed in electrical and tape form is used to convey and record the information handled by the Punch. It is explained in Paragraph 6-2.</td>
</tr>
<tr>
<td>Character</td>
<td>Any unit of information (such as letters and numerals) represented by the code combinations described in Paragraph 6-2.</td>
</tr>
<tr>
<td>Operation</td>
<td>The period measured in degrees of shaft rotation required by the Punch to perforate a character and advance the tape (see Paragraph 6-3.d).</td>
</tr>
<tr>
<td>Operating Speed</td>
<td>The constant speed at which the Punch runs. It is ordinarily given in operations per second (ops) and is equal to the revolutions per second of the main shaft. The Punch can perforate characters at various speeds up to the operating speed (see Paragraph 6-1.c).</td>
</tr>
</tbody>
</table>
Words per Minute (wpm) A word is arbitrarily defined as six characters. Thus a Punch perforating 110 characters per second is operating at $60 \times 110/6$, or 1100 words per minute.

1-2. GENERAL (Figure 1-2)

a. The High Speed Tape Punch Set is an electromechanical apparatus that perforates information in paper tape at speeds up to 110 characters per second (1100 words per minute). The information is received from external control circuits in the form of multi-wire electrical pulses which are translated into mechanical motions that feed the tape and perforate feed and code holes.

b. The basic components of the Set (Figure 1-2) are a Base (BRPEB), a Motor Unit (LMU) and a Punch Unit (BRPE). The Motor and Punch Units are mounted on the Base and are connected by a set of drive parts. The tape winds off a reel mounted on the side of the Base and is fed and perforated at the front by the Punch Unit.

c. The Punch is a synchronous unit having a magnetic pickup that produces synchronizing (or clock) pulses which will trigger the control circuits at the proper time. Variations of the Set permit operation from either transistorized or vacuum-tube circuits, and will produce fully-perforated, standard teletypewriter, paper tape of either five, six, seven or eight levels. It is designed for surface or rack mounting and is provided with vibration mounts. Optional features are drive parts for different speeds and a protective Cover (BRPEC) which encloses the Motor Unit and part of the Base (See illustration on Page B ).

![Tape Punch Base Diagram](image-url)
1-3. BASE (Figure 1-1)

The Base provides a foundation and certain accessories for the Set. It includes the following features:

a. Brackets for mounting the Punch Unit.
b. Motor mounting holes.

c. Power circuitry including a four-point terminal board, a motor switch and mating input connectors.
d. Control circuitry that includes 24-point mating input connectors and a similar connector for interconnecting the Base and Punch Unit.

Figure 1-2. High Speed Tape Punch
e. Provisions for mounting electrical components (resistors, diodes etc.) used in control circuits.

f. A reel and brake assembly which accommodates the tape roll and provides smooth acceleration and deceleration during starting and stopping.

g. A low-tape mechanism that may be used to actuate an external visual or audible alarm.

h. Vibration mounts which may be removed at the customer’s discretion.

i. Rubber grommets for supporting the Cover.

1-4. MOTOR UNIT (Figure 1-3)

a. Mechanical motion to operate the Set is produced by a two-pole, single-phase synchronous Motor Unit which develops 1/20 horsepower at 3600 revolutions per minute. The motor rests in the cradle of a mounting bracket and is held in place by a strap at each end. The cradle is isolated from the motor by resilient mounts which reduce vibration. A small fan is mounted at each end of a rotor within the end bells and a combination fan and handwheel rides on the rear end of the shaft. A start relay, a starting capacitor and a thermal-cutout switch are contained in a lower compartment. The Switch provides protection against an overload. The rotation of the shaft is counterclockwise as viewed from the handwheel end.

CAUTION

If motor becomes blocked for several seconds, thermal-cutout switch will break circuit. Allow motor to cool at least 5 minutes before depressing red reset button.

b. A.c. and d.c. governed motors are available for special applications.

1-5. TAPE PUNCH UNIT (Figure 1-4)

The Tape Punch Unit incorporates the electrical and mechanical elements necessary to translate electrical pulses into actions which feed and perforate the tape. It is mounted on the Base or other equipment by a rear plate. A main shaft mounted on bearings transfers motion from an external source to tape feeding and perforating mechanisms. Under the control of code magnets, the perforating mechanism punches code holes in the tape by means of pins in a punch block. A pin not under the control of a magnet is driven through the tape to punch a feed hole with every code combination. Each time a code combination is perforated, the feed mechanism, under the control of a feed magnet, advances the tape by means of a ratchet and feed wheel arrangement. The feed and code magnets are
energized by electrical pulses fed to the unit on multiple wires. For location of magnets on Punch, see Figure 1-5. The following features are included on the Punch:

a. A magnetic pickup that produces a synchronizing pulse which will trigger the control circuits when the unit is ready to receive; the timing of the pulse is adjustable for varying conditions of operation.

b. A cable and connector for linking the Unit to the control circuits.

c. A feed out lever which will provide continuous blank tape feed out when manually depressed.

d. A transparent chad container.

e. A protective metal cover with a window.

f. A tape cutter.

Variations of the Unit are equipped with different magnets for operation with either transistorized or vacuum-tube control circuits, and with varying numbers of magnets to produce different levels (5, 6, 7 or 8) of tape. A manually operated two position punch block, which allows the operator to select between five level and eight level tape perforation, is standard equipment on certain Punch Units.

1-6. MOTOR MOUNTING AND DRIVE PARTS

a. General - The high speed Tape Punch Unit may be driven by one of two methods, a belt drive system or a gear drive system. A description of each follows.
b. Belt Drive System (Figures 1-2 and 6-2) - The drive parts consist of two sprockets and a timing belt (Figure 6-2), which transfer motion from the Motor Unit to the Punch Unit and determine the Set's operating speed. The Motor is mounted on four spacers (Figure 1-2). The tension of the timing belt is adjusted by adding or removing shims between the spacers and the motor mounting bracket. Standard motor mounting and drive parts are available for operating the Punch at speeds of 63.3 or 110 operations per second. These parts exist as modification kits which may be obtained to change the operating speed of the Punch in the field.

c. Gear Drive System (Figure 3-26) - The drive parts consist of two gears which transfer motion from the Motor Unit to the Punch Unit and determine the sets operating speed. The Motor mounts on two spacers and an adjustable "T" plate. Adjustment between the gears is accomplished by means of an adjusting screw located below the "T" plate.

<table>
<thead>
<tr>
<th>MAGNET</th>
<th>POSITION</th>
<th>TERMINAL POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEED</td>
<td>UPPER RIGHT REAR</td>
<td>REAR</td>
</tr>
<tr>
<td>0 - PULSE</td>
<td>LOWER LEFT REAR</td>
<td>REAR</td>
</tr>
<tr>
<td>1 - PULSE</td>
<td>LOWER RIGHT REAR</td>
<td>REAR</td>
</tr>
<tr>
<td>2 - PULSE</td>
<td>UPPER LEFT REAR</td>
<td>REAR</td>
</tr>
<tr>
<td>3 - PULSE</td>
<td>UPPER RIGHT MIDDLE</td>
<td>DOWN ON 8 LVL, FRONT ON 5 LVL.</td>
</tr>
<tr>
<td>4 - PULSE</td>
<td>LOWER LEFT FRONT</td>
<td>FRONT</td>
</tr>
<tr>
<td>5 - PULSE</td>
<td>LOWER RIGHT FRONT</td>
<td>FRONT</td>
</tr>
<tr>
<td>6 - PULSE</td>
<td>UPPER LEFT FRONT</td>
<td>DOWN</td>
</tr>
<tr>
<td>7 - PULSE</td>
<td>UPPER RIGHT FRONT</td>
<td>DOWN</td>
</tr>
</tbody>
</table>

Figure 1-5, Magnet Positions
1-7. TECHNICAL DATA

a. GENERAL - The data given below is for typical tape punches and may vary for individual coded units. A number of variables are associated with the values in Paragraph 1-7. c and d. If additional information is needed, contact the Teletype Product Sales Department.

b. STANDARD SPEEDS

(1) 110 operations (or characters) per second (1100 words per minute).
(2) 105 operations (or characters) per second (1050 words per minute).
(3) 63.3 operations (or characters) per second (633 words per minute).

c. MAGNET SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>Transistor Operation</th>
<th>Vacuum-Tube Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attract Time (Milliseconds to fully attract)*</td>
<td>3-4</td>
<td>4-5</td>
</tr>
<tr>
<td>Release Time (Milliseconds to fully release)*</td>
<td>6-8</td>
<td>6-8</td>
</tr>
<tr>
<td>Magnet Coil Resistance (Ohms)</td>
<td>2.9</td>
<td>74-82</td>
</tr>
<tr>
<td>Magnet Coil Inductance (Millihenries)</td>
<td>8</td>
<td>100</td>
</tr>
<tr>
<td>External Current Limiting Resistance (Ohms)*</td>
<td>25++</td>
<td>600#</td>
</tr>
</tbody>
</table>

Code and Feed Pulse Requirements*

<table>
<thead>
<tr>
<th></th>
<th>Transistor Operation</th>
<th>Vacuum-Tube Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (Amp.) (I)</td>
<td>1</td>
<td>0.150</td>
</tr>
<tr>
<td>Voltage (dc)</td>
<td>28</td>
<td>115</td>
</tr>
<tr>
<td>Length (Milliseconds)**</td>
<td>4.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

# Must be supplied by customer.

++CAUTION

If the 25 ohm resistors supplied on the base exceed 5 milliseconds on, for one character operation, it is necessary that the resistors be removed from the base and a special external mounting (or blower) be supplied to dissipate the heat from the resistors.

*Since the operation of the magnets is largely dependent on the control circuitry, these values may be varied experimentally for specific applications.

**Production tape punch units are adjusted to a standard optimum input signal of 4.5 ms pulse length with an expected operational tolerance requirement of approximately ±8% margin, i.e., the unit will operate through an approximate range of 4.15 to 4.85 ms without readjustment of armature gap and/or spring tension. Field applications having control equipment generating signals other than that of an optimum 4.5 ms pulse length may therefore require refinement of the magnet armature adjustments and spring tensions to provide some operating margin of the pulse length being used.

d. MAGNETIC PICKUP SPECIFICATIONS

(1) Sets with 60 point timing scale - Output pulse with clearance of 0.010 inch (see Figure 3-20) and pickup connected across load equivalent to 0.01 MF and 1000 ohms in parallel.

| Speed (operations per second) | 63.3 | 110 |
| Voltage (V)                  | 4    | 6   |
| Peak to Peak (microseconds)  | 450  | 450 |
(2) Sets with 160 point timing scale - See Figures 1-6 and 1-7.

e. **TAPE SPECIFICATIONS (See Figure 6-1.D.)**

Levels
- 5, 6, 7 or 8 with in-line feed hole
- 6 with advanced feed hole
- 11/16 inch (5 level)
- 7/8 inch (6 & 7 level)
- 7/8 inch with advanced feed hole (6 level)
- 1 inch (8 level)
- 10

Widths
- 0.0465
- 0.071

Code Combinations per inch
- 5-Level - 0.297; 6, 7, or 8-Level - 0.392
- 6-Level (Advanced Feed Hole) - 0.441

f. **MOTOR UNIT**

Type
- Synchronous

Input Voltage
- Single Phase 115 Volts + 10%, 60 Cycles + 1%
- 9 Amp.
- 2 Amp.

Input Current - Starting
- 1/20 Horsepower at 3600 RPM
- 65 Watts
- 50 Watts

Input Current - Running

Power Output

Power Consumption

Heat Dissipation

Protection

g. **WEIGHTS AND DIMENSIONS**

<table>
<thead>
<tr>
<th></th>
<th>Depth</th>
<th>Width</th>
<th>Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Inches)</td>
<td>(Inches)</td>
<td>(Inches)</td>
<td>(Pounds)</td>
</tr>
<tr>
<td>Punch Unit</td>
<td>6-1/2</td>
<td>6-1/2</td>
<td>10-1/2</td>
<td>8-1/2</td>
</tr>
<tr>
<td>Base</td>
<td>13-1/2</td>
<td>8</td>
<td>10</td>
<td>7-1/2</td>
</tr>
<tr>
<td>Motor Unit</td>
<td>8</td>
<td>4</td>
<td>4-1/2</td>
<td>8</td>
</tr>
<tr>
<td>Set</td>
<td>16-1/2</td>
<td>8</td>
<td>12</td>
<td>24-1/2 (including drive parts)</td>
</tr>
</tbody>
</table>

Mounting Centers (Inches)*
Mounting Centers of Vibration Mounts (Inches)*
Mounting hole diameter (Inch)*

*See Figure 2-1
Figure 1-6. Magnetic Pickup Characteristics

<table>
<thead>
<tr>
<th>CURVE</th>
<th>WPM</th>
<th>AIR GAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1050</td>
<td>0.015&quot;</td>
</tr>
<tr>
<td>B</td>
<td>600</td>
<td>0.015&quot;</td>
</tr>
<tr>
<td>C</td>
<td>1050</td>
<td>0.005&quot;</td>
</tr>
<tr>
<td>D</td>
<td>600</td>
<td>0.005&quot;</td>
</tr>
</tbody>
</table>

ALL MEASUREMENTS TAKEN WITH 0.01 MFD SHUNT CAPACITANCE ACROSS LOAD.
Fig. 1-7. Magnetic Pickup Characteristics
SECTION 2
INSTALLATION

2-1. GENERAL

Certain variations in the following procedures may have to be made for individual coded equipment and specific applications. A Set consisting of a Base (BRPEB), Motor Unit (LMU), Punch Unit (BRPE) and motor mounting and drive parts for 110 ops operation is ordinarily packed assembled in one carton. However, for cases in which the components may be packed separately, Paragraph 2-3 below covers unpacking and assembly. When individual units are obtained, see Paragraph 2-3.a below for unpacking instructions and Paragraph 2-4 for mounting information. Instructions for installing different motor mounting and drive parts are in a specification packed with the set of parts. Parts Bulletin 1154B illustrates the parts mentioned below.

