
Wings
DECEMBER, 1943
FOR VICTORY IN THE BATTLE OF PRODUCTION
The Army and Navy
Publication for the
Aircraft Industry

As the man with the brown derby used to say, "Let's look at the record." And the record system of Thompson Aircraft Products is worth looking at, for it simplifies the handling of every phase of an employee's working life. This story describes and illustrates many of the forms employed with such success that management can now afford to abandon its feats of memory and devote more time to managing.

AT THOMPSON AIRCRAFT . . . page 785

How Republic Aviation Corp. makes bench collections and floor sweepings yield $20,000 a month is told by Gordon S. Sleeper, assistant to the president, in a timely article uniting reclamation and production. Thriftiness in 1942 was almost impossible with vast production to be attained. Today thrift can be popularized if it is intelligently presented to productive departments as this company has done with notable success.

AT REPUBLIC AVIATION . . . page 788

Reclamation is given additional attention in Wings this month by a story on how machines and a sorting table aid thrift at Curtiss-Wright. Other articles from C-W include how production-bent tubing can be quickly inspected with a simple gage, and other methods of increasing production which are included on a picture page titled "Forming Tricks Overcome Troubles." One time-saver was devised by a World War I veteran.

AT CURTISS-WRIGHT . pages 791, 806-08

Better utilization of labor in these days of manpower shortages is of vital importance to the aircraft industry. Suggestion and incentive systems, training and upgrading, avoiding worries and fatigue, "cycle" systems and other methods all help to solve employee problems. Twenty-two questions which management and labor should both like to try answering are included in this comprehensive round-up of important facts.

LABOR UTILIZATION . . . . page 794

"Keep 'em Flying" is as much a matter of maintenance as production. Mechanics at the Romulus (Mich.) Air Base 316th Sub Depot, under Capt. W. C. Erlenbusch, prove that necessity is truly the mother of invention by developing their own service equipment to keep their ships aloft. This story gives you eight maintenance methods put to excellent use at Romulus and of equal merit wherever planes must be kept ready for action.

MAINTENANCE AT ROMULUS . . page 815

In every theater of operations against the Axis, men and aircraft of the Army, Navy, Marine Corps and Coast Guard are doing a superb job with the equipment which men and women at home are sending overseas in ever increasing quantity. Wings' front cover illustrates the campaign ribbons awarded men serving in any military or naval capacity in the three main sectors. At upper left is the ribbon for the American theater. The European-African-Middle Eastern ribbon is shown at lower left, and to the right is the campaign designation for the Asiatic-Pacific theater.

The C-47 Douglas transport which has been greatly instrumental in flying men and supplies to world battlefronts, is depicted on Wings' back cover. The inset shows troops ready to go aboard. This plane, powered by two *Wright Cyclones*, is an adaptation of the DC-3, used by many domestic airlines. A new record of 9 hr. and 34 min. for an Eastbound Atlantic crossing in a transport plane was set recently by a C-47.

WINGS COVERS

Wings

FOR VICTORY IN THE BATTLE OF PRODUCTION

The Army and Navy Publication for the Aircraft Industry

CONTENTS FOR DECEMBER, 1943

Vol. 2 • No. 7

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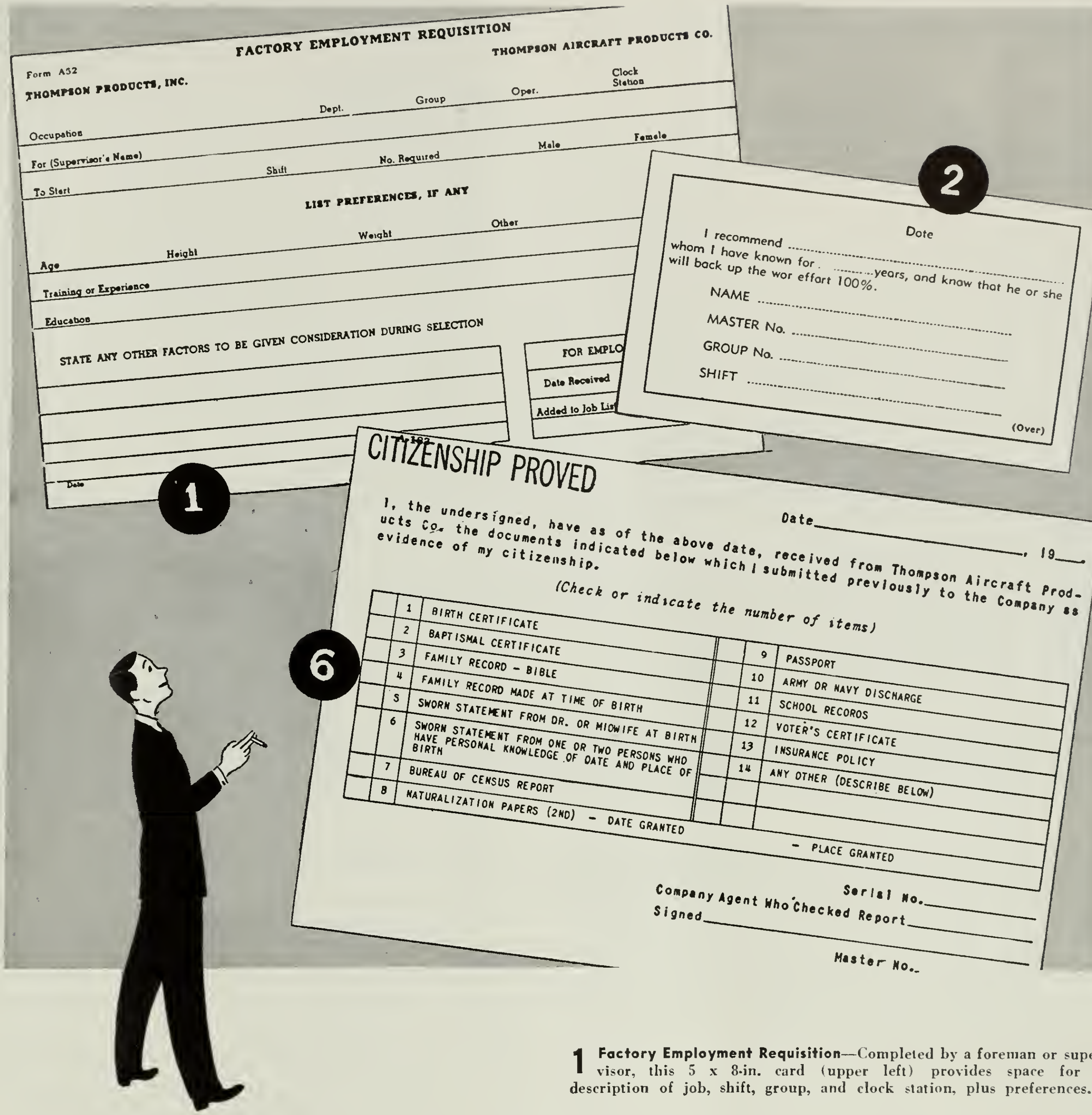


FACTORY EMPLOYMENT REQUISITION

Form A52

THOMPSON PRODUCTS, INC. THOMPSON AIRCRAFT PRODUCTS CO.

Occupation Dept. Group Oper. Clock Station

For (Supervisor's Name) Male Female

To Start Shift No. Required

LIST PREFERENCES, IF ANY

Age Height Weight Other

Training or Experience

Education

STATE ANY OTHER FACTORS TO BE GIVEN CONSIDERATION DURING SELECTION

FOR EMPLO

Date Received

Added to Job Lis

Date

1

2

Date

I recommend ....

whom I have known for ....years, and know that he or she will back up the wor effort 100%.

