



The How and Why of RCA Victor's New Record and Player

By D. D. Cole
Chief Engineer

RCA Victor Home Instrument
Department

In the fifty years since the birth of the record and phonograph industry, many types of records and phonographs — of various sizes, revolving speeds, and design — have been developed. But for the first time in the history of recorded music, there has now been evolved a record with a matching player, a player with a matching record. RCA Victor's new music reproducing system for the home consists of the first record and player designed as complementary units — a combination which provides unprecedented quality, service and efficiency.

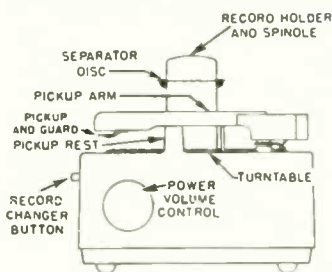
Our introduction of the new system was carefully considered. As the only manufacturer of both phonographs and records, we had a great deal at stake. We based our decision on our confidence that this system is the best we have ever put on the market, and our sincere belief that it is the best that anyone has ever put on the market.

We cast our future on a new recording and reproducing system that requires a new player and a different type record, but provides in return a record-changing mechanism that is free from the conventional troubles, and a record that provides a new high in reproductive quality, low cost, and a convenient size.

We began, fifty years ago, with a simple record player—a single-play, manually operated player. Through the years, we have called upon the player to perform more and more difficult operations and services. The consumer wanted the player to handle large numbers of records, to change them automatically, and to be adjustable for records of various sizes.

While the industry was able to meet these requirements, it found that in meeting them it was running into new problems. Automatic changers were developed, improved, and simplified, but many difficulties persisted — perhaps chief among them the problem of damage to records during changer operations.

More than 10 years ago, RCA Victor began in its laboratories a program of study and development by which it hoped to solve, once and for all, the problems which had piled up on the industry since the be-



RCA VICTOR'S NEW 45 RPM PHONOGRAPH AND RECORD

— first in the history of the industry to be designed specifically to complement each other. Operation at 45 rpm provides up to 5 minutes and 15 seconds of playing time on each side of the small, vinyl plastic records, or up to 42 minutes when eight records are stacked on the automatic record-player, which contains the fastest record-changing mechanism ever devised.

ginning of recorded music. We were willing to stake our future on a system that would solve the problems still encountered with all conventional record changers and provide optimum reproduction quality, economy, and convenience.

Initially, we sought to do these things:

1. Provide a means of automatic record changing without damage to records.
2. Eliminate the need for adjusting a record changer for records of different sizes.
3. Reduce the time required for record changing and make the operation silent.
4. Eliminate from the overall player as many as possible of the conventional moving parts.
5. Reduce the overall size of the player

and record, which we considered larger than necessary, and which required large phonograph cabinets and excessive record storage space.

We tackled the record changing problems. In most conventional systems, the drop mechanism operates from one or two posts located along the outer rim of the turntable. This calls for a large changer, since the post or posts, to handle 12-inch records, must be about 7 inches from the center of the turntable. It also calls for indexing mechanism so that the post can be adjusted to handle 10-inch, as well as 12-inch records. Changer blades in most conventional systems also present record chipping problems, since the design re-

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The How and Why (Cont. from p. 1, Col. 3)

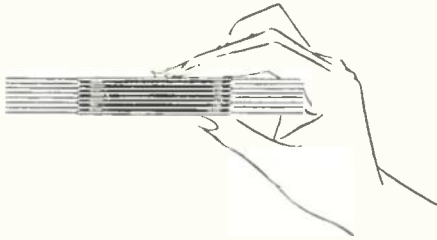
quires them to force themselves between the stacked records.

The solution soon became clear to us. We could not solve the overall changer and record problems by designing a new record to fit conventional changers, or by designing a new changer to handle conventional records. We had to design both a new record and a new changer, complementary units that together would eliminate the basic problems of record changing.

It was found that problems of size and indexing could be solved with a changer mechanism operated from the center of the record. By eliminating outside record posts, it was possible to reduce the dimensions of the player's motorboard from 15 to 11 inches to 10 by 7 inches.

Accordingly, we developed a changer with a drop mechanism which could be housed in a $1\frac{1}{2}$ inch center spindle.

By designing our record with a raised shoulder between the playing area and the rim of the center hole, we were able to produce a wafer-thin disc that had the necessary rigidity, and provided air spaces between the center rims of the stacked records for the operation of the changer blades. The shoulder also provided air cushions between the playing surfaces, eliminating scratching of recorded grooves.



