



# CONTENTS

## THICK TURRET

### STATION ARRANGEMENT

72-station turret (COMA only) .....	1-1
56-station turret (COMA, BELA-II, PEGA and PEGA KING) .....	1-2
52-station turret (COMA only) .....	1-3
48-station turret (COMA only) .....	1-4
32-station turret (COMA only) .....	1-5
46-station turret (COMA only) .....	1-6
44-station turret (COMA only) .....	1-7

### TOOL TYPES

Type A (1/2") .....	1-8
Type B (1-1/4") .....	1-9
Types C (2"), D (3-1/2"), E (4-1/2") and F (6") .....	1-10

### LOADING AND UNLOADING PUNCHES AND DIES

Type A (1/2") .....	1-11
Type B (1-1/4") .....	1-13
Types C (2"), D (3-1/2"), E (4-1/2") and F (6") .....	1-14

### KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

Keys and keyways in-tools .....	1-15
Keys and keyways in turret stations .....	1-16

### MAINTENANCE OF PUNCHES AND DIES

Disassembly and assembly of punches (Types A and B) .....	1-17
Removal and installation of punch tips (Types C, D, E and F) .....	1-18
Re-grinding punches and dies .....	1-19
Adjustment of punch and die height .....	1-19
Lubrication .....	1-21
Inspecting punches and dies .....	1-21
Inspecting worksheets .....	1-21

PUNCH-TO-DIE CLEARANCE .....	j-21
------------------------------	------

PUNCH CAPACITY .....	1-22
----------------------	------

MINIMUM HOLE DIAMETER .....	1-24
-----------------------------	------

PRECAUTIONS FOR PUNCHING THICK WORKSHEETS .....	1-24
---	------

## THIN TURRET

### STATION ARRANGEMENT

40-station turret (VELA II and PEGA) .....	2-1
--	-----

### TOOL TYPES

Small diameter type (1.6 to 31.7 mm dia.) .....	2-2
Large diameter type (31.8 to 88.9 mm dia.) .....	2-3

**LOADING AND UNLOADING PUNCHES AND DIES**

Small diameter type ..... 2-4  
Large diameter type ..... 2-5

**KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS.**

Keys and keyways in tools ..... 2-6  
Keys and keyways in turret stations ..... 2-7

**MAINTENANCE OF PUNCHES AND DIES**

Disassembly of punches (Small dia. type) ..... 2-8  
Removal and installation of punch tips (Large dia. type) ..... 2-8'  
Re-grinding punches and dies ..... 2-8  
Adjustment of punch and die height ..... 2-9  
Lubrication ..... 2-10  
Inspecting punches and dies ..... 2-10  
Inspecting worksheets ..... 2-10

**PUNCH-TO-DIE CLEARANCE ..... 2-10**

**PUNCH CAPACITY ..... 2-11**

**MINIMUM HOLE DIAMETER ..... 2-12**

**PRECAUTIONS FOR PUNCHING THICK WORKSHEETS ..... 2-1.3**

**THICK TURRET WITH AUTO-INDEX DEVICE**

**STATION ARRANGEMENT**

58-station turret (COMA, VELA-II, PEGA and PEGA KING) ..... 3-1  
44-station turret (COMA, VELA-II, PEGA and PEGA KING) ..... 3-2

**TOOL TYPES**

Type A (1/2") ..... 3-3  
Type B (1-1/4") ..... 3-4  
Types C (2"), D (3-1/2") and E (4-1/2") ..... 3-5

**LOADING AND UNLOADING PUNCHES AND DIES**

Type A (1/2") ..... 3-6  
Type B (1-1/4") ..... 3-8  
Types C (2"), D (3-1/2") and E (4-1/2") ..... 3-10

**KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS**

Keys and keyways in tools.. ..... 3-11  
Keys and keyways in turret stations ..... 3-12

**MAINTENANCE OF PUNCHES AND DIES**

Disassembly and assembly of punches (Types A and B) ..... 3-13  
Removal and installation of punch tips (Types C, D and E) ..... 3-14  
Regrinding punches and dies ..... 3-15  
Adjustment of punch and die height ..... 3-15  
Lubrication ..... 3-17  
Inspecting punches and dies ..... 3-17  
Inspecting worksheets ..... 3-17

PUNCH-TO-DIE CLEARANCE .....	3-17
PUNCH CAPACITY .....	3-18
MINIMUM HOLE DIAMETER .....	3-20
PRECAUTIONS FOR PUNCHING THICK WORKSHEETS .....	3-20

**THIN TURRET WITH AUTO-INDEX DEVICE**

**STATION ARRANGEMENT**

40-station turret (VELA II and PEGA) .....	4-1
--	-----

**TOOL TYPES**

Small diameter type (Type A and Type B) .....	4-2
Large diameter type (Type C and Type D) .....	4-3

**LOADING AND UNLOADING PUNCHES AND DIES**

Small diameter type (Type A and Type B) .....	4-4
Large diameter type (Type C and Type D) .....	4-7

**KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS**

Keys and keyways in tools .....	4-8
Keys and keyways in turret stations .....	4-9

**MAINTENANCE OF PUNCHES AND DIES**

Disassembly of punches (Small dia. type) .....	4-10
Removal and installation of punch tips. (Large dia. type) .....	4-10
Re-grinding punches and dies .....	4-10
Adjustment of punch and die height .....	4-11
Lubrication .....	4-12
Inspecting punches and dies .....	4-12
Inspecting worksheets .....	4-12

PUNCH-TO-DIE CLEARANCE .....	4-12
------------------------------	------

PUNCH CAPACITY .....	4-13
----------------------	------

MINIMUM HOLE DIAMETER .....	4-14
-----------------------------	------

PRECAUTIONS FOR PUNCHING THICK WORKSHEETS .....	4-15
---	------

# THICK TURRET

## STATION ARRANGEMENT

72-station turret (COMA only) . . . . .	I-1
56-station turret (COMA, VELA-II, PEGA and PEGA KING) . . . . .	I-2
52-station turret (COMA only) . . . . .	I-3
48-station turret (COMA only) . . . . .	I-4
32-station turret (COMA only) . . . . .	I-5
46-station turret (COMA only) . . . . .	I-6
44-station turret (COMA only) . . . . .	I-7

## TOOL TYPES

Type A (1/2") . . . . .	I-8
Type B (1-1/4") . . . . .	I-9
Types C (2"), D (3-1/2"), E (4-1/2") and F (6") . . . . .	I-10

## LOADING AND UNLOADING PUNCHES AND DIES

Type A (1/2") . . . . .	I-11
Type B (1-1/4") . . . . .	I-13
Types C (2"), D (3-1/2"), E (4-1/2") and F (6") . . . . .	I-14

## KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

Keys and keyways in tools . . . . .	I-15
Keys and keyways in turret stations . . . . .	I-16

## MAINTENANCE OF PUNCHES AND DIES

Disassembly and assembly of punches (Types A and B) . . . . .	9-17
Removal and installation of punch tips (Types C, D, E and F) . . . . .	9-18
Re-grinding punches and dies . . . . .	9-19
Adjustment of punch and die height . . . . .	9-20
Lubrication . . . . .	9-21
Inspecting punches and dies . . . . .	9-21
Inspecting worksheets . . . . .	9-21

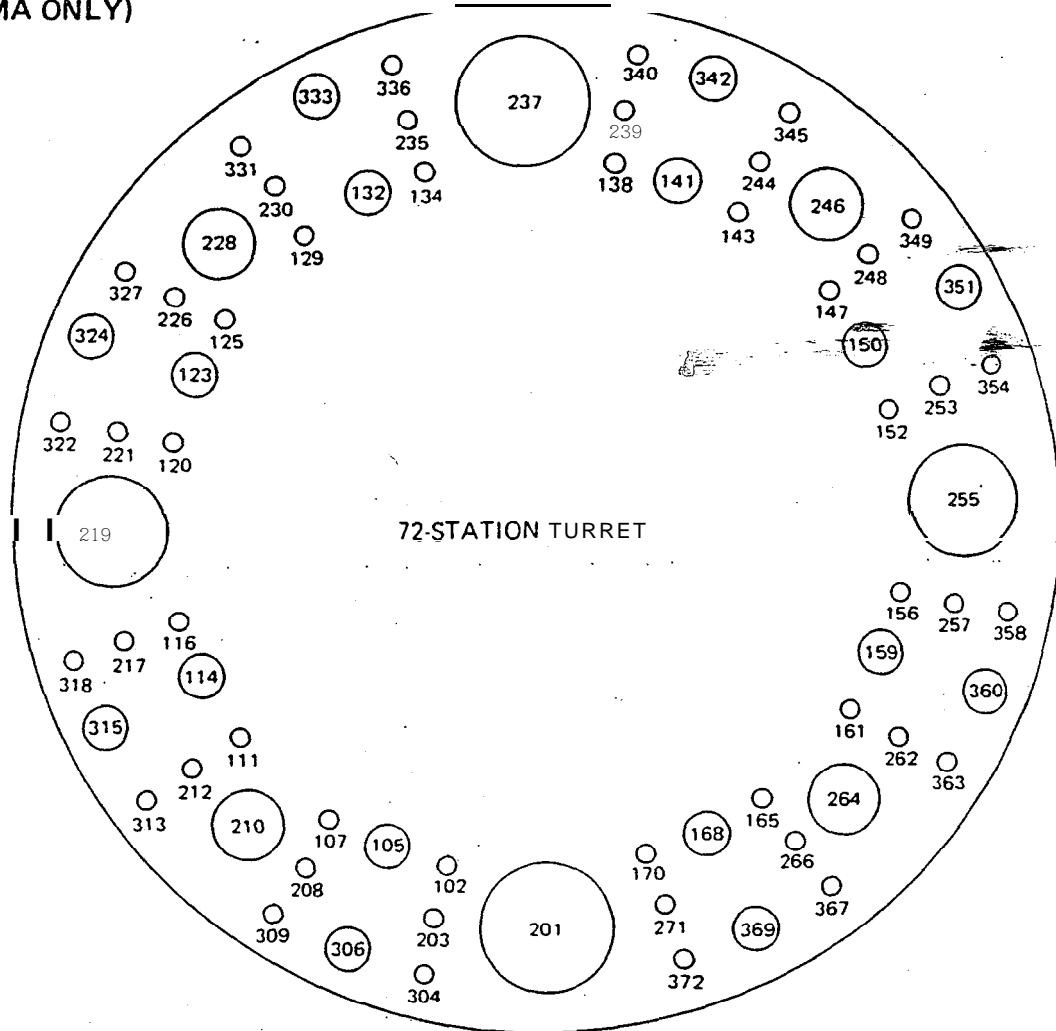
PUNCH-TO-DIE CLEARANCE. . . . .	9-21
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PUNCH CAPACITY . . . . .	9-22
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MINIMUM HOLE DIAMETER . . . . .	9-24
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PRECAUTIONS FOR PUNCHING THICK WORKSHEETS . . . . .	1-24
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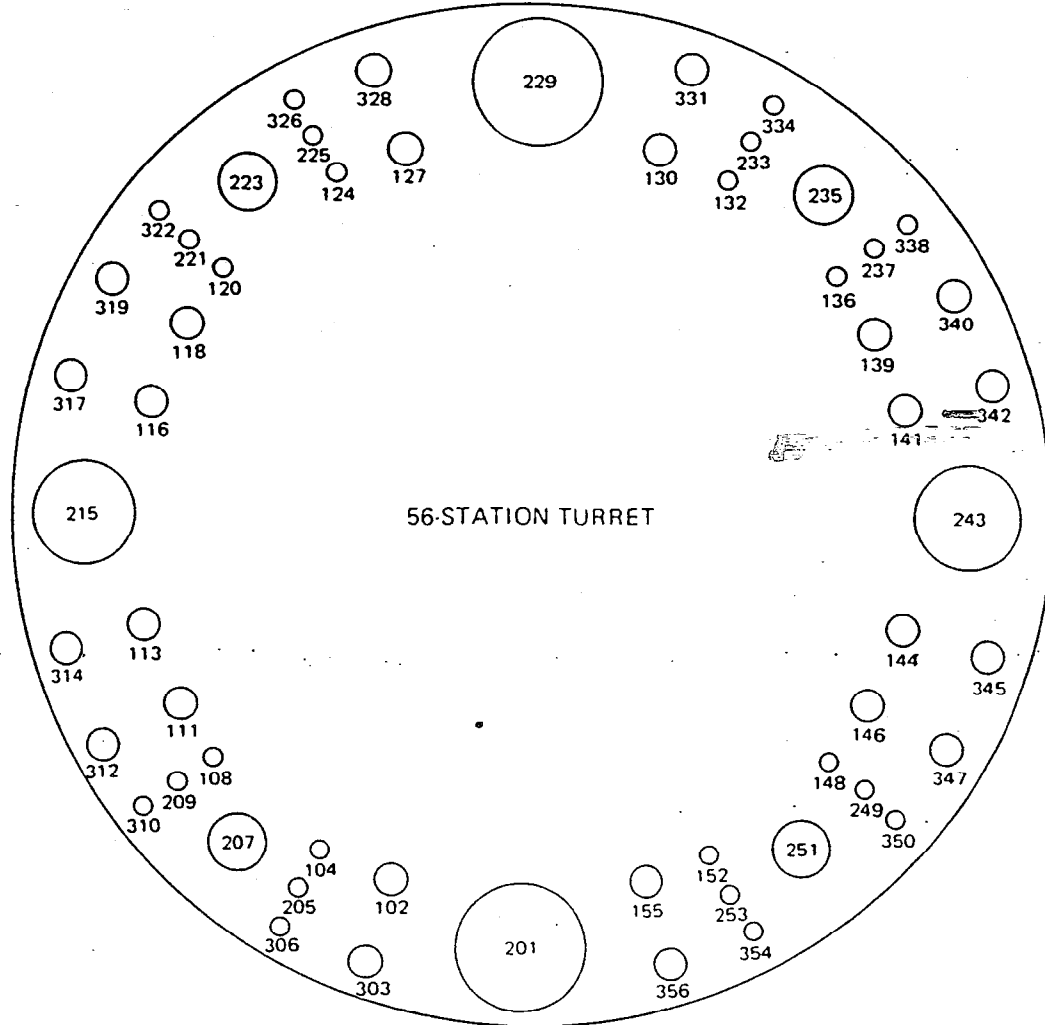
72-STATION TURRET  
(COMA ONLY)



Tool Type	Nominal Tool Size	Standard Punch Size	Number of Stations Available*
A	1/2"	1.6 – 12.7 mm dia. (0.063" – 0.5" dia.)	48 (16)
B	1-1/4"	12.8 – 31.7 mm dia. (0.501" – 1.25" dia.)	16 (8)
C	2"	31.8 – 50.8 mm dia. (1.251" – 2" dia.)	4 (4)
D	3-1/2"	50.9 – 88.9 mm dia. (2.009" – 3.5" dia.)	2 (2)
E	4-1/2"	89.0 – 114.3 mm dia. (3.501" – 4.5" dia.)	2 (2)

\* The numerals in parentheses indicate the number of stations which can accept shaped tools.

56-STATION TURRET (COMA, VELA-II, PEGA AND PEGA KING)



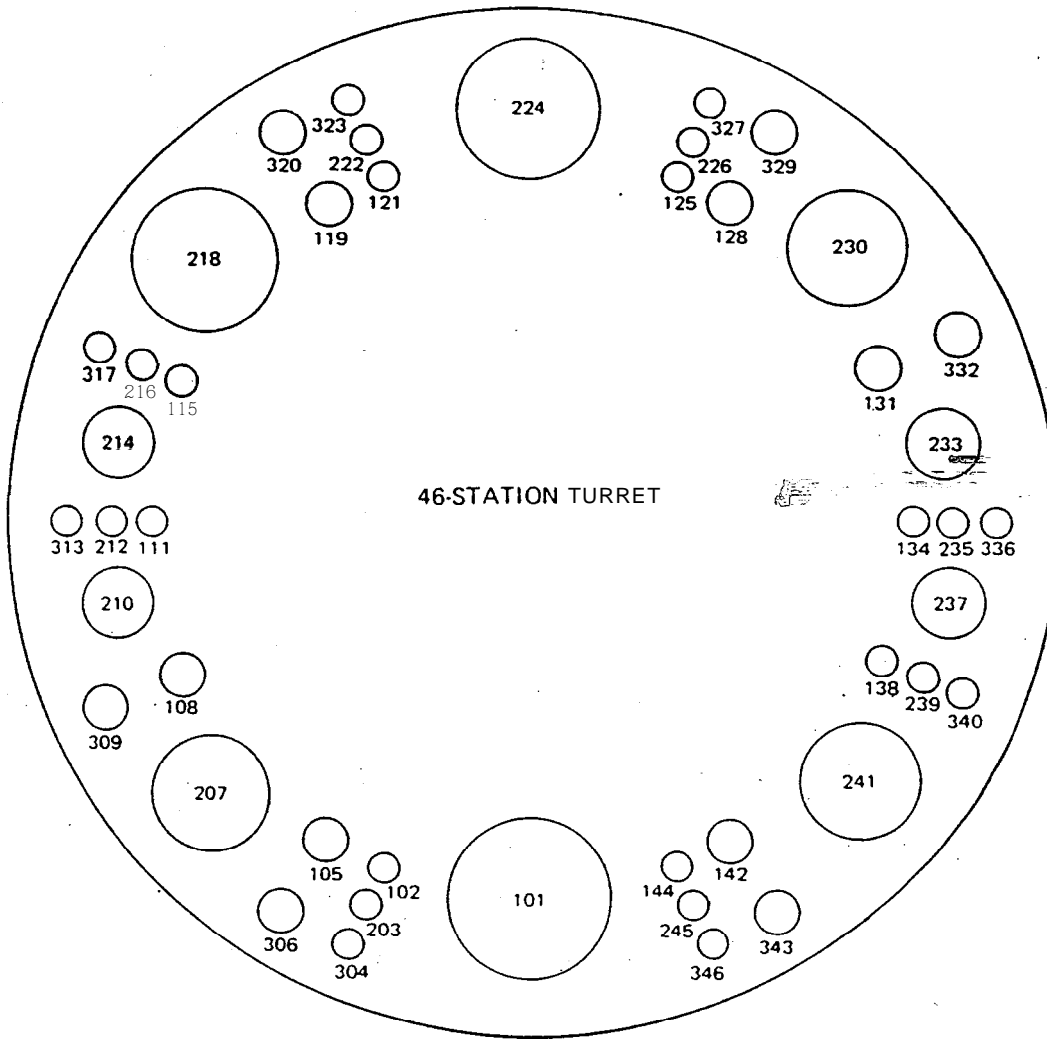
Tool Type	Nominal Tool Size	Standard Punch Size	Number of Stations Available'
A	1/2"	1.6 – 12.7 mm dia. (0.063" – 0.5" dia.)	24 (8)
B	1-1/4"	12.8 – 31.7 mm dia. (0.501" – 1.25" dia.)	24 (12)
c	2"	31.8 – 50.8 mm dia. (1.251" – 2" dia.)	4 (4)
D	3-1/2"	50.9 – 88.9 mm dia. (2.001" – 3.5" dia.)	2 (2)
E	4-1/2"	89.0 – 114.3 mm dia. (3.501" – 4.5" dia.)	2 (2)

• The numerals in parentheses indicate the number of stations which can accept shaped tools.



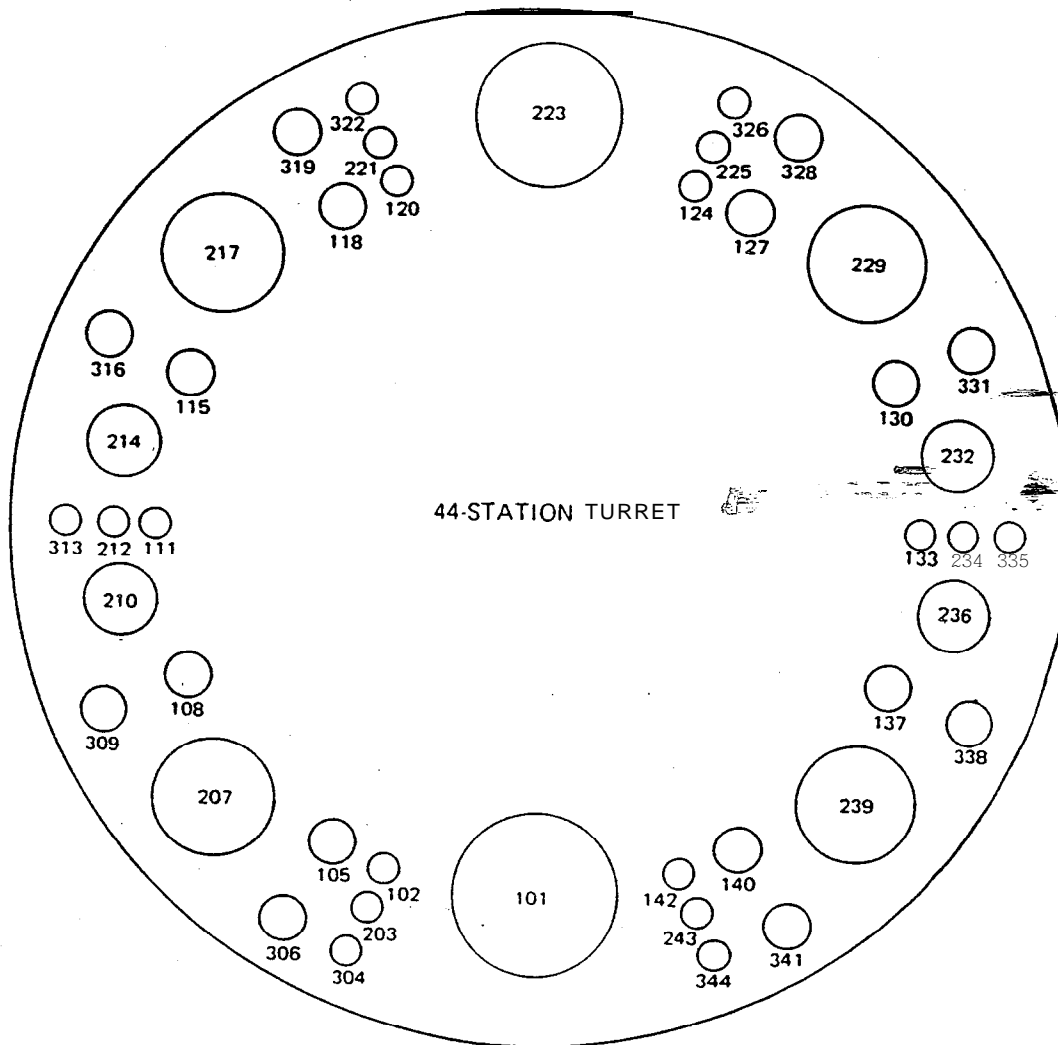






Tool Type	Nominal Tool Size	Standard Punch Size	Number of Stations Available*
A	1/2"	1.6 – 12.7 mm dia. (0.063" – 0.5" dia.)	24 (8)
B	1-1/4"	12.8 – 31.7 mm dia. (0.501" – 1.25" dia.)	12 (6)
C	2"	31.8 – 50.8 mm dia. (1.251" – 2" dia.)	4 (4)
D	3-1/2"	50.9 – 88.9 mm dia. (2.001" – 3.5" dia.)	3 (3)
E	4-1/2"	89.0 – 114.3 mm dia. (3.501" – 4.5" dia.)	2 (2)
F	6"	114.4 – 152.4 mm dia. (9.501" – 6.0" dia.)	1 (1)

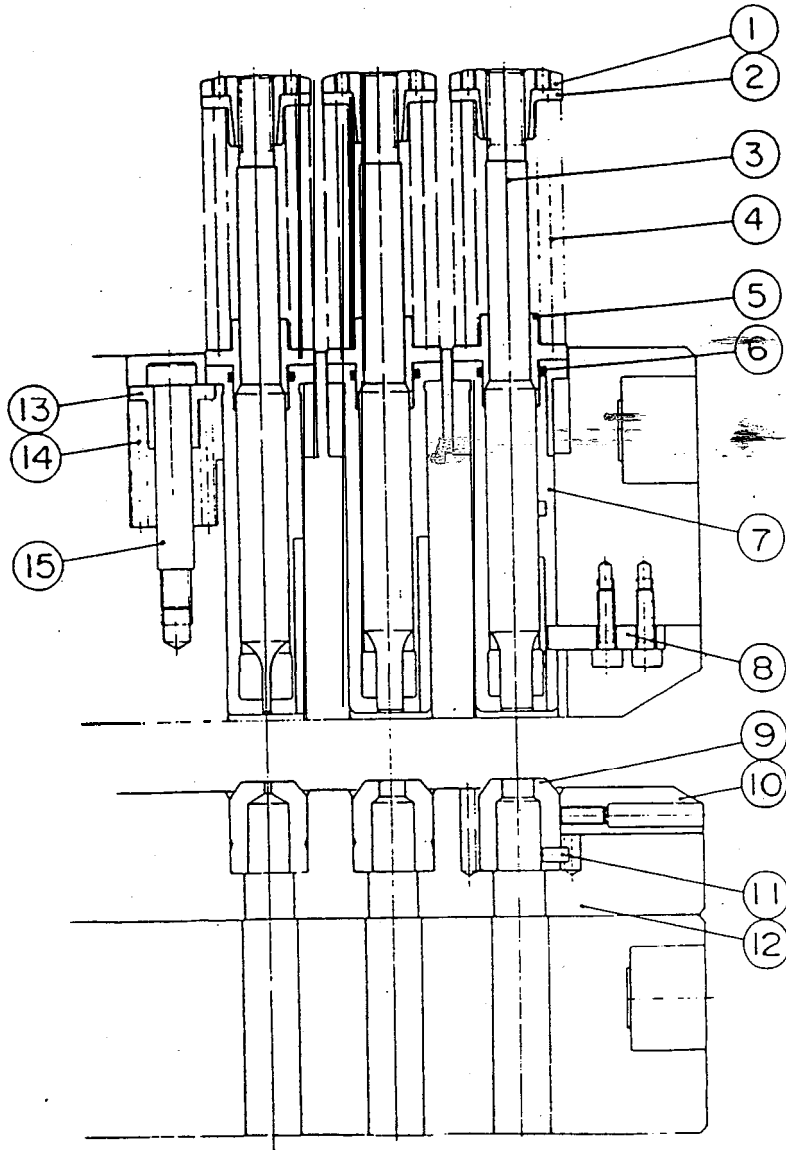
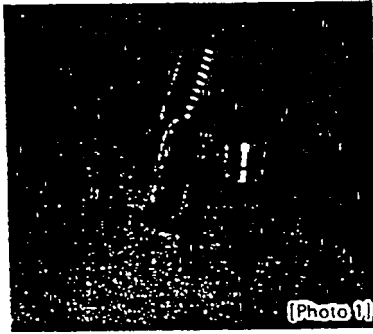
\* The numerals in parentheses indicate the number of stations which can accept shaped tools.