NAME ....

MASTER No. ....

GROUP No. ....

SHIFT ....

(Over)

CITIZENSHIP PROVED

Date________________, 19___.

I, the undersigned, have as of the above date, received from Thompson Aircraft Products Co. the documents indicated below which I submitted previously to the Company as evidence of my citizenship.

(Check or indicate the number of items)

	1	BIRTH CERTIFICATE			
	2	BAPTISMAL CERTIFICATE		9	PASSPORT
	3	FAMILY RECORD - BIBLE		10	ARMY OR NAVY DISCHARGE
	4	FAMILY RECORD MADE AT TIME OF BIRTH		11	SCHOOL RECORDS
	5	SWORN STATEMENT FROM DR. OR MIDWIFE AT BIRTH		12	VOTER'S CERTIFICATE
	6	SWORN STATEMENT FROM ONE OR TWO PERSONS WHO HAVE PERSONAL KNOWLEDGE OF DATE AND PLACE OF BIRTH		13	INSURANCE POLICY
	7	BUREAU OF CENSUS REPORT		14	ANY OTHER (DESCRIBE BELOW)
	8	NATURALIZATION PAPERS (2ND) - DATE GRANTED			- PLACE GRANTED

Serial No.________

Company Agent Who Checked Report________

Signed________

Master No.________

6

Let's Look at the Records

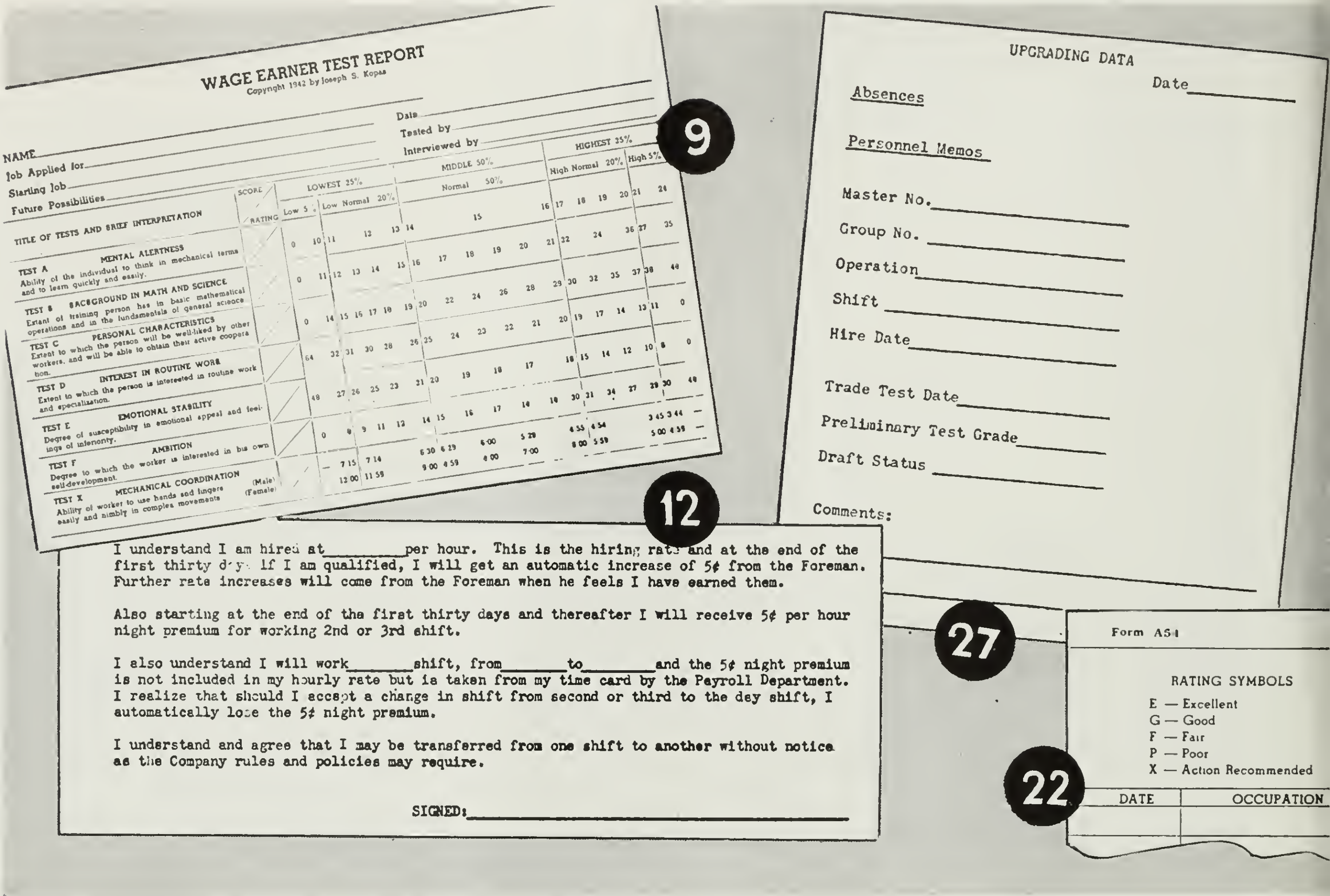
THOMPSON AIRCRAFT PRODUCTS CO., division of Thompson Products, Inc., like other aircraft accessory plants, has mushroomed from a few workers to many thousands. To keep in step with resulting changes in handling manpower, the company has developed an extensive record system. Here are described the 33 forms which simplify handling of every phase of the employee's working life. With information in black and white, management can abandon feats of memory and devote its time to managing.

1 Factory Employment Requisition—Completed by a foreman or supervisor, this 5 x 8-in. card (upper left) provides space for a description of job, shift, group, and clock station, plus preferences.

2 Recommendation Card—Completed by any employee to introduce a prospective employee, this 3 x 5-in. card (upper right) provides space for name of prospect, number of years known, and complete clock information, plus a message to the worker on the reverse.

3 Application for Employment—This 4-page, 8½ x 11-in. form provides blanks for usual information completed by the prospect on the first two pages, plus details on parents, simple medical history, Selective Service status, friends and relatives already employed. Page 3 provides space for both interviewer's comments and for two checkups with previous employers. If possible, these checks are made by telephone while the applicant is filling out later, more-detailed forms. Page 4 is a summary of present employment data, medical examination, previous occupations, training, psychological and aptitude test results, job assignment, and a check list to cover items necessary in handling the employee—such as picture taken, insurance, handbook, hospitalization, etc.

4 Present-Employment Certificate—A mimeographed 8½ x 11-in. sheet certifying that prospect is not employed in essential industry.



