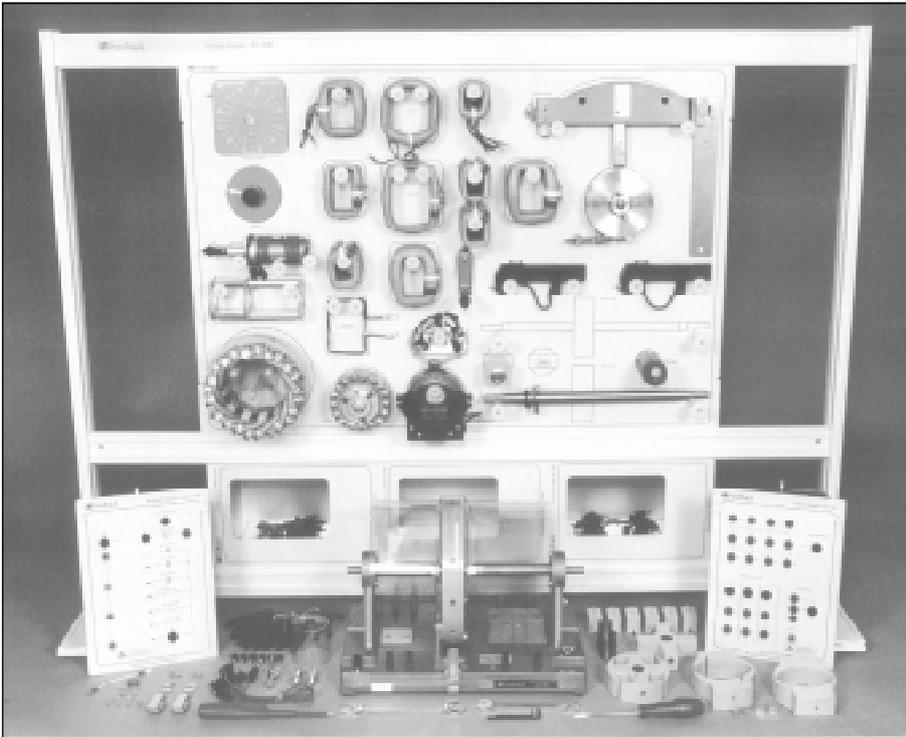


Powerframes - Dissectible Machines



The **Powerframes Dissectible Machines System** is a complete trainer that covers a wide range of dc, Single and Three Phase ac motors and generators. The trainer is built around the unique **Feedback Dissectible Machine**, designed to introduce students to the basic principles of electrical motors and generators. It is supplied with manuals which provide a step-by-step guide to setting up and carrying out a wide range of assignments.

The trainer includes power supplies, drive and control equipment, loading and instrumentation that are all provided in the form of panels which mount into a purpose-designed bench-standing frame, that can be easily slotted in and out as required.

The frame is constructed of an advanced, fibre-loaded, rigid plastics material which is electrically insulated for safety.

The system provides a dynamic approach to understanding electrical machines for a wide range of student and technician engineers.

It gives a step-by-step course of theory and experiment using the versatile and extensive dissectible machine.

The characteristics of the machines that can be assembled closely represent those of their industrial equivalents.

The main constituent items that make up the heart of the system are available separately to enable those with power supplies and metering equipment to configure a trainer that suits their needs.

Machine Assemblies

The following studies and machine assemblies may be investigated using the system:

- Introductory electromagnetism
- Machine operating principles
- Elementary ac & dc generators
- dc series motor - with & without interpoles
- dc shunt motor - with & without interpoles
- dc compound motor - with & without interpoles
- dc separately excited generator - with & without interpoles
- dc series generator - with & without interpoles
- dc shunt generator - with & without interpoles
- dc compound generator - with & without interpoles
- Single Phase ac induction motor, squirrel cage, 2 pole
- Single Phase ac induction motor, squirrel cage, 4 pole
- Single Phase ac series universal motor
- Single Phase ac repulsion motor
- Single Phase ac synchronous motor/generator, 2 pole
- Single Phase ac synchronous motor/generator, 4 pole
- Single Phase ac generator, rotating field
- Single Phase ac generator, rotating armature
- Three Phase ac induction motor, squirrel cage, 2 pole
- Three Phase ac induction motor, squirrel cage, 4 pole
- Three Phase ac synchronous motor, 2 pole
- Three Phase ac synchronous generator, 2 pole
- ac brushless generator
- Stepper motors
- Shaded pole induction motor
- Split field series motor
- Dynamic braking of a dc motor
- Power factor correction of ac motors
- Synchronisation
- Synchronous motor characteristics
- Pole-changing induction motor
- dc shunt motor faults
- 4 pole induction motor faults

The Dissectible Machine

The focus of this system is a fully dissectible experimental machines kit. This allows over fifty machine assemblies to be built covering a wide range of dc and ac Single and Three Phase motor and generator assemblies. The machines that may be assembled use low voltages, have protected rotating parts and operate at relatively low power levels, thereby minimising the risk of accidents. Nominal operating voltages are 50V dc and 125V ac.