Tool Type	Nominal Tool Size	Standard Punch Size	Number of Stations Available*
A	1/2"	1.6 - 12.7 mm dia. (0.063" - 0.5" dia.)	18 (6)
B	1-1/4"	12.8 - 31.7 mm dia. (0.501" - 1.25" dia.)	16 (8)
C	2"	31.8 - 50.8 mm dia. (1.251" - 2" dia.)	4 (4)
D	3-1/2"	50.9 - 88.9 mm dia. (2.001" - 3.5" dia.)	4 (4)
E	4-1/2"	89.0 - 114.3 mm dia. (3.501" - 4.5" dia.)	1 (1)
F	6"	114.4 - 152.4 mm dia. (4.501" - 6" dia.)	1 (1)

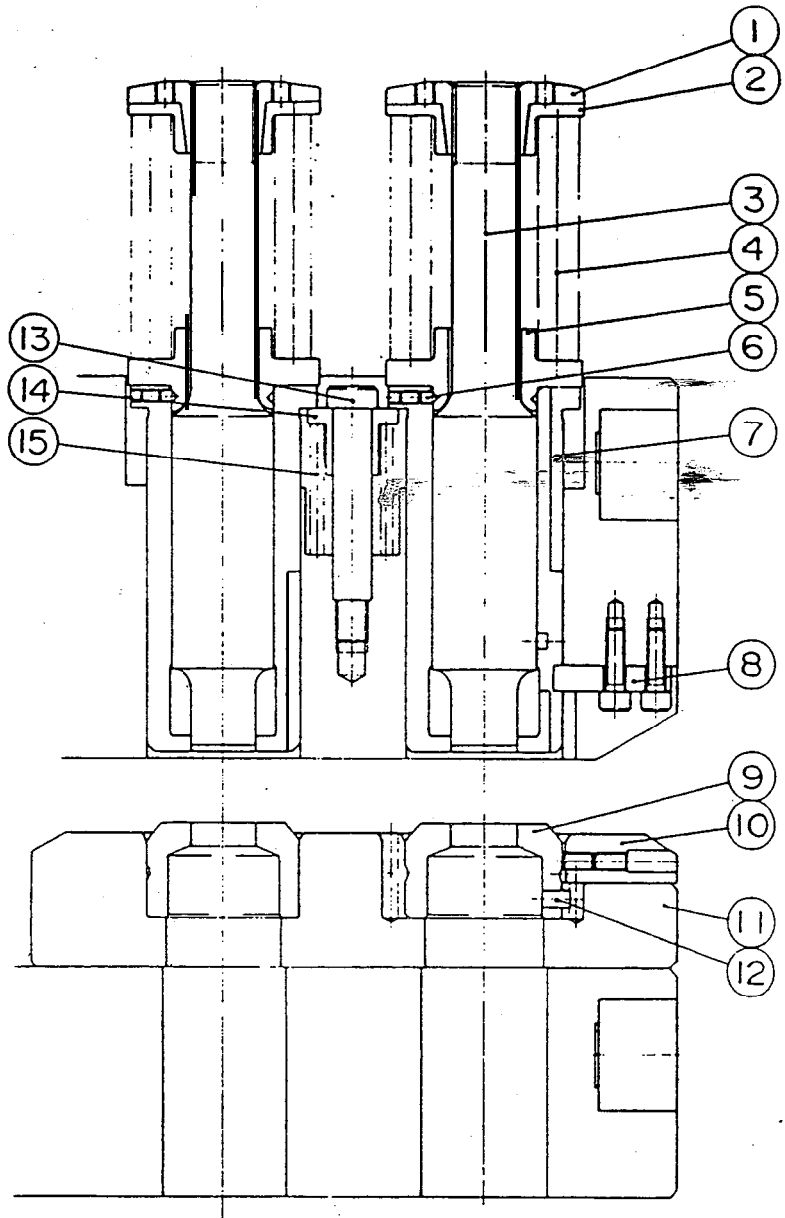
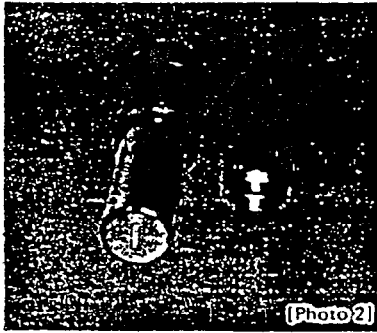
\* The numerals in parentheses indicate the number of stations which can accept shaped tools.

TYPE A (1/2")

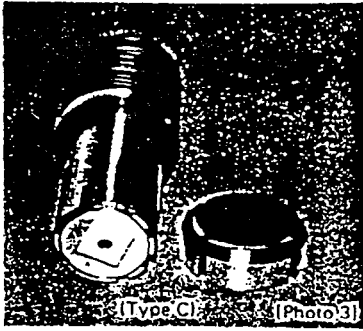


- 1. PUNCH HEAD
- 2. PUNCH HEAD COLLAR
- 3. PUNCH BODY
- 4. STRIPPING SPRING
- 5. RETAINER COLLAR
- 6. RETAINER RING
- 7. PUNCH GUIDE
- 8. GUIDE KEY
- 9. DIE
- 10. DIE SPACER
- 11. KEY
- 12. DIE HOLDER
- 13. LIFT RING
- 14. LIFT SPRING
- 15. SHOULDER SCREW

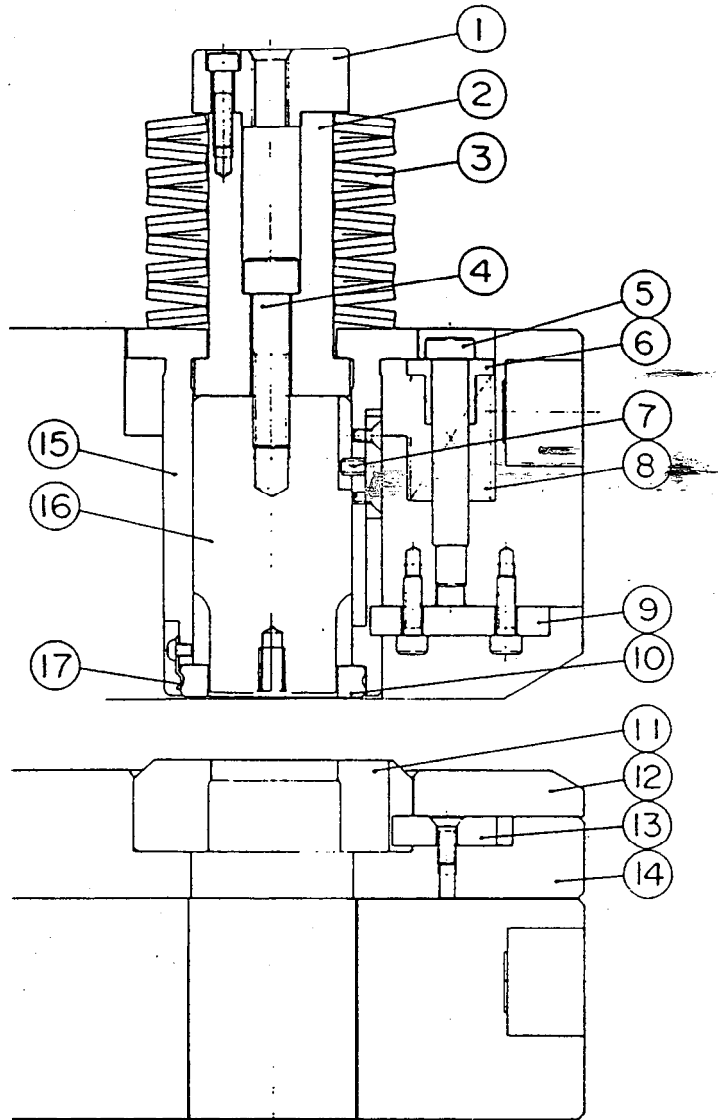
TYPE B (1-1/4")



1. PUNCH HEAD
2. PUNCH HEAD COLLAR
3. PUNCH BODY
4. STRIPPING SPRING
5. RETAINER COLLAR
6. SETSCREW
7. PUNCH GUIDE
8. GUIDE KEY
9. DIE
10. DIE SPACER
11. DIE HOLDER
12. KEY
13. SHOULDER SCREW
14. LIFT RING
15. LIFT SPRING



- 1. PUNCH HEAD
- 2. PUNCH DRIVER
- 3. STRIPPING SPRING
- 4. PUNCH TIP FIXING-BOLT
- 5. SHOULDER SCREW
- 6. LIFT RING
- 7. PUNCH KEY
- 8. LIFT SPRING
- 9. GUIDE KEY
- 10. STRIPPER PLATE
- 11. DIE
- 12. DIE SPACER
- 13. DIE KEY
- 14. DIE HOLDER
- 15. PUNCH GUIDE
- 16. PUNCH TIP
- 17. STRIPPER PLATE SPRING



(Type C)

# LOADING AND UNLOADING PUNCHES AND DIES

## TYPE A (1/2")

### Loading on center and inner tracks

1. Insert the die remover up through the bottom of the lower turret until it protrudes from the top of the upper turret.
2. Place the die on the remover. Put the jig on top of the die, and holding the die between the jig and remover, press the die down until it seats snugly into the die holder of the lower turret (Photos 4 and 5). Remove the jig and die remover.
3. Insert the punch into the upper turret (Photo 6).

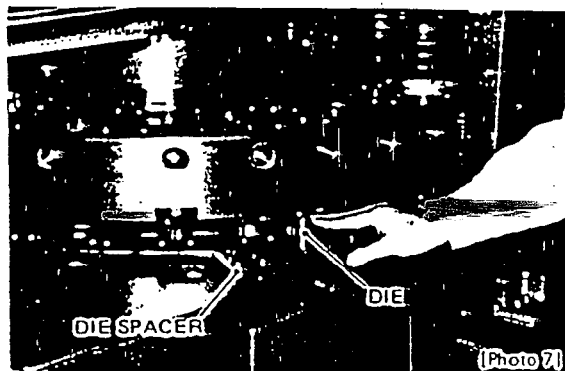
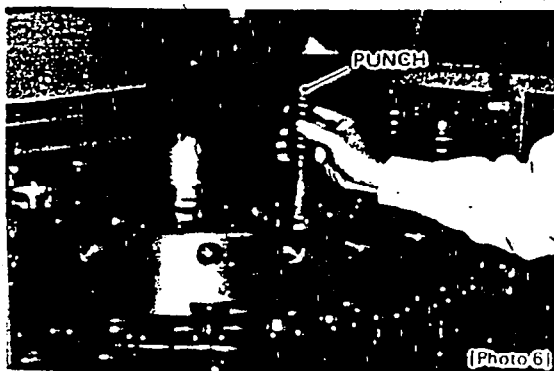
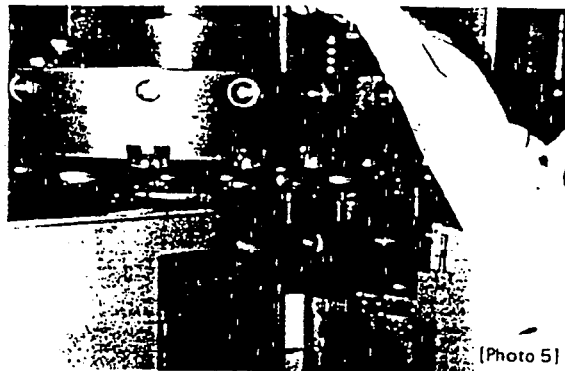
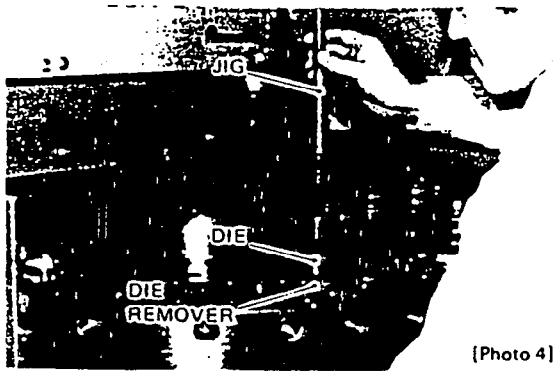
### Loading on outer track

1. Remove the die spacer and insert the die into the die holder of the lower turret (Photo 7)
2. Push the die firmly into the die holder and make sure it is properly seated.
3. Re-install the die-spacer.
4. Insert the punch into the upper turret.

**NOTE:** (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page I-21.

(b) Round punches and dies can be loaded on any of the, inner, center and outer tracks. However, shaped punches and dies can be loaded on only the outer track.

(c) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

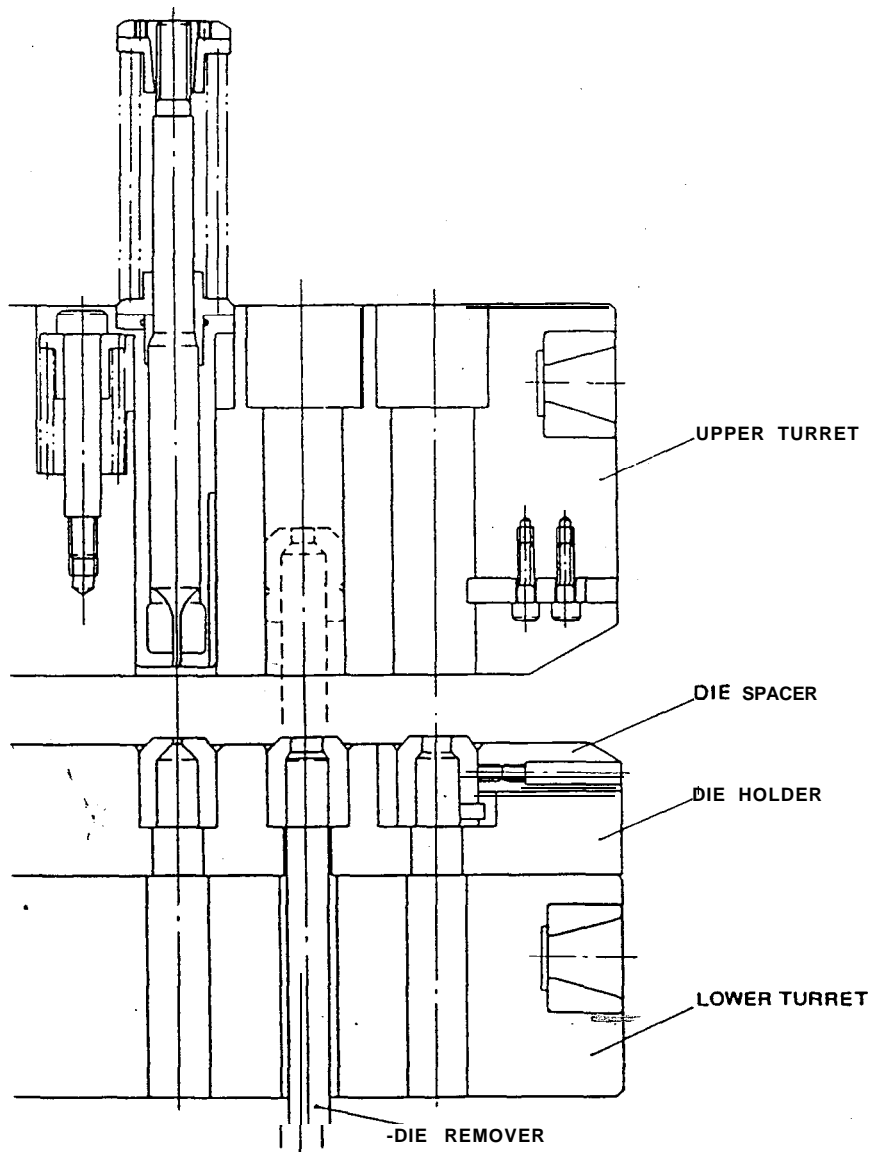


Unloading from center and inner tracks

1. Remove the punch from the upper turret.
2. Insert the die remover into the lower turret through the bottom of the lower turret.
3. Push the die upward with the die remover, and remove the die through the top of the upper turret.

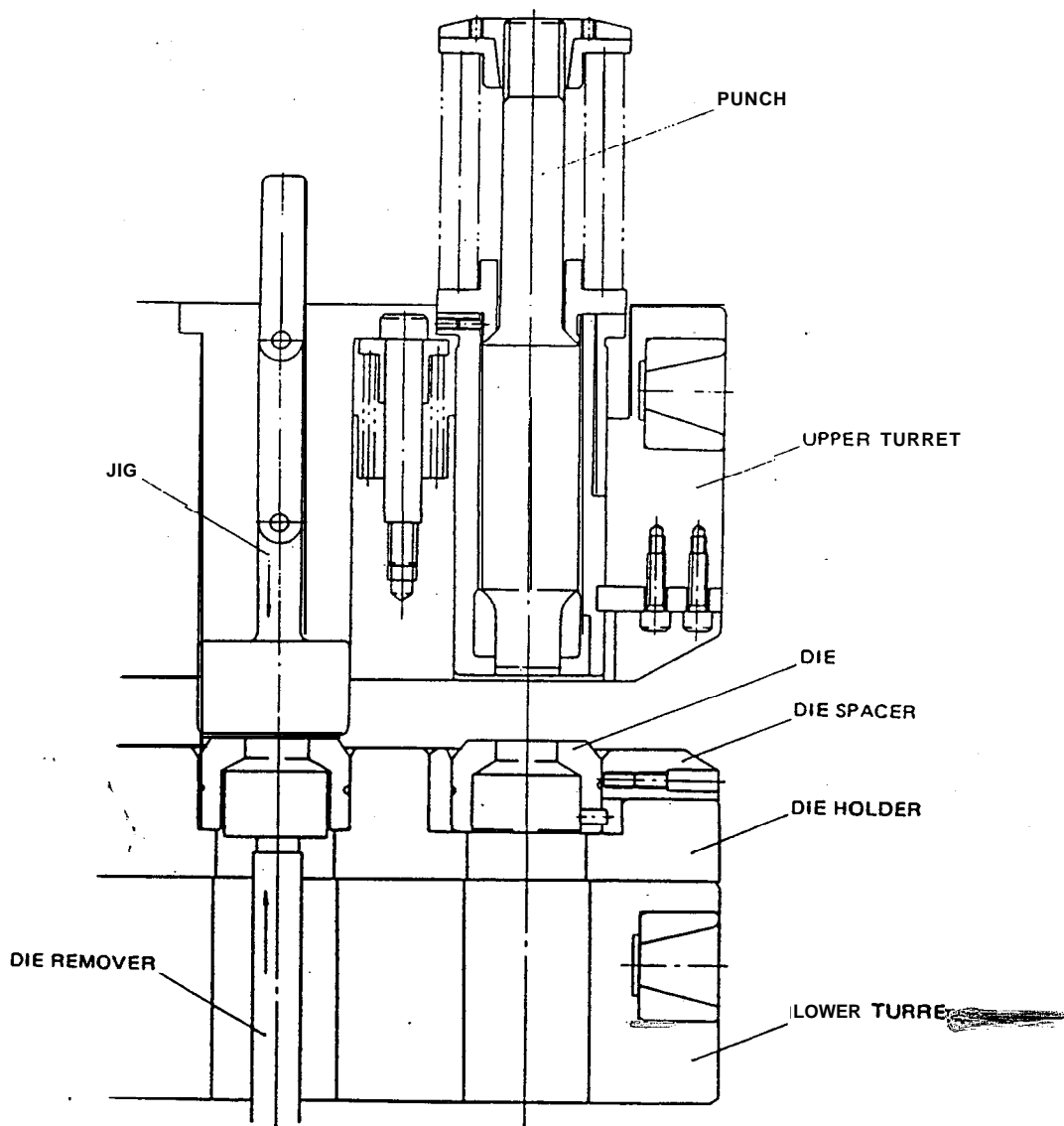
Unloading from outer track

1. Remove the punch from the upper turret and remove the die spacer from the lower turret.
2. Insert the die remover into the lower turret through the bottom of the lower turret.
3. Push the die upward with the die remover, and remove the die between the upper and lower turrets.



Load and unload punches and dies using the same procedures as those used for type A (1/2"). While round punches and dies can be loaded on both the inner and the outer tracks, shaped punches and dies can only be loaded on the outer track.

- NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page I-21.
- (b) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.



TYPES C (2"), D (3-1/2"), E (4-1/2") AND F (6")

#### Loading

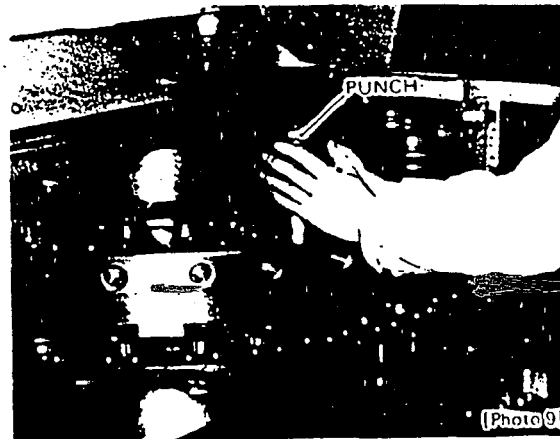
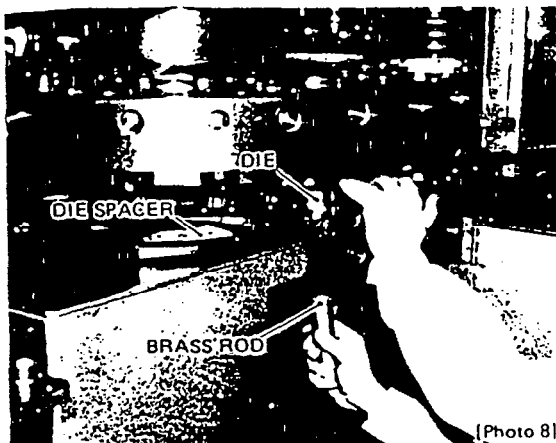
1. Remove the die spacer from the lower turret.
2. Insert the die into the die holder of the lower turret.
3. Insert a brass rod (standard accessory) into the lower turret through the bottom of the lower turret. Using the brass rod, place the die into the die holder securely (Photo 8).
4. Re-install the die spacer and insert the punch into the upper turret (Photo 9).

NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page I-21.

(b) When loading a shaped- punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of die.

#### Unloading

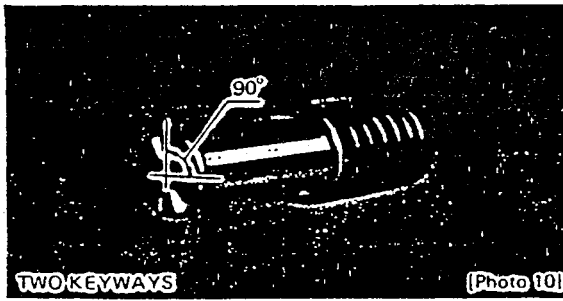
1. Remove the punch from the upper turret.
2. Remove the die spacer from the lower turret and insert the brass rod into the lower turret through the bottom of the lower turret.
3. Push up the die with the brass rod and remove the die between the upper and lower turrets.



