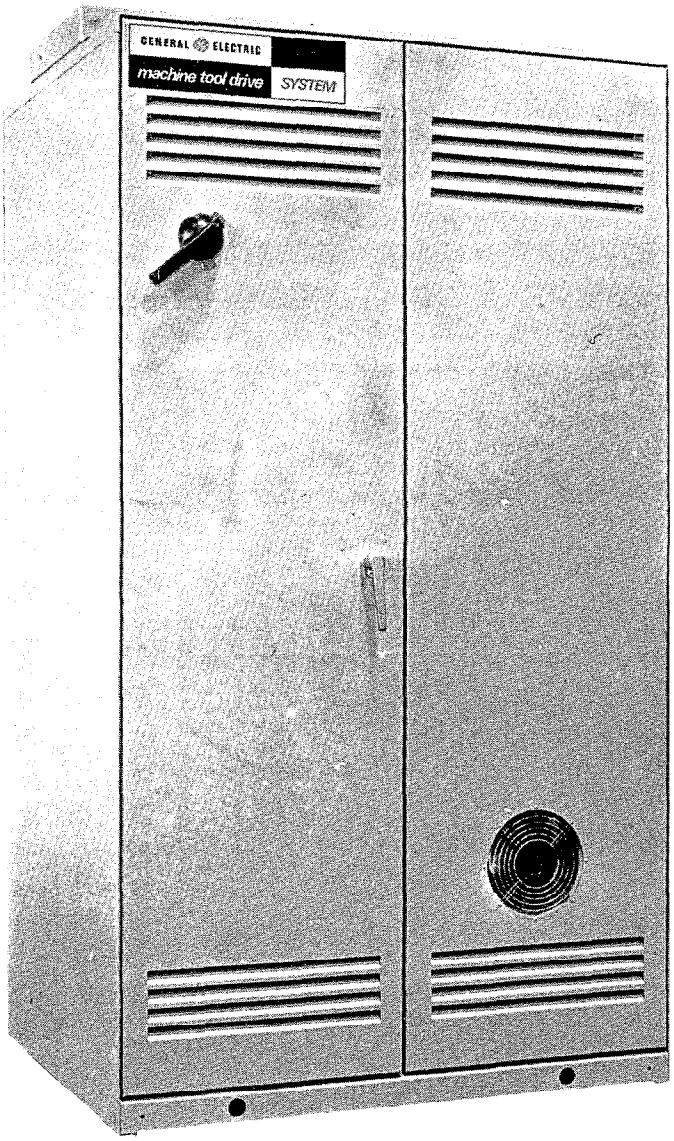
SPEED VARIATOR

INDUSTRIAL DRIVE SYSTEMS



These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to General Electric Company.

GENERAL ELECTRIC

SPEED VARIATOR

INDUSTRIAL DRIVE SYSTEMS

CONTENTS

INTRODUCTION

This instruction book contains helpful suggestions for placing drive equipment in service. It contains general information about drive operation and maintenance.

The operator and maintenance man should have access to a copy of this instruction book.

Additional instructions are included in the supplementary instruction publications and diagrams included in the instruction folder furnished with the equipment.

RECEIVING, HANDLING AND STORAGE

RECEIVING

The equipment should be placed under adequate cover immediately upon receipt as packing cases are not suitable for out–of–doors or unprotected storage. Each shipment should be carefully examined upon arrival and checked with the packing list. Any shortage or damage should be reported promptly to the carrier. If required, assistance may be requested from the General Electric Company, Speed Variator Products Operation, Erie, PA. When seeking assistance, please use requisition number and Model Number to identify the equipment. Telephone 814–455–3219.

HANDLING

Wall mounted power units can be transported by lift trucks with the forks completely under the base, care being taken that the unit does not tip. Floor mounted power units have lifting lugs located on top the enclosure at each end, so that they may be readily handled by a crane.

Where the power unit consists of two enclosures bolted together, a lifting beam is provided to prevent buckling during handling.

WARNING

IMPROPER LIFTING PRACTICES CAN CAUSE SERIOUS OR FATAL INJURY.

LIFT ONLY WITH ADEQUATE EQUIPMENT AND TRAINED PERSONNEL.

SEE CASE LIFTING INFORMATION OF FIGURE 1.

