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IDING Development of Extended Length, Continuous
Wire Feed Systems

Project Report by Bethlehem Steel Corporation
in cooperation with U. S. Maritime Administration

INFORMATION
Research Institute

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L DING Development of Extended Length, Continuous
Wire Feed Systems

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Research Institute

FOREWORD

The purpose of this report is to present the results of one of the research and development programs which was initiated by the members of the Ship Production Committee of The Society of Naval Architects and Marine Engineers and financed largely by government funds through a cost sharing contract between the U.S. Maritime Administration and Bethlehem Steel Corporation. The effort of this project was directed to the development of improved methods and hardware applicable to shipyard welding in the U.S. shipyards.

Mr. W. C. Brayton, Bethlehem Steel Corporation was the Program Manager, Mr. Wade Troyer, Hobart Brothers directed the development work at the Troy, Ohio plant and Technical Center. Grateful acknowledgement is made for the outstanding contribution of Messrs. Charles Strain, and A. Blackburn of the Hobart organization.

Special acknowledgement is made to the members of Welding Panel SP-7 of the SNAME Ship Production Committee who served as technical advisors in the preparation of inquiries and evaluation of sub-contract proposals.

EXECUTIVE SUMMARY

BACKGROUND

Although considerable process has been made in recent years to process impressively large amounts of steel tonnage through automatic processes, the major application of welding manhours is in field locations using portable equipment. Most of the welding in field locations and aboard ship is presently done manually with stick electrode.

Recent developments in the area of semi-automatic welding processes and electrodes offer potentially higher productivity than manual welding in applicable areas. However, the size and weight of wire feeders and the limited distance of 10 or 12 feet from the wire feeder to the gun have seriously limited the applications of semi-automatic welding.

OBJECTIVE

The objective of this project was to develop a semi-automatic welding system with appropriate hardware to permit an operator to weld over 200 feet away from the source of both power and electrode with a gun and cable light enough to provide flexibility comparable to that of manual welding with stick electrode.

ACHIEVEMENT

The system developed by Hobart Brothers under this contract employs a completely new concept in hardware known as a linear wire feeder which feeds the electrode through the hollow shaft of an in-line motor using planetary rollers for propelling the electrode.

ACHIEVEMENT continued

By using a series of these linear wire feed motors at 50 ft. intends it is possible to weld over 200 ft. away from the wire source. Two sizes of motor are required to cover the range of electrode diameters. One for diameters less than 1/16" and another for large diameters through 3/32". Both systems are provided with shock resistant weather repellant covers for use in a shipyard environment.

Field tests made by both Hobart and Bethlehem indicate that the extended length continuous wire feed systems developed under this contract do accomplish the objective. An operator can weld in any shipboard locations within 200 ft. of a wire source adequate to last an entire work shift without interruption for changing wire.

- FINAL REFORT -

TITLE: EXTENDED LENGTH CONTINUOUS
WIRE FEED SYSTEMS

FOR: BETHLEHEM STEEL CORPORATION
PURCHASE ORDER 1560 -831-1506-s

WEUXNG PROJECT SP-1-2 (203)

BY: HOBART BROTHERS COMPANY
TROY, OHIO, U.S.A.

5/31/74

PREFACE

WELDING PROJECT SP-1-2 (203) EXTENDED LENGTH CONTINUOUS IRE FEED SYSTEM

The Hobart Brothers Company of Troy, Ohio, entered into an agreement with the Bethlehem Steel Corporation of Sparrows Point, Maryland., Co-ordinator for the and Contract (2-36214) for the purpose of developing an extended length continuous wire feed system.

From the Marad Contract No. 2-36214, entitled "supplement to Purchase Order or Contract United States Department of Commerce Prime Contract Number 36214 for Research and Development to Ship Production" came the following definition of SP-1-2. This definition as reported from Article IX Paragraph "B" of that report.

SP-1-2 improved portability of welding equipment development of lightweight highly portable semiautomatic welding equipment which can be handled from one work location to another, in shop and for all areas of ship construction by one man.

Hobart Brothers Company's portion of the Marad request is completed by the extended length Linear System Models 5709 and 5710.

This report will provide an indepth account of this extended length continuous wire feed system commencing with its development history and a look into its potential.

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GENERAL - WIRE FEED SYSTEMS FOR CONTINUOUS WIRE 'WELDING

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CHAPTER I

GENERAL - WIRE FEED SYSTEMS FOR CONTINUOUS WIRE WELDING

HISTORY

The continuous wire feed system had its origin in approximately 1920. The first application for the continuous wire feeding of electrodes was first brought about for the use with automatic welding processes. Sometime later this continuous wire welding method was designed into a system suitable for use by an operator and was termed, as we knew it, as semiautomatic welding. In the early models, since it was first used with fully automatic, the driving distance, this is the distance from the wire the cedar to the arc, was of a relatively short length. Through the years, the need has arisen to increase this length from the wire source to the welding arc. Between 1920 and 1973, there has been much change and development in the art and equipment which is used to propel the wire from the wire source to the arc, be it through an automatic torch or through a semiautomatic gun. Through these years the principle used by this equipment and the method have not changed appreciably. The improvement has been in refining what was developed back in the original model sometime in the early 1900s, and it has been used as improved up until the present time. The continuous wire feed system used to propel the wire as we know it includes a gear box of some type to reduce the speed of a DC motor down into the range that is usable for the movement of wire. To this gear box, we have attached a series of two, four, or more round wheels we call feed rolls which pinch the wire, and this pinching will transfer the torque of the motor through the gear box and impart a force onto the wire sufficient to pull the wire from a wire container and push it to the welding arc. This system has been widely accepted; and has proven to be quite a valuable asset to the welding industry. Changes have been made; we have changed the way in which we have governed the speed of the motor

from electromechanical to a complete solid state feedback type of motor control which will, with a more or less degree of accuracy, control the speed setting at which we select the rate at which we feed the wire. Through these years there has been also many changes in the shape of the feed rolls, be it flat, grooved and knurled. Other types of shape and contour have been tried in order to more effectively transfer this torque from the gear box to the wire. In some instances, this type of standard equipment has not been sufficient to do the work required.

Hobart Brothers Company started development work some time ago on a continuous wire feed system using new and unique features to propel the welding wire.

The first preliminary technical release of this feed system was made at the 1973 Annual AWS meeting which was held in Chicago.

CHAPTER I

GENERAL - WIRE FEED SYSTEM FOR CONTINUOUS WIRE WELDING

REVIEW OF AVAILABLE WIRE FEEDING UNITS

At the present time, the following types of units are available:

- (1) Push Only Wire Feed Systems - Figure 1. These units usually consist of a DC motor coupled to a gear box for RPM reduction with one or more sets of drive rolls driven by the output shaft of the gear box, In practically all cases, the motor torque is transmitted to the wire by pinching the wire between sets of drive rolls. Usually one of the drive rolls is spring loaded on the wire to allow some adjustment of the pressure of the rolls on the wire. Deformation of the wire from a circular to an elliptical cross section can occur (Figure 3). By numbers of units in service, this is by far the most popular type of unit.

Since unit physical size is usually not of major importance, push only systems are limited by:

- (a) Ability of size and type of wire to withstand axial load without Collapsing.
 - (b) Ability of drive rolls' to transmit motor torque to wire.
 - (c) Ability of unit control system to maintain a constant wire feed rate with varying input power and wire loads.
-
- (2) Pull Only Wire Feed System - Figure 2. These units pull the wire off a spool, through a feed conduit, and then push it through a very short gun tube. The major advantage of this system is that the axial load on the wire is a tensile rather than a compressive load as in a push only system. The wire pulling mechanism (motor, gear box, and drive rolls) is mounted in

the hand-held gun and, therefore, must be of relatively small size. Wire spool inertia and the drag of the wire being pulled around a curve in the flexible conduit generally requires more force than the small motor can develop or the small rolls transmit to the wire. This type of system is generally used only on "one-pound spool guns" where a very small spool of wire is mounted in the gun with the feed system. Most general application is with small diameter aluminum and some limited steel. Pull only systems (one-pound spool) are limited by:

- (a) Torque that can be developed by small motor.
- (b) Size of wire spool that can be used.
- (c) Weight of electrode and feed mechanism must be supported by operator.

(3) Push-Pull Wire Feed Systems. These units employ a push feed motor at the wire spool and a pull feed motor in the torch. The push motor must overcome the inertia of the large wire spool and push the wire through the conduit. The pull motor must keep the wire under a slight tensile load to eliminate a compressive axial load which could cause the wire to buckle. To accomplish this, the push motor is usually a constant speed motor while the pull motor is a constant torque motor. Balance of these systems is attempted through elaborate electrical circuitry. Small diameter aluminum and steel wires can be fed 15 feet (4.6 m) without difficulty. Distances of 25 feet (7.6 m) have been done with special equipment in localized instances. In all cases, the motor torque is transmitted to the wire through a set of feed rolls. Generally, push-pull systems are limited by:

- (a) Size of wire that can be used -- Usually .045 (1.14 mm) maximum.
- (b) Need for short distance from pull motor to arc -- approximately 8 inches (20.3 cm) maximum
- (c) Ability of electrical system to maintain system balance with varying loads.

The overall review shows:

- (1) All presently available equipment uses drive rolls pinching the wire to transmit motor torque to wire axial force.
- (2) There is no equipment available to give even a moderate extended distance feeding for wires 1/16 (1.6 mm) diameter and over.
- (3) Small. diameter steel and aluminium wires are limited to approximately 15 feet (4.6 mm) maximum.

EFFECT ON WELDING WIRE - PUSH SYSTEM

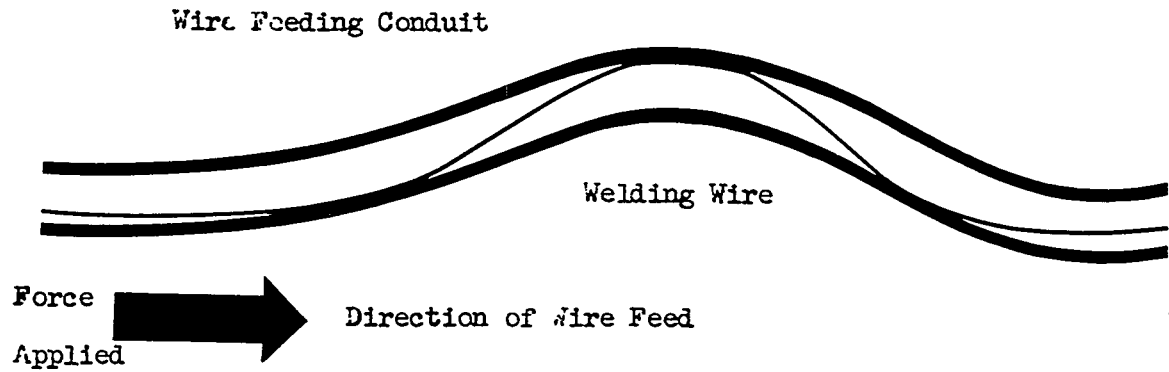


FIGURE 1

EFFECT ON WELDING WIRE - PULL SYSTEM

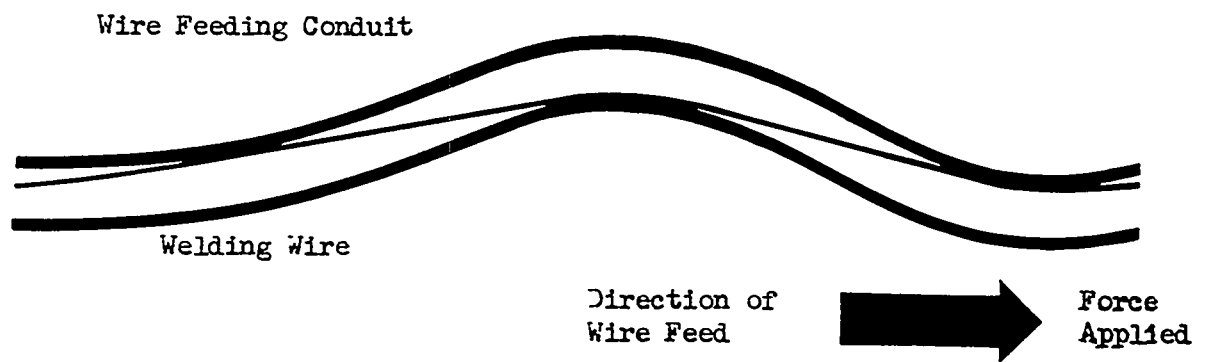


FIGURE 2

CHAPTER I

GENERAL - WIRE FEED SYSTEM FOR CONTINUOUS WIRE WELDING

NEED FOR NEW FEED SYSTEM

In all continuous wire electrode welding processes, it is absolutely essential that the wire drive mechanism provide an uninterrupted flow of wire into the arc. Early application of this process used a relatively large wire (3/32 inch - 2.4 mm or larger) pushed through a fixed and unchanging conduit and torch. Maintaining constant wire feed rate was relatively easy since the system force loading was constant and the large wire would not buckle or collapse under axial loading. The development of the small wire MIG process in the 1950s presented a radially different set of feeding conditions. Use of a hand-held gun on the end of a long flexible wire feed conduit caused rapidly changing force loading on the feed mechanism. These changes occur both in magnitude and frequency. Also, the smaller wires used are not capable of sustaining varying axial loads without buckling or collapsing.

Feeding of small diameter aluminum wire is probably the greatest deterrent to rapidly expanding the GMAW aluminum welding market. The lack of physical strength in axial loading and the general "softness" of aluminum wire allows easy collapsing of the wire and slippage of the drive rolls. A slight arcing between the wire and the inside diameter of the contact tip can easily cause a momentary large increase in the axial load applied to the wire at the drive rolls resulting in the all too familiar "bird's nest" at the wire feeder or "burnback into the tip".

In 1968, the Aluminum Association published a report in which they had sent questionnaires to the association members asking them questions about an equivalent of aluminum arc welding equipment. If any of you have read the report

you will. remember that the association was quite critical of the lack of equipment that the arc welding industry had provided for the use in the arc welding of aluminum products. They felt that this even limited the application of aluminum to industry where the attachment of aluminum pieces had to be made by the arc welding process. So the feeding of aluminum continuous welding wire has been an area that needed additional equipment to fully satisfy this welding process.

Rapid development of flux cored electrodes capable of high quality physical and chemical weld deposits at accelerated rates is causing a major movement to this process. Generally, wire sizes range from 1/16 (1.6 mm) to 1/8 (3.1 mm) diameter with 3/32 (2.4 mm) being the most popular. The cast, helix, and physical strength of the wire cause very high axial force loads on the wire. These loads increase with increased length of the welding cable. Feeder power requirements and ability of drive rolls to transmit the motor torque to axial wire load have placed a practical limit of 14 feet to 16 feet (4.2 m to 4.8 m) for feeding 3/32 diameter (2.4 mm) flux cored wire.

EFFECT ON WELDING WIRE - PINCH FEED ROLLS

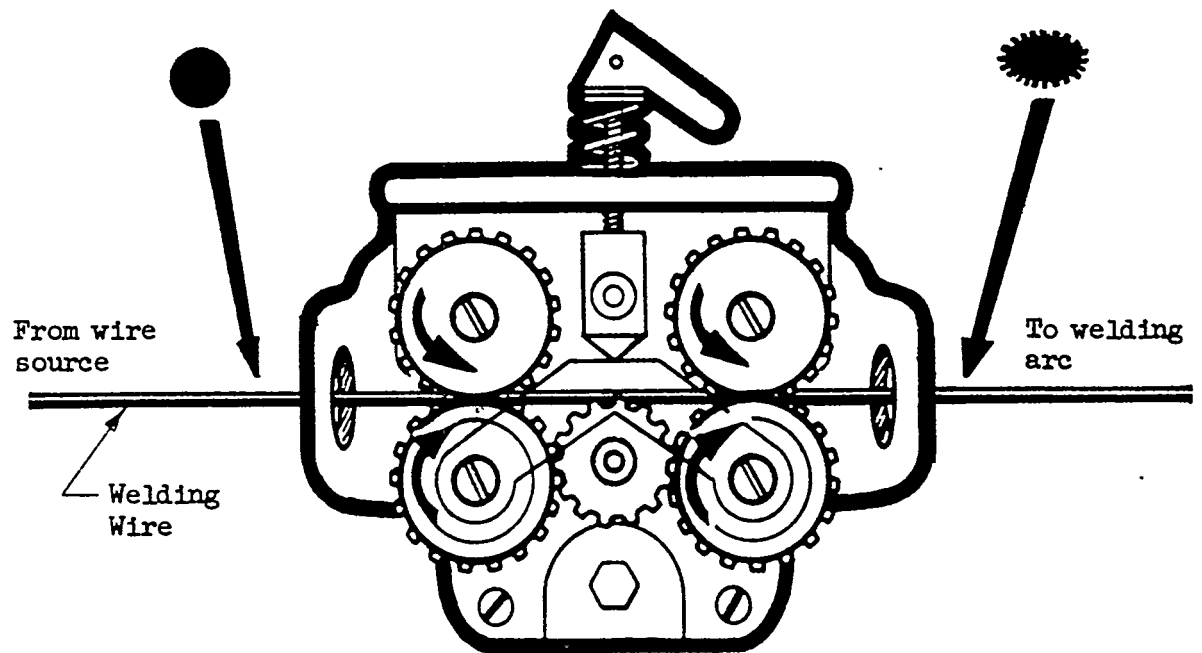


FIGURE 3

CHAPTER II

LINEAR WIRE FEED SYSTEM

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CHAPTER II

LINEAR WIRE FEED SYSTEM

DEVELOPMENT OF EXTENDED LENGTH FEEDING SYSTEM

The need for reliable equipment to feed small diameter ferrous and non-ferrous continuous electrodes for extended distances has been evident since the introduction of the MIG process. In recent years, the shipbuilding and large construction and fabricating industries have voiced their need for equipment to feed large diameter (3/32 inch - 2.4 mm) flux cored wires extended distances. A review of available equipment presently on the market shows no new major developments in either of these areas. Improvements have been made but practically all industrial units continue to use one or more sets of rotating rolls pinching the electrode to apply a driving or pulling force to the wire.

Development was initiated to design a wire feeding system using the principles of an axially stationary but rotating nut turning on a lead screw to propel the lead screw in an axial direction. A series of small drive rolls are mounted on a drive assembly with a preset angle to the wire and are in contact with wire. The drive assembly is then rotated around the wire thus imparting an axial or linear component of force to the wire. Further investigation has shown this system to be self-regulating allowing its use in a booster modular system without the balance problems of electrical/torque push-pull systems. Small diameter (.030 inch - .762 mm) soft (4043) aluminum wire has been fed successfully in an industrial application for distances of 25 feet (7.6 m). Large diameter (3/32 inch - 2.4 mm) flux cored wires have been successfully fed 200 feet (61 m). Changing of various parameters allows two basic size units to accommodate .035 (.89 mm) through .045 (1.14 mm) ferrous and non-ferrous wires and 5/64 (2.0mm) through 7/64 (2.8 mm) flux cored wires.

Economic considerations

power consumption per length of feed conduit, use of larger containers of electrode with corresponding decrease of cost per Pound and decreased lost time due to wire changing, elimination of heavy booms presently used to hold conventional wire feeders and wire coils, and more efficient use of available welding floor space.

During 1969 Hobart Brothers Compny started work on a continuous wire feed system using new and unique features to propel the wire. The system employs small permanent magnet motors with a small feeding device located on one or both ends of the motor shaft. The feeding device is in line with the center of the motor armature causing the welding wire to go through a hollow armature shaft. This "in line" feature has caused the new equipment to be designated "The Linear Wire Feed System". Two systems, Model 5709 for wire sizes .035 (.89 mm) through .045 (1. 14 mm) and Model 5710 for wire sizes 5/64 (1. 98 mm) through 7/64 (2.8 mm) have been developed.

CHAPTER II

LINEAR WIRE FEED SYSTEM

THEORY OF OPERATION

The basic principle of operation for both units is best visualized by the action between a non-rotating threaded rod with a laterally stationary but rotating nut. (See Figure 4.) As the nut turns around the rod, the rod is pushed forward at a rate depending on the pitch angle at which the nut makes contact with the rod and the speed at which the nut is rotated.

In the Linear System, a DC motor with a hollow shaft is used to obtain easy speed control which allows changing of the feed rate of the welding wire. Drive assemblies or hubs are placed on one or both ends of the motor shaft and will rotate with the motor shaft. The wire enters through one drive assembly, goes through the hollow shaft and exits through the second drive assembly. These drive assemblies have three posts about which counterbalance arms containing the drive rolls are free to operate. (See Figure 5.) These counterbalance arms are biased with a spring force and hold the drive rolls so there is a predetermined pitch angle between the plane of the drive roll and the welding wire. As a wire starts through the system, the springs acting through the arms will exert a force through the drive rolls to the wire. The pitch angle between the rolls and the wire causes a component of this force to be exerted in an axial direction thus propelling the wire. Three or six feed rolls per driving mechanism are turned around the wire by the force of the motor while the wire remains in a non-revolving position.

ARTIST SKETCH - LINEAR FEED PRINCIPLE

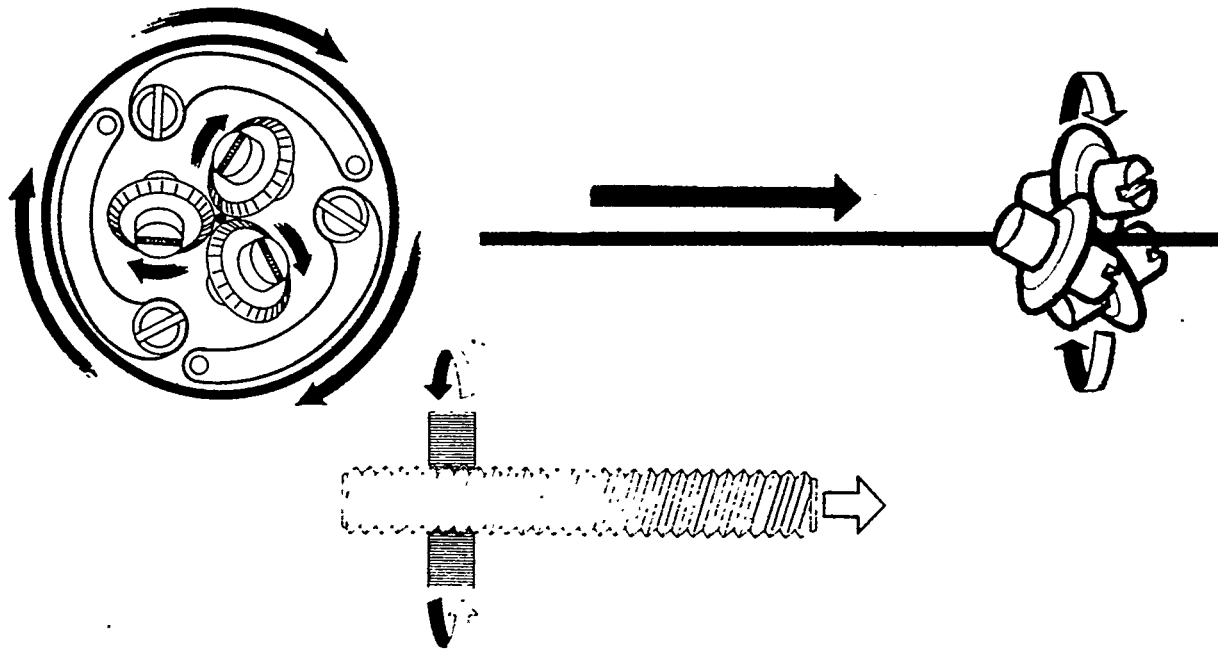


FIGURE 4

PHOTO - LINEAR DRIVE ASSEMBLY

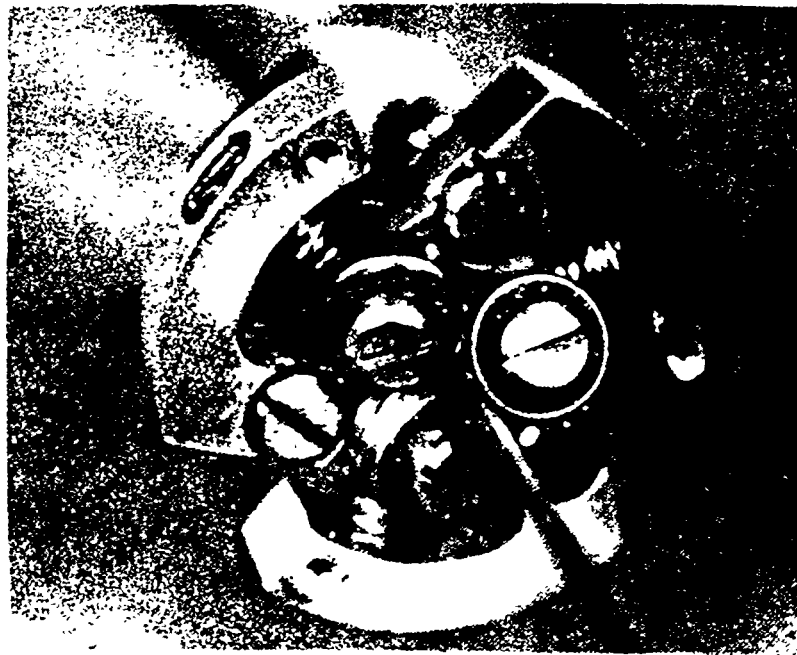


FIGURE 5

CHAPTER 11

LINEAR WIRE FEED SYSTEM

SYSTEM FEED SPEED CHARACTERISTICS

The first step in any development study requiring the feeding of continuous welding wire is to ascertain the maximum and minimum inches per minute for the wire feed rate of each size and type wire to be fed by the feeding system. A chart (Figure 6) shows the welding wires in both diameter and types to be fed with both of the Linear Systems. Listed is the maximum and minimum inches per minute for each wire along with the maximum and minimum welding current for the process required for each of the size wires listed. Figure 7 lists those wire sizes and types usable with each of the Linear Systems along with the corresponding maximum and minimum welding wire feeding rate in inches per minute. Included with this chart is the pitch of the drive rolls' that result in that feeding rate.

Figure 8 combines information in both Figures 6 and 7 to give a summary of each drive assembly coverage of varying welding wire diameters. Most welding applications do not use the full amperage range of any one wire size.

Care should be used in selecting the proper wire drive assembly in the Model 5709, be it the 20° or the 30° roller arm. IN the Model 5710, there is a choice between a 15° and a 20° roller arm. It is noted, reference Figure 8, that both angle drives for each model are usable for most of the wire sizes listed. The proper drive is the one that will use the upper limit of the wire drive feed speed range and still fulfill the welding process desired. The permanent magnet motors used in these systems have a speed torque curve that is characteristic by having a higher torque at the higher motor speed. So the choosing of that drive system that allows the motor to operate at more nearly the upper limit of the motor speed rating, it will- also be operating at the maximum torque rating.

The wire feed rate of this system is controlled by:

- (1) The pitch angle between the drive rolls and the wire.
- (2) The motor speed (RPM).
- (3) The circumference of the wire being fed.
- (4) The spring force or biasing between the rolls and the wire.
- (5) The load vs. RPM characteristics of the drive unit.
- (6) The diameter of the drive rolls.

Two of these variables, motor speed and wire circumference, are controlled by the user. However, the remaining four are fixed parameters that required considerable study.

The effect of various bias force exerting components on wire feed speed is best shown by Figure 9. The theoretical feed speed for a 30° drive angle at various motor RPMs is compared to that actually obtained with various biasing components. Data for all types and sizes of wire, drive angles, components, and system loads were obtained from lab testing.

Permanent magnet motor characteristics are such that motor speed will decrease with increased load. Loads on these motors will vary depending on cable conditions, wire conditions and other factors. Since a varying motor speed would give varying wire feed rate, electrical circuitry was designed into the control module to compensate for these conditions. Figure 10 shows the motor speed variances with load for the compensated and uncontrolled conditions.

The pitch angle between the feed rolls and the wire is a function of wire characteristics and the wire feed rates required. Experimentation has determined that a wide range of welding applications using a number of sizes and types of wire can be accomplished using pitch angles of 15° , 20° , 30° , and 40° . Figure 7 shows the minimum and maximum wire feed rates obtainable for various sizes and types of wire.

