



# Work Charting Methods

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Topics:

1. Pareto Chart – part 1
2. Fishbone (Cause-Effect) Diagram – part 1
3. Operation Process Charts – part 1
4. Flow Process Charts – part 1
5. **Flow Diagrams** – part 2
6. **Worker and Machine Process Charts** – part 2
7. **Gang Process Charts** – part 2
8. **Two-Handed Process Charts** – part 2



# Objectives of Work Charting Methods

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- **Objectively** document the **work task** or **process** for analysis
- Examine some of **many available methods** (new ones **invented regularly**)
- Break down job into **sub-components (tasks)**
- **Describe** the **tasks** in a meaningful way



# Work Charting Methods

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## ***5. Flow Diagrams***



## 5 - Flow Diagrams

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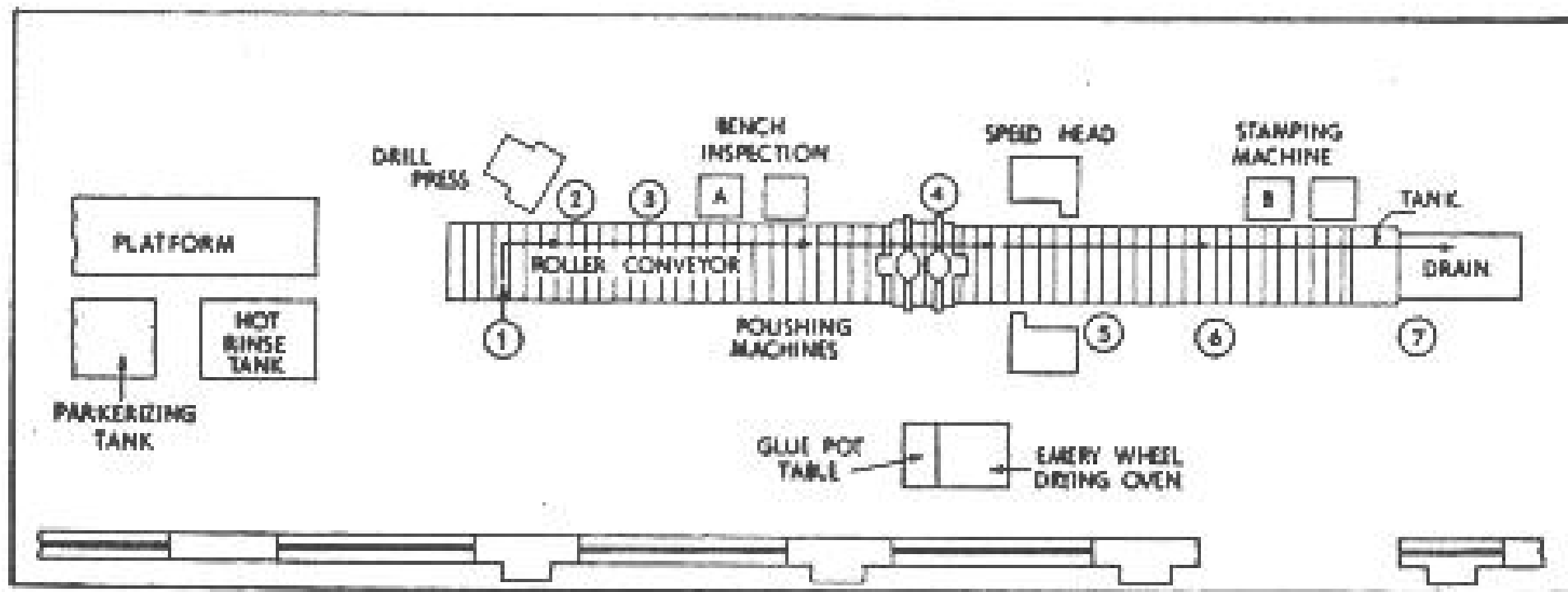
- Diagram in a system representing
  - **process flow** or
  - set of **dynamic relationships**
- Supplement flow process charts
- Provides overhead **pictorial plan** of the facility
- Examples:
  - structure and order a **complex system**
  - show structure of the **elements** and their **interaction**