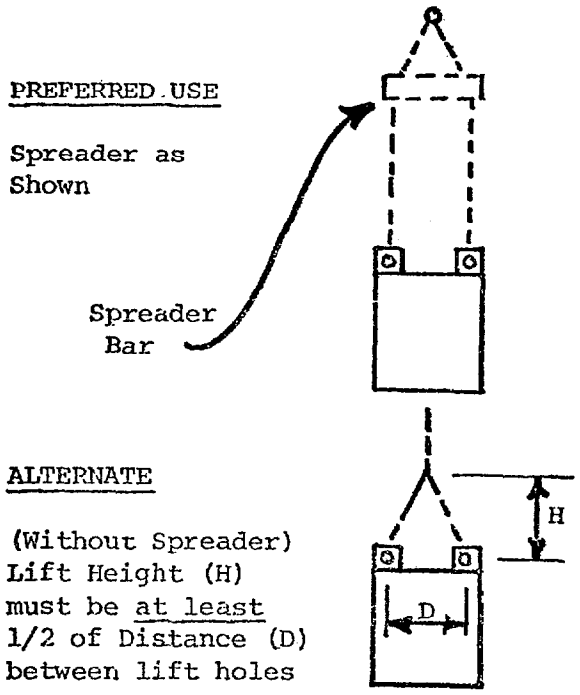


FIGURE 1

CASE LIFTING INFORMATION

STORAGE

If the equipment is not to be installed immediately, it should be stored in a clean, dry location at ambient temperatures of from –20°C (–4°F) to +55°C (131°F). The surrounding air must be free of chemical and electrically conductive or corrosive contaminants.

Precautions should be taken to prevent condensation from forming within the equipment enclosure. If the storage environment exceeds a 15°C (27°F) drop in temperature at 50% humidity over a 4 hour period, a space heater should be installed inside each enclosure to prevent condensation. A 100W lamp can sometimes serve as a substitute source of heat. Higher humidities with smaller temperature changes will also cause condensation.

STORAGE (continued)

Condensation occurs when air containing some moisture is cooled below its dew point. The dew point represents saturation of the air, and is the temperature at which the moisture starts to condense into water. It is not a fixed temperature but rather is related to the initial temperature of the air and its relative humidity at that temperature. The amount of moisture that can be held in the air is related to the air temperature. The following examples illustrate some of these relationships.

		Relative Humidity	Wgt. of Moisture in 1 lb. of Dry	Dew Point	
F	C	%	Air, Grains	F	C
104	40	100	345	104	40
104	40	80	260	97	36
104	40	40	130	75	24
104	40	10	32	37	3
50	10	100	54	50	10
50	10	80	42	43	6
50	10	40	21	25	–4

In industrial drives, condensation is a possibility in applications where air temperature changes are large and rapid and/or the air is moist. For example, an outdoor crane operating in sunshine on a winter day, which then is shut down and parked in the shade will experience a rapid drop in temperature. This can result in condensation inside the equipment. Adding heat to keep the air temperature above its dew point can prevent condensation.

If storage temperatures below $-20^{\circ}C$ ($-4^{\circ}F$) are likely to be present, then auxiliary heat should be added in each enclosure to maintain temperature at or above $-20^{\circ}C$. For assistance in heater size selection contact General Electric Company.

When a drive that has been in operation is shut down for either a short or extended peirod of time, it is recommended the environmental conditions be maintained the same as when in operation. Power, ventilation, or heating and air–conditioning (if used) should be left on during the downtime to prevent large changes in temperature and possible moisture condensation.

SAFETY FOR PERSONNEL AND EQUIPMENT

The following paragraphs list some general safety reminders and safety recommendations to be followed when operating and installing this equipment.

DEFINITIONS OF TERMS AND LABEL COLORS

WARNING: Denotes operating procedures and practices that may result in personal injury or loss of life if not correctly followed.

Color: Black or white lettering on red field.

CAUTION: Denotes operating procedures and practices that, if not strictly observed, will result in damage to, or destruction of, the equipment.

Color: Black lettering on amber field.

NOTE: Denotes an operating procedure or condition which should be highlighted.

Color: Black lettering on white field.

WARNING

IMPROPER LIFTING PRACTICES CAN CAUSE SERIOUS OR FATAL INJURY.

LIFT ONLY WITH ADEQUATE EQUIPMENT AND TRAINED PERSONNEL.

SEE CASE LIFTING INFORMATION OF FIGURE 1.