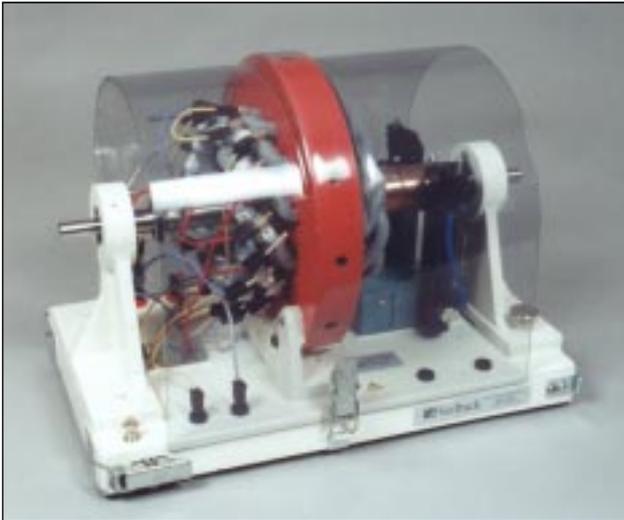
The components of the system include:-

- Baseplate
- Frame Ring
- Shaft
- Fixed and removable bearing housings
- Wound Stator
- Squirrel Cage Rotor
- Hand Crank
- Centrifugal Switch
- Coupling
- Brush Holders and Brushes
- Commutator/Slip Rings
- Interpoles
- Armature Poles and Hub
- Field Poles
- Armature, Field and Interpole coils
- Compound Field Coils
- Tools and Hardware

The separate field poles, interpoles, armature poles, hub, 12-slot stator and squirrel cage rotor are made from electrical steel laminations riveted together. Coils are wound from synthetic enamel-covered copper wire and wrapped with a strong cloth-base tape. Each has 'coil finish' and identification bands. A stainless steel shaft of high corrosion resistance is supported plain and self-aligning ball race bearings. These are held in aluminium alloy housings fixed to a cast aluminium baseplate. The shaft speed can range from very low values up to 3600 rev/min (for ac machines), or 5000 rev/min (for dc machines) according to the application.

The commutator, slip rings and brush gear are of simple design to facilitate armature assembly and give good accessibility. A sturdy component storage panel is provided for easy inventory control.

The Dissectible Machine continued



By using a dissectible machine system, students are able to see clearly the component parts of the machine and how they are interconnected, both electrically and mechanically. They may assemble machines from these component parts and then investigate the operation and characteristics of them.

Curriculum Coverage

The unique character of the Dissectible Machine System enables students to construct and investigate over fifty different machine assemblies.

The System may be used for study over a wide range of topics from the principles of magnetic circuits and electrical machine theory through to Three Phase synchronous machines.

By selection from the courseware supplied and the assemblies that may be implemented with this trainer, users can create a practical and realistic workstation to suit courses at any level from vocational to graduate engineer.

Measuring Equipment

A combination of electronic and more conventional analogue metering is provided to enable a full range of dc and ac parameters to be measured.

The Electronic Single and Three Phase Measurements panel gives digital readout of such parameters as voltage, current, power, kVA, kVAR, kWh, etc.

Analogue voltmeters and ammeters give ac and dc readings and an analogue electronic wattmeter is supplied.

A frequency meter is also provided in the package.

Other measuring equipment included in the package allows machine speed to be determined.

Loading Equipment

Both electrical and mechanical loading devices are provided in the system.

The electrical loading is with variable resistance loads and a resistor/capacitor unit for power factor correction.

The mechanical loading is by a friction (Prony) brake, which is calibrated for quantitative measurement.

Courseware

All of the equipment is supplied complete with courseware, which is manual-based, in convenient loose-leaf format for ease of photocopying, and includes theoretical information, practical assemblies, typical results and questions with typical answers. It is profusely illustrated and gives circuits, step-by-step assembly instructions and procedures.

