Extrusion

- Extrusion is the process of confining the metal in a closed cavity and then allowing it to flow from only one opening so that the metal takes the shape of the opening.

- Exp: The operation is identical to the squeezing of toothpaste out of a toothpaste tube.

Extrusion principle

- The equipment consist of a cylinder or container into which the heated metal billet is loaded. On one end of the container, the die plate with the necessary opening is fixed.
- From the other end a plunger or ram compresses the metal billet against the container walls and the die plate thus forcing it to flow through the die opening, and acquiring the shape of the opening.

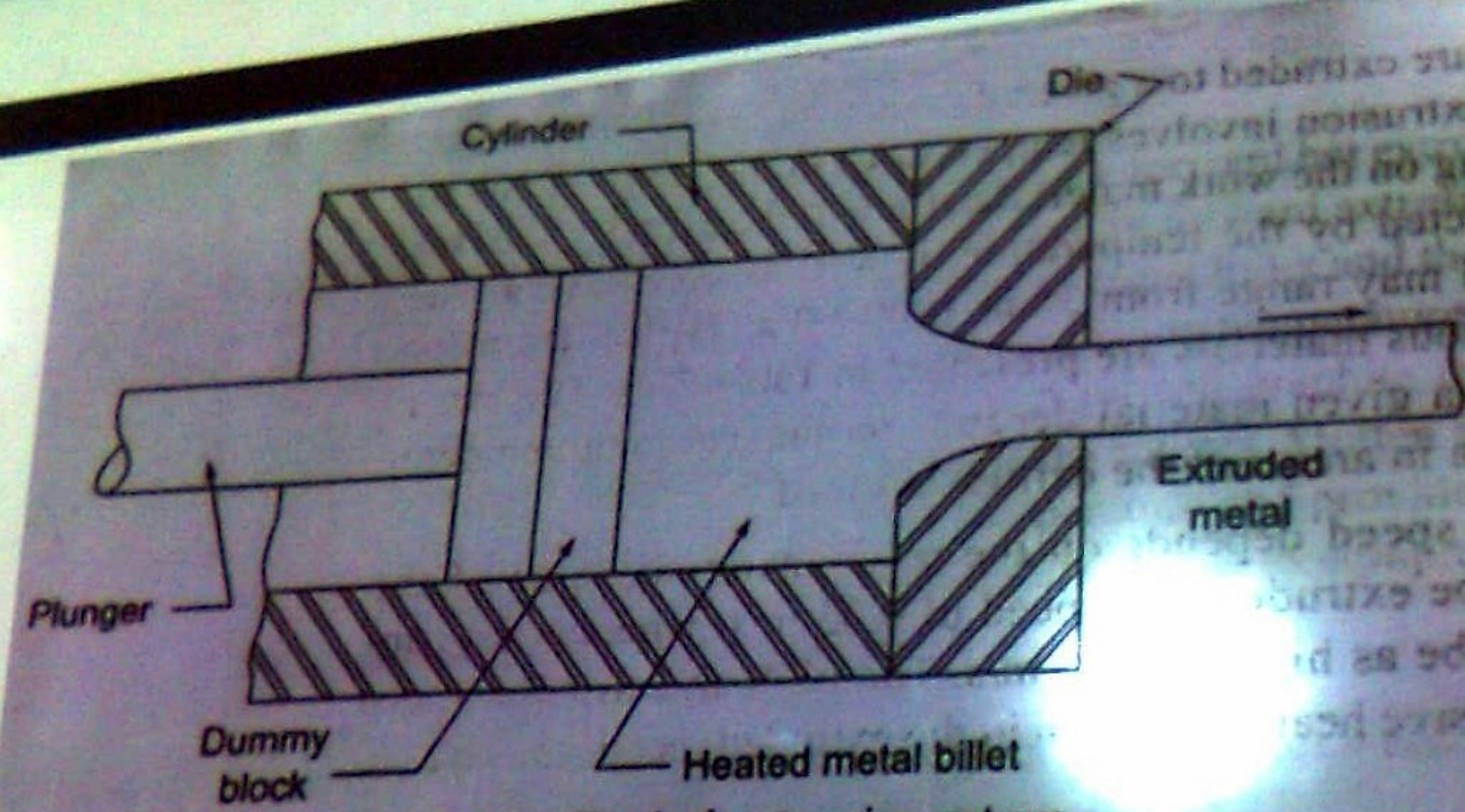

Fig. 7.48 *Typical extrusion set up*

metal handling system as it comes out of the die.

- A dummy block which is a steel disc of about 40 mm thickness, with a diameter slightly less than the container, is kept between the hot billet and the ram to protect it from heat and pressure.

Extrusion

- The complexity of the parts that can be obtained by extrusion is more than that of rolling, because the die required is very simple and easier to make.
- It is single pass process unlike rolling
- The amount of reduction that is possible in extrusion is large.
- Brittle material can also be very easily extruded.

- It is possible to produce sharp corners.
- Large diameters and thin walled tubular products with excellent concentricity and tolerance characteristics can be produced.