WARNING: HIGH VOLTAGE

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC VOLTAGE SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGE TO GROUND WILL BE PRESENT AT MANY POINTS. WHEN INSTRUMENTS SUCH AS OSCILLOSCOPES ARE USED TO WORK ON LIVE EQUIPMENT, GREAT CAUTION MUST BE USED. THE INSTRUMENT COMMMON LEAD SHOULD NOT BE CONNECTED TO AN UNGROUNDED PART OF THE SYSTEM UNLESS THE INSTRUMENT IS ISOLATED FROM GROUND AND ITS METAL PARTS TREATED AS LIVE EQUIPMENT. USE OF AN INSTRUMENT HAVING BOTH LEADS ISOLATED FROM TEH CASE PERMIT GROUNDING OF THE CASE.

When working on or near the equipment with power/voltage applied, it is recommended that all metal objects such as rings, watches, and tie clasps be removed.

It is strongly recommended that all personnel working on this equipment wear rubber–soled shoes (insulated).

SAFETY FOR PERSONNEL AND EQUIPMENT (continued)

WARNING

WHEN WORKING AROUND ROTATING EQUIPMENT, DO NOT WEAR ANY LOOSE CLOTHING THAT COULD BECOME CAUGHT IN THE EQUIPMENT.

CAUTION

DO NOT REMOVE PRINTED CIRCUIT CARDS FROM THE EQUIPMENT WHILE POWER IS APPLIED. THIS CAN DAMAGE THE EQUIPMENT.

NOTE

ALWAYS READ THE COMPLETE INSTRUCTIONS PRIOR TO APPLYING POWER OR TROUBLESHOOTING OF THE EQUIPMENT. FOLLOW THE PROCEDURE STEP BY STEP.

READ AND HEED ALL WARNING, CAUTION AND NOTE LABELS POSTED ON THE EQUIPMENT.

CAUTION

DO NOT REMOVE POWER FROM THE DRIVE UNTIL IT HAS FULLY EXECUTED A STOP SEQUENCE, AS THIS CAN DAMAGE THE DRIVE SYSTEM.

INSTALLATION

LOCATION

Drive power units are suitable for most factory areas where other industrial equipment is installed. They should be installed in a well ventilated area with ambient temperatures ranging from 0°C (32°F) to 40°C (104°F) and relative humidities up to 90%. It should be recognized, however, that since the life expectancy of any electronic component decreases with increased ambient temperature, reduction of the ambient temperature will bring about extended component life. For example, longer component life should be expected if the ambient temperature is held between 20°C (68°F) and 30°C (87°F).

Proper performance and normal operational life can be expected by maintaining a proper environment for the drive system. Environments which include one or more of the following characteristics should be considered hostile to drive performance and life.

1. Dirt, dust and foreign matter
2. Vibration and shock
3. Moisture and vapors
4. Temperature excursions
5. Caustic fumes
6. Power Line fluctuations
7. Electromagnetic interference (noise)

Totally enclosed enclosures should be positioned to permit heat radiation from all surfaces except the bottom. Otherwise, enclosures can be positioned as follows:

A floor mounted power unit enclosure may be placed end-to-end or back-to-back with another enclosure, or may be placed with its ends or back against a wall. Sufficient clearance should be allowed in front of the enclosure so that the door may be fully opened for easy access. This front clearance should be at least equal to the width of the enclosure for single door enclosures or one-half the width of the enclosure for double door enclosures.

A wall mounted power unit enclosure may be placed side by side with another enclosure, or may be placed so that only its front is accessible. Clearance at least equal to the width of the enclosure door should be allowed in front so that the door may be fully opened for easy access.

WARNING

EXPLOSIONS OR FIRES MAY RESULT FROM MOUNTING DRIVE POWER UNITS IN HAZARDOUS AREAS SUCH AS LOCATIONS WHERE INFLAMABLE OR COMBUSTIBLE VAPORS OR DUSTS ARE PRESENT. DRIVE POWER UNITS SHOULD BE INSTALLED AWAY FROM HAZARDOUS AREAS, EVEN IF USED WITH DC MOTORS SUITABLE FOR USE IN SUCH LOCATIONS.

MOUNTING

All floor mounted power units are in enclosures having sturdy fabricated bases. These units may be mounted on any firm, reasonably flat and level floor or foundation. Holes are provided in the enclosure base for bolting down each unit. For best appearance, it may be necessary to shim one front corner of the base in order to have the doors line up perfectly.

Wall mounted enclosures may be mounted on any firm, reasonably flat, vertical surface. Larger units are provided with mounting ears, while smaller units have mounting holes in the back panel of the enclosure.

