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DIRECTED TO BROADCAST ENGINEERS AND EXECUTIVES

Photo-Micrograph of a "Normal" Recording Groove, by N.B.C. Engineer Warren Andresen

Authoritative Source Material

Lacquer Disc Design

Noise Reduction

The Sapphire Stylus

High Fidelity Recording Heads

Crystal Pickup Design

And Many Others

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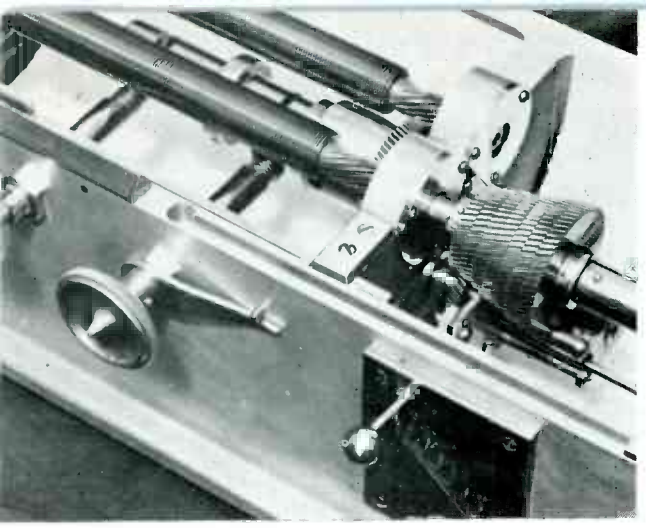
JANUARY **Recording Handbook II** 1941



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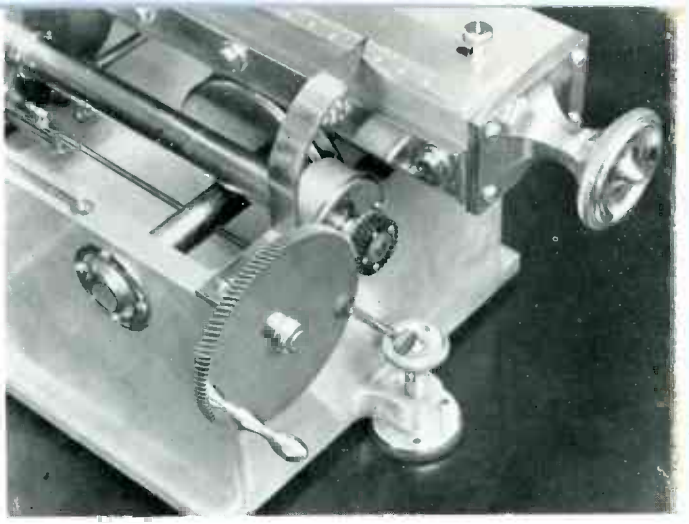

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A Lightweight Crystal Pickup Design

By A. P. Dank

Engineering Department, The Brush Development Company

Fig. 3 and 4 (Inset)

Fig. 3 (Inset)—Photograph showing conventional stylus as compared to stylus and drive wire used in PL-50 and PL-20.
Fig. 4—Photograph of the PL-50.

WITH the advent of instantaneous recording in broadcast studios, the need for a phonograph pickup, that will damage the softer materials used in such recordings, arose. To fill this need, an attempt was made to construct a pickup with optimum design features for a minimum stylus weight. It is the purpose of this article to discuss such a pickup and methods of testing it.

Before discussing design features of such a pickup, it is in order to examine some of the problems which a well-designed pickup must solve. There are two fundamental pinciples normally used in pickup design; namely, magnetic and piezo-electric. There appear to be certain natural advantages which the piezo-electric principle has which makes it easier to construct a light-weight pickup using this principle, although both systems are employed successfully. For the purpose of this article, however, and in the interests of brevity, we shall restrict our discussion to the piezo-electric principle, since better than 90 per cent of pickups in use in this country today apply this principle.

The requirements of a pickup for reproducing instantaneous recordings are as follows:

1. Low stylus force. (Commonly, but incorrectly, known as stylus pressure.)
2. Low moment of inertia of the stylus assembly.
3. Low needle-point stiffness.
4. Extended frequency range.
5. Minimum amount of harmonic distortion.
6. Sufficient output for available amplifiers.
7. Low moment of inertia of the pickup arm both vertically and horizontally while keeping arm resonance below the audible range.
8. Compliance of stylus in the vertical plane.
9. Neat and pleasing appearance combined with utility.

After considerable study and experimentation, a cartridge design for a piezo-electric crystal pickup was evolved, as shown in principle in Fig. 1.

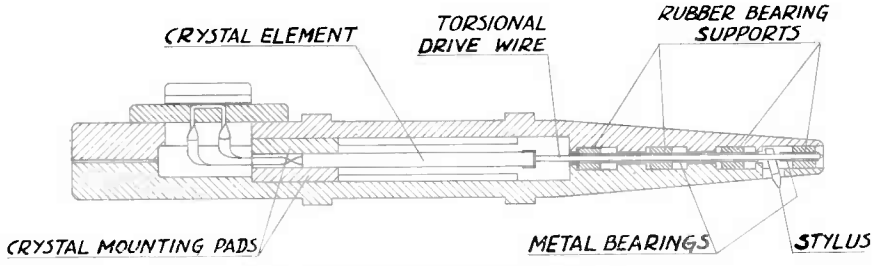

Fig. 1. Sectional View of Cartridge.

One end of the torsion crystal element is clamped in the cartridge by slightly yielding pads; the other end is connected to the stylus by means of a torsional drive wire. This drive wire can twist in metal bearings and these bearings are mounted in rubber bearing supports which are held in the cartridge housing. The record modulations oscillate the stylus, stressing the transmission wire in torque, thus transmitting the groove modulations to the crystal element as a varying pressure. The crystal element then generates a voltage, the amplitude and waveform of which are the counterpart of the groove modulations.

Low stylus force is accomplished by reducing both the needlepoint stiffness and the moment of inertia of the stylus assembly. It became apparent that if the moment of inertia of the stylus assembly must be reduced, a conventional stylus could no longer be used. In its place a tiny sapphire jewel mounted in a short length of nickle tubing was used. It has been found that a certain relationship between stiffness and effective needle-point mass must be used to reduce the mechanical impedance to a minimum for the frequency range to be covered using a conventional recording characteristic. The design formula for this relationship is given as:

$K = .888 \times 10^8 m$ (where K is stiffness in grams /cm; m is mass measured in grams x sec^2 x cm^{-1})

The coupling member between the stylus and the crystal generator is a beryllium copper drive wire rigidly coupled to the stylus at one end and to the generator (crystal element) at the other end, as pointed out above. The needle-point stiffness is inversely proportional to the length of this drive wire and varies with the fourth power of its diameter. The stiffness of this drive wire has a determining influence on the output of the pickup. A stiff drive wire results in a high output and, unfortunately, high needle-point stiffness. To overcome this high stiffness a compromise must be made to obtain the desired results.

The stylus must have compliance in

the vertical plane to allow for the pinch effect which occurs at high frequencies. This is accomplished by supporting the drive wire and its bearings in gum rubber.

The Rochelle Salt crystal element that is used as a generator also determines the output. If a large thin element is used the output will be high but the element will resonate in the audible frequency range. Therefore, as thick an element as is consistent with our other requirements must be employed. Although the compromise just described removes the resonance peak from the usual audible range, it is advantageous to provide some damping of the generating element to suppress the influence of this peak in the audible range.

In a particularly high quality phonograph pickup the crystal element is mounted on damping material and additional oil damping is provided.

Two pickups have been designed as a result of these considerations: The PL-50 and PL-20. Where low stylus point stiffness was of prime importance, as in the case of the PL-50, the compromise between output level and stylus point stiffness has led to the use of a drive wire 1 inch long and .024" in diameter, with the result that a 20 gram stylus force is sufficient for proper tracking, with a large margin of safety.

As for the PL-20 where output was of greater importance than for the PL-50, the diameter of the drive wire was somewhat increased, necessitating a higher stylus force of 30 grams, (slightly over one ounce).

In recognition of the fact that the primary consideration in the case of the PL-50 pickup was an extended flat frequency response and low harmonic content the crystal resonant frequency of the generator was placed at 23,000 cycles. To insure that even this peak is not excessive and has no harmful effects in the audible frequency range, the crystal is not only mounted on viscous pads having a high damping coefficient but is also oil damped by being surrounded by an oil of high viscosity. This, of course, in addition to the thin drive wire used, means that the PL-50 will have a comparatively low output, and, as a matter of fact, is .26 volts for a modulation amplitude of .001".

Concerning the PL-20 where a higher output was desirable, the damping was reduced to the viscous mountings alone and a heavier drive wire was employed. This resulted in an output of 1.6 volts for a modulation amplitude of .001", which is sufficient to drive a conventional radio amplifier.

Both pickup cartridges are housed in the same type of arm. Such an arm must be designed so that the moment of inertia in the vertical plane is sufficiently low so that it can follow uneven and warped records. On the other hand, sufficient moment of inertia must be provided in the horizontal plane so that resonance between the mass of the arm and the needle point stiffness will occur below the audible range.

However, the inertia in this horizontal plane should not be so high as to make it impossible for the arm to properly track an eccentric groove. In Fig. 2 an arm incorporating these desirable design features is shown. This arm has two pivoting points; one allowing vertical motion and another allowing horizontal motion. For the vertical motion, a spring was used to counterbalance the pickup instead of the conventional weight, since a counterweight adds undesirable inertia in the vertical plane. On the other hand, to obtain the necessary moment of inertia in the horizontal plane, the back portion of the arm, which does not participate in the vertical motion of the arm, was made heavy. On both of the pickups being discussed, the horizontal arm resonance occurs between 20 and 25 cycles per second.

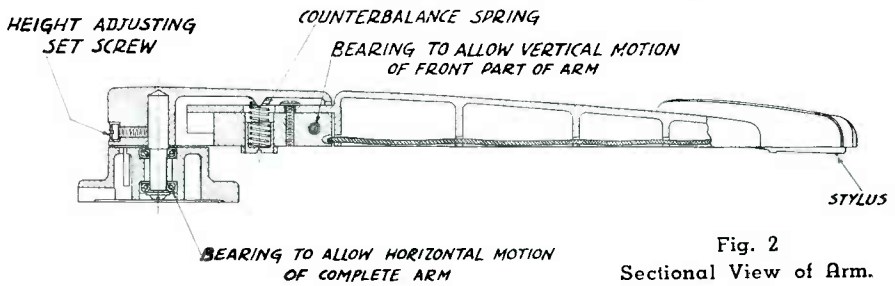

Fig. 2
Sectional View of Arm.

One of the most interesting problems in connection with the design of a high quality pickup is to find a proper method of testing. Such a method of testing should eliminate both the cutter and the record as a source of error. Fortunately, the crystal pickup, being an amplitude-responsive device, lends itself easily to such an objective test procedure. A number of single frequency cuts are used and the speed of the turntable is slowly changed from 78 r.p.m. to 33 1-3 r.p.m. For example, if the frequency at 78 r.p.m. is 10,000 cycles it will be approximately 4,200 cycles at 33 1-3 r.p.m.

Since the same cut is used while the turntable speed is slowed down, the pickup stylus is subjected to "constant amplitude" vibrations of gradually varying frequency and the output level of the pickup should remain constant if the pickup has a flat frequency response on a constant amplitude basis between the two frequencies. If this procedure is duplicated for a number of frequencies, a plot of the whole frequency range can be obtained since it is easily possible to correlate the different measurements for the different frequency bands if these frequency bands overlap. This testing system is independent of the amplitude with which the different frequencies have been recorded on the record. By decreasing the speed slowly between the upper and lower frequency point and by carefully observing the output meter, any peak in this range can be easily observed.

If the frequencies recorded on the record are reasonably free of harmonic distortions, an observation in the oscilloscope of the output of the pickup will give a qualitative indication of the amount of pickup distortion as a function of frequency. Thorough investigation using wave analyzing means has shown that the PL-20, as well as the PL-50, have less than 1 percent harmonic distortion below 400 cycles.

Most important is the proper shape of the jewel stylus tip which has a spherical point of .0025" radius. These tips are tested by means of an optical system with an amplification of 1-100, and care is taken to keep the variation of the radius within ±.0001". This is necessary to assure that the stylus tip is rigidly coupled to the record groove which assures proper quality in reproduction. Continuous tests are made to investigate the stylus life by continuously playing shellac pressings on an automatic machine and by testing from time to time the frequency response on a calibrated frequency record. It has been found that by using the proper stylus force of 30 grams on the PL-20 pickup, 150 hours of continuous playing reduces the output level for a 6,000 cycle tone only 2½ db, while for 4,000 cycles practically no reduction in output level was observed.

Turn Tables in Tribute

By Harold B. Dow

"THIS program is transcribed." . . . So I am informed by a silver throated radio announcer and then follows a favorite dramatic symphonic, sports or news program.

There was a time, not so far distant, when I might have muttered: "Isn't it amazing!" But, today, sound recording has reached such a degree of perfection and is so much a part of radio broadcasting that it makes little difference to me, the listener, whether the program I am tuned in on comes direct from some studio or is picked up from a revolving disc.

And so . . . the phrase, "This program is transcribed" has slipped into a "taken for granted category" along with "She'll do a mile a minute . . . Dial 9-9000 . . . Flight No. 23; now taking off for Cleveland, Chicago and points West."

The high pressure of modern living has somehow dulled our sense of curiosity and of admiration and such terse announcements are now but part and parcel of our inheritance in this age of rapid transit and whirlwind communication.

Yet . . . as in the case of the automobile, the telephone and the aeroplane . . . sound recording didn't just happen. It had to be pioneered, proved practical and developed, finally, to its present peak of perfection.

If we read the available data on the subject, it will become increasingly clear that the locale of our story centers in Bridgeport, Connecticut, and the subject matter largely in the work and achievement of one . . . John J. Scully.

First you ask . . . "What manner of man is this . . . John J. Scully?" And in order that you may understand and appreciate his work more fully, I believe that I should answer this question first, for the radiance of John Scully's personality has played an important part in his success.

The president of the Scully Machine Company is a kindly person. A man whose sagacity and wit has earned for him a countless number of friends. He has three great loves . . . people . . . music and his work, and when he talks a twinkle of merriment dances in his clear blue eyes . . . the kind of jolly merriment that one attributes, usually, to the jovial St. Nicholas.

He was born in Bridgeport and outside of the few years in his early youth that he spent in Louisville, Kentucky, has lived and worked in this Connecticut city.

When sixteen . . . he took his first job as a stock clerk with the Holmes & Edwards Silver Company. Here he became fascinated with the machinery and every minute that he could spare away from his own job he spent talking with the toolmakers and studying the plant equipment.

His evenings he gave over to the study of music, specializing in voice and the piano, and had John Scully not choosen the trade of a machinest as a life work he might well have earned a comfortable living as an instructor of music.

But . . . he liked to work about machinery and at the age of eighteen took a job as an apprentice in the Yost Typewriter factory . . . a job at which he earned $4.00 a week.

Within three years John Scully had earned his journeyman's papers and was put on the company pay roll at the top rate for those days, 35 cents an hour. At that time, if you worked 59 hours in one week, the employer granted a generous bonus of one hour's pay. In 1901 he joined the Machinest Union, a step of which, even today, he is exceedingly proud for though he is now the top executive in his own organization he still holds an active membership card in this union.

After working a short time for the Wheeler & Wilson Company, John Scully, in 1906, took an important step into the field of sound recording when he joined the staff of the famed Columbia Phonograph Company.

Scully found that the cost of coil springs was out of proportion to other phonograph parts and received permission to build a machine that would make the springs automatically. Eight men working at top speed could turn out coil springs for but 250 machines a day. After about a month the device was completed and in operation. It had capacity for making springs for up to 5,000 phonographs a day. One type of spring was made at the rate of 40 per second, 2,400 in one minute! The invention of this coil spring machine gave John Scully the prestige that he needed to be free to go ahead with other ideas, and soon he was placed in charge of the company's experimental laboratories.

The Columbia Phonograph Company at that time owned the Dictaphone. The machine was in its experimental stages and there fell to John Scully the job of making this invention commercially useful. He re-vamped the Dictaphone, changed it from a cumbersome apparatus to its present day size, and the fact that there has been no radical change in the size or workmanship on the Dictaphone since that time, is testimonial indeed to the genius of this man.

Up until 1908, when John Scully designed and perfected an electric motor that would accommodate all types

(Continued on Page Twenty-one)

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High Frequency and Noise Level Characteristics of an Instantaneous Recording Disc

By C. J. LeBel

Chief Engineer, Audio Devices, Inc.

Introduction

INSTANTANEOUS recording has advanced a great deal during the last few years. Figure 1 shows the overall response characteristics of the most popular cutter and pickup of only four years ago. It can be seen that the peak was fairly strong, and that the response dropped off very rapidly above 3,000 cycles. Figure 2 shows the overall response of a cutter and a pickup of today. The real advance which has been made could be determined by adding the cutter and reproducer characteristics. Of course, in doing this we assume that the record coating characteristics are ideal. So far as we know, the ideal record coating material has yet to be found, and in view of the tremendous increase in what modern equipment is demanding of record coatings, it may be a good time to examine critically the record materials available today to see how good a job they can do for us, and to consider wherein they are most deficient so that when, from time to time new materials are introduced, we will know what to look for. At the same time we can see what our present coating materials can do when still further improvement in equipment places still greater demand on the record. This should serve to give the broadcaster some understanding of the problems involved. When he wants a different disc, he will understand what he gains and what he loses by such a change. Every broadcaster has his own idea of what he would like in a disc. He usually does not have much idea of what he would have to lose in obtaining that objective, for that information hitherto has been a closely guarded secret.

Coating Formulas

Before discussing the characteristics of a coating, it might be well to explain exactly what an instantaneous surface consists of. Every disc manufacturer has his own secret formulas, and these are not divulged to anyone. However, all formulas involve the same general materials, and the formulator has the same problems, so that even if we do not take a specific formula, we certainly can give a pretty fair idea of what is in use.

Every formula contains materials to give body to the coating. These may be nitrocellulose, acetyl cellulose, ethyl cellulose, or some sort of resin. In many cases a mixture of two or more of these ingredients is used, all rather brittle in a pure condition. Therefore no one makes the coating of this group alone.

To make a liquid suitable for application to the disc, we add a solvent and a diluent. These are chemicals which dissolve the materials previously mentioned. They all should be evaporated from the coating before it reaches the customers' hands. An improperly dried out coating contains a little solvent which evaporates later, increasing the hardness, and if it evaporates after the groove is cut may well create some distortion. This was a common defect several years ago. And some makers still adhere to the custom, giving an illusion of softness to their discs when fresh. A little storage, and they become too hard to cut properly. If cut before storage they will develop distortion later because the strain of drying has not been relieved.

To keep the first class of materials soft after the solvent has dried out, we add plasticizers. Theoretically these are just softeners. Practically, they are the most important part of the coating. Alone they are valueless, but in combination with the bodying material they give the coating its personality. The problem of the formulator is to develop a combination of bodying material, solvents, and plasticizers which will leave a film having the characteristics desired by customers. This is a real problem, and involves months of work and a great deal of money for even minor modifications.

