# Method Statement
# Operating the Small Steam Engines

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| Date | 14/04/14 | | |
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## Issue History

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| 1-3 | | Data not recorded |
| 4 | May 2011 | Revised Method Statement issued |
| 5 | 14 April 2014 | Version 4 rewritten, with updates, in the format first adopted for Method statements in 2013. |

## Contents

# 1. Purpose and Scope

This method statement sets out the instructions that must be followed when starting up, operating and closing down the 4 small steam engines located on the ground floor at Combe Mill. It does not cover the model engines on the first floor.

The engines are:

- A Weir Steam Pump
- A Horizontal Bradford Mill Engine
- A Sissons Vertical Engine
- A Reader Vertical Engine

The four engines are served by a common condenser.

# 2. Safety

## *2.1. Warnings*

The small engines must only be operated and maintained by approved operators or by trainees under the personal supervision of an approved supervisor.

Only engine operators are allowed within the fenced area when the engines are operating.

Keep the operating area around the engines clear of obstructions at all times.

The engines and their attached machinery have considerable inertia and **cannot** be stopped instantaneously.

## *2.2. Emergency Shut Down*

1 To shut the engines down in an emergency:

a Close the main quarter turn inlet steam valve supplying steam to all four engines (see Figure 1 in section 4.1).

b If the main steam inlet valve cannot be closed, close the four off individual engine steam inlet valves

◊ The valves are located as shown in the Figures on pages 16 - 18.

c In the event of a major steam leak requiring the immediate evacuation of the operating area the engines must be stopped using the steam supply valve on the boiler

◊ This valve is located immediately on top of the boiler and is coloured blue

⇒ All engine operators must know the location of this valve.

d Once the steam has been shut off follow the relevant instructions in the normal shutdown procedure to take the system to the point at which it can be restarted (see Section 6.1).

## *2.3. PPE*

1 The following PPE is necessary for working on the engines:

a Appropriate gloves

◊ Close fitting gloves should be worn if there is likely to be skin contact with any hydrocarbon

⇒ For example oil, grease or fuel

- ◊ Thick gloves or similar insulating material when handling potentially hot components
  - ⇒ For example: steam valves

b Overalls or boiler suit: worn in such a fashion as to prevent any undergarment, neck tie or scarf from becoming entangled in the moving machinery.

- ◊ If coveralls are not worn, the chosen clothing must be close fitting and contain no items that might come into contact with moving machinery.

c Persons with long hair must additionally wear an appropriate close fitting cap.

2 Consider the need to use suitable eye protection if oil is likely to spray into the air

3 PPE is provided for your protection: Members are urged to wear it.

4 Members supervising others must ensure that Members under training, contractors, other volunteers and visitors wear the required PPE. Persons declining to do so must not be allowed to undertake the operation.

## *2.4. Relationship to other systems / equipment*

1 The small engines are dependent on a supply of steam from the boiler and the availability of the beam engine's coldwell as a heat sink.

a The main quarter turn valve (see Figure 1) must not be opened without the permission of the person responsible for the operation of the boiler.

b Normally the engines must not be run unless the beam engine is running and its coldwell is available as a heat sink.

- ◊ If necessary the engines may be run for a short period in the absence of the coldwell as a heat sink
  - ⇒ The Head of the Small Engines Technical Area has established industry custom and practice as to what constitutes a .short period'.

c In the event that the steam supply from the boiler fails, the main quarter turn valve must be closed

- ◊ Following closure, the quarter turn valve must not be reopened without the specific approval of the person responsible for the operation of the boiler.

## *2.5. Lone Working*

1 The small engines must not be steamed unless at least two appropriately approved operators are present at the Mill

- ◊ Operation of the engines also requires the operation of the boiler and one person cannot be in two places at once.

2 Approved operators may carry out routine maintenance on a lone working basis subject to the following conditions:

a All such operators must be aware of and abide by the requirements set out in the method statement on Lone Working (MS_12).

- ◊ Lone working introduces new hazards and increases the risks associated with others.

b Prior to starting a maintenance operation on a lone working basis the operator concerned must satisfy him/ herself that the proposed work can be safely carried out on a lone working basis.