AIR SUPPLY

An ample supply of cooling air must be available for power units and motors. Force cooled power units are typically furnished with filters. Filters

AIR SUPPLY (continued)

must be changed or cleaned whenever they become dirty, since a dirty filter will restrict air flow, resulting in overheating of the power unit. If the power unit is located in an area where the air is clean, the filters may be omitted.

CONNECTIONS

All internal electrical connections between components in drive power units are made at General Electric Company.

Diagrams provided show the connections between the power unit and related apparatus. All terminals to which external connections are to be made are numbered on the equipment as indicated on the diagrams. Conduit entrance can be made through the top, ends, or bottom of the power unit enclosure. A conduit entry opening is located in the base near the left end. Entrance of conduit through other than the left end of the base or top may be blocked by base mounted components or top mounted blower.

Make certain the input voltage, frequency and phase of the power supply agree with the power unit nameplate on the control panel inside the enclosure. For some drives it is necessary on three phase power units to connect the AC supply in the correct phase sequence for proper operation.

If a separate AC line breaker, switch and/or fuse is used, the device and fuse selection should be in accordance with National Electric Code and/or local requirements based on power unit input data and supply system short–circuit capacity. Codes generally require the use of a fused disconnecting switch or circuit breaker.

Connect the DC motor, tachometer generator (if fur–nished), and all operator's control stations in accordance with diagrams.

It is recommended that the signal leads be isolated or separated from power leads by using separate conduits. The input speed command (reference) and tachometer feedback (if supplied) or other external feedback signals should be twisted pairs with at least ten twists per foot or twisted shielded cable with the shield grounded at only one end. Reference the elementary or interconnection diagram.

Be sure to protect the interior equipment from metal particles when cutting or drilling entrances for interconnection wiring and cables.

If additional relays or contactors are added in the SCR equipment enclosure, RC suppression networks should be added across the coils. A series combination of a 220 ohm resistor and a 0.5 mfd capacitor in parallel with each relay coil is recommended.

NOTE

On some systems, transformers and other apparatus are shipped separately and must be mounted and connected to the system.

WARNING

ALL MOTOR BASES AND EQUIPMENT ENCLOSURE HOUSINGS SHOULD BE CONNECTED TO THE FAC–TORY OR FACILITY EARTH GROUNDING SYSTEM.

CAUTION

DO NOT GROUND ANY POWER OR CONTROL CIR–CUITS OF THE DRIVE EXCEPT IN ACCORDANCE WITH THE DIAGRAMS. INSTALLATION WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND BE CONSISTENT WITH ALL LOCAL CODES. SECONDARIES OF 115VOLT CONTROL TRANSFORMERS TYPICALLY HAVE ONE SIDE FUSED AND THE OTHER AVAILABLE FOR GROUNDING BY THE USER.

NOTE

Connection of external circuits other than shown on the elementary diagram, such as ammeter on the shunt or voltmeter on the tachometer, may degrade the drive system performance.

CAUTION

DO NOT USE POWER FACTOR CORRECTION CAPACITORS WITH THIS EQUIPMENT WITHOUT CONSULTING THE SPEED VARIATOR PRODUCTS OPERATION, GENERAL ELECTRIC CO. DAMAGE CAN RESULT FROM HIGH VOLTAGES GENERATED WHEN CAPACITORS ARE SWITCHED.

Before power is applied to the drive system, checks should be made to see that all internal connections are tight, that plug-in printed circuit cards are fully seated and that all open relays and contactors operate freely by hand. Check that the equipment is clean and that no metal chips are present.

MAINTENANCE

Periodically inspect and maintain the equipment de–vices (particularly filters – when supplied) per instruction of this section. Check all electrical connections for tightness, look for signs of poor connections or over–heating (arcing, discoloration).

FANS AND FILTERS

On force ventilated drives, the power unit contains a fan and perhaps an air filter in the intake of the enclosure and/or on equipment inside the enclosure.

Inspect the fan at regular intervals to see that it is operating properly. Check for excessive noise or vibration, fan blades loose or striking the housing, and for overheating of the motors. Keep the fan blades clean. If the fan motor does not operate, replace the motor or fan and integral motor with a unit with the same catalog number.

Clean or replace air filter as appropriate depending on the accumulation of dirt for the type supplied.

To clean metal filters, flush only with warm water, dry and recoat lightly with RP Super Filter Coat or equivalent (light oil) or replace the filter.

Be sure to install filters with air flow direction as indicated on the filter.