2-2. ASSEMBLED SET - UNPACKING

a. Cut the seal and open the top flaps of the cardboard carton. Remove the top corrugated detail. Cut the seal and open the top flaps of the inner carton. Remove the corrugated liner. Detach the chad container from the liner and remove the tissue wrapping. Remove the loose connectors from the container and remove the tissue wrapping.

b. Grasp the Set by the motor housing and carefully lift it out of the carton. Remove the pallet from the Set by removing the four mounting clamps. Remove the string and tape holding the tape reel and wire guide in position. Mount the chad container on the front of the Set by inserting the plastic post at the rear of the container into the provided hole in the Punch Unit’s rear plate and inserting the two studs at the front of the mounting bars into the two holes in front of the container.

c. If a Cover (BRPEC) is included in the Set, cut the seal of its carton and open the top flaps. Lift the Cover out of the carton and remove the tissue wrapping. Hold the Cover over the Set, lower it carefully, and fit the four rubber grommets on the Base into the provided slots.

2-3. DISASSEMBLED SET

a. UNPACKING

(1) Base - Cut the seal and open the top flaps of the cardboard carton. Remove the cardboard detail on top of the equipment. Grasp the Base by the mounting plate and carefully lift it from the carton. Remove the string holding the tape reel and wire guide in position. Remove the two male connectors from the muslin bag attached to the base.

(2) Punch Unit - Cut the seal and open the top flaps of the cardboard carton. Remove any tissue at the top of the carton. Remove the chad container, which is wrapped in tissue, from the small cardboard liner and lay it aside. Remove the small liner. Remove the detail that fits around the Unit. Remove the large liner. Grasp the unit by the cover and the wooden tape roller and carefully lift it from the carton. Remove the string and tissue paper from the cable. When ready to mount the unit, take it off the wooden pallet by removing the two mounting screws.

(3) Motor Unit - Cut the seal and open the top flaps of the cardboard carton. If the Unit is packed in plastic end caps, hold it in place and turn the carton upside down. Lift the carton off the Unit and remove the end caps. If the Unit is not packed in plastic, remove the cardboard detail from the top of the carton. Grasp the Unit by the housing and lift it out of the carton.

b. ASSEMBLY

(1) Remove the Punch Unit from the wooden pallet. Mount it on the Base by means of the mounting hardware in the muslin bag attached to the Punch Unit (see Figure 4-1). The six 156766 screws with 93985 lock washers should pass from the rear through the 142955 and 142956 mounting brackets on the Base into the upper part of the 142800 rear plate of the Punch Unit. The four 157124 screws with 2669 lock washers should pass from the front through the lower part of the rear plate into the 142950 and 142951 side bars of the Base. Connect the male receptacle on the Punch Unit’s cable into the female receptacle on the top of the Base. Mount the chad container on the Unit as instructed in Paragraph 2-2.b above.

(2) Mount the Motor Unit and drive parts as instructed in Specification 5944S which is packed with the motor mounting and drive parts. If a Cover is included in the Set, unpack and mount it as instructed in Paragraph 2-2.c.
2-4. MOUNTING

The Set is designed for mounting with or without the provided shock mounts. There are four screw holes in each mount for securing the Set to the customer's table, shelf, cabinet track or other equipment. For pertinent dimensions, see Figure 2-1, Page 2-2. If the shock mounts are not to be used, they may be taken off by removing their mounting screws. Provisions must then be made by the customer for mounting the Set on specific equipment. Mounting dimensions for the Punch Unit are shown in Figure 2-2, Page 2-2.

2-5. ELECTRICAL CONNECTIONS

See Paragraph 1-7 for pertinent electrical data. Wiring from the power supply and control circuits should be connected to the two loose connectors mentioned in Paragraphs 2-2.a and 2-3.a.(1) above. For specific connections, refer to the wiring diagrams packed with the equipment.

2-6. PREPARATION FOR OPERATION

a. ADJUSTMENTS

(1) Five-level Punches are adjusted at the factory for 11/16-inch tape and should need no further adjustment. Six-, seven- and eight-level equipment is adjusted for one-inch tape. If 7/8-inch tape (6- and 7-level) is to be used, see the Tape Biasing Spring Adjustment in Figure 3-7.

(2) Orientation of the flywheel for synchronization purposes (see Paragraph 6-5) is pre-set at the factory. Refer to Figure 3-15 or 3-18 for the proper flywheel orientation procedure to follow if reorientation is necessary.

b. LUBRICATION - Lubricate the Punch as instructed in Section 5.

c. TAPE ROLL - Remove the tape reel from the tape container. Unscrew the tape re-
tainer and remove it from the reel. Place the tape roll on the reel so that the tape will feed off the bottom-rear. Replace the retainer and place the reel back in the container.

d. TAPE THREADING - The tape path is illustrated in the photograph on page B. Thread the tape off the bottom-rear of the roll, up through the wire guide on the container, forward through the wire guide on the Punch Unit to the left of the upper roller, over and down to the right of the upper roller, to the right of and down under the lower roller, and to the left through the tape guide and punch block. Lift the tape lid and lead the tape between the lid and the feed wheel and then out to the left under the tape cutter.

e. STARTING TAPE - Turn on the motor switch. Depress the feed out lever, pull the tape to the left until it begins to feed and release the feed out lever. If the Set has been properly oriented with its control circuits, it should now be ready for operation.
SECTION 3
ADJUSTMENTS AND SPRING TENSIONS

3-1. GENERAL MAINTENANCE

a. The Punch will require less maintenance and provide more satisfactory service if it is used properly. Although it will perforate tape at speeds less than the operating speed (see Paragraph 1-1 and Paragraph 6-1.c), operating life will be increased if the lowest suitable speed is used. For example, if perforation is not to occur at a rate over 60 characters per second, then drive parts providing 63.3 ops should be employed rather than those providing 110 ops. The Punch will accommodate most paper tapes. However, standard teletypewriter paper tape is recommended because it is impregnated with oil which lubricates the punch pins.

NOTE

Since the equipment is subject to more wear when idling, i.e. running but not perforating tape, it should be turned off during idle periods either manually or by the control circuits.

b. The Punch should be cleaned periodically, but care should be taken to avoid damaging or distorting delicate springs, thus reducing their tension. Check the tightness of all wiring connections at terminal boards and connections. Make sure that the nuts and screws that lock the adjustments are tight. Inspect the equipment at intervals for conditions that might cause trouble later. Oxidized (red) metal dust near bearing surfaces may indicate insufficient clearance or improper lubrication, a condition that should be rectified immediately. Manual operation as outlined in Paragraph 3-2.f below should accompany inspection.

NOTE

Certain parts of the Punch may require replacement at intervals determined by the speed and type of operation (i.e. idling or punching). These parts are available in the form of a Maintenance Parts Kit. For information concerning these kits, contact the Teletype Product Sales Department.

<table>
<thead>
<tr>
<th>Words Per Minute</th>
<th>Punching</th>
<th>Idling</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>3,000 Hrs.</td>
<td>550 Hrs.</td>
</tr>
<tr>
<td>857</td>
<td>1,500 Hrs.</td>
<td>400 Hrs.</td>
</tr>
<tr>
<td>1,100</td>
<td>1,000 Hrs.</td>
<td>300 Hrs.</td>
</tr>
</tbody>
</table>

Maintenance may require that the Punch be disassembled (see Section 4) to make certain adjustments and to replace parts. It is very important that the equipment be thoroughly lubricated at regular intervals in accordance with Section 5.

3-2. GENERAL ADJUSTING INFORMATION

a. Paragraph 3-4 (Pages 3-3 through 3-29) covers adjustments and spring tensions for late-design Punches (BRPE7 and up), while Paragraph 3-5 (Pages 3-30 through 3-39) covers this material for early-design equipment (BRPE5 and lower).

b. In the adjustments and spring tensions covered in this section, location of clearances, position of parts and point and angle of scale applications are illustrated by drawings. Requirements and procedures are set forth in the texts that accompany the drawings. The sequence of the adjustments is that which should be followed when complete readjustment of the Set is undertaken. The letters of the alphabet in parenthesis which precede the texts indicate the sequence to be followed on the individual pages. A procedure should be read all the way through before making the adjustment or testing the spring tension. If any adjustment is changed, related adjustments should be checked.

c. Tools required to make the adjustments and test the spring tensions are contained in Tool Kit 171312. The tools are not supplied with the equipment, but are listed in Teletype Bulletin 1124B. If parts are removed, all adjustments which the removal of these parts might facilitate should be made before the parts are replaced. When a part mounted on shims is removed, the number of shims at each mounting screw should be noted so that identical pile ups can be made when the part is replaced. Unless it is specifically stated to the contrary, after an adjustment has been made, all nuts and screws that were loosened should be tightened.

d. The spring tensions given in this bulletin are indications, not exact values, and should be checked with Teletype scales in the positions shown in the drawings. Springs which do not meet the requirements and for which there are no adjusting procedures should be discarded and replaced by new springs.

CHANGE 4
e. All contact points should meet squarely. Smaller points should fall wholly within the circumference of larger mating points. Points that are the same size should not be out of alignment more than 25 per cent of the point diameter. Avoid sharp kinks or bends in the contact springs.

f. Before proceeding with the adjustments, remove the Cover, (if present) by simply lifting it from the Base, and take off the Punch Unit cover by removing its four mounting screws. Rotate the main shaft slowly in its normal direction (clockwise as viewed from the front) and activate all movable elements. Check for freedom of movement and eliminate any binds. The shaft should be rotated to set up the conditions required in the adjusting procedures.

CAUTION

Improperly adjusted equipment may be seriously damaged in a matter of seconds if operated under power.

3-3. ALPHABETICAL INDEX: ADJUSTMENTS AND SPRING TENSIONS

<table>
<thead>
<tr>
<th>Late Design (Par. 3-4)</th>
<th>3-3 through 3-29</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustments</td>
<td></td>
</tr>
<tr>
<td>Check for Ten Characters per Inch</td>
<td>3-16</td>
</tr>
<tr>
<td>Drag Links</td>
<td>3-11</td>
</tr>
<tr>
<td>Feed Pawl Link</td>
<td>3-15</td>
</tr>
<tr>
<td>Feed Ratchet Detent Arm</td>
<td>3-14</td>
</tr>
<tr>
<td>Flywheel Orientation</td>
<td>3-17</td>
</tr>
<tr>
<td>Flywheel Orientation</td>
<td>3-20</td>
</tr>
<tr>
<td>Low Tape Contacts</td>
<td>3-24</td>
</tr>
<tr>
<td>Low Tape Contact Bracket</td>
<td>3-25</td>
</tr>
<tr>
<td>Magnetic Pick-Up</td>
<td>3-18</td>
</tr>
<tr>
<td>Magnetic Pick-Up</td>
<td>3-22</td>
</tr>
<tr>
<td>Magnet Plate</td>
<td>3-5</td>
</tr>
<tr>
<td>Motor</td>
<td>3-29</td>
</tr>
<tr>
<td>Motor Pinion and Drive Gear Mesh</td>
<td>3-28</td>
</tr>
<tr>
<td>Punch Block</td>
<td>3-10</td>
</tr>
<tr>
<td>Punch Pin</td>
<td>3-3</td>
</tr>
<tr>
<td>Timing</td>
<td>3-19</td>
</tr>
<tr>
<td>Timing</td>
<td>3-23</td>
</tr>
<tr>
<td>Timing Quality</td>
<td>3-19</td>
</tr>
<tr>
<td>Timing Quality</td>
<td>3-22</td>
</tr>
<tr>
<td>Stop Plate</td>
<td>3-4</td>
</tr>
<tr>
<td>Tape Arm Stop</td>
<td>3-26</td>
</tr>
<tr>
<td>Tape Arm Stop</td>
<td>3-27</td>
</tr>
<tr>
<td>Tape Biasing Spring</td>
<td>3-9</td>
</tr>
<tr>
<td>Tape Guide</td>
<td>3-7</td>
</tr>
<tr>
<td>Tape Guide Detent</td>
<td>3-8</td>
</tr>
<tr>
<td>Ten Characters per Inch</td>
<td>3-12</td>
</tr>
<tr>
<td>Timing Belt</td>
<td>3-29</td>
</tr>
<tr>
<td>Wedge Block</td>
<td>3-16</td>
</tr>
</tbody>
</table>

| Spring Tensions        |                  |
| Armature Spring        | 3-5,             |
| Armature Spring        | 3-6              |
| Feed Pawl Spring       | 3-15             |
| Feed Ratchet Detent Arm Spring | 3-14 |
| Long Toggle Arm Springs| 3-4              |
| Low Tape Lever Spring  | 3-26             |
| Operating Link Spring  | 3-10             |
| Tape Feed Out Lever Spring | 3-23          |
| Tape Guide Detent Spring | 3-8             |
| Tape Lid Spring        | 3-13             |
| Tape Reel Brake Spring | 3-27             |

