National RADIO-TV NEWS

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Alumni Association News

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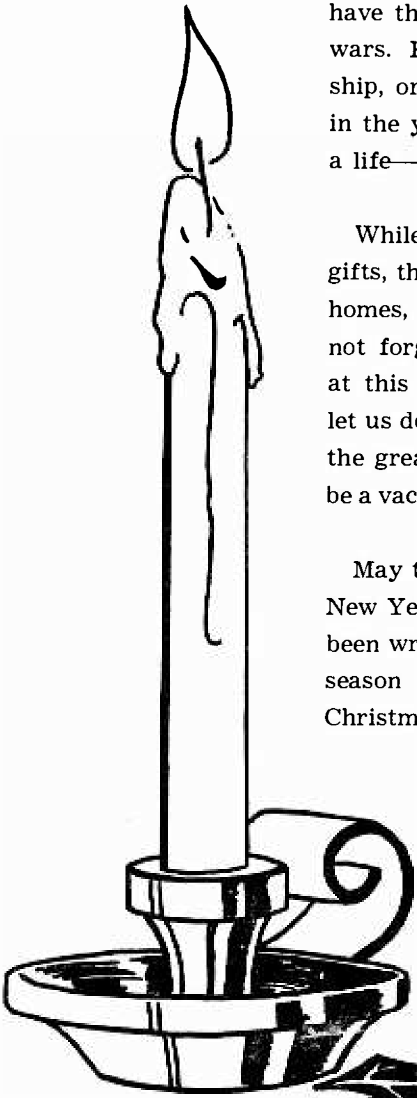
A Merry Christmas



The universal joy of Christmas is profoundly wonderful. Nations have their red-letter days, their carnivals and festivals—and their wars. Popular idols are acclaimed when they are raised to leadership, or a mournful dirge is tolled when they pass away, but once in the year the whole world stands still to celebrate the advent of a life—to join in the spirit of Christmas.

While we are enjoying the double pleasure of giving and receiving gifts, the cheery family reunions in the warmth and comfort of our homes, with those near and dear to us, in these happy hours let us not forget to pray for the many who are homeless and very sad at this Christmas season. Let us do more than pray for them—let us do what we can to bring relief to them. Let us also remember the great many American homes where, again this year, there will be a vacant chair.

May the spirit of Christmas abide and be with you. And may the New Year bring you good health and genuine happiness. Much has been written, but no words better convey our wishes to you at this season than the simple expression, with all sincerity — Merry Christmas and a Happy New Year.

J. E. SMITH, *President.*

Life as a Merchant Marine Radio Officer Means Adventure, Foreign Ports, and Interesting Work

By ROBERT L. SIMPSON
NRI Consultant

Frequently NRI receives requests for information from students or graduates who are interested in a job as radio operator in the United States Merchant Marine. We believe that the personal reminiscences of one of the staff—Bob Simpson, NRI Consultant—who has served in that capacity, will be of interest and informative, not only to them, but to all our readers.—ED. NOTE.

ALTHOUGH it was less than four years, the time I spent on the high seas and in foreign ports has left a more vivid impression than any other period of my life. For anyone who is interested in adventure, foreign places, and interesting work, the job as a radio operator on an ocean going vessel is, in my opinion, the nearest thing to perfection that any occupation could be.

Every boy has visions of adventure and accomplishment, but as time goes by and his responsibilities increase, these dreams are pushed further and further into the background of his life until they are almost forgotten. This was what had happened with me. I started in Radio at the early age of 12, and I can recall the many hours spent in practicing the old Morse code and imagining that the vital messages which I sent and received were instrumental in preventing train wrecks and rescuing people at sea, etc. However, as I got older these dreams seemed more and more unrealistic, and I became "practical" and permitted myself to forget them, attractive as they were, in order to settle down to the jobs at hand.

For nearly a decade these ambitions had been dormant, but one warm afternoon I found myself sitting in the officers' mess watching the green foliage that crowds the shore lines of the Panama Canal and I suddenly realized I was actually living those same dreams. It had taken the second world war, a IV-F classification, dissatisfaction with my job, and various other combinations of circumstances which eventually led to my being aboard the MV Ring Splice. (MV is the abbreviation for motor vessel, just as SS is for steam ship.)

The author and his mascot "Clipper" aboard ship. This was a very rare occasion, as uniforms are seldom worn in the Merchant Marine.

It would be better to be able to say that I achieved the position as Radio officer on this ship through my own endeavor and initiative, thereby proving that where there is a will there is a way. But in all honesty I can say that this was not the case. However, I shall never forget the thought which I had on that particular afternoon — that if my dreams had come true by accident, certainly they could have been achieved by endeavor. I am convinced now of that proverb—where there is a will there *is* a way. However, I know that you are more interested in hearing about the Merchant Marine and foreign ports than you are in my philosophy or outlook on life.

As a radio officer in the United States Merchant Marine you are a private citizen privately employed. You work for a private shipping company, although in time of war these companies may be agencies for the War Shipping Administration. You are not a member of any military organization. You do not derive any benefits from any of the legislation which has to do with military organizations. While it is true that you hold certifications from the US Coast Guard in addition to your FCC license and passport papers issued by the State Department, you are still a private citizen.

As the chief or only radio officer on a merchant vessel you are in charge of the Radio Department. You answer only to the captain or his designated authority. You are officially a ship's officer.

You generally sign on board the ship in reply to a call which the steamship company sends to the radio officers' union. You sign aboard a ship at the time that you sign the ship's articles. Articles are drawn up for each voyage, and are simply a contract between the shipping company and the men who sail. In peacetime, articles last for the duration of the voyage or for one year, whichever is shorter. In time of war the articles last for the duration of the voyage. The duration of the voyage is from the time that articles are drawn up until the ship has returned to any port in its home country. After the completion of the voyage you can change ships, return to shore duty, or sign over (make another voyage on the same ship).

The merchant marine has a reputation for being tough. While this is undeniably true, a genuine, honest and friendly person can get along in the Merchant Marine just as well as he can in any other job. However, it is no place for four-flushers, braggarts, or bullies. In very short order, this type of person has his hand called. Most seamen have the idea that, if you are going to be forced to live in close company with other men for an extended period of time, it is necessary to settle once and for all exactly what you can tolerate and what you cannot.

Coupled with this attitude among the men of "keeping 'em in line," are a number of circumstances which tend to precipitate fighting. The fact that you are away from the restraining influence of municipal policemen, and the fact that the ship's captain does not attempt to extend his authority to foreign shores are among the foremost. Remember, too, that many of these men who have been sailing for most of their lives are accustomed to scenes of brutality which are common occurrences in some parts of the world. It is true that they tolerate no foolishness and are inclined to be a bit rough on anyone who earns their displeasure, but they are staunch and sturdy friends to those who know how to get along.

Because of the vital importance of merchant shipping in war time, there are organizations which try to control the Merchant Marine. You will hear from some of these sources that there is no discipline. While it is true that from a military viewpoint there is little discipline among the men of the merchant marine, there is no lack of discipline when it comes to carrying out their assigned tasks.

Probably the most frequent question posed by 'landlubbers' is "I can understand your interest in foreign places, but isn't the monotony of the long passages unbearable?" This seems so obviously true that even for one who has sailed and knows better, it is difficult to explain. It seems ironical that a man who travels over the face of the whole earth must confine himself to an area 500 feet long and 60 feet wide in doing so. But monotony never occurs to him. Perhaps it is the jog of the engines, steady and continuous, which reassures him. Whatever it is, I know that it is there. The love of the sea is something that is never lost.

There are, of course, some men who sail that just aren't cut out to be sailors, but they never make more than one trip. Most of those who get a taste of salt air seem to come back for more. Many are the times that I have seen the contentment with which men put out to sea. Many are the times that I myself have been restless at having pavement instead of rolling decks under my feet. The knowledge that once the anchor comes up there is nothing you can do to hasten or delay the events which are about to come to your life, causes you to relax in a manner that is possible only at sea. It is as though you willingly put your life into the hands of fate when you came aboard. When the ship heads out to the open sea it is as though fate were answering and accepting your offer.

Life at sea is as varied as on shore. Although confined to the area of the decks, it is not confined in regards to human relationships. Friendships are made and continuing discussions develop. The weather changes, the sea changes, and the food changes—if only from bad to worse.

Pastimes vary with the weather and with the personalities of the men aboard. My favorite pastime, developed on one of my first voyages, was backgammon. To me, this game, which can be played in a gambling manner, is one of the most perfect combinations of skill (which requires concentrated thinking as well as quick decisions) and luck, (which adds spice and thrills at every moment.) Whether it is played at sea where the pitch of the ship causes the dice to roll as well as the pitch from the player's hands, or in your home, backgammon is tops.

As a radio operator your work is not confined to transmitting the messages which are being sent from the ship or receiving messages addressed to the ship. You are responsible for the maintenance of all electronic gear on board. While at sea you are required to be on duty eight hours out of twenty-four. Maintenance of any equipment, even the storage batteries which are used to operate some of your radio gear, is considered overtime work and you are paid accordingly. The hours of watch are generally set by the Radio Officer himself. Although he must comply with any requirements of the shipping company, as well as the orders of his Captain, since the Radio Officer is the principal authority on propagation, which determines the best hours of operation, he generally has the major voice in establishing the hours of radio watch. On a freighter the amount of traffic is normally so small that only one watch period is required. Consequently, most of the time the operator is able to set his watches according to his own personal desires. This means that, except in times of emergencies, the operator rarely misses a meal, and sleeps during the hours he prefers for sleeping. On long voyages in the Pacific tropical areas, I preferred to put in a major part of my time on watch after midnight. This left mornings for backgammon or reading and the afternoons, which are sometimes too hot for anything else, for sleeping. There was another reason for preferring the early morning hours for watch. It seems that everything by way of excitement always broke during the wee hours of the morning. Propagation characteristics are generally such that, at the international watching frequency of 500 kilocycles, more area is covered after dark than during daylight hours.

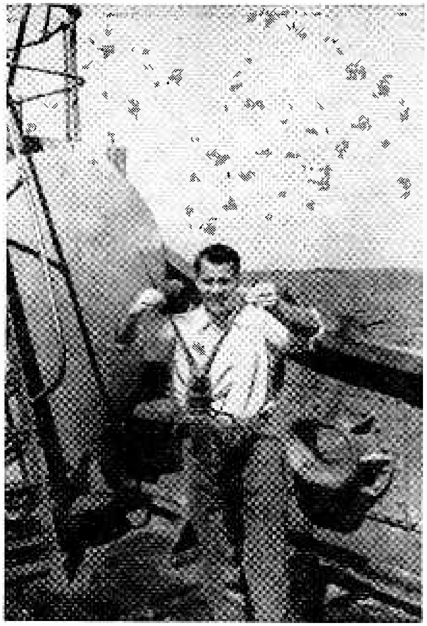
FCC regulations prohibit any unnecessary communications from ship to ship or ship to shore. However, there is no regulation against assisting some other ship in handling its traffic. On the far side of the Pacific, high frequency equipment is convenient for communications with the States. I was fortunate enough to have high frequency equipment on the Ring Splice, and so I would copy the traffic list from the various coastal stations at least once a day. Then if I wanted some conversation to while away the time, whenever I heard a ship's call letters which were listed in the traffic list I had copied, I would call him and advise him KFS-QTC. (This means in Radio language "coast station at San Francisco has a message, or messages, for you.")