WAGE EARNER TEST REPORT
Copyright 1942 by Joseph S. Kopas

NAME
Job Applied for
Starting Job
Future Possibilities
Date
Tested by
Interviewed by

TITLE OF TESTS AND BRIEF INTERPRETATION — SCORE / RATING — LOWEST 25% (Low 5%, Low Normal 20%) — MIDDLE 50% (Normal 50%) — HIGHEST 25% (High Normal 20%, High 5%)

TEST A MENTAL ALERTNESS Ability of the individual to think in mechanical terms and to learn quickly and easily.
TEST B BACKGROUND IN MATH AND SCIENCE Extent of training person has in basic mathematical operations and in the fundamentals of general science
TEST C PERSONAL CHARACTERISTICS Extent to which the person will be well-liked by other workers, and will be able to obtain their active cooperation.
TEST D INTEREST IN ROUTINE WORK Extent to which the person is interested in routine work and specialization.
TEST E EMOTIONAL STABILITY Degree of susceptibility in emotional appeal and feelings of inferiority.
TEST F AMBITION Degree to which the worker is interested in his own self-development.
TEST X MECHANICAL COORDINATION (Male) (Female) Ability of worker to use hands and fingers easily and nimbly in complex movements

0 10 11 12 13 14 15 16 17 18 19 20 21 24
0 11 12 13 14 15 16 17 18 19 20 21 22 24 36 37 35
0 14 15 16 17 18 19 20 22 24 26 28 29 30 32 35 37 38 48
64 32 31 30 28 26 25 24 23 22 21 20 19 17 14 13 11 0
48 27 26 25 23 21 20 19 18 17 18 15 14 12 10 8 0
0 8 9 11 12 14 15 16 17 14 18 30 31 34 27 29 30 48
— 7 15 7 14 6 30 6 29 6 00 5 29 4 55 4 54 3 45 3 44 —
12 00 11 59 9 00 8 59 8 00 7 00 8 00 5 59 5 00 4 59 —

UPGRADING DATA

Date

Absences

Personnel Memos

Master No.

Group No.

Operation

Shift

Hire Date

Trade Test Date

Preliminary Test Grade

Draft Status

Comments:

I understand I am hired at________per hour. This is the hiring rate and at the end of the first thirty days if I am qualified, I will get an automatic increase of 5¢ from the Foreman. Further rate increases will come from the Foreman when he feels I have earned them.

Also starting at the end of the first thirty days and thereafter I will receive 5¢ per hour night premium for working 2nd or 3rd shift.

I also understand I will work_______shift, from________to________and the 5¢ night premium is not included in my hourly rate but is taken from my time card by the Payroll Department. I realize that should I accept a change in shift from second or third to the day shift, I automatically lose the 5¢ night premium.

I understand and agree that I may be transferred from one shift to another without notice as the Company rules and policies may require.

SIGNED:_______________

Form AS-1

RATING SYMBOLS
E — Excellent
G — Good
F — Fair
P — Poor
X — Action Recommended

DATE	OCCUPATION

5 Declaration of Citizenship—Another 8½ x 11-in. mimeographed form, certifying to United States citizenship, giving place of birth and date. Two witnesses must also sign, one an Army, Navy, or Plant Protection representative. Includes statement of the alien employment law. Accompanied by an explanation mimeographed on letterhead, detailing what records will be accepted in lieu of a birth certificate.

6 Citizenship Record—This 5 x 7½-in. file card (on preceding page) shows what records were used to prove citizenship and also is a certificate, signed by the worker, acknowledging return of such records.

7 Character Reference—When a previous employer or character reference cannot be reached by telephone an 8½ x 11-in. mimeographed letter is sent out with return envelope. It is signed by the employment manager and provides space for answers to the conventional questions.

8 Dispensary Record—A detailed medical report printed on an 8½ x 11-in. file sheet. The front provides space for the medical record and the signature of the examining doctor (two doctors and 15 nurses are on duty for examinations alone), and the reverse provides space for reports of regular subsequent examinations.

9 Wage Earner Test Report—Duplex 6 x 9-in. form (upper left), providing an original and file-card copy of seven tests, covering mental alertness, background in math and science, personal characteristics, interest in routine work, emotional stability, ambition, and mechanical coordination. The tests on personal characteristics and emotional stability are psychological questions and answers, providing an index of the prospect's ability to work with others. This is unusual, but Thompson reports it extremely successful in avoiding early separations.

10 Turn-down Card—Infrequently used under today's conditions, this 3 x 5-in. card regrets "that we cannot offer encouragement", and provides five common reasons, one of which is of course checked.

11 Worker-available Index—A duplex 3 x 5-in. file card is prepared in case immediate employment is not found. This lists prospect's primary and two secondary skills on occupations (based on previous experience), names sponsor, and provides spaces for comments and personnel rating. One card is filed by name, the other by skills.

12 Employment Contract—A simple 3½ x 8½-in. Ditto form (lower left) which indicates hiring rate, lists automatic 30-day increase and second- and third-shift premiums and acknowledges company's right to change shift if necessary. It must be signed by the worker.

13 Welcome Card—A 3½ x 5-in. card telling new worker how to report if he will be absent and when returning after absence.

14 Car Transfer Emblem—A 3-in. Decalcomania for the new worker's windshield. In two colors, it carries the company monogram, the words "War Worker" and the plant number which controls gate entry.

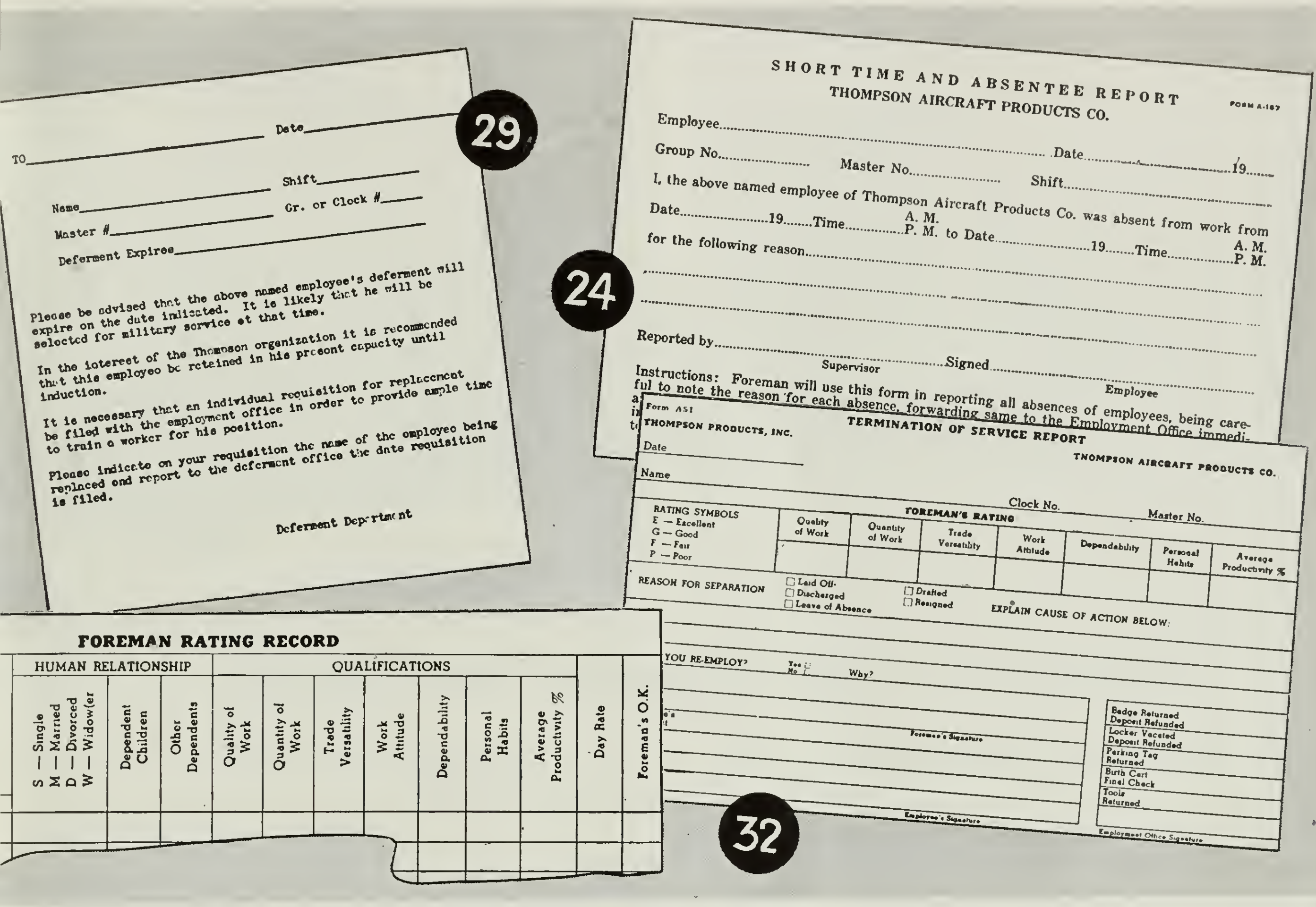
15 Time Card—Conventional 3½ x 7-in. punch card.

