The Columbia "360"

PETER C. GOLDMARK*

Presenting the inside information about an interesting instrument designed to offer high quality in a ready-made form.

AT THE END of the last war, one of the programs facing the Laboratories was to develop a method whereby recorded music of the highest quality and at the lowest cost could be brought to as many homes as possible. It was apparent that this meant a new system of music recording and music reproduction which, because of the magnitude of the task, we had to tackle sequentially. The first phase of our work culminated in the development of the LP record which became the almost exclusive medium for recorded classical music, at a fraction of the cost of the pre-LP albums.

We then entered the second phase of our development program, which involved creating the mate for the LP record. The latter can carry a sound quality which includes everything the average human ear is capable of hearing. Until now, commercial phonographs did little justice to these records and people in their homes wanted high quality in a compact, entirely self-contained, reasonably priced phonograph which can be placed almost anywhere in a room. He or she would also like to be able to bring the instrument home from the store, plug it into a wall socket, and play it. To fill these needs, at the same time reproducing virtually everything recorded on the LP record, the Columbia "360" has been developed.

The term "High Fidelity" is usually associated with wide frequency range,

Fig. 1. The Columbia "360" phonograph, as described in the accompanying article.

yet this is not what the music lover is interested in. We were in search of something that would approach the ultimate in music reproduction and felt that the desired end effect could best be described as realism. The Columbia "360," shown in *Fig.* 1, which is the first one of a new series of music reproducers, represents the beginning to the solution of this problem and in the following paragraphs some technical details regarding the "360" will be discussed.

Realism in music reproduction involves many ingredients which, when properly blended, will approach as nearly as possible a lifelike rendition of the music originally recorded. Sufficient frequency range naturally is one of these and the instrument has adequate response between 50 and 12,000 cps. Most records do not contain much usable information below 50 or above 10,000 cps, and thus reproducing equipment with excessive capability beyond these areas can—unless properly controlled—produce considerable rumble and surface noise.

Effects such as distortion and intermodulation in the "360" were kept down to a sufficiently low limit, but again we did not choose to go overboard.

A great deal of attention was concentrated on the most important processes involved in the translation of electrical impulses to sound waves. The phonograph is only 17 in. wide, 10 in. high and 13 in. deep, yet the sound produced compares favorably with many a large "High Fidelity" installation.

In designing this instrument, we found it best to make the loudspeakers "take a back seat" and let the enclosure do most of the work. The sound does not emerge from a loudspeaker in front of the instrument directed straight at the listener as has been the practice to date. We found that in order to approach the illusion of reality in a room, sound should be diffused before it reaches the listeners' ears. Thus, two speakers have been provided facing outward and mounted on opposide sides of the cabinet, as shown in *Fig.* 2 sound is now

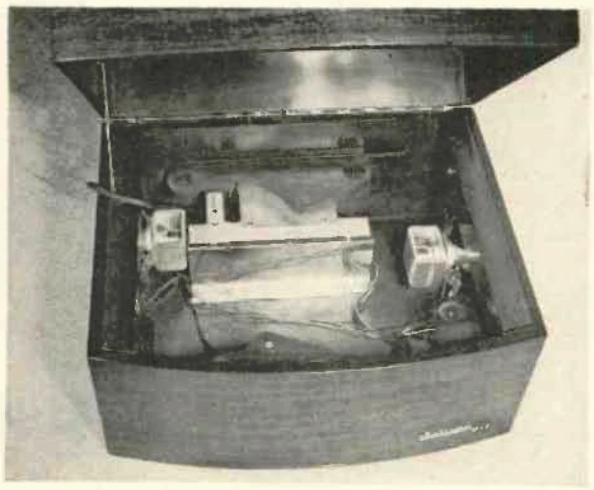

Fig. 2. Internal arrangement of the cabinet with record player removed.

* *Vice-President in Charge of CBS Laboratories Division, 485 Madison Ave., New York 22, N. Y.*

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tances and locations. The resultant curves were integrated and then averaged to yield the one illustrated. Very close correlation can be found between the sound characteristic thus derived and the actual performance of the player in the home.

The amplifier has been designed to give adequate performance for a maximum power output of about two watts, as shown in the distortion curves, *Figs.* 6 and 7. The amplifier frequency response has been shaped so that when combined with the other components of the system, the over-all sound pressure diagram is the desired one. *Figure* 8 shows the frequency response of the pickup by itself.

During the development of the Columbia "360" in the CBS Laboratories Division we had to rely on the support and inspiration of many. In particular, the writer is indebted to Thomas Broderick, Richard Mahler and René Snepvangers for their wholehearted cooperation and many useful suggestions.

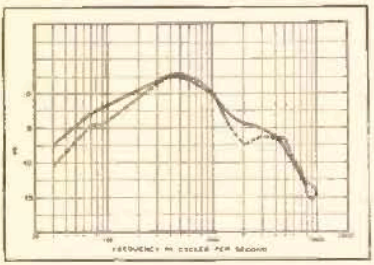

Fig. 8. Typical response plotted against the electrical curve of Columbia 103 test record.

REEVES APPOINTS NEELY

Products of Reeves Soundcraft Corporation, New York, will be distributed to the electronics industry in the Southwest by Neely Enterprises, Inc., Los Angeles, effective at once, according to Frank B. Rogers, Jr., Reeves vice-president.

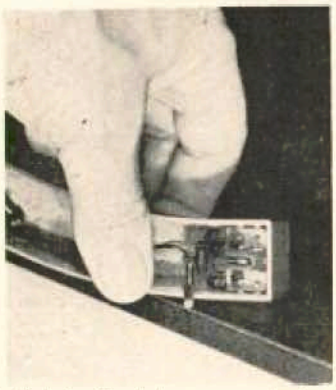

Fig. 3. Underside of the tone arm showing the rotating stylus assembly in the cartridge. The stylus is rotated to change from LP to 78.

radiated practically all around the instrument (hence the name "360") and arrives at the listener after it has been bounced around in the room, resulting in a mixture of many different phases and amplitudes.

The Record Compartment

The record itself is played in the middle of a sealed sound chamber represented by the solid half-inch-thick cabinet walls. Every available air space within this enclosure has been utilized to create the desired sound and the air pressure produced by the speakers has to be preserved during playing by keeping the lid closed. If, while playing records, one were to lift the top even a trifle, the bass would disappear almost completely.

The changer proper is a V-M three-speed type, floating on springs within the sound chamber in such a way that there is no acoustic feedback between the pickup and the loudspeakers. The arm and cartridge have been specially developed; the arm, made of metal, produces a slight resonance of around 50 cps which plays an important role in the over-all frequency response of the system. The cartridge has been developed with the Sonotone Corporation and utilizes a ceramic element. A rotating needle assembly, *Fig.* 3, carries two sapphire points back to back, one with a radius of one mil and the other with a radius of three mils. Needles assembles containing a diamond stylus for LP records will also be available. The frequency response of the cartridge-and-arm combination looking into a load of 1.0 meg. and 100 μμf, is within a few db of the required reproducing characteristic when using the Columbia No. 103 test record as signal source. The cartridge compliance is of the order of 0.9 $\times 10^{-6}$ cm/dyne and the voltage output, using the Columbia 103 test record, is approximately 0.5 volts at 1000 cps. The stylus can easily be changed by any layman by raising the arm, lifting out the entire stylus assembly and replacing it with a new one.

The "360" phonograph has a loudness control instead of the usual volume control, and it has a treble control instead of a tone control. At every setting of the loudness control, the tonal balance is automatically changed to give optimum reproduction for that given sound level. The treble control influences only the very high frequencies; for instance, the difference in output for the maximum and minimum treble positions is 12 db at 10,000 cps, but only 3 db at 3,000 cps. The circuit schematic is presented in *Fig.* 4.

The two six-inch loudspeakers are identical and have a resonance frequency of between 85 and 90 cps. Nevertheless, the over-all sound pressure output of the system is quite adequate below the speaker resonance frequency.

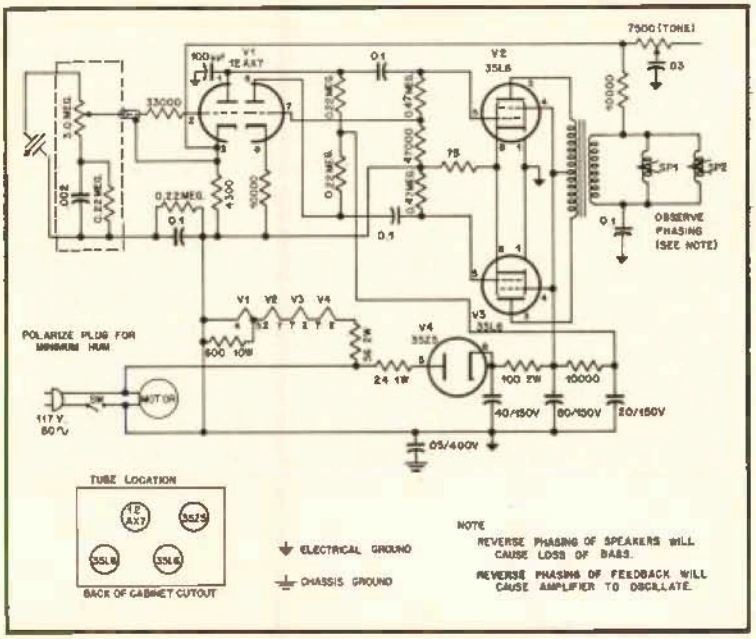

Fig. 4. Over-all schematic of the "360."

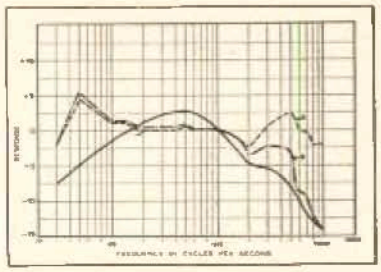

Fig. 5. Measured acoustic response curves, compared with electrical curve of Columbia 103 test record. Curve A is response with maximum treble; B is with minimum treble. Solid curve represents the test record.

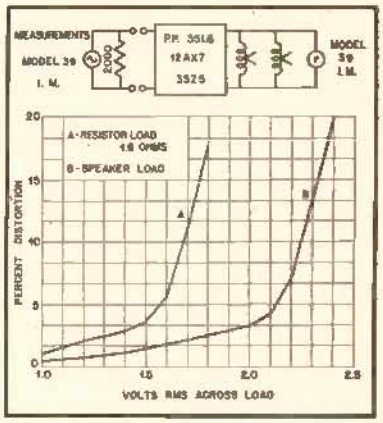

Fig. 6. Intermodulation distortion vs. power output.

Performance

It may be of interest to explain how the sound pressure curves of *Fig.* 5, were taken. Instead of placing the phonograph in a sound test chamber and carrying out measurements the conventional way, the player was set up in a room, the acoustic properties of which approached home listening conditions. A large number of sound pressure curves were derived using different dis-

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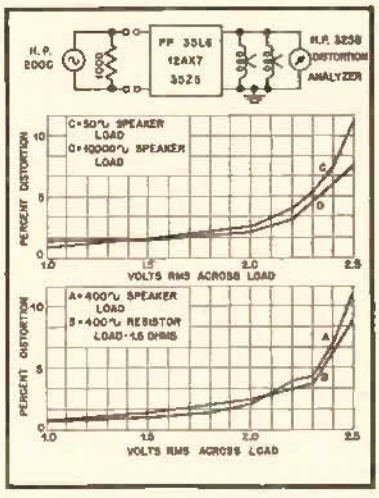

Fig. 7. Harmonic distortion vs. power output.