## 5 - Flow Diagrams

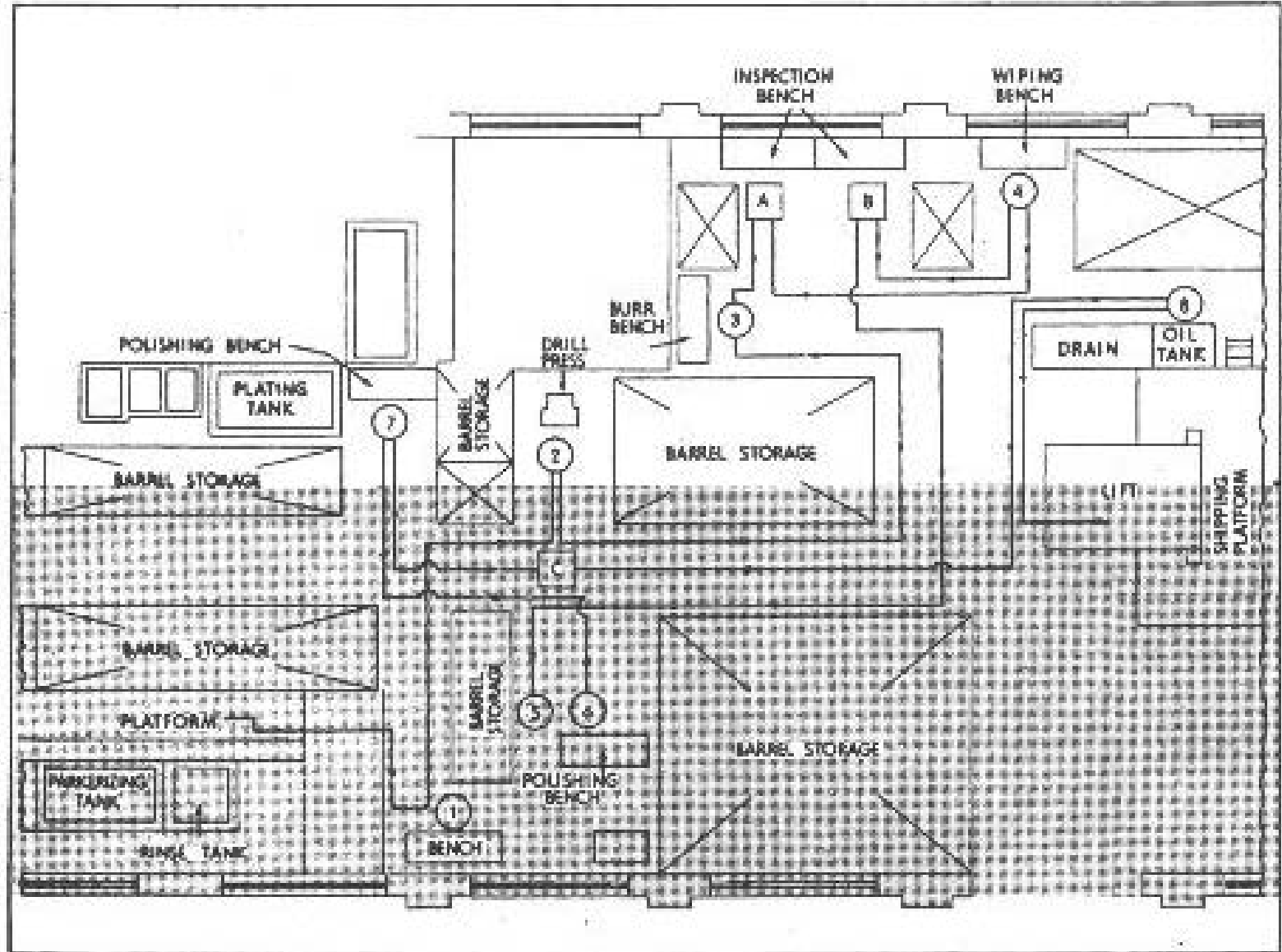
**FIGURE 2-13**

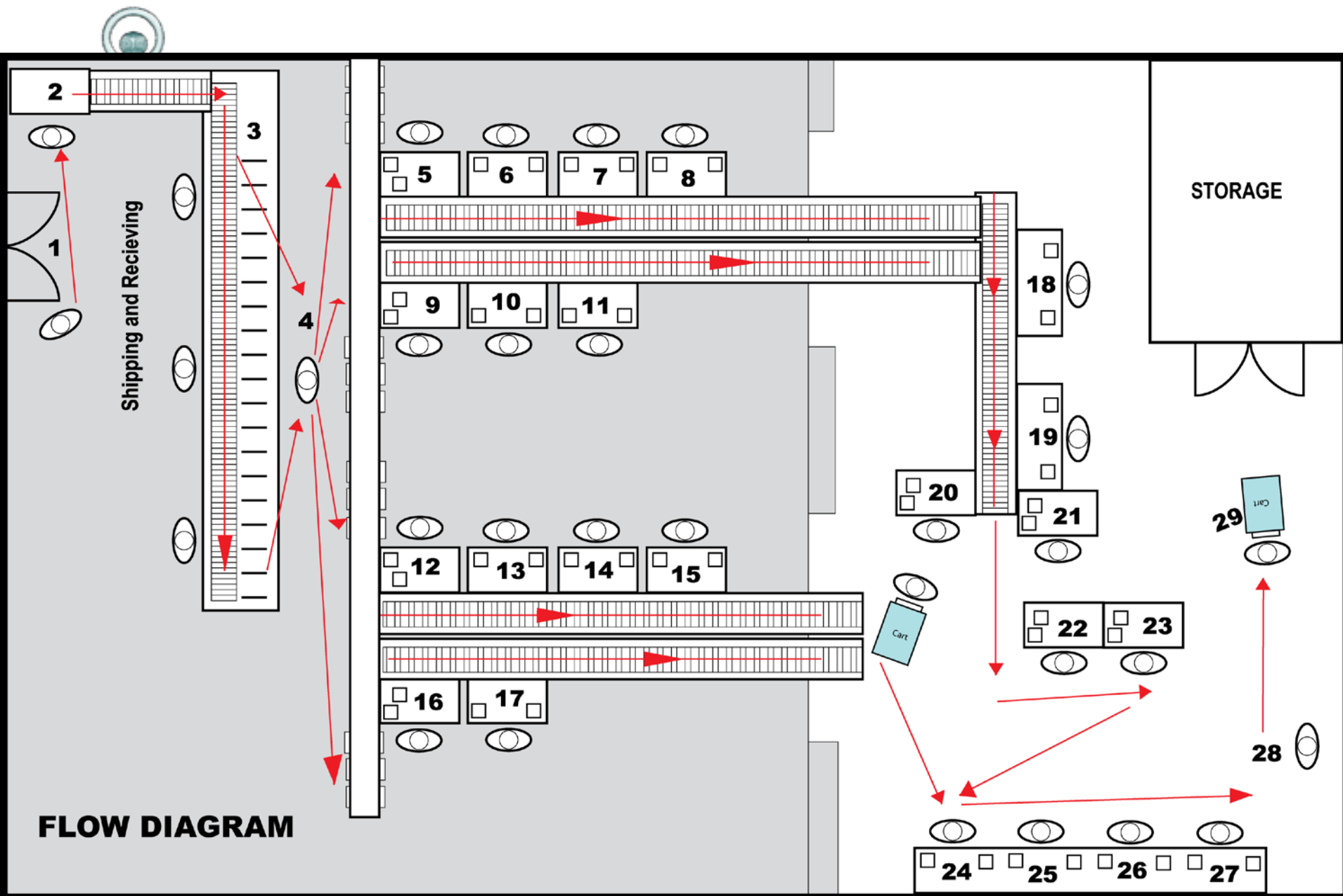
Flow diagram of the revised layout of a group of operations on the Garand rifle.



**FIGURE 2-12**

Flow diagram of the old layout of a group of operations on the Garand rifle. (Shaded section of plant represents the total floor space needed for the revised layout [Figure 2-13]. This represented a 40 percent savings in floor space.)