Classification

- Hot Extrusion
  - Forward
  - Backward
- Cold Extrusion
  - Forward
  - Backward
  - Hydrostatic
  - Cold Extrusion Forging
  - Impact Extrusion

Hot Extrusion Processes

- Forward Hot Extrusion: Fig 7.48 signifying the flow of metal in the forward direction i.e the same as that of the ram.
- In forward extrusion the problem of friction is prevalent because of the relative motion between the heated metal billet and the cylinder walls.
- This is particularly severe in case of steels because of their higher extrusion temp

Hot Extrusion Processes

- To reduce this friction, lubricants are to be used. At lower temperatures, a mixture of oil and graphite is generally used.
- To reduce the damage to equipment, extrusion is finished quickly and the cylinder is cooled before further extrusion.

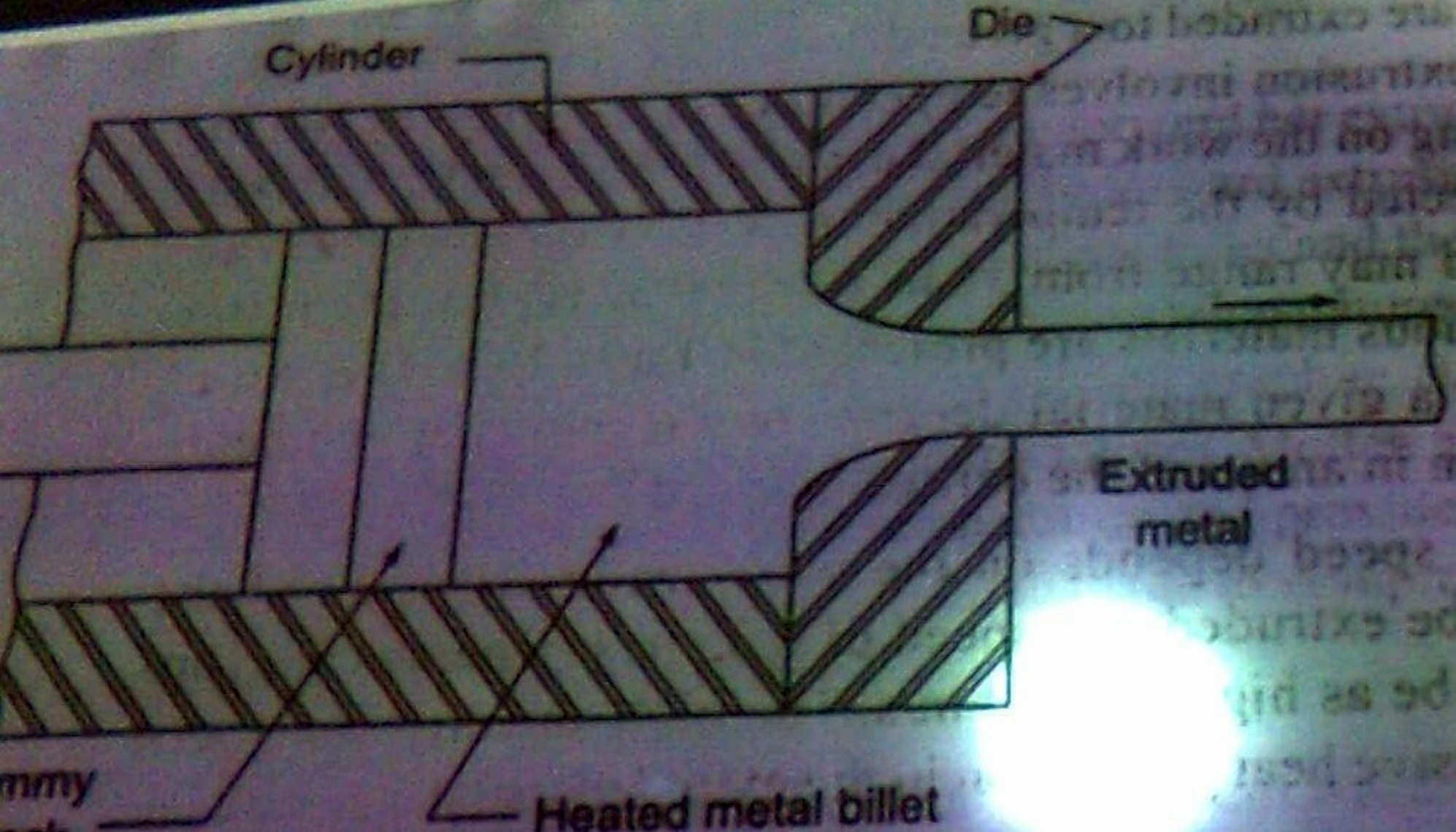

Fig. 7.48 *Typical extrusion set up*

Backward Hot Extrusion

- In order to complete overcome the friction, the backward hot extrusion, is used. In this The ram which houses the die, also the metal is confined fully by the cylinder. compress the metal against the container, forcing it to flow backwards through the die in the hollow plunger or ram.