16 Recreation Club Application—Like most other aircraft companies, Thompson takes care of all details of initiation in the employment procedure. This 3 x 5-in. card authorizes a 25-cent monthly deduction for dues which admit the worker to a considerably larger return in company dances, clambakes, theatre parties and various games.

17 Locker Card—A 3 x 5-in. card which goes inside the employee's locker, showing lock combination, locker number, and users.

18 Badge and Locker Record—Double 3 x 5-in. cards authorize deductions of deposits for badge and locker lock, show who issued them, who issued refunds; with dates, plus space for acknowledgment.

19 Selective Service Record and Introduction Card—Another pair of 3 x 5-in. cards, one for the file on deferred workers, listing



all information on deferment actions, and the other card to be carried to the new worker's foreman, giving pertinent information.

20 Hospital Service Plan—A two-part, 4 x 6-in. card of application for local association benefits.

21 Employment Pass and Group Insurance Form—A four-part, 3 x 5-in. card form providing a gate pass, application for group insurance, authorization for payroll deduction, and combined application and deduction form for sickness and accident insurance. Two separate insurance companies are involved. On the pass back are printed ten factory regulations covering clock punching, paydays, smoking, resignation, absence, reporting injuries, change of address, right to search.

22 Reference and Working Records—These two 5 x 8-in. double-sided cards are kept in a visible index file. The reference record is made out from the application blank and includes a photo, and the foreman rating record on the back (lower center) shows results of frequent checkups on quality and quantity of work, versatility, attitude, dependability, personal habits, etc. This provides an index of productivity. The working record shows rate or shift changes and reasons.

23 Learner Training Application—This double-sided 8½ x 11-in. offset form gives an education and experience record, indicates training desired and qualifications for it, plus an agreement which states rates of pay and conditions under which training is provided.

24 Short-time and Absentee Report—4½ x 7-in., this is the typical "pink slip" (top right). A copy is filed in the employee's personal file in personnel records, where it is available whenever that employee's record is considered.

25 Personnel Memo—This 4 x 6½-in. blue slip is the opposite number to the "pink slip". It also goes into the personal file, and details any suggestion or other evidence of special interest by the employee.

26 Payroll Record—A 3 x 5-in. card giving rate details for the payroll department. It carries an "O.G.T." column, which means "Old Guard Time", premium pay depending on length of employment.

27 Upgrading Report—A 5½ x 8½-in. Ditto slip (top center) sent to a foreman by the personnel department when he is considering upgrading a particular employee. It shows clock numbers, draft status, gives absence reports (No. 24) and "personnel memos" (No. 25), plus other pertinent data on which the foreman may base his decision.

28 Application for Supervisory Training—Similar to No. 23, an 8½ x 11-in. offset sheet. Space is provided for psychological data as a basis for judging potential supervisory ability. Rules cover regularity of class attendance, necessity for maintaining work standards, etc.

29 Deferment Expiration Warning—An 8½ x 11-in. mimeographed report (top) to the foreman or supervisor from the deferment department, warning that the employee is likely to be called on a given date, and requesting that an individual requisition (No. 1) for replacement be filed with the employment office at once.

30 Transfer Cards—Two 5 x 8-in. cards, a pink "Transfer Out of Regular Department" and a blue "Transfer Off Regular Occupation," both for seniority records, which affect pay rates. Filed with:

31 Occupational Listing—A 5 x 8-in. double-sided yellow card also used for seniority records, summarizing transfers, rate and shift changes, and "Old Guard Time".

32 Termination of Service Report—A 5 x 8-in. printed slip (upper right) showing reason for separation and foreman's final rating.

33 Employee's Handbook—A 77-page, 4½ x 5⅝-in. booklet giving all kinds of information to answer employee needs and questions.

Some 700,000 lb. per month of scrap metals are handled by the Scrap Sales Division's own personnel from point of generation to time of sale. This truck train is leaving the main *Thunderbolt* plant on its way to the Scrap Sales Building.

Reclamation and Production Are Partners

Thrift can be popular, if intelligently presented to productive departments. In this case, bench collections and floor sweepings alone yield $20,000 a month from 700,000 lb. of scrap.

Steel turnings are centrifuged for recovery of cutting oils in this set-up. The centrifuge is being loaded at left. Behind it is the filter and storage tanks. Other oils and greases are also recovered.

By GORDON C. SLEEPER
Asst. to President, Republic Aviation Corp.

RECLAMATION IN 1943 is a name to conjure with in many of the great aviation plants of America. Yet even a short year ago it was almost unknown and unwanted—an orphan on the doorstep of production.

The voice of thrift had little chance to be heard in 1942. It was a year of vast expansion, of desperate need for everything that could make an airplane—a paradoxical year of unbalanced inventories, too much and always too little. It was a year of recruiting countless thousands of new workers who knew next to nothing about using the precision tools of aviation and still less about the value of the raw materials and costly hardware with which they worked.

Production was bedeviled by so many problems that even to suggest saving anything was like trying to rescue a teacup from a burning building. Yet reclamation got a toehold in every prime contractor's plant when the War Production Board, startled by the immensity of the President's demands for aircraft production, issued a directive for the collection. segregation and sale of all aluminum scrap.

That was the beginning of reclamation at the Farmingdale, Long Island, plant of Republic Aviation Corp. The P-47 *Thunderbolt,* whose guns are today the scourge of the skies over many lands, was just coming into large-scale production. Barrels marked 2-S, 17S, 24S, Stainless Steel, etc. were dutifully placed about the plant. Floor sweepers of the maintenance department were charged with delivery of filled barrels to a collection shed. Trucks from one of the two primary smelters took away segregated solids. Everything else was sold to scrap dealers authorized by the WPB.

No one understood just why aluminum alloys needed to be segregated and, as production grew, it became a nightmare to maintain any real segregation at the point of generation. The Scrap Sales Division remained a number one headache to the maintenance department until November of 1942.

Meanwhile another problem arose. Republic hired many thousands of new workers, both men and women. They had full access to Rotabins and other dispersing outlets from which some 800 different types or sizes of rivets and all the infinite variety of standard aviation-hardware items were issued. They took too many of everything, and at the end of day and night shifts the enormous total of mixed and wasted hardware and rivets would disgust any prewar mechanic. Production Control people, who kept the shops supplied, collected the mixtures by the ton, but did not know how to sort them.

Still another problem developed. Republic Aviation had built a number of planes before the P-47, notably the P-43 or *Lancer*, the P-35, the AT-12 Army trainer and its prototype for the Swedish government. How about the raw material and hardware left over from those earlier models? Could they be used for the P-47 or should they be considered obsolete? If obsolete, why not offer them for sale to other companies? The procurement department said it would look into this, but it was too busy buying to do much selling.