WELDING WIRE BURN OFF CURVES

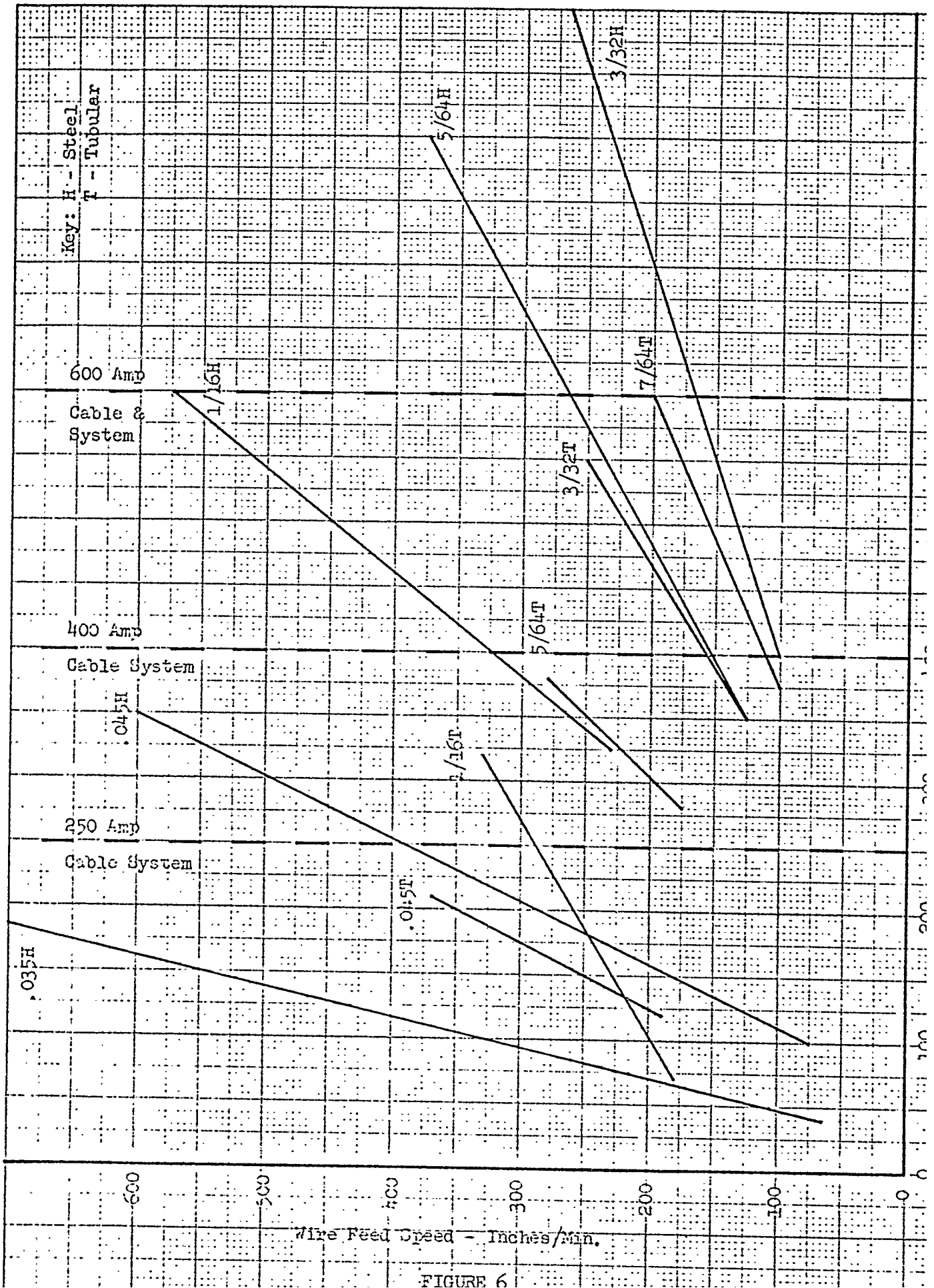


CHART - LINEAR MODELS SHOWING USABLE WIRE DIAMETER

System	Wire		Feed Rate		Pitch Drive Rolls
	Size (In - mm)	Type	In/Min (Min-Max)	mm/Min (Min-Max)	
Model 5709	.035 - .889	H	90 - 450	2285 - 11,430	30°
	.045 - 1.143	H	115 - 575	2920 - 14,605	30°
	.045 - 1.143	T	80 - 400	2030 - 10,160	20°
Model 5710	5/64 - 1.9844	T	80 - 400	2030 - 10,160	20°
	3/32 - 2.3812	T	75 - 375	1905 - 9525	15°
	7/64 - 2.7781	T	85 - 425	2160 - 10,795	15°

Key: H - Steel
T - Tubular

FIGURE 8

EFFECTIVE RANGES OF DRIVE ANGLES

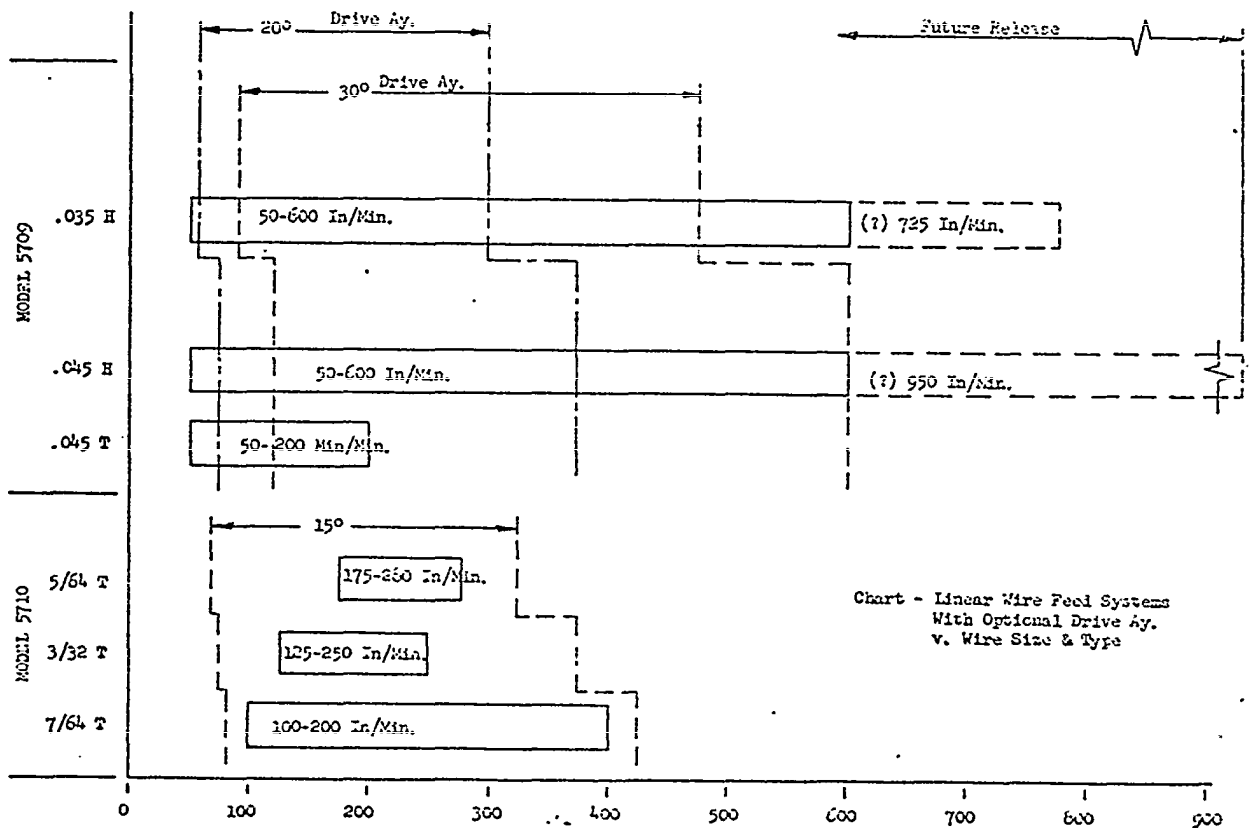


FIGURE 8

EFFECT ON WIRE FEED SPEED BY CHANGE IN DRIVE ROLL - MODEL 5709

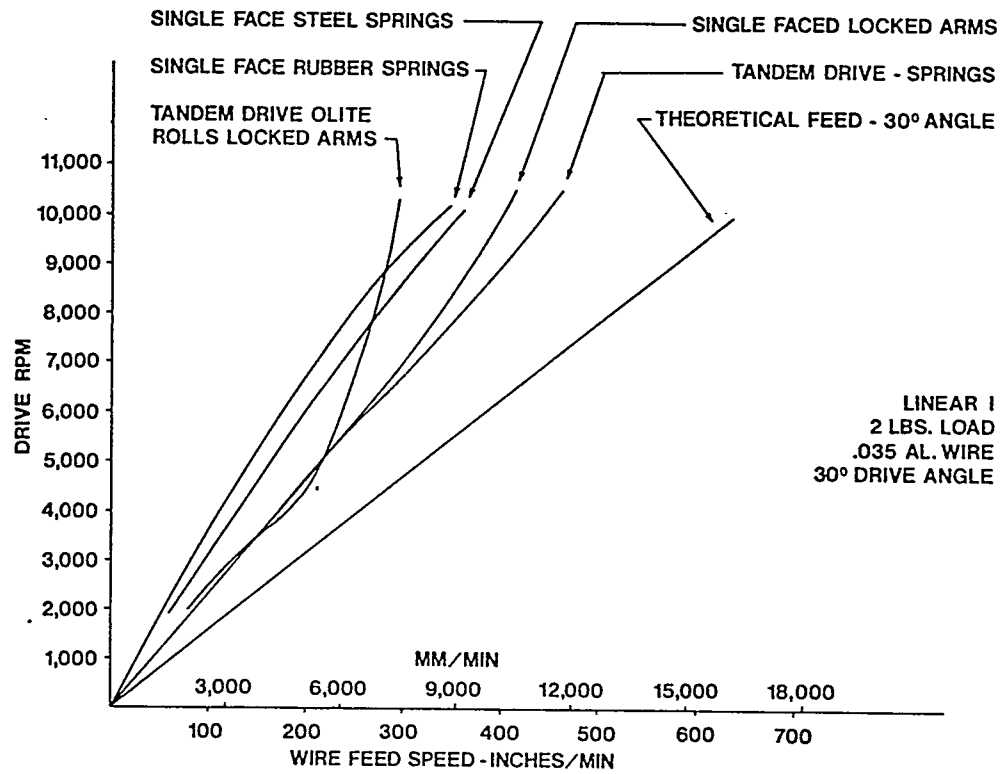


FIGURE 9

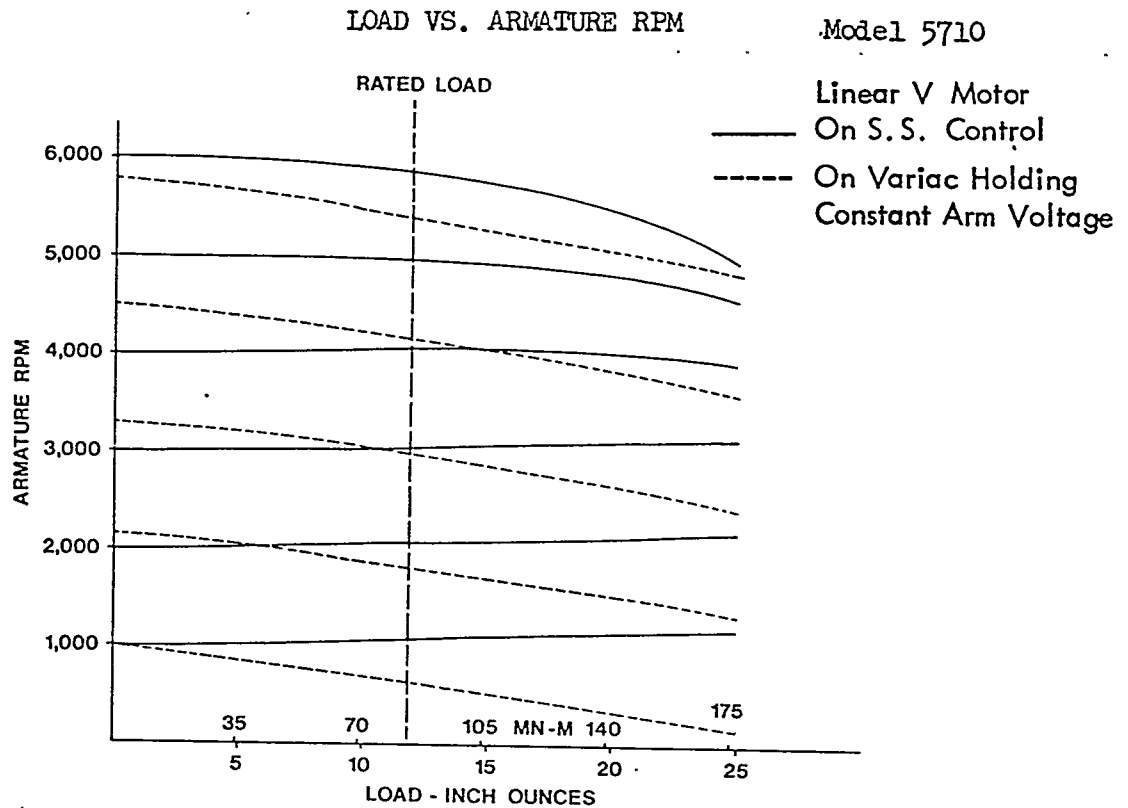


FIGURE 10

CHAPTER II

LINEAR WIRE FEED SYSTEM

PHYSICAL AND MECHANICAL DESIGN

The design of the linear modules has resulted in wire drive mechanisms much smaller and lighter than conventional drive units. Also, the number of moving parts is greatly reduced as the drive mechanism operates at the motor speed thus eliminating the requirement for a gear box. Figure 11 shows a visual comparison between the wire drive assembly in the Model 5709 and 5710, and a conventional drive unit. Figure 12 gives a physical comparison.

The physical size of the Model 5709 drive rolls, their positioning in the assembly and the need to set different biasing forces for different sizes and types of wire require a high degree of training with specialized tools for proper assembly. To eliminate the need for a user to do this, the Model 5709 motor and drive unit module will be self-contained in a sealed aluminum housing. Cable and electrical connections are by mechanical threads and plug-in assembly. Provisions for shielding gas, welding power, and control leads are incorporated. Model 5710 is assembled in parts, motor and two drive assemblies, and requires an additional housing for protection. Extruded ports for cabling and control wires and a shielding gas tube are provided. Electrical connections are plug types. A rubber protective boot with end terminals covers the entire unit.

Other features included are touch start control, inch and purge control, and reverse wire feeding.

The cable assemblies in both the Model 5709 and Model 5710 are basically the same design. The cabling system is made up of an assembly of a power cable with an inner core to provide room for the welding wire moved through, a gas line, and a control cable. These three items are then inserted into a neoprene cover

that confines the individual cables and forms a composite type cable assembly. On each end of the cable assembly is provided rubber molded weather protection. The booster design is different from the Model 5709 to the Model 5710. The Model 5709 motor and drive unit is self-contained in its own housing whereas the Model 5710 is assembled in parts, namely, motor and two drive assemblies which requires an additional housing to be placed around these items for protection. In this Model 5710 motor protection, we have placed extruded ports for the cabling system and gas tube in order to connect from one end of the booster to the other. In the booster assembly, the cabling is soldered to each end of the booster which have fixed in place male lead terminations. A molded plug containing the female lead terminations has been attached to each end of the cable assembly. The attachment necessary for attaching a cable to a booster is to attach the hardware holding the power cable to the inner tube of the booster, connect the female plug to the male plug, connect the gas line and slip the rubber protective boot from the cable assembly on to the booster assembly.

In the Model 5709 construction, since the motor and drive unit is self-contained, we propose to connect the booster to each end of this drive assembly having an external gas line connection and an external cable connection which would then be housed in a rectangular top and bottom housing, forming the booster assembly. The three cables coming from the cable assembly into the booster assembly on the Model 5709 would then be sealed at that point to resist moisture entering the cable assembly and booster assembly.

The linear wire feed control assembly is of a solid state construction and usable on both the CC and CV type power sources. Note: in both cases a contactor is required. Some CC power sources do not have contractors but should be provided if used with the Linear system. The linear drive motors are of permanent magnet

construction and built into the control assembly is a speed compensating circuit which compensates the voltage to the armature. Other features built into the control panel are touch start control, reverse wire feeding. The control assembly is not required to be either mounted at the power source nor at the first booster assembly. Some latitude is available in the placing of the control assembly. Caution should be noted that the cable should not become too excessive in length to cause an increase in line drop through the cabling system from either the control panel to the power source or from the control panel to the first booster.

The completion of Hobart Brothers portion of this contract will be complete by supplying two units, one unit Model 5709 as described in Figure 13 and the second unit Model 5710 as described in Figure 14. A complete description of Model 5709 will be contained in Chapter III. This will include describing the complete system, the method of control, hookup procedures, parts list, and wiring diagrams. The complete description of Model 5710 will be contained in Chapter IV including the general description of this unit, along with the control panel functioning, description of the complete system parts list, and wiring diagrams. Figure 15 contains comparative weights of Models 5709 and 5710 including the total weight and its various components.

PHOTO OF UNIT SIZE COMPARISON

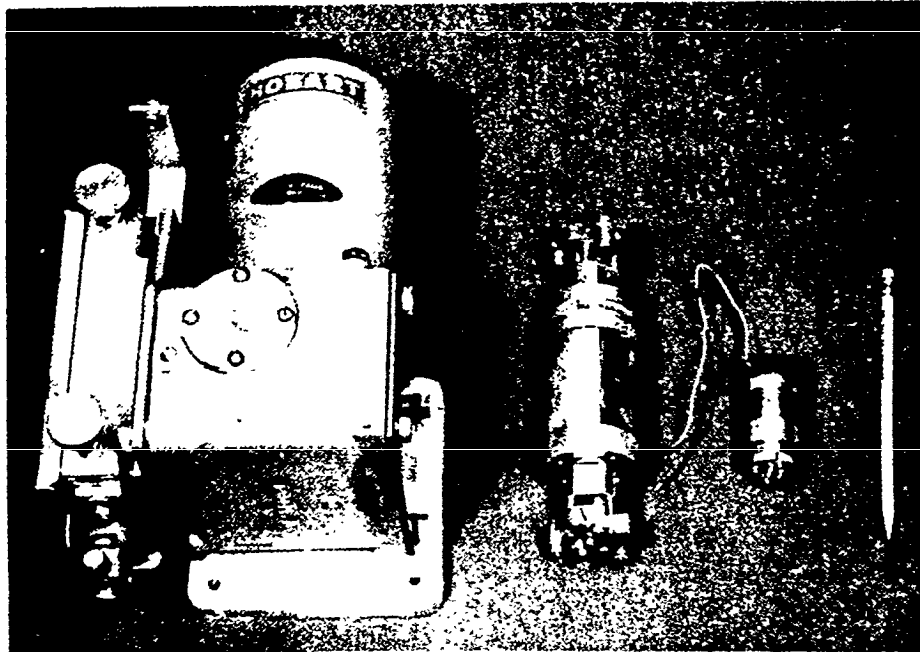


FIGURE 11

CHART - UNIT WEIGHT COMPARISON

Unit	Physical Size (Overall)				Weight (Oz. -Gr.)	Rating
	Length (In-mm)	Width(Dia) (In-mm)	Height (In-mm)	Total Cable (In ³ -Cm ³)		
Model 5709	5.75-146	1.5-38.1	X	3.23-52.9	10-283.5	5 oz-in @ 10,000 RPM
Model 5710	8.5-215.9	2.25-57.2	X	10.76-176.4	43-1219	21 oz-in @ 5000 RPM
H4S	11.25-285.8	8-203.2	6-152.4	185.7-3043.6	352-9979	1/4 HP @ 5000 RPM

FIGURE 12

MODEL 5709 - WIRE FEED SYSTEM
WITH 200 FOOT, 250 AMP CABLE
FOR BETHLEHEM CONTRACT

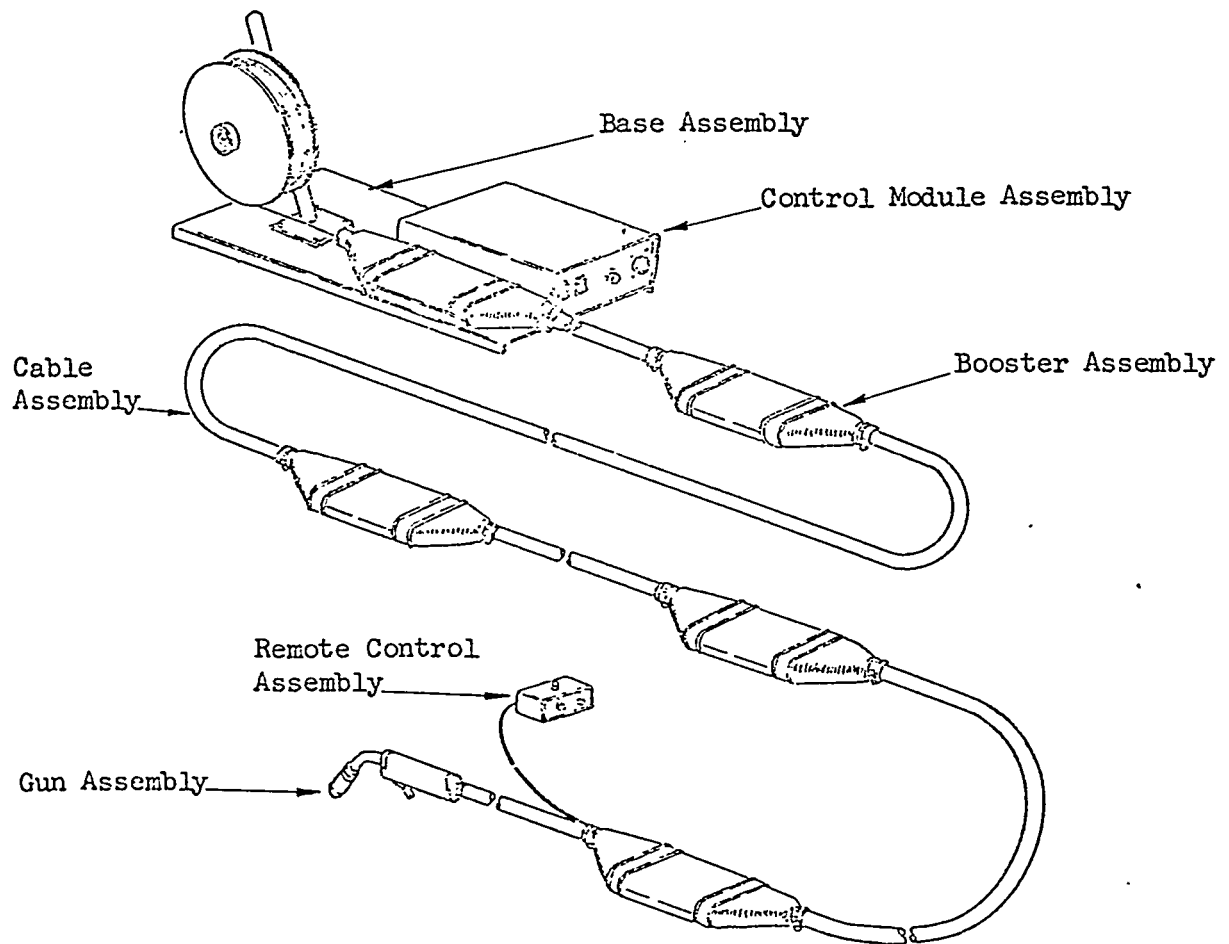


FIGURE 13

MODEL 5710 - WIRE FEED SYSTEM
WITH 200 FOOT, 400 AMP CABLE
FOR BETHLEHEM CONTRACT

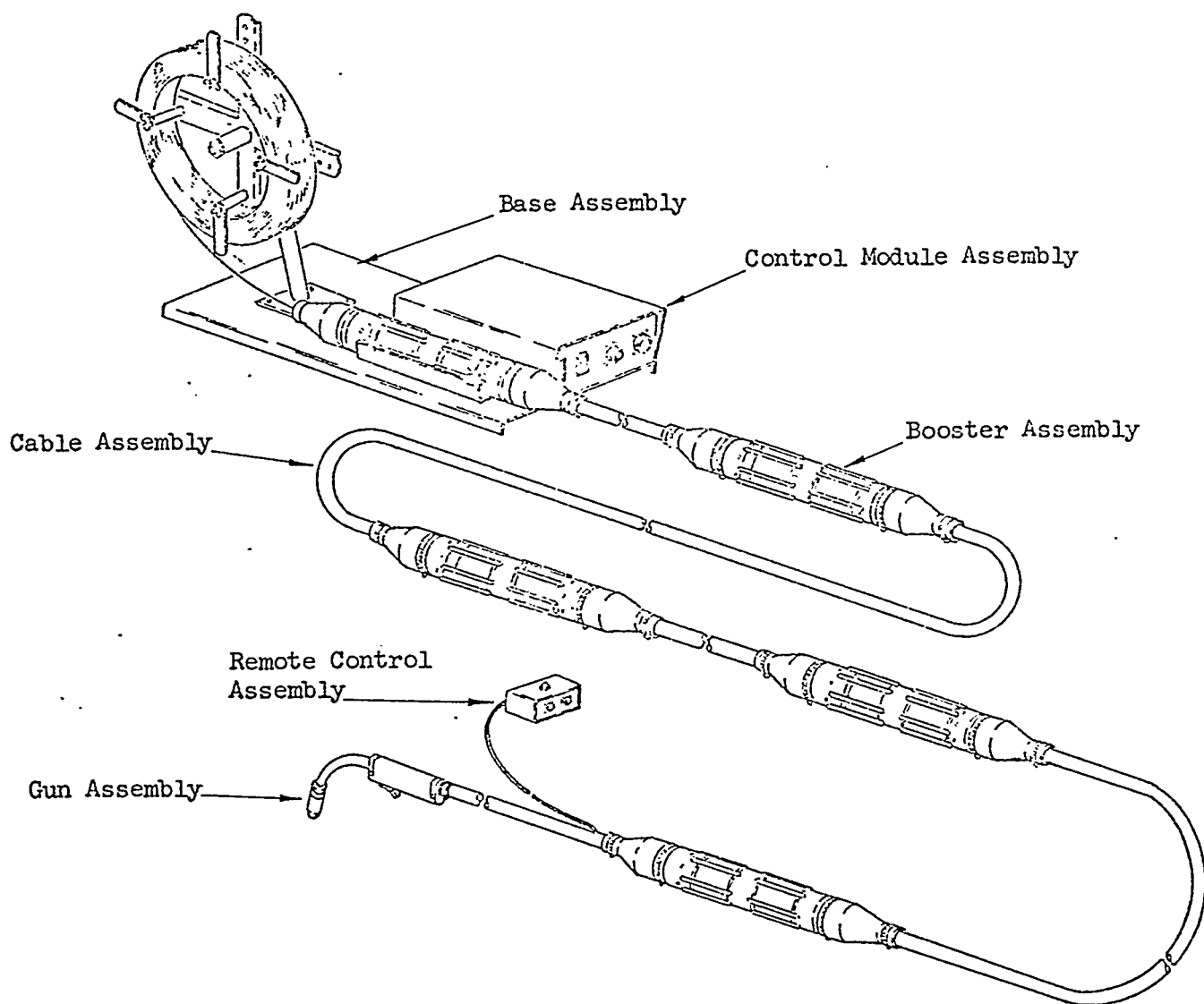


FIGURE 14

CHART - SIZE AND WEIGHT OF COMPLETE UNITS

		Model 5709	Model 5710
1. Base Ay.	Length (In.)	40	40
	Width (In.)		16
	Height (In.)	22½	22½
	Weight (lbs)	49	49
2. Control Module Ay.	Length (In.)	13½	13½
	Width (In.)	10	10
	Height (In.)	5½	5½
	Weight (lbs.)	19½	19½
3. Booster Ay.	Length (In.)		15½
	Width (In.)	3:3/8	x
	Height (In.)		x
	Diameter (In.)	x	4
	Weight (lbs.)	# 10 oz.	9¼
4. Cable Ay.	Length (ft.)		50
	Weight (lbs.)	30	42
5. Gun Ay.	Length (ft.)	10	10
	Weight (lbs.)	7	11¼
6. Remote Control Ay.	Length (ft)	10	10
	Weight (lbs.)	2	2
7. System Total	Weight (lbs.)	205½	296
8. Boosters, Cables & Gun	Weight (lbs.)	137	227½

FIGURE 15

CHAPTER II

LINEAR WIRE FEED SYSTEM

SELF-BALANCING CONCEPT

Feeding large diameter flux cored wire 200 feet (60.8 m) with small fractional horsepower motors would be extremely difficult if there was excessive friction between the wire and the conduit. These friction forces are caused by compressive or tensile forces on the wire forcing the wire against the walls of the conduit. The most unique feature of the linear drive system is that it attempts to maintain the wire between any two drive units in a "floating" or "no load" condition, Figure 16. The rotary motion of the feed rolls around the wire allows each drive assembly to have a "self-balancing" effect in the sharing of added loads from booster to booster. If the load should increase on one booster, the feed rolls will cut a finer lead on the wire. At the same time, the next booster in series will have its load decreased allowing the feed rolls to cut a longer lead. This additional push (or pull) will relieve the increased load on the first booster. The combination of interaction between the drive units will tend to maintain the "no load" condition on the wire.

The actual "slippage" of the drive rolls on the wire is a function of the load on the unit and the surface treatment applied to the rolls. Tests with 3/32 (2.4 mm) AWS Type 70T-1 with drive rolls treated is shown in Figure 17. The control potentiometer used to control the linear wire drive assembly speed remained constant throughout the test. Therefore, the change in wire feed speed was a direct result of additional load being applied. Practical usable range for production applications is within 15 lbs. to 20 lbs. (6.8 to 9.1 kg) range as discussed in Figure 18.

The force load on ny wire drive mechanism is equal to the drag force of the wire passing through the feed conduit and contact tip. This drag force is a function of many factors; length of feed conduit, number and size of curves in the conduit, condition of the wire, etc. In recent years, devices have been built which can determine these loads and the vibrations with loads. One such device, a force transducer connected to a bridge indicator and a strip chart recorder, was used to compare the loading between a conventional push-type feeder and a Model 5710 drive unit. To remove as many variables as possible, the same spool of wire (3/32 diameter [2.4 mm] AWS Type 70T-1), the seune gun with 10-foot (3. 0 m) cable, with the same configuration (Straight, one or two 360° lends at the same location) and the same wire feed rate were used for both systems.

Figure 18 is a record made from the strip charts used in this test. The three sets of conditions are mated top to bottom for easy comparison. The loading for the gun laying straight are approximately equal. However, when one 360° loop of 12 inches (30 cm) diameter is placed in the cable, the load on the Model 5710 increases from 4 to 8 pounds while the conventional unit goes from 4 to over 25 pounds. Also, note that the Model 5710 load is very steady while the conventional unit fluctuates from 20 to 35 pounds. With two loops, the comparisons become even greater.

The heart of the extended length concept of the Linear Wire Feed System is the ability of this system to have a "self-balancing" effect. This self-balancing effect is accomplished by the mechanical interaction of two or more sets of drive rolls working on the welding wire. As described in Chapter 11, the Linear feeder operation can best be described by the drive rolls cutting an imaginary lead screw effect on the welding wire. (Ref. Figure 19.) As one set of drive rolls loads up or unloads in relation to the drive rolls on the next booster assembly, the drive rolls will cut a finer or coarser pitch. (L_1 and L_3 of

Figure 19.) This mechanical interaction takes place with 5 boosters (200-foot system) as well as with 2 boosters while maintaining a wire feed speed variation within $\pm 3\%$. It should be noted this balancing takes place without an electronic feedback circuit between boosters. All the boosters are connected in parallel and each booster is supplied with the same voltage. The system does not use the slave-master drive motor concept found in many extended length feed systems.

This unique feature allows booster units to be added or removed from the feeder without a change in the control assembly.

Investigation as to the cause of these observed results is not complete. Other tests have shown that the conventional feeder pinch-type rolls tend to deform and mark the wire as more load is required. This deformation and marking causes higher friction drag forces further increasing the load. The Model 5710 drive rolls exert a constant pressure on the wire at all times uniformly around the wire due to the rotation of the drive rolls. This eliminates wire deformation and marking. Examination of the wires used in this test with an optical comparator tends to substantiate this theory.

To obtain the extended wire feeding distance desired, the linear drive units were placed in mechanical series to give booster or pumping station effect. The objective for small wire (up to .045 [1.14 mm] diameter) was to have a booster station every 50 feet (15.2 m). For steel wires, a standard 10-foot (3.0 m) push-type gun would be attached to the last booster. Maximum length for an industrial application is undetermined. The major problem with small wires in greater distances is the physical strength of the wire itself. Figure 13 shows the total Model 5709 system which includes the control assembly, cable assembly, and gun assembly.

A small drive module is located at the control assembly and another in each of the booster assemblies. The total length of this system is 210'.