Whenever a station I called was unable to communicate with the States, I would advise him QSP (I will relay your message free of charge). While handling traffic in this manner, it was easy to find out much about my friend of the airways. I could ask him where he had been, and where he was going, as well as when he expected to arrive, weather at his location, etc. Sometimes he would be in a port where there were many ships, none of which had been receiving traffic from the States. In case of a contact like this, I frequently set up a schedule to "see" the operator again the following night. At that time I would have traffic for a number of ships at his port. In this manner more than one lasting friendship was developed, and many interesting things were learned about the ports I expected to visit, as well as those which I never managed to see.

As the Chief Communicator on board you are exposed to most of the various forms of communication at sea. For any radio man who is capable of passing the FCC license requirements concerning the telegraph code, it is a simple matter to learn the blinker system by which ships at sea communicate with each other through the use of powerful spot lights. The speed of the fastest blinker message is so much slower than ordinary telegraph communications that, for a good CW man, blinker copying is child's play. From blinker you naturally drift into flags. Most radiomen become interested in all other forms of Communications as well. When passing a ship at sea, especially in war-time when radio silence is universal, flags and blinker are the principal means of communication. I had learned the semaphore method of signaling in the Boy Scouts and was glad to find that it had not been completely forgotten. After several months in various ports or convoys, I found I could use signal flags in an acceptable manner.

Although many merchant seamen never trouble themselves to learn the semaphore code, I have found that it is particularly helpful in communications with naval vessels. During and shortly after the war, the members of my crew generally appreciated my abilities at semaphore. Whenever we were in port, I was invariably asked to request permission for a liberty party to board one of the naval vessels for the movie programs which they had every evening. A movie is quite a morale booster if you have been anchored off shore for any length of time. In peace-time, however, you are not normally anchored in the bay very long, and consequently you can find your movies and other entertainment ashore.

After my first sorry experience of not getting matters clear before signing articles, I always made arrangements with the captains, that any time in a foreign port was to be considered my



Another ship-board scene showing the author holding a lobster which he caught near Capri in the Mediterranean.

time, and other than to maintain the batteries at full charge, I was not to be required aboard until twenty-four hours before sailing.

Until after the end of the last war, the radio officer, although treated as an officer, did not have that status legally. Consequently, occasionally you would run into a superior officer who delighted in trying to make your life miserable.

In this connection, I had my most unfortunate experience on my first voyage. The Old Man had been brought out of the bone yard, just as many of the merchant ships were, to fill in during the emergency conditions of war-time. He was violent and somewhat eccentric. Although probably sixty years old he was as strong as a bull and just as mean. He did practically anything and everything he could think of to make the life of everyone on board as miserable as possible.

During a three months voyage which touched more than a half dozen ports, he refused to allow anyone to go ashore. After the voyage ended we learned that not one of our letters had been posted during all that time. We assumed that the reason for this was that he was afraid that if news of his treatment of the crew reached home ahead of him, he might be removed from command. My principal gripe was personal. He had ordered me to do a considerable amount of work aside from my regular watch duties. At the end of the voyage he denied having ordered any of it, and I lost payment for more than a hundred hours overtime.

In one way, I was fortunate to have sailed with this man, because after my first voyage I was extremely careful to take into consideration the probable character of the Captain before signing articles under him and in making agreements concerning payments of overtime, hours of duty, etc. I can honestly say that after this experience, I never made a voyage which I did not thoroughly enjoy.

Probably one of the principal reasons for enjoying life at sea and in foreign ports so much is the genuine friendships developed. I shall never forget the friendly and very capable fellow from Texas who had lost his right arm in a shot-gun accident. While most people would have considered this a handicap, he never once indicated that he felt handicapped. He was not left-handed originally but he mastered all of his personal requirements, even including tying his neck-tie, and became a very proficient radio operator.

One of the most remarkable things about this boy was his sense of humor. Some of the most hilarious experiences of my life were enjoyed as a result of his active imagination. I remember one day in Bristol, England, when we decided to ask some of the dock workers to lend us their bicycles. This onearmed lad, whose name was Bob, and I approached two generous looking workers and made our proposition. When one of the gentlemen showed his anxiety concerning Bob's handicap he left himself wide open. Bob winked at me and immediately I knew something was up. One of the many abilities he had perfected was that of sitting backwards on the handle-bars of a bicycle and pedaling with great proficiency.

"Aren't these English bikes a bit different from ours," Bob said to me as he fiddled around with the bicycle.

"I don't know," I replied, waiting to see what the game would be.

Whereupon Bob mounted the handle-bars and began to pedal around the dock to the amazement of the poor old fellow whose "wheel" was in such jeopardy. This was one occasion, however, when Bob's pranks boomeranged. He got up a little too much steam and was having so much fun that he did not heed any of the warnings which were propelled in his general direction. The result was that he plowed into a huge pile of dunnage which was inconsiderately in his way. Aside from bruises and a torn jacket, the cost was more than an English pound for the damaged tire and front wheel.

Bob had a strong persuasive way about him. I shall never forget his persuading me to make a pair of water skis. This, of all places, was at the Normandy beach-head on approximately D+20 (20 days after D Day). He had figured, and rightly so, that as long as the landing craft were waiting around to off-load our cargo, they would act as tows for our water skiing. This worked fine for several days, until the commanding officer of the "water taxi company" learned about it. I have often wondered what some German observer would have thought of his hourly nuisance raids if he could have seen us enjoying this, the ritziest of water sports.

Speaking of friendships opens a subject that is difficult to leave. Perhaps it is the informal names which are given to the various members of all crews which causes one to feel at home even on a new ship. The captain always gets the title of "The Old Man," except when you're talking to him, of course. The chief mate, who is in charge of the deck gang, rates the title of "Mate" from officer and seaman alike. The name "Chief" is sometimes applied to him, and the name "Mate" to any of the mates who stand watch. Most freighters have a chief mate, a second mate, and a third mate. In the engine department you have the chief engineer who rates the title of "Chief" while you have "First," "Second," and "Third" engineers. In the steward's department, the chief steward has charge of the cooks, mess boys, and room stewards. The steward invariably is hailed by the unattractive name of "Stew." Then there is "Chips" (carpenter), "Sparks" (the radio officer), "Bos" (the bosun), etc. With all of these familiar names applied to any crew you sail with, it doesn't seem as though you have changed ships, because you can still speak with all of your new shipmates and call them by name.

Similarly there seems to be a prototype crew that you find repeated over and over again on all ships. There will be a certain number of heavy gamblers, a certain number of heavy drinkers. There are invariably some muscle men as well as some intellectuals.

But while the men with whom you are sailing seem to fall into a general classification, while their characteristics seem to be repeated from one crew to another, while it is easy for you to fall into a feeling of being at home on any ship, the ports you visit will hold none of this familiarity.

Every port is different, and though many ports have certain similarities, each will have its own beauties. The points of interest, the climate, the people, culture, etc. are all different and individual. Consequently, if you were to ask me which port I thought the most beautiful of those I have visited, I would find it difficult to answer. Undoubtedly the Isle of Capri, in the Mediterranean, just off the West Coast of Italy, is one of the most beautiful places in the world. The climate and the people add to the attractiveness of this place. The sincere and genuine hospitality of the friendly Italian people is unexcelled.

Capri is a small, rugged volcanic island rising out of the beautiful Mediterranean waters. Everywhere it is as clean and fresh as the breeze which constantly sweeps it. The picturesque gardens and homes grab little level spots of land and prove that the cultivation of land by men does not need to be something unattractive. Here the cultivation goes hand in hand with the beauties of nature.

Then, of course, there is the much publicized chief attraction of the island, the underwater caverns on the north shore. At times of low tide, you can enter these caverns by small boats and if you are farsighted enough to take picnic lunches, you can stay while the tide comes up and closes the entrances. Then unless you are a good underwater swimmer, you must wait for the tide to recede before you can leave.

The only lighting in the caverns is the light reflected through the water, which gives a blue-green cast to everything. As there is virtually no surface reflection, you can see objects in the water, such as the schools of little fish that swim at the cavern entrances. You can also see the floor of the channel, which is covered by various little bony sea-animals. Occasionally you can see one of the beautiful sea shells from which the famed Italian cameos are carved.

When the tide recedes and you emerge into a glowing red twilight, you feel as though you have just left one strange world and have entered another.

When you see the familiar lanteen sail which is characteristic of the Mediterranean, you are reminded that this part of the world is practically unchanging. The same prows have plowed the same waters for centuries. You see men tending nets as they did in biblical times. All too soon you realize that you must return to duty on a ship made of steel whose means of locomotion is achieved by noisy, soot-producing engines.

There are hundreds of small ports along the shores of the Mediterranean, each with its own beauties. The climate is uniformly pleasant throughout this area, and it seems that wherever you have a beautiful climate, you will have beautiful scenery. Barcelona, Spain, for instance, though large and somewhat cluttered, is surrounded by some of the most beautiful countryside one could find anywhere in the world. Comparatively few seamen, however, get a chance to be impressed with the countryside, because the city of Barcelona abounds in beautiful women.

In Barcelona you can also see the bull fights, and here the street singer serenades you by night or by day. Here both the donkey cart and the flashy limousine are present. Here the street peddler shouts his wares and the shoemaker works on the sidewalk. Balconies and cobblestone streets, fishermen, peddlers and seamen, naked children, and small shops and dogs—this is Barcelona.

The ports on the southern coast of the Mediterranean are no less interesting. Oran, Tunis, Alexandria, all have their own individual attractions. The cliffs which surround the port of Oran, which must be virtually "scaled" in order to enter the city, provide one of the most impressive views of a harbor that one could find. Here on the North Coast of Africa, Moorish influence is evident everywhere. The architecture has changed from the colorful grace of the Spanish to the fantastic intricacies of the Arab. Here the naked children and barking dogs are more in evidence, while the beautiful patios and expensive limousines are considerably more rare. But even here where the desert wind dries the vegetation, the European influence is evident, even to the enormous castle on the highest point overlooking the harbor and city.

Moving eastward we pass Algiers, Tunis, and Tripoli, and if we continue to the east, we will eventually come to Alexandria, which is located at the mouth of the Nile. Here is a strange combination of the new and the old. While some of the piers are equipped with machinery of the most modern design, at some, cargo is unloaded from ships which have not changed in two thousand years. These piers and ships are bound together with rope hand-made from desert grass, and the cargoes are loaded or off-loaded by the power of human muscles alone.

In Alexandria, Egypt, one can partake of the most modern comforts on the beautiful playground-beaches. While you are lolling on the beautiful white sands, dark-skinned waiters will bring you cool, iced drinks. Nightclubs which rate the approval of the foremost classes of Europe are plentiful. The orchestras produce superb music and in many places there is dancing under the stars near the romantic waters.

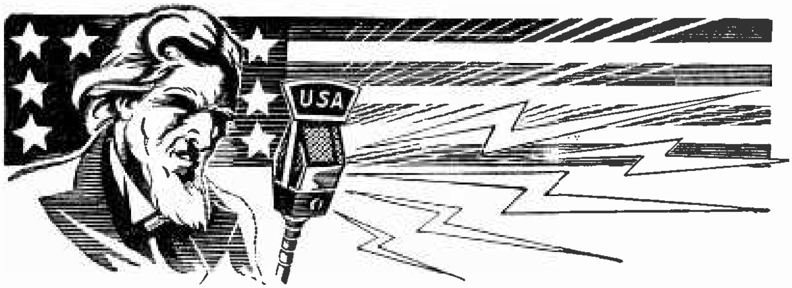
The Alexandria museum of archeology is one of the foremost in the world. Although somewhat smaller than the museum at Cairo, it contains more items of significance in the history of Egypt and of mankind. Here treasures from the ancient world are filed and stored. Only those who are considerably more learned than I can appreciate the full value and meaning of these objects. Nevertheless, I found the fascination of these exhibits to be exceeded only by one place—Peiping, China.