Seeing the problems of maintenance, production control and procurement, the writer was bold enough to suggest creating a reclamation department to relieve these three of their headaches. This was done in November of 1942. What followed is the drama of 1943 and in greater or less degree the story of many other aviation companies besides Republic.

The Scrap Sales Division grew into a great business handling some 700,000 lb. of scrap metals a month; operating its own trucks; cutting, baling and centrifuging metals; reclaiming oils, chemicals and greases; operating its own wood yard and shop to reclaim thousands of board feet of packing lumber and plywood that was formerly burned, shredding blueprints previously burned in incinerators, and selling or supplying shipping with tons of paper, excelsior and cardboard. These are only a few of the services that scrap sales offers to other departments at Republic. For Personnel it reclaims thousands of the metal bases on which plant identification photos are printed; to the hangar it returns for ground run-in nearly 10,000 gal. a month of re-refined engine crankcase oil that was formerly burned in the power house; for

Workers of the Hardware Sorting Division clean, sort, identify, inspect and return to stores over a million pieces of standard aircraft hardware each month—to a value of over $20,000. These are hand sorters—still necessary on intricate hardware.

purchasing it collects and returns to vendors countless drums, carboys and other expensive containers; for the Army it returns engine boxes and many items of government-furnished equipment. Its screening of floor sweepings and its careful handling of defective production parts sent to it by salvage inspectors are not the least of its services.

A new division known as the Hardware Sorting Division undertook to solve the problem of mixed hardware from bench collections and from floor sweepings. The department slogan, "A Penny Saved is a Penny Earned," hangs in huge letters across one wall of the room where its devoted workers, mostly girls, clean, sort, identify, inspect and return to stores over one million pieces of standard aircraft hardware monthly. Returned on credit requisitions, these recoveries as priced by the cost accounting department have been totaling over $20,000 a month.

The Hardware Sorting Division is a Rube Goldberg paradise of strange gadgets and intricate machines that do mechanically much of the sorting work that would otherwise be killing drudgery or too expensive to undertake. Visitors come from all over to see Republic's equipment and to study its sorting methods.

The Sorting Division has more than once kept the production

This new machine does final sorting of rivets by length increments of $\frac{1}{32}$ in. Rivets enter from the magazine at left and pass down the chute to a rotary table, from the rim of which they are sorted to appropriate boxes.

Floor sweepings pass, scoop by scoop, along this conveyor belt, beneath the magnetic shuttle at right. This moves back and forth across the belt, lifting off all ferrous material. The whole rig is portable.

Most useful of the Rube Goldberg devices is this sorting roll. Mixed aircraft hardware is dumped into the top hopper, and is fed out into the channel between the rolls. This channel gradually widens so the mixed hardware is sorted by head size. It drops into chutes which carry it to the proper tray.

line rolling, but its greatest accomplishment has been in teaching production the cost of wasteful handling of material. It has won the respect and friendship of shop supervisors, foremen and many key people among men and women workers. It has asked for and secured the appointment of shop reclamation agents who as foremen on production payroll have made the entire reclamation program their personal interest. Their example and influence is working wonders. Shops now compete with each other in reducing waste. Every bulletin board carries weekly reports of hardware and rivet collections. Shop standing is based on pounds per worker. At the rate totals are dropping, the Hardware Sorting Division hopes that it may soon be pensioned as having outlived its usefulness.

The third division of reclamation has become Republic's *enfant terrible*, a thorn in the side, a disturber of the peace, an asker of questions. If reclamation is the voice of thrift, its Surplus Sales Division amplifies it over all the roar of production.

Discovering some idle inventories, it offered its first catalog to other aviation companies late last November. The results were astounding. Telephone and telegraph orders flooded in from every city the catalog reached. Surplus Sales dug deeper and browbeat Material Control into releasing more inactive, unused inventories. The second catalog was a sellout.

Now the hunt was on in earnest, with Surplus Sales hot on the trail of anything obsolete or in excess of contract requirements. Catalog followed catalog as all departments became converts to the new thinking. Republic's surplus of raw materials, hardware, perishable tools, tool steels and even crib and maintenance supplies has been moving out for many months in a constantly growing program of redistribution that has had the approval and active support of the powerful Aircraft Scheduling Unit as well as the helpful counsel and advice of the War Production Board.

The influence of Surplus Sales activities has been salutory throughout the entire company. Moving inactive items out of General Stores into segregated Surplus Stores was an eye opener to engineering, planning, material control and purchasing departments. All are now more conscious of the effect of their decisions on space, material and money requirements.

In fairness, however, to all who carry the responsibility of placing orders for America's multi-billion dollar aircraft program, surpluses are not large percentage-wise, nor can they be avoided as long as the lessons of combat must be translated overnight into thousands of engineering changes.

Reclamation at Republic Aviation Corp. has proved that thrift can be popular, but its greatest achievement is in proving that its entire program makes it the friend and partner of production.

When rivets, screws or other AN hardware must be sorted accurately by length, this amplifier is used. It amplifies increments of length by four.

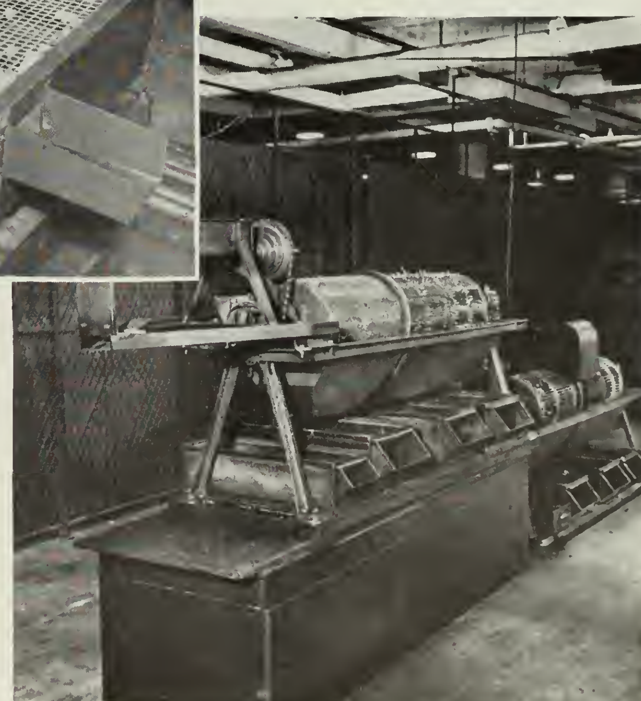
Idle and obsolete stocks are segregated in Surplus Sales Stores, of which this is one corner. These items are advertised in a catalog to other aviation companies, helping to prove the department's slogan, "A Penny Saved Is A Penny Earned."

Sorters Speed Sweepings Salvage

Three special machines and a sorting table are saving considerable reclamation time at the Missouri plant of the Airplane Division, Curtiss-Wright Corp. Developed by the Material Reclamation Dept., they are built of scrap and plywood.

The Rivet-sorter Line—Here is the lower end of the rivet-sorting line. Machines shown in other pictures are in the background, beginning with the sweeping-sorting table, magnetic separator, tandem drums and twin drums in order. The women are sorting rivets as they pass along a moving belt. In the foreground are two machines for sorting rivets by length.