Backward Hot Extrusion

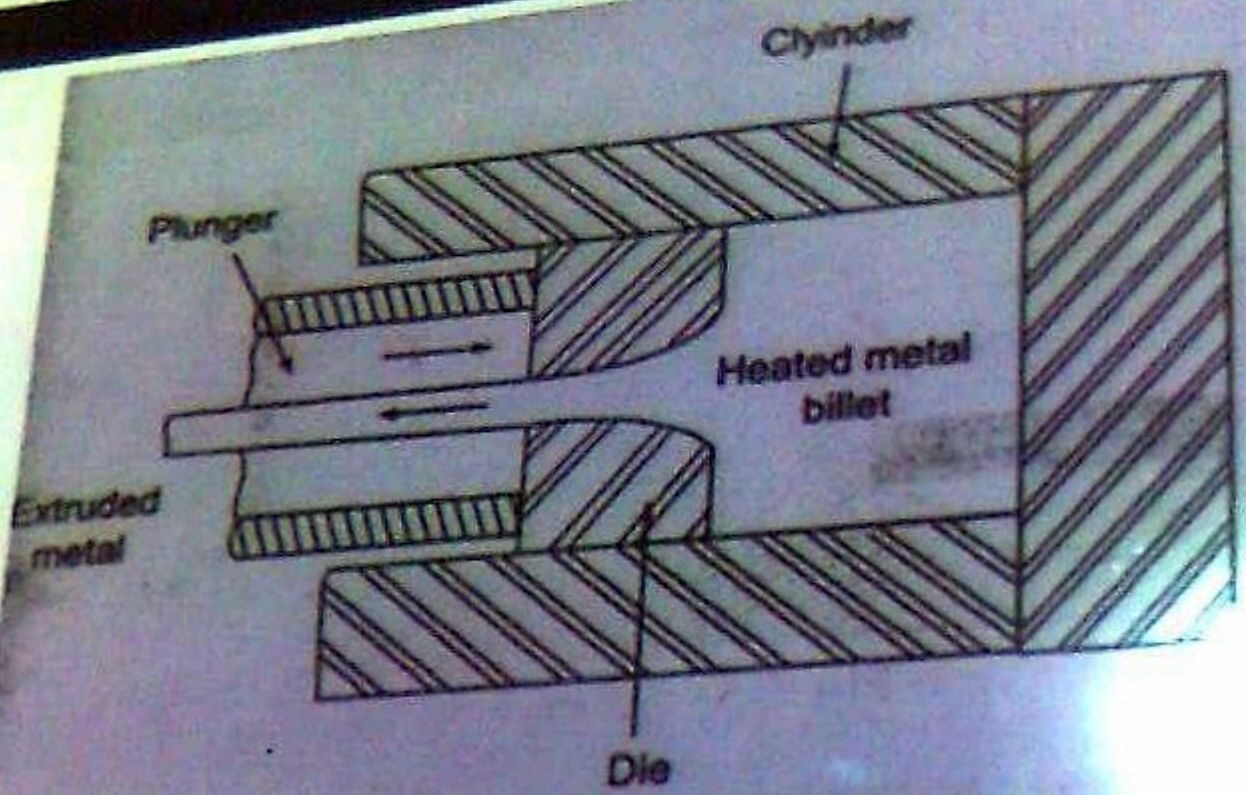

Fig. 7.52 *Backward hot extrusion process*

Backward Hot Extrusion

- The surface quality achieved is generally good since no heat cracking happens due to the friction between the billet and the extrusion cylinder interface.
- Though advantageous this process is not extensively used because of the problem of handling extruding metal coming out through the moving ram.

Cold Extrusion

- **Forward Cold Extrusion**: it is similar to that of forward hot extrusion process except the fact that extrusion ratio possible are lower and extrusion pressure higher than that of hot extrusion.
- It is normally used for simple shapes requiring better surface finish and to improve mechanical properties.

Impact Extrusion

- The backward cold extrusion is much more common particularly with softer materials such as aluminum and its alloys. In backward cold extrusion called impact extrusion.
- The set up consist of a die and a punch. (7.53)
- The slug for making the component is kept on the die and the punch strikes the slug against the die.