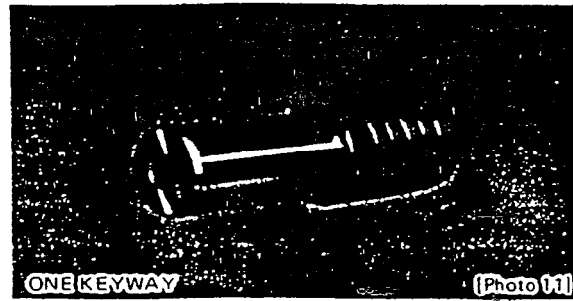
# KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

## KEYS AND KEYWAYS IN TOOLS

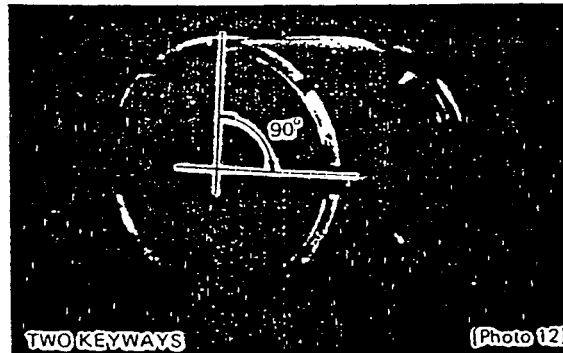
1/2" and 1-1/4" punches (Shaped)



1/2" and 1-1/4" punches (Round)



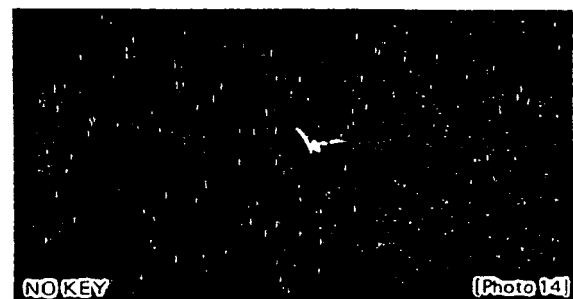
2", 3-1/2", 4-1/2" and 6" punches (Shaped and round)



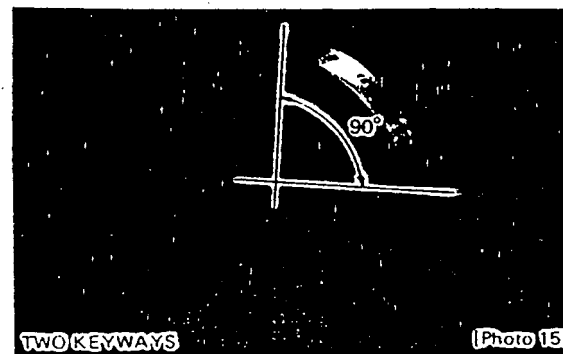
1/2" and 1-1/4" dies (Shaped)



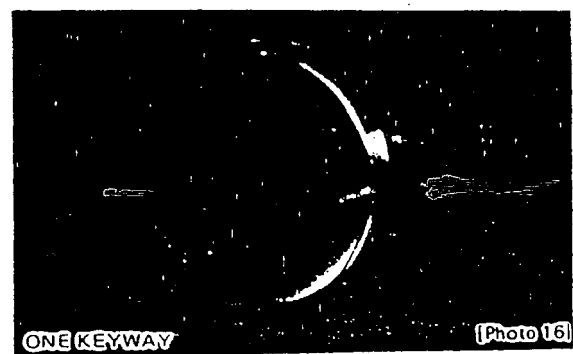
1/2" and 1-1/4" dies (Round)



2", 3-1/2", 4-1/2" and 6" dies (Shaped)

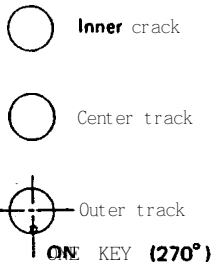


2", 3-1/2", 4-1/2" and 6" dies (Round)

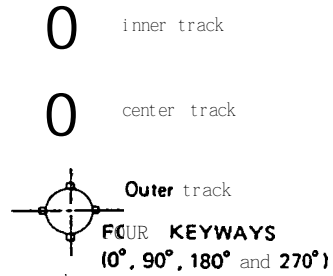


# KEYS AND KEYWAYS IN TURRET STATIONS

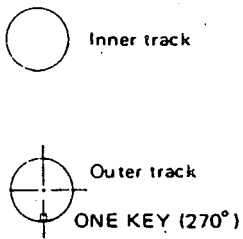
## 1/2" station (upper turret)



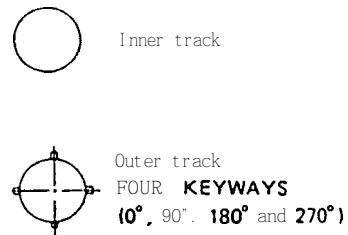
## 1/2" station (lower turret)



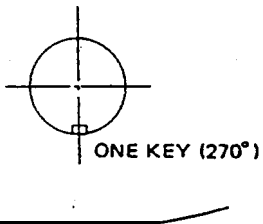
## 1-1/4" station (upper turret)



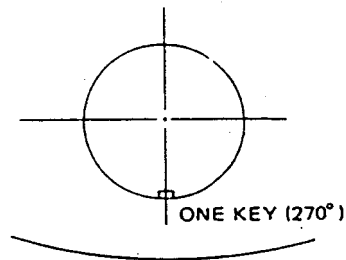
## 1-1/4" station (lower turret)



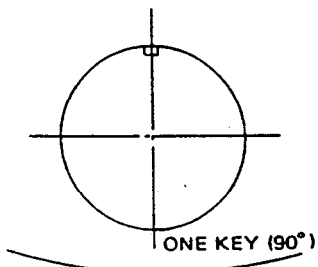
## 2" station (upper and lower turrets)



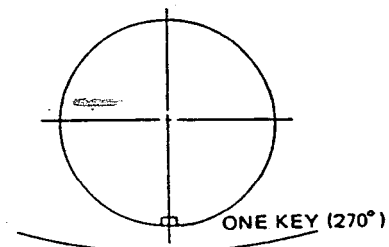
## 3-1/2" station (upper and lower turrets)



## 4-1/2" station (up&r and lower turrets)



## 6" station (upper and lower turrets)



# MAINTENANCE OF PUNCHES AND DIES

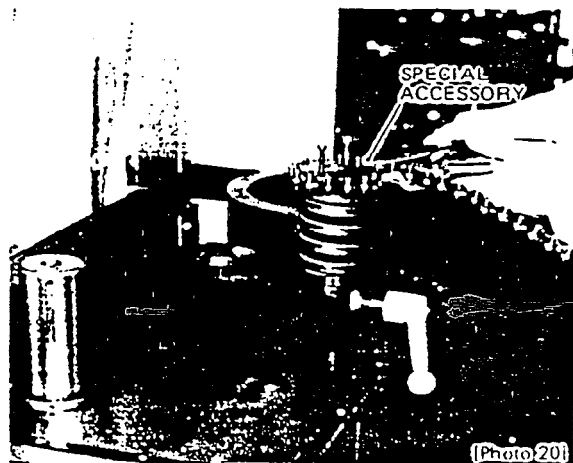
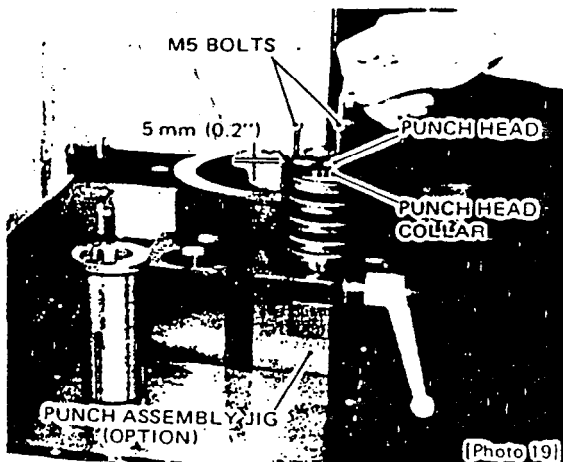
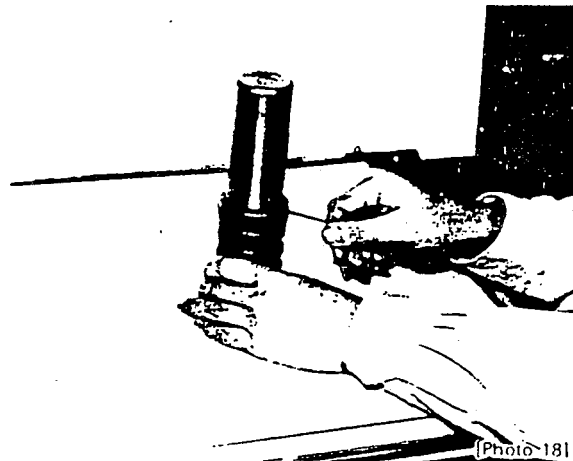
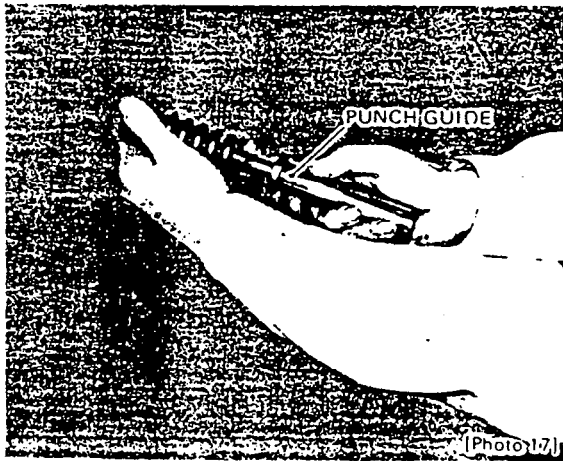
## DISASSEMBLY AND ASSEMBLY OF PUNCHES (Types A and B)

### Disassembly

1. Remove the punch guide from the punch assembly as shown in Photo 17. On the type B punch, loosen the setscrew which retains the punch guide and remove the guide (Photo 18).
2. Place the punch body in a vise with soft jaws.
3. Install the M5 bolts in the two bolt holes in the punch head, and tighten them equally until the clearance between the punch head and its collar is approximately 5 mm (0.2 in) (Photo 19).
4. Loosen the punch head with a pipe wrench and disassemble the punch assembly (Photo 20).

### Assembly

Assemble the retainer collar, stripping spring, punch head collar and the punch head to the punch body. Using a pipe wrench, tighten the punch head until the specified punch height is obtained. Apply a coat of machine oil to the frictional surface of the punch body and assemble the punch guide to the punch body.

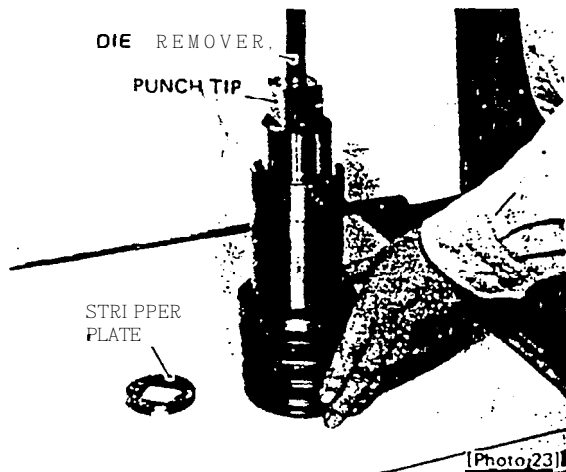
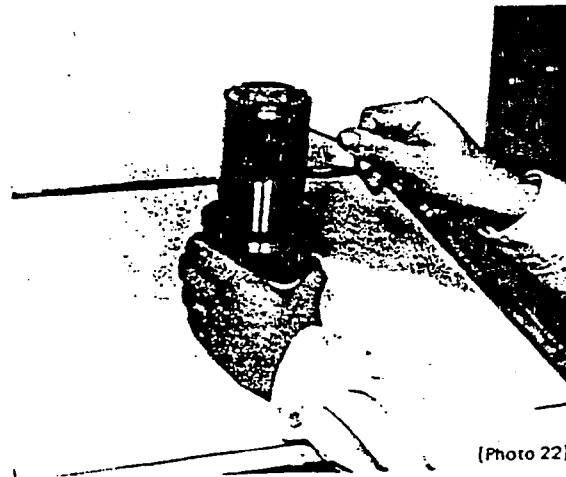
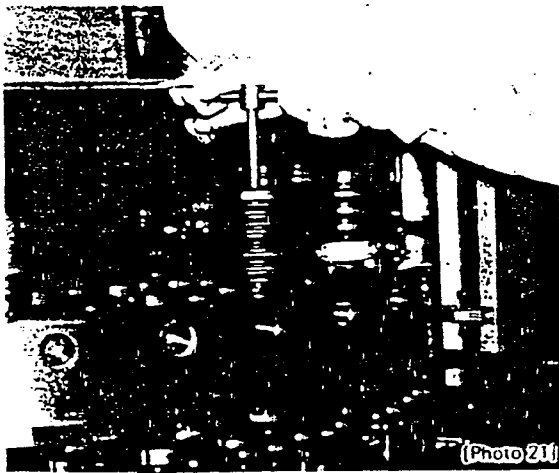


## Removal

1. Using a T-wrench (furnished as a standard accessory), slightly loosen the punch tip fixing bolt with the punch assembly in the upper turret (Photo 21).
2. Remove the punch assembly from the upper turret.
3. Loosen the punch tip fixing bolt just enough to free it from the punch tip.
4. Loosen screws which retain stripper plate springs, and remove the stripper plate (Photo 22).
5. Screw the die remover into the thread hole of the punch tip, and pull the punch tip out (Photo 23).

## Installation

1. Apply a coat of machine oil to the punch tip, and then insert it into the punch guide.
2. Install the stripper plate and tighten screws which retain stripper plate springs.
3. Temporarily tighten the punch tip fixing bolt.
4. Insert the punch assembly into the upper turret, and then tighten the punch tip fixing bolt securely.



The punches and dies should be reground frequently to extend their service life. Observe the edges of the punch and die to be sure that they are sharp and lustrous. If the edges are rounded or have a frosted appearance, the punch and die should be re-ground. If grinding is not done frequently at the correct stage of wear, the extra force required by the already frosted edge causes increasingly rapid and intense wear. Proper grinding for one time would be 0.2 mm (0.008 in) for the punch and 0.1 mm (0.004 in) for the die. The punch can be ground a maximum of 2 mm (0.08 in) during its service life, and the die can be ground a maximum of 1 mm (0.04 in). After the punch and die have been ground, their edges should be finished with an oil stone.

**ADJUSTMENT OF PUNCH AND DIE HEIGHT**

After grinding, the punch and die must be adjusted to their specified height. When adjusting the punch and die height, observe the following:

**Type A and B punches**

Turn the punch head with a pipe wrench until the specified punch height is obtained (See Photo 20 on page I-17).

Specified punch height: 207 mm (8.15")

**Type C, D, E and F punches**

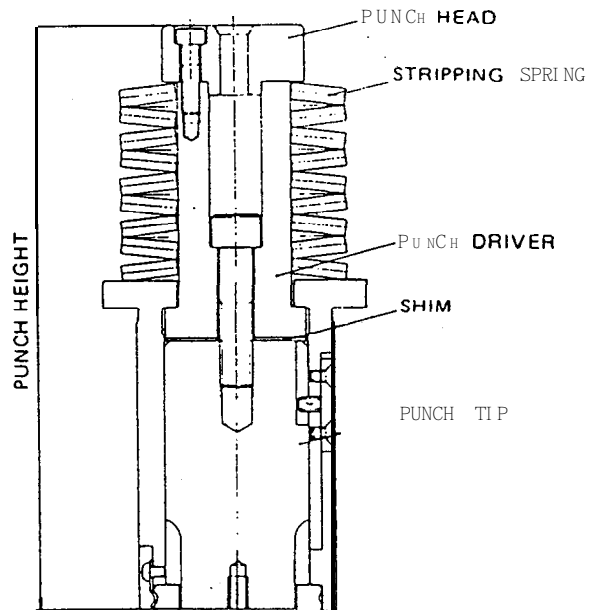
Insert a shim (proportionate to the amount of grinding done) between the punch driver and the punch tip to adjust the punch height to specifications.

Specified punch height:

Type C . . . . . 207 mm (8.15")

Type D . . . . . 209 mm (8.23")

Types E and F . . . . . 210 mm (8.27")



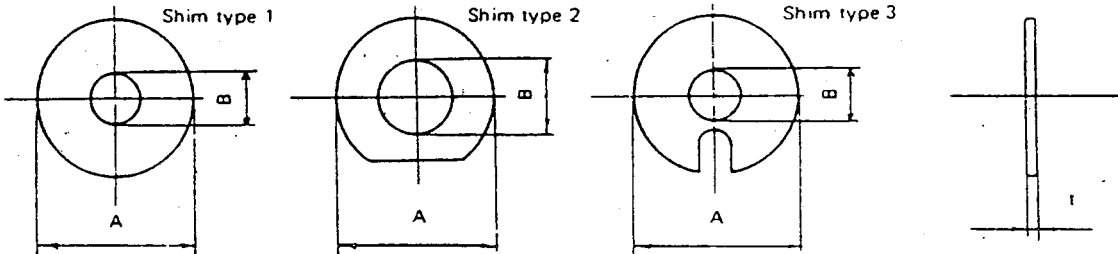
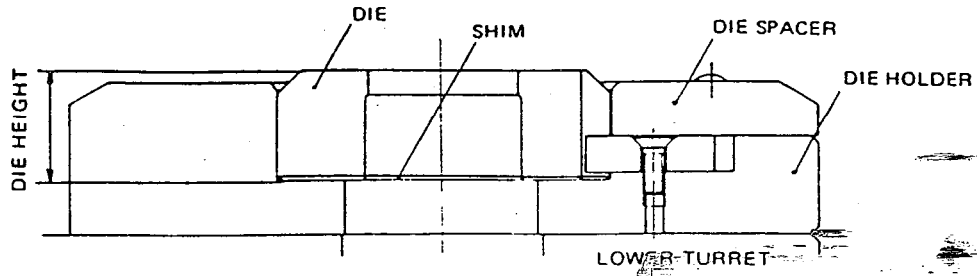
(Type C)

Insert a shim (proportionate to the amount of grinding done) between the die holder and the die.

Specified die height:

Types A, B, C, D and E . . . . . 30 mm (1.18")

Type F . . . . . 35 mm (1.38")

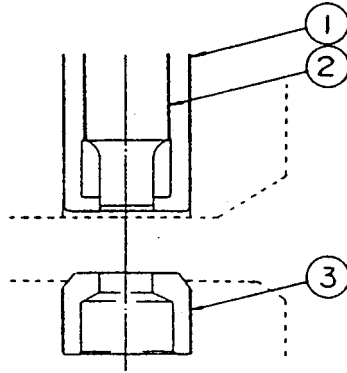


	Tool type	Applicable shim type	Dimensions		
			A (mm)	B (mm)	t (mm)
Punch shim	C	1	40	15	0.4, 0.8, 1.2, 1.6, 2.0
	D	3	89	15	
	E	3	114	15	
	F	3	152	15	
Die shim.	A	1	25	15	0.4, 0.8, 1.2
	B	1	47	35	
	C	2	88	55	
	D	2	125	93	
	E	2	158	119	
	F	2	208	160	

## LUBRICATION

Before loading the punch and die on the turret, apply machine oil to their lubrication points.

Lubrication points:



## INSPECTING PUNCHES AND DIES

1. Disassemble the punch and remove any accumulated scales.
2. If the edges of the punch and die are rounded or have a frosted appearance, regrind them,
3. If the stripping spring is fatigued, replace it with a new one.

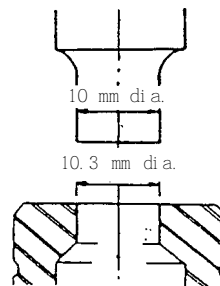
## INSPECTING WORKSHEETS

Check to make sure that the worksheet is not warped. Warped worksheet will cause the punch to stick to the worksheet.

## PUNCH-TO-DIE CLEARANCE

The punch-to-die clearance is indicated by the difference between the punch and die diameters. For example, when a 10 mm diameter punch and a 10.3 mm diameter die are used, the clearance is 0.3 mm.

$$10.3 - 10 = 0.3 = \text{Punch-to-die clearance}$$



The punch-to-die clearance must be determined according to the thickness and type of the worksheet as shown in the table below.

Thickness (mm)	Punch-to-die clearance (mm)	Material		
		Mild steel	Aluminum	Stainless steel
0.8 - 1.6		0.2 - 0.3	0.2 - 0.3	0.20 - 0.35
1.6 - 2.3		0.3 - 0.4	0.3 - 0.4	0.4 - 0.5
2.3 - 3.2		0.4 - 0.6	0.4 - 0.5	0.5 - 0.7
3.2 - 4.5		0.6 - 0.9	0.5 - 0.7	0.7 - 1.2
4.5 - 6.0		0.9 - 1.2	0.7 - 0.9	

## PUNCH CAPACITY

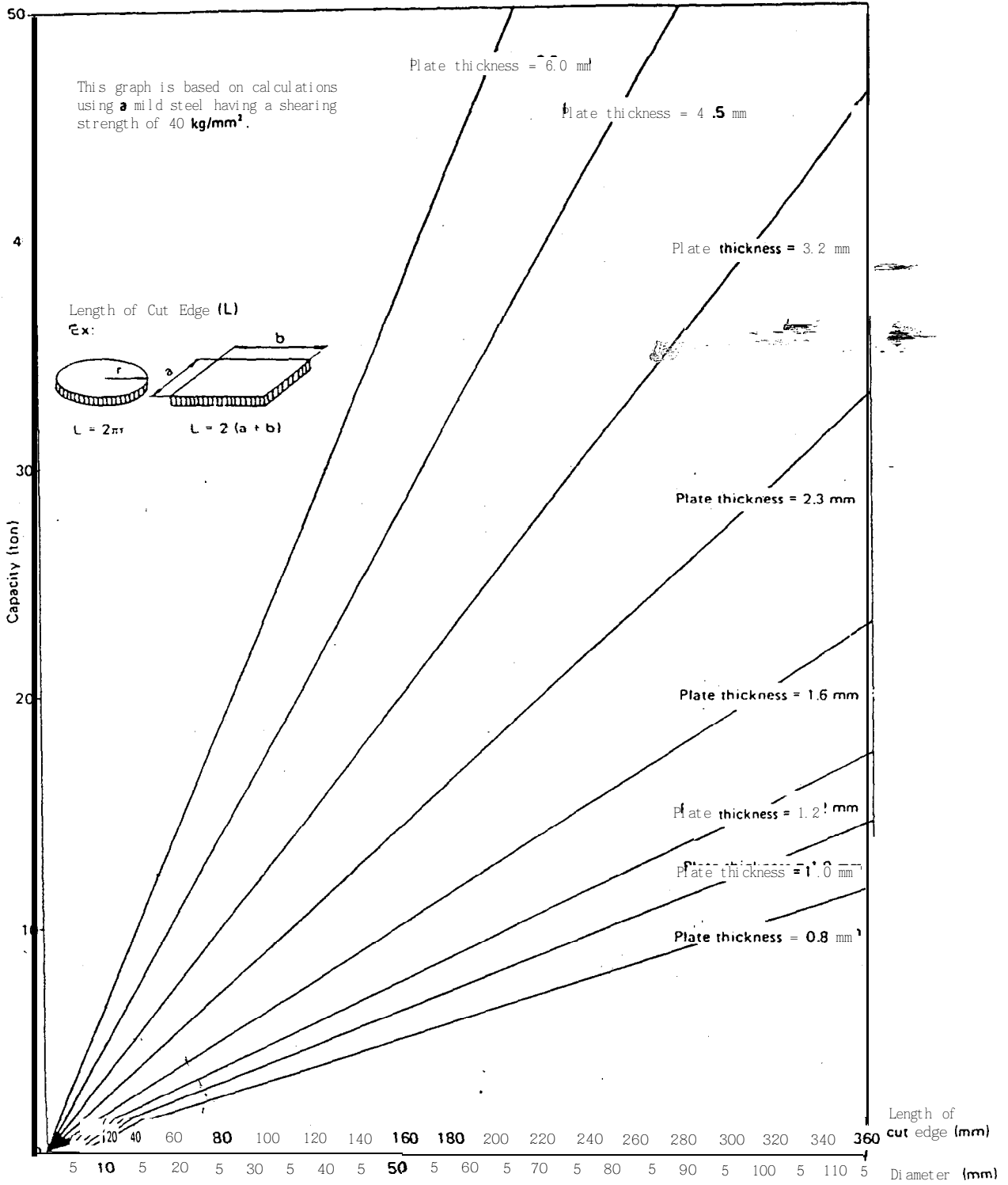
The maximum punchable hole diameter is determined by the type and the thickness of the worksheet. The punching force required is generally calculated by using the following formula:

$$P \text{ (ton)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (kg/mm}^2\text{)}}{1000}$$

- where, P: Force required  
 A: Length of cut edge  
 t: Thickness of worksheet  
 $\tau$ : Shearing strength of worksheet

If P does not exceed the machine capacity (50 tons on COMA and 30 tons on PEGA and VELA-II), the worksheet is punchable. The calculation shows that 66.3 mm (on COMA) and 39.8 mm (on PEGA and VELA-II) are the maximum punchable hole diameters when the worksheet thickness is 6 mm and the shearing strength is 40 kg/mm<sup>2</sup>. On page 1-23 is a graph showing the maximum punchable hole diameters for a variety of plate thicknesses. The graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm<sup>2</sup>.

# PUNCHING CAPACITY



## MINIMUM HOLE DIAMETER

The following table shows the minimum diameters of punchable holes.

Material	Minimum hole diameter
Mild steel	1.0 x t
Aluminum	1.0 x t
Stainless steel	2.0 x t

t: Thickness of worksheet

Example: The minimum hole diameter for mild steel with a thickness of 2.3 mm is:  
 $1.0 \times 2.3 \text{ mm} = 2.3 \text{ mm dia.}$

## PRECAUTIONS FOR PUNCHING THICK WORKSHEETS

When punching the thick worksheet, use a tool one size larger than the normal usage size. If tools in the normal usage size are used, the punch head threads may be damaged.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	8.2 – 12.7 mm
	4.5 mm	11.0 – 12.7 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	8.2 – 12.7 mm

-USE TYPE 8 (1-1/4") PUNCHES.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	22.9 – 31.7 mm
	4.5 mm	30.6 – 31.7 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	22.9 – 31.7 mm

-USE TYPE C (2") PUNCHES.