Coating Characteristics

Let us now take up the effects of a change in plasticizers. First, as we increase the percentage of plasticizer, we will find, within limits and with exceptions, that the noise level will decrease because the coating has become softer, and to a considerable extent, a softer coating is a quieter coating. This does not refer to hardness as felt by the fingernail or hardness as measured by the Brinnell or Sward tests. It concerns cutting hardness which may partly corellate with a fingernail test and which all too often bears no relation to it. The fingernail is a test in compression and flow, whereas cutting hardness is a shear test.

However, generally, durability decreases as hardness decreases, and in fact a change of a few per cent in the amount of some ingredients may change the durability from 25 playings up to

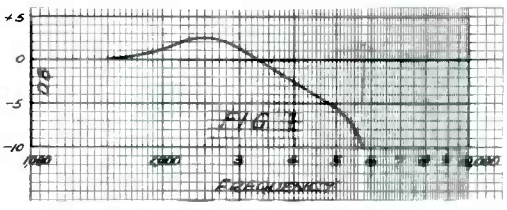


FIG. 1

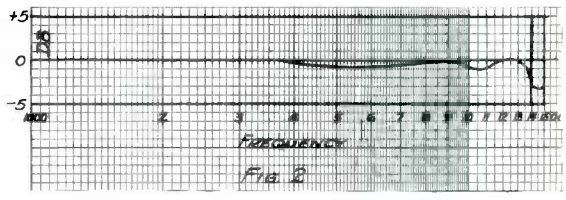


FIG. 2

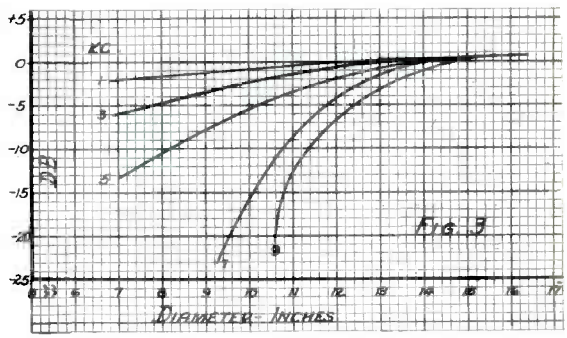


FIG. 3

250 or 500 for a noise level rise of 2 db.

Just to complicate the matter further, we have also the question of high-frequency response. In general as we harden the coating, we find that the high-frequency response of a record is better. At the moment most professional coatings are rather similar in their high-frequency characteristics at 16" diameter and 33/1-3 R.P.M. On the other hand, as we start to go into smaller diameters at that speed, we find

that the personality of the coating begins to assert itself. The diameter loss varies very widely, depending on the hardness of the coating. The response at a given diameter and a given high frequency may vary on playback over a range of several hundred to one when we merely decrease the hardness enough to all on a 50 per cent decrease in cutting pressure. Therefore, the best measure of the quality of a coating is the diameter effect, and it is that which the formulator must consider as well as the noise level.

On the other hand, a harder coating is not as foolproof. A soft coating can be cut with a rusty nail, figuratively speaking, and the record may not be too noisy. A hard record will not give a satisfactorily quiet groove unless a sharp needle and correct cutting angle are used. The little trouble involved in keeping sharp needles in service is the small price the conscientious recordist pays for the better results which he cannot get with softer discs. A machinist must use better tools on steel than on brass, but he knows the steel gives him better results.

Summarizing, then, we find that a harder coating will have higher noise level, better high-frequency response, and better durability than the same formula containing a little more *of the same plasticizers*. Proof of so sweeping a statement and some qualifying are necessary. Let us examine the results of an experimental study, one of several thousand undertaken in the last couple of years.

Test Method

The general method used was to cut a record, play it back, and measure the response on playback. A beat frequency oscillator maintained constant input to a gain set and amplifier whose response was uniform from 50 to 10,000 cycles within 0.2 db. The amplifier was fed into the best cutter available today, a cutter with laminated armature, knife-edged bearings and an extraordinarily wide frequency range. The record was played back through a new pickup of even wider range, using an amplifier similar to the recording amplifier. The output of this flat amplifier was fed to a resistance load and a volume indicator. To eliminate the effect of the needle, all tests were made on a comparative basis, using the same stylus on all discs and playing back under identical conditions. The first set of results secured, of course, was a plot of frequency response at various diameters for various coatings. From such a graph, data could be taken off for any diameter and any coating, even if a test was not made at exactly the diameter desired. Figure 3 shows a typical set of such curves.

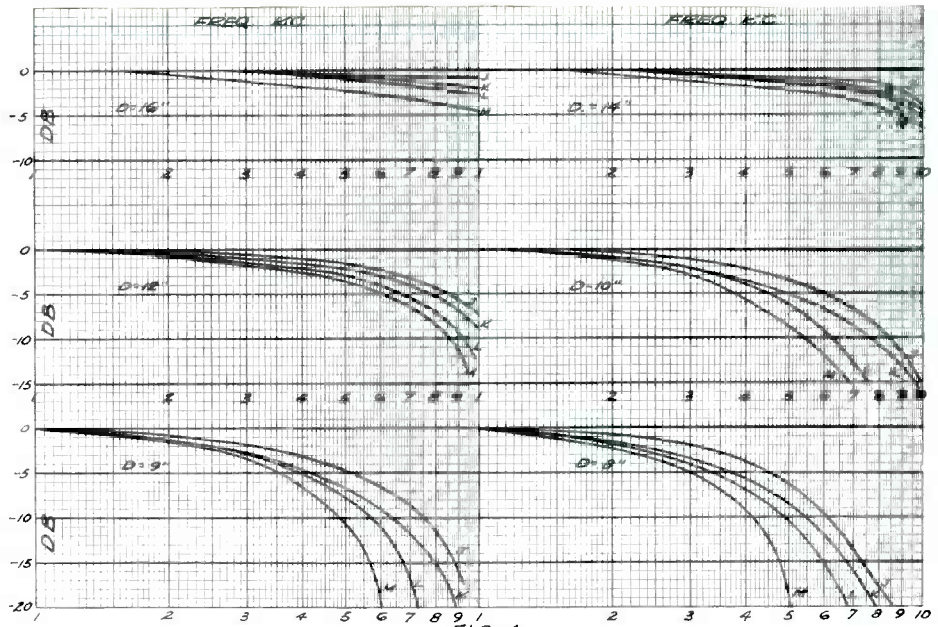


FIG 4

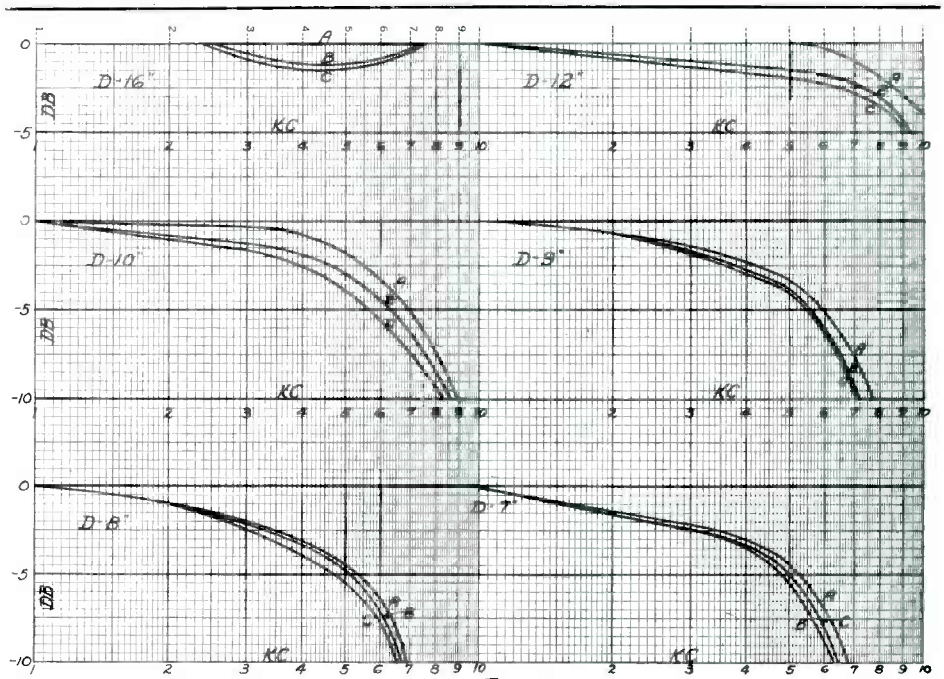


FIG 5

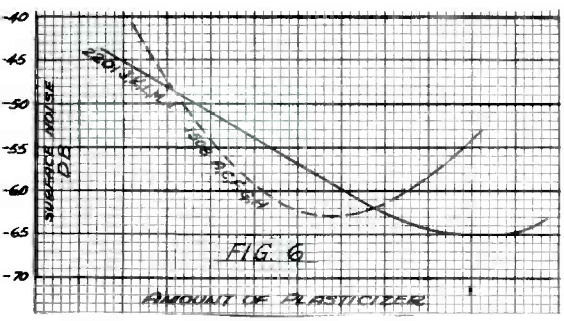
From this set of curves it is possible to pick off the data on frequency response at any diameter under any condition desired. Figures 4 and 5 show a number of studies made by digesting the previous data and applying pickup and cutter correction curves.

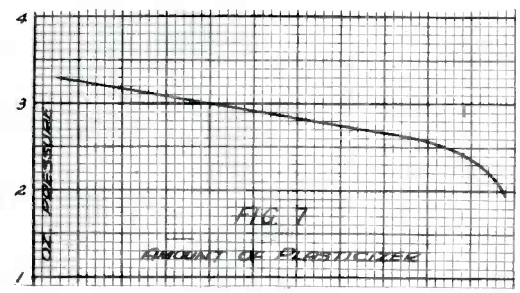
It is interesting to examine the noise level of these coatings, and so we used the same needle to cut a series of blank grooves in the various discs at the same diameter and with a cut of fixed depth. These blank grooves were played back through the same uniform response playback system, and the response was a good indication of the noisiness of the cut. In any such test it is necessary to include an 800 cycle high pass filter to eliminate the effect of turntable vibrations which, in any machine, regardless of cost, is greater than the surface noise of the coating. That is, greater in terms of output voltage but not in terms of annoyance to the ear. Such tests may be criticized on the ground that they do not allow for the high-frequency response characteristics of the ear, but such an objection is not valid. The ear response is *fairly* flat above 1,000 cycles, within the limits of

error with any test of this sort, and most important, the response of the ear does not change much with level, again above 1,000 cycles. The data from such a noise level test is shown in Figure 6.

The discs used for the tests of Figure 4 were specially coated by our research department, and represented one type of formula containing more or less plasticizer. Other plasticizers in varying proportion would produce a similar result. It would not necessarily be the same, but it would vary according to the same general behavior. An entirely different formula employing entirely different ingredients will have the effect of shifting the curve over in one direction or another and of changing its shape. Figure 6 shows how this curve shifts and may change in shape as different formulas are employed. Figure 7 shows the stylus pressure required for a cut of uniform depth.

A set of curves of this sort is fairly instructive, because the formulator very seldom makes a radical change in





formula. He is much more apt to make some set of modifications, because these are easiest to introduce in the factory. If his customers complain too bitterly of the noise level of their records, he is apt to soften things up a little bit and make them happy if he is not too conscientious. A little later, the same individual may receive complaints on high-frequency response, and he will then merely decrease the plasticizer content and improve the high-frequency response, letting the noise level go up. It is very easy to make such a set of modifications, and it takes an iron conscience to refuse such modifications and to hold to a formula which has good high-frequency response and normal noise level. In other words it takes a brave formulator and a courageous employer to insist on a coating of *balanced* characteristics, one that is not superquiet and without highs, nor a coating of perfect high-frequency response and so noisy that it is impossible. There must be a compromise. Many people, curiously, always seem to be fighting for lower noise level regardless of its consequences. Considering the number of stations now using cutters essentially flat to 10,000 cycles it would not be surprising to see this group reverse its stand.

An Invitation

A series of tests of this sort is not hard to run for yourself. Just be sure that

A. You use the same needle throughout. A comparison basis is necessary. The results cannot be made absolute until styli are better standardized than they are now. Tested for commercial work they are very satisfactory: for the laboratory they are not yet instruments of precision.

B. Measure the diameters carefully and only compare diameter for diameter.

C. Check the noise level as well as the high-frequency response, and again be sure you do it at the same diameter on each disc.

Results

It is interesting to note the cutting pressure necessary to maintain a given groove depth, and to observe the comparative noise levels *based on an arbitrary reference level.*

2201J	3.2 oz.	—47db
2201K	2.8 oz.	—55db
2201L	2.8 oz.	—61db
2201M	2.7 oz.	—65db

Figure 4 shows a series of runs on test surfaces numbered 2201J, K, L, M, N.

Each step of softening seems to lose an additional inch of diameter or so, for a given high frequency loss.

Figure 5 shows data on three standard commercial discs now on the market. The results are somewhat different because the formulas are not of the same nature.

A	3.7 oz.	—48db
B	3.0 oz.	—44db
C	3.1 oz.	—45db

The same conclusion on cutting hardness is not quite applicable. It is possible that the minute difference between B and C represents something too close to the normal limit of error. However, A with its higher cutting pressure does have considerably better high frequency characteristics.

That A has lower noise level in spite of its greater hardness is of course a matter of different formula compensating for the hardness.

Conclusions

Using diameter equalizers it is evident that uniform response to 7,000 cycles is easily obtainable with formula A even in to 8 inches diameter. Formula C on the other hand will be good in to only 9 inches for the same drop. This means that the user of Formula C must cut at finer pitch and injure his signal to noise ratio.

Let us now consider an attempt at uniform response to 9,000 cycles. Formula A is down not too far to equalize at about 9½ inches. This will just permit a 15-minute recording on a 16-inch disc at fine pitch. On the other hand Formula C is as good at about 10½ inches. This would compel the use of a 17¼ inch or too fine a pitch to be practical if a 16 inch is attempted. In this case I have allowed for a little more boost because of the lower energy level at 9,000 cycles.

The FM station can get even wider range by working at 78 rpm and reasonable diameters. It is by no means farfetched to say that by proper equalizing and choice of linear groove speed we can now record and reproduce uniformly up to at least 13,000 cycles. This means that a working range to perhaps 15,000 cycles is by no means chimerical on the best instantaneous discs of today under ideal conditions.

On the other hand the soft coating is definitely unsatisfactory in work of the fidelity striven for today. Even in lower fidelity work it compels finer pitch and lower signal to noise ratio than can be achieved with a firmer surface.

New York News

By Ted Kruse

HAPPY NEW YEAR! Yippee! Hurrah! etc. With those words faintly ringing in our ears and with palsied hand, we sit down to write this column. First business at hand is to wish everyone a happy and prosperour New Year.

Among our many New Year's resolutions, we included two that affect the column. One is to write the column on time and not wait for Editor Stolzenberger's monthly haunt; and the other is not to mention Dave Moloney's name

(Continued on Page Twenty-nine)

READY-TO-BROADCAST LOCAL PROGRAMS?

NBC is your Answer! There are two outstanding NBC services available to radio stations for building audience-commanding local commercial and sustaining programs.

1. NBC Thesaurus. This "Treasure House of Recorded Programs" supplies a wide variety of fine musical material, recorded by popular, well-known artists and ensembles. Weekly continuity for 21 outstanding program series (65 programs a week).

2. NBC Syndicated Program Service. Expertly produced musical and dramatic shows including such successes as "The Lone Ranger," "Betty and Bob," "Secret Agent K-7 Returns," "Time Out with Allen Prescott," "Carson Robison and His Buckaroos," and many more.

CUSTOM-BUILT PROGRAMS FOR "SPOTS"?

NBC is your Answer! NBC's "custom" recorded program service is *complete!* It covers writing, casting and production of shows, in addition to recording, processing, manufacturing and distribution of duplicate pressings. NBC offers its splendid recording facilities—NBC Orthacoustic—plus processing and manufacturing of pressings to agencies that prefer to handle their own program production. And for "Spot" and local advertisers, with their choice of any of 200 stations, NBC Thesaurus and Syndicated programs will do an outstanding sales job at remarkably low cost.

PROGRAM PLANNING HELP?

NBC is your Answer! NBC's assistance to advertising agencies in the planning of recorded programs includes studios, fine technical service, casting help and other services. The unmatched facilities of the "Program Center of Radio" are all yours when your show is recorded by NBC. Remember—NBC Orthacoustic gives you recorded programs that literally sound like live studio broadcasts!

AIR CHECKS?

NBC is your Answer! A great many radio artists have discovered that this excellent NBC service best fulfills their requirements for "off the line" or "off the air" recordings.

Scores of advertisers and agencies, large and small, use all or part of NBC's complete radio-recording service. Let us demonstrate how this *outstanding* service fits your requirements.

NBC Radio-Recording Division

NATIONAL BROADCASTING COMPANY

A Radio Corporation of America Service

RCA Building, Radio City, New York • Merchandise Mart, Chicago
Sunset and Vine, Hollywood

Wide Range Recording Head

By George J. Saliba

Presto Recording Corporation

THE field of instantaneous recording has grown so rapidly in the last few years that standards have been constantly raised until good quality now requires that recordings be uniform in response from 50 to 10,000 cycles and distortion be below 3 percent. These specifications have been comparatively easy to meet in so far as amplifiers, record materials and recording machines are concerned but the cutting head, in conjunction

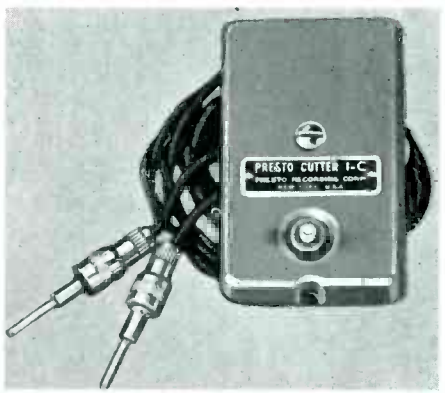


Fig. 1

with the reproducer, has been the "bottle neck". However, in the last few years, reproducers have been designed with extremely low needle impedances, and it is now possible to reproduce frequencies of 10,000 cycles with uniform efficiency. The cutting head to be described herein has been modified from a previous cutter so as to extend its range from 7,000 to 10,000 cycles and also to increase its efficiency.

In designing the cutting head herein described the following specifications were laid down:

(1) It must fully modulate a groove with less than 1 watt of input power.

(2) It must have a good frequency response from 50 to 10,000 cycles.

(3) It must work from a low-impedance source not exceeding 500 or 600 ohms.

(4) It must not be susceptible to weather conditions and high temperatures.

