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A CONSOLIDATED ANALOG DIGITAL RECORDER

TROUBLE-SHOOTING CHECKLIST FOR

FIELD AND OFFICE USE

By

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INTRODUCTION

This manual is divided into two parts; Part I is a Trouble-Shooting Checklist and Part II relates to Disassembly and Assembly Procedures for ADR (Analog Digital Recorder) and Clock. The manual is intended to aid the fieldman in determining and correcting malfunctions. Many repairs and replacements of parts can be made in the field, eliminating the need for removing the ADR from the installation. The exceptions to this are noted in the remedy column of the checklist. It is assumed that the fieldman has at his disposal the equipment needed to make the necessary corrections. The feasibility of field repairs will depend on the fieldman's mechanical ability, availability of parts, proximity to spare ADR's, and possible loss of critical record due to prolonged instrument shutdown.

Part II gives a detailed description of the removal and installation procedures for ADR parts and the Chelsea clock. Throughout the text are references to page numbers and keys which direct the reader to accompanying drawings. There is a brief description of clock parts.

The information herein was compiled from ADR manuals by Fischer & Porter Co., seminars held by technical representatives of Fischer & Porter, suggestions and criticisms from coworkers throughout the California WRD, and my own experience with the equipment. Illustrations for the appendix were selected from the Parts List for Punched Tape Recorders by Fischer & Porter and inserted into the manual.

PART I TROUBLE-SHOOTING CHECKLIST

MALFUNCTION	TROUBLE SHOOTING	REMEDY
Clock stopped	1. Check battery.	Replace battery if lower than 6 volts.
	2. Check leads to battery for polarity, looseness, and breaks.	Tighten leads. Repair leads.
	3. Connect battery. Short between holes #2 and #4 on cannon plug from clock. Rotate clock timer cam. Wind motor should run when on low portion of cam. Short between holes #3 and #4 and rotate cam. Motor should run when on high portion of cam.	Replace clock if wind motor does not run. Note: This check procedure is a good method by which to wind clock. Let motor run approximately one minute for full wind.
	4. Check clock cam for excessive drag from cam switch actuating arm.	If drag is sufficient to slow or stop clock, bend arm or adjust switch mount until drag is at minimum. Rotate cam to check for full switching cycle. Replace clock if above procedure does not correct the malfunction.
	5. Check clock movement after clock has been sufficiently wound.	If slow or erratic, replace clock.
ADR and clock wind motor run continuously	1. Check ADR wiring as per wiring diagram (p. 8). Check motor switch for proper alignment or broken contacts. Check clock as per #3 above.	Replace switch. If no apparent solution exists, remove ADR. If clock does not perform as indicated in #3 above, replace clock.
ADR does not cycle	1. If manual punchout cycles ADR, proceed directly to diode checks in step 3.	

MALFUNCTION	TROUBLE SHOOTING	REMEDY
ADR does not cycle--cont.	2. Check clock lead, plug, and ADR connector for breaks, bent pins, or dirty contacts. Check for proper voltages at plug. Timer Cam / Pin # / Voltages Low — 4 to 2 — 6+ V High — 4 to 3 — 6+ V	Repair or replace defective unit.
	3. Check diodes for looseness in connections or breakage.	Tighten if loose, or replace diode if broken. All diodes except the one between "+" and "A" can be bypassed with a piece of wire. CAUTION: Battery polarity must be strictly observed.
	4. Check wiring for loose connections and/or proper connections as per wiring diagram (p. 8).	Tighten or repair connections.
	5. Check voltages at terminal board on back of ADR (TB2 on wiring diagram, p. 8). Slowly rotate timer cam observing these voltages. Timer Cam / Terminal / Voltage High — 5 to 2 — 6+ V Low — 5 to 4 — 6+ V If voltage is not present, wiring or connector is defective.	Repair or replace wiring harness.
	6. Check voltages at terminal board below motor. Rotate timer cam slowly. Timer Cam / Terminal / Voltage High — "-" to R1 — 6+ V Low — "-" to B — 6+ V	Repair wiring.

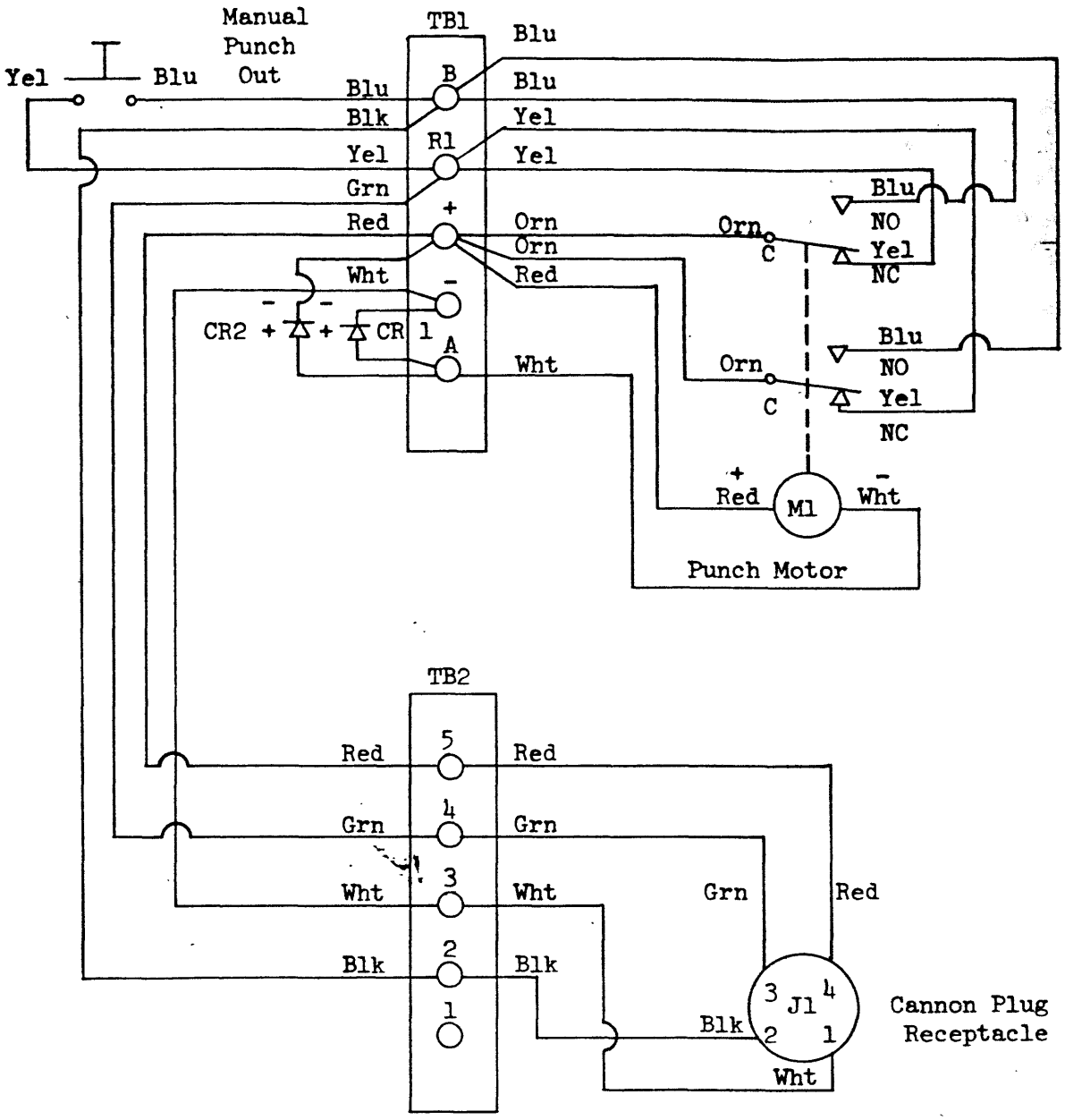
MALFUNCTION	TROUBLE SHOOTING	REMEDY
ADR does not cycle--cont.	If voltage is not present, wiring is defective between TB1 and TB2.	
	7. Check battery for correct polarity before proceeding. Short "-" to "A." Rotate clock cam. If ADR runs, diode between "-" and "A" is defective (CR1, p. 8).	Replace diode or bypass diode temporarily with wire.
	8. Remove diode between "+" and "A." Attempt to cycle ADR. If ADR runs, diode is defective. If ADR does not run, reconnect diode (CR2, p. 8).	Replace with good diode or leave diode out as a temporary measure. CAUTION: DO NOT bypass with wire.
	9. Check voltage between "+" and "A" on TB1. Rotate clock cam slowly. Six volts should register at both the high and low portions of cam when ADR motor is running. If voltage does not register at both portions, check punch motor switch for broken leads and/or misalignment of switch.	Repair or replace switch.
	10. Check punch motor leads for breaks. Remove motor from mount and rotate clock cam slowly. If motor runs, proceed to step 12. If motor does not run, motor is defective. (Check for defective motor by removing motor from ADR. Place red lead to "+" and white to "-" on battery. If motor runs, motor is not defective.) Replace in ADR making sure all connections are good.	Repair or replace motor.