## THIN TURRET

### STATION ARRANGEMENT

40-station turret (VELA II and PEGA) . . . . . 2-1

### TOOL TYPES

Small diameter type (1.6 to 31.7 mm dia.) . . . . . 2-2

Large diameter type (31.8 to 88.9 mm dia.) . . . . . 2-3

### LOADING AND UNLOADING PUNCHES AND DIES

Small diameter type . . . . . 2-4

Large diameter type . . . . . 2-5

### KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

Keys and keyways in tools . . . . . 2-6

Keys and keyways in turret stations . . . . . 2-7

### MAINTENANCE OF PUNCHES AND DIES

Disassembly of punches (Small dia. type) . . . . . 2-8

Removal and installation of punch tips (Large dia. type) . . . . . 2-8

Re-grinding punches and dies . . . . . 2-8

Adjustment of punch and die height . . . . . 2-9

Lubrication . . . . . 2-10

Inspecting punches and dies . . . . . 2-10

Inspecting worksheets . . . . . 2-10

PUNCH-TO-DIE CLEARANCE. . . . . 2-10

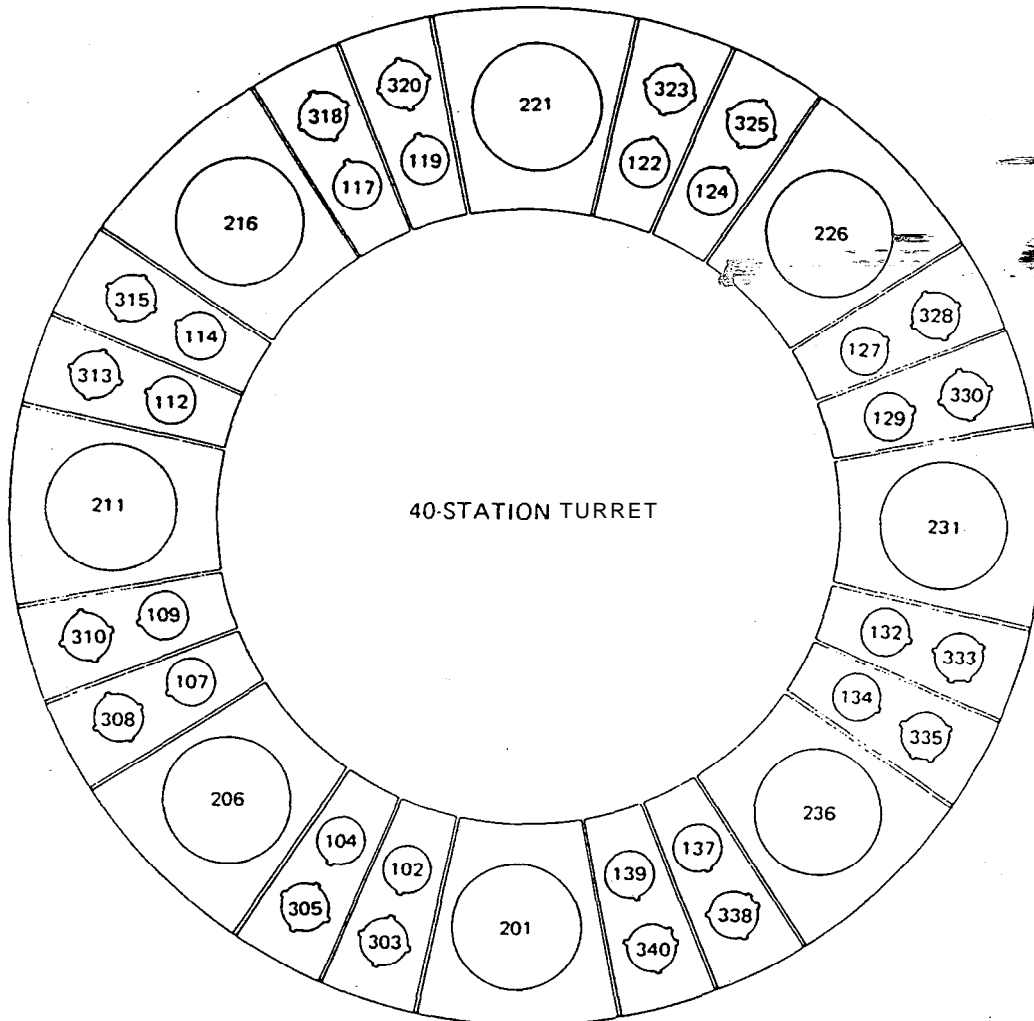
PUNCH CAPACITY . . . . . ~~2-11~~

MINIMUM HOLE DIAMETER . . . . . 2-12

PRECAUTIONS FOR PUNCHING THICK WORKSHEETS . . . . . 2-13

# STATION ARRANGEMENT

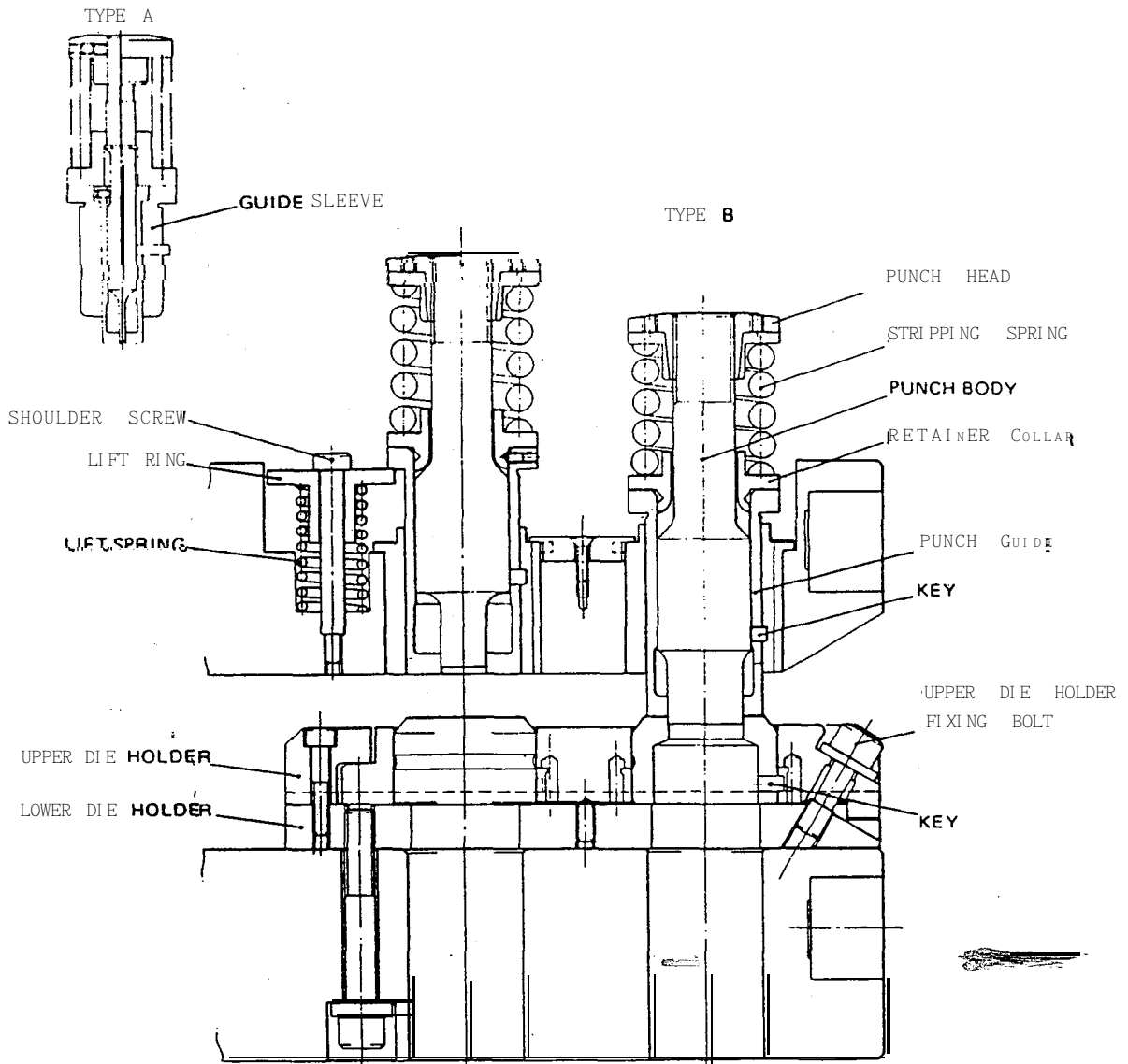
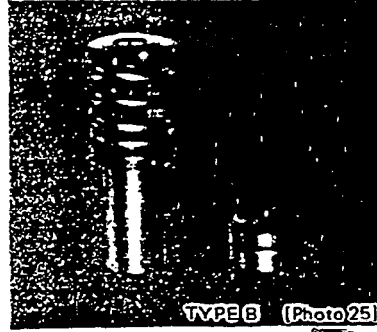
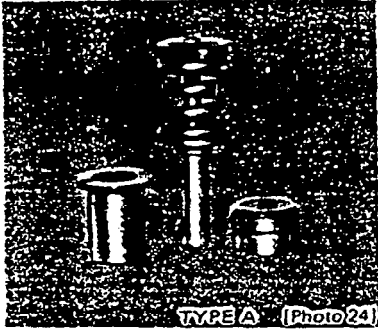
## 40-STATION TURRET (VELA II AND PEGA)



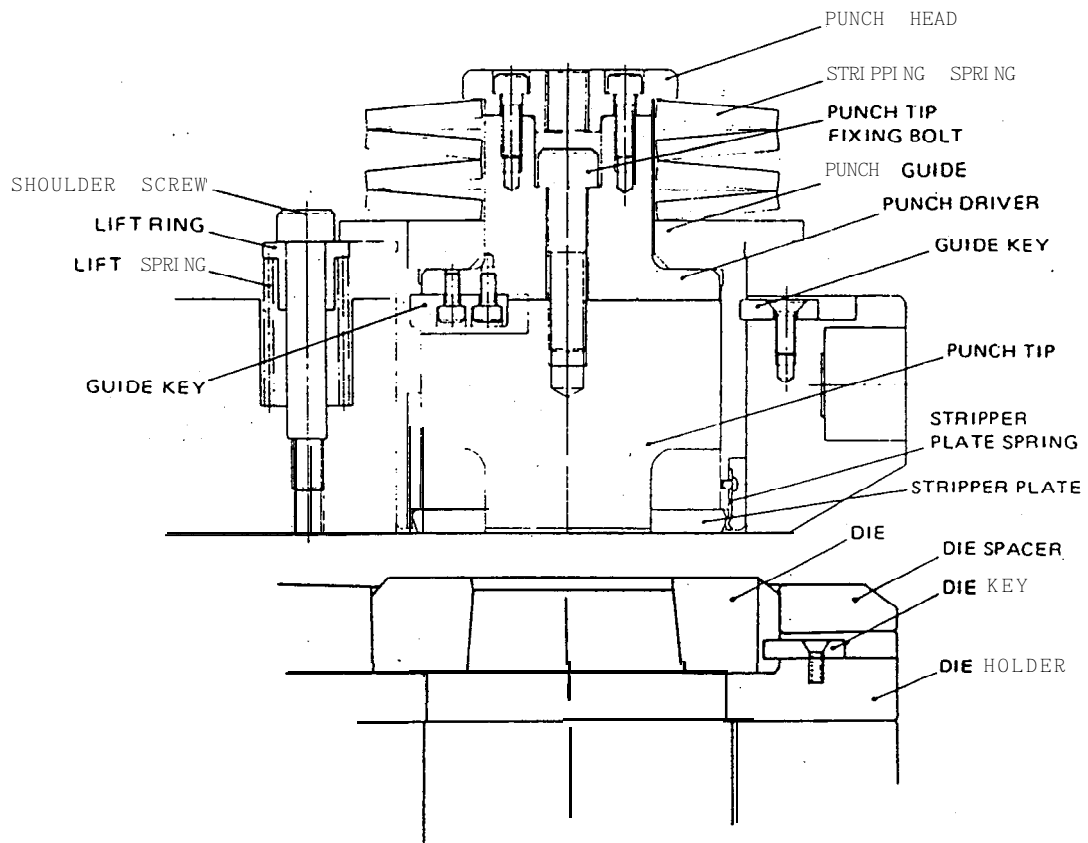
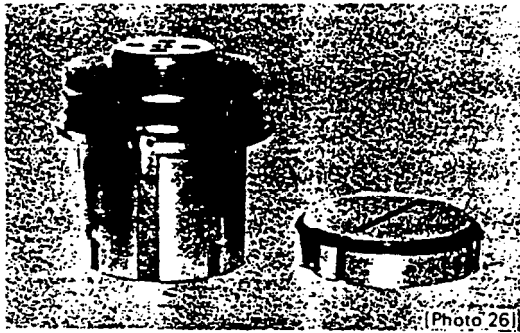
Tool Type		Standard Punch Size	Number of Stations Available
Small diameter	Type A	1.6 – 10.9 mm dia. (0.063" – 0.43" dia.)	32 stations
	Type B	11.0 – 31.7 mm dia. (0.431" – 1.25" dia.)	
Large diameter		31.8 – 88.9 mm dia. (1.251" – 3.5" dia.)	8 stations

# TOOL TYPES

## SMALL DIAMETER TYPE (1.6 to 31.7 mm dia.)



LARGE DIAMETER TYPE (31.8 to 88.9 mm dia.)



SMALL DIAMETER TYPE

Loading

1. Remove the upper die holder fixing bolt (Photo 27).
2. Remove the upper die holder from the lower turret with a puller furnished as a standard accessory (Photo 28).
3. Turn the upper die holder upside down and insert the die into it (Photo 29).
4. Re-install the upper die holder on the lower turret (Photo 30).
5. Tighten the upper die holder fixing bolt.
6. Insert the punch into the upper turret (Photo 31 ).

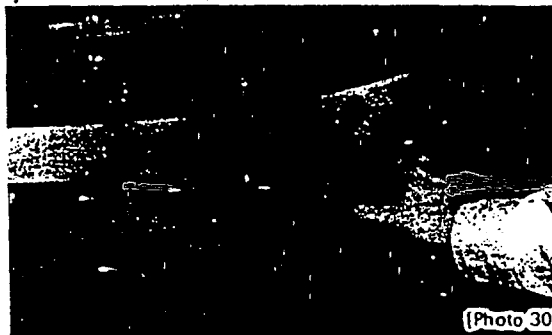
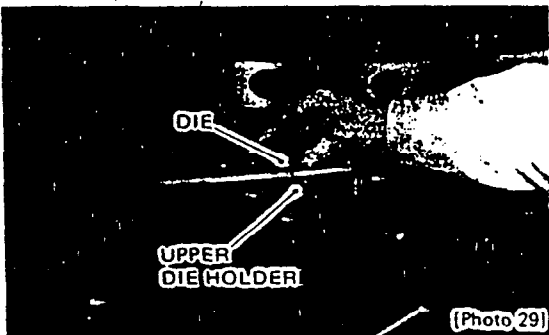
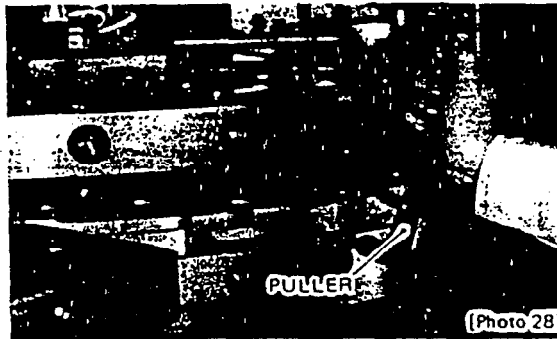
NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 2-10.

(b) When loading the type A punch, use the guide sleeve.

(c) When loading a shaped-punch, align the punch guide key with the keyway in the upper turret so that the orientation of the punch matches that of the die.

Unloading

1. Remove the punch from the upper turret.
2. Loosen the upper die holder fixing bolt, and remove the upper die holder from the lower turret with the puller.
3. Remove the die from the upper die holder by tapping the top of the die with a brass rod (standard accessory).



## LARGE DIAMETER TYPE

### Loading

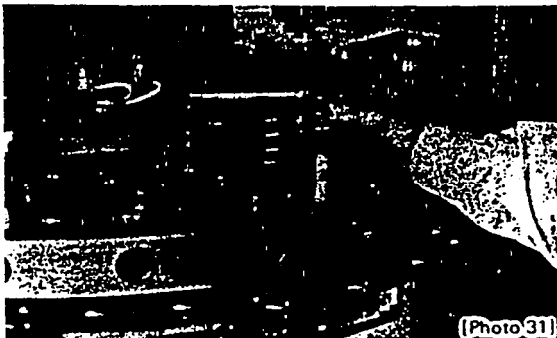
1. Remove the die spacer from the lower turret.
2. Insert the die into the die holder of the lower turret.
3. Insert a brass rod (standard accessory) into the lower turret through the bottom of the lower turret. Using the brass rod, place the die into the die holder securely as shown -in Photo 8 on page 1-14.
4. Re-install the die spacer and insert the punch into the upper turret.

NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 2-10.

(b) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

### Unloading

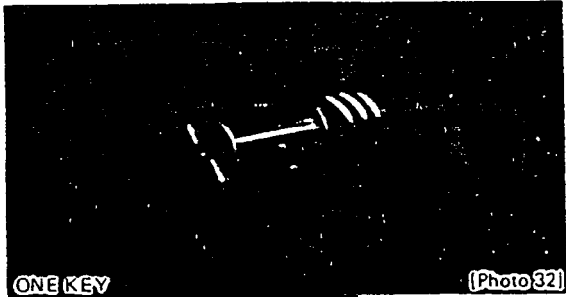
1. Remove the punch from the upper turret.
2. Remove the die spacer from the lower turret and insert the brass rod into the lower turret through the bottom of the lower turret:
3. Push up the die with the brass rod and remove the die between the upper and lower turrets.



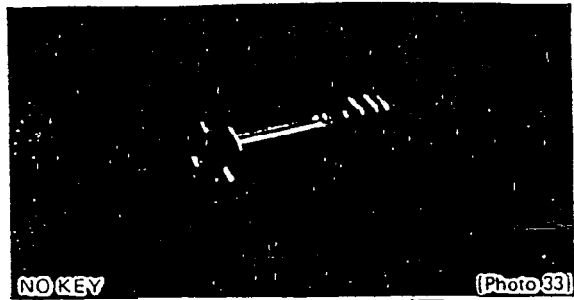
# KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

## KEYS AND KEYWAYS IN TOOLS

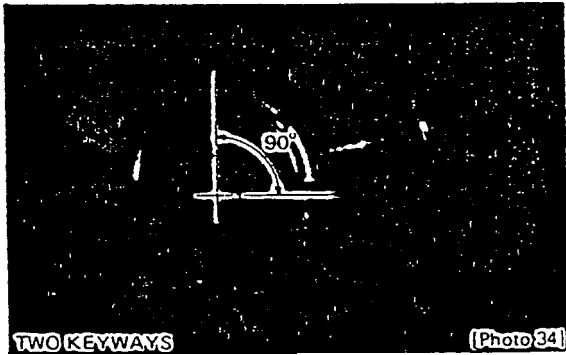
Small dia. punch (Shaped)



Small dia. punch (Round)



Large dia. punch (Shaped and round)



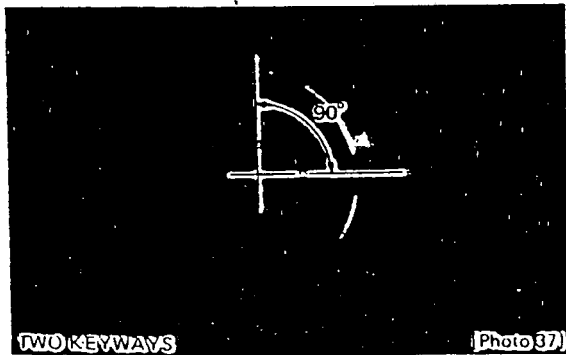
Small dia. die (Shaped)



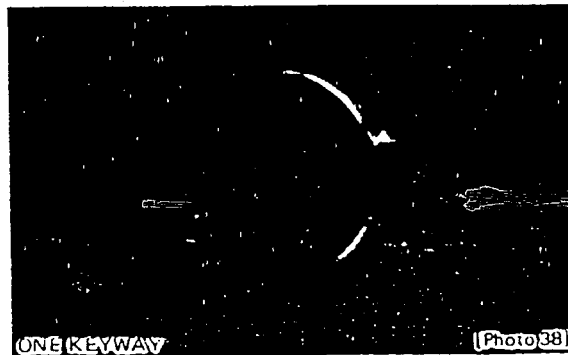
Small dia. die (Round)



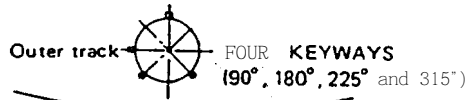
Large dia. die (Shaped)



Large dia. die (Round)



Small dia. station (Upper and lower turrets)



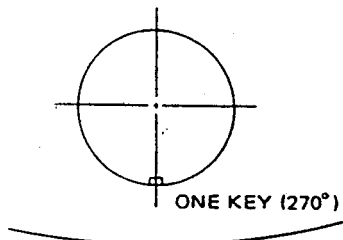
Station Nos. T303, T305, T308,  
T310, T313, T315, T318, T320,  
T323, T325, T328, and T330

Station Nos. 1333 and T335



Station Nos. T338 and T340

Large dia. station (Upper and lower turrets)



## MAINTENANCE OF PUNCHES AND DIES

### DISASSEMBLY OF PUNCHES (Small dia. type)

To disassemble the punch assembly, remove setscrews from the punch head and the punch guide.

### REMOVAL AND INSTALLATION OF PUNCH TIPS (Large dia. type)

#### Removal

1. Using a T-wrench (furnished as a standard accessory), slightly loosen the punch tip fixing bolt with the punch assembly in the upper turret.
2. Remove the punch assembly from the upper turret.
3. Loosen the punch tip fixing bolt just enough to free it from the punch tip.
4. Loosen screws which retain stripper plate springs, and remove the stripper plate. See photo 22 on page I-18.
5. Screw the die remover into the thread hole of the punch tip, and pull the punch tip out. See -photo 23 on page I-1 8.

#### Installation

1. Apply a coat of machine oil to the punch tip, and then insert it into the punch guide.
2. Install the stripper plate and tighten screws which retain stripper plate springs.
3. Temporarily tighten the punch tip fixing bolt.
4. Insert the punch assembly into the upper turret, and then tighten the punch tip fixing bolt securely.

### RE-GRINDING PUNCHES AND DIES

The punches and dies should be re-ground frequently to extend their service life. Observe the edges of the punch and die to be sure that they are sharp and lustrous. If the edges are rounded or have a frosted appearance, the punch and die should be re-ground. If grinding is not done frequently at the correct stage of wear, the extra force required by the already frosted edge causes increasingly rapid and intense wear. Proper grinding for one time would be 0.2 mm (0.008 in) for the punch and 0.1 mm (0.004 in) for the die. The punch can be ground a maximum of 2 mm (0.08 in) during its service life, and the die can be ground a maximum of 1 mm (0.04 in). After the punch and die have been ground, their edges should be finished with an oil stone.

**ADJUSTMENT OF PUNCH AND DIE HEIGHT**

After grinding, the punch and die must be adjusted to their specified height. When adjusting the punch and die height, observe the following:

**Small diameter punches**

Loosen the setscrew which secures the punch head, and turn the punch head until the specified punch height is obtained (Photo 39). Tighten the setscrew after the specified punch height is obtained.

Specified punch height: 139.0 mm (5.47")

**Large diameter punches**

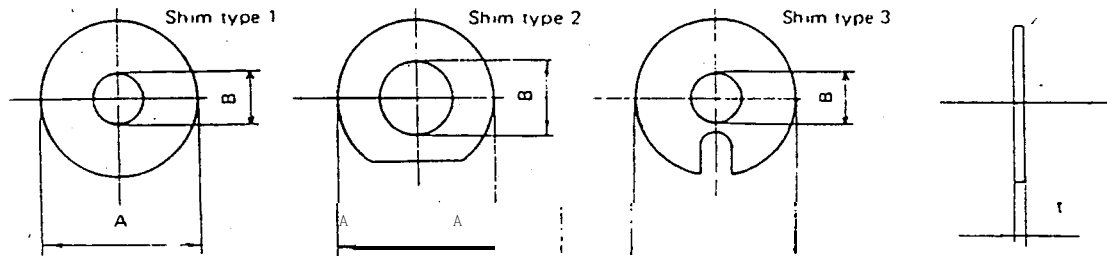
Insert a shim (proportionate to the amount of grinding done) between the punch driver and the punch tip to adjust the punch height to specifications.

Specified punch height: 140.5 mm (5.53")

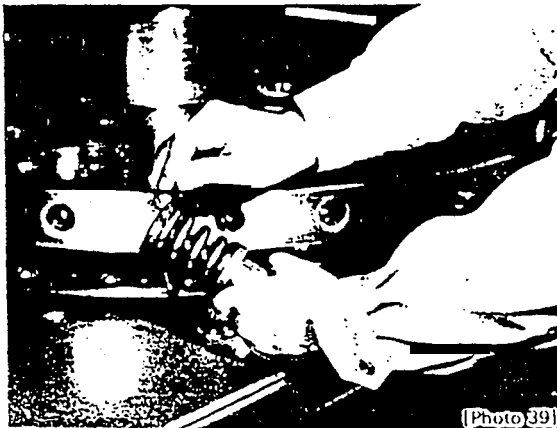
**Dies (small and large dia.)**

Insert a shim (proportionate to the amount of grinding done) between the die holder and the die.

Specified die height: 30 mm (1.18")



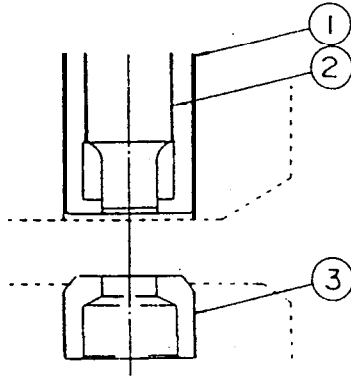
	Tool type	Applicable shim type	Dimensions		
			A (mm)	B (mm)	t (mm)
Punch shim	Large dia.	3	89	15	0.4, 0.8, 1.2, 1.6, 2.0
Die shim	Small dia.	1	47	35	0.4, 0.8, 1.2
	Large dia.	2	125	93	



## LUBRICATION

Before loading the punch and die on the turret, apply machine oil to their lubrication points.