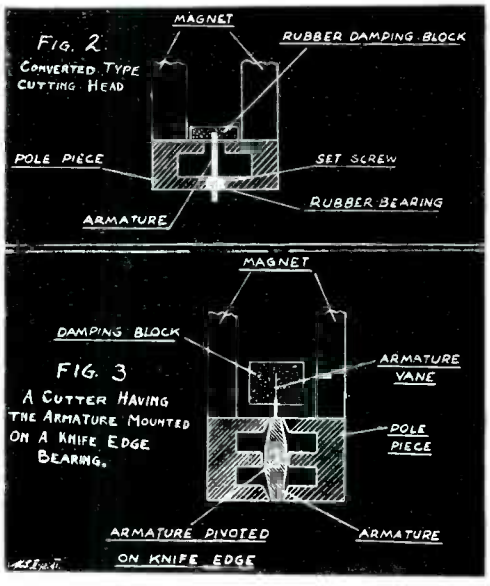
(5) It must maintain its calibration with very little service.

A good recording head operates in a linear fashion over the range of amplitudes involved in speech and music. It is essentially a constant-velocity device. This means that for a given input voltage to the speech coils of the cutter, the amplitude of the wave on the disc at a frequency of 500 cycles will be twice as much as the amplitude for 1,000 cycles and four times as much as the amplitude for 2,000 cycles. Since the energy of speech and the timbre and depth of good music lie principally in the lower frequencies, it is obvious therefore, that the greatest tendency for two adjacent grooves to cut into each other will occur at the lower frequencies. Therefore, below 500 cycles the cutter should have constant amplitude. This means that for a given input the amplitude at any frequency below 500 cycles will be the same.

Up to two years ago the upper limit of high frequency response from lateral recordings was found to be 7,000 cycles. The sharpness of the angle of cut becomes of great importance in the reproduction of frequencies higher than this. At any given distance from the center of the disc, the wave-length of the groove will be inversely proportional to the frequency. Therefore, with increase of frequency the distance between successive points at which the groove crosses the mean will become less and less. If a record is cut with maximum lateral amplitude for a number of single frequencies proceeding from low to high, a frequency will presently be reached for which the wave-length is so small, as compared with the amplitude, that the groove crosses the mean very nearly at right angles.

Up to two years ago, it was impossible, with the pickups then available, for a needle to follow so steep a wave front and, therefore, it was found necessary to reduce the amplitude in order that the needle could track at such frequencies. As soon as the amplitude was reduced, surface noise became quite noticeable with the result that little was gained. Since the linear velocity of the needle in the groove is at all times proportional to the distance from the center of the disc to the groove where the needle rests, it follows that the angle of the cut is of less importance as a limiting factor toward the outside of the disc than it is toward the inside. For example, a frequency of 10,000 cycles might be easily reproduced at the outside of the disc and not be reproduced at the inside. With the present day pickups having extremely low needle impedance and very low pressure, it is possible now for the needle to follow this extremely steep wave front. The introduction of diamond points, carefully polished and lapped, for use as a reproducing needle, has also been a large factor in facilitating the tracking of these high frequencies. The needle point diameter remains absolutely the same over long periods of time whereas when steel needles were used, wear on the needle point increased the diameter so that the radius of the needle point became greater than the radius of the curvature of the groove and this made it impossible for the high frequencies to be reproduced properly. Therefore, it is a comparatively simple matter, with present day equipment, to record and reproduce frequencies to 10,000 cycles.

The electrical principle involved in the operation of recording heads is the same as that involved in the operation of electric motors. The recording head performs the same function as an electric motor; both take electrical energy and convert it to mechanical energy. The principle involved in either



case is the same; namely, that of a wire carrying current in a magnetic field. In recording, alternating current is fed to the coils of the head and the armature vibrates from side to side in direct proportion to the current being fed. In the converted pickup type of cutter the armature is held in place by a rubber block which also acts as a damping block. (Fig. 2). The armature is free to vibrate between the pole pieces, but all magnetic action takes place at the top of the pole pieces. In the cutter shown in Fig. 3 the armature is pivoted in the center and action takes place between both the top and the bottom of the pole pieces. In the cutter of Fig. 2, the armature is held in place by the pressure of the pole pieces which are milled out in semi-circular form to fit the armature. Between the pole pieces and the armature is the rubber washer, and it is this rubber washer with its lost motion that plays the biggest part in limiting the high-frequency response with this type of cutter.

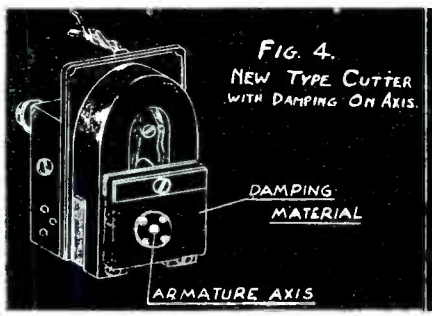


FIG. 4. NEW TYPE CUTTER WITH DAMPING ON AXIS.

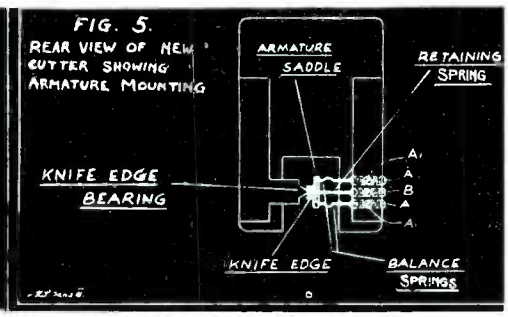


FIG. 5. REAR VIEW OF NEW CUTTER SHOWING ARMATURE MOUNTING

The cutter shown in Fig. 3 is the forerunner of the cutter shown in Fig. 4. Basically there is no difference in the mechanical construction of either cutter. In designing the cutter a great deal of thought was devoted to finding a method of mounting the armature which would eliminate all possibility of lost motion. The method finally found to be the most satisfactory is shown in Fig. 5. This shows a detailed rear view of the armature looking at the back of the cutter. The armature has a V bearing milled out along its longitudinal length. In manufacturing, this operation is very carefully carried out so that a perfect V is made, the apex of which is a fine line. The armature is mounted with this V resting against a knife edge which is carefully ground and hardened.

The method of keeping the armature tight against the knife edge is unique and at the same time practical. On the right side of the armature is mounted the armature saddle on which are mounted three springs. The center spring is known as the retaining spring and is fastened to screw "B". Turning screw "B" pushes the armature up against the knife edge. Inspection of the contact area between the knife edge and the "V" of the armature is then made under a powerful microscope. When the proper contact is made "B" is locked with set-screw "B-1" and sealed. Once this adjustment is made, it need never be tampered with.

The two balance springs are used to center the armature between the pole pieces. Each spring is controlled by its own screw "A" and when the position of the armature is definitely set, the screws are locked by set-screw "A-1". These three screws comprise the entire adjustments on the cutter and, since they are set and adjusted at the factory, the cutter should require very little service and very little adjustment in the field.

In disc recording it is desirable that the groove be fully modulated in order to increase the signal to noise ratio and the cutter shown in Fig. 3 is not able to fill the groove without an increase in distortion. The reason for this is the damping block shown in Fig. 3 which acts more or less as a brake and tends to limit the oscillatory excursion of the armature. This type of damping is known as pressure damping. To improve the level of the cutter and the frequency response, the armature vane was cut off and a large piece of damping material was mounted on the armature axis. See Fig. 4. The use of a large damping piece makes possible the calibration of the cutter to 10,000 cycles or higher if required. This large piece of damping material made a very marked improvement in the performance of the cutter so far as level was concerned because the armature was not held in a damping block. The type of damping now used is known as inertia damping.

This cutter has been designed to use two coils in series to cancel out the even harmonics and thus reduce distortion. In present day instantaneous recording the common practice is to use high frequency equalization to compensate for loss of "highs" due to small groove diameters at 33 1-3 r.p.m. The high frequencies in the neighborhood of 10,000 cycles are sometimes brought up as much as 23 db. This means that more power is put into the cutter at the high frequencies, thereby taxing the limit of safety for the coils. Therefore, new coils had to be designed to take this high power without heating excessively. This new coil design has made the cutter very efficient and the groove can be fully modulated with an input of only 20 db, referred to .006 watts as zero level across a 500 ohm line. Fortunately, in recording, all voltages fed into the cutting head are instantaneous voltages and although a 30 watt amplifier may be required to put in equalized high frequencies without distortion, there are nexer any long sustained notes to really damage the cutter. When making frequency response measurements, the cutter should never be operated at a level that exceeds one watt at any frequency. Otherwise, the coils will heat up excessively and the damping will be affected.

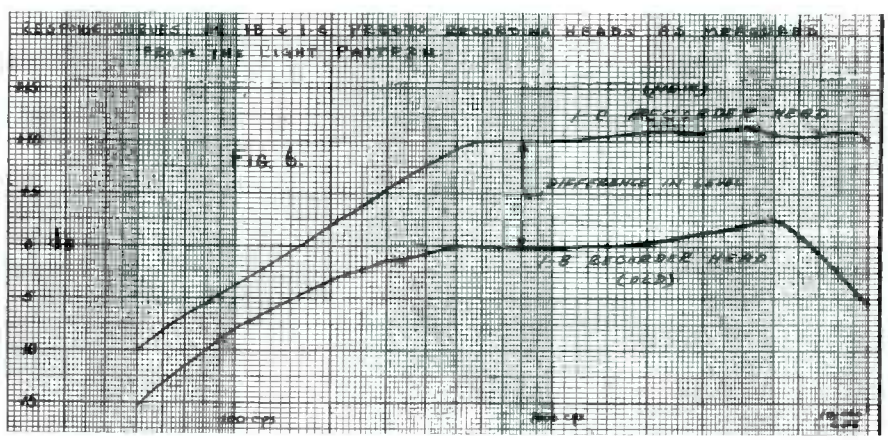


FIG. 6.

The RCA High Fidelity MI-4887 Recording Head and General Notes on Recording

By Ed. Stolzenberger

Engineering Department, National Broadcasting Company

[*A Compendium of Recording Information Supplied by the RCA Mfg. Co., Camden, N. J.*]

THE MI-4887 Recorder Head, shown in Figure 1, is a high-quality magnetic unit that is precision built and accurately adjusted. While primarily intended for use on composition coated discs, it can be used on wax since it does not depend on the record material for damping. Each unit is held within close frequency limits and does not depart from an ideal response curve more than 2 decibels between 50 and 10,000 cycles per second. Heads are matched for sensitivity within 2 decibels at 1,000 cycles per second.

In physical construction, the MI-4887 is a bandpass mechanical network terminated in a dry mechanical resistence material. The armature is of the balanced type and is centered by means of an adjustable tempered steel spring. The armature is supported on rugged knife edge bearings. Pole pieces are of nicaloi.

The recorders should be operated in a temperature controlled room for most uniform results. Frequency response and sensitivity are standard at 72° F. and vary slightly with temperature. Between 65° F. and 80° F. the cutters will remain fairly close to normal characteristic, the variations not exceeding 3 db. from the response at 72° F.

Performance data at the time of manufacture is obtained by scientific optical means, thus excluding errors which might arise from commercial tolerances on cutting styli and disc materials.

A typical response-frequency characteristic of the MI-4887 head is shown in Figure No. 2 and is based

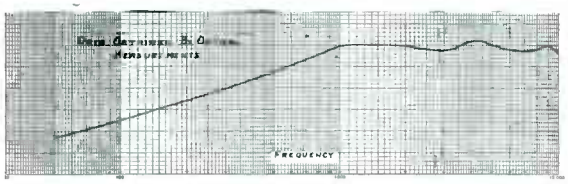


Fig. 2. Frequency Response Curve

upon measurement of the stylus tip motion for constant input. It does not include transfer or needle losses which occur in both recording and reproduction and which are rather severe at high frequencies at low record surface speeds.

Distortion in records made with this head is extremely low. If distortion should be observed, it can usually be attributed to overmodulation which results in failure of the reproducing stylus to follow the groove.

When properly used in well designed machines, the MI-4887 head can consistently produce records equal in quality to the finest commercial transcriptions. This is an everyday occurrence

Fig. 1

in many installations. When such results are not obtained, the cause can usually be traced to some phase of the operating technique which is not being properly performed.

This head will appeal to users interested in realizing the full possibilities of immediate playback recording. It is designed to satisfy the requirements of those who have exhausted the performance capabilities of cheap heads and who are anxious to improve their records by extending the frequency range and fidelity.

It is necessary to provide wide range, high quality reproducing equipment for full appreciation of the improved fidelity of the MI-4887 head. The listening channel should have uniform frequency response between 50 and 10,000 cycles per second and should be compensated in accordance with the latest disc recording and reproducing practice, which will be described. Such a channel could, for example, include the 70-C (MI-4871) transcription turntable with MI-4856 or MI-4875 diamond point reproducer and 64-B (MI-4400) broadcast monitor speaker with MI-11209 Amplifier.

Recommended Associated Equipment for Recording

For ordinary work an amplifier having a uniform frequency response to 10,000 cycles per second and capable of eight watts undistorted output is satisfactory. However, if it is desired to make master discs to be processed, which must equal in loudness certain commercial transcription and phonograph records, it is desirable to use an amplifier having 17 watts output to handle the high peak voltages encountered.

In view of the extended frequency range of this recording head, the program quality should be judged during recording by means of an equally wide range monitor system. For best results it is recommended that an independent monitor system be used consisting of a bridging amplifier and loudspeaker. The reasons for this are because of impedance interaction between cutter and speaker when both operate from a common amplifier output and because cutter amplifiers are normally in a channel that is compensated at high frequencies for recording work. Unless the monitor system adequately covers the entire audible range, one cannot be certain that the program recorded is free of distortion. Some transmissions, especially over long lines, contain considerable distortion compared with those from local studies. The distortion might not be audible on a speaker of limited range, but would probably be noticed in high fidelity recordings of the same program, when played through a wide range playback channel. The tendency would be to blame the recording or reproducing equipment when, if better monitoring facilities had been available, the distortion could have been rightfully accredited to the offending link in the system.

Use of Compensator

The MI-4887 head should never be directly connected to the amplifier. A compensator pack is provided to nullify the inductance of the head and present to the amplifier a nearly constant im-

pedance. The recommended connections provide a resistance of ten ohms in series with the cutting head. This resistance is bypassed with 0.5 microfarad. The only purpose in making the compensator adjustable is to permit obtaining identical senstivity among heads when more than one are used. Critical operators may wish to compensate for manufacturing tolerances by slightly increasing the value of series resistance on the high senstivity units and slightly reducing it on the low heads. This should be done in steps of not more than 2.5 ohms which is possible by series parallel connections. In no case should the total resistance in series with the head be less than 7.5 ohms or the frequency response will be seriously affected. High frequency response can be moderately altered by varying the value of the capacitor.

In the majority of cases, no altering or balancing will be necessary and the compensators can be used as furnished.

Impedance Matching to Amplifier

The average impedance of the MI-4887 head and compensator together is fifteen ohms. Over the frequency range from 50 to 10,000 cycles per second, the impedance will vary a few ohms but not enough to cause objectionable mis-matching.

Cutting Stylus

The use of sapphire styli is recommended for all recordings except unimportant tests. Initial cost is reasonable and the moderate charge for resharpening brings the cost per minute of recording equal to or below that for steel cutting points. Sapphires, if sharp and not chipped, produce a groove surface quieter by 6 db or more than steel styli; furthermore, the groove shape is held accurately.

Practical Hints on Recording

First quality recording blanks are essential. Blanks which are not flat or which have excessive swirls or other defects in the lacquer surface should be rejected or set aside for tests and unimportant recordings.

Recent improvements in formulation of blanks have produced a lacquer coating which is quiet, cuts freely, has a long wearing life and great age stability. The discs stay fresh longer than formerly and while their storage in metal containers is still recommended, the useful life before cutting has been greatly extended. Waxing or lubrication at the time of cutting or afterward is no longer required.

The proper depth of groove can be found by observing the width relative to the remaining wall. The wall should

be approximately two-thirds of the groove width or in other words forty per cent wall and sixty per cent groove. Some operators prefer to measure the thread thickness with a micrometer having a ratchet for insuring uniform pressure. Because of its shape, the thread will always lie flat in the micrometer. It should measure between 0.0018 and 0.002 inch. When grooves are too shallow, the pickup may slide across the record. Care should be taken that the feed mechanism is adjusted sufficiently level that the depth of cut remains substantially constant over the entire record.

The cutting stylus should be nearly vertical to the record. Some prefer a lagging angle 2 or 3 degrees off vertical, while other operators favor a leading or "digging in" angle about 2 degrees off vertical. Laboratory tests have shown a slight lag or lead to be superior to an exactly vertical stylus in producing a highly polished groove. This applies to sapphire styli in particular.

In handling discs they should be protected from dust and finger-prints, two serious problems in record handling. The practice of wearing silk gloves when handling all records including lacquer discs has been suggested but unfortunately, few are willing to take the trouble. Dust and finger-prints cause a rapid rise in surface noise. Records should be kept in their envelopes when not actually being used.

Waxing discs with a solution of carbon tetrachloride, in which a minute quantity of paraffin has been dissolved, increases the initial surface noise somewhat but multiples the number of playings possible before the record is worn out. If more than 25 playings are required, the waxing process has some merit, provided the noise can be tolerated. In general the practice has been abandoned.

Stylus Noise Tests

It is well to make surface noise tests and high frequency response measurements with all the styli which are on hand selecting those which produce quiet, clean cuts. There should be a reasonable number of spare points available to prevent unnecessary use of worn styli. Noise tests from time to time will indicate the condition and degree of wear of the styli. This can be accomplished by cutting unmodulated grooves with each and measuring the relative noise output, using the high fidelity pickup and a volume indicator preceded by a 1,000 c.p.s. high pass filter. This is to exclude turntable rumble or other low frequency noise, since it will be necessary to open the system gain considerably. High frequency response measurements on styli can be made at one frequency, for example 8,000 c.p.s., and the relative reproduced output noted. For this and the noise measurements, recording tests should be made as closely as possible to the same diameter on the disc. The results change rapidly with surface speed.

Tests on styli cannot be omitted if it is desired to obtain the finest possible records. Many of these suggestions may seem unnecessary for ordinary work. Practical requirements will dictate when they can be omitted but all contribute to best results.

Finding the Proper Recording Level

It is impractical to make a plain statement of the correct recording level for any head. While sensitivity of the heads does not vary more than 2 db, the correct level can be established only by experience and test. There are no fixed boundaries in disc recording representing 100 per cent modulation. At low frequencies, it is true that the groove spacing limits the amplitudes. At higher frequencies, the wave slope is the limiting factor. This slope varies with applied voltage and with record surface speed.

The correct maximum recording level therefore is governed by the subject matter being recorded, the energy distribution with respect to frequency, whether high frequency needle loss compensation is used, the record surface speed, the type of pickup to be used, the type and length of recording stylus, what sort of indicating meter is used and its dynamic characteristics, whether peak or average reading, the accuracy of program monitoring, the uniformity of average program levels, whether limiting amplifiers are used, temperature of the studio, type of recording blanks, and how much distortion the user is willing to tolerate.

