DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150867

INSTALLATION PACKAGE FOR HYDE MEMORIAL OBSERVATORY, LINCOLN, NEBRASKA

Prepared from documents furnished by

Solar Engineering and Equipment Co., Inc.
3305 Metairie Road
Metairie, Louisiana 70001

Under Contract NAS8-32247 with

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy

U.S. Department of Energy

Solar Energy

I N D E X

SYSTEM OPERATION & MAINTENANCE

SYSTEM OPERATION & MAINTENANCE

A. GENERAL

This is an air type solar system designed for heating during the winter and is very simple to operate. Basically the system is completely automatic and will function without further adjustment when the control switch is in the "Winter Mode" and the manual override switch is in the automatic position. NOTE: This switch must be left in the automatic position and should only be changed by an authorized serviceman. Upon conclusion of the heating season, the control switch is placed in the Summer Mode which activates the exhaust system fan (F-3) and ventilates the collector. If the vent mode is not operating properly, an alarm has been provided which guards against inadequate ventilation and warns the occupant of this fact. A local serviceman should then be called to rectify said problem. A third switch has been provided to manually turn on the attic fan if necessary for any reason. There is also a system On-Off switch which controls the power to the entire system and is provided for servicing the system.

The moving parts consist of Fans No. 1, No. 2, the Exhaust Fan (F-3), dampers and damper motors 1 - 4. Normally the only reason the system will not operate will be because of the lack of electricity caused by a burned out fuse, or because the driving belts have parted or slipped. These two faults can easily and quickly be determined.

If the system does not shift to the proper operating mode it may be because of lack of power to the damper control systems and this should be checked. (See damper maintenance section). Failure of sensors or jamming of operating motors or solenoids may make the dampers and the control system inoperative and the serviceman should be called. (See list of authorized servicemen).

B. FILTERS

Fan No. 2 is equipped with a standard fiber glass air filter which should be routinely checked and replaced when dirty. (see M-4) of working drawings for filter placement). This will normally be about once each 3 months.

C. COLLECTORS

The collectors should be self cleaning if there is normal rainfall. However, during extended dry periods it may be necessary to hose down the tops to remove accumulated dust. In all events, the local serviceman should check collector cleanliness at least once per month to ensure efficient operation. Periodic checks for water leaks evidenced by obvious rusting and caused by Tedlar damage should be conducted. New Tedlar should be ordered (see collector manufacturer) and rusted areas properly cleaned and repainted. Other than this, there is very little that should go wrong with the collector, although an annual inspection by the local serviceman is advisable to see if anything inordinate has happened.

D. DUCTS

Ducts should be checked for air leaks, cracks, or separations. Duct insulation should also be checked and repaired or replaced as necessary.

E. SITE DATA ACQUISITION

The Site Data Acquisition system should not be touched in any way. This has nothing to do with the actual operation of the SEECO heating system but merely consists of a series of temperature and flow sensors which collect and transmit data to a general computer processing and recording point by a private telephone line which is connected to the transmitter in the house.

Maintenance to dampers, damper motors, fans and the control panel is explained in detail in the following pages. Control diagrams showing the various operating modes are also provided as well as a list of servicemen to contact in the event any complications should develop.

HYDE MEMORIAL OBSERVATORY

Lincoln, Nebraska

SOLAR PROJECT

OPERATIONS & MAINTENANCE MANUAL

VENTURI FANS, 3-WING ALUMINUM BLADES

Air Deliveries Based on AMCA Test Codes. Heavy-Duty Venturi Panel 12 to 24" Fan Blades. Shipped Unassembled. 1 and 2 Speed, Totally Enclosed Motors

Efficient, economical, venturi-type exhaust fans for many commercial, industrial and farm ventilating applications. Shipped unassembled for maximum economy; assemble in minutes using simple hand tools. Air deliveries based on AMCA test codes for exhaust systems. Fans have heavy-duty venturi panel and fixed-position motor base with rigid, tubular supports. 3-wing fan blade is embossed bright aluminum. Gray venturi frame. Available with 1 or 2-speed, 115V, 60 Hz, single phase; 1-speed, 230V, 60 Hz, single phase or 1-speed, 208-220/440V, 60 Hz, single phase, totally enclosed, split phase motor. See index under Shutters, Fan for complete description of recommended automatic wall shutter. Blade, motor and frame shipped in separate cartons.

DIMENSIONS FOR 3-WING ALUMINUM BLADE VENTURI FANS

Blade Dia.	Dimensions A	B	C	D	E	Dia. Opening Required	Recommended Wall Shutter Stock No.	Each
12"	2 1/2"	8 1/2"	2"	16 1/2"	12 3/4"	14"	1C742	$ 9.08
16	2 1/2	8 1/2	1 1/2	20 1/2	16 3/4	18	1C743	11.91
18	2 1/2	8 1/2	2	22 1/2	18 3/4	20	1C744	13.22
20	2 3/4	8 1/2	1 1/2	24 1/2	20 3/4	22	1C745	14.23
24	3 1/4	8 1/2	2	28 1/2	24 3/4	26	1C746	17.09

PERFORMANCE AND PRICES FOR 3-WING ALUMINUM BLADE VENTURI FANS

Blade Dia.	CFM AIR DELIVERY Free Air	1/8" SP	1/4" SP	HP	Motor RPM	TOTALLY ENCLOSED MOTORS Single Phase 115V, 60 Hz Stock No.	Each	Single Phase 230V, 60 Hz* Stock No.	Each	Three Phase 208-220/440V, 60Hz Stock No.	Each
12"	1430	1335	1065	1/4	1725	7F416	$45.00	7F417*	$53.81	7F418	$56.78
	1430/945	1335/670	1065/390	1/4	1725/1140	7F419	61.91	—	—	—	—
16	2275	2150	1975	1/4	1725	7C527	47.21	7F420*	71.02	7F421	71.99
	2275/1505	2150/1280	1975/950	1/4	1725/1140	7C528	64.12	—	—	—	—
18	2845	2680	2525	1/4	1725	7C529	48.90	7F422*	72.71	7F423	73.68
	2845/1875	2680/1625	2525/1125	1/4	1725/1140	7C530	65.81	—	—	—	—
	3275	3125	2875	1/3	1725	7F424	53.27	7F425	55.22	7F426	75.63
	3275/2155	3125/1900	2875/1140	1/3	1725/1140	7F427	70.77	—	—	—	—
20	2920	2760	2575	1/4	1725	7C531	50.77	7F428*	74.58	7F429	75.56
	2920/1930	2760/1630	2575/1215	1/4	1725/1140	7C532	67.68	—	—	—	—
	3445	3275	3110	1/3	1725	7C642	55.14	7F430	57.08	7F431	77.50
	3445/2280	3275/2040	3110/1585	1/3	1725/1140	7C868	72.64	—	—	—	—
	4175	4020	3850	1/2	1725	7F432	67.78	7F433	69.72	7F434	83.82
	4175/2775	4020/2475	3850/2050	1/2	1725/1140	7F435	92.46	—	—	—	—
24	3250	2900	2635	1/4	1725	7C533	54.46	7F436*	78.27	7F437	78.24
	3250/2135	2900/1565	2635/1210	1/4	1725/1140	7C534	71.37	—	—	—	—
	3975	3725	3450	1/3	1725	7F438	58.83	7F439	60.78	7F440	81.19
	3975/2625	3725/2175	3450/1750	1/3	1725/1140	7F441	78.33	—	—	—	—
	4750	4550	4300	1/2	1725	7C869	71.47	7F442	73.41	7F443	87.81
	4750/3145	4550/2775	4300/2350	1/2	1725/1140	7F444	96.15	—	—	—	—

(*) Split phase except * which have capacitor motors with automatic reset thermal protection.

MAINTENANCE

MOTOR - CHECK WIRING FOR SECURE CONNECTIONS. OILING IS NOT REQUIRED AS THIS MOTOR HAS SEALED BEARINGS.

PULLEY- CHECK PULLEYS FOR SECURE FIT AND ALIGNMENT.

BELT - CHECK BELT FOR WEAR AND REPLACE AS NECESSARY. ADJUST BELT TENSION MAKING SURE ALL MOTOR MOUNTING BOLTS ARE SECURE UPON COMPLETION OF MAINTENANCE INSPECTION.

FAN HOUSING-CHECK HOUSING FOR SECURE WALL ATTACHMENT.

F-2 FAN MOTOR

&

BLOWER

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SINGLE-INLET, BELT-DRIVE DUCT BLOWERS

9, 10⅝ and 12½" Sizes. Single-Width. Adjustable Discharge

Dayton

$67.58

No. 2C887

Your best buy in single-inlet blowers with inlet unobstructed, for general duct ventilation, exhausting, air conditioning, processing and industrial use. Comes with bottom horizontal discharge which can be altered on the job to any required discharge position by drilling new holes and rotating blower housing on base and bolting in position. Adjustable top motor mount quickly changed from top to rear mounting. Rugged construction of heavy gauge steel throughout. Very quiet. High volume at low velocity. Over-sized ball bearings. Air deliveries are based on standard test codes of AMCA. Maximum operating temperature is 180°F (82.2°C). Gray finish. 40°C rise, continuous-duty Dayton resilient-mounted, automatic-reset thermally protected, blower motor and drive packed separately when blower is ordered complete. Request Bulletin 706.

BLOWER DIMENSIONS									Shpg. Wt.	
Stock No.	Wheel Dia. W	Shaft Dia.	Inlet Dia.	Outlet H	Outlet W	Overall H	Overall W	Overall D	Less Motor	With Motor
2C887	9" x 4½"	⅝"	9"	10⅛"	6½"	17"	11"	15"	24	40
2C888	10⅝ x 5¼	⅝	10	11¼	8	19	12	18	32	52
2C800	12½ x 6¼	⅞	13¼	13¼	9¼	27	15	22	60	80

CFM AIR DELIVERY AT RPM SHOWN(‡)							BLOWER Less Motor and Drive		BLOWER WITH 1725 RPM MOTOR & DRIVE				
									Motor Data			With Automatic Thermal Protection	
1/8" SP	1/4" SP	3/8" SP	1/2" SP	3/4" SP	1" SP	Blower RPM	Stock No.	Each	HP	Volts 60 Hz	Type	Stock No.	Each
1100	1000	890	800	475	—	1000	2C887	$67.58	1/4	115	Split	7C651	$98.55
1690*	1600	1480	1370	1140	—	1000	2C888	75.00	1/2	115	Split	7C652	123.02
(ƒ)	(ƒ)	(ƒ)	2100	1980	1460	875	2C800	118.75	1/2	115	Split	7C653	171.46

(‡) Overloaded below ¼" SP.
(ƒ) Overload—Not recommended for operation at this SP with specified HP.

MAINTENANCE

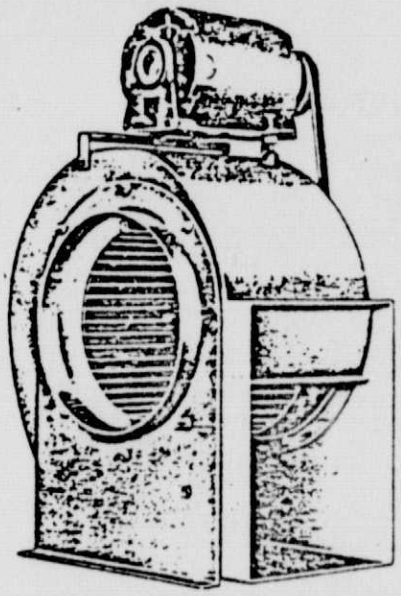
MOTOR - CHECK WIRING FOR SECURE CONNECTIONS. OILING IS NOT REQUIRED AS THIS MOTOR HAS SEALED BEARINGS.

PULLEY - CHECK PULLEY FOR SECURE FIT AND ALIGNMENT

BELT - CHECK BELT FOR WEAR AND REPLACE AS NECESSARY. ADJUST BELT TENSION MAKING SURE ALL MOTOR MOUNTING BOLTS ARE SECURE UPON COMPLETION OF MAINTENANCE INSPECTION.

SINGLE INLET BELT-DRIVE DUCT BLOWERS

Air Deliveries Based on Standard Test Codes of AMCA



9, 10⅝ & 12½", Single-Width, Multi-Vane Wheels
Adjustable on-the-Job to Any Discharge Position
Very Quiet. Adapts to Many General Applications

Economical single-inlet blowers with inlet unobstructed, for general duct ventilation, exhausting, air conditioning, processing and industrial use. Comes with bottom horizontal discharge which can be altered on the job to any required discharge position by drilling new holes and rotating blower housing on base and bolting in position. Adjustable top motor mount quickly changed from top to rear mounting.

Rugged construction of heavy gauge steel throughout. Very quiet. High volume at low velocity. Over-sized ball bearings for long life and dependable operation. Finished in baked-on gray enamel. Motor not included.

Air deliveries of blowers listed below are based on standard test codes of AMCA.

Dayton

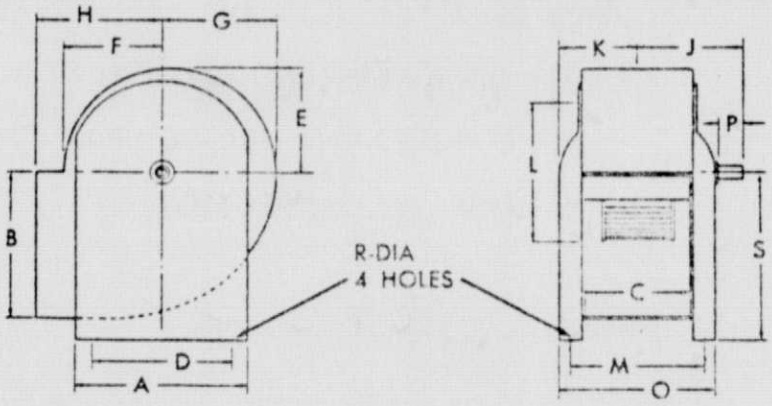
CFM AIR DELIVERY AT BLOWER RPM SHOWN

Model No.	⅛" SP	¼" SP	⅜" SP	½" SP	¾" SP	1" SP	RPM	HP	Shpg. Wt.
2C887	1100	1000	890	800	475	—	1000	1/4	25
2C888	1690	1600	1480	1370	1140	—	1000	1/2	36
2C800	I	I	I	2100	1980	1460	875	1/2	60

(*) Overlooded below ⅛" SP. (‡) Overlooded at this SP at specified HP.