If we continued to travel eastward from Egypt we would approach the Orient. However, that is a story in itself and is best saved for some other time. Of course, there is very much still to be said about Europe, South America, the Caribbean, etc. Perhaps this is one reason why life at sea is never dull—just think of the stories that one crew of thirty-five men, who have been sailing for years, could tell.

Our Cover Photo

This year, as last year, we use a copyrighted photo by H. M. Lambert of Philadelphia. We hope you will like the appropriate Christmas setting.

Blood, unlike vitamins or drugs, cannot be made synthetically and purchased by prescription at the corner drug store. The only way to produce blood is in the bodies of men and women. The only way an injured soldier or sailor or airman can get the blood that will save his life is by the personal gift, in a simple and relatively painless manner, of a patriotic American.



THE VETERAN'S PAGE

Devoted to news items and information of special interest to veterans taking NRI courses under the GI Bill of Rights.

Another New Year!

Veteran students who are still in training should re-assess their positions, take heart, and resolve to push on to a successful conclusion in their courses.

Enrollments have ended under the GI Bill for veterans discharged over 4 years ago, but those men in training may continue to the end of their entitlement or until July 1956, whichever occurs *first*. This presumes continuous training. If training is interrupted, qualifying for resumption is much more difficult than in early 1951 and re-entrance may be denied altogether.

At this season nearly everyone consciously or unconsciously takes stock of his attainments, wishes he had done better, and sets for himself higher goals than he had a year ago. Let us *each* decide *now* that he will make use of the next few months to push himself ahead more *regularly* than he has been, setting for himself a reasonable goal that he can attain. Let him divide his work so that a goal is set for *each week*. Then he can disregard the larger task if he will faithfully accomplish each week the piece of work assigned to it and he will arrive at the end with calmness, realizing the great satisfaction that completing a task can bring.

• • •

Active students have many opportunities to do a friend a favor. There are some veterans entitled to start training after July 25, 1951. They may not be sufficiently familiar with VA regulations to understand that benefits are still available to them.

If you have a friend who was discharged from service *after* July 25, 1947, he may *still* be able to start courses under the GI Bill. He is probably eligible to start courses up to four years from date of discharge, but there are many exceptions which only the VA can evaluate.

Veterans who are permitted to *start* courses after July 25, 1951 have 9 years from date of discharge to complete training, or until entitlement expires if this occurs earlier. Veterans who were required to start courses before July 25, 1951 have until July 25, 1956 to complete training, unless their entitlement expires before then.

• • •

Veterans taking NRI training may be permitted to study even after their entitlement is exhausted:

a. If they have completed over half the lessons in the course when entitlement is exhausted.
b. If the remainder of the course would cost the VA not over $125.00.

If *you* are expecting your entitlement to expire before you can complete your course at your present rate, keep this possibility of extension in mind.

Remember too that even if your course is not extended, every lesson you complete under the GI Bill reduces the amount you would pay if you finish at your own expense. (You are under no obligation to the Institute to do this.) You do, however, owe it to yourself to complete whatever course you start. If you think your entitlement is expiring and you will *not* be able to finish an NRI course before it does, (keeping in mind that correspondence courses reduce your entitlement only 3 months for each year of training) write to us and ask about the possibility of extension.

A HAPPY AND PROSPEROUS NEW YEAR!

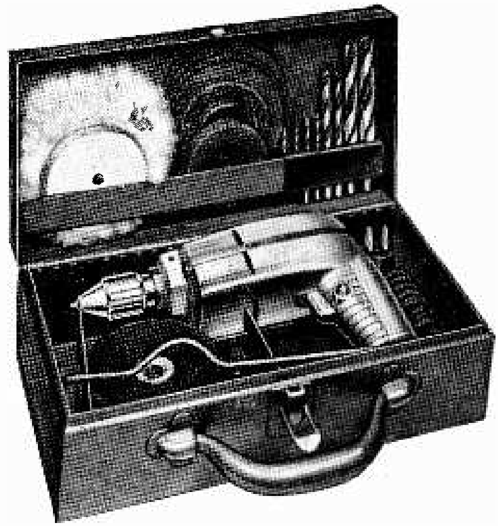
PLACE CHRISTMAS ORDERS EARLY

EACH year at this time we receive many letters from students and graduates, members of their families and even friends inquiring about the NRI Professional Test Instruments, and other NRI services, with a view of purchasing them for Christmas presents. Anticipating this same interest this year we give, in the following several pages, condensed information about these items.

We urge our readers, who are prepared to send orders for these items at this season, to do so very promptly. For those who must wait until nearer Christmas, we promise to try to make shipments within one day of receiving order. That means Monday's orders, for example, are shipped Tuesday. Tuesday's orders are shipped Wednesday, etc., but Friday's orders are shipped Monday. The Institute is closed on Saturdays.

Mail moves slower at this season. A letter may take a day or two longer to reach us. Likewise, shipments move slower, too. We will do everything we can to rush shipments but please help us avoid impossible situations. Every year we receive orders within a few days of Christmas marked "Christmas present, please rush" or "Must get here before Christmas," with not enough time for the shipment to get there. That leads to disappointments.

One more important point. A father, mother, wife, sweetheart or friend may purchase these items for a student or graduate, but we should have the student's name and student number as part of our record: To keep the present secret from the student, the shipment may be sent to any address designated. So, mail your orders early. We'll extend every possible cooperation to help make the lucky recipient of the shipment have a Merry Christmas.



23-Piece DeLuxe Electric Drill Kit

Zephyr Portable Electric Drill, polished chrome finish, with removable auxiliary side handle and precision, hand-operated, 3-jaw drill chuck; adapter; 5" molded-rubber disc; 6" disc polishing bonnet; 2 wood bits, 3/8" and 1/2" dia. with 1/4" shanks; 3 carbon steel twist drills 1/16", 1/8", 1/4" dia.; 3 high speed steel twist drills 1/16", 1/8", 1/4" dia.; 3" buffing wheel; wire wheel brush; grinding wheel; 4 assorted abrasive discs, 5" dia.; paint mixer, horizontal bench stand for electric drill.

The carrying case is of heavy-gauge steel, 12½" x 6" x 4¼", with full length, piano-type cover hinge, lever-type latch, and comfortable, metal handle—finished in beautiful, gray hammerloid. A rack attached to the cover holds the twist drills, sanding discs, and other accessories. There is ample room in the kit for other small tools.

And here is great news! Although the regular price of this De Luxe Drill Kit is $26.35, you can buy this kit direct from NRI at the low price below. Shipped postpaid. Order blank on page 15.

Only $22.40

* * *

Jacobs Gear (For use with above drill kit) Chuck (With Key)

For ¼" electric drills. For the man who desires the very best in a drill chuck. Regular price $5.50, but NRI's special price when purchased with the above kit is only

$4.67, postpaid.

MODEL 45

NRI Professional Volt-Ohm-Mil-Ammeter

IDEAL FOR RADIO OR TELEVISION WORK

We are proud to offer such a fine instrument at this reasonable price. A Volt-Ohm-Mil-Ammeter is a basic instrument, actually seven separate instruments built into one. Each section of the instrument is instantly available merely by turning the center selector switch. Specifications:

1. Five d.c. voltmeter ranges, at 20,000 ohms per volt. Maximum d.c. range 1200 volts.
2. Five a.c. voltmeter ranges available, sensitivity 5000 ohms per volt. Maximum range 1200 volts.
3. Micro-amperes 0-60.
4. Milliamperes, d.c.—0-1.2; 0-12; and 0-120.
5. Amperes: O-12.
6. Four well divided ohmmeter ranges, with maximum range of 100 megohms. Zero adjust control on front panel.
7. Attractive maroon crackle finish—nickel plated hardware—6⅝ inches wide, 7⅞ inches high, 4¾ inches deep.
8. Shipped complete with operating instructions, test leads, alligator clips, and detachable cover.
9. Portable. Actual weight 6 pounds, shipping weight, 11 pounds. Shipped express, collect.

Price $39.95

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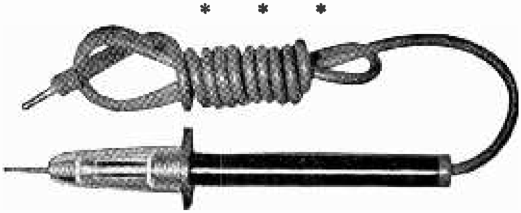

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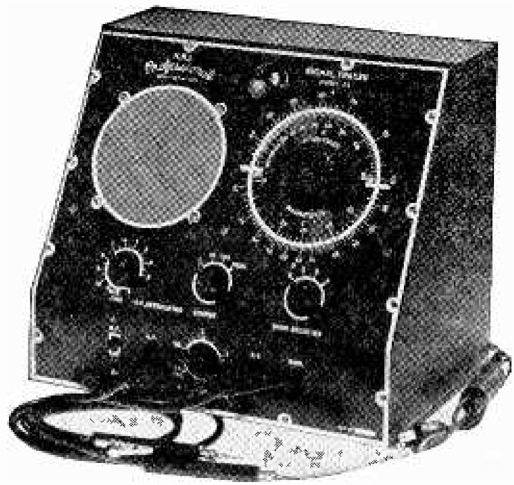

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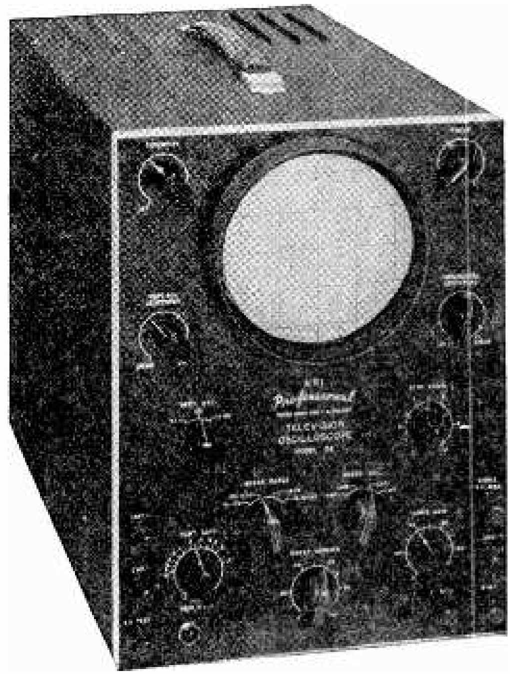

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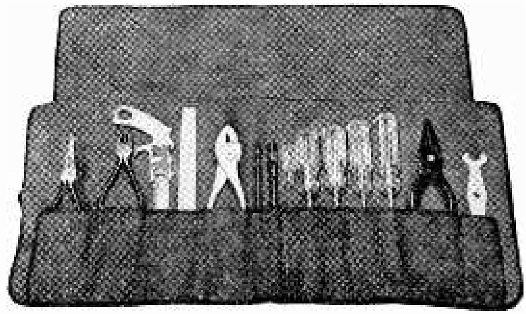

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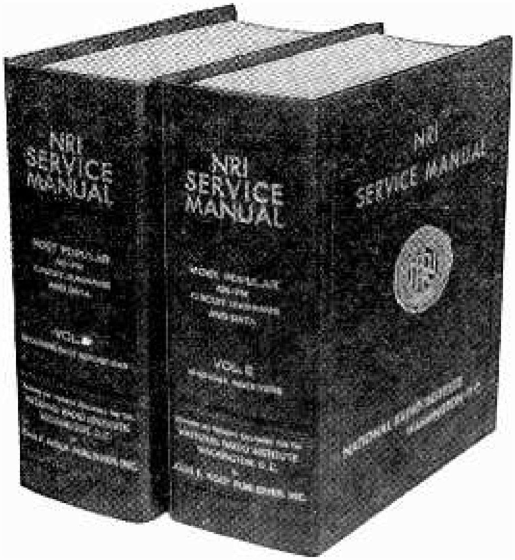

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Leo M. Conner

Applying Ohm's Laws To Service Problems

By LEO M. CONNER

NRI Consultant

ONCE the serviceman has located a defective part, his problem is usually solved. He merely replaces it with a good one. Occasionally, however, an exact replacement part may not be available, especially in these days of military priority and limited production. The serviceman may have found out by past experience what substitute parts he can use in some cases, but sometimes he may have to rely on calculating the electrical values of parts in order to make a substitution. For this he can fall back on the fundamental "laws" dealing with current, voltage, and resistance—Ohm's Law.