<table>
<thead>
<tr>
<th>Early Design (Par. 3-5)</th>
<th>3-30 through 3-39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustments</td>
<td></td>
</tr>
<tr>
<td>Blocking Pawl</td>
<td>3-31</td>
</tr>
<tr>
<td>Contacts</td>
<td>3-34</td>
</tr>
<tr>
<td>Drive Gears</td>
<td>3-38</td>
</tr>
<tr>
<td>Eccentric Arms</td>
<td>3-30</td>
</tr>
<tr>
<td>Feed Pawl Adjustable Link</td>
<td>3-33</td>
</tr>
<tr>
<td>Feed Pawl and Ratchet Alignment</td>
<td>3-34</td>
</tr>
<tr>
<td>Feed Pawl Eccentric Stud</td>
<td>3-33</td>
</tr>
<tr>
<td>Reed Ratchet Detent</td>
<td>3-33</td>
</tr>
<tr>
<td>Indicator Plate</td>
<td>3-35</td>
</tr>
<tr>
<td>Magnet Bracket</td>
<td>3-31</td>
</tr>
<tr>
<td>Motor Mounting Plate</td>
<td></td>
</tr>
<tr>
<td>(Direct Drive)</td>
<td>3-37</td>
</tr>
<tr>
<td>Multiple Unit Base Mainshaft Drive Chain</td>
<td>3-38</td>
</tr>
<tr>
<td>Multiple Unit Punch</td>
<td></td>
</tr>
<tr>
<td>Mainshaft Gears</td>
<td>3-38</td>
</tr>
<tr>
<td>Number 1 Contactor</td>
<td></td>
</tr>
<tr>
<td>Mounting Plate</td>
<td>3-35</td>
</tr>
<tr>
<td>Number 2 Contactor</td>
<td></td>
</tr>
<tr>
<td>Mounting Plate</td>
<td>3-35</td>
</tr>
<tr>
<td>Punch Bail Eccentric Stud</td>
<td>3-30</td>
</tr>
<tr>
<td>Punch Block</td>
<td>3-32</td>
</tr>
<tr>
<td>Tape Guide Bracket</td>
<td>3-39</td>
</tr>
<tr>
<td>Tape Guide Spring</td>
<td>3-39</td>
</tr>
<tr>
<td>Timing Belt</td>
<td>3-36</td>
</tr>
</tbody>
</table>

| Spring Tensions        |                    |
| Feed Magnet Armature   |                    |
| Spring                 | 3-32               |
| Feed Pawl Spring       | 3-33               |
| Feed Ratchet Detent Spring | 3-33            |
| Long Toggle Arm Spring | 3-31               |
| Punch Magnet Armature  |                    |
| Spring                 | 3-32               |
| Tape Feed Out Lever    |                    |
| Spring                 | 3-34               |
| Tape Reel Brake Spring | 3-39               |
| Tape Tension Lever     |                    |
| Spring                 | 3-34               |
3-4. LATE DESIGN

a. PUNCH UNIT

PUNCH PIN
REQUIREMENT

PUNCH PINS SHOULD MOVE FREELY IN PUNCH BLOCK
WITH MINIMUM CLEARANCE BETWEEN PUNCH PINS AND
RETAINING PLATE.

TO ADJUST
POSITION RETAINING PLATE WITH MOUNTING SCREWS
LOOSENED.

NOTE
IF PUNCH BLOCK IS REMOVED
FROM UNIT FOR ANY REASON,
MAKE PUNCH PIN ADJUSTMENT
BEFORE REPLACING IT.

CAUTION
DO NOT ATTEMPT TO ADJUST PUNCH BLOCK DIE PLATE.
(A) STOP PLATE
TO CHECK
HOLD BLOCKING PAWLS AGAINST STOP PLATES AWAY FROM TOGGLE ARMS, ROTATE MAIN SHAFT UNTIL LONG TOGGLE ARMS ARE BELOW ENGAGING SURFACES OF BLOCKING PAWLS.

REQUIREMENT
MIN. 0.002 INCH --- MAX. 0.008 INCH BETWEEN LONG TOGGLE ARMS AND THEIR BLOCKING PAWLS.
TO ADJUST POSITION STOP PLATES WITH MOUNTING SCREWS LOOSENED.

(B) LONG TOGGLE ARM SPRINGS
TO CHECK
(1) CODE MAGNETS
WITH PUNCH BAIL AT TOP DEAD CENTER, HOOK SPRING SCALE ON LONG TOGGLE ARM, PULL UNTIL KNEE BREAKS.
(2) FEED MAGNET
WITH PUNCH BAIL AT TOP DEAD CENTER, ROTATE MAINSHAFT COUNTERCLOCKWISE UNTIL CODE MAGNET LONG TOGGLE ARMS JUST TOUCH BLOCKING PAWLS. FREE FEED MAGNET LONG TOGGLE ARM FROM ITS BLOCKING PAWL BY DEPRESSING FEED MAGNET ARMATURE. HOOK SPRING SCALE ON LONG TOGGLE ARM, PULL UNTIL KNEE BREAKS.
REQUIREMENT (EACH SPRING)
MIN. 6 OZS. --- MAX. 9 OZS.
TO START SHORT TOGGLE ARM MOVING AWAY FROM LONG TOGGLE ARM.

Figure 3-2.
NOTE
IF A 143089 ARMATURE SPRING CLIP IS AVAILABLE, FOLLOW ARMATURE SPRING ADJUSTMENT. (FIGURE 3-4 ).

(A) ARMATURE SPRING
REQUIREMENT (EACH SPRING)
WITH PUNCH BAIL IN HIGHEST
POSITION:
MIN. 14 OZS. --- MAX. 17 OZS.
TO START ARMATURE MOVING.
TO ADJUST
POSITION SPRING ANCHOR WITH
LOCK NUTS LOOSENED.
NOTE
FOR A MORE ACCURATE AND EASIER
METHOD OF CHECKING THIS TENSION,
REFER TO ADJUSTMENT ON FIGURE 3-4.

(B) MAGNET PLATE
REQUIREMENT (EACH MAGNET)
WITH ARMATURE IN ATTRACTED POSITION (BLOCKING PAWL
HELD AWAY FROM TOGGLE ARM, AND AGAINST STOP PLATE):
MIN. 0.004 INCH --- MAX. 0.006 INCH
BETWEEN ARMATURE AND POLE FACE AT POINT WHERE CLEARANCE IS LEAST.
TO ADJUST
POSITION MAGNET PLATE WITH ITS MOUNTING SCREWS
LOOSENED.

NOTE
MAKE CERTAIN THAT TAPPED HOLES IN MAGNET
MOUNTING BARS MATCH HOLES IN PUNCH UNIT
COVER. IF NOT, POSITION BARS BY LOOSENING
TWO MOUNTING SCREWS AT REAR.

Figure 3-3.
NOTE
THE FOLLOWING ADJUSTMENT PERTAINS ONLY TO CODE LEVEL SPRINGS. TO CHECK THE FEED LEVEL ARMATURE SPRING TENSION, USE ADJUSTMENT (A), FIGURE 3-3.

ARMATURE SPRING
TO CHECK
POSITION A 143089 ARMATURE CLIP
OVER ARMATURE AS SHOWN.
REQUIREMENT (EACH CODE LEVEL SPRING)
WITH PUNCH BAIL IN HIGHEST POSITION:
MIN. 5-1/2 OZS. --- MAX. 6-1/2 OZS.
TO START ARMATURE MOVING.
TO ADJUST
POSITION SPRING ANCHOR WITH LOCK NUTS LOOSENED.

NOTE
IF A 143089 ARMATURE CLIP IS NOT AVAILABLE, USE THE ARMATURE SPRING ADJUSTMENT PROCEDURE OUTLINED IN FIGURE 3-3.

Figure 3-4.
TAPE GUIDE REQUIREMENT

WITH PUNCH BAIL IN HIGHEST POSITION, TAPE SHOULD PASS FREELY FROM TAPE GUIDE BRACKET THROUGH PUNCH DIE PLATE. TO ADJUST POSITION TAPE GUIDE BRACKET WITH MOUNTING SCREWS FRICTION TIGHT.
(A) TAPE GUIDE DETENT
REQUIREMENT
TAPE GUIDE PLATE SHOULD DETENT IN BOTH REAR
AND FORWARD POSITIONS.
TO ADJUST
PLACE 7654 SHIM AT FRONT OR REAR OF DETENT POST.

(B) TAPE GUIDE DETENT SPRING
REQUIREMENT
MIN. 6 OZS. --- MAX. 14 OZS.
TO PULL TAPE GUIDE PLATE
FROM DETENT AT REAR POSITION.
TO ADJUST
REFORM DETENT SPRING TO
MEET REQUIREMENT.

NOTE
ADJUSTMENTS (A) AND (B) ONLY
REQUIRED ON PUNCH UNITS
WITH UNIVERSAL PUNCH BLOCK
CAPABLE OF PUNCHING
EITHER 11/16" OR 1" TAPE.

Figure 3-6.
NOTE
THE CONFIGURATION OF TAPE BIASING SPRING AND PUNCH PLATES VARY, BUT THE TAPE BIASING SPRING ADJUSTMENT PROCEDURE REMAINS THE SAME.

CERTAIN PUNCH SETS HAVE PUNCH PLATES DESIGNED TO USE EITHER 1 INCH OR 7/8 INCH WIDTH TAPE. THESE PUNCH SETS ARE ADJUSTED AT FACTORY FOR 1 INCH WIDTH TAPE. IF 7/8 INCH TAPE (6- OR 7-LEVEL) IS TO BE USED, REMOVE BIASING SPRING BY REMOVING ITS MOUNTING SCREWS. INSERT TAIL OF SPRING IN REAR SLOT OF PUNCH BLOCK. INSERT SCREWS IN REAR MOUNTING HOLES AND MAKE FRICTION TIGHT.

CENTER LINES OF FORWARD MOUNTING HOLES

CENTER LINES OF REAR MOUNTING HOLES

PUNCH BLOCK

(RIGHT SIDE VIEW)

PUNCH GUIDE PLATE

MOUNTING SCREWS

PUNCH DIE PLATE

TAPE BIASING SPRING

TAPE

TAIL OF SPRING

REAR SLOT

TAPE BIASING SPRING REQUIREMENT
TAPE BIASING SPRING SHOULD SLANT TAPE TOWARD REAR OF PUNCH BLOCK WITHOUT CRIMPING OR CURLING FRONT EDGE OF TAPE.

TO ADJUST
POSITION SPRING WITH MOUNTING SCREW(S) FRICTION TIGHT.

TO VERIFY
PERFORATE A THREE OR FOUR FOOT SAMPLE OF TAPE, WITH ALL CODE LEVELS MARKING. HOLD ONE END OF THE TAPE SAMPLE AT EYE LEVEL, AND SIGHT DOWN THE TAPE. THERE SHOULD BE NO WAVERING IN THE ALIGNMENT OF THE PERFORATIONS WITH RESPECT TO THE TAPE EDGE. MAKE THIS CHECK AFTER DRAG LINKS ADJUSTMENT (FIGURE 3-9) HAS BEEN COMPLETED.

NOTE
TAPE BIASING SPRING MUST NOT BIND AGAINST PUNCH GUIDE PLATE OR PUNCH DIE PLATE.

Figure 3-7.

CHANGE 4
(A) PUNCH BLOCK
REQUIREMENT
PERCEPTIBLE CLEARANCE (MAX. 0.003 INCH) BETWEEN DRAG LINKS AND PUNCH PINS.
TO ADJUST
POSITION PUNCH BLOCK BY MOVING MOUNTING PLATE WITH MOUNTING SCREWS LOOSENED. TIGHTEN SCREWS. TO REFINISH ADJUSTMENT, LOosen PUNCH BLOCK MOUNTING SCREWS AND LOCATING ECCENTRIC LOCK SCREW. POSITION PUNCH BLOCK BY MEANS OF LOCATING ECCENTRIC. CHECK EACH PIN TO SEE THAT IT IS FREE FROM Binds.

(B) OPERATING LINK SPRING
TO CHECK
OPERATING LINK IN "OUT" (11/16" TAPE) POSITION, SPRING REMOVED FROM POST.
REQUIREMENT
MIN. 6 OZS. MAX. 10 OZS.
TO PULL SPRING TO INSTALLED LENGTH.

NOTE
ADJUSTMENT (B) ONLY REQUIRED ON PUNCH UNITS WITH UNIVERSAL PUNCH BLOCK CAPABLE OF PUNCHING EITHER 11/16" OR 1" TAPE.
DRAG LINKS

(1) TO CHECK
PLACE THE PUNCH UNIT IN IDLE RUNNING CONDITION, AND INSERT TWO
THICKNESSES OF TAPE IN THE PUNCH BLOCK
REQUIREMENT
AFTER TEN MINUTES IDLE RUNNING TIME, THERE SHOULD BE NO PUNCH PIN
IMPRESSIONS (OR MARKS) ON THE UPPER SURFACE OF THE TOP THICKNESS OF
TAPE.

(2) TO CHECK
PLACE ONE THICKNESS OF TAPE IN THE PUNCH BLOCK, WITH PUNCH UNIT
UNDER POWER, PERFORATE A SERIES OF MARKING (HOLES) CODE COMBINA-
TIONS.
REQUIREMENT
EDGES OF ALL HOLES SHOULD BE CLEAN CUT.
TO ADJUST
LOOSEN THREE MOUNTING SCREWS,
START WITH DRAG LINK BRACKET IN CENTER OF ITS ADJUSTMENT RANGE. IF TOP
THICKNESS OF TAPE (SEE (1) ABOVE) SHOWS PUNCH PIN IMPRESSIONS (OR MARKS),
MOVE BRACKET DOWN. IF Punched holes in single tape thickness (See (2)
ABOVE) SHOW BURRS, MOVE BRACKET UP.

