SEPTEMBER

25 CENTS

Science and Invention

Dunninger's Amazing Buzz Saw Illusion

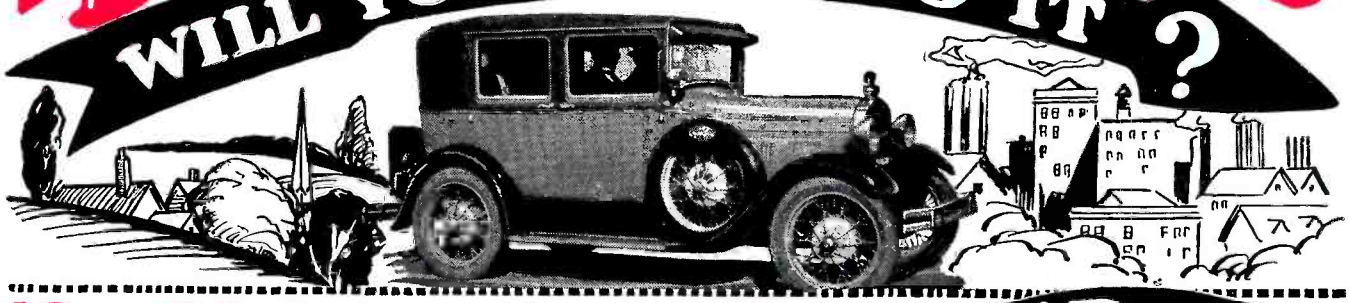
Prizes for Best Solutions

Dr. Worden's $600,000 Hobby

By Alfred M. Caddell

42 Miles on 1 Gallon of GAS

WILL YOUR CAR DO IT ?



New Moisture Humidifier & Carbon Eliminator

for all Makes of Cars, Trucks, Tractors and Engines

An amazing Scientific Humidifier has been patented throughout the World that beats any ever got out. It makes engines run ALL THE TIME with the same wonderful efficiency they do on a cool moist night. It gives MORE pep and power, HIGHER top speed, eliminates hard carbon, and gives AMAZING mileage. Fords report 28 to 42 miles per gallon. Other makes (both American and Foreign) report marvelous increases of ¼ to double mileage. Some of the best records are:

	Miles		Miles		Miles		Miles
Buick	28¼	Essex	32	Nash	30	Pierce Arrow	22
Cadillac	21½	Ford (Model T)	42	Oakland	31	Pontiac	31
Chevrolet	41	Ford (Model A)	40	Oldsmobile	34½	Reo	26½
Chrysler	30¾	Hudson	23½	Packard	21½	Studebaker	29
Dodge	31½	Hupmobile	24½	Plymouth	29	Whippet	41
Durant	41¾	Marmon	21½	Graham-Paige	23½	Willys-Knight	29

And Hundreds of Other Wonderful Records on ALL American and Foreign Makes

Big Profits

to

Man with Car

Spare or Full Time

$350 to $1500 a month

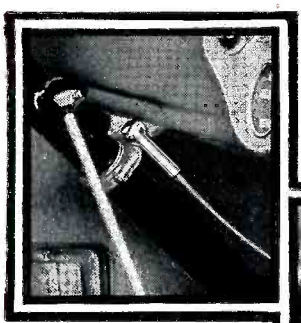
1 man $4,939.66 in 3¾ months.
Another $1,656.60 in 58 days.
$5,150.00 in 5 months to another.
BIG MONEY can be—IS being made.

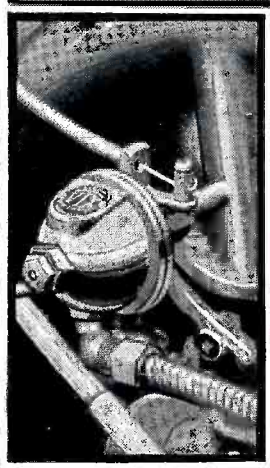
Fitting Motors With Vix

One man sold 8 first morning. Another sells all 3 men can install. Another's profits as high as $100.00 a day.

VIX sells itself by 8 STARTLING demonstrations — BIG, STUNNING, ASTOUNDING DEMONSTRATIONS. Successful VIX men make MORE MONEY than they ever made before.

Free Trial Try This New Principle Gas Saver AT MY RISK





Pictures here and at top show Model "B" VIX attached to my own New Model A Ford. This car is wonderfully improved in performance with the VIX Moisture Humidifier. So is every Auto, Truck, Tractor, Taxi, Bus, Marine, Stationary and Aircraft Engine, both American and all Foreign makes.

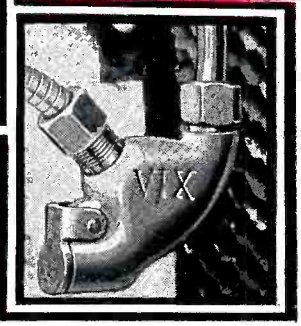
Try this wonderful VIX Moisture Humidifier and Carbon Eliminator AT MY RISK on YOUR OWN CAR to prove that VAPOR MOISTURE (drawn from Radiator to Engine) gives you that wonderful night driving effect ALL THE TIME with MORE mileage from gas and oil—eliminates hard carbon accumulation — gives MORE power, a SNAPPIER, PEPPIER motor. FASTER acceleration, a SMOOTHER, QUIETER running engine and HIGHER top speed.

VIX will PROVE ITS MONEY SAVING MERIT on your own car by 8 DEMONSTRATIONS—conducted by yourself AT MY RISK—the most SENSATIONAL, most ASTOUNDING, most CONVINCING DEMONSTRATIONS you ever saw. If you don't find from your tests that it does MORE than I claim, return it and it COSTS YOU NOTHING. **I want wide-awake, hustling, County, State, Province and National Agencies everywhere, part or full time, to make $350 to $1500 per month filling the great DEMAND for this wonderful invention wherever introduced. Write for my FREE TRIAL and MONEY MAKING OFFER. Use coupon below.**

WALTER CRITCHLOW

Inventor and Manufacturer, 863-K Street, WHEATON, Ill., U. S. A.

GUARANTEED TO SAVE { 1/4 to 1/2 Gas, Carbon Cleaning, Engine Repairs or Costs You Nothing



FREE VIX offer Mail Now

WALTER CRITCHLOW
INVENTOR and MANUFACTURER
863-K Street, Wheaton, Ill., U. S. A.

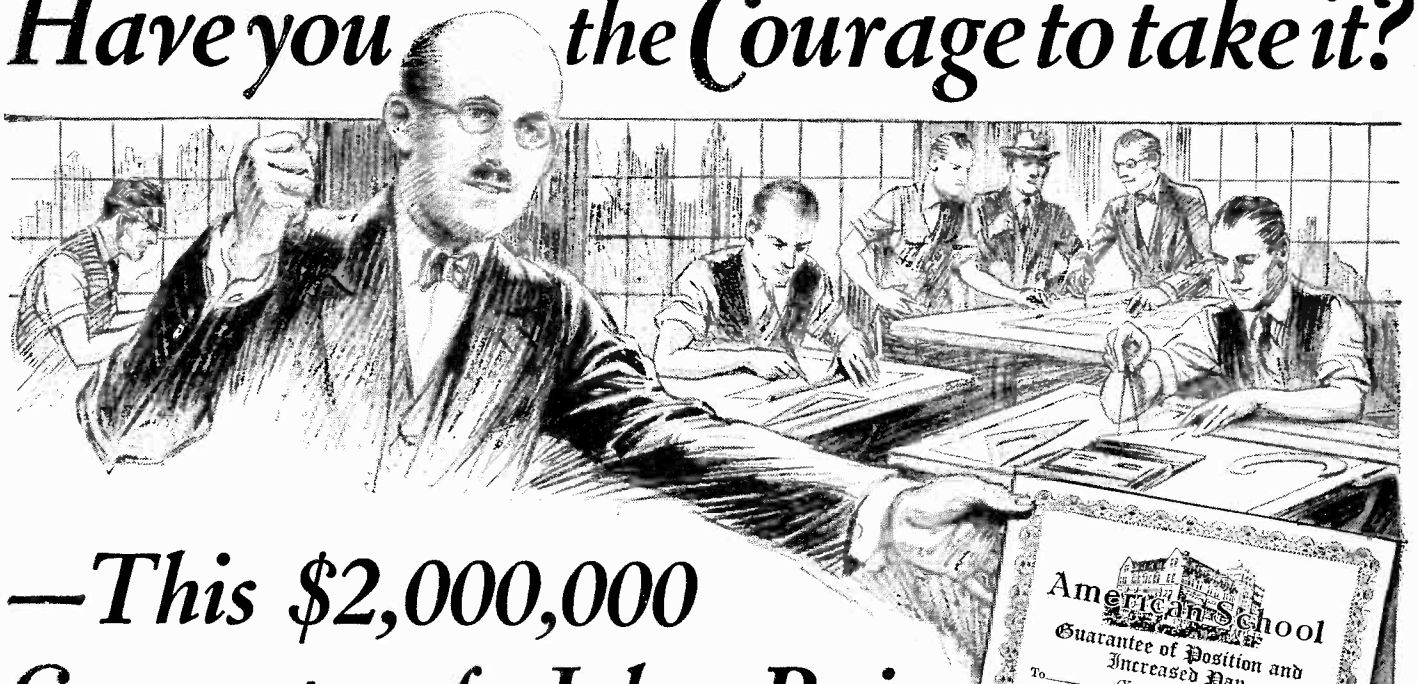
Please send me without obligation or charge your FREE TRIAL and MONEY MAKING VIX OFFER.

Name.....

Address.....

Town.....State.....

Have you the Courage to take it?



—This $2,000,000 Guarantee of a Job and Raise

OF course you'd like to earn $50 or $75 or $100 a week—you'd like to do more interesting work—you'd like to get into a line that offers a real future—but do you know how to go about *getting* these things?

If you have been thinking of "taking a course" but have held back because you were afraid you didn't have education enough to learn better-paid work—if you have hesitated to take the risk that it would actually land you in the better position and increase your salary—*then here's the best news you ever heard in your life!*

I want to tell you about DRAFTING, and show you that it offers you everything in pay and opportunity that you could hope for. I want to show you that a fine Drafting job is now easily within your reach. And I want to set before you an amazing plan which we have worked out with the co-operation of some of the biggest employers and engineers in America, to prepare you at home, in spare-time, get you the job and raise your pay—absolutely without risk of a penny on your part.

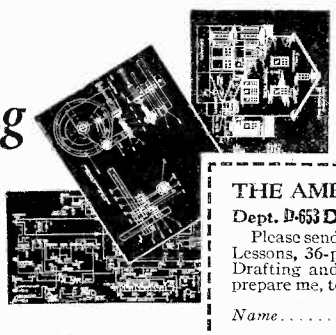
"Only one other man and I, of six taking California State Board examination for Architect, passed. Then I realized the thorough and practical training given by American School. In 18 months I have gone from tracer to Chief Draftsman, in charge of all architectural and engineering work in one of the oldest offices here."
R. L. WARREN,
Los Angeles, Calif.

Come Into DRAFTING!

Thousands of men—not a bit smarter than you, with no more schooling or experience—have gone from poorly paid positions as clerks, mechanics, building trade workers and laborers into Drafting positions paying $50 to $100 a week, with our help. Now with a job and a raise waiting for you *as soon as you are ready for it*, all it takes is the COURAGE to go after it—now if you remain in the rut it's because you choose to, not because you have to.

"When I started American School training in the Spring of 1915 I was working 14 hours a night, seven nights a week for $1.83 a night. That Fall I got a job in the Engineering Dept. of a large firm near here. Today I work 5½ days a week and my salary is larger than I ever dreamed of when I began that course in Mechanical Drafting."
B. H. SEAVERNS,
South Bend, Ind.

3 Drafting Lessons *Actually* FREE *to show you how interesting and simple Drafting is*



Maybe you think Drafting is "over your head"—that it takes artistic talent or some ability you haven't got. In that case you have a pleasant surprise coming to you. For I'll be glad to send you the first three lessons from our home-training to show you that the drawing of plans is purely mechanical, easily learned and the most interesting kind of work you ever tackled. It takes little enough courage *to look into* this wonderful opportunity—just mail the coupon and see for yourself how you like Drafting and our guaranteed way to get into it.

The American School Dept. D-653 Drexel Ave. and 58th St., Chicago, Ill.

Get this "No-Risk" Plan!

I wish I had the room here to tell you all about DRAFTING—how it has become the most important branch of every kind of manufacturing and building construction work—how fascinating the work is—the fine bunch of fellows you'll work with—the big salaries paid—the wonderful chances for advancement. How, while Drafting is white-collar office work, it is hooked up closely with big projects and big men, and offers the thrill that goes with making plans which govern every move of the men who do the work. All this inside dope takes a 36-page book to describe and I'll be glad to send you a copy free when you mail the coupon for my no-risk job and raise plan.

O. C. Miller
Director Extension Work.

THE AMERICAN SCHOOL
Dept. D-653 Drexel Ave. and 58th St., Chicago, Ill.

Please send without cost or obligation, 3 Drafting Lessons, 36-page book with the inside dope about Drafting and your no-risk plan and guarantee to prepare me, to place me and raise my pay, or no cost.

Name.....

St. No......

City.....*State*.....

Age.....*Occupation*.....

This Issue Contains These UP-TO-THE-MINUTE *Articles by* WELL-KNOWN *Authors*

General Science

Aviation

Chemistry and Electricity

Home Movies

Automotive

Television

Radio

How to Make It

NEXT MONTH

When Fate Tricks Tricksters!

Dunninger, peer of magicians, will relate some unusual experiences of fellow-workers in the mystic arts, when the magic machinery did not always work according to specification.

Playing with Death!

Some unusually interesting pictures showing how "the other half of the world" makes a living.

Making Sound Behave

How the latest scientific discovery has resulted in the elimination of the "booming" and reverberation found in many auditoriums.

Glands

Some valuable information for the layman on the why and wherefore of our glands—a subject everyone should be familiar with today. The article is by Dr. G. A. Estabrooks.

Dust!

How many tons of dust do you think there are in the atmosphere of a great city?

SCIENCE AND INVENTION. Published monthly by Experimenter Publications, Inc., at 184-10 Jamaica Ave., Jamaica, N. Y. Entered as second class matter, at the Post Office at Jamaica, N. Y., under the Act of March 3, 1879. Title registered at the U. S. Patent Office.

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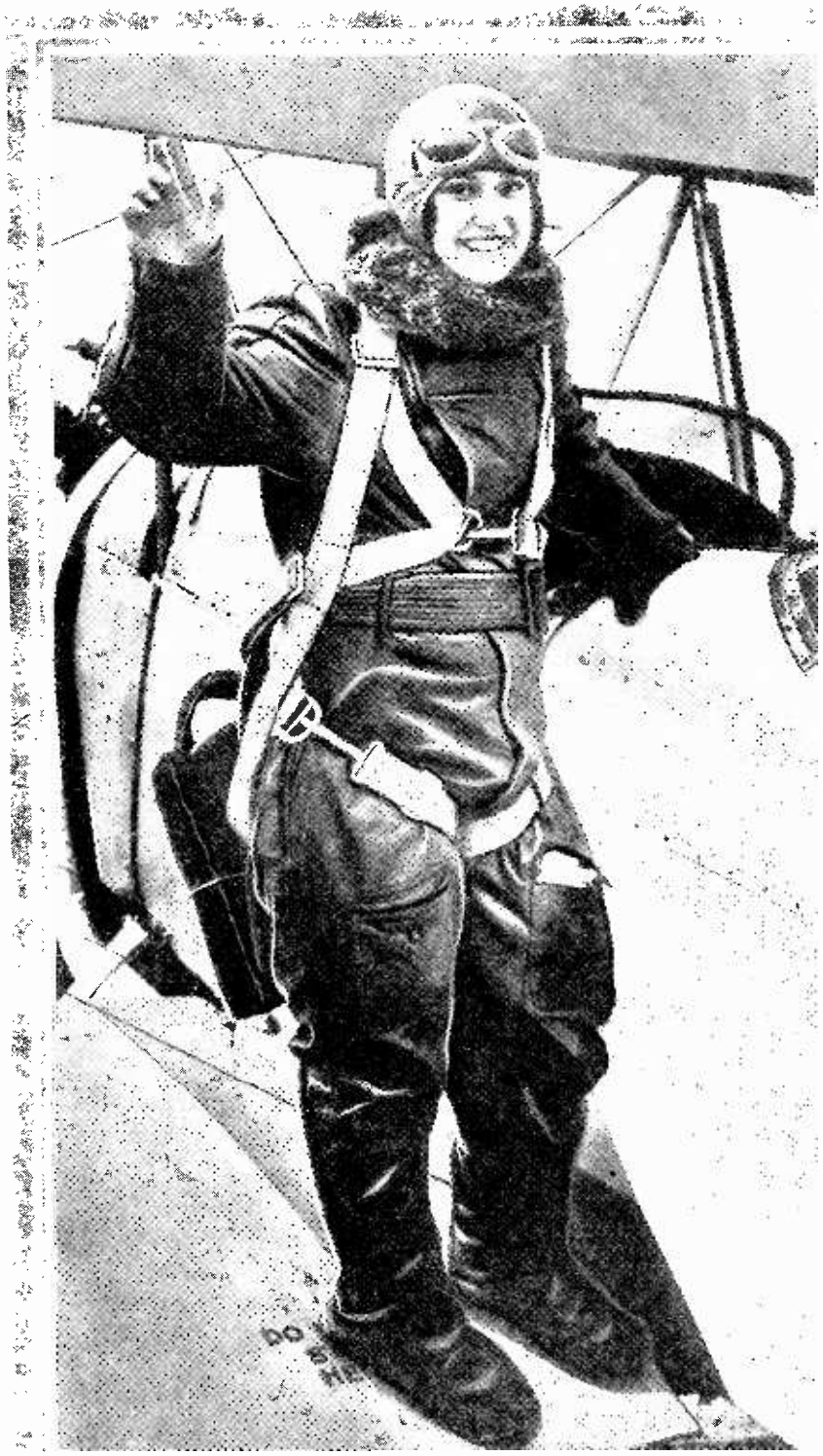


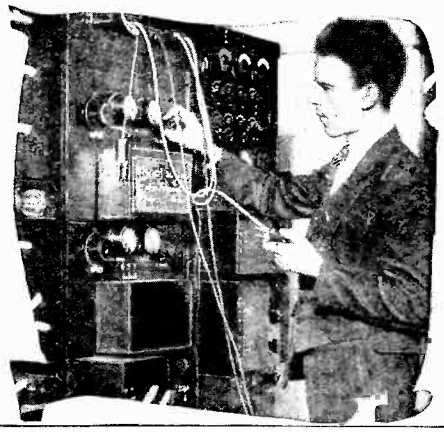
California Wins!

Women's Altitude Record Unofficially Broken

Miss Marvel Crosson, San Diego, California, flier, recently drove her cabin monoplane to an unofficial height of 24,000 feet on May 28 at Los Angeles, California. Miss Crosson left the airport at 11:17 A. M. and landed at 1:23 P. M. The temperature was estimated to be about 15° below zero Fahrenheit, at the highest point of her flight.

The present record of 20,270 feet is held by Mrs. Louis McPhetridge Thaden, of Oakland, California. In East St. Louis, Illinois, on the same day that Miss Crosson made her flight, Barney Zimmerly broke the world's altitude record for light planes when he reached a height of 24,600 feet. As yet both records are unofficial.

I Will Train You at Home to Fill a Big-Pay Radio Job



IF you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. It's FREE. Clip the coupon NOW. A flood of gold is pouring into this new business, creating hundreds of big pay jobs. Why go along at $25, $30 or $45 a week when the good jobs in Radio pay $50, $75, and up to $250 a week. My book, "Rich Rewards in Radio," gives full information on these big jobs and explains how you can quickly become a Radio Expert through my easy, practical, home-study training.

Salaries of $50 to $250 a Week Not Unusual

Get into this live-wire profession of quick success. Radio needs trained men. The amazing growth of the Radio business has astounded the world. In a few short years three hundred thousand jobs have been created. And the biggest growth of Radio is still to come. That's why salaries of $50 to $250 a week are not unusual. Radio simply hasn't got nearly the number of thoroughly trained men it needs. Study Radio and after only a short time land yourself a REAL job with a REAL future.

You Can Learn Quickly and Easily in Spare Time

Hundreds of N. R. I. trained men are today making big money—holding down big jobs in the Radio field. Men just like you—their only advantage is training. You, too, can become a Radio Expert just as they did by our new practical methods. Our tested, clear training, makes it easy for you to learn. You can stay home, hold your job, and learn quickly in your spare time. Lack of education or experience are no drawbacks. You can read and write. That's enough.

Many Earn $15, $20, $30 Weekly on the Side While Learning

My Radio course is the famous course "that pays for itself." I teach you to begin making money almost the day you enroll. My new practical method makes this possible. I give you SIX BIG OUTFITS of Radio parts with my course. You are taught to build practically every type of receiving set known. M. E. Sullivan, 412 73rd Street, Brooklyn, N. Y., writes, "I made $720 while studying." Earle Cummings, 18 Webster Street, Haverhill, Mass.: "I made $375 in one month." G. W. Page, 1807 21st Ave., Nashville, Tenn.: "I picked up $935 in my spare time while studying."

Your Money Back If Not Satisfied

I'll give you just the training you need to get into the Radio business. My course fits you for all lines—manufacturing, selling, servicing sets, in business for yourself, operating on board ship or in a broadcasting station—and many others. I back up my training with a signed agreement to refund every penny of your money if, after completion, you are not satisfied with the course I give you.

Act Now—64-Page Book is FREE

Send for this big book of Radio information. It won't cost you a penny. It has put hundreds of fellows on the road to bigger pay and success. Get it. Investigate. See what Radio has to offer you, and how my Employment Department helps you get into Radio after you graduate. Clip or tear out the coupon and mail it RIGHT NOW.

J. E. SMITH, President
Dept. 9WT
National Radio Institute
Washington, D. C.

Here's the PROOF

$375 One Month in Spare Time

"Recently I made $375 in one month in my spare time installing, servicing, selling Radio Sets."
Earle Cummings
18 Webster St.
Haverhill, Mass.

Jumped from $35 to $100 a Week

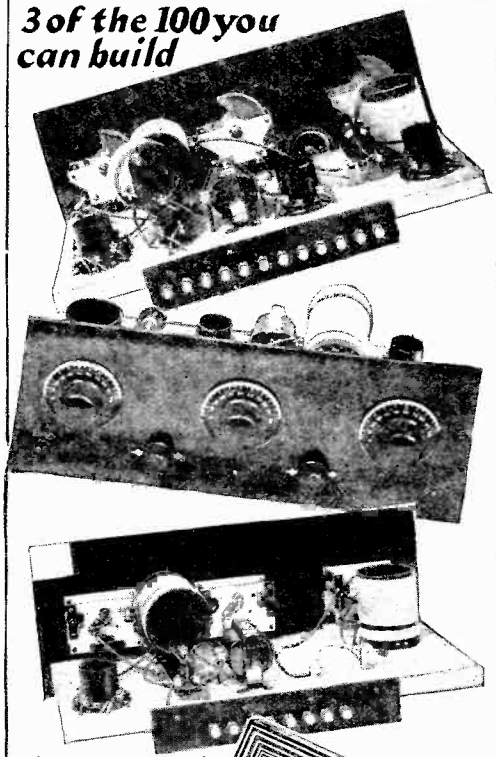
"Last week I had the pleasure of earning $110 servicing and selling Radio sets. I have made as high as $241 in two weeks. Before entering Radio I was making $35 a week. It is certainly great sport to do this kind of work.
J. A. Vaughn
4202 Arsenal St.
St. Louis, Mo.

$450 a Month

"I work in what I believe to be the largest and best equipped Radio shop in the Southwest and also operate KGFI. I am averaging $450 a month."
Frank M. Jones
922 Guadalupe St.
San Angelo, Tex.

You can build 100 circuits with the six big outfits of Radio parts I give you

3 of the 100 you can build



Find out quick about this practical way to big pay

Mail This FREE COUPON Today

J. E. SMITH, President
Dept. 9WT, National Radio Institute
Washington, D. C.

Dear Mr. Smith: Kindly send me your big book, "Rich Rewards in Radio," giving information on the big-money opportunities in Radio and your practical method of teaching with six big Outfits. I understand this book is free, and that this places me under no obligation whatever.

Name ..... *Age*.....

Address .....

City ..... *State*.....

Occupation .....

Employment Service to all Graduates

Originators of Radio Home Study Training

Jules Verne Comes Back to Life!

A MAGIC name—Jules Verne! A name that has brought untold joy to untold millions.

Who can fail to remember his famous novels, "Twenty Thousand Leagues Under the Sea," "From the Earth to the Moon," "To the Center of the Earth," and other equally imaginative triumphs of this world renowned novelist? Few writers have ever equaled Jules Verne's vivid imagination, and still fewer have been able to paint these pictures of the mind so brilliantly in printed words.

And *now* Jules Verne comes back to life! Comes back with stories that increase your pulse and make your heart pound. For in AMAZING STORIES, the magazine of scientific fiction, the famous school of authors who have followed in Jules Verne's footsteps now offer you the fertile fruits of their imagination. In their colorful minds, the inventions and discoveries still to come are already here. They write of a voyage to Venus, that silvery star seen so often in the evening sky; of correspondence with a mythical people on Mars; of radio messages from still more distant planets; of giant insects and of people who have huge heads and no bodies; of the things a man might well see and hear a thousand years from now!

It's a thrill you've never had! For it deals with the Future, and the things your children's children may some day actually experience and enjoy.

Get the next 6 Big Issues of AMAZING STORIES delivered to your home by the postman. Read with a relish these profusely illustrated stories of a weird, but not impossible future.

As a special inducement *we offer all 6 Big Issues for a single $1.* (The news-stand price is $1.50). And if you are not convinced AMAZING STORIES is worth twice the price, after reading the first issue, we will let you keep it FREE, and send your dollar back.

Sit down right now, and fill out the coupon below. It is your insurance against dull evenings from now on!

SIMPLY CLIP AND MAIL THE COUPON BELOW!

AMAZING STORIES

THE MAGAZINE OF SCIENTIFIC FICTION

381 FOURTH AVENUE

NEW YORK, N. Y.

AMAZING STORIES
Dept. 2509-S, 381 Fourth Ave., New York, N. Y.
Gentlemen:
I enclose $1 for which send me your next 6 issues of AMAZING STORIES. (Reg. price $1.50)

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Street.....

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VOLUME XVII
WHOLE NO. 197

Science and Invention

SEPTEMBER, 1929
NUMBER 5

"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - - - - - *HUXLEY*

TRAFFIC

CONSIDER for a moment the automobile. It is at once a great blessing and a great curse Fundamentally it is more of the former. The manner in which we are using it—or failing to use it—is beginning to pull the balance more and more toward the latter. Something must be done about it. Something must be done about it at once.

There are at present many more cars than our street and highway system can comfortably accommodate, and relief in the form of new and better highways is not keeping pace with automobile production. We are going from bad to worse and going fast. Automobile manufacturers now have a different sort of "saturation point" to worry about.

Automotive executives and engineers have tried to relieve the situation by producing cars that will accelerate and decelerate more rapidly. High speed engines and four-wheel brakes are doing their bit to enable more cars to pass over a given section of road because they can be driven at a much greater safe speed than older types due to the braking power and quick acceleration. There have been better roads movements started in all parts of the country. They are of value but the problem continues to grow.

Many urbanites refuse to own a car because the city traffic takes all the joy out of the occasional trip to the country, and the garaging facilities are too expensive and they reach the conclusion that using a car for business driving in the cities is more trouble than it is worth. Holiday traffic on the main arteries in and out of our large cities is a disgrace. It is not at all uncommon to find that we can make a run of one hundred miles through the country in four hours and spend another two in covering the ten miles from the suburbs to the center of town. What can we do about it?

We can arrange for the laying of more, of wider, and of better roads now, with a view to the traffic they will be required to carry five years hence.

We can take immediate steps to have our present streets and highways used to better advantage as follows:

We Can Prevent Parking, even for a short time, in the busy sections of our cities, thus bringing about nearly the same result as widening the streets.

We Can Provide Many Garages specially designed to enable cars to get in and out rapidly so as to house cars, which would, under our present scheme of things, block the street. The charges for a parking service of this nature could be made on some reasonable basis. A system or chain of garages, of this character might include many garages in a single city, and the payment of a single fee could be made to include the housing privilege for a definite period in any of the garages in the chain. A service of this nature would be of real value to the salesman, the shopper, etc.

Department stores and large office buildings could use garages in their buildings to good advantage. Many of the more modern buildings are being constructed along these lines. Certain "automatic" garaging features could be used to extremely good advantage in cases of this nature.

We Can Relieve Congestion at suburban main highway intersections in many ways. The most obvious is the elimination of grade crossings—the greatest single cause of delay on main arteries. We can utilize short detours, thus spreading the traffic at congestion points and bringing it together again on the open highway. We can educate folks to use the so-called "back-roads." Many of these roads are in a better state of repair than the main highways. We can have local newspapers point out the value of using these little-travelled roads, and publish maps showing their location. We can permit the intelligent use of higher speed on the open road and even through town on main highways. We can change some traffic rules, now in force, which would be a hardship even on horses and buggies.

Highway traffic, as bad as it is, does not begin to compare with the traffic congestion in our cities. In this problem we have observed that most of the traffic jams occur in certain comparatively small areas at just about the same time each day.

One of the greatest single contributions to this evil is the *taxicab*, but the fault originates with the passenger rather than the driver, because the former wants to get from one point to another by the shortest route—which many times is neither the quickest nor the cheapest, because much better time can be made where all traffic is made to run in definite channels with a minimum of dodging back and forth, and with slow-moving vehicles directed in definite lanes. We should see to it that pedestrian traffic should stop and flow with vehicular traffic.

And now we make a further suggestion and an offer to assist in its execution. Located in the traffic center of any large city we propose the stationing of a captive balloon, similar to those used for observation purposes during the war. In the observation basket we propose to have one or two traffic experts and a radio man, plus a radio transmitter and receiver. Located at several strategic points at the boundary of the heavy traffic zone, we suggest police stations, equipped with radio receiving equipment, under the direction of the observers.

The observers could be supplied with special cameras to photograph the traffic area at definite intervals, and from these observations much helpful information could be had and an immediate relief for heavily congested areas could be provided by proper orders transmitted by radio to the street stations.

We shall be pleased to co-operate with any city traffic authority in working out the technical details for the trial of this plan.

Arthur H. Lynch

Editorial Director

5 Easy Ways to Make $3.00 an hour in Your Spare Time in RADIO

Each of these plans, developed by the Radio Training Association of America, is a big money-maker. Set owners everywhere want to get rid of static, to have their sets operate from the electric light socket, the tone improved, and the volume increased, and transformed into single-dial controls. Phonograph owners want their machines electrified and radiofied. If you learn to render these services, you can easily make $3.00 an hour for your spare time, to say nothing of the money you can make installing, servicing, repairing, building radio sets, and selling supplies.

Over $600,000,000 is being spent yearly for sets, supplies, service. You can get your share of this business and, at the same time, fit yourself for the big-pay opportunities in Radio by joining the Association.

Join the Radio Training Association of America

A membership in the Association offers you the easiest way into Radio. It will enable you to earn $3.00 an hour upwards in your spare time—train you to install, repair and build all kinds of sets—start you in business without capital or finance an invention—train you for the $3,000 to $10,000 big-pay radio positions—help secure a better position at bigger pay for you.

A membership need not cost you a cent!

The Association will give you a comprehensive, practical, and theoretical training and the benefit of its Employment Service. You earn while you learn. Our cooperative plan will make it possible for you to establish a radio store. You have the privilege of buying radio supplies at wholesale from the very first.

Earned $500.00 Spare Time

Frank J. Deutsch, Penn.: "I have made over $500 out of Radio in my spare time."

Radio Engineer In One Year

Claude De Grave, Canada: "I knew nothing about Radio when I joined a year ago. I am now a member of a very exclusive organization of Radio Engineers, and my income is 225% greater than it was."

Doubles Income in 6 Months

W. E. Thon, Chicago: "Six months after I enrolled I secured the managership of large Radio Store and doubled my income."

ACT NOW—If You Wish the No-Cost Membership Plan

To a limited number of ambitious men, we will give Special Memberships that may not—need not—cost you a cent. To secure one, write today. We will send you details and also our Radio Handbook filled with dollars-and-cents radio ideas. It will open your eyes to the money-making possibilities of Radio.

Radio Training Association of America
4513 Ravenswood Ave., Dept. RN-9, Chicago, Ill.

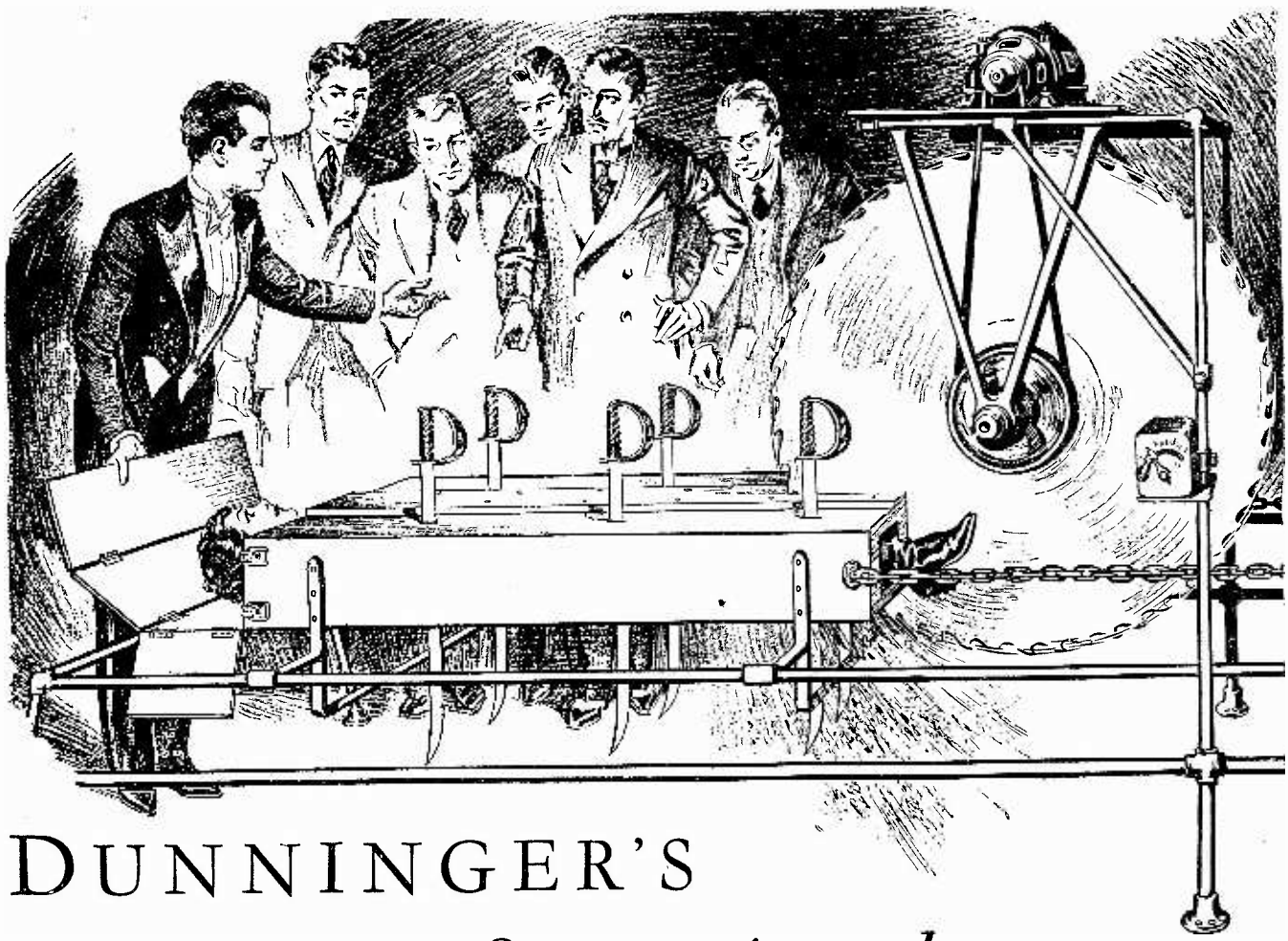
Radio Training Association of America
Dept. RN-9, 4513 Ravenswood Ave., Chicago, Ill.

Gentlemen: Please send me by return mail full details of your Special Membership Plan, and also copy of your Radio Handbook.

*Name*_____

*Address*_____

*City*_____ *State*_____



DUNNINGER'S

Sensational

Buzz-Saw Illusion

Can You Solve This Mystery? More Than $250.00 in Prizes

SCIENCE & INVENTION readers will be given an opportunity of offering a solution to the famous *Dunninger* Buzz-Saw Illusion that has mystified hundreds of thousands of theatre-goers the world over.

During Dunninger's travels, with his own two and one-half hour mystery show, touring both this country and abroad, the feature illusion was known as the *Buzz-Saw Illusion,* which not only created a sensation wherever presented, but has baffled the most learned minds of the entire world. Many explanations were offered, but up to date not one possible solution of the actual *modus operandi* of this startling mystery, which was created by Dunninger, has been forthcoming.

After witnessing a private exhibition of this masterpiece of the illusionist's art the editors of SCIENCE & INVENTION have arranged with Dunninger to present to our readers the Buzz-Saw Illusion and we are going to conduct a

More than $250.00 in prizes
42 Awards

1st prize	$100.00
2nd prize	50.00
3rd prize	25.00
4th prize	10.00
13-5th prizes of $5.00 each	65.00
	$250.00

25-6th prizes. This prize combines a year's subscription to "Science and Invention" magazine and a copy of "Popular Magic and Card Tricks," Vol. 3, by Dunninger and autographed by him. Magazine value $3.00.

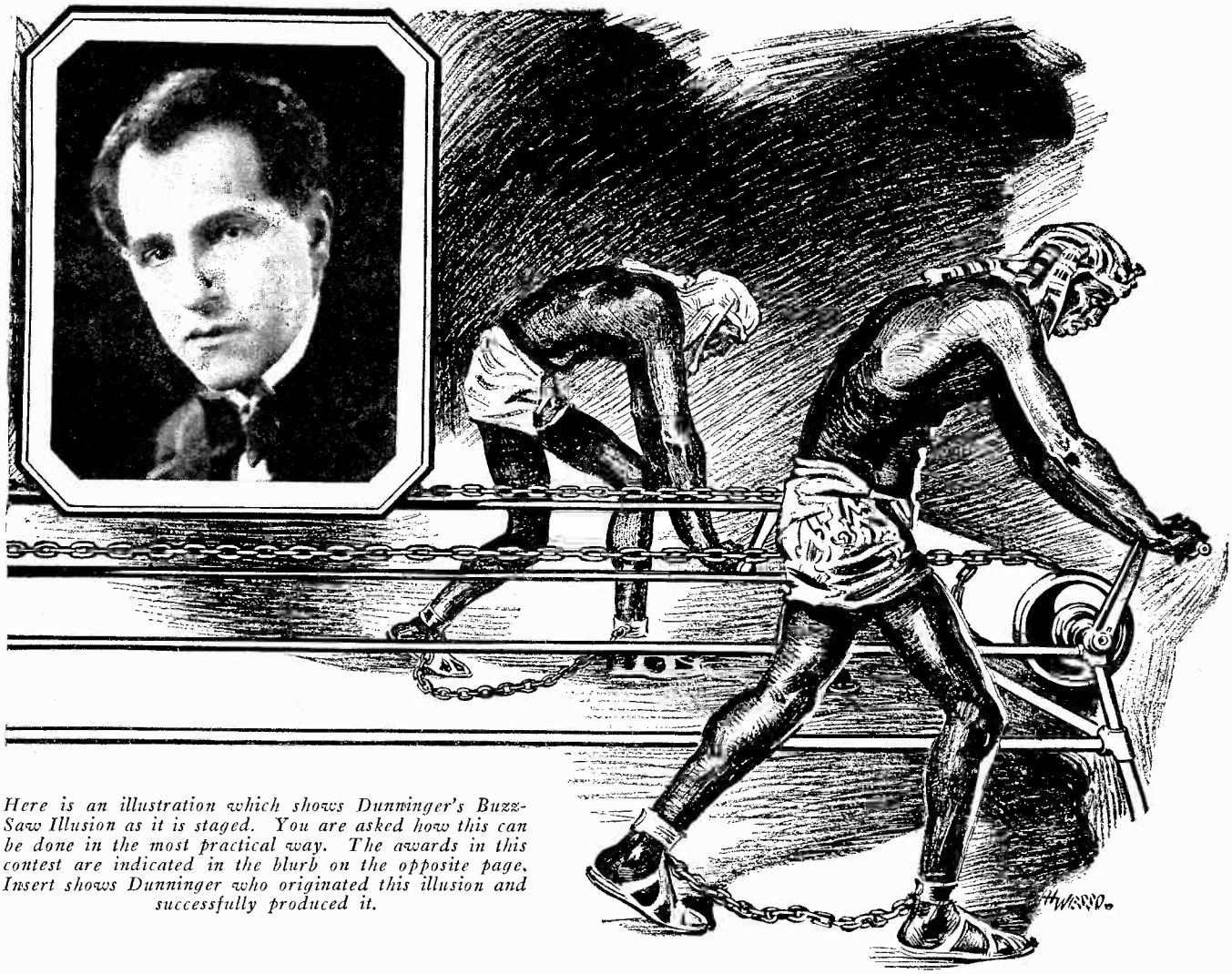
See rules on following page

contest, for ingenious minds, offering the sum of $250.00 (Two hundred and fifty dollars) in gold to those submitting the best workable methods of producing this master mystery act. In addition there are twenty-five prizes, each consisting of a year's subscription to this publication together with an autographed copy of Popular Magic, Vol. 3.

Mr. Dunninger's original idea was to exhibit this illusion on the vaudeville stage, but owing to the fact that this stupendous sensation carries so much necessary apparatus, machinery and a corps of trained assistants, the illusion would be too costly a proposition to present on the vaudeville stage today. With a full evening's performance it was quite a different matter.

Professional and amateur magicians are invited to submit their ideas and solutions and enter the contest to compete for the prizes.

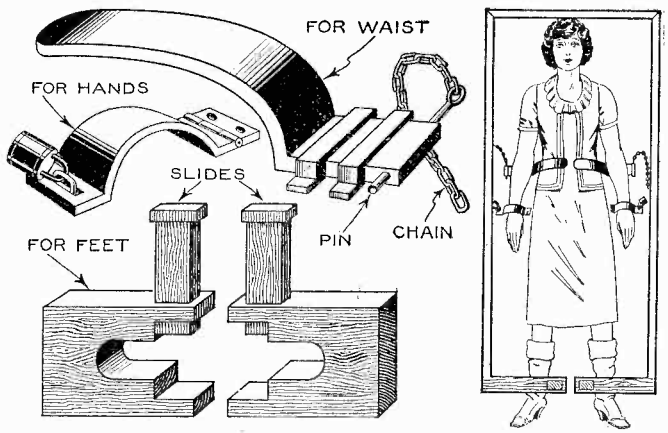
The effect, in brief, of the Dunninger Buzz-Saw Illusion is as follows: A lady is apparently placed under hypnotic control, then lifted by two assistants and put into a box just large enough to hold her. Her feet are put through two circular holes at bottom of the box where they remain in full view throughout the experiment. Her wrists are



Here is an illustration which shows Dunninger's Buzz-Saw Illusion as it is staged. You are asked how this can be done in the most practical way. The awards in this contest are indicated in the blurb on the opposite page. Insert shows Dunninger who originated this illusion and successfully produced it.

placed under suitable steel bands on each side of the box and shackled in position by members of the audience, who are asked upon the stage to act as a committee and to see that everything is done in a fair and aboveboard manner. The locks used to hold the wrist bands may be brought upon the stage by anyone in the audience. These locks may be of any type desired.

The box, containing the lady, is now lifted on a skeleton track arrangement (see illustration), and two chains are affixed to the box which are wound up on to a large drum manipulated by two assistants.



Here are the details of the fastenings in the wooden box of the illusion.

The girl being thus helplessly fastened in the box, it seems utterly impossible for her to move about, let alone make her escape.

Next, a number of swords are passed to committeemen and examined, then taken by the performer and thrust through the box from top to bottom. The swords enter the box at the top and project quite a bit outside of the bottom, proving conclusively that the swords have entered and passed completely through the box and apparently through the young lady.

(*Continued on page* 455)

HERE ARE THE RULES

1. The lady is actually placed in the box, where she positively remains throughout the illusion.

2. No mirrors or special lighting effects are employed.

3. Not for one moment are the projecting feet out of sight of the audience.

4. No stage "traps" are used.

5. Only "one" woman is used.

6. The box is actually sawed into two parts lengthwise. This is not an optical illusion.

7. Each contestant may send in one or more solutions which, if he desires, may be illustrated by diagrams or sketches.

8. Solutions must be typewritten or legibly written by hand on one side of the paper only.

9. Solutions must be limited to 200 words or less.

10. Prizes will be paid to those offering the best workable methods for producing this illusion.

11. Mr. Dunninger will be the sole judge. His word is final. In event of a tie, prizes identical with those tied for will be paid to each contestant so tying.

12. All entries must be in our hands at noon November 21, 1929.

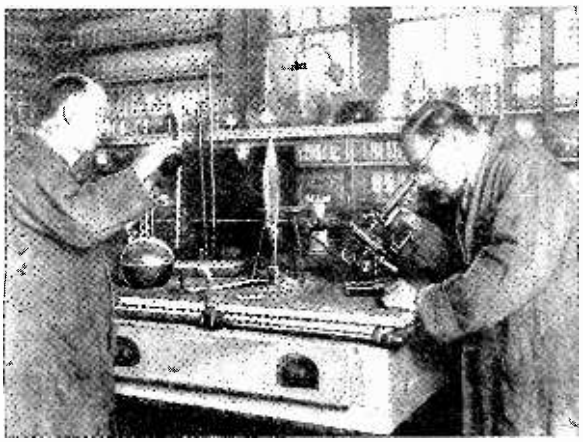
13. From this contest are barred all employees of the Mackinnon-Fly Publications, Experimenter Publications, Inc., and Novel Magazine Corporation, their relatives and members of their families.

14. Mail all solutions to Joseph Dunninger, care of this publication.

Dr. Worden's $600,000

The World's Foremost Authority on Cellulose Chemistry Has Collected Upwards of Half a Million Dollars' Worth of Rare Postage Stamps

By Alfred M. Caddell



The above photograph shows Dr. Worden and Leo Rutstein in the laboratory.

Who Dr. Worden Is

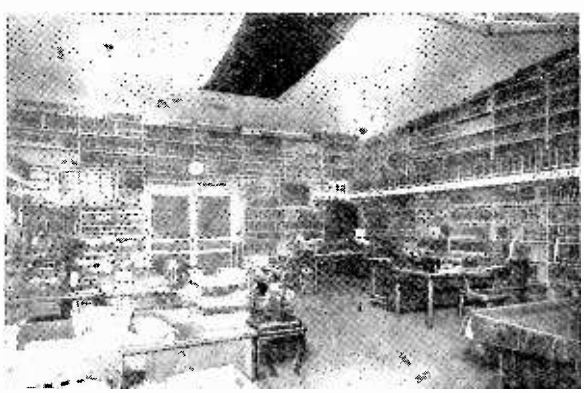
DR. EDWARD C. WORDEN enjoys an international reputation as the foremost authority in the field of Cellulose Chemistry. He was Chief of the Aviation Chemical Division of the U. S. Air Service during the war and is technical chemical advisor to the War Department. He established aviation chemical standards for the United States Air Service, and also for the Allies behind the lines in France.

For years Dr. Worden has been regarded as the Supreme Court in the field of Chemical litigation. In addition, he is retained by some of the largest chemical organizations in the world on a yearly basis.

Dr. Worden is the author of more than fifty books and papers on nitro-cellulose and his compendium on that subject forms the basis of many of our collegiate courses on that subject.

We believe the reader will find the story about his hobby a most interesting one, and we hope to have the author tell us more about this eminent chemist in a subsequent article.

—The Editors



Above is a view of the Worden Library, in which may be found more than 20,000 scientific volumes. The library measures 40′ x 80′ and is 18′ high.

STAMPS! Stamps! Stamps! The boys are collecting——

That which started back in 1840, as a keepsake proposition, has now grown into one of the country's big home industries, numbering among its followers bankers, lawyers, doctors, the baker and the candlestick maker—and not to forget chemists, for this particular story is about a chemist. Millions of dollars' worth of canceled postage stamps, otherwise worthless in themselves, are traded in annually by thousands of business men hobbyists throughout the world. Upwards of one hundred thousand stamp enthusiasts throughout the United States follow the trail of the little square-inch stickers that provide transportation for your letter and mine. The commercial value of odd and rare postage stamps, both canceled and uncanceled, is beyond all computation, but it is safe to say that it approaches, if not surpasses, the billion-dollar mark.

The desire of possession, the same goal that gives diamonds and sapphires their values, is behind the whole thing. And aside from the commercial considerations, the building of stamp albums is the basis of a most delightful hobby for thousands of people, much as golf, bridge and radio supplies an interest in life to others.

They call themselves philatelists, these stamp-collecting enthusiasts. And one of the most pronounced hobbyists in this line is Dr. Edward C. Worden of Millburn, New Jersey.

Dr. Worden does not possess the largest stamp collection in the world by far, but if he wanted to dispose of his collection tomorrow he could probably cash it in for about $600,000—which means a hobby with a price.

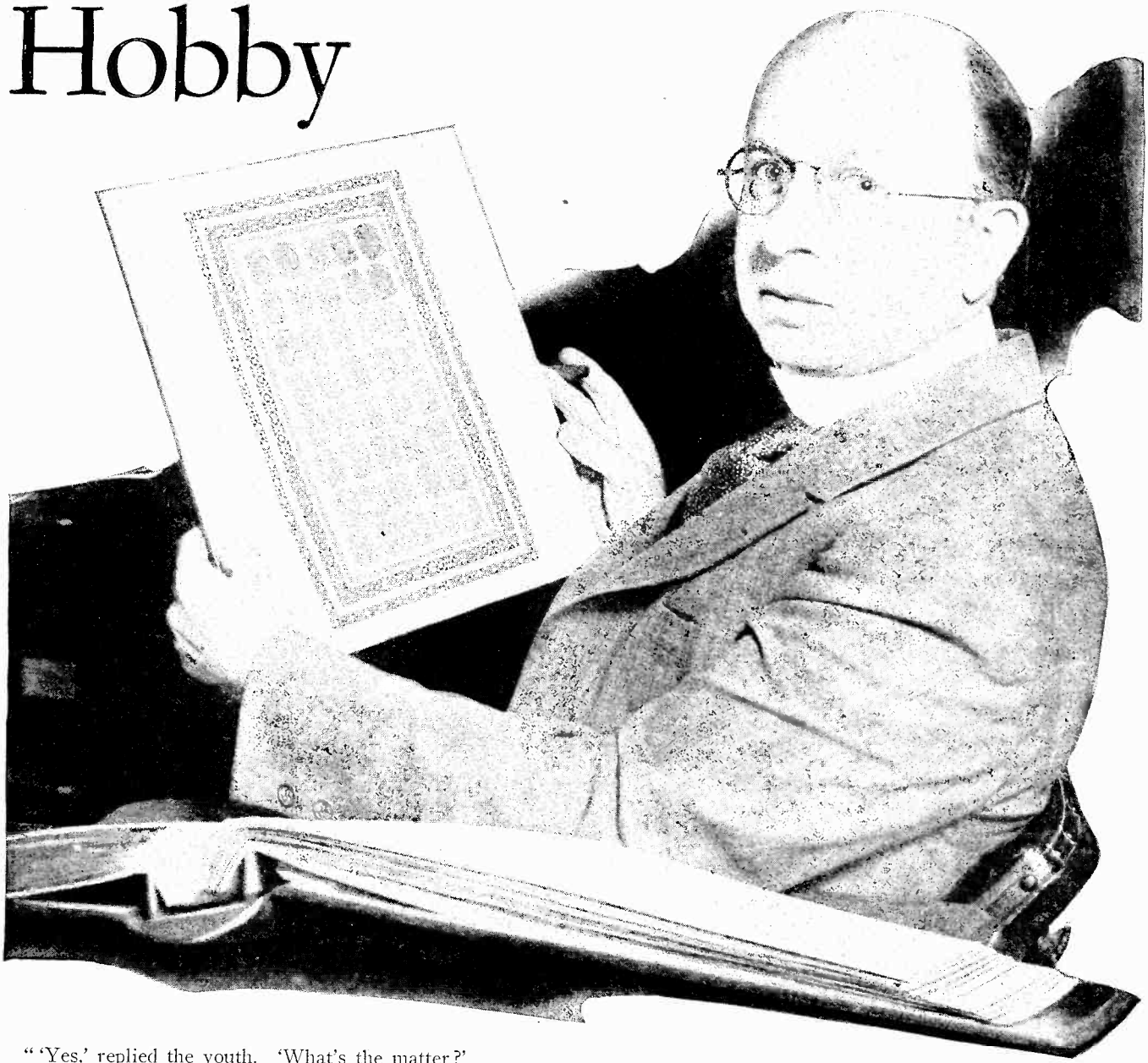
"I get a lot of enjoyment out of the game," is the way the doctor puts it. "I went into it solely from the standpoint of desiring to own rare, history-making mementoes of our lives, and since I got into it the profits that came with increases in value have been amazing and tremendous. Not that I make money from the hobby—I do not, for I do not sell any part of my collection. I like to mount the valuable little things in my albums, and have stayed up many nights just to give an added touch to my designs.

"Not all stamps of value are canceled issues, however. In fact, one may purchase what he believes to be an ordinary stamp or sheet of stamps at his post-office and find that he has bought something of extreme value. Take the 100 inverted 24-cent air-mail stamps of 1918, which appeared in the regular run of stamps. How much do you think they are worth? Well, today the value of these 100 stamps, which originally cost $24, is now $150.000, for less than a month ago one brought $1,500 at public auction!

"These freak stamps got into the hands of philatelists in this manner. One day, soon after the air mail was established, a young man appeared before the post-office window at Washington, D. C., laid down $24 and asked for 100 stamps. Howard A. Mount, the stamp clerk, handed out a sheet of the new issue and the youth started back to the bank by which he was employed as a messenger. Hardly had he left the post-office when a postal inspector overtook him.

"'Here, young man,' he called 'did you just buy 100 24-cent stamps?'

Hobby



Dr. Worden holding a sheet of reconstructed stamps. The border work surrounding this collection is done in pen and ink and is the artistic handiwork of Dr. Worden himself.

"'Yes,' replied the youth. 'What's the matter?'

"'Something went wrong with the work when the plates were being prepared,' explained the inspector. 'Four sheets of those stamps were printed with the picture of the aeroplane upside down. We caught three of the sheets before they got out, but you secured the fourth. So I'll have to ask you to return them and we'll give you 100 of the same issue properly printed.'

"But the youth refused to part with the stamps. He knew that if there were only 100 of such freaks in existence that they must be worth considerable money, and he turned them in at the bank with a report of the incident. The officials of the bank also refused to give them back and later they sold them to a stamp expert for a reported price of $18,000.

"Today Colonel E. H. R. Green, son of the late Hetty Green, famous financier, owns fifty-one of those stamps. I own one and the other forty-eight are scattered.

"Then, too, fortunes have been made by persons who accidentally found rare stamps. Sometimes valuable stamps are picked up in rubbish piles. Several years ago a junk man brought into a New York stamp house a huge bundle of old letters. Many of these letters, experts found, bore valuable stamps. The junkman said that he had found them in two carloads of waste paper that were about to be sent to a New Jersey repulping mill. The stamp company immediately communicated with the owner of the paper and purchased the two carloads outright, hoping that further treasure would come to light. And it did, for they were rewarded with specimens with a value of about $15,000."