Understanding Ohm's law and how to apply it is helpful in servicing electronic equipment. This includes any item using vacuum tubes or electric current. Actually the use of Ohm's law involves only simple arithmetic and anyone can master these easy calculations. If you practice solving problems you will soon become quite proficient.

The purpose of this article is to show how such problems are worked out. Step by step solutions are given and you can then work out these examples or substitute other values. Check your answers by using the proof methods shown.

In Ohm's law problems the current is represented by the letter I, the resistance by the letter R, and Voltage by the letter E. Two of the values must be known in order to find the third.

One very important thing is that current values must be in amperes. In radio work most current values are smaller than an ampere so they are given in milliamperes. To change milliamperes to amperes you move the decimal point three places to the left. Thus, 1 milliampere can be expressed as .001 ampere and 2.4 milliamperes as .0024 amperes.

Now let's take some examples in which the voltage and resistance are known and work out the current. The formula that we will use is $I = \frac{E}{R}$ which is the same as saying, "The current is equal to the voltage divided by the resistance."

In Fig. 1a the voltage is given as 10 volts and the resistance is 100 ohms. The formula then becomes $I = \frac{10}{100}$. The actual voltage and current values are placed in the formula in place of the letters that represent these values. Since 10 cannot be divided by 100 we place a decimal point and a zero after the 10 so that it becomes 10.0. A decimal point is also placed above the long division sign as shown to the right of the figure. The division can now be made and we find that .1 ampere or 100 milliamperes will flow in a circuit which contains 100 ohms resistance with a source voltage of 10 volts.

In Fig. 1b the voltage has been changed to 100 volts and the resistance left at 100 ohms. The formula becomes $I = \frac{100}{100}$. With these values the circuit current is 1 ampere.

In Fig. 1c the voltage is 150 volts and the resistance has been changed to 2,000 ohms. The

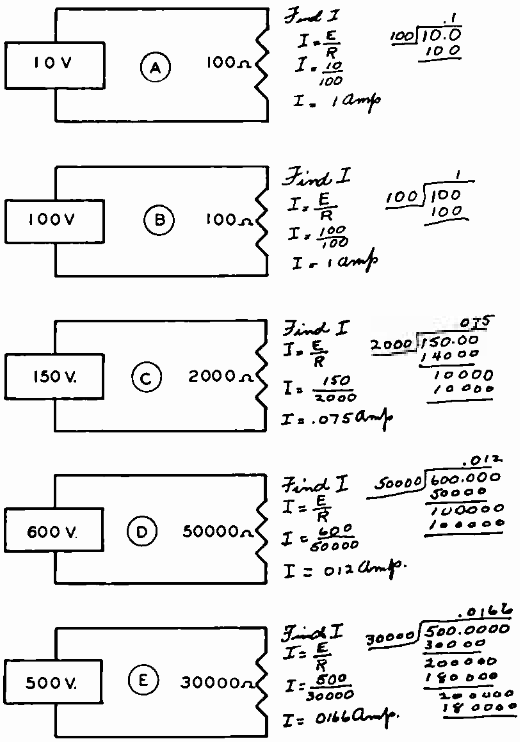

Fig. 1

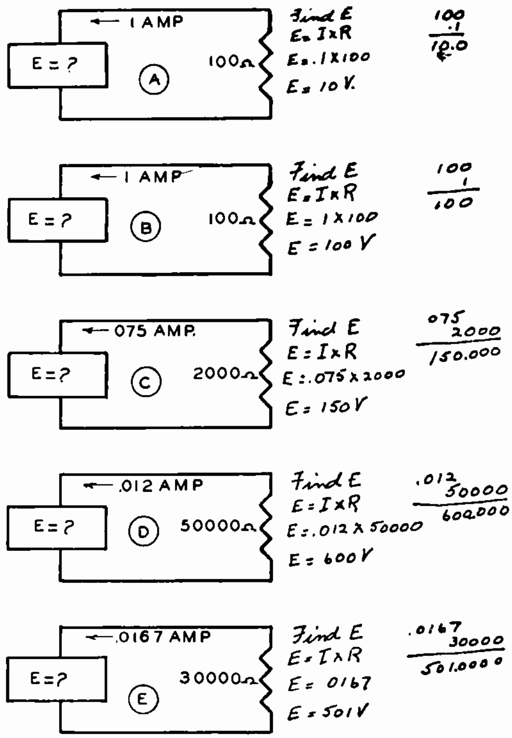

Fig. 2

current, using these values, is .075 amperes or 75 milliamperes.

Fig. 1d shows the voltage as 600. The resistance has been changed to 50,000-ohms. The current, using these values, is .012 amperes or 12 milliamperes.

In Fig. 1e the source voltage is 500 volts and the resistance 30,000 ohms. The circuit current is .01666 amperes. In this case you would call the circuit current .0167 amperes or 16.7 milliamperes. Nothing would be gained by carrying out the answer to a larger number of decimal places.

When the current and resistance are known we can find the voltage by using the formula $E = I \times R$ which is the same as saying, "The voltage is equal to the current times the resistance." The current must be in amperes.

Using the same values as in Fig. 1 we can check the answers that we obtained for the examples.

In Fig. 2a the circuit current is .1 ampere and the resistance is 100 ohms. Multiplying these two values shows that the voltage is 10 volts. Notice that this is a cross check on the correctness of the answer for the example in Fig. 1a.

Fig. 2b shows that the voltage is 100 volts when a current of 1 ampere flows through a resistance of 100 ohms.

Figs. 2c and 2d are three figure decimal values.

The solutions at the right of the figures show how this multiplication should be done. Notice that the voltage checks with that given in Figs. 1c and 1d, respectively.

In Fig. 2e we have a case where the current is not an even number. Using the value of .167 ampere we find that the voltage would be 501 volts. This is one volt greater than the source voltage in Fig. 1e but, as we will show, this small difference can be disregarded. If we had used .166 ampere, the voltage would have been 498 volts according to the formula. If we had carried the answer in Fig. 1e out to six decimal places, we would have had a circuit of .016666 ampere. Using this value in Ohm's law, the voltage would be equal to .016666 times 30,000 ohms or 499.8 volts.

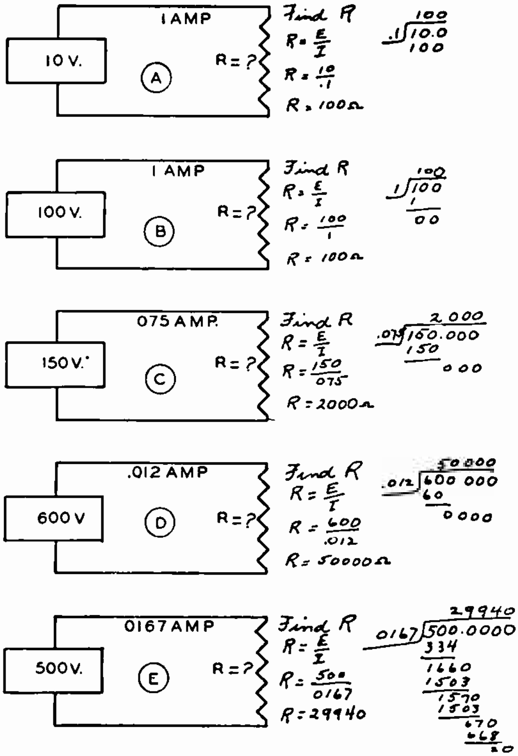

Fig. 3

For all practical purposes the voltage of 501 volts is accurate enough and there is no advantage in carrying out decimals to more than three places.

In order to determine the resistance when the voltage and current are known, you use the formula $R = \frac{E}{I}$. This is the same as saying, "The resistance is equal to the voltage divided by the current." Here, as in other examples, the current should be in amperes.

Using the same values as in the two previous cases we can check the results.

In Fig. 3a we have a source of 10 volts and a circuit current of .1 ampere. If we divide 10 by .1 we find that the circuit resistance is 100 ohms. Notice that this value checks with the other examples.

Fig. 3b values are used in the same manner to find that with a source voltage of 100 volts and a circuit current of 1 ampere the resistance will be 100 ohms.

Fig. 3c contains a decimal of three places. Some students have trouble using decimals. Actually the division of a whole number by a decimal is very simple.

This division will be carried out step-by-step so that you can see just how it may be done. The source voltage is 150 volts. The circuit current is .075 ampere. Write down the 150, put a decimal point after it and add three zeros. Notice that this is the number of decimal places that are in the divisor. The number is then 150.000. If you divide this by .075 it is the same as dividing 150,000 by 75. The answer is 2000, which is the resistance in ohms in a circuit with 150 volts and a current of 75 milliamperes.

The example in Fig. 3d is solved in the same manner as example 3c. Here the circuit current is .012 amperes and the source voltage is 600 volts. If we divide 600.000 by .012 the answer is 50,000 ohms.

In the example shown in Fig. 3e we have a source voltage of 500 volts and a circuit of .0167 ampere. If we divide 500.0000 by .0167 we find that the resistance is 29,940 ohms instead of the 30,000 ohms used in previous examples using the same values. This is because the division used in determining the circuit current did not come out to an even whole number. However, the tolerance of the average resistor marked 30,000 ohms might make the actual resistance farther from the marked value than the calculated result that we obtained. In a case of this kind you can be sure that the resistance is 30,000 ohms for all practical purposes.

Resistors in Series

When resistors are connected in series, the total resistance is the sum of the separate resistors in the group. In a series circuit you will find the end of one resistor connected to a voltage terminal, the free end of this resistor will be connected to the end of another resistor, and so on, depending on the number of resistors in the group. The free end of the last resistor will then be connected to the second terminal of the voltage source.

In Fig. 4a we have two 50-ohm resistors connected in series. In order to find the total resistance we add 50 plus 50 to find that the total resistance is 100 ohms.

The circuit in Fig. 4b shows a 10-ohm, a 30-ohm and a 60-ohm resistor connected in series. Adding these we have 10 plus 30 plus 60 for a total resistance of 100 ohms.

Fig. 4c shows two 500-ohm resistors and a 1000-ohm resistor in series. The total resistance of this group is 500 plus 500 plus 1000 or 2000 ohms.

In Fig. 4d we have five resistors. These resistors have individual values of 20,000 ohms, 50 ohms, 7,550 ohms, 400 ohms and 22,000 ohms. Adding these values we find that the total resistance is 50,000 ohms.

The resistors in Fig. 4e have individual values of 20,000 ohms, 5,000 ohms and 5,000 ohms. The sum of these is 30,000 ohms.

From these examples you can see that all you have to do to find the total resistance of a group of series connected resistors is to add the individual resistance values.

The circuit current for circuits of this type is found in exactly the same way as the examples in Fig. 1. However, it is first necessary to find the total resistance. Then the voltage is divided by this resistance. Since the total resistance in Fig. 4a is 100 ohms, the circuit current is 10 ÷ 100 or .1 ampere.