**FLOW DIAGRAM**



# Work Charting Methods

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## **6. *Worker and Machine Process Charts***





## 6 - Worker and Machine Process Charts

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- Show at a single workstation **time relationship** between:
  - **working cycle** of a **person** and
  - **operating cycle** of a **machine(s)**
- **Machine times** and **operator times** must be known for *each element*
- Chart drawn *vertically* to scale
- Useful in describing any **repetitive worker-machine system**



## 6 - Worker and Machine Process Charts

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- **Solid lines** represent: **productive time**
- **Breaks** indicate: **idle time**
- **Dotted lines** represent: **non-productive time**

FIGURE 2-14

Worker and machine process chart for milling machine operation.



**WORKER AND MACHINE PROCESS CHART**

Subject Charted Milling slot in regulator clamp Chart No. 807  
 Drawing No. J-1482 Part No. J-1482-1 Chart of Method Proposed  
 Chart Begins Loading mchs. for milling Charted By C. A. Anderson  
 Chart Ends Unloading milled clamps Date 8-27 Sheet 1 of 1

ELEMENT DESCRIPTION	OPERATOR	B.&S. Hor. Mill	
		MACHINE 1	MACHINE 2
Stop machine #1	.0004		
Return table mch. #1 5 inches	.0010	Unloading .0024	
Loosen vise remove part and lay aside (mch. #1)	.0010		Mill Slot .0040
Pick up part and tighten vise mch. #1	.0018		
Start machine #1	.0004	Loading .0032	
Advance table and engage feed mch. #1	.0010		Idle
Walk to machine #2	.0011		
Stop machine #2	.0004		
Return table machine #2 5 inches	.0010	Mill Slot .0040	
Loosen vise remove part and lay aside (mch. #2)	.0010		Unloading .0024
Pick up part and tighten vise mch. #2	.0008		
Start machine #2	.0004		Loading .0032
Advance table and engage feed mch. #2	.0010	Idle	
Walk to machine #1	.0011		
Idle man time per cycle	.0000	Idle hours machine #1	.0038
Working man time per cycle	.0134	Productive hours mch. #1	.0098
Man-hours per cycle	.0134	Machine #1 cycle time	.0134
		Idle hours machine #2	.0038
		Productive hours mch. #2	.0098
		Machine #2 cycle time	.0134



# Work Charting Methods

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## ***7. Gang Process Charts***



## 7 - Gang Process Charts

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- These are Worker and Machine Process charts showing
  - **many workers**
  - workers are **interacting** with a piece of **equipment** or a **machine**
- Purpose: determine if interaction between workers is *efficient* and *coordinated*
- Examples:
  - workers at a coal furnace
  - workers in a steel mill