It is not difficult to find the correct operating levels for a complete installation by making test cuts of speech and music at the slowest record speed and smallest diameter to be used. These tests should be made at gradually increasing levels and the results noted upon reproducing. When the reproduced sound ceases to be acceptable from a quality standpoint, the maximum level has been exceeded. The presence of barely perceptible distortion is sometimes less objectionable than high surface noise which is one reason, from a practical commercial angle, for not being too strictly guided by measured distortion. The proper volume indicator and attenuator settings can then be marked. In cases where an accidental change in gain of the recording amplifier is possible, a volume indicator or voltmeter should also be used at the output terminals.

Broadcast records at 33.3 rpm cannot be cut at as high a level as those for 78 rpm service, because of increased wave steepness resulting from reduced surface velocity of the record material. This difference in velocity, roughly two and one-half to one for a given diameter, makes it necessary to hold down the recording level at least 6 decibels on 33.3 discs.

A higher level is usually maintained for 33.3 lacquer master discs for processing than when the original is to be played back repeatedly as high level soft lacquer records will not stand up. Furthermore, surface noise of the direct cut disc is low and there is no need for the maximum level.

Measurement of Recording Levels

A disturbing feature of rectifier type volume indicator meters is that they do not show what is really going on in a circuit. These r.m.s. calibrated meters have to be used to coordinate readings at opposite ends of a line where phase shift occurs. However, in the studio for watching recording levels, it has been found a help to supplement the usual meter with a peak reading device such as a cathode ray oscillograph. If the latter is used, rule three parallel lines representing zero axis, positive and negative peak swings on the face of the tube.

If these markings are set up and coordinated with a 100 per cent modulation mark on the rectifier type meter, using a sine wave signal, the lack of coordination between the two instruments on speech and music will be apparent. The cathode ray tube will show peaks reaching 100 per cent modulation, while the meter will read, in some cases, as much as 8 db lower. An amplifier can be overloaded with no indication on the meter of such a condition. That is why it is desirable to have recording amplifiers with 10 db margin above the maximum needed power as indicated with a sine wave signal.

Amplifier Compensation for High Fidelity Records

See "Lateral Disc Recording," by B. F. Fredendall, member of the NBC Engineering Department, which appeared in the July, 1940, issue of this Journal.

High Frequency Losses

All disc systems suffer from loss of high frequency response at small record diameters. The losses become more noticeable when an attempt is made to extend the frequency range. These losses

are caused chiefly by the size of the reproducing stylus and the length and curvature of the recorded sound waves. For frequencies of the order of 10,000 cps at low record surface speed, almost complete cancellation results. Therefore, it is obvious that full correction cannot be made by compensation. It is desirable to confine high fidelity recording to large diameters, dividing the time on two or more discs, if necessary for maximum quality. Records having extended frequency range cannot be made at a diameter of less than nine inches for 33.3 rpm without extreme loss of high frequency response.

Flutter

The term flutter is used to describe a vertical wave which is sometimes cut in the record because of bouncing of the recording head. This condition can often be observed as a series of radial "spokes" or patterns in the form of long spirals which are nearly concentric with the grooves. These markings are usually visible before the record is reproduced, although after playing they may be seen more plainly. The flutter frequency is usually in the neighborhood of 30 cps and often modulates the surface noise. In severe cases, modulation of the speech wave also occurs. The direction is always vertical. This may be seen with a microscope as an alternating change in width of the cut groove.

Flutter is produced by a resonance in which the reactive elements are the mass of the cutting head and stiffness of the record material plus that of the float suspension spring. The latter, however, is only slightly effective. Record stiffness can be considered as exerting an upward force against the stylus and depends partly on the surface speed of the material. A steady deflection is represented by a groove of uniform depth while an alternating deflection is associated with flutter. If the stylus is pushed further into the record by an external force, the depth of groove increases, but when the force is removed, the stylus immediately returns to its normal depth. It is the combination of this springlike condition plus the suspension spring and the recorder head mass which, because of the presence of very little damping, is responsible for the oscillations.

Vertical oscillations may be excited by an irregular record surface, by low frequency building vibration, a mechanical jar or by signal impulses.

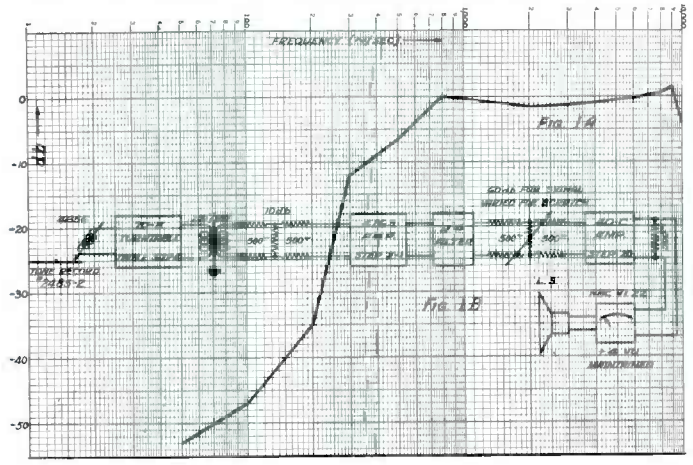
In extreme cases when flutter is not eliminated by the usual stabilizer the operator should look for exceptionally heavy building vibration, low frequency turntable rumble, or a disc having an unusually wavy surface.

Noise Reduction in Disc Recording

By R. A. Lynn
Engineering Department, National Broadcasting Company

IN the interests of maintaining transcriptions at a high degree of excellence, it is necessary that not only the program content be of high quality, but also that the surface noise or scratch of the transcription be of a low order of magnitude. The lower the level of scratch, the higher is the permissible dynamic range of the program.

Basically, the measurement of scratch is relatively simple. All that is necessary is to reproduce unmodulated grooves of the transcription through an amplifier with sufficient gain to obtain a convenient output reading. A few practical considerations must, however, be observed. Low



frequency disturbances, originating from building vibration or from turntable rumble, is normally of sufficient intensity to cause errors in the scratch measurement. For this reason a 500 cps high-pass filter must be used in the reproducing circuit.

The location of the H P filter is important. If placed after the amplifier it is very probable that the rumble levels will overload the amplifier. If placed ahead of the amplifier there is a possibility that hum picked up by induction will be amplified through the high gain system and give erroneous readings. Careful shielding will minimize this condition. However, since the high gain amplifier system normally consists of two units, the easiest expedient is to place the H P filter between the two. In this manner the rumble disturbances have not attained sufficiently high amplification to cause overloading before they are attenuated in the filter and at the same time the inductive hum is not excessively amplified in the final amplifier unit.

The only requirement pertaining to the frequency characteristic is that the circuit be essentially flat from 1,000 cps up to 10 kc and, of course, the lower frequencies must be attenuated below 500 cps by the H P filter. The tone run taken by reproducing the RCA tone record No. 2485-2 is shown in Fig. 1A.

The amount of bass compensation used in the reproducer circuit is relatively unimportant since the 500 cps H P filter attenuate these bass frequencies in any event.

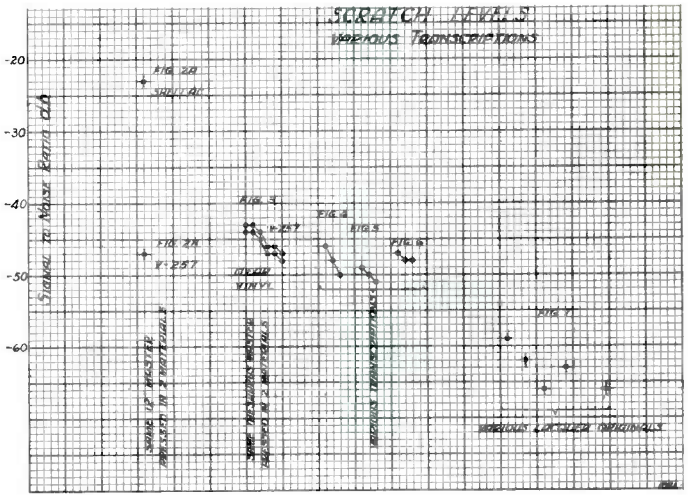
The equipment diagram used by the author is shown in Fig. 1-B. The turntable used is the RCA 70-B with the treble compensation switch set to step "Out" which gives a flat high frequency response.

A 60 db variable pad is inserted in the circuit, as shown, to permit the tone run. For purposes of calibration the gain is so established that a convenient reading is obtained from the tone record. The 1,000 cps reading is especially noted. The scratch sample is then reproduced and sufficient pad is removed from the circuit to permit the scratch reading to duplicate the previously obtained 1,000 cps reading. The 1,000 cps band of the tone record represents the nominal value of a fully modulated transcription. Therefore, the value of the pad removed to make the scratch read the same as the tone represents the signal to scratch ratio and is expressed in db.

The results of the measurements show some interesting effects. It is readily apparent that the discs most commonly used today are easily divided into three general catagories. Shellac discs display the highest noise, vinyl discs come next with lacquer displaying the least amount of scratch.

Figs. 2A and 2B show readings of -23 db for a shellac pressing and -47 db for a V-257 pressing, both pressed from the same master.

It is to be noted that shellac is not intended for transcription work even though it is quite often used for this



purpose. It is of rather coarse texture and so designed to withstand the serious abuse given it on home reproducers and "Juke-Boxes". The reproducing heads are generally found to be heavy (3 oz. or more) with massive styli consisting of the typical steel phonograph needle or equivalent. Under such conditions it is desirable to have the coarse

textured disc to cause the stylus to wear down rather than have the stylus wear out the disc upon a few playings. Even so, a certain amount of wear is incurred on the disc.

An improvement can be obtained, however, when using shellac discs by incorporating a high fidelity type of reproducer which exerts a weight on the disc that is not in excess of approximately ¾ ounce. It is assumed that the stylus compliance is compatible with this figure, that is, no advantage is gained by counterbalancing the tone arm to this reduced stylus pressure if the reproducer contains a stiff moving stylus-armature assembly. In this case disc wear of unmodulated grooves is reduced but the wear of the modulation passages would still be severe. If shellac discs are to be used for transcription work with a high fidelity reproducer, care must be exercised to prevent even a single playing of the disc with an older type of reproducer which will mar the surface.

The various vinyl compounds have been designed specifically for transcription work. They are softer than shellac and will not hold up under conditions of home use. Light weight reproducers with permanent jewel points of low mass and a very flexible armature movement are demanded for the most satisfactory results.

At the present day it can be shown that there is a negligible difference in the scratch content of the various vinyl materials used to make transcriptions. This has not always been the case. For instance, several years ago it was found advisable to use a certain amount of filler in the compound to give optimum results with the reproducers available as of that date. The principle was analogous to but not as severe as that described under the action of shellac and a steel stylus. As improvements have been made in reproducers it has permitted a modification of the filler used in the transcription disc. For the past year the NBC Thesaurus has been pressed in a material known as V-257. This is primarily a vinyl compound with a filler which is microscopic in size. Comparisons made to clear vinyl compounds show negligible differences in reproduced scratch. Fig. 3 shows such a comparison. Additional measurements of vinyl transcriptions are shown in Figs. 4, 5 and 6.

An inspection of the various measurements shows the scratch to be higher for the outside program bands than for the inner program bands. This effect is effected by one or more of several causes. The starting cut of a recording stylus is sometimes noisy which either clears itself or which is readjusted for optimum depth by the operator as the recording progresses. Also in the plating process of the record manufacturing, the deposition of metal is slightly irregular toward the outer diameters of the disc. A third contributing effect is that the flow of the compound, as the record is pressed, is somewhat irregular at the outer edge of the disc. These various factors should be so under control that the spread between the outer and inner diameters of the transcription should be not in excess of 6 db.

Fig. 7 shows that lacquer gives rise to the least amount of scratch upon reproduction. This material is very soft and is intended for transcription work where only relatively few playings are desired.

The scratch measurements as herein described are made with a flat high frequency response. With Orthacoustic, where high frequency attenuation is applied upon playback, a still further improvement is obtained in regard to the signal to noise ratio. The additional improvement amounts to from 6 to 12 db depending upon the distribution of the scratch noise throughout the high frequency spectrum. 8 db is taken as the average figure for this improvement.

Although as has been pointed out, negligible scratch difference is encountered between V-257 and clear vinyl, V-257 has a definite advantage due to its lower susceptibility to accumulating an electrostatic charge. Electrostatic charges are detrimental since dirt particles, which eventually scratch the grooves under the wiping action of the playback, are attracted to the disc. Furthermore, any attempt at brushing off the particles builds up the charge to higher values causing the particles to adhere more persistently to the disc.

Some idea of the severity of this condition is indicated in the results obtained on an elementary laboratory set-up which included an electrostatic voltmeter with a working range from 3,000 volts to 15,000 volts. The mere withdrawal of a clear vinyl disc from the paper envelope created charges in the range of 3,000 to 5,000 volts, the value depending on such factors as the room humidity and the rapidity of withdrawal of the disc. Rubbing the disc with felt created potentials as high as 12,000 volts. Atmospheric conditions caused varying rates of decay of this charge. On one particular day a clear vinyl disc dropped from 11,600 volts to 6,000 in a two-hour period, while the same disc on another day dropped from 11,400 volts to 3,000 volts in the same time period. It was found that V-257, subjected to the same tests, could not be made to exceed a maximum potential estimated at 1,000 volts. The sensitivity of the meter was such that no further data can be presented at this time on the rate of decay of V-257. Sufficient evidence is displayed, however, to show the appreciable superiority of V-257 over clear vinyl from the standpoint of the susceptibility to electrostatic charge.

In the foregoing paragraphs mention has been made of "clear vinyl". To avoid confusion it is perhaps advisable to point out that the terminology "clear vinyl" is used for all vinyl compounds free from filler. However, various dyes are used to attain any desired color of disc, which dyes have no effect on the electrostatic characteristics. In some instances heavy concentrations of dark colored dyes are used which make the discs opaque and consequently similar in appearance to V-257 which is opaque due to the filler used. The susceptibility to electrostatic charging is a reliable test to differentiate the two classes of vinyl discs.

In concluding it is pointed (Continued on Page Twenty-one)

The Frank L. Capps Patented Sapphire Stylus

(A brief explanation of its manufacture and the purpose of its several facets)

By Isabel Capps Rainey

THE recording industry has recognized the supremacy of sapphire as a perfect cutting medium since the advent of the first talking machine. Today, although modern recording has introduced new techniques, new machines and new types of blanks, nothing has been found to surpass, or even equal, the sapphire stylus as the finest needle for all general types of recording.

Until the radio developed amazingly into a real and practical actuality instead of the toy people predicted, recording was done almost entirely on wax with a sharp sapphire stylus. But in the wake of the radio, which for a time seemed even to threaten the very life of the phonograph industries, came a whole new unexplored range of recording possibilities. With the possibilities came problems. Machines would have to be portable instead of fixed, simple instead of complicated; blanks would have to be something besides wax, cutting tools would have to cut whatever was developed to cut on. There was a period of feverish experimenting, building, developing. Out of that period came home and studio portable machines, lacquer blanks, and a new type of sapphire cutting stylus.

It is not the purpose of this article to review those times, or to consider anything except the sapphire cutting stylus developed and patented by Frank L. Capps. During the intervening years we have manufactured and resharpened hundreds of thousands of them and are therefore in possession of data regarding their performance and use that seems worth passing on to those who have been or are potential users of them.

So rapid has the development of instantaneous recording been that it can still be said to be in the experimental stage even though it has reached such amazing proportions. The result is that recording engineers have had to adapt themselves to new techniques and learn the answers to problems presented while actually engaged in the production of the regular work. Many are only vaguely aware of the difference between the new sapphire with which they are cutting acetate and the old one with which wax was cut. Some have not done any recording before at all and are therefore not fully acquainted with the properties of sapphire or their maintenance. At the same time we, on our part, must learn from the engineers who use them just what difficulties are encountered and how the performance of disc and stylus vary under different conditions so that we can adapt the stylus to new demands. In other words, we are all in the same experimental boat and must pool our findings for the advancement of all.

Sapphire was originally selected as the best cutting medium because of its hardness and the fact that it lends itself to specification grinding. Diamond, the only substance harder than sapphire, is too difficult to grind because of its internal structure and hardness to be practicable for this purpose. It is readily seen that if a very hard material was needed for cutting wax it is even more important to have that quality in a stylus for cutting lacquers. However, a sharp pointed cutter makes a gray and noisy groove on lacquer and it was necessary to modify the design of the wax stylus in some way so that it would cut a quiet groove on the new type of blank. That was the problem that confronted Mr. Capps back in 1932. Even after he found the way to effect the necessary modification in the design of the stylus there was a long patient interval of perfecting a technique to accomplish the desired result. Without that design and the technique we have developed, under his supervision, for turning these cutters out in increasing quantities the industry could not have reached its present high level. For today engineers are obtaining results of such high quality with sapphires manufactured under this patent that it is possible to process from lacquer masters, a feat considered impossible a few years ago.

The feature that distinguishes the present sapphire from those made to cut wax is a facet ground along the cutting edge that slightly dulls the point and adds a trailing "heel" that polishes the bottom and sides of the groove as it is cut. This facet is very small and requires great delicacy and skill by the operator. It is the final touch added to the sapphire. Its importance to the performance of the needle and the factors which it controls will be discussed later; it is enough to say here that, all other parts of the sapphire being perfect, it alone spells the difference between a good and a bad cut.

Here, perhaps, a paragraph on how the whole stylus is made would be of general interest to those who use them. There are seven facets ground upon every sapphire, all done by hand, by skilled workers. First the face flat is ground upon the unmounted stone. When this flat is highly polished, without pits or blemishes, and perfectly flat, it is mounted into the shank. This must be done with exactness, the stone being in the absolute center of the shank and perfectly straight so that it does not lean to either side.

Next the flat is ground upon the shank in a milling machine, care having to be exerted to have this flat perfectly true in relation to the face of the sapphire. Lateral cutting styli have this shank flat exactly opposite the face of the sapphire. If there is any error in the milling of this flat, the sapphire when subsequently ground will come up uneven, which, incidentally, does not impair its cutting properties in the least, but does make it look like a careless job. In this connection it should be noted as self-evident that when a shank flat is turned off four degrees in order to throw the chip to either side, it has the above effect and when the needle is inspected under a microscope, or shadowgraphed, it will be

symmetrical, but with one of the cutting edges longer than the other.

When the stone has been mounted into the shank it is a column, round except for one flat surface, the cutting face. It is then passed on to another operator who grinds the first rough shape to the sapphire. This brings it up to a rough point, which must be seen to be correctly centered and to have the shoulders (or extreme ends of the two angles) even. The stone is then ready to have the final and exact cutting angles ground upon it. When the polished surfaces are right, the cutting edges clean, and the point perfectly sharp, the radius is then added.

The final operation is the patented one which adds the previously described "heel" to the needle. It too is done on a wood lap impregnated with fine diamond and held in a specially designed tool. A special test is made and the needle is then tested again on a recording machine, the groove observed and played back for surface noise.