MALFUNCTION	TROUBLE SHOOTING	REMEDY
ADR does not cycle--cont.	11. If motor runs while hooked up to programming shaft but does not turn shaft, internal gearing is probably stripped.	Replace motor.
	12. Programming shaft is jammed. (Major dismantling process is involved.)	Remove ADR.
ADR stopped in cycle	1. Check punch arm tension nut for possibility of catching on flange on front mounting plate.	Replace spring. If none available, stop ADR in cycle when punch arm is forward and adjust tension on spring until the screw, spring, and nut do not move about freely. Do not tighten excessively and replace spring as soon as possible.
Tape jammed in punch and die block	1. Check for bent pins.	Disassemble punch arm assembly to straighten or replace pins. CAUTION: If wired for BDT interrogation, DO NOT remove punch die block. Also, before removing pins, observe special location of BDT parts.
	2. Check for loose or maladjusted retractor plate.	Adjust properly.
	3. Check for chad between punch and die holder. (Usually caused by ripped tape or punch arm spring and bolt not adjusted properly.)	Remove chad using thin piece of plastic or similar device. Loosen lock nut until pins will not penetrate paper. Tighten until pins punch paper cleanly. Tighten 1-1/2 turns further.
Paper bunched on lower front or top of ADR	1. Check for jammed die and punch holder.	See above.
	2. Check take-up spool and drive spring for proper functioning.	Repair or replace spool or spring.

MALFUNCTION	TROUBLE SHOOTING	REMEDY
Paper stopped. Large guide holes stripped at sprocket.	1. Check paper supply spool for friction or jamming.	Repair or replace spool.
Paper will not advance	1. Check paper tape advancement pawl and spring for proper adjustment and operation.	Repair or replace spring.
Punch holes miss time lines entirely		Adjust paper tape advancement pawl until holes nearly centered on lines. (Trial and error procedures.)
Spacing of holes erratic	1. Check paper tape advancement pawl for looseness at screws and at the program shaft. If loose at program shaft, tighten by pressing retaining clip against pawl for minimum sideways movement of pawl at sprocket. If functioning properly, paper tape drive sprocket is probably defective.	Tighten pawl. If pawl is functioning properly, remove ADR.
Spacing of holes too close	1. Paper tape advancement pawl is maladjusted.	Adjust pawl.
ADR cycle time exceeds 15 sec.	1. Listen to motor while cycling and observe rate of rotation of shaft. Then remove motor from mount leaving leads hooked up. Cycle ADR.	If motor runs at same rate as when connected to programming shaft, motor is defective. Replace motor. If motor runs at a much faster rate, excessive friction exists in programming cam assembly. Remove ADR.

Special note regarding ADR installations with manometers (bubble gages) in reference to manometer cutoff relay in ADR

MALFUNCTION	TROUBLE SHOOTING	REMEDY
Manometer does not run when ADR is off	1. Check by hooking manometer directly to battery.	If manometer operates properly, check wiring and relay. Replace relay.
Chain broken off gears. Broken or stripped input shaft assemblies.	1. Disconnect chain. Check by running manometer by the up or down buttons and cycling the ADR. If manometer shuts off during ADR cycle, relay is not defective.	If manometer does not shut off, check wiring for bad connections. Replace relay if it is the cause. DO NOT OPERATE ADR AND MANOMETER TOGETHER UNLESS THIS CIRCUIT FUNCTIONS PROPERLY.



ADR WIRING DIAGRAM

Note: This diagram is drawn according to the 4-pin modification instructions issued by the U.S. Geological Survey. ADR's wired at the factory for 4-pin modification do not follow the color coding and wiring diagram as shown above; pin #4 goes directly to "+" on TB1. Observe the color coding at plug to determine deviation from diagram.

PART II DISASSEMBLY AND ASSEMBLY PROCEDURES FOR ADR AND CLOCK

To remove clock parts:

1. Remove glass inspection plate on front of clock.
2. Remove three bevel screws from front of clock.
3. Remove cover leaving rubber seal on cover.
4. Remove two screws holding wind motor at the back of the clock and pull out motor.
5. Remove three large screws and one flush screw from back of clock.

   A small soldering gun or iron is sufficient to remove all soldered connections.

To install clock parts:

Reverse the preceding operations observing the following points.

Check timer cam switch. It should actuate the short part of the cycle 2-5 minutes before punching. Adjust if different. Check to see that the switch arm clears the switch case when cam is at the high point. If it hits the case, adjust.

To remove paper tape assembly:

1. Cut tape and remove used tape from take-up spool.
2. Remove take-up spool, leaving take-up spring around cam.
3. Remove tape guide below take-up spool.
4. Remove tape from paper drive sprocket.
5. Remove supply roll spool.
6. Remove paper tape assembly bracket.

To install paper tape assembly:

Reverse the preceding operations. All screws should be firmly tightened.

To remove punch arm assembly (p. 30, 32):

1. Remove paper-tape assembly to Step 5.

2. Tear off 6 inches of unused tape from supply roll and insert between punch and die holder.

3. Remove punch arm spring and bolt.

4. Loosen the three retractor plate screws (p. 30).

5. Lift retractor plate to clear shoulders of punches. On some recorders the retractor plate may have to be removed. To straighten a bent punch pin on regular recorders: The bent pin can now be manually straightened without removing the pin from the punch block. The pin is straightened by bending the pin slightly in the block until the pin moves freely in the hole. If it is necessary to remove the pin from the block the retainer plate may have to be entirely removed to provide adequate clearance to remove the pin. Replace punch pin if required. DO NOT USE pliers to straighten bent punch pins.

   To straighten a bent punch pin on telekit recorders (p. 11): Release the tension exerted by the contact arm on the punch pin that is to be replaced. Also release the tension on the contact arms that cover the binding head screws that hold the printed circuit assembly and retainer plate in place (On older model telekit recorders the printed circuit assembly also acts as the punch pin retainer plate while on the newer model telekit recorders the retainer plate is a separate piece.).

   Loosen the binding head screws that hold either the printed circuit assembly or the retainer plate in place. Move the printed circuit board or retainer plate slightly to allow for either the removal of the broken punch pin or straightening a bent pin.

   a. To remove punch, take out retainer plate screws on back of punch holder.

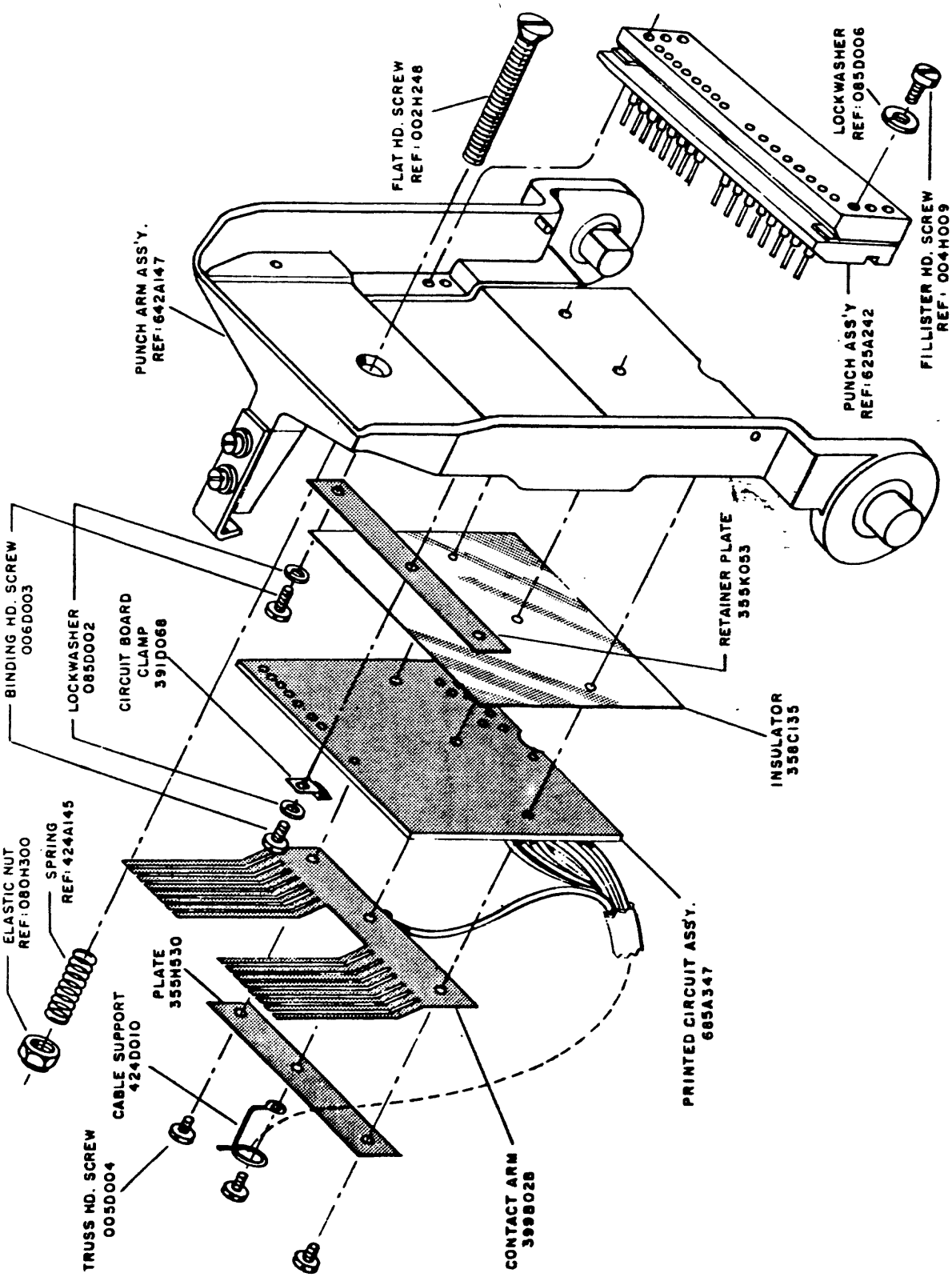
   b. To remove die and punch holder blocks, remove four Allen screws at the front of the die block.

6. Remove Allen screws at front of bearing blocks for paper drive sprocket. CAUTION: Allen screws will strip!

7. Remove punch arm shafts from bearing blocks.

8. To remove cam follower bracket, remove two screws.

FIGURE 2



PUNCH ARM ASSEMBLY

To install punch arm assembly:

Reverse the preceding operations. Observe the following points at the noted operations.