As the courseware for each assembly is stand-alone, users have the ability to select those relevant to their particular syllabus requirements and to create a practical and realistic workstation to suit courses at any level from vocational to graduate engineer.

Dissectible Machines System

Description

Two System Frames are provided: one to house the equipment panels required and the other a storage panel for the components of the Dissectible Machine, leads, etc. A range of optional panels and accessories is available for oscilloscope and computer mounting, etc.

Power Supplies

The mains supply required is a 5-wire, 380/415V Three Phase 50/60Hz power system with neutral and earth connections.

The power supplies in the trainer have earth leakage and overcurrent circuit breakers and have variable voltage outputs for dc, Single Phase ac and Three Phase ac.

The outputs provided are:

- Circuit breaker protection
- Comprehensive Power Supply
- Three Phase: nominally 0-400V ac line at 4A
- 3 x Single Phase: each nominally 0-230V ac line to neutral at 4A dc nominally 0-270V at 6A
- Three Phase 400V line, 230V Single Phase, fixed dc 220V 10A
- Single Phase power distribution
- Safety earth connection for all units

Connections from the power supplies are by leads with 4mm shrouded connectors.

Machine

The package is based on the Dissectible Machine, described earlier.

Variable Speed Drive

A dc Variable Speed Drive is provided.

This comprises a 250W motor mounted on a base unit and an electronic motor drive providing the motor supply. The shaft speed range is from zero to 4000 rev/min and has all controls and fuses are accessible externally.

It has current limiting, electronic control for good regulation and soft-start.

Control Switches

- A panel of heavy duty power switches is provided to allow multipoint metering, component selection and motor speed changing
- The switches are rated at 240V ac, 10A

Loading Equipment

Friction (Prony) Brake

- Fits directly onto the shaft of the machine
- Provides direct loading with integral measurement of the torque output of the motor assemblies under test
- Indicates torque output in either direction up to $\pm 2\text{Nm}$

Resistor/ Capacitor Unit

- Low Power resistive/reactive component unit, for loading ac motor starting and dc power smoothing
- Resistive elements 3 x 68 Ohms
- Capacitive elements:- 2mF, 4mF, 8mF and 10mF
- Nominal ratings Resistance 50W each
- Capacitors 400V (63V for 10mF)

Variable Resistance

High power variable resistance element for use where short term dissipation is required in applications such as:

- Generator loading
- Motor starting
- Motor speed control applications

Dissectible Machines System continued

Measurements

Electronic Single & Three Phase

- Measures all the parameters on 3 or 4 wire, balanced, Three Phase systems. Including: voltage, current, power factor, watts, KVA, KVAR, KWH etc.
- Unit is rated at 750V ac 5A per phase.

dc Voltmeter & Ammeter

- Moving coil dc voltmeter
- Voltmeter ranges 0-50, 0-250, and 0-500V dc
- Ammeter range 0-1A, 0-5A and 0-10A dc
- Ammeter is fuse protected
- Meters are to DIN standard 96 x 96mm

dc Milliammeter, Centre Zero

Ideal instrument for use in:-

- Electrical circuit investigations
- Motor/generator set-ups
- Provides direct indication of polarity and polarity reversal
- Ranges: ± 1 mA, ± 1 A & ± 5 A
- Meters are to DIN standard 96 x 96mm

Rectifier Voltmeter/Ammeter

- Ideally suited to ac measurements over a wide range of voltages and currents with good accuracy
- Voltage ranges 0-50, 0-250 & 0-500Vac
- Current ranges 0-1A, 0-5A & 0-10Aac
- Ammeter ranges are fuse protected

Synchronising Lamps

- Basic synchronising by Phase indicator lamps grouped in a triangle
- Uses either lamps-bright or lamps-dark technique
- A power switch is provided to connect the systems together
- Can accommodate Three Phase or Single Phase

ac Voltmeter & Frequency Meter

- Used in the study of synchronous generators
- Three Phase supply measurements
- Ideally suited to the application of synchronising generators & supplies

Optical/Contact Tachometer

- Versatile measuring of shaft speed
- Non-contact by photo sensing
- Direct shaft contact through conical rubber drive
- Measurement range 99,999 rev/min non-contact, 20,000 rev/min contact

System Frame

- Easy 'lift in/out' panel removal
- Maximises bench space
- Provides clear view of multi-panel experiments

Dissectible Machines Storage System

This storage system holds all the coils and components. The system may be securely coupled to the main frame and has clearly identified positions for components together with two universal bins for further storage. This provides easy inventory control.