BLOWER DIMENSIONS

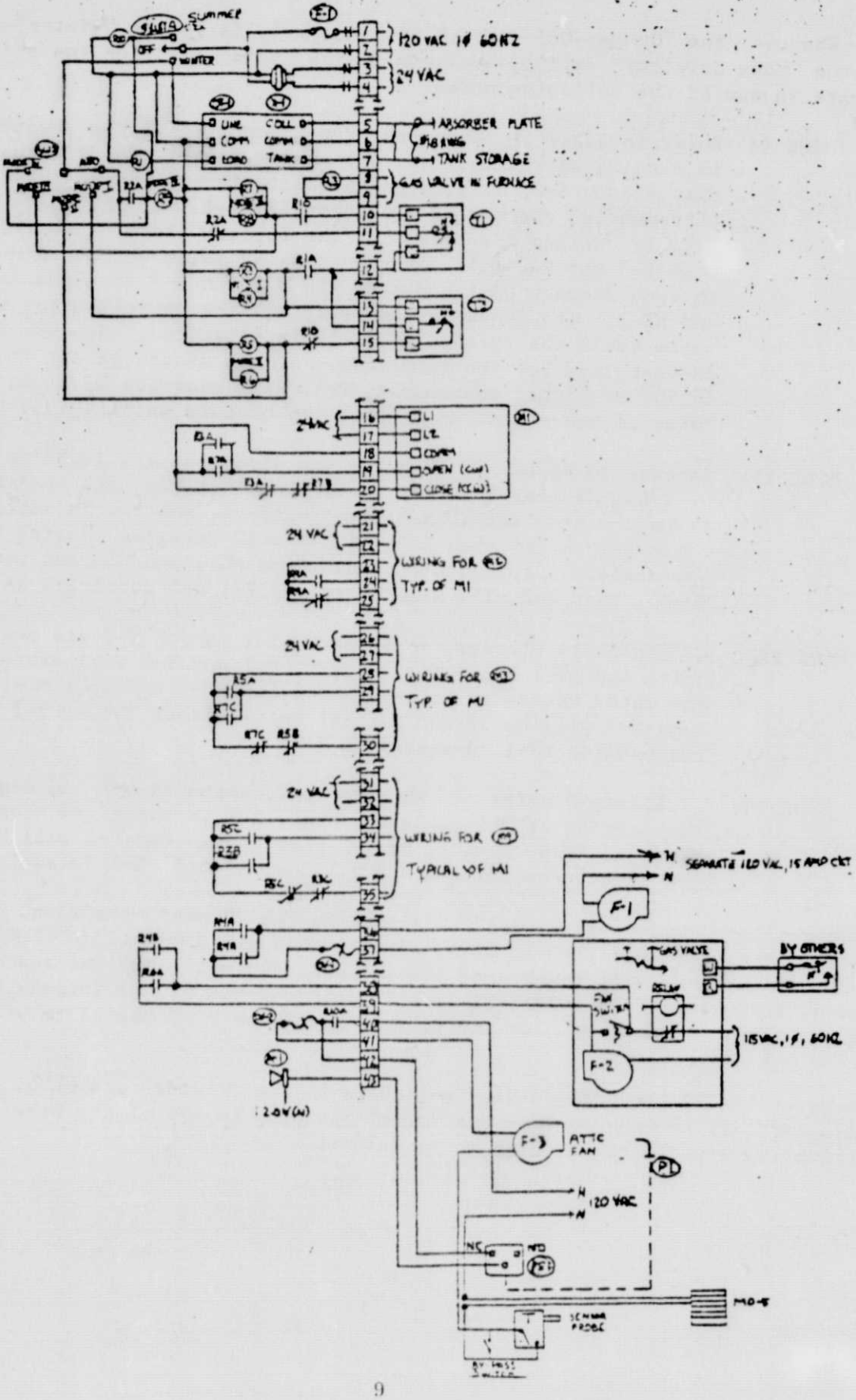
Model No.	Wheel Dia.	Size W	Shaft Dia.	A	B	C	D	E	F	G	H	J	K	L	M	O	P	R	S
2C887	9	4½	⅝	10⅜	10¾	6½	9	6 13/16	5⅛	7 13/14	7⅛	6¼	4½	8 13/16	7¾	8¾	1½	7/16	9⅛
2C888	10⅝	5¼	¾	12¾	11¾	8	11½	7 15/16	6 11/16	9 3/16	8⅛	7	5⅛	9 15/16	9½	10½	1½	7/16	11⅛
2C800	12½	6½	¾	16⅜	13¼	9⅜	14¾	10⅛	8¼	11½	10½	8¼	6⅜	13¼	11⅛	12¾	2	9/16	17



DAYTON ELECTRIC MFG. CO. GENERAL OFFICES CHICAGO

Litho in U.S.A. 76/22

WIRING DIAGRAM



DESCRIPTION OF OPERATION

Whenever the "Summer-Off-Winter" switch, SW-1, is in the "Winter" position and the "Mode Selector" switch, SW-2, is in the "Auto" position the system will operate in one of the following modes:

MODE I: Solar to Space - When sensor S-1, mounted on the absorber plate, is sensing approximately 110°F and is hotter than the temperature that sensor S-2, located in the heat storage tank, is sensing, the differential thermostat will energize R-1. If the space thermostat, T-1, is calling for heat, but the furnace thermostat, T-2, is not, then R-3 and R-4 will energize causing motor actuators M-1 and M-4 to open dampers MD-1 and MD-4 and M-2 and M-3 to close dampers MD-2 and MD-3. The fans, F-1 and F-2, will be on delivering heat to the space until the thermostat, T-1, is satisfied. However if DT-1 is de-energized but the temperature of the discharge air from the absorber is 90° or higher thermostat, T-3, will override DT-1 and allow the Solar to Space mode to continue to operate until T-1 is satisfied.

MODE II: Storage to Space - Whenever the discharge air is below 90°F, and DT-1 has de-energized R-I indicating that the tank storage temperature is hotter than the abosrber temperature, and T-1 is calling for heat while T-2 is not then R-5 and R-6 will energize causing the appropriate motor actuators to close MD-1 and MD-2 and open MD-3 and MD-4. Fans F-2 will also be on and F-1 off until T-1 is satisfied.

MODE III: Collector to Storage - Whenever T-1 and/or T-2 are not calling for heat, and DT-1 has energized R-1, R-7 and R-8 will energize actuating the motor actuators to close MD-2 and MD-4 and open MD-1 and MD-3. Fans F-1 will be on and F-2 off until either T-1 or T-2 call for heat and/or DT-1 de-energizes R-1.

MODE IV: Auxiliary Heating - Whenever T-2, which is set 2 degrees below the setting of T-1 calls for heat, R-2 is energized causing MD-1, MD-3 and MD-4 to close and MD-2 to open. Fan F-1 will be off while the furnace burner and fan will be on until T-2 is satisfied.

Whenever the "Summer-Off-Winter" switch is in the "Summer" position, R-10 is energized closing MD-1, MD-3, MD-4, opening MD-2 and ENERGIZING THE ATTIC FAN CICUIT F-3. Alarm, A-1, will sound upon initial start-up until the fan reaches full speed, activating flow switch PE-1, silencing the alarm. If for any reason R-10 is energized and abnormal low air flow is sensed by PE-1 the alarm will sound.

Whenever the "Summer-Off-Winter" switch is in the "Winter" position, the Mode Selector" may be indexed from the "Auto" position to any of the other four positions activating any one of the four modes desired.

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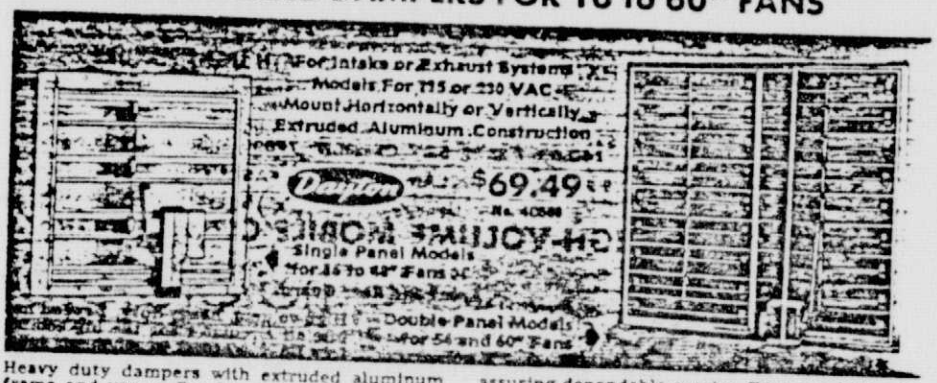
MOTORIZED DAMPERS FOR 16 to 60" FANS



Heavy duty dampers with extruded aluminum frame and vanes. Can be mounted horizontally or vertically. For intake or exhaust applications. The rod linkage is attached to vanes on fan side, assuring dependable service. Frame is 2" D with 1½" flange. Ample ⅝" dia. mounting holes. 16 to 48" units are single panel, 54 to 60" are double panel. Dayton brand.

For Fan Diameter	Volts, 60/50 Hz	(*) Overall Square	Opening Required, Square	Motor Bracket Extension(†)	Stock No.	Retail	Each	Shpg. Wt.
16"	115	19"	17¼"	6¾"	4C560	$104.25	$69.49	18
16	230	19	17¼	6¾	4C562	104.25	69.49	18
20	115	23	21¼	6¾	4C561	110.80	73.85	20
20	230	23	21¼	6¾	4C563	110.80	73.85	20
24	115	27	25¼	6¾	3C315	123.00	82.00	25
24	230	27	25¼	6¾	3C316	123.00	82.00	25
30	24(‡)	33	31⅝	10¼	3C234	176.85	117.91	35
36	24(‡)	39	37⅝	10¼	3C131	205.00	136.65	44
42	24(‡)	45	43⅝	10¼	3C235	247.95	165.29	54
48	24(‡)	51	49⅝	10¼	3C132	298.55	199.03	81
54	230	57	55⅝	10¼	3C188(§)	425.05	283.35	90
60	230	63	61⅝	10¼	3C189(§)	476.80	317.88	101

(*) Including 1½" wide flange on all sides. (†) From damper frame to end of bracket.
(‡) 24V units have 115, 208-240V/24V, 60 Hz transformer for single or 3-phase power.
(§) Double panel damper.

716 NET WHOLESALE PRICES—W.W.GRAINGER, INC.

MAINTENANCE

MOTOR - CHECK WIRING FOR SECURE CONNECTIONS. TEST MOTOR PERIODICALLY TOCHECK FOR PROPER OPERATION.

DAMPER -CHECK DAMPER TO MAKE SURE IT SEALS PROPERLY AS WELL AS OPENS PROPERLY.

PENN BASO

PENN CONTROLS
DIVISION OF JOHNSON SERVICE COMPANY

T26
4054
NEW

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series T26

LINE VOLTAGE THERMOSTAT

Heating, Cooling, Combination Heating and Cooling
Standard Duty and Heavy Duty

APPLICATION

These line voltage thermostats control heating, cooling, or year 'round air conditioning units in commercial, industrial or residential installations. Typical uses are for unit heaters, fan coils, blast coils, refrigerated storage rooms, electric heat, duct furnaces, greenhouses, etc. Models are available with SPST or SPDT contact action and for standard duty (nominal 1/3 hp; 10 amps. non-inductive) or heavy duty (nominal 1 hp; 22 amps. non-inductive) applications. These thermostats are also suitable for low voltage applications.

Where critical or high value products are to be maintained at a specific temperature, a single thermostat should not be applied to perform as both an operating and a limit control. In these applications a separate limit control with alarm contacts should be wired to indicate when the limit control operates.

For line voltage thermostats with integral selector switches refer to Series T22, Bulletin 3233.

For low voltage thermostats refer to Series T51 and Y51 Bulletin 3144.

FEATURES

— Field adaptable to vertical/horizontal mounting and for knob, key or concealed adjustment.

— Knob, key or concealed set point adjuster.

— Low and high limit dial stops — concealed, adjustable throughout set point range. Can be set for locked dial. See Fig. 2.

— Locking cover with Phillips—head screws is standard.

— Close differential without need for anticipator.

— Internal dual celsius and fahrenheit scale is standard.

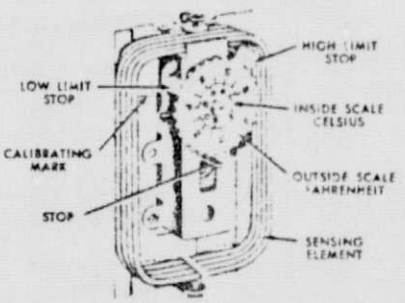


Fig. 2 — Interior of Series T26. Note how element is wrapped around inside of thermostat for maximum sensitivity. Integral adjustable high and low limit stops.

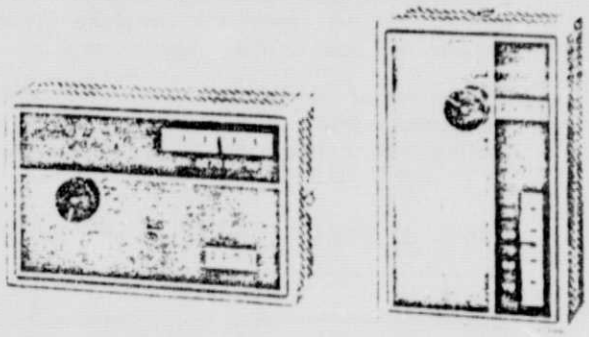


Fig. 1 — Series T26 thermostat with horizontal faceplate (left) or vertical faceplate (right).