# 3. Periodic Inspection, Testing and Maintenance

## *3.1. Periodic Inspection*

1 Prior to each steaming the HTA[1] must inspect the engines and confirm that:

   a Any recorded faults have been addressed

      ◊ In the case of a minor fault it would be sufficient to record that in the opinion of the inspector the fault was minor and did not prevent safe steaming and would be addressed at a later date.

   b Any necessary maintenance, other than that included as part of the startup procedure, had been carried out.

   c Visual inspection had highlighted no reason that would prevent the safe steaming of the engines.

2 The outcome of the inspection must be recorded in the logbook, dated and signed

3 Any review carried out by an Approved Person, acting on behalf the Head of the Small Engines' 'Technical Area, may be further considered by the formal Head.

      ◊ The decision of the formal Head shall be final.

## *3.2. Maintenance*

Apart from the work set out in Section 4, the Society operates a 'maintenance on failure' policy.

1 Operators detecting a need for maintenance or repair should inform the HTA of the need

      ◊ Entry of the requirement into the logbook is a good way of creating a clear record of the need,

      ◊ It is the HTA's responsibility to ensure that any required work is effectively carried out.

2 In addition, at the end of the steaming year, the HTA prepares a list of the work that needs to be done over the winter months.

3 At the end of the winter break the HTA must review the work that was required to be carried out as part of the review process.

      ◊ The process is described in Section 3.1.

4 In the event the HTA concludes that the failure to carry out the required work has compromised the safe operation of a piece of equipment, he shall ban the steaming of the relevant equipment.

      ◊ If the equipment were to be the Weir pump or the Bradford engine, this decision could compromise the operation of all the small engines.

# 4. Start up

## *4.1. Essential Preliminaries*

The instructions in this section must be carried out before the small engines are started up but not necessarily immediately prior to the start up.

1 An approved operator proposing to start up the small engines must satisfy himself that the instructions in Section 3 have been satisfactorily completed,

2 In the event that the engines have not been inspected

[1] Whenever the term HTA is used in this method statement, it is to be interpreted as meaning the Head of the Small Engines Technical Area or an Approved person acting on his/ her behalf.

a An approved operator who is also a competent person may self-certify the engines.
b An approved operator who is not a competent person must seek the approval of a competent person or in the absence of a competent person the Appointed Person before starting the engines.

3 Ensure the oil separator has had all water drained off.
   ◊ Follow the instructions on the side of the separator.

4 Ensure the main steam cock is closed
   ◊ The valve handle should be horizontal as shown in Figure 1:

**Figure 1**
**Main Local Steam System: Supply Valve**

5 Ensure the engines are properly lubricated according to the following schedule:
   a Supply steam oil to the lubricators on all four engines.
   b Apply light oil as follows:
      ◊ Weir Pump
         ⇒ lubricate pivots using oil can
      ◊ Bradford
         ⇒ fill oiling pots and insert wicks (there are 8 pots)
         ⇒ lubricate hole in crosshead on eccentric
         ⇒ lubricate governor bearings
      ◊ Sissons Engine
         ⇒ fill one oil pot
         ⇒ oil pivots on governor,
         ⇒ oil emergency trip wheel
         ⇒ check oil level in sight glass
         ⇒ briefly open sight glass drain to ensure no water in oil
         ⇒ add oil as necessary after check.
      ◊ Reader Engine
         ⇒ This engine has no external oiling points,
         ⇒ Check the sump level by removing the lid on the oil reservoir, open drain to ensure no water in the oil,
         ⇒ Add oil as necessary after check.
   c Apply grease to the grease pots on the Sissons condensate pump.

◊ There are two grease pots just below drive shaft

## *4.2. Initial Steps*

The instructions in this section must be carried out immediately before the small engines are started up.

The start order of the small engines is determined by their function: they should therefore be started in the order listed in Section 4.3 . The Weir pump circulates cooling water through the condenser and the Bradford engine drives the Sissons pump which pumps the condensate.

1 Ensure all engine steam supply valves are CLOSED.
   ◊ The valves are illustrated in the Figures on pages 16 - 18.
2 Ensure all drain valves are OPEN
3 Then proceed as follows:
   a Confirm with the boiler house operator that steam is available.
   b Confirm with the beam engine operator that the beam engine is working
      ◊ Do not start the small engines if the beam engine is not working (see Section 2.4)
   c Confirm the small engine steam gauge has 30 psi available.
      ◊ Do not begin the engine start up procedure until 30psi steam pressure is available
         ⇒ The pressure gauge is located adjacent to the main steam supply valve (see Figure 1 above)
   d Partially open the main steam cock to allow steam into the system
      ◊ The handle should be at approximately $45^0$ to the horizontal
   e Wait until the steam traps stop hammering
      ◊ Silence confirms that water has been cleared from the system.
         ⇒ The hammering arises from the passage of water through the trap
   f Then open the steam cock fully
      ◊ Handle vertical
4 **Reminder**: ensure you have a good pair of gloves available early on as the valves can get too hot to handle without them.