For all of these grinding operations the laps (wheels such as jewel grinders use) must be kept in good condition. They must be perfectly balanced with the motors which drive them so that the sapphire does not bounce when held against it. They must also be kept free from "glaze", an effect produced by heat generated through the friction of the sapphire against the wood. Neither must they be allowed to get gummy through a combination of too much oil or diamond. For these reasons laps must be kept in perfect condition and regularly inspected. Making the tools with which our work is done, keeping the motors and laps in condition and making machinery for various processes keeps a special maintainance department busy and there is one section of our shop given over to this work alone.

When finished, the mounted sapphire has seven facets, two of these roughly ground, five of them highly polished and meeting at exact angles according to standard specifications or special specifications at the request of the individual user. The stone to be perfect must cut a perfect groove. In this connection the first essential is that the cutting edges be sharp and without nicks, and that they meet at the correct angle. Next, the radius must be symmetrical since it shapes the groove. Its size varies according to individual requirements, but the standard is from two and one-tenth mils to two and three-tenths mils, which is the range of Western Electric specifications. Finally, the "heel" must be kept within a certain range of size and be highly polished in order to perform its functions properly.

With all of these facets properly ground the needle should give excellent results but there are other factors which help to determine whether it does or not. As the instantaneous recording field has grown, requirements have become more and more exacting, results scrutinized more and more critically. The manufacturers of blanks and recording machines feel as we do, that when difficulties are experienced by recording engineers, their particular pro-

ducts are the first thing blamed. Actually the machine, blank and stylus must each be good and the engineer must know how to adapt all three in order to have the results satisfactory. Of these three factors there is probably more range of variation in the blanks. It makes no difference to the machine what sort of blank is used on it, but it may make a difference to the stylus, not only as to whether the blank is of the soft or hard variety, but whether it is fresh or dried out. Unfortunately, a stylus that will cut one kind of blank with perfect satisfaction will not always perform with equal results on another variety. Insofar as possible, we make our standard stylus with an eye to its performance on any blank, and where we know in advance the type it is going to be used on, we test on that type of blank before sending the stylus out.

The controllable factor in this connection is the "heel" on the sapphire which can be added to in order to get a cut with a minimum of surface noise. Adding too much to this heel may limit its ability to record the high frequencies; however, a compromise may sometimes be necessary for critical recordings since it is exceedingly difficult to make a stylus that will cut a truly silent groove and at the same time faithfully record the whole range of frequencies on any kind of blank used. The sharper the stylus the higher the frequencies it will record and the higher also the surface noise that will result so that, obviously, a best average must be struck. We are constantly studying the problem of the relation of the stylus to the type of blank used, and would welcome data from experienced recording engineers on this subject. They could help to throw additional light on this study by returning to us for microscopic examination any stylus that gives superlative results, being sure to include information regarding the type of blank used and their personal findings. Such cooperation would help to advance the progress in quality recordings. We have in the past been able to help those who have cooperated with us in this way to their and our mutual advantage. Another bit of information we would be glad to have from recording engineers is the number of recording hours their sapphire cutters average. We are frequently asked for a definite statement on this point but do not guarantee any given number of hours because so much depends on how the cutter is used and cared for.

The initial expense of a sapphire stylus seems high on first thought, but considering the expert hand work that must be put into it, its long life expectancy, and the number of recording hours through which it will stand up, it is not. It is our policy to prolong the life of every sapphire we sell and to give advice that will enable it to perform long service between resharpenings. The following data, based upon our examination of thousands of sapphires returned for resharpening, should therefore be useful in this respect.

It will come as rather a surprise to many that out of every ten sapphires we resharpen only three will be merely dull, while three will have a deposit of aluminum around the point and four will be chipped. The most minute trace of aluminum or a nick on or near the point of the sapphire will immediately result in an audible hissing and a very gray cut. Aluminum is usually picked up through making too deep a cut or through allowing the stylus to hit the edge of the blank where the coating of lacquer may be thin. Nicks may be the result of some foreign particles of grit on or in the disc coating, or through setting down the cutter too abruptly on the disc, or by being improperly protected when not in use. When not actually in the cutting head, sapphires should be kept in a container that protects the point or they should be inserted point first in a piece of pith. Bad breaks occur when the cutting head is accidentally dropped or when the stone strikes against a really bad place in a blank. Occasionally, too, there may be a fault running through the sapphire that will cause it to break under strain although we examine all stones before mounting them to be sure that they are perfect in this respect Such a fault may develop through rough handling or only become apparent after strain has been put on it. Sapphires that are merely dull or have aluminum or tiny nicks in the edge can be resharpened without breaking down the edge at all, which means just that much longer life for it. If there is a bad break or chip out of the edge, then new edges must be ground and much of the sapphire wasted in the process. Under the former conditions a stylus can be resharpened upwards of twenty times, while if badly chipped the number of possible resharpenings is reduced considerably. Incidentally, if there is a chip in the edge of the sapphire well above the cutting point we do not attempt to grind it out since it will not interfere with the performance of the stylus and would unnecessarily wear away the sapphire.

The point at which the limit of resharpenings is reached is determined by the shank. As the sapphire becomes short the shank begins to be ground away with the sapphire as the angles are restored. When too much of the shank has been ground so that it can no longer securely hold the sapphire in place, the graveyard is indicated for that stylus. As a matter of fact when that point is reached there is so little of the stone left as to be almost invisible anyway.

When being resharpened, the stylus goes through all of the original processes of manufacture except face polishing and mounting. It is therefore important to protect the face of the stone at all times. Frequently we come across stones that have been badly scratched, perhaps with tweezers, but more likely by contact with other sapphires. Such a scratch means nothing until repeated resharpenings bring it closer to the point. Then, if it terminates in the edge, a nick results that obviously cannot be removed and it becomes necessary to grind the stone down until a perfect face is restored.

Mutilated shanks should also be avoided. Every facet is ground upon the sapphire with the understanding that it will be used in a vertical position. A bent shank will upset

this principle or, if occuring in a lateral plane, cause more weight to be thrown on one side of the point than the other. We re-mill and straighten such shanks if possible but cannot always do so and it is unlikely that such a stylus will ever give maximum satisfaction, because jewels in bent shanks do not properly meet the grinding laps and will therefore not be absolutely perfect. Finally, sapphires should never be allowed to jostle against one another on a table or be jumbled loosely together when mailed for resharpening. In either case they will cause nicks on the edges or scratches on the face and make it inevitable to grind away more of the jewel than necessary in restoring the point and edge.

Other materials, such as stellite, on which we also put our patented cutting edge, may be less trouble to take care of but the superiority of sapphire makes the effort well worth while. Not only is it virtually impossible to grind such soft materials to precision specifications, but the edges must always be ground down and a new point established so that the number of resharpenings is limited. Stellite, on the other hand, is a good stepping stone for amateurs and beginners in making the jump from steel to sapphire. Even the home recorder will find that in the long run, for the number of cutting hours obtained, for long life and for high class results, sapphire is still the best and most economical buy he can make.

Noise Reduction in Disc Recording

(Continued from Page Seventeen) out that the signal to scratch ratio of present day transcriptions is in the vicinity of from 45 db to 50 db. With the application of Orthacoustic a further reduction to the vicinity of 55 db is realized. Present day developments in the recording and processing techniques gives promise of attaining, within the very near future, transcription reproduction with a signal to scratch ratio in the order of 60 db or better. Experience has demonstrated that this figure is entirely satisfactory for all broadcast requirements.

Turn Tables in Tribute

(Continued from Page Four)

of current, Dictaphone had been buying its motors from another company. For years they had tried to buy a motor that would accommodate any type of electric current so that their machines would have a world-wide sales value. Experts in engineering were called together and they all agreed that such a motor could never be made practical. John Scully was put on the job and within a year he had built and perfected such a motor.

With the working mechanism of the Dictaphone perfected . . . officials soon found that trouble was developing with their voice reproduction unit. Some voices were too loud and others too soft for clear recording. John Scully's next assignment was to invent a speaker that would reproduce the speaking voice. . . . no matter what the level or pitch.

In 1909, Mr. Scully designed and perfected his first disc recording apparatus. Twelve machines of his design were built immediately and sent to the principal recording centers throughout the world, (Paris, London, Brussels, Milan, Budapest, New York, Chicago, Boston). This type of recording was to revolutionize the industry.

John Scully left the Columbia Phonograph Company in 1919 for a more lucrative position as technical engineer with the General Phonograph Corp.

He stayed with this concern but a year and then determined that he would invent and perfect a superior recording machine . . . so he went into business for himself.

By 1921 John Scully had made his first Scully Recorder and it was sold, immediately, to the Cameo Recording Corp. Since this time he has been making superior recording machines. Each year he has discovered some method of making sound reproduction clearer and more life-like. He has invented countless devices that make his machine the epitome of exactness and precision.

Eight years ago Mr. Scully was joined in business by his son, Lawrence J. Scully. Side by side, father and son are today dreaming distant dreams and making greater plans that will carry the art of "serious" sound recording to heights hitherto unknown.

So "Turn Tables in Tribute" to a pioneer and a practitioner in sound recording, John J. Scully.

Recordgraph Film Recorder

By W. L. Woolf
Recordgraph Corporation

THE use of motion picture film for sound recording has long offered the alluring promise of a phonographic sound record of many hours duration without the necessity of changing a record, at prices per hour of recording far below any achieved in disc recording of the conventional phonograph type.

Development Problems

The introduction of a recording instrument profiting by these natural advantages has been delayed by a number of practical problems of such hardihood as to tax both the genius and staying powers of recording engineers. The cellulose nitrate film, for instance, is an ideal recording medium but highly inflammable and therefore unsuitable as a material to be handled by the public. The cellulose acetate or safety film, on the other hand, while as safe to handle as paper, has a cellular structure which responds to a cutting stylus much like a good grade of ocean sand and looks as much under the microscope, leaving a sound track with a noise to signal ratio, like the Mountain to Mohammed. With cutting ruled out as a recording method, burnishing was tried. Fortunately, burnishing, if done at sufficiently high pressure, leaves a smooth, hard, compressed sound track of unbelievable durability and a noise level made conspicuous by its almost complete absence, especially when compared with the noise level of commercially pressed phonograph records.

In burnishing at high needle pressures, however, particularly at low and consequently economical film speeds, the film offers a mechanical impedance of such magnitude as to render all conventional recording heads totally useless. The impedance offered at the stylus point is so high that in rubber damped recording heads the film modulates the rubber rather than vice versa and delicate heads of low inertia and good frequency characteristics designed for cutting wax or nitrate coated records simply break into chattering nodes under the resistance to modulation offered by the acetate film.

With a satisfactory recording head finally designed, there remained other problems of dragon proportions to test the steel of the engineering St. Georges. Vibration, a bugbear in all motor driven sound machines, had to be tamed. Easy threading had to be achieved, convenient and simplified operation was essential, automatic shifting from one track to the next was imperative, a machine must operate over long periods without film breakage or dangerous temperature rise, suitable indexing facilities must be provided as well as means for quickly finding and replaying any portion of a long time record, and for continuous operation a suitable film splice must be developed.

Photographs by J. W. Conn

Practical Operation

These problems have all been faced squarely in a new instrument manufactured by the Recordgraph Corporation of New York City. Several models of these instruments are now in test operation in the New York and Washington offices of the National Broadcasting Company, where they are used to provide a continuous and permanent record of the programs of the Red and Blue Networks. These machines are of the continuous type, operate eighteen hours per day, require very little supervision and only necessitate a change of film every six hours. A battery of four continuous recorders is shown in photograph number one.

The Recordgraph Corporation supplies these instruments in either portable or stationary types or for rack mounting in racks of conventional width.

In these instruments 35 mm. film is used as the recording medium. The space between the perforations is used to record 100 sound tracks. The film is propelled at either 20 ft. or 40 ft. per minute. At the former speed, 6¼ ft. of film per hour are consumed, both sides of the film being utilized. At this speed the sound recording may be described as telephone quality, the upper frequency cut-off being in the neighborhood of 3,000 cycles per second. At 40 ft. per minute, the frequency response is increased to 5,000 cycles per second. At this speed 12½ ft. of film are consumed per hour. The cost of film suitably packaged and ready for use is 18¾c per hour for the slow speed and double that for the high speed recording. Details of one of these machines is shown in the photograph which is a semi-closeup of a portable model.

Mechanical Fundamentals

Fundamentally the instrument consists of a drive sprocket mounted on a spindle provided with a motor driven flywheel. The sprocket draws the film over a recording drum on which rests the point of the recording stylus under control of the recording head which is energized by the signal output of a

suitable amplifier. The recording stylus impresses a laterally modulated sound groove in the film suitable for playback with a conventional electrical pickup.

The film is an endless loop. Each time it makes a complete revolution the recording stylus is automatically moved laterally through an oblique angle to the succeeding sound track. The recording may thus be continued until one hundred tracks have been made on the film, at which time the instrument automatically stops.

In operation the instrument is first threaded with a suitable roll of film. The manufacturer supplies the film in rolls of appropriate lengths for various playing periods ready for immediate use. At the factory the appropriate number of turns is wound on a roll of the correct size and the two ends of the film are spliced together, leaving however, a loop of proper length external to the concentric layers of the roll. The film is then provided with a metal contact for closing an electric circuit treated to reduce surface noise and packed with a blank log for indexing the track number of various parts of the program to be recorded. To thread the film the operator simply places the roll over the film magazine, like putting a hoop over a barrel and threads the loop over the recording drum under a safety switch and over the sprocket. One end of the loop comes from the inside of the roll, passes over the drum and sprocket and back to the outside of the roll.

Simple Controls

With the exception of the starting switch, tone and volume control, all other operations of the instrument are accomplished with a single four position knob. By turning the knob in one position the instrument may be threaded as above described. In the next position the instrument is ready to record, in the third position, to playback, and in the fourth, marked "neutral," both recording and reproducing styli are removed from the film. In this position the amplification system composed of a microphone, amplifier and loud speaker are connected for public address use. A red light indicates when the instrument is in the "record" position, a green light in "playback," and a white light in "neutral." A meter indicates the output volume permitting the operator to set the volume control at the volume desired.

Tracking Mechanism

With the instrument in recording position, recording is commenced. By means of a switch the driving motor is turned on which drives the sprocket, thus propelling the film. A sound track is recorded once around the film, at which time the metal contact attached to the film, closes an electric circuit, starting a small carriage motor which rotates a worm geared to the recording head carriage thus moving the recording head laterally the distance of one sound track. At this point a pawl drops into a notch in a disc attached to the worm simultaneously stopping the lateral movement of the recording head and breaking the carriage motor circuit. During the first round of the film there has been recorded thereon a track parallel thereto. That portion of the sound track recorded while the carriage motor is in motion is made at a small angle obliquely crossing the film. The major portion of each sound track therefore is parallel with the film and a short portion is at a small oblique angle running into the next succeeding track. The sound track is continuous from the start of the first track to the end of the last one.

A counting device indicates at all times the track being recorded or played back, and the operator, while recording, makes an index, jotting down the track number on a log blank supplied with the

film on which each selection is to be found.

The recording drum on which recording is accomplished provides a highly polished and hardened revolving recording floor. The point of the sapphire recording stylus is approximately .002 inches in diameter and records a track between .002 and .003 inches in depth. Unemulsified leaderstock, .008 inches thick, provides adequate body to permit recording on both sides. A sapphire needle is also employed for playback. Since both recording and reproducing styli are raised and lowered by a knob provided with a reduction gear, the styli are both lifted and set down gently, reducing breakage practically to the vanishing point and thus permitting the needles to be permanently set at the factory. In this manner the most advantageous angle is permanently obtained, no material is cut from the surface of the record which has to be disposed of, no needle requires sharpening or change and consequently the conditions of recording are fixed permitting the operator to obtain good results with a minimum of variables and rehearsals.

Drive Motor

The instrument is driven by an alternating current fractional horsepower motor deeply mounted in felt and rubber to isolate motor vibration from both the flywheel, which is rubber driven, and the frame. The power switch with which the motor is started is provided with a cam which relieves the pressure of the motor pulley against the rubber idler when the switch is turned off, thus preventing deformation of the idler when not in use.

Film breakage in this instrument has been reduced to a point below that anticipated in motion picture practice. No projecting lamp is present to dry and weaken the film and intermittent motion, which plays havoc with the perforations in motion picture practice, is absent in the recording instrument. Should the film break, however, there is provided a switch which automatically stops the drive motor, preventing damage to the film.

Recording Head

The recording head is of the magnetic type. The rigidity of the stylus is much greater than that of the conventional recording head in order to properly match the mechanical impedance of the head to the mechanical impedance offered by the film in the process of burnishing, particularly at low speed. Two independent sets of restoring springs hold the recording stylus in its normal unstressed position. One set is applied to the vibrating armature and one set to the stylus. A light metal drive rod connects the armature to the stylus. This structure makes the stylus extremely rigid. In several years' use it has never been necessary to adjust, retune or rebuild a recording head. It has been successfully used while operating in the rear seat of an automobile over miles of rough road. The recording head consumes slightly less than one watt of power in normal recording. The pressure of the recording stylus at the recording point approximates 70,000 pounds per square inch. At this pressure the material becomes plastic flowing around the needle and leaving a compressed, highly polished sound track capable of hundreds of playings without appreciable deterioration and of low noise level.

Conclusions

The outstanding features of this instrument are the long-time recording periods achievable without interruption or changing the film, the small storage space required per hour of recording, low cost of recording medium, permanency of the record and the great stability of the recording instrument. The double spring system of the cutting head, which would be impractical for recording by other methods, but ideal for burnishing on acetate, results in a stability under rough handling not even remotely achieved in any other recording head. The rounded, polished burnishing point of the recording needle possesses a reliability and freedom from attention that can never be achieved by a cutting needle which must be constantly sharpened or changed under the eye of a highly trained technician. The hardened and polished recording and reproducing floors operate for years without wear or attention as compared to the constant attention required by soft or absorbent materials. The native toughness and pliability of the safety acetate film into which is compressed a dense, hardened, polished and toughened sound track, permits hundreds of playings with only a very small fraction of the wear suffered by other records.

Hollywood News

By Bob Brooke

DENNY back from Convention . . . Sun hot . . . Rosebowl Exclusive again . . . OB in and out . . . Draft worrying a few . . . Melrose Studio to Mutual . . . Lots of business . . .

SUN . . . Another wonderful fall . . . Days around 85 with nights cool and starry . . . We read of the UNUSUAL weather in the East, zero to 30 below, while enjoying our warmest weeks . . . Golf has taken the studio by storm leaving the beach deserted except for a day or two a week after or before golf . . . Palm Springs is getting a tremendous play with P. S. Ferguson spending every idle moment at the Desert Retreat . . . Hollywood sun is good enough for most though, as we note the tops down, tanned faces, and Palm Beach suits . . . However, Miami must have something cuz Slappy Maxie's and Bill Jordan's Bar of Music have closed for the winter and gone to Florida . . . Both have signs on the door, "Gone to Miami — back in April" . . . Bet it's the sucker list, not the sun . . .