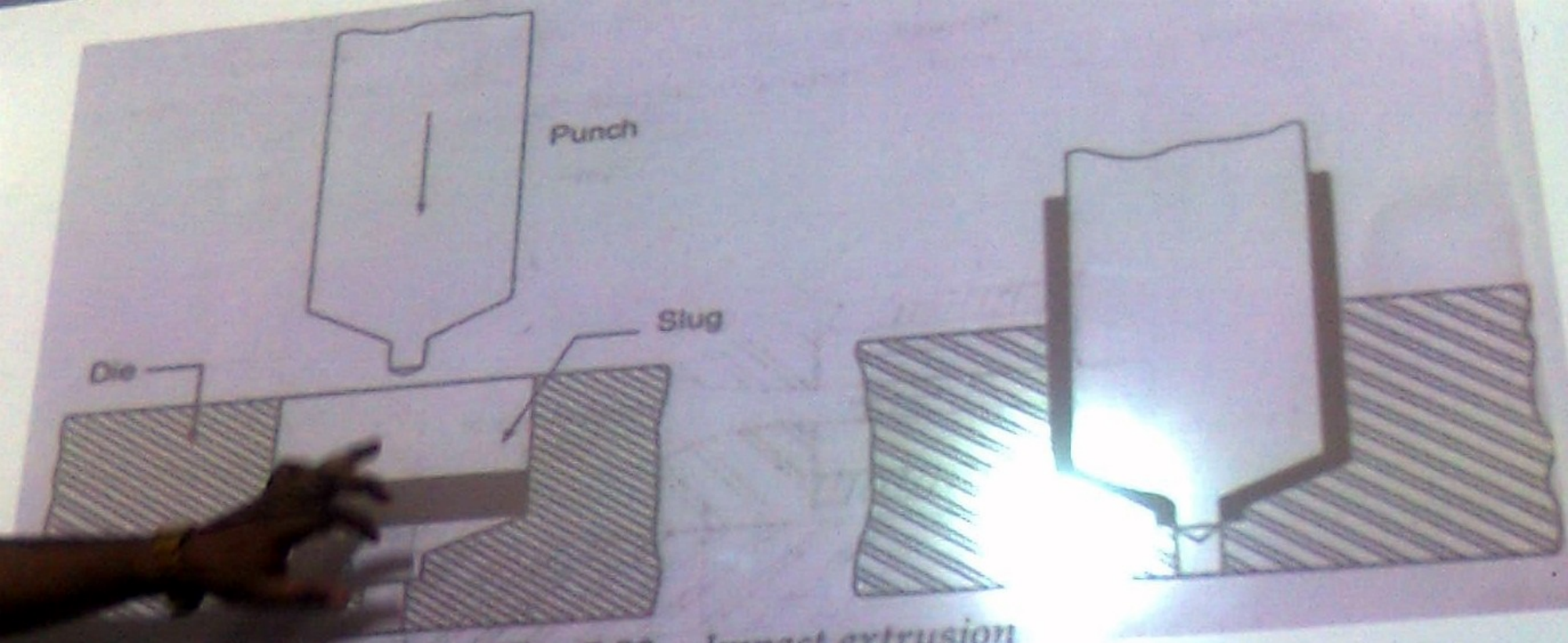

Fig. 7.53 *Impact extrusion*

Impact Extrusion

- The metal is then extruded through the ga between the punch and die opposite to th punch movement.
- Because of the impact force the side walls straight along the punch.
- The height of the side walls is controlled the amount of metal in the slug
- This process is more commonly used making collapsible tubes for housing paste liquids and similar articles.

Cold extrusion Forging

- Cold extrusion is similar to impact extrusion but with the main difference that the side walls are much thicker and their height is smaller.
- This is contains a die and punch.
- The punch slowly descends over the slug kept on the die, thus forging some metal between the punch and the die and the rest being extruded through the clearance between the punch and die side walls.

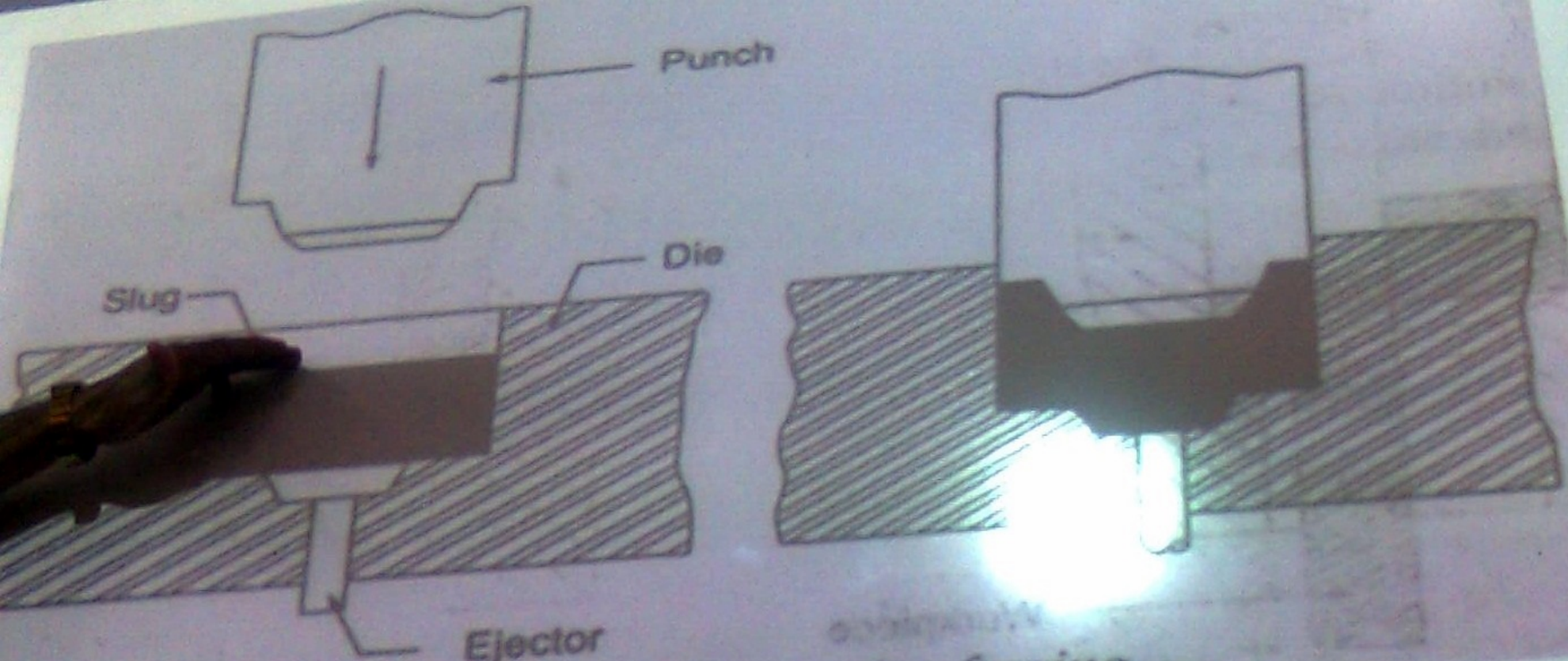

Fig. 7.54 *Cold extrusion forging*

Extruding Tubes

- Hollow objects such as tubes and other shapes can also be obtained by forward hot extrusion. One way of obtaining tube is by means of a solid ram in a double action press.