— Enclosed Pennswitch contact unit — dependable, dust proof and field proven.

— Separable mounting plate allows easy mounting and wiring without removing thermostat cover.

— Switch mechanism and wiring terminals (=8 screws) go into switch box for safety and isolation of load from sensing element.

— Matching humidistat (Series W43A) is available, see Bulletin 3391.

GENERAL DESCRIPTION

These thermostats are extremely versatile. Using different field-installable faceplates, combinations of (1) vertical/horizontal mounting, (2) knob, key or concealed adjustment and (3) with or without thermometer indication are possible. These thermostats have metal locking covers with Phillips-head screws to discourage unauthorized tampering. The standard models are supplied with a faceplate installed for vertical mounting with knob adjustment and thermometer. A field installable faceplate for horizontal mounting is also included on wholesaler models. See Figs. 1 and 6. Standard models are SPDT for heating, cooling or heating and cooling applications.

Standard models can be changed in the field as follows:

1. To convert to key adjustment, remove the screw from center of knob and the knob becomes the key.

2. To convert to other configurations, for example concealed adjustment, select the faceplate kit that meets the desired requirements from the "Faceplate Selection Table" on Page 3.

The cover and faceplate design makes the thermostats adaptable to any decor. The thermostats have a sturdy

steel cover with "tawny silver" finish. The faceplate is dark brown and light brown with aluminum numbers and graduation marks. The internal dial on these thermostats has a dual Fahrenheit-Celsius scale, see Fig. 2. When a faceplate with Celsius thermometer and set point scale is used the thermostat is totally Celsius.

The liquid charged sensing element is formed to achieve maximum sensitivity to surrounding air temperature changes (see Fig. 2). Coupled with a highly efficient diaphragm and leverage mechanism, the element operates a totally enclosed Pennswitch contact unit for close differential and dependable switching action without the use of "heat or cool" anticipators.

Elimination of anticipators increases versatility of these thermostats, which may be used on heating and/or cooling over a wide range of current loads, either on 24 V., 120 V. or 240 V. systems.

TYPE NUMBER SELECTION

Type Number	Function	Typical Application
HEATING		
T26A	SPST heating	Fig. 7
T26B	SPST heavy duty heating	Fig. 7
COOLING		
T26J	SPST cooling	Fig. 8
HEATING, COOLING OR HEATING AND COOLING		
T26S	SPDT heating and cooling	Figs. 9 thru 13
T26T	SPDT heavy duty heating and cooling	Figs. 9 thru 13

SPECIFICATIONS

Thermostat Range °F. (°C.)	Thermometer Range °F. (°C.)
40 to 90 (5 to 30)	50 to 90 (10 to 30)

Mechanical Differential: Approximately 0.7° F. (.4° C.).

Operating Differential: The operating temperature differential of any self-contained thermostat depends on the current flowing through the thermostat (amperage load), the velocity of air over the thermostat, the rate of temperature change to which the thermostat is subjected and whether the thermostat is operating heating or cooling equipment.

Graphs (Figs. 3 and 4) show the operating temperature differentials of these thermostats under various load conditions. These curves are based on tests made in a NEMA standard test box according to NEMA standard

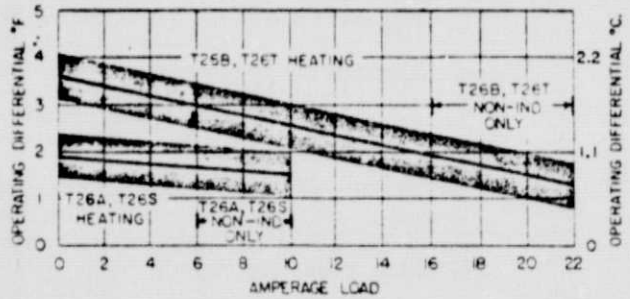


Fig. 3 — Operating differential for Series T26A and heating side of Series T26S (lower graph line). Upper graph line illustrates differential for T26B and heating side of T26T.

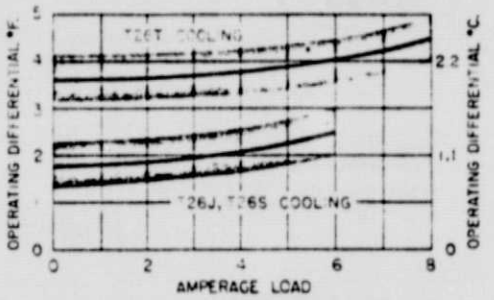


Fig. 4 — Operating differential for Series T26J and cooling side of Series T26S (lower graph line). Upper graph line illustrates differential for cooling side of Series T26T.

The heavy line in each of the above figures is the nominal operating temperature differential. Production thermostats may vary from the norm as indicated by the shaded areas.

DC3-1959. The air velocity was 25 feet per minute (.127 m/sec.) and the rate of temperature change was 6° F. (3.3° C.) per hour. For air velocities greater than 25 feet per minute and/or for rates of temperature change less than 6° F. per hour, the operating differentials will be less than shown in Figures 3 and 4.

Base: .050" (1.27 mm) cold rolled steel. Baked on "tawny silver" finish.

Cover: .025" (.64 mm) cold rolled steel. Baked on "tawny silver" finish. Faceplate is dark brown and light brown with aluminum letters and markings.

Mounting: Separable mounting plate, see Figs. 5 and 6.

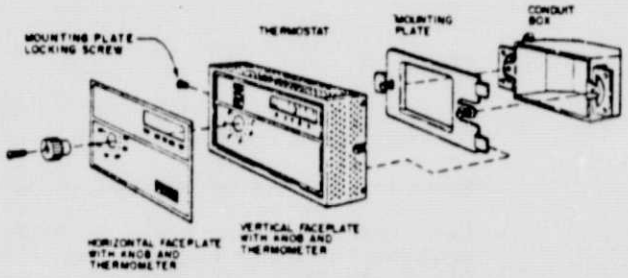


Fig. 5 — Line drawing illustrating method of mounting a vertical thermostat to a horizontal outlet box and installing a horizontal faceplate.

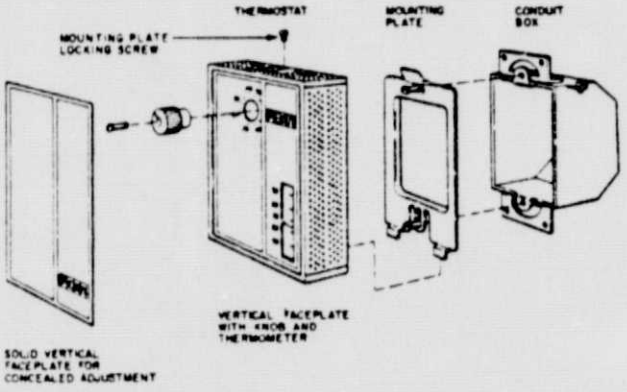


Fig. 6 — Line drawing illustrating method of mounting a vertical thermostat to outlet box. Also shown is a solid vertical faceplate for concealed adjustment when desired.

PENN SERIES T26 LINE VOLTAGE THERMOSTAT

Sensing Element: Liquid charged for positive trouble free operation.

Thermometer: Bimetal type for accuracy and clarity. Thermometer may be quickly calibrated, if ever required, by turning hex-head screw inside cover.

Wiring: All wiring is connected to large, easily accessible wiring terminals located on the contact unit at the back of thermostat. Terminal identification markings are stamped on the back of the case.

ELECTRICAL RATINGS

Type T26A, T26S

Motor Ratings	120 V.	208 V.	240 V.	277 V.
A. C. Full Load Amps.	6.0	3.5	3.0	—
A. C. Locked Rotor Amps.	36.0	21.0	18.0	—
A. C. Non-inductive Amps.	10.0	10.0	10.0	10.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.				

Type T26J

Motor Ratings	120 V.	208 V.	240 V.
A. C. Full Load Amps	6.0	3.5	3.0
A. C. Locked Rotor Amps.	36.0	21.0	18.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.			

Type T26B and Heating Side of T26T

Motor Ratings	120 V.	208 V.	240 V.	277 V.
A. C. Full Load Amps	16.0	9.2	8.0	—
A. C. Locked Rotor Amps.	96.0	55.2	48.0	—
A.C. Non-Ind. Amps.	22.0	22.0	22.0	22.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.				

Cooling Side of T26T

Motor Ratings	120 V.	208 V.	240 V.
A. C. Full Load Amps	8.0	8.0	8.0
A. C. Locked Rotor Amps.	48.0	48.0	48.0
Pilot Duty — 125 VA. 24 to 277 V. A.C.			

TYPICAL APPLICATION DIAGRAMS

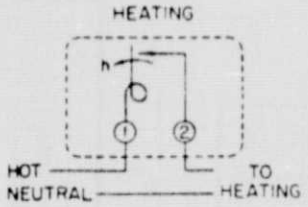


Fig. 7 — Internal diagram of Type T26A and T26B

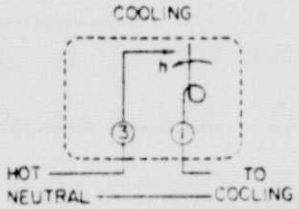


Fig. 8 — Internal diagram of Type T26J.

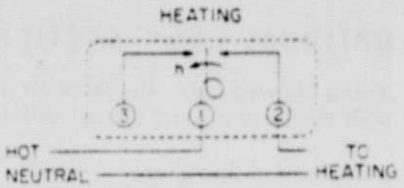


Fig. 9 — Types T26S, T26T wired for heating application.

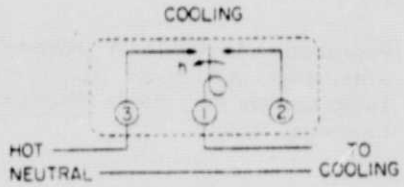


Fig. 10 — Types T26S, T26T wired for cooling application.

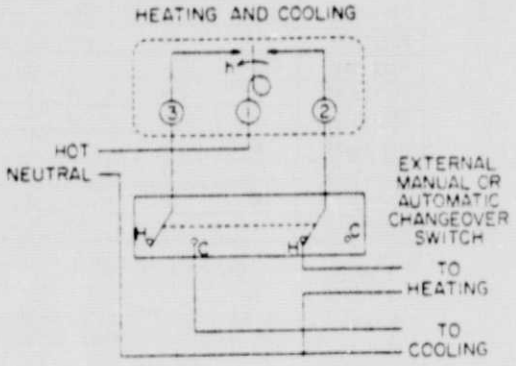


Fig. 11 — Types T26S, T26T wired for heating and cooling with manual or automatic changeover switch.

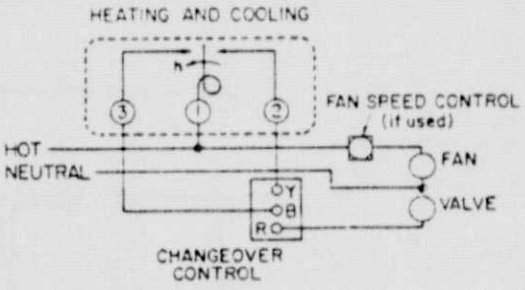


Fig. 12 — Types T26S, T26T on fan-coil unit with cycling valve continuous fan. Terminal markings shown for Type A19CAC changeover control.

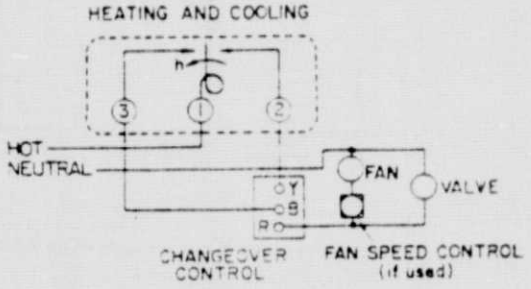


Fig. 13 — Types T26S, T26T on fan-coil unit with cycling fan and valve. Terminal markings shown for Type A19CAC changeover control.

PENN SERIES T26 LINE VOLTAGE THERMOSTAT

OPTIONAL CONSTRUCTIONS

Brand Nameplates: Available on quantity orders. Check with the nearest Penn district office or Customer Service.

Concealed Adjustment: Available on factory order at no extra cost. For field changeover use the concealed faceplate kit and install directly over the faceplate on the cover. Locking cover screws are supplied in the faceplate kit.

Faceplates: Available in separate kits for on-the job installation. All plates have peel-off backing strips. Faceplates are available in all combinations shown in the following table.

FACEPLATE SELECTION TABLE

Kit Number	Mounting Position		Type of Adjustment		Thermometer	
	Vertical	Horizontal	Knob	Concealed	Yes	No
PLT213-5	—	X	—	X	—	X
PLT213-6	X	—	—	X	—	X
PLT213-9*	X	—	X	—	X	—
PLT213-11*	—	X	X	—	X	—
PLT213-15	X	—	—	X	X	—
PLT213-16	—	X	—	X	X	—
PLT213-17	X	—	X	—	—	X
PLT213-18	—	X	X	—	—	X

* Supplied with standard wholesaler models (vertical is factory installed).

Faceplates must be ordered in multiples of ten. Consult Penn salesman or Customer Service for Celsius set point dials or thermometer plates.

Key Adjustment: Remove the knob and keep for key adjustment when set point change is desired.

Locking Cover: Standard construction has Phillips-head cover screws. Allen-head cover screws and wrench are available in a kit for field installation, specify Kit No. SCR15A-600.

Thermostat Guards: Plastic, wire or cast aluminum guards are available at extra cost. See condensed catalog or "GRD" Bulletin No. 3860.