Dr. Worden has ninety-four postage stamps of the first issue ever made in this country. These stamps were put out by Robert H. Morris during his term as postmaster in New York City, which extended from May 21, 1845, to 1849. They were issued in 1845 and are known as a provisional issue. That was at a time before the United States Government started to print stamps. These stamps might stand at the head of provisional issues by postmasters. The stamp of this issue is black and the design contains a picture of the head of Washington engraved from the famous painting by Stuart. It is a five-cent stamp. Today, unused, it has a value of $100. Used, it would be worth $60. Of this issue Dr. Worden's collection contains ten unused and fourteen pairs and fifty-six singles used. Their total value is more than $5,000. Each stamp, before being issued, was initialed.

"With pen and ink the postmaster wrote his initials on the face of the stamp as evidence of its genuineness," explained Dr. Worden. "Think of what any postmaster would be up against today if he should attempt to initial every stamp he sold! But those initials give these stamps a decided increased value."

In 1847 the Government started to issue postage stamps, and in that year two varieties were put out, one a brown five-cent stamp with the head of Benjamin Franklin and the other a black ten-cent stamp with the head of Washington. Of the latter, Dr. Worden owns (*Continued on page* 477)

You saw it in the DAILY MIRROR, *Monday, June 24, 1929.*

Spirit Mediums Reject $21,000 Challenge

DISBELIEVER DRIVEN FROM CONVENTION

By FRANK GOSLING.

A young reporter reports progress on an intriguing assignment.

Several hundred spiritualists are having an ectoplasmic field day at the Hotel Pennsylvania.

John Slater, the Paavo Nurmi of the spirit-chasers, is the principal attraction and the staunchest defender of the faith. He it was who caused the unceremonious ejection of Joseph Dunninger, an avowed disbeliever, who brought a certified check for $21,000 to the meeting, to be paid on proof of pychic accomplishment.

At the left: A newspaper clipping from the "Daily Mirror," describing what happened to the "Science and Invention Magazine" Investigating Committee. Right: A photo of the check which was ready for John Slater, if he was able to do what he claimed he could. We asked nothing more.

EXPERIMENTER PUBLICATIONS, INC.
381 FOURTH AVENUE

No. 6457 JUN 21 1929 NEW YORK, 19

CENTRAL HANOVER BANK AND TRUST COMPANY
SEVENTY BROADWAY

PAY TO THE ORDER OF John Slater $21000.00 DOLLARS

EXPERIMENTER PUBLICATIONS, INC.

PRESIDENT TREASURER

Left to right: H. K. Fly, Secretary and Treasurer of Experimenter Publications, Inc.; Dunninger, Chairman of this magazine's Investigating Committee for Psychical Research, holding $21,000.00 check, and Joseph H. Kraus, Field Editor of this publication, with the sealed message.

Slater Refuses Spirit Test

Medium Who Reads Messages Refuses One More for $21,000

THE newspapers had advertised that John Slater, the world-renowned medium, was going to demonstrate *spirit messages* at the New York State Spiritualist Convention at their public meetings on June 21, 22 and 23 at the Hotel Pennsylvania in New York. Repeated telephone calls and letters arrived at the editor's desk to the effect that we were afraid to challenge a real medium and that our prize award of $21,000.00 for spirit phenomena is merely newspaper talk. These individuals argued that here at last was a medium who could and would take away the prize which we offer. In the interim other calls came from friends of ours; newspaper men and women who had been talking to various spiritualists and reported that these spiritualists would not even walk across the street for $21,000.00. Perhaps the sum was too insignificant, but if anyone will tell the

What a few of the newspapers had to say about our challenge to John Slater.

The Standard Union

BROOKLYN—NEW YORK CITY—SATURDAY, JUNE 22, 1929

SPIRIT WORLD LINK REPEATS $21,000 DEFI

Spiritualists Give Dunninger the Air at Their Annual Conference

Even before the uproary disturbances were reported last evening among the local spirits, as the thirty-third annual convention of the New York General Assembly of Spiritualists swung into its stride at the Hotel Pennsylvania.

John Slater, the evening's link with the Great Beyond, felt it early and passed the word on to his 1,000 or more interested customers.

A small, bird-like, white-haired man, he is regarded in the best occult circles as J. P. Morgan is in Wall Street. John Slater, any good spiritualist will tell you, never misses. Mr. Slater admits it himself. And so his opening words were eagerly taken in.

They proved almost prophetic (except that certain of the newspaper boys had predicted the same th ng two days previously).

"Frankly," he began, "I am not crazy to come to New York. There is always a disturbance of some sort here. I've received nasty telephone calls, scurrilous letters."

The scurrilous part was said with heat.

"I received phone calls et to-night . . .

Disturbance No. 1

And so it was not much of a surprise when Joseph Dunninger arose

THE NEW YORK SUN,

'SPIRIT' MESSAGES READ AT SESSION

Investigator Is Ejected From Convention.

At a lively session of the thirty-third annual convention of the New York State Assembly of Spiritualists, John Slater of Los Angeles, said-to-be-one-time Spiritualist platform medium, read messages to an audience of almost 2,000 that packed the ballroom of the Hotel Pennsylvania last night for the first of three public demonstrations.

Slater also took occasion to order the removal of a man who said his name was Dunninger and who claimed to represent the scientific investigation committee of Science and Invention, a magazine. Dunninger was removed from the meeting. Slater said because he was disturbing a religious assemblage by his shouted claims that he was able to disprove Slater's ability as a medium and would stake a $21,000 prize on it.

"Such disturbances would not be tolerated in a Roman Catholic church or a Jewish synagogue," said Slater from the platform, and the investigator was asked to leave.

Later, the medium said that Dun-

THE NEW YORK TELEG

Joe Dunninger Shatters Peace of Ghost Seance

Friend of Harry Houdini Offers $21,000 to Slater, Hailed by Spiritualist General Assembly as "Greatest Medium of All," for Answers to Two Questions in Sealed Envelope.

John Slater, who in the expressed belief of the General Assembly of Spiritualists, is the greatest medium of them all, had the spirits well under control last night. At the Pennsylvania Hotel they were answering the questions of any who might come along and pay his $1, his $1.50 or his $2.

But Slater, who, as related by the same assembly, left home at the tender age of 20 because his family thought him crazy when he "heard voices," reckoned without an old enemy. Not Satan, whom love will overcome, but Joe Dunninger.

Houdini's Friend Pipes Up.

Joe, who used to be associated with Harry Houdini in exposing mediums, went to the meeting. He paid $1.50 and got a good seat. So did four of his friends. They listened while Slater delivered spirit messages to young and old, black and white.

Then Joe, who prefers to be called "just Dunninger," spoke up. His voice wasn't particularly gentle and he was waving his arms. The thirty-third annual state assembly sat up,

the Hanover Central Bank. He waved it aloft, and he waved the envelopes, both with big red wax seals.

Medium Loses Calm.

It was then that the spirits almost deserted the gathering of 3,000—there was standing room only in the grand ballroom. Physical action seemed forthcoming. Slater's cohorts moved on Dunninger. Dunninger's friends stood up.

Slater, who had just been preaching the advantages of calmness and love, seemed to lose both for a moment. Dunninger left protesting. He offered to duplicate any "spiritual" feat performed by Slater.

"It's not the game, though," he protested. "Any one who takes money to talk to spirits for you and—" Dunninger was spluttering.

"He's a vulture," he finished with heat.

Will Continue Tonight.

Slater, surrounded by admiring cohorts, had regained love and peace, however. He will continue tonight.

"And, my dear people, there will

Evening Graphic

Spiritualists Give Bounce To Inquisitive Doubters

The very dignified investigation committee of Science and Invention was very unceremoniously thrown out of the convention of the general assembly of Spiritualists of New York State at the Hotel Pennsylvania last night.

The booting action followed the furore caused by the committee's challenge to "the great" John Slater, "the foremost platform medium," to prove his supernatural powers by reading a ten-word message contained in a sealed evelope. If Slater could do it, members of the committee roared, above the clamor, he would be given $21,000 on the spot, and a check for that amount was waved to prove it.

Slater ignored the challenge. A group of huskies soon surrounded members of the committee, which included Joseph Dunninger, professional mind reader who makes no claim to supernatural powers; Joseph H. Kraus, field editor of Science and Invention, and H. K. Fly, treasurer of that magazine.

New York American

Spiritualist Spurns $21,000 Offer to Read Hidden Note

JOHN SLATER, of Philadelphia, honorary member of the General Assembly of Spiritualists, is a student of things spiritual, but he cares little for material things—such as money.

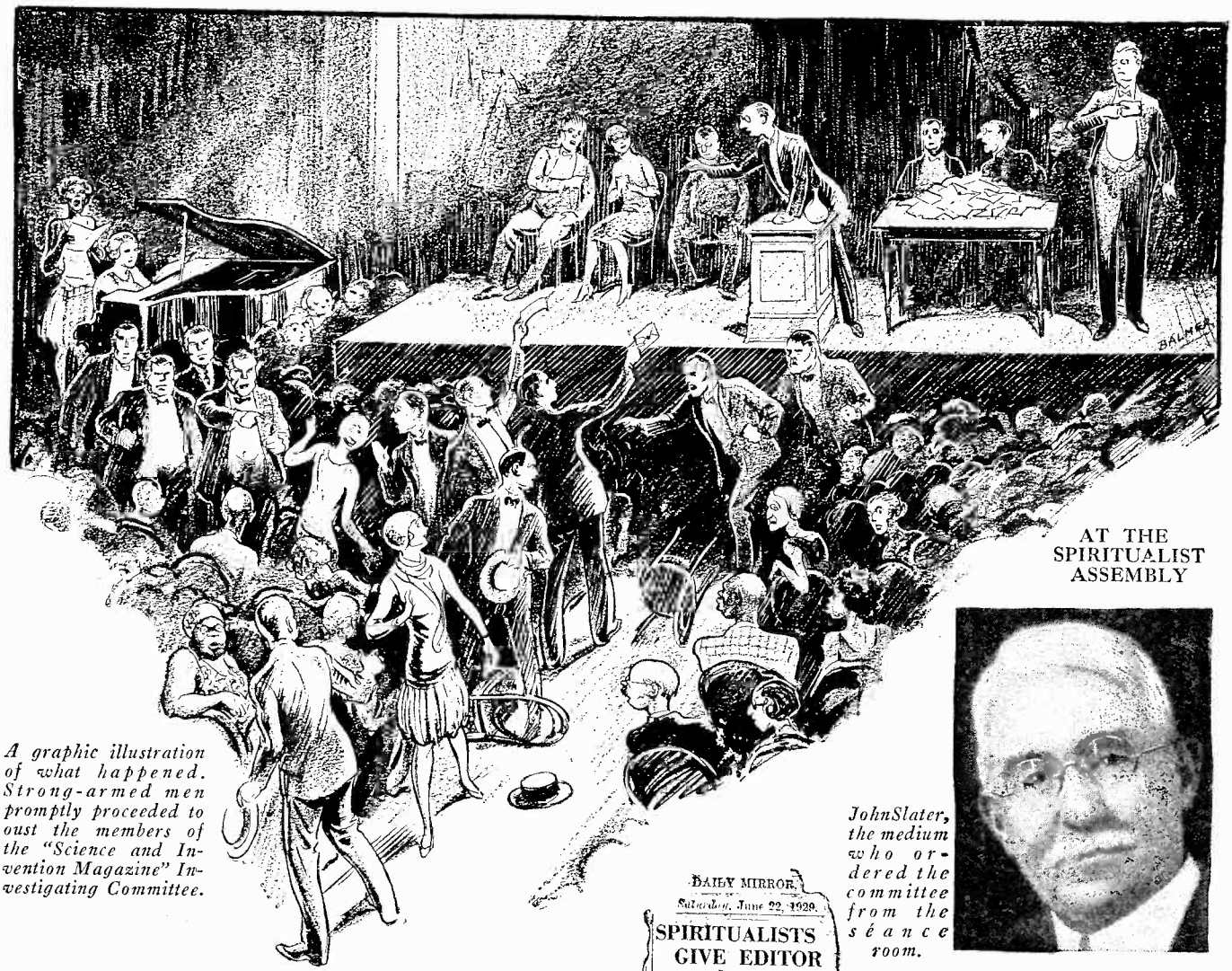
While Slater was giving spiritual readings to an interested audience of delegates to the thirty-third annual convention of Spiritualists at the Hotel Pennsylvania last night, a man in the audience, who insisted his name was [illegible]

grew more insistent, and a few persons sitting near him joined in. Slater became exasperated and ordered the would-be scoffers out of the hall. They left, but not quietly.

Slater, when asked later why he did not read the letter and collect the money, said:

"I was too busy. There were a lot of other messages I had to read."

Delegates remained loyal to Slater,



AT THE SPIRITUALIST ASSEMBLY

A graphic illustration of what happened. Strong-armed men promptly proceeded to oust the members of the "Science and Invention Magazine" Investigating Committee.

JohnSlater, the medium who ordered the committee from the séance room.

NEW YORK HERALD TRIBUNE,

Skeptic Ousted With $21,000 By Spiritualists

Dunninger Flaunts Check as John Slater Is Relaying News From Other World

Offers It as a Challenge

Disturber, Disciple of Houdini, Acting for Magazine

By Ishbel Ross

John Slater, sixty-nine-year-old missionary of the National Spiritualistic Association, was in the midst of reading spirit messages to an enthralled audience in the Pennsylvania last night when he ran afoul of Joe Dunninger, who has assumed the mantle of Houdini as the nemesis of clairvoyance.

More than 500 persons, attending the night session of the thirty-third annual convention of the New York State Assembly of Spiritualists, shouted and cheered while Mr. Dunninger was thrust, prodded and expedited out of the ballroom. However, he still clung to the $21,000 check he had offered Mr. Slater if the spiritualist would answer either one of two questions.

The meeting was a love feast of harmony and enthusiasm until Mr. Dunninger, who is guardian of a $21,000 prize offered by "Science and Invention" for a proof of the transmission of a spirit message, cut in on the amiable messages flowing from the platform.

Father Gets Words From Beyond

Mr. Slater, who acheived [illegible]

BROOKLYN DAILY EAGLE

MEDIUM SPURNS $21,000 OFFERED FOR SPIRIT TEST

Man Who Tenders Check Is Put Out of Convention at Hotel Pennsylvania.

While John Slater of Philadelphia, honorary member of the General Assembly of Spiritualists, was giving spiritual readings last night at the annual convention of spiritualists in the Hotel Pennsylvania, he was interrupted by Joseph Dunninger, a skeptic, and offered $21,000 if he would read the contents of a sealed envelope.

Slater had been giving readings of letters for his audience without opening the envelopes. He tried to ignore Dunninger, who waved a certified check back and forth as he talked. Dunninger grew more insistent, and a few persons sitting near him joined in. Slater became exasperated and ordered the scoffer out of the hall. They left quietly.

THE WORLD

SCEPTIC EXPELLED BY SPIRITUALISTS

Medium Refuses Offer to Test Skill for $21,000

WOMEN ACCLAIM "SEER"

He Refuses to Answer Questions By Science Worker

John Slater, medium, was peacefully introducing people to their deceased loved ones at the General Assembly of Spiritualists in the Hotel Pennsylvania last night when a voice which was not from a spirit cried out:

"I have two questions here in sealed envelopes. Will you undertake to answer one of them without opening the envelope for a prize of $21,000?" Joseph Dunninger, sceptic, was speaking.

"Put him out! Throw him out!" the spiritual believers cried.

Sceptic Is Expelled

Slater shouted:

"If this man had adopted these tactics in a Roman Catholic Church or a Jewish synagogue, what would you have said? Throw him out!"

While the Spiritualists proceeded to do so, Dunninger, who was accompanied by Joseph H. Kraus, explained outside that he is Chairman of the Science and Invention Investigating Committee for Psychical Research. He produced a check for $21,000 on the Central Hanover Bank and Trust Company made out to Slater and signed by R. A. McKinnon, President of the Experimenter Publishing Company.

[illegible] to Dunninger's interruption, told quite a number of people [illegible] their

DAILY MIRROR,

Saturday, June 22, 1929.

SPIRITUALISTS GIVE EDITOR 'BUM'S RUSH'

While 1,000 infuriated spiritualists yelled "put him out," Joseph Dunninger, editor of Science and Invention, got what is generally known as the "Bum's Rush" out of the crowded ballroom of the Hotel Pennsylvania last night.

The General Assembly of the Spiritualists were holding a meeting, John Slater was announcing spirit messages when Mr. Dunninger arose to say he had a certified check for $21,000 which he would give Mr. Slater if he had the spirits answer questions in two sealed envelopes Mr. Dunninger held up to the audience.

Mr. Dunninger, equipped with a similar offer, had been thrown out of many spiritualistic meetings in the past, and he was not disappointed this time.

Reporters then flocked around Mr. Slater, wanting to know why he had the spirits slight Mr. Dunninger, but Mr. Slater severely said to the members of the press, "You must have been drinking," and refused to say more.

Religious Notices

[illegible] SPIRITUALIST

[illegible] GRAND SPIRITUALIST CONVENTION

Public Meetings: Fri., 8 p.m., Sun., June 21, 22, 23, at 8 P. M.

HOTEL PENNSYLVANIA

Spirit messages demonstrated by

JOHN SLATER

world-renowned medium.

Lectures by leading national speakers

Left: A few more newspaper clippings. They tell a graphic story in themselves.

A newspaper clipping advertising John Slater's appearance at the Hotel Pennsylvania in New York.

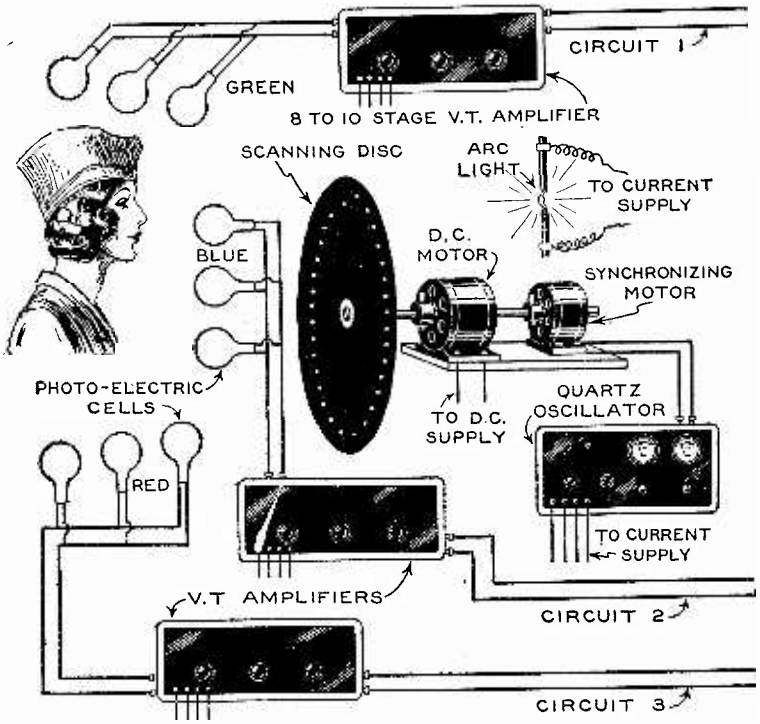
editors where they can get $21,000.00 by walking either across the street or across the continent, we shall be more than obliged and at least will make an attempt to do so.

However, that is aside from the story. As long as the mountain wouldn't come to Mohammed, Mohammed decided to go to the mountain.

John Slater is a world-renowned medium! He demonstrates his ability to read a message on the inside of a sealed envelope. With this information in advance, Joseph H. Kraus, Field Editor of SCIENCE AND INVENTION MAGAZINE, prepared two questions. One of them was a facsimile of a question asked by a person now deceased. The second was along the line of questions that Mr. Slater answers. These messages were placed in envelopes and appropriately sealed.

So that there would be no question about the $21,000.00 in awards, Mr. H. K. Fly, Secretary and Treasurer of our organization, appeared on the scene armed with a check drawn to John Slater, a photographic reproduction of which appears with this article. Note that while the check was drawn on June 21st, it was not canceled until July 2nd, giving Slater every opportunity to put in his claim for it. Dunninger, the Chairman of the SCIENCE AND INVENTION MAGAZINE Investigating Committee for Psychical Research, was on hand to start the ball rolling. H. Winfield Secor, the Managing Editor, was ready to pay his respects to the winner, and three other committeemen, N. J. (*Continued on page* 460)

Miss Charlotte Papillon, dressed in bright colored costume, seated before color television transmitter.



The color television transmitter shown schematically; with vacuum tube (V.T.) amplifiers, scanning disc, quartz crystal controlled V.T. oscillator supplying synchronous motor, photo-electric cells, arc supplying scanning light pencil, etc.

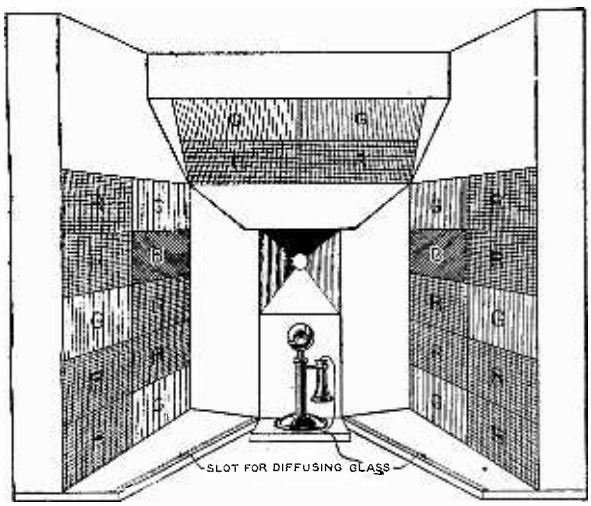


Diagram showing how red, green and blue color screens, together with their respective photo-electric (light responsive) cells are arranged. A glass diffusing screen is placed over the color screens.

Television

Moving images in natural colors are successfully transmitted and received over newly devised television system of Bell Telephone Laboratories

OVER two years ago Bell Telephone Laboratories demonstrated a practical system of television. For the first time successful representations of objects at rest or in motion were transmitted electrically—over wires or through the ether—for considerable distances. The reproduction of the scene then transmitted was in monochrome —the orange-red color of the neon lamp. Recent developments of the laboratories, however, have made it possible to reproduce scenes with their true color values. The appearance of reality in the reproduced scene is thus greatly enhanced.

One of the most significant features of this new achievement is that it does not require completely new apparatus. The same light sources, driving motors, scanning discs, synchronizing systems, and the same type of circuit and method of amplification are used as in the monochromatic system. The only new features are the type and arrangements of the photo-electric cells at the sending end, and the type and arrangements of the neon and argon lamps at the receiving end. The outstanding contributions that have made the present achievement possible are a new photo-electric cell, new gas cells for reproducing the image, and the equipment associated directly with them.

To render the correct tone of colored objects, it was necessary to obtain photo-electric cells which—like the modern orthochromatic or panchromatic plate—would be sensitive throughout the visible spectrum. This requirement has been satisfactorily met. Through the work of A. R. Olpin and G. R. Stilwell a new kind of photo-electric cell has been developed, which uses sodium in place of potassium. Its active surface is sensitized by a complicated process using sulphur vapor and oxygen instead of by a glow discharge of hydrogen as with the former type of cell.

The response of the new cell to color, instead of stopping in the blue-green region, continues all the way to the deep red. Because the former potassium cells were responsive only to the blue end of the spectrum, objects of a yellowish color appeared darker than they should have and the tone of the reproduced scene was not quite correct. This disadvantage applied particularly to persons of dark or tanned complexion. When the new cells are used in the original television apparatus and with yellow filters—similar to those used in photographing landscapes in order to make the blue sky appear properly dark—this defect is corrected and the images assume their correct values of light and shade no matter what the color of the object or the complexion of the sitter. It is the availability of the new photo-electric cells which makes color television possible by their use.

The development of color television has been greatly simplified by the fact that as far as the eye is concerned any color may be represented by the proper mixture of just three fundamental colors—red, green, and blue. This fact was utilized in the development of color photography, and all the research that had been done in that field was available as

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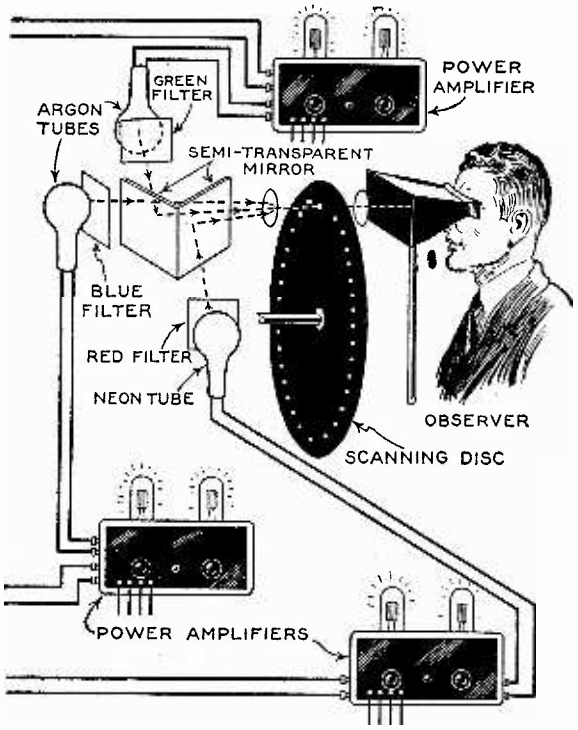
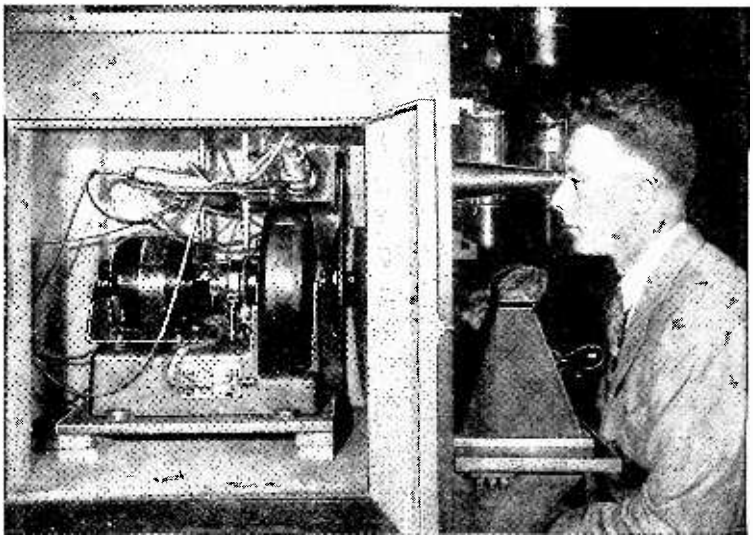


Color television receiver in schematic form is here shown. Power amplifiers boost the incoming television signals, which are led into argon and neon tubes as shown. Light fluctuations are viewed through scanning disc, thus reconstructing the colored image.

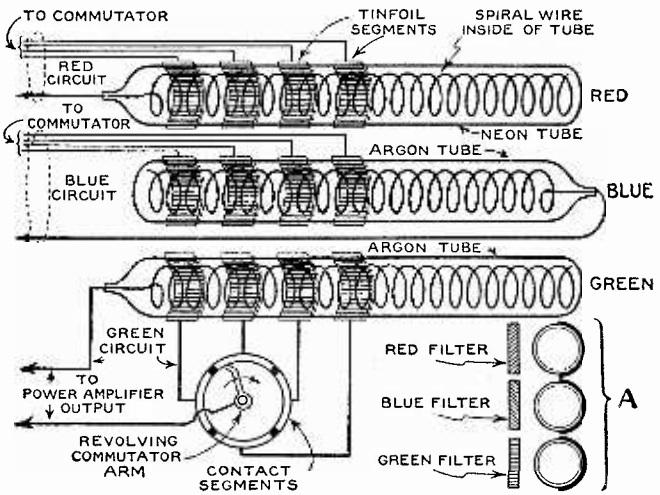


Side view of color television receiver, showing two argon tubes and one neon tube mounted behind scanning disc. Note two disc driving motors and viewing hood used by the observer, A. L. Johnsrud, of Bell Tel. Labs.

in Color

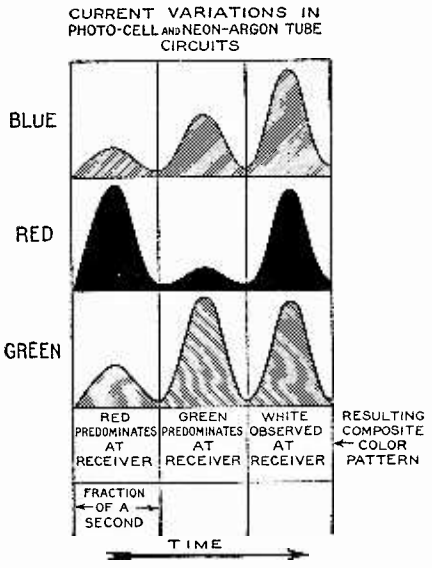
By Dr. Herbert E. Ives

Member of the Technical Staff, Bell Telephone Laboratories



Above: How large glass tube screen may be arranged for reproducing color television images. Each tube has its own color filter, the tinfoil segments being connected progressively into circuit.

Graphic curves at right illustrate how different colors are transmitted and received. When red green and blue are equally strong, at a given instant, the resulting color is white. If green predominates at a certain instant, then that is the major color observed at the receiver.



background for color television. A host of methods of combining the three basic colors to form the reproduced image was available but, in so far as the sending or scanning end is concerned, a method was developed which has no counterpart in color photography. The method of "beam scanning"—used in the first television demonstration*—has been employed.

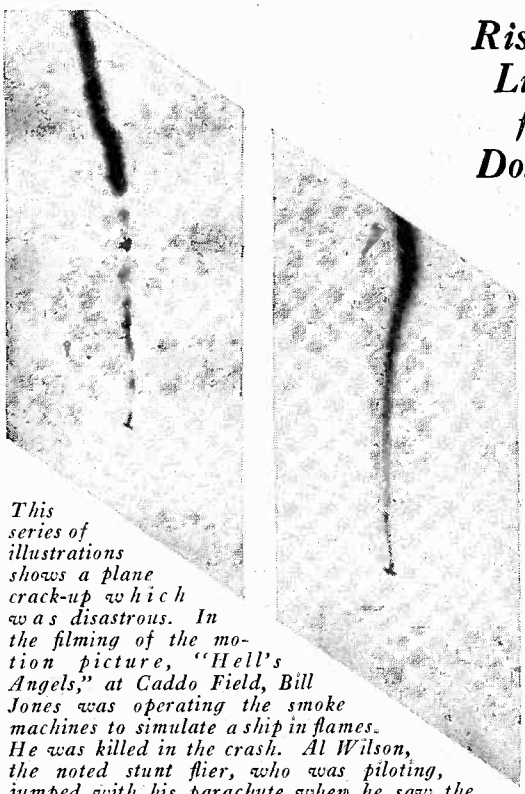
To apply this method to color television, three sets of photo-electric cells are employed in place of the one set used before. Each of these sets is provided with color filters made up of sheets of colored gelatine. One set has filters of an orange-red color which make the cells see things as the hypothetical red sensitive nerves of the retina see them; another set has yellow-green filters to give the green signal, and the third set has greenish-blue filters which perform a corresponding function for the blue constituent of vision. The scanning disc and the light source are the same as with the beam scanning arrangement used in monochromatic television. The only difference is in the photo-electric cells, and thanks to the tri-chromatic nature of color vision, it is only necessary to have three times the number of cells used previously to reproduce all colors. Three series of television signals, one for each set of cells, are generated instead of one and three channels are used for the transmission of the television signals.

The photo-electric cell container, or "cage," has been built in a somewhat different form from that used in our first demonstration. There three cells were used arranged in an inverted "U" in a plane in front of the object. In the new photo-cell cage twenty-four cells are employed, two with "blue" filters, eight with "green" filters, and fourteen with "red" filters. These numbers are so chosen with respect to the relative sensitiveness of the cells to different colors that the photo-electric signals are of about equal value for the three colors. The cells are placed in three banks, one bank in front of and above the position of (*Continued on page* 474)

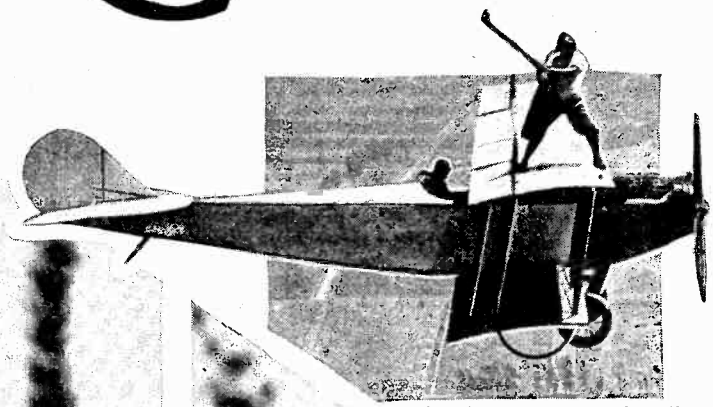
* Bell Record, June, 1928, page 325.

CRACK

Risking Lives for Dollars



This series of illustrations shows a plane crack-up which was disastrous. In the filming of the motion picture, "Hell's Angels," at Caddo Field, Bill Jones was operating the smoke machines to simulate a ship in flames. He was killed in the crash. Al Wilson, the noted stunt flier, who was piloting, jumped with his parachute when he saw the hopelessness of the situation and escaped with a broken ankle.



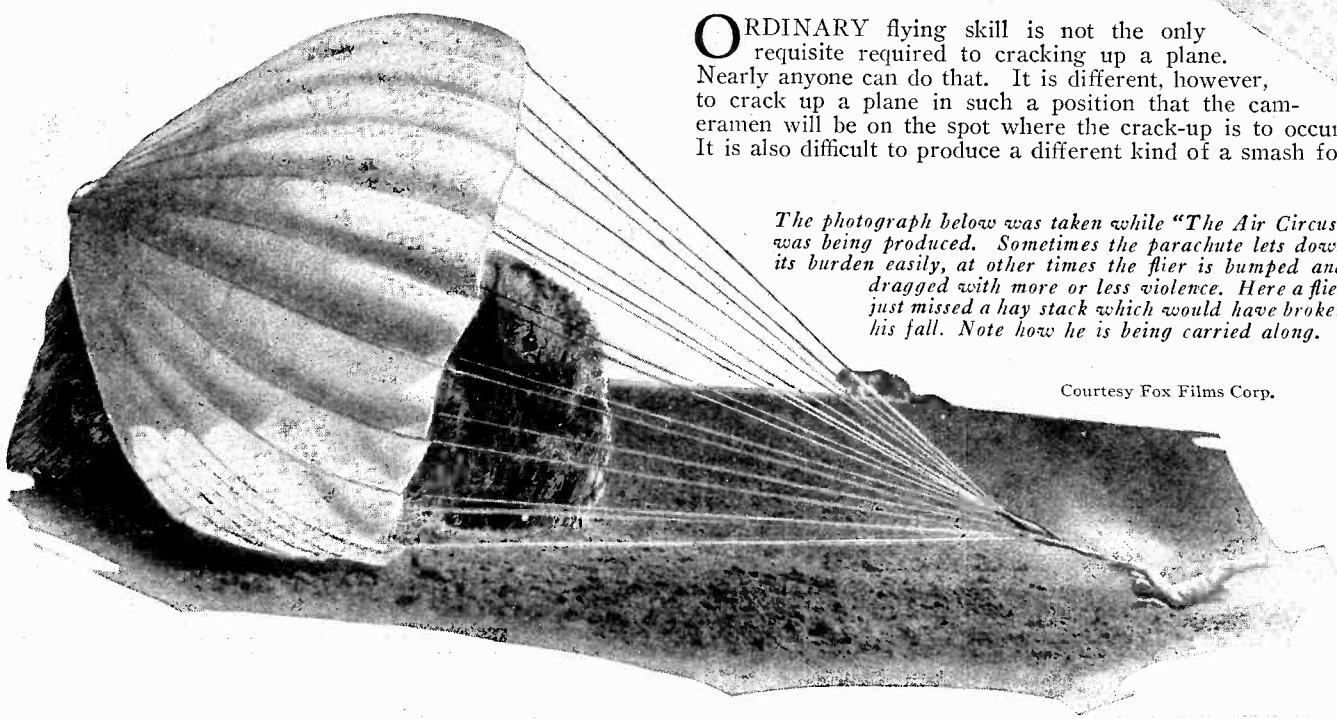
This picture shows Al Wilson in the "early days." He was the first man to actually drive a golf ball from the top of a plane's wing.

AIR stories are very popular among movie fans and particularly among those who are going "air-minded." But ordinarily there is no thrill in watching an airplane make an ordinary flight, nor do scenes from an airplane make the heart beat faster. It is up to the aviators to provide a thrill. This they can do by any one of a group of sensational ways, but the most sensational one of all is to take out a plane and crack it up in the exact spot designated by the cameraman so that he will be able to film the crash.

Producers are usually able to film a "dog" fight, substituting models for real planes. Such models are operated by strings, and a moving cloud panorama is employed to indicate flight, but when it comes to crack-ups, the model gives but a poor showing. Even if one could use a "prop" plane, the audience knows that there is something missing, and the picture leaves no impression upon them.

Skill Required—Science Enters

ORDINARY flying skill is not the only requisite required to cracking up a plane. Nearly anyone can do that. It is different, however, to crack up a plane in such a position that the cameramen will be on the spot where the crack-up is to occur. It is also difficult to produce a different kind of a smash for



The photograph below was taken while "The Air Circus" was being produced. Sometimes the parachute lets down its burden easily, at other times the flier is bumped and dragged with more or less violence. Here a flier just missed a hay stack which would have broken his fall. Note how he is being carried along.

Courtesy Fox Films Corp.

UPS

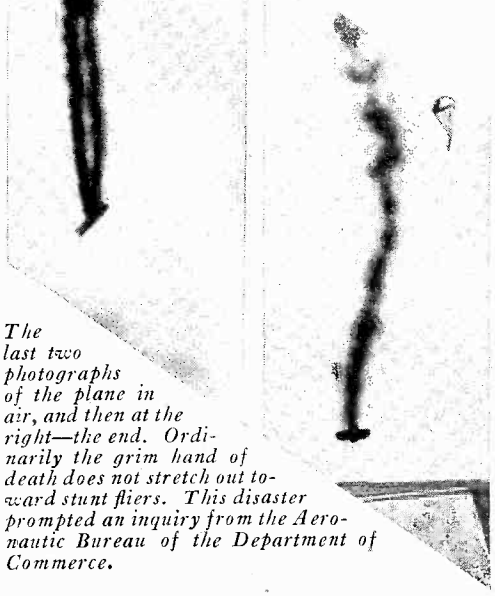
Science and Skill combine in properly cracking up a plane without sacrificing life

By Joseph H. Kraus

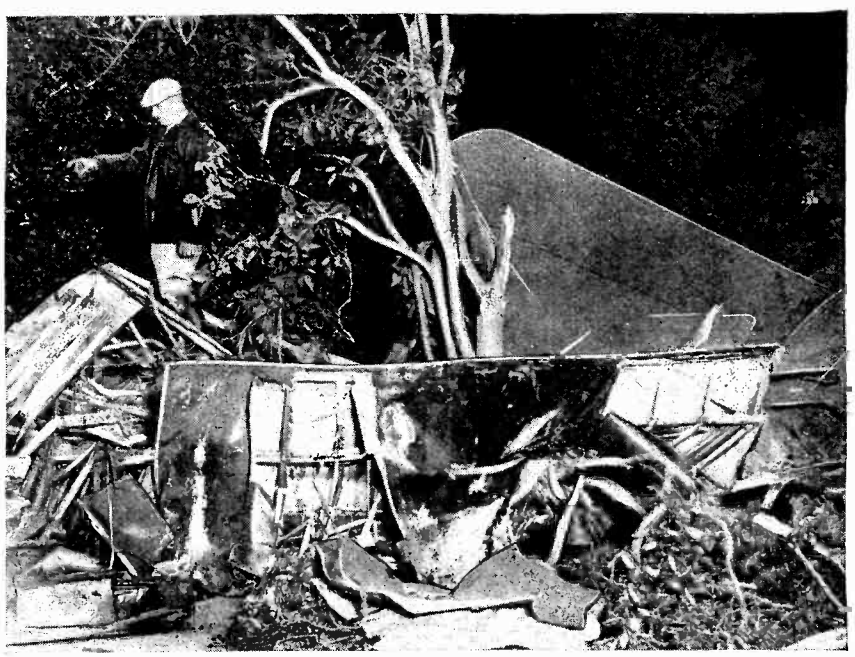
The three illustrations above show photographs from the film "Lilac Time," a First National Production, starring Colleen Moore. Note that in several of the pictures the pilot can be seen. Observe in the top photo how the plane is made to dig its wing into the ground. This is also true in the photo immediately above.

various parts of the film, and, last but not least, to come out alive.

Most pilots and stunt fliers engaged in this work figure out their moves to a nicety. They know exactly what they are going to do before they do it, and they have laid plans for practically any difficulty that might arise. The cockpits of the planes are usually well provided with padding. On occasion, the aviator also manages to place several hand or foot holds in the plane, so that he will not be thrown out when the ship smashes. In one case the aviator even went so far (*Continued on next page*)



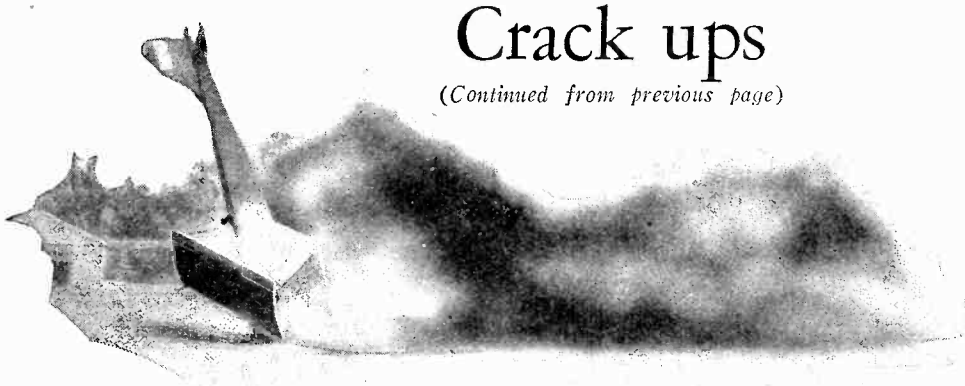
The last two photographs of the plane in air, and then at the right—the end. Ordinarily the grim hand of death does not stretch out toward stunt fliers. This disaster prompted an inquiry from the Aeronautic Bureau of the Department of Commerce.



as to tie an anvil weighing several hundred pounds under the front axle of the plane, so that the plane would surely go over on its back after its nose was made to sink into the soft turf.

Crack ups

(*Continued from previous page*)



One of the most remarkable photographs is shown above. The pilot may be seen at his place in this plane, which executed a nose dive near hangars during the filming of Fox Films' "The Air Circus."

Stunt Fliers Receive Little Money

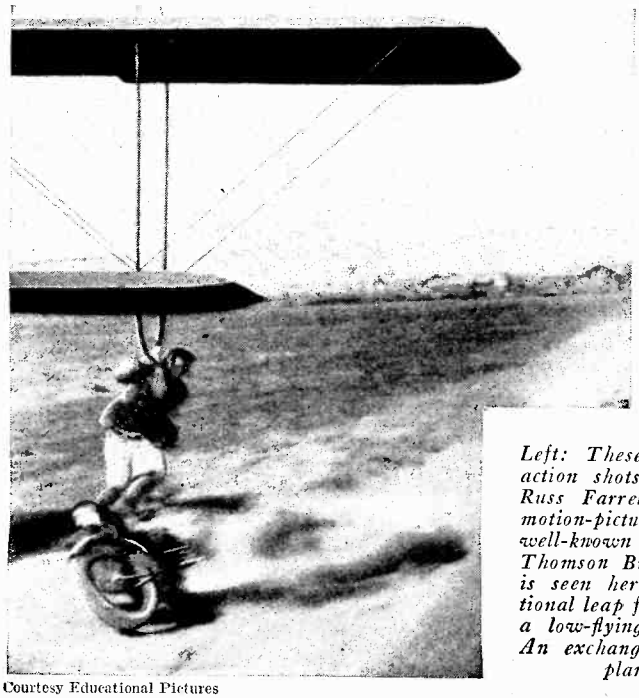
ONE would think that the reckless fliers engaged in these breath-taking stunts would receive very high salaries for risking their lives the way they do, yet there is perhaps no group of persons who risk their lives as often and are paid more cheaply than these men who gamble with death. Mr. George M. Atkins, of Monroe, N. Y., has compiled a group of prices which the stunt fliers get for their tricks. The maximum salary for any trick is $1,500, but in order to collect this you must take your plane up in the air and blow it up in midair by firing off a charge of dynamite. If you can get away by taking to a parachute and if you land safely, you collect; if not, the money goes for funeral expenses. Don't forget that this is maximum salary, many aviators get less for performing the same stunt. Also, as Mr. Atkins put it, "your parachute may forget to open, and in most scenes it is a long distance to earth."

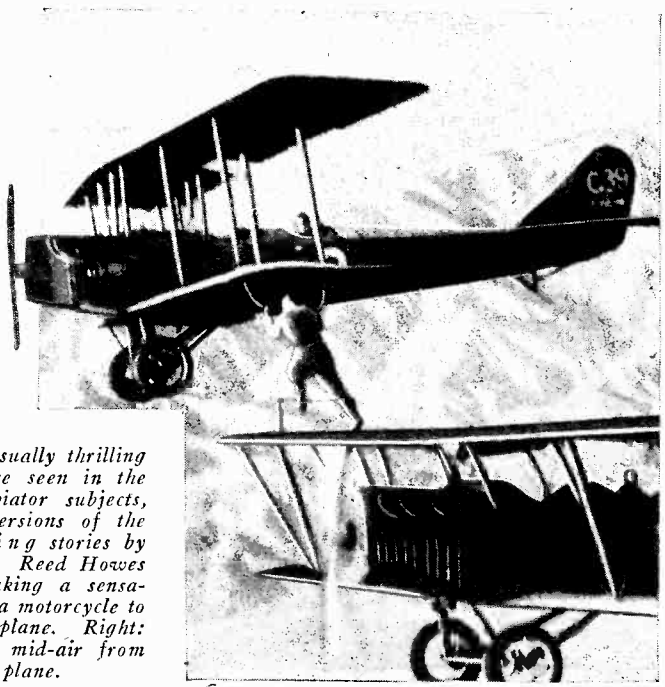
Here is an illustration of quite a remarkable crash. This picture was taken in 1927, and starred Milton Sills. Note man running to the wreckage. The clouds are not smoke but dust.

Crashing your plane into a house or tree makes a wonderful smash and a marvelous scene. It thrills the audience, worries the wife and family, and gives the aviator $1,200.00. Spinning the plane to earth in a crash gives the aviator the same price, but that is the limit of the big money. And now we come to the lower-paid attractions.

For the sum of $500.00 you must loop the loop with a man on top of the plane, and changing from a plane upside down to another in mid-air nets you a check for $450.00. Fighting on top of the wing and being knocked off gives you but $225.00, if you are the fortunate individual that is thrown off the top of the wing. Doing a double parachute jump gives $180.00; that is, two men on but one 'chute. Flying upside down with a man hanging on the landing gear adds to the official account a sum of $150.00. A parachute jump nets only $80.00. For flying your plane upside down and holding on you get $100.00; changing from one plane to another in midair is worth but $100.00, and changing from a plane to a railroad train means $150.00.

But like every other game, the one of stunt flying is thrilling. Each time the flier (*Cont'd on page* 462)

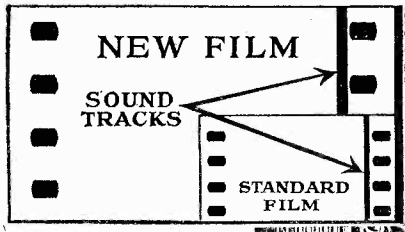




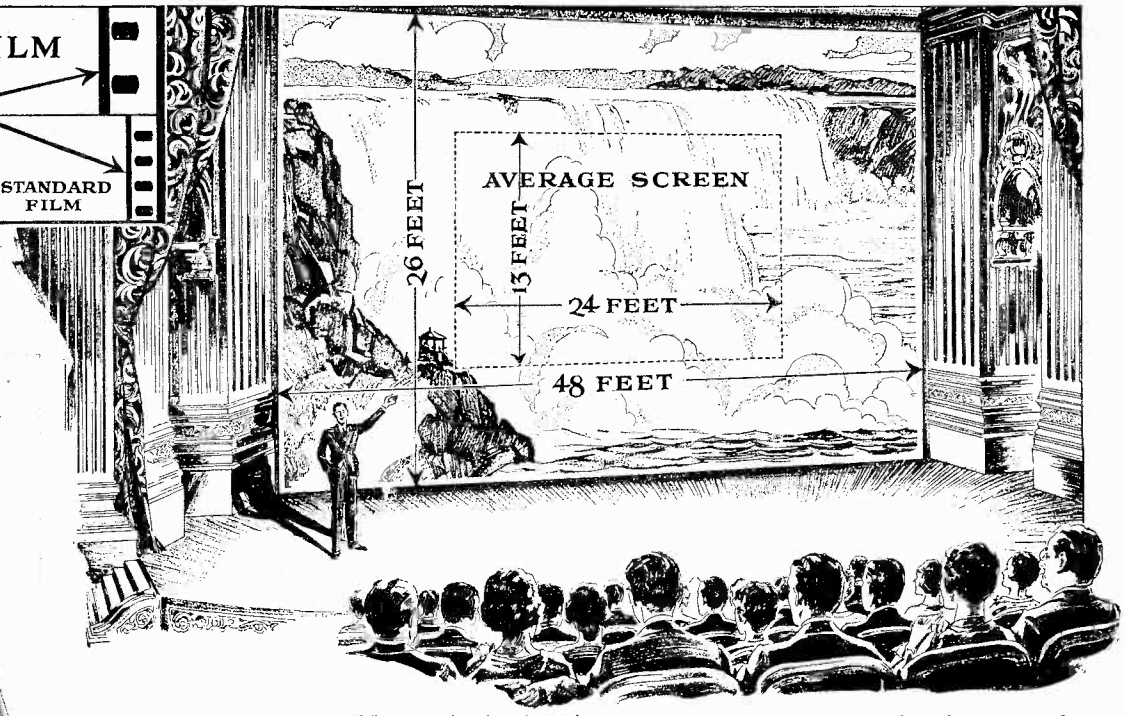
Left: These unusually thrilling action shots were seen in the Russ Farrell aviator subjects, motion-picture versions of the well-kwown flying stories by Thomson Burtis. Reed Howes is seen here making a sensational leap from a motorcycle to a low-flying airplane. Right: An exchange in mid-air from plane to plane.

Courtesy Educational Pictures

Courtesy Educational Pictures



The illustration above shows differences in film sizes.

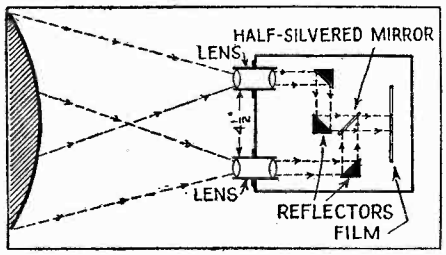


This illustration shows the difference in the size of the screen between that on which the present-day movie is projected in a large show house and the screen used with the new system. The grains of silver on the film are not enlarged to any greater extent than at present. Left—the camera.

Stereoscopic Movies

With Color and Voice in the Making

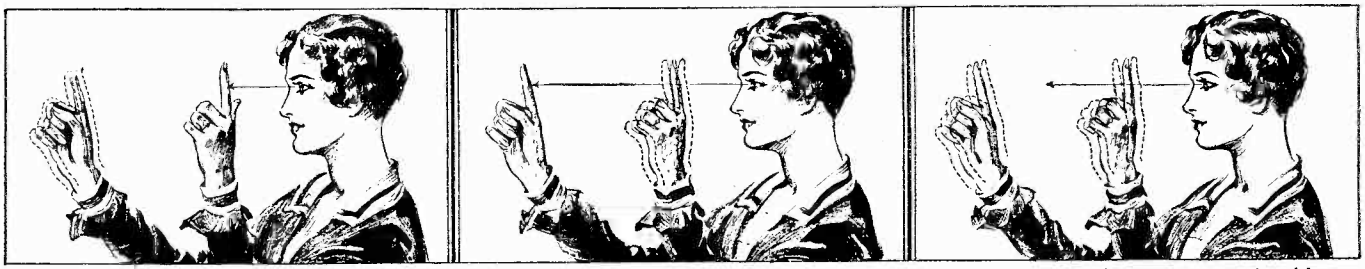
By H. Winfield Secor



Details of the camera are not available, but this gives a clear idea of how an effect of three dimensions is obtained. Images from both lenses are made to register perfectly on the same film. Shadow differences are produced.

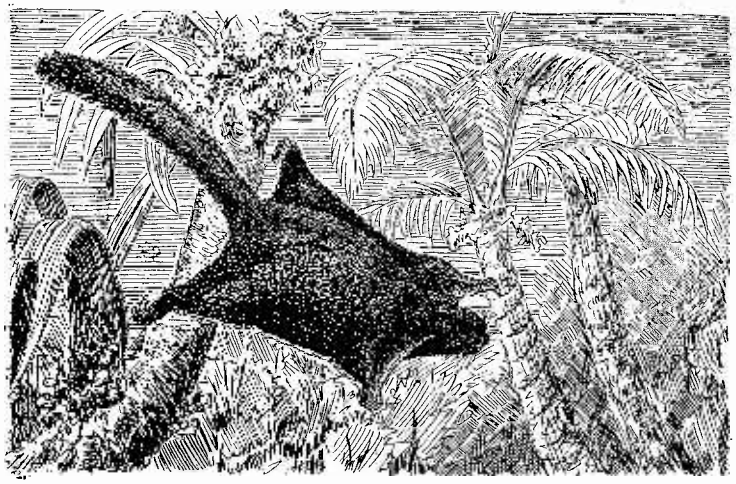
THE movies took another stride forward recently, when a new photographic and projection system of producing a three-dimensional effect was demonstrated at the R. C. A. Photophone Studio in New York. This motion-picture system was developed by (*Continued on page* 456)

The camera and its developers, P. John Berggren and George K. Spoor.



How three-dimensional effect is produced. Looking at near finger makes distant finger appear double and vice versa. Look midway between and both fingers appear double.

Many Creatures of the Field and Stream Have Mastered the Principles of Gliding



Above is Vampirus (Phyllostoma) spectrum, the bat, which is capable of actual flight. At the left is a flying rodent, Petaurista oral (Pteromys petaurista). The young squirrels are equipped with a membranous fold where the arm joins the body. This fold forms a bridge between the rump and upper arm. In the matured animal this fold has disappeared, as it would be a disadvantage.

Animals that

By Dr. Ernest Bade

THE name of Lillienthal will always be closely allied to the science of aeronautics, especially motorless flight. That such gliding flights are comparatively easy to accomplish is attested by the way nature has adapted certain typically land and aquatic animals for this action, as distinguished from flying. Such creatures differ greatly from the birds, true masters of the air. While the majority of the birds are able to fly at will, other animals, with the exception of the bat, must be satisfied with a more or less gliding motion through the air, and such a gliding flight is by no means rare in the animal kingdom.

A large number of tree-inhabiting creatures are able to employ it successfully and to utilize this gift as a rapid means of escape from danger or to capture their prey from above. Confidence and sure-footedness in the crowns of the trees and ease in securing food undoubtedly have been an important factor in the selection of such dwelling places. But they could only feel at home after they had, in addition to their climbing and jumping proclivities, surfaces or "airfoils" adapted for gliding, which protect them from missteps and sudden falls, enabling them, as it does, to glide gracefully and uninjured to the ground far below.