Lubrication points:



## INSPECTING PUNCHES AND DIES

1. Disassemble the punch and remove any accumulated scales.
2. If the edges of the punch and die are rounded or have a frosted appearance, regrind them.
3. If the stripping spring is fatigued, replace it with a new one.

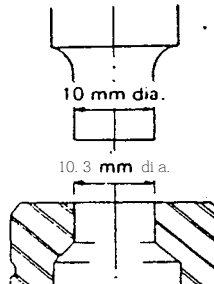
## INSPECTING WORKSHEETS

Check to make sure that the worksheet is not warped. Warped worksheet will cause the punch to stick to the worksheet.

## PUNCH-TO-DIE CLEARANCE

The punch-to-die clearance is indicated by the difference between the punch and die diameters. For example, when a 10 mm diameter punch and a 10.3 mm diameter die are used, the clearance is 0.3 mm.

$$10.3 - 10 = 0.3 = \text{Punch-to-die clearance}$$



The punch-to-die clearance must be determined according to the thickness and type of the worksheet as shown in the table below.

Punch-to-die clearance (mm) Thickness (mm)	Material		
	Mild steel	*Aluminum	Stainless steel
0.8 – 1.6	0.2 – 0.3	0.2 – 0.3	0.20 – 0.35
1.6 – 2.3	0.3 – 0.4	0.3 – 0.4	0.4 – 0.5
2.3 – 3.2	0.4 – 0.6	0.4 – 0.5	0.5 – 0.7
3.2 – 4.5	0.6 – 0.9	0.5 – 0.7	0.7 – 1.2
4.5 – 6.0	0.9 – 1.2	0.7 – 0.9	

## PUNCH CAPACITY

The maximum punchable hole diameter is determined by the type and the thickness of the worksheet. The punching force required is generally calculated by using the following formula:

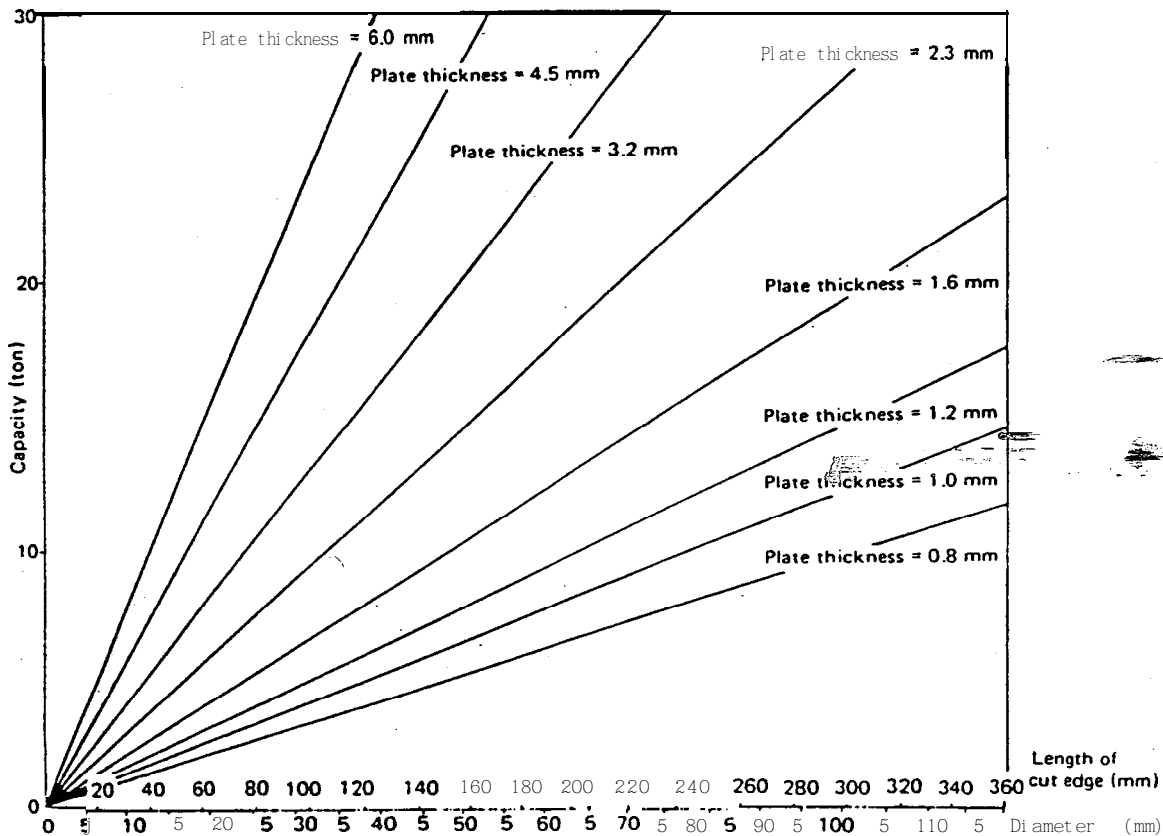
$$P \text{ (ton)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (kg/mm}^2\text{)}}{1000}$$

where, P: Force required  
 A: Length of cut edge  
 t: Thickness of worksheet  
 $\tau$ : Shearing strength of worksheet

If P does not exceed the machine capacity (30 tons), the worksheet is punchable. The calculation shows that 39.8 mm is the maximum punchable hole diameter when the worksheet thickness is 6 mm and the shearing strength is 40 kg/mm'.

The graph on page 2-1 2 shows the maximum punchable hole diameters for a variety of plate thicknesses. The graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm'.

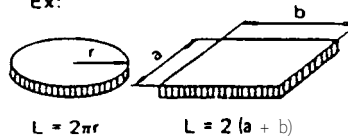
# PUNCHING CAPACITY



This graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm<sup>2</sup>.

Length of Cut Edge (L)

Ex:



## MINIMUM HOLE DIAMETER

The following table shows the minimum diameters of punchable holes.

Material	Minimum hole diameter
Mild steel	1.0 x t
Aluminum	1.0 x t
Stainless steel	2.0 x t

t: Thickness of worksheet

Example: The minimum hole diameter for mild steel with a thickness of 2.3 mm is:  
1.0 x 2.3 mm = 2.3 mm dia.

## PRECAUTIONS FOR PUNCHING THICK WORKSHEETS

When punching the thick worksheet, use a tool one size larger than the normal usage size.  
If tools in the normal usage size are used, the punch head threads may be damaged,

<u>Material</u>	<u>Thickness</u>	<u>H o l e d i a m e t e r</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	8.2 — 10.9 mm
	4.5 mm	11.0 - 10.9 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	8.2 — 10.9 mm

-USE TYPE B PUNCHES.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	22.9 — 31.7 mm
	4.5 mm	30.6 — 31.7 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	22.9 — 31.7 mm

-USE LARGE DIAMETER TYPE PUNCHES.

# THICK TURRET WITH AUTO-INDEX DEVICE

## STATION ARRANGEMENT

58-station turret (COMA, VELA-II, PEGA and PEGA KING) . . . . .	3-1
44-station turret (COMA, VELA-II, PEGA and PEGA KING) . . . . .	3-2

## TOOL TYPES

Type A (1/2") . . . . .	3-3
Type B (1-1/4") . . . . .	3-4
Types C (2"), D (3-1/2") and E (4-1/2") . . . . .	3-5

## LOADING AND UNLOADING PUNCHES AND DIES

Type A (1/2") . . . . .	3-6
Type B (1-1/4") . . . . .	3-8
Types C (2"), D (3-1/2") and E (4-1/2") . . . . .	3-10

## KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

Keys and keyways in tools . . . . .	3-11
Keys and keyways in turret stations . . . . .	3-12

## MAINTENANCE OF PUNCHES AND DIES

Disassembly and assembly of punches (Types A and B) . . . . .	3-13
Removal and installation of punch tips (Types C, D and E) . . . . .	3-14
Re-grinding punches and dies . . . . .	3-15
Adjustment of punch and die height . . . . .	3-15
Lubrication . . . . .	3-17
Inspecting punches and dies . . . . .	3-17
Inspecting worksheets . . . . .	3-17

PUNCH-TO-DIE CLEARANCE . . . . .	3-17
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PUNCH CAPACITY . . . . .	3-18
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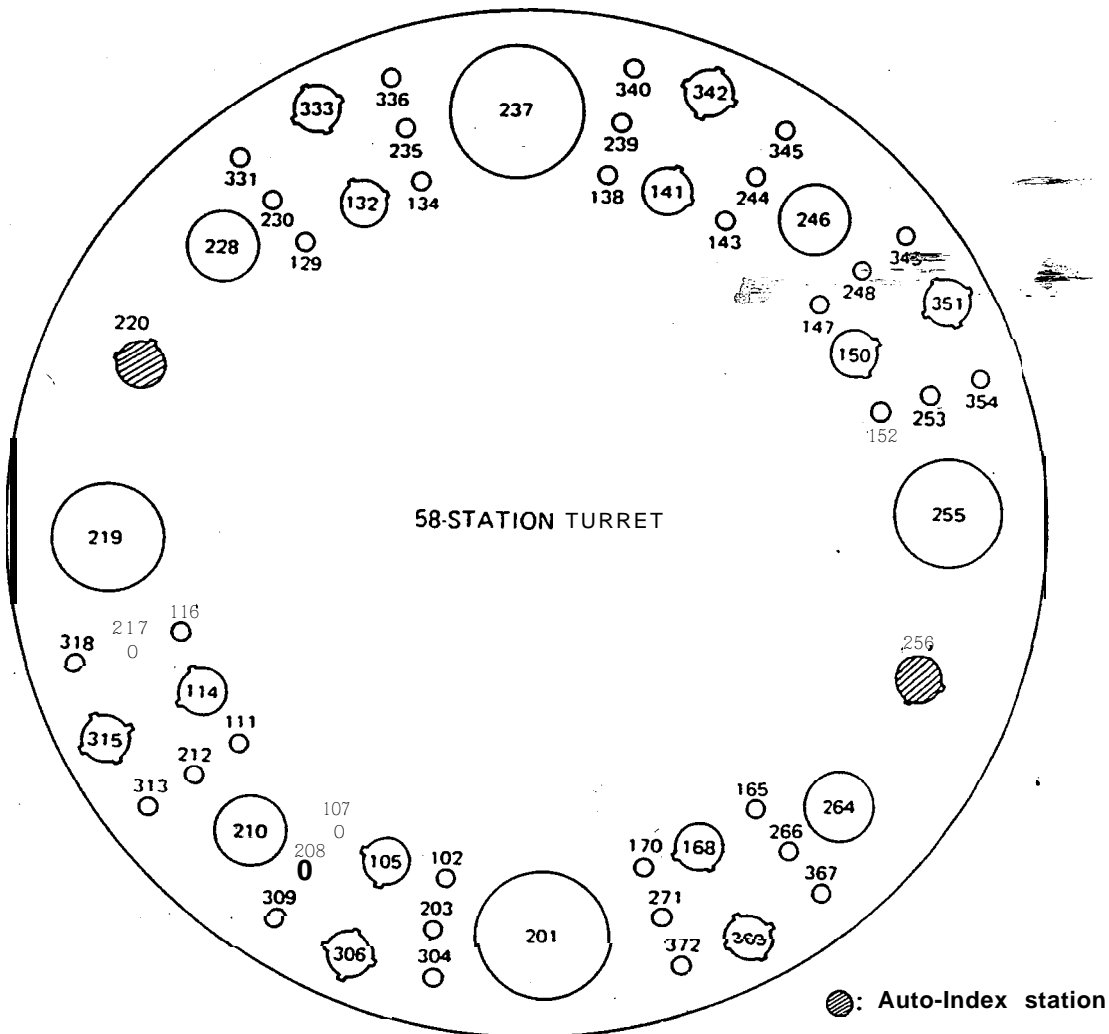
MINIMUM HOLE DIAMETER . . . . .	3-20
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"PRECAUTIONS FOR PUNCHING THICK WORKSHEETS . . . . .	3-20
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# THICK TURNER I WITH AUTO-INDEX DEVICE

## STATION ARRANGEMENT

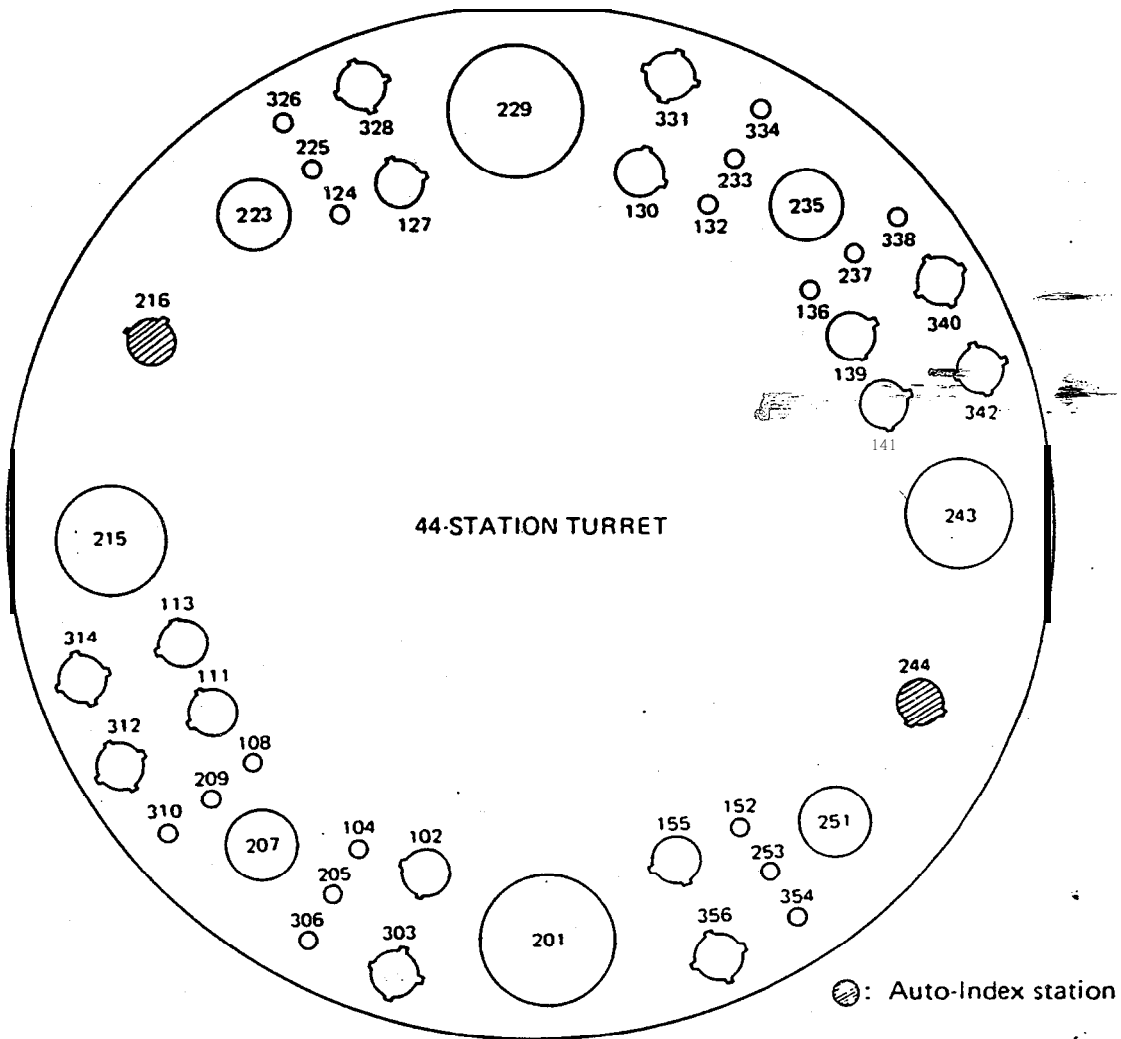
### 58-STATION TURRET (COMA, VELA-II, PEGA AND PEGA KING)



Tool Type	Nominal Tool Size	Standard Punch Size	Number of Stations Available*
A <sup>2</sup>	1/2"	1.6 – 12.7 mm dia. (0.063" – 0.5" dia.)	36 (12)
B	1-1/4"	12.8 – 31.7 mm dia. (0.501" – 1.25" dia.)	14 (14)
C	2"	31.8 – 50.8 mm dia. (1.251" – 2" dia.)	4 (4)
D	3-1/2"	50.9 – 88.9 mm dia. ( 2 . 0 0–1 3/5" dia.)	2 (2)
E	4-1/2"	89.0 – 114.3 mm dia. (3.501" – 4.5" dia.)	2 (2)

\* The numerals in parentheses indicate the number of stations which can accept shaped tools.

44-STATION TURRET (COMA, VELA-II, PEGA AND PEGA KING)

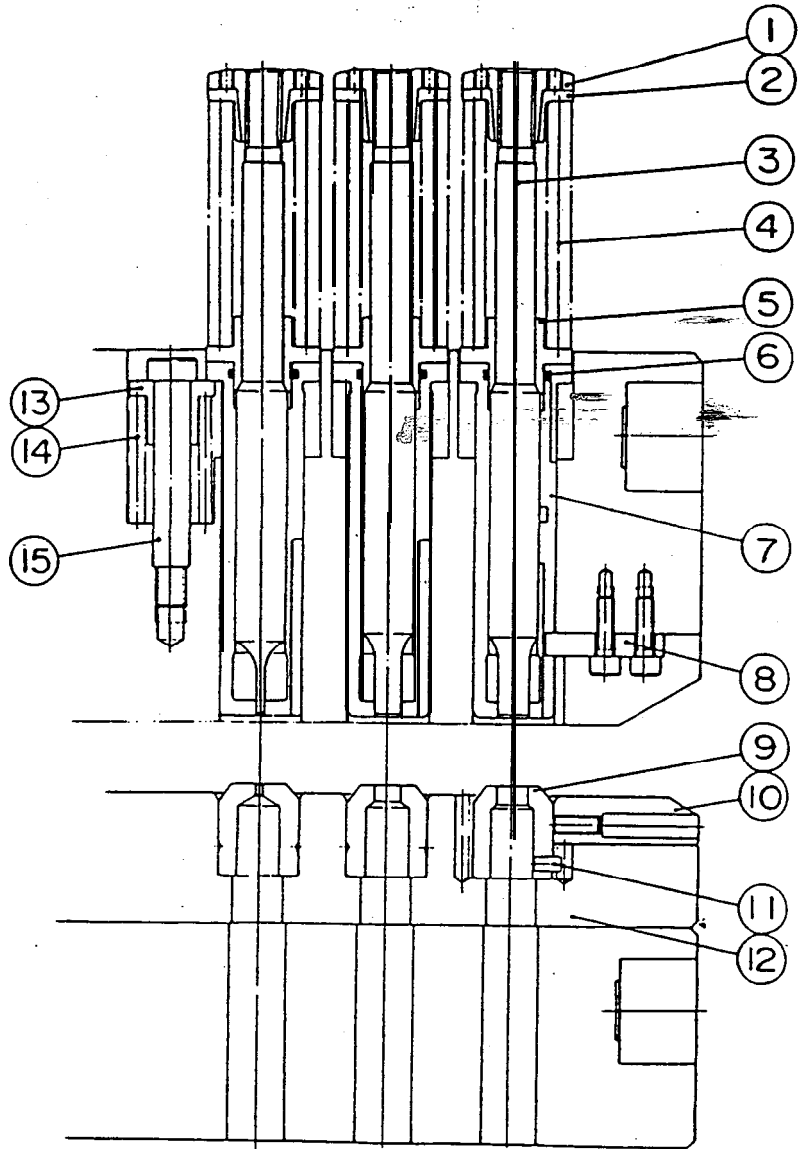
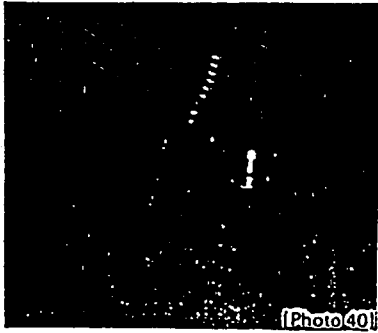


Tool Type	Nominal Tool Size	Standard Punch Size	Number of Stations Available*
A	1/2"	1.6 – 12.7 mm dia. (0.063" – 0.5" dia.)	18 (6)
B	1-1/4"	12.8 – 31.7 mm dia. (0.501" – 1.25" dia.)	18 (18)
C	2"	31.8 – 50.8 mm dia. (1.251" – 2" dia.)	4 (4)
D	3-1/2"	50.9 – 88.9 mm dia. (2.001" – 3.5" dia.)	2 (2)
E	4-1/2"	89.0 – 114.3 mm dia. (3.501" – 4.5" dia.)	2 (2)

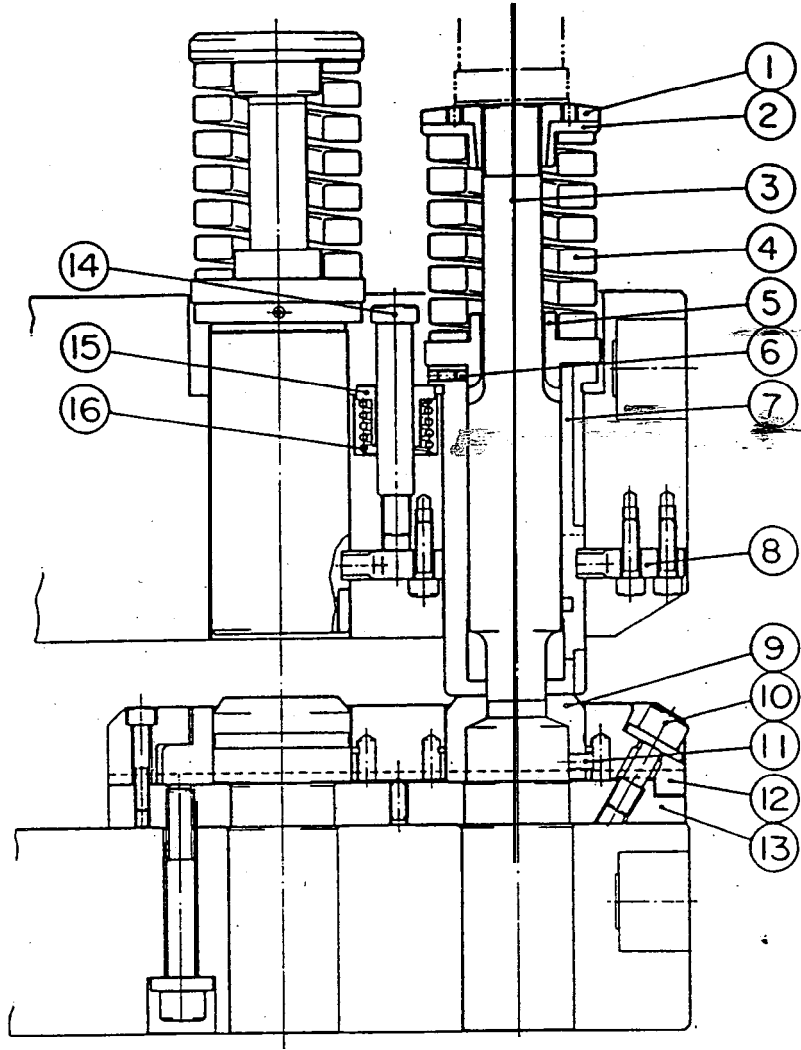
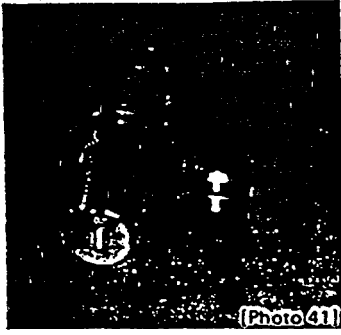
\* The numerals in parentheses indicate the number of stations which can accept shaped tool.

