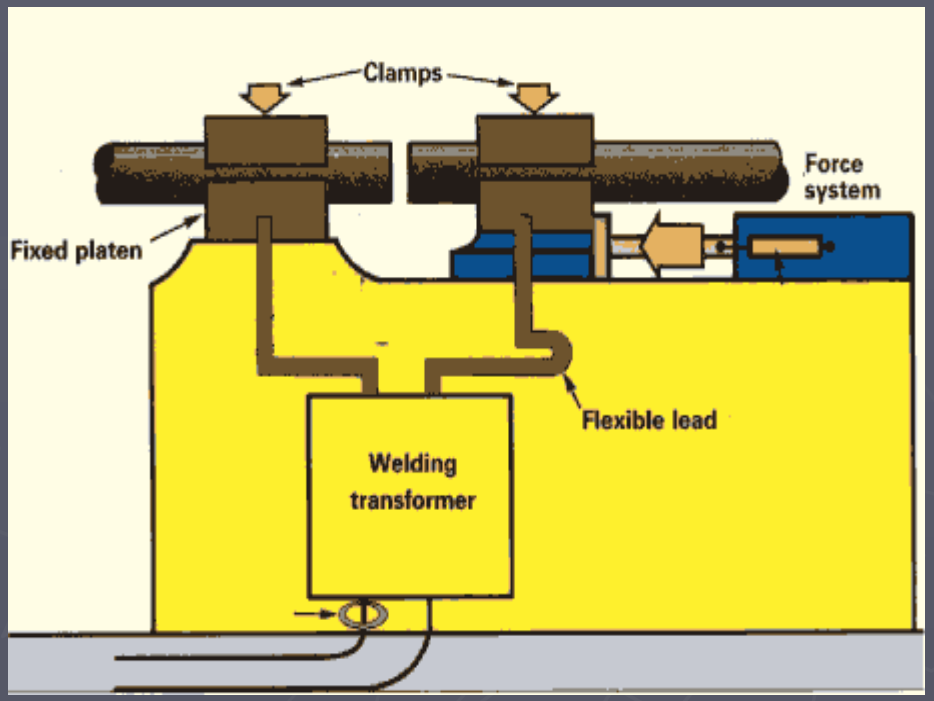
FLASH, UPSET, AND PERCUSSION WELDING

- Flash, Upset, and Percussion welding constitute a family of welding processes used to join parts of similar cross section by making a weld simultaneously across the entire joint area, without adding filler metal. Upset force is applied at some point before, during, or after the heating cycle to bring the parts into intimate contact. The method of heating and time of force application distinguish these three welding processes. Percussion welding may also be used to join the tip or end of a small part to a flat surface.