## *4.3. Starting up the Engines*

### 4.3.1. Weir Pump

1 Start the Weir Pump using the following procedure:

a Check that:

- ◊ The pump water suction and discharge valves are open
- ◊ The valves to the pump by the Bradford are closed
- ◊ The two drain cocks below the valve chest are open

b Prime the pump with water as necessary.

c Open exhaust valve to vent to atmosphere

- ◊ This prevents exhaust steam going into the condenser before the system is ready

d Slowly open the steam valve until water comes out of the drains (see Figure 2).

- ◊ Allow pump to warm through
- ◊ **Warning**: Do not open the steam valve further at this stage

e Once steam comes out of the drains, partially close the drains.

- ◊ They should be fully closed once the pump is operating automatically

f Open the steam valve until the piston starts to move

- ◊ Use the operating lever to move the valve rod by hand until the pump is operating automatically.

g Once the engine is operating smoothly:

- ◊ Remove the handle
- ◊ Close exhaust valve to atmosphere
- ◊ Fully close the drain cocks on the valve chest.

h Adjust the pump to run at approximately 60 strokes per minute (spm)

- ◊ Do not let the engine run below 10 spm as this will cause stalling.

i Check oil pump is operating correctly:

- ◊ Adjust the oil flow rate as necessary.
  - ⇒ The design flow is one drop every three minutes

### 4.3.2. Bradford Engine

**Reminder**: the Weir Pump needs to be running before the Bradford engine is started.

1 Start the Bradford engine using the following procedure:
   a Confirm that the two cylinder drain cocks and the valve chest drain cocks are open
   b Turn the flywheel by hand to just beyond top dead centre
      ◊ The crank should be at 1pm
   c Slightly open the steam supply valve (see Figure 3)
      ◊ Allow the engine to warm through
   d Wait while water runs from the drain
      ◊ This normally takes about 1 minute.
   e When steam issues from the drain cocks, close the drains
   f Open steam valve to start the engine and adjust the engine to run relatively slowly
      ◊ Ensure that it does not knock.
   g Check oil pump is operating correctly:
      ◊ The design flow is one drop every three minutes
      ◊ Adjust the oil flow rate as necessary.
   h Check that the Sissons pump is being driven correctly by the Bradford engine.

### 4.3.3. Sissons Engine

**Reminder**: the Weir Pump and the Bradford engine need to be running before the Sissons engine is started.

1 Start the Sissons engine using the following procedure:
   a Confirm that
      ◊ The steam line drain valve is open
      ◊ The cylinder and steam chest drain valves are open
   b Slowly open the steam supply valve (see Figure 4)
      ◊ The steam pipe cannot be drained until this valve is opened
         ⇒ Allow water to drain
      ◊ Allow engine to warm through
      ◊ When steam issues from the steam line drain valve, close it
      ◊ Turn engine by hand and adjust main steam valve until engine turns slowly
   c When steam issues from the cylinder and steam chest drain valves, close them
   d Open main steam valve fully and adjust governor for slow steady running at 150 rpm
   e Check lubricator is operating correctly,
      ◊ The design flow is one drop every three minutes
      ◊ Adjust the oil flow rate as necessary.
   f Check the oil pressure gauge is indicating the expected oil pressure.

### 4.3.4. Reader Engine

**Reminder**: the Weir Pump and the Bradford engine need to be running before the Reader engine is started.

1 Start the Reader engine using the following procedure:
   a Open the drain cocks
   b Open the exhaust line valve by one turn
   c Slightly open the main steam valve (see Figure 5)
      ◊ Allow the engine to warm through
   d Turn engine by hand
      ◊ When it starts watch the oil pressure on the gauge,
   e When the oil pressure reaches required level, adjust the main steam valve to increase speed,
   f When steam issues from cylinder and steam chest drain valves, close them
   g Adjust main steam valve for slow steady running
   h Adjust exhaust valve just sufficiently for steady running and maximum vacuum
   i Open half way the valve on displacement lubricator on cylinder head
      ◊ **Warning**: This valve's action is abnormal. It is closed when the handle is vertical. And it has therefore to be moved from the vertical to approximately $45^0$ to the horizontal (see Figure 6)
   j Fully open valve on lubricator above steam chest
      ◊ Lever vertical
   k Adjust screw at top of displacement lubricator above steam chest to empty an initially full lubricator in about four hours.