Flying Squirrels

THE necessity and value of such gliding surfaces becomes evident in younger animals which have not, as yet, attained the proficiency and agility in climbing of more mature individuals. It is for this reason that young squirrels possess a peculiar membranous fold where the arm joins the body. This fold forms a bridge between upper arm and rump. In the mature individuals this gliding surface has disappeared, for that which is an advantage in youth is a disadvantage in the more mature form.

Of mammals provided with gliding membranes, the majority belong to the order of the rodents, but certain marsupialia and lemurs are also represented. A lemur, *Galeopithecus volitans,* from the Sunda Isles, has a fold of skin extending from the neck, taking in the forelegs to the fingers, and extending along the sides, encircling the hind legs and ending at the muscles of the tail. This fold is thickly covered with hairs on both of its sides and is spread when the creature jumps. With its aid, it is said, the animal can glide 240 feet when it hurls itself from a lofty tree. It is not improbable that the strong and massive tendons which project from the arm bone into the gliding membrane serve the purpose of raising or lowering the fold while in flight. But observations on this point have not, as yet, been made. At any rate, very little is known about the life history of this interesting and unique creature.

Far less developed is the gliding membrane of the flying squirrels. Our native species, *Glaucomys volans,* has a peculiar cartilage attached to the base of the hand which is used to spread the fold while gliding. These creatures become exceptionally lively at dusk; their jumps can hardly be followed with the eye. Like a ghost, they hurry from the height to the depth and quickly reclimb the trunks of the trees. Southern Asia is profusely provided with such forms and the Sunda Islands are inhabited by more than half a dozen species, the largest attaining a length of about 1½ feet.

Dragons That Fly

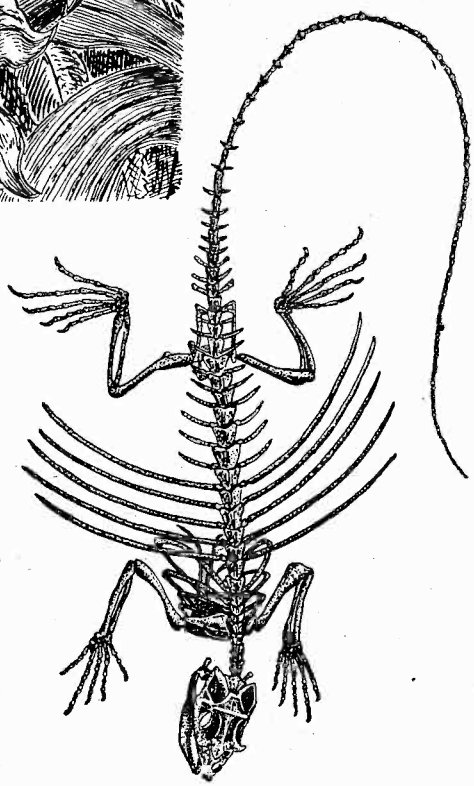
THE tiny dragon, *Draco,* of which more than 20 different species are native of the Sunda Isles, have solved the problem of gliding flight in an entirely different manner. The usually ridged ribs, movable only in snakes, have been employed to spread the gliding membrane. In addition to this these dragons pump this fold of the skin full of air. At rest, this surface is folded together and placed close to the body. Such a structure, where part of the ribs fulfill a different purpose, a purpose for strengthening another structure, is not found in any other animal.

These little dragons are true arboreal lizards. They are never found upon the ground unless forced to descend when danger threatens them. High in the loftiest crowns is their abiding place, sunning themselves in these airy heights. In color these creatures, which are only about 8 inches in length with their tail, are exceptionally vivid. Like glittering gems they float through the air as they hunt their insect food. While in flight they cover distances of approximately 60 feet, land lower than the starting place and quickly return, running up the trunks of the trees. The grotesquely tinted flying lizards, *Ptychozoon,* of the Malay Archipelago, also

The flying dragon, Draco limbriatus, is shown at left in flight. While in flight, the animals are capable of covering distances as great as sixty feet in one glide. Flying fish, Exocœtus (volitans) rubrescens, shown at left below, have large pectoral fins which form an excellent gliding surface. The peculiarly formed tail fins also aid the fish in flight. Flights of approximately 600 feet made by the fish have been observed.

Learned to Fly

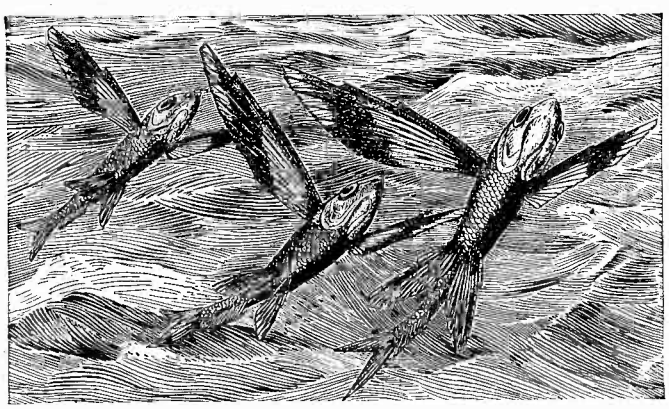
have web-like structures on each side of their body. This extensible membrane has but little sustaining power, although it does aid materially in extending their jumps.

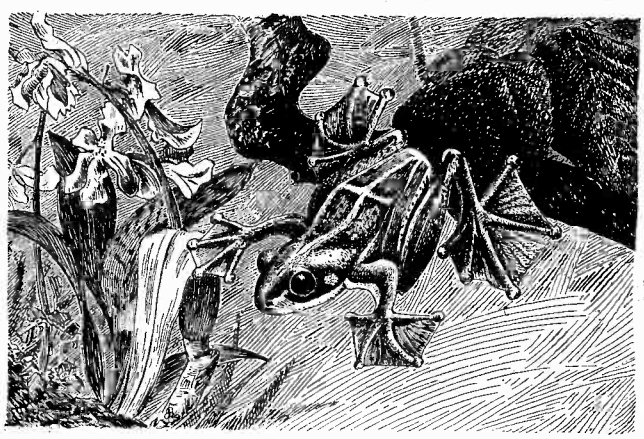


The skeleton of the small dragon, Draco, is shown at the right. The usual ridged ribs, movable only in snakes, are used to spread the gliding membrane.

Aerial Frogs

IT is peculiar that the region of the large Sunda Islands is profusely inhabited by numerous gliding creatures of the most varied form. Even flying frogs are native to this section. Here the toes, which are already provided with a swimming web and suction disks for climbing, can also be used for gliding. Such a frog, having a length of 2 inches and a width of ¾ of an inch while at rest, has a horizontal surface of approximately 1½ square inches, while in flight more than six times this horizontal area is easily covered. On the level this flying frog can cover a distance of 6 feet in one jump, when the abnormally developed webbed feet come into play as gliding surfaces. As soon as the frog is in the air, it brings its body into a characteristic gliding position. The elbow joints of both front legs are tightly bunched against the body and the large webbed feet spread and held in such a position that they are turned outward. The same occurs with the hind legs. At the same time the loosely folded skin of the legs is (*Continued on page* 461)

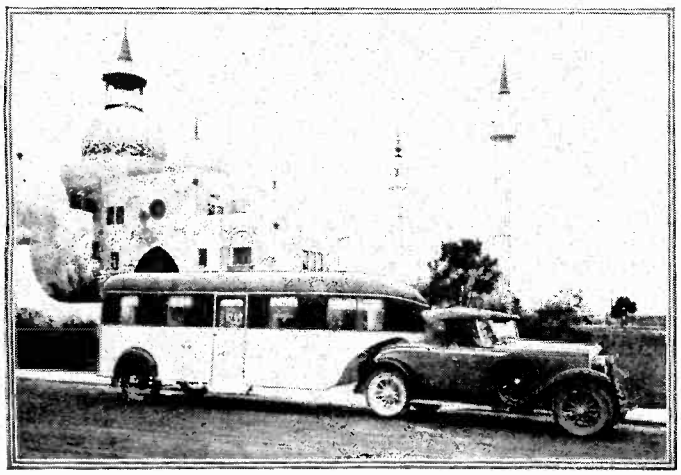




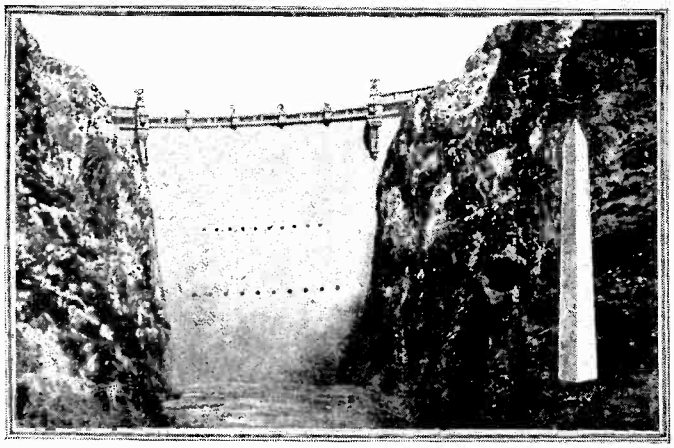
A frog which can glide, Rhacophorus reinwardti, a native of the Sunda Islands, is shown above. The toes, which are already provided with a swimming web and suction disks for climbing, can also be used for gliding. While at rest, such a frog, two inches long and three-quarters of an inch wide, has a horizontal surface of about one and one-half square inches. In flight more than six times this area is covered.

RAIL-BED RENOVATOR: Above is a mechanical device, developed by the Pennsylvania R. R. Co. and the Industrial Brownhoist Co., for automatically renovating track ballast by excavation, removing the dirt, returning the stone to the track and leveling the renovated ballast to standard profile. Ballast can be cleaned at the rate of 1,200 ft. of track per hour.

Scientific Progress



AEROCAR: A new type of vehicle, called the Aerocar, invented by Mr. Glenn H. Curtiss, is shown above. It is attached directly to the power unit, which may be any type of automobile capable of pulling the load. When drawn by a Ford roadster, the Aerocar will attain a speed of 55 miles per hour.



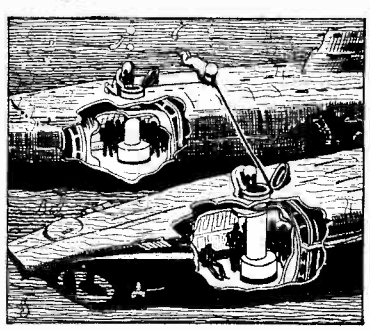
BOULDER DAM: At the right is an artist's conception of the Boulder Dam across the Colorado River. It is estimated that eight years' time will be required to finish it. Note size of Washington Monument.

Latest News in Various Fields as Caught by the Camera's Eye

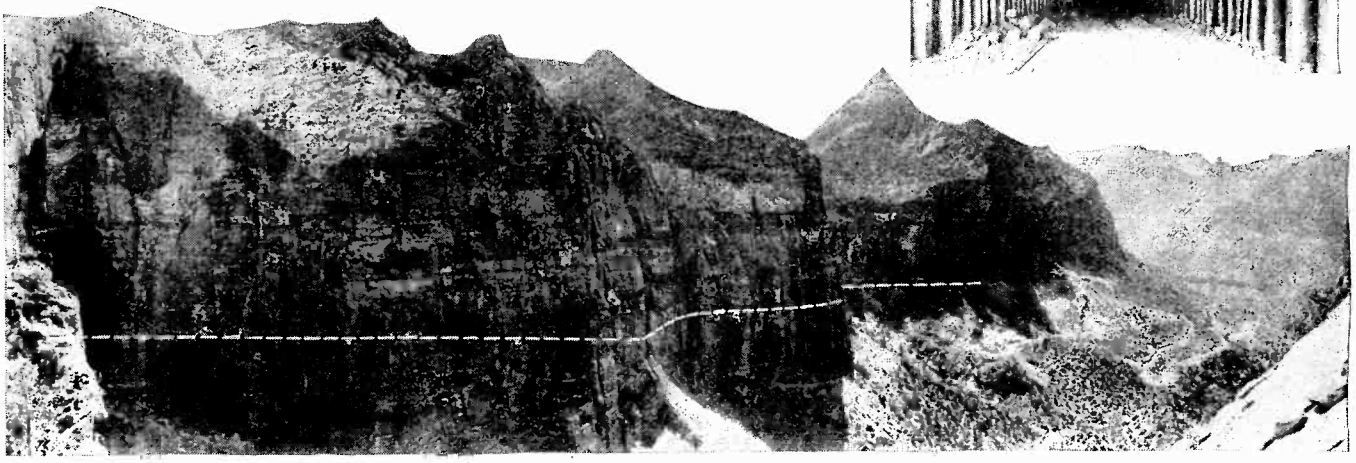
SYNTHETIC STONE: The photograph at the left shows samples of a new composition which can be used to replace stone in all building construction. The material is porous and nails can be readily driven into it without splitting the block. The composition stone is also waterproof and is not affected by changes in temperature.

SUB ESCAPE TUBE: The illustration at the left shows a new escape tube for submarines. A member of the crew is seen leaving it.

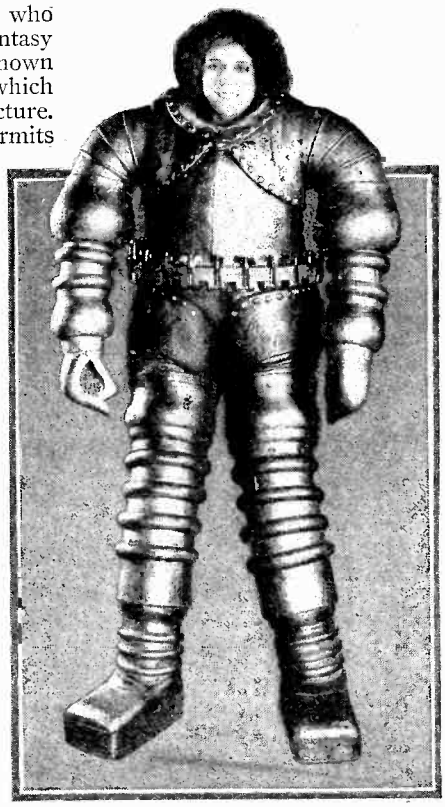
Right: How crew can be transferred from one submarine to another along a cable connecting the two escape chambers. The sailor enters and closes the lock in the "sub," then lets in the sea water. When chamber is nearly full, he opens the external gate.



AUTO TUNNEL: The three photos appearing here show views of the Zion-Mount Carmel Highway, in southern Utah, which is nearing completion and will be open to vehicles shortly. It is the longest tunnel outside of a city in the United States. A two-way illuminated bore, 1⅛ miles from portal to portal, runs through an unscaled mountain. The dotted line in the photo below shows course of tunnel. The photograph at the right shows a section of the tunnel, and the view below, to the right, shows the high scaffolds which were erected against the cliff faces during the course of construction.

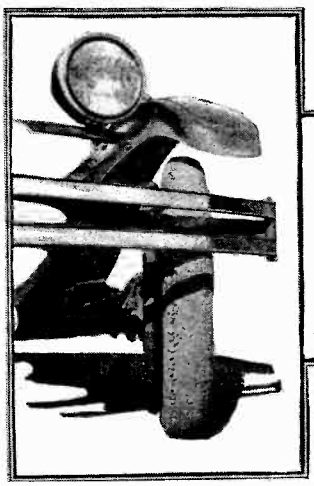


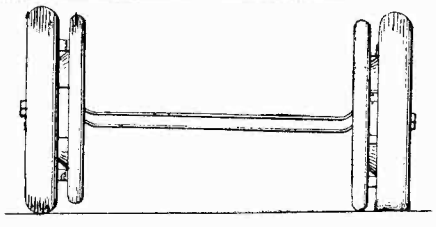
DIVING SUIT: Miss Jane Daly, who plays in the motion-picture undersea fantasy entitled "The Mysterious Island," is shown here in her copper-plated diving armor, which she wore during the filming of the picture. Although cumbersome, the diving suit permits free movement in any direction.

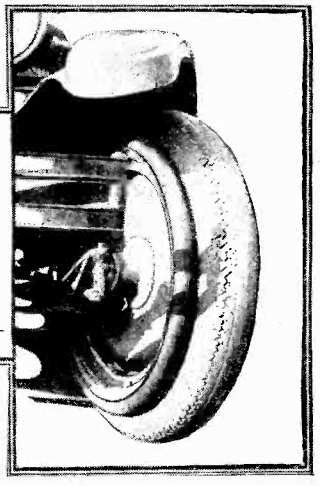


DAREDEVIL: Mr. Kambrinow, German daredevil, recently bet that he would drive his automobile without pneumatic tires on wires, which were stretched 100 ft. above the ground. The wires were 1,000 ft. long and the driver won his bet, making a speed of 15 miles per hour. The course was laid in the vicinity of limestone quarries in Berlin, Germany. The photograph shown here was made during the perilous trip while the driver, showing a disregard for life and limb, proceeded to win his bet.

AUXILIARY TIRE: A new invention, which should become most popular with car owners, is shown in the photographs and drawing appearing below. Provision is made for a solid rubber tire of smaller diameter than the car shoe, to be placed on the inside of the wheel. When the tire goes flat for any reason, the car settles slightly on that particular side and the rest of the driving is done on the auxiliary tire.



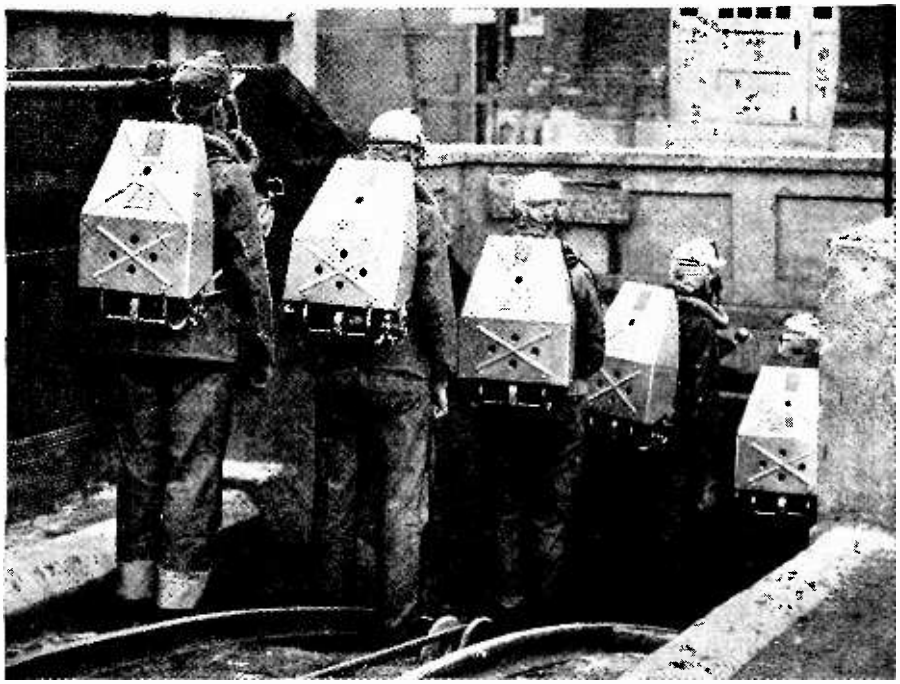




The drawing above shows clearly the action of the supplementary tire. By running the car up on blocks, which support the solid tire, the need for a jack is eliminated.

Coal Miner's Job Safer

By Alvin F. Harlow



A trained rescue crew furnished with the latest equipment about to enter a mine. Note modern entrance portal.

A HUMOROUS poem of fifty years ago pictured Barney Buntline and Billy Bowling, at sea on a stormy night, as thanking their lucky stars that they were not on shore, where houses were liable to be unroofed or struck by lightning and burned, or chimney pots blown down on their heads, but instead they were snug on shipboard and safe from all those dangers. Even so, a miner, a thousand feet down in the bowels of the earth, sitting on a box of dynamite as he eats his noonday lunch and glances over a scrap of newspaper, may be supposed to shudder as he reads the numberless hazards of life on the surface—of the whistle of bullets and the crunch of automobiles over human bodies in city streets; of shipwrecks, tornadoes and crashing airplanes; of men teetering dizzily on skyscraper skeletons hundreds of feet in air; of the deadly splash of great ladles full of molten metal and the dreadful lunge of giant locomotives smashing through coaches full of tortured humanity. For mining, though intrinsically a very hazardous occupation, is now by reason of safety methods, mechanical safeguards and the safety instruction constantly being hammered into the workers, becoming a less dangerous occupation than many an outside job, and would be safer yet if it were not for that ever-weak link in any chain—the thoughtless, perverse human individual, who is supposed to remember and obey the rules but doesn't!

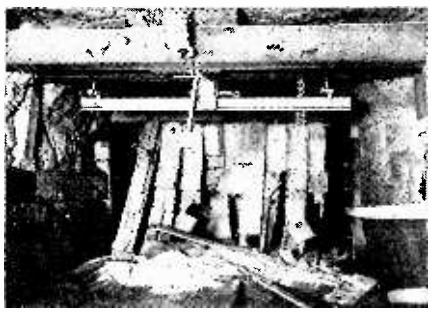
Of course mining isn't the pleasantest of all occupations; but it has been bettered enormously since the early days of coal production, some six or seven hundred years ago, when the job was regarded with so little favor, that Scotch coal miners had to be chained at their work. When one remembers that no explosives were used in mining then nor for several centuries thereafter, and that every foot of the way had to be dug with pick and crowbar and fires built against the rock to crumble it, when one hears from some early writers that the miner was compelled to work (possibly in gaseous pits) with no better light than the phosphorescent glow from certain kinds of dried fish, one marvels little that the miner displayed an occasional tendency to run away from the job.

So unpleasant was the ancient and medieval miner's work that one of the favorite forms of punishment, for whatever was called crime in those days, was a sentence to labor in the mines. It came to be questioned, said Georgius Agricola, a sixteenth-century writer on the subject, "whether to work in metals is honorable employment for respectable people or whether it is not degrading and dishonorable."

Not until within the last century—one might almost say within the last half century—have many medieval methods disappeared from the mines, even from those of America. As the workings were driven deeper and wider, and became more complex, and as our demands for speed and greater production goaded operators and men on to greater recklessness, the daily toll of disabling accidents and the record of large and terribly fatal mine disasters began to assume dreadful dimensions. The first moves in the direction of modern safety work in the mining industry were made in the Pennsylvania anthracite field in 1869. Industrial prophets were arising who hinted that safety was desirable not only for humanitarian reasons but because it made for economy and larger production. They were among the earliest heralds of the age of modern business efficiency.

There has been more accomplished in the matter of making life safer and comfortable in the mining industry in the past fifty years than in the previous five hundred. By far the greater part of it has been achieved in the last two decades.

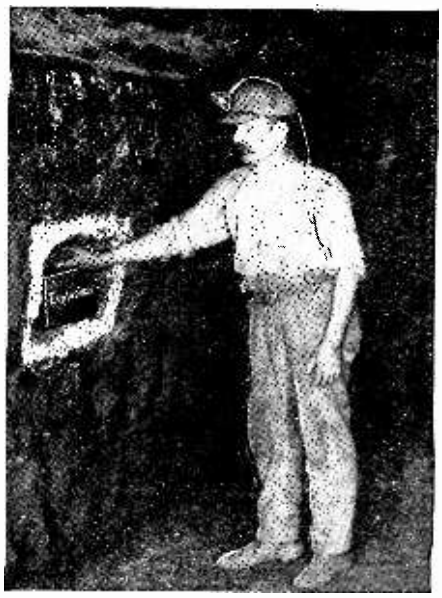
The photograph at the left shows a rock dust barrier ready to smooth a coal dust explosion. Below is a view of the rock dust shelf after the air wave has passed. The tendency of coal dust to explode is nullified by the rock dust.



After some years of groping effort on the part of a few mine owners, it became apparent that a great national agency was needed to obtain the best possible study of the numerous problems. This need was brought to public and Congressional attention in very tragic fashion in 1907 by two of the greatest subterranean disasters in American history—the Monongah mine explosion in West Virginia, in which 361 men lost their lives, followed only thirteen days later by the explosion at Jacobs Creek,

than Yours!

Workers' lives scientifically protected and made tolerable underground



Explosive materials are placed in whitewashed niches in the walls. The danger from explosives has been greatly reduced.

Below: Miner making repair on railroad system immediately after trouble occurred. At bottom of page: Example of carelessness — miner smoking cigarette and opening powder can with pick. All photos courtesy U. S. Bureau of Mines.

Pennsylvania, in which 239 men were killed. The United States Bureau of Mines was established by Congressional act in 1909 with the purpose, not only of conserving human life and health in the industry, but also of assisting in curbing the waste from inefficient methods and excessive competition.

To this Bureau much credit is due for the reforms and improvements of recent years. More recently the National Safety Council, sponsored by all classes of industry and engineering, has done valuable work along similar lines; and there are still other agencies—the manufacturers of explosives, for example, whose interest it is to prove that their products when properly handled are as docile and gentle as any dove.

The first great desideratum in making life more tolerable underground is that it be made safer. The accidents having the greatest immediate possibilities for danger to men working in mines are explosions. These are of three kinds: those caused by man's own blasting agents, those caused by coal dust and those caused by gases. The two last named have been responsible for the greatest and most appalling of mine disasters, but in a great number of cases these explosions of gas and dust have been set off by blasts of powder or dynamite or by flames or sparks used for or created in firing such blasts.

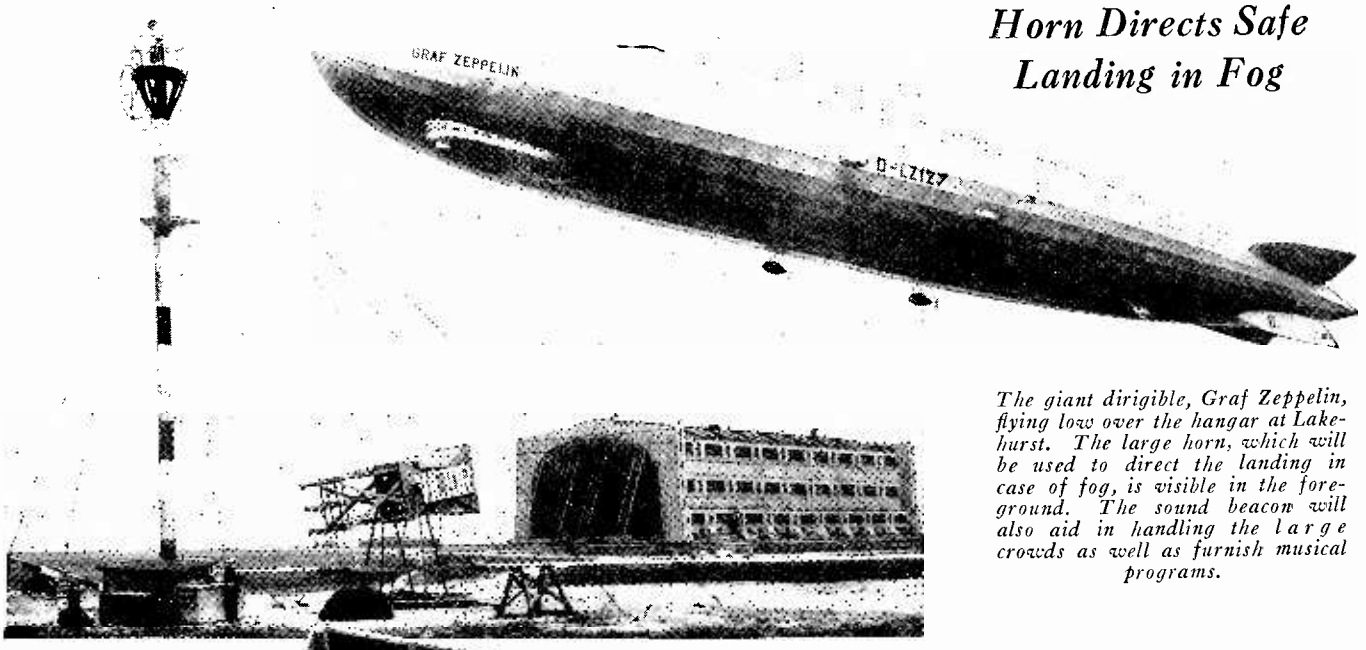
The first labor of the Bureau of Mines was the collection of data regarding accidents. This work had not proceeded very far when it was discovered to the astonishment of many that explosions of gas and dust which, because of their dramatic character, seemed to the public to be the greatest of mine dangers, in reality cause on an average less than one-fifth of all the coal-mine fatalities, and in some districts a much smaller proportion, while in metal mines in general the danger from such things is negligible. By far the greatest percentage of deaths and disablements results from falls of rock, ore or coal from roof or side of tunnel, with haulage, loading and other individual casualties following close behind.

But the spectacular disasters in which many men were killed at once attracted the greatest public attention and were the problem first attacked by the new safety engineering. For years the most elaborate precautions were devoted to reducing this danger. After long study it was learned that explosions not only cause fewer fatalities and disablements, but that they were more easily controlled than certain other types of accident which kill or disable only one or two men at a time, but which take a steady toll throughout the year. In recent years the danger from the use of blasting media and from the explosion of the natural elements in the mines had been greatly reduced. In fact, if all operators could be induced to install all the known safeguards and all the workers could be induced to obey all the rules, the danger from explosions would be well nigh eliminated. This may sound extravagant, but it is true. Explosives are not in the habit of blowing up of their own accord nor do coal dust and gases do so.

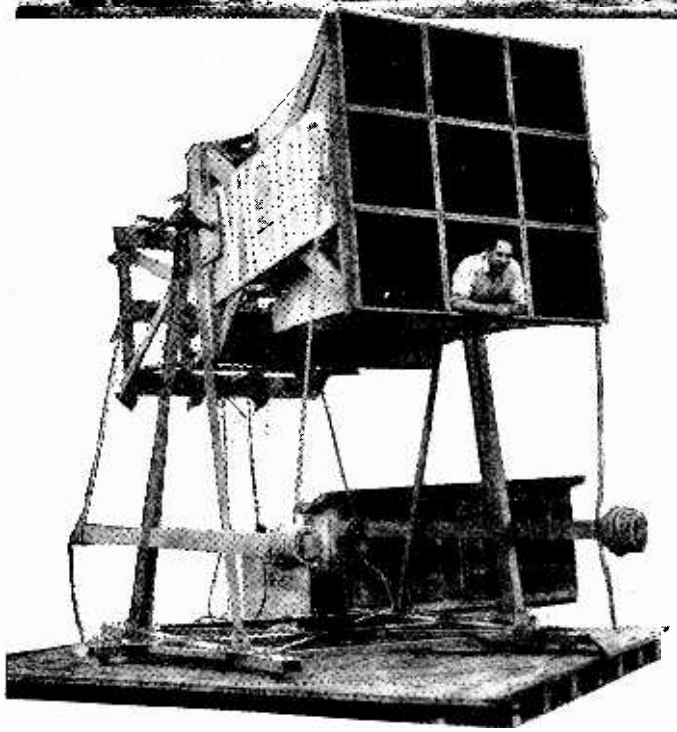
It appeared, therefore, that in the matter of explosions much good might be done by using some protection, some education and some elimination of hazard; but as to guarding against falls of material from roof, or against loading and haulage casualties, education must be relied upon; and because of human recklessness and forgetfulness this has proven to be a difficult proposition.

It was formerly believed that all the great explosions in mines were caused by gas, or as it was popularly called, fire-damp. That coal dust could explode was for a long time unknown, and when miners began to talk of dust explosions, many authorities scoffed at the idea. But within the last ten or twelve years the explosive quality of bituminous coal dust when mixed with oxygen has been amply proven by the Bureau of Mines, which staged actual dust explosions in its experimental coal mine at Bruceton, Pennsylvania. That mine, by the way, has been a remarkably useful laboratory. The (*Continued on page* 468)

Super-Directional Horn Directs Safe Landing in Fog



The giant dirigible, Graf Zeppelin, flying low over the hangar at Lakehurst. The large horn, which will be used to direct the landing in case of fog, is visible in the foreground. The sound beacon will also aid in handling the large crowds as well as furnish musical programs.



A close-up view of the giant horn appears above. An excellent conception of the size of this horn can be determined by comparison with the man.

Giant Voice Helps Land ZEP

WHEN the giant dirigible, Graf Zeppelin, arrives at Lakehurst an easy landing will be assured, even though the weather is of the worst. The newest development in sound communication, made by the Victor Talking Machine Company at Camden, N. J., will be used to help the Zeppelin to a safe berth on the ground.

Super-Directional Horn

A HUGE horn having super-directional qualities will enable communication between the ground and the Zeppelin while the ship is still several hundred feet above the field. Naval officers will thus be in a position to advise the Zeppelin commander as to the best way in which to bring the ship safely into port.

A microphone is being placed in the Navy Communications Department at the Lakehurst hangar and several others will be positioned about the field at strategic points. All of these posts will be connected with the commandant's office by a special telephone system.

Details

THE huge horn will be placed on a turn-table, so that the direction of the sound can be changed at will and made to follow the path taken by the dirigible. Two standard auditorium amplifiers will be placed in the hangar. These will provide the necessary volume to enable the horn to be heard over the entire field. When used in conjunction with a phonograph, this equipment will be employed to entertain the crowds. Warnings and instructions can also be given to the sightseers through the medium of the huge horns and associated equipment.

Construction

THE giant horn consists of a cluster of small-mouthed conical horns, each equipped with a special unit. These horns are joined to a single mouth, straight sided, and assembled in a space approximately 8 feet square and 12 feet long.

Should fog make the visibility poor, the Zeppelin will be signaled to follow the sound beam from the horn. Two horn units will be mounted on the hangar.

It is estimated that no difficulty will be experienced in reaching as many as 350,000 persons with both messages and music through the medium of the giant horns. During recent tests individuals in cars as far distant as one mile from the hangar plainly heard the music but were, of course, unable to determine the exact source of the sound.

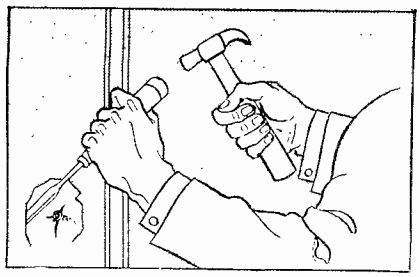
Cost and Tests

NAVAL officers are deeply interested in this development of sound beacons, and the results of the latest aviation communication system are being watched eagerly. Representatives from the Guggenheim Fund will also conduct a number of tests with naval aircraft.

Engineers supervising the installation stated that four five-ton trucks were required to transport the equipment from the Camden laboratories. The apparatus is valued approximately at $50,000.

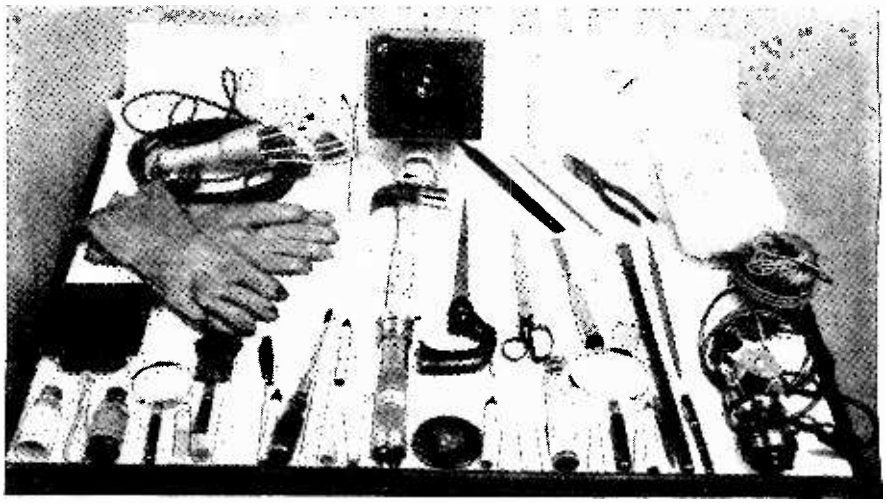
The Modern Sherlock Holmes

"Homicide Kit" Is Part of the Equipment of Present-Day Sleuths



The above illustration shows how a bullet is removed from the wall, so as not to destroy any markings which may have been imparted to it as it was propelled through the gun barrel.

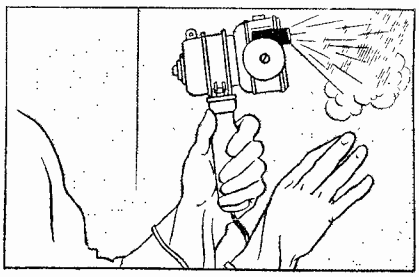
THE forerunner of our present-day *scientific detective* was undoubtedly that fictional character, Sherlock Holmes, well known to all. The modern sleuth is aided by science in his investigations, and if he does not go so far as to deduce from a torn shred of cloth that the wearer of the garment was a middle-aged man with a sandy mustache, who walked with a limp and had a large wart on the back of his neck —nevertheless, some of the present-day deductions are nearly as startling.



"Homicide Kit"

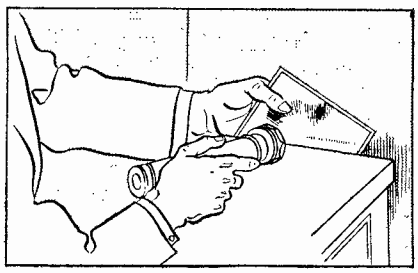
ACTING CAPTAIN DONOVAN and Sergeant McGuire, of the Homicide Division, Police Department, New York City, are the inventors of what has come to be known as a "homicide kit," which is now part of the equipment of homicide squads in the five boroughs of New York City.

The case contains a number of tools, such as hammer, chisel, screw-driver, pliers, saw and scissors. The accessories for securing fingerprints include a special camera, a blower for powder, a brush and a pair of rubber gloves. Various other miscellaneous articles, such as a magnifying glass, pencils, tape measure, mirror, flashlight, cord, cheesecloth and test tube, are also provided.



Various accessories which are included in the police department "homicide kit" are shown above.

Aluminum powder, sprayed upon the walls or furniture with an electric blower, quickly reveals fingerprints.

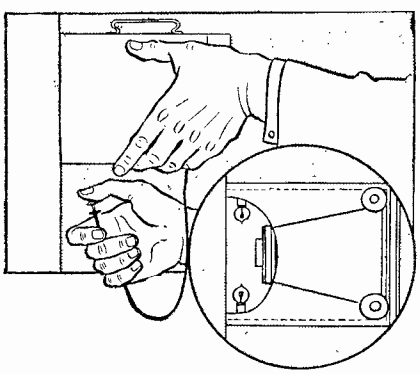


A mirror and a flashlight permit the detective to investigate inaccessible nooks and corners.

Uses of the Kit

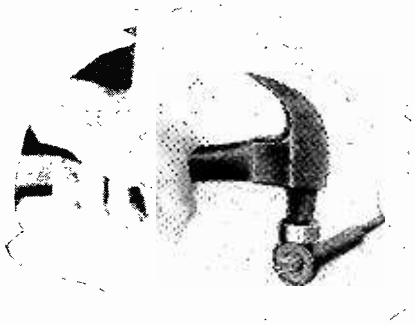
UPON arriving at the scene of the crime, photos of the body and surroundings are taken; the detective then uses his tape measure and notes the exact position of the body, also taking fingerprints of the deceased. The magnifying glass is used to reveal fingerprints on objects. Next the electric blower is brought into use and aluminum powder sprayed over the walls, floor and possibly large articles of furniture. Fingerprints are thus revealed and are then photographed by means of a special camera, which is placed directly against the wall or other object over the fingerprint. Illumination is provided by small electric bulbs placed in the front of the camera. Where dark objects are to be investigated for fingerprints, aluminum (*Continued on page* 465)

The photographs below show a group of kits used in the five boroughs of New York City and a view of one of the kits with trays removed.



Fingerprints on the walls of a room are photographed with a special camera, illustrated at the right.

Valuable Time and Labor Savers



Plug

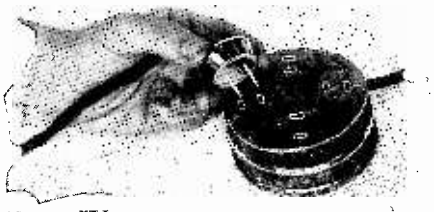
This is a new kind of soft rubber plug. It can be stepped on or struck with a hammer and is not damaged.

Owl Clock

In this clock the rotating eyes tell the time. The time indicated here is 6:02. Each orbit is marked with radial lines.

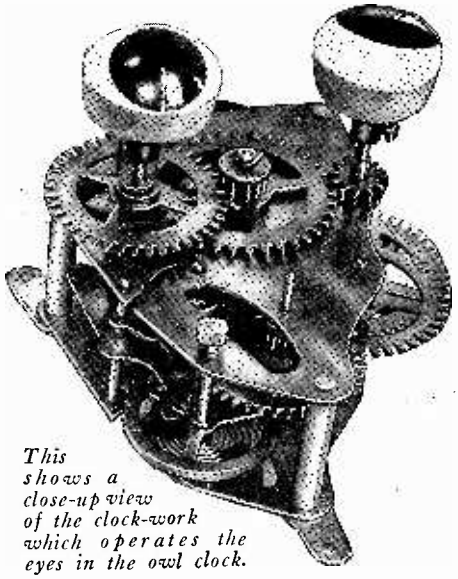
Sink Stopper

This device fits into the drain of the kitchen sink. When it is turned, it stops up the outlet, making the sink a basin, in which the dishes can be washed. Insert shows close-up of the device.

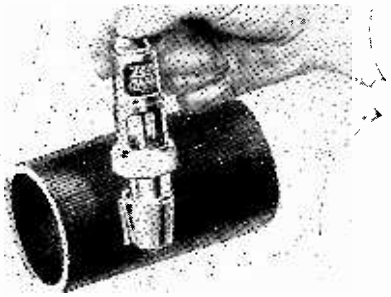


Four-Way Outlet

An outlet for the table top which enables the housewife to plug in four utilities to the lines. It is made in figured bakelite.

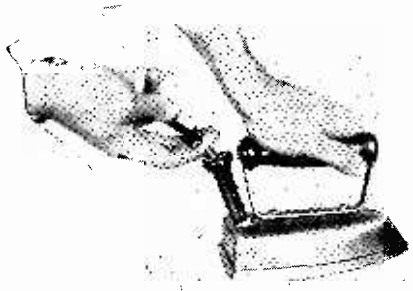


This shows a close-up view of the clock-work which operates the eyes in the owl clock.



Zerometer

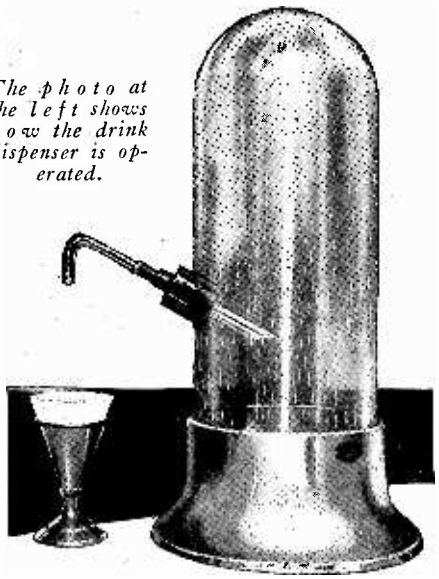
Don't wait until the winter sets in before you prepare your car for cold weather. This simple meter tells you instantly the freezing point of the mixture in your radiator.



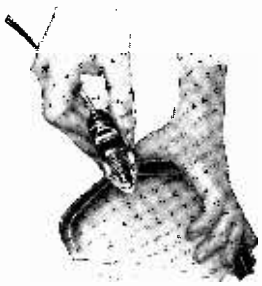
Iron Attachment

This plug, made in colored bakelite, has a grip for the fingers. The grip moves back and forth in a ball-like joint.

The photo at the left shows how the drink dispenser is operated.



When the glass nozzle is pushed into the path of the stream, the cup is filled.



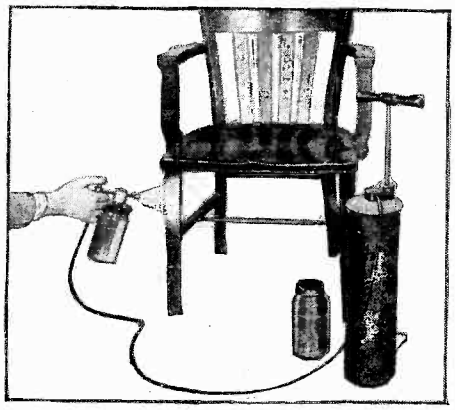
Electric Hot-Water Bottle Attachment

This plug will heat the water in the hot-water bottles and maintain an even temperature.

Drink Dispenser

A new type of drink dispenser for fountains. It is made of bakelite. A pump beneath the fountain produces a continuous liquid stream.

For Your Home



Paint Sprayer

By aid of this sprayer, modern furniture can be easily and quickly decorated. Illustration at the right shows the details of the sprayer itself. The tank has a pump and an air-pressure gauge.

A Dangerous Weapon

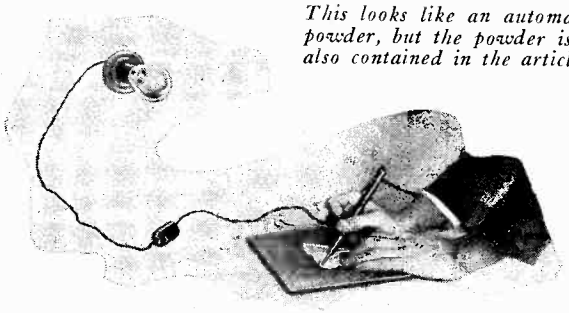
This looks like an automatic pistol, and it is actually filled with powder, but the powder is for facial use. Mirror and rouge are also contained in the article. No matter how used, it's dangerous.

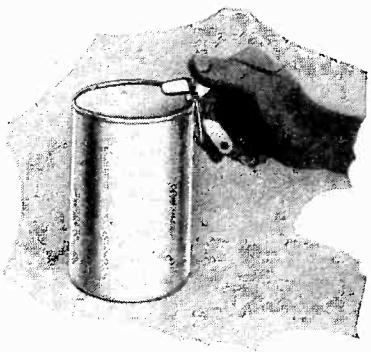
Rubber Stamp

This new type of stamp permits a perfect impression, regardless of how the handle is held. The ball joint allows freedom of motion of the stamp proper.

Slide Rule

A new slide rule extended. It is equivalent to an 88-inch rule.





Electric Pen

This shows a new type of pen provided with a heated metal point. The heat intensity is regulated by the size of the lamp connected in series with the pen. Gold, silver, and other metallic foils can be burnt into bakelite or leather by its aid.

Can Opener

Placing this can opener on a can and turning the key, cuts out the top and leaves a smooth edge.

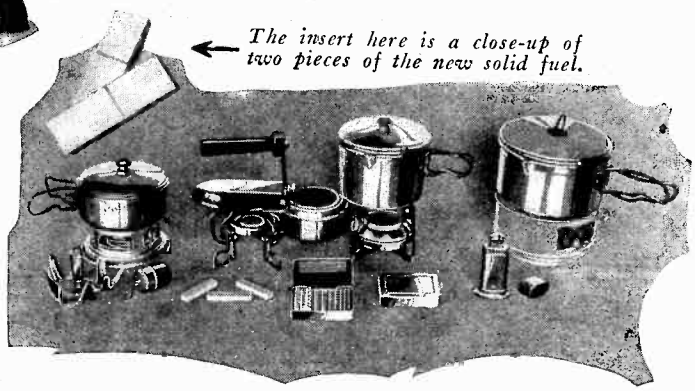
Modernist Furniture

Much difficulty is found in painting straight bands on new furniture. Adhesive tape makes an excellent straight-edged stencil. Tape is left in place until paint is dry.—George W. Sutton, Jr.

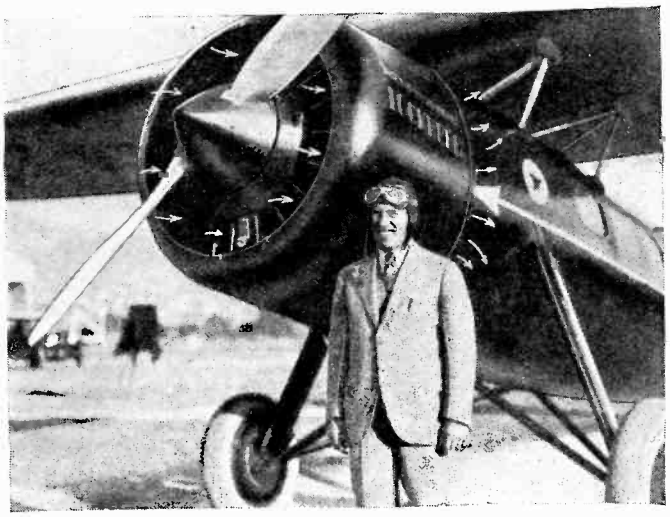
Portable Utensils, Stoves and Solid Fuel

At the right are shown a few portable utensils and different styles of stoves which use the new solid fuel. This fuel comes in stick form and produces a greater quantity of heat than alcohol. The flat-iron folds up and in every case the stove fits the utensil to be used with it.

The insert here is a close-up of two pieces of the new solid fuel.



AVIATION



SPEED: The above photograph shows Captain Frank M. Hawks with his Lockheed express monoplane, in which he lowered the coast-to-coast non-stop record. A cowling protects the motor and lends greater speed. Arrows show air current.

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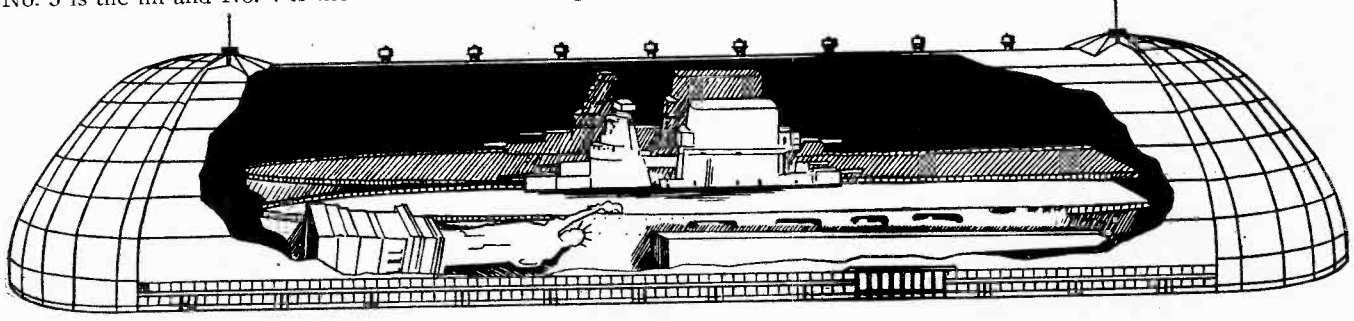
striking illustration of the United States Navy's giant dirigible ZRS-4, now under construction, as it will appear when completed. This huge aircraft will be provided with guns at the bow, the center and stern. These guns are clearly visible in the picture.

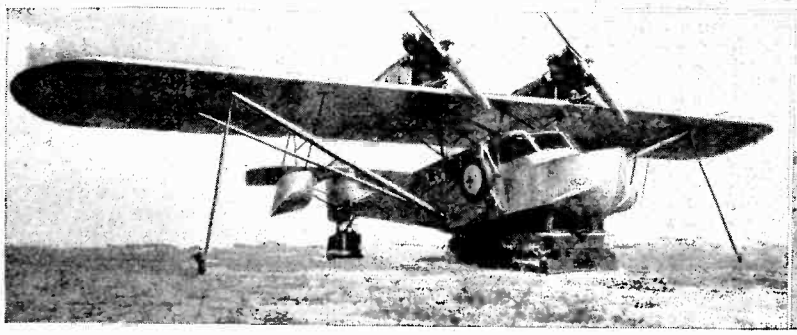
AIRPLANE TERMS: Aeronautical terms are now being explained in diagram form, as shown above. No. 1 is the stabilizer, which controls the longitudinal stability; No. 2 is the elevator; No. 3 is the fin and No. 4 is the rudder.

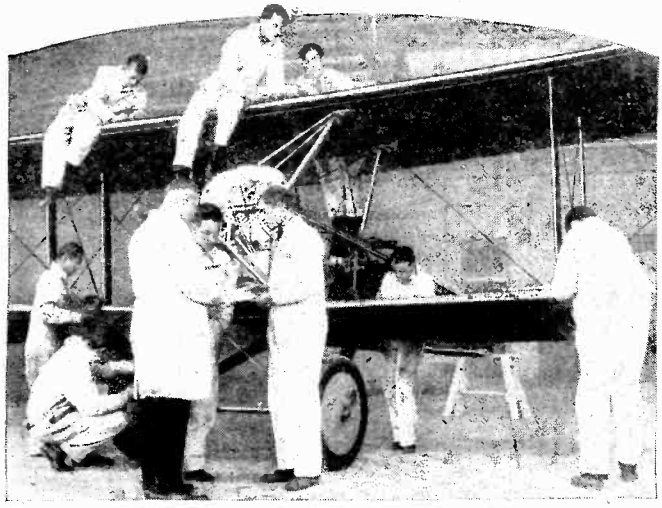
WORLD'S LARGEST HANGAR, shown below, is soon to be erected at the Municipal Airport at Akron, Ohio. The Washington Monument and the Statue of Liberty, placed end to end, could be fitted within the hangar and still leave room for the airplane carriers, "Saratoga" and "Lexington," the two largest ships afloat. The immense hangar will be 1,200 feet long, 360 feet wide and 200 feet high, having an unobstructed floor area of 389,000 square feet. The doors at each end will run on forty wheels and are operated automatically. The structure is the largest building in the world without supporting pillars or posts.



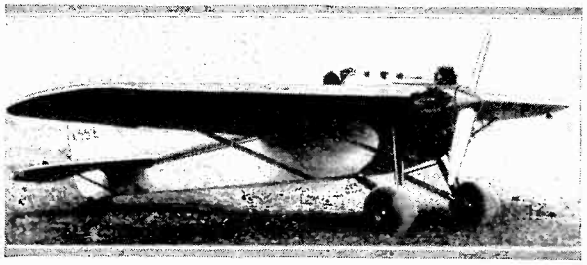
Up-To-Date

AMPHIBIAN: We give three views of a new amphibian, with a speed of 115 miles per hour. The cabin will hold six persons.

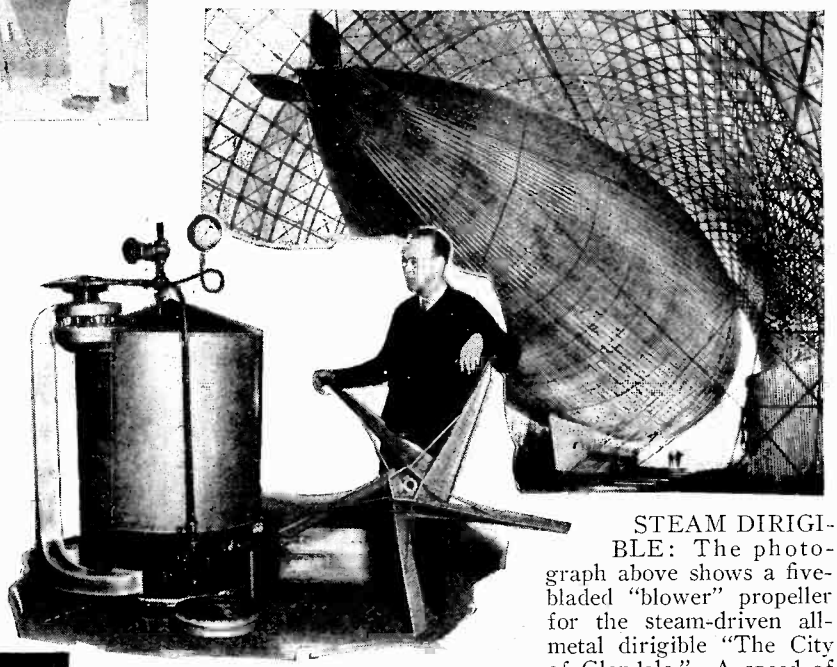




AVIATION CLASSES: The above view shows students and their instructor studying the various parts of a large biplane, which is part of the equipment of the George Washington High School in Los Angeles, California. This is the first high school to offer classes in aviation to the students.