TOOL TYPES

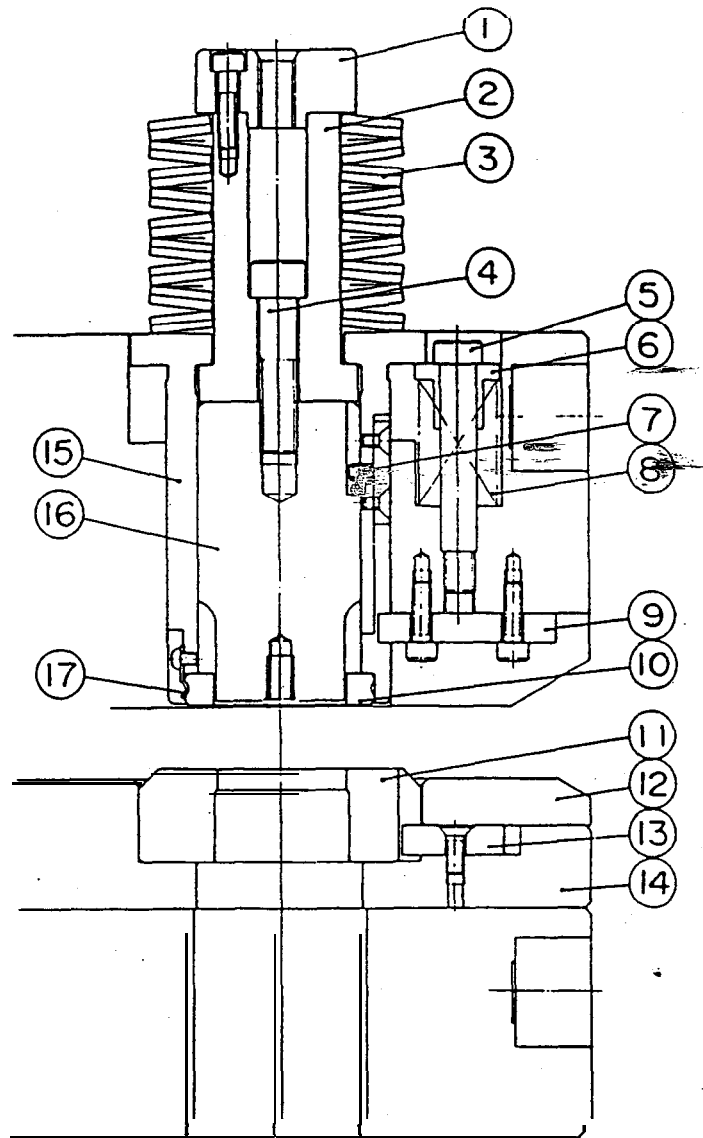
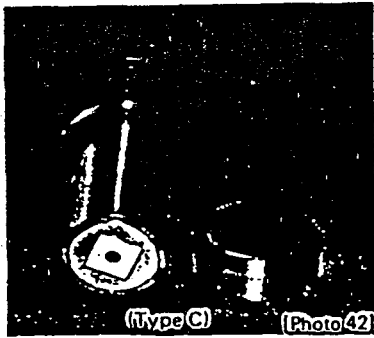
TYPE A (1/2")



- 1. PUNCH HEAD
- 2. PUNCH HEAD COLLAR
- 3. PUNCH BODY
- 4. STRIPPING SPRING
- 5. RETAINER COLLAR
- 6. RETAINER RING
- 7. PUNCH GUIDE
- 8. GUIDE KEY
- 9. DIE
- 10. DIE SPACER
- 11. KEY
- 12. DIE HOLDER
- 13. LIFT RING
- 14. LIFT SPRING
- 15. SHOULDER SCREW



- 1. PUNCH HEAD
- 2. PUNCH HEAD COLLAR
- 3. PUNCH BODY
- 4. STRIPPING SPRING
- 5. RETAINER COLLAR
- 6. SETSCREW
- 7. PUNCH GUIDE
- 8. GUIDE KEY
- 9. DIE
- 10. UPPER DIE HOLDER  
FIXING BOLT
- 11. KEY
- 12. UPPER DIE HOLDER
- 13. LOWER DIE HOLDER
- 14. SHOULDER SCREW
- 15. LIFT RING
- 16. LIFT SPRING



- 1. PUNCH HEAD
- 2. PUNCH DRIVER
- 3. STRIPPING SPRING
- 4. PUNCH TIP FIXING BOLT
- 5. SHOULDER SCREW
- 6. LIFT RING
- 7. PUNCH KEY
- 8. LIFT SPRING
- 9. GUIDE KEY
- 10. STRIPPER PLATE
- 11. DIE
- 12. DIE SPACER
- 13. DIE KEY
- 14. DIE HOLDER
- 15. PUNCH GUIDE
- 16. PUNCH TIP
- 17. STRIPPER PLATE SPRING

(Type C)

TYPE A (1/2")

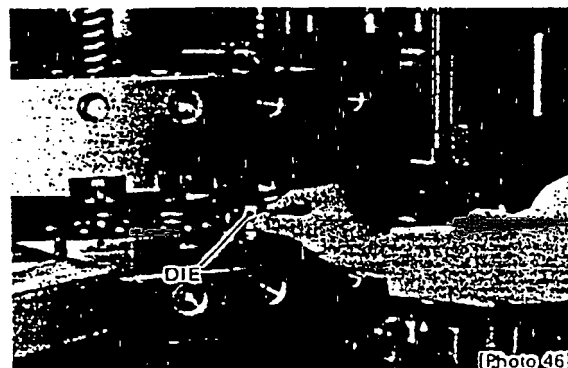
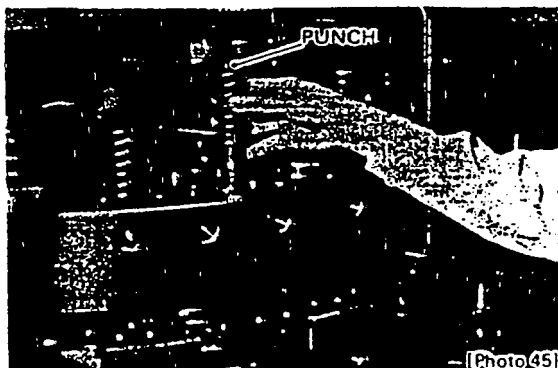
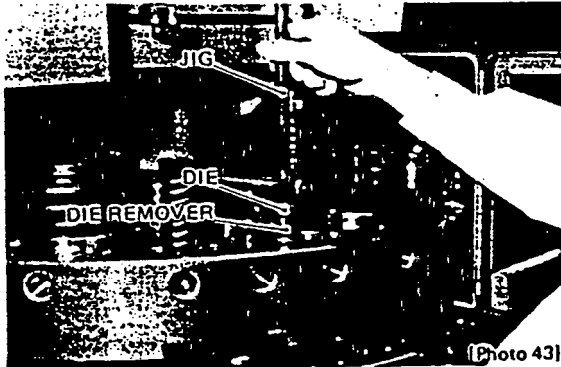
Loading on center and inner tracks

1. Insert the die remover up through the bottom of the lower turret until it protrudes from the top of the upper turret.
2. Place the die on the remover. Put the jig on top of the die, and holding the die between the jig and remover, press the die down until it seats snugly into the die holder of the lower turret (Photos 43 and 44). Remove the jig and die remover.
3. Insert the punch into the upper turret (Photo 45).

Loading on outer track

1. Remove the die spacer and insert the die into the die holder of the lower turret (Photo 46).
2. Push the die firmly into the die holder and make sure it is properly seated.
3. Re-install the die spacer.
4. Insert the punch into the upper turret.

- NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 3-17.
- (b) Round punches and dies can be loaded on any of the inner, center and outer tracks. However, shaped punches and dies can be loaded on only the outer track.
- (c) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

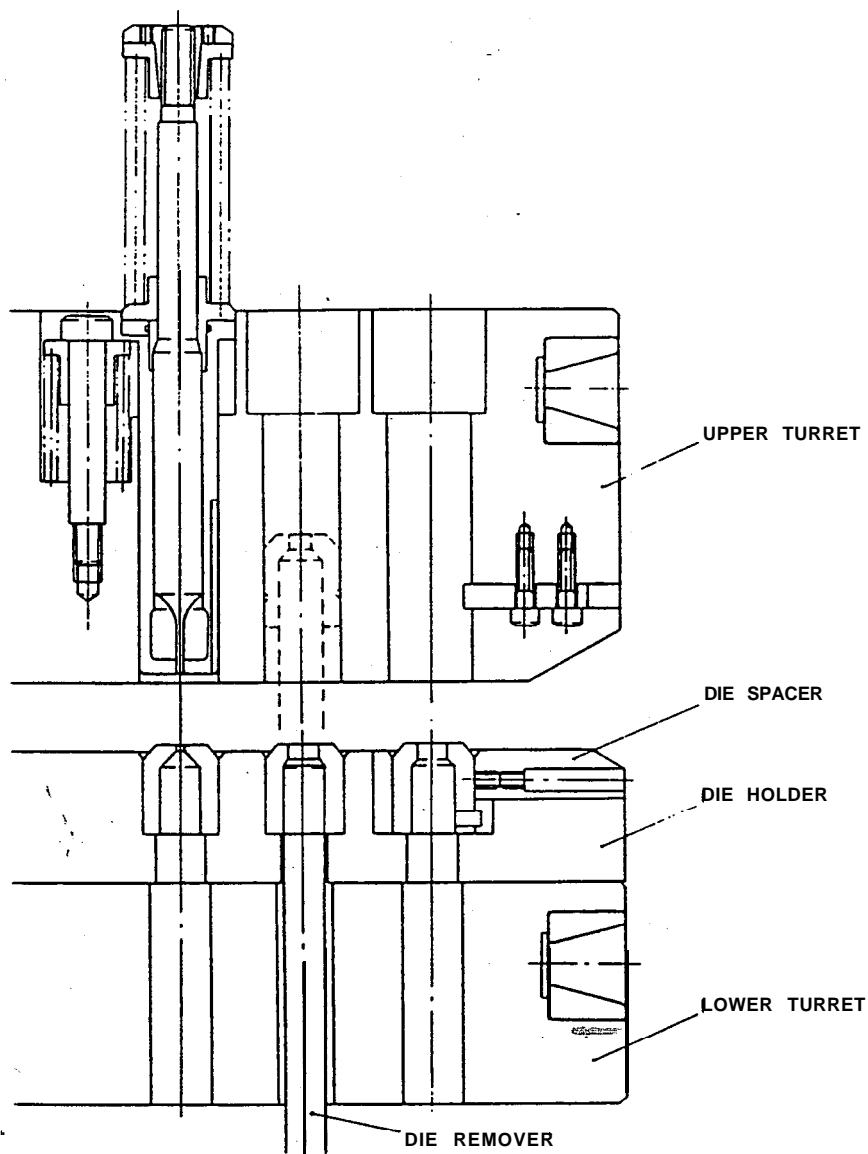


**Unloading from center and inner tracks**

1. Remove the punch from the upper turret.
2. Insert the die remover into the lower turret through the bottom of the lower turret.
3. Push the die upward with the die remover, and remove the die through the top of the upper turret.

**Unloading from outer track**

1. Remove the punch from the upper turret and remove the die spacer from the lower turret.
2. Insert the die remover into the lower turret through the bottom of the lower turret.
3. Push the die upward with the die remover, and remove the die between the upper and lower turrets.



## TYPE B (1-1/4")

### Loading on auto-index stations

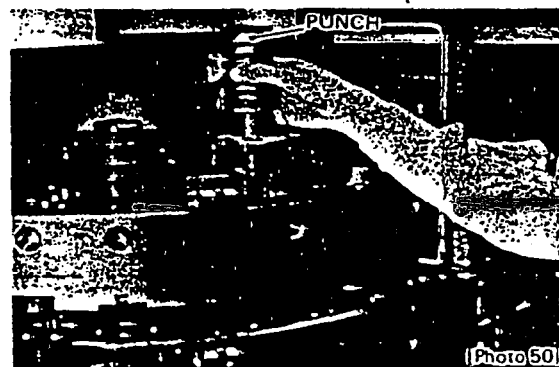
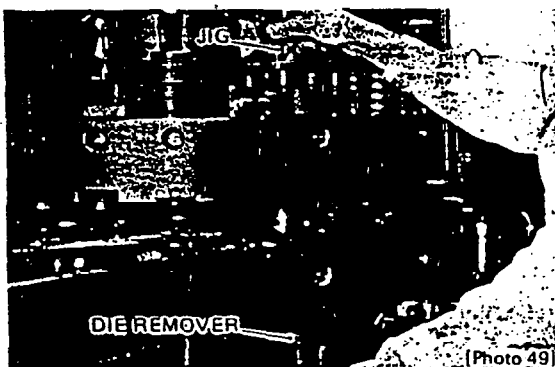
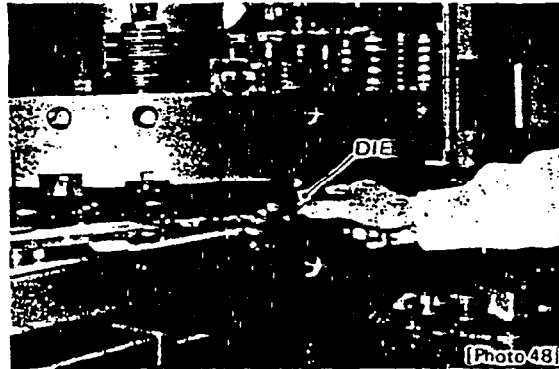
1. Remove the bolt securing the die spacer, and remove the die spacer (Photo 47).
2. Insert the die into the die holder of the lower turret (Photo 48).
3. Insert the die remover up through the bottom of the lower turret. Insert the jig down through the top of the upper turret. Holding the die between the die remover and jig, set it firmly into the die holder (Photo 49).
4. Re-install the die spacer and tighten the die spacer securing bolt.
5. Insert the punch into the upper turret (Photo 50).

### Loading on standard stations

1. Loosen the upper die holder fixing bolt, and remove the upper die holder from the lower turret with a puller furnished as a standard accessory (Photo 51).
2. Insert the die into the upper die holder through the bottom of the upper die holder (Photo 52).
3. Re-install the upper die holder on the lower turret and tighten the upper die holder fixing bolt.
4. Insert the punch into the upper turret.

NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 3-1 7.

(b) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

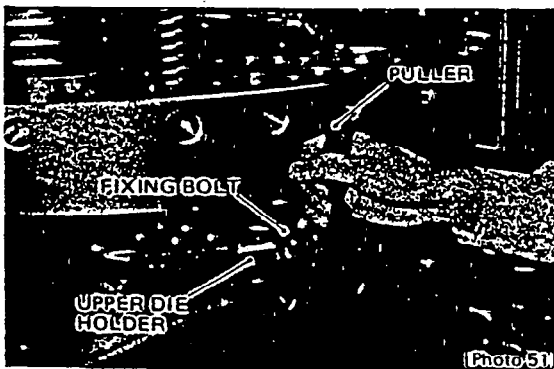


### Unloading from auto-index stations

1. Remove the punch from the upper turret.
2. Remove the bolt securing the die spacer, and remove the die spacer from the lower turret.
3. Push the die up with the die remover, and remove the die from the die holder.

### Unloading from standard stations

1. Remove the punch from the upper turret.
2. Loosen the upper die holder fixing bolt, and remove the upper die holder from the lower turret with the puller.
3. Remove the die from the upper die holder by tapping the top of the die with a brass rod (standard accessory).



## TYPES C (2"), D (3-1/2") AND E (4-1/2")

### Loading

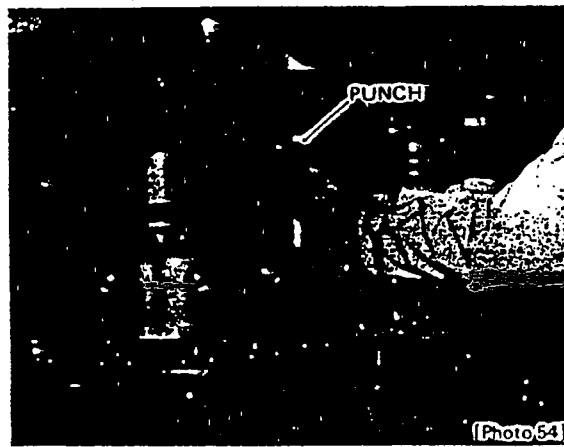
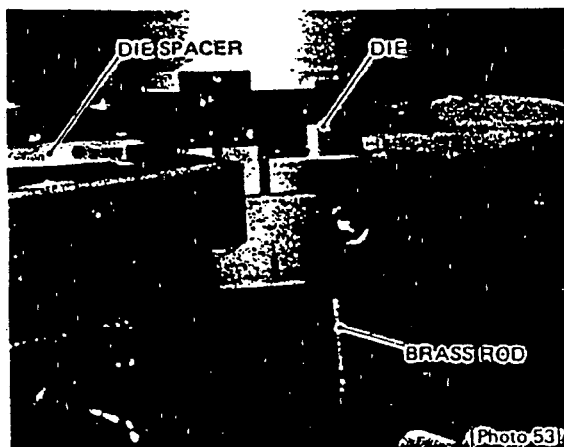
1. Remove the die spacer from the lower turret.
2. Insert the die into the die holder of the lower turret.
3. Insert a brass rod (standard accessory) into the lower turret through the bottom of the lower turret. **Using the brass rod, place the die into the die holder securely (Photo 53).**
4. Re-install the die spacer and insert the punch into the upper turret (Photo 54).

**NOTE:** (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 3-17.

(b) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die.

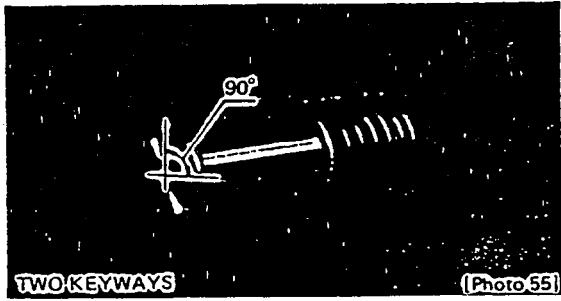
### Unloading

1. Remove the punch from the upper turret.
2. Remove the die spacer from the lower turret and insert the brass rod into the lower turret through the bottom of the lower turret.
3. Push up the die with the brass rod and remove the die between the upper and lower turrets.

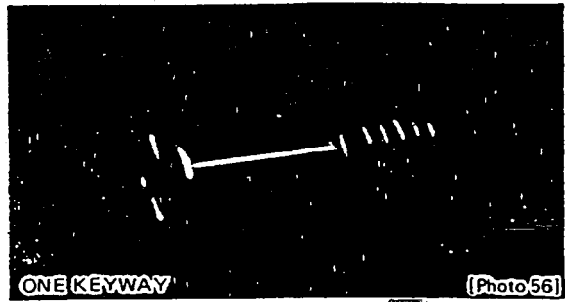


KEYS AND KEYWAYS IN TOOLS

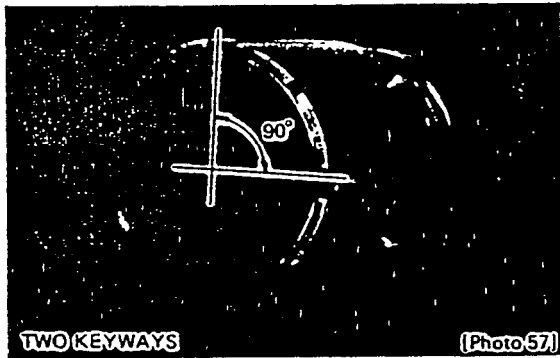
1/2" and 1-1/4" punches (Shaped)



1/2" and 1-1/4" punches (Round)



2", 3-1/2" and 4-1/2" punches (Shaped and round)



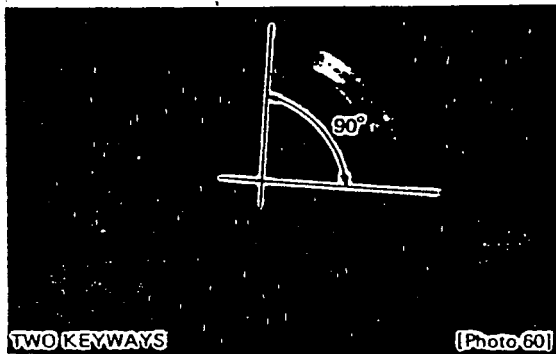
1/2" and 1-1/4" dies (Shaped)



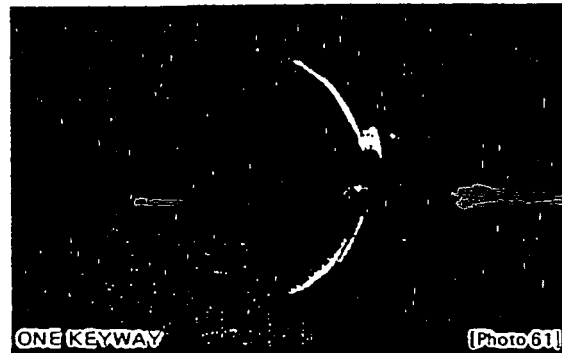
1/2" and 1-1/4" dies (Round)



2", 3-1/2" and 4-1/2" dies (Shaped)

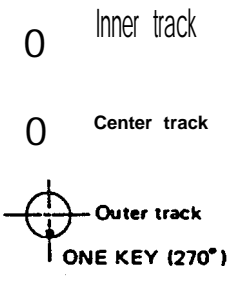


2", 3-1/2" and 4-1/2" dies (Round)

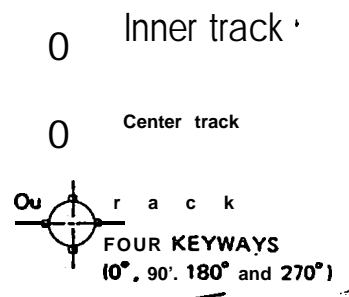


**KEYS AND KEYWAYS IN TURRET STATIONS**

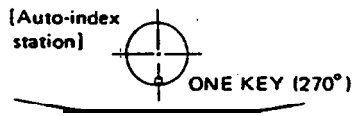
**1/2" station (upper turret)**



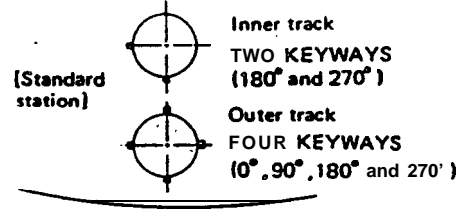
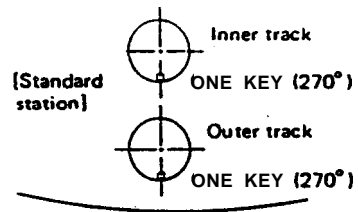
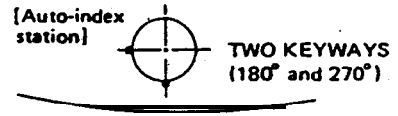
**1/2" station (lower turret)**



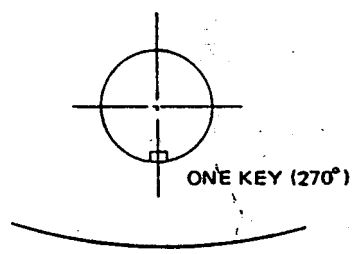
**1-1/4" station (upper turret)**



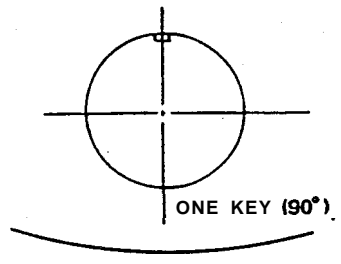
**1-1/4" station (lower turret)**



**2" and 3-W" stations (upper and lower turrets)**



**4-1/2" station (upper and lower turrets)**



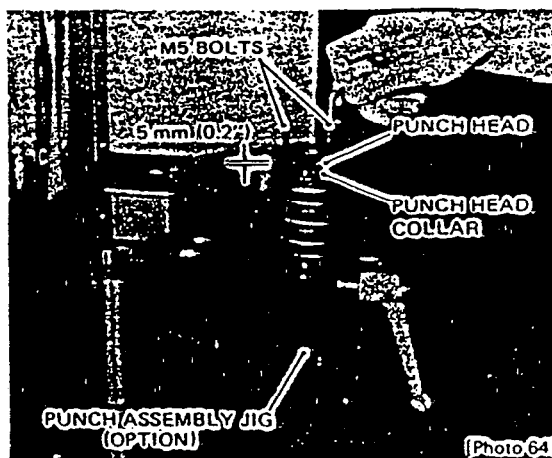
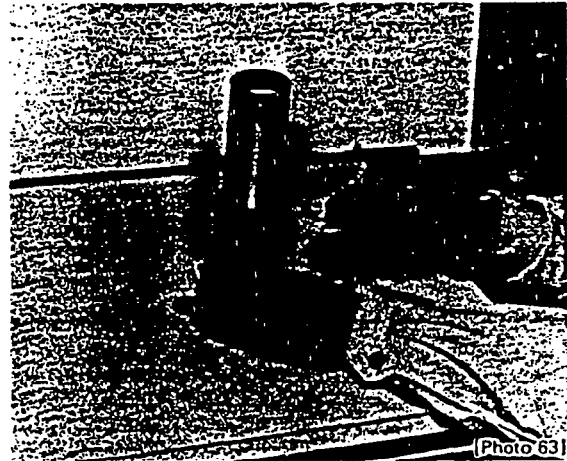
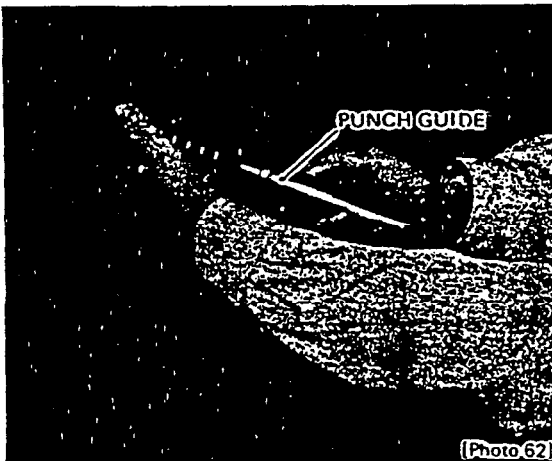
## DISASSEMBLY AND ASSEMBLY OF PUNCHES (Types A and B)

### Disassembly

1. Remove the punch guide from the punch assembly as shown in Photo 62. On the type B punch, loosen the setscrew which retains the punch guide and remove the guide (Photo 63).
2. Place the punch body in a vise with soft jaws.
3. Install the M5 bolts in the two bolt holes in the punch head, and tighten them equally until the clearance between the punch head and its collar is approximately 5 mm (0.2 in) (Photo 64).
4. Loosen the punch head with a pipe wrench and disassemble the punch assembly (Photo 65).

### Assembly

Assemble the retainer collar, stripping spring, punch head collar and the punch head to the punch body: Using a pipe wrench, tighten the punch' head until the specified punch height is obtained. Apply a coat of machine oil to the frictional surface of the punch body and assemble the punch guide to the punch body.