CHANGES . . . Our first permanent home in Hollywood, the Melrose Studio, has been leased by Mutual KHJ as of December 1, 1940 . . . The building stood unused since completion of Radio City except for a few overflow shows and an occasional rental to RKO or RCA Victor . . . The old plant was put in service December 7, 1935, to replace our single studio on a rehearsal stage at RKO . . . The Melrose studios occupied a thoroughly remodeled building once the scene of a famous film laboratory fire . . . The studios were planned by Mr. Hanson and built under the direction of Gordon Strang and Bill Clark . . . They served NBC well and acted as a very economical stepping stone between our single studio at RKO and Radio City . . . A grand crew is taking over . . . So long, Melrose. Good Luck . . .

PERSONALS . . . The Hollywood column has missed its personals . . . We'll try and touch the high spots . . . Les Culley, formerly of Master Control, has been made Recording Supervisor with a staff of six men . . . Craig Pickett was moved up in Master Control and Jim Brown, our budding lawyer, was moved from maintenance to take Pick's spot as Control Relief . . . Kay Phelan has moved up again taking a position as secretary to John Swallow, Coast Program Director . . . Art Brearley and Rick Riekeberg were formally inducted into A.T.E. after their summer as vacation relief men . . . Art stays in studio and Rick goes to maintenance . . . Paul Greene back from N.Y. where his wife, Marie, sang a leading role in several Lucky Strike

shows . . . Denny back from a pretty grueling trip to the convention . . . He drove a new Buick in from Detroit . . . We should spend a few paragraphs on Denny's trip and all the details of the convention as we have done on these pages before but I forgot to be an inquiring reporter and get all the low-down when I saw him yesterday . . . Let's just offer our appreciation and thanks on a third convention handled successfully by him for us . . . We hear Figgins is going in for shots of nude trees on bleak and barren hillsides . . . Still using his Super Iconta B . . . We hear with horror that Anabella's latest offspring has been sold down the river for chops by the Pickett family . . . Pick with a new Studebaker . . . Ken Hicks finally started on his house . . . Charley Norman and the Joe Kays in their new places . . . Jake O'Kelly moving to swanky Encino to be neighbors with the Ameche's, Gables, Fibber MaGees, Jolsons, not to mention Alice Faye or the great Lombard . . . Earl Sorenson bought his folks a nice little place down near Long Beach . . . Television boys, Scheuch, Graham, Turner, doing a swell job handling overflow studio shows . . . Ken Hicks in before 5 a.m. to record the Chicago Breakfast Club shows for later release . . . Murdo MacKenzie still wearing his sun glasses in the booth and ringing the SOS for maintenance to come and fix 'em quick . . . Mac to N.Y. and mebbe Miami with Jack Benny . . . Jack says a joke can't be in my script until I see Mac laugh . . . Miller had a wonderful vacation in the high Sierras and is still doing Maxwell House and Chase and Sanborn . . . We hear he doesn't touch the stuff either . . . Al Korb drained his pool last week and reports another Chevy purchased . . . Races again with the opening of Santa Anita . . . Bob Moss doing great as new night manager . . .

GOSSIP . . . Johnny Morris is the Ghost writer of this column . . . He's the best digger outer of news I have . . . So don't always blame me for these stories you may read in the JOURNAL . . . Mr. Saxton to SF occasionally on business . . . Daughter Dorothy a mighty fine young lady now . . . Understand she's talking college already and wants to go to Stanford . . . She's almost as tall as her dad . . . The Don DeWolfs are fine and their three daughters are pretty nearly grown up . . . De, as operations chief, stays pretty close to the office these days except an occasional special event he may go out on, to keep in touch with field . . . Miv Adams plenty busy with many changes in dance remotes and quite a few special events for a change . . . A number of field commercials keep him busy, too . . . A new Photographic store has opened across Vine Street (Send their advertising copy Air-Mail —Ed.) . . . We already have one across Sunset . . .

FLASH — Jim Brown elected Chapter Chairman. Congratulations. Replaces Denny, who certainly has done a swell job.

KFI-KECA News

By H. M. McDonald

MANY ex ship operators now in broadcast sailed on the intercoastal liner Mongolia, or at least worked old WWN. One of the most widely known ships in American waters in its day, later renamed the President Fillmore by the Dollar Lines and now called the Panamanian, it's in the news again. The old packet is at Pedro, loaded with gasoline in drums, and was ready to sail for Japan, where it will be sold for junk, it is said, or perhaps be used in coastal service in the Orient, but has been ordered to lay to until a few trifling bills totalling $50,000 have been paid.

Glen Litten has resigned his position as transmitter engineer at KFI and is taking active duty in the U.S.N.R. He has been in the Reserve for many years and his present rating is Lieutenant J.G. He is stationed at the new million-dollar Navy and Marine Corps Armory here in Los Angeles and is a division commander of 50 or 60 men, an instructor in the Radio and Signal School, and Ships Service Officer. His work enables him to be home nights and he has taken a house on nearby Park Drive.

Charley Young, Carl Sturdy and Jonathan Smith were the recent proud recipients of Hamilton watches bearing their names and the words "Presented in appreciation of ten years loyalty to Earle C. Anthony, Inc., and the Packard Motor Car Company."

Perusing the technical magazine "Radio" we discover that our own Dawkins Espy contributed the article "Noise Free Antennas" in the November issue, and "Recording—Theory and Practice" in the current year book, and we learn that he writes regularly for that excellent publication.

Bob Brooke wins the prize, for telling the tallest tale in 1940, with his article in the December issue about the Eddy Millers hiking in the high Sierras above 20,000 feet, but the prize will not be awarded until we are sure it was not a printer's error. Mount Whitney, the highest in the State, is only 14,495 feet.

Much rejoicing at KFI-KECA the day before Christmas, when a bonus of a week's salary was distributed.

Blatterman and Moore envied by all when they left for Palm Springs for a two-day special job. They returned five days later reporting that there were five days of hard work connected with the job and that it was "no picnic." They do not appear exactly haggard, though, and we still envy them.

George Tokar played Santa Claus, but in reverse, taking out of his sock rather than putting in, and giving himself a nice shiny Packard sedan, two-tone tan, complete with everything.

The Engineers who attended the egg-nog party at Jonathan Smith's home Christmas night say that those who did not missed a good time.

John Hidy tired of life in a flat and is moving out in the Valley where he can have a badminton court, a patio, and a barbecue pit.

Lloyd Roe moved from Los Angeles to Fullerton, about 15 miles closer to KFI transmitter, thereby saving the cost of driving his car 7,000 miles a year, enough to pay vacation expenses.

Carl Lorenz and Harry Saz were over to our studios a day or so ago, but were called back to Hollywood before we had a chance to say hello.

The Christmas issue of the Journal was the best yet.

Something to brag about—the weather here New Year's Day—a cloudless blue sky and 67 degrees warm.

Whose face is red because he failed to put stamps on some of his Christmas cards—yours truly.

San Francisco News

By Lee Kolm

IT IS interesting to note that: George MacElwain has replaced his low-slung Cord with a conservative Packard . . . Frank Barron, SE, did all the redecorating of his new Burlingame home . . . E. E. Jefferson, FE, has a new Simplex 16mm camera. First pictures taken were of the ground-breaking ceremonies at Taylor and O'Farrell Streets . . . Warren Andresen, SE, has turned in his Packard and now causes much feminine head-turning with a flashy Ford convertable . . . Robert Barnes and Mort Brewer of KPO are still trying to prove that fishing is good in the vicinity of San Pablo Bay . . . A mighty fine job is being done by Henry Dunton, KGO,

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Who's Who in Chicago

(The Second of a Series)

Edwin A. MacCornack

By Tom Gootee

Edwin A. MacCornack

THE changeable winter weather in Chicago has probably had a disturbing influence on many lives and careers around the old Windy City, but never more so than the part it played in Edwin A. "Mac" MacCornack's past fifteen years of radio work.

Prefacing his present—and comparatively tame—nine year service with NBC, Mac worked six years "on the boats"—a period that involved many and various forms of travel, toil and trouble.

And the primary reason for much of his traveling was the variably inclement weather that settles on Chicago every winter.

Mac was born in 1907 at Elgin, Illinois, two skips and a jump west of Chicago. After finishing grade and high school in that city, Mac began looking around for something that resembled a profession. Deciding on radio—but with no intention of becoming an operator—he spent a year at the University of Illinois.

Early in the spring of 1926 the lucrative possibilities of radio operating entered his plans, and Mac went to the only radio school near Chicago, at Valparaiso: Dodge's Ham Shop. In order to earn enough money to attend that institute of learning, and also eat, Mac worked on a pie wagon—which was probably the steadiest job he ever had, except there was too much work involved.

At Dodge's Institute he studied spark transmitters for a full five weeks; then they taught vacuum tubes for four days. After that the course went back to spark transmitters again, and Mac departed—optimistic in the belief he knew enough about radio to at least get an operator's ticket. Those were lean days, and Mac had a hard job making both ends meet. The day he left school he borrowed ten dollars, rode all night on a bus to Detroit, took his license examination the next day, then returned to Elgin via bus and thumb. There, at home, he waited the outcome of his efforts.

Two days later a wire from Detroit offered him a job as operator on the coal boat S.S. *Alpena*. Mac jumped at the opportunity, and stepped into his first operating berth—a job that lasted all during the summer and fall until December, under the call WCU. Upon his return to Detroit Mac turned down a broadcast job with WWJ, in favor of a vacation.

But on his return to Chicago he found the region almost buried under a cold winter blizzard. With so much cold and snow around him, his thoughts easily turned to visions of the south—and the farther south the better! Employment conditions were very good back in those days, and with only a year's service on the Lakes as experience, Mac took a bus to New Orleans and there contacted R.C.A.

A few days after the New Year Mac took his first job out of Mobile, aboard the sea-going tugboat *H. C. Cadmus*. It was a new and different experience for him, but it was far from hard work. There were only six white officers, including himself, and the rest of the crew was composed of West Indian negroes. The tub was equipped with a quarter-kilowatt spark transmitter that Mac swears must have been the inventor's working model. It was somewhat loosely installed in the radio room: a six-foot-square cabin, that also housed Mac's bunk, and a nondescript ancient navy receiver without benefit of calibration. Down through the center of the cabin ran the mainmast, and there was just room enough for Mac to squeeze in between the equipment. Whenever the tug ran into a bad blow or a hurricane the mast would creak, and bend back and forth, and the transmitter would most likely shake loose and send broken parts flying all over Mac's bunk. Due to a loose condenser shaft on the rig, it was impossible to keep the transmitter on any one frequency for any length of time and as a result no other land or ship station could copy his traffic. This condition was particularly exasperating when the tug would be within seeing distance of a port, and Mac could raise no one with any kind of a CQ call!

Trips made on the tug included Tampa, Havana, Puerto Rico, San Domingo and down to Cartagena, Colombia. On the trip to Colombia Mac brought back a three-foot baboon which had the run of the ship—until they returned to New Orleans. As a mascot, however, the baboon did not live up to expectations, mainly because it spent most of the time climbing around the rigging and did about as much damage on the tug as the gulls overhead.

During one of his last trips to Havana Mac had quite an adventure with a taxicab, which later resulted in some difficulty with the American Coast Guard. While seeing the sights in Havana with a fellow crew-member, Mac conceived the idea of loading their rented taxi with cases of various liquors—to bring back to the "dry" United States. This they did, and then proceeded to see the remaining sights of the Cuban capital. As the evening wore on trouble began to brew. At one point they sent the taxi driver into a store to determine directions, and then Mac and his henchman took over the cab themselves and set off on a wild ride back to the waterfront. The Cuban police soon gave chase, but Mac reached the wharves two jolts ahead of the gendarmes, loaded their precious cargo into a bumboat, and eluded the police who lost them in the darkness of the piers.

A week later the tug steamed into New Orleans, and almost immediately the ship was swarming with Coast Guard officers—who were apparently aware of the small but illicit cargo. About half of the cases had been disposed of before the arrival of the Coast Guard, and fortunately Mac "lost" all of his liquid property. But most of the crew was thrown in the Jug at New Orleans, and the tug held at dock under guard for two weeks. Finally all the difficulties were ironed out, and Mac was allowed to leave—which he did, and permanently.

Within a week he was hired by the

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WOR News

By R. A. Schlegel

All summer we water, cut, feed and nurse the lawn. When fall arrives, we breathe a sigh of relief and then go out to buy more seed for planting during the winter so that we'll have a nice turf the next year. Who's crazy?

Hadden is going in so heavily for miniature railroads that the system has outgrown its present quarters with the result that Hax had to go out and buy a house with a basement large enough for the railroad.

Cribbing again, this time from Radio Daily: "Some of the news commentators should close their programs with, 'For further details, you have already seen your local newspaper.'"

Some of the staff have been concerned over the proposed increase in income taxes. Engineers Ted Kasna and Jack Byrne and Al Helfer, our diminutive announcer, have solved this problem to some extent by having their wives present them with additions to the family. It was a boy in each case. Hadden please note.

The war jitters indirectly affected Jim Shannon, who had a visitor from the Department of Justice. The agent told Jim that he had been reported as a suspicious character. Some patriotic soul had spotted Shannon's antenna and reported it as the location of a foreign agent's transmitter. Shannon had difficulty in explaining, as he had sent his license to the FCC for renewal and therefore had nothing to show that he was a duly licensed ham.

The ham spirit is increasing around these parts with most of the fellows getting up on 80 meter cw. for a bit of code practice. We'll have to request the ARRL to schedule their daily code practice during the midday so that the rest of the gang can get their code proficiency certificates . . . and did you get yours?

Debut of that press camera mentioned earlier is being delayed due to legal difficulties. It will be marketed by Burke and James, who also handle the Solar enlargers. The lens board on the camera will be interchangeable with the enlarger. I've seen the salesman's sample of the camera and it is a knockout, has everything that a shutterbug could ask for. Hope they get the legalities untangled soon. Speaking of new cameras, Pat Miller has acquired sole ownership in a new Rolliflex, and the pictures that he's been taking with it certainly have plenty of snap to them. His talents lean more towards the "True Story" magazine type of picture.

Hadden and Herud have been adding more rolling stock to their "0" gauge miniature railroad and it won't be long before they'll be charging admission to the fellows who want to go over and play trains.

Add to things we could do without: The "tks fr QSO QRU 73s" type of ham . . . The lid who sends "QSFR QSO" for "TKS FR QSO" . . . The ham who sends "OK" ten times and then fails to answer your questions . . . The 15 wpm lid with his bug set for 50 wpm . . . The 20 meter band folding by 8 p.m. EST.

Who's Who in Chicago

(Continued from Page Twenty-six)

Munson Line aboard the *Munaires* for a trip to Rio de Janeiro and Buenos Aires. The voyage took about a month, and little of importance happened—since Mac was more of a tourist, and on his good behavior for a change. Working conditions were a little better for him than on the previous tugboat. The ship was equipped with a two kilowatt spark set which, for a change, was at least reliable and would stay on frequency.

Upon his return to New Orleans he signed up with the Luckenbach Line aboard the *Lena Luckenbach,* and spent over nine months making coastal trips: New York, Tampa, Mobile, through the Panama Canal, to San Diego, San Francisco, and Portland—then back again over the same route. Steel cargoes were shipped from the east to the west, and lumber was the main cargo returning.

Following his release from the Luckenbach Line—mainly because Mac disliked the cold weather encountered in the northern ports—he spent several months, early in 1928, on the Mallory line excursion boat *Comal,* between New Orleans and Tampa.

Then followed his employment on the S. S. *Senator* which, in itself, is something of an epic.

Early one morning in the spring of 1928 Mac was aroused from sleep by a call from R.C.A., in New Orleans. An operator was urgently needed on a small freighter, sailing within a few hours for Central and South America. Not quite realizing what he might be getting into at the time, Mac went down to the waterfront and signed on. The ship itself was as dirty a looking scow as ever struggled into port—and from the beginning Mac figured something must be wrong. As soon as he was aboard the lines were cast off, and he was on his way southward on the S. S. *Senator.*

Then he found out what it was all about. The freighter was Norwegian, with as mangy a crew as had ever been seen or heard about. The crew itself consisted of twenty-four Norwegians, one German, and Mac—who, in his haste to depart, had neglected to bring any form of identification with him to prove he was an American. Only the Skipper and the German could speak passable English, so in time Mac and the third engineer became fast friends. Not so with the rest of the crew. They resented the fact that Mac was making as much money as the Skipper himself—and by the time the ship reached its first port in Yucatan there was anything but good feeling between Mac and the crew.

To add to his discontent, Mac found the radio equipment in the last stages of decay and decomposition. There was very little water to drink, and Mac did not relish the Norwegian hash which was served alternately with fried fish—at all meals, including breakfast.

The laboring freighter finally reached the Port of Progresso, in the Yucatan, with its load of grain. Then the trouble began. The Mexican port officials came aboard ship, and lined up the crew for inspection. The officers — in typical fashion — wore full regalia with admiral's hats, fifty pounds of gold braid, two swords apiece — and no shoes. It was high noon, about 130 degrees in the shade, and Mac was not in any pleasant disposition anyway. The Mexican officials could not understand why Mac was on such a ship if he was an American. If he was an American, where were his papers, and if he wasn't an American who and what was he? At which point Mac told everyone concerned, including the Skipper, where they could go.

Whereupon he was marched down the main street of Progresso, in the center of an infantry regiment of about thirty soldiers—all without shoes—to the Progresso Jailhouse. There he was locked up, and there he stayed for three days—until the freighter was ready to sail again. Alone in a cell about ten feet cube, Mac's indifference soon resolved into despondency. And all his efforts to bribe the guards were to no avail. Finally the infantry regiment returned the morning the ship sailed, and escorted him back to the freighter—where they personally put him on board, and watched from the shore as the S. S. *Senator* slowly steamed southward to Belize, in British Honduras.

By the time they were three days out Mac had succeeded in becoming everybody's bitter enemy—except the Skipper and the German engineer. There was a particularly important feud between Mac and the Chief Mate—a feud that had reached mean proportions by the time the ship arrived at the British port for a load of bananas. Finally, one night Mac and the third engineer trailed the First Mate into a dark alley along the Belize waterfront and almost murdered the Norwegian.

Needless to say, this little incident did little to improve relations between the crew and the radio operator. With a cargo of bananas aboard, the freighter steamed north toward New Orleans—and for the remainder of the trip Mac slept very little, stayed in his cabin most of the time, and subsisted mainly on dry bread, bananas and little water.

When he arrived back in the United States in one piece he lost little time in parting company with the *Senator.* Adding insult of injury, however, the Skipper docked him for all the time he had spent in jail and on shore leave!

After a short rest—and with some decent food under his belt—Mac again looked around for work, and finally signed up with the Standard Oil tanker S. S. *Polarine.* This ship was on a regular run between New Orleans and the oil fields of northern Venezuela. But after several trips on the tanker, Mac was offered another job with Creole Petroleum —owned by Standard Oil.

The Creole Petroleum Company was at that time engaged in developing the vast northern Venezuelan oil fields. They were then prospecting and laying pipelines in and around the delta of the Orinoco, where the San Juan River flows into the Gulf of Paria. Mac operated field communicating equipment for the prospecting parties that were penetrating deep into the heavy jungle growth that chokes the river and its many tributaries in this region. Mac spent six months with Creole, and finally had to quit because of a case of malaria jungle fever.