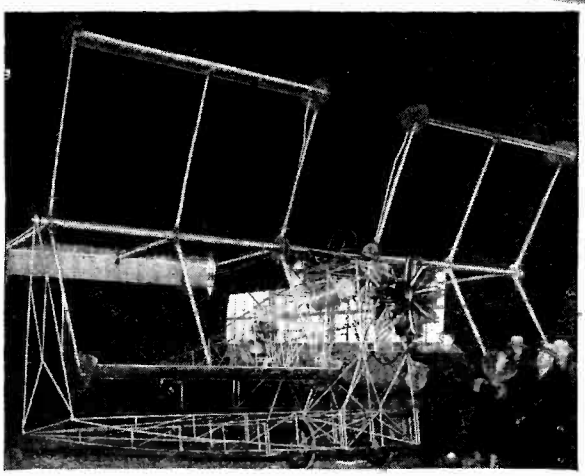


THE PLANE, shown above, is a new monoplane capable of attaining a speed of 95 air miles per hour. The craft is equipped with tires that eliminate the need for shock absorbers.



STEAM DIRIGIBLE: The photograph above shows a five-bladed "blower" propeller for the steam-driven all-metal dirigible "The City of Glendale." A speed of 100 miles per hour is expected with 40 passengers.

HELICOPTER: Below is a view of a vertical rising plane of a type which may revolutionize flying and eliminate the need for large landing fields. The skeleton shown is of steel. The new craft will be first tested in a trial flight some time during the fall at the Municipal Airport in Chicago. The inventor and his wife are shown inspecting the plane in the army hangar, where it is now stored.



"SHOVEL-NOSE" PLANE: Above is a plane of odd design, driven by a propeller which whirls through an aperture in the large wing. The wing covers the suspended cabin, motor, and landing gear. Due to its construction, the airplane will lift 5½ pounds per square foot. The ordinary plane can only lift 2½ pounds per square foot. Mr. E. E. McClary of Long Beach, California, is the designer.

Is a College Education

Helps more after success has been attained

—W. O'Neil

President of the General Tire and Rubber Company

Yes, but lack of it is not necessarily fatal to success

—Frank Melville, Jr.

President of the Melville Shoe Corporation

Few leaders in American industry can match the romantic career of Frank Melville, Jr., president of the Melville Shoe Corporation. He was born seventy years ago in the old Ninth Ward in New York City the son of a schoolmaster father and a cultured, talented mother. At fifteen he ran away from the Ft. Edward Academy (N. Y.) because, he explains, no one ever translated the word education *to him. His first job was clerking in a shoe store; but for ten years he drifted from one employment to another. He was master of a sailing boat, owner of a bathing concession; he worked in a factory where they made straw hats from canton flannel and he tried his hand at punching cows in the Dakotas.*

It was as a rider for the famous S & G outfit in the Black Hills that Mr. Melville first tasted the life of the plains country and found it good. Later he drove stage and farmed for a space. Then Fate upset all of his plans. Returning East to spend Christmas with his parents, he became engaged, and with the announcement of his troth, all idea of again going West left him. He went back to selling shoes; perhaps, he told himself, it was *a good business if one stuck to it long enough!*

His idea of mass production—and chain distribution—of low priced good *shoes came during a visit to the cutting room of a New England shoe factory. He saw shelf after shelf crowded with rolls of leather—scraps. There was imitation alligator and real; kangaroo and calf and vici kid. These were the left-overs, he was told. "Supposing," said he, turning to the manufacturer, "that I gave you an order for all the shoes of one style you could make for one week, and on the following week I gave you a similar order, to be followed out week after week. What saving would it mean in manufacture?"*

"It would mean a tremendous saving," the factory man said finally.

"All right then," said Mr. Melville. "I'll bring you the orders, you make the shoes."

Since that day his career has been one of steadily mounting responsibility in the shoe retailing field. In 1906 *he had eight modern stores; in* 1920, *nineteen. Today there are eleven great factories making shoes for his* 430 *Thom McAn, Rival and John Ward stores in* 222 *cities.*

By Frank Melville, Jr.

President of the Melville Shoe Corporation

ALMOST every boy starts out with a burning ambition to win fame in some particular field. Usually he wants to be a soldier, a sailor or an engineer 'neath tropical skies. My own case was the exception; when I ran away from school at fifteen, my motivation was not a consuming impatience to encounter romance and adventure; rather it was because I never had had the word *education* translated to me in its simple, human values.

So I can state unreservedly that I believe a college education is worth while; at the same time I do not believe the lack of it is necessarily fatal to success. It all depends upon the boy. If he is willing to fight, to practice self-denial and to forego immediate rewards in the interest of doing a better job, he will eventually reach the top, college trained or no.

Now, it seems fairly simple for us to understand that if we would be active in sports, we must exercise our physical equipment. The body must be groomed for its job; the particular nerves, (*Continued on page* 454)

W. O'Neil is president of one of this country's largest tire and rubber companies, known as the General Tire and Rubber Co., at Akron, Ohio. Mr. O'Neil's opinion on the value of a college education in business is interesting because it presents the subject from the viewpoint of a man at the head of a large business enterprise.

By W. O'Neil

President General Tire and Rubber Co., Akron, Ohio.

THE value of a college education is a hard thing to measure by any mathematical calculation. It is something like debating the benefits of a spring training trip for a baseball team. The spring training trip cannot make a baseball player out of a dub but it does seem to help Babe Ruth. The analogy of the baseball training trip is not exactly paralleled, since this training involves the actual practice in the business of baseball from which they turn immediately to the full swing of baseball activity. With a college education, however, the training is general and they do not step immediately into the full swing of any activity and whatever business activity they step into is going to be entirely different from the training they have gone through.

The field of business is a university itself. There are no rules and theories laid down as accurately as those in mathematics text-books. Thus we often find that a man who has been very good as a student while all the rules and regulations were exact and laid down for him in book does not seem to be able to continue his education in the field of business. He sometimes doesn't seem

Worth While?

Desirable, but not necessary

—Edwin Franko Goldman
Conductor, Musician, Composer

That depends on the kind of college education

—Prof. T. N. Carver
Professor of Economics, Harvard

Professor Thomas Nixon Carver was born on March 25, 1865. He has an A.B. degree from the University of Southern California, a Ph.D. from Cornell and LL.D. from Oberlin. He was a professor of economics at Oberlin College from 1894 to 1900 and since then at Harvard, where he still is professor of political economy. He is a profuse writer on economic subjects and was at one time adviser in agricultural economies to the U. S. Department of Agriculture.

able to grasp the more or less indefinite and even more necessary principles of ordinary business life.

I do not think that a college education to the average man of business has very much to do with his initial success but the country is going to be better off and the successful individual happier if he possesses an education and a knowledge of the things outside of his own line of business. A knowledge (*Continued on page* 454)

Edwin Franko Goldman was born on January 1, 1878, in Louisville, Kentucky. He began the study of the cornet at eight years of age, and at fourteen was awarded a free scholarship at the National Conservatory of Music of New York. At the age of seventeen he was a cornetist in the Metropolitan Opera House Orchestra, where he remained ten years. In 1918 he started to give band concerts to audiences of over 20,000 people, and his band concerts on the "Mall" in Central Park and the "Green" at Columbia University are well known. He has been a guest conductor in five New York theatres, has been honored by the state in recognition of services rendered to the people. He is a composer of note.

By Edwin Franko Goldman
Musician, Conductor, Composer

AS to just how necessary a college education is, I should say depends entirely upon the individual involved. I do not believe that a college education is essential for success in business.

I should say that a college education is always a desirable thing to have, but not a necessity, or perhaps not even a help in seven-eighths of the mercantile pursuits.

To my mind, college does not always educate, but life's school of experience does, and only those who are awake to the opportunities offered and ready to grasp them, make a success of their careers.

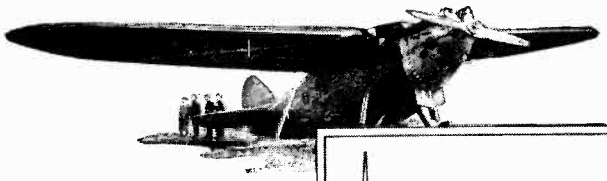
There is no reason why a college graduate should not achieve success in business, but, what is needed more in business than book knowledge (*Continued on page* 454)

By Professor Thomas Nixon Carver
Professor of Political Economy, Harvard

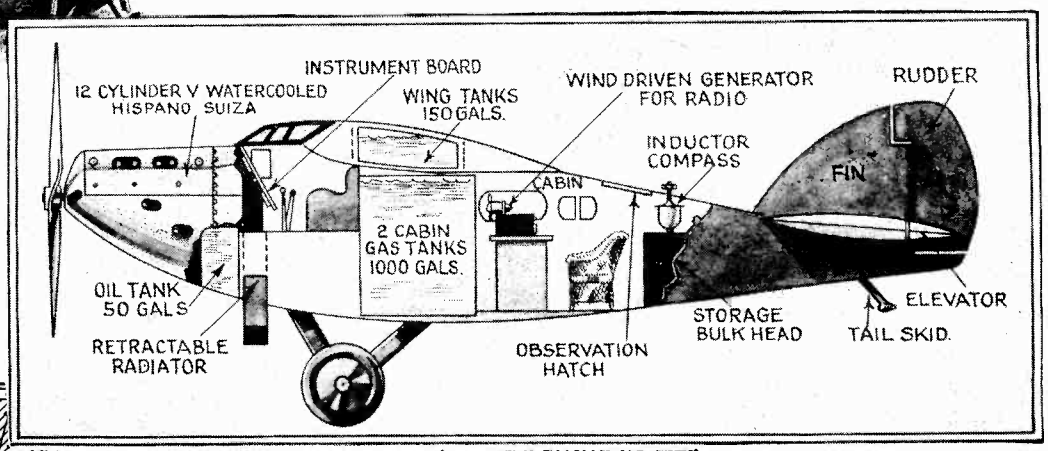
THERE is no reason for believing that a college education, as such, is either a help or a hindrance in business. It all depends upon the kind of a college education one has. A college education pursued mainly for the purpose of breaking into good society, of acquiring expensive tastes, or being able to speak disparagingly of the *bourgeoise,* the Babbits or the middle classes, is probably a hindrance in any honest career. A college education pursued exclusively for the purpose of personal enjoyment, of æsthetic cultivation, or of self-expression, while having a peculiar and sufficient value of its own, is probably neither a help nor a hindrance in business. But a college education pursued for the purpose of fitting oneself into the world of which one is a part and of training one's powers for participation in whatever of productive work the world is doing is certainly more often a help than a hindrance.

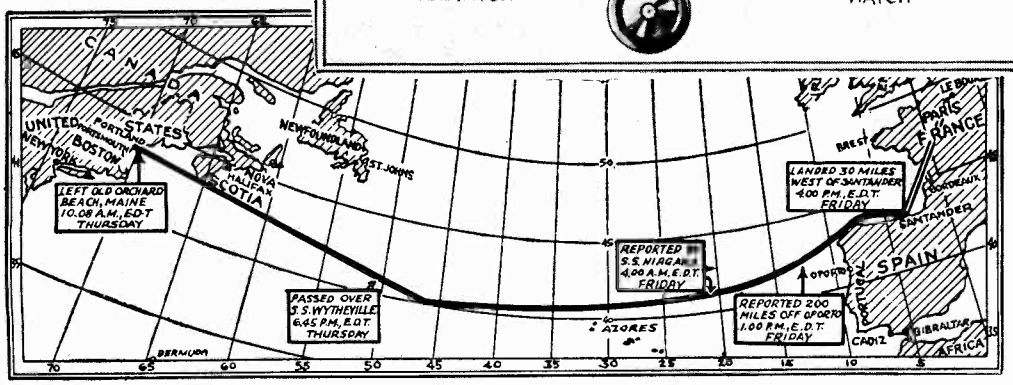
Of course we are all familiar with the facility with which round pegs get into square holes and square pegs in round holes. A college education is no insurance against that error. To train oneself for work for which one is by nature unfitted may be disastrous. On the other hand, a college education does not increase the frequency of that error. In fact it may be supposed to diminish that frequency because, if for no other reason, it somewhat delays the choice of a career, giving the young man a longer time to think about the problem, and a somewhat wider outlook on life before the choice is made.

In order to be of use in a business career a college education does not have to be definitely vocational, though a vocational purpose has a legitimate place in every plan for a college education. It need not be a selfish purpose. The world needs trained men in many fields. To train oneself for some of these fields is less selfish than to seek an education without regard to the needs of the world or to any useful (*Cont. on page* 454)



The photograph above shows the "Yellow Bird," and the illustration at the right shows the internal construction of this same plane, which took Captain Armeno Lotti, Jr., the sponsor and co-pilot, with Jean Assollant, Rene Lefevre and a stowaway, Arthur Schreiber, across the ocean to Spain.





Left: The route taken by the "Yellow Bird," showing where the plane was reported as having been sighted. This plane kept in communication with ships along the route. It was finally forced to land at Santander, Spain.

Smashing Aviation Records

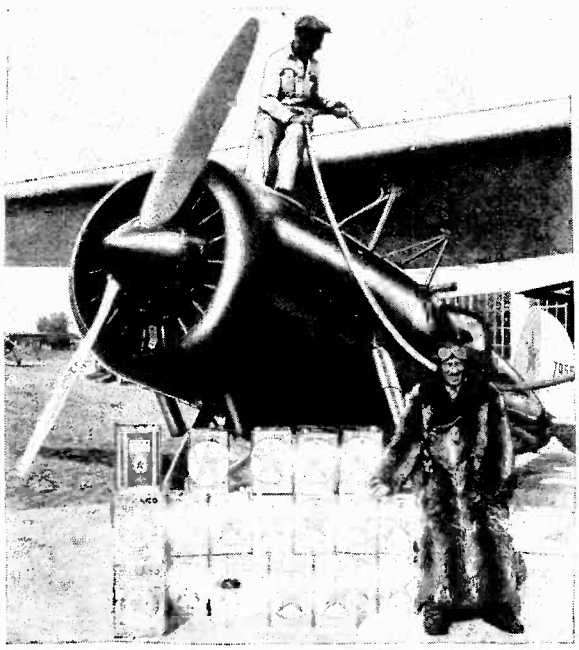
Two Trans-Atlantic Flights, Trans-Continental Speed Record and New Refueling Record Made and Smashed a Week Later

Paris Flight

AT 8 o'clock on June 15th, 5 P. M., New York, Eastern standard time, the French airmen, Jean Assollant, Rene Lefevre and Armendo Lotti, together with a stowaway, Arthur Schreiber, landed on the beach near Santander, Spain, 29 hours and 52 minutes after the start from Old Orchard beach, Maine. Two-thirds of the way the fliers had to contend with storms. They were further hampered by the extra man who had crept into the plane just before it took off from Old Orchard. Forced to swing south of the steamship lanes because of storms, their flight covered a distance of 3,128 miles. They then took two hops before they reached Paris, which was their destination.

New Trans-Continental Record

ON the morning of June 27th Captain Frank Hawks left Mines Field, Los Angeles, California, traveled to Roosevelt Field, Long Island, and again left Roosevelt Field to land in Los Angeles on June 29th, after a total elapsed time of 43 hours, 55 minutes and 47 seconds. His flight east was accomplished in 17 hours, 38 minutes and 16 3-5th seconds. His flight west was made in 19 hours, 10 minutes and 32 seconds. His average speed on the east-west flight was 152 miles per hour. By this flight Captain Hawks broke all previous records for the trans-continental journey.



Captain Frank Hawks standing beside the plane in which he made a new trans-continental record.

New Endurance Record

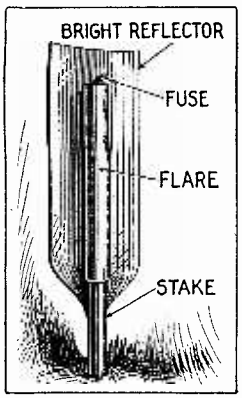
BYRON K. NEWCOMB and Roy L. Mitchell set a new refueling duration flight on July 6th of 174 hours and 59 seconds. This was done at Cleveland in a plane appropriately named The City of Cleveland. By this record they passed the former record set by James Kelly and Reginald Robbins at Fort Worth, Texas, only a short time ago. When refueling, the gasoline is delivered to the endurance plane at the rate of a gallon a second.

At the time of going to press the American monoplane *Pathfinder*, en route from Old (*Continued on page* 456)

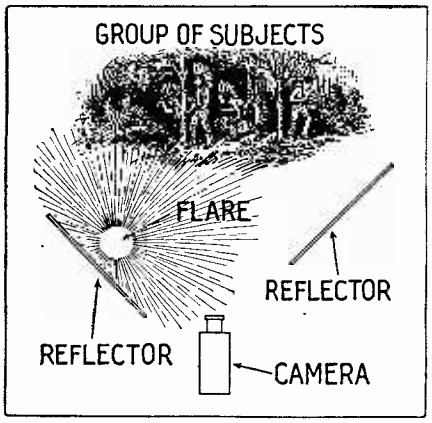
Home Movies

How the Amateur Movie Maker Can Use Smoke and Fire to Make Unusual Scenes and Titles for His Films

By Don Bennett



This shows how night flare is arranged in front of tin reflector, all mounted on stake driven into the ground. Figs. 1 and 1A.



Showing how to place night flare in front of reflector and also how to use a second reflector to kill shadows on the faces, etc.

Fire and Smoke

HAVE you ever seen the news-reel pictures made at Lake George and other winter resorts showing the skaters on the ice at night? Have you ever wondered how they are made, when you can't even light a small room successfully without several high-powered lamps?

This night work out-of-doors is made possible by the use of flares, sticks of an especially prepared compound containing magnesium powder that burns slowly, producing an intense white light. These flares are furnished, ready to use, in a cardboard tube with a socket for mounting. A stick is inserted in the hollow tube to support the flare at the required height and a piece of bright tin is tacked to the stick to act as a reflector (see Fig. 1). The top is torn open and a fuse is revealed which, when lighted, ignites a slow-burning yellow composition containing the magnesium mixture.

Magnesium flares are furnished in sizes according to the time they will burn. The smallest burns half a minute and from that, in half-minute steps, the time for the flares increases up to four minutes. One flare provides sufficient light for a small group out-of-doors, if a reflector is used on the flare and an additional reflector is placed to one side to kill shadows on the features (Fig. 1-A).

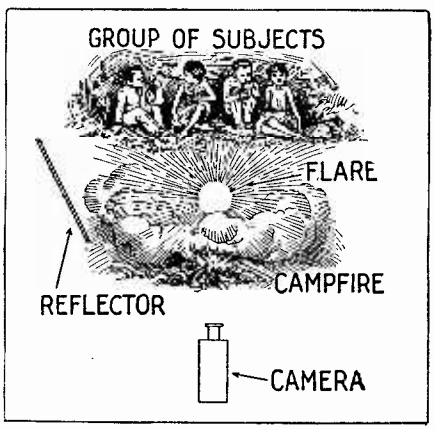
A novel effect is secured by placing a flare beside a camp-fire on the side away from the camera, sunk in a small pot, so that it does not reach the lens (Fig. 2). One flare used in this manner will provide enough illumination for five or six persons.

To take successful pictures of a large area, many flares and reflectors are needed, an expensive proposition unless the event warrants it.

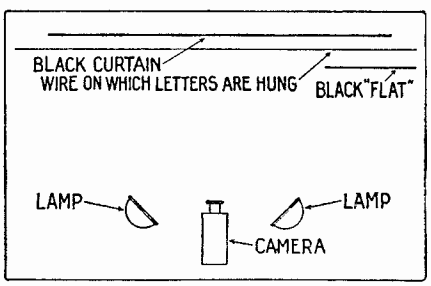
Usually manufactured by the same company is another movie-maker's aid, the opposite in effect of the flare, the smoke-pot, so-called because of its shape. Whereas the flare brightens up everything, the smoke-pot darkens it, laying down a heavy black smoke that gives the effect of burning buildings—buildings can burn in this way for 365 days a year without harm.

Smoke-pots offer the amateur many opportunities for tricks. The smoke is so thick that it obscures everything before the lens. Under its curtain substitutions can be made that produce either novel or comic effects. Let's work out a scenario for a little episode and see what will happen. Of course careful editing is necessary in working out any trick, so that the lapses are not seen on the screen.

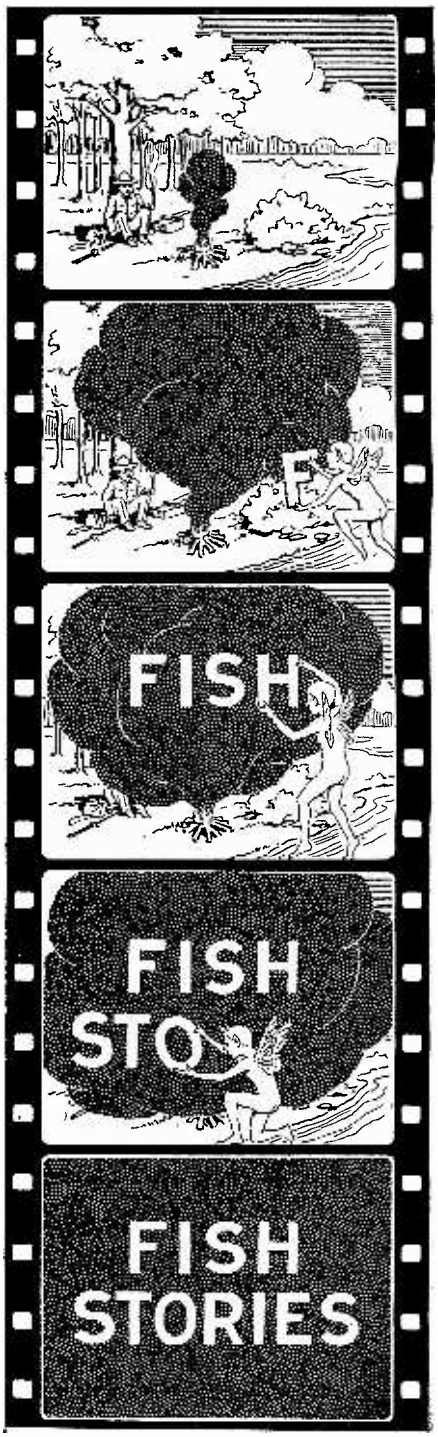
Down the road comes a flivver with the hero and heroine. They must be eloping, for they keep looking back as if watching pursuers. They approach a fork in the (*Continued on page 472*)



Novel effect by placing flare on far side of camp-fire. Note the reflector. Fig. 2.



Top view of setting for making "smoke" title, illustrated above at right. Letters are hung on wire indicated. Fig. 4.



Smoke-pots lend themselves nicely to the making of fancy or mystic titles. Here a wood-sprite emerges from the smoke and hangs up the letters, one by one, which eventually form the complete title. Fig. 3.

The Truth About Gasoline Savers

Revealed By George A Luers, *Automotive Engineer*

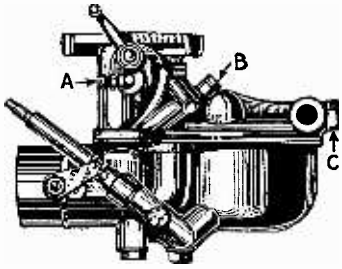


Illustration A, above, shows a carburetor of a moderate-priced car. The throttle stop screw is shown at A, the idling adjustment at B, and the filter plug at C.

CARBURETORS are not perfect, which fact accounts for the adjustments provided by the manufacturers for metering the gasoline, the air and also the heat. Almost every owner is satisfied if he can set the carburetor so that the engine hits on all cylinders at all speeds.

Even running and the best mileage from the fuel burned is a much-sought and desired combination, but even the service-station attendants cannot adjust the carburetor to do both. The mechanic may adjust for mileage, and you will find the car limping along at low speeds. If he adjusts to give *even running* without *skipping*, you find your gasoline bill mounting.

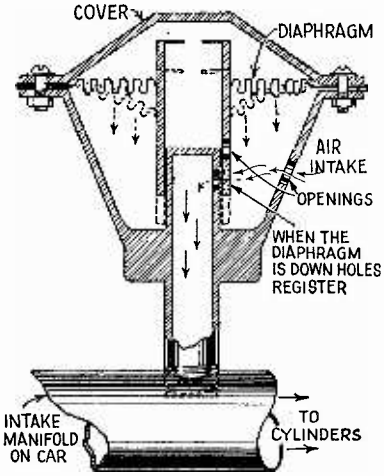
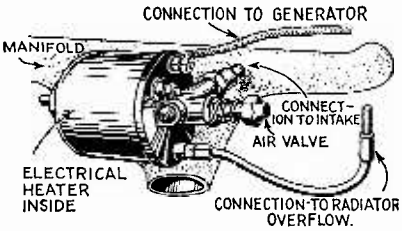


Illustration B, above, shows the working principles of a gas saver.

Much time and money have been spent by individuals, in attempts to correct the faults in carburetors. Inventions of merit have been made, which inventions improve the operating conditions of the engine and at the same time provide for much increased milcage from the gasoline.

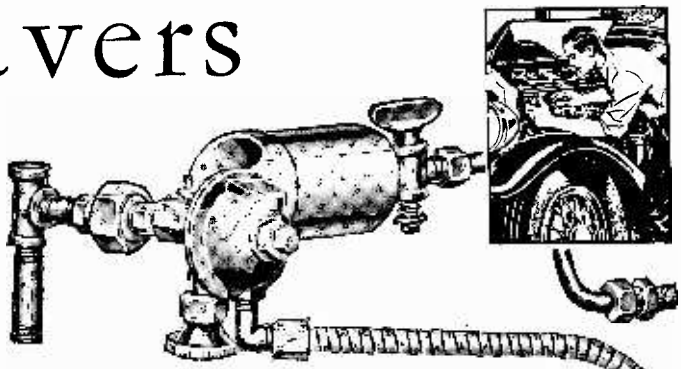
A brief description of the operation of a carburetor in a moderate-priced car will show the difficulty of setting the adjustments to give high mileage. In the carburetor at illustration A the air passes through the inlet of the carburetor, across a nozzle in which there is gasoline. The gasoline is held at a specific level through means of a chamber and a float.



Drawing D, above, shows the product of the Electro Gas Saver Manufacturers.

When the engine is running slow or is being started, the pistons pull air through at a very low speed. Not having much capacity to pick up gasoline, this nozzle must be opened up quite wide, in order that sufficient gasoline will be picked up and carried into the cylinders.

When the engine is operating at a high speed, the piston suction is great. If the nozzle is not immediately closed, the gasoline is fed in at an excessive rate. Of course there are other devices in the carburetor which are there to compensate for this great change in air speed; however, none of these are perfect and none can compensate precisely or to the greatest advantage.



Gasoline Economizers

MAINLY the inventor starts in to work out the difficulties of changing the imperfect mixture, which goes through the carburetor, into a more perfect mixture before it reaches the cylinders. Where the invention has been worked out to the extent that it has proven a means to give better carburetion and do this with less fuel, it becomes a marketable invention and is made available to the public.

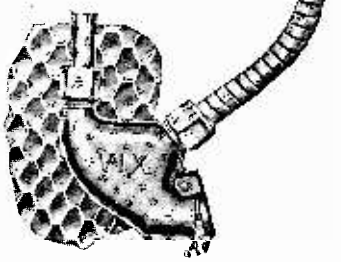
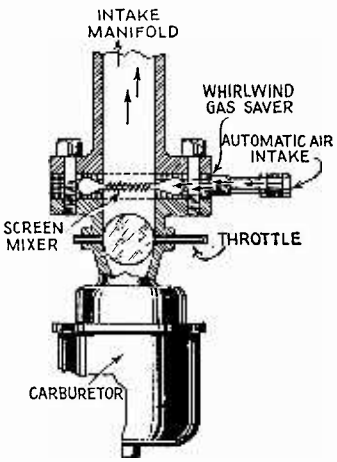
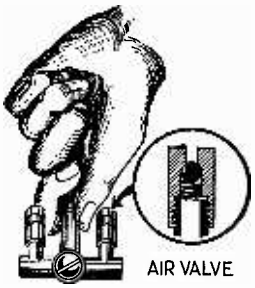


Illustration E, above, shows Vix completely automatic device, which dilutes the gas mixture and adds moisture according to the needs of the engine.



The gasoline saver made by the Whirlwind Manufacturing Co. is shown above in illustration F. This device is fastened between the flanges of the intake manifold and the carburetor.



The J. A. Stransky Manufacturing Co. make the device shown above in illustration C. This is a manifold attachment, but with valves and adjustments for individual fittings.

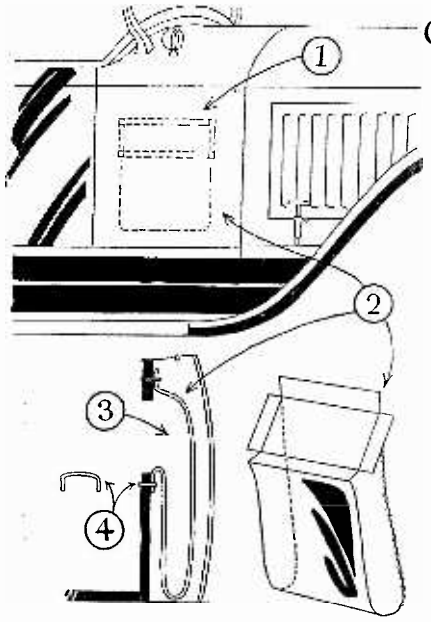
Gasoline economizers, featuring special methods but with the same ultimate aim of gasoline economy, are available to drivers of various makes of cars. Some of these are priced very moderately, while others, due to their more extensive and exacting details of manufacture, are correspondingly higher priced.

Illustration B is given to show the working principles of one of the inexpensive types of gas savers. This device screws into the intake manifold, above the carburetor. In this device there is a diaphragm, operated by the suction of the engine pistons. At low speed the diaphragm is stiff enough to resist movement. At high speed the diaphragm is moved, causing a hole in the attached tube to register with an opening in the manifold pipe. As a result a stream of cool air is brought into the (*Continued on page* 456)

Motor Hints

Conducted by George A. Luers

Practical Ideas for Autoists

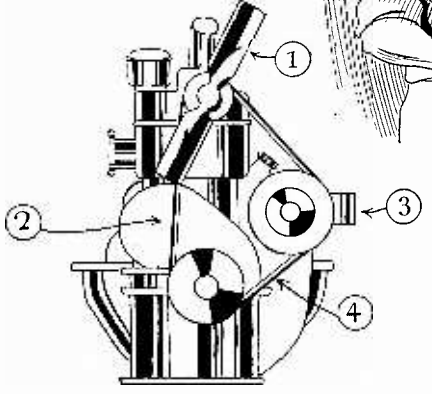


Tool Pockets

ADDITIONAL tool pockets can be fitted to the automobile, as shown in the above illustration, where 1 indicates the tool compartment; 2, the pocket made of rubberized cloth; 3, hole cut through facing inside body; 4, wire staples holding bag to facing. The pockets are made by cutting an opening 6″ x 4″ in the lining inside the car. Inside of these holes are fitted bag-shaped pockets made from heavy material. The pockets are secured with small steel staples, often used in clipping letters and papers together. Compartments so located can be used for storing tools used most frequently, the grease gun and other articles which could not be kept in the usual fancy door pockets.

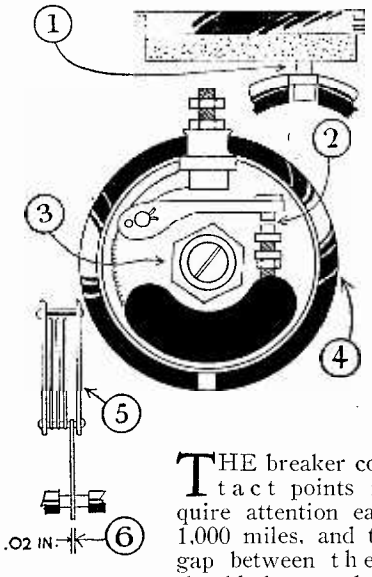
Care of Fan Belt

THE illustration below shows at 1, the fan; at 2, the belt; 3, generator; 4, belt drive. The fan belt should be kept free from grease and adjusted tightly at all times. Once the belt becomes oily, it should be changed. Wipe off all grease from pulleys and install new belt. Clean old belt with rag moist with gasoline and pack away in box of sawdust as at 5.

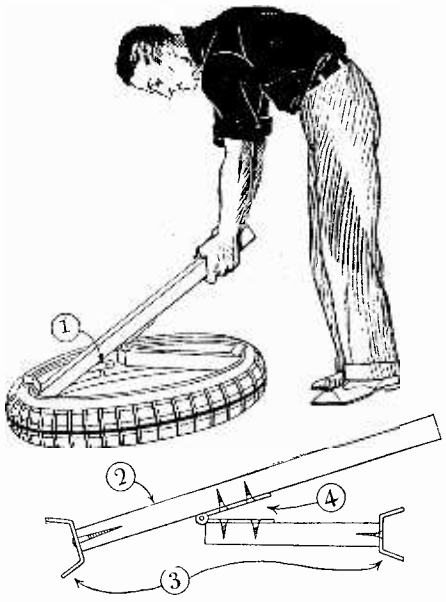


DO YOU KNOW—when the engine stops suddenly it is due to one of three causes most frequently? These are lack of fuel, loose wires or a broken mechanical part. Test for fuel at the carburetor. Examine for loose wires at battery, plugs, switch and at coil. For broken mechanical parts, determine if the rotor in the distributor turns. If the motor cannot be turned by hand, a piston or bearing may be seized.

Adjusting Breaker Points



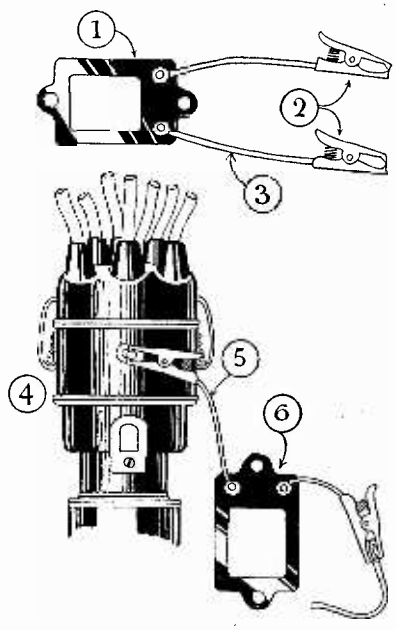
THE breaker contact points require attention each 1,000 miles, and the gap between them should be equal to .02 inch. It is advisable that the points be removed and dressed down flat on an oil stone. To adjust the contact points, proceed as follows: Lift off the distributor cap and remove rotor. Turn engine slowly with crank until the breaker arm rests on one of the six high points of the cam. The points are then removed and finished smoothly. Replace the points and adjust the gap. The illustration shows at 1, oil stone; 2, contact points; 3, cam; 4, distributor; 5, thickness gauge; 6, spacing.



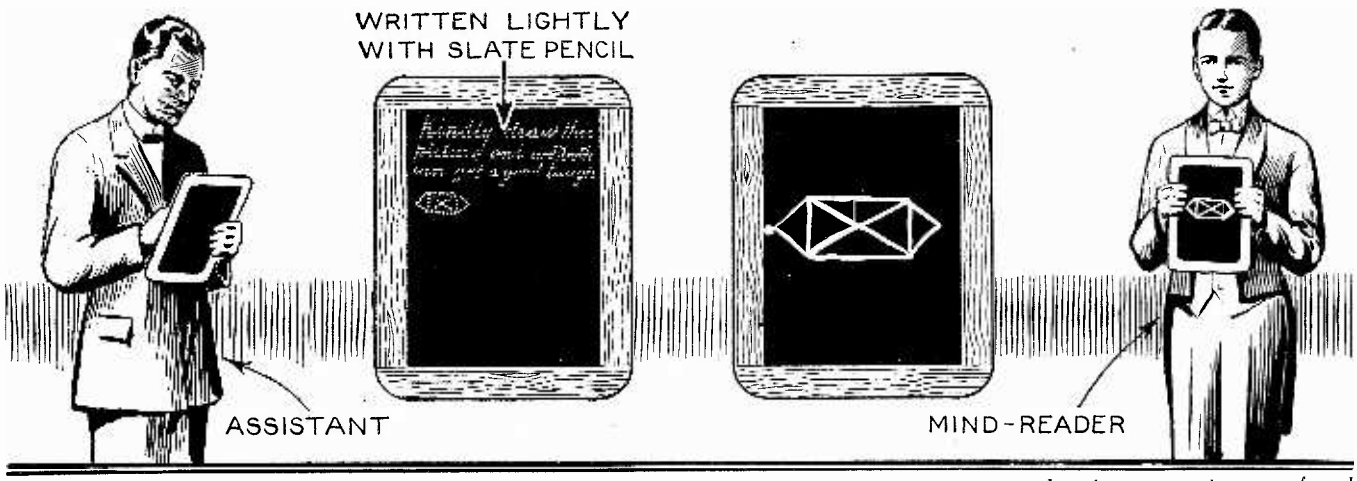
Home-made Rim Spreader

A WOODEN rim spreader which can be readily duplicated is shown in the above illustration, where 1 is the joint of rim; 2, side view of tool; 3, ends of iron; 4, hinge. The two pieces of wood are 2″ x 4″ in cross-section, and an ordinary strap hinge fastens the short member to the handle. Pieces of iron are placed across the ends to grip the rim. The extended length will vary according to tire size.

Testing Car Wiring



ONE of the simplest aids in testing the electrical circuits of a car is an ordinary buzzer of the 6-volt type. By means of this, the lead to each part, coil, lamps, stop-light and horn can be safely tested prior to connecting. In the illustration, 1 is the buzzer; 2, small battery clips; 3, test leads; 4 is the distributor, the circuit of which is under test; 5, test lead, and 6, buzzer.



Large audiences throughout this country have been mystified by this trick, originated by the writer. At present, various so-called "dealers in magic" are charging fabulous prices for the secret. Effect: The mind reader exhibits two clean slates. One of them is handed to a spectator with the instruction to go to the far side of the hall and draw any picture he desires with the chalk with which he is provided. While doing this, the "mental marvel" sketches a picture upon the duplicate slate. When the spectator returns, both slates are held up for examination, and to the amazement of the spectators, the drawings upon them are found to be identical. Secret: The slate handed to the volunteer is apparently clean, yet upon close examination one will find a message lightly written with slate pencil. It reads, "Kindly draw this picture and we both will get a good laugh." Thus, if you are clever enough to pick the right assistant, he will do as the message indicated. Both he and the magician will find much amusement in the thunderous applause, and the assistant will not acknowledge his complicity to any except closest friends.

MAGIC

By Hugo Gernsback

NUMBER 73
OF A SERIES

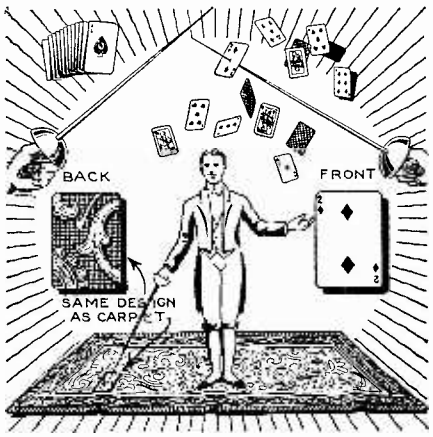
Materializations

THIS is an interesting spirit effect. The wizard is stripped of his clothing and examined to prove that no apparatus is concealed about his person. After dressing in a borrowed suit if desired, he is securely bound in a seated position to an ordinary office chair. The lights are extinguished and a few moments thereafter a small sphere of a ghostly green color becomes visible, gradually grows larger and takes

Even though the magician has been thoroughly searched and securely bound, he can materialize a ghost in a dark-room séance.

on the form of a face. After a few minutes, the sphere again shrinks and disappears. The secret lies in the fact that a small toy balloon painted with a non-poisonous luminous paint was concealed in the mouth of the performer; the balloon, on being blown up, produces the materialization. The face should be artistically finished.

Demon Swordsmanship

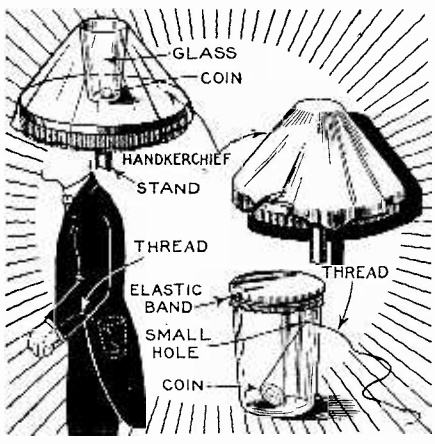


With the aid of a card, on the back of which a piece of cloth has been pasted, the magician can catch a card in air on the point of a previously examined sword.

ALL kinds of mechanical swords have been constructed for catching a previously selected card in midair, but this is the first trick in which the sword can be passed for examination before and after presentation. The effect is briefly as follows: A card is selected from a pack, shuffled into the pack again and the spectator, upon request, tosses the entire deck into the air. The wizard thrusts the point of the sword among the falling cards and mysteriously catches the chosen card. Secret: The card is forced. A duplicate has been prepared by pasting a piece of cloth of the same color and design as the carpet upon the back. When the card is faced down on the carpet. it is quite invisible. The magician pushes the sword point into the card on the floor and then brings this up among those in the air.

The Talkative Coin

IN previous articles in this series. I have mentioned "talking" coins wherein the coin beneath the cover is the one manipulated. The effect: A coin is examined, marked and dropped into a glass which is placed by the spectator on an end table. A handkerchief is then borrowed and used to cover the glass. Any questions now asked are answered by clinks of the coin. At any moment the coin can be examined. The secret:



A duplicate coin in a glass, concealed in the performer's hip pocket, produces the sound which spectators believe comes from a glass and coin on the table.

All of the paraphernalia on the table is absolutely innocent of deception. The performer has prepared himself by placing a duplicate tumbler in his hip pocket. This contains a coin attached to a thin thread which runs down his sleeve and is fastened at the vest. By moving the string the duplicate coin in the pocket is made to produce the sound.

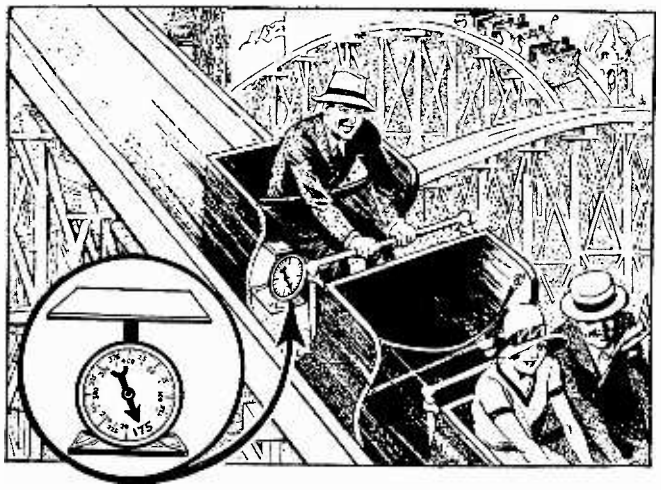


Fig. 3—When the car starts, the scale registers the normal weight of the man or 175 pounds.

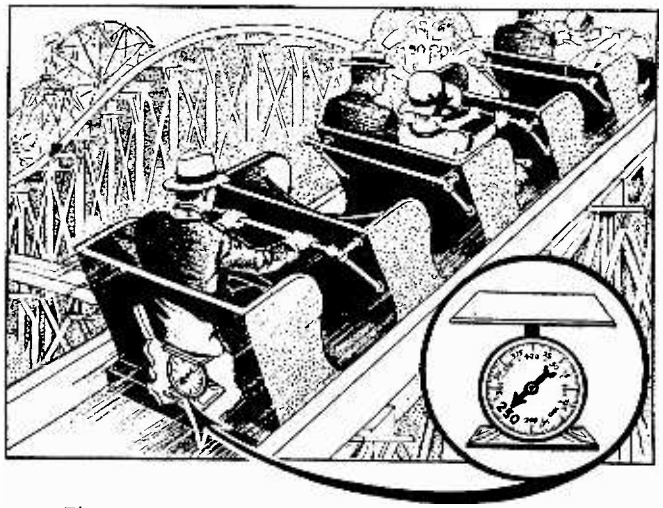


Fig. 4—As the car rushes up the grade, the scale reads 250 pounds. The weight is now greatest.

How a ROLLER COASTER Demonstrates Relativity

By Donald H. Menzel, Ph. D.

THE characters in this trialogue are a Relativist, a Physicist, and a Layman; the latter being a mere dabbler in the theory. To all appearances they are bent upon pleasure, for they are entering an amusement park, where the din of merriment, the cries of the barker and the gay music of the merry-go-round are heard. Strange occupation for men of science? We shall see. The relativist carries a large suitcase, to what purpose will soon be made apparent. In the following, for sake of brevity, much of the irrelevant conversation has been omitted:

Relativist (paying for the tickets)—My treat, boys. I brought you here on this wild goose chase for the express purpose of demonstrating to you some of the more interesting truths of Relativity.

Chorus—Relativity?

R.—Yes. Both of you, particularly my friend the Layman, are always insisting that Relativity never comes within our experience. I'm going to prove that you're wrong.

Physicist—There's a dip-the-dips (roller-coaster). I'll take a chance that gravitation will hold the car to the tracks.

Layman—If I remember correctly, you claim that the force of gravity is only an illusion, due to the fact that an object is made to deviate from the path it would naturally take if nothing disturbed its motion.

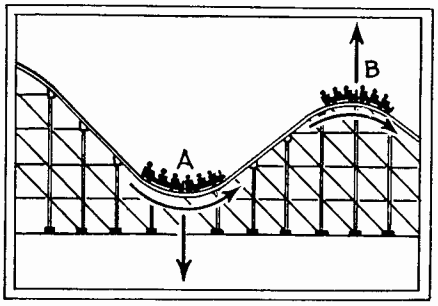


Fig. 5—When the car is at A, the curved path develops a centrifugal force that throws the man against the scale. At B the force is upward.

R.—That's about right.

P.—I'm not satisfied with your calling gravitation an illusion. It seems very real to me.

R.—In what way?

P.—Well, I should think that the movement of an object is caused by some force acting upon it.

R.—How will you measure the force?

P.—One of the most common means is by weighing the object.

R.—I think you are reasoning in a circle. The object moves when you weigh it, causing a pointer to move also. Are you not guilty of saying this, "A force, acting on a body, produces motion. The presence of a force is detected by the tendency of the body to move."

P.—That does sound a little shaky, I'll admit. Perhaps I can fix it up. The object does not have to move. I could weigh it on scales rather than a spring balance. (Fig. 1.)

R.—No, that is still unsatisfactory. In that case you are merely balancing the tendency (*Continued on page* 466)

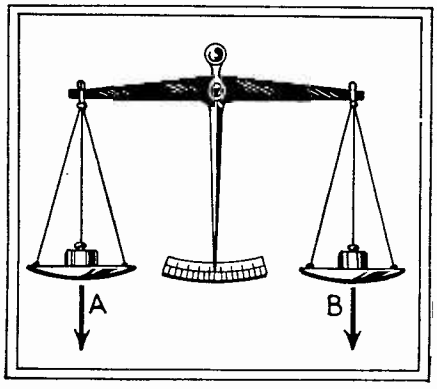


Fig. 1—The pull of gravity on weight A is equal to that on weight B. Consequently the tendency of the pointer to move in one direction is compensated by its tendency to move in the other.

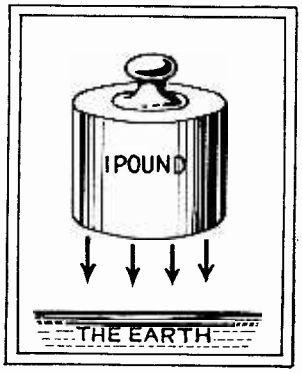


Fig. 2—The earth seems to attract the weight with a force of one pound. It is that force we have called gravitation. However, gravitation is as mysterious as ever.

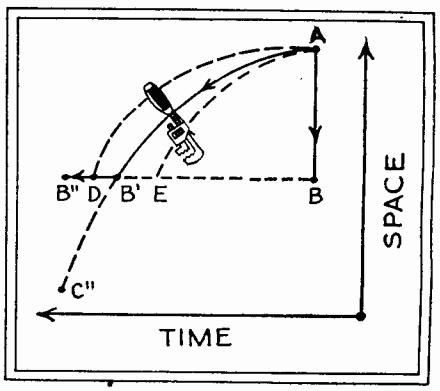


Fig. 6—The "world lines" of a falling monkey-wrench are shown above. The track of a body through space-time is a line called a "world line" or geodesic.

Experiments *with* Little-Known Chemicals

By Dr. Ernest Bade

To acetamide in a large flask add bromine and shake. Then add a solution of potassium hydroxide to decolorize the solution.

The Amides and Amines

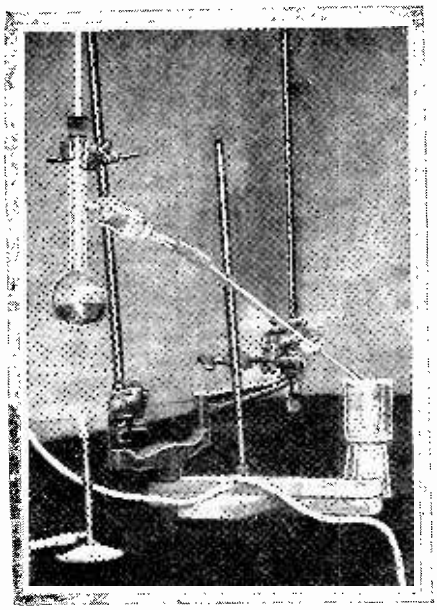
THE amides may be described as derived from ammonia, NH_3, in which the hydrogen has been partly or entirely replaced by organic acid radicals. They are prepared by the action of ammonia on the acid chlorides, anhydrides or the esters. The amines, on the other hand, may be considered as coming from ammonia (NH_3), one or more of the hydrogen atoms being replaced by an alkyl group. Both of these groups, the amides and the amines, give primary, secondary and tertiary compounds, each group having its own distinct reactions and thus its distinguishing chemical differences.

Acetamide, a primary amide, is acetic acid with its hydroxyl radical removed and the amido group (NH_2) in its place. A secondary amide is formed when a primary amide and an acid anhydride react, thus replacing another hydrogen, while the tertiary amide, which is formed entirely differently, is prepared by the reaction of an anhydride on a nitrile, all the three hydrogens of the NH_3 group being replaced by the acid radicals.

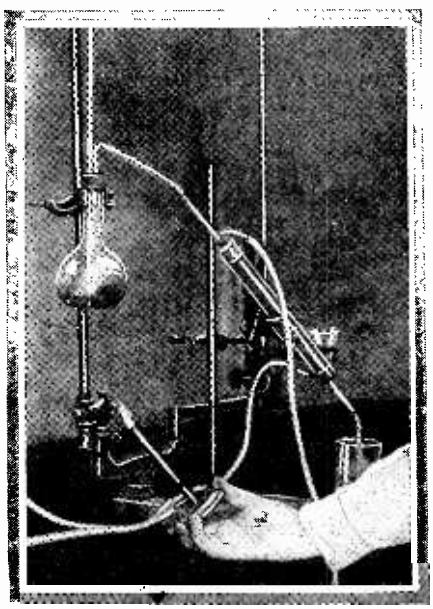
Methyl amine is a primary amine of the simplest or lowest sort. It is ammonia (NH_3), with one hydrogen atom removed and a methyl group substituted. The secondary amine has two of the hydrogen atoms of ammonia substituted for two alkyl radicals, while the tertiary form has lost all of its three hydrogen atoms, using alkyl radicals in its place. The preparation of these amines is usually difficult in the smaller laboratory, although some of the simpler ones may be prepared.

Since the amine is prepared from the amide, acetamide is first made. The reactions are simple and just require time.

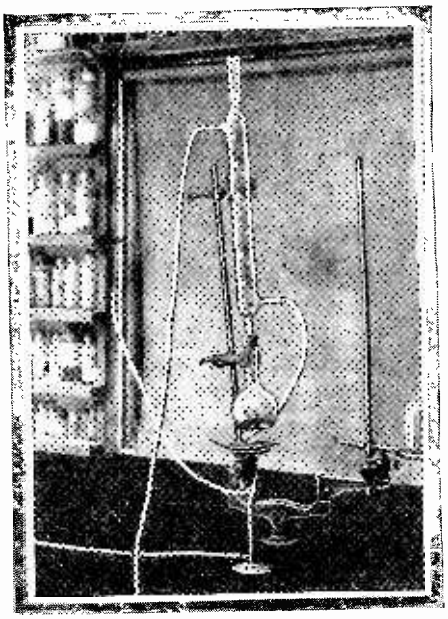
Mix equal volumes, say 40 c.c. of ethyl acetate and 40 c.c. of strong ammonia water, in a flask. Stopper loosely and shake the two layers vigorously. After a lapse of two or three days,



When the mixture of ethyl acetate and ammonia is homogeneous, it is distilled slowly with a small flame, using an air condenser.



Collect the gas of methyl amine by passing through a condenser and into an inverted funnel placed in a solution of equal volumes of hydrochloric acid and water.



Acetamide can also be made by refluxing a mixture of dry ammonium acetate and glacial acetic acid.

shaking occasionally, the liquid will appear homogeneous. As soon as the liquid is uniform and does not separate into two layers, it is distilled slowly with a long and wide air condenser. As soon as the vapors in the flask reach a temperature of 170° C., the receiver is removed and another substituted. Save this fraction and continue until all has come over. If the acetamide crystallizes as it distills in the air condenser, heat the condenser and the acetamide will run into the receiver. It melts at 82° C. and boils at 222° C. If it does not crystallize at once, let its stand over night. Remove the crystals and dry on filter paper. The remaining liquid may be again distilled and the higher boiling fraction saved for another crop of crystals.

Another way to prepare acetamide is by refluxing a mixture of dry ammonium acetate and a little more glacial acetic acid. After boiling for about four hours, distill with an air condenser as mentioned above.

Dry the crystals of acetamide rather quickly, for they are deliquescent, that is, they absorb moisture from the air and liquefy.

A characteristic reaction of the amides is the formation of the acid by reacting with nitrous acid. Acetamide gives acetic acid.

The amines form a group of compounds which are exceptionally interesting, although not readily prepared by simple means. It is with their aid that one can pass from one member of a homologous series of a compound to the next. This, truly, is a fascinating study, especially in this age where all sorts of chemicals are produced from so-called waste. Take wood alcohol. This compound of the destructive distillation of wood (as well as other substances) can be converted to grain alcohol. Naturally the method is not a commercial process, but since similar reactions in the building up of compounds is (*Continued on page* 464)

Which Articles Do YOU Like Best in Science and Invention?

Be Sure to Vote on the Ballot Below Your Particular Choice of Articles

FROM time to time the editors make a survey of SCIENCE AND INVENTION readers' opinions as to their likes and dislikes. Here is your chance to vote for *more* or *less* of the various classes of articles which appear in SCIENCE AND INVENTION. As the editors and publishers of SCIENCE AND INVENTION aim to please their readers, they will naturally be guided as far as possible by the final results obtained in computing the number of votes cast pro and con for the various subjects here listed. If you do not wish to mutilate your magazine, you may copy this list either in pen and ink or else have it typewritten, and mail it to the Ballot Editor, Science and Invention, 381 Fourth Ave., N. Y. City.