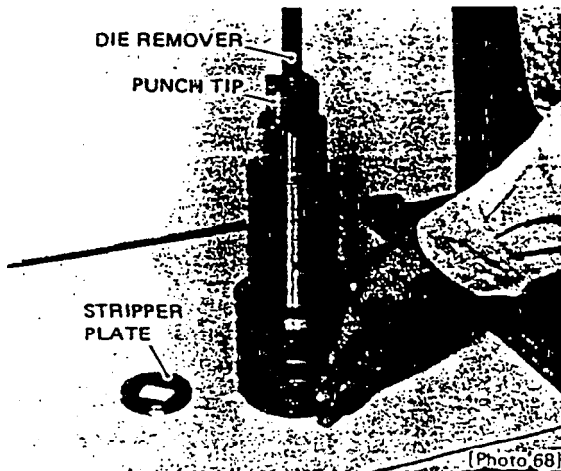
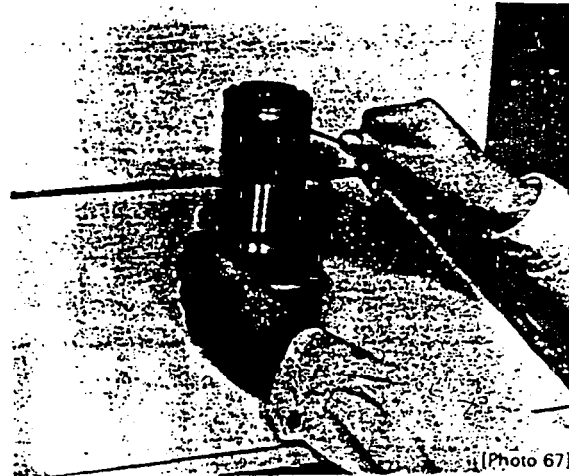
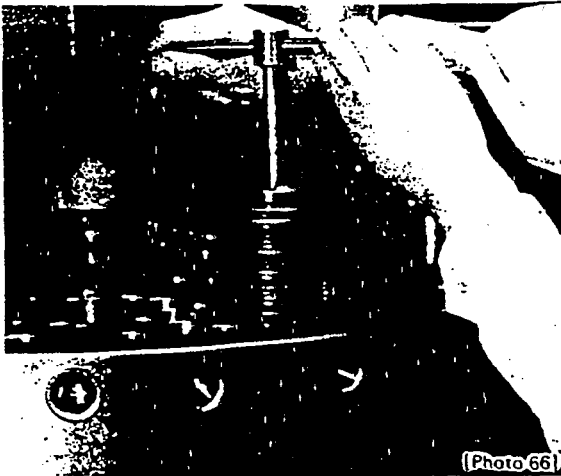
## REMOVAL AND REINSTALLATION OF PUNCH TIP (Types C, D and E)

### Removal

1. Using a T-wrench (furnished as a standard accessory), slightly loosen the punch tip fixing bolt with the punch assembly in the upper turret (Photo 66).
2. Remove the punch assembly from the upper turret.
3. Loosen the punch tip fixing bolt just enough to free it from the punch tip.
4. Loosen screws which retain stripper plate springs, and remove the stripper plate (Photo 67).
5. Screw the die remover into the thread hole of the punch tip, and pull the punch tip out (Photo 68).

### Installation

1. Apply a coat of machine oil to the punch tip, and then insert it into the punch guide.
2. Install the stripper plate and tighten screws which retain stripper plate springs.
3. Temporarily tighten the punch tip fixing bolt.
4. Insert the punch assembly into the upper turret, and then tighten the punch tip fixing bolt securely.



The punches and dies should be reground frequently to extend their service life. Observe the edges of the punch and die to be sure that they are sharp and lustrous. If the edges are rounded or have a frosted appearance, the punch and die should be re-ground. If grinding is not done frequently at the correct stage of wear, the extra force required by the already frosted edge causes increasingly rapid and intense wear. Proper grinding for one time would be 0.2 mm (0.008 in) for the punch and 0.1 mm (0.004 in) for the die. The punch can be ground a maximum of 2 mm (0.08 in) during its service life, and the die can be ground a maximum of 1 mm (0.04 in). After the punch and die have been ground, their edges should be finished with an oil stone.

#### ADJUSTMENT OF PUNCH AND DIE HEIGHT

After grinding, the punch and die must be adjusted to their specified height. When adjusting the punch and die height, observe the following:

##### Type A and B punches

Turn the punch head with a pipe wrench until the specified punch height is obtained (See Photo 6.5 on page 3-13).

Specified punch height: 207 mm (8.15")

##### Type C, D and E punches

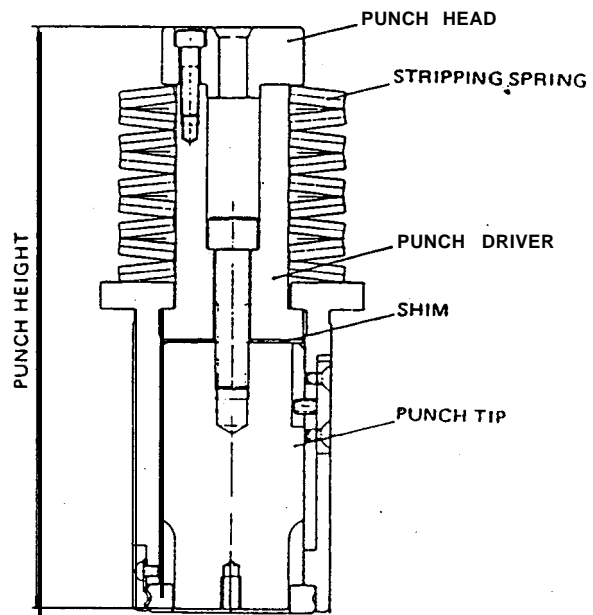
Insert a shim (proportionate to the amount of grinding done) between the punch driver and the punch tip to adjust the punch height to specifications.

Specified punch height:

Type C . . . . . 207 mm (8.15")

Type D . . . . . 209 mm (8.23")

Type E . . . . . 210 mm (8.27")



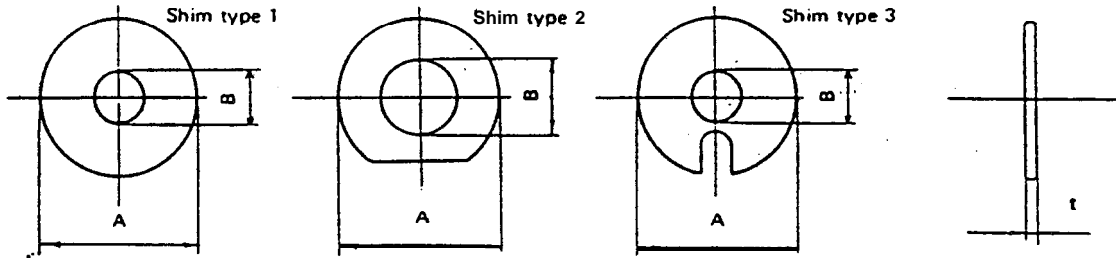
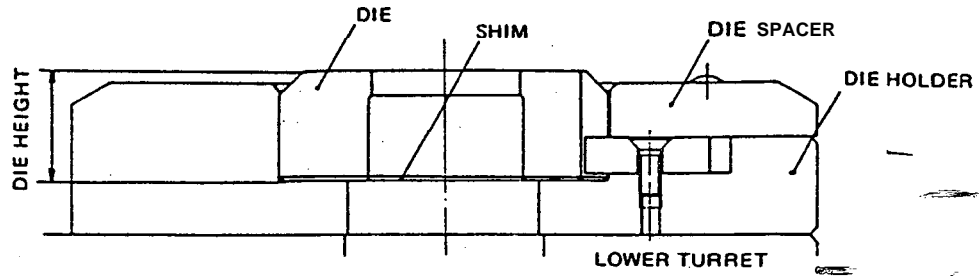
(Type C)

**Dies**

Insert a shim (proportionate to the amount of grinding done) between the die holder and the die.

Specified die height:

Types A, B, C, D and E . . . . . 30 mm (1.18")

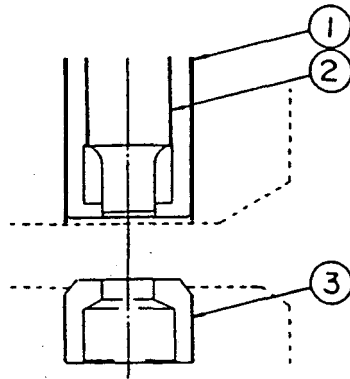


	Tool type	Applicable shim type	Dimensions		
			A (mm)	B (mm)	t (mm)
Punch shim	C	1	40	15	0.4, 0.8, 1.2, 1.6, 2.0
	D	3	89	15	
	E	3	114	15	
Die shim	A	1	25	15	0.4, 0.8, 1.2
	B	1	47	35	
	C	2	88	55	
	D	2	125	93	
	E	2	158	119	

## LUBRICATION

Before, loading the punch and die on the turret, apply machine oil to their lubrication points.

Lubrication points:



## INSPECTING PUNCHES AND DIES

1. Disassemble the punch and remove any accumulated scales.
2. If the edges of the punch and die are rounded or have a frosted appearance, regrind them.
3. If the stripping spring is fatigued, replace it with a new one.

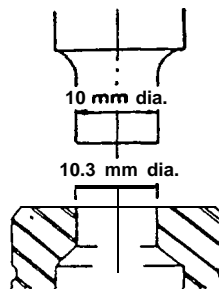
## INSPECTING WORKSHEETS

Check to make sure that the worksheet is not warped. Warped worksheet will cause the punch to stick to the worksheet.

## PUNCH-TO-DIE CLEARANCE

The punch-to-die clearance is indicated by the difference between the punch and die diameters. For example, when a 10 mm diameter punch and a 10.3 mm diameter die are used, the clearance is 0.3 mm.

$$10.3 - 10 = 0.3 = \text{Punch-to-die clearance}$$



The punch-to-die clearance must be determined according to the thickness and type of the worksheet as shown in the table below.

Punch-to-die clearance (mm) Thickness (mm)	Material		
	Mild steel	Aluminum	Stainless steel
0.8 – 1.6	0.2 – 0.3	0.2 – 0.3	0.20 – 0.35
1.6 – 2.3	0.3 – 0.4	0.3 – 0.4	0.4 – 0.5
2.3 – 3.2	0.4 – 0.6	0.4 – 0.5	0.5 – 0.7
3.2 – 4.5	0.6 – 0.9	0.5 – 0.7	0.7 – 1.2
4.5 – 6.0	0.9 – 1.2	0.7 – 0.9	

### PUNCH CAPACITY

The maximum punchable hole diameter is determined by the type and the thickness of the worksheet. The punching force required is generally calculated by using the following formula:

$$P \text{ (ton)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (kg/mm}^2\text{)}}{1000}$$

where, P: Force required

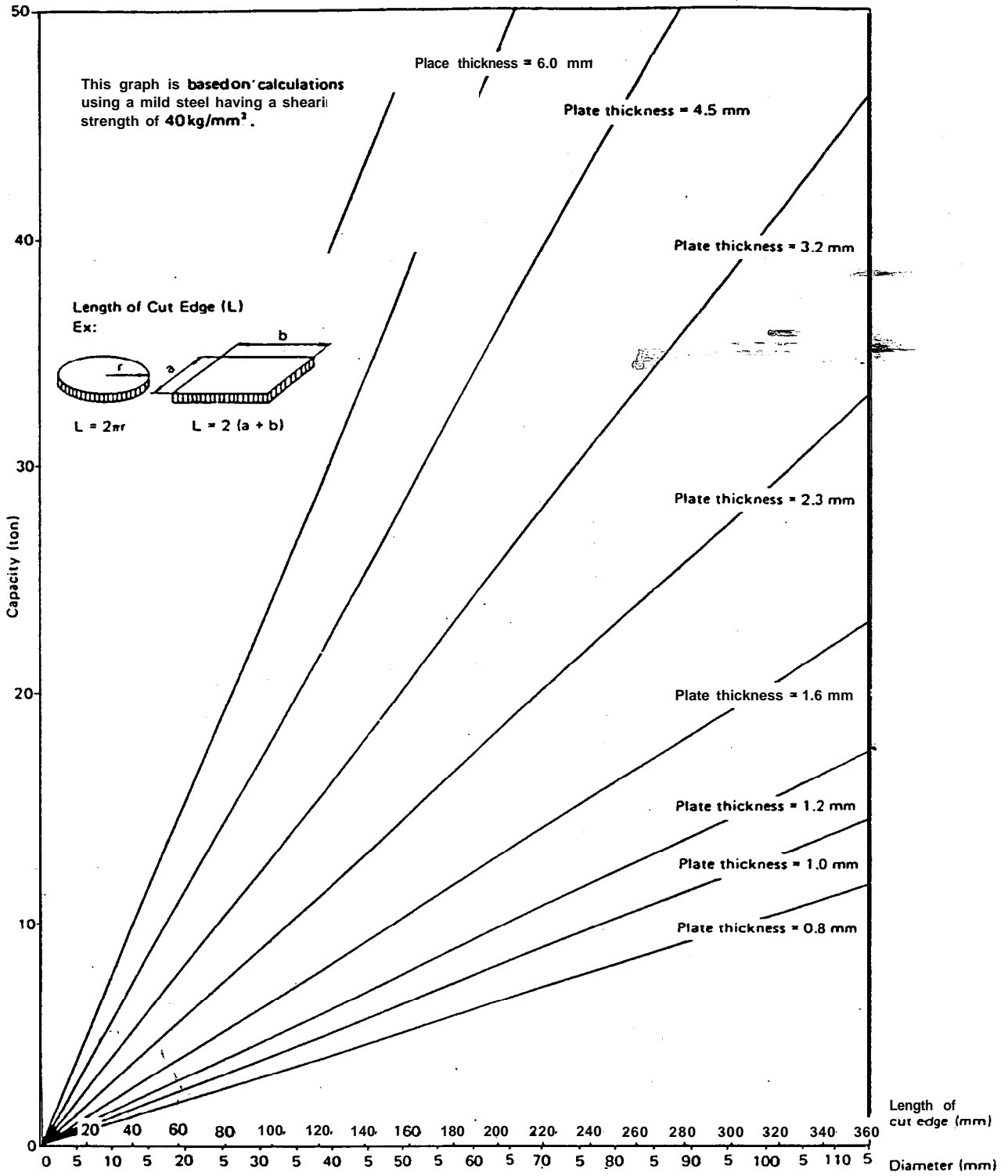
A: Length of cut edge

t: Thickness of worksheet

$\tau$ : Shearing strength of worksheet

If P does not exceed the machine capacity (50 tons on COMA and 30 tons on VELA-II and PEGA), the worksheet is punchable. The calculation shows that 66.3 mm (on COMA) and 39.8 mm (on VELA-II and PEGA) are the maximum punchable hole diameters when the worksheet thickness is 6 mm and the shearing strength is 40 kg/mm<sup>2</sup>. On page 3-19 is a graph showing the maximum punchable hole diameters for a variety of plate thicknesses. The graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm<sup>2</sup>.

# PUNCHING CAPACITY



## MINIMUM HOLE DIAMETER

The following table shows the minimum diameters of punchable holes.

Material	Minimum hole diameter
Mild steel	1.0 x t
Aluminum	1.0 x t
Stainless steel	2.0 x t

t: -Thickness of worksheet

Example: The minimum hole diameter for mild steel with a thickness of 2.3 mm is:  
 $1.0 \times 2.3 \text{ mm} = 2.3 \text{ mm dia.}$

## PRECAUTIONS FOR PUNCHING THICK WORKSHEETS

When punching the thick worksheet, use a tool one size larger than the normal usage size. If tools in the normal usage size are used, the punch head threads may be damaged.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	8.2 – 12.7 mm
	4.5 mm	11.0 – 12.7 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	8.2 – 12.7 mm

-USE TYPE 8 (1-1/4") PUNCHES.

<u>Material</u>	<u>Thickness</u>	<u>Hole diameter</u>
Mild steel (40 kg/mm <sup>2</sup> )	6.0 mm	22.9 – 31.7 mm
	4.5 mm	30.6 – 31.7 mm
Stainless steel (60 kg/mm <sup>2</sup> )	4.0 mm	22.9 – 31.7 mm

→USE TYPE C (2") PUNCHES-

# THIN TURRET WITH AUTO-INDEX DEVICE

## STATION ARRANGEMENT

40-station turret (VELA II and PEGA) ..... 4-1

## TOOL TYPES

Small diameter type (Type A and Type B) ..... 4-2

Large diameter type (Type C and Type D) ..... 4-3

## LOADING AND UNLOADING PUNCHES AND DIES

Small diameter type (Type A and Type B) ..... 4-4

Large diameter type (Type C and Type D) ..... 4-7

## KEYS AND KEYWAYS IN TOOLS AND TURRET STATIONS

Keys and keyways in tools ..... 4-8

Keys and keyways in turret stations ..... 4-9

## MAINTENANCE OF PUNCHES AND DIES

Disassembly of punches (Small dia. type) ..... 4-10

Removal and installation of punch tips (Large dia. type) ..... 4-10

Re-grinding punches and dies ..... 4-10

Adjustment of punch and die height ..... 4-11

Lubrication ..... 4-12

Inspecting punches and dies ..... 4-12

Inspecting worksheets ..... 4-12

PUNCH-TO-DIE CLEARANCE ..... 4-12

PUNCH CAPACITY ..... 4-13

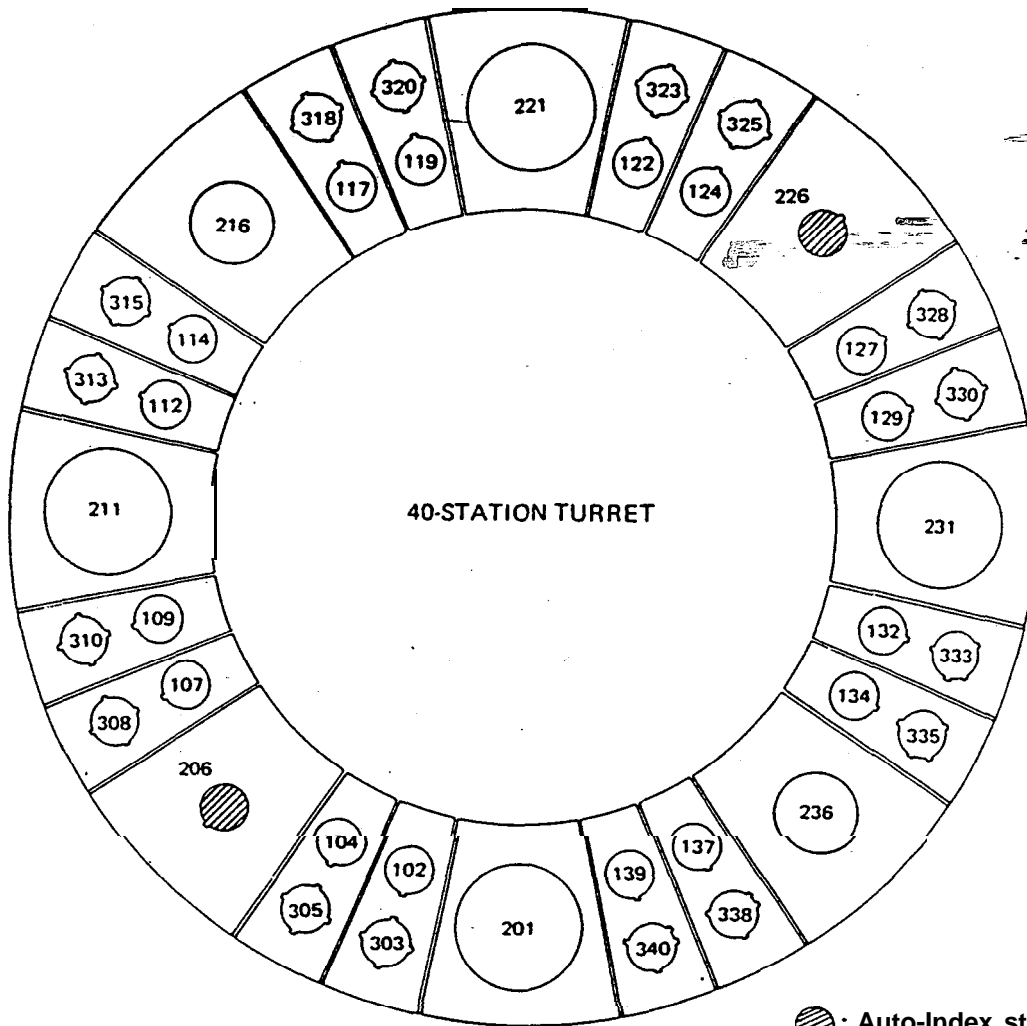
MINIMUM HOLE DIAMETER ..... 4-14

PRECAUTIONS FOR PUNCHING THICK WORKSHEETS ..... 4-15

THIN TURRET WITH AUTO-INDEX DEVICE

STATION ARRANGEMENT

40-STATION TURRET (VELA II AND PEGA)

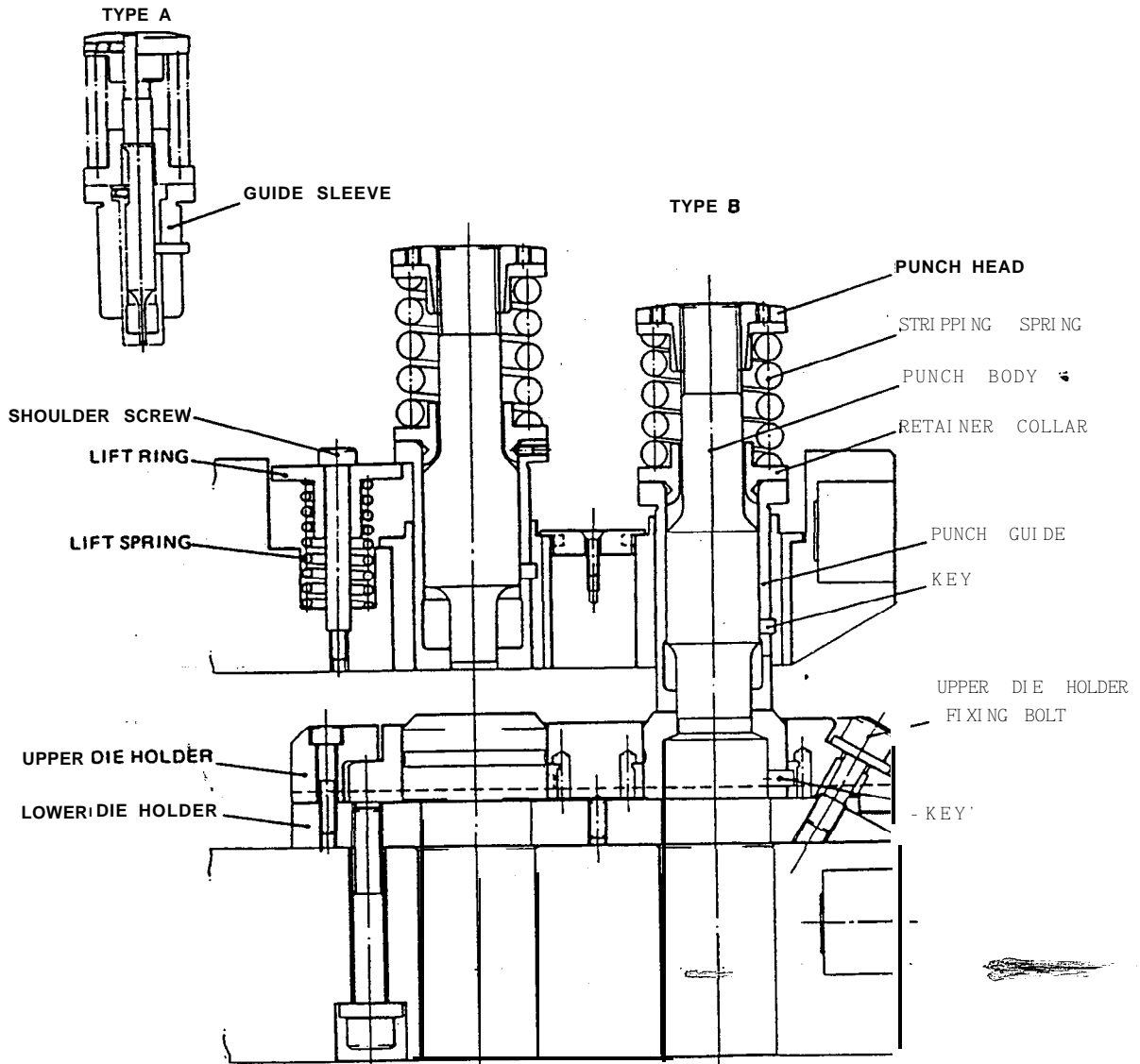
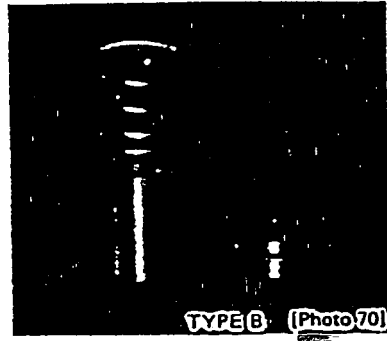