Shaker Table for Sifting Floor Sweepings—Washers, small nuts, aluminum and steel scraps, rivets, metal fasteners, etc., are separated from floor sweepings and sifted by size on this shaker table. With it, one worker sifts 600 lb. of sweepings in 2½ hr., instead of the 8 hr. or more required when a gravel vibrator unit over a barrel was used. The base is angle iron, supporting a lower shelf and a wooden-frame top. One end of the top is pivoted on anti-friction bearings, the other is on an eccentric shaft rotated at 200 rpm. by a chain drive from a ½-hp. motor. Inside the frame are four 15x30-in. screens separated by ⅛-in. metal partitions. They are 6 in. shorter than table width and fastened alternately to opposite sides. Screens ⅛-in., ¼-in., ½-in. and ¾-in. mesh in order are tilted 1 in. alternately toward these fence openings, so sweepings zigzag downward as the table shakes. Sweepings are fed in over the ⅛-in. mesh screen through a 16x30x6-in. hopper. All dirt drops through this screen into a chute. Rivets and small steel parts drop out through the second screen (¼ in.) into another chute. Larger parts fall similarly through the other two screens and chutes into bins on the lower shelf. Trimmings and miscellaneous trash work out the end.



"Squirrel-cage" Rivet-sorting Drums Separate by Head Size—This tandem set of drums can sort 4,000 lb. of rivets in 78 hr. The first drum, of ⅛-in. perforated sheet metal, is in three sections, perforated 112, 144 and 174 diameters respectively, these sizes being approximately 0.015 in. larger than standard rivets to be segregated. Perforations are countersunk 100 deg. inside. The drum is sloped so rivets move down slowly until they fall through into the proper receptacle. The second drum, on a lower level and fed by chute from the first drum, is perforated 204 diameters and countersunk 100 deg. A ½-hp. motor drives both through a standard ½-in. V-belt. The feeder for the first drum is built on the principle of an old-style gravel separator and has a worm-conveyor feed. The drum drives the feeder through an adjustable V-belt.

Twin Drums Sort Rivets by Shank Diameter—After "squirrel-cage" sorting by head size, rivets are sorted further in these twin drums. They are about three times as large in diameter and longer than the "squirrel-cage" drums. They are made of steel mesh instead of perforated metal. In each drum is a stationary metal chute with deflectors at the top and along the sides. The chute is curved, has a diameter about $\frac{3}{4}$ drum diameter, and slopes downward at 60 deg. from entry to exit. Drums, mounted on rollers in plywood cradles, are driven by $\frac{1}{2}$-in. V-belts from a single $\frac{1}{2}$-hp. motor. The metal hopper which feeds each drum has a lever-operated gate (see photo below) which is struck each rotation by a knob inside the drum. Rivets tumble from the hopper into the bed of the drum, and those with shanks 0.015 in. smaller than the mesh drop into the openings and are caught heads up, as they work forward. The rotating drum carries these sticking rivets up until they drop out by gravity into the chute. Shavings and dirt drop through the mesh onto a shelf beneath the drum, and rivets with shanks too large to catch in the mesh eventually pass out the drum end into a tray. They are sorted further in the second drum, of coarser mesh.

Sorting Table Replaces Trays and Pans on Bench—A seat for the sorter, sturdy bins arranged within easy arm reach, identifying samples fastened over each bin, and plenty of light—these have multiplied by ten the rate of sorting parts from floor sweepings (excluding rivets). This 1-in. table is 9 ft. long by 5 ft. wide and 38 in. above the floor. The sorting cabinet above it is 38 in. high and consists of four sections of $\frac{3}{4}$-in. plywood set in an arm-length arc. Each section contains fifteen 6x6-in. pigeon-hole compartments built as chutes 2 ft. long with $\frac{7}{8}$-in. plywood floors at 45 deg. with the face. Thus each compartment has the capacity of a carrying tray. Trap doors of scrap steel close chutes in back. The crib at left is for unclassified items, that at right is for pre-sorting. Three semi-circular openings in the table are scrap outlets. They and the cutout to clear the operator are edged with metal bands to hold parts on the $\frac{1}{4}$-in. Masonite-covered table. A bottom shelf built into the 2x4 legs provides scrap bins and a foot rest. A fluorescent-tube fixture gives "wide" illumination.

Schedules Must Be Maintained

America must have fighting planes and parts delivered on time or ahead of time! The strategy of our attack is based on schedules of equipment availability—which in turn are based on your promised delivery dates.

The Army, the Navy, and the War Production Board all stand ready to assist in expediting procurement of essential supplies—but there are certain things that the contractors' organization must do. Production, Planning, Purchasing, and Follow-up departments in every aircraft plant will have to cooperate to maintain vital schedules. These steps are particularly important:

Place orders for the full contract requirements with deliveries scheduled to meet production needs, and issue purchase orders just as promptly as possible. Every delay in your issuance increases the chances of future failures.

Support each purchase order with proper allotments and preference ratings. Delay in obtaining complete data means delay in delivery.

Have more than one source for important parts—each capable of increase if another falls behind for any reason. The Army, Navy or WPB will assist in providing necessary tooling at a secondary source.

Be sure selected sources can meet delivery schedules. A subcontractor has the same difficulty performing miracles as you do.

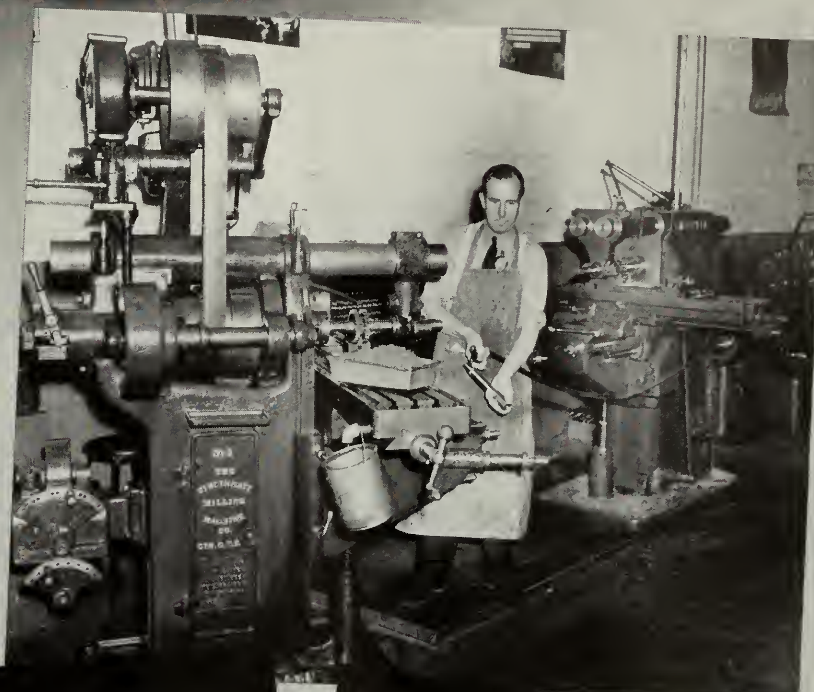
Submit critical-shortage reports just as soon as a shortage threatens. Don't let a shortage become a stoppage.

Report to the Army, Navy or WPB on materials you are having recurrent difficulties in obtaining. The sooner these agencies learn of threatened "bottlenecks" the sooner they can take action to prevent them.

Blind Worker Operates Two Machines, Increasing Output

Other handicapped employees help expand production by efficient work, spurring generally greater efforts.