Large diameter (3/32 - 2.4 mm) flux cored wire has been successfully fed 60 feet (18 m) on an industrial test. This Model 5710 system had a drive module at the wire source, 50 feet (15 m) of cable, a booster (second drive module) and a 10-foot (3 m) standard push-type gun. As a demonstration, this same wire has been fed 210 feet (64.0 m) from the wire supply using four boosters and a drive module at the wire source. In both of these cases, the cable was placed at random on the shop floor with no attempt made to limit bends. Figure 14 shows the Model 5710 system.

The push-pull effect can be described by Figure 20. In Figure 20, the force required by various feeding conditions has been recorded from our feedability tests in conjunction with a strip chart recorder. Chart (C) is the force required to push a 3/32 diameter flux cored welding wire through a 50-foot wire feed conduit. NOTE: Each vertical line represents 5 pounds of force. Every item used, wire feeder, (push system), gun, 50-foot wire feed conduit, conduit liner, and welding wire are standard and commercially available. The push force ranges from 75 lbs. to 85 lbs. and indicates an oscillation of force during feeding.

By applying a 5 lb. pull on the welding wire, the push force required is reduced by one-half or about 25 to 40 lbs. This effect is shown in (b) whereas the force was reduced oscillation is at a very unacceptable rate.

The amazing item in Figure 20 is in (a) when a 10 lb. pull force is applied, the push force required dropped to 3 or 4 lbs. and is free from oscillation. This means that a 75 lb. push force with a bad resulting feeding condition has been replaced with a 15 lb. combined push-pull resulting in an excellent feeding condition.

EFFECT ON WELDING WIRE - LINEAR PUSH-PULL

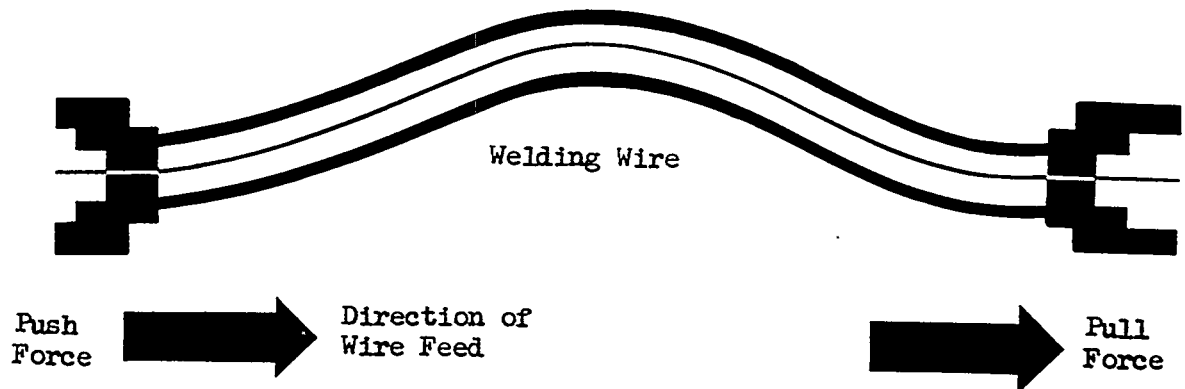


FIGURE 16

CHART - WIRE FEED SPEED VS. DRIVE ROLL SURFACE

WIRE FEED SPEED		LOAD ON WIRE		REMARKS
IN/MIN	CM/MIN	LB.	KILOGRAM	
280	711	0	0	
278	706	5	2.27	
275	698	10	4.54	All drive rolls treated
273	693	15	6.80	
270	686	20	9.07	
265	673	25	11.33	
280	711	0	0	
278	706	5	2.27	
275	698	10	4.54	All drive rolls untreated
255	645	15	6.80	
205	521	20	9.07	
110	280	25	11.33	

FIGURE 17

CHART - FORCE VS. GUN CABLE LOOPS

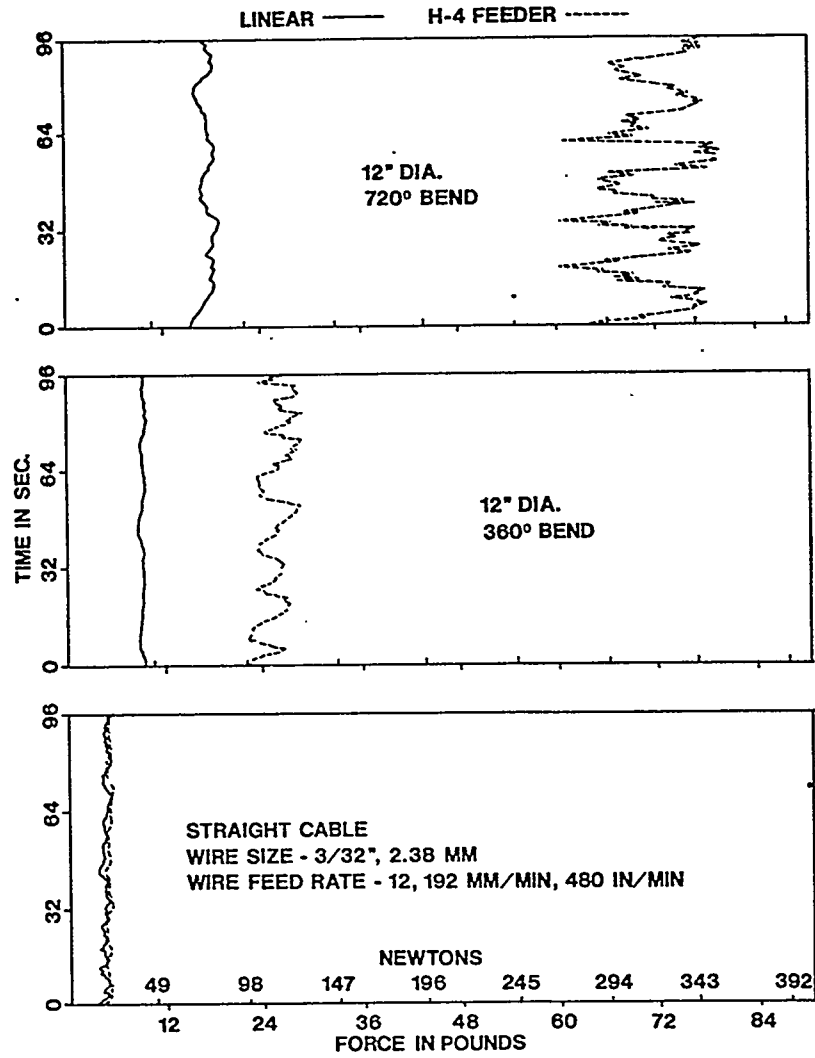


FIGURE 18

DRIVE ASSEMBLY BALANCING EFFECT

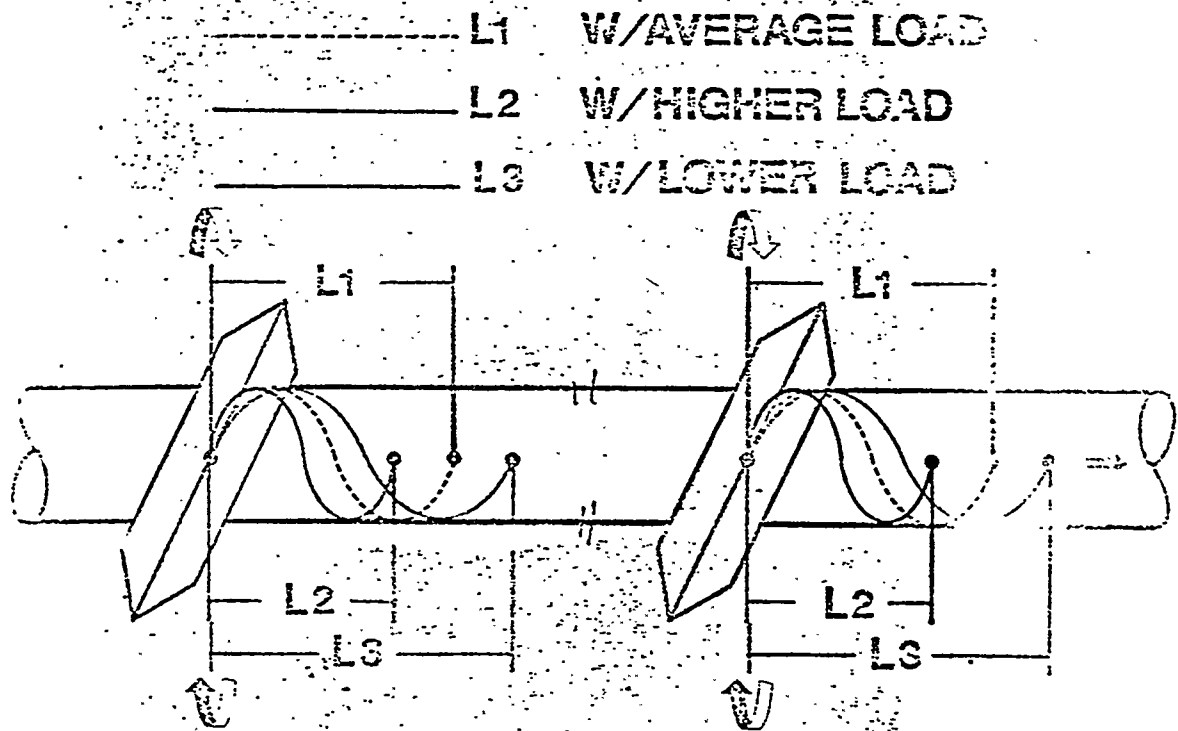
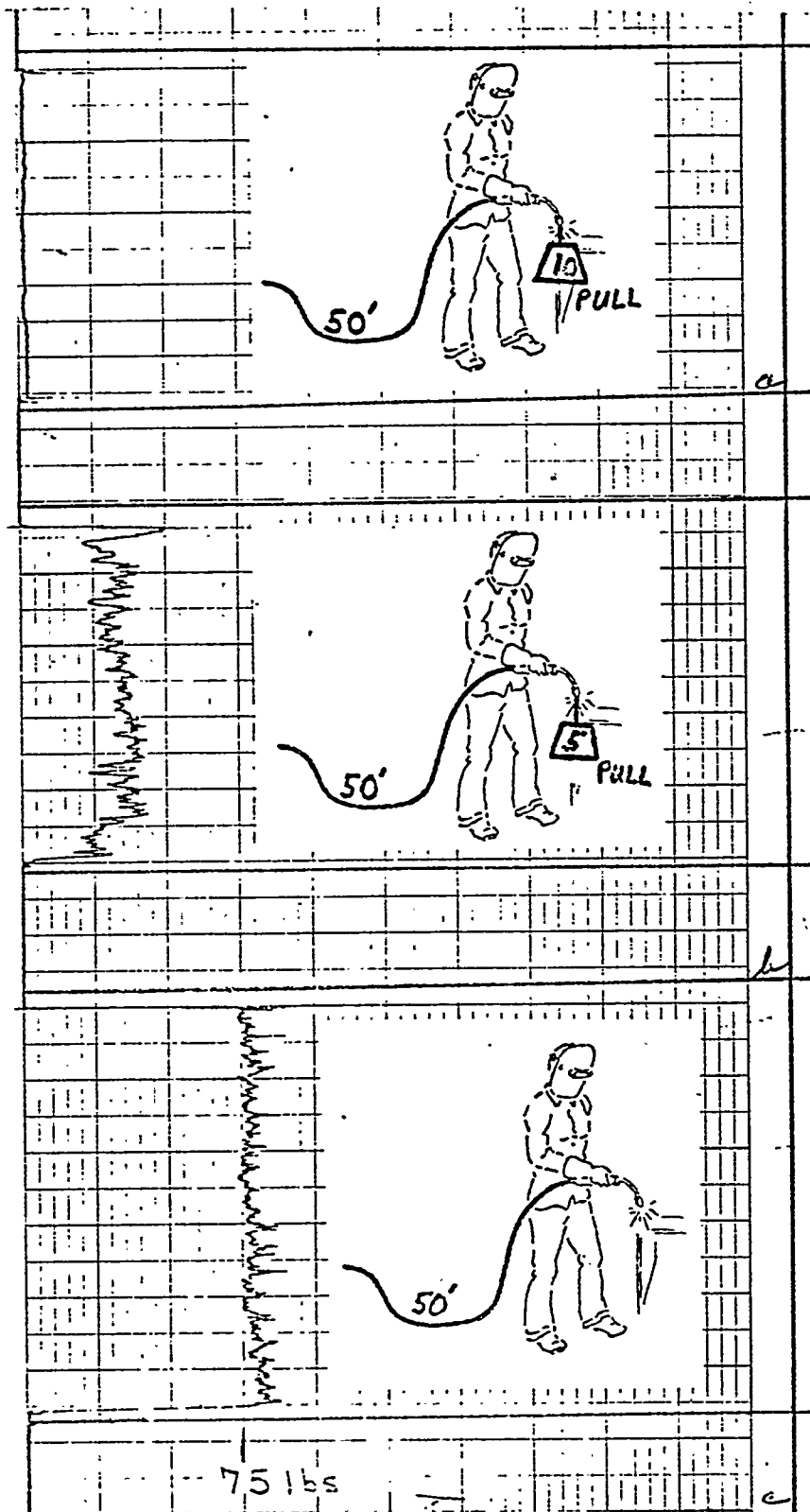


FIGURE 19

CHART - EFFECT DUE TO INCREASE PULL FORCE



PUSH-PULL EFFECT TYPICAL DATA

FIGURE 20

CHAPTER II

LINEAR WIRE FEED SYSTEM

ENGINEERING TEST DATA

Included in this section of the report are selected test data concerning the linear wire feed systems. In Chapter II of this report under the section "System Feed-Speed Characteristics" are listed Figures 9 and 10. Figures 17 and 18 and 20 are found in the section entitled "Self-Balancing Concepts". These figures as listed will also be referred to in this section on Engineering Test Data. Additional test data Figures 21 through 27 are included in this section Engineering Test Data. The following will be a description of those above mentioned figures appearing as test data along with pertinent descriptions of that test data:

Figure 9 -- As described in System Feed Speed Characteristics, illustrates the relationship of the various drive rolls and their loading methods of reference to the theoretical wire feed speed line of the 30° roller arm. With a drive system giving us 100% efficiency, we would have a resulting wire feed speed line coinciding with the theoretical feed line.

Figure 10 -- As described in System Feed Speed Characteristics, shows the relationship to the armature RPM of the linear motor and the load as it relates to a control panel built with both a solid state control with a speed biased circuit provision and that of a control panel built with electromechanical variable transformer control. It should be noted that the biasing of the solid state control can be set to overcome the normal RPM drop due to increased leading through the most common usable speed range of that motor.

Figure 17 -- As described in Self-Balancing Concept, lists the wire feed speed change in inches per minute due to an increased load on the welding wire. This was done for both the smooth drive rolls and for drive rolls that had treated OD to increase the co-efficient of friction. It should be noted that the increased efficiency or lack of slippage due to this drive roll treatment is extremely important. In both cases, the inches per minute was 280 with zero pounds and dropped to 110 inches per minute for 25 pounds on the untreated drive rolls, but maintained a good 265 inches per minutes with 25 pounds on the treated rolls. The conclusion is that there was an unacceptable amount of slippage between the drive rolls and the welding wire on the untreated drive rolls.

Figure 18 -- As described in Self-Balancing Concept, indicates the loading on a standard automatic system and a linear system due to the increase in total degrees bend in-the feed conduit.

Figure 20 -- As described in Self-Balancing Concept, illustrates the effectiveness of a slight pull in relationship with a push system.

Figure 21 -- Illustrates the effect of various feed rolls and the method of applying force to those rolls as it applies to the linear system Model 5710. The companion graph can be found in Figure 9 for the Model 5709. In comparing Figures 9 and 21, it is noted that there is less variable due to feed roll treatment in the larger drive roll as found in Model 5710 than on the smaller drive roll as found on 5709. This is due to the line of contact on the welding wire is much greater in Figure 21 than it is in Figure 9.

Figure 22 -- Is a chart which shows the welding performance when using various sizes of 200-foot welding cable. The object of this test was to determine the voltage drop due to the 200-foot welding cable and how it affected the welding arc.

Figures 23, 24, 25, 26, and 27 were tests conducted to determine the slip angle and the efficiency of the various sizes and types of drive rolls used in developing both Models 5709 and 5710.

GRAPH - WIRE FEED SPEED VS. RPM MODEL 5710

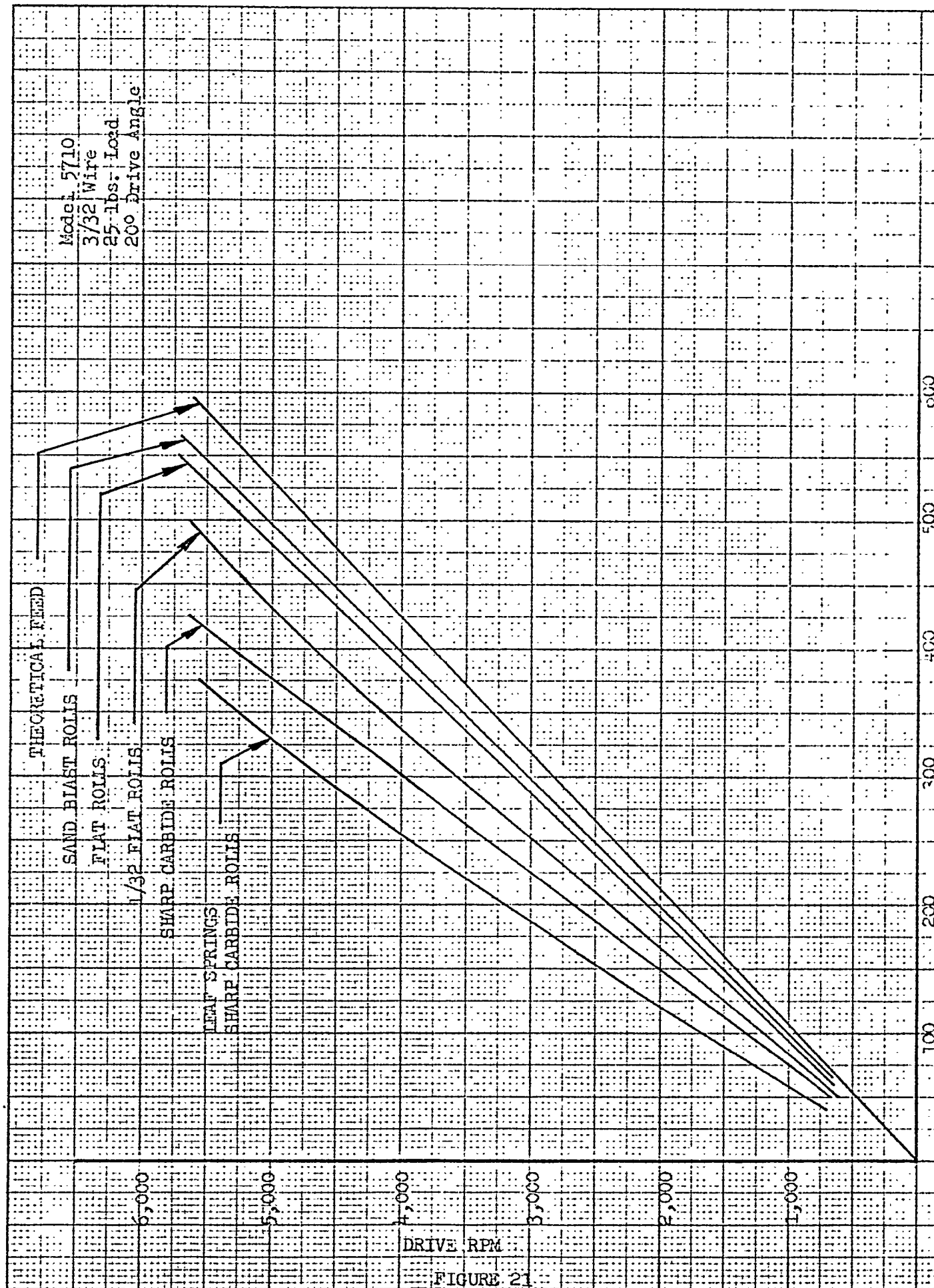


FIGURE 21

CHART - WELDING CABLE VOLTAGE DROP

WELDING CABLE	POWER SOURCE TAP	POWER SOURCE VOLTAGE	ARC VOLTAGE	SPATTER	STABLE ARC	WELD CURRENT	WIRE TYPE	WIRE SIZE	ARC START
200' - 2/0	High	27	20.5	C	Poor	400	81	3/32	Fair
200' - 2/0	High	35	28	B	Good	400	81	3/32	Good
200' - 2/0	Low	29	22	C	Poor	400	81	3/32	Good
200' - 2/0	Low	33	26	B	Good	400	81	3/32	Good
200' - 2/0	Low	35	28	B	Good	400	81	3/32	Good
200' - 2/0	Low	47	37	B	Good	550	81	3/32	Good
200' - 2/0	Low	47	28	C	Fair	550	81	3/32	Good
200' - #1	Low	42	28	B	Good	400	81	3/32	Good
200' - #1	Low	48	33	B	Good	400	81	3/32	Good
200' - #1	Low	34	23	C	Fair	400	81	3/32	Fair
200' - #1	Low	36	27	B	Good	330	71	1/16	Good
200' - #1	Low	30	22	C	Fair	330	71	1/16	Poor
200' - #1	Low	40	30	B	Good	330	71	1/16	Good
200' - #1	Low	38	29	B	Good	300	28	.045	Good
200' - #1	Low	32	22	C	Poor	300	28	.045	Fair
200' - #1	Low	38	29	B	Good	300	28	.045	Good
200' - #1	Low	28	23	B	Good	175	28	.035	Poor
200' - #1	Low	28	23	B	Good	175	28	.035	Poor
200' - #1	Low	32	27	C	Fair	175	28	.035	Fair

FIGURE 22

GRAPH - LOAD VS. SLIP ANGLE MODEL 5710

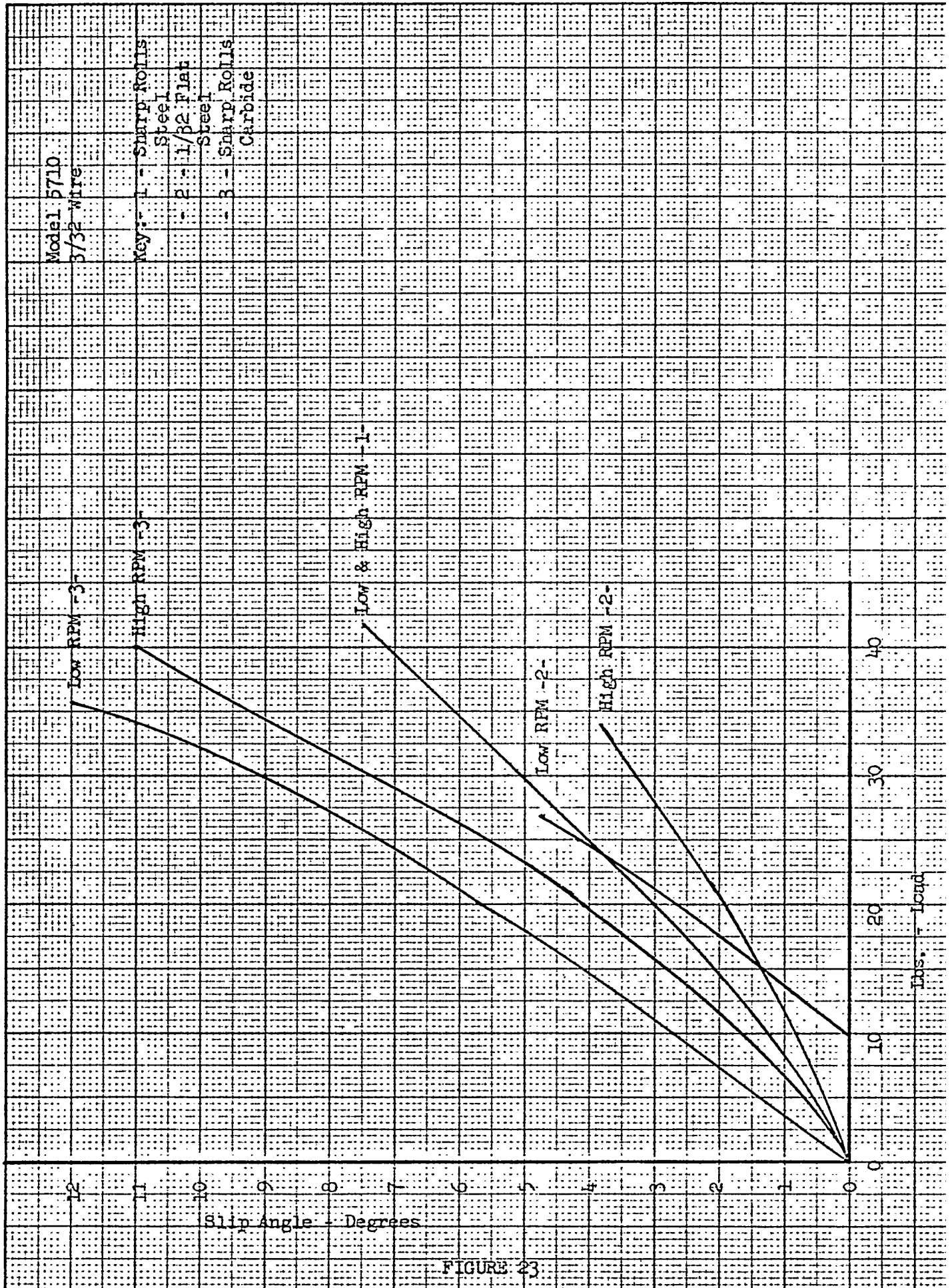
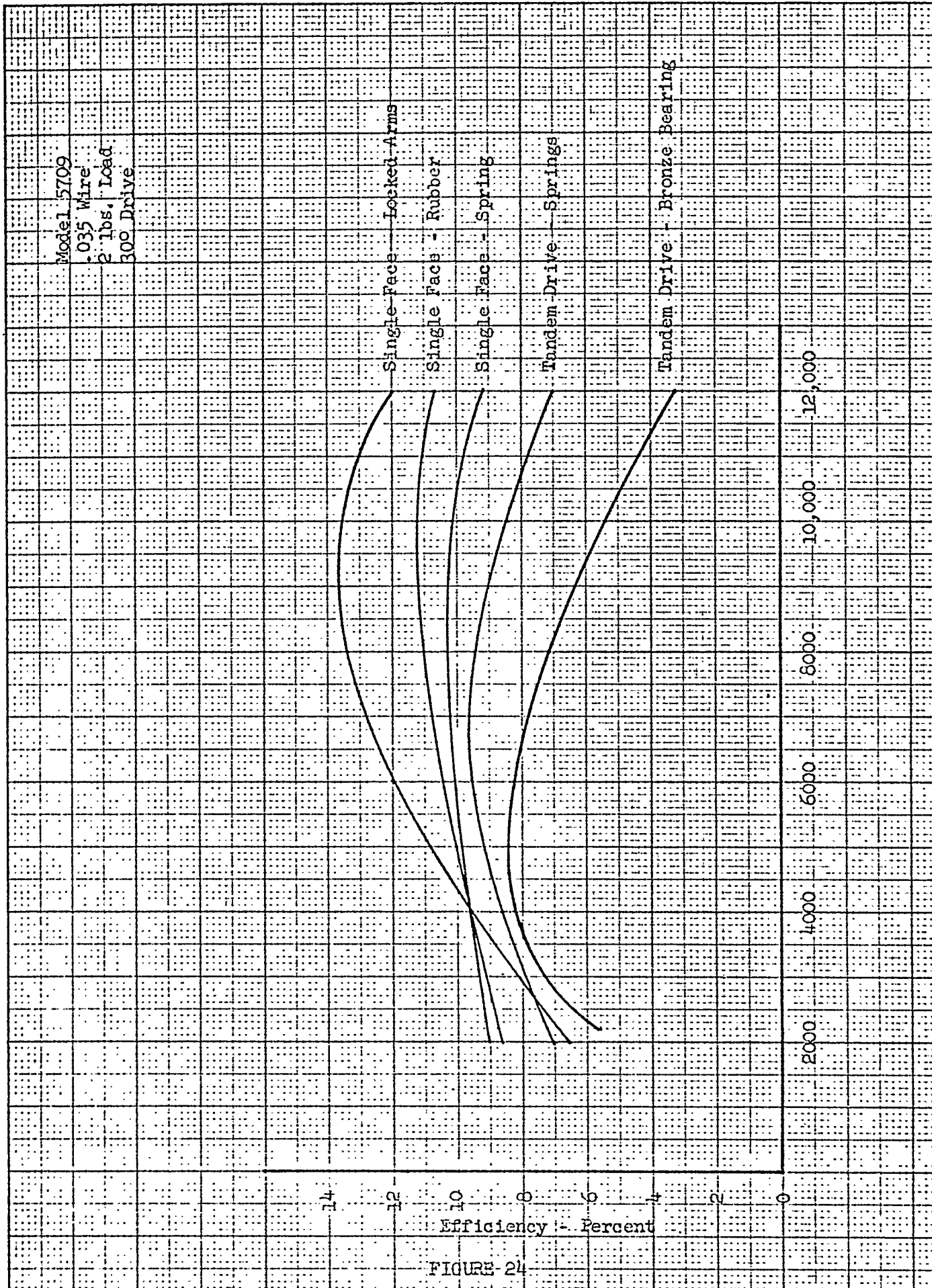