The blades of the new changer never touch the recorded grooves of the record. On the center spindle are two supports or shelves, which form the support for the record stack. When records are changed, the two shelves recede into the spindle, and simultaneously two changer blades move out through slots in the spindle and into the air space to form a shelf for all the records stacked above the bottom record. As the bottom record drops gently to playing position, the shelves emerge again to take over the holding job from the blades, which then disappear into the spindle.

Since the shelves are latch-type projec-

tions, records cannot be forced down over them, but records being removed from the turntable automatically depress the shelves as they are brought up over the spindle.

Through novel design, we developed not only a simple record-changing mechanism but the fastest one in the industry. On the underside of the turntable we designed a cam track that swings the arm up and out from the records, drops a new record, and brings the arm back to playing position in about two seconds.

The large center spindle and the design of the trouble-free drop mechanism called for the designing of a new type of record to fit our new player.

With our changer and player plans formulated, we turned our attention to the record. Our plans called for a record as unique in its characteristics as the player.

Again, let us look to the past. Here, the record, too, has undergone a steady evolution of progress and advancement.

As we advanced from acoustic to electric recording, and from acoustic to electric pickups, recorded music became finer and truer. But, as we cut down some covering noise, such as motor rumble and needle chatter, record surface noise became audible.

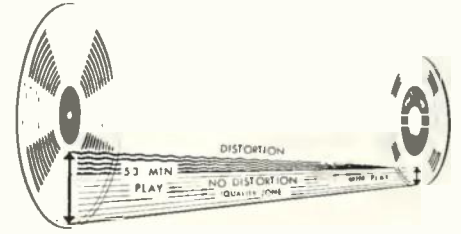
Conventional records also posed other problems which we insisted on solving. Here are the objectives we sought:

1. Elimination of discernible surface noise and distortion, even at wider frequency ranges which may be used as better and better instruments are developed.
2. Reduction of the size and weight of records, making for lower cost, easier handling, more convenient storage, and faster and quieter action of the changer mechanism.

Distortion is caused by the inability of the stylus to track properly in the record groove. On standard records, this becomes more apparent as the stylus moves from the outside groove of the record toward the center.

Whether we use the standard 78 rpm, the conventional transcription speed of $33\frac{1}{3}$ rpm, or the new 45 rpm, the stylus will cover a greater distance in any given interval in the outside groove, and less and less as it moves toward center. Although the turntable revolves at a constant rpm rate, the stylus will track the groove at an increasingly slower linear speed as it approaches center. Beyond a certain point, the modulations are crowded so close together that the stylus has difficulty in tracking, and distortion results. The area up to that point in the record is called the quality zone, where there is no discernible distortion. Beyond that critical point on any record, of any size or revolving speed, distortion is set up and becomes more and more apparent, the closer the stylus moves toward center. We determined, then, that our new records would not be recorded

past the critical point — the music would be recorded entirely within the quality zone of the record.



While we desire to reduce the size of the record, we also wanted to maintain the playing time associated with standard 12-inch discs — up to five and one-third minutes — and we wanted to put the entire five and one-third minutes within the quality zone of the record. We also wanted to eliminate the need for records of more than one size. We sought a one-size record that could handle all classifications of music — popular, classical, hillbilly, and rhythm.

Having established the size of our center spindle, we knew we required a record with a center hole $1\frac{1}{2}$ inches in diameter. We had to allow space for the raised shoulder and the label, and additional space for the lead-out groove which carries the tone arm to the tripping point for operation of the changer mechanism.

The new step was to determine the minimum overall size required to offer five and one-third minutes of "quality-zone" music.

By scientific and listening test, we established the critical point beyond which we could not record without discernible distortion. With that point established, we began to buildout — to provide the smallest record providing the desired playing time. The tests indicated that our new record, to meet all of our goals, should be $6\frac{7}{8}$ inches in diameter, and operate at 45 rpm.

We made our records of non-breakable vinyl plastic for minimum surface noise, and developed a tone arm that exerts only five grams of pressure on the record. The stylus has a .001-inch tip radius. The combination of fine-point stylus and light pressure makes for less record wear and a more sensitive pickup. RCA Victor's famous Silent Sapphire permanent-point pickup is employed in the new tone arm, though it is only approximately one-third the size of the standard Silent Sapphire cartridge.