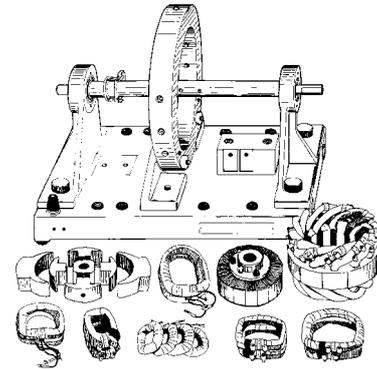
Universal Lead Storage Bin

- Holds leads and tools associated with the System
- Can be used in either landscape or portrait format

Dissectible Machines Components & Accessories

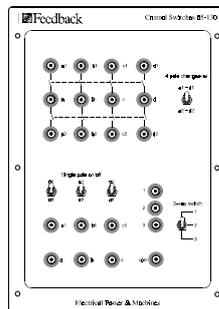
Dissectible Machines Components

This Tutor provides the basic dissectible machines components as described in 'The Dissectible Machine' section at the beginning of this document. It is intended for use where there are already power supply, drive, loading and measuring instruments available. Included in this package are the Resistor/Capacitor unit and the Control switches panel providing the basic elements of electrical loads and electromechanical control.



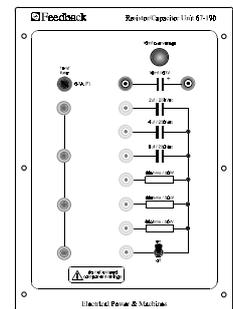
Control Switches

- Component selection
 - Changing motor speed
- Switches are:- 1x3 way,
3x1 way, 1x4 way
Switch ratings 240V ac 10A



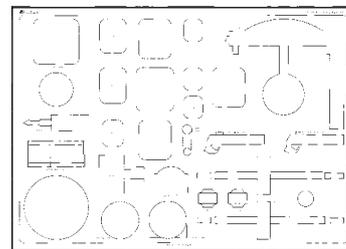
Resistor/Capacitor Unit

- Low power resistive/reactive component unit
- Resistive elements
3 x 68W
- Capacitive elements:-
2 μ F, 4 μ F, 8 μ F and 10 μ F
- Nominal ratings
Resistance 50W each
Capacitors 400V
(63V for 10 μ F)



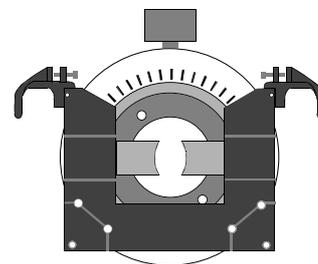
Dissectible Machines Storage Panel

- Holds coils and components for the Dissectible Machine
- Provides easy inventory control
- Clearly identified positions for components
- Can be mounted in a System Frame, or wall-mounted.



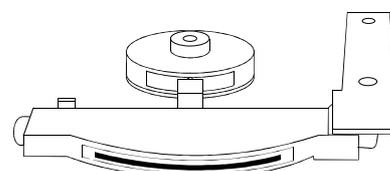
Rotatable Brush gear

- Replaces the Dissectible Machine static brush gear
- Easily fitted to the non-drive-end bearing mounting
- Can be rotated to any angle with respect to the neutral axis
- Scale calibrated in 5° increments
- Thumbscrew locking



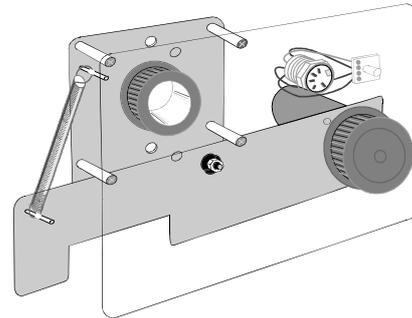
Friction (Prony) Brake

- Fits directly onto the shaft of the Feedback range of machines
- Provides direct loading with integral measurement of the torque output of various motor assemblies
- Indicates torque output in either direction up to ± 2 Nm



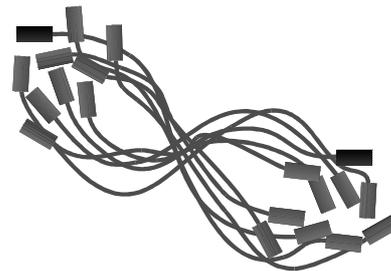
dc Tachogenerator and Mount

- Specifically for use with the dissectible machines
- Attaches to motor frame and shaft to provide a dc voltage or current output for connection to electronic systems or speed indicators.
- Output - 2V dc/1000rev/min to 6000rev/min
- Connection: 5 pin DIN 180°connector



4mm Patch Leads

- For interconnections between panels and bench mounted equipments.
- Leads are fitted with 4mm stackable shrouded safety connectors & made from double insulated cable.