NOTE
IN SOME CASES, PUNCH PINS MAY CONTINUE TO MAKE
IMPRESSIONS OR MARKS IN TOP THICKNESS OF TAPE WHEN
DRAG LINK BRACKET IS IN ITS LOWERMOST POSITION (SEE (1)
ABOVE). TO CORRECT, LOOSEN PUNCH BLOCK MOUNT-
ING SCREWS AND PUSH PUNCH BLOCK DOWN. TIGHTEN
MOUNTING SCREWS. REMAKE DRAG LINKS ADJUSTMENT.
IN EXTREME CASES, IT MAY BE NECESSARY TO MOVE THE
MOUNTING PLATE (SEE FIGURE 3-8) DOWN. AFTER MOVING
MOUNTING PLATE, RECHECK THE FOLLOWING ADJUSTMENTS:
PUNCH BLOCK (FIGURE 3-8) AND TAPE GUIDE (FIGURE 3-5).

Figure 3-9.

CHANGE 4
NOTE
THE FOLLOWING SEVEN ADJUSTMENTS - (1) TAPE LID SPRING (FIGURE 3-11), (2) FEED RATCHET DETENT ARM (FIGURE 3-12), (3) FEED RATCHET DETENT ARM SPRING (FIGURE 3-12), (4) FEED PAWL SPRING (FIGURE 3-13), (5) FEED PAWL LINK (FIGURE 3-13), (6) WEDGE BLOCK (FIGURE 3-14), AND (7) CHECK FOR TEN CHARACTER PER INCH (FIGURE 3-14) - MUST BE PERFORMED AS OUTLINED IN ORDER TO ACHIEVE PROPER CODE HOLE INTERVALS (TEN CHARACTERS PER INCH).

TEN CHARACTERS PER INCH
TO CHECK
WITH MAXIMUM TAPE SUPPLY LOAD (FULL ROLL), POWER PERFORATE SIX SERIES OF NINE "BLANK" COMBINATIONS FOLLOWED BY ONE "LETTER" COMBINATION (ONLY "LETTERS" OR "BLANKS" ACCEPTABLE).

REQUIREMENT
PLACE TAPE OVER SMOOTH SIDE OF 95960 TAPE GAUGE SO THAT FIRST #2 CODE HOLE IN TAPE IS CONCENTRIC WITH FIRST (0.072") HOLE OF TAPE GAUGE (SEE NOTE BELOW). THE NEXT FOUR 0.072" HOLES IN TAPE GAUGE SHALL BE VISIBLE THROUGH #2 CODE HOLES IN TAPE, AND LAST (SIXTH) #2 CODE HOLE IN TAPE SHALL BE ENTIRELY WITHIN THE 0.086" DIAMETER HOLE OF THE TAPE GAUGE.

NOTE
THE FIRST FIVE HOLES IN GAUGE ARE SAME SIZE AS CODE HOLES IN TAPE (0.072" DIAMETER), BUT SIXTH HOLE IN GAUGE IS LARGER (0.086" DIAMETER). THIS ARRANGEMENT ALLOWS ± 0.007" VARIATION IN FIVE (5) INCHES.

![Diagram](image_url)
TEN CHARACTERS PER INCH (CON'T)
TO ADJUST
(1) TAPE LID SPRING
REQUIREMENT
MIN. 4 OZS. --- MAX. 6 OZS. TO START TAPE LID MOVING.
TO ADJUST
LOosen TAPE LID POST AND ROTATE TO OBTAIN REQUIRED TENSION.

TAPE LID POST
(LOCK NUT ON OTHER END)

TAPE LID

TAPE LID SPRING

FEED WHEEL

NOTE
SLOT IN HEXAGONAL HEAD OF TAPE LID POST SHALL BE IN UPPER POSITION.
SPRING TENSION CAN BE HELD TO SPECIFIED LIMIT BY TURNING POST.

Figure 3-11.
TEN CHARACTERS PER INCH (CON'T)

(2) FEED RATCHET DETENT ARM

REQUIREMENT

FEED RATCHET DETENT ARM SHALL BE POSITIONED SO THAT ECCENTRIC IS IN ITS LOWERMOST POSITION.

TO ADJUST

POSITION ECCENTRIC TO ITS LOWERMOST POSITION.

NOTE

REFINEMENT OF FEED RATCHET DETENT ARM ADJUSTMENT MAY BE NECESSARY AFTER COMPLETING WEDGE BLOCK ADJUSTMENT. SEE CHECK FOR TEN CHARACTERS PER INCH ADJUSTMENT (FIGURE 3-14).

(3) FEED RATCHET DETENT ARM SPRING

REQUIREMENT

WITH ECCENTRIC APPROXIMATELY VERTICAL:

MIN. 36 OZS. -- MAX. 46 OZS.

TO MOVE FEED RATCHET DETENT ARM.

TO ADJUST

REFORM FEED RATCHET DETENT ARM SPRING.

Figure 3-12.
(4) FEED PAWL SPRING REQUIREMENT

WITH FEED ARMATURE IN ATTRACTED POSITION AND FEED PAWL IN UPPERMOST POSITION:
MIN. 3 OZS. --- MAX. 5 OZS.
TO START FEED PAWL MOVING.

(MOUNTING SCREWS
PLATE MOUNTING SCREWS
FEED LINK
PLATE ECCENTRIC (LOCK NUT ON OTHER END)
FEED PAWL PLATE
FEED PAWL SPRING
MOUNTING SCREW
FEED PAWL GUIDE
WEDGE BLOCK
PLATE
WEDGE BLOCK ECCENTRIC (LOCK NUT ON OTHER END)
FEED RATCHET
DETENT ROLLER

(5) FEED PAWL LINK
TO CHECK
(a) LOOSEN WEDGE BLOCK MOUNTING SCREW AND WEDGE BLOCK ECCENTRIC. MOVE WEDGE BLOCK ECCENTRIC AND WEDGE BLOCK TO LOWERMOST POSITION.
(b) HOLD FEED MAGNET ARMATURE OPERATED. ROTATE MAIN SHAFT REQUIREMENT
FEED PAWL SHALL ADVANCE FEED RATCHET ONE FULL TOOTH WITH PERCEP-TIBLE OVERTRAVEL BEYOND THE FULLY DETENTED POSITION OF THE FEED RATCHET.
TO ADJUST
LOOSEN PLATE MOUNTING SCREWS AND PLATE ECCENTRIC. POSITION FEED LINK BY ROTATING PLATE ECCENTRIC. TIGHTEN PLATE MOUNTING SCREWS AND PLATE ECCENTRIC. RECHECK TO SEE THAT THE FEED PAWL PICKS UP THE NEXT TOOTH AT THE TOP OF THE NEXT FEEDING CYCLE. REFINE BY REDUCING THE AMOUNT OF OVERTRAVEL.

Figure 3-13.
(6) WEDGE BLOCK REQUIREMENT

There shall be no clearance between wedge block and feed pawl when feed pawl is in lowermost position.

To adjust:

Move wedge block to its uppermost position and tighten mounting screw friction tight.

Move wedge block eccentric to its lowermost position.

Depress feed magnet and rotate mainshaft by hand to position wedge block. Tighten mounting screw. Move wedge block eccentric up to touch bottom of wedge block. Recheck requirement.

Note:

There shall be no jamming when turning mainshaft by hand.

(7) CHECK FOR TEN CHARACTERS PER INCH REQUIREMENT

Perform "to check" and "requirement" parts of ten characters per inch adjustment. (Figure 3-10).

To adjust:

Perforated holes too far apart:

Loosen lock nut and move eccentric a very small amount clockwise. Tighten lock nut.

Perforated holes too close together:

Loosen lock nut and move eccentric a very small amount counterclockwise. Tighten lock nut.

Recheck feed pawl link (Figure 3-13), wedge block (Figure 3-14), and tape biasing spring (Figure 3-7) adjustments.

Figure 3-14.
NOTE
FOLLOWING ADJUSTMENT PROCEDURE, FIGURES 3-15 THRU 17, PERTAINS TO PUNCH UNITS WITH A 160 POINT TIMING SCALE. SEE FIGURES 3-18 THRU 21 FOR ADJUSTMENTS PERTAINING TO PUNCH UNITS WITH A 60 POINT TIMING SCALE. ADJUSTMENTS MUST BE MADE IN INDICATED ORDER.

FLYWHEEL ORIENTATION
(1) VIEWING UNIT FROM THE REAR, POSITION TIMING SCALE UNTIL NUMBER 80 IS LINED UP WITH INDICATOR. SECURE TIMING SCALE. ROTATE MAIN SHAFT UNTIL KEY-WAY IS AT 12 O'CLOCK POSITION. HOLD SHAFT IN THIS POSITION.

(2) PLACE FLYWHEEL ON SHAFT WITH FLYWHEEL HUB TO REAR. ROTATE FLYWHEEL UNTIL MAGNETIC INSERT LOCATING MARK ON FLYWHEEL IS ADJACENT TO ZERO ON TIMING SCALE.

(3) INSERT SET SCREW IN TAPPED HOLE OF FLYWHEEL HUB AT 12 O'CLOCK POSITION. ADVANCE SET SCREW JUST ENOUGH TO RETAIN LOCATION OF FLYWHEEL WITH RESPECT TO KEY-WAY. DO NOT TIGHTEN SET SCREW.

NOTE
SET SCREW MUST LINE UP WITH KEY-WAY. ALIGNMENT MAY NECESSITATE MOVING FLYWHEEL SO THAT LOCATING MARK NO LONGER LINES UP WITH ZERO MARK ON TIMING SCALE.

(4) ASSEMBLE WASHER, LOCK WASHER, AND FLYWHEEL RETAINING NUT ON MAIN SHAFT AND TIGHTEN SECURELY.

(5) TIGHTEN FLYWHEEL SET SCREW.
MAGNETIC PICK-UP

TO CHECK
TIMING SCALE POSITIONED SO THAT INDICATOR IS OPPOSITE 80. TIGHTEN
INDICATOR LOCK NUT,
TAKE UP PLAY BETWEEN FLYWHEEL AND MAGNETIC PICK-UP SO THAT
CLEARANCE IS A MINIMUM.
REQUIREMENT
MIN. 0.010 INCH --- MAX. 0.015 INCH
BETWEEN FLYWHEEL AND MAGNETIC PICK-UP COIL AT POINT OF LEAST
CLEARANCE.
TO ADJUST
LOosen MOUNTING SCREWS FRICTION TIGHT. POSITION BRACKET AT PRY-
POINT TO MEET REQUIREMENT. TIGHTEN MOUNTING SCREWS.

Figure 3-16.
NOTE
TIMING IS ADJUSTED TO OBTAIN PROPER SYNCHRONIZATION BETWEEN THE CODE PULSE DELIVERY FROM THE MAGNET DRIVERS AND THE MECHANICAL TIMING OF THE PUNCH.

(A) TIMING QUALITY
TO CHECK
OPERATE PUNCH FROM CONTROL CIRCUITS USING RECEIVING TEST TAPE 146605 OR EQUIVALENT. LOOSEN INDICATOR LOCK NUT. TO DETERMINE OPERATING MARGIN, ROTATE TIMING SCALE IN ONE DIRECTION AND RECORD NUMBER ON SCALE OPPOSITE INDICATING LINE WHEN ERRORS BEGIN TO OCCUR. ROTATE TIMING SCALE IN OPPOSITE DIRECTION AND RECORD NUMBER WHERE ERRORS OCCUR.

REQUIREMENT
MIN. 90 POINTS OF CONTINUOUS OPERATING MARGIN WHILE RECEIVING 110 OPS AT 28 VDC 1A.

TO ADJUST
CHECK AND CORRECT MAGNET PLATE ADJUSTMENT (FIGURE 3-3) AND ARMATURE SPRING ADJUSTMENT (FIGURES 3-3, 3-4). AN ADDITIONAL FACTOR RELATED TO THE AMOUNT OF MARGIN OBTAINABLE IS THE LENGTH OF CURRENT PULSE TO THE MAGNETS.

NOTE
WELL ADJUSTED EQUIPMENT WILL PROVIDE AT LEAST 90 POINTS OF OPERATING MARGIN. THE EQUIPMENT WILL OPERATE WITH LESS, BUT AN OPERATING MARGIN OF LESS THAN 90 POINTS INDICATES THAT THE RELATED ADJUSTMENTS ARE OF POOR QUALITY.

(B) TIMING REQUIREMENT
USING INFORMATION OBTAINED FROM TIMING QUALITY "TO CHECK" ABOVE, MAGNETIC PICK-UP SHALL BE AT CENTER OF OPERATING MARGIN.

TO ADJUST
POSITION TIMING SCALE SO THAT INDICATING LINE IS OPPOSITE NUMBER ON TIMING SCALE WHICH IS CENTER OF OPERATING MARGIN.

Figure 3-17.
NOTE

FOLLOWING ADJUSTMENT PROCEDURE, FIGURES 3-18 THRU 21, PERTAINS TO PUNCH UNITS WITH A 60 POINT TIMING SCALE. SEE FIGURES 3-15 THRU 17 FOR ADJUSTMENTS PERTAINING TO PUNCH UNITS WITH A 160 POINT TIMING SCALE. ADJUSTMENTS MUST BE MADE IN INDICATED ORDER.

FLYWHEEL ORIENTATION

(1) GENERAL

THE FLYWHEEL MAY BE ORIENTED IN 60-DEGREE STEPS WITH RESPECT TO MAIN SHAFT, THIS PROVIDES AN OPTION OF SIX INITIAL POSITIONS FROM WHICH VARIOUS COMBINATIONS OF OPERATING SPEEDS, MAGNETS, AND CONTROL-CIRCUIT DELAYS MAY BE ACCOMMODATED.

(2) DETERMINE O'CLOCK POSITION

COMBINE ATTRACT TIME OF MAGNETS (PAR. 1-7,c ) AND DELAY TIME OF CONTROL CIRCUITS TO OBTAIN TIME (T) IN MILLISECONDS (MS) AT WHICH ARMATURES ARE FULLY ATTRACTED AFTER PICKUP FIRES.