DC MOTORS

Maintenance instructions covering motors are found elsewhere in the instruction folder supplied with the drive.

CAUTION

IT SHOULD BE NOTED THAT WHEN THE DRIVE SYSTEM IS STOPPED AND POWER IS NOT REMOVED FROM THE POWER UNIT, FIELD SUPPLIES MAY CONTINUE TO EXCITE CONNECTED MOTOR FIELD EVEN AT STAND STILL.

DC MOTOR SHUNT FIELDS ARE NOT DESIGNED FOR FULL EXCITATION AT STAND STILL FOR EXTENDED PERIOD OF TIME (SEVERAL HOURS). UNDER THIS CONDITION, POWER SHOULD BE REMOVED, OTHERWISE THE FIELD COILS WILL BE SUBJECTED TO EXCESSIVE TEMPERATURE AND SUBSEQUENT REDUCED INSULATION LIFE.

AN ALTERNATE TO THIS PROCEDURE IS TO EMPLOY A FIELD ECONOMY CIRCUIT WHICH AUTOMATICALLY REDUCES THE LEVEL OF EXCITATION WHENEVER THE DRIVE IS SHUT DOWN. SEE MOTOR FIELD CONTROL CARD (MFC).

PRINTED CIRCUIT CARDS

Printed circuit cards normally require no maintenance except to keep them free from dirt and tightly plugged into their receptacles or secured to their terminal boards. Clean as follows:

1. Dry dust – Vacuum clean, then blow dry with dry, filtered compressed air (low pressure supply).

2. Oily dirt – Certain Components (electrolytic capacitors, switches, meters, potentiometers and transformers) can be damaged by solvent, so its use is not recommended. If necessary, use solvent sparingly on a small brush, and avoid above components. Clean contact terminals with dry non–linting cloth after solvent has been used. Recommended solvent FREON* RF or TF.

3. If the card is badly contaminated or corroded, replace.

SILICON CONTROLLED RECTIFIERS

Keep SCR's and heatsink free from dirt, oil or grease, since any accumulation of dirt may cause overheating. Clean as follows:

1. Dry dust – Vacuum clean, then blow with dry, filtered compressed air (low pressure).

CAUTION

SOLVENT CAN HARM NON–METAL COMPONENTS.

2. Oily dirt – use dry or barely moist (with solvent) non–linting cloth. Repeat until cloth remains clean. All SCR's must be cleaned with dry non–linting cloth after solvent has been used. Recommended solvents: FREON* RE or TF.

CONTROL DEVICES

Inspect all relays and contactors at regular intervals and keep them free from dirt, oil or grease. Check for freedom of moving parts, corrosion, loose connections, worn or broken parts, charred insulation or odor, proper contact pressure, and remaining wear allowance on contacts. Do not lubricate the contacts as lubrication shortens their life.

Both copper and silver contacts will become darkened and somewhat roughened in normal operation. This does not interfere with their performance and does not indicate that the contacts should be filed. In general, contacts will not need attention during their normal

* Trademark of E.I. DuPont Company

CONTROL DEVICES (continued)

life, but if prominent beads form on the surfaces due to severe arcing, the contact faces may be dressed with a fine file. Do not use sandpaper or emery cloth.

Any contact that is worn to the point where contact wipe or pressure is lost should be replaced. Contactor shunts which are badly frayed or broken should also be replaced.

Cleaning procedure is the same as previously given for SCR and heatsink.

DESCRIPTION OF OPERATION

A DC–SCR drive utilizes silicon controlled rectifiers for AC to DC voltage conversion and for DC to AC inversion to control DC voltage to a DC load or source e.g. a DC motor.

Drive motors may be operated over wide speed and torque ranges by appropriate control.

A DC–SCR drive typically consists of the following equipment:

1. The Drive Power Unit
   This contains the SCR power conversion module and associated control and power components.

2. The Drive Motor
   Typically the drive motor is an adjustable speed DC motor. It is available in a variety of speed ranges and enclosures. DC motors may have controlled armature and field voltages.

3. The Operator's Control Station
   The station, if supplied, usually contains the speed setting potentiometer and necessary operating pushbuttons.

   The station may vary in complexity from a simple three unit pushbutton unit to a floor mounted operator's console with all the controls for a complex system.

INSTRUCTION INFORMATION

The instructions furnished with the equipment include detailed instructions and diagrams applicable for each specific drive system.

In addition to this general system instruction, the folder includes instructions for the control functions, conversion module(s), motor(s), and other components furnished. Start–up and Troubleshooting guides are included. All instructions and the accompanying diagrams should be consulted before applying power to the system.