	MORE	LESS
Physics	☐	☐
Experimental Chemistry and Electricity	☐	☐
Scientific Problems and Puzzles	☐	☐
How to Make It	☐	☐
Editorial	☐	☐
Construction Articles	☐	☐
What Our Readers Think	☐	☐
Aviation—General News	☐	☐
Airplane Construction Articles	☐	☐
Glider Construction Articles	☐	☐
Astronomy	☐	☐
Oracle	☐	☐
Shop Mechanics	☐	☐
Radio—New Sets and General Articles	☐	☐
Radio Set Construction	☐	☐
Exposés	☐	☐
Motor Hints	☐	☐
Latest Patents	☐	☐
Geology	☐	☐
Biology	☐	☐
Naval Advances	☐	☐
Model Department	☐	☐
Radio Oracle	☐	☐
New Radio Devices	☐	☐
Wrinkles, Recipes and Formulas	☐	☐

	MORE	LESS
Magic	☐	☐
Scientific Fiction	☐	☐
Automotive	☐	☐
Botany	☐	☐
Wood Working	☐	☐
Wood Turning	☐	☐
Patent Advice	☐	☐
Book Review	☐	☐
Home Movies	☐	☐
Home-Made Furniture	☐	☐
Agriculture	☐	☐
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Spiritualism Exposés	☐	☐
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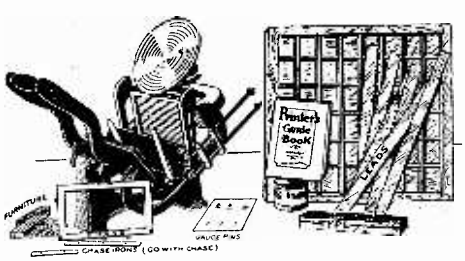
Making Professional Movie Titles at Small Cost

THOSE who desire neat looking titles for their home-produced movies, and yet do not feel skilled enough to attempt hand lettering, will find a small press and outfit a great help. A small machine, which may be purchased together with the type, ink etc., for around $18.00 complete, will answer every purpose. Black type can be printed on white cards or the reverse—white characters may be used on black cards. Most amateurs find printing in black on white cards the most satisfactory.

If artistic backgrounds for the titles are available (these can often be cut from magazines) the printing can be done right on the background. There are no limits to the possibilities and the first expense is practically the only expense, except for the trifling cost of the cardboard. Handsome poster backgound effects may be obtained by cutting designs in ordinary floor linoleum, mounting the linoleum on a wood block and printing from the block in the press. The words may be either cut in the linoleum or type may be used on a linoleum-block printed background. In the latter case, one or more good designs may be used over and over again, with change of title on each. Making your own Christmas or birthday cards from linoleum blocks printed in anywhere from two to seven or eight colors, is much in vogue nowadays, and this may also be done with the same small press.



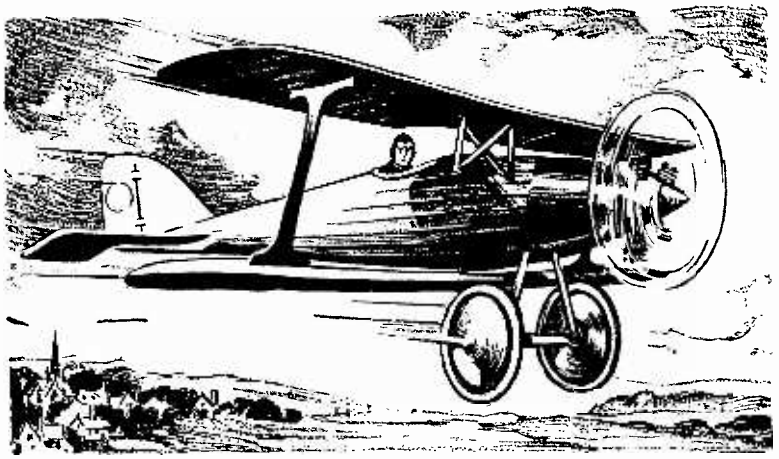
The amateur movie producer will find this printing press invaluable for title work.

The owner of a small printing outfit for movie titling will find it very convenient to print his or her own personal stationery, cards, and other similar work. Bookplate designs in linoleum may be also made, and for those who want to put a little more money into the hobby, pen-and-ink sketches may be made, zinc cuts produced from them by the company furnishing the press, and printing can be done from the cut. Just as in the case of a linoleum-block title background, several good pen-and-ink or painted backgrounds may be developed, and these may be made into cuts and printed with your press. The makers carry quite a variety of type.

Building a Sport Plane

PART II

(*Conclusion*)



The completed sport biplane is shown above in flight. It will attain a speed of 100 miles an hour when powered by a 30-horsepower motor.

BY looking at the drawings, if you are somewhat familiar with airplane controls, you will see that the standard control as used in all the Army planes, is here utilized. The so-called "joy stick," as will be seen from the drawings, is pushed forward or backward in order to raise or lower the horizontal rudders which cause the tail to rise or fall, as the case may be. By moving the joy stick sidewise, the outboard ailerons are moved up and down for turning and banking. The vertical rudder of use in turning and banking is moved sidewise as required by means of the two vertical rudder wires running back through the fuselage from the foot control lever, which can be seen in dotted lines in the top view of the airplane.

The fuselage or body of this sport plane is made up of strips of wood, such as spruce, and after being built to the proper shape, is covered with airplane linen, which can then be given several coats of nitrate dope and then Valspar. A great many of the accidents which have occurred in flying airplanes has been due to the wing breaking off, especially when making a turn due to the great stress put on the wing which crumpled up or simply broke off at this critical juncture.

Therefore it is important to remember before attempting to fly any airplane, whether factory or home built, to stand on the wings and pull on them so as to see that they are good and strong. The "flying course" cited above, as well as many of the leading books on flying, tell how to check up all of the angles of the wings accurately and also how to put a test on them, so as to know just how strong they are. As pointed out in the U. S. Army Flying Manual, it is very important to carefully check up the various angles of the wings and the angle of one wing with respect to the other, for on these factors depends the stability of the airplane when in flight.

SO great has been the interest shown by our readers in airplane construction articles and so excellent is the design of the Lincoln sport plane which originally appeared in the July and August, 1926, issues of this magazine, that we are again publishing this data. The first part of the article appeared in the August issue and is concluded here. Many of these planes have been successfully built and flown. The plane is economical and will fly 35 miles on a gallon of gas. The cost with an Anzani motor totals about $1,250.

Selecting Wood

IN selecting wood for airplane construction only straight grain wood, such as spruce, which is very tough, should be tolerated, and, furthermore, it should be free from knots. Unlike building a piece of furniture or a model out of wood with glue and a few bolts, it is not sufficient in building an airplane to carry you through the air safely, that the finished job simply looks strong; it must be strong, and as aforementioned, it is the best idea to get the opinion of an experienced flyer before you venture aloft in any airplane, whether home or factory built.

Dependent upon what type of engine you elect to fit on your sport plane, the matter of the engine mounting frame at the front of the plane will vary. The steel plate mounting shown in the drawings here is for the Anzani three-cylinder 30-35 h.p. motor. This engine mounting plate is made from No. 12 gauge sheeet steel, and the very important point to be watched here is that this engine mounting plate is rigidly secured to the fuselage. This feature is taken care of by means of turn buckles and the ⅛-inch stranded steel cables, as drawings clearly show.

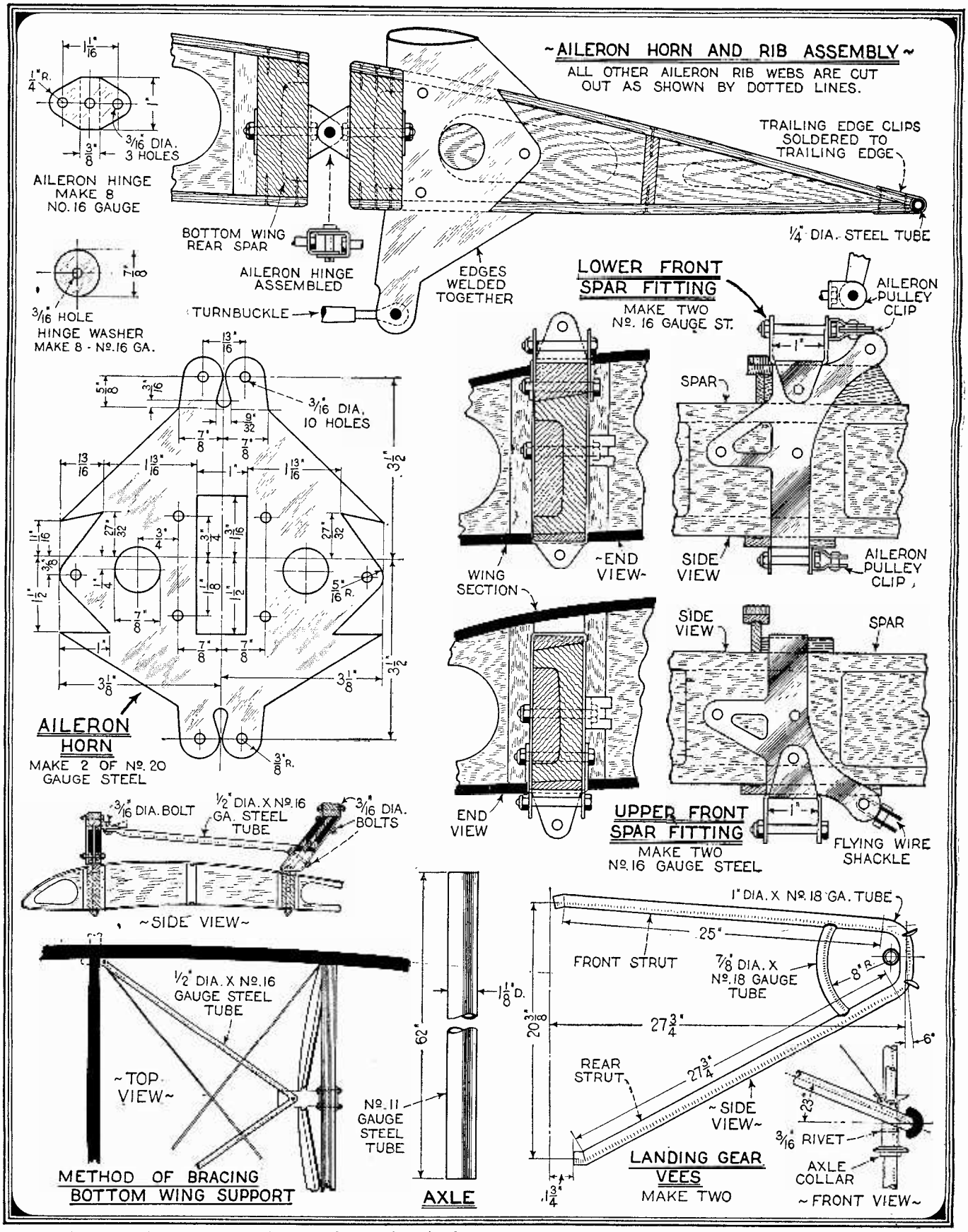
It is practically impossible for an amateur to make a satisfactory propeller, and so this is to be purchased. It can be obtained from various airplane companies or from the designers and builders of this sport plane. The wheels of the landing gear are fitted with pneumatic tires, and the landing gear is made doubly resilient by means of ½-inch diameter rubber band, several turns of which are placed around the axle and the landing gear V frames, as the drawings indicate. The tail skid, as will be seen, is adjustable, and has a resilient feature, thanks to several turns of ½-inch diameter round rubber band.

If the prospective builder of this sport plane is a swimmer, it will probably be a very good idea to first try out the plane as a seaplane, fitting pontoons to the bottom of the landing gear vee's, instead of the wheels. With the pontoons, the weight of the plane will be greater and no smaller engine than the Anzani 30-35 h.p. three-cylinder type should be tried. A little experimenting will have to be done in order to find the best position of the pontoons under the plane.

It is strongly recommended that the builder secure flying instructions from a flying school or licensed pilot. However, if this is impossible for financial or other reasons, the following hints will be useful. Taxi slowly around the field, getting the feel of the flipper and rudder control. When once the pilot can taxi in a straight line, short hops may be tried. Keep a foot or so above the ground. Taxi fast into the wind or slowly with the wind. In making the first flight ascend to an altitude of only about a hundred feet and fly over a good landing place. The best angle of climb lies between 3 and 8 degrees, depending upon the power plant.

The stick should never be pulled back too sharply. The first turn should be shallow and should cover two or three miles. Additional instructions on flying will be found in the July issue of this magazine, on page 279.

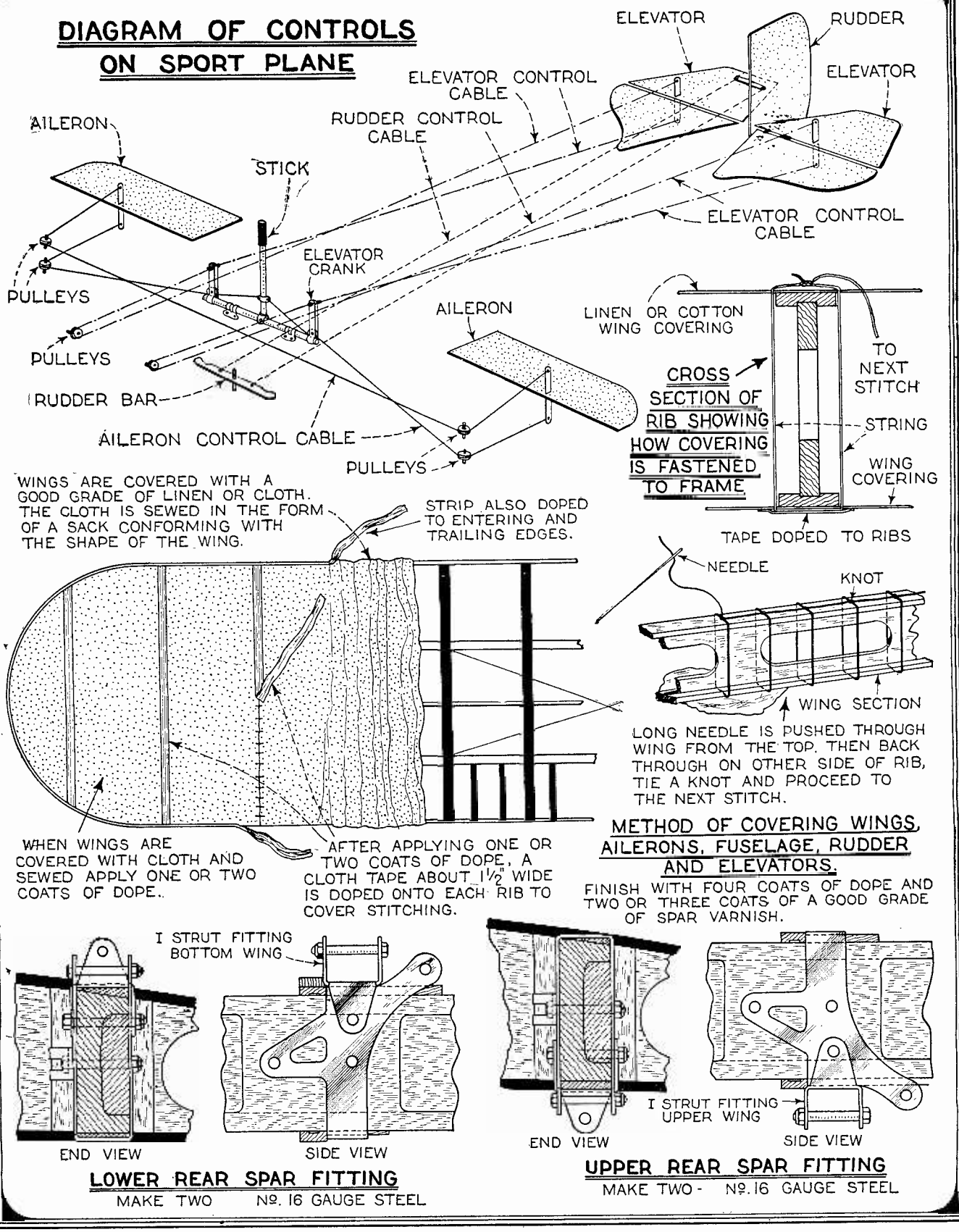
Details *of* Home-Built Plane



The details of the aileron horn and rib assembly are given in the drawings at the top of the page. The illustration at the center left shows how the aileron horn is made from a piece of sheet steel, bent to the required shape. The details of the lower and upper front spar fittings appear at right center. The tubular construction shown at the lower right-hand corner is for the landing gear vees, the axle being resiliently mounted at the lower ends of the vees by means of standard airplane rubber. The method of bracing the bottom wing support is also illustrated in the above drawing.

(Additional drawings on next page)

Sport Plane Control Features



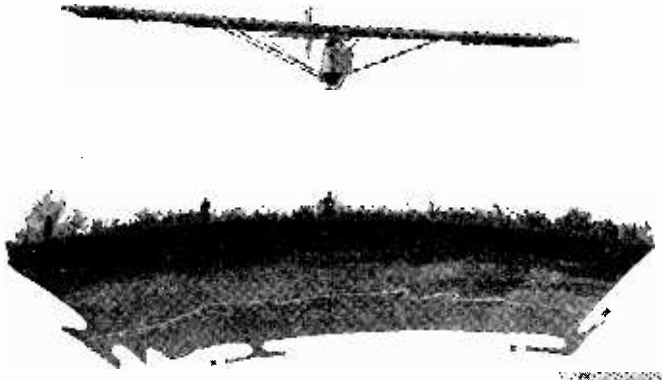
The control system for the sport plane is shown in the above drawing. The cables leading from the control stick to the ailerons and tail rudders are composed of standard steel cable 3/16" in diameter. The horizontal and vertical rudders as well as the ailerons are strengthened with a number of ribs.

The airplane cloth is sewn to the ribs of the rudders and ailerons, in the same manner as that shown for the wings. These control members have their cloth treated with dope, which is followed by two or three coats of spar varnish. The upper and lower rear spar fittings are shown in the lower drawings.

Hints *on* Flying *a* Glider

By Henry Townsend

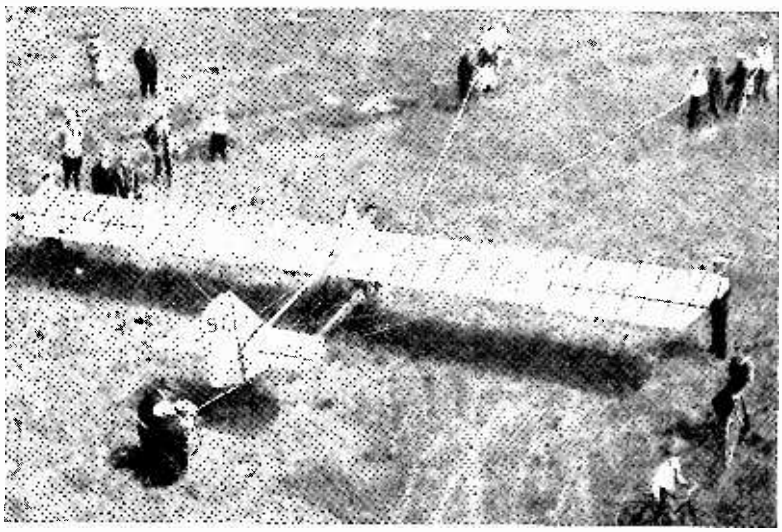
Gliding Is Undoubtedly the Greatest and Most Rapidly Growing Sport We Have Today



Above we see a glider of the enclosed fuselage type in flight. Note launching rope on ground.

THE greatest sport in America today is undoubtedly that of gliding. Not all of us have the financial means to afford one of the better built gliders, such as that shown in the photo opposite, but by following the plans given in the past few issues of this journal, a group of young men may readily build a successful glider and receive a vast amount of pleasure and thrills with it, not to mention the real aviation experience they obtain. It has been said by many aviation experts that it is more difficult to skilfully fly a glider than it is a regular engine-driven plane. With the airplanes of today, especially those fitted with the Handley-Page slotted wings, or else having a design of wing giving great stability in flight, the engine will pull the student aviator through the air, and his major difficulties lie in the successful taking off and landing of the ship. Gliding is therefore a desirable first step.

With gliders, one has a very good control of the whole situation, and the student flier does not have to take unnecessary chances at all when he is learning to manipulate the controls of the glider. By having the glider towed behind an automobile, for example, a low speed of say ten to fifteen miles an hour may be employed, so that the glider just flies along a short distance above the earth. In this way the student pilot learns how to keep the glider on an even keel, by working the control stick and changing the position of the ailerons at either end of the wing, as well as the horizontal rudders at the rear of the glider.

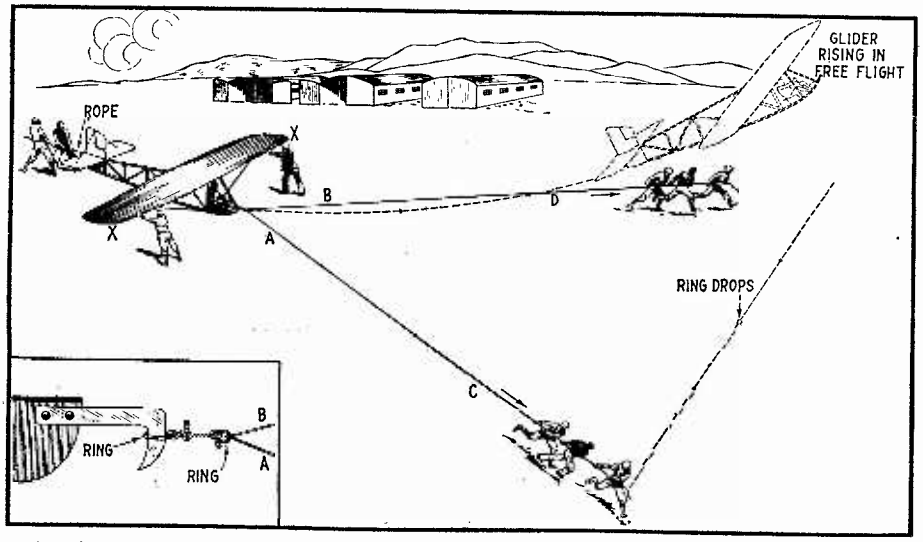


Chicago glider enthusiasts ready to launch one of their man-carrying gliders. After being started by pulling on the rubber cords, the glider rose to a height of 50 feet and was then flown by the pilot for a distance of 500 feet.

MORE GLIDER DATA COMING

Watch for it!

Gliders have been launched by attaching one, or in other cases two, cables, as the diagram herewith shows, the cables being either pulled by men running down a hill or else attaching the cables to automobiles. One of the cleverest tricks lies in the utilization of rubber shock cord, such as that used on the under-carriage of planes, suitable lengths of this rubber cord being secured to ordinary ropes, as the diagram shows. A tail rope is either held by a group of men or preferably secured to a release trigger mounted on a stiff peg driven into the ground. The two groups of men walk forward at a diverging angle, as indicated in the picture, and when the rubber cord has been stretched to a fairly high degree, the pilot gives the signal—the tail rope trigger is released and the glider is shot into the air at a high velocity. It goes without saying that a green pilot who has never flown a glider should never be catapulted into the air in any such manner as this. He should have learned through previous lessons how to keep the glider on an even keel when being towed behind an automobile. We presume some of our glider friends will shortly be building gliders with pontoon hulls, so that they (*Continued on page* 451)



The diagram above shows arrangement of rubber cords A and B, joined to manila ropes C and D, also self-releasing ring on hook of nose of glider and position of men at wing ends X X and men at tail release rope.

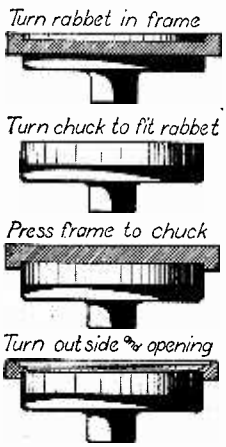
Article No. 13 in a Series

Wood Turning

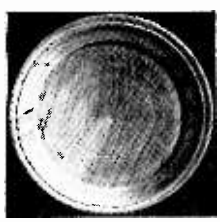
By H. L. Weatherby

Quaint old pictures make excellent plaques. They are glued to the wood and varnished. Round picture frames are easily made and solve many of the framing problems for wood workers who have lathes.

Frames and Plaques



Steps in turning.



Upper—frame in first stage. Lower—finished frame.

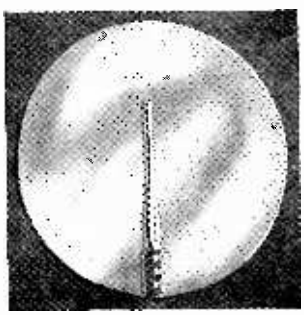
Turned Picture Frames

IN order to secure a truly professional-like job of picture framing, we usually have to take our work to one who is equipped to handle this sort of a job. The ordinary home mechanic doesn't have facilities for making moulding; and if he buys the moulding, it costs him nearly as much as the frame made up would cost. He doesn't have a miter clamp, and probably lacks a fine cutting miter saw; and, viewing all of the arguments against framing a picture, he usually decides that the easiest and cheapest way out of it is to have it done for him.

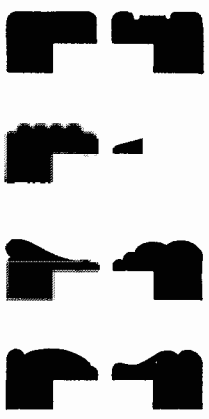
These arguments do not hold, however, for a round frame. The most beautiful and delicate of mouldings may be turned and decoration may take any form desired. It is true that all pictures cannot be framed in round frame, but on the other hand there are a great many pictures that would look better in a round setting than in the square or rectangular one which they perhaps already occupy. This is particularly true of portraits and especially of old ones that have been in the family for years or generations. Nothing sets them off like a simple round, black frame.

The construction itself is simple. The thing that will probably worry the prospective builder first, if he is already familiar with his lathe, is the cutting of the glass. Of course a professional glass cutter could do this with little trouble, but why take it to a professional when one can do it himself?

The first step in cutting a piece of glass to the desired shape and about ⅛″ smaller than size is to cut a template, either of thick cardboard, using knife or scissors, or out of a piece of thin wood on the lathe. This must be the glass size desired. Lay this template on the glass and with an ordinary glass cutter, purchased from the "five-and-ten," cut carefully around the template, being careful to get a good cut the first time around and avoiding a going over.

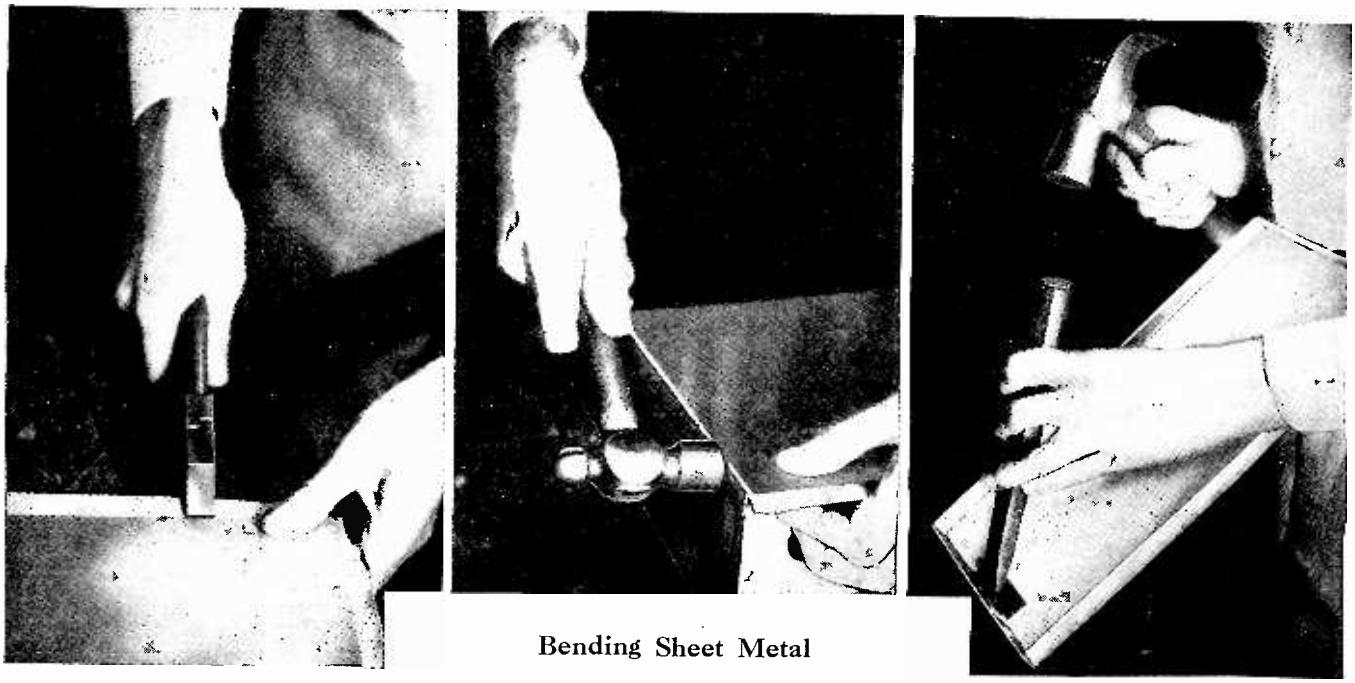


For cutting circles of glass, a template is first made. After the circle has been scribed on the glass with the cutter, the glass is tapped gently on the bottom side. Drawing at bottom of page shows types of molding.



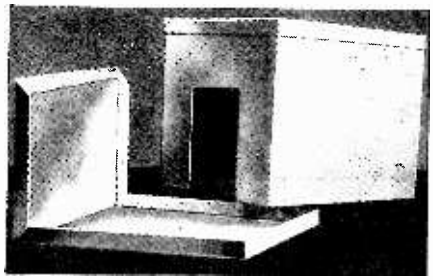
Now, tapping gently from the under side, work around the circle until the circular section, if it is carefully handled, will drop out. In case difficulty is experienced in getting results this way, sections on the outside may be removed by cutting into the circle and breaking loose a piece at a time until all outside glass is removed. These steps are fully illustrated and with some slight possible breakage, a (*Continued on page* 471)

How to Make It



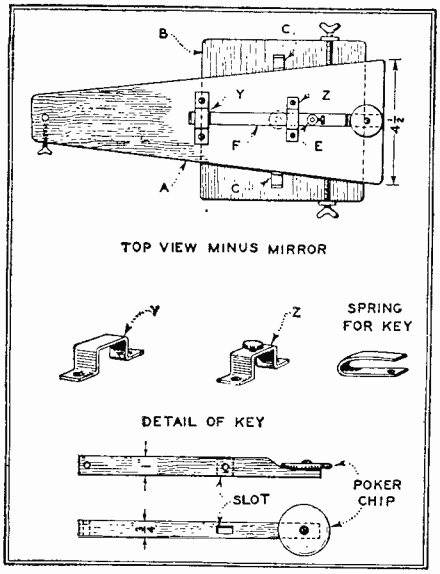
Bending Sheet Metal

WITH the aid of two pieces of angle iron, one about 3 inches long and the other a foot or more in length, sheet metal can be bent expertly in a professional manner. After the bend has been indicated by a line, the metal is bent slightly with a pair of pliers or with light blows of a cold chisel. Next, the metal is further turned by means of a hammer and a wooden block. For final forming, the rough bend is placed in the groove of a large piece of angle iron and the smaller piece placed on top, as shown in the photograph. A cold chisel resting on the small piece is struck a sharp blow, forcing the metal into conformation with the shape of the angle. This will result in a sharp bend having a clean edge.—*Walter E. Burton.*



Constructing a Heliograph

By L. B. Robbins

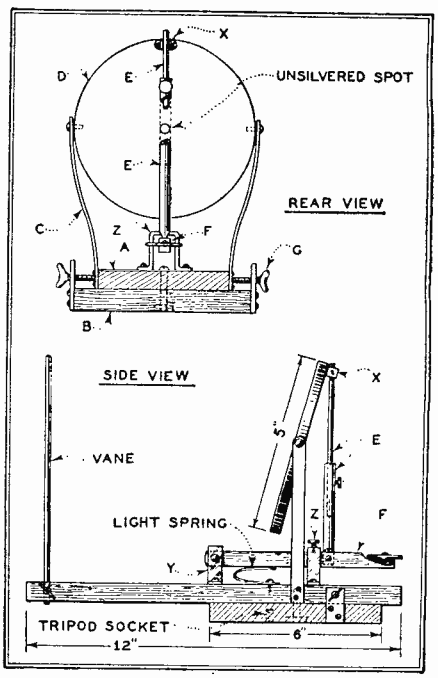


A top view of the instrument without the mirror and details of the key are shown in the above illustration.

NOTWITHSTANDING the advent of radio for long-distance signaling, the heliograph still is extensively used by the armies of many nations for signaling in bright weather. This is because the signals can be made absolutely secret. They cannot be even seen or read out of line of the two instruments in action.

The base should be cut from ⅞-in. hard wood, wedge-shaped as indicated by "A." The back is 4 in. wide and tapered to 1½ in. wide at the front and is 12 in. long. Scribe a line down its exact center. Then drill a ¼-in. hole 4 in. from the back, on this line, for the pivot hole. Also drill a second ¼-in. hole close to the front end and a small hole at right angles to it through the edge for a set screw. Then cut out a sub-base, B, 6 inches square. A ¼-in. hole should be drilled through its center and countersunk below. Pivot the two together with a wide, flat washer between and countersink the bolt head in the recess in the sub-base B. Tension between the two should be fairly stiff, but must allow them to turn smoothly. Just in front of the bolt in B drill a second hole and force in a tripod socket taken from a discarded camera. Use cement or glue to hold it firmly.

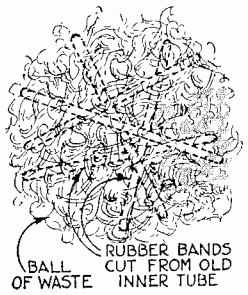
Screw two metal uprights, C, to the sides of A (*Continued on page* 460)



A side and rear view of the heliograph appear above. The instrument operates with a key exactly as a telegraph is operated and is readily portable.

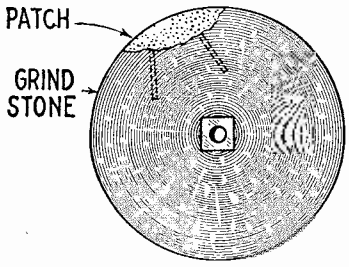
Shop Mechanics

Waste Ball Kink



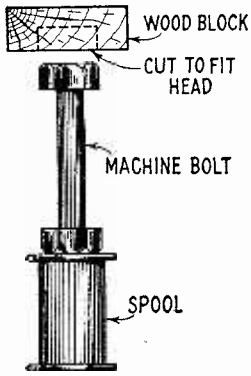
The usual ball of waste kept on a bench or in a tool box can be handled more easily by cutting four or five bands from an old inner tube about one-eighth inch in width and snapping them around the loosely packed ball. As the ball gets smaller, the bands compress it, holding the waste together.—Frank W. Bentley, Jr.

Grindstone Repair



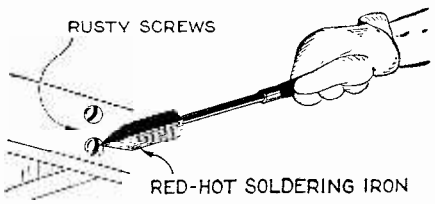
Chipped grindstones may be repaired by drilling two holes at the point of breakage and patching with a mixture of one part of cement and two parts stone dust.—August Jeffers.

Flushing Surfaces



One of the best ways to flush one surface up against another is by using the device illustrated. This consists of a spool, a machine bolt and a block of wood cut out to receive the head of the bolt. Place bolt in spool and block of wood on bolt.—Delmar Overstake.

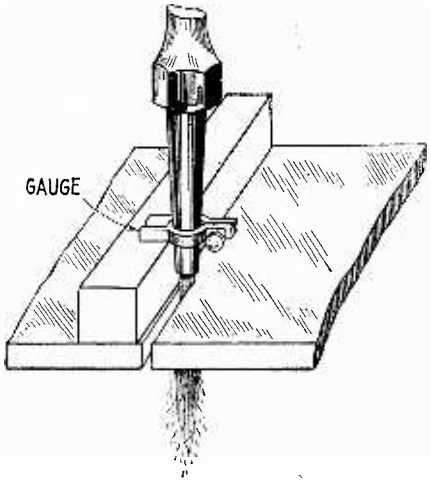
Removing Rusty Screws



To remove a rusty screw, apply a red-hot iron to the head for a short time. The heat will readily loosen the screw and it may be removed with a screw-driver while it is still hot.—A. C. Wilson.

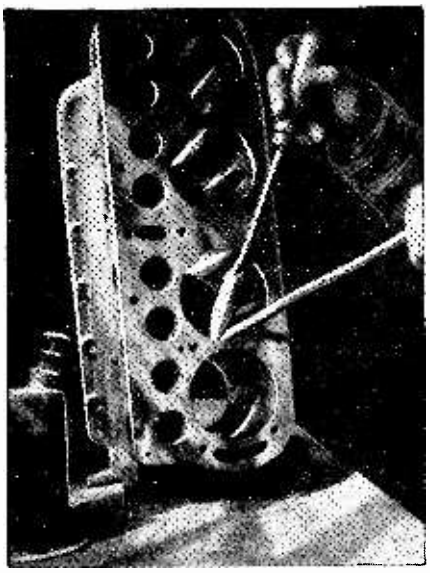
FIRST PRIZE, $10.00

Blow-Pipe Guide



The above illustration shows a blow pipe equipped with an adjustable gauge or guide. With the aid of this adjustable gauge, a more narrow and much neater cut will result. The distance between the tip and the iron can be adjusted according to the thickness. Both edges of the cut will be sharp and the lower one is almost free from oxide.—Fred Kautz.

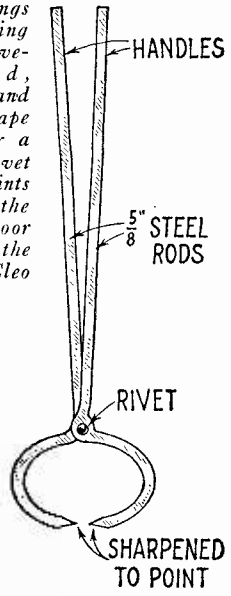
Soldering Cylinder Scores



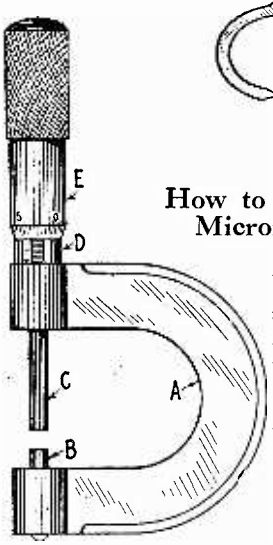
Anyone who is handy with tools may repair a score in the cylinder block with solder. Very strong acid must be used when soldering the score, which should be well cleaned and scraped; otherwise the solder will not stick to the cast iron. The solder can be applied while the motor is in the car, or the block may be removed and set up as shown in the illustration. After the solder has been applied, the surplus is removed with a half-round file. The solder will remain in the score until the cylinder wall wears away.—A. C. Wilson.

Flooring Remover

A handy flooring tongs can be made by taking two pieces of five-eighths-inch steel rod, about 3 feet long, and bending them to shape as shown. Drill for a three-eighths-inch rivet and sharpen the points well. To use, place the tongs over the floor board and press the handles together.—Cleo W. Morris.



How to Read a Micrometer



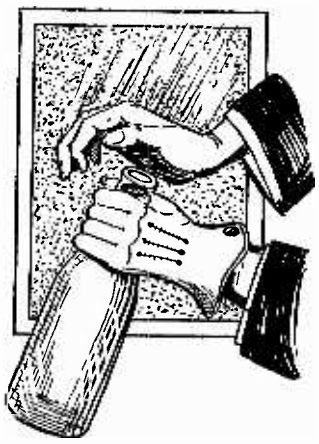
In the most usual form the micrometer comprises a frame, A, carrying the anvil or fixed measuring point, B, and a spindle, C, attached to the thimble, E, which latter moves over the sleeve, D, fixed to the frame. Both sleeve and spindle carry graduations as shown. The part of the spindle within the sleeve and the thimble has a thread of 40 to the inch, which fits a nut in the frame. Hence, one complete turn of the screw moves the spindle one-fortieth of an inch or 0.025 inch. The number of turns given the screw is shown on the sleeve D, each sleeve division, marked 1, 2, 3, 4, etc., representing tenths of an inch. The beveled edge of the thimble has 25 divisions, and rotating one of these marks to the next, moves the spindle one-twenty-fifth of one-fortieth of an inch or 0.001 inch. To take a reading, multiply the number of marks shown on the sleeve by 25, and add the number of divisions on the thimble.—Harry S. Wake.

PRIZE AWARD

Each month $10.00 will be given to the contributor of the best shop wrinkle. Shop Mechanics is a new department, and garage men, shop workers and those engaged in similar occupations will find much of interest on this page and are asked to submit their own favorite kinks to the editors.

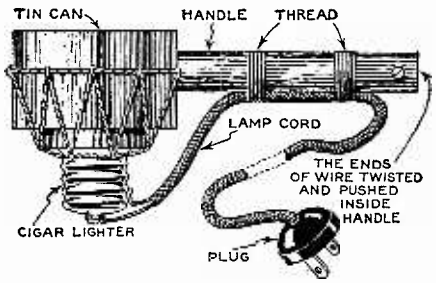
Wrinkles Recipes *and* Formulas

Bottle Trick



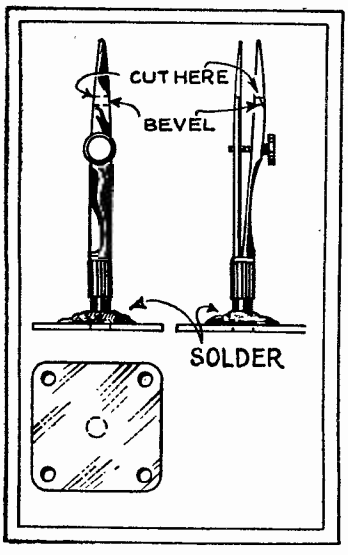
Fill a large bottle with water to one-eighth inch of the top. Grasp neck firmly with left hand and, using a glove or cloth as protection, strike the mouth of the bottle with a short, swift stroke of the right hand. The sudden compression of air in the neck of the bottle is sufficient to shatter the glass.—E. R. Vass.

Electric Pot



An electric cigar lighter, purchased in the five-and-ten-cent store, a small can and an old handle can be assembled to form an electric melting pot, as shown above.—W. H. Happe, Jr.

Small Vise



By cutting off tips of lettering pen and soldering to brass plate as shown, a vise for delicate work may be had and can be screwed to work bench.—E. R. Vass.

Remedy for Poison Ivy

Swab the poisoned area with a five-per-cent. solution of potassium permanganate. This solution leaves a brown stain, but can be removed by repeated washings with soap and water.—*Contributed by Clifton Ask.*

Door Pulls

Pry the cross chains off an old tire chain and fasten the ends to the door, leaving a little slack. Wrap the chain with tire tape, so it will be easier to grasp.—*Contributed by Clifton Ask.*

Model Airplanes

Model airplanes are generally made of wood. A very good substitute for wood in some parts of the plane, such as the body and wings, is viscoloid or celluloid, which can be obtained in many colors and any thickness. It is easy to cement and can be sawed and drilled the same as wood, also it can be heated and bent any shape. Transparent viscoloid can be used for windshields, etc., or to go over and protect letters or figures.—*Contributed by Leslie Carpenter.*

Keeping Workshop Hardware

A good method for keeping screws, nails, washers and various workshop supplies is to use glass jars with screw tops, several sizes of which may be purchased in the 5-and-10-cent store. Mayonnaise jars also may be used.

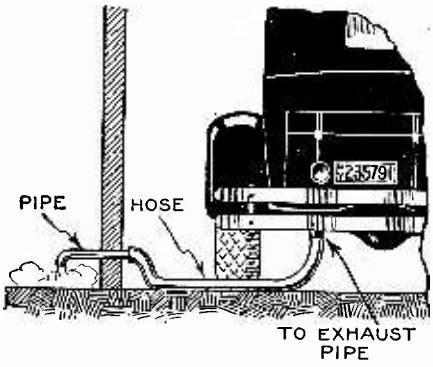
When buying screws, etc., by the box, tear off the top label and place it in the jar for identification. As the jars are of glass, you can always see what you have got on hand.—*Edmund Mills.*

Auto Trouble or Spotlight Connection

Secure an ordinary porcelain base electric light socket and a screw plug from the 5-and-10-cent store. Locate the socket in a convenient place on the body of the car just below the instrument board and on the driver's side. Run one wire to the ignition switch or other convenient place, connecting with the positive side of the battery, and the other to the metal body of the car (for one-wire system).

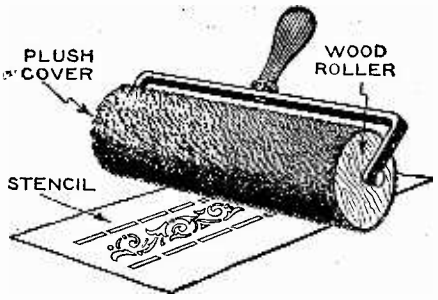
Attach pronged part of the plug to the wires on the lamp and you will have a handy connection for your lamp.—*Edmund Mills.*

Exhaust Pipe Hose



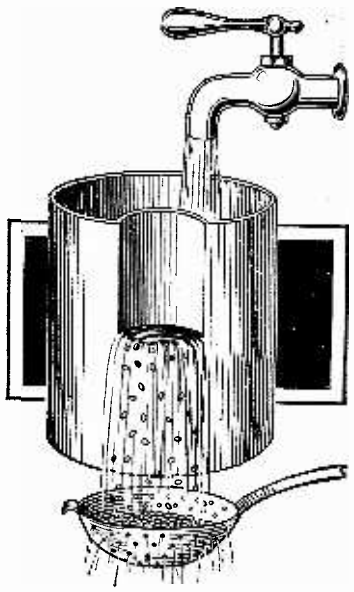
While working in the garage with the motor of the car running, the deadly carbon monoxide gas can be led to the outer air with a piece of two-inch pipe with hose attached. The hose is slipped over the exhaust pipe and the other end of the pipe is led outside the garage.—Ray H. Balken.

Stencil Roller



For neat work a plush roller not only makes a cleaner stencil, but is much quicker in operation. A roller for spreading stencil colors is shown above.—Frank H. Carlberg.

Lentil Separator



A metal can, provided with a hole with the upper section indented, can be used for separating lentils. The lentils are thrown into the box and follow the water current running out, while the small stones remain in the bottom.—Charles Mohr.

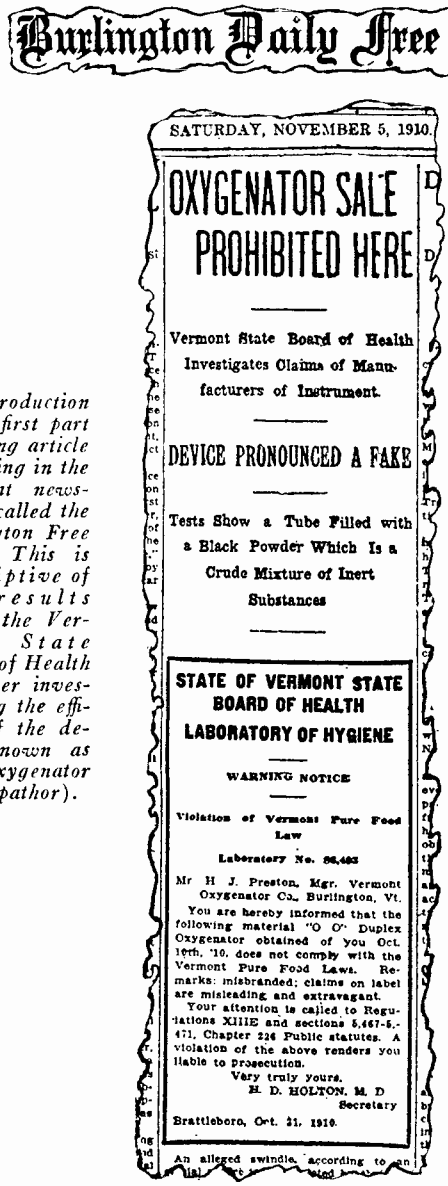
Readers' Opinions and Comments Will Be Welcomed by the Editors

What Our

Ionaco and Oxygenator

Editor, SCIENCE AND INVENTION:

I have been a reader of your magazines for many months, being a true scientist at heart, and ready at all times to investigate and fairly try out all things given to science by the great minds of the day for the cure of disease. I wish to set you right in regard to two of the most wonderful things ever given to sick and suffering humanity outside the science, art and philosophy of chiropractic, namely, that wonderful something called Ionaco and Oxygenator.



Burlington Daily Free Press

SATURDAY, NOVEMBER 5, 1910.

OXYGENATOR SALE PROHIBITED HERE

Vermont State Board of Health Investigates Claims of Manufacturers of Instrument.

DEVICE PRONOUNCED A FAKE

Tests Show a Tube Filled with a Black Powder Which Is a Crude Mixture of Inert Substances

STATE OF VERMONT STATE BOARD OF HEALTH
LABORATORY OF HYGIENE

WARNING NOTICE

Violation of Vermont Pure Food Law

Laboratory No. 86,463

Mr H J. Preston, Mgr. Vermont Oxygenator Co., Burlington, Vt.

You are hereby informed that the following material "O O" Duplex Oxygenator obtained of you Oct. 10th, '10, does not comply with the Vermont Pure Food Laws. Remarks: misbranded; claims on label are misleading and extravagant.

Your attention is called to Regulations XIIIE and sections 5,467-5,471, Chapter 236 Public statutes. A violation of the above renders you liable to Prosecution.

Very truly yours,
H. D. HOLTON, M. D
Secretary

Brattleboro, Oct. 21, 1910.

An alleged swindle, according to an

A reproduction of the first part of a long article appearing in the Vermont newspaper called the Burlington Free Press. This is descriptive of the results which the Vermont State Board of Health got after investigating the efficacy of the device known as the Oxygenator (Oxypathor).

I believe that after eight years of use of the Oxygenator and two years' use of the Ionaco, I can speak with good authority in defense of these wonderful modalities.

My mother was cured of a stoppage of the nasal passages by the Oxygenator after all other methods had utterly failed. Specialists were all stumped on the case. After seven days' use, eight hours per day, of the Oxygenator, the condition in her sinuses broke loose, and her head condition cleared at once, enabling her to breathe through her nostrils, the first time in weeks, except when the silver tubes were inserted. This is only one case; I could cite you hundreds of them.

Now as to the Ionaco. There is no question but that it is a specific for all types of rheumatism. I have been using one in my practice for quite a while, and it is really remarkable how fast it works in relieving neuritis pains. In fact, in almost any condition, it seems to have a powerful action for good. Especially with my old patients, or folks past 70 years of age, it seems to have a remarkable rejuvenating effect. Now I realize that it is only a bundle of wire, but "boy, oh boy," how fast that bundle of wire will cure a case of sciatica or neuritis or cure a case of varicose veins.

In view of the fact that I am a successful drugless physician, with a large practice, I think I can, after a large experience, speak with authority on these two instruments.

Why is it that wonderful inventions and even the wonderful science of chiropractic, which is recognized now in many states of our Union, is condemned and criticised?

After all, gentlemen, clinical results are what tell the tale.

Also, I wish to add here that the Ionaco I have been using was given to me by one of my patients who cured herself of a long-standing complaint. Proof of the pie is in the eating. I am simply writing this to you because I like to see credit given where credit is due.

Concerning Mr. Wilshire's death from two diseases which the Ionaco is supposed to cure, I would answer you thus:

There comes a time in every man's life when the disorganizing powers of nature are greater than the physical body cells can stand, and we have the dissolution of the physical and mental, which is death. No doubt in Mr. Wilshire's life had come that particular time, the same as nature has decreed that it shall come to everyone through some means, even to you and me.

The polarizer of the Oxygenator is filled with coke dust, so you claim.

Well, I don't care what it is filled with. I'll tell you what can be done with it in a case of pneumonia. When all other methods fail to make a patient perspire and the temperature is high, I can, by placing the polarizer in the ice water and proper connections made on wrist and ankle with contact plates, room properly aired, cause the patient to perspire freely in a short time. Many lives thus have been saved by the reduction brought about in the temperature, through more rapid oxidation of the toxins.

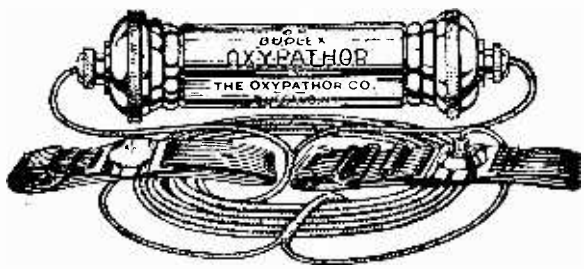
So, if it is the coke dust in the polarizer which accomplishes the desired result, many congratulations to the man who had brains enough to discover that coke dust would do this, and I know it will do it, and I don't mean maybe.

Now, dear friend, I am not writing this letter in a spirit of antagonism. I am simply writing this letter that it may be published, and some poor sick individual may be helped in seeking health.

Thanking you again for further consideration of this matter, I am

L. P. Roys, D.C., Ph.C.,
Little Falls, New York.

(In the October, 1927, issue of Science and Invention magazine an article appeared on the subject of the Ionaco, entitled, "The Ionaco Swindle." The apparatus consists of a coil large enough to encircle the body, even though it is generally worn hanging over one shoulder. This coil contains 626 turns, or 3,411 feet of ordinary No. 22 single cotton covered enameled



The Oxypathor itself. For this piece of metal pipe, filled with an inert product, the sum of $35.00 was paid. This was called the Oxypathor, but was originally sold under the name of Oxygenator.

Readers Think

Questions and Discussions of General Scientific Interest

copper wire. In the original advertising, Mr. Wilshire claimed that there was a mile of wire in it. He evidently never measured the length of the wire himself. There is also a separate coil, a miniature of the large one, to the two ends of which a

This line illustration is reproduced from the October, 1927, issue of SCIENCE AND INVENTION *Magazine, where the photographic illustration was used for an article entitled "The Ionaco Swindle."*

small incandescent lamp is attached. If the large coil is connected to a source of alternating current and the small coil held near it, the lamp will glow. This test is supposed to indicate the efficacy of the coil of wire. Attempts at scientific explanation are made in the advertising literature of the Ionaco. The apparatus itself can be built at a cost of approximately $5.75. It sold for $58.50 originally, although (judging by the literature which we received) some organizations have cut down the price to only $40. Testimonials for this product have come from all over the country, just as they have for every fraudulent medical treating device. As a cure-all it is as worthless as a rabbit's foot.

As for the Oxygenator, this product was originally sold under this name for some time, and then its name was changed to Oxypathor. It is merely another of the gas-pipe cures which have been foisted on the public, and is comparable to the Oxygenor, the Electropoise, the Oxydonor, the Oxybon, and the numerous other products of similar ilk. The article was examined in the laboratories of the University of Vermont to determine the composition of the material with which the cylinder was filled. The laboratory stated that "The hollow interior . . . is filled with a black powder, which analysis discloses to be a crude mixture of inert substances, apparently the waste or by-product of a manufacturing plant. The powder is a rough mixture of iron filings, clayey material, and a dark colored carbonaceous mass, apparently nothing more than coke dust, or carbon black. As a result o fthese findings, the State Board of Health of Vermont declared the Oxygenator or Oxypathor, as it was subsequently known, to be physically and therapeutically inert, and on Saturday, November 5, 1910, the Burlington *Daily Free Press* announced that the Oxygenator sale was prohibited in the state of Vermont. An official proclamation was issued by the Australian Government, prohibiting the importation of the Oxypathor (Oxygenator) into that country. On November 14, 1914, E. L. Moses, of Buffalo, N. Y., the General Manager of the Oxypathor concern, was found guilty of using the mails to defraud and was sentenced to serve 18 months in the Federal Penitentiary. He appealed, but the Appellate Court confirmed the judgment and he had to serve sentence. At the trial it was brought out that the Oxypathor (Oxygenator) costs $1.23. It sold for $35. Purchasers of the Oxypathor could have obtained just as valuable curative effects from an empty tomato tin, filled with coke dust, closed, a string attached to it, and the product dropped into water after the strings were attached to the wrists. Yet at the trial hundreds of witnesses came forth with testimonials. Subsequently other organizations, such as the Oxygenator and the Oxybon, were declared fraudulent and were excluded from the mails.