LOCATE T ON TIME SCALE AT LOWER LEFT OF FIGURE 3-19, EXTEND A LINE HORIZONTALLY TO RIGHT UNTIL IT INTERSECTS LINE REPRESENTING OPERATING SPEED OF PUNCH UNIT IN OPERATIONS PER SECOND (OPS).

EXTEND A LINE VERTICALLY UPWARD FROM THIS POINT UNTIL IT INTERSECTS ONE OF THE O'CLOCK LINES.

EXTEND A LINE FROM THIS POINT HORIZONTALLY TO LEFT UNTIL IT INTERSECTS SCALE AT UPPER LEFT. THIS POINT REPRESENTS POSITION OF TOGGLE LINKAGES IN DEGREES (AS ILLUSTRATED IN FIG. 6-8 ) WHEN ARMATURES REACH FULLY ATTRACTED POSITION. IT SHOULD FALL WITHIN SELECTION INTERVAL. USE O'CLOCK POSITION REPRESENTED BY INTERSECTED LINE IN POSITIONING FLYWHEEL AS INSTRUCTED BELOW.

(3) EXAMPLE

ASSUME THAT PUNCH UNIT IS TO OPERATE AT SPEED OF 110 OPS, THAT ATTRACT TIME OF MAGNETS IS 2 MS AND DELAY OF CONTROL CIRCUITS IS 1 MS, COMBINED TIME (T) IS THUS 3 MS.

LOCATE 3 ON TIME SCALE IN FIGURE 3-19. EXTEND A LINE FROM 3 TO RIGHT UNTIL IT INTERSECTS 110 OPS LINE.

EXTEND A LINE VERTICALLY UPWARD FROM THIS POINT. AS CAN BE SEEN IN FIGURE 3-19 , LINE INTERSECTS 9 O'CLOCK LINE.

WHEN A LINE IS EXTENDED TO LEFT FROM THIS POINT, IT INTERSECTS SCALE AT 339°. THIS TOGGLE LINKAGES ARE IN SELECTION INTERVAL WHEN MAGNETS REACH FULLY ATTRACTED POSITION. POSITION FLYWHEEL AT 9 O'CLOCK AS INSTRUCTED BELOW.

(4) POSITION FLYWHEEL

VIEW UNIT FROM FRONT. ROTATE FLYWHEEL UNTIL SET SCREW IS IN 12 O'CLOCK POSITION. IF IRON INSERT IS NOT AT O'CLOCK POSITION DETERMINED ABOVE, LOOSEN FLYWHEEL NUT AND REMOVE SET SCREW.

POSITION SHAFT SO THAT KEYWAY IS IN 12 O'CLOCK POSITION. HOLD SHAFT IN THIS POSITION AND ROTATE FLYWHEEL SO THAT IRON INSERT IS AT O'CLOCK POSITION DETERMINED ABOVE. INSERT SET SCREW IN HOLE IN HUB AT 12 O'CLOCK POSITION AND TIGHTEN JUST ENOUGH TO HOLD FLYWHEEL IN POSITION. TIGHTEN NUT. TIGHTEN SET SCREW SECURELY.

NOTE

SET SCREW MUST LINE UP WITH KEYWAY ON MAINSHAFT.
Figure 3-19.
Fig. 3-20.

(A) MAGNETIC PICK-UP

TO CHECK
POSITION INDICATING LINE OPPOSITE 30 ON TIMING SCALE. (SEE FIGURE 3-21)
TAKE UP PLAY BETWEEN FLYWHEEL AND MAGNETIC PICK-UP SO THAT CLEARANCE IS A MINIMUM.
REQUIREMENT
MIN. 0.005 INCH --- MAX. 0.010 INCH
BETWEEN FLYWHEEL AND MAGNETIC PICK-UP AT POINT OF LEAST CLEARANCE.
TO ADJUST
LOOSEN LOCK NUT AND SET SCREW. POSITION MAGNETIC PICK-UP TO MEET REQUIREMENT.

NOTE
TIMING IS ADJUSTED TO OBTAIN PROPER SYNCHRONIZATION BETWEEN THE CODE PULSE DELIVERY FROM THE MAGNET DRIVERS AND THE MECHANICAL TIMING OF THE PUNCH.

(B) TIMING QUALITY

TO CHECK
OPERATE PUNCH FROM CONTROL CIRCUITS, USING RECEIVING TEST TAPE 146605 OR EQUIVALENT. LOOSEN BRACKET LOCK NUT. TO DETERMINE OPERATING MARGIN, ROTATE PICK-UP BRACKET IN ONE DIRECTION AND RECORD NUMBER ON SCALE OPPOSITE INDICATING LINE WHEN ERRORS BEGIN TO OCCUR. ROTATE BRACKET IN OTHER DIRECTION AND RECORD NUMBER WHERE ERRORS OCCUR.
REQUIREMENT
MIN. 90 POINTS OF CONTINUOUS OPERATING MARGIN WHILE RECEIVING 110 OPS AT 28 VDC 1A.

NOTE
TO CHECK FOR 90 POINTS OF OPERATING MARGIN IT IS NECESSARY TO ROTATE THE FLYWHEEL A 60 DEGREE STEP TO ONE SIDE THEN/OR TO THE OTHER SIDE OF THE FLYWHEEL ORIENTATION (FIGURE 3-18) WHERE SOME ERROR FREE OPERATION IS OBTAINED.

TO ADJUST
CHECK AND CORRECT MAGNET PLATE ADJUSTMENT (FIGURE 3-3) AND ARMATURE SPRING ADJUSTMENT (FIGURES 3-3, 3-4). AN ADDITIONAL FACTOR RELATED TO THE AMOUNT OF MARGIN OBTAINABLE IS THE LENGTH OF CURRENT PULSE TO THE MAGNETS.

NOTE
WELL ADJUSTED EQUIPMENT WILL PROVIDE AT LEAST 90 POINTS OF OPERATING MARGIN. THE EQUIPMENT WILL OPERATE WITH LESS, BUT AN OPERATING MARGIN OF LESS THAN 90 POINTS INDICATES THAT THE RELATED ADJUSTMENTS ARE OF POOR QUALITY.

Figure 3-20.
(A) **TIMING REQUIREMENT**

Using information obtained from timing quality "to check" (Figure 3-20), magnetic pick-up bracket shall be positioned at center of operating margin.

To adjust position magnetic pick-up bracket so indicating line is opposite number on scale at center of operating margin.

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(B) **TAPE FEED OUT LEVER SPRING REQUIREMENT**

Min. 4 OZS. --- Max. 6 OZS. to start tape feed out lever moving.

Note: All punches do not have tape feed out lever spring.

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Figure 3-21.
b. BASE

LOW TAPE CONTACTS
REQUIREMENTS
WITH LOW-TAPE LEVER HELD AWAY FROM SWINGER:
(1) MIN. 0.025 INCH --- MAX. 0.035 INCH
   GAP AT REAR CONTACT.
(2) MIN. 4 OZS. --- MAX. 5 OZS.
   TO OPEN FRONT CONTACT.

TO ADJUST
REMOVE TRANSPARENT COVER BY REMOVING ITS MOUNTING NUTS.
(1) BEND STIFFENER TO MEET (1) ABOVE.
(2) BEND SWINGER CONTACT SPRING TO MEET (2) ABOVE.
   REPLACE COVER.

Figure 3-22.
(A) INDICATOR PLATE REQUIREMENT
MIN. 0.020 INCH
MAX. 0.030 INCH
CLEARANCE BETWEEN INDICATOR AND NUMBER 2 CONTACOR PLATES,
ADJUST INDICATOR PLATE WITH SCREW LOOSENED.

NOTE
ADJUSTMENTS ON THIS PAGE DO NOT APPLY TO SINGLE-CONTACT UNIT.

(b) NUMBER 2 CONTACOR MOUNTING PLATE REQUIREMENT
"0" OPPOSITE LINE ON INDICATOR PLATE, ADJUST PLATE WITH THUMB SCREW LOOSENED.

Figure 3-33.

(C) NUMBER 1 CONTACOR MOUNTING PLATE REQUIREMENT
SCIBED LINE OPPOSITE "0" LINE ON NUMBER 2 CONTACOR MOUNTING PLATE, ADJUST THE PLATE WITH ITS MOUNTING SCREW LOOSENED.
NOTE
MAKE MOTOR ADJUSTMENT IN FIGURE 3-27.

CAUTION:
IF MOTOR BECOMES BLOCKED FOR SEVERAL
SECONDS, THERMAL CUT-OUT SWITCH WILL
BREAK CIRCUIT. SHOULD THIS HAPPEN, ALLOW
MOTOR TO COOL AT LEAST 5 MINUTES BEFORE
DEPRESSING RED RESET BUTTON.

TIMING BELT REQUIREMENT
BY MEANS OF A SCALE, APPLY ONE POUND
PUSH TO CENTER OF THE BELT SPAN. THE
BELT SHOULD YIELD 3/16 INCH. SPROCKETS
ALIGNED. SHAFTS PARALLEL.
ADJUST
MOTOR WITH FOUR MOUNTING SCREWS
LOOSENED.

Figure 3-34.
(A) TAPE ARM STOP
REQUIREMENT
WITH TAPE REEL BRAKE IN
CONTACT WITH TAPE REEL
(SEE BELOW): PERCEPTIBLE
CLEARANCE BETWEEN TAPE
REEL BRAKE AND REAR
MOUNTING STRIP.
TO ADJUST
LOSEN MOUNTING SCREWS
HOLDING REAR PLATE AND
MOVE TAPE REEL ASSEMBLY TO
MEET REQUIREMENT.

(B) TAPE REEL BRAKE SPRING
REQUIREMENT
MIN, 12 OZS. --- MAX, 15 OZS.
TO START TAPE REEL BRAKE MOVING.
c. MOTOR-MOUNTING AND DRIVE PARTS

NOTE
MOTOR PINION AND GEAR MESH
ADJUSTMENT IS NOT REQUIRED ON ALL PUNCHES.

MOTOR PINION

MOTOR

DRIVE GEAR

FLYWHEEL

MOUNTING PLATE

LOCK NUT

ADJUSTING SCREW

MOTOR PINION AND DRIVE GEAR MESH
REQUIREMENT
BARELY PERCEPTIBLE AMOUNT OF BACKLASH AT POINT OF
MINIMUM CLEARANCE.

TO ADJUST
WITH ADJUSTING SCREW LOCK NUT LOOSENED, ROTATE
ADJUSTING SCREW TO MEET REQUIREMENT.

NOTE
MOTOR IS TURNED END FOR END WHEN A GEAR DRIVE
SYSTEM IS USED INSTEAD OF A BELT DRIVE SYSTEM.

Figure 3-26.
(A) MOTOR REQUIREMENT
OILERS SHOULD BE UPWARD AND APPROXIMATELY EQUIDISTANT FROM A VERTICAL LINE THROUGH MOTOR SHAFT. TO ADJUST POSITION MOTOR WITH CLAMP SCREWS (2) LOOSENED.

CLAMP SCREW (2)

OILER

TIMING BELT

MOTOR SHAFT

MOUNTING SCREW

LOCK WASHER

SPARE SHIMS

SHIMS

SUPPORTING SPACER

CAUTION:
IF MOTOR BECOMES BLOCKED FOR SEVERAL SECONDS, THERMAL CUT-OUT SWITCH WILL BREAK CIRCUIT. SHOULD THIS HAPPEN, ALLOW MOTOR TO COOL AT LEAST 5 MINUTES BEFORE DEPRESSING RED RESET BUTTON.

(B) TIMING BELT REQUIREMENT
ONE POUND PRESSURE AT CENTER OF TIMING BELT SPAN SHOULD DEFLECT BELT APPROXIMATELY:
1/16 INCH FOR 110 OPS OPERATION,
3/16 INCH FOR 63.3 OPS OPERATION.
TO ADJUST REMOVE FOUR MOTOR MOUNTING SCREWS WITH LOCK WASHERS, FLAT WASHERS AND SPARE SHIMS. LIFT MOTOR UNIT FROM SUPPORTING SPACERS. ADD SHIMS TO, OR REMOVE THEM FROM SUPPORTING SPACERS. REPLACE MOTOR UNIT. REPLACE MOUNTING SCREWS WITH THEIR HARDWARE * AND MAKE FRICTION TIGHT. REFINISH ADJUSTMENTS BY SHIFTING MOTOR HORIZONTALLY. TIGHTEN MOUNTING SCREWS AND RECHECK REQUIREMENT.

*RETAIN SPARE SHIMS BY PLACING THEM ON MOUNTING SCREWS ABOVE MOUNTING BRACKET AS SHOWN IN DRAWING.

Figure 3-27.
3-5. EARLY DESIGN

CHECK FOR BINDS BY ROTATING MAIN SHAFT AS INSTRUCTED IN PAR. 3-2.f.

(A) ECCENTRIC ARMS
REQUIREMENT
SOME CLEARANCE BETWEEN SIDES OF ECCENTRIC ARMS AND CONTACT BOX OPENINGS.
ADJUST EACH ECCENTRIC ARM ON OUTER BEARING RACE WITH CLAMP SCREW LOOSENED.

(B) PUNCH BAIL ECCENTRIC STUD
REQUIREMENT
HOLD ARMATURE OPERATED (MARKING), BLOCKING PAWL AGAINST STOP PLATE, ROTATE THE MAIN SHAFT UNTIL THE ENGAGING SURFACES OF LONG TOGGLE ARMS ARE BELOW ENGAGING SURFACES OF THE BLOCKING PAWLS, CLEARANCE BETWEEN END OF LONG TOGGLE ARMS AND BLOCKING PAWLS MIN. 0.003 INCH MAX. 0.015 INCH.
ADJUST PUNCH BAIL ECCENTRIC STUD WITH ITS LOCK NUT LOOSE.
(A) BLOCKING PAWL REQUIREMENT

PUNCH BAIL IN EXTREME UPPER POSITION,
EACH BLOCKING PAWL IN BLOCKING POSITION,
MIN. 0.003 INCH
OVERTRAVEL BETWEEN EACH PAWL AND LOWER SURFACE OF LONG TOGGLE ARMS.
ADJUST
STOP ARM BRACKET WITH MOUNTING NUTS LOOSE (TAP BRACKET DOWN).