Schematic representation of a flash welding machine

FLASH WELDING

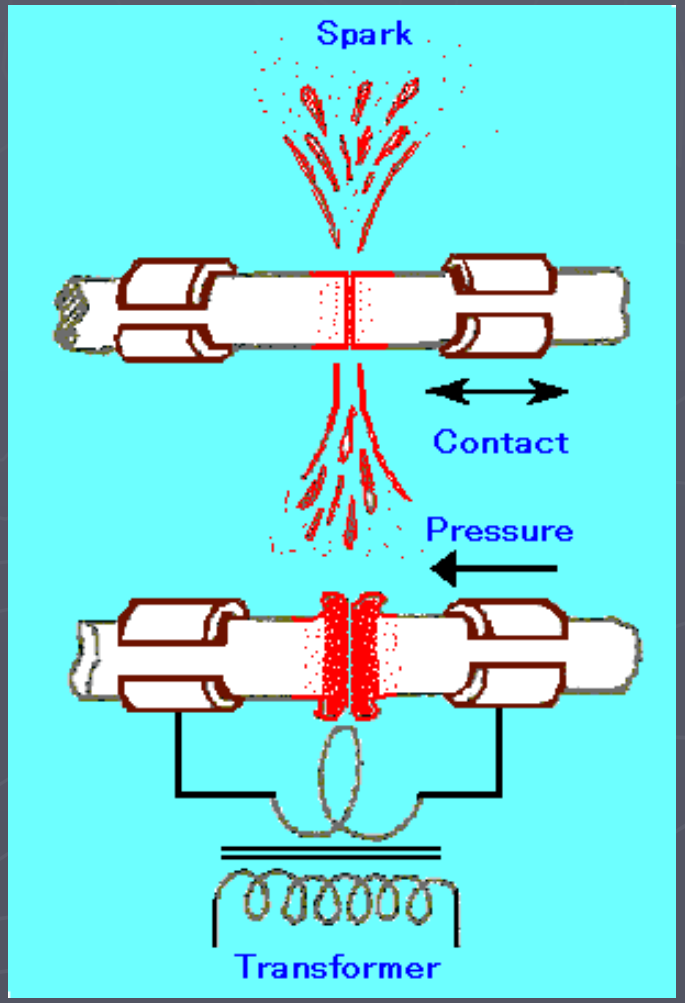
- Flash Welding (FW) is a resistance welding process that produces a weld at the faying surfaces of a butt joint by a flashing action and by the application- of pressure after heating is substantially completed.
- The flashing action, caused by the very high current densities at small contact points between the workpieces, forcibly expels material from the joint as the workpieces are slowly moved together.
- The weld is completed by a rapid upsetting of the workpieces.
- Two parts to be joined are clamped in dies (electrodes) connected to the secondary of a resistance welding transformer.
- Voltage is applied as one part is advanced slowly toward the other. When contact occurs at surface irregularities, resistance heating occurs at these locations.

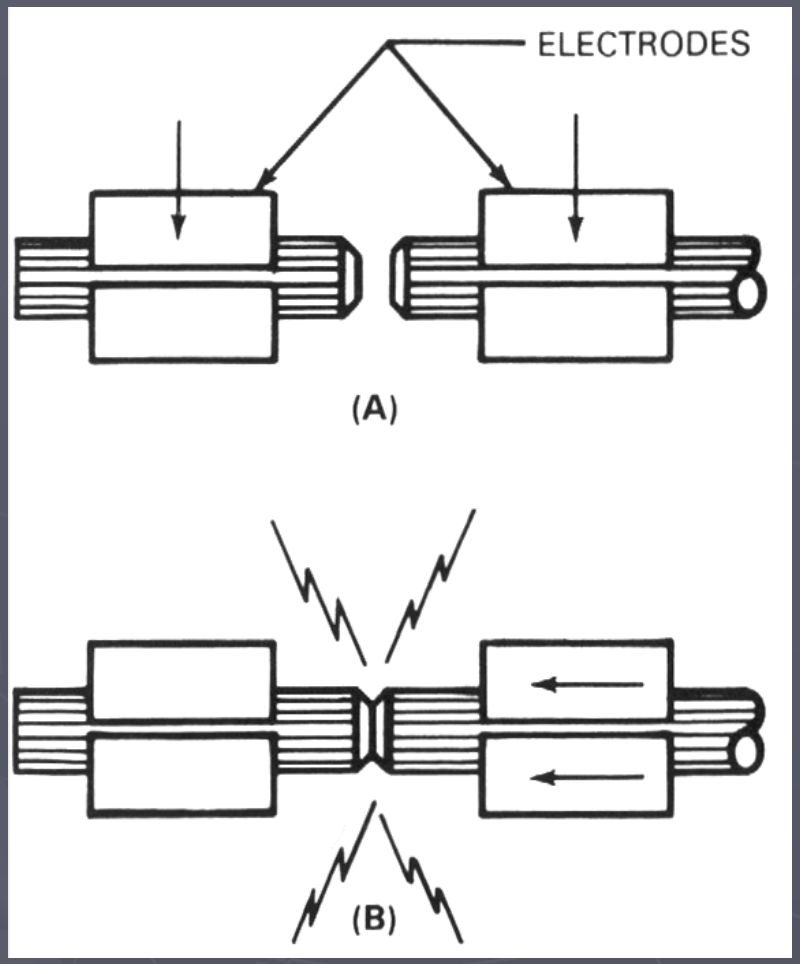
- High amperage causes rapid melting and vaporization of the metal at the points of contact, and then minute arcs form. This action is called “flashing”.
- As the parts are moved together at a suitable rate, flashing continues until the faying surfaces are covered with molten metal and a short length of each part reaches forging temperature. A weld is then created by the application of an upset force to bring the molten laying surfaces in full contact and forge the parts together.
- Flashing voltage is terminated at the start of upset. The solidified metal expelled from the interface called “flash”