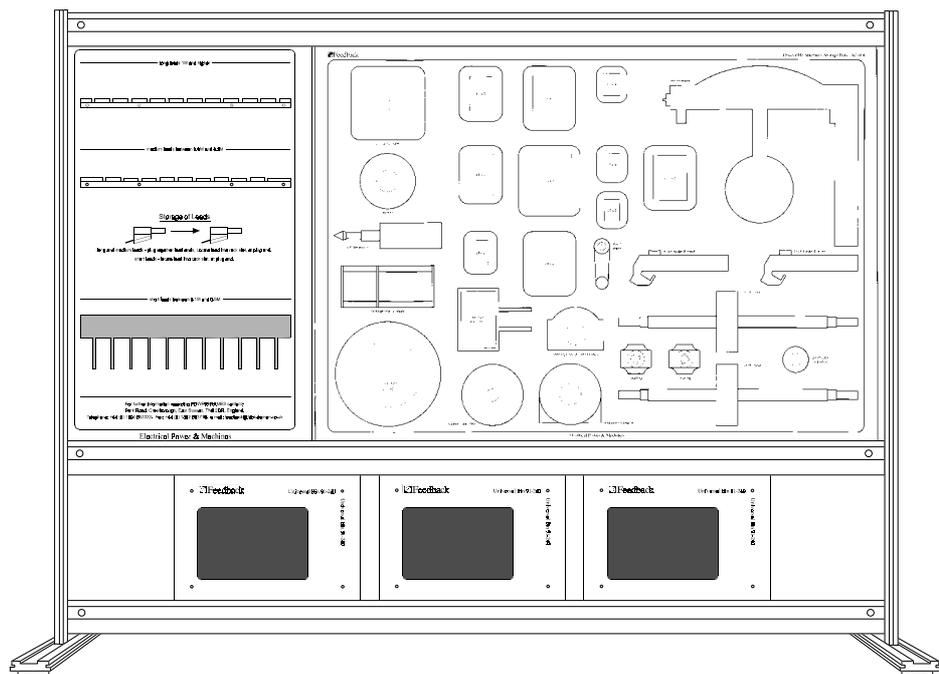


Dissectible Machines Storage System

This storage system holds all the leads, coils and components for the Complete Dissectible Machines System. The system has clearly identified positions for components together with three universal bins for further storage. This provides easy inventory control.

The System comprises:

- The Dissectible Machines
- Storage Panel
- Machines Frame
- Three Universal Bins
- Lead Storage



List of equipment in Complete Dissectible Machines System 62-005 composite:

- Universal Power Supply
Variable ac/dc Supply 5A
- Dissectible Machines Tutor
- Variable Speed Drive
- Control Switches
- Variable Resistance 200W 3A
Resistor Capacitor Load Unit
Friction (Prony) Brake
- Electronic Single and Three
Phase Measurements
dc Voltmeter and Ammeter x2
dc Milliammeter Centre Zero
Rectifier Voltmeter/Ammeter
Synchronising Lamps
ac Voltmeter and Frequency Meter
Digital Optical/Contact Tachometer
Patch Leads
- Dissectible Machines Storage System
System Frame

62-005 Optional Equipment

- Oscilloscope/Computer Housing
- Universal Bin

Ordering Information

Please quote the following product names and numbers when ordering equipment:

- Dissectible Machines System 62-005
(230/400V operation)
- Dissectible Machines System 62-035
(120/208V operation)

List of other Dissectible Machines Items available:

- Dissectible Machines Components 62-110
including Control Switches and
Resistor/Capacitor Unit
- Dissectible Machines Storage Panel 62-101
- Rotatable Brush gear 62-102
- Friction (Prony) Brake 67-470
- dc Tachogenerator and Mount 68-432
- Standard set of Patch Leads 68-800
- Dissectible Machines Storage System 90-100
- Oscilloscope Computer Housing 91-210
- Universal Bin 91-240
- System Frame 91-200

For further information on these and other equipment in the Feedback range please contact

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