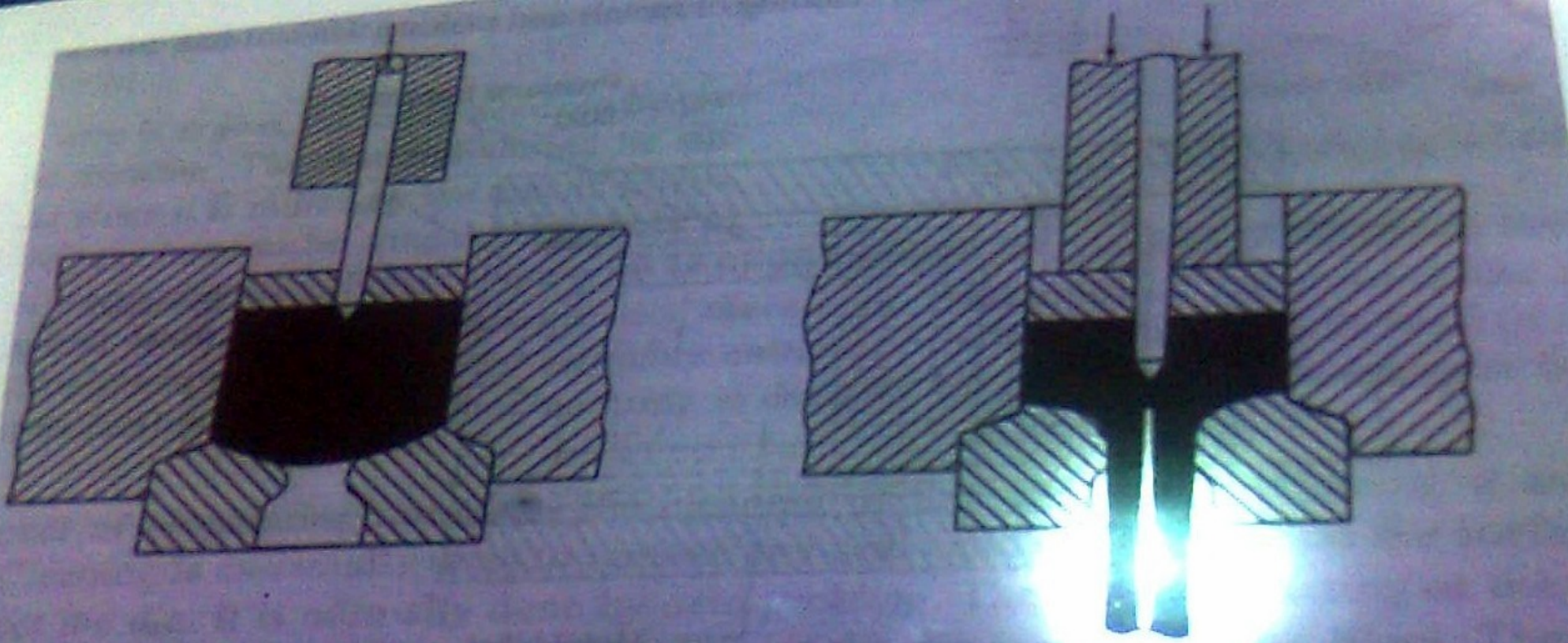

Fig. 7.57 Extruding tubes in a double-action press

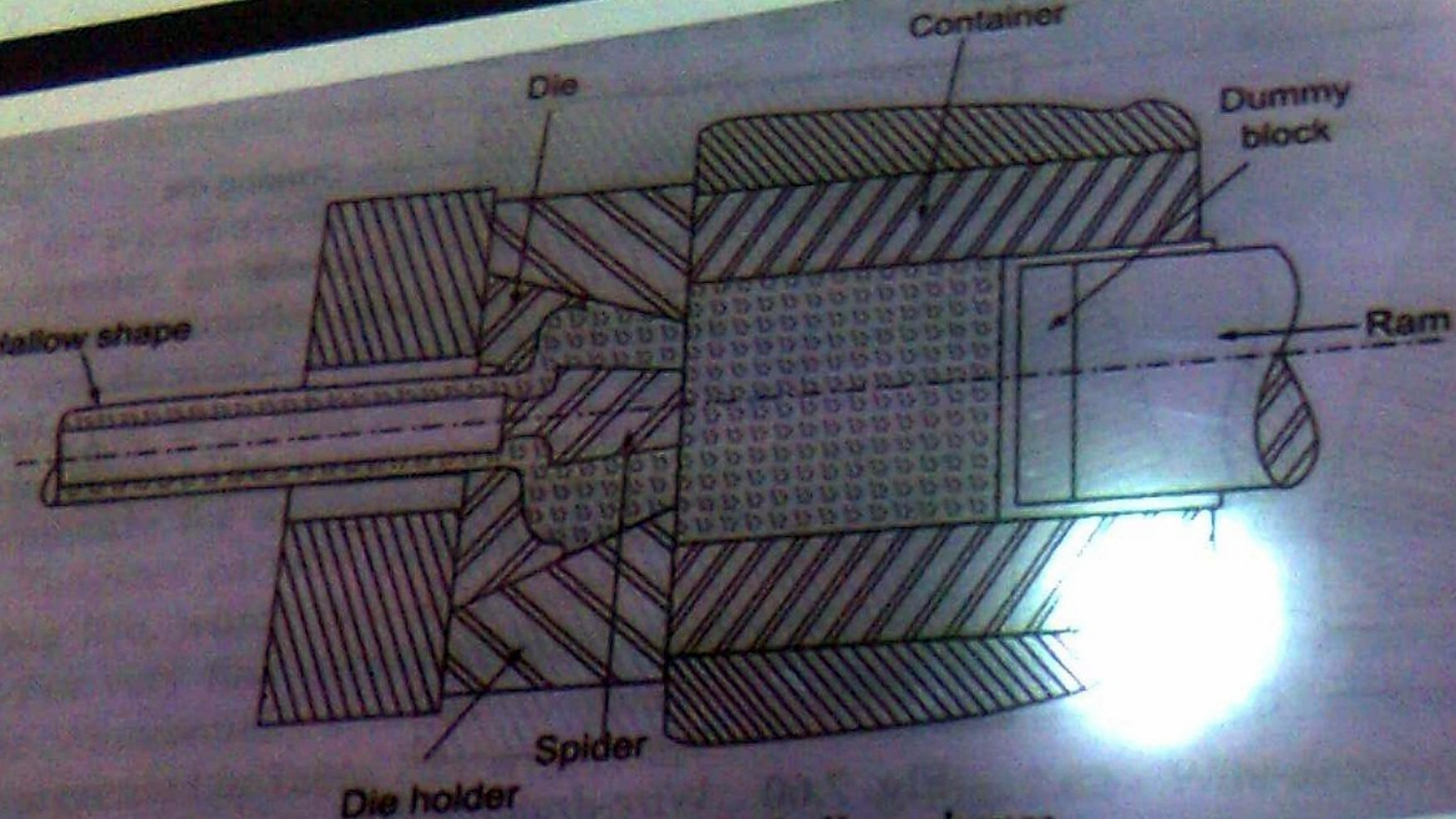

Fig. 7.58 *Spider die for hollow shapes*

- Another way of obtaining hollow shapes is by the use of spider extruding die. The spider die is essentially an extrusion die with a stub mandrel, for the hollow portion to be generated. It is held to the die by means of thin ribs simulating the spider legs. The material when extruded, flows through the opening between the legs and forms the central opening because of the mandrel. The metal flowing out is actually separated but get welded together since it is still in a plastic state.

Wire drawing

- The process of wire drawing is to obtain wires from rods of bigger diameter through a die.
- The wire drawing machine in Fig 7.61.
- The wire drawing die is of conical shape. The end of the rod or wire, which is to be further reduced, is made into a point shape and inserted through the die opening