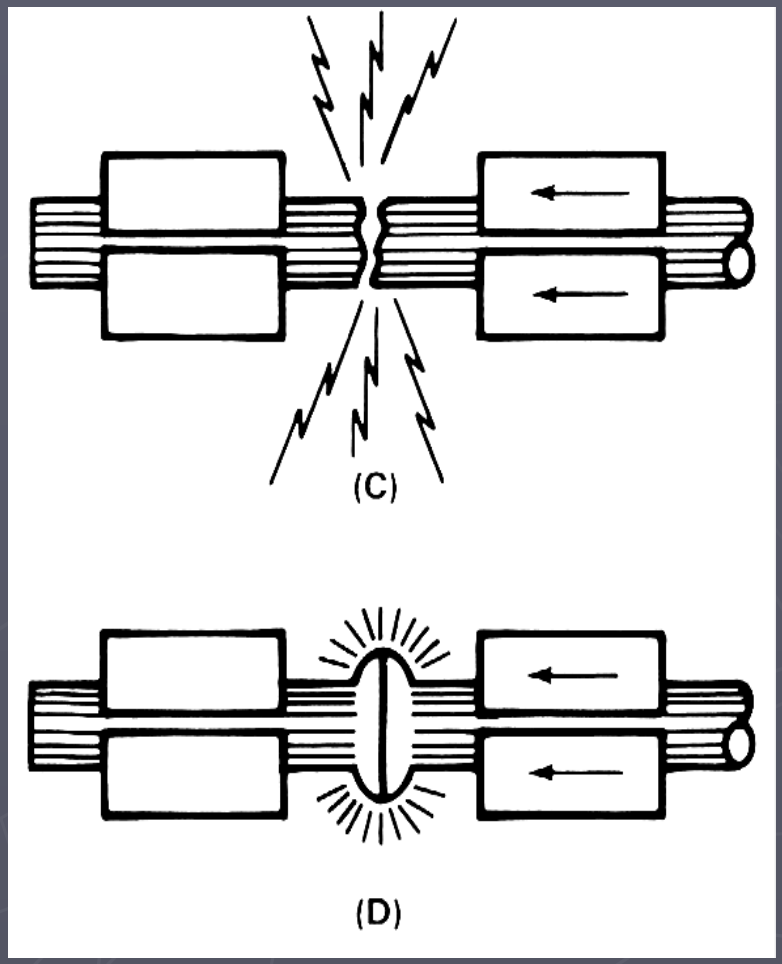
PRINCIPLES OF OPERATION

THE BASIC STEPS in a flash welding sequence are as follows:

- Position the parts in the machine.
- Clamp the parts in the dies (electrodes).
- Apply the flashing voltage.
- Start platen motion to cause
- Flash at normal voltage.
- Terminate flashing.
- Upset the weld zone.
- Unclamp the weldment.
- Return the platen and unload.
- Flashing.







(A) Position and Clamp the Parts; **(B)** Apply Flashing Voltage and Start Platen Motion; **(C)** Flash; **(D)** Upset and Terminate Current

Advantages

Listed below are some important advantages welding:

- Cross sectioned shapes other than circular can be flash welded: for example, angles, H sections, and rectangles. Rotation of parts is not required.
- Parts of similar cross section can be welded with their axes aligned or at an angle to each other, within limits.
- The molten metal film on the faying surfaces and its ejection during upset acts to remove impurities from the interface.
- Preparation of the faying surfaces is not critical except for large
- parts that may require a bevel to initiate flashing.
- Rings of various cross sections can be welded.
- The heat-affected zones of flash welds are much narrower than those of upset welds.