# 7 - Gang Process Charts

FIGURE 2-15

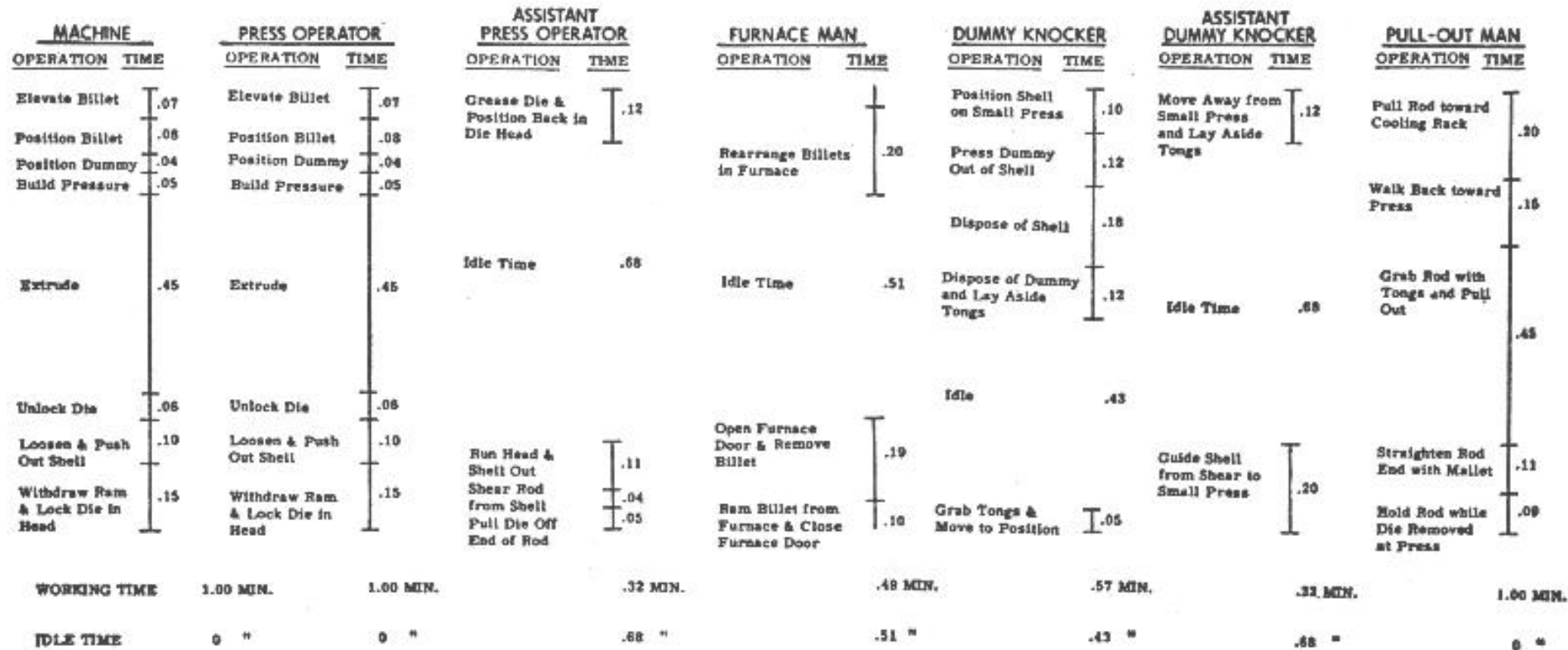
Gang process chart of the present method of operation of a hydraulic extrusion process.

## GANG PROCESS CHART OF PRESENT METHOD

HYDRAULIC EXTRUSION PRESS    DEPT. 11    BELLEFONTE PA. PLANT

CHARTED BY B.W.N. 4-15-

CHART NO. G-85



IDLE TIME = 2.30 MAN-MINUTES PER CYCLE = 18.4 MAN-HOURS PER EIGHT-HOUR DAY

**FIGURE 2-16**

Gang process chart of the proposed method of operation of a hydraulic extrusion process.



**GANG PROCESS CHART—PROPOSED METHOD**  
 Hydraulic Extrusion Press Dept. II Bellefonte, Pa. Plant  
 Charted by B.W.N. 4-15 Chart G-85

MACHINE		PRESS OPERATOR		ASSISTANT		DUMMY KNOCKER		PULL-OUT MAN	
OPERATION	TIME	OPERATION	TIME	OPERATION	TIME	OPERATION	TIME	OPERATION	TIME
Elevate Billet	.07	Elevate Billet	.07	Grease Die & Position Back in Die Head	.12	Position Shell on Small Press	.10	Pull Rod toward Cooling Rack	.20
Position Billet	.08	Position Billet	.08	Walk to Furnace	.05	Press Dummy Out of Shell	.12	Walk Back toward Press	.15
Position Dummy	.04	Position Dummy	.04	Rearrange Billets in Furnace	.20	Dispose of Shell	.18		
Build Pressure	.05	Build Pressure	.05	Return to Press	.05	Dispose of Dummy and Lay Aside Tongs	.12	Grab Rod with Tongs and Pull Out	.45
Extrude	.45	Extrude	.45	Idle Time	.09	Idle Time	.23		
				Open Furnace Door & Removes Billet	.19				
Unlock Die	.06	Unlock Die	.06	Ram Billet from Furnace & Close Furnace Door	.10	Grab Tongs & Move to Position	.05		
Loosen & Push Out Shell	.10	Loosen & Push Out Shell	.10	Run Head & Shell	.11	Guide Shell from Shear to Small Press	.20		.11
Withdraw Ram & Lock Die in Head	.15	Withdraw Ram & Lock Die in Head	.15	Shear Rod from Shell	.04				.09
				Pull Die Off End of Rod	.05				
Working Time	1.00 Min.	1.00 Min.		.91 Min.		.77 Min.		1.00 Min.	
Idle Time	0	0		.09 Min.		.23 Min.		0	