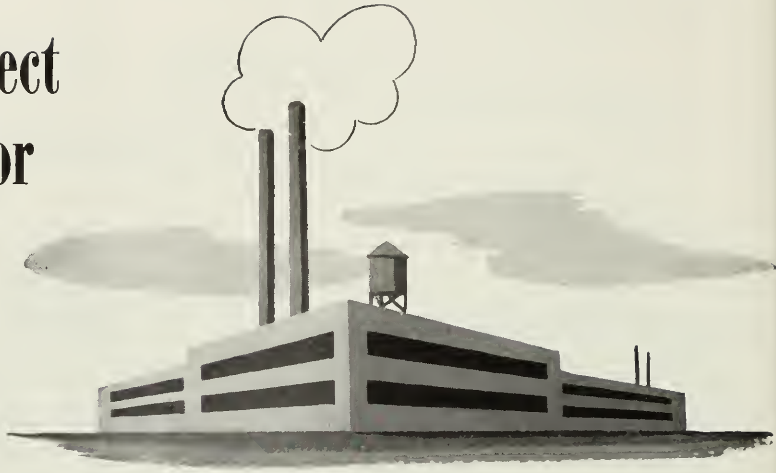
Totally blind, Robert Courtney, 47-year-old employee of Breeze Corporations, Newark, N. J., operates two milling machines at the same time by means of special notches in controls of both millers and an acute sense of hearing. His fingers and ears tell him when the part of a cartridge starter which he mills is about finished so that he may prepare another part for insertion in the machine. Courtney is so adept at his work that his foreman says he has increased production in his department by 10 percent.



Deaf workers have proved themselves capable of doing intricate work with speed and precision. Nimble hands are shown instructing deaf employees how to assemble complicated electrical wiring for airplane instrument panels at the Tulsa, Oklahoma, plant of the Douglas Aircraft Company.

William A. Teuscher, one-armed employee of the Columbus plant of the Curtiss-Wright Corp., works in the time study department. He is representative of many physically handicapped persons who have found employment of many types in the aircraft industry—proving their thorough capabilities and helping solve the manpower shortage problem.

Many Human Factors Affect Better Utilization of Labor



Incentive systems hold great promise, where applicable, but numerous other aids deserve most careful consideration and are getting attention.

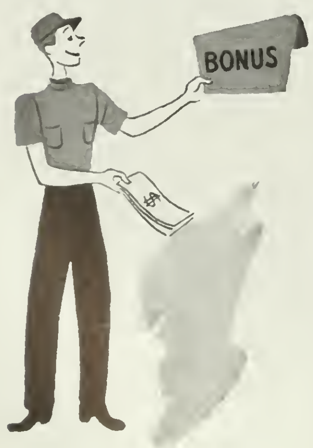
By HERBERT CHASE

VIRTUALLY ALL PLANTS engaged in manufacture of aircraft and their components are or soon will be faced with labor shortages, yet high production must be built up and maintained despite handicaps. This makes it essential that whatever supply of labor is available shall be utilized to best advantage. How can this be brought about?

There is, of course, no simple or all-inclusive answer. But there are many things which can be done in almost every plant. A few of the human factors here considered are summarized in a "check list" of questions. Any plant executive who asks himself which of the items is being overlooked or not being used to full advantage in his plant and applies the remedy can improve the situation. All the items listed are in effective use in at least one and some in many plants. They have proved themselves in actual use in one or more of 25 recently visited plants.

Incentive Systems

Perhaps the most promising of all plans for more efficient utilization of labor are those which offer a definite incentive for a definite increase in production. Usually the most potent incentive is a pay increase, preferably in direct proportion to the production increase. All incentive systems put a premium upon intelligence and initiative through appropriate and logical awards for results. Various considerations may make it difficult or almost impossible to apply an effective incentive system, but, where there is a will, a way usually can be found. Incentive systems are highly regarded by officials of the War Production Board. President Roosevelt is understood to have authorized a system of incentive pay and provided for exempting it from general rules against wage increases. Where incentive pay can be shown to be a true incentive to higher production, the National War Labor Board is understood to be sanctioning such pay increase or is willing to do so.



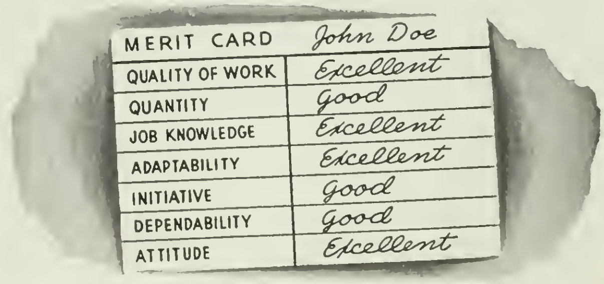
Incentives take many forms. One of the most common is the piecework system in which a standard rate is set for a given production rate and a bonus is paid for each unit produced above this rate. To be truly successful, however, the standard must be justly set and then *not varied merely because it is regularly exceeded* through the initiative, skill and perseverance of the labor involved.

Among the best of incentive systems is that in which groups or even the entire plant personnel benefit by the production increases which the whole group brings about. Under group plans, laxity or indifference is frowned upon by the workers because it is injurious to the group as a whole. Naturally, the success of any bonus or incentive system rests upon its honest and reasonable administration, without prejudice to either labor or management and with means for remedying amicably any differences which arise.

Suggestion systems are a logical part of incentive systems where some sort of bonus is paid for initiative resulting in production increase. Where, as in some General Motors, among many other plants, the award bears some relation to the extent of the saving effected, excellent results are reported.

Merit Systems

Where only hourly pay rates are employed, a form of incentive commonly termed a "merit rating" is often used along with a system of "job evaluation," as in some Pratt & Whitney and Martin plants, for example. Job evaluation fixes, within specific high and low limits, the base pay for the type of work and the merit rating grades the workers within the pay band and controls their advancement into better jobs, often subject to other considerations, such as length of service, prior experience or the like. At Martin



Nebraska, merit ratings are based on such factors as: quality of work, quantity produced, job knowledge, adaptability, initiative, dependability and attitude, judged on a point basis and with precaution against favoritism. Attainment of a good rating should have a favorable effect upon better utilization of labor, as it tends toward higher pay for those entitled to advancement.

Training and Upgrading

Aside from the foregoing incentive plans, few things do more toward better utilization of labor than well-operated methods of training, especially those looking toward upgrading which, of course, is an incentive. Many plants have their own systems for training candidates for upgrading. Although it is usual to select for upgrading training the more skillful workers who show intelligence and initiative, all ambitious workers are usually given opportunity to benefit from training opportunities to better their skills and/or to learn new ones. Better utilization of labor is encouraged by offering courses which give the worker a grounding in subjects which the regular shop routine does not afford, yet many plants do not have courses for this purpose. Those having them do not always offer suitable encouragement to workers to improve their skill and their earnings through training.

Unfortunately, too many workers, having learned one job, are disinclined to make themselves more useful by learning others in the same or adjacent departments. A good in-plant training system tends to overcome this inertia and is insisted upon in some plants. In one department building turrets, for example, employees are constantly shifted from one job to the next until they can do any or almost any job in the department with fair skill. The worker may find a type of work which he can do better or with more satisfaction than the starting or some other job and, consequently, he or she works to better advantage. Such a plan also helps to prevent delays in production when someone is needed to do an absentee's job and can be made to greatly improve the over-all effectiveness of the whole department. Such in-plant training is vastly better than any ordinary class training, since it deals with the specific jobs to be done, whereas class work often is, of necessity, too general in character. Such training can be done by workers already skilled and without extra hours and without interfering with an orderly flow of production.