Limitations

The following are some limitations of the process:

- The high single-phase power demand produces unbalance on three-phase primary power lines.
- The molten metal particles ejected during flashing present a fire hazard, may injure the operator, and may damage shafts and bearings. The operator should wear face and eye protection, and a barrier or shield should he used to block flying sparks.
- Removal of flash and upset metal is generally necessary and may require special equipment.
- Alignment of workpieces with small cross sections is sometimes difficult.
- The parts to be joined must have almost identical cross sections.

UPSET WELDING

DEFINITION

Upset Welding (UW) is a resistance welding process that produces coalescence over the entire area of faying surfaces, or progressively along a butt joint, by the heat obtained from the resistance to the flow of welding current through the area where those surfaces are in contact. Pressure is used to complete the weld.

PRINCIPLES OF OPERATION

With this process, welding is essentially done in the solid state.

The metal at the joint is resistance heated to a temperature where recrystallization can rapidly take place across the faying surfaces.

A force is applied to the joint to bring the faying surfaces into intimate contact and then upset the metal.

Upset hastens recrystallization at the interface and, at the same time, some metal is forced outward from this location. This tends to purge the joint of oxidized metal.

Sequence of Operations

- PROCESS VARIATIONS

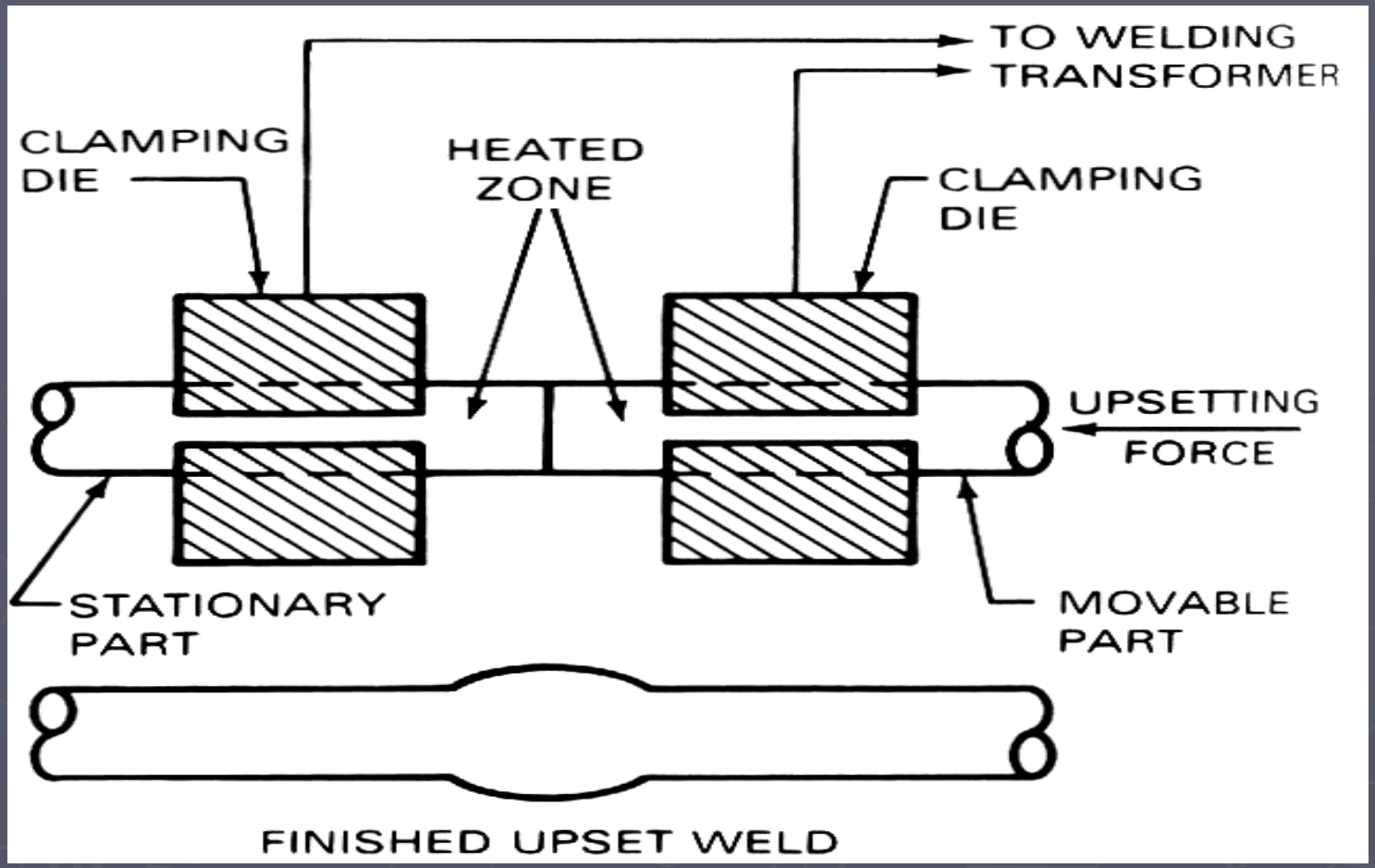
  Upset welding has two variations:

  (1) Joining two sections of the same cross section end- to-end (butt joint)

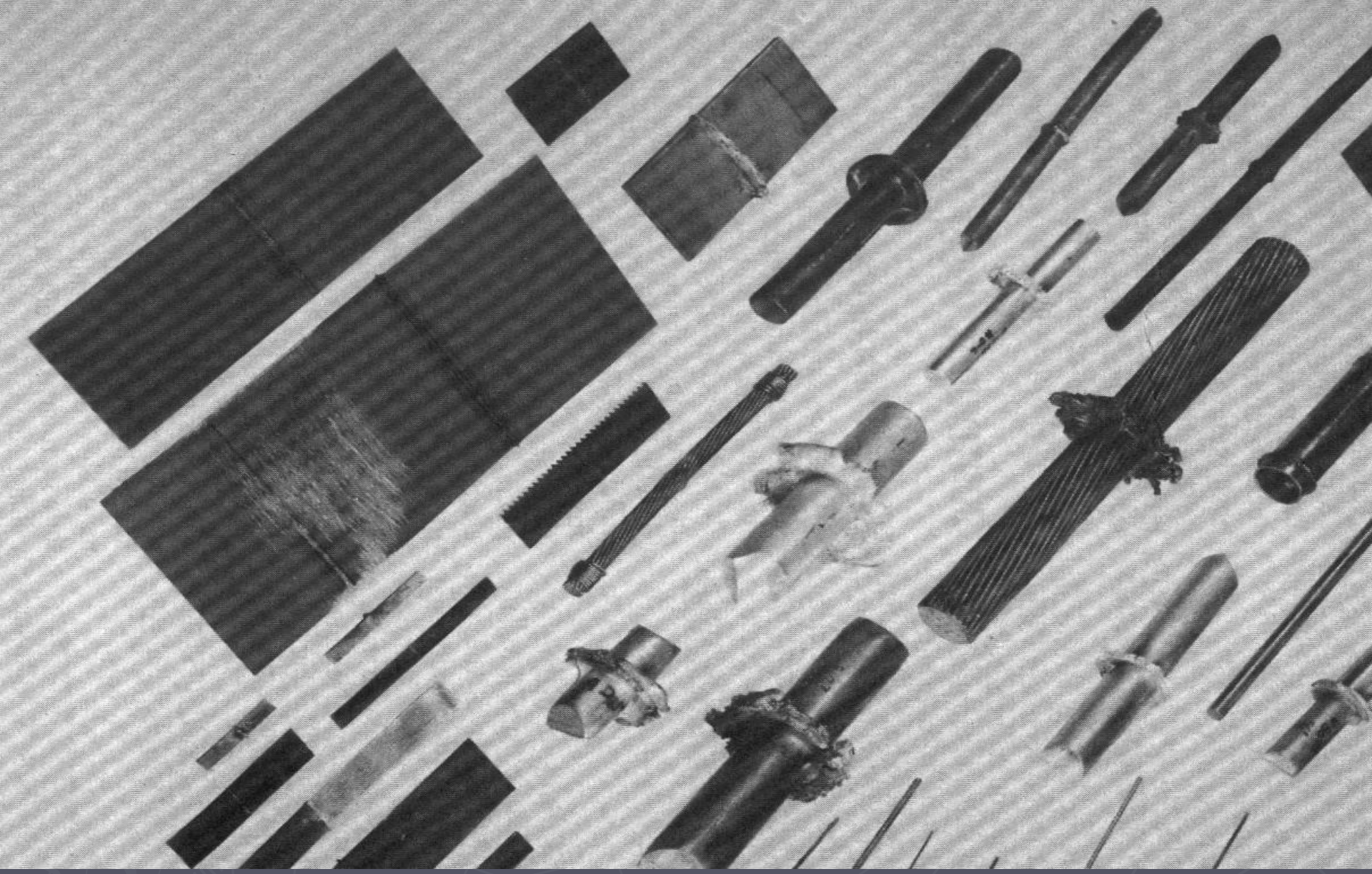
  (2) Continuous welding of butt joint seams in roll- formed products such as pipe and tubing.