Once the circuit current is known it is possible to calculate the voltage drop across each resistor in the group. To do this you multiply the actual resistance of each resistor by the circuit current. If we multiply 50 by .1 we find that there are 5 volts across each resistor. As a check, add up the voltage drops across each resistor to see if the total of all the voltage drops equals the source voltage. If it does not then there is an error in some of your calculations. This fact brings up an important electrical law—Kirchoff's law which states that, "The sum of all the voltage drops around a series circuit will be equal to the source voltage."

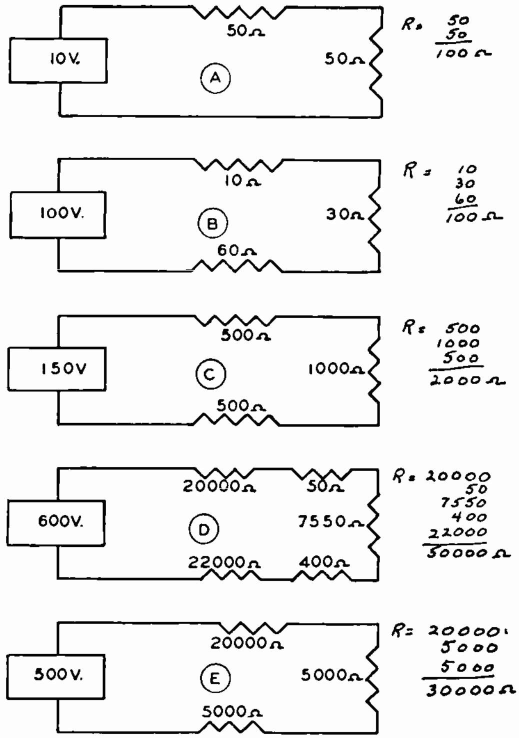

Fig. 4

In Fig. 4b we have 100 ohms and 100 volts source voltage. The circuit current will be 100 divided by 100 or 1 ampere. The voltage drop across the 10-ohm section is 10 × 1 or 10 volts. Across the 30-ohm section, 30 × 1 or 30 volts, and across the 60-ohm section, 60 × 1 or 60 volts. Adding all the voltage drops we have 10 plus 30 plus 60 or 100 volts. This is equal to the source voltage so the calculations are correct.

In Fig. 4c the circuit current is 150 divided by 2000 or .075 ampere. Multiplying 500 by .075 shows that the drop across the 500-ohm sections is 37.5 volts each. The voltage drop across the 1000-ohm section is 1000 × .075 or 75 volts. The total is 37.5 plus 37.5 plus 75 or 150 volts.

Fig. 4d is more difficult only because there are more calculations to make. First you would determine the total resistance, and then the circuit current, which is equal to 600 divided by 50,000 or .012 ampere. This current value is then used to find the voltage drop across each section. The 20,000-ohm section is 20,000 × .012 or 240 volts. Across the 50-ohm resistance it is 50 × .012 or .6 volts. Across the 7550-ohm section the voltage is 7550 × .012 or 90.6 volts. The voltage drop across the 400-ohm section is 400 × .012 or 4.8 volts and across the 22,000-ohm section it is 22,000 × .012 or 264 volts. Adding the voltage drops we have 240 + .6 + 90.6 + 4.8 + 264 or 600 volts, so our calculations are correct.

In Fig. 4e the total resistance is 30,000 ohms and the source voltage is 500 volts. The circuit current is .0167 ampere. If we multiply 5000 by .0167 we find that the voltage drop across the 5000-ohm sections is 83.5 volts each. The drop across the 20,000-ohm section is 20,000 × .0167 or 334 volts. Adding these drops we get 501 volts. This is due to the fact that the calculated current does not come out even. However, the one volt difference can be neglected and the calculated value across each resistor can be accepted.

Tube Filaments in Series

In some radio receivers, the tube filaments are connected in series in order to eliminate a power transformer. When tube shortages develop, it is sometimes necessary to substitute tubes in order to restore the set to operation. The filament voltage or current requirements of the substitute tube may be different than the original, but if you know how to apply Ohm's law you can easily work out the necessary changes.

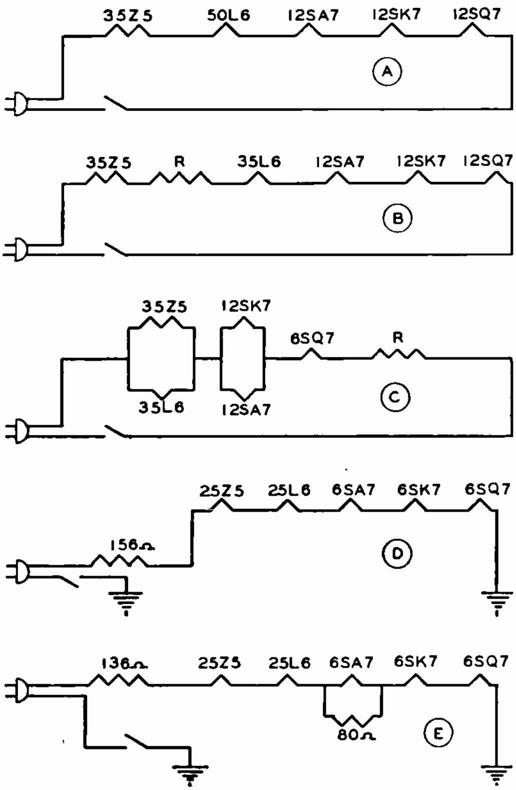

Fig. 5

Fig. 5a shows a typical tube lineup used in AC-DC sets. The number preceding the first letter in the tube type designation represents the filament voltage required by the tube. If you add up the total filament requirements you will see that the total is 121 volts. The normal line voltage is usually around 110 volts but the set will still operate. In designing sets of this type, the normal line voltage is assumed as 115 volts. All of the tubes used in a circuit of this type must have the same current requirements, since the same current flows in all parts of a series circuit.

Now assume that the 50L6 tube filament burns out and no replacement is available. However, you do have a type 35L6 tube. A tube chart shows that the tubes are identical except for filament voltage.

In order to use the tube you first see what the total filament voltage requirement would be with a 35L6 tube in the set. This would be 35 + 35 + 12 + 12 + 12 or 106 volts.

Actually, in a practical case, you could plug the 35L6 in the socket and the set would operate with no changes. This is because of the fact that these tubes are very tolerant in regard to filament voltage.

However, suppose you wish to install a series resistor as shown in Fig. 5b. Assuming a normal line voltage of 115 volts, you would subtract 106 volts from the line voltage in order to find the voltage drop which must take place across the series resistor. Then using Ohm's law you would determine the value of the resistor. The formula is $R = E \div I$. This is 9 volts divided by .150 ampere or 60 ohms. Therefore, a 60-ohm resistor should be connected in series with the filaments.

Just any 60-ohm resistor will not do for this job. The resistor consumes power, so we must find the wattage of the resistor. Power is equal to the square of the current times the resistance or $P = I^2R$. The current is .150 and to square this you multiply .150 by .150. The result is .022500. Multiplying this by the resistance (60 ohms) we find that the resistor will dissipate 1.35 watts. In order to have a reasonable safety factor, this value should be doubled. There are no commercially available resistors rated at 2.7 watts so you would use a 3 watt resistor. Of course, an adjustable wire wound resistor could be used after setting the resistance to the proper value.

In another case, a 12SQ7 tube might be burned out and no replacement available. Fig. 5c shows how the circuit would be changed in order to use a type 6SQ7 tube. This tube requires .3 ampere for its filament. The other tubes in the set require .150 ampere for their filaments. By connecting the tubes which require the same voltages in parallel, we can make the current requirement for these tubes .3 ampere.

Note that the 35Z5 and 35L6 tubes are in parallel and that the 12SK7 and 12SA7 tubes are in parallel. The total voltage requirements then become 35 + 12 + 6 or 53 volts. The series resistor ohmic value is found next.

Assuming a line voltage of 115 volts, we subtract 53 volts from that value to find the required voltage drop across the resistor. This is 62 volts. The current is .3 ampere so we divide 62.0 by .3 to find that the series resistance should be 206 ohms. Because this is an odd value, you would use a 200-ohm resistor. The wattage rating of the resistor is then $.3 \times .3 = .09 \times 200$ or 18 watts. The nearest commercially available wattage rating to twice the dissipation is 40 watts. However, line cords having the correct resistance are available and are considerably cheaper than the resistors. In addition the resistance is spread out along the length of the cord so that the heat generated is spread more evenly. This is why line cords used in some AC-

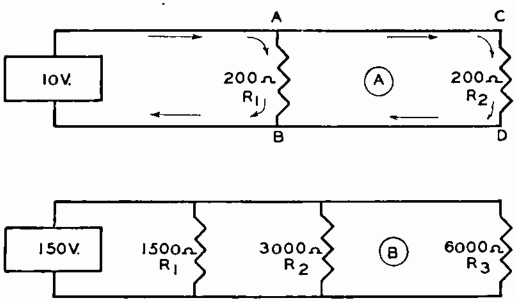

Fig. 6

DC receivers feel warm while the set is operating.

Still another case is where the set uses tubes which require .3 ampere and the substitute tube requires .150 ampere. In a set using the tube lineup shown in Fig. 5d, the value of R would be 156 ohms. Now let us assume that the 6SA7 tube is defective and that the only suitable replacement is a type 12SA7 tube. To make this substitution it will be necessary to shunt the filament of the 12SA7 tube with a resistance so that .150 ampere flows through the filament and .150 ampere flows through the resistor.

To find the required resistance, you divide the filament voltage by the current which must flow through the shunt. 12.000 ÷ .150 = 80 ohms, so an 80-ohm resistor should be connected across the filament terminals of the socket. This resistor dissipates power, so the next thing is to find the wattage. Squaring .150 (.150 × .150) is .022500, and multiplying this by 80 shows the actual wattage to be 1.8 watts. Doubling this for safety is 3.6 watts. However, if the resistor is located so it gets good air circulation, a 3-watt resistor could be used.

The circuit now appears as in Fig. 5e. However, a 12SA7 tube is now used in place of the 6SA7 shown in the diagram. Because the filament voltage requirements have changed, a new series resistor is required. Totaling the voltage requirements we have 25 + 25 + 6 + 6 + 6 or 68 volts. Subtracting this from 115 volts shows that the series resistor must drop 47 volts. Using Ohm's law for resistance we have 47 ÷ .3 or 157 ohms as the new value for R. The wattage is found by using .3 × .3 × 157 = .09 × 157 or 14.1 watts. Doubling this and using the nearest commercially available wattage rating shows that a 25 watt resistor should be used.

Resistors in Parallel

One of the basic rules to remember when resistors are connected in parallel is that the total resistance will always be less than the smallest resistance in the group.

If all resistors in a parallel group have the same ohmic value, the total resistance is then the resistance of one resistor divided by the number of resistors in the group. Thus three 30-ohm resistors in parallel would have a net resistance of 10 ohms.

In Fig. 6a we have two 200-ohm resistors connected in parallel across a 10-volt source. Since the resistors have the same ohmic value, the total resistance is 200 ÷ 2, or 100 ohms. We can find the current drawn from the source by using the formula, $I = E/R$. Dividing 10 by 100 shows the current to be .1 ampere. All of this current does not flow through each resistor. In fact, the current divides according to the resistance of the parallel connected resistors.

To find the current through each arm divide the voltage across the resistor by the resistance. The source voltage is 10 volts so 10 ÷ 200 is .05 ampere. This is the current which flows through each of the 200-ohm resistors.

This brings up another Kirchoff's law which states, "The sum of the currents flowing away from a point is equal to the current flowing toward that point." In Fig. 6a there will be .1 ampere flowing from the source to point "a." At point "a" the current will divide into .05 amp. through R1 and .05 amp toward point "c." There will be .05 amp through R2 from point "c" and this .05 amp will then flow from "d" to "b" where it will be joined by the .05 amp flowing through R1. From point "b" there is .1 amp going back to the source.