7, 6. Center the punch arm spring evenly with the retractor plate. Adjust and tighten the paper drive sprocket bearing blocks to allow .010" end play. The punch arm should pivot freely and the paper drive sprocket must rotate 360° without excessive drag.

5a. On regular recorder adjust the retainer plate so that the plate is approximately .005 inch from the milled flats on the punch pins. Tighten the retainer plate in place. Check that all punch pins are captured in the milled cut-out area on the pins and that the retainer plate is not being forced or bent by the punch pins.

On telekit recorders proceed as above except that on the older telekit recorders the printed circuit assembly acts as the retainer plate. Replace the tension exerted by the contact arm on each of the punch pins. The contact arms can be moved laterally and depressed so that they clear the ridge on the punch pin and then released in place.

5. Set punch arm actuating cam so that the cam follower is at the lowest part of the cam. Adjust the extension for 1/32" clearance between roller and cam when the punch arm is against the stop. Set both code discs at 9999 and set cam at lowest position. Align the pins so they hit the middle of the hills on the high order disc. For punch penetration, move arm in until punches are against paper; then push in manually. The distance moved is noted and should exceed .015". Adjust the expension correspondingly to correct any deficiency of the punch penetration.

4. Manually retract all punches to the stop and install, or lower if already installed, the retractor plate, being sure that all punch retractor lugs are behind it. Then slowly pull arm forward, allowing plate to ride loosely on punches, until motion is stopped by plate. Holding arm in this position, tighten retractor plate screws. This should establish the proper clearance when arm is again against stop.

3. Set code disc at 7777. Increase spring pressure until clean holes are punched. Then increase spring pressure 1-1/2 turns of the nut. CAUTION: If spring pressure is too great, program shaft may become blocked and gear train in drive motor will strip.

To remove retractor plate assembly (p. 26):

1. Remove punch arm assembly to step 5.

2. Remove retractor plate.

3. Remove retractor support plate (two screws).

To install retractor plate assembly:

Reverse preceding operations. Observe the following points at the noted operations.

3. Make sure plastic stop is in the proper position.

2. The washer arrangement is: the flat washer against retractor plate; then the lock washer against the screw head.

To remove high-order code disc (p. 26):

1. Remove retractor plate assembly.

2. Loosen pointer screw and rotate pointer downward.

3. Loosen two Allen screws in collar at front of disc.

4. Remove collar.

5. Remove high-order disc.

6. Remove the shaft.

To install high-order code disc:

Reverse the preceding operations. Observe the following points at the noted operation.

3. Test for positioning of high-order disc with low-order disc. Rotate programming cam until locking lever is at the low point. Remove locking lever spring (p. 24, Key 23). Set the low-order disc at "99" by lifting locking lever, rotate the disc, and then lower the lever. "99" position on the low-order disc is lowest position of synchronizing cam. Unmesh high-order disc from level gear (p. 24, Key 36) and rotate to "0" position, remesh.* Push rocker arm forward. Raise punch arm so that the pins rest on the ridges (hills). If the punches (80, 10, 8, 1) are in the center of the ridges, tighten collar allowing .003" of end play. If not, determine which of the following apply and follow the corresponding instructions.

To install high-order code disc--cont.

a. Pins do not hit proper ridges or miss completely. Unmesh high-order disc and rotate 1/2 a digit toward the proper position. Remesh and repeat test starting at the asterisk (*).

b. Pins do not hit in center of proper ridges. Unmesh high-order disc, do not rotate, lift locking lever, and rotate low-order disc one full turn to the right. Lower locking lever, remesh high-order disc, and repeat test starting at the asterisk (*).

To remove input shaft, gearing, and locking lever assembly (p. 24):

1. Remove paper tape assembly.

2. Remove pinion gear (Key 34) by loosening two Allen screws, sliding shaft to the right, and disengaging worm wheel (Key 33) from worm gear (Key 29).

3. Remove locking lever torsion and tension spring (Key 21 and 23).

4. Remove screws (four) holding locking lever and gearing case (Key 1).

5. Loosen collar (Key 6) on input shaft at back side of locking lever and gearing case.

6. Lift locking lever to clear plate and slide the case backwards on input shaft.

7. Remove bevel and spur gear by removing external grip ring and washer. Remove bevel gear collar (on newer models).

8. Remove worm wheel (Key 33) and shaft by loosening two Allen screws on worm wheel and sliding shaft out to right.

9. Remove rocker arm by loosening nut on right side of case. Take off tape guide shaft by unscrewing. Loosen Allen screw on guide roller between the pivots and pull shaft out to the right. Remove input shaft (see following operations).

10. Remove locking lever, slide pivot pin to the right noting position of spring. (This may be removed by only steps 4 through 10.)

Remove input shaft (following steps):

11. Remove nut on back side of drive pully assembly.

12. Remove flange by unscrewing (p. 24, Key 10).

13. Remove spring washer.

To remove input shaft, gearing, and locking lever assembly--cont.

14. Remove drive pully assembly.

15. Remove hub by loosening two Allen screws.

16. Remove external ring and washer holding worm gear spring. CAUTION: May fly off when removing.

17. Slide worm gear forward and remove groove pin in input shaft.

18. Slide input shaft forward and slide off locking lever case, worm gear, and spring.

19. Remove lock lever guide, two screws (p. 26, Key 45).

20. Remove bearings--mounting plate bearing slides forward, locking lever case bearing slide backwards. To remove back plate bearing, remove three screws on back side of plate.

To install input shaft, gearing, and locking lever assembly:

Reverse the preceding operations observing the following points at the noted operations.

15. Make sure the hub clears the screws and washers when shaft is rotated.

5. Do Step 4 first, then adjust collar so that the low-order disc has about .003" end play. Check for full free rotation of input shaft. Should not have excessive drag. If excessive drag is present, remove drive pully assembly (steps 11 to 15) and loosen the screws holding back plate bearing. Shift position of bearing until minimum drag is obtained. At the same time check other bearings for proper seating.

2. Adjust locking lever stop so that the heel clears the detent wheel by 1/32".

After completing this step, go to the high-order code disc removal procedure and do steps 1 and 3. Then follow installing operations and adjustments.

To remove programming cam shaft assembly (p. 30):

1. Remove paper tape bracket assembly.

2. Remove punch arm assembly to Step 5.

3. Release locking lever torsion spring.

4. Remove punch motor bracket (2 screws).

5. Remove programming cam shaft bearing blocks.

6. Remove sections of cam off of hex shaft. CAUTION: Make note of orientation. For paper tape advancement lever cam, remove external grip ring.

To install programming cam shaft assembly:

Reverse the preceding operations observing the following points at the noted operations.

6. Line up moulded ridges on paper tape advancement, punch arm actuating, and code disc locking cams. On the advance and punch cams, the ridge is to the right of the cams. The code disc locking cam ridge is at the low position of the cam. The hex shaft pin and stamped mark should be in line (12:00) and the ridges at 2:00 looking from the motor end.

5. Align bearing blocks so that the cam shaft rotates freely through 360°.

4. Rotate the cam shaft until the motor switch falls into the cam valley. Shut off power. Depress the switch until it "clicks." Allow it to return until the switch clicks again. The distance between the switch and the cam should be approximately 1/32 inch. Reapply power.

Advance the cam shaft until the high position of the cam shuts off the motor. Re-energize the motor with the timer and note that the switch moves downward approximately 1/32 inch. Adjust accordingly if the requirements are not met.

After completing step 1, see the following page for positioning sequence of programming cam shaft.

Table 1.-- COMPLETE SEQUENCE OF EVENTS IN ADR AND CLOCK DURING A FULL CYCLE

	Clock timer cam	Clock cam switch	Punch motor	Punch motor cam	Paper advance cam ridge (from left side)	Paper tape advance lever	Punch arm	Punch arm cam	Locking lever cam	Locking lever	Low order disc
Before advance cycle	Low	NC[1]	Stopped	Low	2 o'clock	½ down	Out	High	High	Up back	Free
Advance cycle (cock)	5-2 min. before punch	NO[2]	Stopped	Middle	1	Down	Out	High	High	Up back	Free
Punch cycle	Drop to low	NC	Running	High	11	Start up	Out	High	Start to low	Down back	Locked
Punch cycle	Low	NC	Running	High	10	¼ up	Out	High	Low	Down forward	Locked
Punch cycle	Low	NC	Running	High	9	½ up	In	Low	Low	Down forward	Locked
Punch cycle	Low	NC	Running	High	8	3/4 up	Start out	Middle	Low	Down forward	Locked
Punch cycle	Low	NC	Running	High	6	Snapped to next notch	Finish out	Near high	Start high	Down forward	Locked
Punch cycle	Low	NC	Running	High	4	Starting down	Out	High	Near high	Down back	Locked
Punch cycle	Low	NC	Running	High	3	¼ down	Out	High	High	Up back	Free
Punch cycle	Low	NC	Stopped	Low	2	½ down	Out	High	High	Up back	Free

[1] Normally closed
[2] Normally open

The ADR can be stopped at any point during the punch cycle sequence, as follows:

1. Clock, ADR, and battery connected normally.
2. Remove red lead from "+" terminal of battery.
3. Push and hold manual punch-out switch on ADR.
4. Touch red lead to "+" terminal of battery.
5. Remove red lead when desired point in sequence is reached.

To remove paper drive sprocket assembly (p. 30):

1. Remove punch arm assembly. Don't do steps 5a, 5b, and 8.

2. Remove tape retainer spring and advance lever tension spring.

3. Remove sprocket supports (note position of fiberboard washers and spring). For removal of sprocket, remove only one support.