- THE ESSENTIAL OPERATIONAL steps to produce an upset welded butt joint are as follows:

  →Load the machine with the parts aligned end-to-end
  →Clamp the parts securely
  →Apply a welding force
  →Initiate the welding current
  →Apply an upset force
  →Cut off the welding current
  →Release the upset force
  →Unclamp the weldment
  →Return the movable platen and unload the weldment



General Arrangement for Upset Welding of Bars, Rods, and Pipes



Typical products formed by Upset Welding

PERCUSSION WELDING

- Percussion welding is a joining process that produces coalescence with an arc resulting from a rapid discharge of critical energy. Pressure is applied percussively during or immediately following the electrical discharge.
- In general, “percussion welding” is the term used in the electronics industry for joining wires, contacts, leads, and hr items to a flat surface. On the other hand, if the item ,metal stud that is welded to a structure for attachment purposes, it is called capacitor discharge stud welding.
- In application of the process, the two parts are initially separated by a small projection on one part, or one part is ‘moved toward the other.
- At the proper time, an arc is initiated between them. This arc heats the faying surfaces of the parts to welding temperature.
- Then, an impact force drives the parts together to produce a welded joint.

THE ESSENTIAL SEQUENCE OF EVENTS

- Load and clamp the parts into the machine.
- Apply a low force on the parts or release the driving tern.
- Establish an arc between the laying surfaces (1) with high voltage to ionize the gas between the parts or (2) with high current to melt and vaporize a projection on one part.
- Move the parts together percussively with an applied force to extinguish the arc and consummate a weld.
- Turn off the current.
- Release the force.
- Unclamp the welded assembly
- Unload the machine.

PRINCIPLES OF OPERATION

- Welding heat is generated by a high current arc between the two parts to be joined. The current density is very high, and this melts a thin layer of metal on the faying surfaces in a few milliseconds.
- Then the molten surfaces are brought together in a percussive manner to complete the weld.

ADVANTAGES

- The extreme brevity of the arc in percussion welding limits melting to a very thin layer on the faying surfaces. Consequently, there is very little upset or flash on the periphery of the welded joint (but enough to remove impurities from the joint). Heat-treated or cold- worked metals can be welded without annealing them.
- Filler metal is not used and there is no cast metal at the weld interface. A percussion welded joint usually possesses higher strength and conductivity than does a brazed joint. Unlike brazing, no special flux or atmosphere is required.
- A particular advantage of the capacitor discharge method is that the capacitor charging rate is easily controlled and low compared to the discharge rate. The line power factor is better than with a single-phase ac machine. Both these factors give good operating efficiency and low power line demand.
- Percussion welding can tolerate a slight amount of contamination on the faying surfaces because expulsion of the thin molten layer tends to carry any contaminants out of the joint.

LIMITATIONS

- The percussion welding process is limited to butt joints between two like sections and to flat pads or contacts joined to flat surfaces. In addition, the total area that can be joined is limited since control of an arc path between two large surfaces is difficult.
- Joints between two like sections can usually be accomplished more economically by other processes. Percussion welding is usually confined to the joining of dissimilar metals not normally considered weldable by other processes, and to the production of joints where avoidance of upset is imperative.
- Another limitation of this process is that two separate pieces must be joined. It cannot be used to weld a ring from one piece.