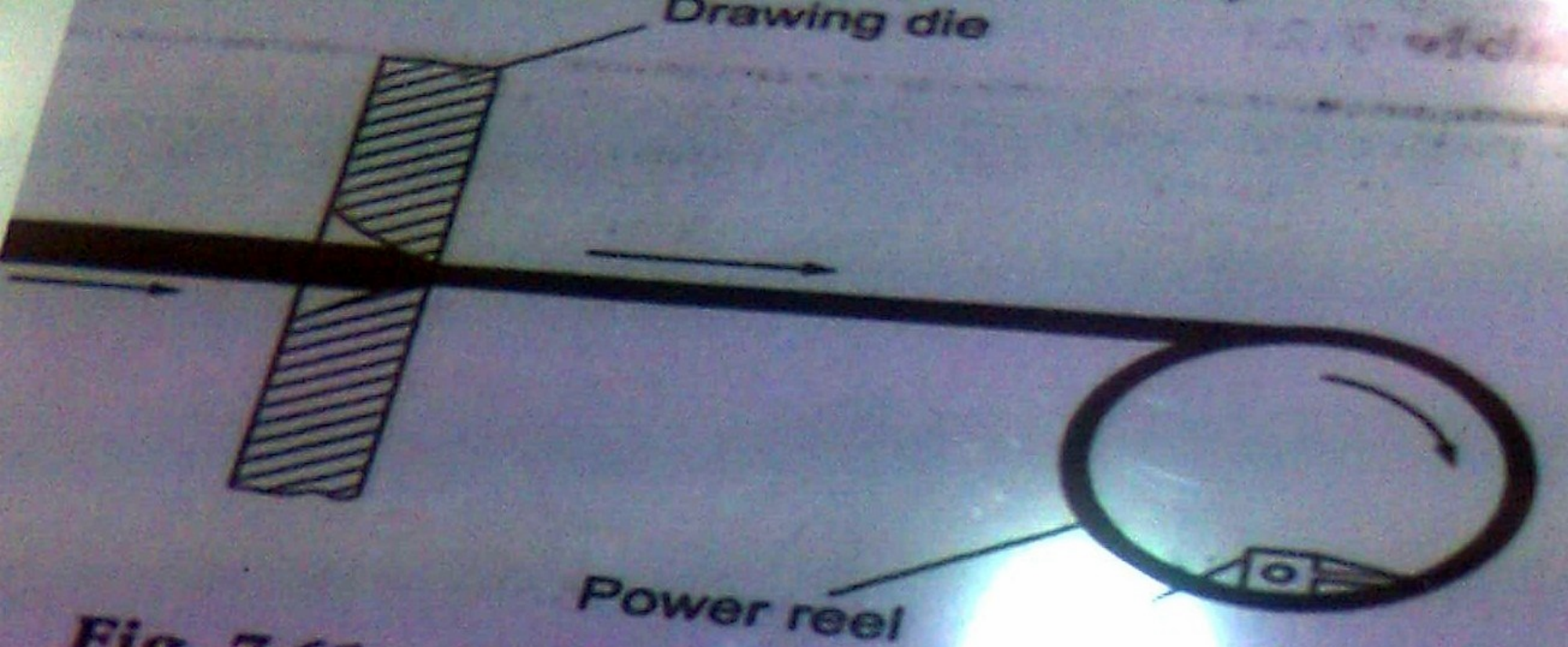

Fig. 7.61 *Wire-drawing set-up*

- This end is then gripped on the other side with a gripper, which would then pull the wire through the die. The wire thus drawn is then coiled round a power reel as shown in fig. 7.61.
- Before the wire is drawn, the stock needs to be prepared for wire drawing. The material should be sufficiently ductile since it is pulled by the tensile force. Hence, the wire have to be annealed properly to provide the necessary ductility.

Rod and Tube drawing

- Rod drawing is similar to wire drawing except for the fact that the dies are bigger because of the rod size being larger than the wire.
- For larger sized stock called bars, the heavy equipment which generally keeps the drawn product straight, is used since a bar cannot be coiled.

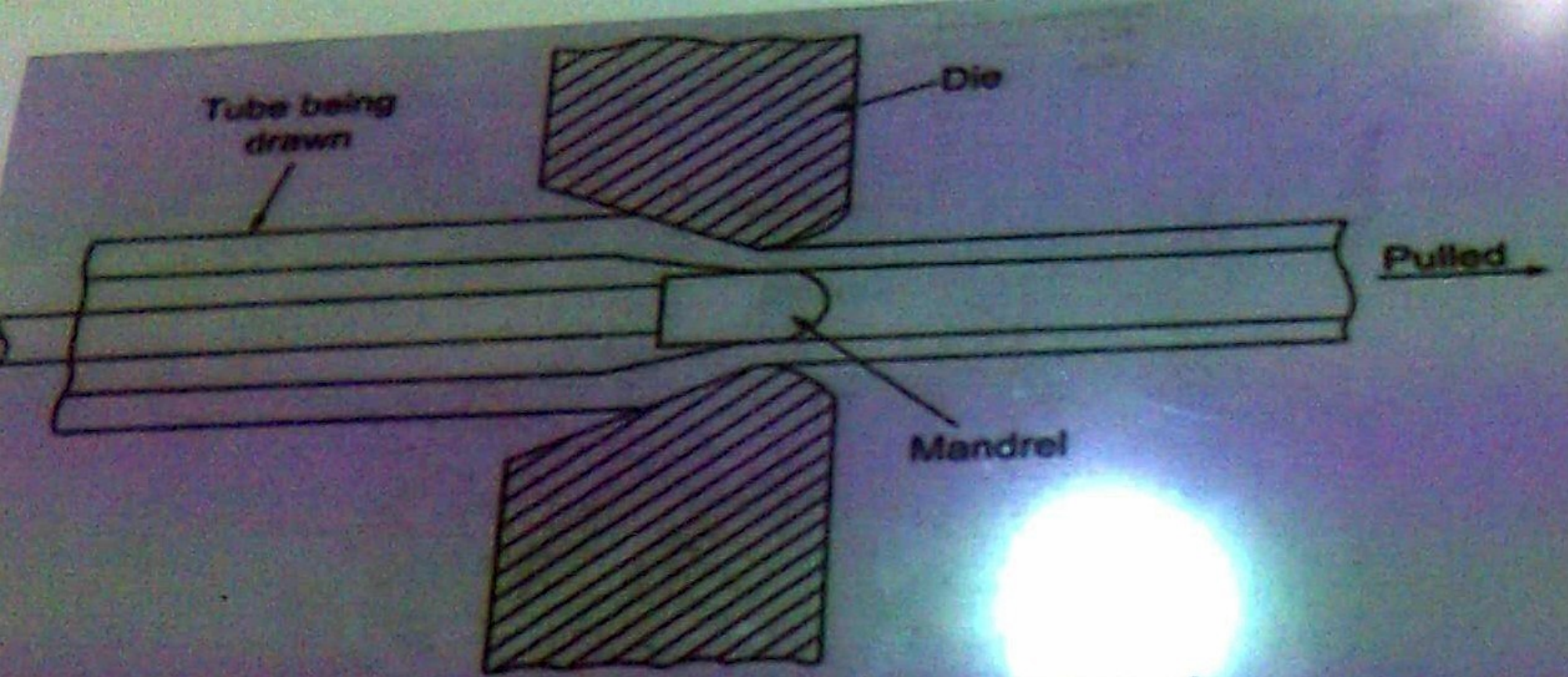

Fig. 7.63 *Tube drawing with a mandrel*

- Tube drawing is also similar to other drawing process. The main difference is that it requires a mandrel of the requisite diameter to form the internal hole as in fig 7.63.
- The tubes are also first pointed and then entered through the die where the point is gripped in a similar way as the bar drawing and pulled through in the t designed along a straight line.