(B) LONG TOGGLE ARM SPRING REQUIREMENT

ARMATURE HELD OPERATED, PUNCH BAIL IN EXTREME LOWER POSITION,
MIN. 3 OZS.
MAX. 6 OZS.
TO PREVENT ARMS REUNITING WHEN BARELY PERCEPTIBLE SEPARATION EXISTS.

(C) MAGNET BRACKET REQUIREMENT

ARMATURES HELD OPERATED,
CLEARANCE BETWEEN ARMATURE AND CORE:
MIN. 0.003 INCH
MAX. 0.006 INCH
IF BRACKET HAS ONE MAGNET
ONE AT MINIMUM (0.003 INCH) CLEARANCE AND THE OTHER NOT MORE THAN 0.006 INCH CLEARANCE IF THE BRACKET HAS TWO MAGNETS.
ADJUST
EACH MAGNET BRACKET ON ITS PIVOT SCREW LOCATED TO REAR OF STUD MOUNTING SCREW, WITH ALL THREE MOUNTING SCREWS LOOSE. ADD OR REMOVE SHIMS BETWEEN MAGNET YOKE AND MOUNTING PLATE IF NECESSARY.
(A) PUNCH MAGNET ARMATURE SPRING REQUIREMENT
PUNCH BAIL DRIVE LINK ASSEMBLY IN TOP CENTER POSITION,
MIN. 13 OZ.
MAX. 15 OZ.
TO MOVE ARMATURE.

PUNCH MAGNET ARMATURE SPRING

(B) FEED MAGNET ARMATURE SPRING REQUIREMENT
PUNCH BAIL DRIVE LINK ASSEMBLY IN TOP CENTER POSITION,
MIN. 13 OZS.
MAX. 15 OZS.
TO MOVE ARMATURE.

(C) PUNCH BLOCK REQUIREMENT
1. PINS MOVE FREELY IN PUNCH BLOCK, MINIMUM CLEARANCE BETWEEN STEMS OF PUNCH PINS AND EDGES OF DRAG LINK SLOTS.
2. SOME CLEARANCE BETWEEN RETAINING PLATE AND PUNCH PINS.

ADJUST
FIRST THE RETAINING PLATE WITH ITS MOUNTING SCREWS LOOSENED; THEN POSITION PUNCH BLOCK, WITH MOUNTING SCREWS LOOSENED, BY MEANS OF ITS LOCATING ECCENTRIC.

Figure 3-30.
(A) FEED RATCHET DETENT REQUIREMENT
PERFORATE TAPE UNDER POWER, CHECK FEED HOLES FOR STANDARD SPACING OF TEN TO THE INCH WITH TAPE GAUGE NO. 95960.
ADJUST
FEED RATCHET DETENT ECCENTRIC WITH ITS LOCK NUT LOOSENED, RECHECK FEED PAWL ADJUSTABLE LINK AFTER EACH DETENT ADJUSTMENT.

(B) FEED PAWL ADJUSTABLE LINK REQUIREMENT
(1) HOLD FEED MAGNET ARMATURE OPERATED, ROTATE MAIN SHAFT, FEED PAWL ADVANCES FEED RATCHET ONE FULL TOOTH WITHOUT NOTICEABLE OVERTRAVEL AND DETENT ROLLER FULLY DETENTS RATCHET WHEEL.
(2) WITH FEED MAGNET ARMATURE RELEASED AND FEED PAWL IN ITS LOWEST POSITION, PAWL SHOULD CONTACT NEXT RATCHET TOOTH.
ADJUST
FEED PAWL UP OR DOWN, BY MEANS OF A SCREWDRIVER, WITH CLAMP SCREW FRICITION TIGHT, CHECK FEED RATCHET DETENT ADJUSTMENT.

(C) FEED PAWL SPRING REQUIREMENT
MIN, 4 OZS.
MAX, 5 OZS.
PULLED TO POSITION LENGTH WITH PUNCH BAIL DRIVE LINK ASSEMBLY IN TOP CENTER POSITION.

(D) FEED PAWL ECCENTRIC STUD REQUIREMENT
ROTATE MAIN SHAFT UNTIL FEED PAWL IS IN EXTREME LOWER POSITION, WHEN FEED PAWL IS HELD FIRMLY AGAINST RATCHET IT SHOULD CONTACT STUD. ADJUST ECCENTRIC STUD COUNTER-CLOCKWISE WITH LOCK NUT LOOSENED.

Figure 3-31.
(A) TAPE TENSION LEVER SPRING REQUIREMENT
- MIN. 4-1/2 OZ.
- MAX. 5-1/2 OZ.
To start lever moving away from feed wheel, adjust TAPE TENSION LEVER STUD WITH LOCK NUT LOOSENED.

(B) TAPE FEED OUT LEVER SPRING REQUIREMENT
- MIN. 2-1/2 OZ.
- MAX. 3-1/2 OZ.
Pulled to position length.

(C) FEED PAWL AND RATCHET ALIGNMENT (SEE FIGURE 3-31.) REQUIREMENT
- FEED PAWL FULLY ALIGNED WITH FEED WHEEL RATCHET.
Adjust shim the detent arm eccentric stud that is fastened to the mounting plate. Use 71074 washers for shims.

NOTE
The following adjustments are arranged to provide contactor operation. The opening or closure of the contacts (or contact in case of single-contact unit) may be advanced or retarded in the punching cycle by rotating the contactor mounting plates about the main shaft. Rotating the contactors in the direction of shaft rotation will delay the time at which they are activated. Rotating the contactors against the direction of shaft rotation will advance the time at which they are activated. The contactors (double-contact units only) may be moved individually or together in either direction to facilitate coupling of the punch mechanism to auxiliary control equipment (refer to timing diagram, figure 6-9).

(D) CONTACTS REQUIREMENT
- ECCENTRIC ARMS IN EXTREME RIGHT, THEN IN EXTREME LEFT POSITIONS.
- ALL GAPS
  - MIN. 0.008 INCH
  - MAX. 0.012 INCH AND EQUAL TO EACH OTHER WITHIN 0.002 INCH.
Adjust box horizontally with screws loosened.

Figure 3-32.
(A) **INDICATOR PLATE REQUIREMENT**
- MIN. 0.020 INCH
- MAX. 0.030 INCH
CLEARANCE BETWEEN INDICATOR AND NUMBER 2 CONTACTOR PLATES.
ADJUST INDICATOR PLATE WITH SCREW LOOSENED.

(B) **NUMBER 2 CONTACTOR MOUNTING PLATE REQUIREMENT**
- "0" OPPOSITE LINE ON INDICATOR PLATE.
ADJUST PLATE WITH THUMB SCREW LOOSENED.

(C) **NUMBER 1 CONTACTOR MOUNTING PLATE REQUIREMENT**
- Scribed line opposite "0" line on number 2 contactor mounting plate.
ADJUST THE PLATE WITH ITS MOUNTING SCREW LOOSENED.

**Figure 3-33.**
NOTE
MAKE MOTOR ADJUSTMENT IN FIGURE 3-27.

CAUTION:
IF MOTOR BECOMES BLOCKED FOR SEVERAL SECONDS, THERMAL CUT-OUT SWITCH WILL BREAK CIRCUIT. SHOULD THIS HAPPEN, ALLOW MOTOR TO COOL AT LEAST 5 MINUTES BEFORE DEPRESSING RED RESET BUTTON.

TIMING BELT REQUIREMENT
BY MEANS OF A SCALE, APPLY ONE POUND PUSH TO CENTER OF THE BELT SPAN. THE BELT SHOULD YIELD 3/16 INCH. SPROCKETS ALIGNED. SHAFTS PARALLEL.
ADJUST MOTOR WITH FOUR MOUNTING SCREWS LOOSENED.
SINGLE UNIT BASE ADJUSTMENTS NOTE:

MOTOR MOUNTING PLATE - (DIRECT DRIVE) REQUIREMENT
MOTOR SHAFT IN ALIGNMENT WITH PUNCH MAIN SHAFT. ADJUST ELEVATION AND LOCK NUTS AT FOUR CORNERS OF MOTOR MOUNTING PLATE, POSITION MOTOR HORIZONTALLY WITH LOCK NUTS LOOSENED.
(A) **MULTIPLE UNIT BASE MAIN-SHAFT DRIVE CHAIN**

**REQUIREMENT**
- Motor shaft parallel with base mainshaft, driving sprocket aligned with driven sprocket, drive chain taut, without noticeable slack, between sprockets.
- Adjust motor with its mounting screws loosened.

(B) **MULTIPLE UNIT PUNCH MAIN-SHAFT GEARS**

**REQUIREMENT**
- Just perceptible backlash between each punch mainshaft gear and its associated base mainshaft gear throughout complete revolution of gears.
- Adjust each punch unit up or down with gear guards removed and its mounting screws loosened friction tight.

(C) **DRIVE GEARS (SETS WITH GEAR-DRIVE ONLY)**

**REQUIREMENT**
- Gear aligned, with minimum backlash and no bind.
- Adjust motor on mounting posts with mounting screws loosened.

Note:
To mount punch units on a multiple base, remove gear guards and place each punch unit so scribed line on its gear mates with scribed line on its associated base mainshaft gear. In order to maintain same relative position for all punches, mount each punch on the base, friction tight, and adjust as directed below, at left.

Figure 3-36.
(A) TAPE REEL BRAKE SPRING
REQUIREMENT
MIN. 18 OZ.
MAX. 21 OZ.
PULLED TO POSITION LENGTH.

(B) TAPE GUIDE SPRING
REQUIREMENT
TOP, CURVED EDGE OF SPRING
PARALLEL TO TOP EDGE OF TAPE
GUIDE. CLEARANCE BETWEEN
SPRING AND CUT-OUT PORTION
OF GUIDE IS GREATER WITH A
TAPE IN GUIDE THAN WHEN
GUIDE IS EMPTY BY A
MIN. 0.005 INCH
MAX. 0.010 INCH.

ADJUST
SPRING, WITH MOUNTING SCREWS
LOOSENED, FOR ALIGNMENT. BEND
SPRING FOR CLEARANCE.

(C) TAPE GUIDE BRACKET
REQUIREMENT
WITH PUNCH BAIL IN EXTREME
UPPER POSITION THE TAPE
PASSES FREELY FROM THE TAPE
GUIDE THROUGH PUNCH
BLOCK DIE PLATES, CLEARANCE
BETWEEN TAPE GUIDE AND DIE
PLATES SHOULD BE
MIN. 0.010 INCH
MAX. 0.040 INCH.

ADJUST
VERTICALLY BY MEANS OF ADJUSTING
SCREW WITH ITS LOCK NUT
LOOSENED AND WITH MOUNTING
SCREW TIGHT. CHECK WITH UNDER-
SIZE (ONE HALF) TAPE. POSITION
HORIZONTALLY WITH MOUNTING
SCREWS LOOSENED FRICITION TIGHT.
REFINE VERTICAL POSITION IF
NECESSARY.

Figure 3-37.
SECTION 4
DISASSEMBLY

4-1. GENERAL

a. The disassembly procedure covered in this section will break the Punch down into its major subassemblies. Teletype Parts Bulletin 1154B illustrates the complete disassembly and includes drawings of the parts referred to below.

b. If a part that is mounted on shims is to be removed, the number of shims used at each of its mounting screws should be noted so that the same shim pile-up can be replaced when the part is remounted. Retaining rings are made of spring steel and therefore have a tendency to release suddenly. Loss of these rings can be minimized as follows:

Hold the retaining ring to prevent it from rotating. Place the blade of a screwdriver in one of the slots. Rotate the screwdriver in a direction to increase the diameter, and the ring will come off easily without flying.

4-2. COVER

a. To remove the cover, lift it from the Set.

Figure 4-1. Rear Plate Mounting
b. To replace the cover, hold it over the Set, lower it carefully and fit the four rubber grommets on the Base into the provided slots.

4-3. MOTOR UNIT

a. To remove the Motor Unit, remove the timing belt from the sprockets. Disconnect the motor cable leads from the terminal board on the Base. Note the position of the hardware on the four motor mounting screws and then remove them. Lift the motor from the Base.

b. To replace the Motor Unit, place the four mounting spacers over the screw holes in the base plate and reverse the removal procedure. Check the Timing Belt Adjustment (Figure 3-27).

4-4. PUNCH UNIT

a. REMOVAL FROM BASE (Figure 4-1)

(1) Remove the timing belt from the sprockets. Remove the Punch Unit's cable connector from the connector on the base. Remove the Punch Unit by removing the six mounting screws that pass through the 142955 and 142956 brackets on the Base into the 142800 rear plate of the Punch Unit and the four mounting screws that pass through the rear plate into the 142950 and 142951 side bars on the base.

(2) Replace the Punch Unit by reversing the procedure used to remove it.

b. PUNCH BLOCK MOUNTING PLATE ASSEMBLY

(1) To take off the assembly first remove the chad container. Then remove the Punch Unit cover by removing its four mounting screws. Remove the retaining ring from the stud at the left end of the 143014 feed link. Remove the 142917 tape cutter by removing its mounting screw. Remove the two screws that pass through the 142911 plate on the punch block into the 142880 front plate. Remove the three 151606 mounting screws from the 142901 mounting plate. Move the mounting plate slightly to left to disconnect the punch pins from the drag links. Pull the assembly forward slowly and disconnect the 143045 feed pawl link from the stud on the 143014 feed link.