FIGURE 23

GRAPH - RPM VS. EFFICIENCY MODEL 5709



GRAPH - RPM VS. SLIP ANGLE AND EFFICIENCY MODEL 5710

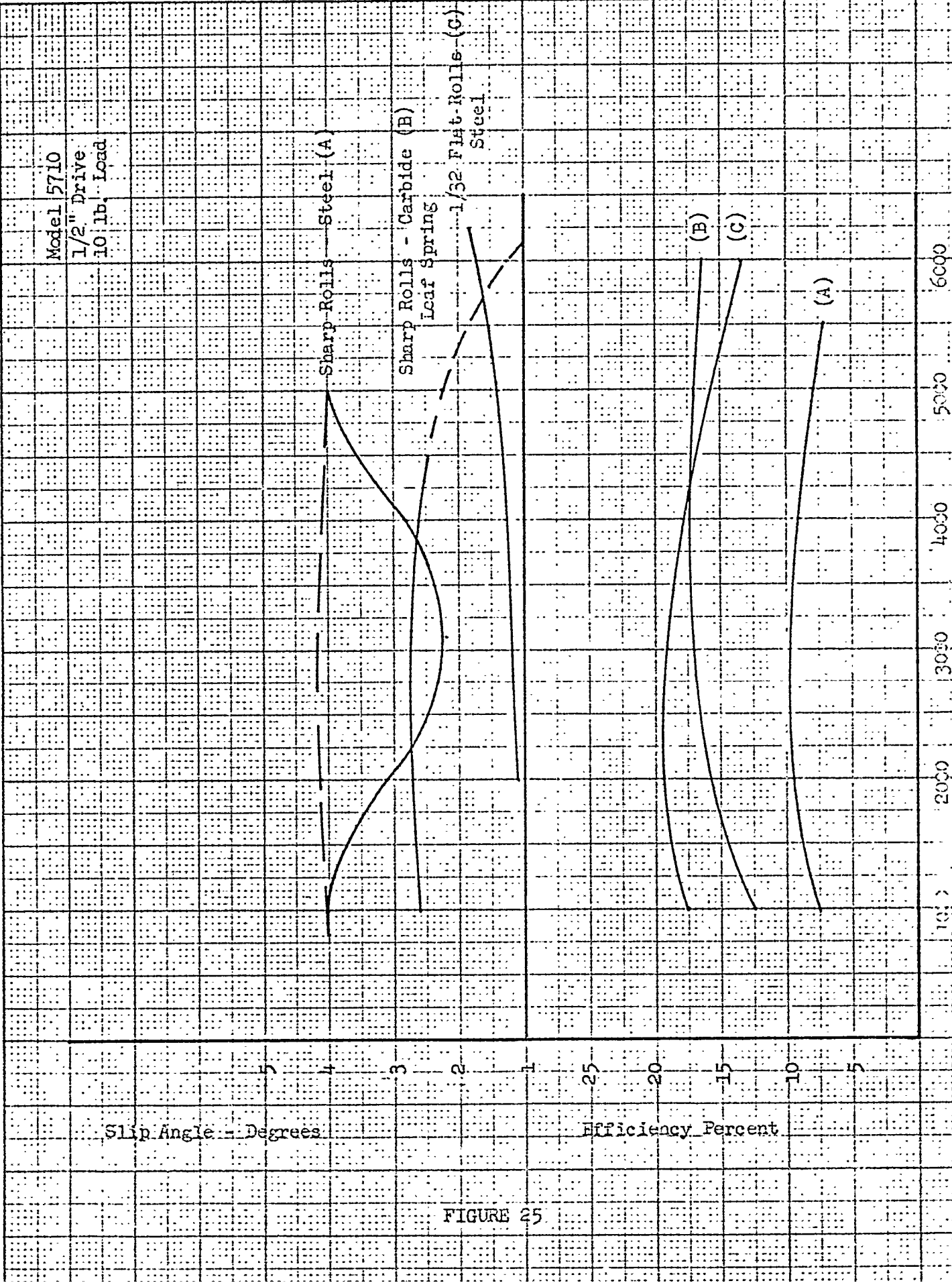


FIGURE 25

GRAPH - RPM VS. SLIP ANGLE AND EFFICIENCY MODEL 5710

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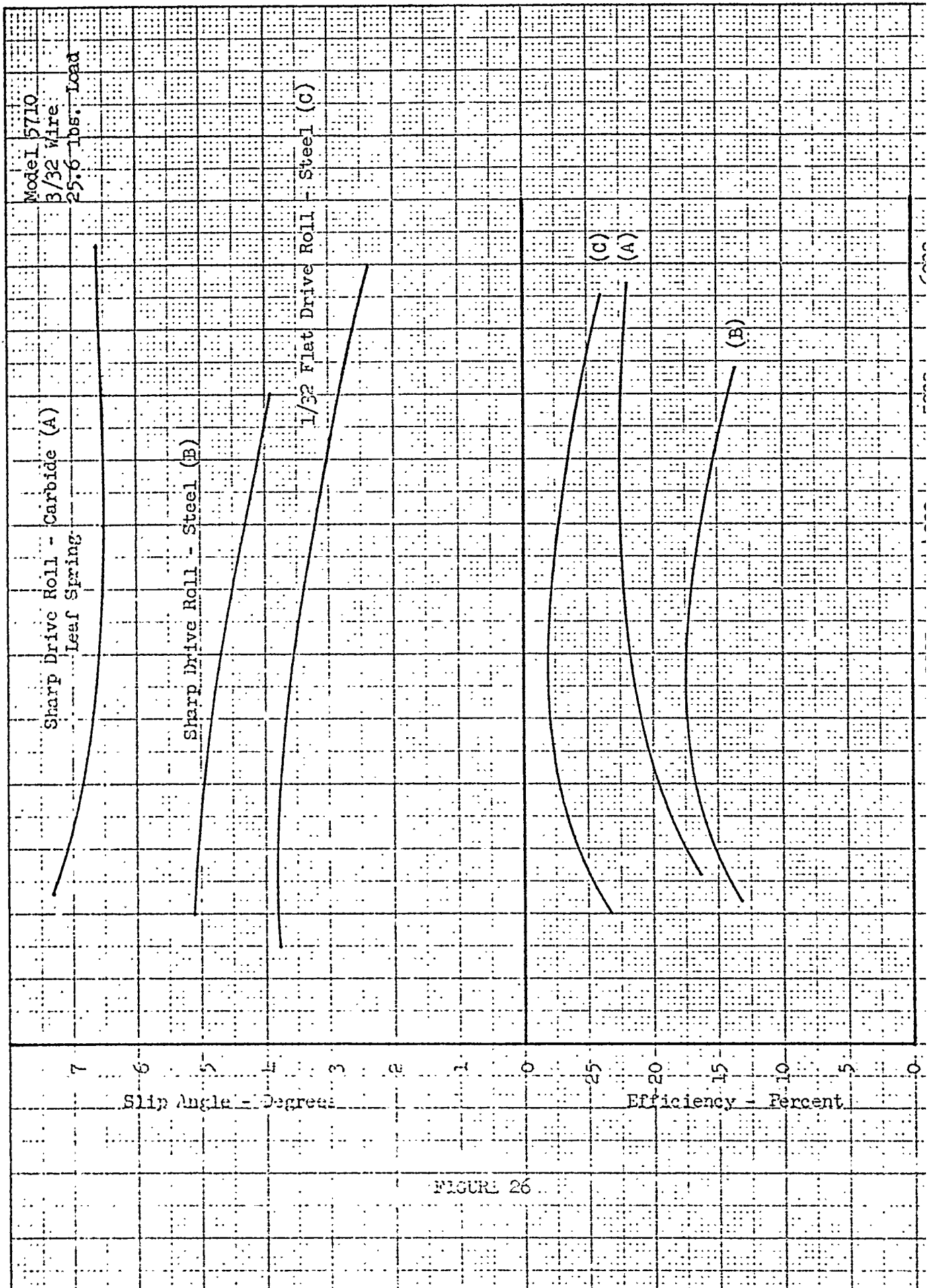


FIGURE 26

GRAPH - SMOOTH ROLLS VS. SAND BLASTED FINISH

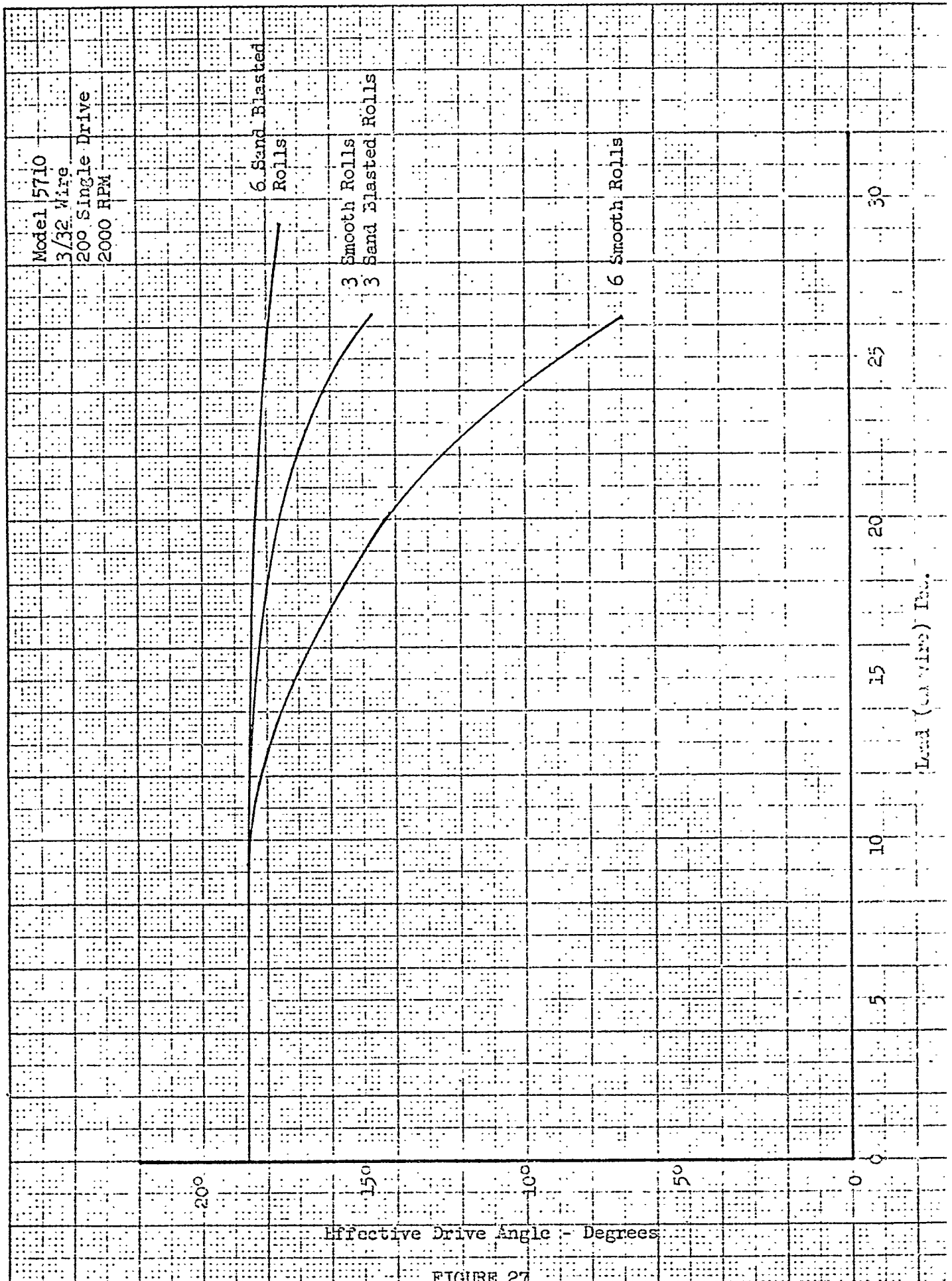


FIGURE 27

CHAPTER III

WIRE FEED SYSTEM - MODEL 5709

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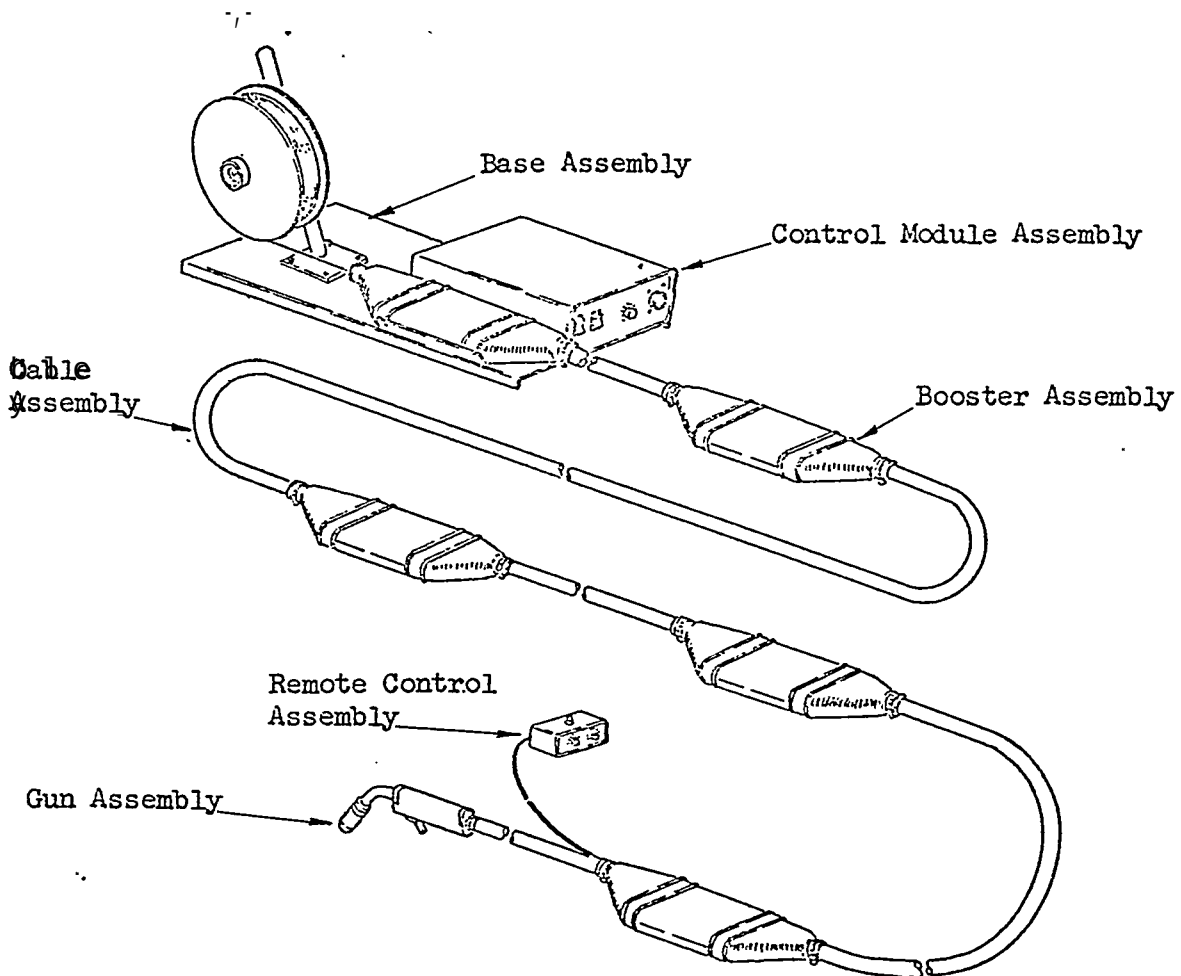
CHAPTER III

WIRE FEED SYSTEM - MODEL 5709

GENERAL INTRODUCTION

The Model 5709 Linear Wire Feed System is usable to feed steel welding wire (.035 and .045 diameters) up to 210 feet.

The Model 5709 Linear Wire Feed System is completely described in View 1. The system comes standard equipped with wire drive assemblies for .035 diameter wire. Optional wire drive assemblies for .045 diameter wire are included, and can be interchanged with those wire drive assemblies in each booster assembly.



VIEW 1

Model 5709 is made up of six (6) basic assemblies:

- Ease Assembly
- Control Module Assembly
- Booster Assembly
- Cable Assembly
- Gun Assembly
- Remote Control Assembly

The following notes describe the general function of the above six basic assemblies:

- (1) Base Assembly -- The base assembly is equipped with both a spool adapter (25 pound Spool) and wire reel adapter (60 pound coil).
- (2) Control Module Assembly -- Control module assembly is bolted to the base assembly. This unit is connected to the power source and booster assemblies by control cables only. Therefore, the control module assembly can be relocated from the base assembly by adding the proper extension cables.
- (3) Booster Assembly -- The booster assembly is shipped equipped with a wire drive assembly for .035 diameter wire (30° roller arm). Optional wire drive assemblies for .045 diameter wire (20° roller arm) are included as replacement in the booster assembly.
- (4) Cable Assembly -- The cable assembly is 50 feet long built with a power cable having a copper equivalent of a #2 cable. This cable has a plastic tube inner core through which the welding wire moves between boosters. The welding ampere rating of this cable assembly is 250 amps. Two optional cable assemblies are available, one having a copper equivalent of a #2 cable with a steel inner core, with a rating of 250 amps; and a second cable assembly having a copper equivalent of a #1 cable with a steel inner core, with a rating of 400 amps.

- (5) Gun Assembly -- The gun assembly is that portion of the system from the last booster to the welding are. The gun assembly is built using Hobart Brothers Model GA-400 gun handle assembly and a 10-foot #2 cable.
- (6) Remote Control Assembly -- The remote control assembly is a device which attaches at the gun to booster connection, to control the welding current, welding voltage and purge the gas lines. The remote control assably will clamp onto the gun cable near the handle or be equipped with magnet to allow the welding operator to locate this unit nearby. With this device, the operator can have full control of wire feeder and power source while located some 200 feet away.

CHAPTER III

WIRE FEED SYSTEM - MODEL 5709

WELDING TEST DATA

Test performed by Hobart Brothers Welding Procedure Laboratory.

Evaluation Test:

Objective of test: To run a vendability and feedability evaluation of the Model 5709 Linear Wire Feed System using solid wire.

Brief description of test: Using the remote control (amperage and voltage) amperage and voltage settings were noted at power source. Also using local wire feed control at feeder, settings were checked. Welds were made to determine voltage drop from power source to arc. Minimum and maximum wire feed speeds were noted. Test was made using .035 HB-25 wire using CO₂. The power source was an RC- 500 ar RC-750 variation 3.

Electrical Performmce:

Electrical performance was satisfactory. All controls worked very well with no problems encountered.

Mechanical Performance:

The control console is equipped on the front with a wire feed speed control, gun cable control receptacle, off-on switch and an inch-purge switch. The rear of control console hasa CC/CV selector switch, touch start switch, forward-reverse wire feed switch, local-remote control switch, power source receptacle, voltage reference jack, run in speed control, gas receptacles, and a wire drive assembly. A 15-minute weld was made to determine voltage loss after cables were warm. Weld was made at 180 amps. No voltage loss was recorded in the 15 minutes of welding. Welds were made using a range of amperages from 120 amps to 180 amps; these are usable amperages. We found a voltage drop of 11. volts from power source to the

arc. Example: 150 amps and 33 volts at power source and 150 amps 22 volts at the arc. The open circuit voltage was checked at power source, 44 volts, and at the gun it was 44 OCV. Threading wire through unit was no problem as long as cable is reasonably straight and you cut wire on a 45° angle or relatively close to that. The remote control worked very well as the local wire feed control.

Conclusions:

This Model 5709 wire feeding system will run 0.35 HB-25 solid wire 210' satisfactorily. A power source of adequate size should be used because of the voltage drop from power source to arc of 11. volts . The remote voltage and amperage control works satisfactorily in all settings. This linear wire feed system will a .035 diameter hard wire 210' satisfactorily.

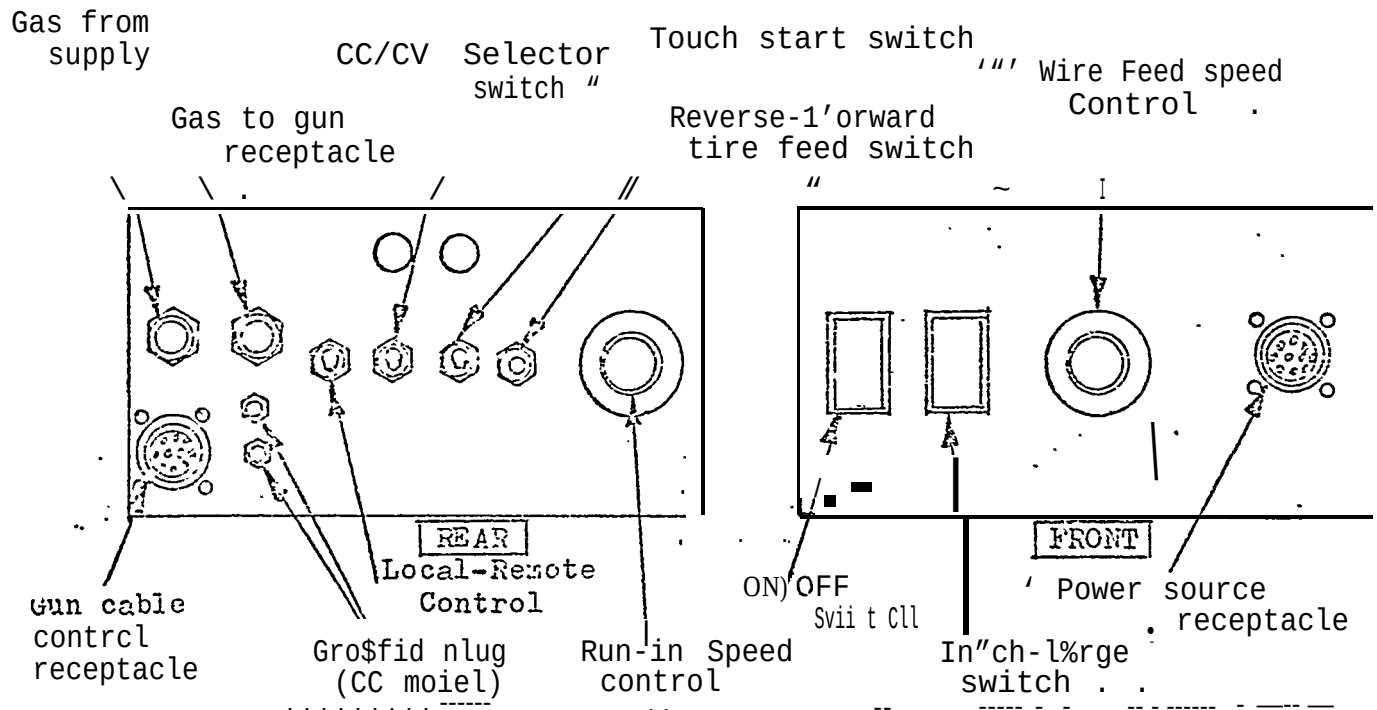
CHAPTER III

WIRE FEED SYSTEM - MODEL 5709

CONTROL DEFINITION

The controls, connectors, and receptacles used to operate and control the Model 5709 wire drive system are located on the front and rear panels of the control module. See View 1.

A. CONTROL MODULE ASSEMBLY



Rear and Front Panels of
Control Module

View 1

" Component Functions of the Control Module

(1) Wire Feed Speed Control (on front panel)"

The red knob located in the center of the panel is on the potentiometer which controls the speed at which the welding wire will travel through the

wire drive modules. To increase the speed, turn the knob clockwise, and to decrease the speed, turn it counterclockwise. See (5) below.

(2) ON/OFF Rocker Switch (on front panel)

Controls the 110-volt AC input circuit, applying or removing power supply to the unit. Red indicator light in the center of the switch will glow when the switch is ON.

(3) INCH/PURGE Rocker Switch (on front panel)

Pushing in on the INCH side (top) of the rocker switch will cause the welding wire to advance through the wire drive module(s), through the cable and thence through the welding gun. Wire will feed as long as the rocker switch is held in the INCH position. INCH speed is preset, and will not change by regulating the wire feed speed control (1), above.

Pushing in on the PURGE (bottom) side of the rocker switch will cause shielding gas to flow for as long as the switch is held in the PURGE position.

(4) LOCAL/REMOTE Switch (on rear panel)

When a remote wire feed speed control is used, this switch must be in the REMOTE position to allow the remote gun feed control to be used to regulate the wire feed speed. Otherwise, be sure that the switch is in LOCAL position.

(5) CC/CV Switch (Constant Current/Constant Voltage) (on rear panel)

In CV position, feed motors operate at a constant speed, selected by the wire feed speed control. It is used when welding with (CV) constant voltage power sources.

In CC position, the wire, the wire feed speed is controlled by arc voltage. The wire feed speed control selects the arc voltage. It is used when welding with constant current power sources.

NOTE: The voltage reference wire must be plugged in and connected to the WORK before the wire feed system will operate.

(6)' TOUCH START Switch (on rear panel)

To be used in conjunction with CC/CV switch for CC welding. Before the arc is struck, with touch start ON, wire feed speed can be set with the RUN-IN speed control. After the arc is struck, control shifts to wire feed speed, control automatically.

(7) REVERSE/FORWARD Switch (On rear panel)

The position of this switch determines the direction in which the wire will feed when the gun switch or the INCH switch is depressed. It is a three-position switch. See below:

In FORWARD position - Wire will feed forward from gun.

In CENTER position - Wire will not feed either way.

In REVERSE position - Switch must be held, and INCH switch depressed at the same time.

(8) RUN IN Speed Control (on rear panel)

Sets the initial wire feed speed for touch starts. Speed can be set from 0 to approximately 255 of maximum speed.

(9) Nameplate (on rear panel)

Shows specification (SPEC) number (S-5709) and serial number of particular linear wire feed system).

Connections to Control Module (view 1)

(1) Power Source Receptacle (on front panel)

A control cable from the "control" receptacle on the power source connects here. This cable and plug assembly contains the control wires for the

welding contactor, and also the power cable for the 110-volt AC power supply for the operation of the printed circuit board and its control functions, and the wire drive assembly.

(2) Gas supply Connection (on rear panel)

Inlet gas supply to the solenoid valve. This valve is controlled by the PURGE switch, either from a remote control or on the enclosure controls for preflow shielding gas.

(3) Gun Cable Control Receptacles (on rear panel)

Connection point for the input cable from the wire drive module. Wire feed speed control, prepurge of shielding gas and tithing of wire through the cable and gun, as well as contactor control, is accomplished through this cable.

(4) Gas-to-Gun Connection (on rear panel)

Fitting where the gas hose to the gun is attached. Flow of gas is controlled by the solenoid valve on the inside of the control module.

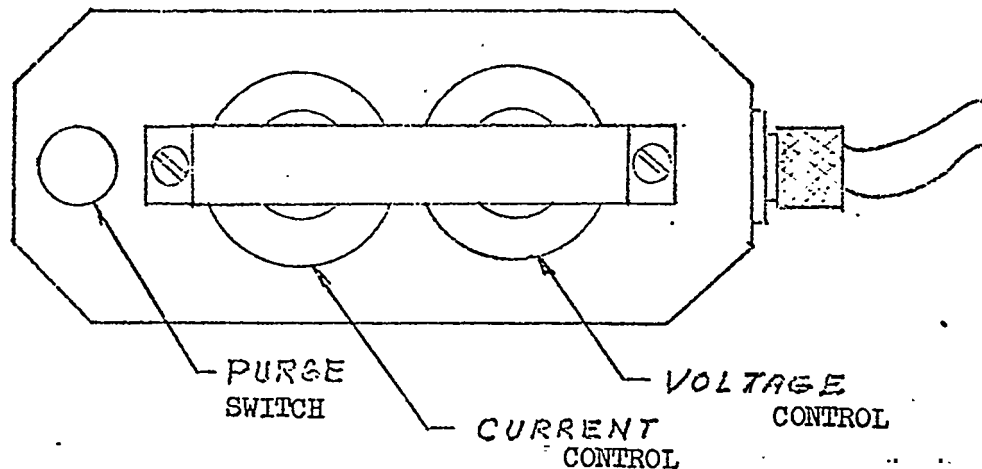
(5) Ground Plug (on rear panel)

An insulated tip plug is furnished, to which a length of 16-ga. wire must be attached, which must be plugged into the jack when the CC/CV switch is in the CC (constant current) position. Attach the other end of this wire (by clamp or some means of secure attachment) to the work (the material being welded).

CAUTION: IF THIS WIRE IS NOT ATTACHED, THE LINEAR WIRE SYSTEM WILL NOT OPERATE WHEN THE SWITCH IS IN CC POSITION. SOME (CC) TYPE POWER SOURCES DO NOT HAVE BUILT-IN CONTACTORS. AN AUXILIARY CONTACTOR SHOULD BE ADDED TO A POWER SOURCE NOT EQUIPPED WITH A BUILT-IN CONTACTOR.

B. REMOTE CONTROL ASSEMBLY

The controls and switch used to operate and control the Model 5709 wire drive system remote from the control module are located on the top of the remote control module. See View 2.



TOP OF REMOTE CONTROL MODULE

VIEW 2

Component Function of Remote Control Module

(1) Current Control (Wire Feed Speed)

The red knob of the current control is located on the top and in the center of the remote control module, View 2. The control will vary the speed at which the welding wire will travel through the wire drive modules. To increase the welding current, turn the knob clockwise, to decrease the welding current, turn it counterclockwise.

(2) Voltage Control (Welding Arc Voltage)

The red knob of the welding voltage control is located on the top and toward the end of the remote control module, View 2. The control will vary the welding arc voltage at the per source. To increase the arc voltage turn the knob clockwise. To decrease the arc voltage turn it counterclockwise. NOTE: This voltage control will operate only with the power source designed for use with the Model 5709 system.

(3) Purge Switch

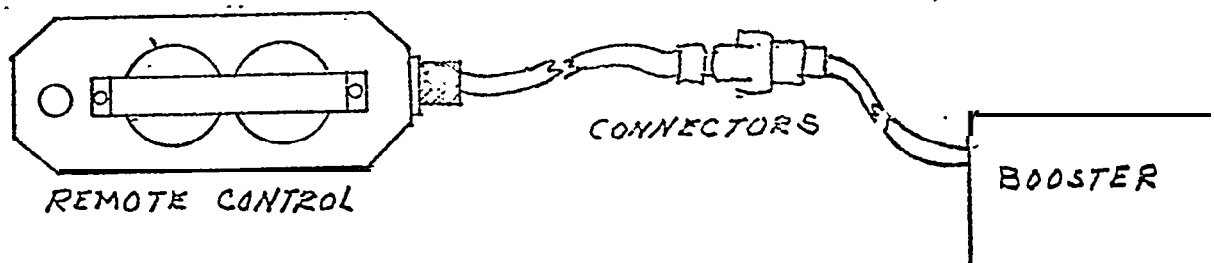
The purge switch is located in the top and to the end of the remote control module, View 2). Pushing the purge switch will cause shielding gas to flow for as long as the switch is held depressed.

(4) Inch Wire

For remote operation, close the gun switch on the welding torch to inch the wire. The welding torch should be placed in a position that will not cause the wire being tithed to strike an arc. Wire will feed as long as the gun switch is held closed.

Component Connection

- (1) The amphenol connector from the remote control module is connected to the connector of the first wire drive booster, View 2).



REMOTE VOLTAGE CONTROL

CONNECTION WITH BOOSTER

VIEW 3

CHAPTER III

WIRE FEED SYSTEM - MODEL 5709

FEED SYSTEM OPERATION

The Model 5709 wire feed system must have a wire feed liner in both the 10-foot ~~gun~~ cable as well as the 50-foot cable between booster. Both of these cables are constructed with a plastic inner core. To have proper life of these cables, a steel wire feed liner is inserted in the plastic core. The welding wire passes from the wire spool to the arc through this steel wire feed liner.

For correct operation, the wire drive assembly and contact tips must be selected for the desired diameter welding wire (either .035 or .045 diameter) being used.