Fig. 6b shows three resistors of unequal ohmic value connected across a 150-volt source. The step by step procedure for finding the total resistance of the circuit will be shown, and then we will find the total circuit current and the current through each of the branches.

First find the resistance of R1 and R2 using the formula $\frac{R1 \times R2}{R1 + R2}$. Substituting the actual resistance values in the formula, we have $\frac{1500 \times 3000}{1500 + 3000} = \frac{4{,}500{,}000}{4500} = 1000$ ohms. This value is now used with the resistance of R3, so we have $\frac{1000 \times 6000}{1000 + 6000} = \frac{6{,}000{,}000}{7000} = 857$ ohms. This is the total resistance of a 1500-ohm, a 3000-ohm, and a 6000-ohm resistor connected in parallel.

The total circuit current is found by dividing the source voltage by the total resistance: 150 ÷ 857 = .175 ampere.

The current through each branch is equal to the voltage across the branch divided by the resistance of the branch, so $I_{R1} = \frac{150}{1500}$

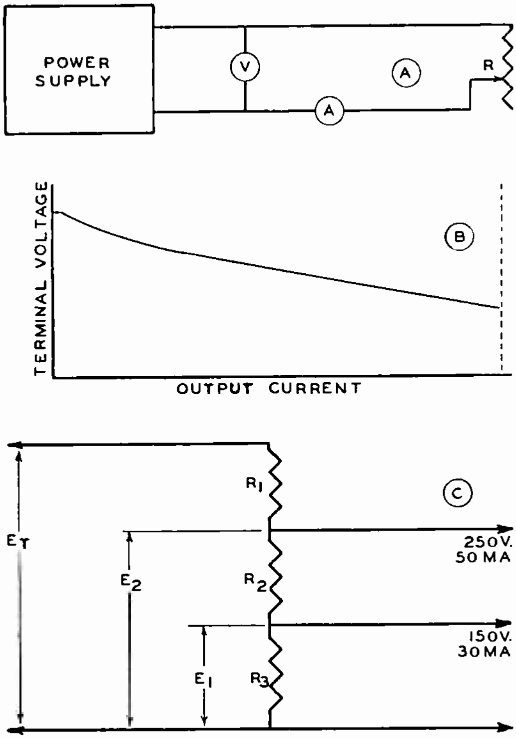

Fig. 7

$= .1$ ampere; $I_{R2} = \frac{150}{3000} = .05$ amp; and $I_{R3} = \frac{150}{6000} = .025$ amp.

We know from Kirchoff's law that the current through the branches should be equal to the current drawn from the source. Adding .1 + .05 + .025 we get .175 which is the current drawn from the source, and it checks with our previous calculation.

You might find it necessary at some time to replace a burned out resistor. If the resistor was a one-watt unit and you had only half-watt resistors on hand, you could connect two of the half-watt resistors in parallel. This would give the required one-watt power rating. However, the resistor ohmic values must be such that the correct total resistance is obtained. If the one-watt resistor was rated at 1500 ohms, you would use two 3000-ohm, ½-watt resistors in parallel as a replacement.

Voltage Dividers

A radio receiver contains several stages and each stage may require different voltages. It would be very costly to provide a separate power supply for each stage. Therefore, a power supply which will furnish the highest voltage required by the set is used in connection with a voltage divider. The voltage divider does just what its name implies—it divides the output voltage of the power supply so that each stage receives the correct voltage.

A voltage divider performs two other jobs—it provides a small load at all times and it furnishes a discharge path for the voltage stored by the filter condensers. Before starting the design of a voltage divider there are some facts that must be considered first.

Most power supplies, such as "B" supplies for radio receivers, have a certain amount of internal resistance, so the voltage obtained at the power supply terminals varies with the current output. When the terminal voltage of the power supply remains CONSTANT over a wide range of current output, the power supply is said to have good regulation. If the output voltage drops off rapidly as the current drain is increased, the unit is said to have poor regulation.

If you are to design a voltage divider for use with a power supply, you must know the terminal voltage when the power supply is furnishing the total value of current required by the loads and the voltage divider. If you do not have this information, you can easily get it by determining the regulation characteristics of the power supply.

Fig. 7a shows a simple circuit that can be used to obtain this information. If you plot a curve showing output current vs terminal voltage, as shown in Fig. 7b, you will have a characteristic curve of the power supply regulation. With the information contained in the graph, you can design a voltage divider or alter any existing voltage divider as changes in load conditions occur.

One more value is required before you can go ahead with the design of a voltage divider. Look at Fig. 7c. When two different voltages are required, you use three resistors. Resistor R3 is referred to as the bleeder resistor and stabilizes the voltage at the other taps.

The current through the bleeder resistance is known as the bleeder current. Any current through this resistor is wasted in heat so some care is required in choosing the value of this section. It is safe, in most cases, to assume a bleeder current which is equal to 10 per cent of the total current to be drawn from the power supply.

Let us assume that the loads require the voltages and currents shown in Fig. 7c. We see that one load requires 30 milliamperes and the other

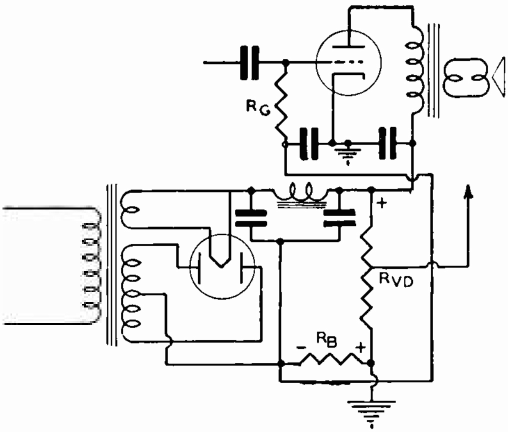

Fig. 8

50 milliamperes. This is a total of 80 milliamperes. To this we must add a bleeder current. If we use a bleeder current equal to 10 per cent of the total required current we would add 8 milliamperes but to get a round number let us assume a bleeder current of 10 milliamperes. This makes a total of 90 milliamperes to be drawn from the power supply.

A circuit like Fig. 7a is set up with an adjustable resistor connected to the output. Use a 50 watt resistor. Connect a voltmeter across the power supply terminals and a milliammeter (100 ma full scale) in series with the load and power supply. Start out with all of the resistance (50,000 ohms or so) in the circuit. Note the voltage and current and plot these points on your curve. Then decrease the resistance slightly and note these values on your curve. Keep reducing the resistance until the milliammeter indicates that 90 ma is being drawn from the power supply. Note the final output voltage and current on your graph and draw a smooth line connecting all of the points.

We will assume that the output voltage was 300 volts when 90 ma was being drawn from the power supply. This means that the power supply is furnishing 50 volts more than the highest voltage required by a load. Therefore, R1 must drop the voltage 50 volts.

All of the current drawn from the power supply will flow through this resistor. The resistance of R1 will then be $R = \frac{E}{I} = \frac{50}{.090} = 555.5$ ohms.

The 30 ma load current and bleeder current, 10 ma, will flow through R2. The voltage drop across R2 will be 250 — 150 or 100 volts. R2 is then $\frac{100}{.040}$ or 2500 ohms. Only the bleeder current, 10 ma flows through R3. There is 150 volts drop across this section, so R3 is $\frac{150}{.010}$ or 15,000 ohms.

As long as the loads draw the current for which the voltage divider was designed they will receive the correct voltage. However, there is one thing more before our design is complete. This is the proper wattage ratings for the resistor sections. R1 wattage is $.090^2 \times 555.5$ or 4.499 watts. Call this 5 watts and double it for safety so that R1 should be a 10-watt, 555.5-ohm resistor. R2 wattage is $.040^2 \times 2500$, or 4 watts. Since an 8 watt resistor is an odd size, you would also use a 10 watt rating for R2. The wattage for R3 is $.010 \times 15{,}000$, or 1.5 watts. A 3-watt, 15,000-ohm resistor would be used here.

You will note that a 555.5-ohm resistor is specified for R1. In actual practice, you would not need to hold the resistance to this close tolerance. A 550-ohm or 560-ohm resistor could be used, or a 10 watt adjustable resistance of 3000 ohms used in place of R1 and R2. The slider would be adjusted until the load voltage was correct.

If the radio set required three voltages you would add another section to the voltage divider and include the current drawn by the third load in your calculations.

Resistors Used for Bias Purposes

In sets operating from power line, resistors are used for bias purposes in order to make the sets completely ac operated.

A resistor can be used to obtain a bias voltage by placing it in the high voltage center tap return of the power supply. If more than one bias voltage is desired, the resistor can be tapped.

If the resistor is placed in the cathode return circuit of a tube, and the grid return made to minus end of the resistor, the grid will then be negative with respect to the cathode.

A resistor can also be placed in the grid circuit so that convection currents produce the bias voltage.

We will show just how each of these methods work.

Fig. 8 shows a power supply, filter, voltage divider, bias resistor, and part of the wiring for an output stage. R_B in this circuit is the bias resistor and R_{VD} is the voltage divider. To see how R_B will furnish bias for the output stage, let us trace the electron flow in the plate circuit of this stage.

The cathode, when heated, will emit electrons. These electrons will be drawn to the plate because the plate is positive with respect to the

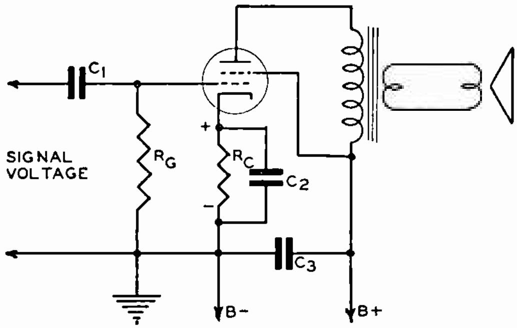

Fig. 9

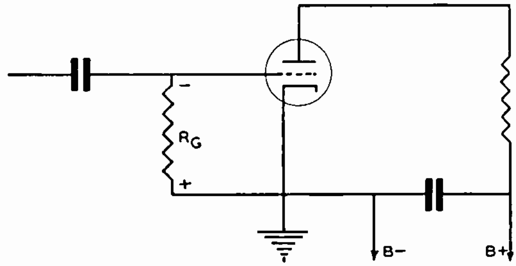

Fig. 10

cathode. From the plate they will flow through the output transformer primary to B+, from B+ through the filter choke to the rectifier tube filament, from the rectifier filament to one of the rectifier plates, from the rectifier plate through half the high voltage secondary to the center tap, from the center tap through R_B to chassis, through the chassis back to the cathode. Since the end of a part at which electrons enter is always negative with respect to the other end of the part, the voltage drop across R_B will have the polarity shown on the diagram.

If we return the grid of the tube to the minus end of this resistor, the grid will then be negative with respect to the cathode by the amount of the voltage drop across R_B since the cathode is connected to the positive end of R_B through the chassis.

In an actual set, the plate and screen grid currents as well as the bleeder resistance current will flow through R_B, so they must be taken into account when the bias resistor ohmic value is calculated. If bias voltages for two stages were needed, then either two resistors or a tapped resistor would be used at R_B. The resistance required would be equal to the desired bias voltage divided by the current flowing through R_B.

A cathode resistor bias circuit is shown in Fig. 9. In this circuit the electrons flow from cathode to plate, through the plate load to the B+ terminal, through the power supply to B—, from B— through R_C and back to the cathode. The screen grid current also flows through R_C. The end of R_C which is connected to B— is negative because electrons enter at that point. Therefore, the voltage drop across this resistor will have the polarity marked on the diagram.