SHIPPING WEIGHTS

Individual Pack — lbs. (kg)	Overpack of 20 Units — lbs. (kg)
1.0 (.45)	22.0 (9.9)

REPAIRS AND REPLACEMENT

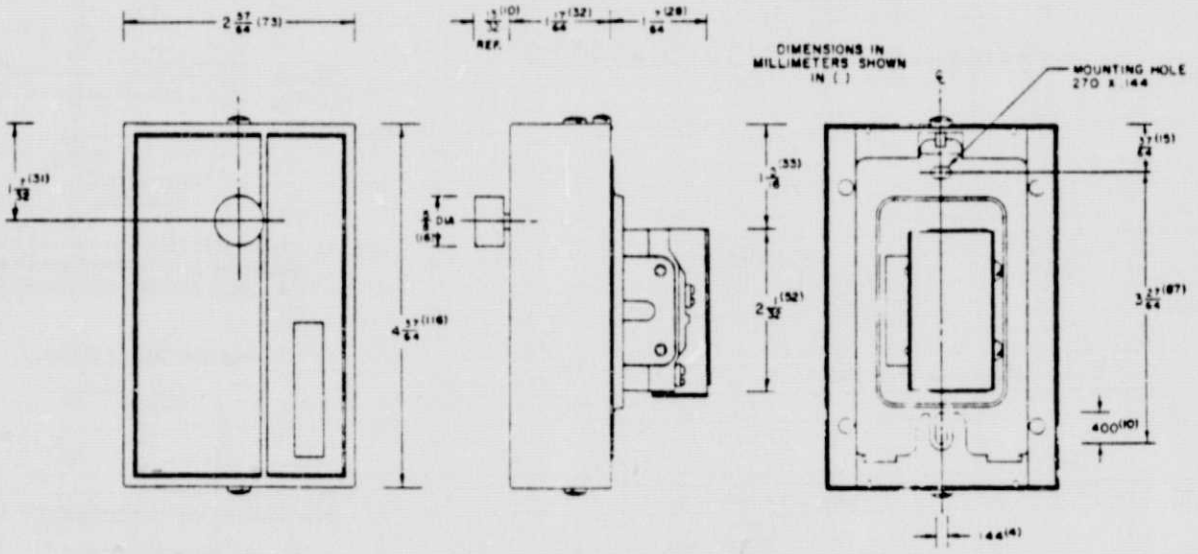
Field repairs must not be made. Replacement thermostats may be obtained from the nearest Penn-Baso Counterline Wholesaler. When ordering a replacement thermostat, specify Product Number and Serial Number as shown on cover label of the thermostat.

ORDERING INFORMATION

To order, specify:

1. Product Number, consult condensed catalog.
2. Faceplate kit, if other than standard is required. Order in multiples of ten.
3. Other optional construction features, if required (quantity orders only).
   a. Faceplate required if other than standard vertical.
   b. SPST contact action.
   c. Brand nameplate.

DIMENSIONS



Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

PENN CONTROLS
DIVISION OF JOHNSON SERVICE COMPANY
2221 CAMDEN COURT, OAK BROOK, ILL. 60521

Litho in U.S.A.

4-5-75

series A19

UTILITY THERMOSTATS

For Farm, Industrial and Commercial Use

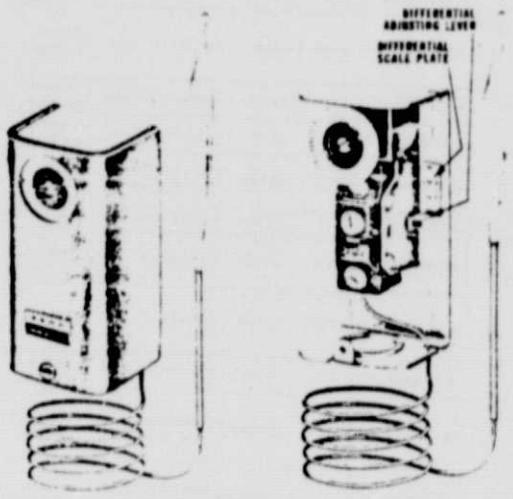


Fig. 1 — (Left) Control with external range scale, screwdriver adjustment. (Right) Interior of model with adjustable differential.

APPLICATION

These temperature controls are designed to cover a broad range of uses for heating and general purpose requirements. See "Application" column, "Specifications" Page 2, for typical uses. Controls have SPST contacts which open on temperature increase or they may be supplied in single-pole, double-throw contact action.

Various control ranges are available to cover working temperatures from -30 to 550° F. Closed tank fittings and bulb wells are available for immersion applications.

For single stage and two stage farm building wall thermostats see Bulletin 3542. For temperature controls for cooling applications see Bulletin 3531.

ADVANTAGES

1. Dependability . . . precision snap-acting contacts in dust-tight enclosure.
2. Dependability . . . low volume, responsive liquid filled sensing elements.
3. Wide choice of temperature control functions with a minimum number of models.
4. Precision "repeat" accuracy which is unaffected by barometric pressure and cross ambient problems.
5. Special close differential models available for critical requirements.

GENERAL DESCRIPTION

The Series A19 is a small, compact control with adjustable or non-adjustable differential. Models with adjustable differential and ranges of 20/80° F. and -30/+50° F. have a differential scale plate showing differential in degrees. Other ranges have a scale plate (see Fig. 1) with a multiplier shown. For example when "min" differential is 5° F. then X2 is 10° F., X3 is 15° F., etc. The controls are supplied with adjusting lever at minimum differential stamped on the control. To adjust move the lever to the differential required. Models are available with or without external range adjustment and visible scale. External range adjustment may be by screwdriver slot (Fig. 1) or range adjusting knob (Fig. 2).

A built-in, high limit stop is an integral part of these controls and may be adjusted quickly and easily in the field.

Model Number A19BAG-1 is specially designed for portable heaters. It is supplied with a 6' cord, 120 V. A.C. polarized plug, and a chain hanger kit.

Fig. 2 — Space thermostat with Style 3 coiled bulb and finger-tip adjusting knob.

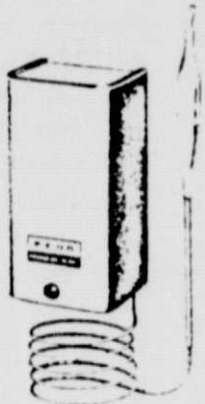


Fig. 3 — Control with plain cover, concealed adjustment.

ELECTRICAL SPECIFICATIONS

Types A19AAB, A19AAC, A19BAB, A19BAC

Volts A.C.	120	208	240
Full Load Amps.	16.0	9.2	8.0
Locked Rotor Amps.	96.0	55.2	48.0
Non-Inductive or Resistance Load Amps. (Not Lamp Loads)	* 22 Amps. 120 to 277 V. A.C.		
Pilot Duty — 125 VA. 24 to 600 V. A.C.			

* SPST RATING

Type A19AAE

Volts A.C.	120	208	240
Full Load Amps.	6.0	3.4	3.0
Locked Rotor Amps.	36.0	20.4	18.0
Non-Inductive or Resistance Load Amps. (Not Lamp Loads)	10 Amps. 120 to 277 V. A.C.		
Pilot Duty — 125 VA. 24 to 277 V. A.C.			

SERIES A19 UTILITY THERMOSTATS

SPECIFICATIONS

Model Number	Replaces Code No.	Replaces Type No.	Application	Switch Action	Range °F.	Diff. °F.	Max. Bulb Temp. °F. ①	Bulb Style	Bulb Size and Finish	Bulb Well if Req'd.	Cap Length	Bulb Support	Cover Plain	Cover Scale	Range Adjuster Screwdriver Slot	Range Adjuster Knob
A19AAB-4	7T3	6218	Fluid Limit	Opens on Rise	30 to 110	3	140	1	⅜ x 4 13/16"	239-608	6'	3"		X	X	
A19AAB-5	7T19	6218	Hot Water Limit	Opens on Rise	100 to 250	5	290	2	.290 x 2 11/16"	Direct Immersion ½" NPT Conn.	None	—		X		X
A19AAB-7	7T9	6218	Industrial Oven	Opens on Rise	100 to 300	7	350	1	3/16 x 10 7/8"	—	6'	—		X		X
A19AAB-10	7T10	6218	Industrial Oven	Opens on Rise	200 to 550	10	620	1	3/16 x 5 5/8"	—	6'	—		X		X
A19AAC-1	7T6	6218X	Dual Fuel Changeover	SPDT	−30 to +50	5	140	1	⅜ x 4 13/16"	Outdoor Shield Supplied	6'	3"	X		X	
A19AAC-9	7T7	6218X	Fluid Limit	SPDT	100 to 250	6	290	1	⅜ x 3 9/16"	239-608	6'	3"		X	X	
A19AAC-11	7T8	6218X	Fluid Limit	SPDT	100 to 250	6	290	2	.290 x 2 11/16"	Direct Immersion 431-605	None	—		X	X	
A19AAC-12	7T20	6218X	Hot Water	SPDT	100 to 250	5	290	2	.290 x 1 13/16"	Direct Immersion ½" NPT Conn.	None	—		X		X
A19AAE-3	7T11	6218C	Crop Drying	Opens on Rise	80 to 180	2	200	7	1/8 x 1 1/4" Copper Coil	—	10'	—		X		X
A19ADB-2	8T20	6218AN	Hot Water Limit Manual Reset	Opens on Rise	100 to 250	Lock-out	290	2	.290 x 2 11/16"	Direct Immersion ½" Conn.	None	—		X		X
A19ADB-3	—	6218AN	Hot Water Limit Manual Reset	Opens on Rise	100 to 250	Lock-out	290	2	290 x 2 11/16"	Direct Immersion ¾" Conn.	None	—		X		X
A19BAB-3	7T2	6218	Heating	Opens on Rise	35 to 95	3	140	3	Coil	—	None	—		X		X
A19BAC-1	7T1	6218X	Farm Thermostat Heat or Ventilate	SPDT	30 to 110	3	140	3	Coil	—	None	—		X		X
A19BAG-1	7T13	6218T	Portable Heater (with Cord and 120 V. A.C. Polarized Plug)	Opens on Rise	35 to 95	3	140	3	Coil	—	None	—		X		X

① Maximum bulb temperature which the element can withstand at infrequent intervals during life of control, such as shipping conditions. This is not the temperature which the control can withstand on repeat cycles.

OPTIONAL CONSTRUCTIONS

NOTE: For most prompt service, select controls listed under "Specifications," above. If these are not entirely suitable for your application, then the following variations are available. Consult factory or nearest Penn representative.

Contact Unit: Close differential or special close differential may be supplied.

Ranges: Ranges may be supplied other than those shown in "Specification" table.

Capillary Tube: Additional length of capillary over 6' available at extra cost. Extra length in 2' increments from 6' to 10'; over 10' in 5' increments.

Armored Capillary: Single braided copper armor may be supplied at extra cost.

Range Adjustments: Concealed dial with screwdriver slot (plain cover), exposed dial with screwdriver slot, dial and knob adjustment or models with factory sealed setting may be supplied (see Figs. 1, 2, 3).

Sealed Stop: Available at extra cost.

Adjustable Differential: Available at extra cost.

MISCELLANEOUS SPECIFICATIONS

Case: .062" cold rolled steel. Special corrosion resistant dichromate dip finish.

Cover: .025" cold rolled steel. Gray baked enamel finish.

Contact Unit: Precision Pennswitch. Snap acting contacts in dust-tight enclosure.

Mounting Bracket: Optional at extra cost.

SHIPPING WEIGHTS

Shipping weights shown below are approximate. Weights vary depending upon construction. Generally, outer pack will contain 25 individually packed controls.

Individual pack: 1.0 lb.

Outer pack containing 25 individually packed units: 26.0 lbs.

ORDERING INFORMATION

1. Specify Model Number only, if available (see "Specifications" chart).
2. If Model Number is not available specify Type Number (see "Type Number Selection" chart).
   a. Capillary length.
   b. Range.
   c. Bulb style.
   d. Bulb well, if required.
   e. Packing nut, if required.
   f. Any other miscellaneous specifications.

REPAIRS AND REPLACEMENT

Repairs are not recommended in the field other than replacement of the cover, well assembly and packing nut assembly. When ordering replacement parts, give control Model and Serial Numbers. Controls requiring attention should be returned to the factory or nearest Penn-Baso Counterline Wholesaler for inspection and service.

ELEMENT STYLES

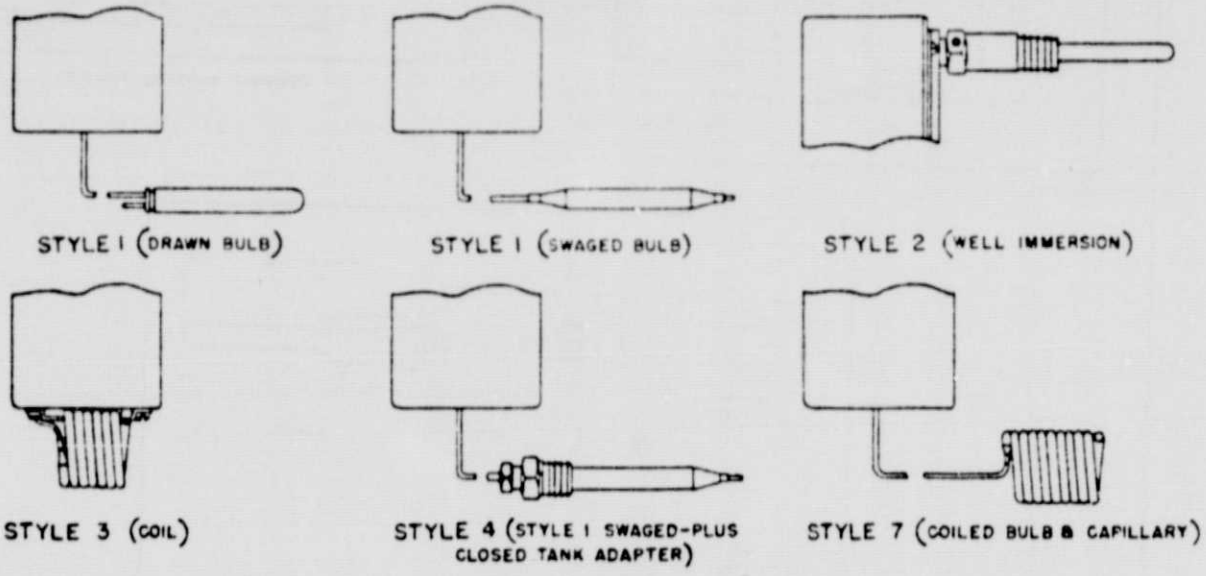
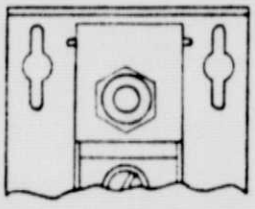
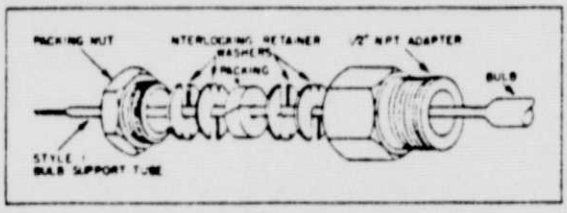


Fig. 4 — Element styles available on Series A19

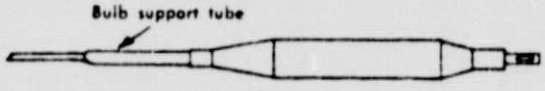
BULB AND BULB ACCESSORIES



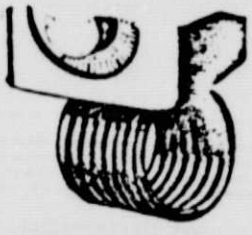
Optional factory sealed setting available on quantity orders.