We have been asked by those who are not familiar with record engineering why we did not design our new system for operation at the familiar home phonograph speed of 78 rpm or the conventional transcription speed of $33\frac{1}{3}$ rpm. The simple answer is that at either speed we would have been required to make a larger record thicker and without the raised shoulder feature, at 78, or larger in diameter, if we were to maintain the same quality level, at $33\frac{1}{3}$. Nothing would be

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Questions and Answers on the New RCA Victor Record Playing System

(Prepared for Audio Record by RCA Victor)

Q. Why was the new RCA Victor Record Playing System developed?

A. With the advent of the automatic changer, mechanical difficulties were encountered because of the lack of standardization of records. The cost of repairing changer units, plus the inconvenience to the consumer, prompted RCA Victor to commission its engineers to develop a new system based on the following objectives:

1. To develop a trouble-free automatic mechanism for changing records.
2. To design a record with the following features:
 - a. Distortion-free reproduction
 - b. Minimum surface noise
 - c. Maximum quality and tone
 - d. Smallest practical size
3. To disregard all limitations or restrictions formerly placed on the designer of both players and records.

Q. Why 45 Revolutions per minute?

A. For the size record selected, and the extremely high quality standards adopted, it was determined mathematically that 45 rpm was the slowest speed that would accomplish the desired results.

Q. How does it work?

A. Contrary to present methods, the new system is based on the principle of a 7-inch record with the size of the grooves reduced, revolving at 45 rpm on a specially designed player, and reproduced by a lightweight jewel-point pickup. All of these

factors contribute to greatly improved quality of reproduction.

Q. Why a 7-inch record?

A. The 7-inch record has many advantages: easy handling... small, efficient, attractive... no storage problems... sturdier product with less wear... same amount of music as recorded on a 10 or 12-inch record... the entire recorded surface limited to the quality zone.

Q. Is this a long-play record?

A. No, the new record has a playing time of up to five minutes twenty seconds within its "Quality Zone"... undistorted reproduction... approximately the same playing time as standard records. However, with the development of the new RCA Victor rapid changer, the lapse between records has been greatly reduced.

Q. How does the new Rapid Record Changer work?

A. The changer operates entirely from the center hole of the record. The spindle of this changer, which is 1½ inches in diameter, houses the trigger action mechanism which drops the records swiftly and silently to the turntable below. The entire operation takes only two seconds! This is the world's fastest record changer — and also the simplest mechanically.

Q. Can I use this system with my present radio?

A. Yes, you may purchase an attachment which will play through your present radio or phonograph, regardless of make.

Q. What types of instrument will be available with this new system?

A. The new RCA Victor system will be available not only in the attachment which you can use with your present radio, but also in complete table model phonographs, table model radio-phonographs, console radio-phonographs, and console combinations with television, radio and phonograph. These instruments all have the famous "Golden Throat" tone system.

Q. How many records will the Changer hold at one time?

A. The changer accommodates 10 records, which change automatically without attention, providing up to 50 minutes of listening pleasure at one sitting.

Q. What type of Needle is used with this new player?

A. There is no needle. This system uses an improved "silent sapphire" permanent point pickup.

Q. How heavy is the tone Arm?

A. The tone arm exerts a pressure of only five grams on the record. Obviously this reduces record wear.

Q. Is it expensive?

A. No, the new RCA Victor system was developed with low cost in mind both for the record playing equipment and the records themselves. As a matter of fact, the savings in record purchases will pay for the player in an amazingly short period of time.

Q. How much cheaper are the records?

A. Up to 33% in albums, and 24% in single records, depending on the type of entertainment you want.

Q. Will the fine grooves present a problem?

A. No. The records are so designed, with a center shoulder providing air space between each record, that the playing surfaces do not touch while the records are on the changer or in storage. Further, the large center hole and the size of the record itself permits easy and careful handling; fingers never need touch the playing surface of the record.

Q. Are all the records 7-inch?

A. Yes, all seven inch, a complete standardization of records, but there is a color code for each type of entertainment.

Q. What do you mean by a color code?

A. Each musical category will be recorded on a different color record. For example: Red Seal music — red record — Popular music — black record — Country and Western music — green record — Children's Entertainment — yellow record — Blues and Rhythm music — cerise record — International music — sky blue record — Popular classics — midnight blue record.

