PROJECT ABSTRACT

Compressed Air Engine using Slider Crank

A working compressed-air engine in which a double-acting pneumatic cylinder drives a slider-crank mechanism through a crank-timed solenoid valve, with flywheel, tachometer and rope-brake dynamometer — delivered as a built-to-order hardware project with the engine, instruments, build manual, report, PPT and viva kit.

01. Title

Compressed Air Engine using Slider Crank

02. Introduction / Background

Before electric motors took over, compressed air drove real machinery — and the slider-crank engine that converts a piston's push into rotation is the same mechanism at the heart of every internal-combustion engine. This project rebuilds that idea as a clean student prototype: instead of fuel and spark, a double-acting pneumatic cylinder fed by shop air drives the piston, a solenoid valve times the air admission to each stroke, and the crankshaft and flywheel turn it into smooth rotary motion. The student assembles the mechanism, times the valve, measures RPM and brake power, and learns first-hand why air engines are simple and clean but inefficient.

03. Problem Statement

Slider-crank kinematics and pneumatics are taught separately and rarely meet in a working machine students can tune and measure. The project addresses this with a benchtop air engine: a double-acting cylinder (~32 mm bore class) on a machined crankshaft with flywheel, a 5/2-way solenoid valve switched in sync with crank position, an FRL unit regulating 4–6 bar shop air, a digital tachometer and a rope-brake dynamometer so the buyer measures their own torque and power figures.

04. Objectives

- Fabricate the slider-crank assembly: machined crankshaft, connecting rod, crosshead and plummer-block bearings on an MS frame.
- Integrate the double-acting pneumatic cylinder with the 5/2-way solenoid valve and crank-timed switching (adjustable timing).
- Fit the flywheel for dead-centre carry-through and torque smoothing, plus the FRL unit and regulator for 4–6 bar working pressure.
- Provide tachometer and rope-brake dynamometer with the test protocol and power-calculation worksheets; deliver the report, PPT and viva Q&A.

05. Proposed Methodology

Shop air enters the FRL unit, which filters, regulates (4–6 bar) and lubricates it. The 5/2 solenoid valve, timed to crankshaft position, admits air to one side of the double-acting cylinder while exhausting the other; pressure drives the piston, the connecting rod turns the crankshaft, and the valve switches ports each half-revolution for the return power stroke. The flywheel smooths the pulsating torque. The buyer maps RPM against supply pressure and valve timing, then applies the rope brake to measure torque and compute brake power ($P = 2\pi NT/60$) with air-consumption notes per run for the report's efficiency discussion.

06. System Architecture / Working

The engine has four subsystems. (1) Air conditioning: FRL unit + regulator on the shop-air inlet. (2) Timing valve: 5/2-way solenoid switched in sync with crank position (adjustable advance/retard). (3) Power train: double-acting cylinder, piston rod, connecting rod, crankshaft in plummer blocks, flywheel. (4) Instrumentation: digital non-contact tachometer on the crankshaft and a rope-brake dynamometer on the output shaft. The build manual sequences assembly, timing setup and the test protocol.

07. Hardware / Software Requirements

- Double-acting pneumatic cylinder (~32 mm bore / ~100 mm stroke class)
- 5/2-way solenoid valve with crank-timed switching circuit
- Machined crankshaft, connecting rod, crosshead; plummer-block bearings
- Flywheel (cast/machined); MS fabrication frame
- FRL unit + pressure regulator (4–6 bar working range)
- Digital non-contact tachometer; rope-brake dynamometer
- External shop compressor 6–8 bar (not included); 230 V AC for valve circuit

08. Expected Outcomes

A running air engine with buyer-measured RPM-versus-pressure and RPM-versus-timing maps, rope-brake torque and power figures computed from the student's own readings, and a report with an honest energy audit of why air expansion is inefficient. No power or efficiency figure is pre-claimed; results are reported with their test conditions.

09. Applications

- Teaching material for theory of machines: slider-crank kinematics, dead centres, flywheel sizing
- Pneumatics laboratory demonstrations: FRL, 5/2 valves, timing
- Reference build for student experiments on valve timing and pressure effects

- Base for multi-cylinder or rotary-vane air-motor comparisons as future scope

10. Future Scope

- Electronic cam-based timing with a rotary encoder replacing fixed switching
- Twin-cylinder opposed layout for smoother torque
- Compressed-air energy-storage framing with charge/discharge efficiency study
- Exhaust-air heat-recovery demonstration

11. References

- Shigley, J. E. and Uicker, J. J. — Theory of Machines and Mechanisms, Oxford, 2010.
- Majumdar, S. R. — Pneumatic Systems: Principles and Maintenance, McGraw-Hill, 1995.
- Projectech — Compressed Air Engine using Slider Crank, project page (projectech.in).