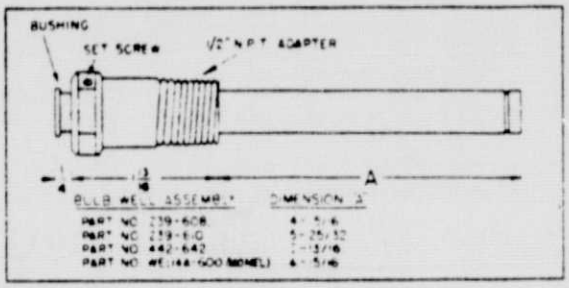
Part No. 442-638 packing nut assembly. (Use with Style 1 bulb with support tube for direct immersion application.)



Style 1 swaged bulb with support tube.

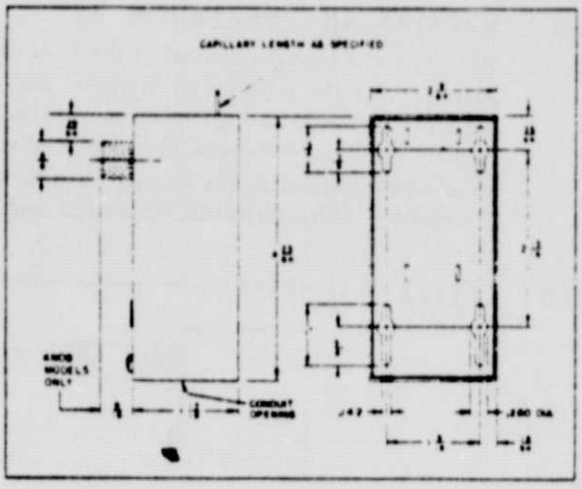


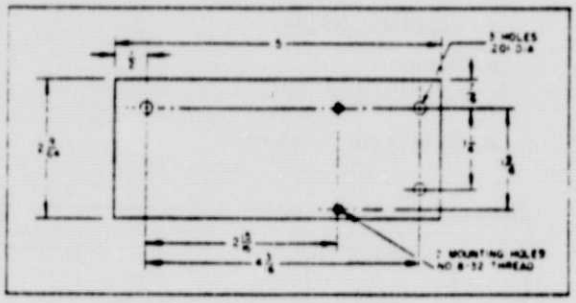
Style 3 element attached to the case.



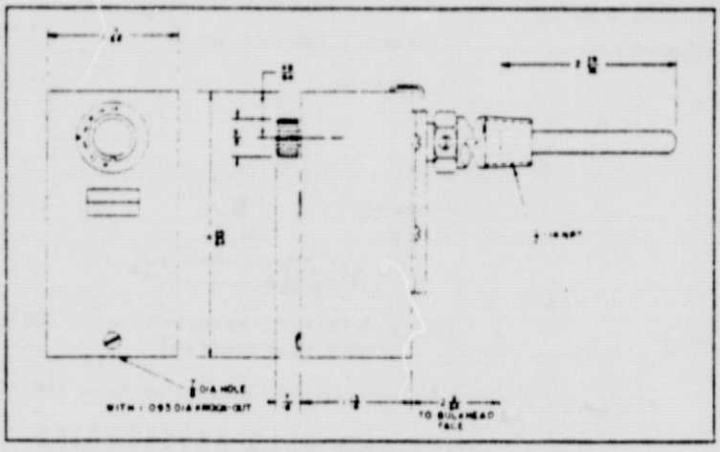
Bulb well dimensions.

DIMENSION DRAWINGS





Optional mounting bracket.



Style 2.

series M40A, M40B

MEDIUM DUTY MOTOR ACTUATOR

On-Off, Floating and Proportional Action

APPLICATION

These motor actuators position air dampers, burner fuel valves and similar equipment in heating, air conditioning and industrial applications.

FEATURES

- Long-lived shaded pole primary motors.
- Die-cast aluminum housing.
- On-off models have enclosed, snap acting travel limit switches.
- Proportional models have solid state motor drive — self contained within motor case. No balance relay or mechanical travel limit switches.
- Proportional models accept inputs from most three-wire potentiometer controllers, 135 up to 1000 ohms, with no readjustment required.
- Models available with adjustable internal auxiliary switches.
- Both 120 V. A.C. and 24 V. A.C. versions, all with low voltage control circuitry.
- Proportional action models with dual travel for wholesaler stock.

GENERAL DESCRIPTION

These motor actuators have shaded pole motors enclosed in a gasketed die-cast aluminum case with mounting feet. They have a hardened steel output shaft.

The Series M40 motor actuator is available in on-off models and proportional models with solid state drive and travel limits.

The on-off models require low voltage SPDT controllers, snap acting or floating. They have cam-operated snap-acting travel limit switches that stop the shaft rotation at determined limits of travel. Travel is field adjustable from 90 to 270 angular degrees.

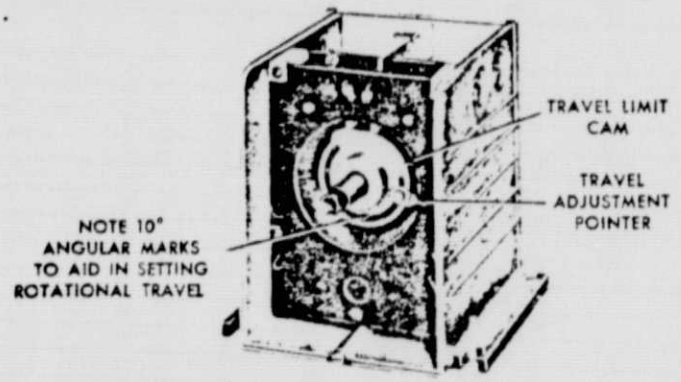


Fig. 2 — Internal view of Series M40A motor actuator showing adjustable travel limit cam.

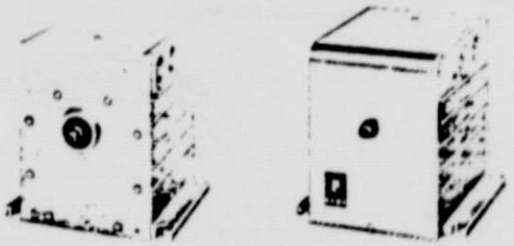


Fig. 1 — Series M40 motor actuator. Load end view (left) and back view (right).

The proportional model requires a low voltage three wire, 135 to 1000 ohms, potentiometer controller. It has solid state drive and limits that prevents erratic control performance often caused by excessive vibrations. The actuator will accurately position its output shaft in direct proportion to the control signal. OEM models are factory set at 90°, or at other specified rotation up to 160° on quantity orders. Dual travel models for wholesalers have a jumper installed for 90° travel. Remove the jumper located in the wiring compartment when 160° travel is required.

The motor should travel through its full stroke (determined by its limit switches) while performing its function, even though the motor's full range may not be employed. Motor may be *damaged* if it is not free to complete its full stroke. The motor should be stopped at the end of its stroke by the limit switch, *not* stalled by the damper or valve.

SPECIFICATIONS

Ambient Temperatures: Minimum −40° F. (−40° C.); maximum 130° F. (54° C.).

Built-In Auxiliary Switches: SPDT, adjustable operating points from 0 to 160° of motor rotation. Adjustable differential from 5 to 90°

ELECTRICAL RATINGS

Volts A.C.	120	240	277
Full Load Amps.	5.8	2.9	2.6
Locked Rotor Amps.	34.8	17.4	15.6
Non-Inductive Amps.	10.0	8.3	7.2
Pilot Duty 125 VA., 24 to 277 V. A.C.			

SPDT Switch ratings at ambient temperatures to 131° F. (55° C.)

Factory Setting for Auxiliary Switch: 15 ± 5° from CCW travel limit with minimum differential, unless otherwise specified.

Conduit Opening: Two openings with knockout for ½" conduit on each side of wiring compartment.

Control Signal Input (Low Voltage): On-off models — SPDT, snap acting or floating control; Proportional models—135 to 1000 ohms, ½ watt, 3 lead potentiometer.

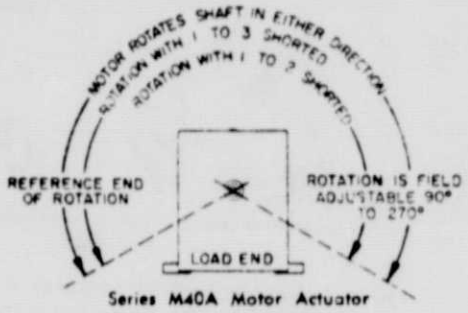
PENN SERIES M40A, M40B MEDIUM DUTY MOTOR ACTUATOR

Enclosure: Die cast aluminum body. Rolled aluminum cover with gasket.

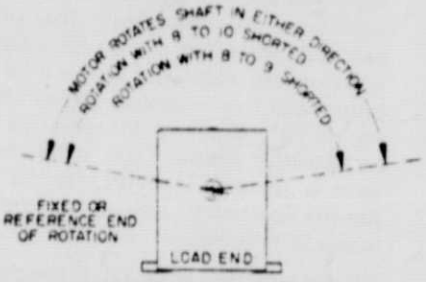
Mounting Position: Mount with shaft horizontal.

Power Requirement: 40 VA., 120 Volts A.C. or 24 Volts A.C., 50/60 Hz.

Rotation: Direction of rotation when viewing load end (end opposite cover).



Series M40A Motor Actuator



Series M40B Motor Actuator

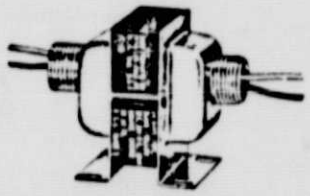
Shaft Specification: ½" diameter double ended shaft with ⅜" square on each end.

ACCESSORIES

Transformers: A transformer is required to provide low voltage motor actuators with the necessary 24 volt A.C. power supply. Plate mounted transformers mount on a 4" electrical box. Transformers No. Y65AS-1 and Y65-BS-1 have a ½" conduit fitting on the primary and secondary to permit direct mounting into the conduit opening in the motor wiring compartment. See Penn Series Y63, Y64 and Y65 Bulletin No. 3742 for additional information.

Transformer Capacity	Type Mounting	Primary Power Supply (V. A.C.)	Transformer Part No.
40 VA.	Plate	120	Y65AJ-1
		240	Y65BJ-1
	Foot	120	Y65AS-1
		240	Y65BS-1
50 VA.	Plate	120	Y63AJB-1
		480	Y63KJB-1
		208/240	Y63SJB-1
	Foot	120	Y63ALB-2
		208/240	Y63SLB-2
100 VA.	Plate	120	Y64AJ-1
		208/240	Y64SJ-1
	Foot	120	Y64AL-2
		208/240	Y64SL-1


Plate mounted transformer is illustrated above


Foot mounted 40 VA. transformer, Y65BS-1 is shown

Valve: The M40 motor actuator can be used with Series V90 valves. Use Product No. Y20EAA-1 valve linkage when installing the Series M40 on valve body. Refer to Bulletin No. 3428 when using Type V90SA butterfly valve.

SPECIFICATIONS

Product Number	A. C. Volts	*Timing Secs./90°	Travel Factory Set	Torque Lb.-Inches	Damper Rating-Sq. Ft.	Auxiliary Switches
ON/OFF ACTION						
M40AAA-1	120	34	90	35	25	None
M40AAB-1	120	34	90	35	25	1
M40AAC-1	120	34	90	35	25	2
M40AGA-1	24	34	90	35	25	None
M40AGB-1	24	34	90	35	25	1
M40AGC-1	24	34	90	35	25	2
PROPORTIONAL ACTION						
M40BAA-2	120	34	90	35	25	None
M40BAA-4	120	34	90/160**	35	25	None
M40BAB-1	120	34	90	35	25	1
M40BAB-2	120	34	90/160**	35	25	1
M40BAC-1	120	34	90	35	25	2
M40BAC-2	120	34	90/160**	35	25	2
M40BGA-1	24	34	90	35	25	None
M40BGA-2	24	34	90/160**	35	25	None
M40BGB-1	24	34	90	35	25	1
M40BGB-2	24	34	90/160**	35	25	1
M40BGC-1	24	34	90	35	25	2
M40BGC-2	24	34	90/160**	35	25	2

*This is 60 seconds at 160° travel.

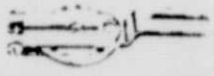
**Dual travel model with jumper installed for 90° travel. Remove the jumper for 160° travel.

PENN SERIES M40A, M40B MEDIUM DUTY MOTOR ACTUATOR

Damper Linkage Components: A variety of crank arms, ball joint connectors, push rods and right angle mounting bracket provide easy connection of the motor actuator to a damper. Two complete sets are offered to simplify selection of proper components.

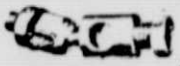
Description	Part No.	Application or Construction
Damper Linkage Set	Y20DAA-2	For mounting of actuator to top of duct or any flat surface. Contains LVR27A-602, LVR27A-600, SWL10A-601 (2 ea.), and ROD16-3.
	Y20DAB-2	For mounting of actuator to side of duct or wall. Contains LVR27A-602, LVR27A-600, SWL10A-601 (2 ea.), ROD16-3, and BKT22A-602.
Crank Arms	LVR27A-600	For use on ½" or ⅜" diameter damper shafts. Adjustable radius from ¾" to 4½".
	LVR27A-602	For use on motor actuator. Adjustable radius from 1 11/16" to 2⅛".
	BKT19A-600	Damper angle bracket to connect linkage to damper blade.
Ball Joint Connector	SWL10A-601	With ¼"-28 diameter stud—use with LVR27A-602, LVR27A-600, and BKT-19A-600 crank arms.
Push Rods	ROD16-2	⅜" diameter x 48" long plated steel shaft.
	ROD16-3	⅜" diameter x 24" long plated steel shaft.
Mounting Bracket	BKT22A-602	Right angle mounting bracket.

RIGHT ANGLE BRACKET
BKT22A-602

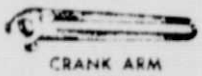


CRANK ARM ASSEMBLY
LVR27A-602

DAMPER BRACKET
BKT19A-600



BALL-JOINT
CONNECTOR
SWL10A-601



CRANK ARM
LVR27A-600

SHIPPING WEIGHT (Approx.)

Individual Pack: 6½ lbs. (2.9 kg.)

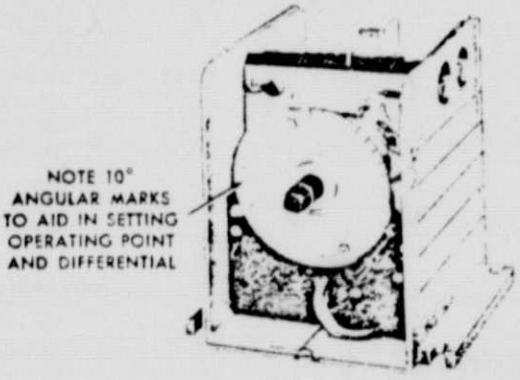


Fig. 3 — Internal view of Series M40B showing auxiliary switch adjustment cam.

REPAIRS AND REPLACEMENT

The drive motor and gear train are immersed in oil and sealed in a die-cast case, therefore, periodic maintenance is not required.

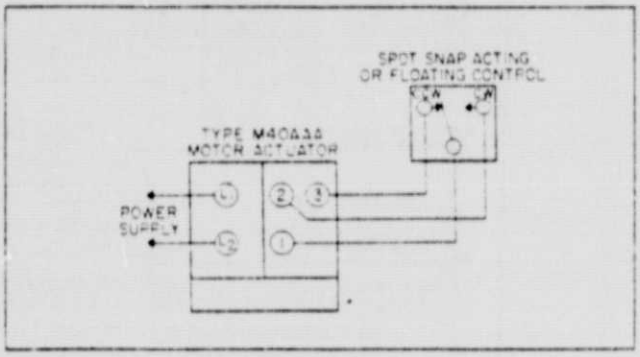
Field repairs are not recommended. Motors requiring attention must be returned to the factory for repair.

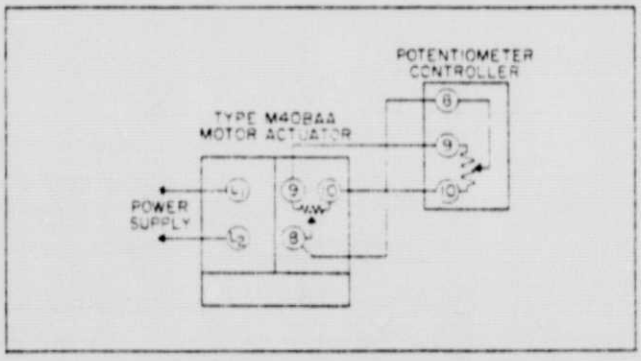
ORDERING INFORMATION

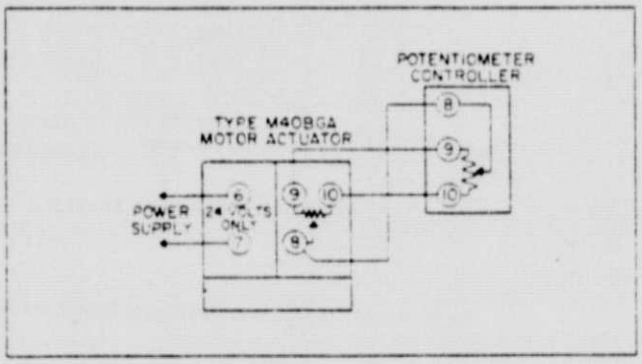
To order specify:

1. Complete Product Number, if available.
2. If complete Product Number is not available, specify Type Number and specifications required.
3. Accessories required.

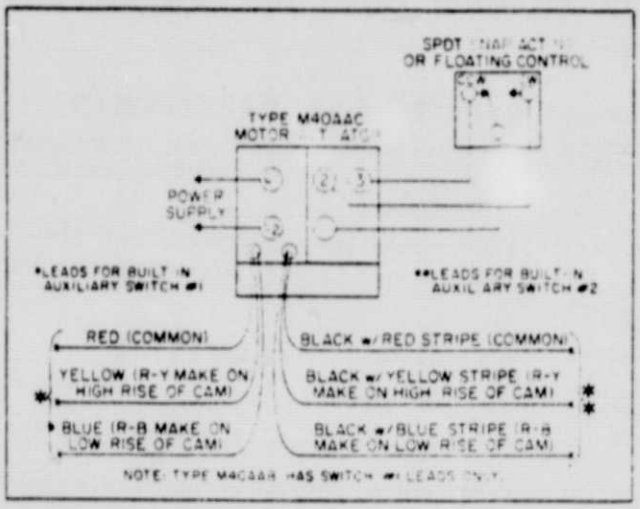
WIRING DIAGRAMS

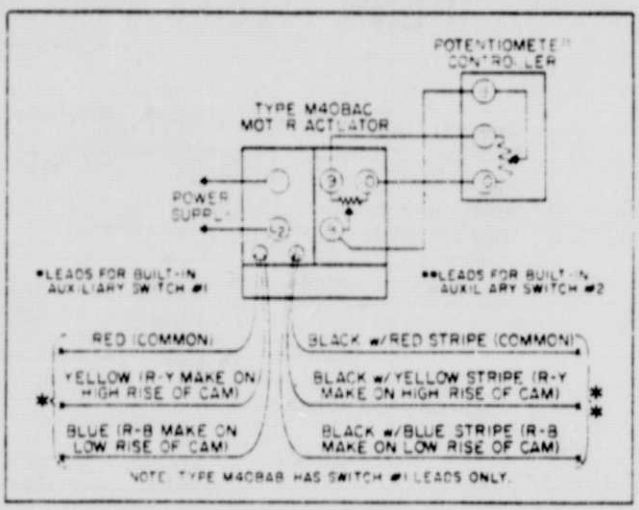


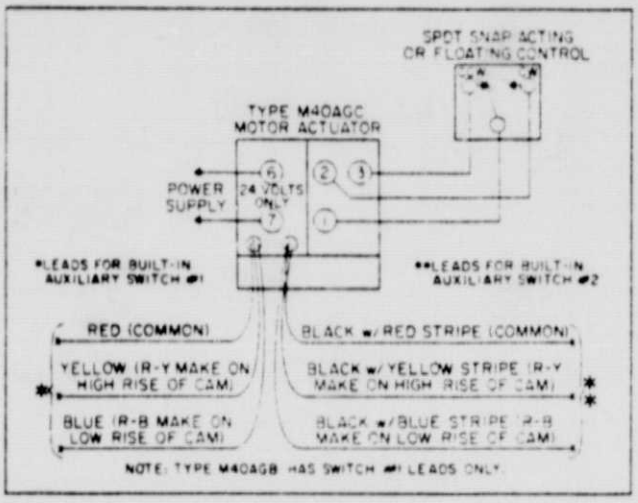


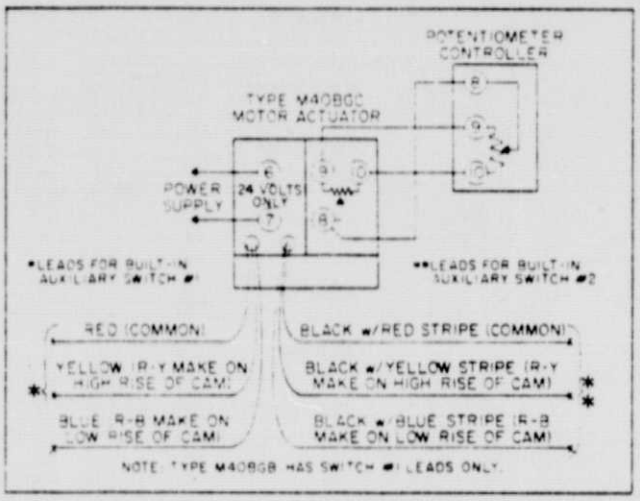


Wiring Diagrams continued on Page 4

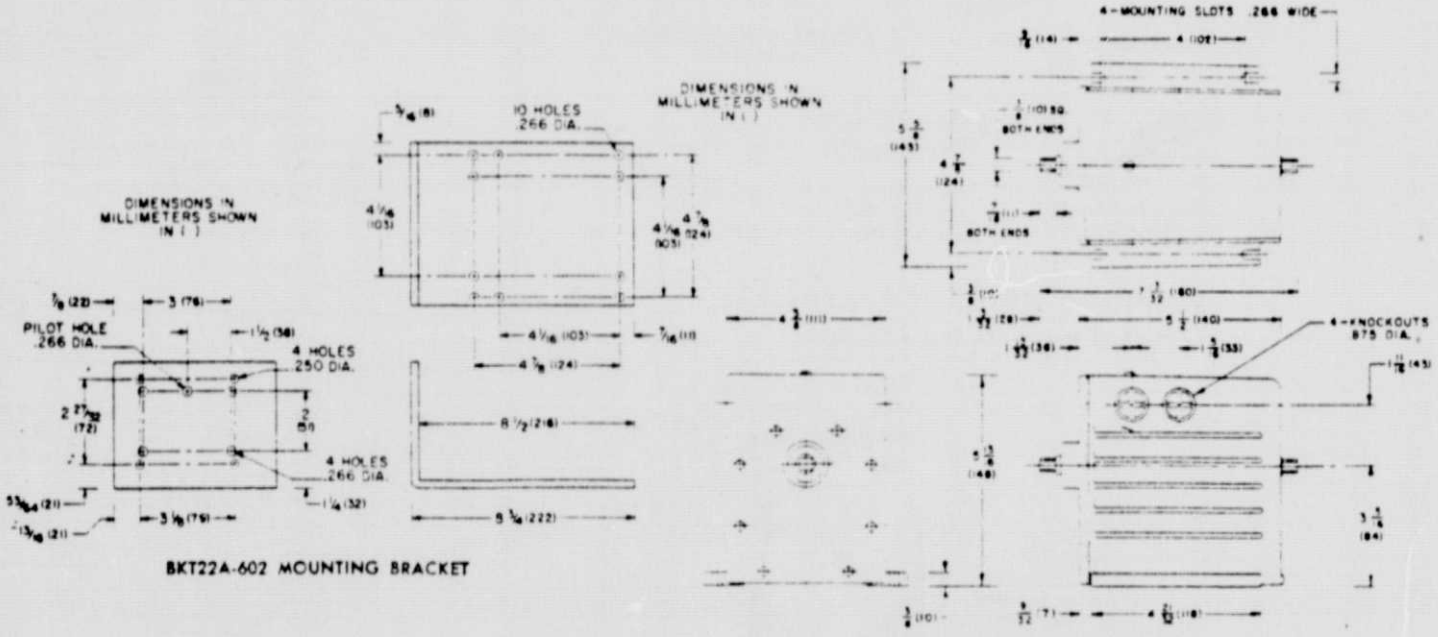








DIMENSIONS



BKT22A-602 MOUNTING BRACKET

Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

PENN CONTROLS
DIVISION OF JOHNSON SERVICE COMPANY
2221 CAMDEN COURT, OAK BROOK, ILL. 60521

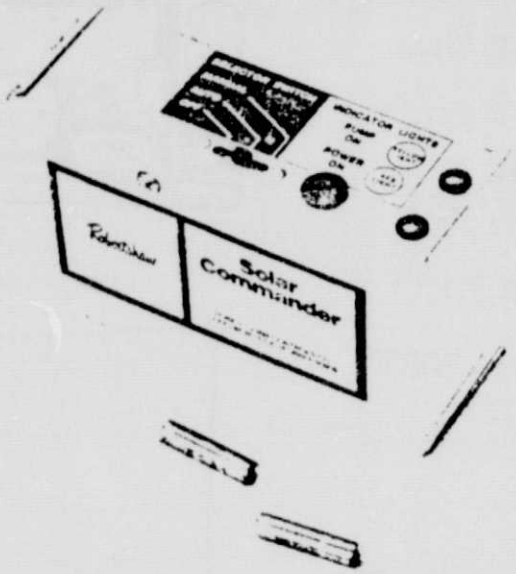
Litho in U.S.A.

7-10-74

Robertshaw

PRODUCT INFORMATION BULLETIN

THE SD-10 SOLAR COMMANDER



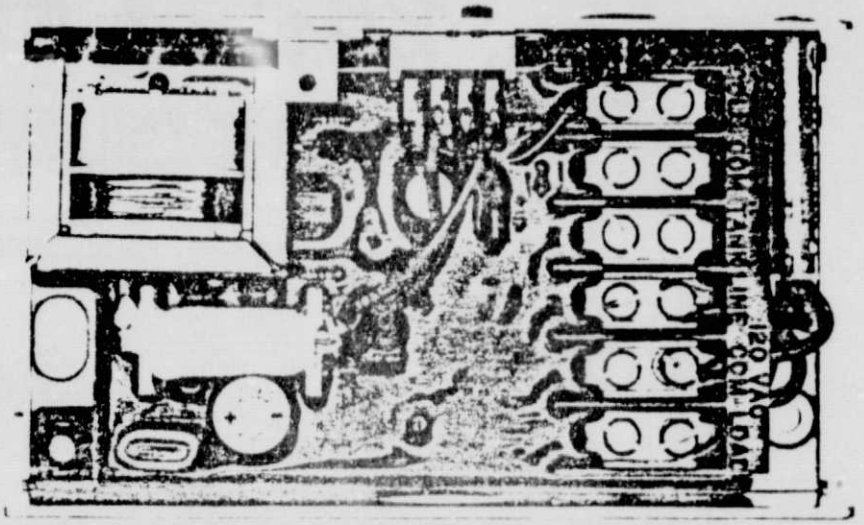
Provides sensitive temperature response and solid state switching to effectively operate a circulating pump in a liquid filled solar heat storage system.

Solid State Thermistor Sensors, of special design, are utilized to accurately signal temperature differential to the control circuit from the solar collector and the storage tank with maximum accuracy from extended distances up to several thousand feet if necessary.

The Solar Commander provides pump circulation cut-in any time the collector panel temperature is 15° higher than the storage tank. Temperature differentials of 5° or less between these points will signal the solar commander to turn the circulating pump off. The pump switch action is accomplished with solid state components, capable of handling loads up to 3.8 amp inductive, eliminating the need for any moving parts in the controller circuit. The Solar Commander cut-in temperature can be an adjustable option between 8° and 20°F.

The Solar Commander circuit incorporates electrical isolation protection for both input and output signal. The entire electrical circuit is protected by space age encapsulation.

The Solar Commander comes equipped with an easy access terminal strip for the low voltage sensor circuit and line leads hook-up. The case-frame is equipped with line lead conduit adapter access. The Solar Commander sensors are conveniently encapsulated in 5/16" x 1¼" copper tubing and come with 6" lead lengths.



FEATURES

- Solid State Pump Switching
- Thermistor Sensors
- Encapsulated Circuit
- Fixed Pump Cut-In Differential
- Circuit Isolation, Both Input and Output
- UL Approval

BASIC CONTROL

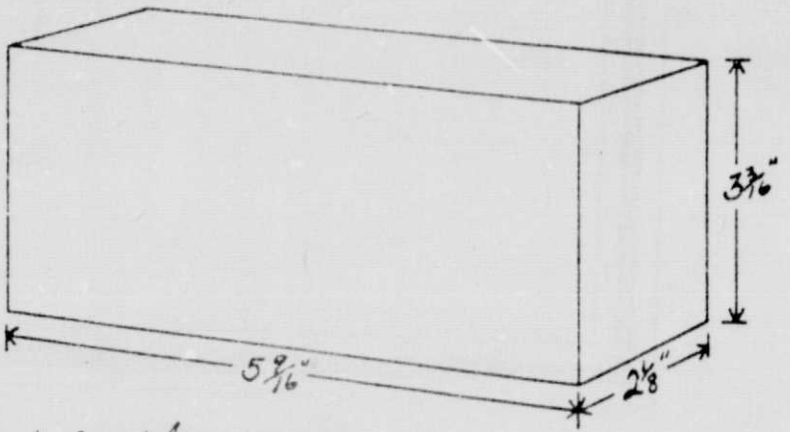
- Cut-In Differential 15° ±5°F (fixed)
- Cut-Out Differential 5° ±3°F (fixed)
- Thermistor Sensors + 300°F rated (interchangeable)
- Available without case-frame and cover

OPTIONS

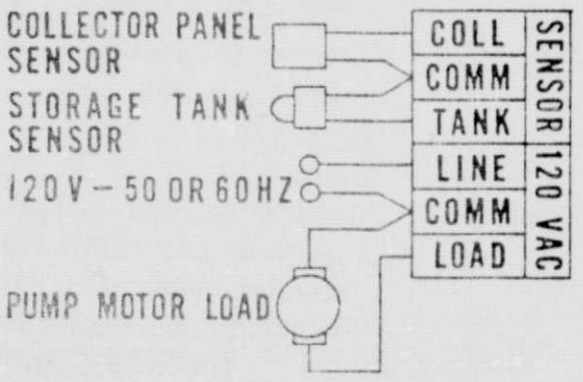
- Adjustable Cut-In Differential (8° to 20°F)
- Recycling Upper Limit (160°F to ~~200°F~~) 195°
- Positive Off Lower Limit (90°F) pump won't run below 90° storage despite cut-in diff.
- Power Pilot Indicator Light
- Pump Cycling Indicator Light
- Three-Position Manual Switch (On-Off-Auto)
- Two-Position Manual Switch (Off-Auto)
- High Temperature Sensors (400°F)
- Freeze Protection (Pump on 40°F) can't have with pos. off limit

ELECTRICAL SPECIFICATIONS

- Input 80 to 130 volts, 50 or 60 cycles Hz
- Load – 3.8 amp inductive full load amperes 29 amp locked rotor
- Thermistor Linearity – included in control tolerance between 60 and 190°
- Operating Temperature (32°F to 150°F)

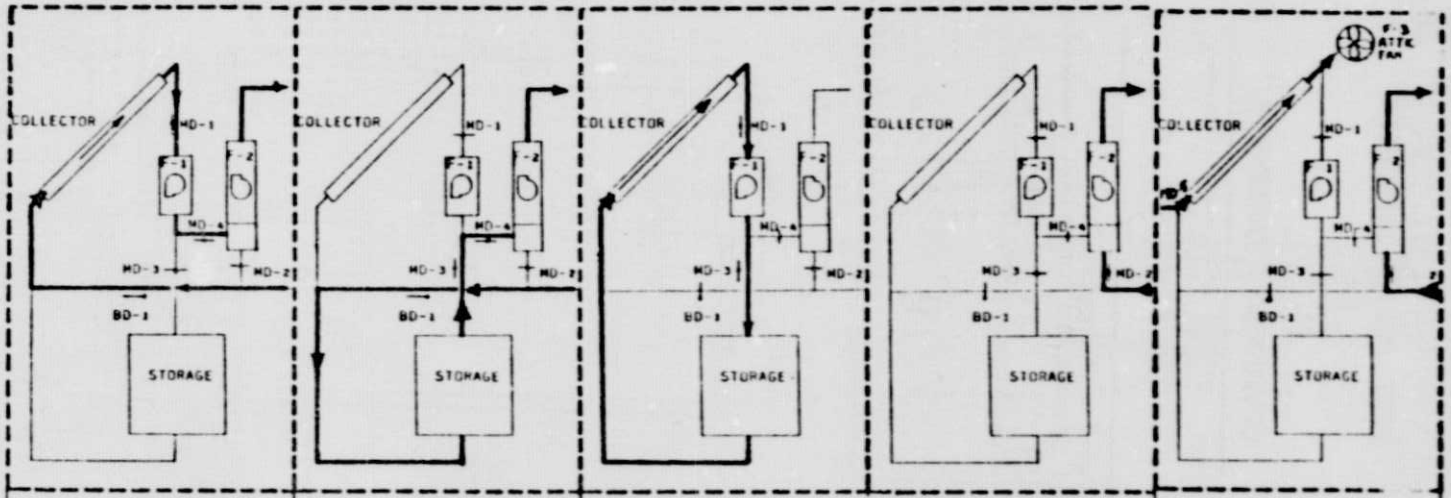


DIFFERENTIAL THERMOSTAT
SOLAR HEAT CONTROL
SD-10



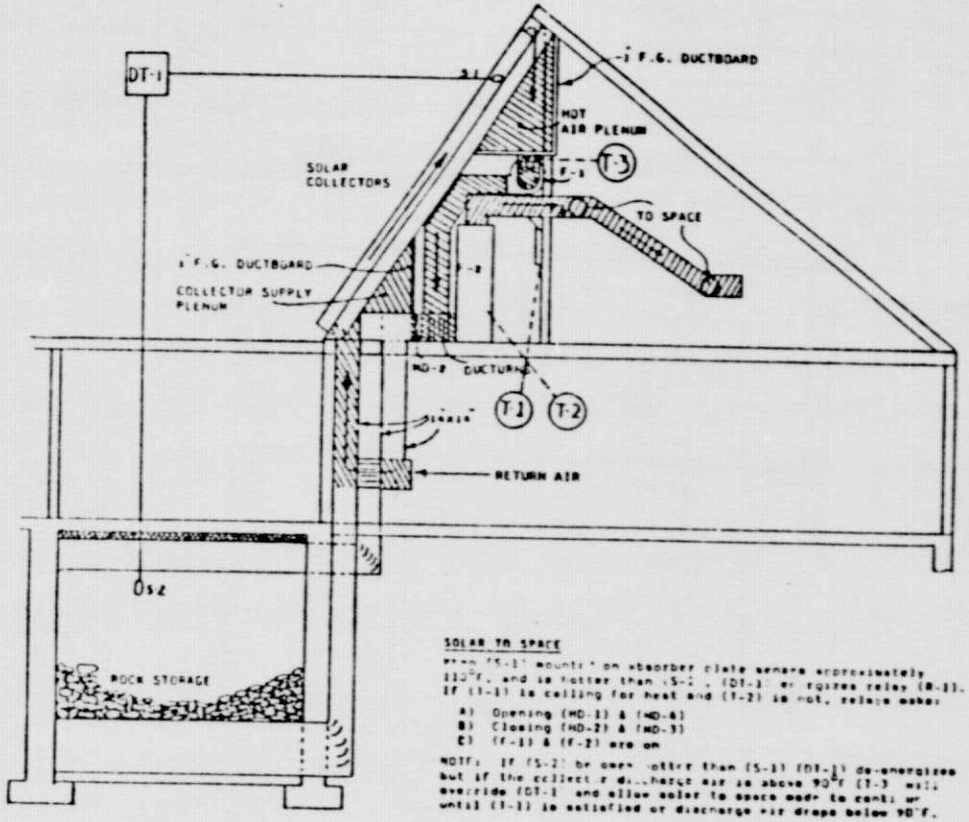
Robertshaw
CONTROLS COMPANY
Temperature Controls Marketing Group
100 W. Victoria Street, Long Beach, CA 90805

28-050-0415



MARK	TYPE	SIZE	MODE I SOLAR TO SPACE OPERATION	MODE II STORAGE TO SPACE OPERATION	MODE III COLLECTOR TO STORAGE OPERATION	MODE Iy AUXILIARY HEATING OPERATION	MODE V VE T CYCLE OPERATION
BD-1	BACKDRAFT	14"x14"	OPEN	OPEN	CLOSED	CLOSED	CLOSED
MD-1	MOTORIZED	14"x14	OPEN	CLOSED	OPEN	CLOSED	CLOSED
MD-2	MOTORIZED	14"x14"	CLOSED	CLOSED	CLOSED	OPEN	OPEN
MD-3	MOTORIZED	14"x14"	CLOSED	OPEN	OPEN	CLOSED	CLOSED
MD-4	MOTORIZED	14"x14"	OPEN	OPEN	CLOSED	CLOSED	CLOSED
MD-5	MOTORIZED	24"x24"	CLOSED	CLOSED	CLOSED	CLOSED	OPEN
F-1	CENT.	1500 CFM	ON	OFF	ON	OFF	OFF
F-2			ON	ON	OFF	ON	OFF
F-3	SPLIT PHASE	24" 3950/2100	OFF	OFF	OFF	OFF	ON

CONTROL DIAGRAMS

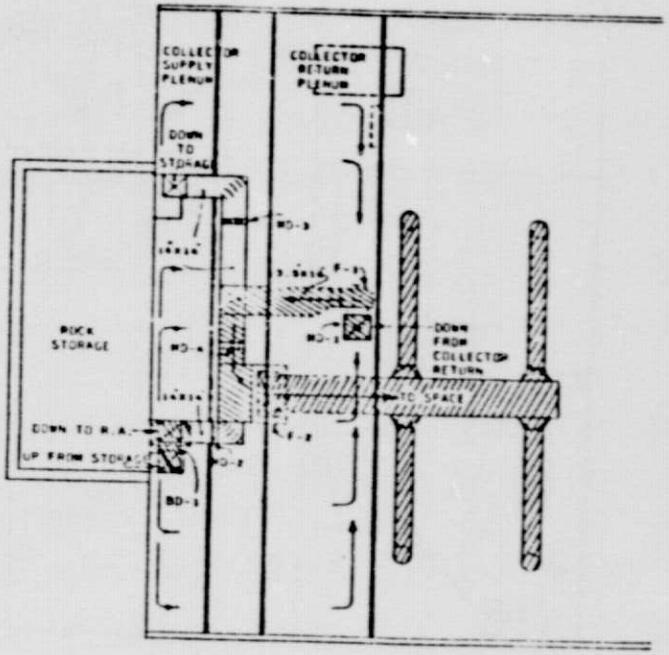


SOLAR TO SPACE

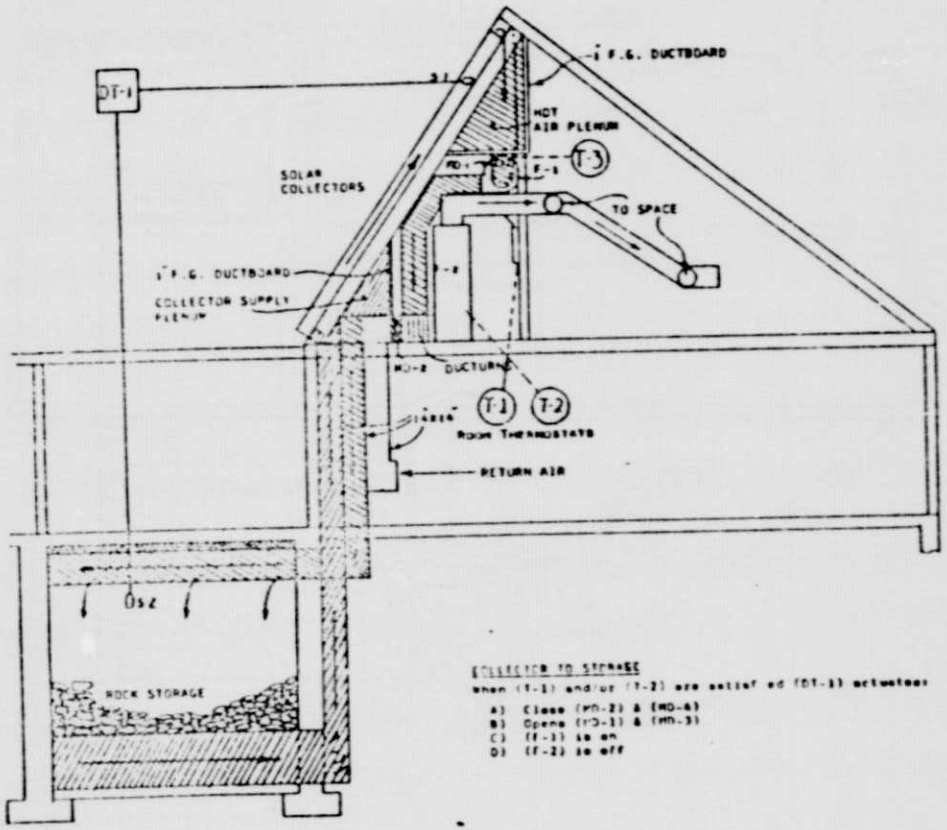
When (S-1) mounted on absorber plate senses approximately 130°F. and is hotter than (S-2), (DT-1) or (QTR) relay (R-1). If (T-1) is calling for heat and (T-2) is not, relays make:

A) Opening (MD-1) & (MD-4)
B) Closing (MD-2) & (MD-3)
C) (F-1) & (F-2) are on

NOTE: If (S-2) or (QTR) hotter than (S-1) (DT-1) de-energizes but if the collector discharge air is above 90°F (T-3) will override (DT-1) and allow solar to space mode to cont. or until (T-1) is satisfied or discharge air drops below 90°F.



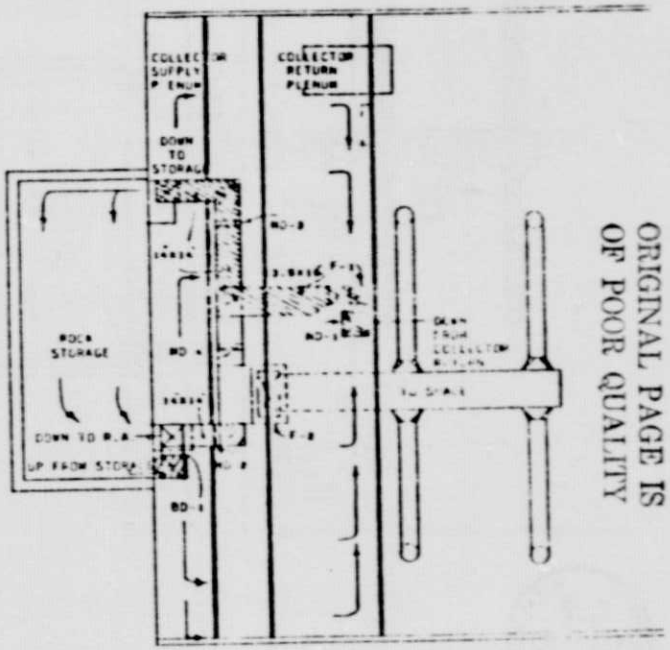
CONTROL DIAGRAM
SOLAR TO SPACE



COLLECTOR TO STORAGE

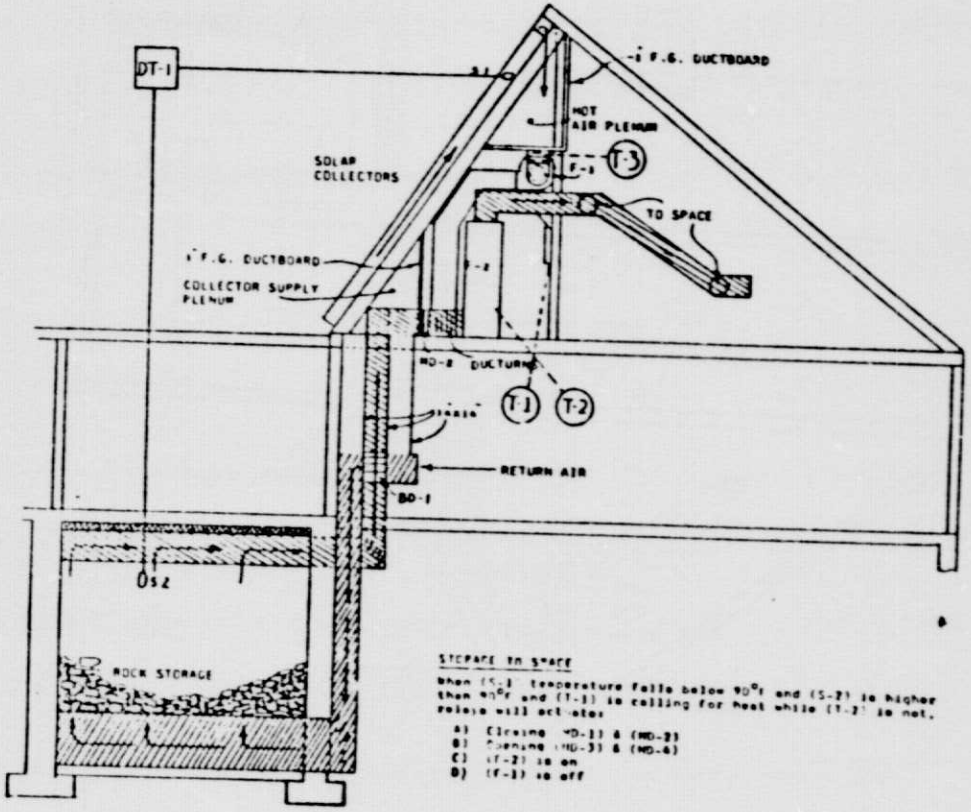
When (T-1) and/or (T-2) are satisfied at (DT-1) actuates:

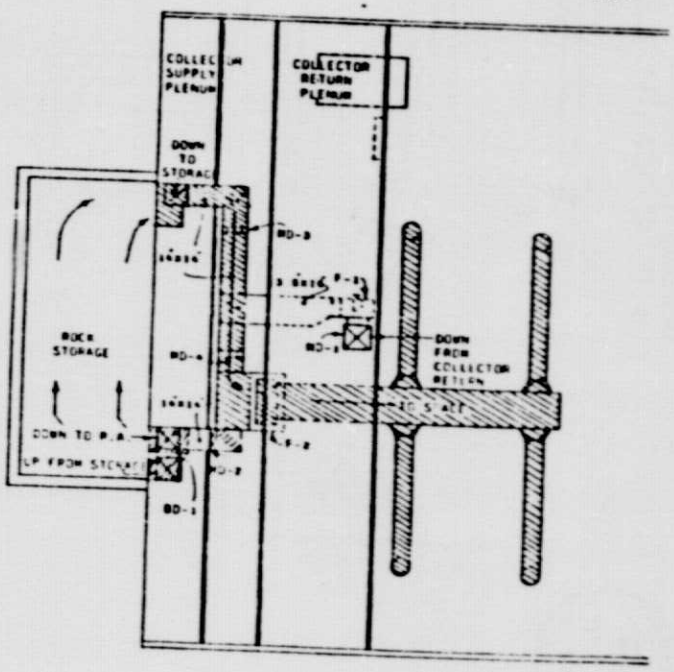
A) Close (MD-2) & (MD-4)
B) Opens (MD-1) & (MD-3)
C) (F-1) is on
D) (F-2) is off



CONTROL DIAGRAM

SOLAR TO STORAGE

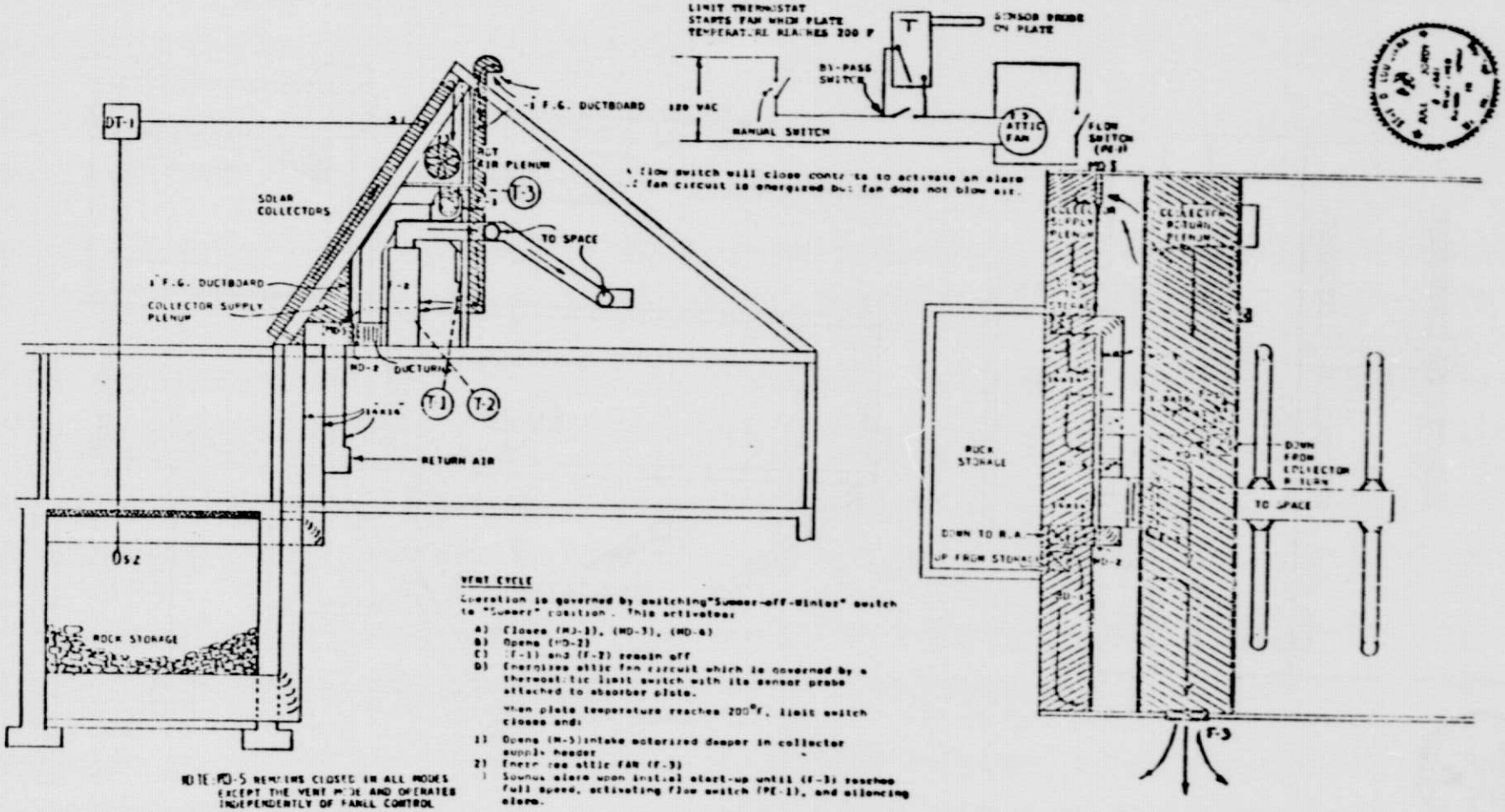




CONTROL DIAGRAM
STORAGE TO SPACE

CONTROL DIAGRAM

AUXILIARY HEATING



VENT CYCLE

Operation is governed by switching "Summer-off-Winter" switch to "Summer" position. This activates:

A) Closes (MD-1), (MD-3), (MD-4)
B) Opens (MD-2)
C) (F-1) and (F-2) remain off
D) Energizes attic fan circuit which is governed by a thermostatic limit switch with its sensor probe attached to absorber plate.

When plate temperature reaches 200°F, limit switch closes and:

1) Opens (M-5) intake motorized damper in collector supply header
2) Energizes attic FAN (F-3)
3) Sounds alarm upon initial start-up until (F-3) reaches full speed, activating flow switch (PE-1), and silencing alarm.

NOTE: MD-5 REMAINS CLOSED IN ALL MODES EXCEPT THE VENT MODE AND OPERATES INDEPENDENTLY OF PANEL CONTROL

CONTROL DIAGRAM

VENT CYCLE

M. LIST OF SERVICEMEN

ELECTRICAL and CONTROLS CONTRACTOR

MEYERS & SON
2835 Leonard St.
Lincoln, Nebraska 68507

Phone 402-464-4498

COLLECTOR HARDWARE

THE BINKLEY COMPANY
Building Products Division
Warrenton, Missouri 63383

Phone 314-456-3455

SOLAR CONTRACTOR

Solar Engineering & Equipment Co. Inc.
3305 Metairie Road
Metairie, LA 70001

Phone 504-837-7313

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