It follows then that you have been using a product officially declared fraudulent by the U. S. Government, and you commend it from the standpoint of clinical results, which results cannot, by the greatest stretch of the imagination, be ascribed to the piece of gas pipe.—Editor.)

Athlete's Foot

Editor, SCIENCE AND INVENTION:

I have recently heard of an ailment known as Athlete's Foot. Can you give me some further information about this?

J. E. D., New York City.

Athlete's Foot is the name commonly given to ring-worm of the foot, and Dr. Chas. F. Pabst, chief dermatologist of the Greenpoint Hospital in Brooklyn, says that, as a rule, it begins between the toes where it is often overlooked, and spreads gradually along the sole and the sides of the foot. The skin becomes pink or red in color, and the affected part is frequently covered with a white scale or crust. The scales may be dry or moist, and when peeled, leave an inflamed area. The condition extends very slowly, and is accompanied with slight itching. The ailment is caused by a parasite which is a vegetable fungus. The fungus is very common and is found on the floors of gymnasiums, swimming pools and bathing establishments. The fungus takes easy hold and grows rapidly when the feet are warm and moist. The disease can be cured by applying a mild antiseptic, and it must be completely eradicated, otherwise it may start anew. Hence the treatment in some cases is quite long. Dr. Pabst claims that the condition is very prevalent in America.—Editor.

Shortening Hours of Sleep

Editor, SCIENCE AND INVENTION:

If science understands just what chemical phenomena takes place within us when we sleep, why can't some means be devised that will enable us to get a full night's rest equal to eight hours sleep in a much shorter period? As it is, a man spends twenty-five solid years of his life sleeping if he lives to an age of seventy-five. A lot of people would welcome the opportunity of being able to condense their sleep.

Perhaps a glass-enclosed bed with added oxygen and sun rays (arc lights) playing over the naked body would help us to cut the time down. Has anything ever (*Continued on page* 459)

THINGS do not always run smoothly for the man who chooses magic as a professional calling. Hair-breadth escapes, curious accidents, ludicrous moments and interesting anecdotes are ladled from the caldron and placed before the readers of this publication in a new series of articles to commence with the next issue.

Intimate glimpses of the lives of conjurers and escape artists never before published will be featured in the new series called, "When Fate Tricks Tricksters," by Dunninger.

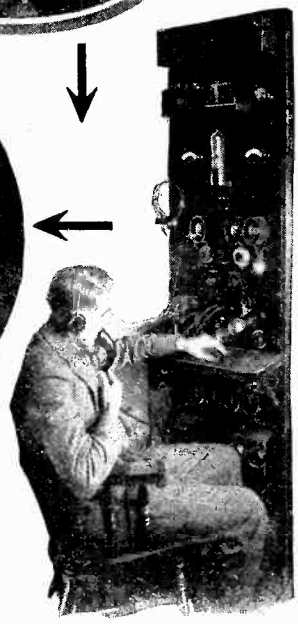
The photograph at the left shows the Canadian National Railways train which was used during the telephone demonstration just before it left on its run. Below is Mr. W. D. Robb, the Vice-President in charge of Telegraphs and Telephones of the Canadian National Railroad, phoning the first message from the moving train. Note the antenna stretched across the top of one of the cars.

You Can Now Call Your Home From Moving Train

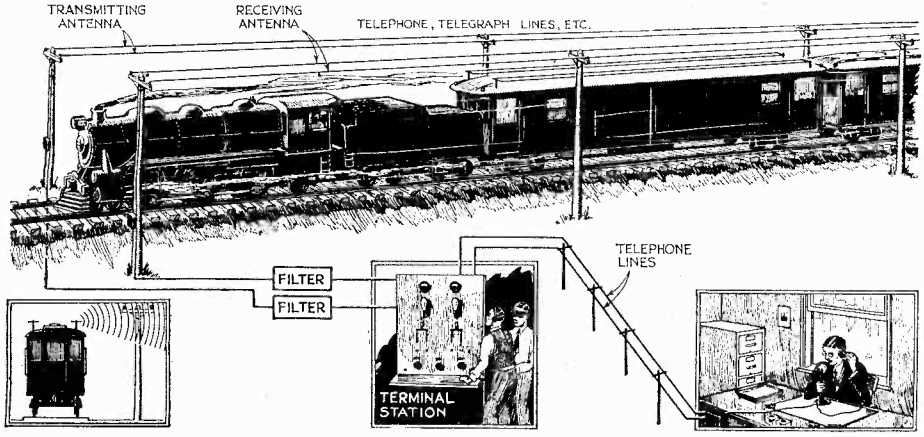
ON May 5th of this year the engineers of the Canadian National Railways publicly demonstrated a system of radio telephony whereby passengers on a moving train were enabled to communicate with stationary points served by ordinary telephone service. There are many advantages present in such a system. Those on board the train need not lose touch with the outside world, so to speak. In making a transcontinental trip it often happens that a day or more passes before the traveler can reach a telephone center of a size sufficient to warrant placing a call and completing it before the train pulls out. Not until the next stopping place is reached can the traveler communicate with points past or ahead. Shortening the time of communication and making such contact available at all times will mean much to business men. Germany is perhaps the only country where a train radio communication system is used, but the Canadian arrangement is superior in some ways.

A special test car, equipped with a laboratory, was used by the Canadian National (*Continued on page* 463)

Mr. W. G. Barber, General Manager Canadian National Telegraphs, receiving the first message.



Mr. H. Lang, assistant engineer, is shown at the panel of the terminal station control board, at Davenport Station, Canadian National Railways, Toronto. The drawing at the left illustrates how the telephone system is made possible. The telephone and telegraph lines paralleling the railroad tracks pick up the signals from the train by induction and also transfer signals to the moving train in the same manner. Filters are placed in series with these lines, so that there is no interference with the existing telegraph and telephone messages which are carried by these wires.



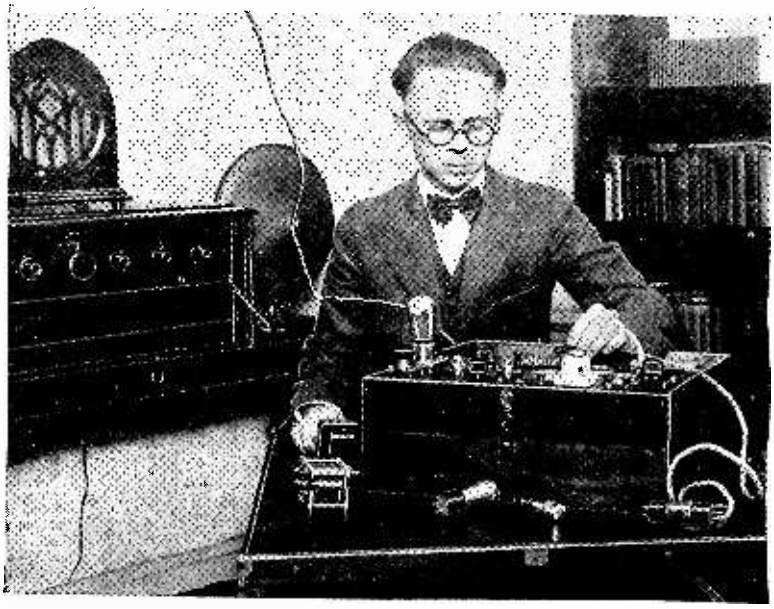
Above is a photograph of Ralph Stair with his portable set tester, which is entirely self-contained.

The Radio Robot

An Electrical and Mechanical Set Tester

By J. E. SMITH, President, National Radio Institute

A MECHANICAL and electrical trouble-shooter—a radio Robot, as it were, for the service man—has been designed and built by Ralph Stair of the Bureau of Standards. The functions of a tube tester and rejuvenator, the trouble-shooting for condensers, transformers, and other radio parts, and the testing of complete radio receivers have been combined into a single unit—withal, a test kit without a counterpart in the completeness of its diagnosis of sick and crippled receiving sets.



The above photograph shows the radio Robot in use. The tester can be used with all types of receiving tubes as well as with parts and complete sets and is provided with both d.c. and a.c. meters.

The average human trouble-shooter, detailed on service errands by retail radio stores, is properly equipped to test a vacuum tube for filament emission, and with a pair of head telephones he may be enabled to determine a broken circuit in a transformer. However, his facilities are often inadequate to locate many common troubles with which receivers are afflicted. For instance, a rectifier tube may light and yet not function properly and a short circuit in the receiver may necessitate a disjointing of the parts. If the service man is pretentiously equipped with test kits, the latter are so numerous as to defy ready transportation, and their sum total of testing deficiencies are too glaring to enumerate.

This conspicuous absence of a unified and complete radio tube and set test kit, one that would test all types of receiving tubes, as well as parts and complete sets, prompted Ralph Stair to design the compact and thorough-working outfit we are about to describe. The finished product gives added virtue to the threadbare adage that necessity is the mother of invention. For Mr. Stair was impressed with the needs for such a trouble-shooter in diagnosing sick and crippled sets of his neighbors and at home.

Mechanical-Electrical Tester

THE mechanical and electrical trouble-shooter or radio Robot weighs approximately 25 pounds and is relatively small. It is completely self-contained, with the exception of two insulated wires having metal feet for associating the test kit with a transformer or other source of suspected trouble. The panel on which the testing devices rest is rectangular in shape. Underneath this trouble-shooting equipment proper is a compartment for holding soldering irons, screw-drivers and other instruments necessary to the vocation of a radio service man. This convenient compartment for tools reduces the practice of scattering them all over the service man's car to a suitable location, where they are readily available when needed. This tool compartment is sufficiently roomy to install all the necessary radio tools and possibly space for a "C" battery or an "A" dry-cell battery.

The 7-by-8-inch panel for testing as well as rejuvenating radio receiving tubes contains two small automobile lamps. These tiny lights occupy a position, in miniature, on this trouble-shooting board corresponding to coastal lighthouses as they flash their beacons to troubled navigators. For instance, if one of these miniature lamps radiates a glow, his is unmistakable proof of a short-circuit between the plate and filament elements of the vacuum tube under examination; if, on the other hand, the other tiny lamp lights, there is indication of a short-circuit between the filament and grid elements of the tube under test. If the two lamps light simultaneously, there is indication of a short-circuit between the grid and plate elements.

Tube Testing

THE tube-testing section so thoroughly comprehends the diversified needs of a trouble-shooter that practically every type of radio receiving and rectifying tube can be accommodated, including past and present models. The test board contains three sockets which, with the aid of a set of adapters, accommodate all tubes of the old and new 199-type base, the WD-11, old and new 1A-type base and UY-227 or its equivalent (the new alternating current detector tube). Since the WD-12, the alternating current amplifier tubes and most rectifier tubes have the new UX-type base, all common tubes of American manufacture are readily accommodated. This is not the case with the ordinary tester.

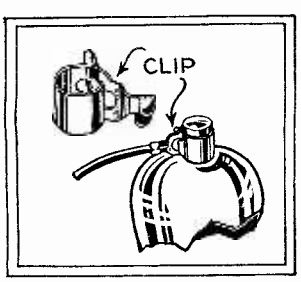
The tube-testing compartment of this radio Robot, by use of resistance units in parallel, will indicate the filament emissions of vacuum tubes having a plate current as high as 2½ amperes. By the same token of completeness which characterizes the entire outfit, if the prongs of the three elements in a tube are touching this undesirable condition is disclosed. With a plate voltage range from zero to 200 volts, this critical test can be applied to rectifier tubes as well as to conventional receiving tubes. Types of tubes subject to the rejuvenation process are accommodated, which includes type 201A—a flash of 15 volts on filament for 60 seconds and aging at 7½ volts for ten minutes. Also types UX-120 and UV-199 are likewise accommodated, a flash of 10 volts for 30 seconds and an aging process of 4½ for 10 minutes. The turn of one switch gives filament voltages variable by predetermined steps.

The human trouble-shooter, upon the introduction of this radio Robot, would not be required to carry his inseparable head telephone set for testing purposes. By opening the circuit in this new test kit and (*Continued on page* 475)

New Radio Devices

Shield Grid Clip

A NEW England manufacturer is now making a shield clip or grip for use with UX-222 and UY-224 tubes. The clip is made from spring metal in one piece. A slight pressure of the thumb and forefinger allows the clip to be opened so that it may be slipped over the control grid terminal of the screen grid tube. The control grid is brought out at the top of the bulb to a special contact cap. which has a maximum diameter of .369 inch. The opening of the clip has a slightly smaller diameter than the control grid terminal so that good contact is assured. By referring to the illustration it will be seen that one end of the clip is provided with a lug for connecting the control grid lead. The lug is stamped out of the single metal piece. The cap is easily removable and is provided with a handy finger grip. Radio set constructors will save much trouble and will be enabled to make a good connection to the control grid by using the grip described here. When repairing the receiver or replacing tubes, the control grid connection can be removed in a second's time.



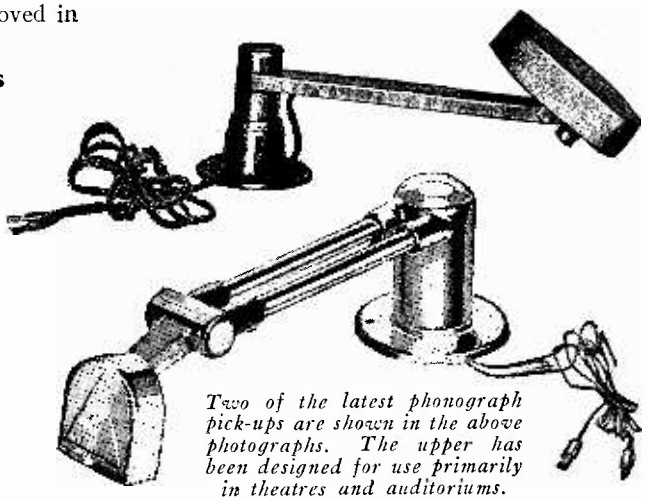
The illustration at the left shows the shield grid clip attached to the control grid terminal

Phonograph Pick-Ups

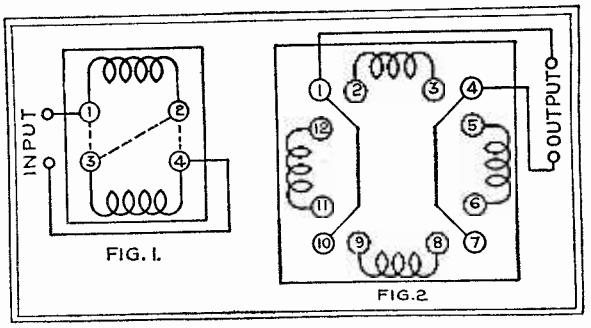
THE two pick-ups shown herewith are of latest design. The upper one is of large size and is a theatre pick-up which has been designed for home use as well as in auditoriums. A suspension bridge counterbalance makes it possible to use the pick-up on the same record over and over again without destroying the recording thereon. A volume control and adapter are furnished for four or five prong tubes in the event that the receiver is not equipped with a phonograph jack. The head of the pick-up is simply tipped back and stays in that position while records are being changed. This is made possible by a perfect balance.

The needle holder on this pick-up is entirely different from those of the usual types, as no clamping screw is provided. The needle merely fits loosely into a steel tube and is held there by magnetism. The only attention which the needle holder requires is an occasional application of a small quantity of vaseline to the inside of the needle holder tubing. This prevents corrosion and allows the needles to be removed easily. No special coupling transformer is required as the pick-up is wound with a high impedance winding which works satisfactorily through an ordinary input transformer or directly into the grid circuit of a vacuum tube.

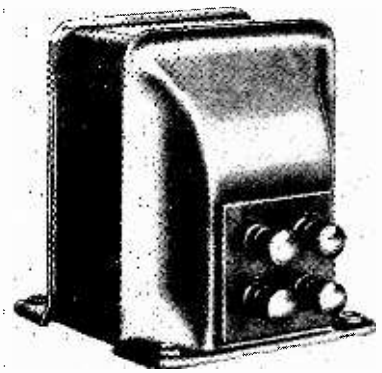
The lower pick-up has excellent response characteristics as shown in laboratory tests. It is equipped with a mounting plate for attaching directly to the phonograph, with leads brought out through the center of the support standard. The pick-up head is held by a double bar. As in the case of the other pick-up, this one also rests upon the record with but a few ounces pressure. The instrument is finished in a pleasing color combination and is among the best which have come to the attention of this department.



Two of the latest phonograph pick-ups are shown in the above photographs. The upper has been designed for use primarily in theatres and auditoriums.



Figs. 1 and 2 above show the internal connections of the impedance adjusting transformer. Fig. 1 shows the input connections, and Fig. 2, the output connections. The instrument appears in the photograph at the right.



Impedance Adjusting Transformer

A MAXIMUM transfer of power occurs when the internal impedance of a source is equal to the load into which this source is working. Most of the apparatus used for reproduction have impedances which vary with the frequency. With different types of units the impedance-frequency characteristics are different. Transformers are inserted to approximate the proper relation between the impedance of the load and the impedance of the source. It is usually only possible to obtain the correct relation of impedances at one frequency because the impedance-frequency characteristics of both the source and the load do not vary at the same rate.

An impedance adjusting transformer, the product of a New England manufacturer, is designed to adapt various loads to the output of a power amplifier. Loud speakers of several types or different combinations of reproducers may be connected to the power amplifier and best results obtained. The impedance adjusting transformer consists of two identical primary windings and four identical secondary windings, as shown in Figs. 1 and 2. Fig. 1 shows the input terminal block and the connections for series or parallel operation of the coils. The input leads are always connected to terminals 1 and 4. Fig. 2 shows the connection of the secondaries. The output leads should be fastened to terminals 1 and 4. A table is furnished by the manufacturer which shows the load impedances and connections for the output terminals when working from an impedance of 2,000 ohms. By proper connection of the coils, the desired impedance ratio can be approximated. Each primary winding will safely carry 150 milliamperes of current and each secondary winding 300 milliamperes. When two windings are placed in parallel, the current-carrying capacity of the circuit is doubled. With primary windings in series, the transformer works out of a 2,000-ohm impedance

Names of manufacturers furnished upon request

Radio Oracle

A Monthly Question and Answer Department Conducted with a View Toward Helping Radio Constructors and Experimenters

How a Loop Antenna Operates

(724) B. Selig, Muncie, Ind., writes:

Q. 1. How is it possible for a loop aerial to function when it is only a few thousandths of a wavelength in length?

A. 1. If a loop antenna is rotated so that its horizontal wires are at right angles to the direction in which the signal is traveling, then the loop has no length in so far as these signals are concerned. As the wave passes, it strikes both sides of each turn in the loop at exactly the same instant and the voltages generated are, therefore, equal and opposed and there is no terminal voltage. This gives the loop antenna its directional characteristic. If the loop is turned slightly from the zero position, then the voltages no longer cancel each other and a voltage will appear at the terminals. The maximum position of the loop is very broad and the zero position extremely sharp. When a loop antenna is used with a radio receiver, it is necessary to tune it to resonance with the desired signal. The maximum inductance of the loop with the maximum capacity of the condenser must give resonance to the longest wavelength to be received. The loop should not have an inductance value greater than that required for tuning. The inductance of a coil of wire increases considerably as the turns are wound closer together. The maximum inductance is obtained with a minimum number of turns when they are wound closely. In order to get the maximum number of turns for a given inductance which the loop requires, the turns should be wound as far apart as possible.

The turns of wire on the loop are in series with each other, forming a continuous winding. If the maximum voltage is to be generated in any one turn of the loop, then the voltage generated in the two sides of this turn should be in opposite directions so that they will not oppose each other.

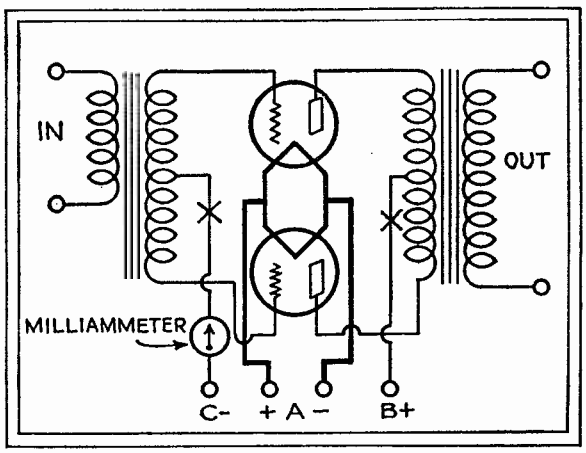
Oscillation Test for Push-pull Amplifier

(725) W. C. Beach, Mt. Hamilton, Calif., writes:

Q. 1. Will you please give me some information, together with a circuit diagram, showing how I may test a push-pull amplifier for oscillations?

A. 1. On this page you will find a circuit diagram of a conventional push-pull amplifier. The test consists of placing a meter in the "C" minus lead in order to determine if any current is flowing in the grid circuit. The location of the milliammeter is shown in the diagram and under normal conditions there should be no deflection of the needle. However, if the circuit is oscillating, several milliamperes of current may be found to flow in the grid circuit.

An oscillating condition in the push-pull amplifier may be corrected by connecting a 50,000 ohm resistor in the "C" minus lead at the point marked X. In some cases, in order to suppress the oscillations completely, it will be necessary to connect a choke coil in the "B" plus lead at the point marked X. If a resistor is used in this position there will be a loss in plate voltage.



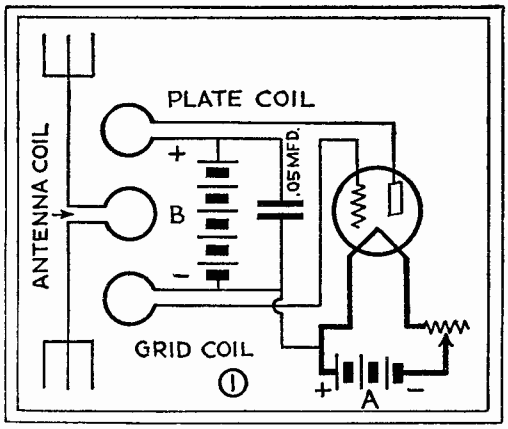
The test for oscillation in a push-pull amplifier is shown above. A milliammeter is placed in series with the C minus lead.

Short Wave Transmitter

(726) C. O. Burton, Albany, N. Y., writes:

Q. 1. Will you please give me a circuit diagram of a 10 meter short wave beam transmitter, together with the necessary data for making the coils?

A. 1. On this page you will find the circuit diagram of a short wave beam transmitter having a wavelength of 10 meters. As may be seen in fig. 1, the transmitter is of the Hartley type. The plate coil consists of a single turn of wire about 17 centimeters in diameter, and the grid coupling coil is of similar construction. These coils, together with the capacity between the elements of the vacuum tube, form an oscillatory circuit. The antenna system shown in figs. 2 and 3 is coupled to the transmitter by means of a coil which is of the same size as the plate and grid coils. The antenna consists of two sets of vertical wires, each set being composed of six parallel wires arranged in a circle as shown in fig. 2. The wires are spaced about three centimeters apart, as shown in fig. 3, and are 1.8 meters in length. The parabolic reflector can be used to obtain directional beam transmission. Such an antenna can be made in the form of a segment of a parabolic cylinder by suspending 40 wires from a frame in the form of a parabola. Each of these wires is tuned to 10 meters and they are spaced one foot apart. The focal distance should be equal to 2.5 meters, or 8 feet 2.4 inches.



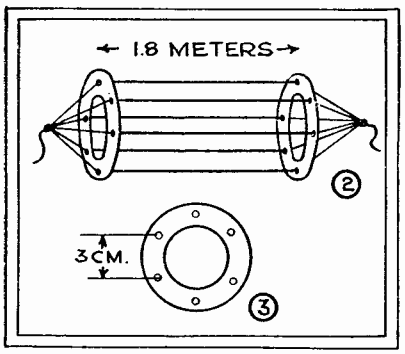


Figure 1 shows the schematic diagram of the short-wave transmitter, Figure 2 and Figure 3 the antenna.

Substitute Electrolytes

(727) H. Scott Roan, Racine, Wis., asks:

Q. 1. There are a number of substitutes for battery electrolytes of sulphuric acid on the market. Are these harmful to the battery?

A. 1. In reply to this question, we can do no better than to cite several of the important paragraphs from a report issued by the National Better Business Bureau.

The principal ingredients found in the majority of both liquid and solid preparations have been Epsom Salts and Glauber's Salts. Manufacturers of batteries do not approve of the use of such ingredients as a substitute for the electrolyte in a lead

(*Continued on page* 456)

Scientific Humor

A Monthly Fun Page for Those Who Enjoy a Laugh

SOUNDS WINDY

Two men were spending the night at a hotel where they had their first experience with electric lights. Upon retiring, one of them tried to blow out the light. The other seeing him, said:

"Don't show yer ignarance; y'u can't blow these lights out."

"Well, how do y'u put 'em out then?" was the reply.

"I don't know, but I heard the feller downstairs say somethin' about blowin' out a fuse somewhere."

—*H. R. James.*

NOT RELATIVITY

HARD-BOILED (in a crowded street-car)—Why don't you put your feet where they belong?

HARDER-BOILED—Listen, if I put my feet where they belong, you wouldn't be able to sit down for a week! —*L. D. Peckenus.*

CAN'T PLACE ME

"Did you ever kilowatt?"

"Ohm, yes, I often choke coils, too."

"Oh, A. C.!

—*Martha Betty Barton.*

ANATOMICALLY SPEAKING?

A base ball park is a regular ball-and-socket joint! —*George A. Field.*

A BLANK EXPRESSION

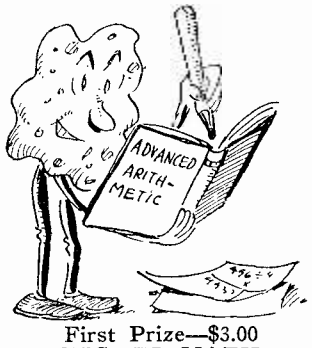
FLAPPER TEACHER—What is the difference between concrete and abstract?

SCHOOL BOY—Concrete is that which can be seen; and abstract is that which cannot be seen.

FLAPPER TEACHER—Give examples.

SCHOOL BOY—My face is concrete and yours is abstract.

—*Robert J. Dobbs.*



First Prize—$3.00

HIGHER MATH

TICK—Say, the amœba must be some mathematician.

TOCK—How come?

TICK—Well, he multipljes by dividing. —*John Motheral.*

MIGHT GET PALE

POP (in cellar)—It can't be done. It can't be done.

VOICE UPSTAIRS—What can't be done?

POP—Drink Canada Dry!

—*C. Kamarunas.*

ALL jokes published here are paid for at a rate of $1.00 each; $3.00 is paid for the best joke submitted each month.

Jokes must have a scientific strain and should be original.

Write each joke on a separate sheet of paper and add your name and address to each.

Unavailable material cannot be returned.

WIRE YOU SO DUMB?

ELECTRICIAN—Where did you get that wire?

ASSISTANT—That ain't wire, that's yarn made out of steel wool.

—*Leslie F. Carpenter.*

TOO CIRIUS

PROFESSOR—Shooting stars are the the most disorderly things in the universe.

AMATEUR—Then why do the directors allow them to carry guns.

—*Robert J. Dobbs.*

NEITHER HARD NOR CARPET

CURIOUS LAD—Pa, what does Uncle Sam live on?

FATHER—Tax.

CURIOUS LAD—Does he ever have a stomach ache from eating them?

—*Robert J. Dobbs.*

A STICKY LINING

MR. BLACK—What's this cream cheese doing in my den?

MRS. BLACK—Slight mix-up, dear. I must have spread the sandwiches with library paste. —*Eula C. Hill.*

CHERRY-O

CLANCY—Last night I went to a party; while I was talking someone gave me a drink.

DINTY—What was it?

CLANCY—Gold paint.

DINTY—How do you feel?

CLANCY—Gilty, very gilty.

—*G. Daniel.*

THEN SHE BEANED HIM

WIFE—In my opinion, sheep have very little brain.

HUBBY—Yes, my lamb.

—(*Author please send name.*)

CAN'T FACE THIS

Run upstairs and get my watch.

Wait a while, and it will run down.

No, it won't; ours is a winding staircase. —*Fred Erdos.*

SOME CHEEK

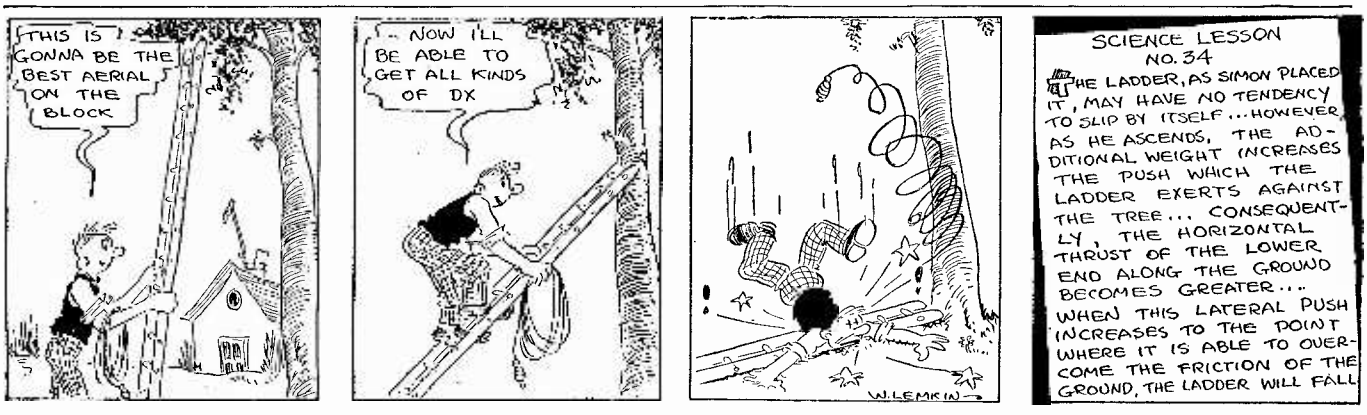
ABSENT-MINDED PROFESSOR—I want some powder.

DRUGGIST—Some that goes off with a *bang?*

ABSENT-MINDED PROFESSOR—It's for my sister; I think she wants the kind that goes on with a *puff.*

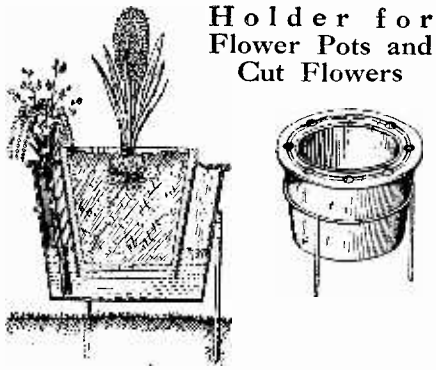
—*Leslie F. Carpenter.*

SCIENTY SIMON SCIENTIST



Latest Patents

Holder for Flower Pots and Cut Flowers

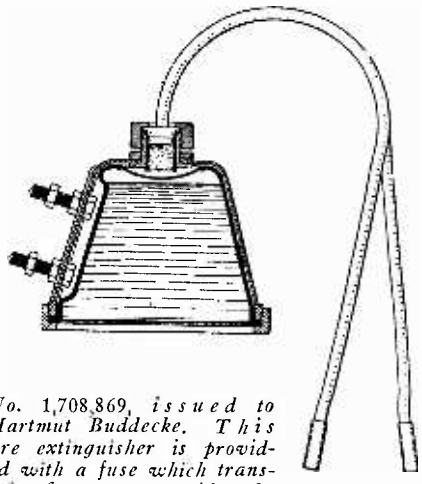


No. 1,712,986, issued to Joseph Favata, Jr. The object of this invention is to provide a water supply for potted plants and to make provision for surrounding the potted plants with cut flowers, the stems of which will be partly submerged within the water provided for moistening the ground within the pot of the potted plant. Provision is made to accumulate rain water and deliver it to the water reservoir of the device so that manual replenishment of water is not required except during dry spells.

Notice to Readers:

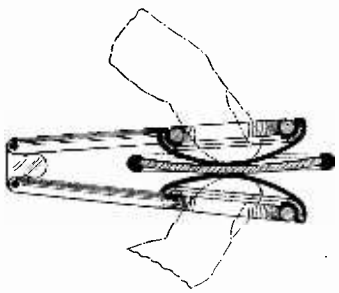
These illustrated and described devices have recently been issued patent protection but are not as yet, to our knowledge, available on the market. We regret to advise that it is impossible to supply the correct addresses of inventors of the devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information, as it is practically impossible to obtain up-to-date addresses.

Fire Extinguisher



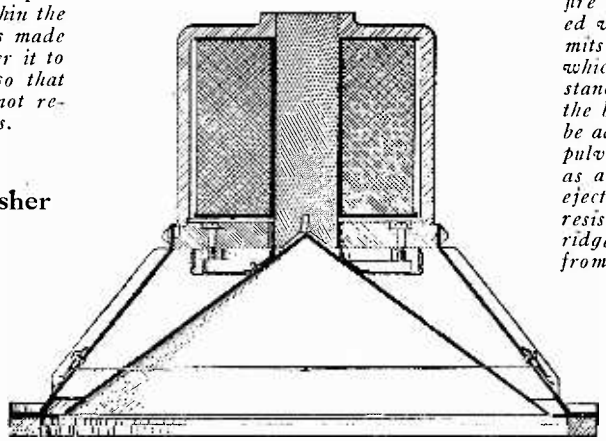
No. 1,708,869, issued to Hartmut Buddecke. This fire extinguisher is provided with a fuse which transmits fire to a cartridge by which the extinguishing substance is then thrown automatically upon the burning object. It is so designed as to be adapted for use in connection with a dry pulverized extinguishing substance as well as a liquid one. The casing has an open ejecting end and the walls are adapted to resist high internal pressure. The cartridge is located at the top of the vessel from which a fuse extends through a tube.

Eyeglass Cleaner and Polisher



No. 1,712,325, issued to David Brandfon. The device shown above has two pockets supported on arms pivotally connected. The pockets are of chamois or other flexible material and receive the finger of the hand and the thumb, so that the chamois may be pressed against opposite surfaces of an eyeglass and permit the desired pressure for cleaning.

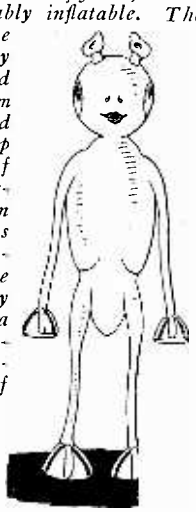
Sound Reproducer



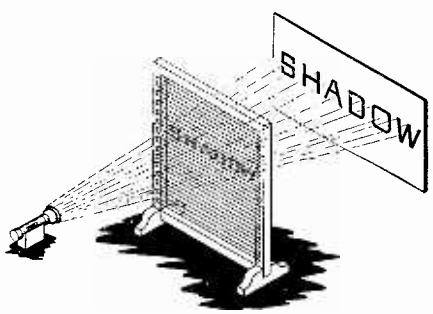
No. 1,712,920, issued to Frederick A. Kolster. The loud speaker shown here comprises a conical-shaped diaphragm, a frame, a flexible membrane for suspending the diaphragm at a position intermediate to the apex and a pair of cord members fastened at opposite ends to the frame and extending through the diaphragm at right angles thereto. These permit the diaphragm to be centered. The conical-shaped diaphragm of this electro-magnetic reproducer is free at the peripheral edge and is supported solely at points intermediate to the apex.

Clinging Figure

No. 1,710,989, issued to Andrew Kelly. This invention relates to toy or decorative figures, which are preferably inflatable. The figure may be bent in any position and is provided with vacuum cups at the fingers and toes. The vacuum cup is hollow and made of rubber, so that by pressing the cup against an object the arms and legs may be held in any desired position. Since the figure is flexible, it may be made to assume a great variety of positions and can be supported by one or all of the vacuum cups.

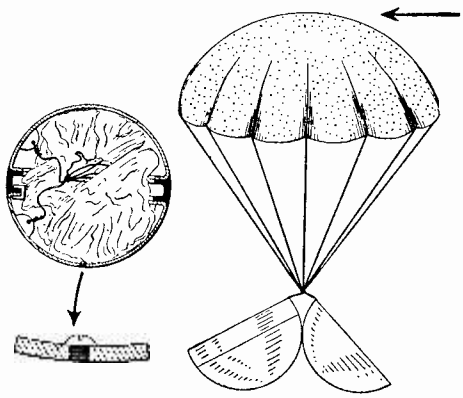


Shadow Letter Production



No. 1,712,371, issued to Frank J. Wilkins. This device provides for the production of shadow letters or shadow figures and designs which may be used in the production of signs or lettering for any sort of printing or painting, by allowing the shadow to fall upon the blank card upon which the sign is to be painted. The device is placed between a light source and a screen. The figures or letters are stretched across a frame on slender cords.

Toy Parachute



No. 1,713,432, issued to Theodore G. Griggs. The toy shown at the left is composed of a hollow ball of two sections, held together for a predetermined length of time by suction or partial vacuum. These sections separate while the ball is in the air after being thrown and release a parachute enclosed within and connected to the sections of the ball, so that the device will descend slowly to the ground. An elastic channel-shaped ring is located between the sections of the ball, secured to one section and held to the other section by suction or partial vacuum. One of the sections is provided with an opening to regulate the passage of air. The two sections of the ball are pressed toward each other, and when the pressure is released a partial vacuum is created.

A Monthly Scientific Question and Answer Page

The Oracle

Lightning

(2323) J. B. Marlow, Atlantic City, N. J., asks:

Q. 1. What are the known types of lightning and how are they characterized?

A. 1. Probably the most familiar type of lightning is streak lightning. Not classified as distinct types, but variations of streak lightning are the following: Ribbon, rocket and bead lightning. Forked and zigzag lightning are also included. Other types more rarely observed are ball or globular lightning and sheet lightning.

Streak lightning exhibits a white or pink path of rather small diameter, from an inch to a foot, and up to a mile in length, depending upon the conditions of the discharge. In many cases the path is sinuous and forked, in others it appears as a single streak. The discharge may take place within a cloud, between separate clouds, between clouds and the earth, or between a cloud and surrounding air.

Occasionally a flash or streak of lightning assumes the form of a number of parallel streaks called "ribbon lightning." Most streak discharges consist of several successive discharges, with an appreciable time interval between them. In the intervals between discharges the path may be shifted by the wind. Thus, several successive discharges displaced by the wind may appear as parallel streaks due to the persistence of vision.

Rocket lightning is a term applied to streak lightning discharges, the growth of which is so slow as to appear like a rocket.

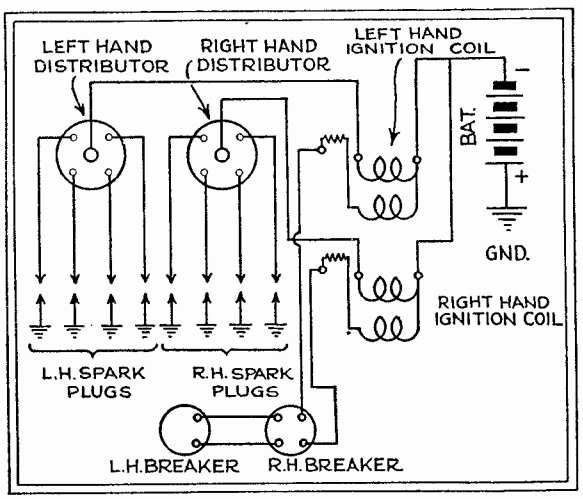
Bead lightning is that form in which the path of the discharge appears as a string of luminous globes or beads, separated by darker intervals. Several explanations are given for this form of lightning. One is that it is due to variations of the path of the discharge with respect to the line of sight. Another holds that the striae of haze obscure portions of the path. A third is that it is a combination of streak and globe lightning.

Forked lightning refers to the branching of the streak discharge at its lower end in some cases. Two or more objects are often struck at the same time by the forks.

The term zigzag lightning is applied to streak discharges which assume an extremely sinuous path. Such discharges present entirely different appearances from different points of observation.

Globular lightning is a discharge which consists of luminous globes, or ball-shaped masses which are seen to move along the ground, or through the air. These globes sometimes explode with a loud report and cause serious damage. It is a brilliant brush discharge moving along a path of low dielectric strength in an electric field of a storm. This discharge probably proceeds or follows streak lightning, immediately. This would account for the apparent explosions.

Sheet lightning is a term applied to silent discharges occasionally observed in clouds and haze. This constitutes a distinct type of lightning. Such discharges are somewhat similar to a brush discharge and are usually of white color. The discharge appears to occur as a sheet, although it is more likely a volume effect. It is distinguished from the aurora by the fact that it takes place in the cloud layers, while the aurora is only observed in the rarefied upper atmosphere. The name sheet lightning is falsely given to the illumination arising from streak lightning, the source of which is visible due to cloud banks or because the discharge takes place below the horizon and is so distant that the thunder either comes too late, to be associated with the illumination, or cannot be heard at all. Sheet lightning is distinguished by its persistence and comparatively slow variation of intensity.



The wiring diagram of the dual ignition system is shown above. Two sets of spark coils are employed in each cylinder.

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.

2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.

3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.

4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Dual Ignition

(2324) O. T. Bausch, Manhattan, Kan., asks:

Q. 1. Will you please publish the wiring diagram of a double ignition system such as that used in the Stutz series K motor cars?

A. 1. On this page you will find illustrated the wiring diagram of the dual ignition circuit. The motors used with dual ignition system have two spark plugs per cylinder. The Stutz engine is a dual valve engine, with intake valves on one side of the cylinder, and exhaust valves on the other. There are two spark plugs per cylinder, one on the intake side and the other on the exhaust side. In the illustration these spark plugs are marked left-hand and right-hand plugs. The ignition primary circuit (left-hand coil) is as follows: From the positive (ground) of the battery, if starting, or ground of generator, if generator is running at proper speed, to ground of contact breaker points, through points, through ignition resistance, through primary coil, to switch, to ammeter. The ignition primary circuit for the right-hand coil is exactly the same as that for the left-hand coil, except that the contact breaker points for the right-hand coil are at the lower part of the interrupter. The secondary circuit from the secondary coils of both spark coils can be traced to the center terminal of the distributor to the spark plugs, to ground, and so on to the other end of the secondary winding.

Dermatitis from Oil

(2325) T. C. Novak, Pasadena, Calif., writes:

Q. 1. Several men working in a machine shop and handling lubricating oil used for cleaning and rust removal, have acquired what seems to be a skin disease of the hands. The oil has an odor similar to wintergreen and is of a purplish color.

A. 1. The type of oil mentioned is known as "penetrating oil" and the basic ingredients are kerosene, benzine, benzene and paraffin oils. These may be employed singly or in various combinations. A heavier lubricating oil in small quantities is usually added. In order to be patentable, these oils may contain special agents such as phenols, cresols, toluene, coloring agents and deodorants. According to the Journal of the American Medical Association, dermatoses may be expected from the use of any penetrating oil or similar lubricant. This may be due in part to the defatting of the skin, which property is shared by substances such as gasoline, benzene and turpentine. In part, dermatoses may be the direct results of chemical burns from irritating agents found in the oils. Phenols, when present, may produce systemic poisoning from skin absorption. Aldehydes and particularly acrolein are detectable in this type of product and may contribute to the cause of skin lesions.

How the Stock Exchange Works

How Brokers Execute Orders

By Alfred M. Caddell

Financial Editor

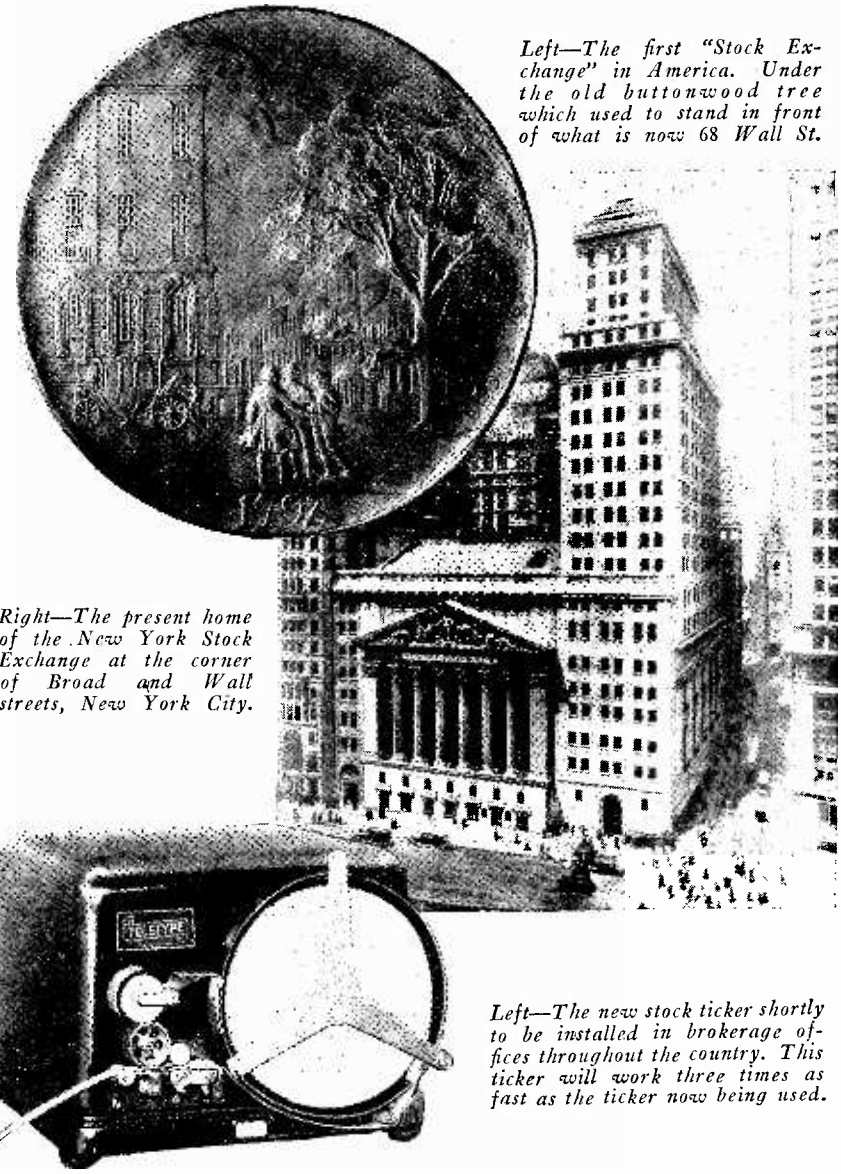
IT'S a far cry from the launching of the American republic up to the present; from the days of the canalboats and Indian trails up through the early railroad and telegraph era to the telephone, the electric light, electric and gasoline motors and the radio age. And it is an equally long story from the year several men gathered under an old buttonwood tree in front of what is now 68 Wall Street, New York, to establish a market for the buying and selling of securities.

In the year 1790, the first Congress of the United States authorized the issue of $80,000,000 in bonds, which were promptly taken up by investors. About the same time three important banking institutions were incorporated and their stock sold to the public. The sale of these securities created a demand for a market in which the purchasers could liquidate their holdings for cash, if desired. And many people did desire to dispose of what they owned and invest in something else, so trading in securities began.

The establishment of this market in 1790, afterwards to be administered by a formal organization effected for the purpose in 1792, may rightly be regarded as the nursery wherein American industry has been cultivated. For without liquidation facilities, the sale of securities, no matter how promising, would have been an impossibility. Railroads, the telegraph, the telephone, manufacturing, public utilities, mining and the other vast enterprises with which we are now familiar, could never have been launched and built into dividend-payers without the facilities of sale offered by the Stock Exchange. An outgrowth of industrial ambition supported by public financing, it is at once a financial mirror of the public's investment desires and a clearing-house of security values.

To conceive of the workings of the Stock Exchange in the days of the old buttonwood tree would not require much stretch of the imagination. But the importance of the stock market commanded early recognition and a formal organization with a membership of twenty-four brokers was effected in 1792. The War of 1812 resulted in the government offering more bonds and this, with the subsequent rapid development of the nation, broadened

(*Continued on page* 448)

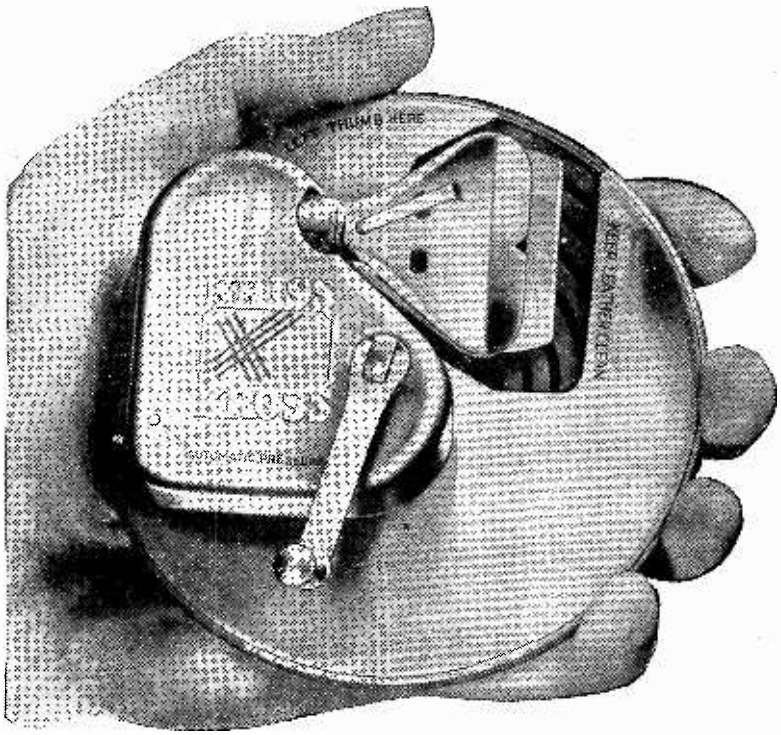


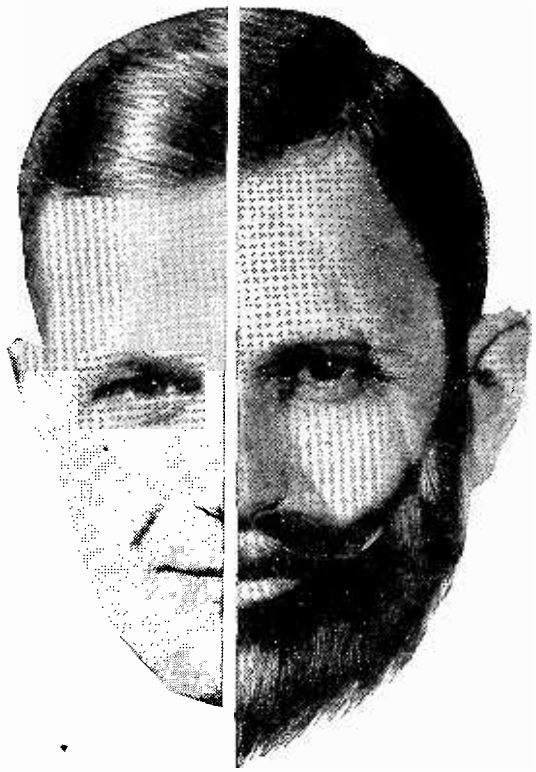
Left—The first "Stock Exchange" in America. Under the old buttonwood tree which used to stand in front of what is now 68 Wall St.

Right—The present home of the New York Stock Exchange at the corner of Broad and Wall streets, New York City.

Left—The new stock ticker shortly to be installed in brokerage offices throughout the country. This ticker will work three times as fast as the ticker now being used.

No More Razor Blades To Buy!





365 Keen Shaves
A YEAR WITH ONE SINGLE BLADE

"I want to say that KRISS-KROSS Stropper is the best thing I ever saw. I have been using **one** blade continuously for one year and nine months and have no idea how much longer it will last."
C. S. Stephenson, Okla.

Inventor Discovers Amazing New Way to Shave! —*Without Buying Blades!*

KEEN velvety shaves forever and no more blades to buy! That's what the astonishing invention of a St. Louis man offers the great army of American shavers today!

KRISS-KROSS is destined to revolutionize all existing traditions of shaving! Its performance is so sensational that it seems hardly fair to call it a stropper. Rather it is a super-stropper or blade-rejuvenator! Almost literally it makes a new blade out of an old one every day. No longer do you find that your blades "die" after five or six shaves. KRISS-KROSS "brings 'em to life" a surprising way, week after week and month after month and endows them with a keenness that they never possessed when **brand-new!** Actually you can take a blade right out of a fresh package and improve it as much as 100% in eleven seconds with KRISS-KROSS! No wonder experts pronounce it one of the greatest inventions ever patented!

Mystery Razor FREE

Magic Diagonal Stroke

Until you've seen KRISS-KROSS, fitted its sturdy nickeled smoothness into the palm of your hand and tested its uncanny dexterity yourself, you'll never know how amazing it really is! It employs the famous **diagonal stroke**, same as a master barber uses. Never before has anyone captured the secret of reproducing it automatically. Eight "lucky leather grooves" do the trick in 11 seconds with a precision it takes a master barber years to attain.

But that's not all, KRISS-KROSS embodies still another feature that has hitherto baffled mechanical reproduction. It strops from **heavy** to light. It's absolutely uncanny the way the strokes start with strong pressure and grow lighter and lighter until an adjustable, automatic jig flies up and notifies you that your blade is ready—**ready with the keenest cutting-edge that steel can take!**

Fits All Makes of Blades

KRISS-KROSS produces unbelievable sharpness and prolongs the life of any razor blade for months and even years. Fits all brands and makes except Durham. Eliminates 83% of shaving costs. No more "raking" and scraping with dull blades. No more stinging and smarting that has to be relieved with messy lotions and harsh astringents. KRISS-KROSS solves your blade problem for all time and gives you keen velvet-smooth shaves forever!

Sensational Offer

And now for my surprising offer. To introduce KRISS-KROSS, I am giving with it Free a new kind of razor. Possesses remarkable features. Instantly adjustable to any shaving position. A flip of the finger makes it (1) T-shaped; (2) straight (old style); (3) or diagonal (new way). Gives a **sliding** instead of **pulling stroke.** Simply zips right through the toughest crops of whiskers. Made of **rustless** metal. Comes with 5 special-process blades and is entirely unlike anything you ever saw before!

Get Free Offer

Send for full information on these surprising new inventions today. KRISS-KROSS products are never sold in stores. You deal direct with me or my authorized representative. Write for illustrated description and full details of free razor offer. It's even more remarkable than I can tell you in this short space. Clip the coupon now. Mail it today.

Agents $30.00 a Day

Make big money with KRISS-KROSS. Giving away FREE razors boosts your profits amazingly. H. King made $66 in one day. N. C. Paige made $104 in 3 days! Others average $350 and up to $750 a month! **Spare-time** workers. **Office** and **Factory** men make $6-$12 extra a day showing KRISS-KROSS to friends and fellow employes. S. Kantala made $154 extra just working evenings 3 weeks. Get details at once. Check bottom of coupon and mail it today!

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St. Louis, Mo.

Canadian Address:
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39 Wellington Street East
Toronto 2, Canada

KRISS-KROSS CORP'N, Dept. M-3104
1418 Pendleton Ave., St. Louis, Mo.

Without obligation, please send me illustrated description and full details of your special introductory offer on KRISS-KROSS super-stropper and FREE 3-way razor.

Name .....

Address .....

Town .....

☐ Check here if interested in making money as authorized KRISS-KROSS representative.