If the grid is connected to the minus end of R_C, then it will be negative with respect to the cathode. R_G serves to make this connection. There is no current flow through R_G because there is no complete circuit, so there will be no bias voltage drop across R_G. The effect so far as "no signal" bias is concerned is the same as if a straight wire were connected between the grid and the negative end of R_C.

However, C1 and R_G form a capacitance-resistance voltage divider for the signal voltage. The capacity of C1 is such that it has low reactance for the signal frequencies and consequently most of the signal voltage appears across R_G.

This puts the signal voltage in series with the bias voltage and the grid voltage will then vary in accordance to the signal voltage. The variation in grid voltage produces variation in the plate current which, of course, produces a varying voltage drop across the plate load.

The variations in plate current cause a variable voltage drop across R_C. Since we do not want a varying bias voltage, something must be done to stabilize this voltage. Therefore, C2, a large capacity (20 mfd or so) electrolytic condenser is connected across R_C. When the greatest plate current is flowing through R_C the voltage drop across R_C will be at its highest value. The condenser, C2, will be charged to this voltage. When the voltage drop across R_C starts to decrease as the plate current begins to fall, the condenser will discharge into R_C, thus tending to keep the voltage drop constant across the resistor. You may find circuits of this type in which the cathode resistor is not bypassed. If so, degeneration has been introduced to lower the gain of the stage and give better overall frequency response.

Convection bias is sometimes used as shown in Fig. 10. The plate will draw a large number of electrons from the cathode of the tube and, since the grid is located between the cathode and plate inside the tube structure, some of these electrons will strike and stick to the grid. They then seek to return to the cathode. The return path is through R_C and, since the end of a part at which electrons enter is always negative with respect to the other end of the part, the voltage drop across R_C will have the polarity shown. Therefore, the grid is negative with respect to the cathode. Since fairly small current flows in

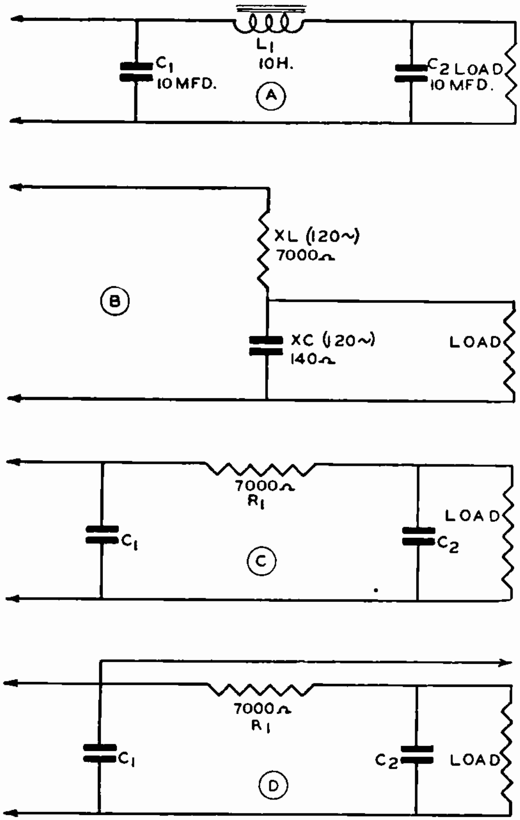

Fig. 11

a circuit of this kind, the grid resistor may have an ohmic value of 10 megohms or more.

Using Resistors in Place of Filter Chokes

Some AC-DC sets do not use an inductance in the filter circuit. Instead a resistor is used. To see how this can be done, let us review the action of an LC filter. Fig. 11a shows a conventional filter circuit. So far as the ripple voltage is concerned, C1 can be considered as the source voltage. L1 and C2 form an inductance-capacitance voltage divider for the ripple voltage. If full-wave rectification is used, the ripple frequency will be 120 cycles per second. At 120 cycles per second a 10-henry choke has a reactance of 7000 ohms and a 10 mfd condenser has a reactance of 140 ohms as shown in Fig. 11b. Now assume that 100 volts of ripple is present across C1. The ripple voltage will then divide according to the reactances of L1 and C2. If we use Ohm's law, we see that the current flowing through these reactances will be 100 ÷ 7140 or .014 ampere. The ripple voltage drop across XL will be .014 × 7000 = 98 volts. The ripple voltage drop across C2 will be .014 × 140 = 1.96 volts which is applied to the load.

As far as the dc voltage is concerned, the only voltage drop will be due to the dc resistance of the wire used in the filter choke. Usually this is around 200 ohms for a 10-henry choke, so the dc voltage drop is not too serious. Assuming that .070 amp was flowing through the choke, the voltage drop due to the dc resistance would be .070 × 200 = 14 volts.

Now let's see what would happen if we connected a 7000-ohm resistor in place of L1. Fig. 11c shows the circuit. Assuming the same ripple voltage across C1, the ripple voltage division would be exactly the same as when a choke was used. The load would still receive 1.96 volts ripple.

However, the dc voltage is affected considerably. Still using a load current of .070 ampere the voltage drop across the 7000-ohm resistor would be 490-volts! If the load required 200 volts, the power supply would need to furnish 690 volts to satisfy the load and the voltage drops across the resistor. This would be a very costly way to eliminate a filter choke since the resistor would have to dissipate 34.3 watts, and, for safety, a 70 watt resistor would be needed. Fig. 11d shows how these disadvantages can be partially overcome.

Some stages in a receiver do not require as much filtering as the other stages. The plate supply for the output audio stage, for example, can be taken from the input of the filter. Assuming that this stage required 40 milliamperes, the current which would then flow through the filter resistor would be .070 — .040 = .030 ampere. The dc voltage drop would decrease from 490 volts to 210 volts and the power dissipation cut to 12 watts. This method is the one used in most AC-DC receivers which use resistors as filter chokes.

All of the points brought out in this article have a very definite practical value. Of course, there are many, many more applications that could be shown. The principal thing to remember is that a knowledge of a few simple rules and the ability to divide and multiply are all you need to work out these problems.

There's nothing difficult about it and a few hours' practice will show the truth of this statement. If you care to do so, take a few resistors and hook them up as shown in some of the examples. Work out the results using Ohm's law and then check your work with your ohmmeter and voltmeter. You'll have fun and you'll get a great deal of practical knowledge.

Read How NRI Graduates Are Forging Ahead In Radio and Television

NRI Training Provided a Solid Foundation

"When I enrolled for your course, I was a young immigrant. I didn't know the English language too well. I am still thankful for the many good pointers that you gave me in those days. Such advice is especially valuable to young men who have limited education. I can honestly say that your training was the foundation of my future success in Radio and Electronics. With the help that you gave me, I have been able to work my way up from a common pulp-wood cutter to a well paying and respected position with the Hydro-Electric Power Commission of Ontario. It's the foundation that counts. You built a solid foundation for me."

E. J. SCHMIDT
Box 101
Virgil, Ont., Canada

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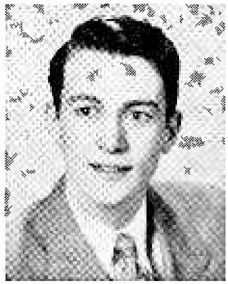

Found a Good Radio Job In the Army

"Your training has helped me find a good job in the army today. I am in charge of 'Operation and Repair' of 10 radio transmitters and receivers.

"I hope to go into business for myself when I leave the army. During my training I made from 40 to 60 dollars a week doing odd jobs and part time work."

PAUL L. MILLER
"A Btry. 229 FA Bn.,
28 Inf. Div.
Camp Atterbury, Ind.

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Has Own Radio and Television Business

"I have a business of my own. I have been in business now for 15 months and have built a good reputation for myself among my customers.

"Thanks to NRI, through your simplified study course in Radio and Television, I am now my own boss and doing very well. I am clearing better than $350 a month and I like this kind of work. My future looks very bright."

CHARLES W. CROWELL
3186 Main
San Diego, California

Handicapped—Now a Full-Time Serviceman

"I lost my job as Manager of a telegraph office after some twenty years with the company. Having a physical handicap, I started to readjust to a new line of work. Having always had a desire to take up radio work, I contacted a couple of radio servicemen who seemed to be making a good livelihood. Both of these men were NRI Graduates and highly recommended the NRI course.

"I enrolled at once, and believe me when I say I was repairing radios in twenty weeks from the date I got my first lesson. Long before I completed my NRI training, I was doing radio servicing, and have never yet been stuck on any repair job. I do all of the radio, phono, and amplifier work for Carter Television, South Euclid, Ohio."

JAMES W. BRUCE
32 Roberts Road
Willoughby, Ohio

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Likes Radio Servicing Fine

"Thanks for the good start which you gave me in Radio. I think that NRI is tops and I am proud to be an NRI Graduate.

"Am now employed in Fajnion Radio and Electric Service at Ord, Nebraska, and like radio servicing fine. I do almost all of the radio work in our shop. We have plenty of work to do. We do a large amount of auto radio work, also.

"I recommend your course to anyone who really wants to learn Radio at home in their spare time."

ZELE E. SMITH
Box 153
Scotia, Nebraska

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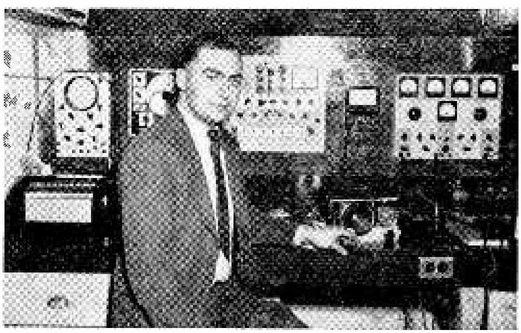

Owns Thriving Radio Business

"We are repairing from 200 to 250 radios each month, which leaves little spare time. Our business is one of only two radio repair stores in all of Western Newfoundland.

"We have had all types for repairs during the past seven years that we have been doing full time work, Corner Brook being a sea port. We see sets from time to time built in different parts of Europe. At the present time, we are starting to move into our new store."

BAXTER WATTON
14 Broadway
Corner Brook,
Newfoundland

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As space permits, from time to time, we plan to devote a page or two in NR-TV News to short success stories such as above. They are taken from testimonial letters we have on file. Photographs and letters of this kind are always greatly appreciated by us. We feel we should pass them on to our readers for the inspiration to be gained from a reading of them.

N.R.I. ALUMNI NEWS

ALEX REMER OF NEW YORK CITY WILL BE 1952 PRESIDENT OF NRI ALUMNI ASSOCIATION

Vice Presidents elected are F. Earl Oliver of Detroit, Harvey Morris of Philadelphia, Lou J. Kunert of New York City and Claude Longstreet of Westfield, N. J.

IN one of the closest elections we have had in years Alex Remer of New York was returned winner over Norman Kraft of Perkasie, Pennsylvania. Mr. Remer will assume the duties of president of the NRI Alumni Association on January 1, 1952.

Many of our members know of the great interest Mr. Remer has always taken in the activities of our Alumni Association. He is frequently mentioned in the columns of *National Radio-TV News*. He is one of the prime movers in New York Chapter. For many years he has served as Vice Chairman of that Chapter, is a member of the Executive Committee, and is one of the men who are responsible for the excellent programs which are arranged for that local. Remer is a go-getter, a very good Radio and Television man and a man who gets a great thrill out of doing something for a fellow member. He will make a fine President.