### 4.3.5. Condenser

1 Be aware that
   a The condenser (see Figure 7) is a passive object and will start to operate when the Weir pump starts to circulate the cooling water and exhaust steam is admitted to the condenser.
      ◊ Be aware, that at one time a Stuart pump could be driven off the Bradford engine. It is not now used and consequently its circuitry ends at closed valves.
   b It may be necessary to bleed air out of the steam side of the condenser in order to facilitate the condenser's operation.

# 5. Operation

## *5.1. Ongoing actions / observations*

1 The engines will run trouble-free most of the time
2 All operators must be able to recognize the sound of the Weir pump mal operating
      ◊ Mal operation of the Weir pump is a serious condition and requires urgent action (see Section 5.2.2).
3 Carry out the following observations and associated actions at regular intervals not exceeding two hours
   a Confirm that all the oil pots and lubricators retain an adequate supply of oil

- ◊ Top up the supply as necessary

b Check the rate at which oil is being consumed and adjust the flow rates as necessary

- ◊ Be aware that the displacement lubricator on top of the reader engine must be adjusted so that it empties in approximately 4 hours.

c Check that all moving parts remain adequately oiled

- ◊ Re-oil as necessary.

d Check the readings on the oil pressure gauges

- ◊ Shut down any engine whose oil pressure cannot be maintained at the correct value.

e Check the greasing arrangements on the Sisson pump are working correctly

- ◊ Refill and adjust if necessary

f Check the speed of operation of the various engines

- ◊ Make any necessary adjustments
- ◊ Shut down any malfunctioning engine.
  - ⇒ **Warning**: Because of the pivotal roles of the Weir pump and the Bradford engine, if either of these engines is shut down, then all the other small engines must also be shut down.

## *5.2. Likely issues arising during operations*

### 5.2.1. Failure of the Sisson or Reader engines

1 Malfunction of either of these engines is unlikely: should such a failure occur, the operator must:

a Close down the affected engine in accordance with the relevant instructions in Section 6.1.

- ◊ The operation of the other engines would not normally be affected by the closure of either the Sissons or the Reader.

b Inform the HTA

c Enter the failure into the logbook

### 5.2.2. Mal operation of the Weir pump

1 The most usual sign that the Weir pump is mal functioning is a change in the sound issued by the engine.

- ◊ All operators must be able to recognize the sound emitted by a failing Weir pump

2 The diagnosis of a failing pump can be confirmed by visual observation.

- ◊ All operators must be able to recognize a failing Weir pump

3 Faced with a malfunctioning Weir pump the operator must

a Increase steam supply to the pump

b Reattach the operating lever to the engine

c Use the operating lever to move the valve rod by hand

d Continue to use the rod until the pump is operating automatically

- ◊ The valves must continue to be operated manually until either normal operation is reestablished or the small engines are shut down.
  - ⇒ Failure to observe this requirement will in time lead to serious over heating of the condenser and consequent possible damage to the engines.

e Once normal operation is reestablished detach the rod and adjust speed to normal

4 If normal operation cannot be reestablished the operator must:

a Close down all the small engines in accordance with the relevant instructions in Section 6.1.

b Inform the HTA

c Enter the failure into the logbook

◊ If the Mill is open to the public the Authorised Person should also be informed.

### 5.2.3. Sissons pump drive belt failure

The Sissons pump is driven via a belt from the Bradford engine.

1 If the belt comes off the pulleys the operator must:

a Stop the Bradford engine in accordance with the instructions in Section 6.1.

b Ensure the cock on top of the condenser is open

c Reattach the belt drive to the pulleys

d Restart the Bradford engine.

2 If the belt continues to become detached the operator must:

a Close down all the small engines in accordance with the relevant instructions in Section 6.1.

b Inform the HTA

c Enter the failure into the logbook

◊ If the Mill is open to the public the Authorised Person should also be informed

### 5.2.4. Failure of the Bradford engine

1 Malfunction of the Bradford engine is unlikely: should such a failure occur and normal operation cannot be reestablished, the operator must:

a Close down all the small engines in accordance with the relevant instructions in Section 6.1 .

