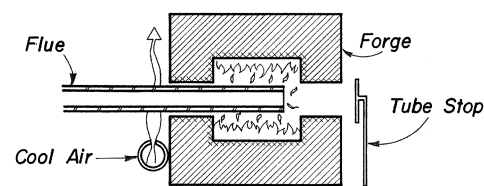
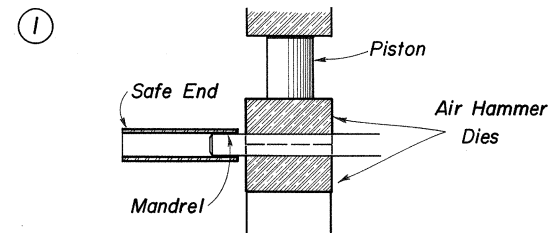
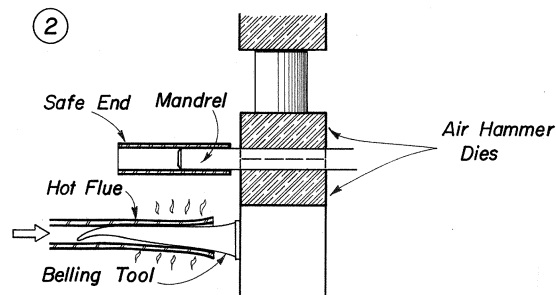


LOCOMOTIVE BOILER TUBE SWAGING PROCESS

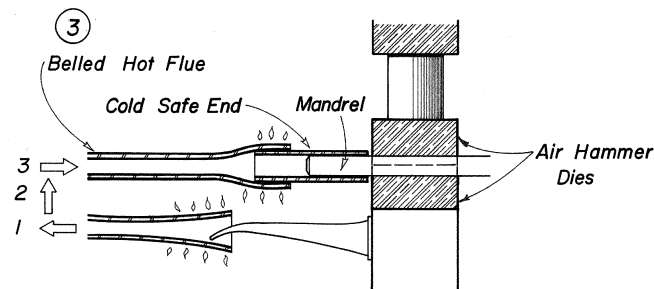
The boiler of a steam locomotive contains a cluster of parallel tubes, or flues, through which hot gases from the firebox pass and heat circulating water to produce steam. These boiler flue tubes are exposed to boiler water that is often acidic and high in minerals, which was the case on the East Broad Top Railroad. These tubes became encrusted, or leaky, and had to be repaired periodically. When the boiler flue tubes were removed from the locomotive, they were cut off flush with the rear fluesheet, and any scale was removed. A new length of boiler tube, about eight inches long, called a "safe end," was welded on to restore the proper length of the tube.



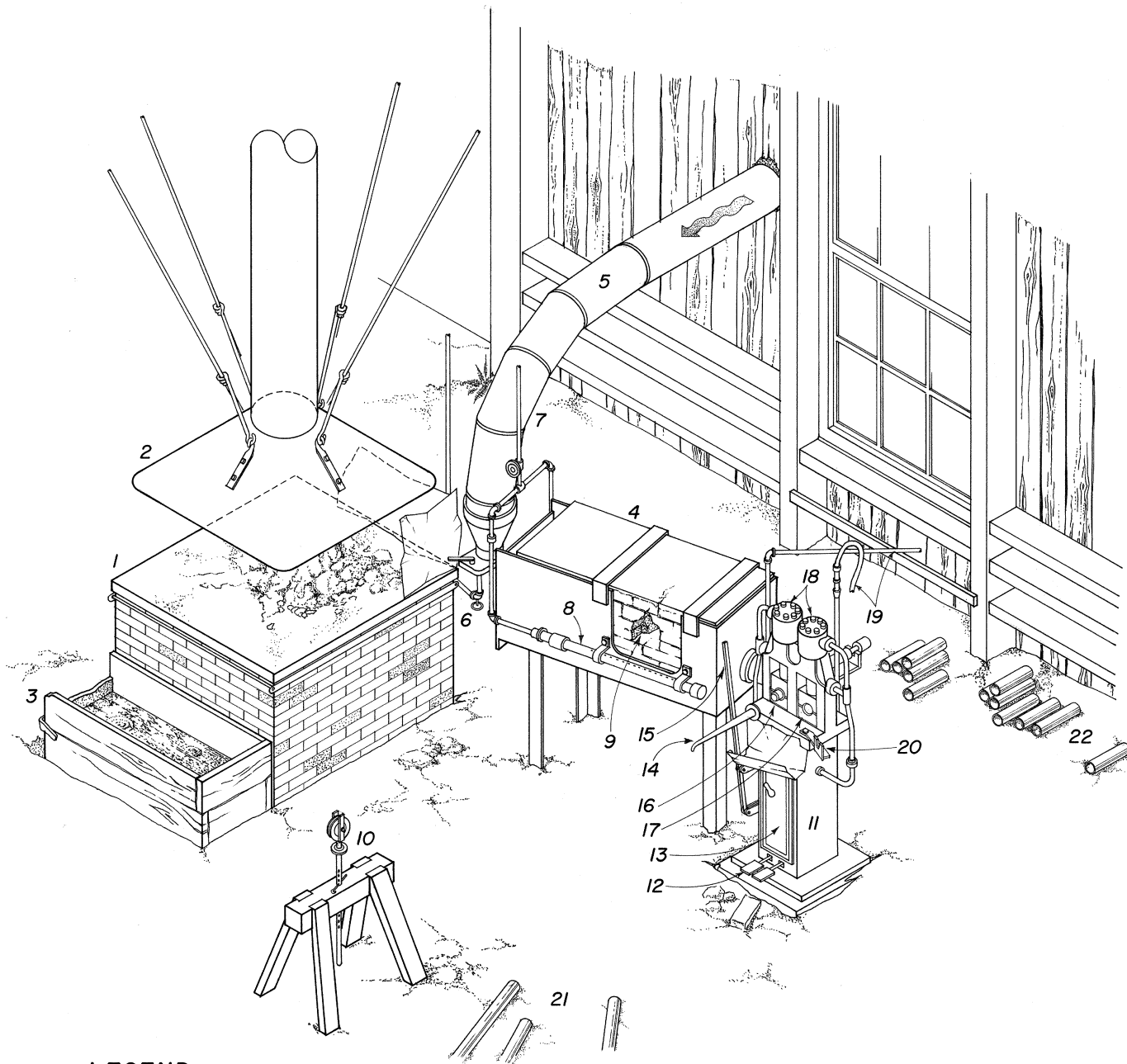
A "safe end" was placed on the mandrel in the left-hand air hammer. The end of the boiler flue was inserted into the forge, and brought up to a welding heat.