He came back to New Orleans and rested up for a few months before again taking to the sea. In June, 1929, he signed up with the *H. M. Flagler*—another oil tanker. Mac really took the job because he heard the ship was going to England—but it took over a year for the tanker to finally get there. After a few short hauls between New Orleans, St. Thomas and Puerto Rico, the tanker went on a regular run between Las Pedras, Venezuela and Halifax, Nova Scotia, until the spring of 1930. Then the boat made one trip to England, and Mac spent three whole hours in London —an achievement. After that the tanker shifted to a South American run for six months, mainly between Talara, Peru, and Rio de Janeiro, Buenos Aires, Santiago, and Las Pedras, Venezuela.

Until the tanker arrived at Las Pedras, late in 1930, Mac had had a comparatively easy job as operator. But after a little incident there, the Old Man really put Mac to work.

The Irish Third Mate and Mac had become fast friends, and had succeeded in getting into and out of a multitude of minor scrapes, brawls and riots. So upon their arrival at Las Pedras they went to the town's one and only gin mill, and proceeded to celebrate according to cus-

tom—neglecting to bear in mind that the tanker was sailing in less than five hours.

When Mac and the Third Mate finally awoke it was mid-afternoon. They dashed out on to the sandy street, and far down at the end of the long quay they could see the tanker—still moored to the pier! Whereupon they set off at a fast gallop, only to be almost run down by two of the local police constables in a Model T Ford car. The gendarmes obligingly gave the boys a lift to the pier, and with the two men aboard the ship steamed away. Later Mac found out why the ship had waited. The Venezuelan officials wouldn't let the Old Man sail unless he posted $1,000 bond for his two missing men; rather than pay the money the Skipper decided to wait until they showed up.

And after that the Old Man put Mac to work. He had to take bearings on every coastal, land and broadcast station from there to New York—at intervals of never more than two hours. All of a sudden the ship's traffic messages jumped from a few words a day to a few thousand. By the time the tanker reached New York Mac was ready to call it quits, and left the ship.

With visions of the Argentine climate still fresh in his mind, Mac decided to go back to South America and do a little free-lance operating. He went to Buenos Aires, and worked there for several months under R.C.A. Then he went to Bogota, Colombia, Caracas, Venezuela, and finally came back to the United States in March of 1931.

While visiting his parents at Elgin, during that month, he learned that NBC was looking for operators in Chicago—whereupon he applied for his present job with the Company.

Even though Mac has now settled down, and with his own family, he still dreams about those many trips around and about Central and South America and the West Indies. In fact, according to Mac, there is nothing quite to compare with laying out on a shaded beach of the Virgin Isles—with a jug alongside, and about three negritos fanning him with palm leaves to keep away the flies.

He particularly thinks about such things when the temperature hovers around zero in Chicago, and the wind and snow blow up and down the Windy City.

New York News

(Continued from Page Eight)

more than twelve times during 1941. Having broken the former, we feel better already.

The Journal staff may justly feel proud of the Christmas Journal. It is the biggest issue ever published.

Among the many who contributed their time and energy soliciting ads, we bow to Henry Meyer, Alex Horwath, Don Abbott, George Butler and Don Ewert.

Herman Gurin, SE, formerly of Video, has been called to active duty in the Navy. Herman holds the rank of Lieutenant, Junior Grade. Good luck, OM, see you in three hundred sixty-five days. Gordon Windham, ME, has become the victim of car thieves and is at present using the new Sixth Avenue subway on his travels. Carlos Clark, NBC Commissioner of Vehicles, has been trying to sell him 1941 plates but "Windy" is holding out until he gets his car back.

We welcome Fritz Rojas to the Journal staff. Fritz will coordinate the activities of the different departments and so relieve Editor Stolzenberger of a lot of headaches. Frank Williams received a beautiful hair brush with Lucite handle from his wife for Christmas. Frank's only complaint is that al-

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San Francisco Recording

By J. A. O'Neil, S.F.R.E.

AS IN other N.B.C. Divisions, San Francisco Radio Recording is an outgrowth of a system intended primarily for reference work, an occasional air-check or an artist's order. The original installation, while designed for completely automatic operation with any available engineer in attendance, was never used as intended. Experience quickly proved that manual operation in the hands of a few engineers was preferable. The equipment consisted of two Presto 6D tables, cutter heads of limited frequency range, two driver amplifiers, a switching system and a jack field in the recording room proper. And of course a playback-dubbing channel. Selection of the program to be recorded was impossible in the recording room itself, it being necessary to go to, or phone the master control room and have an isolation-driver amplifier patched to the desired bus or channel, thence through a loop to recording. An inconvenience at best, particularly on short notice. We often wonder now why more openings were not missed.

In 1938 the recording load increased tremendously, due to a daily contract on soap operas for delivery to a local station for later release on its network. Auditions, artists' and clients' orders and delayed broadcasts increased in like manner. The existing facilities were improved as far as possible but "one channel" operation continued. It was wondrous to behold control room and recording patching and the changing of four discs in 20 to 30 seconds to accommodate protective copies on the commercials and simultaneous recording of different programs. This continued for nearly two years and had the recording personnel on the verge of talking to themselves.

Then, day of days. The arrival of RCA Type MI-4887 cutting heads and an ND-45 A.A.G.C. amplifier. In rapid succession came the Presto 8A's, more ND-45's, ND-46 drivers and specifications for cross-over filters. Maintenance put each into service as soon as possible. Shortly after, Bev Fredendall arrived to co-ordinate the equipment and to design a control and selection system suited to our particular needs. From a series of conferences evolved our present set-up, moved to larger quarters.

Alan O'Neil in the Recording Room

The 6D's were modernized, giving four serviceable channels. Each channel consists of an effective fifteen position rotary selector making available any studio bus or incoming or outgoing line through isolation pads, dubbing equipment and radio; audio key; ND-45; fader (invaluable in lowering the level on the protective master and clients' copies, using higher level at 78 R.P.M. and compensating for changes which may escape MCD momentarily due to other activities); ND-46; cross-over filter; MI-4887 cutter head and continuity check speaker. Two high fidelity speakers on rotary selectors usually provide sufficient monitoring but when more than two programs are being recorded, the check speakers are pressed into service for cueing and monitoring as well as their original purpose. The playback table is between the 6D's and the 8A's, simplifying dubbing to one man operation even when four copies are desired.

All equipment is in the recording room proper and due to the compact physical layout every control is on the panels, which are in easy reach of any of the four tables. This simplified wiring and minimized possibility of jarring. Incidentally, no patch cords are necessary except in emergency.

Cutting is outside-in at either 120 or 136 lines per inch. A vacuum chip exhaust takes care of the thread. Each channel is checked several times a day for level and noise. Frequent test cuts are made for visual inspection of the high frequencies, playback and plotting of the lower end, detection of wows or other mechanical irregularities and condition of the stylii.

A Presto portable with associated gear is provided for Field use.

Approximately 1,100 sides per month are recorded, including masters for processing, commercial accounts, delayed broadcasts, rehearsals, auditions and reference file. At times our facilities are taxed, although we manage not to farm out anything. So we are looking forward to the new building, to be completed within a year, where we will have two Scullys and four 8A's or their equivalents. By the way, we will be under glass, so drop around, if in the vicinity, and watch us perform.

The recording personnel is made up of M. W. Dunnigan, K. G. Morrison, J. A. O'Neil and D. R. Hall, when he can be spared from Maintenance. If the schedule becomes heavy, several of the Studio Group with recording experience may be called upon.

Chicago News

By Con Conrad

HODGE-PODGE . . . Abfalter, one of the few eligible bachelors of this Chapter, still making those periodic trips to Detroit. The boys say it's love. Kempkes spent the Christmas Holidays as best man for a friend. Dave is a pretty cagey gent around these weddings and has never been caught in the middle of one. Joe Alusic completely recovered from his recent hospitalization. Ray Bierman made his first airline hop to St. Louis the day before Christmas with the Ralston Straight Shooters. Chicago & Southern certainly gained an enthusiastic booster of air travel. That parade of yellow cabs frequently observed is only Bob Jensen moving field equipment to the Women's Club Studio for his Brown & Williamson shows. Knight sporting a new Pontiac. Woody Lahman proudly reports, "It's a girl!" Born December 11 and named Nancy. MacCornack and his family spending the holidays over in Ohio.

Attention New York and Hollywood . . . Hunter Reynolds, the rabbit breeder, has brushed off his tuxedo and you'll be seeing him again this season. Ralph Davis is now Recording Supervisor and Vern Mills replaces him at Control Relief. Fred Shidel leaves for a tour of active duty with the Signal Corps at Fort Monmouth, N. J. Local A.T.E. elections now completed. Miller and Corliss swapping surplus Christmas gifts in a deal that smacked of horse-trading. Howard Crissey bowled a perfect 300 game and has the key to the City as substantial proof. Frances Morton's artistic embellishments of the Christmas and New Year's field schedules are something to behold. Conrad's New Year's party a huge success. He claims that the Western Suburban boys and girls drained the barrel. When George Maher really wants something he will even pay the retail price for it. Many thanks to Conrad for most of the material used here.

New York News

(Continued from Page Twenty-nine)

though the hair brush is guaranteed for life his hair was not!

Frank Crowley of the Set Up staff, won the A.T.E. bird, a fifteen pound turkey the boys raffled off for Christmas. A new organization has made an appearance in NBC. It is called The New York Shine Club and meets every morning in the Maintenance stock room. The membership dues are fifteen cents and the requirements, plenty of elbow grease. Mr. Emil Del'Era, financial secretary of the club, should be addressed for further details.

Harry Hiller, SE, spent the holidays in the hospital as the result of an automobile accident. His car hit an icy patch on the road, turning over. Harry suffered seven broken ribs and assorted bruises. Being a healthy outdoor enthusiast, Harry should be back in harness by the time you read this. C. W. Phelan reports that Waldo MacQueen is so careful while driving the new Oldsmobile that he does not even take his hands off the wheel to wave at someone he knows. Mac, of course, insists that it isn't so.

Weis and Geist back from Miami. Tough assignment for winter period. Ashworth also. However, Ash points out that he went at his own expense. This due delayed vacation. Larson and Whittemore on an extended tour of Army Camps in mobile unit.

Ed Whittaker now goes around in an even deeper trance. On hearing a noise he smiles adroitly and says: It has a reminiscent air. Some say Ed is attuned to the infinite. Ed says he is tuned to 2.5 meters! Eastern Division Engineer G. O. Milne on the air on the Behind-the-Mike program. Dramatized the importance of the studio engineer and described some of the work entailed. Needless to say he had an attentive audience.

Alfred Saunders, formerly of Maintenance, has been transferred to Audio Facilities from Recording. Arthur Anderson, from the Mail Room, replaces Jerry Truhler, who takes over Ed Kahn's job in Mr. McElrath's office. Dick Berrien replaces Bob Massell in Mr. Milne's office. Ed Kahn and Bob are now Apprentice Engineers. If all this is a little confusing, read it over a few times, you'll get it.

The following story regarding Ed Gundrum is told by Art Holub. It seems that Ed invited a few people over to his house for a New Year's party. One of the guests brought along a bottle of champagne. Not having tasted champagne in a dog's age, Ed's eyes became misty with thoughts of the golden grape. While Mrs. Gundrum ran to the cupboard to get the champagne glasses Aunt Clotilda had presented them on their marriage, years ago and never been used, Gummy prepared the ice bucket for the ritual befitting a delicious drink. Finally everything was ready. The guest was given the honor of opening the bottle. When suddenly he raised the bottle to his lips and emitted a raucous note. It wasn't champagne,—it was a horn shaped like a bottle! Poor Gummy hasn't been the same since.

Reynolds (Chgo S.E.) in New York recently to do Quiz Kids program. Came wearing proof of the fact that contrary to current rumor, he does not knit his own suits. Wonder who does. The A.T.E. Journal will pay $1.00 and give a handsomely autographed copy of a future issue to the first person who submits the correct solution to the amazing "REYNOLDS EFFECT".

JOURNAL READERS!
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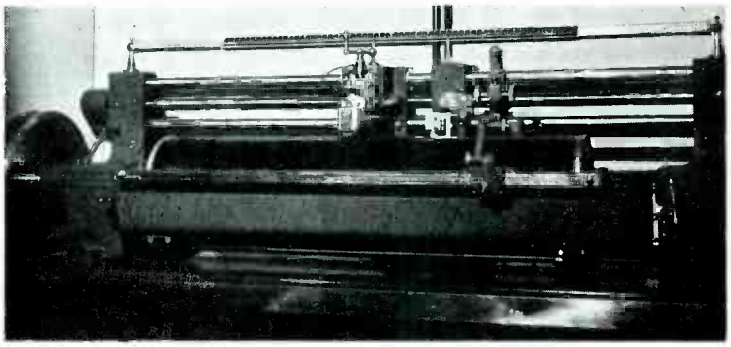
Cylindragraph

By R. A. Schlegel



Photographs by R. A. Schlegel

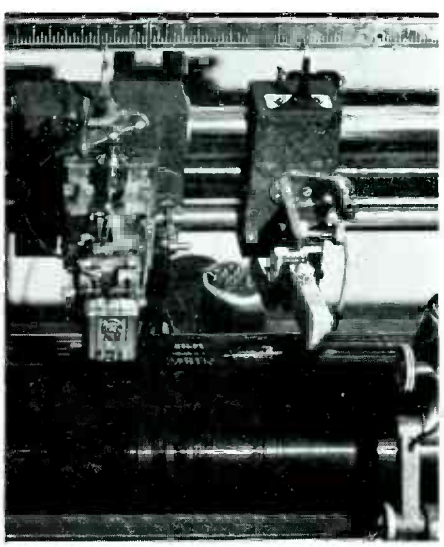
SOUND recordings today may be divided into two major types, one being the film or tape and the other the disc.

Constant velocity is obtainable with the film method, while in the disc method commonly employed, the groove velocity is constantly changing with a corresponding change in quality. Several methods have been introduced to compensate for this change in quality. Some of these are only compromises in equalization while others actually vary the speed of the turntable so as to maintain constant groove velocity.

Film, thus far, has not met with general acceptance in radio broadcasting due probably to the need for special equipment for recording and reproduction. Storage of film is also a problem while discs may be stored with no particular requirements other than space whereas film requires special containers, temperature control and ventilation, etc.

Recognizing the fact that constant velocity as well as non-tangential tracking of the playback stylus are essentials to good reproduction of groove recording, Ray Lyon, manager of WOR'S Recording Division, in cooperation with Presto Recording Company, has developed a new type of instantaneous lateral recording machine. For want of a better name the machine has been called the "Cylindragraph."

As the name implies, it employs an aluminum cylinder ten inches in diameter and thirty-six inches long. This cylinder is ground to an accurate surface and is coated with the same type of lacquer used to coat flat discs.



Recording at 66-2/3 rpm the groove velocity is equivalent to a 14″ diameter on discs. Cutting 120 lines per inch at this speed makes it possible to record at a higher level than can be employed safely on discs but the level is not greater than can be satisfactorily tracked by the reproducing stylus.

The "Cylindragraph" is of course limited to instantaneous recordings and is primarily designed for rebroadcasting programs on a delayed basis. At present many programs are recorded on discs at WOR for the Mutual line and rebroadcast at a later period. This is an important function of the Recording Division for it widens the scope of programs that can be heard by WOR listeners.

To improve the quality of such rebroadcasts to the highest degree is the aim in utilizing the cylinder method of recording.

While the entire cylindrical unit is under test at WOR and it is a bit too early to make any claims for fidelity and distortionless reproduction, a brief description of the machine in its present state may be interesting to those who are interested in radically different equipment.

The machine itself is approximately 54″ in length and 15″ wide and is built with the utmost precision. The cylinder is driven by a 1/8 h.p. 3 phase motor, back geared through a belt driving a flywheel which in turn drives the cylinder.

The recording and reproducing units are mounted on separate carriages which are driven along two rods by the lead screw. Either recorder or reproducer may be engaged with the lead screw by a cam lever on its carriage. The reproducer is mounted so that it may be moved ten grooves either side of center to facilitate spotting the correct groove for playback and is lowered to the cylinder surface by a cam in a manner similar to lowering a cutter.

The "Cylindragraph" is capable of recording continuously for sixty minutes. This is a decided advantage as it eliminates cueing. Anyone having to cue a symphony where the length of the selection may run twenty minutes or more would appreciate this. Another feature is that it eliminates the sudden change of quality when switching from the inside diameter of one disc to the outside diameter of the next disc being played. If a copy is required for reference file, it can easily be recorded on discs at the time of delayed broadcast. When the cylinder has served its purpose it may be returned to the factory for re-coating.

We hope to be able to present the technical data on this method of recording in an early issue of the Journal.

San Francisco News

(Continued from Page Twenty-five)

who has charge of the American Legion's Christmas tree lots in Oakland. Dunton is also a Legion post commander . . . A new one kw rig is being built by Dick Parks, KGO, W6PHS, and the new hetrodyne exciter circuit is being used . . . Joe Baker, KPO, is back to work after a few days illness caused by those "flu" germs . . . KGO is leading all stations in the race for the 1940 General Electric plaque; good luck, men . . . Reports indicate that Robert Ball's, KGO, new high-fidelity tuner and amplifier is all the name implies . . . Harry Jacobs, SE, has at last completed his boat and now awaits good sailing weather before christening the "Nemo" . . . Tommy Phelan, Audio Facilities, passed out the cigars in early December upon the arrival of a son and heir . . . George Dewing, SE, was seen wearing his overcoat as he came into town on the 5:07 a.m. car December 12. His weather observations from Golden Gate Heights have been a regular feature of the KPO Musical Clock, so when "Deep Sea" George says it's Winter you can bank on it . . . Bev Palmer, CS, and George Greaves, FS, are making use of the NBC Playroom during the noon hour and the billiard game of both is becoming something for the experts to watch . . . Lt. Proctor (Buddy) Sugg, former CS, finds time to show his Navy buddies around the studios during his lunch hours. From what he says the work is not too difficult.

Television Christmas Party

NOT to be outdone by its big brother, Audio, Television staged its own Christmas party on December 24. It was held in the television studio 3H and was timed to coincide with the close of the audio party which was held in the large 8H studio.

Although 8H featured Santa Claus and two Christmas trees, 3H modestly contented itself with only one tree and no Santa Claus, although genial "Doc" Morton was present and adequately filled this lack as far as the grownups were concerned.

A one hundred percent attendance was noted from both the engineering and production offices. "Doc" Shelby led the engineering delegation and Tom Hutchinson led the production guests.

Music for dancing was provided by extra hi-fidelity recordings, ranging from rhumbas to waltzes depending on the requests of the assembled guests. Walt O'Hara of Video effects adequately presided over this department.

A special television camera was available for the guests to peer through and see a particularly interesting scene in full color. Men only were allowed this privilege and those that availed themselves of the opportunity refused to comment on it afterwards. This was later identified as the "Protzman effect".

A bar was provided by courtesy of the prop department. It came from the set of "Jesse James" telecast and lent a wild western note to the otherwise Christmas scenery. The bar was ably if not efficiently presided over by members of the prop department, Ken Shaw and Al Albert.