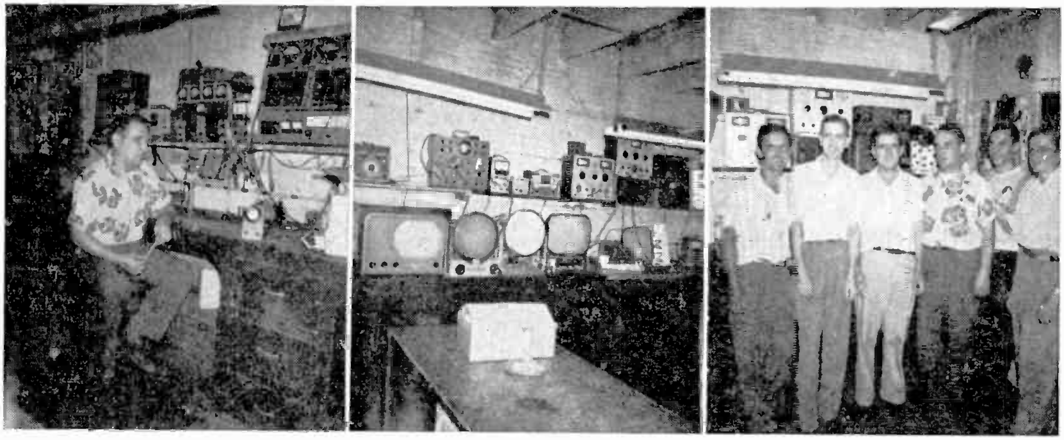
Alex Remer, President-Elect NRIAA for 1952.

Norman Kraft, who served as Vice President during 1951, and who is Chairman of Philadelphia-Camden Chapter is sure to be a strong candidate next year. He ran a very strong race.

It is not surprising to have F. Earl Oliver of Detroit and Harvey Morris of Philadelphia elected Vice Presidents. Oliver has held this office for many years, Morris is a past President, has been Vice President and again is taking a national office. Louis J. Kunert of New York likewise is a past President, a past Vice President and it is good to know that he has again joined our official family.

The one man in our National family of officials is Claude J. Longstreet of Westfield, New Jersey who seems to carry the banner for a great many of our members who do not have chapter affiliations. This is a very healthy condition. Mr. Longstreet rounds out a strong staff of officers to serve during 1952.

It is fitting that a few words of praise should be given to Mr. H. J. Rathbun of Baltimore who will retire as President on December 31, 1951. Mr. Rathbun has worked hard to benefit the members of our Alumni Association and Radio and Television men everywhere. He has been very much interested in opposing legislation which has to do with the licensing of Radio and Television men. A salute to a man who has done his job very well.



Philadelphia-Camden Chapter activities. Left, Henry Whelan at his bench; center, another scene in the Whelan Radio and TV Co.; and from left to right in the group photo, Lynford Trexler, Harvey Morris, Joe Nuccio, Henry Whelan, Billy Whelan, and John Berzesk.

Chapter Chatter

Philadelphia-Camden Chapter. Membership is increasing in our Chapter. Among the newer members are R. T. Benbow, T. C. Sheppleman, J. F. O'Rourke, G. C. Bryden, M. Perrin, R. C. Neitzel, S. Mosely, R. Shaw, C. Graff, T. F. Klatt, and F. B. Giordano.

As a change from Television discussions, Norman Kraft and Harvey Morris have demonstrated and lectured on Radio trouble-shooting, using our RCA dynamic demonstration board. The students really went for this demonstration.

We are very proud of the election of Harvey Morris as a National Vice-President. We feel that he deserves this recognition because of his outstanding contributions to NRIAA.

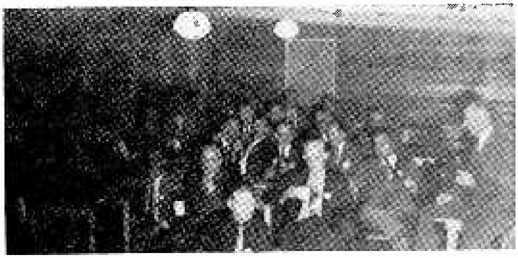
We were sorry that our candidate for President, and incidentally, our esteemed Chapter Chairman, Norman Kraft, was not elected to the office of National President this year. Of course, we will be plugging for him again next year. Incidentally, Kraft is doing fine in spare-time TV service and installation and was very instrumental in providing his local Church minister with a complete Television installation.

With the purchase of our new Television Oscilloscope (NRI Model 55, of course) our members have become very intent on learning how to use this new instrument. Such things as this new piece of test equipment are bolstering our attendance. We also have a campaign to get individual members better acquainted with each other. Accompanying photographs show several of our members. Philadelphia-Camden Chapter meets on the second and fourth Monday of the month at K of C Hall, Tulip and Tyson Streets, Philadelphia.

Detroit Chapter. High-light of our Fall season was our stag party held at the Chrymoto Club, Windsor, Canada. We have a grand time at these social get-togethers.

We are proud to again have our member F. Earl Oliver among the National Alumni Association officers for 1952 as a Vice President.

Alumnus Norman Kraft, very able and well-liked Chairman of Philadelphia-Camden Chapter.



Detroit Chapter stag affair at the Chrymoto Club, Windsor, Can. Good food, good friends, and a good time had by all.

At a regular meeting our member Floyd Buehler, instructor at Electronics Institute, gave an outstanding talk and demonstration on the different stages which make up a Television transmitter. This lecture and demonstration has carried over into several meetings. We have made use of the Electronics Institute's TV Studio equipment so that our members could see themselves portrayed on a cathode ray screen.

Our Television kit is now completely assembled and installed in its cabinet. Members voted to hold a raffle to dispose of it. Tickets will be on sale soon. Next regular meeting on December 14 includes election of officers. Detroit Chapter meets on the second and fourth Friday evening of each month at 21 Henry Street, at Woodward, Detroit.

Chicago Chapter. Of prime interest now is the launching of a program following the National Radio Institute's "Practical Training in TV Servicing," and in acquiring one of the recommended Television sets for this purpose. This should be a very rewarding project.

It was resolved that our officers who served our Chapter during 1951 were to remain in office during the calendar year of 1952. Charles C. Mead will serve as Chairman, Raymond J. Brooks as Secretary, Clark A. Adamson as Treasurer, Lloyd B. Straessle as Librarian, and Raymond Siwek as Sergeant at Arms.

Recently we enjoyed a comprehensive and exceptionally interesting talk by our Mr. Adamson, who gave detailed procedure, backed by his personal experience, on correcting defects in picture and sound reception in TV receivers.

Chicago Chapter holds meetings on the second and fourth Wednesday of each month, 33rd floor, Tower Space, in American Furniture Mart Bldg., 666 Lake Shore Dr., Chicago. Use West entrance.

New York Chapter. We are well into a fine season of Winter lectures under the skillful guidance of Chairman Bert Wappler. Very lucky in having Thomas Hull, Jr., who conducts the "Radio Clinic." One of our best known lecturers, James Newbeck, is continuing his series of lectures on Television, including such subjects as "Video Frequency Amplifiers." James deserves a big hand. Willie Fox has contributed some of his experiences on repairing receivers, as only Willie can tell them. He is great!

We can always count on Alex Remer to informally discuss his experiences in service work. In the absence of Mr. Hull, Remer takes over the "Radio Clinic." And by the way, are we ever proud of Alex Remer's election to the office of National President for the coming year! We are also proud that Lou Kunert is again among the National Vice-Presidents for next year.

Attendance has been good, averaging fifty members or more. New members include S. P. Janier, M. Lamicela, A. M. Gay, P. Engler, and D. Scinto. New York Chapter meets on the first and third Thursday of each month, at St. Mark's Community Center, 12 St. Marks Place, between Second and Third Ave., New York City.

Baltimore Chapter. Things are humming along as usual in our Chapter. We are pleased to welcome Mr. Wilton Shaw as a new member. In addition to our usual technical discussions, we devoted one evening to a consideration of the Baltimore County Electrical Law. Baltimore Chapter meets on the second and fourth Tuesday of each month at Redman's Hall, 745 W. Baltimore St., Baltimore.

MERRY CHRISTMAS

Here And There Among Alumni Members

HAPPY NEW YEAR

Fred B. Uzzle, of Jacksonville, Florida, a Graduate of the NRI Servicing course, recently received his first class radiotelephone license. Uzzle is now working at Municipal Radio Station WJAX (AM-FM) as an announcer. He is also enrolled in the NRI Communications course.

n r i

Leslie H. Harry of Pinehurst, Idaho, writes that he has accepted a position with Tabor's Radio, in Wallace, Idaho, the largest radio and appliance store in his county. Harry also holds the Amateur call W7-PTI.

n r i

Eugene Smith, NRI Alumnus, reports that he is now Chief Engineer of Radio Station KVAL, in Brownsville, Texas.

n r i

Graduate Loren F. Willian has accepted a position with the Radio Supply, Inc., of Oklahoma City. Willian is very enthusiastic about his new work. Besides regular radio parts, he handles ham equipment and broadcast station equipment.

n r i

Alumnus Ben Newman, of Chicago, Ill., who does spare-time TV work, reports winning a ten dollar bet. It seems his friend, a full-time serviceman (not NRI trained) was stuck on a certain TV job. Graduate Newman bet that he could fix the set in less than two hours, and he collected the ten dollar bet in forty-five minutes.

n r i

Graduate R. I. Burlingame of Berrien Springs, Michigan, reports that he has recently opened a Radio and TV Service Shop.

n r i

Douglas E. Bradshaw, of Hamilton, Ontario, Canada reports that he is making about $30 each week through his spare time service work. He is doing Television repairing. Hopes to have his own business soon.

n r i

John W. Creamer, of Denver, Colorado reports that he has just completed the erection of the 3-element rotary beam which was described in the October-November issue of this magazine. He says: "Hope to be the first Alumni member to report completing the beam. It is a honey. I am using it strictly for receiving, as I am still working for my amateur's license, but I am sure that it will be swell for transmitting also. Thanks again for your article, Mr. Mullings. Can we have more articles relative to amateurs and their problems?"

n r i

Mr. Humberto Carvajal writes from Barranquilla, Colombia, to say he is Maintenance Procedure Supervisor at the airport at that point. He graduated in 1929 — that's 22 years ago. Gives much credit to NRI for what he terms a wonderful start. We get a kick out of letters of this kind.

n r i

Gerald J. Macheak of Cedar Falls, Iowa, is opening a Radio and Television business at 111 2nd Street. Previously he was employed by Belmont Radio Corp. in Olivier, Iowa as a Radio serviceman.

n r i

Bruce Durrell of Knowlton, Que., Canada is doing very nicely in his spare time business. His shop is in a jewelry store. The jeweler takes in the Radios during the day and Mr. Durrell repairs them in the evening. Net profit of $2,800 in last year from sales and service.

n r i

Alumni member Arthur Krieski and wife, of Rock Creek, Ohio stopped at NRI for a short visit while on a vacation trip. Krieski has a part-time radio shop.

n r i

Donald H. Peters, of Findlay, Ohio, reports a new amateur's license, call W8HDF. He also reports having passed the license examination for a first class radiotelephone license. Congratulations.

n r i

William G. Meiter is employed as an Electronic Laboratory Technician with Babcock and Wilcox Research and Development Co., in Alliance, Ohio. Meiter stopped at NRI while in Washington.

n r i

NRI Graduate A. L. Hissong, of Chicago, Ill., is now Production Manager for Magnecord, Inc., manufacturers of magnetic recorders.

n r i

Graduate Joseph E. Moyer, of Altoona, Penna., reports passing the Philco examination for Field Engineer. By the time this magazine is in print, he expects to be working at their Philadelphia indoctrination center. Moyer holds a second class radiotelegraph license and a class A amateur license.

n r i

Alumnus Robert Perlman, of New York City reports that he has established his Radio and Television store. It is now a going concern.

n r i

We extend our best wishes to Alumnus Arthur J. Cherpoff of Paterson, New Jersey, who announces his marriage to Ann Strouse, also of Paterson, New Jersey.

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