Model 5709 comes equipped with both a spool mount and a wire reel mount. This allows either a 25-pound spool or a 60-pound coil of steel wire.

The Model 5709 is equipped with cable having a rating of 250 amperes. Care should be exercised to keep the welding process within the rating of the equipment.

1. Threading the Wire Through the Linear Drive Unit

NOTE: Before installing wire and threading it through the linear drive unit, determine that the drive unit is properly equipped with drive rollers to handle the wire to be fed. The size and type of wire which may be fed with a particular drive unit will be stamped on the outside of the unit. DO NOT TRY TO FEED ANY OTHER TYPE OR SIZE WIRE WITH THAT UNIT.

Proper unit for a particular wire size and type may be ordered from Hobart Brothers Company.

- A. Turn the power source ON, and the wire feeder power switch ON.
- B. Unfasten the end of the wire from the spool with care, so that it does not "get away" from you.
- C. Adjust the drag on the spool such that the spool will not coast when the drive unit stops. This may be accomplished by turning the bolt in the center of the spool clockwise to increase drag or counter-clockwise to decrease drag.

CAUTION: DO NOT TIGHTEN SPINDLE TOO TIGHTLY.

- D. Cut off the bent end of the wire to be fed into the drive unit, and remove any sharp burrs from the end of the wire after cutting it off. Cut the wire off at some angle (approximately 45°).
- E. Grasp the wire near the end with fingers or pliers, and insert the wire through the hole in the input guide. While inserting the wire, engage drives with the INCH button until the wire begins to feed through linear drive unit. Continue to INCH the wire through the unit until it appears at the nozzle of the welding gun.

II. Replacing Steel Liners (Gun Assembly)

- A. Remove gun assembly from last booster assembly.
- B. Pull out old liner.
- C. Install new liner (for part number see parts list) nominal 10-foot.
- D. Push liner in as far as possible, then pull liner back 3/16", cut liner flush with cable fitting, push liner into gun assembly.

E. Reassemble gun assembly to booster assembly.

III. Replace Steel Liners (Cable Assembly)

A. Remove cable assembly (one end) from booster assembly.

B. Pull out old liner.

C. Install new liner (for part number see parts list) nominal 50 foot.

D. Push liner in as far as possible, then pull liner back 3/16", cut liner flush with cable fitting, push liner into cable assembly.

E. Reassemble cable assembly to booster assembly.

IV. The following caution must be noted when removing wire drive assemblies from booster shells and/or disassembling wire drive assemblies. The end cap must be reassembled to the same end of the wire drive housing and the wire drive assembly fitted into the molded booster shell. with the leads in the end opposite the locating pad. Care should be taken to insure the leads being placed in the center cavity formed by the two molded booster shells. This will protect the leads from being sheared when clamping the booster assembly together.

CHAPTER 111

WIRE FEED SYSTEM - MODEL 5709

WELDING WITH THE COMPLETE SYSTEM

The first step in welding with the complete system is to properly set up the system.

The Linear Wire Feed System will be complete as shipped - Model 5709. To complete the welding system, the the following are needed:

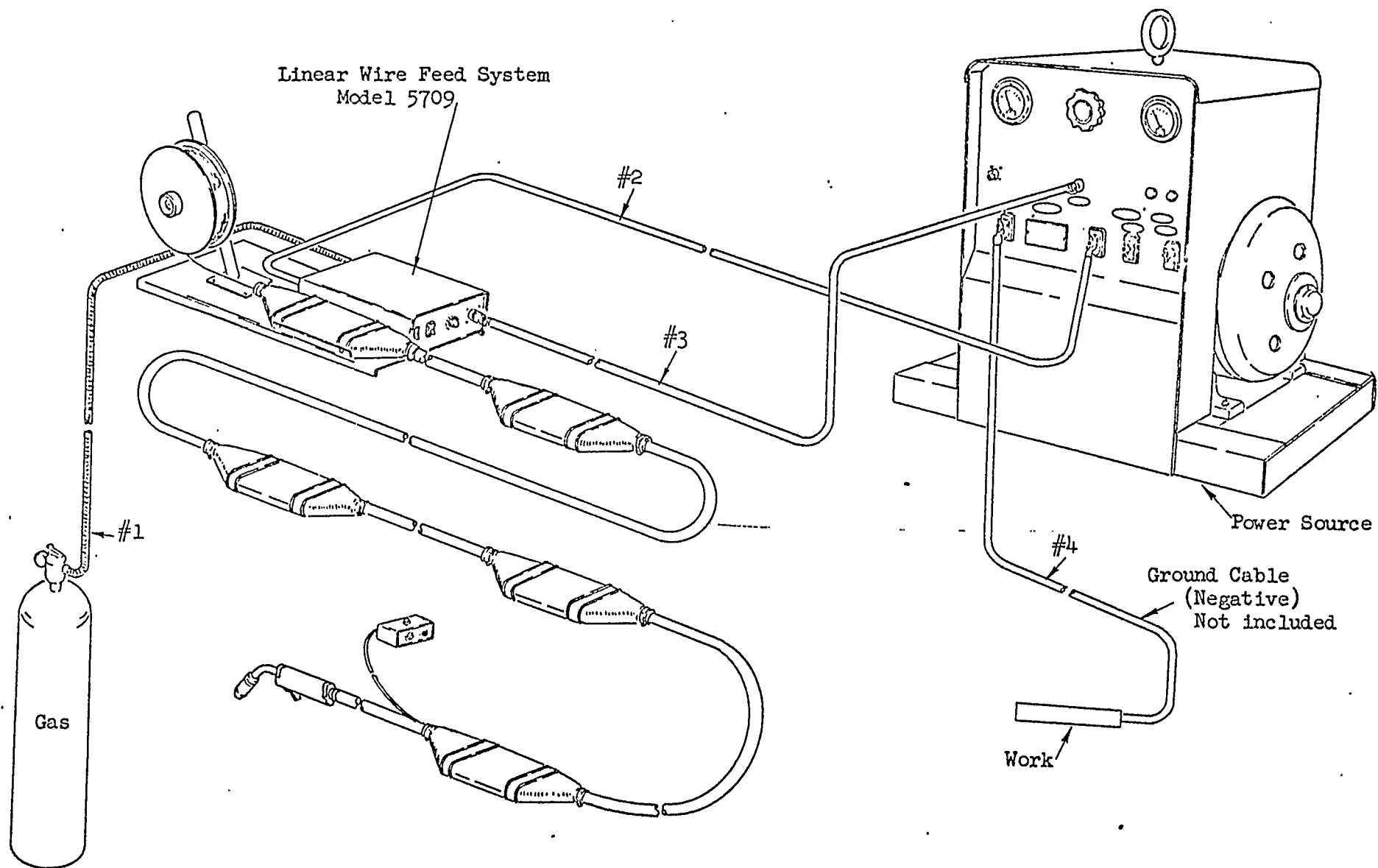
(1) Power source can either be a constant voltage (CV) power source or a constant current (CC) power source.

(a) The complete system using the constant voltage power source (CV) is illustrated in view 1 page 64. The power source can be any Hobart Brothers constant voltage power source to which the SCR voltage regulator has been added. A typical power source would be Model RC-750 Spec 4558C Var. 3. A schematic diagram to show the modification necessary from a standard power source to one with the SCR voltage control is shown in View 2 page 65.

The control cables, welding cables and gas hose as shown in View 1 and View 3 are described as follows:

<u>Item No.</u>	<u>Part NO.</u>	<u>Description</u>	
1	16DA-4577-10	Hose, Gas, Ay.	1
2	W-9234-96	Cable, Power, Ay. (10') (Electrodes)	1
3	373372	Cable, Control (10')	1
4	---	Cable, Power (Ground - Furnished - by user).	

NOTE: 1 - When using self-shielding type of welding wire, the gas supply and gas hose is not required.

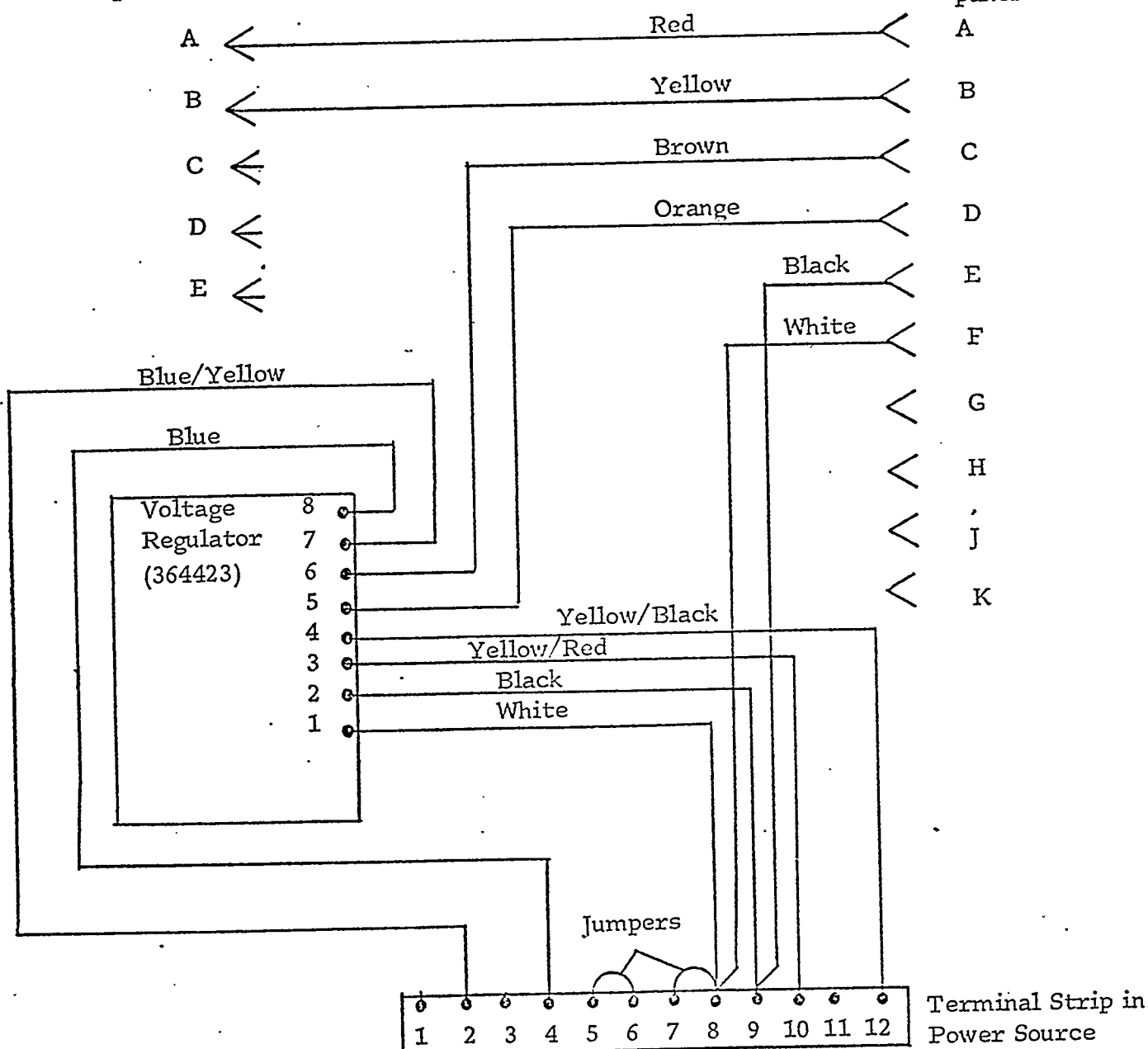


VIEW 1 - SYSTEM CONNECTION CONSTANT VOLTAGE (CV) POWER SOURCE

CONNECTION DIAGRAM FOR RC-750 (OR OTHER CONSTANT VOLTAGE) POWER SOURCE AND A VOLTAGE REGULATOR WITH 10-PIN AMPHENOL (401533) REPLACING THE STANDARD 5-PIN AMPHENOL IN FRONT PANEL.

5 Pin Amphenol Plug-to connect to 5-pin amphenol removed from front panel

10-Pin Amphenol mounted in front panel



CONSTANT VOLTAGE (CV) POWER SOURCE WITH SCR VOLTAGE CONTROL - WIRED FOR AMPHENOL CONNECTION TO FEEDER CONTROL

View 2

2 - All switches on the rear of the control module assembly to be in the CV position.

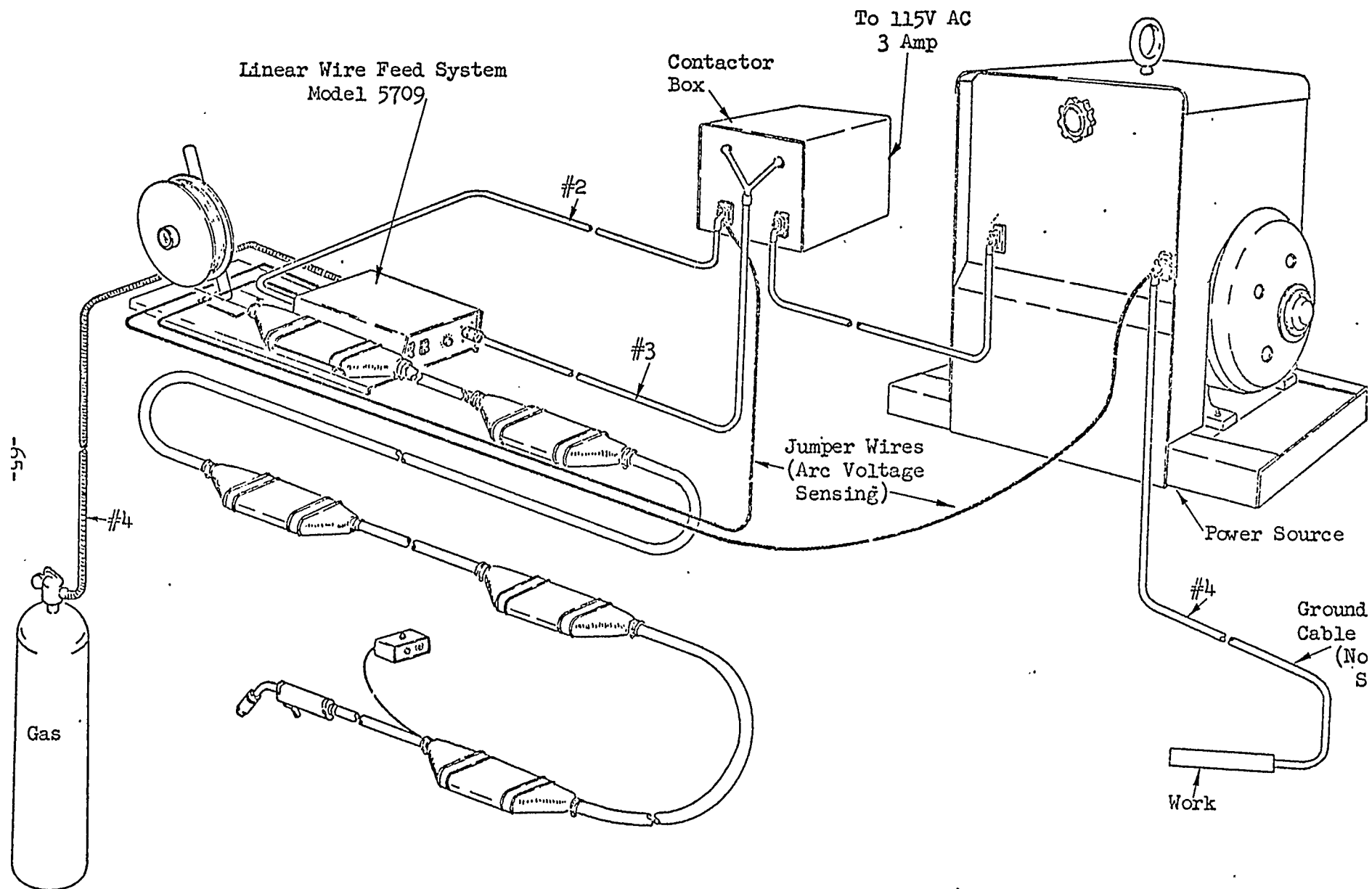
(b) The complete system using the constant current power source (CC) is illustrated in View 3 page 65 . The power source can be any constant current (CC) power source having a contactor in the welding circuit.

Most constant current (CC) power sources are not built with a contactor. In this case an auxiliary contactor, such as Hobart Brothers contactor part number 373303, should be used.

NOTE: 1- When using self-shielding type of welding wire, the gas supply and gas hose is not required.

2 - All switches on the rear of the control module assembly to be in the (CC) position.

3. Be sure one of the voltage reference jack is connected to the electrode terminal of the power source and the other voltage reference jack is connected to the ground terminal of the power source.



VIEW 3 - SYSTEM CONNECTION CONSTANT CURRENT
(CC) POWER SOURCE

Once the complete system is properly set up) the correct welding procedures be secured by referring to this proper welding guide. The following are a few pointers that should be observed:

- (1) only the welding wire diameter specified should be used in the system. For change of wire diameter, a change in wire drive assembly is necessary.
- (2) Do not exceed the rating of gun and cable assembly.
- (3) Both a wire spool assembly and a wire reel is shipped with the unit. Care should be taken not to overtighten the spindle. The proper adjustment is to adjust the drag on the spool such that the spool will not coast when the drive unit stops.
- (4) WARNING: When the gun switch is depressed, the electrode (welding wire) is electrically "hot". Do not permit it to touch any common metal ground, or a welding arc will be established.

The welding process is accomplished by the following steps:

- (1) Turn the power source and wire feeder switches "on".
- (2) Depress purge switch and adjust the flow of shielding gas to the proper value.
- (3) Adjust the voltage of the welding power source to the desired value. This can either be done at the power source or at the operator with the remote control.
- (4) Adjust the wire feed speed control to the desired welding amperage. If the amperage is not known, it is suggested that the dial be set to mid-point position, and then readjusted to increase or decrease the amperage (or welding current), which will also increase or decrease the wire feed speed

to the desired value. This can either be done at the control module or at the operator with the remote control.

- (5) Position the gun above the work piece and depress the gun switch.

CAUTION: When the wire feeder is being used in conjunction with the gas shielded or open arc processes, be careful to lower the face and eye welding shield before starting to weld.

- (6) Release the gun trigger will *cause* the wire to stop feeding, the gas to shut off and, after a fixed delay, the welding contactor to open.
- (7) When welding has been completed, or at the end of the work day, it is recommended that the gas (when used) be shut off at the tank, and the weld power source be shut off. If the unit is energized from a power source other than the welder power source, it is advisable to turn off the power rocker switch on the wire feeder.

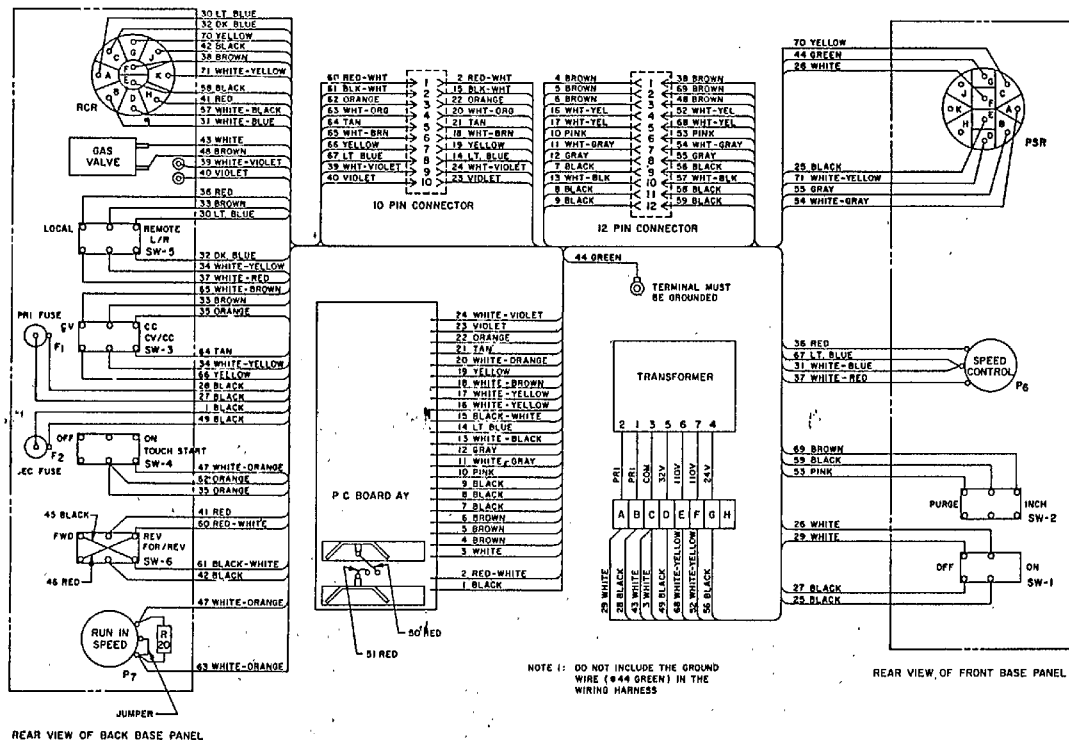
CHAPTER III

WIRE FEED SYSTEM - MODEL 5709

DIAGRAMS

Included in this section are the diagrams necessary to connect and trouble shoot the Model 5709, Linear Wire Feed System.

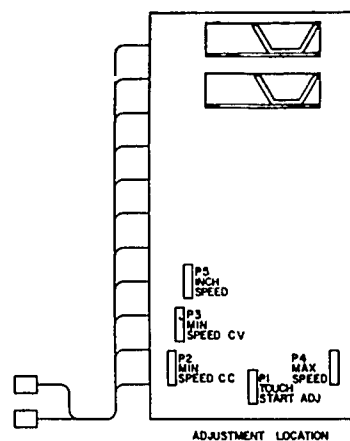
- (1) P/N 373339 Connection Diagram, Model 5709
- (2) P/N 373335 Schematic Diagram, Model 5709
- (3) P/N 373368 Outline, System, Model 5709
- (4) P/N 373370 Diagram, Power Source Conversion



PROTECTIVE FINISH				CHANGE RECORD				WHERE USED				ACTIVITY				P-1			
NO	INDEX	DATE	NO	INDEX	DATE	NEXT ASSY.	NO	USED ON	USED ON	MATERIAL NO.	MATERIAL WFC	INDEX	DATE	SCALE	REVISION	DATE	BY	QUANTITY	REMARKS
1			13			5-3709													
2			14																
3			15																
4			16																
5			17																
6			18																
7			19																
8			20																
9			21																
10			22																
11			23																
12			24																

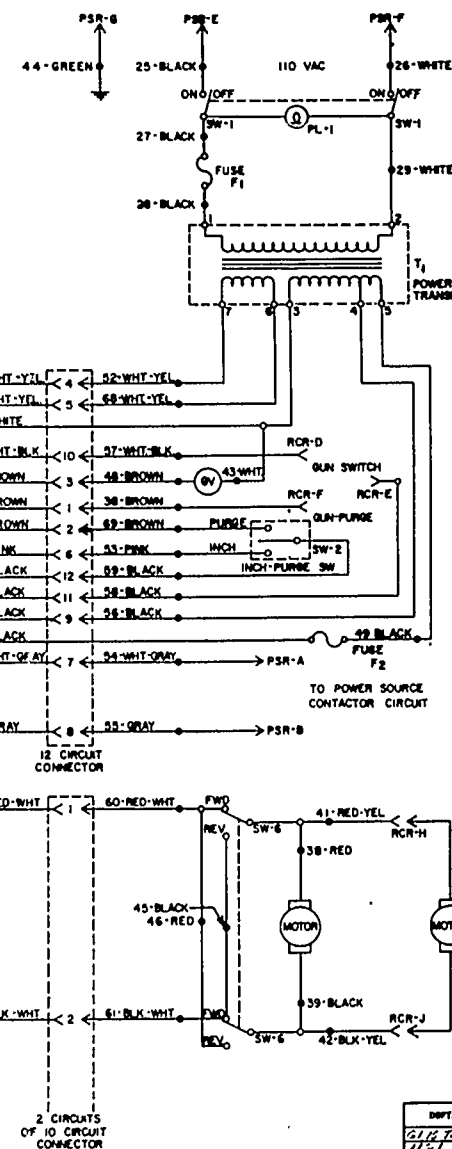
CONFIDENTIAL: This drawing, including all information contained therein, is the exclusive and confidential property of Hobart Brothers Company of Troy, Ohio, and is not to be copied, reproduced or delivered or disclosed to others, in whole or in part, except with written permission.

① PC BOARD LEAD WIRES
● AY LEAD WIRES

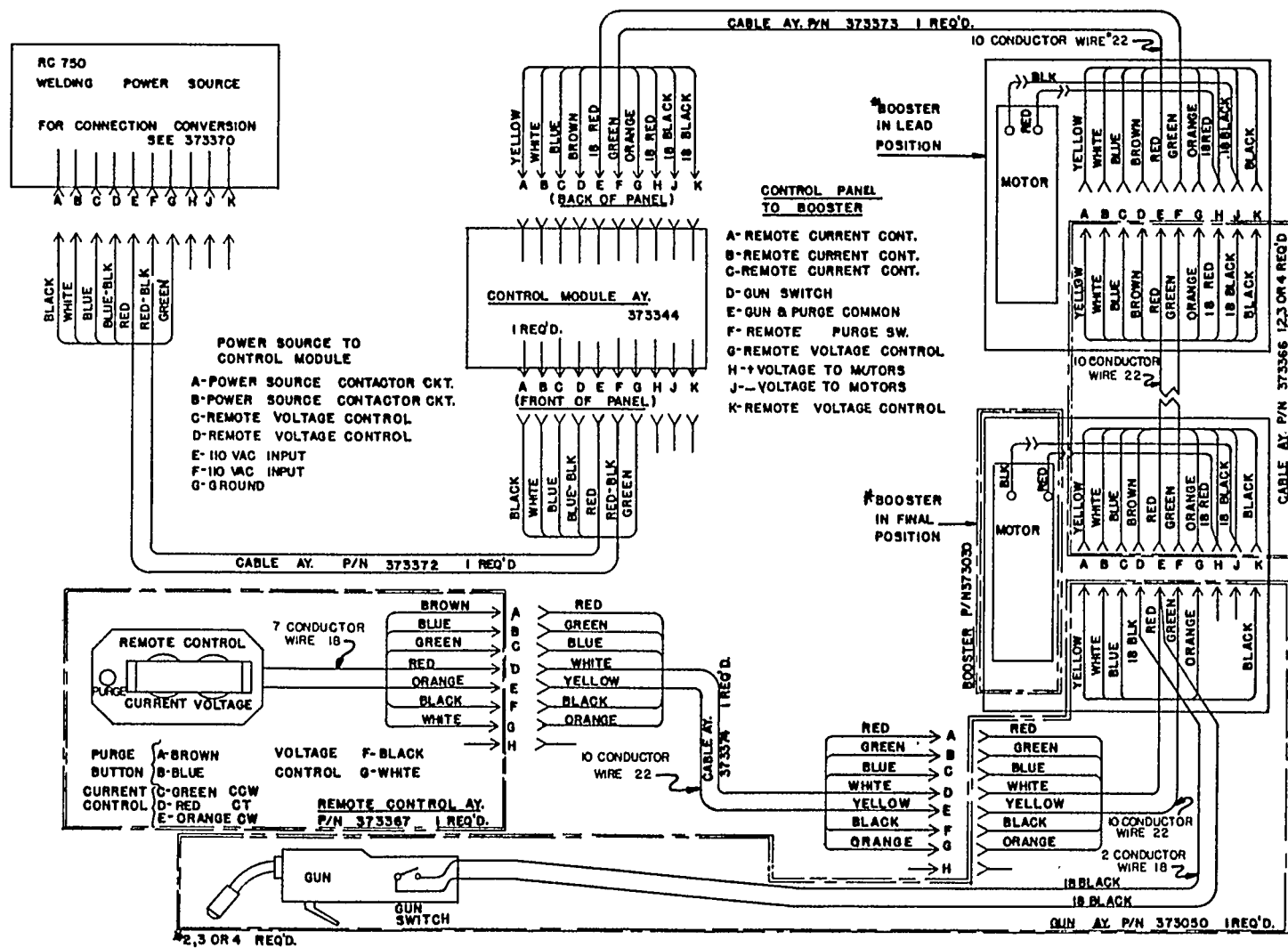


- | | |
|-------------|---------------------------------------|
| ICA,2C4 | CONTROL RELAY |
| C1 | CAPACITOR .02/100 |
| C2 | CAPACITOR .03/600 |
| C3-CA-C6 | CAPACITOR .17/100 |
| C7 | CAPACITOR 1/15 |
| C8 | CAPACITOR 6.8/35 |
| CM-C5 | CAPACITOR 25/25 |
| D1-D3 | DIODE |
| DA-D5 | DIODE POWER |
| DB, DB2 | DIODE BRIDGE |
| F1,F2 | FUSE |
| GV | GAS VALVE |
| IC1 | OPERATIONAL AMPLIFIER LM-741 |
| P1,P2,P4 | POTENTIOMETER 15K TAPM |
| P1 | POTENTIOMETER 35K TAPM |
| P5 | POTENTIOMETER 35K TAPM |
| P6 | POTENTIOMETER 10K CONTROL |
| P7 | POTENTIOMETER 5K CONTROL RUN-IN-SPEED |
| PL1 | PILOT LIGHT |
| PSR | POWER SOURCE ACCEPTABLE |
| Q1,Q2 | TRANSISTOR 2N-1303 |
| Q3 | TRANSISTOR 2N-2647 |
| R1 | RESISTOR .45 OHM 1/2 W |
| R2,R3 | RESISTOR 27 OHM 1/2 W |
| RA,R6 | RESISTOR 470 OHM 1/2 W |
| R7 | RESISTOR 1.5K OHM 2 W |
| RB | RESISTOR .25 OHM 3-1/4 W |
| R9,R11 | RESISTOR 10K OHM 1/2 W |
| R12,R15,R17 | RESISTOR 22K OHM 1/2 W |
| R18,R7 | RESISTOR 47K |
| R10,R19 | RESISTOR 47K OHM 1/2 W |
| R20 | RESISTOR IN OHM 2 W |
| RCR | REVERSE CONTROL ACCEPTABLE |
| SCR1,SCR2 | SILICON CONTROLLED RECTIFIER |
| SW1 | POWER ON-OFF SWITCH |
| SW2 | 1/2CH/PURGE SWITCH |
| SW3 | CC/CH SWITCH |
| SW4 | TOUCH START SWITCH |
| SW5 | LOCAL/REMOTE SWITCH |
| SW6 | FORWARD/REVERSE SWITCH |
| T1 | TRANSFORMER, POWER |

- ```
T2 TRANSFORMER, PULSE
Z1 ZENER 22 V
Z2 ZENER 6 V
```