◊ **Warning**: The Bradford engine drives the Sissons pump whose correct operation is essential for the operation of the condenser

b Inform the HTA

c Enter the failure into the logbook

◊ If the Mill is open to the public the Authorised Person should also be informed.

# 6. Normal Shutdown Procedures

## *6.1. Shut down all engines*

1 To shut down all of the engines proceed as follows:

a For each of the engines carry out the detailed instructions in Section 6.2, then

b Shut the main steam supply valve (see Figure 1)

c Open any remaining drain points down stream of the main steam supply valve.

d Pull out the wicks from the oil pots

e Stop oil flow from lubricators

f Lubricate and wipe-down the engines.

2 Emergency shutdown of the engines is covered in section 2.2.

### *6.2. Shutdown individual engines*

1 **Note**: If an engine is to be stopped for only a short period it is sufficient to close the relevant engine's main steam valve.
   - ◊ A short period is defined as being a period of time such that there is unlikely to be significant condensation in the engines components and associated pipework
   - ◊ Restart involves the execution of the relevant instructions in section 4.3.

2 To shut down a particular individual engine use the relevant procedure below:

a Weir pump
   - ◊ Close the pump's steam stop valve (see Figure 2 )
   - ◊ Open the two cocks below the steam chest
   - ◊ Open the exhaust valve to atmosphere

b Bradford engine
   - ◊ Close the steam stop valve (see Figure 3)
   - ◊ Open the cylinder drain cocks
   - ◊ Turn the engine by hand until no further water issues from the cocks.

c Sissons engine
   - ◊ Close the steam stop valve (see Figure 4)
   - ◊ Open the cylinder and steam chest drain valves
   - ◊ Turn engine by hand until no further water issues from valves.

d Reader engine
   - ◊ Close the steam stop valve (see Figure 5)
   - ◊ Open the cylinder and steam chest drain valves
   - ◊ Rotate the engine by hand until no further water issues from valves.
   - ◊ Close the exhaust valve

## 7. Preparation for Extended Lay Offs

1 If the small engines are to be laid up for a few or more weeks the following actions, in addition to those set out in Section 6.1, are required:

a Ensure that all drain valves are open

b Drain Weir pump as follows:
   - ◊ Open air valve on top of pump cylinder
   - ◊ Open pump cylinder drain valve and drain pump cylinder
     - ⇒ The required valve handle angle is 45°
     - ⇒ Leave valve open.

c Replace oil.