Everyone present had a good time and agreed television's Christmas party should be made an annual affair, and that next year the FCC be invited!

Rules Waived for Radio Operators

As a particular convenience to licensees drafted or otherwise called into military service, the Federal Communications Commission today suspended until January 1, 1942, that part of its rules and regulations requiring proof of satisfactory service in connection with renewal of commercial and amateur radio operators (Section 13.26 governing commercial operators, and Sections 12.26 and 12.66 affecting amateurs). This blanket exemption pertains to nearly 100,000 operators of both classes.

General waiver of these provisions was considered at a conference of Commission officials with representatives of interested labor organizations, including the International Brotherhood of Electrical Workers, Commercial Telegraphers Union of North America, American Communications Association, Maritime Committee of the CIO, National Federation of Telephone Workers, Federation of Long Lines Telephone Workers, and the Association of Technical Employees of NBC.

The controlling factor in the formulation of this broad and simple procedure was the mutual desire to relieve those called into service of routine details. The commission is aware of the importance of maintaining the present high standards of proficiency of licensed operators, and also of guarding against a shortage of such skilled workers. It will, accordingly, continue to give these problems careful attention, and, should experience indicate the need for change, the commission will act accordingly.

Re-Allocation Day

Just a reminder that the F.C.C. has designated March 29, 1941, as the day when a number of broadcast stations above 730 kc will be re-allocated. The RCA Tube and Equipment Division announces a booklet entitled, "Radio's Moving Day", which is being supplied to radio servicemen and dealers, which is intended to ease the task of adjusting millions of push-button radios.

A.T.E. Journal Trustees

The Seventh National A.T.E. Convention, which convened in New York from November 11 to November 26 at the Abbey Hotel, appointed Ed. Stolzenberger Managing Editor of the A.T.E. Journal. The National Council decided to hold the number of Journal Trustees to five, and named Messrs. G. M. Sellar, R. W. Clark, G. E. Stewart, F. R. Rojas, and E. Stolzenberger to fill these important posts.

Washington News

By A. R. McGonegal

AL POWLEY, Washington Chapter Chairman, returned from the convention in New York during the month, bearing news of raises and such. He and his fellow delegates did a fine piece of work and Washington thanks them all. Incidentally, Al brought back a story too good to keep. It seems that a couple of the delegates decided to invite a certain Engineering executive out to dinner, in hopes of getting him slightly carbonated and prying out some information. The affair was ended several hours later by the executive stooping under the table to tell the boys goodnight, and then walking with firm and unfaltering step out into the night.

Starting December 15th, Washington will be feeding some forty programs a week to the new Southeast Blue leg. Added to a schedule already productive of considerable overtime, these new shows should keep our studios well filled during the coming winter.

Dan Hunter had the pleasure of making the trip to Miami last week, to see the President off. Not hard to take, in this weather. He is now at Charleston, S. C., waiting for the return of the Tuscaloosa and F.D.R. Another field tripper during the month was Keith Williams, Field Supervisor, who assisted in launching the new aircraft carrier Hornet at Newport News, Va., on December 14th.

One of the first big parties of the winter season was given by Frank Fugazzi on December 1st. Your correspondent, becoming unaccountably weary, left shortly after 4 a.m., but most of the others stayed for breakfast. Unwilling to give up when they were having so much fun, some of the crowd re-assembled at Ralph Hamill's house the following evening and took up the party where they had left off the night before.

The field groups' favorite winter sport, hockey, is again in full swing at Riverside Stadium twice a week, and there is considerable competition among Washington engineers for the assignment. So far, Speed Clark leads, having seen four games.

H. A. Wadsworth, WMAL Station Engineer, has moved into a house near his new transmitter site, and is really spreading out for the first time, after ten years of apartment-dwelling. Wait until the grass starts to grow in the spring. Harold Yates, not to be outdone, bought a house in University Park, and can now sleep an additional thirty minutes every morning, WRC transmitter now being only five minutes drive away.

One of our Naval Reserve members, John Rogers, has been through all the pangs of mobilization four times, and hasn't gone yet. About once a week, the Navy Department issues his orders, and cancels them three days later. John says he doesn't mind going, but he does wish that the Admirals would make up their minds.

A Dodge driver of many years standing, Bob Chapman, has finally slipped from the straight and narrow, buying a Hudson this time. Bob says he will have to turn it back to the dealer the first of January, as his 1 per cent raise will not support a new car.

John Stetson, last summer's studio relief man, is back at work again, after a trip to the West Coast. Here's hoping that his connection with NBC will be permanent this time.

WRC's new directional array is about complete, all that remains to be done is the tuning and proof-of-performance measurements, which shouldn't take more than a week or two. If it works half as well as it looks, there is nothing to worry about. A recent kickoff at WRC was explained when Wally English found a well-done mouse in the transmitter. Holes drilled by the electricians during the construction work have permitted the rodents to enter a building which has hitherto been mouse-proof.

WMAL's new building in nearby Maryland is now finished, all four towers are up and painted, the transmitter is in place and wiring is going forward. The new transmitter is an RCA Type 5-DX, gray-finished and streamlined, mounted flush in a wall of the operating room. The audio racks and operating console have arrived, but are not yet installed. The staff have hopes of getting on the air by February 1st. Bill Simmons suggests that they sell the old transmitter by inserting an ad in QST or the A.T.E. Journal, "Transmitter for sale—owner leaving town."

In making out his 1940 inventory sheets, H. A. Wadsworth, WMAL Station Engineer, listed his two G. E. Merit Award Plaques under the heading "Speech Output Equipment." On being asked why, he said "Well, I had to give a speech each time I got one, didn't I?"

And that's all the news from Washington, except that your correspondent is grinding a telescope mirror. "It's easy, just a few hour's work," said a friend. But after some thirty hours of grinding, all we have is an eight-inch slab of Pyrex with a shallow scratchy depression in it, and the prospect of another thirty hours of polishing. Drop around to the house and see the stars sometime—next year.

A Word With the Editor

SINCE the inauguration of the present Journal Administration, effective with the July, 1940, Recording Issue, we found ourselves entirely too busy "learning the business" to do any editorializing.

With time there is change; the recent twelve-man Board of Trustees was stream-lined and limited to five men by action of the A.T.E. National Council. It is with sincere regret that we lost the services and sage advice of Bev. Fredendall, who had been a keystone in the Journal since 1935, and Messrs. Phelan, Townsend, Moloney, Meyer, Resides, Compton, and Isberg. We know that the affection of these men for the Journal is deeper than temporary titles and authority, and relax with the thought that their counsel is available at all times for the good of the Journal. We are happy with the thought that C. W. Phelan and D. J. Moloney are handling the treasurer's office in a very creditable manner, a true reflection of their ability and unimpeachable character.

It has been a pleasure [and a liberal education] to have had the opportunity of learning the problems, mechanics, and jargon of the linotyper, printer, photo-engraver, bindery, advertising man, and editor. But the keenest reward that we recognized to date has been the pleasure of visiting most of our advertisers' places of business and meeting the *men* — their personalities and character — that stand behind their companies' reputations.

Managing and guiding the destiny of the Journal has proved a very liberal experience in the Literary, Executive, and Administrative fields, and has resulted in a keen appreciation and insight into some of the problems of the Business Man—big or little.

It is our pleasure to present to you this comprehensive "Recording Handbook II," a fitting companion to our July, 1940, Recording Issue, devoted to a better understanding of all of the factors involved in producing "better recordings." —Ed. Stolzenberger.

Radiophone a la Mode

Times do move ! ! !

There are undoubtedly many among the A.T.E. membership whose recollections go back to commercial operating days when band-switching transmitters on shipboard represented the highest refinement of the art—even though the band-switch control bore a striking resemblance to a baseball bat in its proportions.

Today every little charter fishing boat, commercial fisher, tug and pleasure boat (above the outboard-motor class), is feeling the urge to carry marine radiophone equipment. And why not? The owner himself can be the operator, with a regular official "ticket" obtained as soon as he has memorized the penalties involved for operating out of bounds, or for divulging private information picked up via the air channels, etc. He may not know a grid from a plate; a condenser from a resistor. But what matter? Less knowledge is required to operate the complete 10-channel phone transmitter and receiver combination than used to be required to nurse along the old regenerative receiver—and with actually fewer controls!

Take a look at the accompanying illustration, for instance. It shows a complete phone transmitter-receiver combination (Hallicrafters Model HT-12) with all except the power supply compacted into a single corrosion-proofed metal cabinet only about 20 inches square by 12 inches deep. Yet it can pump 50 watts into the ships antenna on ten ship-to-ship, ship-to-shore, or Coast Guard channels; and can likewise receive on any of the ten corresponding receiving channels, with both the transmitter and receiver crystal controlled.

The controls number six in all, of which three are simple toggle switches used to turn on the transmitter filaments and the receiver, and to switch incoming signals from loudspeaker to the telephone handset. A fourth control regulates the loudspeaker (or headphone) volume.

The other two controls are the channel-selector switches by means of which the transmitter and receiver, respectively, are instantly switched to any of the ten channels provided by each. No tuning or fishing around, no secondary adjustments! Let's see just how it works.

An owner cruising off the Florida coast has a yen to talk to his office in New York. He flips on the two power switches and while waiting for the tubes to warm up (that's one thing he still has to do) he sets the two channel switches for the frequencies employed by the Miami shore exchange's transmitting and receiving stations. If the Miami station isn't busy he picks up the handset and calls it. His carrier goes on the air automatically when he speaks; when he stops speaking it goes off and his receiver goes into operation—also automatically. Having placed the call, giving the name of his ship so that he can later be billed for the call, he hangs up to wait for the operator to call him back. He can either switch in the loudspeaker or a bell-ringer circuit which responds to any incoming call for him. When Miami calls him back he finds his office on the wire and proceeds to carry on, his voice hopping the air waves to Miami, thence via landwires to New York.

If he wants to call another boat which is within the range of his transmitter he switches to the ship-to-ship channel and calls that boat direct by its assigned call letters. Or if the desired boat is too distant for direct contact he can call through the shore telephone exchange, establishing contact through the medium of the higher power employed by the land station, or perhaps through an intermediate land-line link.

The one bit of "professional" attention required by the equipment is the adjustment of the various tuning circuits and couplings at the time the installation is made. These adjustments must, of course, be made by an operator with a suitable higher grade license. These adjustments are all inside the cabinet and are no longer accessible when the cover has been replaced—making things just about as nearly foolproof as is humanly possible.

Verily — Times do move ! ! !

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There are undoubtedly many members of your staff or close friends who would appreciate a PERSONAL copy of the A.T.E. JOURNAL.

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RCA Development for Selective Signalling Groups of Receivers

RADIO COMMUNICATIONS have been put on the same basis as dial telephone service with the new signalling system developed by the Emergency Communications section of the RCA Manufacturing Co. By means of this new system it is no longer necessary for the operators of receivers to constantly monitor in order not to miss any transmission directed to them. They are called by an alarm system whenever the transmitting station has a message for that particular receiver.

The transmitter sends out a coded audio signal. Each receiver is adjusted to respond to a different combination of timed audio tones. When the receiver is actuated by its own particular combination it rings an alarm, calling the receiving operator to listen to the subsequent message.

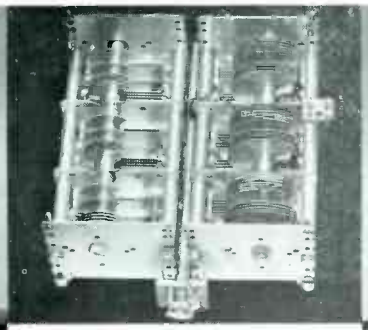
At the transmitter the coded signal is set up by pushing one or more of sixteen buttons. This automatically sends out the coded audio tones which actuate one particular receiver. From these sixteen buttons, 200 different combinations can be set up.

The receiver decoding unit may also be adjusted to respond to another combination of tones, so that several receivers may be called in a group. Or, the receiver may be coded to respond to a third set of tones so that all receivers may be called at once. In this case the tone combination would be the same for all receivers. Each receiver would respond to one set of tones for its own particular call, a second set of tones for the group call, and a third set of tones for the general call.

The transmitter coding unit may be connected to the audio input of any standard transmitter. It consists of four panels—power supply, coding unit, tone generator and control panel. The receiver decoding unit is housed in a metal case 11″ by 7″ by 7″ and weighs approximately 15 pounds. It operates from six volts DC and requires 15 milliamperes at 200 volts from the receiver power supply during times of signal transmission and two milliamperes on stand by. The decoding unit will operate from audio signal inputs of 100 milliwatts to three watts.

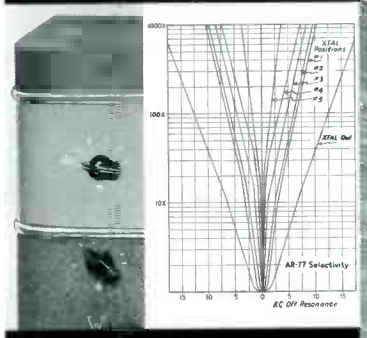
One of the ideally suited uses is for utility companies with fleets of radio equipped service and maintenance cars. Heretofore, all workmen in the field have found it necessary to stop work and return to their cars to ascertain for whom the message was intended. Now it is possible to call the one receiver, while all other receivers remain inoperative and the crews of those cars remain on active duty.

Dual alignment of r-f circuits provides greater approach to constant sensitivity, higher image rejection throughout each range. H-f end of each coil aligned with Air-Dielectric Trimmer. L-f end inductance tuned.



Electrical bandspread at its best results from use of this special 3-gang, triple-section condenser connected in parallel with the 3-gang, double-section main-tuning condenser. Ceramic insulation used for dependability, strength.

A temperature-compensated trimmer condenser in the h-f oscillator circuit stabilizes frequency from effects of temperature changes. A voltage-regulator tube guards against frequency shifts caused by line voltage variations.



Selectivity is variable in six steps. Curves show degree of selectivity for each step. Note that step #6 has a bandwidth at "two times down" of less than 100 cycles!

AN RCA ENGINEERING ACHIEVEMENT

The few features shown above will give you some idea as to why the AR-77 is one of the finest, most sensitive and most stable receivers on the market today. Space here does not permit the inclusion of other outstanding features ranging all the way from more effective use of insulation to the manually-adjusted Noise Limiter. That is why we suggest that, before buying your new receiver, you see the AR-77, look it over from stem to stern and give its dials a whirl at your nearest RCA Amateur Equipment Distributor's store. You be the judge!

AR-77
Communication RECEIVER

Stay-put tuning; break-in operation; highest signal-to-noise ratio; uniform sensitivity; bandspread tuning for the amateur 10, 20, 40 and 80-meter bands; improved image rejection; negative feed back; antenna trimmer, etc.

Amateurs' Net Price, **$139.50**
MI-8303 Table Speaker in matched cabinet, **$8.00** *extra*
F.O.B. Factory

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From microphone to antenna

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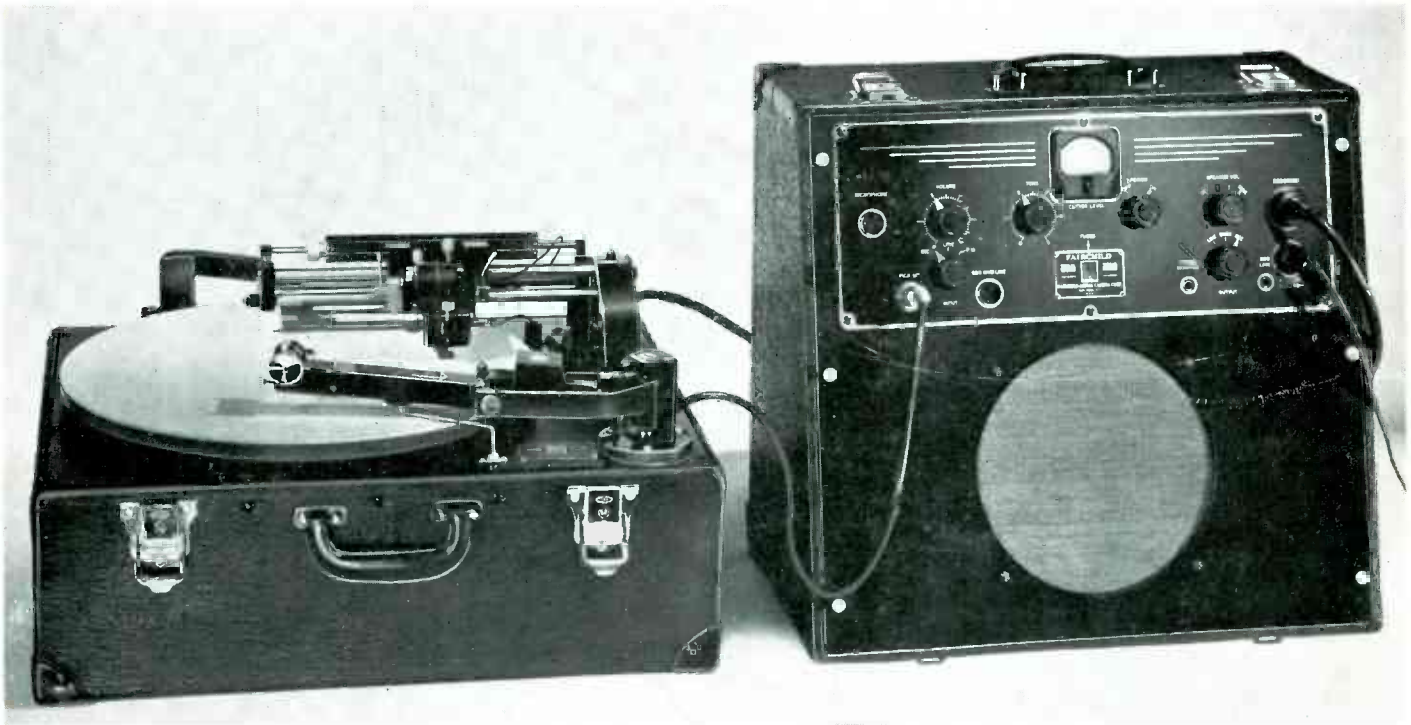
Precision Built Recorder



You helped us build this Fairchild F-26-3 Recorder, because it was perfected on the firing-line — in actual use by rough-and-ready engineers who demand that recorders both "take it" and "give it out". They KNOW that the F-26-3 will deliver better recordings and stand up under tougher punishment.

Read these precision features; your guarantee of noise-free, trouble-free recording.

- *Amazing new cutterhead and network with a frequency response flat to 8,000 cycles (also available to fit Unit 199 and 220 Recorder, Model 2).*
- *Recording time scale in minutes for all pitches and both OUT-IN and IN-OUT.*
- *Floating motor mount eliminates objectionable vibration.*
- *Instantaneous variation of pitch and direction of cut eliminate expensive feedscrews — a Fairchild exclusive feature.*
- *16" dynamically balanced turntable with direct synchronous drive assures split-second timing.*
- *Instant change from 78 r.p.m. to 33 1/3 r.p.m.*

SOUND EQUIPMENT DIVISION

FAIRCHILD AVIATION CORPORATION

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