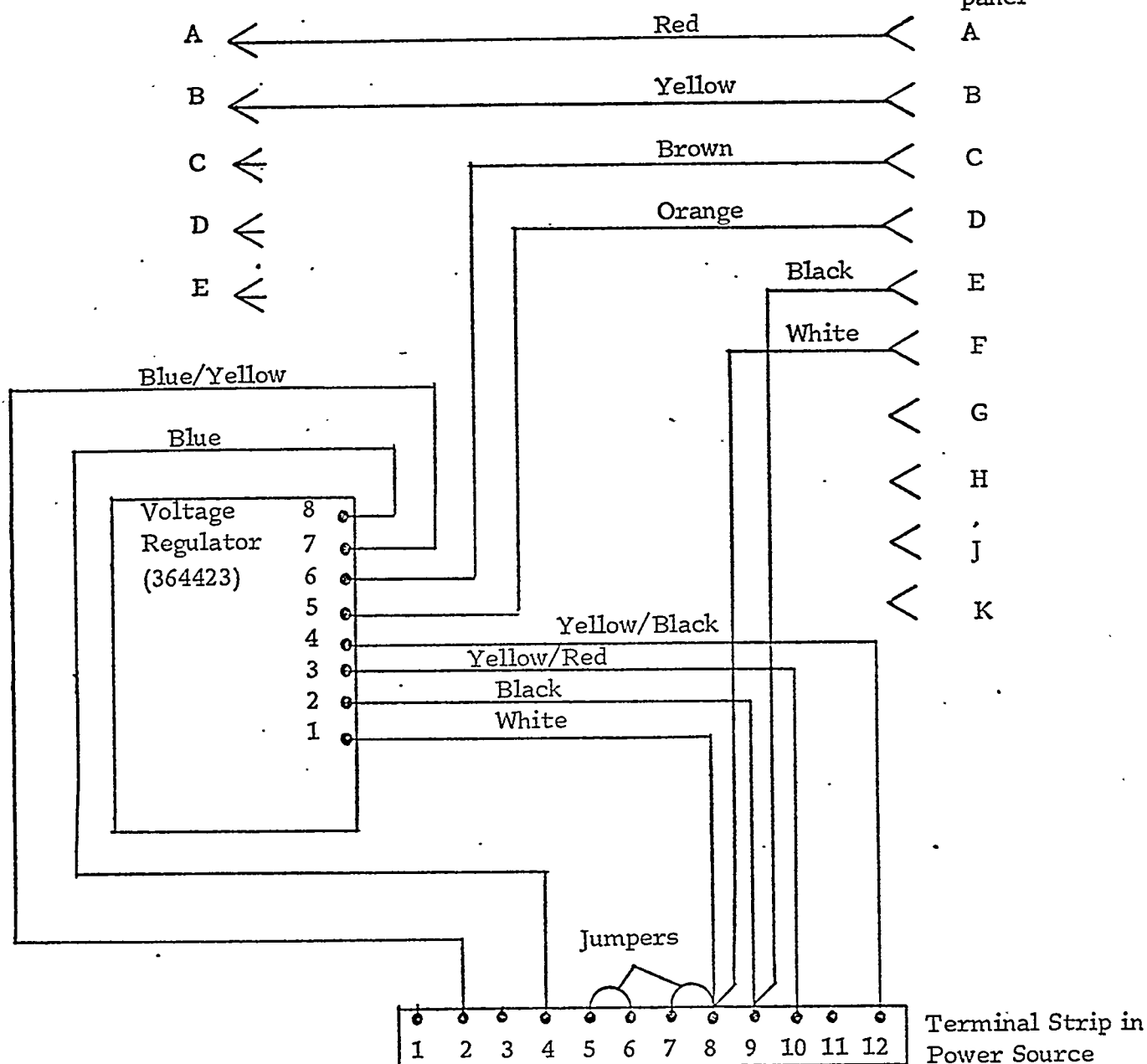
|                               |       |      |     |       |      |            |        |     |           |                          |  |                 |  |
|-------------------------------|-------|------|-----|-------|------|------------|--------|-----|-----------|--------------------------|--|-----------------|--|
| PROTECTIVE FINISH             |       |      |     |       |      |            |        |     |           | M                        |  | ACCESS NO. 1130 |  |
| CHANGE RECORD                 |       |      |     |       |      | WHERE USED |        |     |           | REPLACED BY<br>NPL/AGITE |  |                 |  |
| NO.                           | INDEX | DATE | NO. | INDEX | DATE | SPEC       | MODEL  | REQ | NEXT ASBY | MATL. NO.                |  |                 |  |
| 1                             |       |      | 13  |       |      | ST03       | LINEAR | 1   |           | MATL. NO.                |  |                 |  |
| 2                             |       |      | 14  |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| 3                             |       |      | 18  |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| 4                             |       |      | 19  |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| 5                             |       |      | 20  |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| 6                             |       |      | 21  |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| TITLE DIAGRAM, SCHEMATIC      |       |      |     |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| MODE DATA LINEAR WIREFEEDER 3 |       |      |     |       |      |            |        |     |           | MATL. NO.                |  |                 |  |
| 3000001 IN QWL 1 MATL         |       |      |     |       |      |            |        |     |           | MATL. NO.                |  |                 |  |



CONNECTION DIAGRAM FOR RC-750 (OR OTHER CONSTANT VOLTAGE) POWER SOURCE AND A VOLTAGE REGULATOR WITH 10-PIN AMPHENOL (401533) REPLACING THE STANDARD 5-PIN AMPHENOL IN FRONT PANEL.

5 Pin Amphenol Plug-to connect to 5-pin amphenol removed from front panel

10-Pin Amphenol mounted in front panel



CONSTANT VOLTAGE (CV) POWER SOURCE WITH SCR VOLTAGE CONTROL - WIRED FOR AMPHENOL CONNECTION TO FEEDER CONTROL

View 2

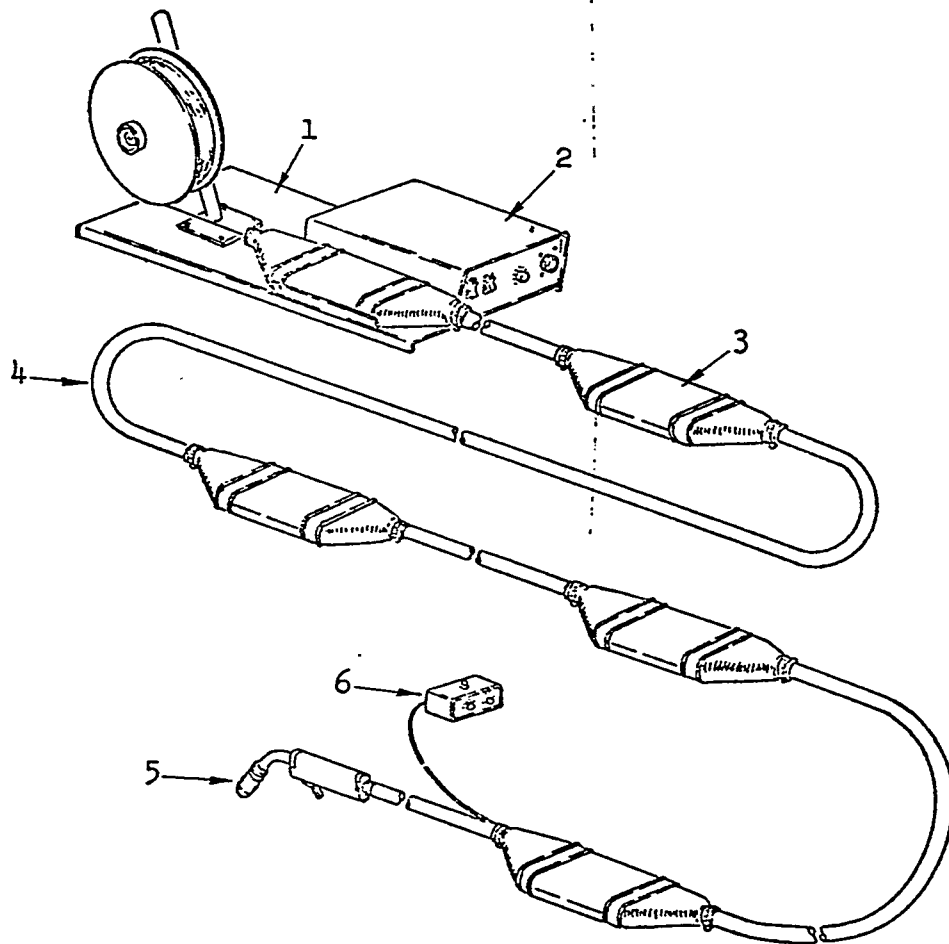
## CHAPTER III

### WIRE FEED SYSTEM - MODEL 5709

#### PARTS LIST

The following instructions should be noted when using this section on identification of parts and information needed for reordering spare parts:

- (1) The detailed parts listed under various assembly headings are those needed for spare parts. Parts not considered as spare nor subject to failure have not been listed.
- (2) List model number of unit (Model 5709) when ordering spare parts. The equipment nameplate carrying this information is located on the rear panel of the control module.



MODEL 5709 - WIRE FEED SYSTEM

VIEW 1

Listed under each view and index number is the spare parts for that assembly unit.

| <u>View and<br/>Index No.</u> | <u>Part<br/>Number</u>       | <u>Description</u>          | <u>Units for<br/>Assembly</u> |
|-------------------------------|------------------------------|-----------------------------|-------------------------------|
| 1-1                           | 373365<br>(No spares listed) | Base Assembly               | 1                             |
| 1-2                           | 373344                       | Control Module Assembly     | 1                             |
|                               | 401972-2                     | Fuse MDX-5                  | 1                             |
|                               | 16DA-4252-18                 | Fuse MDL-2.8                | 1                             |
| 1-3                           | 373030                       | Booster Assembly            | 5                             |
|                               | 373046-1                     | Wire Drive Assembly (.035H) | 1                             |
| 1-4                           | 373366                       | Cable Assembly              | 4                             |
|                               | 373371                       | Cable, Power, Assembly      | 1                             |
| 1-5                           | 373050                       | Gun Assembly                | 1                             |
|                               | 378645                       | Nozzle                      | 1                             |
|                               | 377932A                      | Nut, Tip                    | 1                             |
|                               | 378401                       | Nut, Tip, Contact           | 1                             |
|                               | 373094-2                     | Cable, Power, Assembly      | 1                             |
| 1-6                           | 373367<br>(No spares listed) | Remote Control Assembly     | 1                             |

The following parts are listed as optional equipment usable on Model 5709:

| <u>Item</u> | <u>Part No.</u> | <u>Description</u>           | <u>Units per<br/>Assembly</u> |
|-------------|-----------------|------------------------------|-------------------------------|
| 1           | 377462          | Tip, Contact, .035H          | 1                             |
| 2           | 377464          | Tip, Contact, .045H          | 1                             |
| 3           | 373046-2        | Wire Drive Assenibly (.045H) | 5                             |
| 4           | 378090-7        | Liner, .035/.045, 10ft.      | 1                             |
| 5           | 70926           | Liner, .035/.045, 50ft.      | 4                             |

## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

|                                        | Page |
|----------------------------------------|------|
| General IntrOduct ion -----            | 78   |
| Welding Test Data -----                | 81   |
| Control Definition -----               | 83   |
| Feed System Operation -----            | 89   |
| Welding with the Complete System ----- | 92   |
| Diagrams -----                         | 99   |
| Parts List -----                       | 104  |

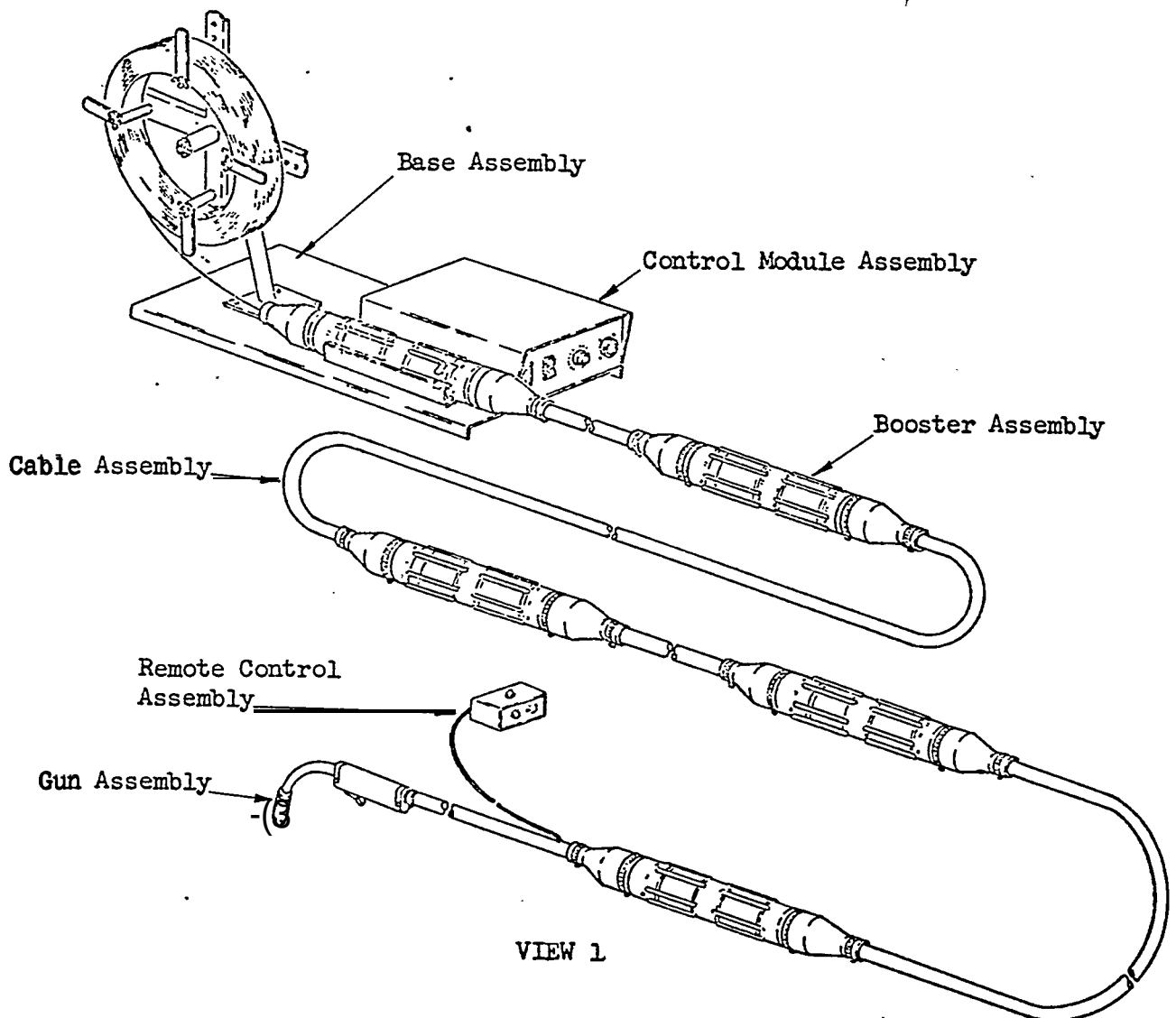
## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

#### GENERAL INTRODUCTION

The Model 5710 Linear Wire Feed System is usable to feed steel welding wire (5/64, 3/32, and 7/64 diameters) up to 210 feet.

The Model 5710 Linear Wire Feed System is completely described in View 1. The system comes standard equipped with wire drive assemblies for 3/32 and 7/64 diameter wire. Optional drive assemblies for 5/64 diameter wire are included, and can be interchanged with those drive assemblies in each booster assembly.



## Model

Base Assembly  
Control Module Assembly  
Booster Assembly  
Cable Assembly  
Gun Assembly  
Remote Control Assembly

The following notes describe the general function of the above six basic assemblies:

- (1) Base Assembly -- The base assembly is equipped with both a spool adapter (25 pound spool) and wire reel adapter (60 pound coil).
- (2) Control Module Assembly -- Control module assembly is bolted to the base assembly. This unit is connected to the power source and booster assembly by control cables only. Therefore, the control module assembly can be relocated from the base assembly by adding the proper extension cables.
- (3) Booster Assembly -- The booster assembly is shipped equipped with a wire drive assembly for 3/32 diameter wire (15° roller arm). Optional wire drive assemblies for 5/64 diameter wire (20° roller arm) are included as replacement in the booster assembly.
- (4) Cable Assembly -- The cable assembly is 50 feet long built with a power cable having a copper equivalent of a #1 cable. This cable has a steel inner core through which the welding wire moves between boosters. The welding ampere rating of this cable assembly is 400 amps. An optional cable assembly is available, having a copper equivalent of 2/0 cable with a steel inner core, with a rating of 600 amps.
- (5) Gun Assembly -- The gun assembly is that portion of the system from the last booster to the welding arc. The gun assembly is built using Hobart Brothers Model GA-600 gun handle assembly and a 10-foot #1 cable.

(6) Remote Control Assembly -- The remote control assembly is a device which attaches at the gun to booster connection, to control the welding current, welding voltage and purge the gas lines. The remote control assembly will clamp onto the gun cable near the handle or be equipped with magnet to allow the welding operator to locate this unit nearby. With this device, the operator can have full control of wire feeder and *power source* while located some 200 feet away.

## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

#### WELDING TEST DATA

Test performed by Hobart Brothers Welding Procedure Laboratory.

#### Evaluation Test:

Objective of test: To run a weld ability and feedability evaluation of the Model 5710 wire feed unit using FabCO wire.

Brief description of test: Using the remote control (amperage and voltage ), amperage and voltage settings were noted at power source. Also using local wire feed control at feeder, settings were checked. Welds were made to determine voltage drop from power source to arc. Minimum and maximum wire feed speeds were noted. Test was made using 3/32" FabCO 81 wire using CO<sub>2</sub>. The power source was an RC-75 variation 3.

#### Electrical Performance:

Electrical performance was satisfactory, however, we do foresee a problem that could occur if wire feed module comes in contact with a ground.

All controls worked very well with no problems encountered. Threading wire through unit was no problem as long as cable is reasonably straight, and you cut wire on 45° angle or relatively close to that.

Arc stability was good and spatter level was low in most beads. Hook-up was easy.

#### Mechanical Performance:

The front of the control console is equipped with a wire feed speed control, gun cable control receptacle, inch-purge switch, and an off-on switch.

On the rear of control console is a CC/CV selector switch, touch start switch, reverse-forward wire feed switch, local-remote control switch, power source receptacle, voltage reference jack, run in speed control, and gas receptacles. Also a linear drive assembly.

Welds were made using a range of amperages from 350 amps to 550 amps; these are usable amperages. We found a voltage drop of 13 volts from power source to arc. Example: 400 amps and 40 volts at power source and 400 amps and 27 volts at the arc

A 15 minute weld was made to determine voltage loss after cables were warm. Weld was made at 400 amps and 27 volts; after 8 minutes of welding time, voltage dropped off to  $25\frac{1}{2}$  volts and remained there for the remainder of the 15-minute welding time

The open circuit voltage was checked at power source,  $59\frac{1}{2}$  volts, and at the gun it was  $58\frac{1}{2}$  OCV.

#### Conclusions:

This linear wire feeding system will run 3/32" E6010 wire 200' satisfactorily.

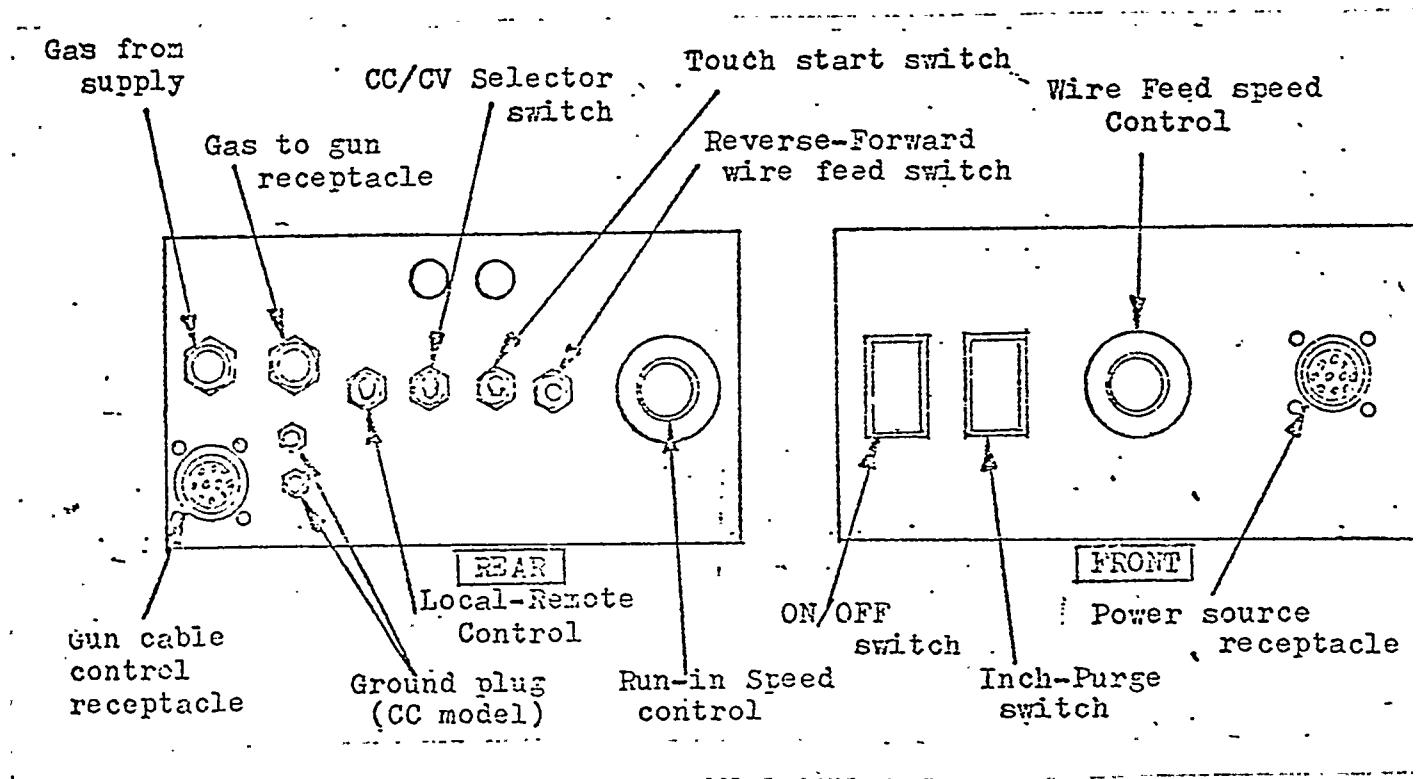
## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

#### CONTROL DEFINITION

The controls, connectors, and receptacles used to operate and control the Model 5710 wire drive system are located on the front and rear panels of the control module. See View 1.

#### A. CONTROL MODULE ASSEMBLY



REAR AND FRONT PANELS OF  
CONTROL MODULE

VIEW 1

#### Component Functions of the Control Module

##### (1) Wire Feed Speed Control (on front panel)

The red knob located in the center of the panel is on the potentiometer which controls the speed at which the welding wire will travel through the

wire drive modules. To increase the speed, turn the knob clockwise, and to decrease the speed, turn it counterclockwise. See (5) below.

(2) ON/OFF Rocker Switch (on front panel)

Controls the 110-volt AC input circuit, applying or removing power supply to the unit. Red indicator light in the center of the switch will glow when the switch is ON.

(3) INCH/PURGE Rocker Switch (on front panel)

Pushing in on the INCH side (top) of the rocker switch will cause the welding wire to advance through the wire drive module(s), through the cable and thence through the welding gun. Wire will feed as long as the rocker switch is held in the INCH position. INCH speed is preset, and will not change by regulating the wire feed speed control (1), above.

Pushing in on the PURGE (bottom) side of the rocker switch will cause shielding gas to flow for as long as the switch is held in the PURGE position.

(4) LOCAL/REMOTE Switch (on rear panel)

When a remote wire feed speed control is used, this switch must be in the REMOTE position to allow the remote gun feed control to be used to regulate the wire feed speed. Otherwise, be sure that the switch is in LOCAL position.

(5) CC/CV Switch (Constant Current/Constant Voltage) (on rear panel)

In CV position, feed motors operate at a constant speed, selected by the wire feed speed control. It is used when welding with (CV) constant voltage power sources.

In CC position, the wire, the wire feed speed is controlled by arc voltage. The wire feed speed control selects the arc voltage. It is used when welding with constant current power sources.

NOTE: The voltage reference wire must be plugged in and connected to the WORK before the wire feed system will operate.

(6) TOUCH START Switch (on rear panel)

To be used in conjunction with CC/CV switch for CC welding. Before the arc is struck, the touch start ON, wire feed speed can be set with the RUN-IN speed control. After the arc is struck, control shifts to wire feed control automatically.

(7) REVERSE/FORWARD Switch (on rear panel)

The position of this switch determines the direction in which the wire will feed when the gun switch or the INCH switch is depressed. It is a three-position switch. See below:

In FORWARD position - Wire will feed forward from gun.

In CENTER position - Wire will not feed either way.

In REVERSE position - Switch must be held, and INCH switch depressed at the same time.

(8) RUN-IN Speed Control (on rear panel)

Sets the initial wire feed speed for touch starts. Speed can be set from 0 to approximately 25% of maximum speed.

(9) Nameplate (on rear panel)

Shows specification (SPEC) number (S-5710) and serial number of particular linear wire feed system).

Connections to Control Module (View 1)

(1) Power Source Receptacles (on front panel)

A control cable from the "control" receptacle on the power source connects here. This cable and plug assembly contains the control wires for the

welding contactor, and also the power cable for the 110-volt AC power supply for the operation of the printed circuit board and its control functions, and the wire drive assembly.

(2) Gas supply Connection (on rear panel)

Inlet gas supply to the solenoid valve. This valve is controlled by the PURGE switch, either from a remote control or on the enclosed controls for preflow shielding gas.

(3) Gun Cable Control Receptacles (on rear panel)

Connection point for the input cable from the wire drive module. Wire feed speed control, prepurge of shielding gas and inching of wire through the cable and gun, as well as contactor control, is accomplished through this cable.

(4) Gas-to-Gun Connection (on rear panel)

Fitting where the gas hose to the gun is attached. Flow of gas is controlled by the solenoid valve on the inside of the control module.

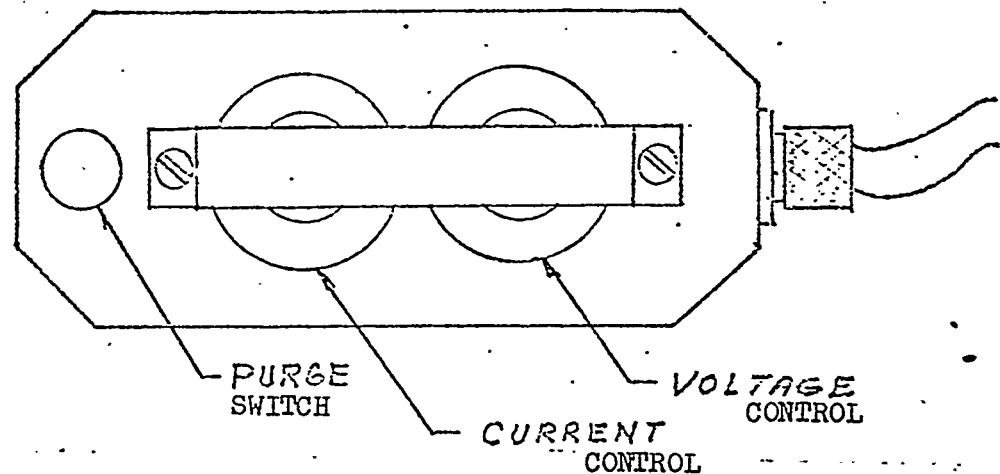
(5) Ground Plug (on rear panel)

An insulated tip plug is furnished, to which a length of 16-ga, wire must be attached, which must be plugged into the jack when the CC/CV switch is in the CC (constant current) position. Attach the other end of this wire (by clamp or some means of secure attachment) to the work (the material being welded).

CAUTION: IF THIS WIRE IS NOT ATTACHED, THE LINEAR WIRE SYSTEM WILL NOT OPERATE WHEN THE SWITCH IS IN CC POSITION. SOME (CC) TYPE POWER SOURCES DO NOT HAVE BUILT-IN CONTRACTORS. AN AUXILIARY CONTACTOR SHOULD BE ADDED TO A POWER SOURCE NOT EQUIPPED WITH A BUILT-IN CONTACTOR.

B. REMOTE CONTROL ASSEMBLY

The controls and switch used to operate and control the Model 5710 wire drive system remote from the control module are located on the top of the remote control module. See View 2.



TOP OF REMOTE CONTROL MODULE

VIEW 2

Component Function of Remote Control Module

(1) Current Control (Wire Feed Speed)

The red knob of the current control is located on the top and in the center of the remote control module, View 2. The control will vary the speed at which the welding wire will travel through the wire drive modules. To increase the welding current turn the knob clockwise, to decrease the welding current turn it counterclockwise.

(2) Voltage Control (Welding Arc Voltage)

The red knob of the welding voltage control is located on the top and toward the end of the remote control module, View 2. The control will vary the welding arc voltage at the power source. To increase the arc voltage, turn the knob clockwise. To decrease the arc voltage, turn it counterclockwise.

NOTE This voltage control will operate only with the power source designed for use with the Model 5710 system.

(3) Purge Switch

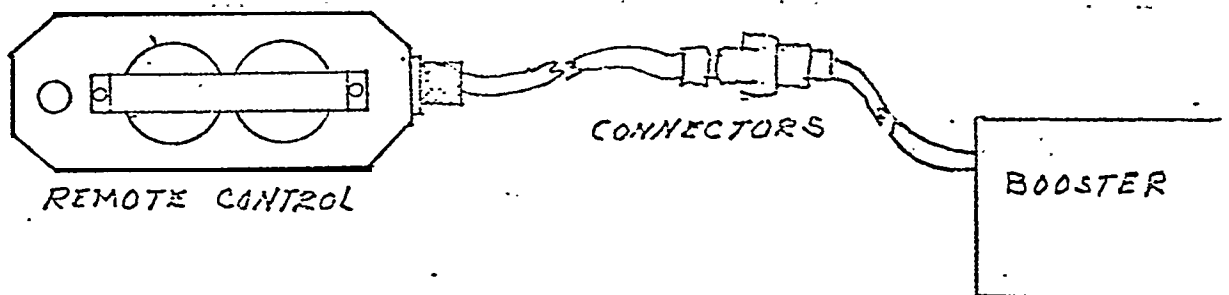
The purge switch is located in the top and to the end of the remote control module, View 2). Pushing the purge switch will cause shielding gas to flow for as long as the switch is held depressed.