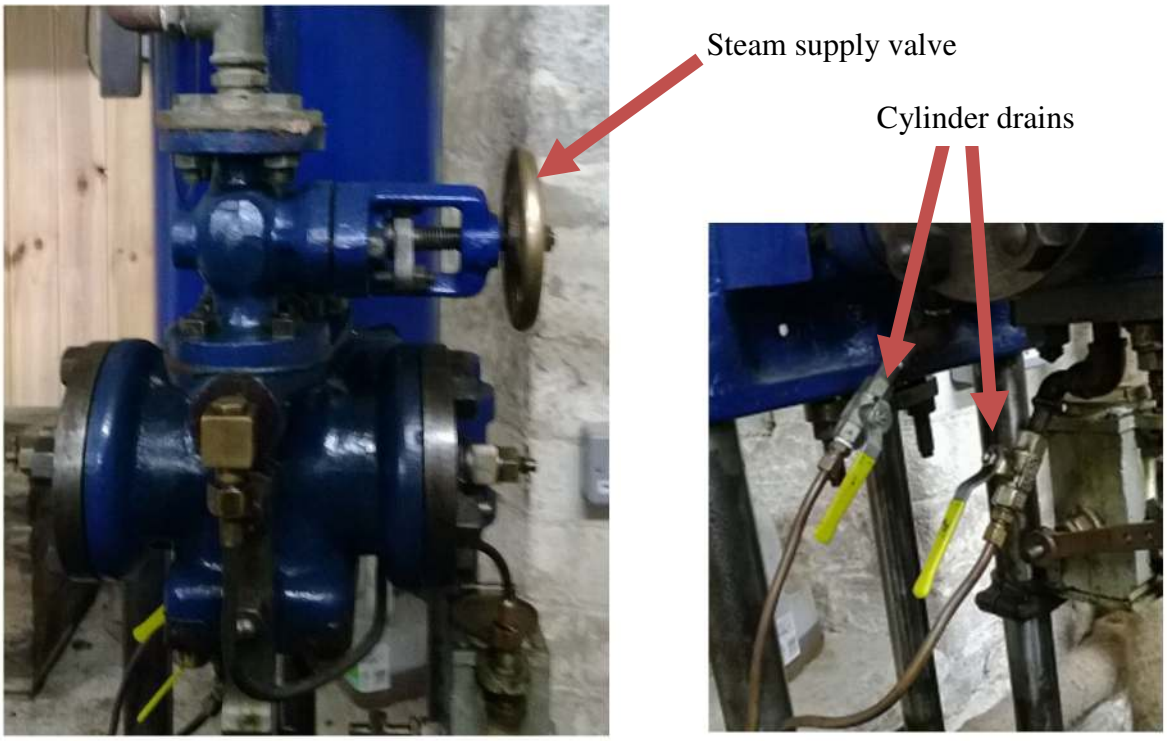


**Figure 2 Weir Pump: Steam Supply Valve and Cylinder Drains**

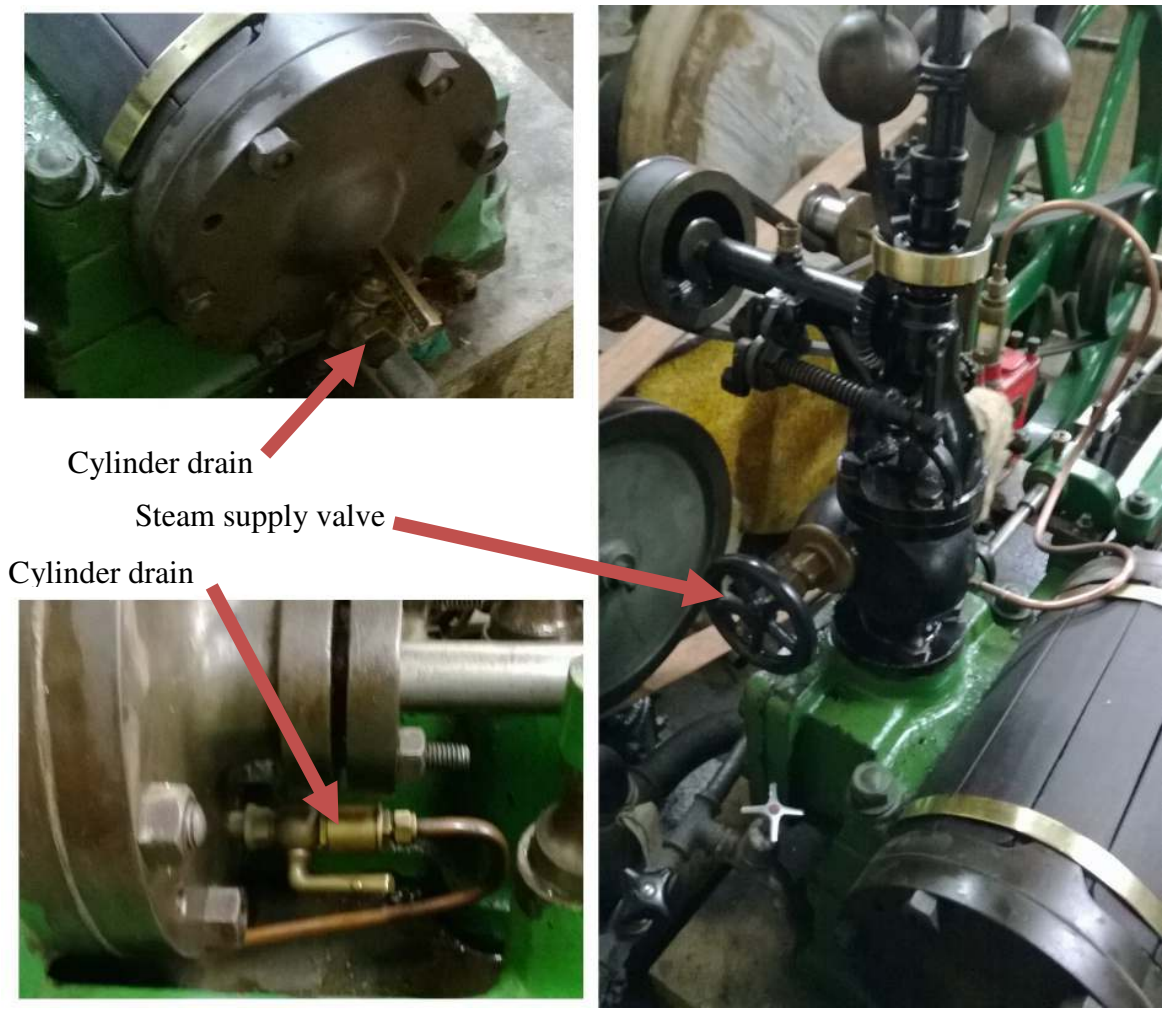


**Figure 3 Bradford Engine: Steam Supply Valve