To install paper drive sprocket assembly:

Reverse preceding operations, observing the following point at the noted operation.

3. Sprocket should easily turn through 360°. Also, at this point install the punch arm pivots and arm (steps 7 and 6) and check for end play. Then proceed according to the above instructions.

APPENDIX

APPENDIX

Chelsea Clock Parts

Glass inspection plate--Located on the front of the clock.

Clock cover--Enclosure for clock works. Cover is held by three screws at 1030, 0130, and 0430.

Clock stand--Brass plate bent at 90° angle. Clock works are mounted on the front side, and the wind motor is mounted on the back side.

Clock works--Mounted on front of clock stand by four screws in the upper right corner, upper left corner, lower left corner, and under wind motor.*

Wind motor--Winds main spring at each position of timer cam switch. The wind motor is mounted on back of clock stand with two screws, right and left side. Two wires (red, white) lead from it via left hole below wind motor at the lower left corner of stand into the clock interior.

Clock timer cam--Located on center front of clock works and attached by knurled plastic knob.

Clock timer switch--Located in lower left front corner. Metal spring arm riding on clock timer cam activates the switch. From left to right, terminals read "NC," "C," "NO."

Fast-slow adjust--Located on upper right front plate of clock works. Move knurled wheel to right (F) to speed up clock and to left (S) to slow down clock. A change of one knurl is equal to approximately 4 (four) seconds per 24 hours, or 2 (two) minutes per month.

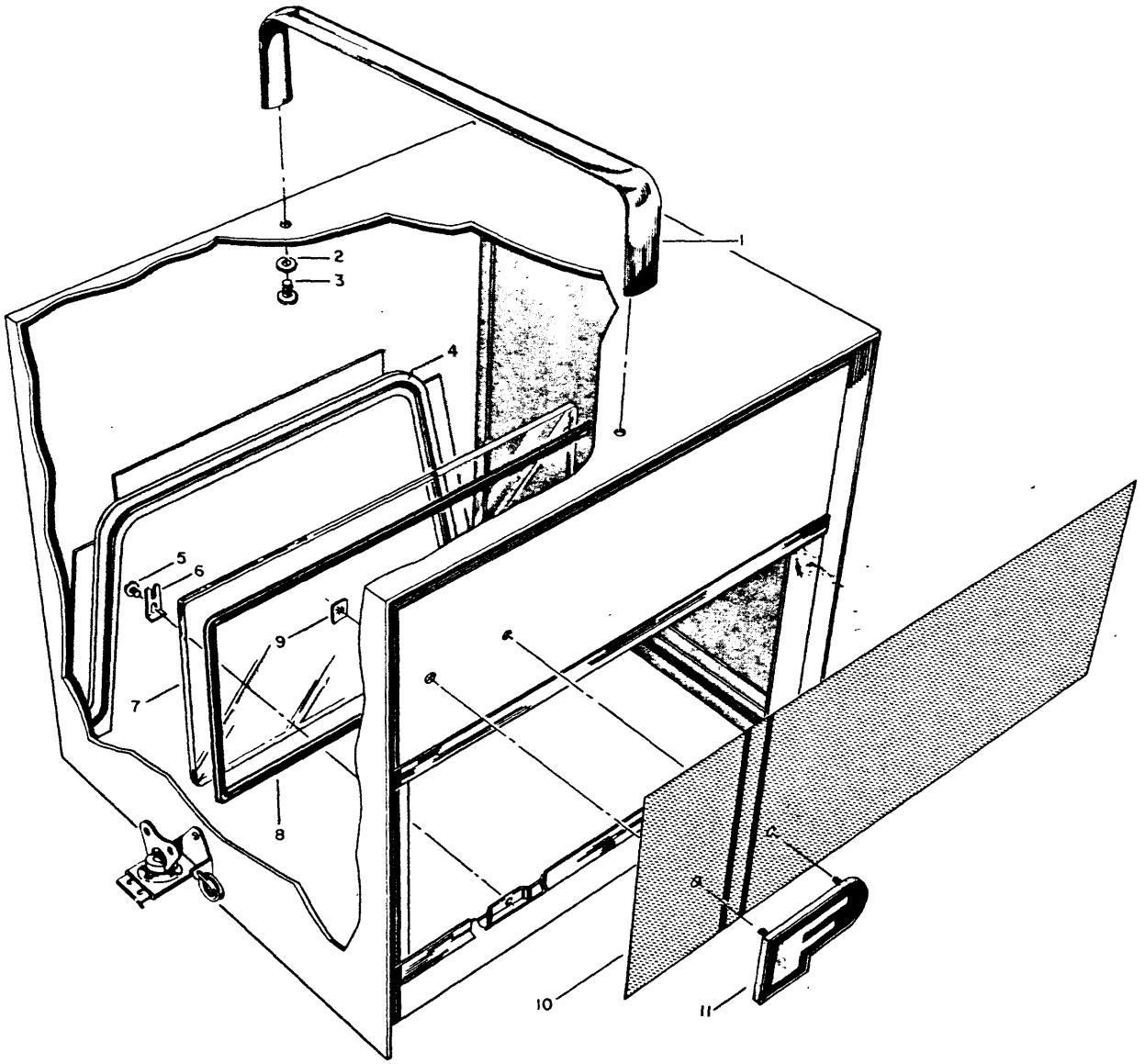
Terminal strip--Mounted on front, lower left corner of clock stand by two screw. Terminals are numbered from left to right as "1" to "5."

Wiring harness to ADR--With Cannon plug, leaves clock via right-hand hole below wind motor.

Wiring harness to battery--Leaves clock via left-hand hole below wind motor. Has two leads, red (+) and black (-).

Diode--Connected to terminals number $3^{(+)}$ and $4^{(-)}$. This is a one-way device to prevent any voltage reaching the wind motor if the battery is hooked up backwards.

*All left and right positions are as the clock faces the operator.



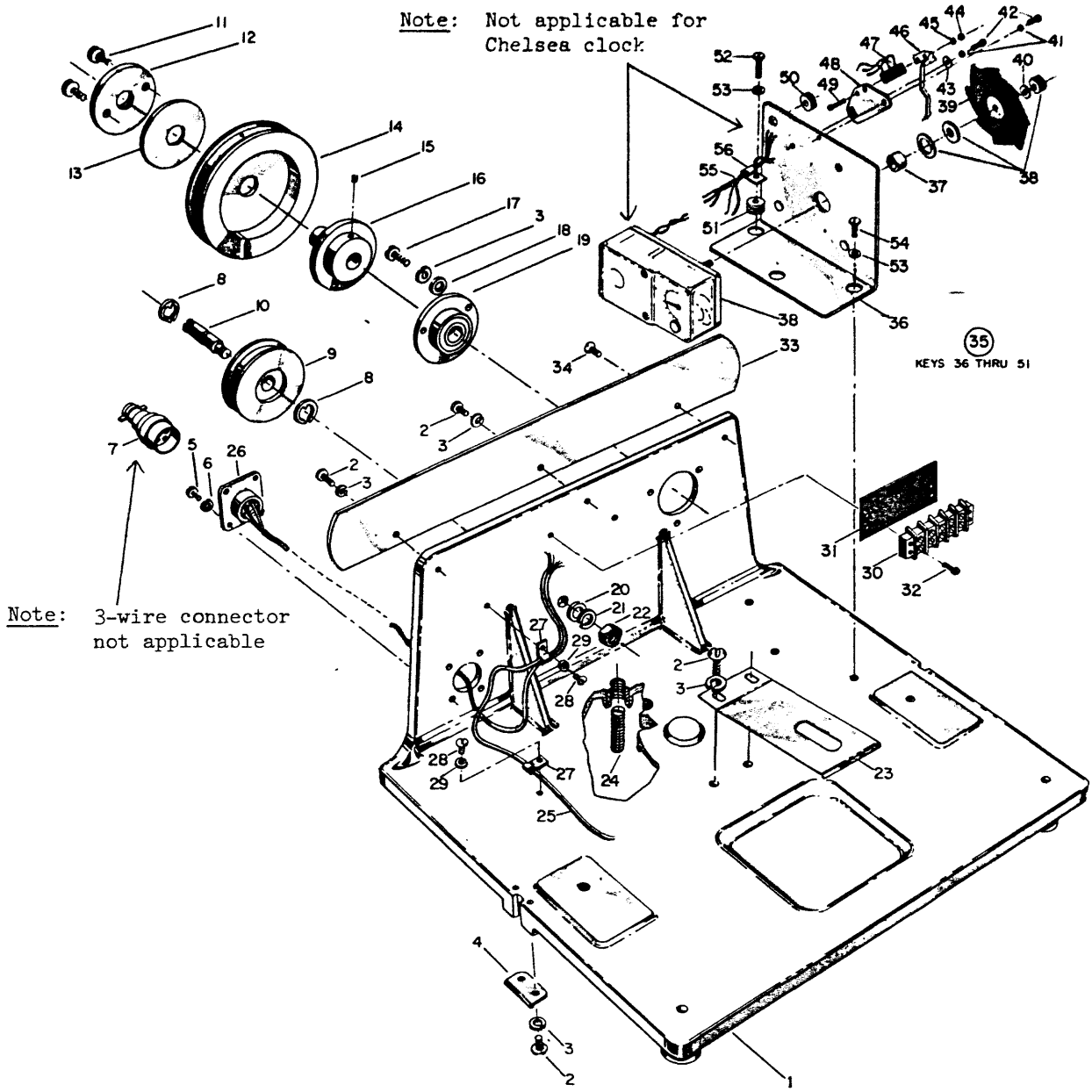
STANDARD CASE ASSEMBLY

SERIES 1542 & 1544

KEY	QUANTITY	PART DESCRIPTION	PART NUMBER
	1	COMPLETE ASSEMBLY	612A176X99
1	1	HANDLE	124D025
2	2	WASHER, Lock #10	085D010S31
3	2	SCREW, Bind Hd #10-32 x 1/2"	006L008T30
4	1	PACKING, Strip Rubber	116A001
5	6	SCREW, Bind Hd #6-32 x 3/16"	006H003T30
6	6	CLIP, Window Retaining	390A004
7	1	*WINDOW	332A060
8	1	*GASKET, Window	333E073
9	2	NUT, Speed	106D009
10	1	PLATE, Face	324A145
11	1	MONOGRAM	338A031