(4) Inch Wire

For remote operation, close the gun switch on the welding torch to inch the wire. The welding torch should be placed in a position that will not cause the wire being inched to strike an arc. Wire will feed as long as the gun switch is held closed.

Component Connection

- (1) The amphenol connector from the remote control module is connected to the connector of the first wire drive booster, View 3).



REMOTE VOLTAGE CONTROL  
CONNECTION WITH BOOSTER  
VIEW 3

## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

#### FEED SYSTEM OPERATION

The Model 5710 wire feed system must have a wire feed liner in both the 10-foot gun cable as well as the 50-foot cable between booster when using 5/64 and 3/32 diameter wire. Both of these cables are constructed with a steel spring inner core. To have extended life of these cables, a steel wire feed liner is inserted in the steel spring core. The welding wire passes from the wire spool or coil to the arc through this steel wire feed liner.

For correct operation, the drive assembly and contact tips must be selected for the desired diameter welding wire (either 5/64, 3/32, or 7/64 diameter) being used.

Model 5710 comes equipped with both a spool mount and a wire reel mount. This allows either a 25-pound spool or a 60-pound coil of steel wire.

The Model 5710 is equipped with cable having a rating of 400 amperes. Care should be exercised to keep the welding process within the rating of the equipment.

#### I. Threading the Wire Through the Linear Drive Unit

NOTE: Before installing wire and threading it through the linear drive unit, determine that the drive unit is properly equipped with drive rollers to handle the wire to be fed. The size and type of wire which may be fed with a particular drive unit will be stamped on the outside of the unit. DO NOT TRY TO FEED ANY OTHER TYPE OR SIZE WIRE WITH THAT UNIT.

Proper units for a particular wire size and type maybe ordered from Hobart Brothers Company.

- A. Turn the power source ON, and the wire feeder power switch ON.
  - B. Unfasten the end of the wire from the spool with care, so that it not "get away" from you.
  - C. Adjust the drag on the spool such that the spool will not coast when the drive unit stops. This maybe accomplished by turning the bolt in the center of the spool clockwise to increase drag or counter-clockwise to decrease drag.
  - D. Cut off the bent end of the wire to be fed into the drive unit, and remove any sharp burrs from the end of the wire after cutting it off. Cut the wire off at some angle (approximately 45°).
  - E. Grasp the wire near the end with fingers or pliers, and insert the wire through the hole in the input guide. While inserting the wire, engage drives with the INCH button until the wire begins to feed through linear drive unit. Continue to INCH the wire through the unit until it appears at the nozzle of the welding gun.
- II. Replacing Steel Liners (Gun Assembly) (No liner required for 7/64 diameter wire )
- A. Remove gun assembly from last booster assembly.
  - B. Pull out old liner.
  - C. Install new liner (for part number see parts list) nominal 10-foot.
  - D. Push liner in as far as possible, cut liner 2-in/16" beyond cable fitting.
  - E. Reassemble gun assembly to booster assembly.

III. Replace Steel Liners (Cable Assembly) (No liner required for 7/16 diameter wire)

- A. Remove cable assembly (one end) from booster assembly.
- B. Pull out old liner.
- C. Install new liner (for part number see parts list) nominal 50 foot.
- D. Push liner in as far as possible, cut liner 2-u/16" beyond cable fitting.

NOTE: If both ends of cable assembly are removed from booster assembly, liner to stick out of cable fitting 2-u/16" on both ends.

- E. Reassemble cable assembly to booster assembly.

## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

#### WELDING WITH THE COMPLITE SYSTEM

The first step in welding with the complete system is to properly set up the system

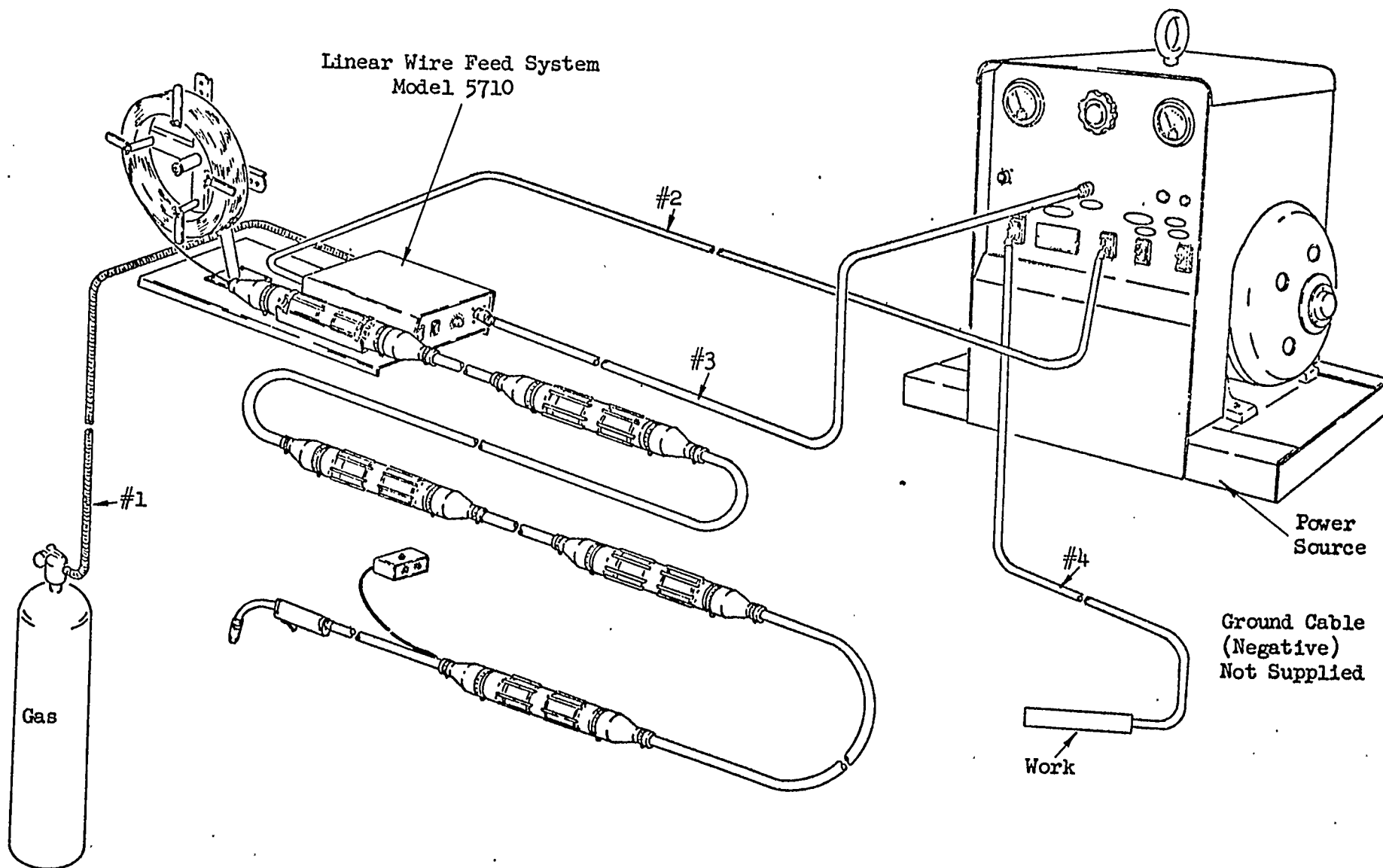
The Linear Wire Feed System will be complete as shipped - Model 5710. To complete the welding system, the following are needed:

- (1) Power source can either be a constant voltage (CV) power source or a constant current (CC) power source.
  - (a) The complete system using the constant voltage power source (CV) is illustrated in View 1 page 97. The power source can be any Hobart Brothers constant voltage power source to which the SCR voltage regulator has been added. A typical power source would be Model RC-750 Spec 4558C Var. 3. A schematic diagram to show the modification necessary from a standard power source to one with the SCR voltage control is shown in View 2 page 98.

The control cables, welding cables and gas hose as shown in View 1 and View 3 are described as follows:

| <u>Item No.</u> | <u>Part No.</u> | <u>Description</u>                           | <u>Qty/Unit</u> |
|-----------------|-----------------|----------------------------------------------|-----------------|
| 1               | 16DA-4577-10    | Hose, Gas, Ay.                               | 1               |
| 2               | w-9218-u        | Cable, Power, Ay. (10')<br>(Electrode)       | 1               |
| 3               | 373372          | Cable, Control (10')                         | 1               |
| 4               |                 | Cable, Power (Ground - Furnished<br>by user) |                 |

NOTE : 1- When Using self-shielding type of welding wire, the gas supply and gas hose is not required

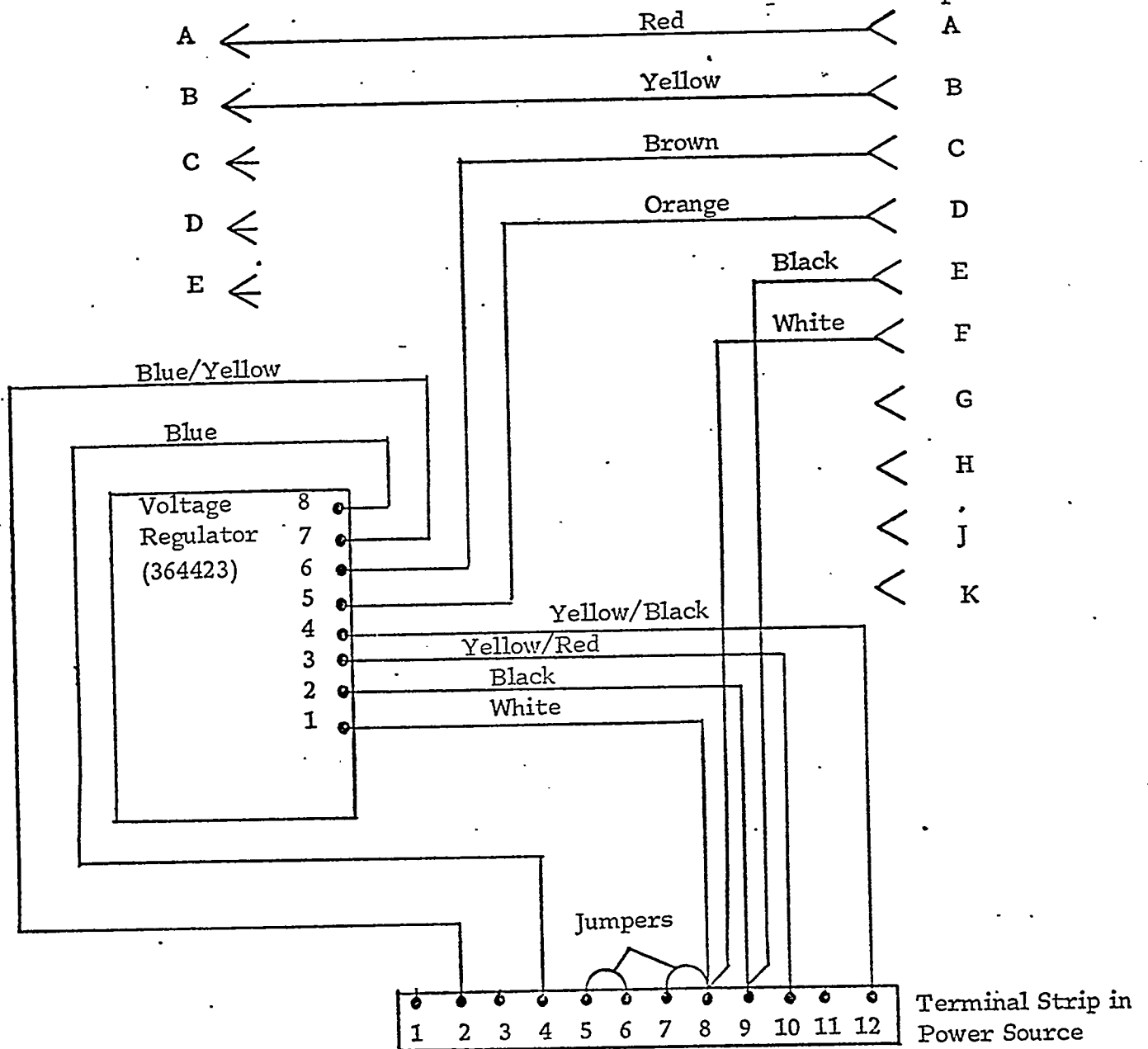


VIEW 1 - SYSTEM CONNECTION CONSTANT VOLTAGE (CV) POWER SOURCE

CONNECTION DIAGRAM FOR RC-750 (OR OTHER CONSTANT VOLTAGE) POWER SOURCE AND A VOLTAGE REGULATOR WITH 10-PIN AMPHENOL (401533) REPLACING THE STANDARD 5-PIN AMPHENOL IN FRONT PANEL.

5 Pin Amphenol Plug-to connect to 5-pin amphenol removed from front panel

10-Pin Amphenol mounted in front panel



CONSTANT VOLTAGE (CV) POWER SOURCE WITH SCR VOLTAGE CONTROL - WIRED FOR AMPHENOL CONNECTION TO FEEDER CONTROL

2 - All. switches on the rear of the control module assembly to be in the CV position.

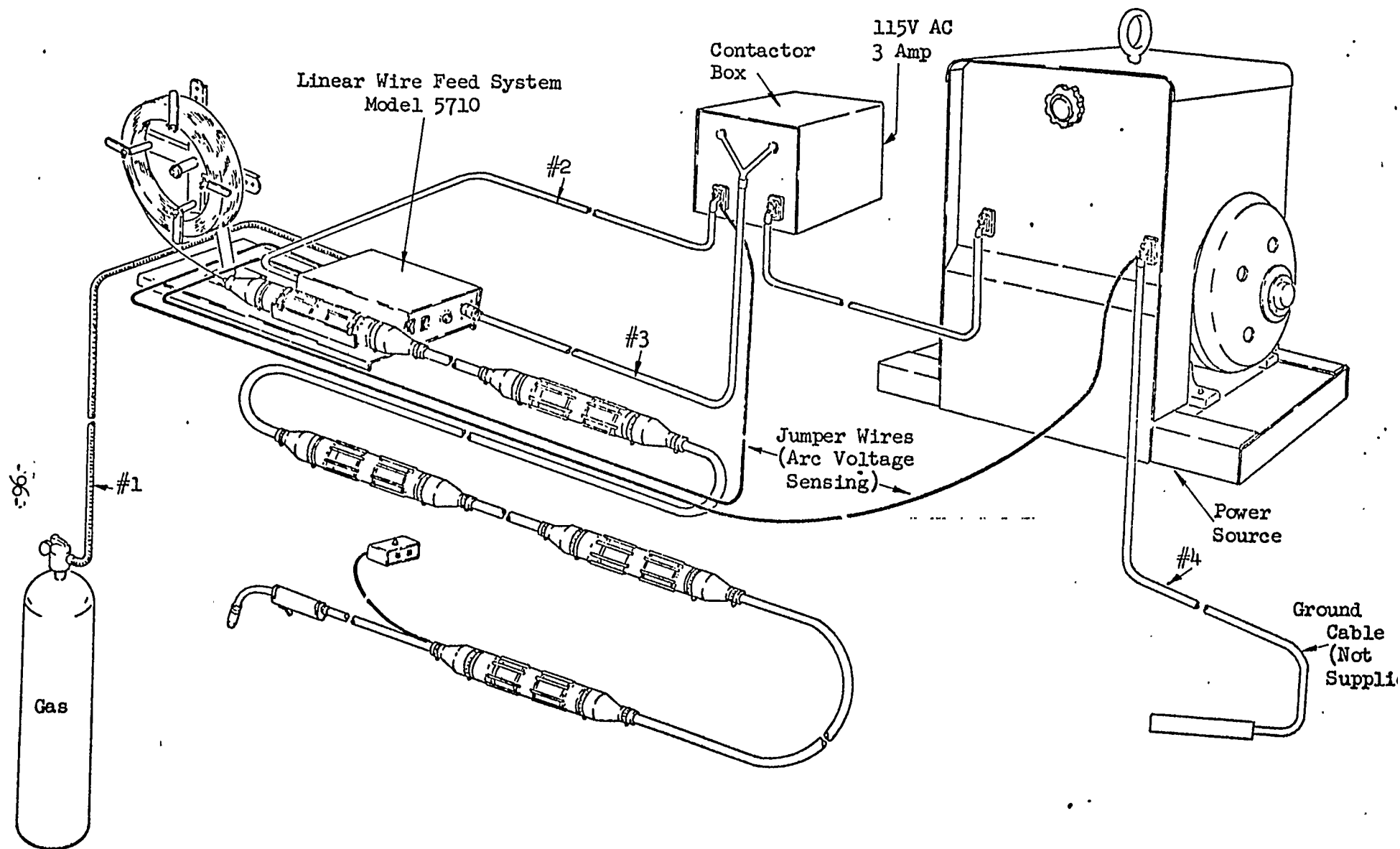
(b) The complete system using the constant current power source (CC) is illustrated in View 3 page 100. The power source can be any constant current (CC ) power source having a contactor in the welding circuit.

Most constant current (CC) power sources are not built with a contactor. In this case an auxiliary contact or, such as Hobart Brothers contact or part number 373308, Should be used.

NOTE: 1 - When using self-shielding type of welding wire, the gas supply and gas hose is not required.

2 - All switches on the rear of the control module assembly to be in the (CC) position.

3 - Be sure one of the voltage reference jacks is connected to electrode terminal of the power source and the other voltage reference jack is connected to the ground terminal of the power source.



VIEW 3 - SYSTEM CONNECTION CONSTANT CURRENT  
(CC) POWER SOURCE

Once the complete system is properly set up, the correct welding procedures can be secured by referring to this proper welding guide. The following are a few pointers that should be observed;

- (1) Only the welding wire diameter specified should be used in the system. For change of wire diameter, a change in wire drive assembly is necessary.
- (2) Do not exceed the rating of gun and cable assembly.
- (3) Both a wire spool assembly and a wire reel is shipped with the unit. Care should be taken not to overtighten the spindle. The proper adjustment is to adjust the drag on the spool such that the spool will not coast when the drive unit stops.
- (4) WARNING: When the gun switch is depressed, the electrode (welding wire) is electrically "hot". Do not permit it to touch any common metal ground, or a welding arc will be established.

The welding process is accomplished by the following steps:

- (1) Turn the power source and wire feeder switches 'on':.
- (2) Depress purge switch and adjust the flow of shielding gas to the proper value.
- (3) Adjust the voltage of the welding power source to the desired value. This can either be done at the power source or at the operator with the remote control.
- (4) Adjust the wire feed speed control to the desired welding amperage. If the amperage is not known, it is suggested that the dial be set to mid-position, and then readjusted to increase or decrease the amperage (or welding current ), which will also increase or decrease the wire feed speed

to the desired value. This can either be done at the control module or at the operator with the remote control.

- (5) Position the gun above the work piece **and** depress the gun switch.

CAUTION: When the wire feeder is being used in conjunction with the gas shielded or open arc processes, be careful to lower the face and eye welding shield before starting to weld.

- (6) Release the gun trigger will cause the wire to stop feeding, the gas to shut off and, after a fixed delay, the welding contactor to open.
- (7) When welding has been completed, or at the end of the work day, it is recommended that the gas (when used) be shut off at the tank, and the welding power source be shut off. If the unit is energized from a power source other than the welder power source, it is advisable to turn off the power rocker switch on the wire feeder.

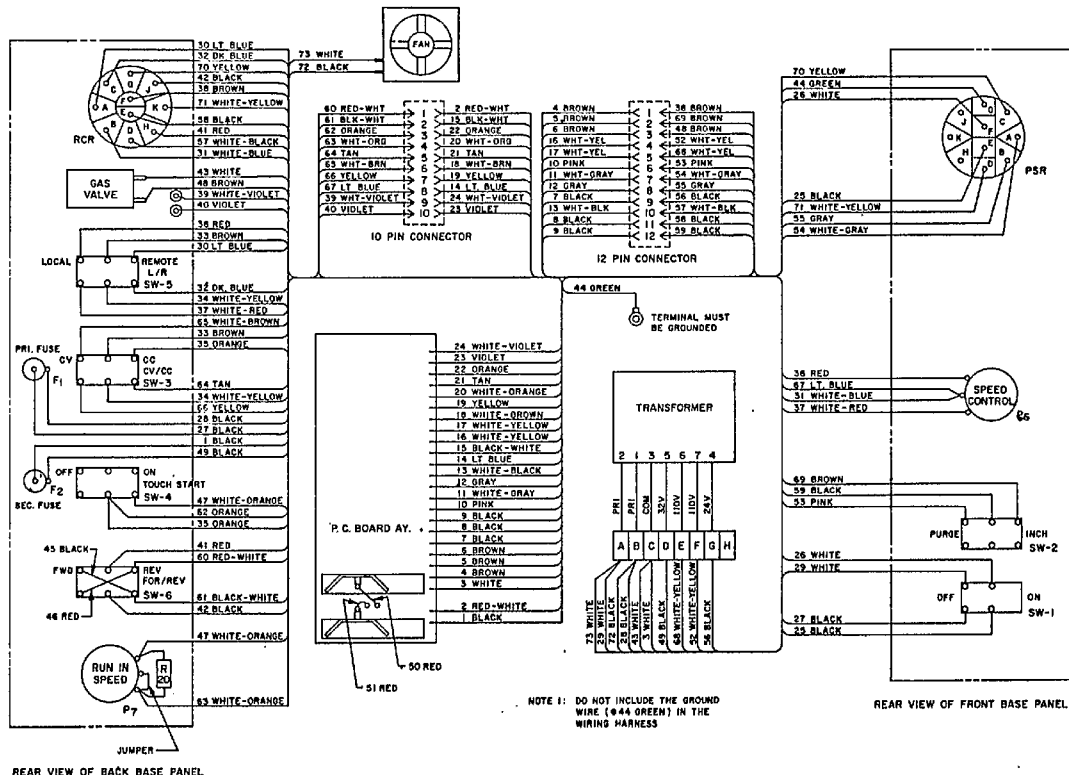
## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5710

#### DIAGRAMS

Included in this section are the diagrams necessary to connect and trouble shoot the Model 5710, Linear Wire Feed System.

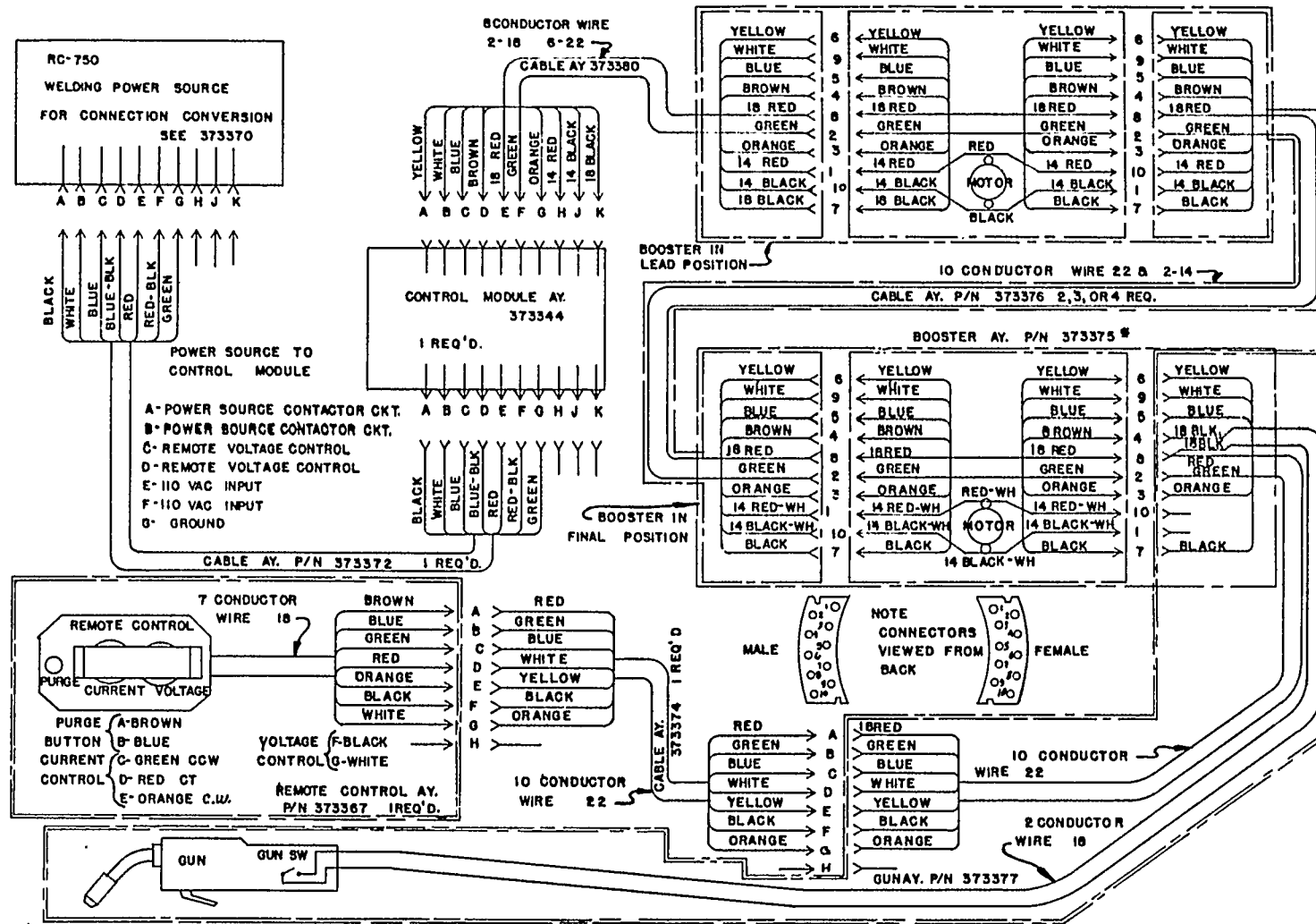
- |                |                                  |
|----------------|----------------------------------|
| (1) P/N 373340 | Connection Diagram, Model 5710   |
| (2) P/N 373336 | Schematic Diagram, Model 5710    |
| (3) P/N 373369 | Outline, System, Model 5710      |
| (4) P/N 373370 | Diagram, Power Source Conversion |



|     |     |
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| PROTECTIVE FINISH |       |      |     | CHANGE RECORD |      |            |          | WHERE USED |          |   |   | ACTIVITY |   |   |   | ACCORDING TO 1150-07 |   |   |    |
|-------------------|-------|------|-----|---------------|------|------------|----------|------------|----------|---|---|----------|---|---|---|----------------------|---|---|----|
| NO.               | INDEX | DATE | NO. | INDEX         | DATE | NEXT ASMT. | NO. REG. | UNION      | ST. STD. | 1 | 2 | 3        | 4 | 5 | 6 | 7                    | 8 | 9 | 10 |
| 1                 |       |      | 2   |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 3                 |       |      | 14  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 4                 |       |      | 15  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 5                 |       |      | 16  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 6                 |       |      | 17  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 7                 |       |      | 18  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 8                 |       |      | 19  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 9                 |       |      | 20  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 10                |       |      | 21  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 11                |       |      | 22  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 12                |       |      | 23  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |
| 13                |       |      | 24  |               |      |            |          |            |          |   |   |          |   |   |   |                      |   |   |    |

|                   |       |      |    |       |      |            |          |     |         |                                |  |                    |  |
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| PROTECTIVE FINISH |       |      |    |       |      |            |          |     |         | M                              |  | ACCESS NO. 1180-07 |  |
| CHANGE RECORD     |       |      |    |       |      | WHERE USED |          |     |         | REPLACED BY                    |  |                    |  |
| NO                | INDEX | DATE | NO | INDEX | DATE | SPEC       | MODEL    | REQ | NEXTARY | REPLACES                       |  |                    |  |
| 1                 |       | 12   |    |       |      | STD        | LINEAR V | I   | SPRFS   | MATL SPEC                      |  |                    |  |
| 2                 |       | 14   |    |       |      |            |          |     |         |                                |  |                    |  |
| 3                 |       | 19   |    |       |      |            |          |     |         |                                |  |                    |  |
| 4                 |       | 18   |    |       |      |            |          |     |         |                                |  |                    |  |
| 5                 |       | 17   |    |       |      |            |          |     |         |                                |  |                    |  |
|                   |       |      |    |       |      |            |          |     |         | TITLE DIAGRAM, SCHEMATIC       |  |                    |  |
|                   |       |      |    |       |      |            |          |     |         | INDEX DATA LINEAR WIREFEEDER V |  |                    |  |
|                   |       |      |    |       |      |            |          |     |         | DESIGNED DRAWING DATE SCALE    |  |                    |  |



\* 2,3, OR 4 REQ.