# Work Charting Methods

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## ***8. Two-Handed Process Charts***





## 8 - Two-Handed Process Charts

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- **Left-hand / right-hand** chart
- **Operator process** chart
- Flow process chart directed at an operator
- Each hand is **documented separately**
- Activities of worker's **hands** (or limbs): recorded in their **relationship** to one another
- Useful when doing work methods analysis



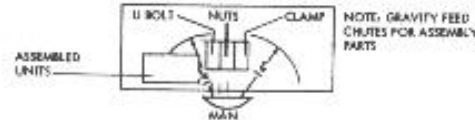
**FIGURE 4-17**

Two-hand process chart for assembly of cable clamps

**Two-Hand Process Chart**

Operation: Assemble Cable Clamps	Part: SK-112	<b>Summary</b>	Left Hand	Right Hand
Operator Name and No.: J.B. #1157		Effective Time:	2.7	11.6
Analyst: G. Thuring	Date: 6-11-96	Ineffective Time:	11.6	2.7
Method (circle choice): <u>Present</u> Proposed		Cycle Time =	14.30 sec.	

Sketch:



Left Hand Description	Symbol	Time	Time	Symbol	Right Hand Description
Get U-Bolt (10")	RE G	1.00	1.00	RE G	Get Cable Clamp (10")
Place U-Bolt (10")	M P	1.20	1.20	M P RL	Place Cable Clamp (10")
Hold U-Bolt	H	11.00	1.00	RE G	Get First Nut (9")
			1.20	M P	Place First Nut (9")
			3.40	U	Run Down First Nut
				RL	
			1.00	RE G	Get Second Nut (9")
			1.20	M P	Place Second Nut (9")
Dispose of Assembly	M RL	1.10	3.40	U	Run Down Second Nut
				RL	
			0.90	UD	Wait



# 8 - Two-Handed Process Charts

## TWO-HANDED PROCESS CHART: CUTTING GLASS TUBES

TWO-HANDED PROCESS CHART						
CHART No. 1 SHEET No. 1 OF 1,			WORKPLACE LAYOUT			
DRAWING AND PART: <i>Glass tube 3 mm dia., 1 metre original length</i>						
OPERATION: <i>Cut to lengths of 1.5 cm</i>						
LOCATION: <i>General shop</i>						
OPERATOR: <i>D. G.</i>						
CHARTED BY: <i>A. B.</i> DATE: <i>22. 7. 52</i>						
LEFT-HAND DESCRIPTION	○	⇨	⇩	⇨	○	RIGHT-HAND DESCRIPTION
<i>Holds tube</i>						<i>Picks up file</i>
<i>To jig</i>						<i>Holds file</i>
<i>Inserts tube to jig</i>						<i>File to tube</i>
<i>Presses to end</i>						<i>Holds file</i>
<i>Holds tube</i>						<i>Notches tube with file</i>
<i>Withdraws tube slightly</i>						<i>Holds file</i>
<i>Rotates tube 120°/180°</i>						<i>Holds file</i>
<i>Pushes to end jig</i>						<i>Moves file to tube</i>
<i>Holds tube</i>						<i>Notches tube</i>
<i>Withdraws tube</i>						<i>Places file on table</i>
<i>Moves tube to R.H.</i>						<i>Moves to tube</i>
<i>Bends tube to break</i>						<i>Bends tube</i>
<i>Holds tube</i>						<i>Releases cut piece</i>
<i>Changes grasp on tube</i>						<i>To file</i>

METHOD	PRESENT	
	L. H.	R. H.
<i>Operations</i>	8	5
<i>Transports</i>	2	5
<i>Delays</i>	—	—
<i>Holds</i>	4	4
<i>Inspections</i>	—	—
<b>Totals</b>	<b>14</b>	<b>14</b>