 : Auto-Index station

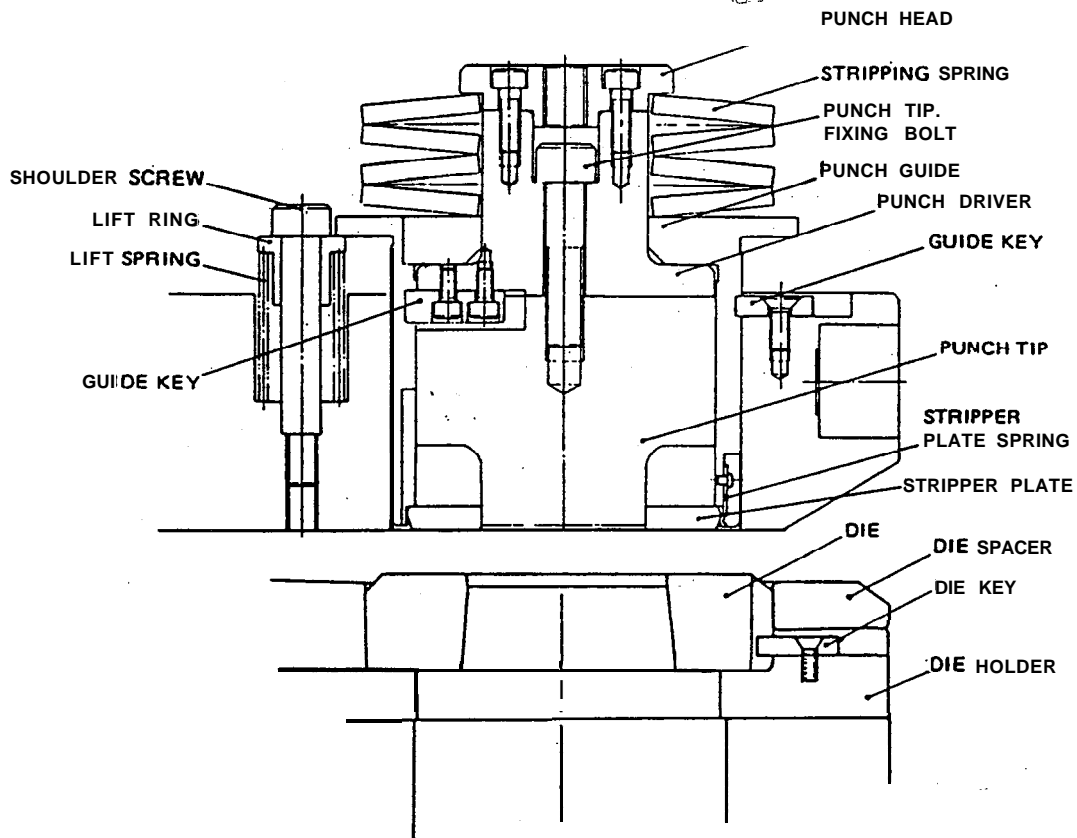
Tool Type		Standard Punch Size	Number of Stations Available
Small diameter	Type A	1.6 – 10.9 mm dia. (0.063" – 0.43" dia.)	34 stations
	Type B	11.0 – 31.7 mmdia. (0.431" – 1.25" dia.)	
Large diameter	Type C	31.8 – 50.8 mm dia. (1.251" – 2" dia.)	2 stations
	Type D	50.9 – 88.9 mm dia. (2.001" – 3.5" dia.)	4 stations

# TOOL TYPES

## SMALL DIAMETER TYPE (Type A and Type B)



LARGE DIAMETER TYPE (Type C and Type D)



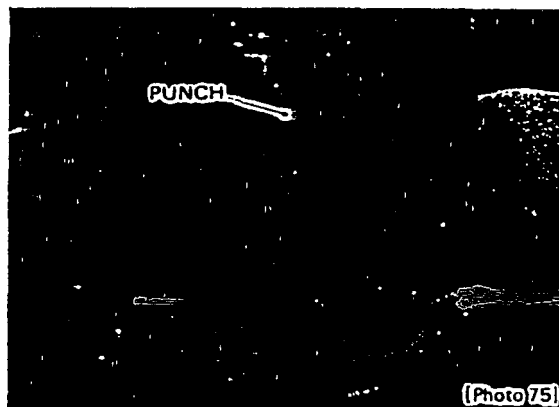
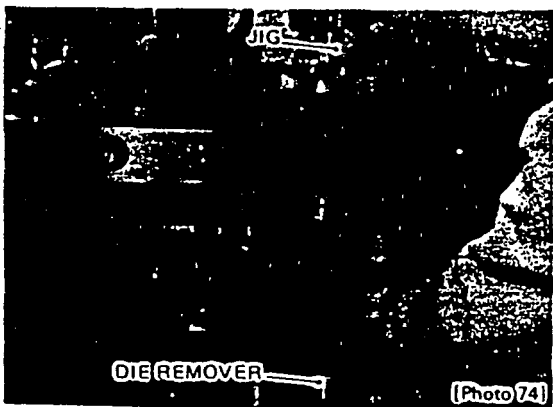
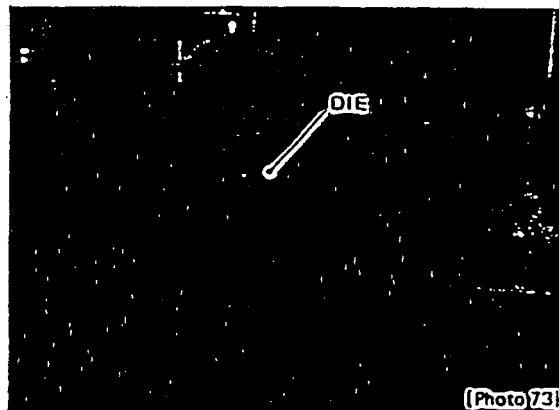
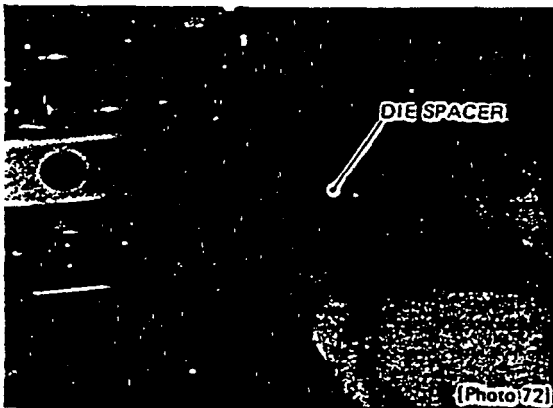
## SMALL DIAMETER TYPE (Type A and Type B)

### Loading on auto-index stations

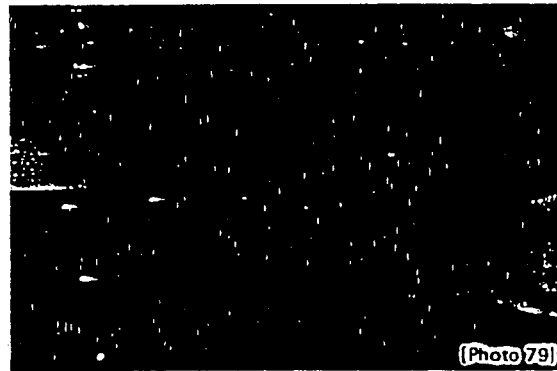
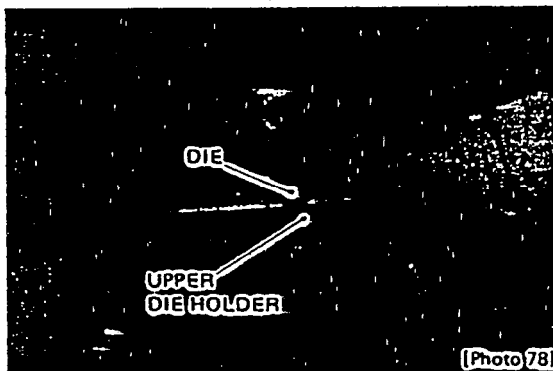
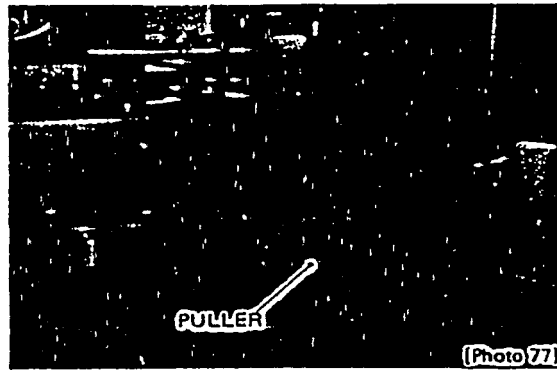
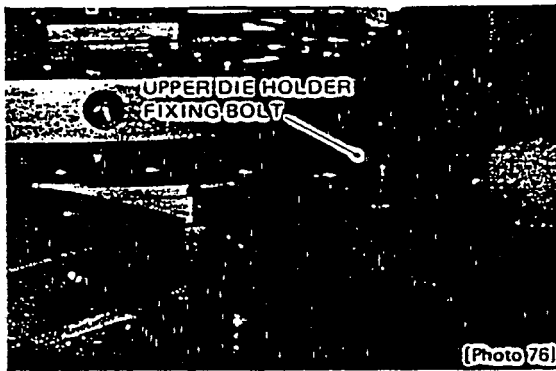
1. Remove the bolt securing the die spacer and remove the die spacer (Photo 72).
2. Insert the die into the die holder of the lower turret (Photo 73).
3. Insert the die remover up through the bottom of the lower turret. Insert the jig down through the top of the upper turret. Holding the die between the die remover and jig, set it firmly into the die holder (Photo 74).
4. Re-install the die spacer and tighten the die spacer securing bolt.
5. Insert the punch into the upper turret (Photo 75).

### Loading on standard stations

1. Remove the upper die holder fixing bolt (Photo 76).
2. Remove the upper die holder from the lower turret with a puller furnished as a standard accessory (Photo 77).
3. Insert the die into the upper die holder through the bottom of the upper die holder (Photo 78).
4. Re-install the upper die holder on the lower turret and tighten the upper die holder fixing bolt (Photo 79).



- NOTE: (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 4-12.
- (b) When loading the type A punch, use the guide sleeve.
- (c) When loading a shaped punch, align the punch guide key with the keyway in the upper turret so that the orientation of the punch matches that of the die.



Unloading from standard stations

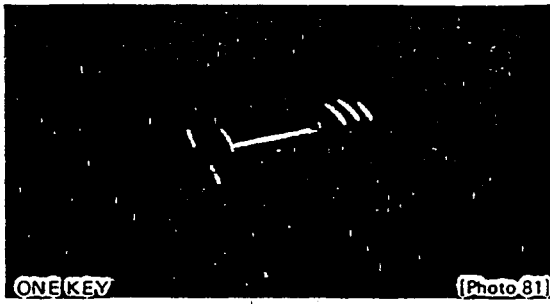
1. Remove the punch from the upper turret.
2. Remove the bolt securing the die spacer, and remove the die spacer from the lower turret.
3. Push the die up with the die remover, and remove the die from the die holder.

Unloading from standard stations

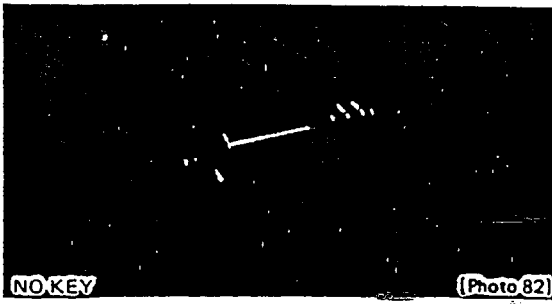
1. Remove the punch from the upper turret.
2. Loosen the upper die holder fixing bolt, and remove the upper die holder from the lower turret with the puller.
3. Remove the die from the upper die holder by tapping the top of the die with a brass rod (standard accessory).

KEYS AND KEYWAYS IN TOOLS

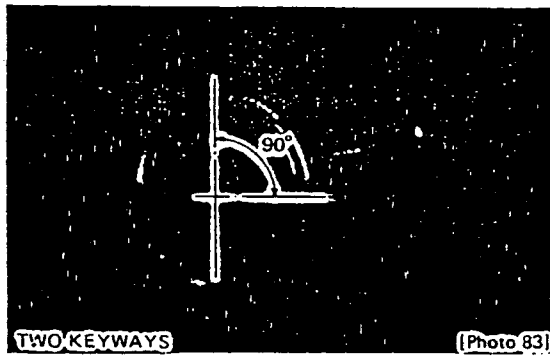
Small dia. punch (Shaped)



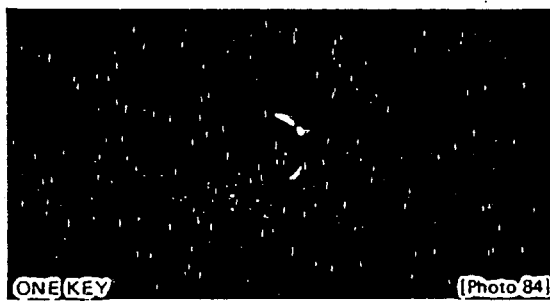
Small dia. punch (Round)



Large dia. punch (Shaped and round)



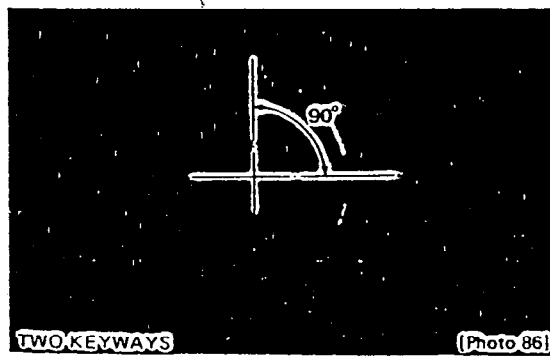
Small dia. die (Shaped)



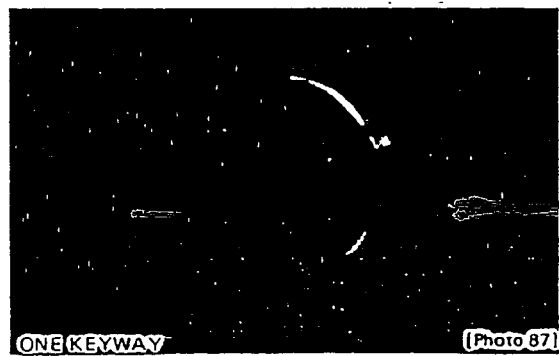
Small dia. die (Round)



Large dia. die (Shaped)



Large dia. die (Round)



**LARGE DIAMETER TYPE. (Type C and Type D)**

**Loading**

1. Remove the die spacer from the lower turret.
2. Insert the die into the die holder of the lower turret.
3. Insert a brass rod (standard accessory) into the lower turret through the bottom of the lower turret. Using the brass rod, place the die into the die holder securely as shown in Photo 8 on page I-14.
4. Re-install the die spacer and insert the punch into the upper turret.

**NOTE:** (a) Before loading the punch and die on the turret, apply machine oil to their lubrication points. For the lubrication points, see page 4-I 2.

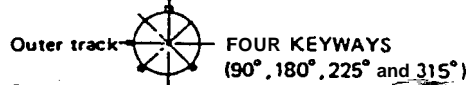
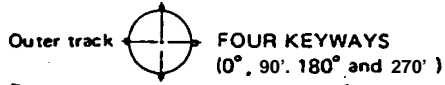
(b) When loading a shaped punch, align the punch guide keyway with the key in the upper turret so that the orientation of the punch matches that of the die:

**Unloading**

1. Remove the punch from the upper turret.
2. Remove the die spacer from the lower turret and insert the brass rod into the lower turret through the bottom of the lower turret.
3. Push up the die with the brass rod and remove the die between the upper and lower turrets.

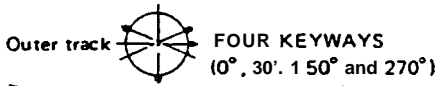
# KEYS AND KEYWAYS IN TURRET STATIONS

Small dia. station (Upper and lower turrets)



Station Nos. T303, T305, T308,  
T310, T313, T315, T318, T320,  
T323, T325, T328, and T330

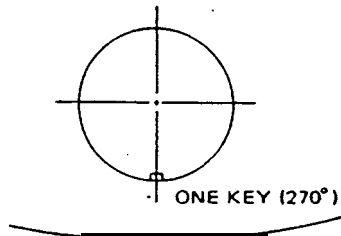
Station Nos. T333 and T335



Station Nos. T338 and T340

Station Nos. T206 and T226  
[Auto-index station]

Large dia. station (Upper and lower turrets)



## MAINTENANCE OF PUNCHES AND DIES

### DISASSEMBLY OF PUNCHES (Small dia. type)

To disassemble the punch assembly, remove setscrews from the punch head and the punch guide.

### REMOVAL AND INSTALLATION OF PUNCH TIPS (Large dia. type)

#### Removal

1. Using a T-wrench (furnished as a standard accessory), slightly loosen the punch tip fixing bolt with the punch assembly in the upper turret.
2. Remove the punch assembly from the upper turret.
3. Loosen the punch tip fixing bolt just enough to free it from the punch tip.
4. Loosen screws which retain stripper plate springs, and remove the stripper plate. See photo 22 on page I-1 8.
5. Screw the die remover into the thread hole of the punch tip, and pull the punch tip out. See photo 23 on page 1-I 8.

#### Installation

1. Apply a coat of machine oil to the punch tip, and then insert it into the punch guide.
2. Install the stripper plate and tighten screws which retain stripper plate springs.
3. Temporarily tighten the punch tip fixing bolt.
4. Insert the punch assembly into the upper turret, and then tighten the punch tip fixing bolt securely.

### REGRINDING PUNCHES AND DIES

The punches and dies should be re-ground frequently to extend their service life. Observe the edges of the punch and die to be sure that they are sharp and lustrous. If the edges are rounded or have a frosted appearance, the punch and die should be re-ground. If grinding is not done frequently at the correct stage of 'wear, the extra force required by the already frosted edge causes increasingly rapid and intense wear. Proper grinding for one time would be 0.2 mm (0.008 in) for the punch and 0.1 mm (0.004 in) for the die. The punch can be ground a maximum of 2 mm (0.08 in) during its service life, and the die can be ground a maximum of 1 mm (0.04 in). After the punch and die have been ground, their edges should be finished with an oil stone.

## ADJUSTMENT OF PUNCH AND DIE HEIGHT

After grinding, the punch and die must be adjusted to their specified height. When adjusting the punch and die height, observe the following:

### Small diameter punches

Loosen the setscrew which secures the punch head, and turn the punch head until the specified punch height is obtained (Photo 88). Tighten the setscrew after the specified punch height is obtained.

Specified punch height: 139.0 mm (5.47")

### Large diameter punches

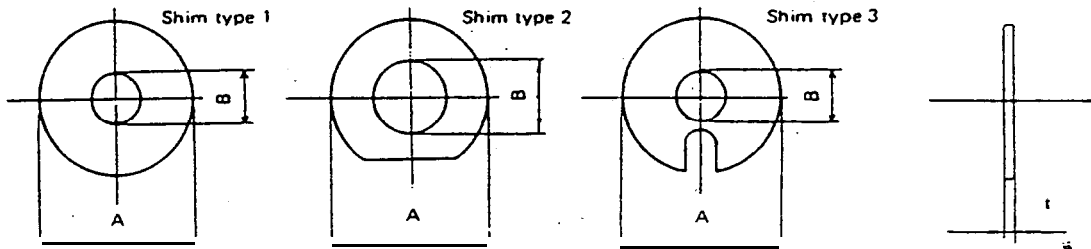
Insert a shim (proportionate to the amount of grinding done) between the punch driver and the punch tip to adjust the punch height to specifications.

Specified punch height: 140.5 mm (5.53")

### Dies (small and large dia.)

Insert a shim (proportionate to the amount of grinding done) between the die holder and the die.

Specified die height: 30 mm (1.18")



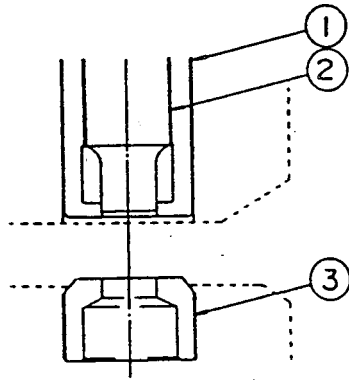
	Tool type	Applicable shim type	Dimensions		
			A (mm)	B (mm)	t (mm)
Punch shim	Large dia.	3	89	15	0.4, 0.8, 1.2, 1.6, 2.0
Die shim	Small dia.	1	47	35	0.4, 0.8, 1.2
	Large dia.	2	125	93	



## LUBRICATION

Before loading the punch and die on the turret, apply machine oil to their lubrication points.

Lubrication points:



## INSPECTING PUNCHES AND DIES

1. Disassemble the punch and remove any accumulated scales.
2. If the edges of the punch and die are rounded or have a frosted appearance, regrind them.
3. If the stripping spring is fatigued, replace it with a new one.

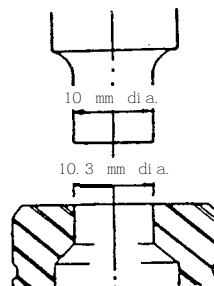
## INSPECTING WORKSHEETS

Check to make sure that the worksheet is not warped. Warped worksheet will cause the punch to stick to the worksheet.

## PUNCH-TO-DIE CLEARANCE

The punch-to-die clearance is indicated by the difference between the punch and die diameters. For example, when a 10 mm diameter punch and a 10.3 mm diameter die are used, the clearance is 0.3 mm.

$$10.3 - 10 = 0.3 = \text{Punch-to-die clearance}$$



The punch-to-die clearance must be determined according to the thickness and type of the worksheet as shown in the table below.

Punch-to-die clearance (mm) Thickness (mm)	Material		
	Mild steel	Aluminum	Stainless steel
0.8 – 1.6	0.2 – 0.3	0.2 – 0.3	0.20 – 0.35
1.6 – 2.3	0.3 – 0.4	0.3 – 0.4	0.4 – 0.5
2.3 – 3.2	0.4 – 0.6	0.4 – 0.5	0.5 – 0.7
3.2 – 4.5	0.6 – 0.9	0.5 – 0.7	0.7 – 1.2
4.5 – 6.0	0.9 – 1.2	0.7 – 0.9	

## PUNCH CAPACITY

The maximum punchable hole diameter is determined by the type and the thickness of the worksheet. The punching force required is generally calculated by using the following formula:

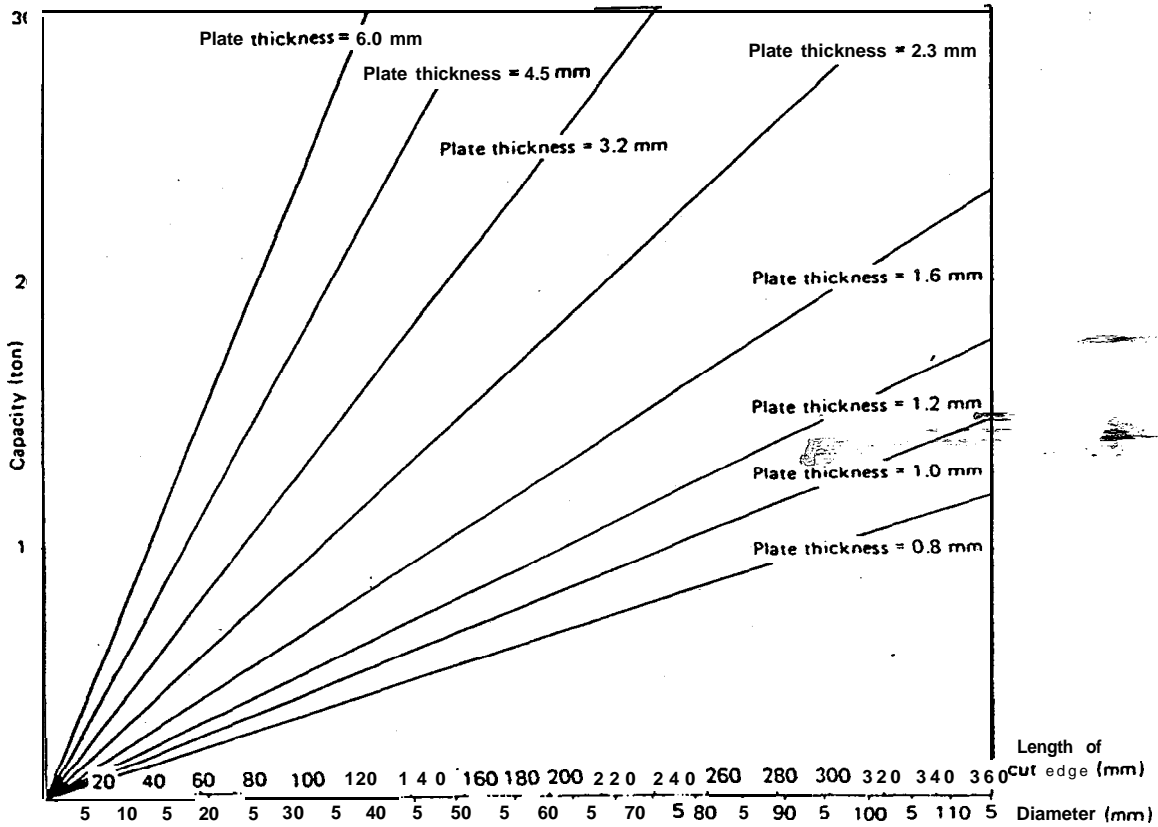
$$P \text{ (ton)} = \frac{A \text{ (mm)} \times t \text{ (mm)} \times \tau \text{ (kg/mm}^2\text{)}}{1000}$$

- where, P: Force required  
 A: Length of cut edge  
 t: Thickness of worksheet  
 $\tau$ : Shearing strength of worksheet

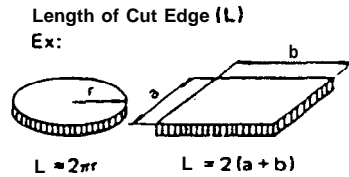
If P does not exceed the machine capacity (30 tons), the worksheet is punchable. The calculation shows that 39.8 mm is the maximum punchable hole diameter when the worksheet thickness is 6 mm and the shearing strength is 40 kg/mm<sup>2</sup>.

The graph on page 4-14 shows the maximum punchable hole diameters for a variety of plate thicknesses. The graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm<sup>2</sup>.

## PUNCHING CAPACITY



This graph is based on calculations using a mild steel having a shearing strength of 40 kg/mm<sup>2</sup>



## MINIMUM HOLE DIAMETER

The following table shows the minimum diameters of punchable holes.

Material	Minimum hole diameter
Mild steel	1.0 x t
Aluminum	1.0 x t
Stainless steel	2.0 x t

t: Thickness of worksheet

**Example:** The minimum hole diameter for mild steel with a thickness of 2.3 mm is:  
1.0 x 2.3 mm = 2.3 mm dia.