There may be more than one pass required

- In this the metal billet is compressed from all sides by a liquid rather than the ram.

The presence of liquid inside the container eliminates the need for any lubricant and also the material is more uniformly compressed from all sides throughout the eformation zone. Because of this highly ittle material such as grey iron can so be extruded.

Hydrostatic Extrusion

- In this the metal billet is compressed from all sides by a liquid rather than the ram.
- The presence of liquid inside the container eliminates the need for any lubricant and also the material is more uniformly compressed from all sides throughout the deformation zone. Because of this highly brittle material such as grey iron can also be extruded.

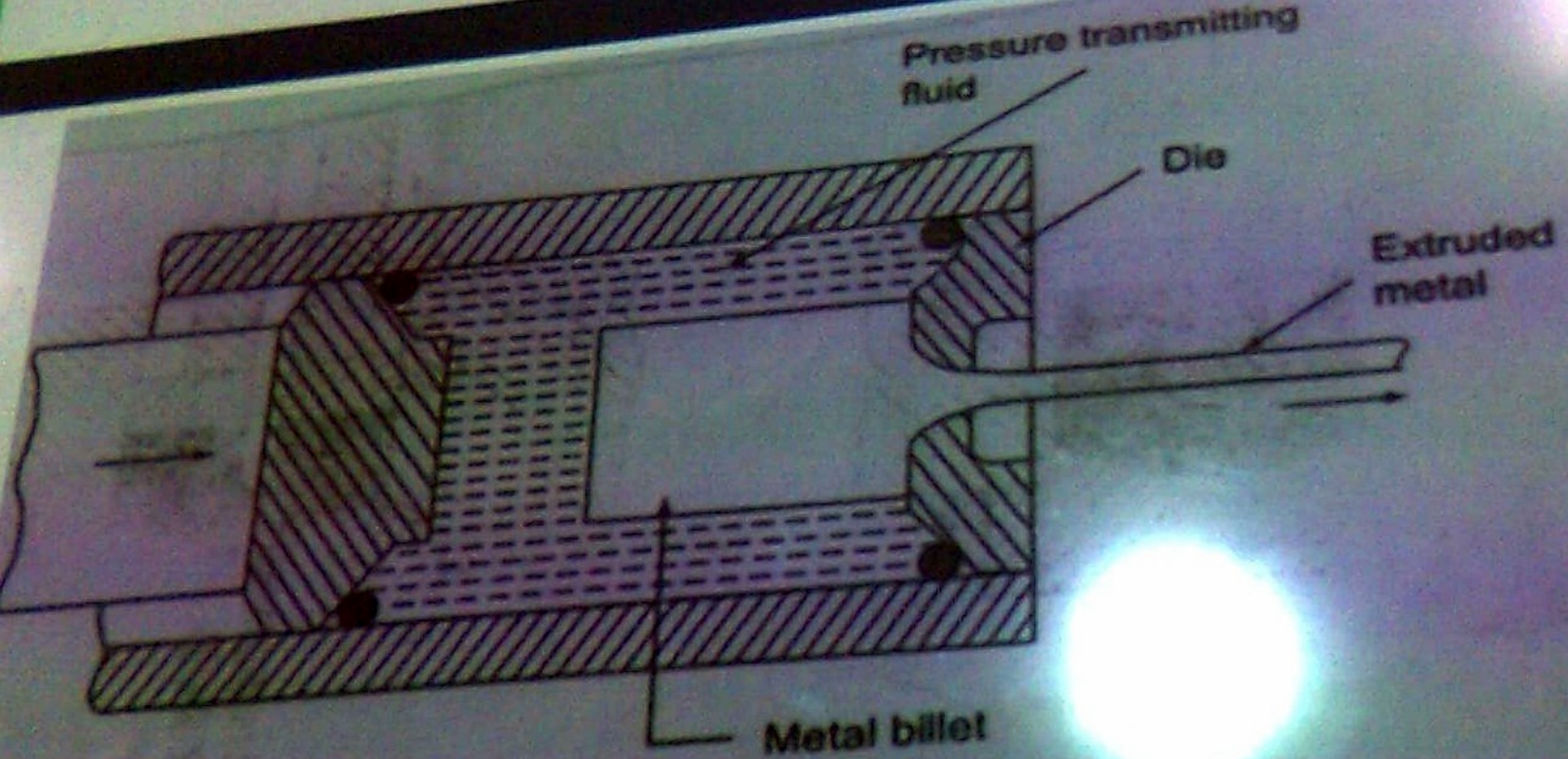

Fig. 7.59 Hydrostatic extrusion