*INDICATES RECOMMENDED SPARE PARTS

REF.: BM-15 1012



BASE ASSEMBLY STANDARD CASE

SERIES 1542

KEY	QUANTITY	PART DESCRIPTION	PART NUMBER
1	1	BASE w/o Telemetering w/Telemetering	355A162 355A182
2	8	SCREW, Bind Hd #10-32 x 3/8"	006L006T30
3	11	WASHER, Lock #10	085D010S31
4	2	KEEPER, Latch	353B325
5	4	SCREW, Fill Hd #4-40 x 3/8"	004F006T30
6	4	WASHER, Lock #4	085D004T30
7	1	CONNECTOR	172F240U01
8	2	RING, Retaining	106A111
9	1	PULLEY, Idler	655A512
10	1	SHAFT, Pulley	395D024
11	2	SCREW, Thumb #10-32 x 13/16"	396B019
12	1	FLANGE	363B075
13	1	WASHER, Flat	377B002

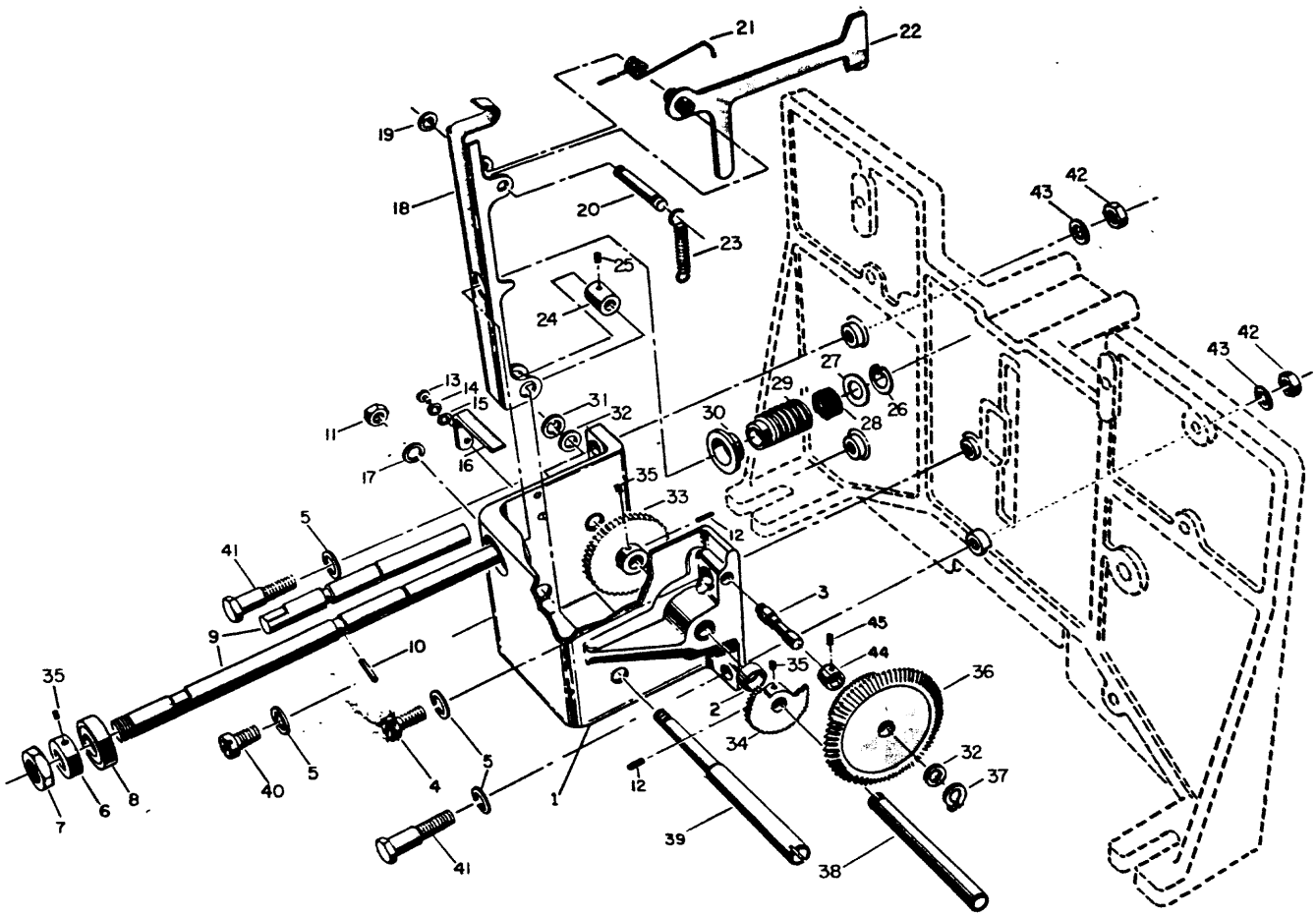
BASE ASSEMBLY (Continued)

KEY	QUANTITY	PART DESCRIPTION		PART NUMBER
4	1	DRIVE PULLEY ASSEMBLY		655A511
5	2	SET SCREW, Hex Hole #10-32 x 5/16"		019L005S31
6	1	HUB		371D079
7	3	SCREW, Fill Hd #10-32 x 3/8"		004L006T30
8	3	WASHER, Plain #10		085A010T30
9	1	BEARING ASSEMBLY		634A116
10	1	WASHER, Plain 1/4"		085A416T30
11	1	WASHER, Lock 1/4"		085D416S31
12	1	NUT, Hex 1/4-20		081B200T30
13	1	SPRING, Tape Retainer		424F017
14	1	SCREW, Slotted Set 3/8-16 x 1-1/2"		047F148S30
15	1	WIRING HARNESS - Key 30 To Front Plate Terminal Board		677A594
16	1	WIRING HARNESS - Key 7 To Key 30		677A598
17	3	CLAMP, Cable		108A003
18	2	SCREW, Bind Hd #6-32 x 1/4"		006H004T30
19	2	WASHER, Lock #6		085D006S31
30	1	TERMINAL BOARD		171F005
31	1	MARKER STRIP		358D021
32	2	SCREW, Fill Hd		004H007T30
33	1	STRIP, Case Guide		405B055
34	1	SCREW, Flat Hd #10-32 x 3/8"		002L006T30
35	1	TIMER UNIT (When Required)	5 Minute Interval	665A214
			6 Minute Interval	665A219
			15 Minute Interval	665A215
			30 Minute Interval	665A218
			60 Minute Interval	665A216
			12 Hour Interval	665A217
36	1	BRACKET		353C549A15
37	1	BUSHING - SEE NOTE 1		368A022
38	1	CLOCK ASSEMBLY		133E022
39	1	CAM ASSEMBLY	5 Minute Interval	637A143
			6 Minute Interval	637A162
			15 Minute Interval	637A141
			30 Minute Interval	637A144
			60 Minute Interval	637A142
			12 Hour Interval	637A128
40	1	WASHER		377A188R60
41	2	WASHER, Lock #4		085D004S31
42	2	SCREW, Fill Hd #4-40 x 1/4"		004F004T30
43	1	WASHER, Plain #4		085A004T30
44	2	NUT, Hex #2-56		080D200T30
45	2	WASHER, Lock #2		085F002S31
46	1	*LEVER ASSEMBLY		647A325X99
47	1	*SWITCH		154E099U02
48	1	PLATE, Switch		355C256A15
49	2	SCREW, Flat Hd #2-56 x 1/2"		002D008T30
50	1	GROMMET		104B010
51	3	GROMMET		104B008
52	1	SCREW, Bind Hd #6-32 x 5/8"		006H010T10
53	3	WASHER, Plain #6		085A006T10
54	2	SCREW, Bind Hd #6-32 x 7/16"		006H007T10
55	1	WIRING HARNESS		677A593
56	1	CLAMP, Cable		108A003

*INDICATES RECOMMENDED SPARE PARTS

NOTE 1. Referenced Item Is Not Used On 12 Hour Interval Timer Unit.