## SYSTEM OUTLINE

FIGURE

2590-02

SPEC 1 3-5710

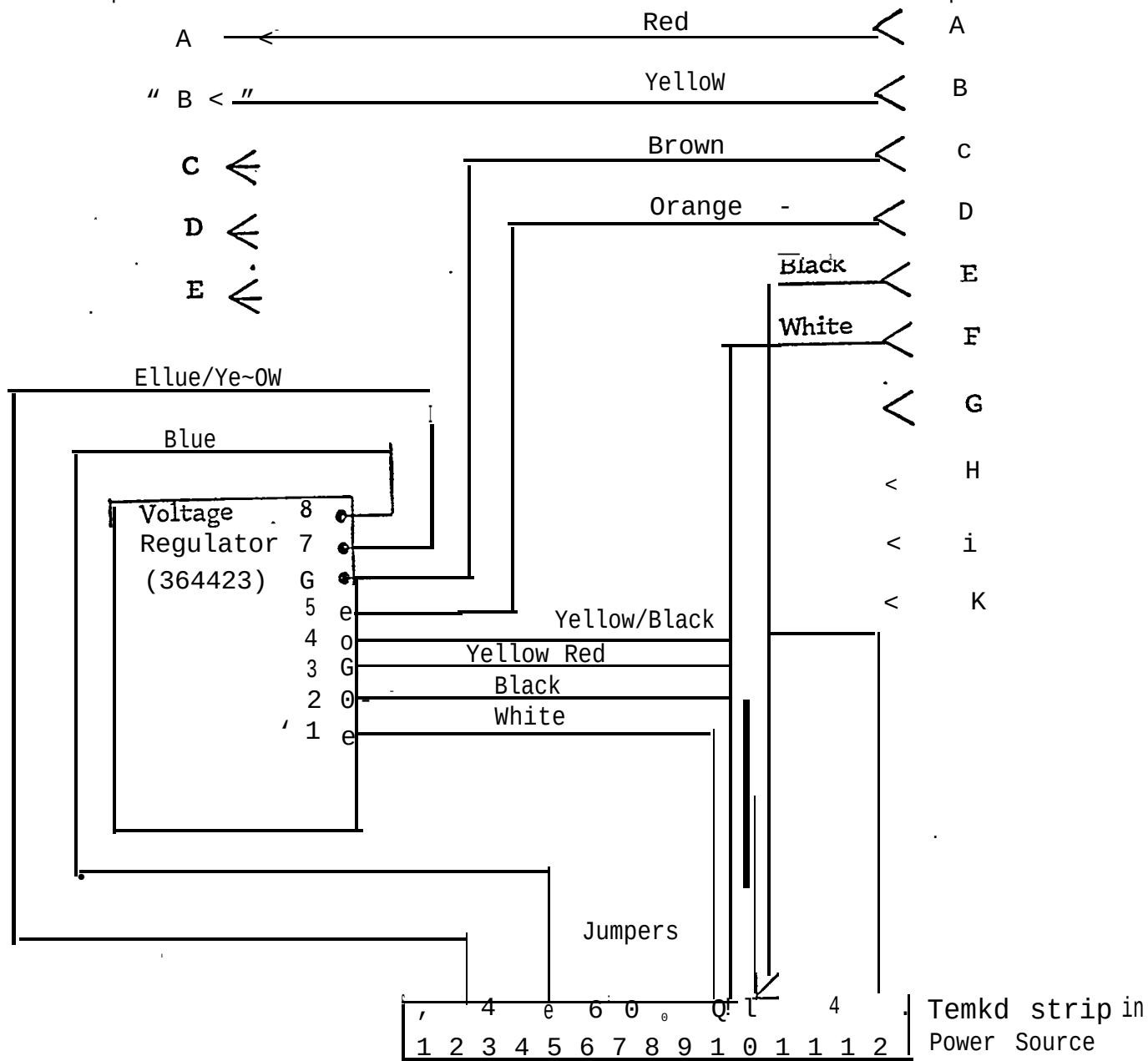
OUTLINE SYSTEM

P E S G M D 7-9-74 NONE

connection D~GUFORRC-750 (OR OTHER CONSTANT VOLTAGE) POWER  
SOURCE AND A VOLTAGE REGUMTOR WITH 10-PIN AMPHENOL (401533) RE-  
REPMC~G THE STANDARD 5-PIN AMPHENOL IN FRONT PANEL.

5 Pin Arnphmol Plug-to connect  
to 5-pin amphen@ removed from  
front panel

10-Pin Amphwol  
mounted in front  
panel



CONSTANT VOLTAGE (CV) POWER SOURCE WITH SCR VOLTAGE  
CONTROL - WIRED FOR AMPHENOL CONNECTION TO FEEDER  
CONTROL

View 2

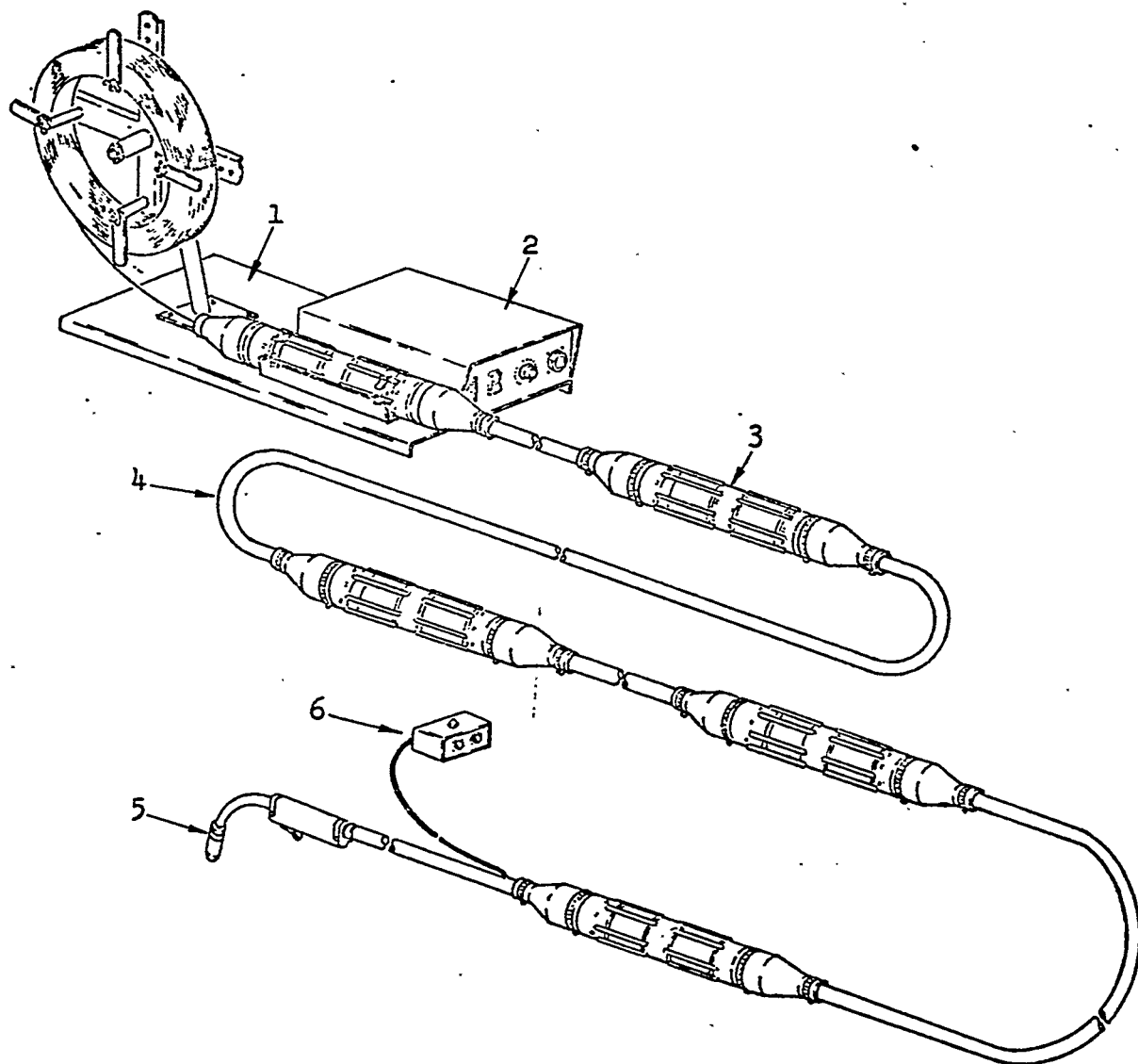
## CHAPTER IV

### WIRE FEED SYSTEM - MODEL 5720

#### PARTS LIST

The following instructions should be noted when using this section on identification of parts and information needed for reordering parts:

- (1) The detailed parts listed under various assembly headings are those needed for spare parts. Parts not considered as spare nor subject to failure have not been listed.
- (2) List model number of unit (Model 5710) when ordering spare parts. Model number nameplate carrying this information is located on the rear panel of the control module.



MODEL 5710 - WIRE FEED SYSTEM

VIEW 1

Listed under each view and index number are the spare parts for that assembly unit.

| <u>View and<br/>Index No.</u> | <u>Part<br/>Number</u>        | <u>Description</u>            | <u>Units for<br/>Assembly</u> |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 1-1                           | 373365<br>(170 spares listed) | Ease Assembly                 | 1                             |
| 1-2                           | 373348                        | Control Module Assembly       | 1                             |
|                               | 801-2-2                       | Fuse MDX-5                    | 1                             |
|                               | W-U66-4                       | Fuse AGC-15                   | 1                             |
| 1-3                           | 373375                        | koster Assembly (3/72 & 7/64) | 5                             |
|                               | 373=8                         | Drive Assembly (3/32 & 7/64)  | 1                             |
| 1-4                           | 373376                        | Cable Assembly                | 4                             |
|                               | 378095-5                      | Cable, Pwer, Assenibly        | 1                             |
| 1-5                           | 373377                        | Gun Assembly                  | 1                             |
|                               | 378669                        | Nozzle                        | 1                             |
|                               | 378320                        | Nut, Tip                      | 1                             |
|                               | 378668                        | Adapter, Nozzle               | 1                             |
|                               | 378400                        | Nut, Tip, Contact             | 1                             |
|                               | 377775-3                      | Elsulator                     | 1                             |
|                               | 378095-1                      | Cable, Pouer Assemb~          | 1                             |
| 1-6                           | 373367<br>(No s~res listed)   | Remote Control Assembly       | 1                             |

The following parts are listed as optional equipment usable on Model 5710:

| <u>Item</u> | <u>Part No.</u> | <u>Description</u>           | <u>Units Per Assembly</u> |
|-------------|-----------------|------------------------------|---------------------------|
| 1           | 377 *           | Tip, Contact, 5/64           | 1                         |
| 2           | 377943          | Tip, Contact, 3/32           | 1                         |
| 3           | 377944          | Tip, Contact, 7/64           | 1                         |
| 4           | 373228-2        | Drive Assembly (5/64)        | 5                         |
| 5           | 377655A         | Washer, 5/64/3/32, 10 in.    | 1                         |
| 6           | 70927           | Insulator, 5/64/3/32, 50 in. | 4                         |

**CHAPTER V**  
**LINEAR WIRE FEED SYSTEMS**

**CONCLUSIONS**

|                  |            |
|------------------|------------|
|                  | page       |
| Review -----     | 109        |
| The Future ----- | <b>111</b> |

**CHAPTER V**  
**LINEAR WIRE FEED SYSTEMS**

**CONCLUSIONS**

**Review**

A review of a development project, such as the extended length feed system, would start with those items that aroused questions during the period of development. One of the key questions in the extended length feed system is what is the practical length of a successful feeding system. This length must not only be determined by the ability to design components which will allow extended lengths to be accomplished, but also must be usable *at the same time*. With the linear wire feeding concept, the length is limited only by the size of cables supporting the components in the system. The fact that we can move wire from one booster to another in increments of 50' can be duplicated over and over until there is a limitation in the size of welding cable to supply the welding current, and also the control cable supplying the power to the motor armatures. But this must be tempered by the limitation of the on-job site restrictions. Once this usable range of lengths are determined, then further work could be done on optimizing the welding power cable for that length selected, as well as determining the overall weight of the total booster and cable assemblies. There needs to be some form of cable to booster reinforcement designed into the cable system. When using these cables in a vertical condition whereas the total weight of the cable and boosters maybe exerted on one booster assembly. The weight of the booster and cables alone perhaps will dictate some tension device necessary between boosters.

In the further review of the Linear Wire Feed Systems, additional work needs to be done in the area of welding with 1/16 diameter wire. A study would indicate whether the 1/16 diameter wire should be feed with the Model 5710 unit or a new

wire drive assembly perhaps half-way between the 5709 and 5710 would be the best answer for the 1/16 diameter wire.

**CHAPTER V**  
**LINEAR WIRE FEED SYSTEM**

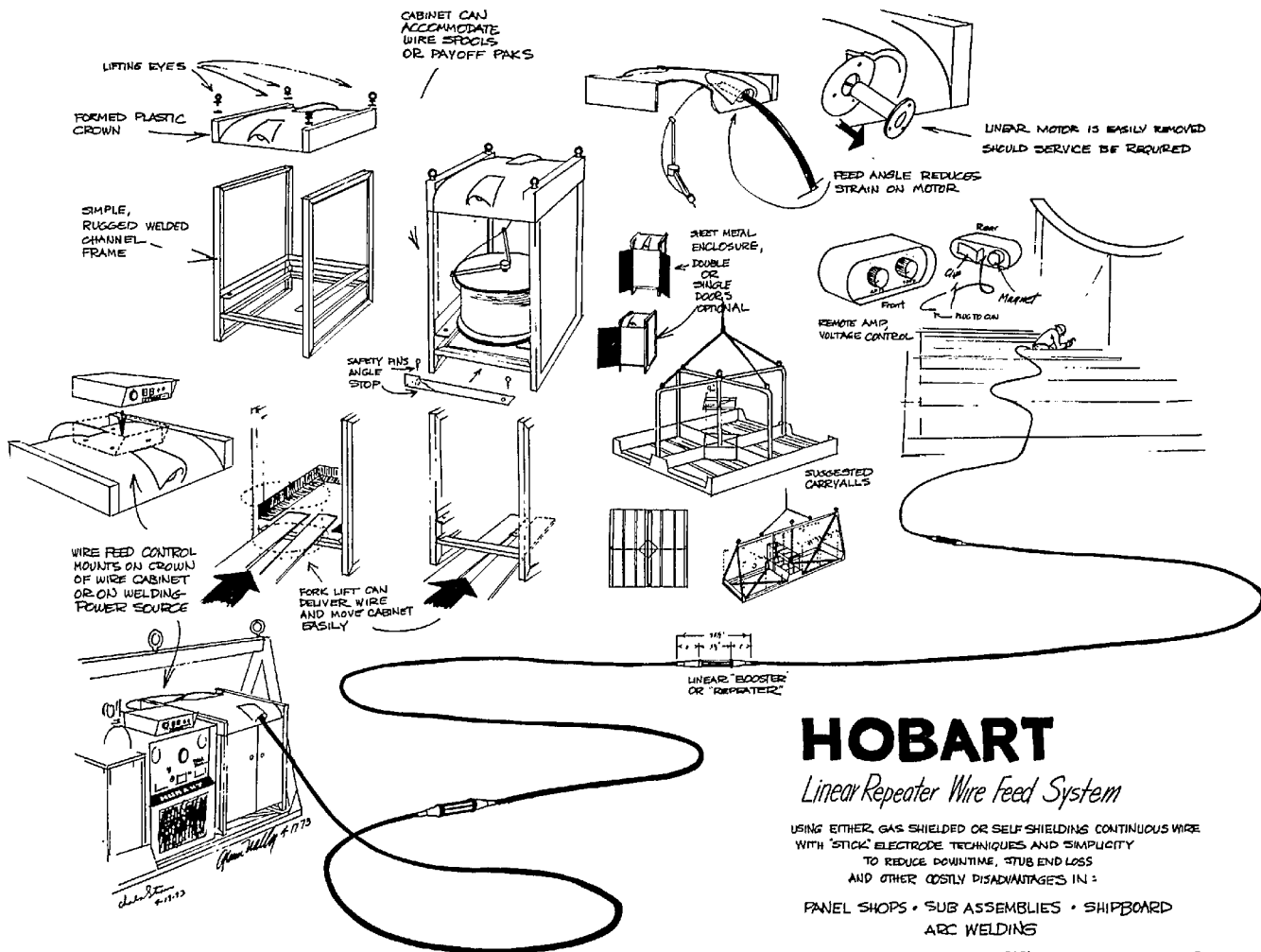
**CONCLUSIONS**

**The Future**

The Linear Wire Feed System has a tremendous future in the welding of the large items such as shipbuilding or field erection. The patented self-balancing feature which allows more than two units to be used in series gives it much potential in these areas. Some of the potential is obvious, that being the ease in which distance from the source of wire to the arc can be altered very quickly, be it a short distance of 10' or 200'. This allows the power sources and wire to be semi-permanent, whereas the feeding system can be taken and moved as the work progresses. As more and more of these units are used, the yards and plants using the extended length wire feeders will be designed to accept the long length feed cables either in a tunnel effect under the floor or in an overhead situation neither of which will interfere with the normal flow of material. By removing the *power sources* and wire source to a place away from the arc will allow both of them to be serviced quicker and with less interruption to the normal work patterns. The normal improvements will come on this system, some of which could be a quick-disconnect cam-off and cam-on type of connector between cable assembly and booster. Another could be the manufacture of the *various* components making the cable assembly into one composite cable.

In Views 1, 2, and 3 are shown ideas which may lead to other ideas for the broad use of the Linear Wire Feed Systems. View 1 represents an artist's conception of various racks and mounts for power sources, wire spool dereelers, and linear control panel mounts, be it one, two, or four units, and how they may be used for shipbuilding or field erection. View 2 is a conception of an enclosed container

for either a wire spool or pay-off packs into which the first booster can be mounted. View 3 is an idea where a weather resistant case could be made to enclose a 60-lb. coil of wire and used in conjunction with the linear wire feed system. The future looks very promising for the Linear Wire Feed Systems and the extended length linear wire feed systems. The future is only limited by the imagination used in applying this modular concept to the weldments needed to be manufactured.



# HOBART

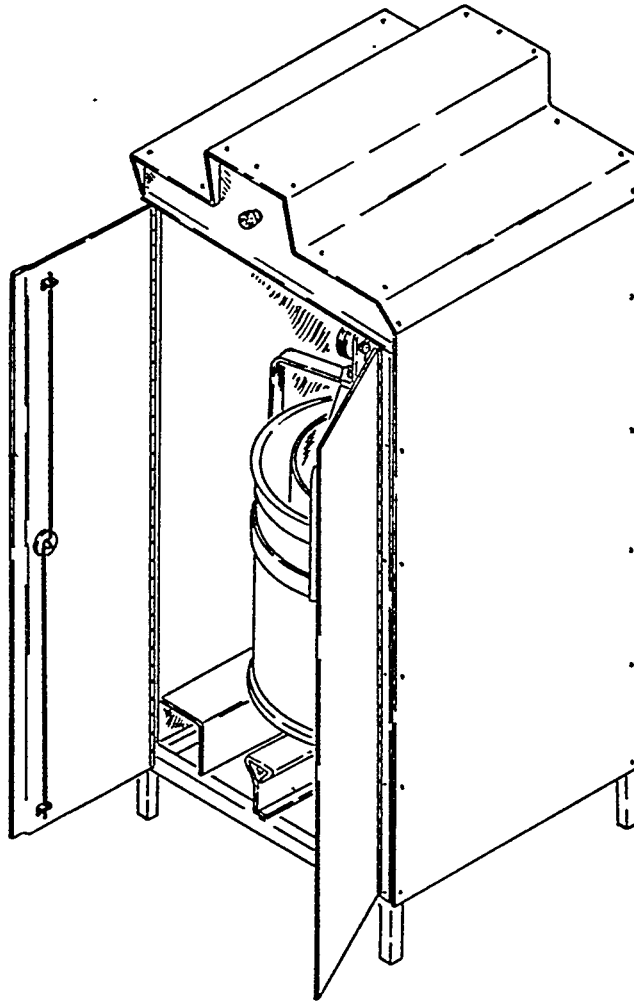
## Linear Repeater Wire Feed System

USING EITHER GAS SHIELDED OR SELF SHIELDING CONTINUOUS WIRE WITH "STICK" ELECTRODE TECHNIQUES AND SIMPLICITY TO REDUCE DOWNTIME, STUB END LOSS AND OTHER COSTLY DISADVANTAGES IN:

PANEL SHOPS • SUB ASSEMBLIES • SHIPBOARD ARC WELDING

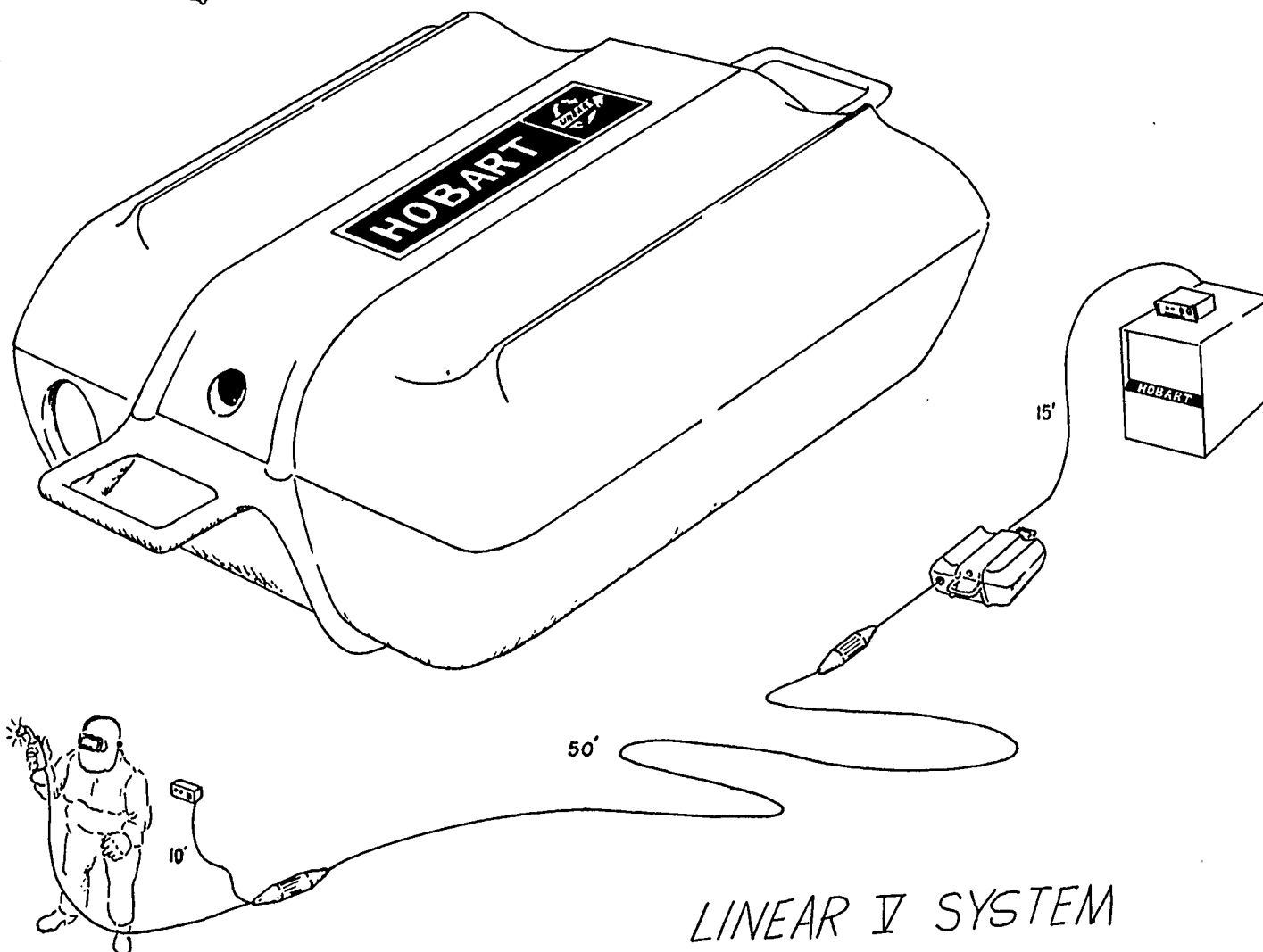
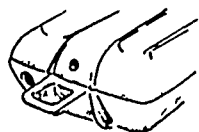
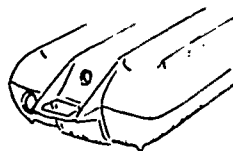
PERMITS OPERATOR TO WELD UP TO 200' FROM SOURCE OF POWER, WIRE

OPTIONAL WIRE SUPPLY  
LINEAR WIRE FEED SYSTEMS  
FOR BETHLEHEM CONTRACT



VIEW 2

*Alternate  
handle treatments*



*LINEAR II SYSTEM*

## ERRATA

Corrections to be noted in Report "Development of Extended Length, *Continuous Wire Feed Systems*".

### Chapter II

Page 19 - Chart at top of page should be "Figure 7"  
in lieu of "Figure 8" as shown.

Page 21- Second line from bottom of page delete  
the word "moved" and insert "to pass".

### Chapter III

Page 57 -Line 19- "View 2" should read "View 3".

Page 61- Line 19- "Page 64" should read "Page 62".

Line 14- "Page 65" should read "Page 63"..

Pages 75 & 76 - Replace with attachments.

### Chapter IV

Page 92- Line 9- "page 97" should read "page 93".

Line 14- "Page 98" should read "Page 94".

Page 95- Line 4- "Page 100" should read "Page 96".

Pages 106 & 107 - Replace with attachments.

Listed under each view and index number is the spare parts for that assembly unit.

| <u>View and<br/>Index No.</u> | <u>Part<br/>Number</u>       | <u>Description</u>                           | <u>Units for<br/>Assembly</u> |
|-------------------------------|------------------------------|----------------------------------------------|-------------------------------|
| 1-1                           | 373365<br>(No spares listed) | Base Assembly                                | 1                             |
| 1-2A                          | 373344-0                     | Control Module Assembly<br>(200-foot system) | 1                             |
|                               | W-11166-3                    | Fuse, AGC-10                                 | 1                             |
|                               | 16DA-4252-18                 | Fuse, MDL-2.8                                | 1                             |
| 1-2B                          | 373344-1                     | Control Module Assembly<br>(100-foot system) | 1                             |
|                               | W-11166-2                    | Fuse, AGC-5                                  | 1                             |
|                               | 16DA-4252-18                 | Fuse, MDL-2.8                                | 1                             |
| 1-3A                          | 373030-0                     | Booster Assembly (.035H)                     | 5                             |
|                               | 373046-1                     | Wire Drive Assembly (.035H)                  | 1                             |
| 1-3B                          | 373030-1                     | Booster Assembly (.045H)                     | 5                             |
|                               | 373046-2                     | Wire Drive Assembly (.045H)                  | 1                             |
| 1-4A                          | 373366-0                     | Cable Assembly (250 amp)                     | 4                             |
|                               | 373371A-1                    | Cable, Power, Assembly (250 amp)             | 1                             |
| 1-4B                          | 373366-1                     | Cable Assembly (400 amp)                     | 4                             |
|                               | 373371A-2                    | Cable, Power, Assembly (400 amp)             | 1                             |
| 1-5A                          | 373050-0                     | Gun Assembly (250 amp - .035H)               | 1                             |
|                               | 378645                       | Nozzle                                       | 1                             |
|                               | 377932A                      | Nut, Tip                                     | 1                             |
|                               | 378401                       | Nut, Tip, Contact                            | 1                             |
|                               | 373414-2                     | Cable, Power, Assembly                       | 1                             |
| 1-5B                          | 373050-1                     | Gun Assembly (400 amp - .045H)               | 1                             |
|                               | 378645                       | Nozzle                                       | 1                             |
|                               | 377932A                      | Nut, Tip                                     | 1                             |

| <u>View and<br/>Index No.</u> | <u>Part<br/>Number</u> | <u>Description</u>                            | <u>Units for<br/>Assembly</u> |
|-------------------------------|------------------------|-----------------------------------------------|-------------------------------|
| 1-5B<br>(Cont'd)              | 378401                 | Nut, Tip, Contact                             | 1                             |
|                               | 373414-3               | Cable, Power, Assembly                        | 1                             |
| 1-6                           | 373367                 | Remote Control Assembly<br>(No spares listed) | 1                             |

Note: Index No. 2 - Control Module Ay. 373348 may be substituted for Control Module Ay. 373344. The above listed fuses must be used.

The following are listed as optional equipment usable on Model 5709:

| <u>Item</u> | <u>Part No.</u> | <u>Description</u>       | <u>Units per<br/>Assembly</u> |
|-------------|-----------------|--------------------------|-------------------------------|
| 1           | 377462          | Tip, Contact, .035H      | 1                             |
| 2           | 377464          | Tip, Contact, .045H      | 1                             |
| 3           | 378090-7        | Liner, .035/.045, 10 ft. | 1                             |
| 4           | 70926           | Liner, .035/.045, 50 ft. | 4                             |

Listed under each view and index number is the spare parts for that assembly unit.

| <u>View and<br/>Index No.</u> | <u>Part<br/>Number</u>       | <u>Description</u>                           | <u>Units for<br/>Assembly</u> |
|-------------------------------|------------------------------|----------------------------------------------|-------------------------------|
| 1-1                           | 373365<br>(No spares listed) | Base Assembly                                | 1                             |
| 1-2A                          | 373348-0                     | Control Module Assembly<br>(200 foot system) | 1                             |
|                               | 401972-2                     | Fuse MDX-5                                   | 1                             |
|                               | W-11166-4                    | Fuse AGC-15                                  | 1                             |
| 1-2B                          | 373348-1                     | Control Module Assembly<br>(100 foot system) | 1                             |
|                               | 401972-2                     | Fuse MDX-5                                   | 1                             |
|                               | W-11166-3                    | Fuse AGC-10                                  | 1                             |
| 1-3                           | 373375                       | Booster Assembly (5/64-3/32-7/64)            | 5                             |
|                               | 373228-1                     | Drive Assembly (5/64-3/32-7/64)              | 1                             |
| 1-4A                          | 373376-0                     | Cable Assembly (500 amp)                     | 4                             |
|                               | 378095-5                     | Cable, Power, Assembly (400 amp)             | 1                             |
| 1-4B                          | 373376-1                     | Cable Assembly (600 amp)                     | 4                             |
|                               | 377950-4                     | Cable, Power, Assembly (600 amp)             | 1                             |
| 1-5A                          | 373377-0                     | Gun Assembly (400 amp)                       | 1                             |
|                               | 378669                       | Nozzle                                       | 1                             |
|                               | 378320                       | Nut, Tip                                     | 1                             |
|                               | 378668                       | Adapter, Nozzle <sup>1</sup>                 | 1                             |
|                               | 378400                       | Nut, Tip, Contact                            | 1                             |
|                               | 377775-3                     | Insulator                                    | 1                             |
|                               | 378095-1                     | Cable, Power, Assembly (400 amp)             | 1                             |
| 1-5B                          | 373377-1                     | Gun Assembly (600 amp)                       | 1                             |
|                               | 378669                       | Nozzle                                       | 1                             |
|                               | 378320                       | Nut, Tip                                     | 1                             |
|                               | 378668                       | Adapter, Nozzle                              | 1                             |

| <u>Item No.</u> | <u>Part No.</u>              | <u>Description</u>               | <u>Quantity</u> |
|-----------------|------------------------------|----------------------------------|-----------------|
| 1-5A<br>Cont'd) | 378400                       | Nut, Tip, Contact                | 1               |
|                 | 377775-3                     | Insulator                        | 1               |
|                 | 377950-1                     | Cable, Power, Assembly (600 amp) | 1               |
| 1-6             | 373367<br>(No spares listed) | Remote Control Assembly          | 1               |

The following parts are listed as optional equipment usable on Model 5710:

| <u>Item</u> | <u>Part No.</u> | <u>Description</u>       | <u>Units per<br/>Assembly</u> |
|-------------|-----------------|--------------------------|-------------------------------|
| 1           | 377942          | Tip, Contact, 5/64       | 1                             |
| 2           | 377943          | Tip, Contact, 3/32       | 1                             |
| 3           | 377944          | Tip, Contact, 7/64       | 1                             |
| 4           | 377655A         | Liner, 5/64-3/32, 10 ft. | 1                             |
| 5           | 70927           | Liner, 5/64-3/32, 50 ft. | 4                             |