(2) To replace the assembly, place it back into position and connect the 143045 feed pawl link onto the stud of the 143014 feed link. Make sure that the drag links properly engage the punch pins. Then reverse the procedure used to remove the assembly.

c. FEED AND PUNCH MAGNETS

(1) To remove any group of magnets, remove the two 153442 mounting screws and lockwashers from the magnet bar.

(2) To remove any individual magnet assembly, remove the two 156632 mounting screws with hardware from the 142992 mounting plate.
5-1. GENERAL

a. The Punch should be thoroughly lubricated, but over-lubrication which might allow oil to drop or grease to be thrown on other parts should be avoided. Teletype KS7470 oil, or 145867 grease, should be used as indicated in the specific instructions in this section.

b. Lubricate the equipment before putting it in service or prior to storage. After a short period of service, repeat the procedure to make sure that all specified points have received lubricant. Thereafter, lubricate at regular intervals as needed. The lubrication interval should not be more than 160 hours or one month of service, whichever occurs first.

c. Make certain that no oil or grease accumulates between the armatures and magnet pole faces or between contact points. Wire off the excess lubricant from the armatures and yoke pivot points.

d. Paragraph 5-4 applies to early-design punches.

e. Paragraphs 5-2 and 5-3 cover late design equipment. In these paragraphs general lubricating areas are shown by photographs. Specific areas to receive lubricant are indicated by line drawings with text. The drawings are keyed to the photographs by paragraph numbers.

The symbols in the text indicate the following:

- **O** Apply one drop of KS7470 oil.

- **O2** Apply two drops of KS7470 oil, etc.

- **SAT** Saturate with KS7470 oil (felt washers, oilite bearings, etc.)

- **FILL** Fill with KS7470 oil (oil holes, oil cups, etc.)

- **M** Apply 1/64 inch coating of 143484 or 145867 grease.
5-2. PUNCH UNIT (LATE DESIGN)
   a. GENERAL AREAS
d. GENERAL AREAS

PAR. 5-2.d.

PAR. 5-2.e.

PAR. 5-2.f. & g.

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e. PERFORATING MECHANISM

SLOTS
CONTACTING SURFACES
GUIDE SURFACES
STOP PLATES
LONG TOGGLE ARMS & BLOCKING PAWLS
LONG TOGGLE ARMS & PUNCH BAIL
TOGGLE ARM SHAFT BRACKET
FELT WASHERS
FELT WICKS
HOOKS - EACH END
LONG & SHORT TOGGLE ARMS
BEARING SURFACES

5-4

CHANGE 4
5-3. BASE AND MOTOR UNIT

a. GENERAL AREAS

b. TAPE REEL AND BRAKE MECHANISM

- Bearing Surfaces (2 Places)
- Tape Reel Shaft
- Pivots (2)
- Hooks - Each End
- Spring

CHANGE 4
c. MOTOR UNIT

O2  OILER* (4) --- (DEPRESS OILER WITH METAL OBJECT.)  MOTOR SHAFT

NOTE: DO NOT LUBRICATE SPROCKETS.

*APPLY OIL EVERY FOUR MONTHS. IF MOTOR IS DISASSEMBLED AT ANY TIME, REPACK BEARINGS WITH 195298 GREASE. DO NOT REPACK BEARINGS OTHERWISE.
5-4. EARLY DESIGN

a. GENERAL - Paragraphs 5-1.a through c apply to the early-design Punch. 1/32 inch coating of 145867 grease should be applied to the places listed below unless other instructions are given. Oil both loops of all helical springs that exert a nominal tension of less than 2-1/2 pounds. Grease both loops of all helical springs that exert a nominal tension of 2-1/2 pounds or more.

b. PUNCH UNIT

- MAIN SHAFT - grease all unshielded ball bearings.
- FEED LINK & LONG TOGGLE ARM JOINT.
- TOGGLE JOINT OF LONG TOGGLE ARM FEED PAWL EXTENSION.
- BLOCKING PAWL PIVOTS - 1 drop of oil.
- TOGGLE ARM SHAFT - saturate felt washers with oil.
- TOGGLE JOINT OF LONG AND SHORT TOGGLE ARMS.
- SOCKET JOINT OF SHORT TOGGLE ARMS AND DRAG LINKS.
- DRAG LINK PIVOT POINTS - 1 drop of oil.
- DRAG LINK AND PUNCH PIN JOINTS.
- PUNCH AND FEED PIN HOLES.
- DETENT ARM ROLLER.
- DETENT ARM PIVOT - 2 drops of oil.
- FEED LINK BEARING - fill oil holes with oil.

FEED PAWL PIVOT - 1 drop of oil.

FEED WHEEL BEARING - fill oil cup with oil.

FEED PAWL RATCHET.

BLOCKING PAWL - point of contact between blocking pawl and armature - wipe off excess grease.

CONTACTOR MOUNTING PLATES - light film of grease between plates and bearing housing.

c. SINGLE UNIT BASE

- MOTOR - two drops of oil at infrequent intervals in oilers at each end of motor.
- TAPE REEL SHAFT - light film of grease at both bearings.
- BRAKE SHAFT.

d. MULTIPLE UNIT BASE

- MOTOR - five to ten drops of oil at infrequent intervals in the oilers at each end of the motor housing.
- DRIVE CHAIN - oil frequently and adequately to provide a noticeable film of oil on the chain links at all times.
- GEARS - medium film of grease, visible at all times.
- MAIN SHAFT BEARINGS - grease center bearing.

e. BASE WITH GEAR DRIVE

- GEARS - light coat of grease visible at all times.
SECTION 6

PRINCIPLES OF OPERATION

6-1. GENERAL

a. Paragraphs 6-2 through 6-11 below treat the Late-Design Punch. Paragraph 6-12 covers the Early-Design, the operation of which is similar to the Late-Design except for the method of producing synchronizing pulses.

b. The function of the Punch is to record information in paper tape at speeds up to 110 characters per second. The information is received from control circuits as combinations of electrical code pulses. These pulses are translated into mechanical motions that perforate corresponding combinations of code holes. The code pulses are accompanied by a feed pulse which causes the equipment to advance the tape. A feed hole is automatically punched with each code combination.

c. The terms character, operation and operating speed are defined in paragraph 1-1e. Being a synchronous unit which produces synchronizing (or clock) pulses, the Punch does not necessarily have to receive and perforate a character each time it undergoes an operation. For example, operating at 110 ops, it might over a period of one minute (6600 total operations) perforate 100 intermittent bursts of twenty characters (2000 in all) which arrive at the rate of 110 per second. During the remaining operations (4600) it would run idle perforating no characters. Thus it may be used to perforate characters at various speeds up to the operating speed. For this type of operation, provisions must be made in the control circuits to correlate the Punch’s timing with the character source. In tape-to-tape telegraph systems, the Punch is usually run at speeds slightly faster than the transmitter to ensure synchronization.

6-2. CODE (Figure 6-1)

a. The information handled by the Punch is in the form of a binary permutation code. The units of the information—characters, numerals etc—are represented by combinations of binary intelligence levels (bits), each of which may be in one of two states, i.e., on or off, yes or no etc. Different versions of the equipment will accommodate codes whose combinations consist of either five, six, seven or eight levels. Figure 6-1.A illustrates a six-level code. In addition to the intelligence levels, a feed level is indicated which is explained below. The total number of permutations available in a given code is equal to two to the n power where n is the number of levels. For example, the permutations that can be expressed by a six-level code is equal to two to the sixth power, or 64.

b. The code is expressed in either electrical or tape form. In electrical form, each level of the code combinations consists of either a current condition (referred to as a marking pulse) or no-current condition (spacing pulse). Figure 6-1.B is a graphical representation of a six-level code combination with alternate marking and spacing levels (0-2-4-). In addition to the intelligence pulses, each combination is accompanied by a feed pulse which actuates the feed mechanism of the Punch. The feed and code pulses of each combination are fed to the equipment on individual wires. In tape form the characters are represented by combinations of code holes. Each intelligence level consists of either a hole (corresponding to a marking pulse) or the absence of a hole (corresponding to a spacing pulse). The electrical combination of Figure 6-1.B is shown in tape form in Figure 6-1.C. Code and feed hole configurations for the different levels of tape are illustrated in Figure 6-1.D.

6-3. GENERAL OPERATION (Figure 6-7)

a. Figure 6-7 is a schematic diagram of the operation of the Punch Set. It illustrates the reception of five-level, electrical code combination 1-3-5 and its perforation in tape. It also illustrates the relative timing of the process. The operation as represented by the figure is described below.

b. A.c. power is fed to the Motor Unit through the motor switch. When the switch is On, the motor converts the electrical power into rotary mechanical motion which is delivered by the drive parts to the drive mechanism on the Punch Unit. The drive mechanism translates the motion from rotary to oscillating and distributes it to the perforating and feed mechanisms.

c. The basic motion of the Punch is oscillating, or simple harmonic. There are actually two sets of motions involved, those of the perforating mechanism and those of the feed mechanism. In Figure 6-8 the vertical motions of key parts of these mechanisms are plotted against the rotation of the main shaft in degrees. Top dead center (TDC) of the perforating mechanism
has been designated as $0^\circ$. As can be seen, the drive mechanism is so designed that the feed mechanism reaches TDC $45^\circ$ after the perforating mechanism.

d. An operation of the Punch may be thought of as measured from TDC of the perforating mechanism to TDC of the feed mechanism, a period of $405^\circ$ (Figures 6-7 and 6-8). This is the period required by the equipment to perforate a character and advance the tape if an electrical code combination has been received. As shown in the figures, the operations overlap each other by $45^\circ$.

e. Each operation the magnetic pickup, actuated by an iron insert in the fly wheel, sends out a synchronizing pulse whose function is to actuate the control circuits. The timing of this pulse is adjustable to a number of factors explained in Paragraph 6-5, below. If no intelligence is ready in the control circuits, no feed or code pulses are sent to the magnets, and the Punch undergoes an operation without perforating or feeding the tape.

f. On the other hand, if there is intelligence ready in the control circuits, a combination of code pulses and a feed pulse are applied
to the code magnets and feed magnet respectively. Under the control of the code magnets, the perforating mechanism punches code holes in the tape corresponding to the marking pulses received. In addition, the perforating mechanism automatically punches a feed hole with each code combination. As indicated in Figures 6-7 and 6-8, perforation occurs about midway through the operation following reception of the pulses.

g. The feed magnet, energized by the feed pulse, causes the feed mechanism to advance the tape late in the operation after perforation has been completed (Figures 6-7 and 6-8). As the Punch continues to cycle, it perforates a character each operation that the control circuits has one ready.

6-4. MOTION

a. MOTOR UNIT (Figure 6-10)

(1) Mechanical motion to operate the Set is ordinarily supplied by a synchronous Motor Unit. The motor is comprised of a two-pole, wound stator and a squirrel-cage rotor. The stator includes a main operating winding and a start winding connected in parallel (Figure 6-10). A 43-microfarad, electrolytic starting capacitor and the switch of a start relay are in series with the start winding, and the coil of the start relay and a thermal cutout switch are in series with the main operating winding.

(2) When the motor switch is closed, the initial surge of current energizes the start relay coil which closes the relay contacts. The magnetic flux produced by the main-operating and start windings causes the rotor to turn. As the rotor accelerates the current through the motor-start relay, main operating winding and thermal-cutout switch decreases; and at approximately 5.7 amperes the relay coil permits its contact to open and remove the start winding from the circuit. The rotor continues to accelerate until it reaches synchronous speed. The thermal-cutout switch is placed in the circuit to prevent damage that might be caused by an overload. Should the unit draw excessive current--because of a blocked rotor, for example--heat generated in the coils will cause the switch to open and remove power from the motor. The switch can be closed by pressing the red reset button that projects through the motor mounting plate (see caution note in Paragraph 1-4).

(3) A fan mounted at each end of the rotor within the frame draws cooling air through slots in the end bell and exhausts it through slots in the stator frame. Additional cooling is provided by a combination fan-handwheel mounted at the rear end of the shaft.

b. DRIVE PARTS (Figure 6-2) - The drive parts gear up the speed of the Motor Unit's rotary motion and transfer it to the main shaft of the Punch Unit. The drive parts are described in Paragraph 1-6.

c. DRIVE MECHANISM (Figure 6-2) - The drive mechanism translates the rotary motion of the drive parts to oscillating motion and distributes it to the perforating and feed mechanisms. Two portions of the main shaft are formed into cams. Through bearings and drive links, the forward cam causes the punch ball of the perforating mechanism to oscillate in simple harmonic motion as represented by the heavy solid line in Figure 6-8. The other cam causes a feed drive lever of the feed mechanism to oscillate as represented by the light solid line in Figure 6-8. The throws of the two cams are so related that the feed drive link reaches top dead center 45° after the punch ball does. The drive mechanism cycles and transfers motion to the feed and perforating mechanisms as long as the motor switch is ON.

6-5. SYNCHRONIZATION

a. GENERAL - Since the Punch cycles continuously, the feed and code pulses must be introduced at a specific time (within certain limits) to be properly processed by the Punch. To achieve synchronization between code pulse delivery and mechanical timing of the Punch, a flywheel and magnetic pickup system is utilized. Timing requirements are discussed in Paragraph 6-11, and illustrated in Figure 6-8.

b. FLYWHEEL AND MAGNETIC PICKUP SYSTEM - The flywheel and magnetic pickup arrangement used in the High Speed Tape Punch Set with a 60 point timing scale differs from that used in the set with a 160 point timing scale. Although the systems are similar in appearance and operation, they will be discussed separately.