The How and Why (Cont. from p. 2, Col. 3)

gained by such a compromise, since use of the unique and vastly improved record changer would require a record of complementary design, regardless of operating speed. Since the advantages of the new system could only be made available to the consumer through the combination of a new record and a new player, there was no advantage in clinging to an old standard. This left us free to make the system in every respect the best ever developed at low cost.

As previously stated, RCA Victor will continue to serve the standard market by making all selections recorded for the 45 rpm system also available on 78 rpm records. To insure a smooth transition, we will also make Victrola radio-phonographs with playing facilities for both types of records, as well as instruments incorporating only the new system.

Summing up, then, we have in our new disc a record that provides up to five minutes and 20 seconds of music that is free from discernible distortion and surface noise, with every note recorded in the established quality zone of the record.

Having a standard size disc that will take both the popular and classical categories of music, we have eliminated the confusion of indexing changers and have gone a long way toward solving the record storage problem in the home, the warehouse, and the dealer's shop. The small record and changer will also permit an overall reduction in the size of console instruments and give the stylist unprecedented latitude and flexibility in cabinet design.

The changer itself has solved many of the problems encountered with conventional changers. From the consumer standpoint, this changer assures a gentle handling of precious records, and the blades cannot scratch, chip, or break the records. It also provides silent operation and the fastest changing action of any mechanism yet devised.

Our complete faith in the quality, service and merit of this new system is implied in the simple fact that we are planning around it our future in the record and phonograph business, in which we have the largest stake of any organization in the industry.



MICROGROOVE IN YOUR STUDIO PART III THE STYLUS

by C. J. LeBel, Vice President,
AUDIO DEVICES, Inc.

We are continuing our discussion of the problems of microgroove recording with a study of the most difficult problem, that of the cutting stylus. It will be recalled that a recording stylus has a burnishing facet which "breaks" the cutting edge. This



C. J. LeBel

polishes the groove walls, removing some of the scratches of cutting, and making a quieter groove. The effect is just like that of the dulled edge (on a lathe tool) used to produce a shiny cut in turning metal. In 1942 the writer published a study† of the effect of the length of this burnishing facet on the high frequency response. The longer the facet, in terms of groove wavelength, the more the attenuation. A facet length of less than .15 wavelength produces no attenuation. While the original study involved transcription size grooves, undoubtedly the results are not far off when applied to microgroove, as we will do.

Questions and Answers

(Cont'd. from page 3, Col. 3)

Q. How many selections are recorded on one side of the new records?

A. The records are recorded just as you are accustomed to hearing them on 78 rpm records, side for side.

Q. Will only RCA Victor make this new type record?

A. Other manufacturers, in addition to RCA Victor are planning to make this new type record. Others are planning to make the new player.

Q. Are you still going to make the conventional record?

A. Yes, all selections recorded for the 45 rpm system will also be available on 78 rpm records.

Q. How long did it take RCA Victor to develop this new system?

A. Research and experimentation began in 1939. By 1942 the first model was perfected. Then followed years of testing and refinement from which finally emerged the new RCA Victor record playing system.

The data presented covers only the diameter effect produced by the facet — that is, the recording loss only. Reproduction by a stylus of finite size produces a reproduction diameter effect, which adds to the recording loss. Reproduction or tracing loss is fixed by the groove velocity and stylus size, and we can do little about it, so that recording loss is all that we can minimize.

The data is presented in terms of the relative loss, that is, the difference in diameter loss between 1,000 cycles and the frequency under discussion. There is a small loss at 1,000 cycles, too, but this can be compensated for so easily that it is not worth considering.

In modern transcription work, cutting at 136 pitch for a maximum of 15 minutes, we come in to a minimum diameter of 8 inches. We then observe the following:

Frequency, kc	8	8	10	10	10	
Burnish length, mils	.4	.5	.6	.4	.5	.6
Attenuation, db	1½	3	4	3	4½	6

For ordinary transcription work, if we are willing to accept a loss of 3 db at 8 kc or 4½ db at 10 kc, at 8 inch diameter, then a facet length of .5 mil is the largest we can use. For those who wish to make transcriptions with a fine-bottom groove, for reproduction with either standard or micro stylus, we have available a stylus with small tip radius and restricted facet length, our type #14 SM (standard microgroove). This dural shank recording sapphire sells at the same price as our present #14 and can be resharpened at the same price.

†Reference: Properties of the Dulled Lacquer Cutting Stylus, C. J. LeBel, Jour. Acoust. Soc. Amer., Vol. 13, No. 3, pp. 265-273, January 1942.

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they speak for themselves

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