FIGURE 5



INPUT AND GEARING ASSEMBLY

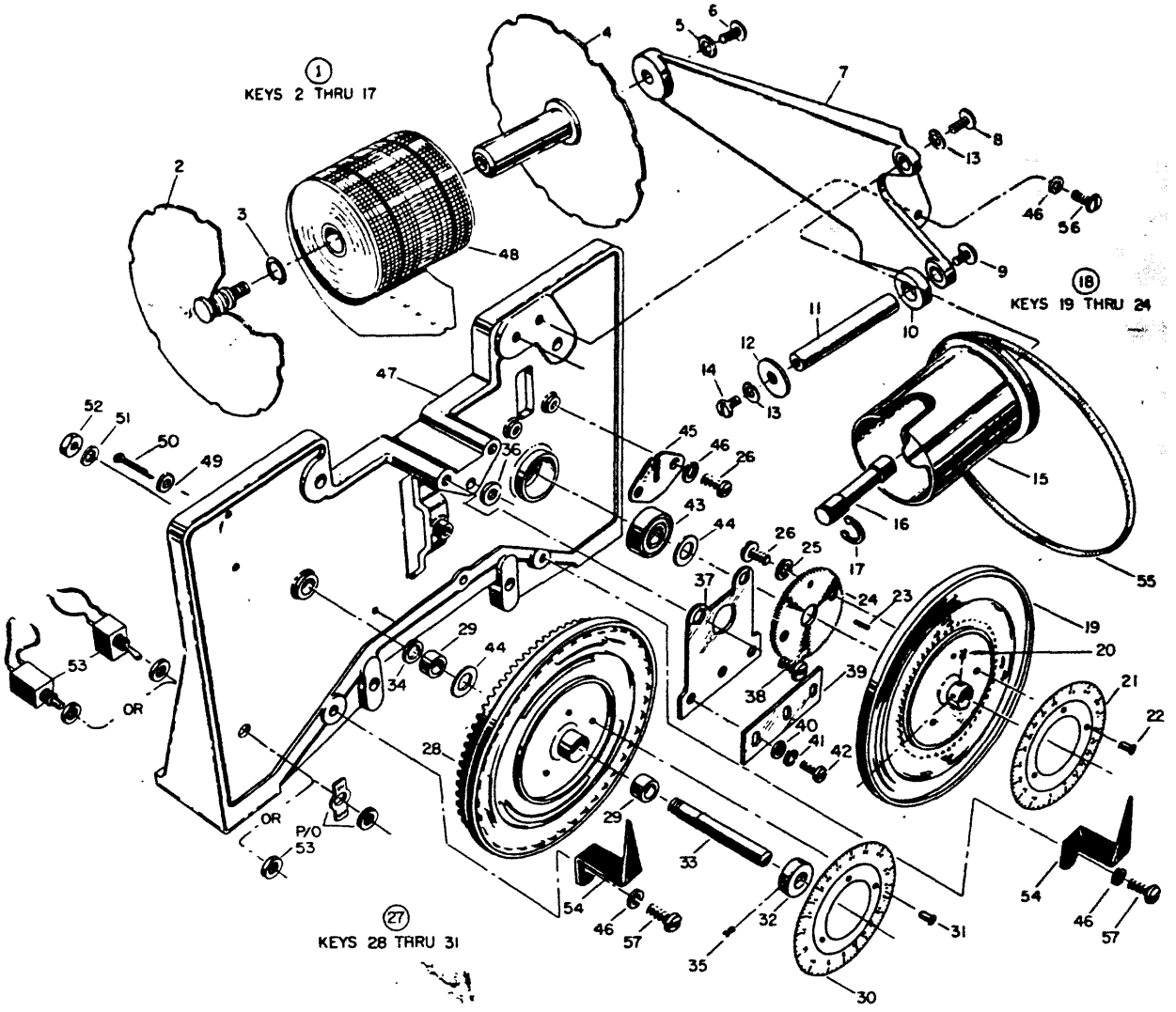
INPUT & GEARING ASSEMBLY

SERIES 1542, 1544 & 1546

KEY	QUANTITY	PART DESCRIPTION		PART NUMBER
1	1	BRACKET ASSEMBLY	Series 1542	623A314
	1		Series 1544 & 1546 10:1 & 20:1 Ratio	623A315
	1		Series 1544 & 1546 1:1 & 2:1 Ratio	623A318
2	2	SLEEVE, Bearing		103J015
3	1	SHAFT, Bevel Gear		370E031
4	1	SCREW, Fill Hd #10-32 x 1"		004L016T10
5	4	WASHER, Lock #10		085D010S32
6	1	COLLAR, Locking		371C025T30
7	1	NUT, Hex 5/16-24	Series 1542 Only	093C001T30
8	1	*BEARING		103C016U01
9	1	SHAFT, Input: 10-1/2"	Series 1542	370E064
	1	5-7/8"	Series 1544 & 1546 10:1 & 20:1 Ratio	370E063
	1	6-3/8"	Series 1544 & 1546 1:1 & 2:1 Ratio	370E082T30
10	1	PIN, Groove		107B025
11	1	NUT, Hex 1/4-20		081B300T10
12	2	PIN, Groove		107A004
13	2	SCREW, Fill Hd #6-32 x 1/4"		004H004T10
14	2	WASHER, Lock #6		085D006S31
15	2	WASHER, Plain #6		085A006T30
16	1	STOP, Locking Lever		353B266T21
17	1	WASHER, Lock 1/4"		085D416S31
18	1	ARM, Rocker		400C033T10
19	1	RING, Retaining		106A115
20	1	SHAFT, Rocker Arm Roller		370D079
21	1	SPRING, Torsion		424C024S13
22	1	LOCKING LEVER ASSEMBLY		647A343X99
23	1	SPRING, Tension		424B026S13
24	1	ROLLER, Guide		371D071B10
25	1	SET SCREW, Hex Hole #4-40 x 1/8"		019F002S31
26	1	RING, Retaining		106A111
27	1	WASHER, Flat		377A144T21
28	1	SPRING, Compression		424A222T10
29	1	GEAR, Worm		422G010T30
30	1	COLLAR		371C017N31
31	1	RING, Retaining		106A109
32	2	WASHER, Flat		377A120N31
33	1	WHEEL, Worm		422G021B10
34	1	GEAR, Pinion		422A237B11
35	4	SET SCREW, Hex Hole #6-32 x 1/8"		019H002S32
36	1	GEAR, Bevel & Spur		422D006B10
37	1	RING, Retaining		106A308
38	1	SHAFT, Transverse		370D127T30
39	1	SHAFT, Tape Guide		370E052T30
40	1	SCREW, Fill Hd #10-32 x 5/8"		004L010T10
41	2	SCREW, Shoulder		396D026T30
42	2	NUT, Hex #10-32		080L200T30
43	2	WASHER, Plain #10		085A010T10
44	1	COLLAR		371C042A10
45	1	SET SCREW, Fluted Hole #2-56 x 1/8"		020D002S31

*INDICATES RECOMMENDED SPARE PARTS

FIGURE 6



FRONT PLATE ASSEMBLY

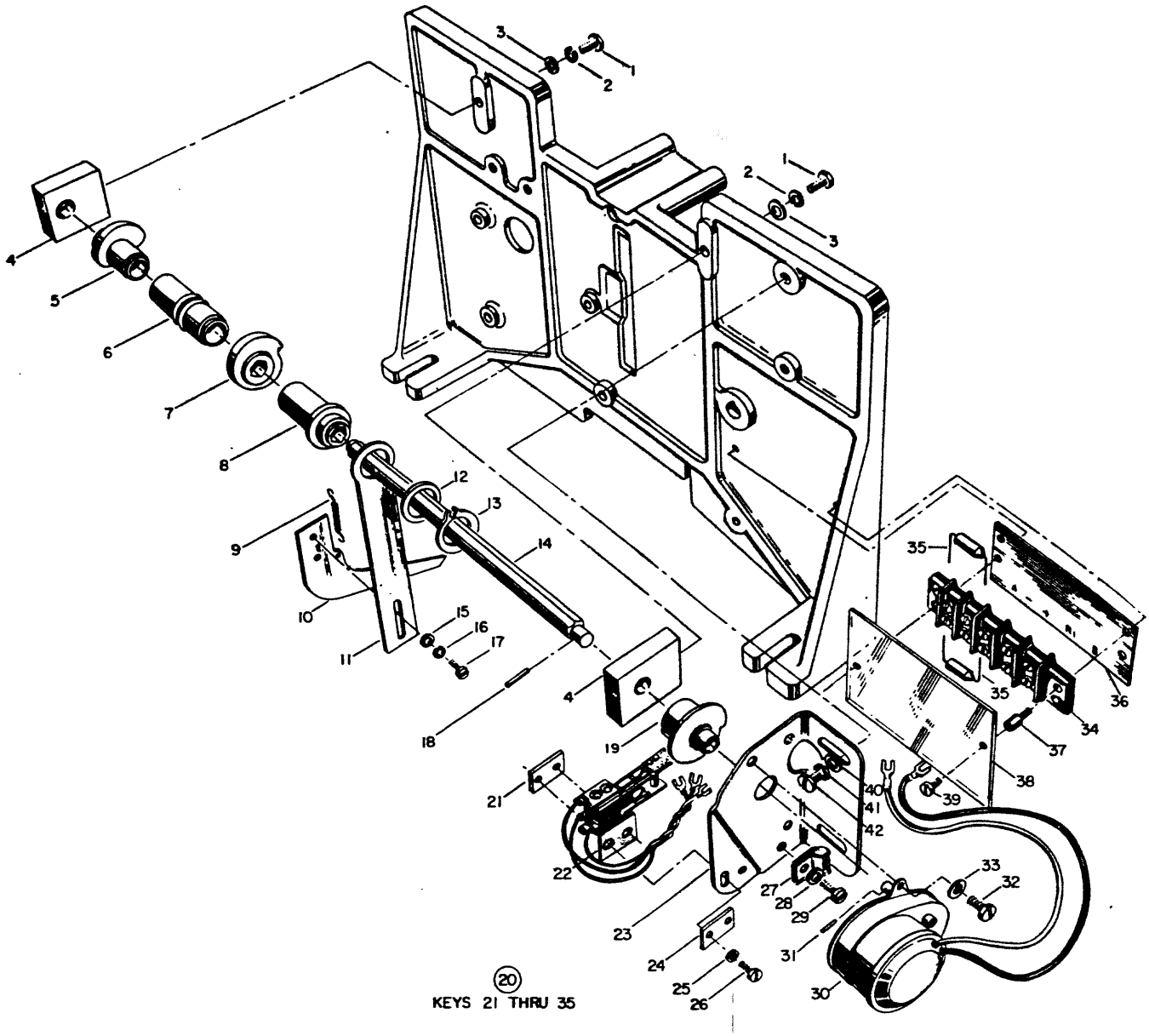
SERIES 1542, 1544 & 1546

KEY	QUANTITY	PART DESCRIPTION	PART NUMBER
1	1	TAPE BRACKET ASSEMBLY	623A244X99
2	1	MALE SPOOL END ASSEMBLY	655A995
3	1	*"O" RING	107A705
4	1	FEMALE SPOOL END ASSEMBLY	655A994
5	1	WASHER, Lock 1/4"	085H416S31
6	1	SCREW, Truss Hd 1/4-28 x 5/8"	035A010T30
7	1	BRACKET	353B351
8	1	SCREW, Bind Hd #10-32 x 5/8"	006L010T30
9	1	SCREW, Truss Hd 1/4-20 x 5/8"	035B010T30
10	1	SPACER	371B152
11	1	GUIDE, Tape	402E043
12	1	WASHER, Flat	377A251
13	2	WASHER, Lock #10	085H010S32
14	1	SCREW, Bind Hd #10-32 x 1/4"	006L004T10
15	1	SPOOL, Take-Up	413C275
16	1	SHAFT, Spool	370E028
17	1	RING, Retaining	106D014