(1) Sixty Point Timing Scale (Figures 6-3 and 3-21) - In this arrangement, the pick-up consists of a permanent magnet and coil (with an iron core), so arranged to create a permanent magnetic field about the pick-up. Each rotation of the main shaft, the iron insert on the periphery of the flywheel passes through and disturbs the field, inducing a voltage in the coil. The flywheel may be oriented in 60-degree steps with respect to the main shaft. This provides an option of six initial positions from
which various combinations of operating speed, magnets, and control-circuit delays may be accommodated. Fine adjustment of the pickup is made by means of the timing scale, which is adjustable 60 degrees.

(2) One Hundred Sixty Point Timing Scale (Figures 3-15 and 3-17) - The pick-up consists of a coil with an iron core, in this arrangement. Each rotation of the main shaft, a permanent magnet insert on the flywheel periphery passes by the coil. The magnetic field of the insert cuts across the coil windings and induces a voltage in the coil. The flywheel may be oriented in 90 degree steps with respect to the main shaft, allowing an option of four initial positions from which various combinations of operating speed, magnets, and control-circuit delays may be accommodated. Fine adjustment of the pickup is made by means of the timing scale, which is adjustable 160 degrees.

(3) Output Pulse - The voltage induced in the coil, due to the rapidly rotating insert,
produces a pulse which is applied to the control circuits (see Paragraph 1-7.d). The design of the control circuits must be such that the pulse will cause them to apply a feed pulse and release any code combination they have ready in storage.

6-6. TAPE PERFORATION (Figure 6-4)

a. The perforating mechanism is shown in Figure 6-4. For each level of the code there is a code magnet, armature, blocking pawl, toggle linkage, drive link and punch pin. In the idling condition --- i.e., motor running and no intelligence being received --- the armatures are held by their springs away from the magnet pole faces. This is referred to as their released (or spacing) position, and they, in turn, hold associated blocking pawls in their spacing position. As the drive mechanism cycles, it causes the punch ball and toggle linkages to oscillate as represented in Figure 6-8.

b. When the toggle linkages move down at the beginning of each idling operation, toggle extensions encounter the blocking pawls and cause the linkages to buckle at 51° of shaft rotation. Motion is imparted to the punch pins through the drag links, but not enough motion to drive them through the tape. Thus no code holes are perforated. The travel of the pins for spacing is represented by the heavy dotted line in Figure 6-8. Each operation the drive mechanism causes a feed hole toggle arm and drive link (having no associated magnet or buckling knee) to drive a feed hole punch pin through the tape. In the idling condition this pin moves up and down in the same hole.

c. When a code combination is received, the magnets and associated parts corresponding to the spacing levels of the code operate the same as described in the two previous paragraphs. For the marking levels of the combination, the
magnets are energized and pull their armatures to their attracted (or marking) position. The armatures, in turn, hold the blocking pawls in their marking position. The timing is such that the armatures reach their marking position before the end of the selection interval (320° to 40° of shaft rotation) illustrated in Figure 6-8.

d. As the toggle linkages move down at the beginning of the operation, the toggle extensions associated with the marking levels clear their blocking pawls, and the unbuckled linkages drive their pins through the tape and punch code holes. The motion of the pins for marking is represented by the solid heavy line in Figure 6-8. As can be seen, perforation occurs about midway through the operation between 140° and 220° of shaft rotation. Each time the tape is advanced (described in Paragraph 6-7 below), the feed hole punch pin perforates a feed hole with the combination of code holes.

6-7. TAPE FEEDING (Figure 6-5)

a. The tape feed mechanism is shown in Figure 6-5. It includes a magnet and toggle linkage similar to those of the perforating mechanism. In the idling condition the magnet is de-energized, and the armature and blocking pawl are held under spring tension in their spacing position. The drive mechanism, through the feed drive lever, causes the toggle linkage

![Figure 6-5. Tape Feeding Mechanism](image-url)
to oscillate. As the linkage moves down during the early part of each idling operation, it is buckled by the blocking pawl at 90° of shaft rotation (Figure 6-8). The linkage rotates a pivot arm which, in turn, lifts the feed pawl, but not enough to raise it above the next tooth on the feed wheel ratchet. The motion of the feed pawl for idling (or spacing) is represented by the light dotted line in Figure 6-8. In this condition the feed wheel is not rotated and the tape is not advanced.

b. When a code combination is received, a feed pulse is applied to the feed magnet which pulls the armature and blocking pawl into their marking position. The timing is such that the armature does not reach its fully released position before the end of the feed selection interval (Figure 6-8). As the toggle linkage moves down during the early part of the operation, the toggle extension clears the blocking pawl, the linkage remains in its unbuckled condition, and the feed pawl is lifted above the next tooth on the ratchet. When the linkage moves up during the latter part of the operation, it causes the pawl to act on the ratchet and rotate the feed wheel one tooth. Pins on the periphery of the wheel engage the feed holes and advance the tape one character. As shown in Figure 6-8, feeding occurs between 293° and 44° of shaft rotation.

c. Near the end of its downward travel, the pawl is engaged by a wedge block which prevents overtravel. Constant spacing of the code perforations is ensured by a detent with a roller that is held under spring pressure against the ratchet and secures the feed wheel and tape in position between feeding operations. Constant spacing of the perforations in relation to the edge of the tape is maintained by a biasing spring which holds the tape back against a reference surface on the block (Figure 3-7). The tape is fed into the punch block through a tape guide (Figure 3-5) and is held on the feed wheel by a spring-biased tape lid which may be raised to initially insert the tape.

6-8. MANUAL FEED OUT (Figure 3-21)

When the feed-out lever is manually depressed, it moves the feed-magnet armature and its blocking pawl to their marking position. As the Punch cycles, the feed mechanism operates as if the feed magnet were energized and tape is fed out continuously until the lever is released. The code magnets are de-energized and thus no code holes are perforated. Since the feed hole punch pin is driven through the tape every operation, a feed hole is perforated each time the tape is advanced.

6-9. TAPE REEL AND BRAKE MECHANISM (Figure 6-6)

The tape reel and brake mechanism on the Base provides a rotating reel for the tape roll and controls its rapid acceleration and deceleration during starting and stopping. When feeding starts, the abrupt pull of the tape on the tape guide pivots a brake and moves its friction surface away from the periphery of the reel. The "giving" action of the tape guide serves to dissipate the inertia of the stationary tape roll. During feeding the tape guide and brake keep the tape taut by alternately braking and releasing the reel. When feeding stops, the tape's pressure on the tape guide is released, and the reel is quickly braked to a stop to prevent excess tape from unwinding.

6-10. LOW TAPE MECHANISM (Figure 6-6)

The low-tape mechanism may be connected so as to actuate an external audible or visual alarm when the tape roll is near depletion. A low tape lever under spring tension rides on the tape roll. When the roll reaches a predetermined diameter, the lever closes the low tape contacts which will complete an alarm circuit. The lever serves a secondary purpose by holding any loose loops on the roll until they are taken up by the feeding operation.

6-11. TIMING (Figure 6-8)

a. GENERAL. The mechanical and electrical conditions outlined below and illustrated in Figure 6-8 are those recommended for normal operation and may be varied experimentally in specific applications. Additional information may be obtained by contacting the Teletype Product Sales Department. The timing of the Punch is based on the top dead center position (TDC) of the perforating mechanism (or the punch bail) which is designated as 0 degrees of shaft rotation and 0 time in milliseconds.

b. MECHANICAL

(1) The feed and code selection intervals are represented by bars (a) and (b) in Figure 6-8. As illustrated by the insert in Figure 6-8, the selection interval is that period during any operation when the feed or code toggle extension is above the blocking surface of the blocking pawl. When a feed or code pulse is applied to a magnet, the associated blocking pawl (operated by the armature) must be in its marking position (i.e., out of the way of the toggle extension) at the end of the selection interval for
the tape to be advanced or perforated. The feed mechanism operates 45° after the perforating mechanism to allow perforation to be completed before the tape is advanced.

(2) The code selection interval for any given operation (e.g., the second operation in Figure 6-8) extends from 40° before to 40° after TDC of the perforating mechanism (bar (a) of Figure 6-8). The feed selection interval extends from 0° to 90° after TDC of the perforating mechanism (bar (b)). For simultaneous feed and code pulses — i.e., the feed and all code pulses start and end at the same time — the feed and code magnet armatures should reach their fully attracted position before the end of the code selection interval, and should not reach their fully-released position until after the end of the feed selection interval.

c. ELECTRICAL

(1) To meet the mechanical requirements in Paragraph 6-11.b.(2) above for operating speed of 110 ops, 4.5-millisecond feed and code pulses should start between 390.0° (9.75 ms) and 100.0° (2.50 ms) before TDC of the perforating mechanism (bar (c)). A typical 4.5 ms feed or code pulse for 110 ops is represented by the shaded portion of bar (d). It begins at 120.0° (3.00 ms) before and ends at 60.0° (1.50 ms) after TDC of the perforating mechanism. Since the armature fully attracted time is 3.00 ms (120.0°), the armature is fully attracted at 0.0° (0.00 ms) TDC. The armature fully released time is 8.00 ms (320.0°) and is fully released at 380.0° (9.50 ms) after TDC of the perforating mechanism.

(2) To meet the mechanical requirements for operating speed of 63.3 ops, 4.5-millisecond feed and code pulses should start between 180.0° (7.82 ms) and 50.0° (2.17 ms) before TDC of the punch ball (bar (e)). A typical 4.5 ms feed or code pulse for 63.3 ops is depicted by the shaded portion of bar (f). It begins at 80.0° (3.48 ms) before and ends at 23.6° (1.02 ms) after TDC of the perforating mecha-
anism. Since the armature fully attracted time is 3.00 ms (69.1°), the armature is fully-attracted at 10.9° (0.47 ms) before TDC. The armature fully released time is 8.00 ms (184.2°) and is fully released 207.8° (9.02 ms) after TDC of the perforating mechanism.

(3) Instructions for orienting the fly-wheel of Punches for various speeds are given in Figures 3-15, 3-18, and 3-19.

6-12. EARLY-DESIGN PUNCHES (Figure 6-9)

a. The early-design Punch operates on 115 volts d.c. with sufficient series resistance to maintain a magnet operating current of 25 milliamperes d.c.

b. It should operate normally under the following conditions:

(1) For each marking code pulse received, a code magnet armature should reach the fully attracted position between 90° before and 20° after the top dead center position (TDC) of the punch ball. The feed magnet armature should reach the fully attracted position between 47° before and 70° after TDC of the punch ball. The code magnet armature should be held in the fully attracted position until 60° after TDC of the punch ball. The feed magnet armature should be held in the fully attracted position until 110° after TDC of the punch ball.

(2) For each spacing code pulse received, the feed magnet armature should reach the fully released position between 250° before and 70° after TDC of the punch ball. The code magnet armatures should reach the fully released position between 300° before and 20° after TDC of the punch ball.

c. The code magnets fully attract their armatures between 6 and 8 milliseconds after being energized from a 115 volt d.c. power supply with series resistors limiting the operating current to 25 milliamperes. The code magnet armatures are fully released within 6 milliseconds after opening this circuit.

d. The feed magnet fully attracts its armature between 8 and 10 milliseconds after being energized from a 115 volt d.c. power supply with series resistors limiting the operating current to 25 milliamperes. The feed magnet armature is fully released within 4 milliseconds after opening this circuit.

NOTE

The operation of all magnet armatures is largely dependent upon the circuitry of the auxiliary apparatus: The values in Paragraphs c and d above can be varied experimentally for specific applications.

e. When operating the Punch under the conditions described in Paragraphs c and d at 3600 rpm, and applying voltage simultaneously to (energizing) the feed magnet and any or all code magnets, the code and feed magnets should be energized between 140° (8 ms before 313°) and 207° (8 ms before 380°) of the operating cycle. The magnets should be de-energized between 110° and 250° (6 ms before 380°) of the operating cycle. The 110° applies to all punch speeds. The values given in milliseconds apply to all punch speeds if the voltage and current conditions remain the same as indicated in Sub-paragraphs c. and d. above. See Figure 6-9 for the timing diagram of required mechanical results.

f. The synchronizing pulses are provided by two contactors, each having a set of (make before break) two pairs of contacts. The timing of the make-break point of one contact set (No. 2 contactor) is adjustable throughout a range of 225° of the operating cycle. The timing of the make-break point of the other contact set (No. 1 contactor) is adjustable throughout a range of 170° with respect to a fixed position of the No. 2 contactor set (Figures 3-32 and 3-33).
NOTE
FOR SPATIAL RELATIONSHIP OF MECHANISMS, SEE FIGURES 1-1 THRU 1-4
Figure 6-7, Schematic Diagram of Punch Operation
Under rated conditions, armatures fully attracted 3 ms after magnets energized, and fully released 8 ms after magnets de-energized.

For simultaneous feed and code pulses, armatures should be fully attracted before end of code selection interval and should not be fully released before end feed selection interval.

See paragraph 6-11.

Figure 6-8. Timing Diagram (Late Design)
Figure 6-9. Timing Diagram (Early Design)
FOR 8-LEVEL CODE USE ALL MAGNETS AND ASSOCIATED RESISTORS AND DIODES.
FOR 7-LEVEL CODE OMIT MAGNET NO. 7 AND ASSOCIATED RESISTOR AND DIODE.
FOR 6-LEVEL CODE OMIT MAGNETS NO. 7 & 6 AND ASSOCIATED RESISTORS AND DIODES.
FOR 5-LEVEL CODE OMIT MAGNETS NO. 0, 7 & 6 AND ASSOCIATED RESISTORS AND DIODES.

Figure 6-10. Schematic Wiring Diagram: Typical Tape Punch Set