and Cylinder Drains**

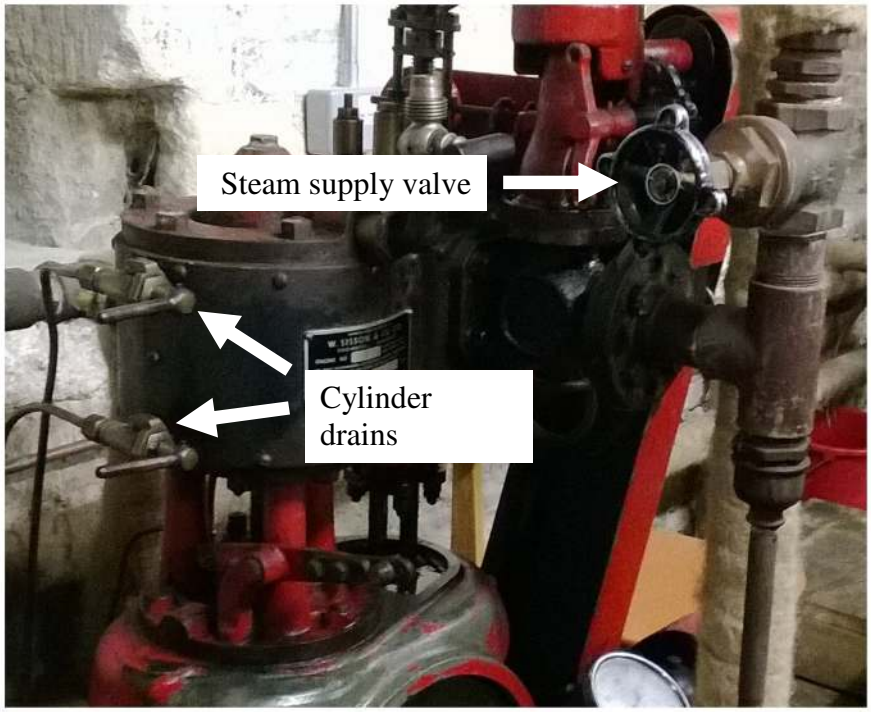


**Figure 4 Sisson's Engine: Steam Supply Valve and Cylinder Drains**

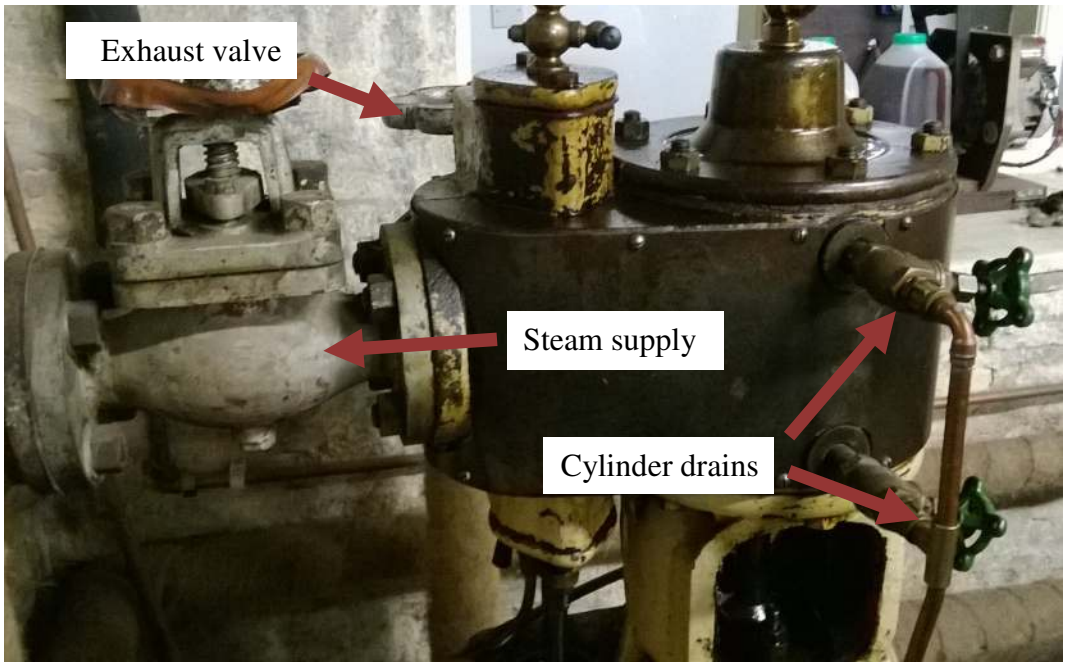