FRONT PLATE ASSEMBLY (Continued)

KEY	QUANTITY	PART DESCRIPTION	PART NUMBER
18	1	CODE DISK ASSEMBLY, Low Order	625A065X99
19	1	DISK, Code	355F139Z10
20	2	SET SCREW, Hex Hole #8-32 x 3/16"	019K003S31
21	1	SCALE, Dial	335C068A10
22	3	PIN, Drive	107G035
23	1	PIN, Groove	107B027
24	1	WHEEL, Detent	412B007T12
25	2	WASHER, Lock #10	085D010S32
26	4	SCREW, Truss Hd #10-32 x 5/16"	005L005T10
27	1	CODE DISK ASSEMBLY, High Order	625A186X99
28	1	DISK, Code	355F047
29	2	BEARING, Sleeve	103J014
30	1	SCALE, Dial	335C067
31	3	PIN, Drive	107G035
32	1	COLLAR	371C025T30
33	1	SHAFT, High Order Code Disk	370D077T30
34	1	WASHER, Flat	377A120N31
35	2	SET SCREW, Hex Hole #6-32 x 1/8"	019H002S32
36	1	WASHER, Flat	377A142Q81
37	1	PLATE, Retractor Support	355C098T12
38	2	SCREW, Flat Hd #10-32 x 3/8"	002L006T10
39	1	PLATE, Retractor	355H257T12
40	3	WASHER, Lock #6	085D006S32
41	3	WASHER, Plain #6	085A006T10
42	3	SCREW, Fill Hd #6-32 x 3/16"	004H003T10
43	1	*BEARING	103C016U01
44	2	SHIM	377A144T12
45	1	GUIDE, Locking Lever	355K027B60
46	5	WASHER, Lock #10	085D010S32
47	1	PLATE, Mounting	355A113A50
48	1	TAPE, Data Recording: 5 Minute Increments; All Series	212B009
		6 Minute Increments; All Series	212B015
		15 Minute Increments; Series 1542	212B007
		Series 1544 & 1546	212B010
		30 Minute Increments; Series 1542	212B013
		Series 1544 & 1546	212B012
		60 Minute Increments; Series 1542	212B014
		Series 1544 & 1546	212B008
		12 Hour Increments; Series 1546 Only	212B011
49	1	WASHER, Plain #2	085A002T10
50	1	PIN, Cotter	107C001U01
51	1	WASHER, Lock 1/4"	085D416S32
52	1	NUT, Hex 1/4-20	081B200T10
53	1	*SWITCH, Pushbutton for Series 1542 & 1546	154D034
	1	*SWITCH, Toggle for Series 1546 Only	154B016
54	2	POINTER	410C026A15
55	1	SPRING, Take-Up	424B019T21
56	2	SCREW, Fill Hd #10-32 x 3/4"	004L012T10
57	2	SCREW, Bind Hd #10-32 x 1/4"	006L004T10

*INDICATES RECOMMENDED SPARE PARTS



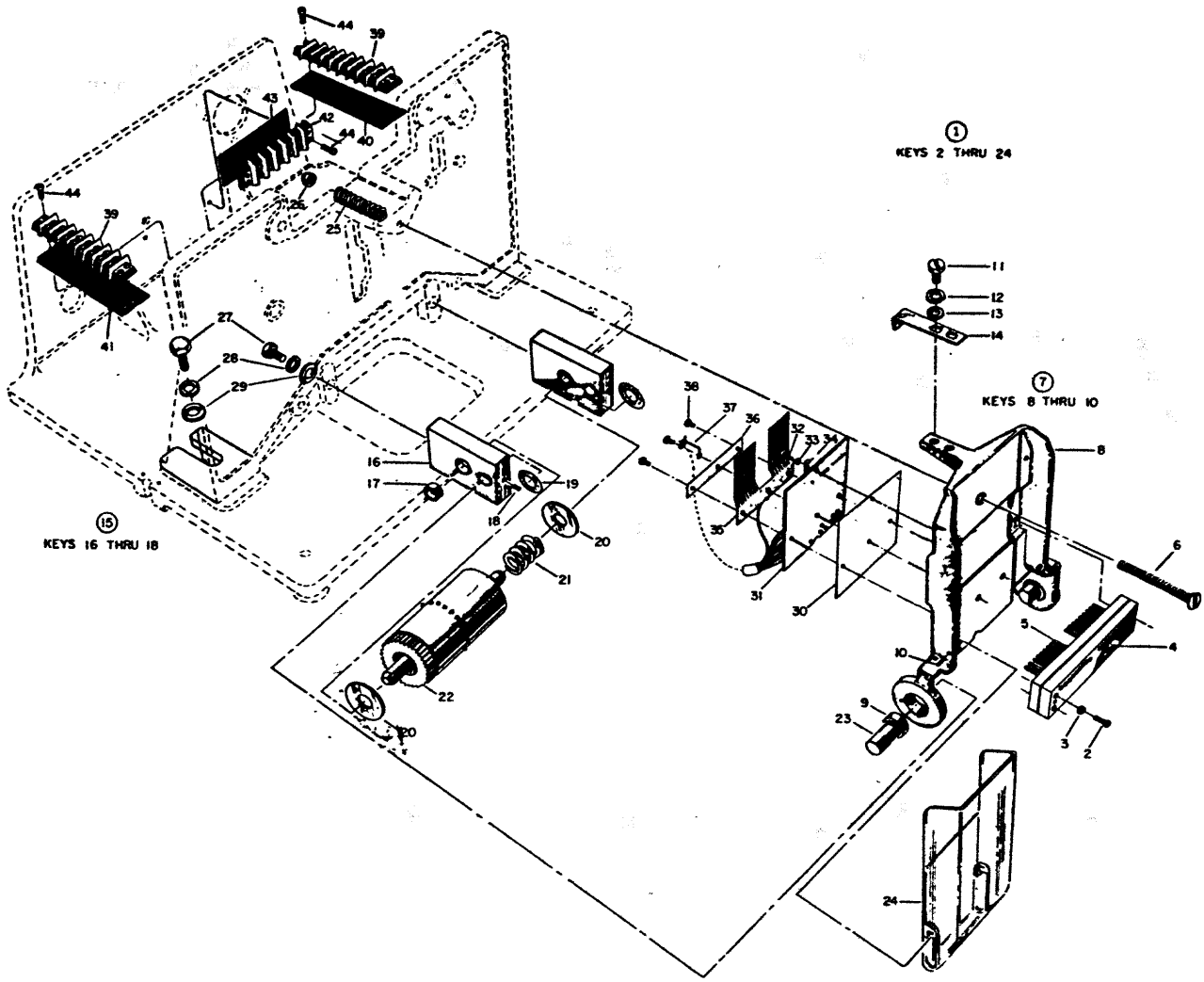
PROGRAMMING SHAFT ASSEMBLY

PROGRAMMING SHAFT ASSEMBLY

SERIES 1542, 1544 & 1546

KEY	QUANTITY	PART DESCRIPTION		PART NUMBER
1	2	BOLT, Hex Hd 1/4-20 x 1"		040B108T10
2	2	WASHER, Lock 1/4"		085D416S32
3	2	WASHER, Plain 1/4"		377A259T21
4	2	BEARING BLOCK ASSEMBLY		634A118X99
5	1	CAM, Code Disk Locking		423A040Q81
6	1	PULLEY, Take-Up Spool		413E011Q81
7	1	CAM, Punch Arm Actuating		423A042Q83
8	1	CAM, Eccentric: Paper Tape Advancement		423A030Q81
9	1	SPRING, Tension		424B016T10
10	1	PAWL, Lower Feed: Paper Tape Advancement		400D038T12
11	1	PAWL, Upper Feed: Paper Tape Advancement		400D037T12
12	1	WASHER, Flat		377A133N41
13	1	RING, Grip		106A320U01
14	1	SHAFT, Cam: Hex		370E042T30
15	2	WASHER, Plain #4		085A004T10
16	2	WASHER, Lock #4		085D004S32
17	2	SCREW, Fill Hd #4-40 x 1/4"		004F004T10
18	1	PIN, Roll		107B026U01
19	1	CAM ASSEMBLY, Motor Switch		660A109X99
20	1	PUNCH MOTOR ASSEMBLY	Series 1542 & 1546	623A235X99
	1		Series 1544	623A239X99
	1		Series 1542_D (Telemeter)	623A540X99
21	1	NUT, Bar #4-40		397C035
22	1	SWITCH ASSEMBLY		674A193
23	1	BRACKET		353A267
24	1	WASHER, Bar		377A196
25	2	WASHER, Lock #4		085D004S31
26	2	SCREW, Fill Hd #4-40 x 5/16"		004F005T30
27	1	CLAMP, Cable		108A004
28	1	WASHER, Plain #6		085A006T30
29	1	SCREW, Bind Hd #6-32 x 1/4"		006H004T30
30	1	MOTOR		165K002
31	1	PIN, Groove		107B025
32	2	SCREW, Bind Hd #6-32 x 3/16"		006H003T30
33	2	WASHER, Lock #6		085D006S31
34	1	TERMINAL BOARD		171F005
35	2	*DIODE	Series 1542 & 1546	166B050
	1		Series 1544	166B050
	2		Series 1542_D	166B051
36	1	MARKER STRIP		358D056F62
37	2	POST		403B159A14
38	1	COVER, Terminal Board		379A015P10
39	2	SCREW, Bind Hd #4-40 x 3/16"		006F003T10
40	2	WASHER, Plain #10		085A010T10
41	2	WASHER, Lock #10		085D010S32
42	2	SCREW, Bind Hd #10-32 x 1/2"		006L008T10