How the Stock Exchange Works

(*Continued from page 446*)

the scope of the securities market. In 1817, rooms were engaged at No. 40 Wall Street and it was there that the first indoor securities market in the United States began to function under a constitution and set of rules.

Before the coming of the telegraph, all offers to buy and sell were carried between brokerage offices and the Stock Exchange by fleet runners, who also conveyed the latest quotations and market news. But in 1867, an invention called the ticker revolutionized this primitive means and put security quotations on an instantaneous basis.

The ticker was invented by a telegraph operator by the name of E. A. Calahan, who conceived the idea of transmitting the various sales taking place on the floor of the Stock Exchange to brokers' offices by electrical means. There are two parts to this system—a transmitter on the floor of the exchange and a ticker or recording instrument in the office of the broker, which records the various sales as they are made.

The transmitter employs the principle of permutation control of a printing device (the ticker) which is located in a distant office. Permutation control means control of that printer to bring about various combinations of a small number of units to control a large number of symbols and figures. By means of the telegraph principle utilized in connection with a polarity reverser, the transmitter causes the type wheel of the distant ticker to rotate in synchronism with the typewheel of the transmitter. The typewheel is made to rotate back and forth by this system of reversing polarity and come to a stop at a combination of the right letters from which symbols representing various securities and figures representing various price combinations are composed. Thereupon the combined letters and figures become imprinted on a paper tape, from which brokers and their customers may learn what is taking place in the market.

How Orders Are Handled

LET us suppose that you, John, and you, Edna, desire to buy 100 shares of U. S. Steel common stock. Let us suppose, also, that you live in Portland, Oregon, or Kansas City, Missouri—in these days of electrical communication it makes no difference where you live so long as you have access to a ticker in a brokerage office or are content to conduct business with a broker by phone or telegraph. We will assume, however, that you are sitting in the customers' room of a broker's office in Kansas City and that you have authorized your broker to buy 100 shares of U. S. Steel "at the market," which means at the then prevailing price.

Your order is recorded by a clerk and transmitted over the broker's private telegraph wire to his New York office. Here it is received, practically instantaneously, and turned over to a telephone clerk in the New York house for transmission by private wire to the floor of the exchange. The floor telephone is situated in one of the many booths set aside for brokers and is manned by clerks employed by the brokers.

As the telephone clerk receives your order over his telephone he jots it down on an order slip and at the same time presses a button in his booth, which operates a number on the large annunciator board. This particular number has been assigned by the Exchange to the floor member of the brokerage firm with whom you are dealing, and upon seeing it the floor member goes to his booth to receive your order. Telephone clerks are not permitted to leave their booths.

With your order in his hand, your broker must buy for you 100 shares of U. S. Steel at as low a price as he can buy it for in the market at that time. In a word, he becomes your personal representative on the floor of the Exchange and must act in your behalf according to his best judgment.

In order to facilitate execution of orders, the system of trading posts was established. A stock, such as Steel, is assigned, among others, to a certain post, and there it may be found by any broker interested in executing an order. Similarly, each of the several trading posts throughout the room is the market for twenty or thirty different stocks.

On his arrival at the post designated for Steel, your broker hears this stock being offered at, let us say, 142¼ ($142.25). He also hears another broker bidding 142⅛ (142.12½) for it. Thus he is at once informed of the true market for the stock—$142.12½ a share bid, offered at $142.25 a share.

As your broker has authority to buy the stock for you "at the market," or at the lowest price at which it can be had, he says to the broker offering to sell at 142¼ (142.25): "Take it," and the transaction is consummated. No written agreement or memorandum of any kind is exchanged by the contracting brokers, the purchasing broker making a notation on the form bearing your order who sold it to him and at what price, and the selling broker making notation on a pad who bought the stock from him, and the price. All contracts made on the floor of the Exchange, involving in the aggregate, frequently upwards of three or four hundreds of millions of dollars in a day, are made in this apparently informal way, and yet such contracts are always held inviolable by members of the Stock Exchange.

Your broker now sends to his telephone clerk a memorandum that he has bought 100 Steel at 142¼ from Broker So-and-so. The clerk promptly telephones the report to his office, and it is telegraphed to the Kansas City branch office where you are waiting, and if you are watching the ticker you will see the following quotation appear: X 142¼, which means a transaction of 100 shares of Steel has taken place at that price, X being the symbol for U. S. Steel. If the transaction had been for 500 shares, the ticker tape would read 5X 142¼, and so on.

It has naturally taken quite a few words to tell the story of the transaction you set in motion, but due to the efficiency with which your order is executed, it is possible that the ticker will report the transaction before you have regained your seat in the broker's office. So swiftly are orders put through that there are instances on record where orders given in San Francisco have been executed on the floor of the Stock Exchange in New York, 3,000 miles away, and reported back to the customer within one minute's time! And since branch offices and correspondents of Stock Exchange firms can be found in practically every city of size in the United States, it will be seen that the Exchange to all intents and purposes succeeds in bringing to its floor, face to face, all investors in the land interested in buying or selling listed securities.

Outstanding Features

THE buying and selling of securities has long since entered the realm of Big Business, but a few facts setting forth the magnitude of this business may prove of interest.

The membership of the New York Stock Exchange, for years restricted to 1,100, has lately been authorized to total 1,375 memberships, or "seats," which at present are valued in the neighborhood of $500,000 each.

The branch offices of these members, totaling 1,192, are to be found in nearly every state of the Union and in Canada, England, France, Hawaii and Cuba.

For the year 1927 (since then the sum total has been greatly increased) the value of securities dealt in on the Stock Exchange totaled $59,814,924,265.70.

Stock and bond tickers in operation throughout thirty-five of the forty-eight states number 7,916. Thus, thanks to the wonders of this electrical age, security traders in California or Washington may obtain the market quotations just as quickly as a broker whose office is next door to the Stock Exchange.

The Stock Exchange is open five hours per day (two hours Saturday), and during those hours approximately 2,000,000 calls are transmitted over the private wires connecting members' offices with the floor of the Stock Exchange. There are about 2,000 members' private wires to the floor and between 1,050 and 1,100 telephone clerks are engaged on the floor in handling orders.

The telephone booths on the floor of the Exchange are connected with the trading posts for exchange of messages by a pneumatic tube system which contains 35 miles of aluminum tubing and six 75-horsepower compressors delivering 30,000 cubic feet of air per minute at 1½ pounds pressure.

On June 12, 1928, when total sales amounted to more than 5,000,000 shares (since then the day's record of sales has reached 8,000,000 shares), approximately 17,500,000 feet of paper tape or 3,314 miles (enough to span the continent) were used on the stock tickers alone.

As of October 1, 1928, there were 1,513 bonds and 1,131 stocks listed on the New York Stock Exchange. These had a market value of $47,059,543,168 and $59,332,123,511 respectively.

New Stock Ticker

SO great was the volume of business handled by the Stock Exchange during 1928, that the machinery for handling the large number of security transactions fairly creaked under the burdens imposed upon it. On various days the ticker service was all but useless as far as recording transactions was concerned. It was not unusual for the ticker to be from half an hour to one hour late—on one day it was one hour and forty-two minutes behind the transaction it was reporting.

To take care of big share days which will inevitably occur in the not distant future, the Exchange has been experimenting with a kind of ticker service which is reported to be three times as fast as the one now in service. When finally installed, this instrument will be capable of a maximum speed of about 900 characters per minute as compared with 300 characters on the ticker now in use. One of the principal improvements made in the new ticker is that printing of the characters selected from the typewheel for impression—such as GM 126 or TC 17⅜—in accordance with the master tape cut by the operator of the transmitting apparatus, will occur simultaneously with the selection, instead of the typewheel stopping after selection before printing, as at present.

Financial Questions and Answers

Edited by Mr. Caddell, Financial Editor

Question—I own 200 shares of Timken Roller Bearing, and would like your opinion on the future earning possibilities of this stock. C. H. H., Chicago, Ill.

Answer—Timken Roller Bearing Co. enjoys the distinction of being the largest domestic manufacturer of tapered roller bearings, its equipment being used on about 90% of all makes of passenger automobiles, trucks and buses, including Fords. At present 116 steam railroads and 26 electric railways are using Timken bearings. The company owns steel and tube mills and sells a large part of its production in this division to outside customers.

Capital stock consists of 2,407,824 no-par shares. There is no funded debt and the formerly outstanding preferred stock was wholly redeemed in 1922. Present dividend rate on the new common is $3 a share annually, equal to $6 a share on the stock before the split-up last January, compared with a total payment of $5.25 in 1928, $5 in 1927 and $4.50 in 1926.

Balance sheet as of Dec. 31, 1928, was exceptionally strong. In the first quarter of this year the company reported net of $4,264,225, equivalent to $1.77 a share on the $2,407,824 no-par shares of capital stock. With motor production at record levels, Timken's report for the three months ended June 30 will undoubtedly be highly satisfactory. Steel production continues to remain at high levels, and inasmuch as farm purchasing power is large and railway equipment buying is on a satisfactory basis, the outlook for this company would appear to be continuously promising.

Question—What is your opinion regarding a purchase of New York Title & Mortgage 5½s? P. P. L., Chattanooga, Tenn.

Answer—New York Title & Mortgage 5½s are sound first mortgage certificates, backed by one of the leading title and mortgage companies in the field, with capital and resources of more than $60,000,000. This company sells title insurance policies which constitute the basis of sound mortgage loans.

Question—I would like to have a report on Credit Alliance Corporation stocks. C. H., Cheney, Kan.

Answer—This company finances the sales and purchases of necessary industrial equipment, and is similar in operation to the General Motors Acceptance Corp., buying equipment for manufacturers and permitting them to pay the purchase price by means of monthly notes.

On March 1, 1928, this company's entire issue of preferred stock was called in at $110 a share. There are still some debenture bonds and equipment trust notes ahead of stock dividends, but the latter are being retired every six months and the company expects to retire them completely within this year. The class A stock, of which there are 45,543 shares outstanding, pays $2 in dividends, which at the present market price yields a little better than 5.75%. The company is now in its biggest year, the first five months of 1929 being far ahead of the similar period last year. The securities of this company would appear to offer a fair speculation.

Question—I would thank you to give me information regarding Cities Service Company as a safe investment. B. C. H., St. Joseph, Mo.

Answer—The year 1928 was the most successful year in the company's history. Large increases were made in assets, gross and net earnings, and also the number of security holders, who now total more than 450,000. Excess of current assets over current liabilities increased 26.75%, from $52,932,000 to $67,094,000. Consolidated net earnings of Cities Service and its subsidiaries exceeded $64,000,000, equal to 9.43% on the total capitalization and funded debt. Total consolidated assets of this nation-wide organization increased during the year from over $809,000,000 to

more than $913,000,000; quite a growth. This stock recently underwent a 4 to 1 split-up and while the dividend policy on the new stock has not been announced, it can be stated with reasonable certainty that the 6% in cash and 6% in stock paid on the old stock annually will be cut one-fourth, making the payment on the 24,000,000 shares now outstanding exactly the same as that received on the old shares. At current market prices the stock yields only slightly less than 7%. At the present market prices, however, the future of this stock has been somewhat discounted, a factor which influences the rise in value of the stock only and not its dividend earning capacity.

Information on securities will be furnished readers of Science and Invention free of charge by mail and through these columns. A 2-cent stamped, self-addressed envelope should be included in your letter. Address your inquiries to

The Financial Editor, Science and Invention, 381 Fourth Avenue, New York City.

Hints on Flying a Glider

By Henry Townsend

(*Continued from page* 431)

can be towed along by a motor-boat on the water, the glider of course rising a fair distance above the water as the motorboat moves along.

The advantage of using two ropes for launching the glider as shown in the diagram, lies in the fact that when the glider snaps into the air and is in free flight, as shown by the dotted lines in the diagram, the ring attached to the two ropes and rubber cord will drop, but it will not fall on someone's head. The ring, by the way, should be considerably larger than the hook so that there will be no question of its falling off. If so desired, a special release dog and lever arrangement may be worked out by the glider constructor. A low-priced glider which young boys of twelve to fifteen years of age can build at small cost and have a lot of pleasure with, as well as learning the first steps in actual flying, was described with working drawings in the last issue of this journal. Previous to that there appeared complete working drawings of a professional type glider and blueprints of this larger glider are available.

The two photos accompanying this article are very interesting, the smaller photo showing an American built glider, with enclosed fuselage, in free flight just after the launching ropes have dropped. The large photo showing a glider about to be launched, depicts the first glider made by the members of the German-American Glider Club of Chicago. Quite a few of the members of this club gained their practical glider experience in Germany. Mr. Joseph Steinhauser of Chicago was the designer of the particular glider shown in the picture. An illustration of a beautiful glider trophy, as well as the cash awards offered for glider flights, were described in the July, 1929, issue of this magazine.

Glider Builders!

If you have successfully built and flown a man-carrying glider, take some photos of it, and send them along with a description, to the Editor.

PATENT ADVICE

CONDUCTED BY JOSEPH H. KRAUS.

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain patent phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail, a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

Perpetual Motion

(1184) Charles C. Laney of Fair Play, Mo., suggests a system for attaining perpetual motion which comprises an automobile, which moves back and forth on a track. The track is supported on a fulcrum at its center so that it will teeter back and forth. A pendulum hangs from the center of the track. A spring at either end is supported to facilitate the action of the machine. He asks our opinion.

A. 1. One can no more expect that a pendulum with a shifting weight will operate longer than an ordinary pendulum, than one can expect to get something for nothing. In your device, when analyzed, one finds merely a pendulum which works back and forth combined with which there is a shifting weight. Just as much energy is required to compress the springs as those springs will give when they rebound, minus a few losses inherent in such actions. As a consequence, your machine for perpetual motion will come to rest within a few seconds after it has been started. The system is so easily built, that if you doubt our word you can proceed to construct it and see for yourself the absolute impossibility of obtaining motion in this fashion.

Talking Home Movie

(1185) George N. Buntin, Hermitage, Tenn., suggests a method of connecting a phonograph with a small movie camera, a microphone and an amplifier for the purpose of making talkie movies at home.

A. 1. The idea which you have advanced for a combination movie and phonograph, is not new and we are quite confident that you could not secure a basic patent thereon. The talking part is now obtainable in any store catering to the wants of the movie enthusiast.

We would advise no further action on this suggestion.

Axe Head Fastener

(1186) Henry L. Ledoux, New Orleans, La., asks whether it would be worthwhile to patent an idea in which a pin or rivet is driven through an axe-head and through the handle so as to prevent the axe-head from coming off.

A. 1. Attempts have been made to secure axe-heads to handles by placing screws and rivets laterally through the axe and handle.

The difficulty is that the pins shear off or the handles are destroyed. No axe has as yet been devised in which the axe is riveted to the handle, with the exception of the steel axes. However, these axes are not employed in preference to the wooden handled ones, because of the concussive effect which the steel construction produces on the hands of the user.

You will note that practically any axe you have used slides on the wooden portion. If the head were pinned to the handle either the handle or the pin would suffer.

We advise no action in this case.

Toaster

(1187) George N. Buntin, Hermitage, Tenn., asks whether he could secure a patent on a toaster, the nature of which he does not disclose, and which is to be marketed for five and ten cents store trade.

A. 1. An electric toaster is not ordinarily a patentable article. While a design patent is possible on such a toaster, the basic idea consists of a wire which is heated by means of electrical current, a grid which prevents the piece of bread from touching the wires and some means of supporting both the wire, grid and the whole contrivance.

We doubt if you will have very much difficulty in manufacturing the product provided that it is different enough from others on the market. But unless the article is divided into two or three parts, we believe it will be difficult for you to sell the same at a profit in the stores to which you intend to offer it.

Sign Painters' Guide

(1188) Victor Elder, Pittsburgh, Pa., has designed a sign painters' guide and asks whether he should patent it.

A. 1. We do not see any material advantage in the sign painters' guide, which you have built. While it is possible that you might be able to secure a limited market on a device of this nature, it is extremely doubtful that patenting the product will result in material gain from a financial standpoint.

There is nothing to prevent someone else from duplicating your idea and also placing that on the market.

Protractors with levels thereon are old and have been known for many years. The slightly different shape which you give your protractor will not constitute a basic patent claim.

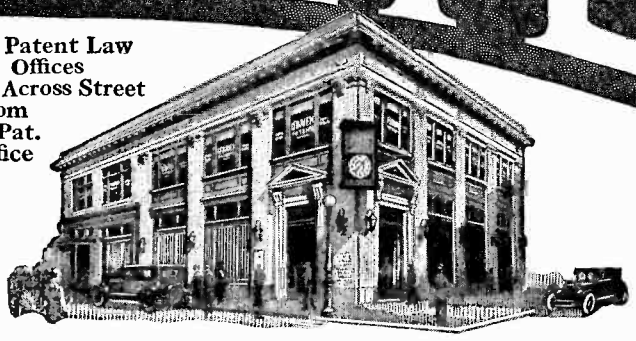
We advise no action on the above mentioned idea.

PATENTS

At the right is a view of my drafting and specification offices where a large staff of experienced experts are in my constant employ.

All drawings and specifications are prepared under my personal supervision.

My Patent Law Offices Just Across Street From U.S. Pat. Office



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Is a College Education Worth While?

Views of Frank Melville, Jr.

(*Continued from page* 418)

muscles and tendons which are to be called upon to function at the right moment and in the right way, require training, painstaking preparations. That is the physical side.

Our minds need identical training. You can probably take more out of the brain than you put into it, principally because of its faculty of putting things together and multiplying the number of its products. But it must be nourished and exercised. It must be fed with sound, basic facts, with the best standards in all things; with the obligations of life and the conventions which we all are better off for observing.

Many ambitious young men have asked me what constitutes true happiness in business. This is perhaps easier to answer indirectly by defining what true happiness is *not*. The millionaire isn't happy because he is a millionaire; he's happy in spite of it. So my idea is that if an individual puts his whole heart in his work, doesn't worry, but concerns himself solely with doing a better job than the other fellow; if he does this without continually asking himself, "How much am I going to make out of this?" that chap is going to awaken some day to the fact that he is earning a lot of money!

Happiness consists in being busy, being content and being well. Money doesn't figure in it at all. My own idea was to regard business—life!—as a game. I wanted the best value in my merchandise; wanted the best store first in the block, then in the section, then in the city. I wanted to do the biggest volume of business and strove to have the most satisfied customers. The question of money was one I figured would take care of itself.

My precepts in merchandising? I believe I can make them clear in a single paragraph—

Try always to sell a better product at a better price than the customer can get anywhere else. In buying, practice the same rule. Buy so that the seller can make a profit, too. Maybe it will be only a small one on the individual purchase, but on large orders it will mount up. This keeps both sides contented and happy.

You might call it the practical application of the Golden Rule in business. It has been our cardinal principle from the time our first store was founded. For example, when we sell a customer a pair of shoes for four dollars, we consider that we are making him a present of a dollar. And when you realize that we sell 7,000,000 pairs of shoes a year you can appreciate the saving we enable our customers to make.

The Opinion of W. O'Neill

(*Continued from page* 419)

of history, the arts and sciences broaden a man's viewpoint and enable him to meet the problems into which his larger sphere of influence brings him. While he is attending college this doesn't seem so necessary but once he has attained this education and has entered a business life, the ever-increasing value keeps unfolding in the field of business.

To my mind the college education helps a man more after he has attained success than it does in the actual attaining.

The bright, intelligent college graduate who lets his education stop with his diploma can never equal the man who recognizes that in the field of business there is a still greater university for his continued education. He must keep studying and show a certain amount of originality and resourcefulness which wasn't necessary in college. The college which develops these characteristics in its students will go a long way to make its graduates successful in business. The man who leaves college thinking he has learned everything generally finds that in the field of business he has learned nothing.

What Edwin Franko Goldman, Famous Bandmaster, Thinks

(*Continued from page* 419)

is experience, integrity, common-sense and personality.

Some of the world's greatest men, both in the business world and in the world of arts and letters, were not college bred. They were students by nature, acquiring knowledge and information from each and everything with which they came in contact, and having the capacity to grasp and retain any and everything worth-while. Such men have vision and judgment, and have a natural aptitude for assimilating knowledge. They are "self-made"—"self-taught."

If my son were bent on a business career, I should feel that a college education was not necessary for him. Inasmuch as he is not to follow a business career, he is at present at college.

As for my own career, I graduated from public school and did not even have the opportunity of attending high school. My success has been achieved through the school of experience.

As I said before, a college education is always a desirable thing, but not always a necessity.

What Prof. T. N. Carver Says

(*Continued from page* 419)

work that one might do. To seek an education with a fairly definite idea as to what the world needs, even though the world is willing to pay well for it, harmonizes perfectly with a social purpose. The fact that a young man with high ideals will be well paid for his work need not deter him, provided the work is useful. Of course, he does not need to spend his high earnings in selfish indulgence. There are too many opportunities to reinvest them in productive industries, which is also social service, to permit one easily to adopt a life of passive enjoyment.

The study of economics, for example, may have a definitely vocational purpose. There is a large and growing demand for well trained economists, not only as teachers, but in business as well. Business becomes a more and more intellectual calling as civilization advances and the industrial system becomes more and more complicated. Problems of investment, of valuation, of co-ordinating the factors of production, of forecasting business tendencies, are not solved by men whose chief qualification is the ability to "hustle." They are solved by men who have a grasp of facts and principles and the ability to think about them, to distinguish the relevant from the irrelevant facts in a situation, and to see what principles apply to the problem in hand.

This grasp of facts and principles may, of course, be acquired without a college education. So also may the facts and principles of law, of medicine, of engineering

(*Continued on page* 465)

Dunninger's Sensational Buzz-Saw Illusion

(*Continued from page 395*)

Attention is now called to the buzz-saw, which stands on a specially built platform and skeleton stand contrivance. The saw is rotated by a powerful motor. The saw is put in operation and at the same time assistants, operating the drum slowly, set the same into motion and to the surprise, horror and mystification of the entire audience, the box containing the lady is seen, slowly but surely, inch by inch, to approach the whirling circular saw.

At last the box comes in contact with the buzzing saw and as the box continues to slowly slide along the skelcton tracks of the platform, the saw whirls its way, buzzing loudly, through the box. When the box is in the position indicated in the diagram, the slaves are ordered to stop while the magician closes the top of the box, covering the girl's head completely. Then the command to proceed is again given. The box is now completely sawed in half lengthwise . . . a feat never before, in the annals of magical history, accomplished by any magician the world has ever known!

The box is then pushed back to its former position, after committeemen make a thorough examination, proving to their own as well as the audiences' satisfaction that the box is completely sawed through; the box is then opened, the lady is freed of her manacles, brought out of her hypnotic trance by the performer and she trips daintily to the footlights to take her bow.

Here is a problem to tax the mind of the cleverest thinker.

How can it be done?

That's what we want our readers to conjecture upon.

One hundred dollars in gold is the reward for the ingenious brain who offers the most workable method. We have in our safe the blueprint and correct *modus operandi* written and sketched by Dunninger, but we want you, our readers, to develop a solution to this sensational buzz-saw illusion.

$21,000.00 FOR SPIRITS

$1,000.00 offered by this publication for spirit manifestations which cannot be duplicated or explained by scientific means.

$10,000.00 for spiritual phenomena offered by Joseph F. Rinn.

$10,000.00 offered by Joseph Dunninger for manifestations which he cannot explain or duplicate under identical conditions.

Total: $21,000.00 now offered.

Stereoscopic Movies with Color and Voice in the Making

By H. Winfield Secor

(*Continued from page* 405)

George K. Spoor, and P. John Berggren of the Essanay Studios of Chicago. The motion pictures can be produced in color and are synchronized with sound. The pictures were projected on the world's largest screen the size of which was variously given of 48 feet wide by 26 feet high to 52 feet wide by 30 feet high. The pictures could have been projected on a screen 70 feet wide.

As will be noted, the film itself is four times the size of an ordinary film and as a consequence the picture from it can be projected on a screen 4 times as large as ordinarily employed without enlarging the grains of silver more than at present.

A noteworthy advance is made in the attempt at getting the three dimensional effect. This was explained by Mr. Berggren in the following way. If you hold your two hands in front of you and raise the index finger of both hands, and if you look at the index finger of the hand nearest your eye, the index finger of the hand furthest away will appear double. If instead, you look at the distant finger, the one closer to your eye will appear double, but if you look midway between the two fingers both of them will appear double. It is on this basis that the new camera was developed. An object or a person is photographed from two different points, the lenses of the camera being separated by a distance of approximately 4½ inches. Each of these lenses transmits a different view of the object, and as a consequence the shadows photographed on the film are slightly different.

Instead of using two frames for a picture as has been the practice heretofore, in any attempt at stereoscopism the inventors perfectly align the pictures on the same frame of film and in that way get the shadow variation spoken of in the hand experiment.

Because of the fact that patents of the system are now pending and it was not desirable to release the details for publication, the diagram appended to the text of this article is not exactly accurate but it is schematic enough to give an idea of what goes on in the camera. As will be seen a picture of a circular object is being taken. The lenses of the camera are 4½ inches apart, and while prisms are used in the original construction to direct the rays of light upon the film, and to make the two views register on top of each other, we have chosen to use reflectors and a half silvered mirror to explain the principle.

The inventors exhibited the film on the biggest screen in the world. Some of the shots were of Niagara Falls. Here one could see the splendid depth but strictly speaking the pictures are not stereoscopic. They merely give the illusion of much greater depth than has ever been heretofore presented with any device which does not necessitate looking at the screen through colored glasses or through a revolving shutter. The screen itself was made of finely beaded glass. Appropriate music was furnished by loud speakers operated through the R. C. A. Photophone system. With this method pictures have been taken of objects five miles from the camera lense, and the full feeling of depth has been inculcated.

Smashing Aviation Records

(*Continued from page* 420)

Orchard, Maine, to Rome, Italy, was forced down because of a lack of fuel near Santander, Spain, after having made a non-stop flight across the Atlantic of 3,401 miles. The pilots were Roger Q. Williams and Lewis A. Yancey. The average speed was 107.2 miles, the date July 9th. They later completed the trip to Rome.

Meanwhile in California Pilots Loren W. Mendell and R. B. Reinhart broke the new refueling record established a week previously by the Cleveland fliers and listed. Their time was 246 hrs., 43 mins., made in a plane named The Angeleno, and powered by a Wright Whirlwind motor. They landed on July 12.

Radio Oracle

(*Continued from page* 441)

acid battery. In 1925 the U. S. Bureau of Standards tested a number of preparations advertised as substitutes for the usual electrolyte and published their findings in a bulletin. Their report stated that changing the solution in a storage battery does not charge it. Tests have shown that batteries containing these solutions, contrary to the claims made for them, behave in accordance with well-established laws of electrochemistry. Comparison was made between batteries containing these solutions and batteries containing electrolytes of sulphuric acid of equivalent strength. No essential differences were shown in the charging, the voltage, the efficiency or the temperature. It takes as long to fully charge a battery containing one of these solutions as to charge a similar battery containing the ordinary electrolyte.

Although the materials and coloring matter considered individually may be harmless, the disadvantages in using such solutions more than offset any temporary gain. The usual electrolyte of pure sulphuric acid and water, adjusted to the proper specific gravity at the completion of a full charge, is believed to be the best.

The Truth About Gasoline Savers

By George A. Luers

(*Continued from page* 422)

manifold at right angles to the mixture, diluting and agitating the same into a uniform desirable condition. As will be obvious, this air adds volume to the gas mixture, reducing the quantity which must pass through the carburetor and consequently results in saving fuel.

Illustration (C) is a device of similar characteristics, manufactured by the J. A. Stransky Manufacturing Co. This is a manifold device, but with valves and adjustments for individual fitting to the needs of the car to which it is to be attached. As will be noted by comparison with the hand in the illustration, this device is compact, yet is rugged and not capable of being easily put of order.

The ingenious product of the Electro Gas Saver Manufacturers, is a combined electrical heater, with automatic injection of moist air taken from the radiator. The electrical device connects to the car generator, while the gas saver is piped into the intake manifold. The advantages of moist air in preventing the formation of hard carbon, and tending to keep down carbon deposits, have long been claimed, and the periods of tests through which manufacturers of these devices have operated them must be evidence enough to substantiate these claims.

Steam and water vapor devices, which inject moisture into the gas mixture, go to improve the running of the engine. Apart from the fact that the engine functions more efficiently in damp weather or at night when the air is moist, laboratory tests show that gasoline to which water vapor is added, explodes with less detonating effect.

The explosion is made gentler and instead of kicking the piston down, a more gentle shove is applied, exercising power more uniformly. The addition of water vapor,

thus causing this slight delay in the explosion of the gas or the more uniform application of the thrust, allows for a more advanced spark position, without the usual "pinking." Obviously driving with the fullest advanced spark is effective in reducing the gasoline consumption.

One of the latest and most improved devices, embodying full automatic vapor air injection means to improve the operation of the engine and to reduce the quantity of fuel required to operate the car, is known as the Automatic VIX Vapor Humidifier and Gas Saver.

This device is shown by illustration (E), the manufacturer of which has spared no pains to make this complete in every detail. Costly castings and other parts are made of bronzes and other rust-resisting materials.

The operating details of the "VIX" are —a special trap connecting to the overflow of the radiator, providing a continuous supply of moist air. This trap is fitted with a gravity shutter to keep any water which overflows in filling the radiator from entering and interfering with the starting of the engine. The trap is connected by means of a flexible metal hose to the injector or humidifier valve. Connecting to this valve is a piston, operating in a cylinder which connects to the exhaust pipe of the engine. The pressure of the exhaust, varying with the speed of the engine, is constantly changing the piston position. This provides for automatic regulation, related exactly to the engine speed and consequently the needs in carburetion.

The "humidifier" is connected through pipe and couplings into the intake manifold of the engine.

The entire assembly of the "VIX" provides a wholly and completely automatic and self-regulating device, diluting the gas mixture and admitting moisture according to the speed and needs of the engine, without any attention whatever from the driver while running. The entire design and construction shows that the inventor has given much study and months of tests in the development, to make the detail parts operate in unison and accomplish the gasoline dilution automatically.

The gasoline saver manufactured by the Whirlwind Manufacturing Co., shown by illustration (F), mixes air with the gas mixture at the period of high vacuum and in addition attains a secondary mixing of the fuel, by means of a special screening disc. This device is inserted between the flanges of the intake manifold and the carburetor. The air injecting nozzle is automatic in operation requiring no dash connection or manual control.

The Blancke Auto Devices manufacture a small and compact fuel saver, which also connects into the intake manifold. The manufacturers of this device have on file many affidavits from users, which show extremely high gas mileage.

While there are a large number of excellent gasoline economizers available to owners, capable of reducing gasoline costs, it is not possible to explain all in this short article. The writer would point out, however, that the more perfected of these devices do materially aid in proportioning the fuel mixture, diluting it with air and reducing the amount of fuel used. The simpler and less expensive devices also have the same facility to reduce the quantity of fuel used; however, perfection in operation is most usually attained by perfection in all details. This means more parts and more mechanism, testing and designing, and consequently a higher-priced article.

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What Our Readers Think

(*Continued from page 437*)

been done along this particular line?

Amos Utterback,
Hammond, Ind.

(The unfortunate part is that science does not understand what chemical phenomenon takes place within us when we sleep. It is known that there are certain bodies in the nerves which become smaller as fatigue comes on, and that after sleep these bodies again enlarge. Whether or not the bodies produce the energy necessary to carry on work is something which no scientist has as yet discovered. Sleep is largely a matter of habit. Some individuals will be thoroughly rested after a sleep of but four hours. Others require as much as twelve.

We do not see how a glass-enclosed bed with added oxygen and sun-rays would help to cut down the amount of sleep required. As a matter of fact, an increase of oxygen increases metabolism. Decreasing the amount of oxygen decreases metabolism. At the same time it adds additional losses because of the necessity of more rapid breathing.—Editor.)

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Slater Refuses Spirit Test

(*Continued from page* 399)

Stone, E. de Lopatecki and Dave Lustig were also present. Songs and sermons occupied the first part of the program. Then amid much applause, John Slater mounted the raised dais and proceeded to read messages in sealed envelopes. He repeatedly impressed upon his audience the fact that he had no way of telling the contents of the sealed envelopes; that he did not know the people for whom he read these messages, that they never saw him, nor he them, and that there was *no other possible way* in which he could have gotten the information.

To forcibly impress upon his hearers the magnitude of this mysterious power that Slater claimed to possess, he stated that he had a standing offer of $5,000 that he would give to any one who would prove that he tampered with or in any way examined the contents of any of the sealed envelopes. This was the occasion for action. Dunninger jumped up and asked, "May I say a few words, please?" He was promptly booed down, told he would get a chance later, and advised to resume his seat. A strong arm squad found its way to that part of the hall where the Science and Invention Magazine committee were seated.

Knowing that Slater absolutely refuses to answer any more questions after his séance period is over, and knowing that he undoubtedly would evade a test, Dunninger was reluctant to let the matter slide to the end of the séance as he was requested to do. At quarter of 11, Slater had about 10 more minutes to go. He had just completed saying, "And I had no way of knowing the contents of your letter, did I?" While he was being roundly applauded, Mr. Kraus jumped up and waving the sealed message in his hand, exclaimed in a voice that could be heard above the handclapping, "Mr. Slater, will you read the contents of this envelope for $21,000? We have the check on hand made payable to you." Dunninger added, "Will you do this, Mr. Slater?"

Slater's response was, "If this man had adopted these tactics in a Roman Catholic Church, or a Jewish Synagogue, what would you have said? Throw him out!" With that, the strong arm squad started to descend from all directions and to carry out Slater's order. Again Dunninger repeated, "Will you do this?" Slater refused, but his refusal could not be heard above the din of "Put him out! Throw him out!" The Managing Editor tarried and prevented the squad from coming up in back. Slater heard the challenge; he refused it!

The editors of SCIENCE AND INVENTION were asking Slater to do nothing more than he professed to be able to do. In a Catholic Church, in a Jewish Synagogue, or in any other religious assemblage, of this nature, any member of the congregation has a right to question the minister and expect the courtesy of a reply. It seems that in spiritualism one entertains no such right. One cannot expect the preacher or the minister to do the very things he claims he is able to do.

It seems that in spiritualism the mediums are not supposed to accept $21,000 for a *test séance,* even though they could turn that money over to charity or to the furtherance of their cause; that evidently is unethical.

And so we conclude with the statement that if this man who is advertised as being the world-renowned medium, John Slater, and who since the age of 22 has been producing similar effects, is not capable of giving just *one* for the benefit of not only his audience, but also science, can we not consider all mediumistic manifestations as belonging to the same category?

Constructing a Heliograph

By L. B. Robbins

(*Continued from page* 433)

exactly opposite the pivot bolt. Bend slightly so they are 5 inches apart and stand them exactly vertical as shown. Select mirror D with care. The surface should be free from waviness. It should be about 5 inches in diameter. Turn the mirror over and strike the exact center with dividers. Scribe a ¼ circle from this point, scraping away the backing within this circle. Drill a small hole in the metal edging of the mirror in line with the center. Then at the exact top drill two small holes in the glass for the trunnion X which is secured by two small bolts. Trunnions are made by bending a piece of stiff brass U-shaped as detailed. The holes in sides are for the pivoting bolt as shown.

Mount the mirror between uprights CC by drilling a hole in the top of each threaded for small machine screws to fit in pivot holes in sides of mirror. When properly assembled the bottom of mirror should swing 2 inches clear of A and the diameter line across mirror should be exactly parallel with surface of A.

The mirror arm E is a small metal rod sliding inside a tube which is adjusted by a thumb screw. Drill several closely placed holes in the top of the rod and pivot to the trunnions with a cotter pin. Flatten the bottom of the tube and drill a hole through the center; attach to key as at F.

The key consists of a wood bar 5 inches long. 1 inch high and ¾ inch thick. Cut one end down half the thickness and fit with a poker chip to act as a knob. Drill and pivot the other end as indicated inside an inverted U-shaped metal piece Y fastened to base A and straddling the center line. The washer should rest over the end of A. A second piece of metal forms an adjustment bridge over the middle of the key. This bridge Z is fitted with an adjustment screw that can be turned down from the top. A flat spring fastened to A under the key near Y holds the key solidly against screw Z. Drill several holes through the key just back of Z and cut into a slot. Then drill a hole through sideways and, letting the flattened end of mirror arm E down into the slot, secure it so it pivots easily with a small bolt.

Two tangent screws GG must be fixed near B at each side, near the back and work in tapped metal uprights fastened to B as shown. These adjust relation of A on B. A white painted wooden dowel standing vertical in the small end of A, with thumbscrew, completes the transmitter.

Set the sub-base B on a camera tripod or other firm support. A short tripod or box so the operator can sit on the ground makes for a steady beam. Sight along the key so adjusting nut on Z and vane come in line with the point to which you wish to transmit. Then with the mirror at angle shown while key is held down, adjust the tangent screws so the vane turns in its horizontal plane and the sun's rays are played upon the receiving spot. Make final adjustment with mirror sliding rod and lock in position while key is down. When ready send the code exactly as with a radio or telegraph key. The length of time the key is down determines a dash or a dot.

By throwing the beam of a powerful searchlight on the mirrors at night messages can be sent after nightfall.

The sighting is checked up by having the unsilvered spot in the center of the mirror cast a shadow on the white-painted vane in front of the mirror. This should appear there at any angle of the mirror when the flash is centered correctly on the receiving point.

Animals that Learned to Fly

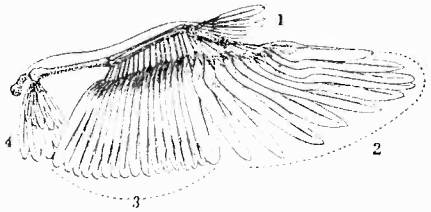
By Dr. Ernest Bade

(*Continued from page 407*)

pumped full of air and the lungs filled to capacity. In this position of gliding the flying frog always lands upon some solid object. These creatures are only active at dusk at which time they seek their food. During the day they cling to the leaves, the green coloring of their body blending with the foliage, the gayly colored parts being hidden between the stomach and the folds in the joints.

Flying Fish

WITHOUT question the so-called flying fish are mere gliders although they do throw themselves comparatively high into the air. This is not the case with any other gliders, as they are not built for an upward flight, and are not provided with a driving muscular device attached both to the skeleton and to the organ of flight, as is the case with bats, birds and insects. Here it is nothing more than an adaption for enlarged bodily surface area which increases the resistance of the air to their falling and so enables the creature to glide downward gradually. The flying fish prolong their flight over the water—their fall—but they can not fly.



Schematic diagram of the wing of a bird. 1-4, thumb feathers; 2-10, hand or primary feathers; 3-17, forearm feathers; 4, shoulder feathers.

Very few of all the so called flying fish are true gliders. The majority hurl themselves out of the water and then employ their comparatively large and well developed pectoral fins as gliding surfaces. In this way the butterfly fish, *Pantodon buchholzi,* an African fresh water fish, jumps out of the water after those insects flying just above the surface. The large pectoral fins are spread and these carry the fish for a short distance before it falls back into the water. In the same way the Indian fish *Nuria danrica* glides when the pectoral fins are spread. The same is also true of the South American species *Gasteropelecus stellatus* and the related form *Canegiella fasciata.* When their life is endangered they cut through the surface of the water. Breast and tail are usually left in the water but the pectoral fins beat the surface, and sometimes they rise into the air and glide for 2 or 3 yards.

The organs of flight, or better, gliding, are far more perfect and more highly developed in the salt-water fish. Two species are of special importance, the flying fish *Exocoetus* and the flying gurnard *Dactylopterus.* The large pectoral fins of these animals when extended horizontally, produce a very good gliding surface and in the flying fish the peculiarly formed tail fins also aid in its flight. The tail fins of all fishes act like propellers in driving or "sculling" the creature through the water,

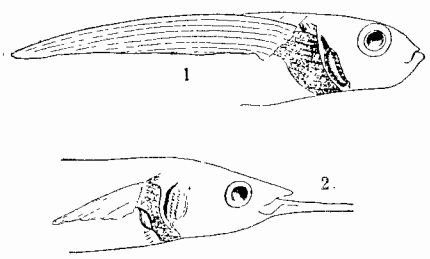
and in *Exocoetus*, the flying fish, the lower flap of the tail fin is much longer, broader and stronger than the upper flap.

When this fish swims through the water, the large pectoral fins are folded closely to the body and, by means of a sculling movement of the tail fin, the fish is driven forward rapidly until the force is increased sufficiently to hurl it above the surface of the water. Then the pectoral fins are spread and the creature glides through the air. As its speed decreases, the heavier tail sinks back into the water. A few renewed vigorous driving blows with the tail fin, suffices to lift the animal into the air again and permit it to continue its glide. The fish, therefore, can not remain continually out of its natural medium. Since the tail fin can not act upon the air, it must be used in the more resistant water to be effective.

Flying fish represent an incomplete airplane and the lower, somewhat lengthened tail fin may be considered as acting like a propeller when the fin is partially submerged. Then, too, the flying fish take advantage of rising air currents produced at the crests of the waves. They cover considerable distances in the air, and flights of approximately 600 feet have been observed. Seitz noticed the flight of these animals from the bottom of a boat and said that the jump from the water was aided by a lively fluttering movement. Specimens 8 inches in length beat their pectoral fins from 4 to 4½ inches when they reached the crest of their flight. Then the gliding membrane is stretched horizontally or slightly upward and the fish glides gently downward without any conscious movement. A fluttering of the pectoral fins is noticeable when the fish rises the second time. Then, too, the same flutter is observed when it glides over the crest of a wave, but this probably only occurs when the wind lies in a certain direction from the axis of flight.

The muscles of the pectoral fins are strongly developed to produce both a lifting and a forward driving force. In birds the muscles comprise about 1/6th of the entire bodily weight, in flying fish it is 1/32d, in non-flying relatives it is only 1/154th, while the bats stand between the birds and the flying fish with a muscular weight of 1/13th of their entire weight.

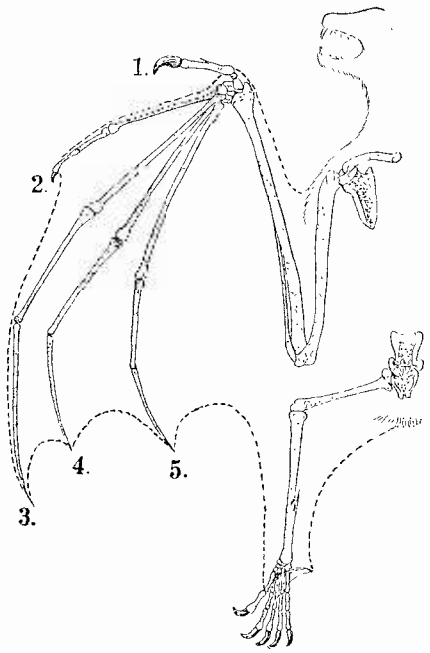
When the flying fins are spread they seem to be slightly curved, the curvature being 1/10th the height of the chord or the



At 1 we see the muscle of a flying fish. At 2 is perceived the muscle of a relative of a flying fish.

width of the fins. They also possess, if only to a moderate degree, a strengthening of the front of their gliding surface as well as a certain curvature which aids the forward movement just as it is the case with both bats and birds.

The duration of flight lasts longer, if the fish is flying into the wind, than if it glides with or at an angle to the wind. While in flight, the fish is capable of steering a course diagonal to the course selected at the beginning of the flight. The body is bent into a quadrant and the large tail fin becomes the rudder and the air resistance turns the direction of flight. Under normal conditions the course of flight lies just above the surface of the water but when caught in rising currents they may be lifted as much as 18 or 20 feet. Like large blue darning needles schools of these creatures, frightened by a steamer, skim over the water, sink into



Figures 1 to 5 show the fingers of the bat.

the valleys of the waves, carried upward again by the rising currents of the following crest, and disappear in a graceful glide, back into the water.

And so, watching and studying, during centuries of restless activity, the brain of man has attempted to solve the problem of building a flying machine which would carry him at will into the dizzy heights of the air just as a boat is carried upon the ocean. It was in our age that the problem was successfully solved by building a light motor to drive a propeller.

Crack Ups

By Joseph H. Kraus

(*Continued from page* 404)

tries to execute a more spectacular scene than his last and he tries to come as close to being killed as possible without actually arriving at this destination.

The flier himself rarely gets any publicity, although once in a while, if he engages in a particularly severe crash and is quite badly mangled, his name appears as a filler in the local newspapers. He may eventually occupy a little more space in the obituary columns, but such publicity will never do him any good.

Yet it's all in the game, plenty of fun, exercise, a real good thrill, and the aviator can see himself doing the trick as often as he desires. After all, don't we all take as great a chance daily?

The photographs on these pages indicate that, if you know how, you can fall with a plane and land as safely as if you fell off a motorcycle or horse.

You Can Call Your Home From Moving Train

(*Continued from page* 438)

telegraph engineers in their experiments, and it was on this car that much of the preliminary work was carried out. Many problems had to be solved and a special modulator circuit developed. Difficulty was experienced in the design of a suitable antenna system, the proper carrier frequencies and the establishment of a reliable duplex transmission.

Circuits and Apparatus

A RADIO telephone transmitting and receiving set are placed on the train and similar apparatus positioned near the railway right of way constitutes what is known as the terminal station. It was found necessary to employ a separate antenna for transmitter and receiver. The telegraph lines paralleling the railway tracks are used for this purpose at the terminal station. Filters are interposed between the terminal receiver and transmitter and the telegraph lines so that there is no interference between the new system and the existing telephone and telegraph systems already operating over these wires. The train antenna consists of two pairs of parallel wires strung along the roof of one of the cars. The antennas used in the German system are wires extending along the roofs of several cars, thereby necessitating the employment of coupling devices to allow the cars to be separated. The radiophone messages are transferred from the train antenna to the nearby telegraph and telephone lines, are conducted along these wires and received at the terminal station.

Frequency of Signals

CONSIDERABLE research work was entailed in the determination of the correct carrier frequency, since the attenuation of high frequency currents on wires is opposite to that experienced when these currents travel through the ether. Compromise frequencies had to be chosen, so that the minimum of over-all attenuation would be experienced. Experiment showed that frequencies between 90 and 200 kilocycles (3,500 and 1,500 meters) were the best suited for this purpose. A different frequency is used for the carrier from the train to the terminal station than that for the carrier from the terminal station to the train. The power of each transmitter was set at 20 watts, as this is sufficient to bridge the maximum distance of transmission that separates the trains and the telegraph wires. At places where the lines are more than 200 feet from the train auxiliary pole lines are erected.

Phone Lines "Tied-in"

FOR connecting the terminal station with the ordinary telephones a circuit known as the conjugate Wheatstone bridge circuit is used and enables the two pairs of wires from the receiver and transmitter to be connected to a single pair of wires constituting a telephone line without having the transmitter and receiver interfere with each other. The voice currents are allowed to pass from the receiver to the telephone line and from the telephone line to the transmitter.

The design of the signal circuits permits the transmitting amplifiers and power oscillators to be turned off when the line is

not in use, and yet it is possible for either operator to signal the distant station by simply turning a key. This transmits signals to the station, which ring a telephone bell. In order to eliminate the possibility of false signals, the circuit is so arranged that only a specific combination of impulses will ring the bell. Thus the operators need not be connected with each other continually.

A traveler on the train wishing to communicate with his home or make a business call asks the train operator to ring a certain number. The operator signals the terminal operator and gives him the necessary information. When the connection is made the train operator notifies the passenger and he will then be able to converse with the individual called.

The first installation of the equipment will probably be between Montreal and Toronto. A number of the important trains between these two cities will be so fitted within the next two or three months.

Experiments with Little-Known Chemicals

By Dr. Ernest Bade

(*Continued from page 426*)

being used, its explanation is of value.

First iodine is added to wood alcohol to form methyl iodide. This process is similar to the preparation of ethyl iodide, but greater care is necessary in its production, since it boils at 43° C., just a little more than half the temperature required to boil ethyl iodide. The methyl iodide is then caused to react with potassium cyanide in an aqueous wood alcohol solution, whereby methyl cyanide (acetonitrile) is obtained. At the same time potassium iodide is formed. Methyl cyanide is a colorless liquid, soluble in all proportions in water and it boils at 82° C. The methyl cyanide is then reduced with metallic sodium, the methyl cyanide being dissolved in wood alcohol. Four molecules of hydrogen, which are liberated from the alcohol, enter the methyl cyanide and convert it to ethyl amine, a very volatile liquid boiling at 19° C. It is also soluble in water. This ethyl amine is readily converted to ethyl alcohol by dissolving the ethyl amine in dilute hydrochloric acid and then adding an aqueous solution of sodium nitrite. On warming, bubbles of nitrogen are evolved and ethyl alcohol will be found in solution.

This process adds a carbon atom. It is a building-up process, which, as time goes on, will become more and more important in the chemical industry. The tearing down or splitting up of a complex compound into one or more of a simpler nature is also a process extensively employed. Here, for instance, a higher member of a homologous series is converted into the next lower member. That means that ethyl alcohol may be converted to methyl alcohol, just the reverse of the previous process.

Here the ethyl alcohol is oxidized by sulphuric acid and potassium bichromate to, first, acetaldehyde, which is not distilled off, but, on heating with a reflux condenser, it is further oxidized to acetic acid. The dilute acetic acid obtained is concentrated by making a sodium salt of the acetic acid, and on distilling this salt with sulphuric acid, pure acetic acid is obtained. This acetic acid, which may also be obtained in the vinegar fermentation of ethyl alcohol in dilute solution with more ethyl alcohol, forms ethyl acetate with the aid of sulphuric acid. The ethyl acetate is then changed to acetamide and the acetamide to methyl amine, which is a gas at ordinary temperatures having a boiling point of —6° C. This gas is collected by passing it into a dilute solution of hydrochloric acid where a soluble salt of the compound is formed. Then, by the addition of an aqueous solution of sodium nitrite, methyl alcohol will be obtained.

Methyl amine is prepared with the aid of acetamide, the final product being the salt, methyl amine hydrochloride. Place 10 grams of acetamide in a large flask. Add 9 c.c. of bromine and shake lightly. Then add a previously prepared and cold solution of 12 grams of potassium hydroxide in 50 c.c. of water. Pour the alkali slowly into the bromine solution until the red color has changed to a bright yellow. During the mixing the flask should be kept cool. If a precipitate is formed, add a few drops of water to dissolve it. This is the first reaction, and a mono-brom derivative of acetamide is formed. This is now placed in a dropping funnel and the funnel is placed in a flask containing a solution of 30 grams of potassium hydroxide in 80 c.c. of water. A thermometer reaches to the solution. Then gently heat until a temperature of 70° C. has been attained. Then slowly drop the reaction mixture from the funnel into the hydroxide solution, taking care not to heat it above 75° C. If the temperature rises above this, cool the flask with water. Keep at this temperature until the reaction mixture is colorless. This may take from ten to fifteen minutes. Then add a few pieces of broken glass or pumice stone to prevent bumping and heat gently to drive off the gas methyl amine which is collected in a mixture of 20 c.c. of water and 20 c.c. of hydrochloric acid in a beaker. The gas is led to the beaker by means of a funnel inverted in the acid and which dips just below the acid level. This prevents the acid from being drawn up into the distilling flask. As soon as the liquid in the condenser shows no alkaline reaction, the distillation is discontinued.

The methyl amine hydrochloride is obtained by evaporating the solution in the receiver over a water bath. When the salt is dry, place in a beaker after powdering and add 15 c.c. of hot absolute alcohol. This dissolves the methyl amine hydrochloride and, on filtering, the ammonium chloride present will remain on the filter. Recrystallize the methyl amine hydrochloride and dry in a dessicator. The crystals may also be spread upon an unfolded filter paper and placed in a pint jar containing calcium chloride. The cover of the jar must fit tightly.

As a whole both types of reactions are complicated but well within the range of advanced laboratory work. The breaking down and building up of a series will always remain vital factors in chemical work, the procedure on a commercial scale probably taking short cuts, using entirely different reactions and, which is more important, entirely different raw products from which the desired end products may be more easily and more cheaply obtained.

But the values, for the laboratory, of changing from one member of a series to the next will always be great, for often a member, difficult to obtain in the open market, will then be within the range of production in the laboratory of a competent chemist.

In the Next Issue—

Another valuable article on Finance—

By Alfred M. Caddell

Is a College Education Worth While?

(*Continued from page* 454)

and of any other subject. In every field there are great scholars who never went to college. The question is, however, can that grasp be as easily acquired, or when acquired will it be as comprehensive, when acquired by serving an apprenticeship in practical work as when acquired as a result of specialized and systematic study? In law, medicine and engineering, there does not seem to be much doubt as to the advantage of the school. There is a growing recognition of the advantage of the school method of training for business.

Of course the school does not entirely displace the apprenticeship. The graduate of the medical school serves as an intern, and the graduate of the law school serves as assistant in a law office, to learn the practical sides of their professions under veteran experts. General principles are learned in the schools, practical details are learned under experts in a hospital or in an office. No college education, not even a course in a business school, will fit one for business until one has served a long apprenticeship. But as in other professions there seems to be some advantage in learning general principles in a school and practical details in an office.

Even if one does not take a professional business course, there is something to be said for a general college education, provided courses are chosen which are related to the world of men and affairs. Courses in economics are peculiarly adapted to that end. One's education ought to initiate one into the intellectual life of the world. When the learning of the world was limited to a knowledge of ancient literatures, no one could be called an educated man unless he shared that knowledge. Without it he could not understand the language of educated men, nor enter into their thoughts and feelings.

To an increasing extent, the world is thinking and talking about great economic questions. The "thoughts that shake mankind" are economic thoughts: the revolutions and the attempted revolutions of the world are economic revolutions. To enter intelligently into the thought of the world one must have some training in economics. To achieve any kind of constructive leadership in this field, or to be able to direct the thinking of the world into constructive channels, requires specialized training in economics.

I emphasize economics for no other reason than that it is my special interest. Courses in history, in government, in mathematics, and in all the sciences which underlie the technique of production, should all be positive aids in the grasp of business principles.

The Modern Sherlock Holmes

(*Continued from page* 413)

powder is used, and if the object is very light in color, a bronze powder is dusted over the surface. Finger-prints on small objects are revealed by dusting the surface lightly with powder applied with a brush.

If a bullet is found lodged in the wall or ceiling, it is carefully extracted by using the tools provided in the kit. Care is taken in removing the bullet, a rather large hole cut completely around it so as to preserve certain tell-tale markings which are imparted to any bullet after passing through the barrel of a gun. Bits of hair, cigar ashes, threads of cloth, and the like, which must later be examined are placed in test tubes and brought back to headquarters. A mirror and a flashlight enable the detective to look into inaccessible corners.

How a Roller Coaster Demonstrates Relativity

By Donald H. Menzel, Ph. D.

(*Continued from page* 425)

of one object to move against the tendency of another to do the same thing.

P.—I see my difficulty. Really the tendency of an object to move and my hypothetical force are one and the same thing. It is not legitimate to speak of them separately. (Fig. 2.)

R.—Exactly. You have never seen gravitation. You cannot tell me whence it comes or how it acts. All you can say is, "If there is a force, an invisible, intangible force that makes bodies attract one another, then they will tend to come together, a stone to fall, for instance." Your assumption that the force is *attractive* instead of repellant is simply due to the fact that you observe bodies tend to approach each other instead of to separate.

P.—I think I begin to understand. The savages note the sun goes south in winter. Everything freezes. When the sun returns, the earth blooms again. Their superstitious minds sought for some explanation of the *observed* fact, hence they decided that the sun was a god who smiled upon them each summer and who became angry in winter. Their theory accounted for the *observations* every bit as well as do our modern ideas of the nature of the sun. A theory, obviously concocted to fit the facts should fit the facts, but that it does so is no proof of its truth. So with gravitation. It was developed to explain why objects fall. Therefore we cannot legitimately reverse our reasoning and say that the observed fact of falling objects is a proof of gravitation, any more than the savage could argue that the recurrence of summer and winter proves the sun to be a god.