**Figure 5: Reader Engine: Steam Supply Valve and Cylinder drains**

**Figure 6 Reader Engine: Lubrication Valves Shown in their CLOSED Positions**

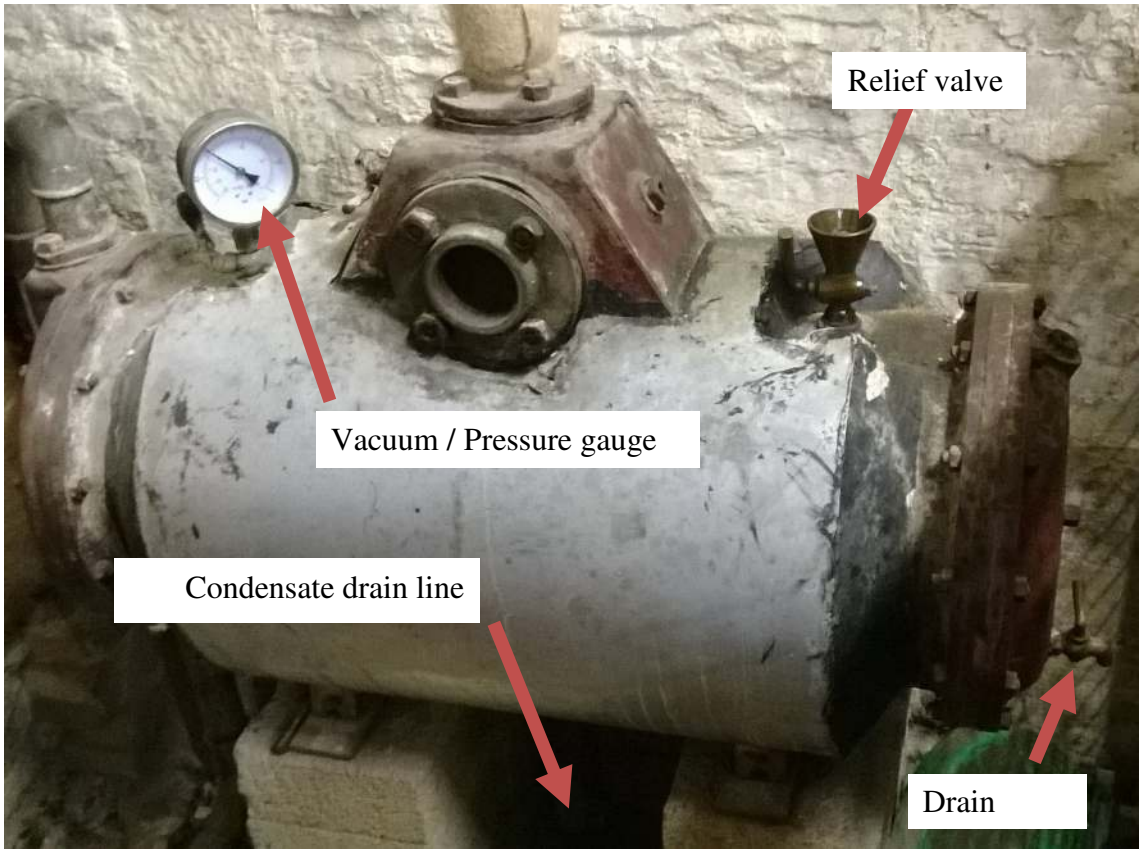


**Figure 7 Condenser**