*INDICATES RECOMMENDED SPARE PARTS



PUNCH ARM ASSEMBLY
1542-D

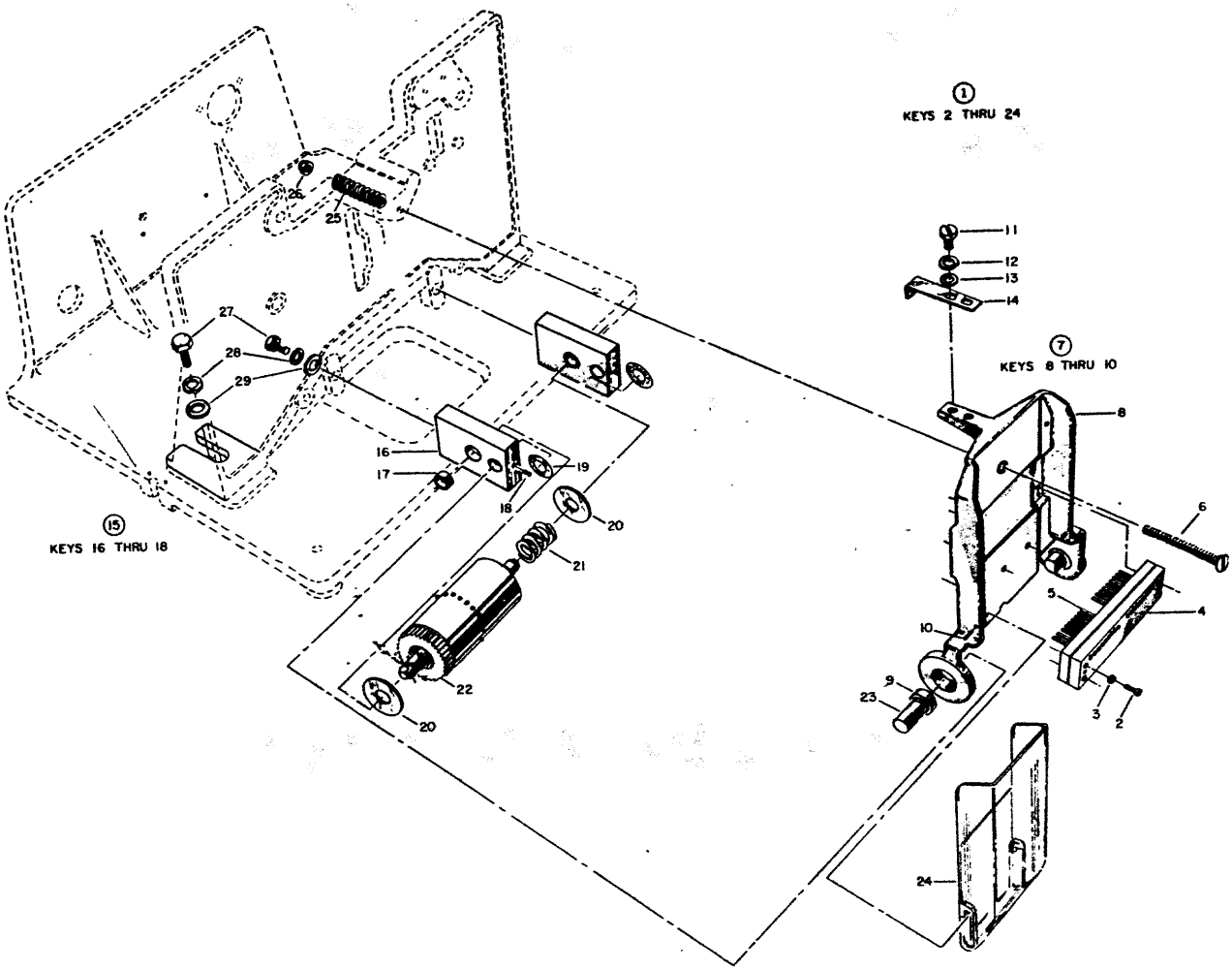
PUNCH ARM ASSEMBLY

W/TELEMETER - SERIES 1542_D ONLY

KEY	QUANTITY	PART DESCRIPTION	PART NUMBER
1	1	COMPLETE PUNCH ARM ASSEMBLY	642S002
2	4	SCREW, Fill Hd #6-32 x 9/16"	004H009T10
3	4	WASHER, Lock #6	085D006S32
4	1	PUNCH BAR ASSEMBLY	625A242X99
5	18	PUNCH	402B014
6	1	SCREW, Flat Hd #6-32 x 2-1/2"	002H248T10
7	1	PUNCH ARM ASSEMBLY	642A112X99
8	1	ARM, Punch	399C027
9	2	SLEEVE, Bearing	103J014U01
10	2	PIN, Groove	107B002
11	2	SCREW, Fill Hd #10-32 x 3/8"	004L006T10
12	2	WASHER, Lock #10	085D010S32
13	2	WASHER, Plain #10	085A010T10
14	1	BRACKET, Cam Follower	353C621T12
15	2	BEARING BLOCK ASSEMBLY	611A199X99
16	1	BLOCK, Bearing	323C018A14
17	1	SLEEVE, Bearing	103J014U01
18	1	SET SCREW, Hex Soc #10-32 x 1/4"	023L004T30
19	2	WASHER, Flat	377A147P30
20	2	WASHER, Flat	377A122P22
21	1	SPRING	424A104T10
22	1	SPROCKET ASSEMBLY	659A199X99
23	2	SHAFT, Punch Arm	370E033T30
24	1	*TRAY, Chad	327C012K31
25	1	SPRING, Punch Arm	424A145S13
26	1	NUT, Hex Self Lock #6-32	080H300T10
27	4	BOLT, Hex Hd 1/4-20 x 1"	040B108T10
28	4	WASHER, Lock 1/4"	085D416S32
29	4	WASHER, Plain 1/4"	085A416T10
30	1	INSULATOR	358C135P91
31	1	PRINTED CIRCUIT ASSEMBLY	685A347X99
32	3	SCREW, Bind Hd #2-56 x 3/16"	006D003T30
33	3	WASHER, Lock #2	085D002S31
34	1	CLAMP	391D068T12
35	1	ARM, Contact	399B028C20
36	1	PLATE	355H530T12
37	1	SUPPORT	424D010T10
38	3	SCREW, Truss Hd #2-56 x 1/4"	005D004T30
39	2	TERMINAL BOARD	171F008U01
40	1	MARKER STRIP	358D577X99
41	1	MARKER STRIP	358D576X99
42	1	TERMINAL BOARD	171F005U01
43	1	MARKER STRIP	358D578X99
44	6	SCREW, Fill Hd #6-32 x 9/16"	004H009T30

*INDICATES RECOMMENDED SPARE PARTS

FIGURE 9



PUNCH ARM ASSEMBLY

1542, 1544, and 1546

PUNCH ARM ASSEMBLY

SERIES 1542, 1544 & 1546

KEY	QUANTITY	PART DESCRIPTION	PART NUMBER
1	1	COMPLETE PUNCH ARM ASSEMBLY	642S002
2	4	SCREW, Fill Hd #6-32 x 9/16"	004H009T10
3	4	WASHER, Lock #6	085D006S32
4	1	PUNCH BAR ASSEMBLY	625A242X99
5	18	PUNCH	402B014
6	1	SCREW, Flat Hd #6-32 x 2-1/2"	002H248T10
7	1	PUNCH ARM ASSEMBLY	642A112X99
8	1	ARM, Punch	399C027
9	2	SLEEVE, Bearing	103J014U01
10	2	PIN, Groove	107B002
11	2	SCREW, Fill Hd #10-32 x 3/8"	004L006T10
12	2	WASHER, Lock #10	085D010S32
13	2	WASHER, Plain #10	085A010T10
14	1	BRACKET, Cam Follower	353C621T12
15	2	BEARING BLOCK ASSEMBLY	611A199X99
16	1	BLOCK, Bearing	323C018A14
17	1	SLEEVE, Bearing	103J014U01
18	1	SET SCREW, Hex Soc #10-32 x 1/4"	023L004T30
19	2	WASHER, Flat	377A147P30
20	2	WASHER, Flat	377A122P22
21	1	SPRING	424A104T10
22	1	SPROCKET ASSEMBLY	659A199X99
23	2	SHAFT, Punch Arm	370E033T30
24	1	*TRAY, Chad	327C012K31
25	1	SPRING, Punch Arm	424A145S13
26	1	NUT, Hex #6-32	080H300T10
27	4	BOLT, Hex Hd 1/4-20 x 1"	040B108T10
28	4	WASHER, Lock 1/4"	085D416S32
29	4	WASHER, Plain 1/4"	085A416T10

*INDICATES RECOMMENDED SPARE PARTS

GPO 975-139