R.—You're on the right track. Now for the "Dip-the-Dips," where I think I can make the subject a little more graphic. (Opens suitcase and takes therefrom a small "bathroom" scale. Puts it on the seat of one of the cars and sits down upon it.*)

R.—According to relativity, as you well know, the apparent force acting on a body is supposed to disappear when the object is allowed to "take its own course." Now, what would be the most natural path for myself to follow?

L.—If all supports and obstacles were removed, you would fall toward the center of the earth.

R.—The car is starting. Note that my normal weight is 175 pounds (Fig. 3). The physicist would say, I am sure, that the earth is attracting me with gravitational force of 175 pounds. Here we are at the top— Now watch the pointer . . .

(The car sweeps dizzily down the grade.)

L.—Twenty-five pounds!

R.—I think you will agree that the car more nearly followed its most natural path when it went down the incline than when it was standing still or moving uniformly. Consequently the apparent force of gravity as evidenced by my weight was much less. If the car had been allowed to fall freely, the scales would have read zero. Now watch.

(The car careens up a steep incline.)

L.—Two hundred and fifty pounds.

R.—In accordance with my general principle, it is plainly more unnatural for the car to swing up hill than to fall or remain motionless. Therefore my weight, or the apparent force of gravity, is greatest under these conditions.

P.—But it is very easy to explain these facts without the help of relativity.

R.—I am quite familiar with the explanations, but I must remind you again that the various laws you are about to enunciate are little more than statements of what we observe. Pardon me for disagreeing with you, but I do not think it easy to *explain* these observations on the basis of modern physics.

P.—But we can foretell these events exactly.

R.—A man drops a monkey wrench from an airplane. You can calculate the path the object will take, how fast it will fall, where and when it will strike. Yes, the law of gravitation tells you all these things. But you have not told me why the wrench falls. Gravitation is as mysterious as ever. You have borrowed from Peter to pay Paul, and, by doing so, have only postponed slightly the day of judgment. Why does the earth attract or at least seem to attract the monkey-wrench? Relativity is an attempt to dig more deeply into the nature of things.

P.—But there seems to be an obvious explanation for your apparent loss and gain in weight. The track of the dip-the-dips is highly curved. Here, I'll draw you a picture (Fig. 5). Now when the car is swinging around a curve, a certain amount of centrifugal force is developed that throws you toward the scales when you are at A and away when you are at B. This explains why your weight is greater in the former instance. I could calculate in advance exactly what the scales would read at every point of the track.

R.—I'll grant that you could tell me the figures. But how about the scales? Can it handle arithmetic and algebra so that it will know just where to set its pointer? When you make your computation you say, "So much of the deflection of the scales is due to gravitational force, so much to centrifugal force," and you add or subtract the two. We have noticed that the scales made no distinction between the various forces. This behavior is more in accord with my explanation: that the car's most natural path would be toward the center of the earth. If allowed to fall freely no force would be felt on it or in it. The forces arise when the car is made to deviate from its natural path by some obstruction, in this case the track; the greater the deviation the greater the apparent force.

L.—But why is it "more natural" for a body to fall? I do not feel that you have made any simplification. I see that gravitation does not really tell us why an object falls, but neither have you told us. You must tell us why downward motion is more natural than upward.

R.—I knew you would come to that question sooner or later, and, to be perfectly frank, I have been dreading it; not because it cannot be answered but because it is very difficult to explain in elementary language.

P.—The mathematical part of the theory enters here, does it not?

R.—Yes. And I'll try to make the difficulty plain by means of an analogy. Sur-

* Since the question may be raised, we should remark that the relativist and the manager of the amusement park were great friends. The latter freely gave permission and arranged for the performance of the various experiments. (Ed.)

veying a piece of land is a simple task to a surveyor. Suppose that an engineer is laying out a farm. The owner of the land, although entirely ignorant of geometry and trigonometry, does not wish to be cheated and asks that the process of measurement be explained. This turns out to be a very difficult task, for the man is extremely ignorant of mathematics. After some trial, the owner admits defeat and decides that he will have to accept the surveyor's measures on faith.

It is much the same way with relativity. The mathematics of relativity are rather complex; although they are no more mysterious to me than arithmetic to you, it would take more time than we have at our disposal to go over every step in the development of the equations of relativity. For the present, you will have to take my mathematics on faith.

Like the engineer, the relativist deals with geometry. There is only one difference. Where the surveyor deals with space only—length, breadth, height—I deal with time—duration—as well. In other words, I deal with four dimensions instead of three. There is nothing curious about this.* The surveyor's world was built of points in space, mine from points in space-time, events. It may be somewhat new for you to think of time as a geometrical relation, but it isn't difficult. Take this dip-the-dips. The track we have followed is a geometrical path in space. But we have progressed through time as well; we are some minutes older than when we left our starting point. And we can represent our dual path through space and time in geometrical form.

Einstein was one of the first to investigate the geometry of space-time. He found that there were certain general mathematical relations that this geometry *must* conform to. Out of several alternatives he chose the simplest. This choice was somewhat arbitrary. It is as though I might say to you, some time when you are at my house, "You are welcome to leave in any way that you please. You may climb through the chimney, jump out of the window, saw a hole in the roof or go out the door." Of course, you may adopt one of the three former alternatives, but I think you would prefer the simplest method.

So it is with Nature. While there are complicated alternatives, it seems that she, too, prefers the simplest, for the various predictions of Einstein upon that basis have been amply verified by experiment.**

One of the chief consequences of the Relativity "World Geometry" is that objects *appear* to attract one another, to a first approximation, with a force that corresponds to Newton's gravitation. That is why I say, "The most natural path of an object is toward the center of the earth"—the most natural because it is the simplest.

There is another way of looking at the matter. Einstein's geometry, as I have said, dealing as it does with space and time, is a geometry of events.

L. (interrupting)—I don't follow you at all. I still don't see how events and geometry can be related.

R.—Very simply. Geometry, among other things, treats of lines. The orbit of a body in space is a line. The track of a body through space-time is a line—a world line (often called a geodesic). A (Fig. 6) is the monkey-wrench dropped by the careless airplane mechanic. Considered as a path through space alone, the wrench will fall in the straight line AB, striking the earth at B, say 1,000 feet below, one minute later. But A and B both have progressed through one minute of time. Representing this by the horizontal direction, B will have progressed* to B′ during the minute.

The "world line" of the falling wrench will be AB′. After it strikes the earth it remains motionless in space, though it progressed in time to B″. If, however, the solid earth had not prevented, it would have gone to C″ in the interval. According to Einstein then, the path AB′ is the most natural, the simplest thing that could have happened to the wrench. Similarly B′ C″ is simpler than B′ B″, but the earth prevents the motion. Nevertheless, the wrench, in an attempt to follow the "greased path" B′ C″, presses against the earth with a force that you call gravitation, but which actually originates in the geometry of world lines. There is obviously a natural tendency for world lines of different objects to intersect.

L.—I think I understand it better now. Your expression "greased path" helped me. Do you not mean that among all the possible paths the wrench could have taken, AD or AE for example, the smoothest route of all was AB′?

R.—Correct. The wrench could have followed either of your paths only if something material, a gust of wind perhaps, had caused it to deviate from its natural path. Now you are able to see why our ups and downs on the dip-the-dips apparently produced changes in the earth's gravitational force.

(Next month, the Relativist and his two friends ride the Merry-Go-Round.)

* Note that I do not say *moved*. I have supposed B stationary in space, for the sake of simplicity.

* The idea was developed to some extent in previous article. (Ed.)

** See last month's article.

Coal Miner's Job Safer Than Yours!

By Alvin F. Harlow

(*Continued from page* 411)

Government experts have had no respect whatever for it, having repeatedly blown it up with dust and gas, and inflicted other indignities. An explosion due to anthracite dust is practically out of the question, the ignition point of the anthracite dust and air mixture being so high as to make it improbable that the dust will ever be fired in the ordinary processes of mining.

One of the greatest nuisances underground has always been the gases—most of them noxious, even deadly to the human organism, and some of them explosive when ignited. Fire damp, for example, the variable explosive gas, usually consisting largely of light carburetted hydrogen, became a nuisance early in the history of the industry, and many men were killed before its dangers were full understood. In the first primitive pits and tunnels, gases were a problem serious enough, but if they had had the enormously complicated mine systems of today, extending several miles from the shaft or tunnel mouth, they could not have fought the hazard with the simple contrivances then in existence.

The first clumsy attempts at forced ventilation of mines were being made four and five hundred years ago; but fan ventilation was not introduced into American mines until about 1850. Previous to that time our workings had been neither deep nor extensive enough to make artificial ventilation imperatively necessary.

A hundred years and more ago there were men employed called "candle watchers," who were highly expert in detecting by the appearance of the candle flame or other open light the first hint of fire damp in the mine air. Then in 1815 Sir Humphry Davy invented his safety lantern, in which the flame was encased by a cylinder of gauze through which the gas could not penetrate. This was until very recent years considered the greatest boon ever devised for miners. But even it was not perfect. If the lamp should happen to be not properly assembled or if the gauze should become torn, then it is no longer a safety lamp; and furthermore, the gauze prevents its giving forth a very brilliant light.

In recent years carbide or acetylene lamps have been much used, but these also have their disadvantages. The latest and best idea for the individual light is the electric lamp. This gives the most brilliant light of any yet devised for use in mines and is by all odds the safest. It is worn in the usual place on the front of the cap and is connected by an insulated wire with the storage battery, which is preferably fastened to the back of the man's belt. The battery casings of approved lamps are provided with locks; first, to prevent malicious tampering with the battery; second, to prevent the use of the battery for firing blasts; and third, to prevent accidental ignition of explosives by inadvertent contact with the battery terminal.

The lamps are turned in at night to the lamp room and their keys are also kept by the lamp room attendant. A card index of the miner and his lamp record is kept by number. No matter what happens below, the miner will never let his lamp get away from him; and in case of explosion, the lamp number often serves to identify its bearer's body. If a man's lamp is not turned in at the end of a working shift, the lamp house attendant at once gives his name and working place to the foreman of the following shift, so that he may be looked up, lest he may have suffered an accident.

Another great advance in safety has been brought about by the invention of what are known to the mining industry as permissible explosives. These are the result of intensive study of the problem by the mining and powder-making industries, and the system first began to be used about 1902.

About four out of every ten of the more disastrous mine explosions in this country have been the result of ignition of gas or dust by explosives. Black powder is the most dangerous of all. It ignites very readily, and being in powder form, is very apt to be spilled in handling, and thus lay the train for a serious explosion. It has also a long, hot flame which is very apt to ignite gas or dust. Very few coal operators whose mines are at all dusty or gaseous now venture to use black powder.

Dynamite is somewhat less dangerous than black powder, but it too is very tricky stuff, especially when it has been frozen or when it is heated or when it begins to age a bit; and it has a very hot flame.

The permissible explosives vary more or less in their formulas, but at present they are all made to conform to certain standards set by the Bureau of Mines. They explode with a flame much shorter and cooler than that of black powder and much cooler than that of dynamite. When unconfined they are difficult to ignite, and are therefore far less likely to ignite gas and dust; and many of them will not continue to burn unless continually reignited. With their use accidental explosions are very unlikely to occur.

Although the use of these permissible compounds is increasing rapidly, yet metal mines and coal mines not gaseous or dusty (anthracite mines in particular) still continue to use large quantities of black powder and dynamite. But the specific rules for handling them and other safeguards thrown around them today are such, that even with high pressure production and with the mines extended into vast labyrinths strung with trolley and light wires, the hazard from explosives is not increasing but is rather decreasing.

One of the chief reasons for this is the extreme care used in handling and transportation. Magazines are strongly built, barricaded and guarded and are remotely located. A recent clever idea is that of making the magazine roof of a special concrete consisting of six parts sand to one of cement. This would crumble to dust in case of an explosion in the magazine, and no large chunks of material would be thrown about the neighborhood.

Specially constructed closed cars are used to transport explosives in and around the workings, and are usually preceded by a man carrying a red light. In these cars no metal is used on the inside. A lining of thoroughly seasoned wood, attached to the body by wooden pegs and wedges, covers all inside bolt-heads and other metal parts. A layer of asbestos comes next and is held in place by a second wooden lining, also fastened with wooden pegs. Thus thorough insulation is secured and there is no danger of explosion from contact with live wires.

A severe test was made of a car of this kind at an Illinois colliery. It was filled with kegs of powder and loose powder was poured all over and between the kegs. The doors of the car were closed and copper wire wound around the body in all directions. A current of 275 volts was then turned through the wires; but though the sides of the car were charred and some of the wires melted, no explosion resulted.

At least one State now has a law against carrying explosives in mine cars hauled by electric locomotives, and many mines forbid it. Men are not allowed to carry more than one day's supply of explosives into the

mines, and there are many strict regulations regarding blasting. In some of the most up-to-date mines the blasts are not fired by the miner himself but by a shot-firer—a man appointed solely for that work because of his long experience with explosives, expertness in testing the air for gas before firing a blast and general temperamental fitness. The miner may be allowed to carry his day's supply of dynamite or other explosive to his working place, but detonators are entrusted only to the shot-firer, who must account for every cap and make formal report of every one that is defective. At many mines all blasts are now fired just at the end of a shift, or if there is no night work, they are set off after the men quit work for the day. The use of hand-lighted fuse is decreasing rapidly, being replaced by electric firing, which is positive, instantaneous and permits the men to be in safety before any move is made to explode the charge. The battery or blasting machine is locked, and no one but the shot-firer carries the key.

The greatest difficulty found in dealing with the hazard of explosives is that of inducing the workman to treat them with due deference. Nowhere has the adage that familiarity breeds contempt been more beautifully demonstrated than in the miner's attitude towards the peevish and touchy agents used in blasting. Here is one relation where it would be supposed that familiarity would breed respect; but instead, we find that the old-style miner would (and does yet at mines where he is not properly coached and restrained) work around loose black powder with a pipe in his mouth; punch a hole in a powder can with a blow from the point of a pick; open cases of dynamite with a hatchet or a hammer and chisel, both likely to cause a spark if they strike a nail; send dynamite down into the mines in the original box with the lid removed, furnishing a fine opportunity for somebody to stand over it with a lighted candle or torch and start an explosion; put frozen dynamite inside his shirt to thaw it; crimp detonating caps full of highly explosive fulminates with his teeth; throw a sack of dynamite down a bank rather than have the trouble of carrying it; cut fuse so short that if he stubs his toe as he runs for shelter, he may not arrive; stuff sticks of dynamite into several coat pockets or carry a bundle of them swung under his arm, put blasting caps into another pocket and a coil of fuse around his neck and thus laden, go stumbling through dark tunnels or climbing up and down ladders, when a slip or fall might set off a blast that would wreck the mine, and leave perhaps not even a trace of the human cartridge which caused it.

Among the ironclad rules now framed to overcome this form of carelessness are clauses forbidding the carrying of caps and powder or dynamite together; imperative orders that boxes of explosives must be opened with a wooden mallet and wooden wedge; specifying the length of fuse to be used; directing that fuse must be tested every two weeks for speed of burning; insisting that men handling explosives must be able to speak English; forbidding the use of frozen dynamite, and many others. To supplement this rule-making, a continuous campaign of education is being carried on by the National and State mine bureaus, explosive manufacturers and trade journals.

By these various means the danger from explosives has been reduced to a minor place among mining hazards. During a recent ten-year period, when an average of more than 900,000 men were employed in the mines of the United States, the deaths from the use of explosives averaged 216 per year, or one for every 4,279 men employed. In a group of ten of our largest cities, persons were killed in almost the

same ratio by automobiles; and this hazard is increasing rapidly, whereas the death rate from explosives in mines is slowly decreasing. Today, therefore, the average citizen runs an even greater risk of being killed by an automobile than does the miner by the explosives which he uses daily.

Dust explosions were formerly harder to combat than those of gas; but in recent years a remarkable discovery has gone far towards controlling them. This idea, when fully and properly used, will practically eliminate the hazard. The remedy is rock-dust.

For a long time the only device that anybody could think of to keep down coal dust was water. Now, water is highly desirable when drilling rock, especially in metal mining, to hold down the sharp-pointed siliceous dust which gets into the lungs and tends to bring on miner's phthisis and tuberculosis. But it is extremely difficult to wet coal dust. It has been proven that sufficient coal dust will lie dry upon the surface of water to cause an explosion if thrown into the air. It is also impossible to make coal dust stay wet in a mine through which the necessary ventilation currents are constantly passing.

The only expedient left was to nullify the explosive tendency of the coal dust. It was found that this could be done by mixing rock dust with it. The specific heat of rock dust is low, and when half-and-half mixture of rock and coal dust is thrown into suspension in the air, the rock-dust absorbs heat and lowers the temperature of the flame of propagation below the ignition point of the coal dust. Also the particles of rock dust getting between the particles of coal dust act as a cold curtain, impeding the progress of the flame from one coal atom to another.

It is declared that this remarkable remedy—which has begun to be employed only very recently in America, though some British concerns have been using it for fifteen years—will eliminate at least 85 or 90 percent of the dangers of a coal dust explosion. Hereafter, such dust explosions as may occur in coal mines should be small and trifling affairs, attended by little if any loss of life.

The dust to be used should contain little or no free silica, which is so detrimental to the mucous membrane. Either limestone or shale is good for the purpose. It is ground extremely fine, and according to the best practice a carload of it is sent through the various tunnels at intervals of a week to a month, according to conditions, spraying the stuff on walls and floor with an air ejector. Some assert that even a ten percent mixture of rock dust with coal dust will reduce the pressure and corresponding violence of an explosion by 90 percent.

As an additional safeguard, quenchers, or barriers of rock dust are placed at various points in a mine so as to confine an explosion to a small area. These consist of light shelves near the ceiling piled with rock dust, or boxes full of it suspended on pivoted supports. When an explosion of either gas or dust occurs in the vicinity, the air wave preceding the explosion upsets the box or shelf and fills the atmosphere with a cloud of incombustible material which smothers the flame. Some German miners even hang a small paper bag of the dust at the mouth of a drill hole after it is loaded. If the flame blows out of the drill hole, the bag of dust, bursting, quickly quenches it.

Other benefits are derived from rock dust. About 90 percent of the light underground is absorbed in the blackness of the coal. Rock dust, especially if it is limestone, is so light in color that a tunnel coated with it is much better illuminated, increasing efficiency and decreasing the number of accidents. As a fire extinguisher, rock dust is said to be safer than either water or chemicals.

As to the expense, it is claimed that in British mines rock dusting costs only one-tenth of a cent per ton of coal mined. In America its cost as spread over a period of years will probably be no more than one cent per ton. Some mines are now using what they call "mudite," a mixture of rock dust with a little earth and plenty of water, which is sprayed on the walls of the mine like paint, where it hardens and stays in place better than the dry rock-dust. In some cases a coating an inch thick has been applied, and in addition to its other functions, it is said to act as a preservative for the mine timbers.

The Bureau of Mines, as well as other authorities, declare that the majority of accidents are preventable, and are due to forgetfulness, carelessness or deliberate ignoring of safety rules and instructions. The greatest difficulty is that of keeping the human mind constantly on the alert against danger. Among men who come in contact with hazards daily for years, there is not only forgetfulness but a disregard of danger amounting to contempt. Many a miner will calmly step over a barrier upon which a danger sign is hanging and walk into the forbidden entry, confident that the danger is exaggerated, and that even if it isn't, he can take care of himself. At bituminous mines which are gaseous the men are forbidden to take matches or pipes underground; in some States this is prohibited by law. But so persistently do the men violate this regulation, that many collieries in desperation, have found it necessary to search the men's pockets for the tabooed article before they enter the mine.

There are some foreign born miners who are unfamiliar with the English language, and some illiterates who are unable to read and digest the safety instructions and advice offered them. Many of foreign stock are fatalists, who regard it as a waste of time to take precautionary measures for or against the inevitable. In their opinion, if a man's death is not scheduled for today, he could lay a blasting cap a-top of a can of nitro-glycerine and swing a twelve-pound hammer on it with perfect confidence that nothing untoward will happen. Needless to say, it is difficult to get this type of mind interested in safety measures or precautions.

It is human weakness, therefore, which counts to a considerable degree for the fact that falls of material from roof or wall cause the greatest number of deaths and injuries in the entire mining industry. About half the fatal accidents to men employed underground in coal mines and one-third of those in metal mines result from this hazard; also a large percentage of the lost time. Many such accidents are difficult to foresee, it is true, but it is nevertheless true that a miner will often fail to examine the roof and wall in his working place for loose rock after a blast, or make the inspection carelessly, perhaps tapping the roof directly over his head with a pick and bring down a loose flake or stone large enough to kill him.

About 18 percent of the deaths in coal mines are due to haulage accidents; that is, men are struck or run over by cars, crushed between cars or between cars and walls. Haulage causes relatively few fatalities but many disablements. Next come accidents from the use of hand tools, and after this, injuries from falls, accidents connected with machinery, electricity, shafts, cages and so forth.

(To be concluded)

Wood Turning
By H. L. Weatherby

(*Continued on page 432*)

perfectly round piece of glass will be the result.

Turning the frame is done with the aid of a chuck and the whole process is face-plate work, which is a familiar operation to the readers of these articles.

The first step in the turning is to turn the back surface of the frame cutting the rabbet which holds the glass, picture and backing. This is, of course, taking it for granted that a picture has been selected and that the size is known; and that a satisfactory piece of wood has been mounted on a face-plate for this purpose. At this time also the outside diameter and even the opening, can be cut square if care is taken that the frame does not jump off of the lathe and break up. A word of caution is in order when considering the opening. The cut should be made, working from the middle out, otherwise a border frame may be the result.

After cutting the rabbet at least, remove the frame piece from the face-plate and attach to the face-plate a block that can be used for a chuck. Turn this to the exact size of the rabbet cut, which is also the glass size, and carefully fit the chuck to the frame. This should be a tight press fit, or the frame will slip during the subsequent operation, which consists in turning the beads, fillets or curves which make the moulding. Cut the opening through, if this has not already been done, sandpaper and the job is ready for finishing.

The writer cannot help but feel that, for most small frames of this type, a dull black finish is the most satisfactory. This is, however, entirely up to the builder, and a stain and varnish finish or a polychrome effect might suit better.

Plaques

AS another suggestion as to what may be done along the line of circular frames, the woodworker, who has a lathe, may use it to get beautiful results in making plaques. For example: The writer has prepared a great many imitation miniatures by securing circular prints representative of the miniature period (such prints may be secured from firms advertising in art magazines) and mounting them on the surface of a turned plaque, painting the curved surface with an ivory enamel or lacquer and the frame a black. After this had been allowed to dry, the whole was given a couple of coats of varnish and rubbed. The effect is beautiful, the operations are simple, and the possibilities are practically unlimited. Paste may be used to fasten the picture to the unpainted wood, or in case the wood is painted first, varnish allowed to become tacky before the print is applied will hold it in place. In any event the print will probably require one or more coats of white shellac after setting; before it is varnished, to act as a filler, before the varnish is used on the outside.

For truly professional-looking work, the turned frame answers the amateur's problems, where it can be used, and it opens up wonderful possibilities for the expression of ideas.

DON'T FORGET TO VOTE!

If you have not indicated to the editors just what kind of articles you like best, don't fail to mark ballot appearing on page 427.

In the September Issue of

AMAZING STORIES

GOLD DUST AND STAR DUST, by Cyril G. Wates. This time our first prize winning author tackles the fourth dimension—a favorite subject about which so much is written and so little is known. It is no wonder the author finds it necessary to put a detective on the job.

THE RED PERIL, by Capt. S. P. Meek, U. S. A. If it is interesting to watch the advance of the Machine Age, it is equally interesting and perhaps more important to give a thought to the possibilities of future warfare. Being an army man himself, our author goes beyond the "war in the air" period and shows us possibilities far more dangerous.

THE YOUNG OLD MAN, by Earl L. Bell. When the meaning of electricity is discovered, many new, and today unthought-of, uses would probably be found for it. For instance, if by a strong enough electric shock life can be taken away, might it not also be a means for making or perpetuating life? It is an interesting theme to play with and Mr. Bell does so in a manner absorbing to the reader.

OUT OF THE VOID (an interplanetary serial in two parts), Part II, by Leslie F. Stone. The concluding chapters of this story gain momentum as they proceed. The adventures of Dana Gleason on this planetoid beyond Mars are particularly fascinating because of the wealth of scientific detail that is included in the story.

THE DOG'S SIXTH SENSE, by W. Alexander. What is it that enables a dog to understand his master's wishes and commands? What would be likely to happen if this extra sense—and there must be one—were combined with man's intelligence? Much might happen—and much does happen in the story.

THE WHITE ARMY, by Dr. Daniel Dressler. Even the layman is greatly concerned over the mechanism and mechanical arrangement of various machines. Only the human machine seems to be taken entirely for granted and is treated with a vast amount of indifference. Yet it is the most marvelous machine of all, and as yet has not been capable of reproduction in even the slightest degree. Dr. Dressler, with an expert's knowledge on the subject, weaves a romance around it worthy of anybody's careful study.

THE CORAL EXPERIMENT, by Alexander Snyder. If you are a dentist you will be interested in the story professionally. If you are not a dentist, the interest will be entirely personal. Anyway, you ought to know what it is all about.

Home Movies

By Don Bennett

(*Continued from page* 421)

road, the camera shifts, approaching the fork but on the other road is papa in his car urging his driver to hurry and catch those young fools.

At the intersection is a line of trees that screens each road, cars on one road can't see cars on the other until they reach the intersection. The camera shifts again, this time so that we can see down both roads and we discover the two cars rapidly approaching the intersection—they pass the trees and discover each other but are going too fast to swerve, they crash, a flash, and a black pall covers the whole scene. It slowly clears and we see the wreckage in the middle of the scene, papa and his chauffeur ringed with tires, faces black and sooty, their clothes in tatters, looking at each other. Over them in the background are the two kids running down the road, papa and the driver relax into oblivion and we fade out.

Slapstick and hokum, you say. But from such situations as this you will derive much fun and enjoyment, both in making and in showing, and it gives one good experience for tackling heavier problems of drama.

Let's analyze this episode from the production standpoint, and see just how it was done. The first two scenes are easy, the camera is mounted on the running board of the car for the moving shots. The approach of the two cars requires careful timing and rehearsal as well as expert driving. If your drivers are not expert enough to handle the situation, have them start from a collision position and rapidly *back away from the camera.* The camera of course must be upside down for this shot, so that the cars going backwards will appear to go forward. Or you can use your mask box (described in May, 1929, issue), cutting off half the scene for each exposure. This requires very careful timing or the cars will not crash. Use it only if you cannot get the smash-up any other way. Now comes the trickery. When the cars meet at the intersection they should both swerve so that they almost collide and then sheer off. The expressions of your actors must fit the scene of course.

Now plant an old wreck so that it looks like two. A trip to the local junkyard will secure a fine looking wreck for practically nothing. Lay some torn cloth on the wreck, have eight or ten tires lying around and any odd bits of junk that are available. Have the actor who plays papa bring an old suit along and tear one sleeve out of it, cut it into ribbons and wreck it completely in every way you can find. Do the same to the chauffeur's clothes. Blacken their faces and lay them in the wreck in as grotesque a position as possible, even upside down. Then put a short smoke-pot in the wreck and light it. It will lay a heavy smoke over everything. As soon as it has started to burn out, start the camera. This will give you a black screen and as the smoke blows away your wreck will appear and as soon as the smoke is cleared away sufficiently, start the boy and girl running down the road. They, too, have been concealed by the smoke. When all desirable action has been recorded, fade out.

Now for the editing. When the two cars are closest together, cut the film and splice on two or three frames of clear film. That is the explosion. Then take the film where the smoke has started to clear away and cut it about two feet before anything is discernible through the smoke. Splice this to the two clear frames and your film is complete. A somewhat better effect is obtained by using a white smoke bomb which contains phosphorus and emits an opaque white smoke screen. In this case two bombs are necessary, one exploded at the moment of impact and the other before you start the camera when the wreckage is revealed.

Going from the ridiculous to the sublime, very pretty effects may be obtained with smoke-pots, as they can be used in many ways. There are several ways of setting the stage and carrying out the action, but we will consider just one, an introductory episode for a film concerning a fishing trip. This episode also includes the main title of your film as well as the end and will not consume more than twenty or thirty feet of film.

The scene fades in on a man reclining against a tree. He is dressed in outdoor garb, various accoutrements of the fisherman lying on the ground around him. He is sleeping but has been nodding only a few minutes, as his pipe still smoulders in his hand. A wisp of smoke arises from it. Near his feet is a fire on which he has evidently just piled some wood. As we watch it starts to throw out a heavy column of smoke which gradually covers the scene. A tiny wood-sprite emerges from the smoke and gestures that he is going to play a trick on the fisherman, pointing down to the position the fisherman occupied before the smoke obscured him. He reaches down and picks something up, it is a letter "F." He hangs it up on the air and reaches down again, picking up "I" and so on, until he has hung the words *"Fish Stories"* up on the curtain of smoke. Then he vanishes and the words fade out. (Fig. 3.)

Here is how you do it. The fire conceals a smoke-pot which is lighted by remote control. If the smoke does not cover the whole screen, have a still camera set up, covering the same angle as your movie camera and snap a still. The wood-sprite is of course double exposed on the black portion of the film against a black curtain and the letters he hangs up are painted white on cardboard. The letters are hung on a black wire or two wires strung in front of the curtain and the cards have hooks on their backs for support. If the smoke has completely covered the scene, you simply fade in on the sprite, in any portion of the scene, and he carries out his action, until at the end, he steps behind a black "flat" and disappears from sight, after which the letters fade out. (Fig. 4.) If the smoke has only covered part of the scene, the sprite must confine his action to that part covered by the smoke, and as a safety precaution *mask off* the other portion, so that it will not be fogged. The use of a gauze on the first exposure will heighten the beauty of the scene.

While our "sleeping fisherman" is still in position, we start another smoke-pot, fading in just before it is ignited, but with the camera upside down. We then double expose again on our sprite, but this time he has the words *"The End."* This must also be made in reverse motion and therefore all his actions must be the reverse of the way they appear on the screen. Suppose we want to fade in on the title, then have the sprite take the letters away and disappear, the smoke returns to the fire and the fisherman wakes up and rubs his eyes. Then, on the start of the scene, that is, where we fade in on the fisherman, have him rubbing his eyes and stretching, then he relaxes and goes to sleep. With our camera still upside down, the sprite appears as if by magic, merely by stepping out from the flat, which should be on another part of the set and hangs the letters up and then we fade out. The effect on the screen is as described above.

Many other settings can be used with this as a basis; in fact, a whole story can be carried through by merely fading out on the sprite and fading in on a story. This will be a dream sequence and is ended, the same as the other episode was ended, by having the sprite in pantomime express his approval or disapproval of the story and then, as he disappears, the smoke returns to the fire and the actor wakes up in wonderment at his surroundings. A cut from reverse to normal action is easily made in a case like this by inserting a close-up to cover the change or discrepancy in matching the camera angle. The camera may then be placed right side up and the action resumed in normal direction.

(George Blake and his shadow, Jones, were absent this month on their respective vacations, but a "wish you were here. Good movie weather" postal advises the Editor that Blake is going to tell us a lot about capturing autumnal colors next month, both in black and white and in color.)

Sport Plane Blueprints Available at Nominal Cost

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SCIENCE AND INVENTION
381 Fourth Ave., New York City

IN RADIO NEWS for September

THE RADIO NEWS FOUNDATION TUNER. A tuning unit embodying extremely compact design and incorporating the new A. C. screen-grid tubes, power detection, plug-in coils to cover a wide range of wave-bands. This unit has been designed especially for adaptability to a wide variety of uses; a feature to gladden the heart of the dyed-in-the-wool radio experimenter.

WHY NOT GET THE UTMOST FROM RADIO ON YOUR PLEASURE BOAT? Lloyd Jacquet points out some of the uses and pleasures—as well as some of the pitfalls—of radio as it applies to pleasure-boating.

WHAT HAS BROUGHT RADIO TUBE PRICES DOWN? A pictorial description of the ingenious machinery and production methods which have made your radio tube dollar worth ten times what it was a few years ago.

FACTORS AFFECTING THE INSTALLATION AND SERVICING OF SOUND AMPLIFIERS. This is the second of a series of articles by S. Gordon Taylor and takes up the practical angles which must be considered by local servicemen who wish to capitalize the decidedly worth-while business in their communities.

DR. LEE DeFOREST WRITES THE REMINISCENCES OF A RADIO PIONEER. All the way back to the early days of trying to put the first soprano voice on the air by means of an arc transmitter, as well as some of the pioneering which has lead to developments far afield from the original experiments.

FOR REAL THRILLS, GET DOWN IN THE AMATEUR WAVE BANDS. Lieutenant Wenstrom writes of the fascinations of amateur radio, both as a spare-time hobby and as a service of immense value in times of disaster as well as in the more thrilling field of communication with explorers in all parts of the world.

Television in Color

By Dr. Herbert E. Ives

(*Continued from page* 401)

the scanned object, one bank diagonally to the right, and another bank diagonally to the left, so that the cells receive light from both sides of the object and above. In placing the cells they are so distributed by color as to give no predominance in any direction to any color. In addition large sheets of rough pressed glass are set up some distance in front of the cell containers so that the light reflected from the object to the cells is well diffused.

The television signals produced in the color sensitive photo-electric cells through the color filters are no different electrically from those used in monochromatic television. Three sets of amplifiers are required, one for each color, and three communication channels in place of one, but the communication channels are exactly similar to those which were used with the same scanning disc before.

For color television the three images must be received in their appropriate colors, and viewed simultaneously and in superposition. The first problem was to find light sources which, like the neon lamp previously used, would respond with the requisite fidelity to the high-frequency signals of television, and at the same time give red, green, and blue light. With such lamps available a decision would have to be made as to how the three colors could best be combined to form a single image.

Several methods of reception are possible. For displaying the transmitted image to a large audience a grid* could be employed similar to that used for the earlier demonstration but it would consist of three parallel tubes instead of a single one.

Thus far the television images have been received in a manner similar essentially to our method for monochromatic television. The surface of a disc similar to that used at the sending end is viewed, and the light from the receiving lamp is focused on the pupil of the observer's eye by suitable lenses. To combine the light of the three lamps, they are placed at some distance behind the scanning disc and two semi-transparent mirrors are set up at right angles to each other but each at 45° to the line of sight. One lamp is then viewed directly through both mirrors and one lamp is seen by reflection from each, as illustrated by the accompanying diagram.

The matter of suitable lamps to provide the red, green and blue light has required a great deal of study. There is no difficulty about the red light because the neon glow lamp which has been used previously in television can be transformed into a suitable red light by interposing a red filter. For the sources of green and blue light nothing nearly so efficient as the neon lamp was available. The decision finally made was to use another one of the noble gases —argon—which has a very considerable number of emission lines in the blue and green region of the spectrum. Two argon lamps are employed, one with a blue filter to transmit the blue lines and one with a green filter transparent to the green lines of its spectrum.

These argon lamps unfortunately are not nearly so bright as neon lamps and it was, therefore, necessary to use various expedients to increase their effective brilliancy. Special lamps to work at high current densities were constructed with long narrow and hollow cathodes so that streams of cold water could cool them. The cathode is viewed end-on. This greatly foreshortens the thin glowing layer of gas and thus increases its apparent brightness. Even so it is necessary to operate these lamps from a special "I" tube amplifier to obtain currents as high as 200 milliamperes.

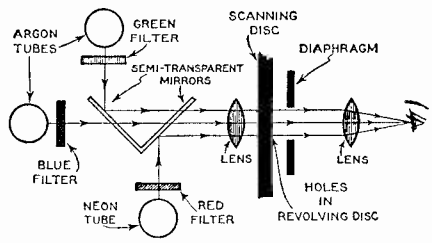
* Bell Record, *May*, 1927, *page* 319.

Standard Scanning Disc Used

THE receiving apparatus at present consists of one of the 16-inch television discs used in our earlier experimental work. Behind it are the three special lamps and a lens system which focuses the light into a small aperture in front of the disc. The observer looking into this aperture receives, through each hole of the disc as it passes by, light from the three lamps—each controlled by its appropriate signal from the sending end. When the intensities of the three images are properly adjusted he therefore sees an image in its true colors, and with the general appearance of a small colored motion picture.

Satisfactory television in colors is a far more difficult task than is monochromatic television. Errors of quality which would pass unnoticed in an image of only one color may be fatal to true color reproduction where three such images are superimposed and viewed simultaneously. In three-color television any deviations from correct tone rendering throw out the balance of the colors, so that while the three images might be adjusted to give certain colors properly, others would suffer from excess or deficiency of certain of the constituents. A further source of erroneous color exists at the scanning end. If the light from the object were not distributed equally to all the cells, the object would appear as if illuminated by lights of different colors shining on it from different directions.

Color television constitutes a definite further step in the solution of the many problems presented in the electrical communication of images. It is, however, obviously more expensive as well as more difficult than the earlier monochromatic form, involving extra communication channels as well as additional apparatus.



This diagram shows clearly how the three light beams from the red, green and blue filters and their associated tubes are all gathered together and viewed simultaneously through a single hole in the scanning disc at the receiver. There are 50 holes in the whirling disc, but at any given instant all three color beams are visible, in their respective strengths. Lenses and a diaphragm help to make the image clearer.

LATEST TELEVISION NEWS

appears every month in the columns of this magazine. If you have an efficient television receiver, send photos and description of it to the Editor.

The Radio Robot

By J. E. Smith

(*Continued from page 439*)

using a pair of wires a condenser can be tested for leakage by impressing any voltage from 0 to 200 volts direct current across it and then noting the milliammeter reading. Any kind of condenser, variable or fixed, may be tested for short circuits. The method of procedure is to plug tester cord into house lighting circuit and hook the test wires on two binding posts after inserting a vacuum tube in a socket and if it shows filament emission, then open a double pole double throw switch and bring the ends of the wires in contact with the rotor and stator plates of the condenser. A reading on the milliammeter indicates a short-circuit; absence of a reading suggests that the condenser is not a fit subject or patient for a radio hospital. A source of alternating current voltage is also provided for testing condensers; there being high voltage and low voltage switches available for testing, as well as a shunt switch for the milliammeter when using direct current as rectified by a vacuum tube of any type.

This test kit provides both direct current and alternating current voltmeters. The latter, with a range from 0 to 6 volts, may be employed for testing both a.c. and d.c. receiving sets. For instance, in testing transformers of a.c. receivers, connections are made to the two posts of the a.c. voltmeter and the condition of the secondary windings of the transformers is revealed. Also, a test can be made to determine whether the voltage of the filament windings is correct for the type of vacuum tube employed. The same wires and same set-up may be used in diagnosing the troubles of loud-speakers, telephones, choke coils, and other types of coils. A milliammeter reading indicates that the circuit of the coil under test is in satisfactory operating condition; at least, it gives proof that wire in the coil is not broken.

In an attempt to confound the manifold and almost uncanny performances of this mechanical and electrical trouble-shooter, the writer inquired of the designer what provision had been made to test shielded grid vacuum tubes. Quick as a flash Mr. Stair offered a somewhat improvised method and yet an effectual one. By use of an extra piece of wire, he pointed out, the four-element tube could be subjected to test by associating the two grid elements and thus short-circuiting them. Then, search for "shorts" in the other tube elements and after bringing the wire in contact with the plate, if there is no light in the tiny automobile lamps on the test board, the shielded grid tube is not short-circuited. In addition to this test and those already enumerated, there are three terminals for testing batteries.

This radio Robot can subject the entire receiving set to the searching "eye" of a trouble-shooter, with a minimum disturbance to the completeness of the set. The two voltmeters and one milliammeter, when applied independently, determine the voltages of A, B and C batteries. A flexible five-wire lead and plug with adapters to fit all radio sets is easily plugged successively into each socket of the radio set. The A battery, its lead wires, and the rheostat of one vacuum tube are examined and their condition revealed at a single reading. Similarly, by use of the direct current voltmeter, the conditions of the B battery or B eliminator unit and the primary winding and the loud-speaker are checked at one reading. And, finally, the milliammeter causes to pass in review the condition of the grid biasing battery as well as the condition of the secondary of the preceding transformer.

BOOK REVIEW

ASPECTS OF SCIENCE, Second Series, by J. W. N. Sullivan. Stiff cloth covers, 5" x 7½", 205 pages. Published by Alfred A. Knopf, New York City. Price $2.50.

Fifteen essays incorporated in this volume cover a wide field, such as is indicated by the following titles: On Being Oneself, On Private Universes, Relativity Theory, Structure of the Atom, The Materialist Creed, The Science of Everything, which are among some of the chapter headings. The main theme illustrated in these essays is that science depends not only upon the nature of the external world but also upon the constitution of the human mind.—P. L. W.

SCIENCE: LEADING AND MISLEADING, by Arthur Lynch. Stiff cloth covers, 5" x 7½", 376 pages. Published by E. P. Dutton & Co., New York City. Price $3.00.

Science is great and the true scientist is one who always searches for the truth and holds this paramount above all things. Despite our schools and universities, the average man is prone to accept a false interpretation of science, which in many cases may have been partly due to the scientists themselves. The author examines physics, chemistry, biology, mathematics, physiology, psychology, relativity and psychoanalysis, together with other subjects and exposes the untruths in them which have been accepted as fact by the general and too gullible public. Popular misconceptions are upset and we are told that many things are not true, simply because tradition tells us that they are.—P. L. W.

ICE ENGINEERING, by Howard T. Barnes, F.R.S. Stiff cloth covers, 6" x 9¼", 364 pages, illustrated. Published by the Renouf Publishing Co., Montreal, Canada. Price $5.00

The author of the present work is a Professor and former Director of Physics at McGill University, in Montreal, and some time ago wrote a book concerning ice formation. The volume reviewed here deals with the rapid advance which has been made in the science of ice engineering. The structure and formation of various kinds of ice are covered, together with chapters upon ice navigation and expansion. A section has also been devoted to ice remedial work with use of steam, thermite, hot water, calcium chloride, and other chemicals which may be used in controlling winter floods. The book is written primarily for those engaged in the immediate work of ice engineering and undoubtedly will not be of interest to the layman, as it is quite mathematical in its treatment. Engineers, however, will find much of interest and assistance in solving their problems in this text.—P. L. W.

THE SUN, THE STARS AND THE UNIVERSE, by W. W. Smart. Stiff cloth covers, 5½" x 8¾", 288 pages, illustrated. Published by Longmans, Green & Co., New York City. Price $5.00.

This book presents a historical review, together with an account of recent astronomical discoveries, the constitution of the heavenly bodies, and the modern view concerning their characteristics. It has been written for the general public interested in science, and therefore, the use of technical language has been avoided. The text is well illustrated with line drawings and photographs and has been arranged in a systematic manner. Fundamental concepts have been treated concisely and a chapter is devoted to stellar evolution. The first seven chapters deal with the sun, planets and comets, and the others with the movement of stars, their distances, light characteristics, double stars, star clusters, the origin of the planetary and stellar systems and the structure of the universe.

INDEX TO ADVERTISERS

Dr. Worden's $600,000 Hobby

By Alfred M. Caddell

(*Continued from page* 397)

eighty-two separate stamps, fifteen pair and three joined in a strip. Their total value is over $2,500.

A five-cent stamp, with head of Thomas Jefferson, was issued in 1851. Like its predecessors it had edges not perforated and therefore the stamps, turned out originally in sheets of 100, had to be separated by cutting. The 1851 stamp was brown. There are twenty-nine of them in Dr. Worden's collection, five unused, twenty-four used, four pair and three strips of three. Another Jefferson stamp in brown, issued in 1856, is the first of the stamps with perforated edges. There are twelve of these unused and sixty-seven used possessed by Dr. Worden. The seventy-nine stamps which he owns of these two issues—1851 and 1856—represent a value of $5,000.

As Dr. Worden continued to turn page after page of costly, rare stamps of a bygone age, he came to a page bearing three stamps which are decidedly rare. Close inspection showed that the picture in the center of each stamp was printed upside-down. That was the first time this error on the part of the Government Printing Office ever occurred and such stamps are eagerly sought by collectors. These stamps were issued in 1869. One, a fifteen-cent stamp, unused, is worth $5,000; a second, a twenty-four-cent, used, has a value of $600, and the third, a thirty-cent stamp, is worth $2,000.

"Of course, a famous stamp has a history," said the doctor, "just as a famous *diamond* may have. There is the interesting British Guinea, 1 cent, 1856. To the ordinary mortal this phrase means nothing, but to the stamp collector it is the acme of ambition. It is an octagonal bit of paper comprising about one square inch. On it are engraved a full-rigged ship and a few Latin and English words, almost obliterated now by time and the cancellation mark. Once it was red, but now it is worn and faded to anaemic cream. It would be hard to imagine a more insignificant appearing bit of paper. And yet it sold for $32,500 at a Paris auction in 1922, the highest price to date ever paid for a stamp. It gains its great value from the fact that it is the only one of its kind in existence. Arthur Hind, of Utica, N. Y., one of America's leading collectors, paid that price for it.

"King George of Great Britain, who is an enthusiastic collector, had an agent at that sale and bid $31,500 for this famous stamp. Mr. Hind secured it by paying a thousand dollars more than the King offered. But the American did not know at the time that he was bidding against the King. Later, Mr. Hind was a guest at a reception in Buckingham Palace. There, in conversation with the King, he expressed regret that he had bought the famous stamp in competition with his host, and offered the stamp as a present to the King, but the latter replied that he could not think of depriving his guest of so rare a possession.

"Many stamp collectors specialize in freak stamps—those that show errors in design or printing. It would seem that the scope of such collections would be limited, yet hardly a year passes that some country does not blunder in one of its issues."

Dr. Worden's collection of stamps is mounted in eighteen large volumes, bound in Morocco, and the books, made to order cost alone, without their contents, about $1,100. But $1,100 is practically nothing compared with the value of the stamps.

The first stamp, it developed, was issued in 1840 in Great Britain, and is known as the Mulready, in honor of the person of that name, who was a member of the Royal Academy of Science. That the business, which is a hobby for some, has grown to tremendous proportions is further attested by the fact that the Government in Washington conducts a special office where the first run of stamps may be purchased by collectors. This office alone, at current stamp prices, does an annual business of nearly $500,000 a year. These issues may subsequently have a greatly enhanced value.

Dr. Worden keeps his valuable stamp collection in a huge fireproof vault, in which are also housed other records of incalculable worth. For his business is the assembling, indexing and furnishing of very valuable chemical information to any and all who may wish to purchase it. In this vault, adjacent to his library, is all the knowledge of the world pertaining to cellulose chemistry, which knowledge he sells to industrial concerns, patent attorneys and inventors anxious to safeguard their ideas by patents. He has a copy of every chemical patent issued in the United States and foreign countries, each of which patents is indexed and cross-indexed, one patent alone being covered by 3,015 index cards, so involved are its ramifications. Besides, in his library, he has more than 20,000 scientific books, each of which has been abstracted and the information therein placed on cards. In all, he has more than 6,000,000 chemical and allied scientific references, the work of about seventeen years.

And this man started on less than the proverbial shoestring. Born in Ypsilanti, Michigan, in 1875, his father died when he was less than a year old, leaving nothing to his widow and child. Somehow, they existed and the boy managed to attend school and earn enough money to keep the home together. Later, he shot sparrows to obtain the bounty of three cents each offered by the county, and with this money—$35.04—paid his first year's tuition at the Michigan School of Pharmacy at Ann Arbor, riding a bicycle ten miles there and ten miles back every day. And on the way to and fro, over the actual road made famous by Will Carleton in his poem "Over the Hill to the Poorhouse," he used to look at that same poorhouse as he pedaled by, and wondered if he would ever be able to pedal through life sufficiently strong to escape riding within its gates!

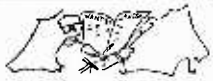
$5,000 FOR PERPETUAL MOTION

The editors have received thousands of different designs of perpetual motion devices, and have received hundreds of circular letters soliciting finances for the building of perpetual motion machines.

The editors know that if they receive these letters, there are thousands of others in this country who get similar letters and who fall for the claims made in the numerous prospectuses giving the earning capacities of the various machines.

Most of the shares of stock for these perpetual motion machines are being sold at a rate of **$1.00** per share, although some inventors are trying to sell shares of stock at **$100.00** per share.

Therefore, the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you **$5,000.00**. But the machine must not be made to operate by tides, winds, waterpower, natural evaporation or humidity. It must be perpetual motion."



OPPORTUNITY AD-LETS

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section fifteen cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Objectionable or misleading advertisements not accepted. Advertisements for the November issue must reach us not later than September 1st.

EXPERIMENTER PUBLICATIONS, INC., 381 Fourth Avenue, New York, N. Y.

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$60-$200 a week. Genuine Gold Letters for store windows. Easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 441 B., North Clark, Chicago.

Big Money applying Gold Initials on Automobiles. Easiest thing today. No experience needed. $1.45 profit every $1.50 job. FREE SAMPLES. "RALCO," R1043 Washington, Boston, Mass.

$10 daily silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. D, Decatur, Ill.

$50.00 Weekly. Men wanted to demonstrate and take ten orders daily direct from motorists. Amazing Magnetic Trouble Light. Sticks anywhere! More orders, bigger pay. Write for demonstrator and particulars. Magno, Beacon Bldg., Dept. 49-C, Boston, Mass.

Agents—I'll pay you $19 daily to wear fine Felt Hats and show them to friends. Smartest styles. Latest shades. $2 to $5 saving on every hat. Samples Free. Write Taylor Hats, Dept. MC-170, Cincinnati, Ohio.

Succeed With Your Own Products. Make them yourself. Formulas, Processes, Trade-Secrets. All lines. Catalog. Circulars free. D. Thaxly Co., Washington, D. C.

You Are Wanted to resilver mirrors at home. Immense profits plating autoparts, tableware, etc. Write Sprinkle, Plater, 955, Marion, Indiana.

Big Ohio Corporation wants county manager. Opportunity $50 to $75 weekly. Earnings start immediately. Good for $5,000 yearly. We furnish everything, deliver and collect. Capital or experience unnecessary. Fyr-Fyter Co., 1906 Fyr-Fyter Bldg., Dayton, Ohio.

Big Money Weekly. Newest window letters out. Easiest to put on. No experience needed. Free samples. "Ralco," S-1043 Washington, Boston, Mass.

$2.45—Raincoats all Colors. Trenchcoats, Tweeds, Alligators, Leatherettes. Sample Coat and bonus to workers. Beautiful Outfit Free. Bradley, Dept. AD-9, 230 S. Wells, Chicago.

Sell High Life Cigars. Big money made. Write for information. John S. Davey & Co., Stop 25, Schenectady Road, Albany, N. Y.

Gold Leaf Window Letters and Script Signs; no experience; 500% profit; samples free. Consolidated, 69-R, West Van Buren, Chicago.

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$12.00 Daily Showing New Tablecloth. Looks like Linen. Wash like oilcloth. No laundering. Sample free. Bestever, 651 Irving Park Station, Chicago.

Agents Wanted (Continued)

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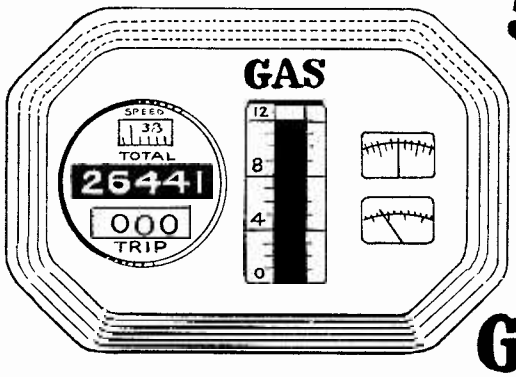

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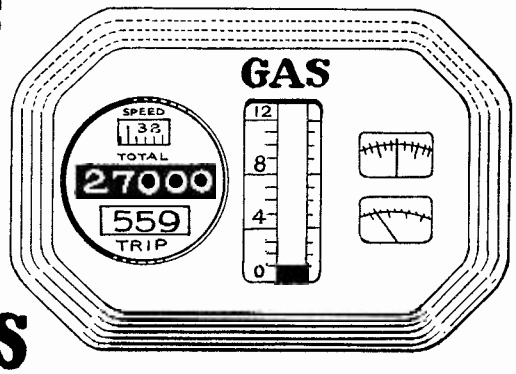

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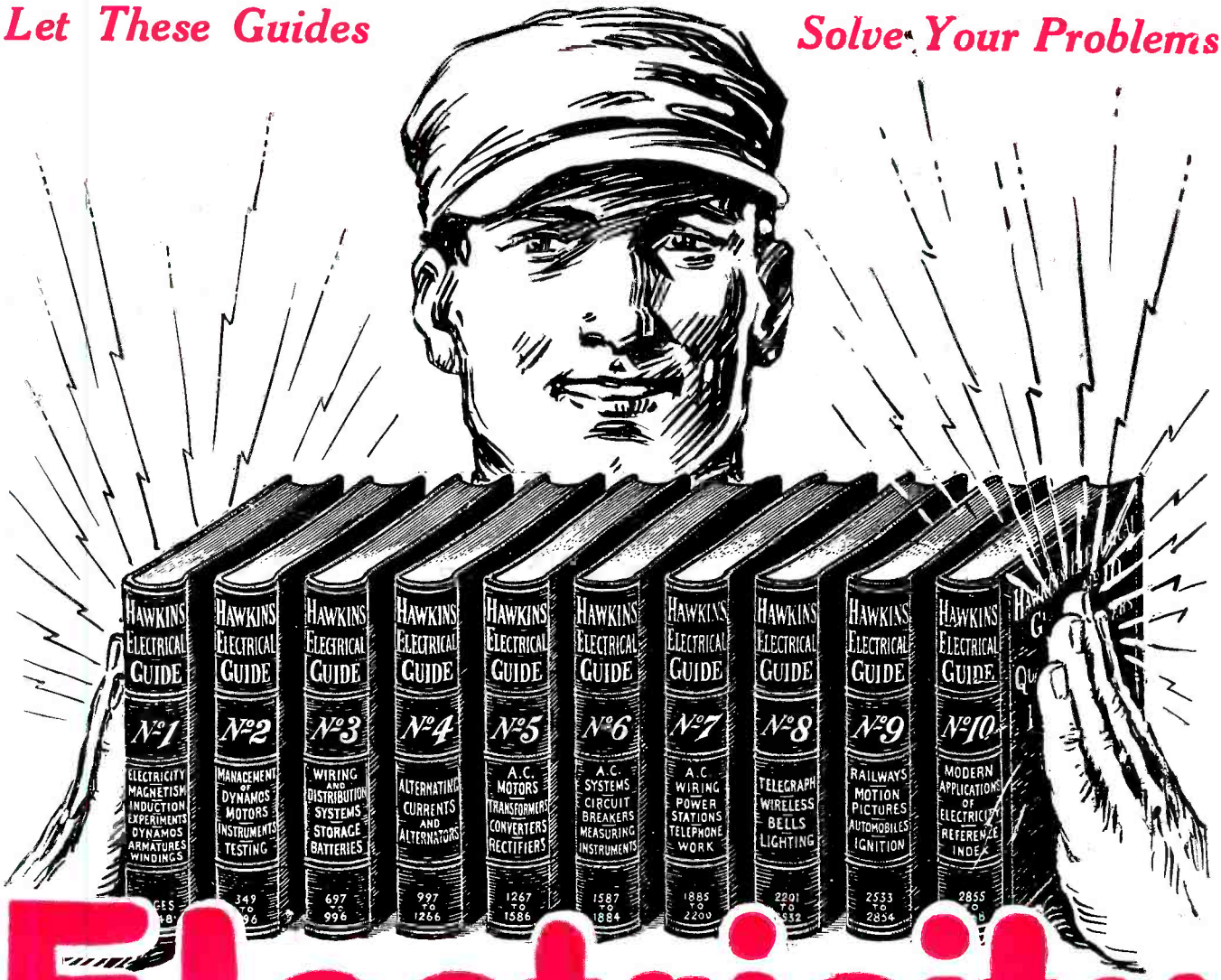

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