TYPES OF DIAGRAMS

Different types of control diagrams are provided for specific purposes. The type of control diagram is noted in the title block of each diagram sheet.

The three major types of diagrams are elementary (sometimes referred schematic), layout or connection and interconnection.

The elementary diagram represents (in symbolic form) the fundamental operation and relationship of the electrical parts of a system. These diagrams are drawn in such a manner that operation is easily understood. Mechanical relationships of control devices are subordinated to simple presentation of the electrical circuits. Connections made between control devices and power devices within the enclosure, as well as outgoing terminal points, are usually also shown on this type of diagram.

The layout or connection diagram, when supplied, is one which shows the relative physical position of the devices as well as other electrical components located within the same enclosure.

The interconnection diagram indicates the type and number of connections to be made between major components of the system (power unit, motor and operator's station), the plant power source, auxiliary devices, and other electrical machines. On less involved units, connection and interconnection diagrams or elementary and interconnection diagrams may be combined. The interconnection information may also be presented in tabular form.

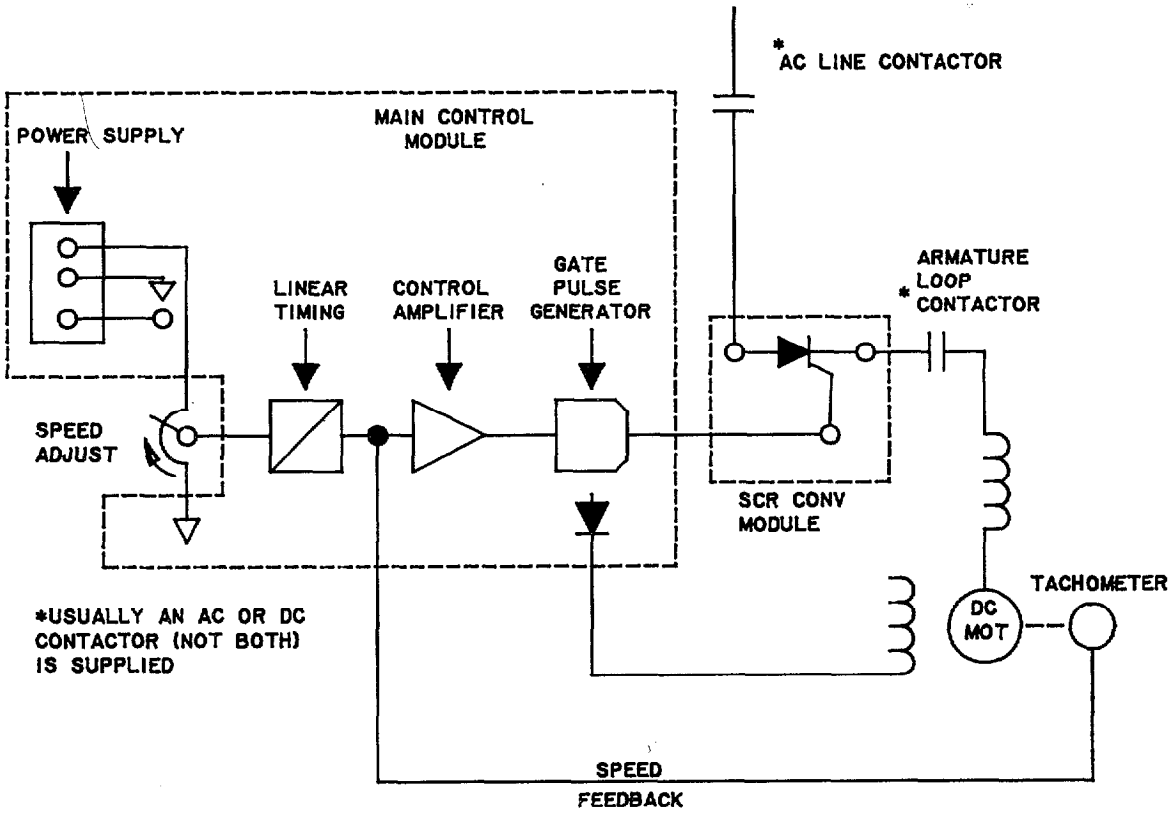


FIGURE 2

BLOCK DIAGRAM OF BASIC DC SCR DRIVE

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ERIE, PENNSYLVANIA 16531

GENERAL ELECTRIC