The hot flue was removed, and the hot end was forced onto the conical belling tool attached to the swaging forge, enlarging the inside diameter of the hot end.

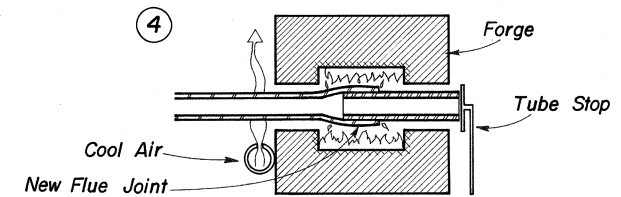


The enlarged end was forced over the end of the cold "safe end" on the mandrel.

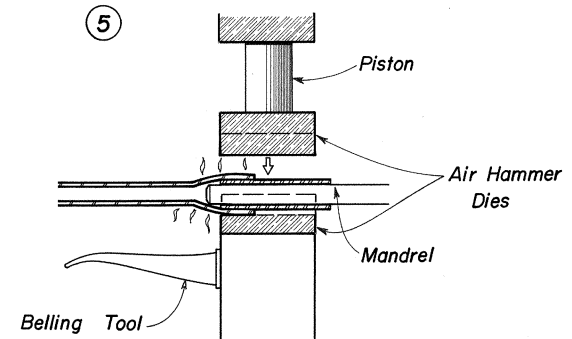


LEGEND

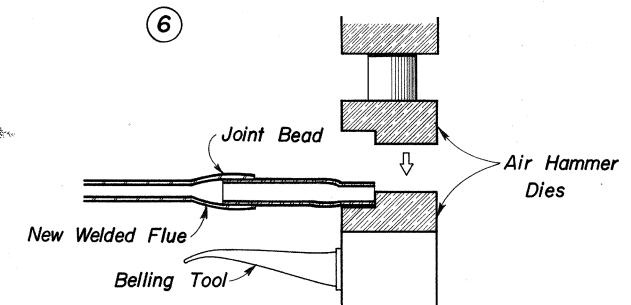
- | | |
|--|--|
| 1 Coal-Fired Blacksmith's Forge | 12 Operating Treads |
| 2 Vent Hood | 13 Access Door |
| 3 Quenching Tub | 14 Belling Tool |
| 4 Tube Heating Forge | 15 Operating Lever |
| 5 Duct from Forge Blower | 16 Mandrel |
| 6 Pressurized Oil Line | 17 Swaging Dies |
| 7 Compressed Air Line | 18 Pneumatic Cylinders |
| 8 Cooling Manifold | 19 Compressed Air Lines |
| 9 Forge Mouth | 20 Tube Notching Tool |
| 10 Pipe Support Jig | 21 Typical Locomotive Flue Sheet Tubes |
| 11 Draper Pneumatic Flue Welder and Swager | 22 "Safe Ends" |



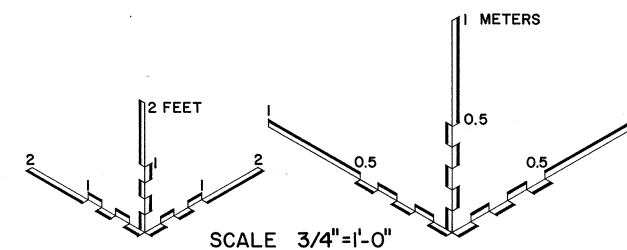
The fitted tubes were placed back in the oil-fired forge, and brought back to welding heat. The tube stop located the joint in the hottest part of the forge.



The hot fitted tubes were slipped deep on to the mandrel, and the air hammer closed the hot joint.



The new flue end was then swaged down to the size necessary to fit into the rear fluesheet of the locomotive boiler.



SCALE 3/4"=1'-0"
SWAGING PROCESS
ISOMETRIC LOOKING SOUTHWEST



HISTORIC AMERICAN ENGINEERING RECORD
 SHEET 3 of 6
 PENNSYLVANIA
 c.1882
 BLACKSMITH SHOP
 EAST BROAD TOP RAILROAD & COAL CO. (MEADOW STREET) WEST OF U.S. ROUTE 522
 ROCKHILL FURNACE (ORRISONIA) HUNTINGDON COUNTY
 DELINEATED BY: ANDRIY PRYBEHA, IVELISSE SANTOS, MATTHEW KIERSTEAD (text), 1994.
 SOUTHWESTERN PENNSYLVANIA RECORDING PROJECT
 NATIONAL PARK SERVICE
 UNITED STATES DEPARTMENT OF THE INTERIOR
 IF REPRODUCED, PLEASE CREDIT: HISTORIC AMERICAN ENGINEERING RECORD, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING