

MIXERS AND ATTENUATORS

INTRODUCTION

A mixer is a device used to *increase* smoothly with unrecognizable steps the signal in the line from a point of infinite attenuation. This is called "fading-in" the program material. Secondly, the function of a mixer control is to raise and lower the level of the program material during a performance over a range within the dynamic, or the working limits, of the associated equipment. Thus, either the maximum, or a lower desired dynamic range can be maintained without overloads, without signal reduction into the noise threshold of the equipment, and without recognizable frequency discrimination during the process.

A variable attenuator is defined here as a resistive device used in audio transmission circuits to reduce level uniformly at all frequencies flowing through the interconnecting line. Philosophically, then, a mixer control is a specialized type of attenuator.

Attenuators used in some measuring equipment, for instance, reduce the signal a certain number of db and sometimes cut off to infinite attenuation on the last step. This abrupt transition makes it unsuitable for use as a mixer, all other things being equal. A mixer is designed so that the last few steps attenuate to infinity rapidly but without abrupt or noticeable transitions during the last few degrees of travel.



HERE IS THE DIFFERENCE

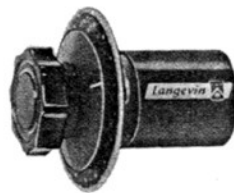
This leads us to the heart of the problem in selecting a good mixer: smooth transition from one degree of attenuation to another. The greater the number of steps, the smoother and less noticeable is the mixing operation in the sound output.

A comparison of signal levels only 1 db apart requires close study by AB comparison to detect a level change. A change of 1½ db is perceptible by study, but under program operating conditions cannot be discerned. Thus, 30 steps 1½ db apart determines the number of transitions required for high quality mixing and is standard throughout the industry for rotary mixers.

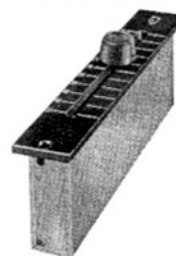
Smaller, less expensive mixer controls are limited to 20 steps. This allows 2 db of attenuation per step. Sometimes, especially in portable equipment, space is the vital consideration and this limits the choice to units with this number of steps. Operation can be classed as good.

SLIDE WIRE MIXERS

Smoothest operation is achieved by slide wire mixers, where the transitions from one level to another are only one tenth of a db apart. For this reason they are employed in music scoring and other critical applications where best quality is demanded.



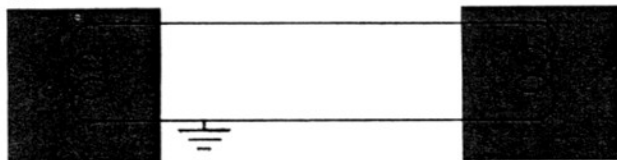
ROTARY TYPES



STRAIGHT LINE TYPES

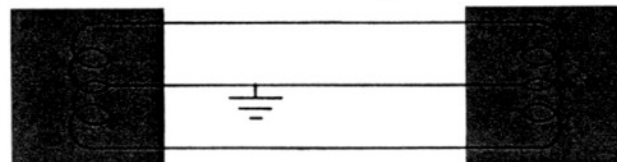
CIRCUIT TYPES for MIXERS AND ATTENUATORS

There are two classes of circuits for mixers and attenuators. These are the *unbalanced* and *balanced* types.



UNBALANCED CIRCUITS

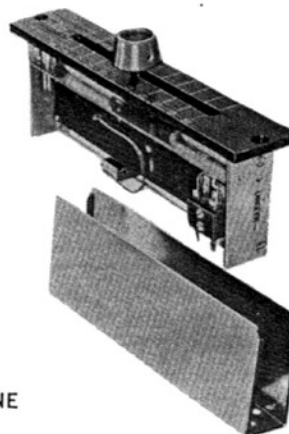
In unbalanced circuits one side of the line must be grounded. In a mixer control the position in the equipment circuit is usually predetermined, allowing unbalanced operation where provision is made to insure against induced hum resulting from a ground loop. In the case of attenuators, their use in gain sets and balanced lines invokes a determination as to whether a ground on one side will short out parts of the circuit or cause an undesirable ground loop.



BALANCED CIRCUITS

Symmetrical components with the central part of the configuration going to ground characterize a balanced circuit. This circuit is not susceptible to hum from loops due to misplaced grounds. In addition the balanced characteristic eliminates the shorting out of circuit components if the ground is used and if it is centrally located with respect to each side of the line.

STEREO'S MOST MODERN MIXER



SLIDE-WIRE
LADDER
STRAIGHT LINE

CHOOSING THE MIXER FOR CIRCUIT, FORM AND TYPE

While Langevin supplies all classes, forms and circuit types in mixer controls, it would be remiss in its obligation to the user if it did not make recommendations and cite advantages and disadvantages in the use of the various kinds available. Accordingly we will treat on these recommendations in three sections: the choice of circuit for mixing, submastering and mastering; the choice of attenuator form, that is, rotary or straight-line, and the choice of step type versus continuous slide wire.

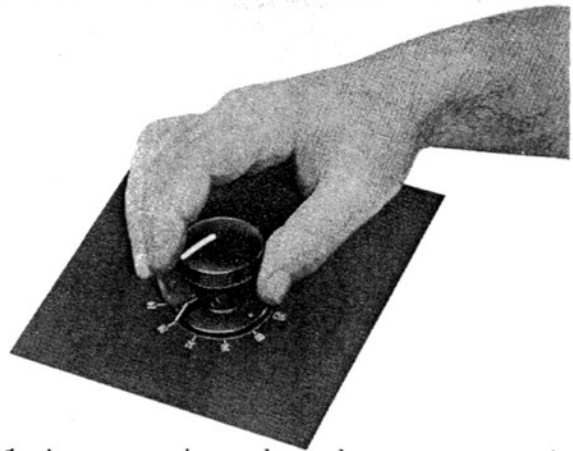
THE MIXER CIRCUIT LOW OR HIGH LEVEL MIXING

Mixing in low-level circuits before preamplification saves on the number of preamplifiers, as the inputs can be combined in varied proportions through the mixers and then fed to a single preamplifier. Referring to the illustrations succeeding, it will be seen that beyond a certain number of inputs the paralleling losses cannot be overcome by the amplifier with Ladder networks, whereas "T" networks, with lower insertion loss, allow a greater number. Thus, the designer's judgement enters the picture, considering at the same time the higher susceptibility to contact noise because of amplification *after* the mixing operation and other system noise. Thus, low-level mixing is distinctly a compromise, and finds favor usually in cases of portable, light weight mixer designs whose application is not critical in final output quality. The cost of "T" networks is higher than that of ladders.

LADDER VERSUS "T" CIRCUITS

The ladder circuit allows virtually an infinite cut-off to about -120 db; the "T" circuit extends down to the order of only -100 db. But the "T" circuit still has proponents who point out, for example, that in the last six positions of a 600 ohm ladder 30 step mixer there is a 30% drop in impedance at the output of the mixer to about 400 ohms. The argument holds that mixers are employed in multiple, and that the slight mismatch, as shown by the illustration, will preclude virtually any measurable discrimination due to mismatch.

Here, then, is a listing of the points in favor of the ladder circuit for mixers:

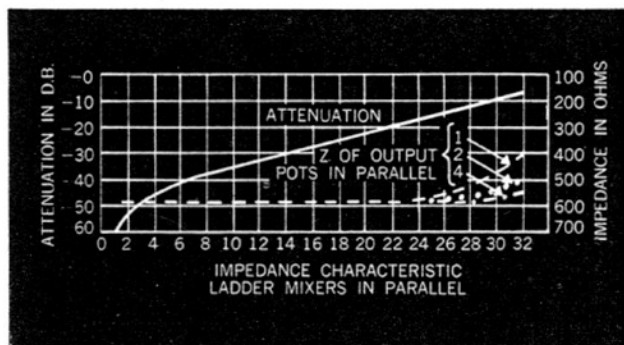


1. As attenuation takes place, contact noise decreases in proportion. This is the converse of "T" circuits, where the contact noise remains the same in any position.
2. Mismatch effects, however theoretical, decrease in direct proportion to the number of units that are paralleled into the next circuit, so that with 3 or 4 units or more operating in a bank of ladder mixers, impedance mismatch practically vanishes.
3. In the smaller units, size, too, must be taken into account, for the added parts of the "T" circuit require more space.
4. The last consideration, if not the most important one, is cost, for double the circuitry and moving parts are necessary for "T" configurations.

"T" AND BALANCED "H" ATTENUATORS

After a group of mixers have been paralleled it is standard practice to add further amplification in the form of a booster amplifier to offset the paralleling or matching losses occasioned by the restoring of the 600 ohm circuit impedance. After the booster amplifier, a submaster or master control is employed to feed this group on to other circuits containing equalizers, limiters, or perhaps the bridging bus. Because the latter parts of the circuit sometimes are located in racks distant from the mixer section, balanced lines may be desirable to provide insurance against hum from ground loops as well as for other circuit reasons. In these cases the submasters and masters may be balanced as well. Because we are dealing with one circuit after all combining has taken place and now have higher levels, possible contact noise from "T" and "H" attenuators presents less hazard. In addition, these controls are usually preset, and accordingly may be provided with detents to facilitate changes in precise increments as well as return to marked positions. Moreover, after preamplification and subsequent matching and equalizing, it is desirable to introduce as few other losses into the circuit as possible, and the zero loss feature of the "T" and "H" circuits becomes helpful.

"T", "H", and "L" circuits also find use in measuring equipment, and Langevin lists these further on without taper, as well as with tapered cut-offs, with and without detents. All mixers are also available with cue circuits.



MIXER CIRCUITS

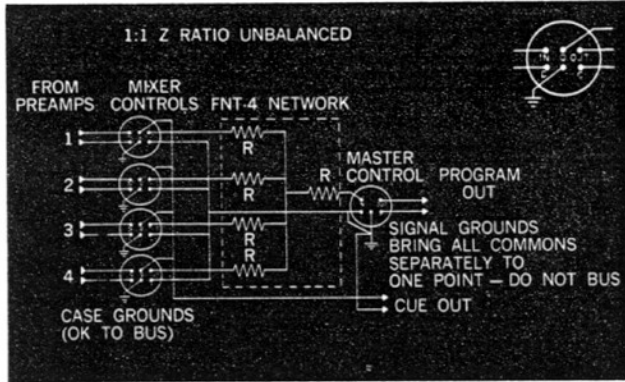
There are a number of different circuits which may be used to combine mixer outputs to form a composite program channel. Several types are illustrated with the advantage and disadvantages listed for each. While it is not the policy of Langevin to dictate design, it is felt that the making of recommendations is a duty of the equipment manufacturer.

HIGH LEVEL PARALLEL LADDER MIXER

The most highly recommended circuit for combining mixer outputs is shown below. This circuit is used to combine equal impedances to form a single program channel with a master gain control of the same impedance. Any number of circuits may be combined in this way by selecting the proper fixed network as shown on another page in this catalog. In the illustration 4 circuits are shown which would result in a loss of 24 db if a ladder master control is used.

Note that the attenuator cases are shown grounded. But signal grounds (common) are taken on individual wires to a single point ground.

The phase relationships of all inputs are the same, and this configuration may be duplicated for additional stereophonic channels as required.

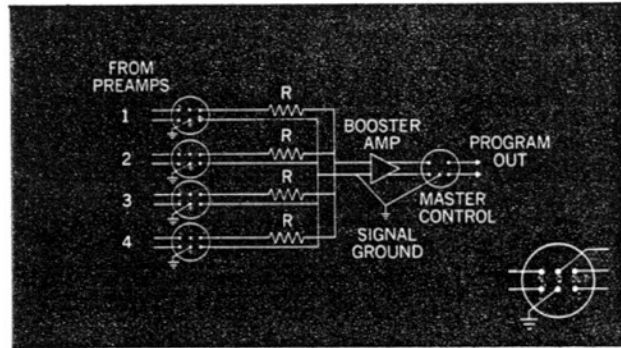


PARALLEL LADDER MIXER WITH MINIMUM LOSS NETWORK

This is a special application of the mixer circuit shown above. It is used where more mixer circuits may have been added or losses otherwise have been incurred, and more gain would be advantageous to offset these losses. It is only applicable where an unloaded input is available in the booster stage. It should be noted that the series output resistor has been eliminated. The master gain control must be used after the booster amplifier.

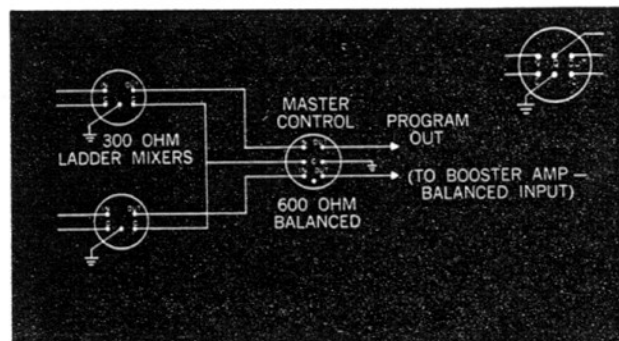
All phase relationships are maintained and the circuit may be duplicated for additional stereo channels.

The advantage of this circuit is displayed when a large number of mixer attenuators must be combined. In all cases this will produce a loss of 6 db less than the conventional mixer network first treated on.



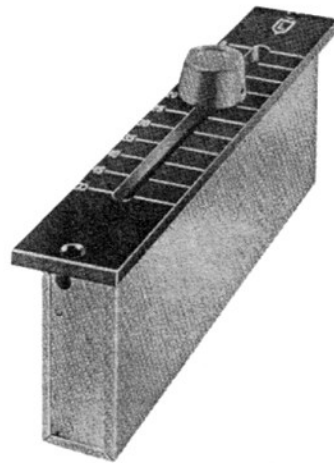
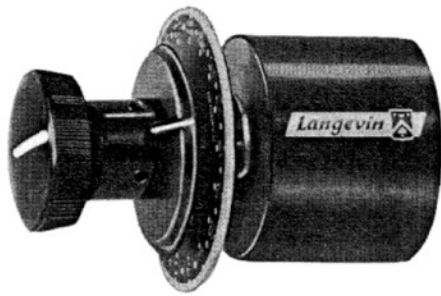
HIGH LEVEL SERIES MIXER CIRCUIT

Mixers in series with a balanced master gain control have been used in some applications, such as in lower cost, lighter weight portable units. Where quality is not paramount, low level mixing may be employed, saving on the number of preamplifiers. 3 db less loss is typical of this configuration. The disadvantage of this circuit is the presence of unequal impedances, the phasing is not maintained in all circuits, and the master must be a balanced control. This circuit is *not* recommended for stereo applications because of multiple microphone phasing problems, but can be used, probably with complete satisfaction, for monophonic radio remotes.



| TOTAL CHANNELS COMBINED | LOSS IN DB DUE TO PARALLELING | | TOTAL LOSS IN DB IF MASTER IS USED | |
|-------------------------|-------------------------------|--------|------------------------------------|--------|
| | "T" | LADDER | "T" OR "H" | LADDER |
| 2 | 6 | 12 | NO ADDED LOSS | 18 |
| 3 | 9.5 | 15.5 | | 21.5 |
| 4 | 12 | 18 | | 24 |
| 5 | 14 | 20 | | 26 |
| 6 | 15.6 | 21.6 | | 27.6 |
| 7 | 16.9 | 22.9 | | 28.9 |
| 8 | 18.1 | 24.1 | | 30.1 |
| 9 | 19.1 | 25.1 | | 31.1 |
| 10 | 20 | 26 | | 32 |
| 11 | 20.8 | 26.8 | | 32.8 |
| 12 | 21.6 | 27.6 | | 33.6 |
| 13 | 22.3 | 28.3 | | 34.3 |
| 14 | 22.9 | 28.9 | | 34.9 |
| 15 | 23.5 | 29.5 | | 35.5 |
| 16 | 24.1 | 30.1 | | 36.1 |

MIXER FORM



MIXER FORM

SHOULD YOU CHOOSE STRAIGHT LINE OR ROTARY MIXERS?

The advent of stereo recording has vastly increased the complexity of control consoles. Precise regulation of individual sections of the orchestra and soloists in monaural recording has called for the use of a multiplicity of mixer controls. The use of a complex of mixers has been virtually trebled by the demands of 3 channel stereo.

An expansion of the console in the horizontal plane has been called for. But a recording engineer has arms only so long, so that when we consider practicalities, the following calculations should enter into the choice of mixer control form:

Rotary mixers have a diameter usually of 2 to 3 inches; dial and knob or panel engravings are on approximately 6" centers. It can be seen that horizontal console dimensions can become inordinately large. On the other hand, Langevin Straight Line Mixers present an ideal solution to the problem in a number of ways.

These narrow vertical mixers require only 1½ inches between mounting centers (1¼" on order with narrower escutcheon), permitting a full complement of control for 3 channels, all within easy reach. Moreover, at least two mixer controls can be operated with one hand; many recordists operate three, and for some effects, as many as four. To facilitate this multiple use, sometimes practice dictates the patching in of the reverberation control adjacent to the mixer regulating the main signal in a particular bank.

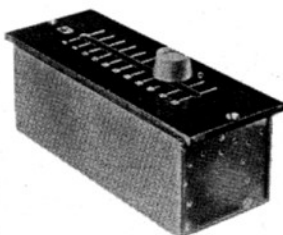
There are other advantages to the Langevin Straight Line units. Full recognition of the mixer level setting is apparent from the vertical position of the knob, giving better indication of position than a round knob affords. Operation is smoother than with rotary mixers, as only two grams of static friction need be overcome to change position of the control. While it is true that rotary mixer knobs allow "rolling" with the side of the palm for effects, the vertical mixer exceeds in flexibility because the knob can actually be "snapped", as well as faded rapidly. This can be done with only one finger if necessary.

CHOICE OF MIXER TYPE

It is true that convention and habit enter into the choice of mixer form, so Langevin makes all types. Remember that smoothest mixing is delivered by straight line slide wire mixers because of the small .1 db increments. But the use of straight line mixers calls for the development of new skills by the recording engineer; as long as fifteen years ago the motion picture studios employed vertical mixers on 20 channel re-recording consoles for best quality and as the sole solution to human requirements. Stereo has intensified operations to the end that Langevin Straight Line Mixers present a practical manner of achieving high quality and complete stereo control within physiological limits.



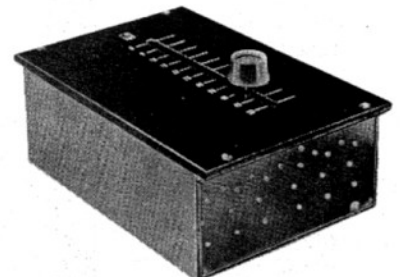
MX-111-2
2-GANG MIXER



MX-111-3
3-GANG MIXER



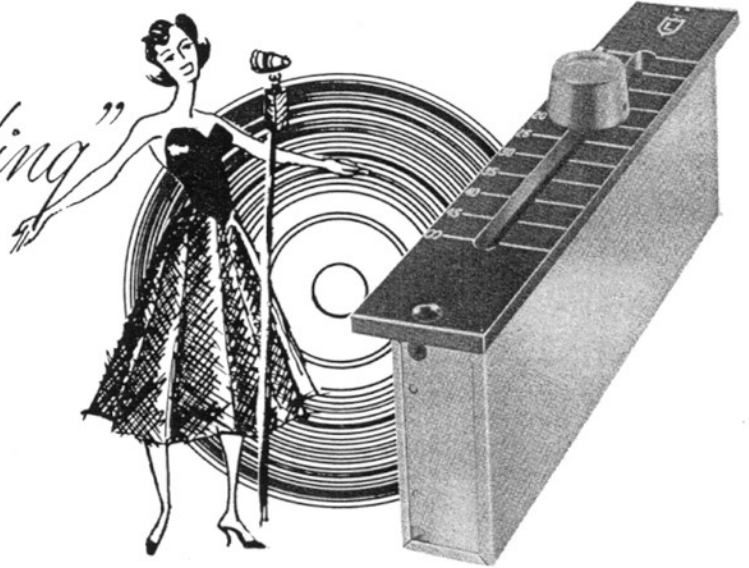
MX-111-4
4-GANG MIXER



MX-111-6
6-GANG MIXER

MODEL MX-111 STRAIGHT LINE MIXER CONTROL

*"Between the Artist
and the finest recording"*



The MX-111 Straight Line Mixer Control is a highly developed slide-wire unit using resistances in a ladder configuration to afford unusual facility in operation on control consoles. It is used to blend signals of various origin for music scoring, re-recording, high quality public address, radio and TV broadcasting. It requires only 1½" of horizontal panel space (1¼" with alternate escutcheon) and is 6½" long. It is the most compact unit of this type available, and extends only 2¼" below the top of the mounting surface. Several units can be operated with one hand when mounted adjacent.

FEATURES

1. SMOOTH, SILKY OPERATION FOR EASY CONTROL

Most important to the operator is the overcoming of friction in the mixer control. In the MX-111 precision-built mixer, a nylon bearing rides along a longitudinally honed, hardened chrome-plated shaft. Smooth operation is the result of the exceedingly low coefficient of friction; only 2 grams of pressure is required to overcome the inertia and bearing friction of the control assembly.

2. LOW CONTACT NOISE FOR CLEAN, CLEAR SIGNAL

A single contact brush fabricated of the same material as the resistance wire prevents generation of thermal voltages, contact oxidation and consequent noise. This brush is connected to the input circuit by a beryllium copper spring strip, eliminating the need for additional noise inducing brushes.

3. EXCLUSIVE DIRT AND LINT BARRICADE FOR TROUBLE-FREE PERFORMANCE

An accessible lint and dirt trap over the windings eliminates the cleaning nuisance formerly associated

with this form of control. In addition, the contact portion of the winding itself is upside down, so that the tendency of foreign matter is to fall off rather than on.

4. PLUG-IN DESIGN FOR EASY MAINTENANCE

Connections are made by an integral plug to the connecting cable socket. This permits rapid disassembly for inspection and cleaning.

IMPORTANT NOTICE

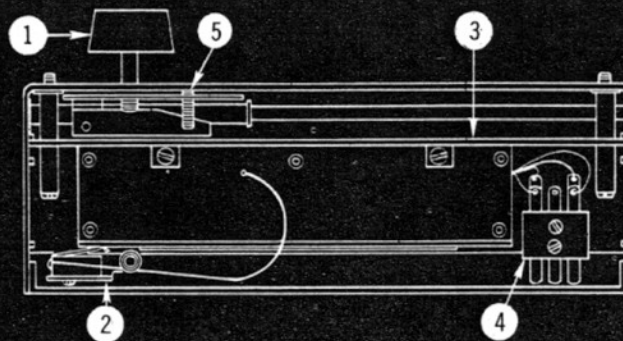
ALL SLIDE WIRE MIXERS REQUIRE PERIODIC CLEANING.

5. FRICTION ADJUSTING SCREW FOR ANGLE OR VERTICAL MOUNTING

For those recording engineers who desire less freedom of movement in the control, or for the designers who wish to incorporate a steep or vertical slope to the control panel, a friction adjusting screw on the guide shaft is accessible through the front slot on the control in which the knob assembly rides.

6. AVAILABLE IN 2, 3, 4, AND 6 GANGS FOR STEREO

For stereophonic controls the MX-111 is available in 2, 3, 4 and 6 gang assemblies operating from a single knob. This vastly simplifies console controls.



SPECIFICATIONS

SPECIFICATIONS

| | |
|------------------------------------|--|
| Circuit | Ladder. |
| Frequency Response | Flat, within $\pm .5$ db at all settings from 0 to 20 kc. |
| Accuracy of Resistors | $\pm 2\%$. |
| Input Level | Maximum: 1 watt or 25 volts rms. |
| Slider Pressure | 20 grams. |
| Static Friction | Within 2 grams of sliding friction. |
| Insertion Loss | 6 db. |
| Total Excursion | $4\frac{1}{8}$ ". |
| Impedance | Standard 600/600 ohms. Special impedance of 150/150 ohms may be obtained on order. |
| Knob | Supplied with red knob as standard. |
| Dimensions | $6\frac{1}{4}$ " long by $15/16$ " wide by $2\frac{1}{4}$ " high. Height with knob: $3\frac{1}{4}$ ". |
| Escutcheon Plate Dimensions | $1\frac{1}{2}$ " or $1\frac{1}{4}$ " wide by 7" long by $3/16$ " thick. Escutcheon must be ordered separately. |
| Panel Finish | Engraved black anodized dural. |
| Multiple Mounting | $1\frac{1}{2}$ " or $1\frac{1}{4}$ " centers between adjacent units according to escutcheon used. |

ORDERING INFORMATION

MODEL MX-111 STRAIGHT LINE MIXER CONTROL with red knob, cable socket and plug, complete less escutcheon. Weight, net, $\frac{1}{2}$ lb., 1 lb. shpg.

Price, Net Each \$40.00

MODEL MX-111-EW STANDARD ESCUTCHEON FOR ABOVE, $1\frac{1}{2}$ " wide by 7" long by $3/16$ ", black satin finished anodized dural with engraved designations **Price, Net Each \$4.00**

MODEL MX-111-ES ESCUTCHEON: Same as Model MX-111-EW Escutcheon but $1\frac{1}{4}$ " wide . **Price, Net Each \$4.00**

COLORED KNOBS AVAILABLE

Red knob is standard. White, Blue, Yellow, Green and Black are available at no increase in price. Please specify these alternate colors when ordering from the factory.

MODEL MX-111-2, 2 GANG STRAIGHT LINE MIXER CONTROL. Same as MX-111, but ganged. Size, $1\frac{1}{8}$ " wide by $6\frac{1}{4}$ " long by $2\frac{1}{4}$ " deep below mounting panel. Weight, net, 1 lb., $1\frac{1}{2}$ lbs. shpg.

Price, Net Each \$87.50

MODEL MX-111-E2 ESCUTCHEON FOR MODEL MX-111-2. Size, $1\frac{1}{4}$ " wide by 7" long by $3/16$ " thick **Price, Net Each \$5.00**

MODEL MX-111-3, 3 GANG STRAIGHT LINE MIXER CONTROL. Same as MX-111, but ganged. Size, $2\frac{1}{2}$ " wide by $6\frac{1}{4}$ " long by $2\frac{1}{4}$ " deep below mounting panel. Weight, net, 1 lb. 3 oz., $1\frac{1}{2}$ lbs. shpg.

Price, Net Each \$130.00

MODEL MX-111-E3 ESCUTCHEON FOR ABOVE. Size, $2\frac{1}{8}$ " wide by 7" long by $3/16$ " thick . . . **Price, Net Each \$5.50**

MODEL MX-111-4, 4 GANG STRAIGHT LINE MIXER CONTROL. Same as MX-111, but ganged. Size, $3\frac{3}{16}$ " wide by $6\frac{1}{4}$ " long by $2\frac{1}{4}$ " deep below mounting panel. Weight, net, $1\frac{1}{2}$ lbs., 2 lbs. shpg.

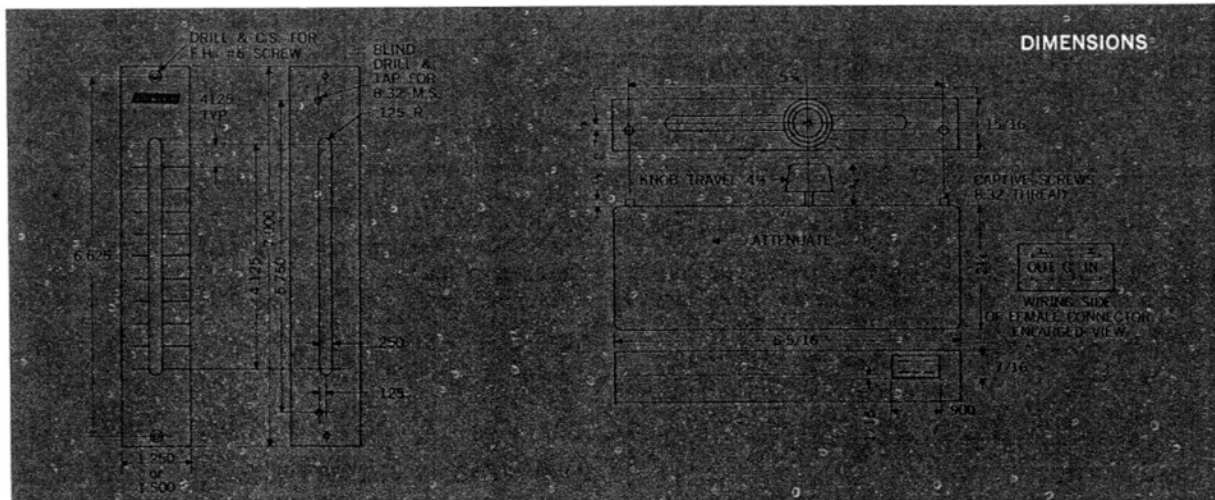
Price, Net Each \$175.00

MODEL MX-111-E4 ESCUTCHEON FOR ABOVE. Size, $3\frac{1}{4}$ " wide by 7" long by $3/16$ " thick. **Price, Net Each \$6.00**

MODEL MX-111-6, 6 GANG STRAIGHT LINE MIXER CONTROL. MX-111 but ganged. Size, $4\frac{3}{8}$ " wide by $6\frac{1}{4}$ " long by $2\frac{1}{4}$ " deep below mounting panel. Weight, net, $1\frac{1}{4}$ lbs., 2 lbs. shpg.

Price, Net Each \$265.00

MODEL MX-111-E6 ESCUTCHEON FOR ABOVE. Size, $4\frac{1}{4}$ " wide by 7" long by $3/16$ " thick . . . **Price, Net \$6.50**



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