Avoidance of rejects helps to economize in both labor and materials and is often dependent upon proper training. At Bell plants, if rejects in a given department rise above a certain percentage, the cause is at once carefully analyzed. Then the employees involved are given a short but intensive training in the use of the tools and methods which, through misuse, have caused the rejects. This has been found highly effective and saved not only the time of those responsible for the rejects, but of supervisors and salvage workers.

The use of well-made perspective drawings, sketches, and/or properly labeled photographs along with carefully prepared operation sheets has helped and continues to aid workers in North American, Vultee, Eastern Aircraft, Curtiss, Sperry, and many other plants. This applies especially to those lacking in experience and in ability to read blueprints, but also to more experienced help and even to busy supervisors. Such illustrations and operation sheets not only indicate the steps in the process but, when assembling is involved, show which parts are placed in which locations and often indicate how hand tools and fixtures must be used for best results.

Many companies are making excellent use of motion pictures, often shown in off-hours. These illustrate methods, such as proper grinding and setting of tools, how to use various machines or equipment to best advantage, how to work different classes of materials, and the like. The pictures may or may not show the specific jobs being handled, but offer suggestions which are stimulating and likely to bear fruit in more efficient work. Many such films are available from companies who supply materials and equipment. Others can be had from government and general training sources.

Fitting Workers to the Job

Much more effective use of labor is often gained by making sure that, as far as possible, every worker is given a type or kind of work which is congenial and which he or she is temperamentally and otherwise fitted to do. Misfits rarely work efficiently, and a worker who is a flat failure on one job or under one boss may be a great success under another boss or on another job. Much of labor turnover (which is always wasteful) can be avoided by fitting the individual to the job and, within reason, making the job as congenial as conditions permit. Workers who have gripes are properly given an opportunity to discuss them with councilors or others in authority and, where the cause of the gripe is not readily removed, a shift to another job or another department is usually a far better solution than to lose the worker.

Keeping the worker satisfied by removing ground for gripes benefits both the plant and the worker, but there are often cases in which workers are well satisfied in a given job when they are, in reality, not doing the best job they are equipped to do or the kind of a job most helpful to the war effort or the plant involved. They may not, for example, be using skills or training which fit them for a more useful job than that in which they are engaged. To meet this situation, as well as to get help not forthcoming from other sources, at least one Curtiss plant had a careful survey made of application forms filed when workers were employed. Classifications were made on the basis of prior experience and training. Now, when the personnel department receives requisitions for persons with a given training and experience, a search under the appropriate classification often reveals that a better person for the job is available from among present employees than from outside sources. This has

involved readjustments in departments from which the employees were shifted but with over-all benefit to both company and to employees. The survey revealed many hidden abilities which probably would not have been discovered otherwise.

Avoiding Worries and Unnecessary Fatigue

Workers who are worried or unduly fatigued are unlikely to work efficiently. It follows that, if worries can be avoided or removed and fatigue mitigated, more efficient work is a likely result. Worries may be financial, result from impaired health or other difficulties of employee or his family, or come from poor housing, bad traveling facilities or other sources. Not all such worries can be solved or mitigated by employer help, but many can be and are being through counselors, programs for better housing, provision for better transportation, including car sharing and the like. Some phases of such matters have already been outlined in WINGS.

Government and other public agencies often give assistance in helping, for example, to provide better housing and transportation facilities, to establish nurseries or schools where mothers who work can leave their children, and to see that "loan sharks" are not permitted to take advantage of workers. Provision for medical assistance and health advice are often of exceptional importance.

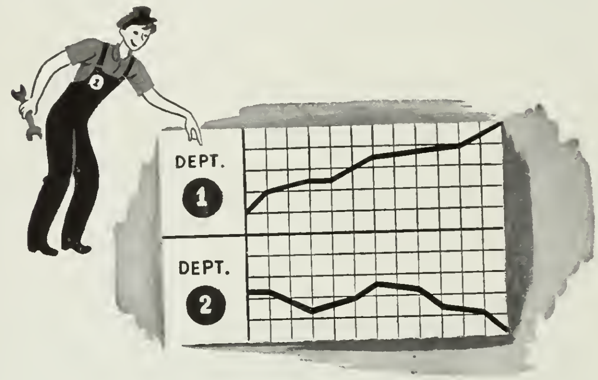
Closely related are such matters as provision of suitable rest periods, canteens and/or cafeterias where wholesome food is available under sanitary conditions and at moderate prices and provision of rest rooms and smoking areas for such reasonable relaxation as will prove a net gain in production.

Fatigue depends upon many factors, some of them relating to physical equipment of plants, to be considered in a later article. Good ventilating and heating (or cooling) are often neglected as is the matter of proper lighting at all hours. In some plants (even those not having ovens or furnaces or other heat-generating equipment needed in manufacture) departments had to be closed for many hours or days last summer because inadequate ventilation or insulation made them unlivable on exceedingly hot days.

Continual performance of repetitive operations hour after hour and day after day results in excessive fatigue and lack of interest in some individuals. In other cases, especially where women are involved, the repetition appears not to have this effect. Where it is experienced, however, it can be avoided by a rotation in the jobs performed by a group or department, often with beneficial results on output. There is a further advantage that, where several persons learn to do many jobs well, the chance that production will be held up unduly by absence of any individual who is the only one specially trained for the job is much reduced.

In some plants, especially where the noise level is not too high, occasional or even continuous radio music is said to have a beneficial effect in combatting fatigue or in promoting higher output or both. Jack & Heintz is one plant reported to benefit by radio music. A proper choice of programs is judged essential. Where there are objections to music during working hours, it is often considered beneficial during rest periods or is confined to rest areas. Excessive noise, especially of some types, has been shown by test to cause fatigue and can be mitigated by proper use of sound-absorbing ceilings or partitions or by isolation of noisy operations.

Facilities for off-time recreation, including exercises and athletic competitions, picnics, movies and other entertainment may have only an indirect though a beneficial effect on production. They certainly can help in maintaining a high morale which is generally conceded to be highly favorable to the maintenance of a high production rate. This is considered true at the Allis-Chalmers supercharger plant, for example, where a high percentage of women is employed. There, too, it has been found helpful to provide off-time talks on subjects of special interest to women, such as those dealing with beauty treatments. Some plants are said to have even provided facilities for such treatments, in off hours, at favorable rates. There is, however, a definite tendency to avoid anything in the way of "glamour girl" outfits and to insist upon the wearing of sensible and safe costumes, including caps for protection of the hair, for safety as well as for morale.



Friendly Competition

Many plants find it helpful to promote friendly competition aimed at maximum production output between groups, departments or even plants under the same management. Some General Electric, Pullman Standard Car and Bell Aircraft plants follow this procedure. In effect, a sort of par figure may be set up and the groups rated by charts or other means with reference to their respective outputs. Some highly favorable results are attributed to this simple expedient which appeals to patriotic pride.

"Cycle" Systems

Some companies, Republic Aviation Corp. being one, report excellent results from the use of "cycle" systems, especially for assembly work. In such a system, the same group of workers repeats the same set of operations on each unit assembled, moving from station to station unless the line is conveyorized so that each unit moves through a given station in a given time. Such crews become highly proficient in the respective operations performed and, if the system is properly operated, are never in the way of other crews. They know which parts go in which locations, how to install them quickly and how to perform such other operations as are assigned. As the group usually operates as a team and each individual may perform a variety of operations and not necessarily the same ones on each assembly, the repetition need not become unduly monotonous. The size of the crew or the number of operations it performs can be varied easily to meet production requirements.

Control of Absence and Tardiness

Uncounted expedients are being employed to combat absence and tardiness which constitute a serious problem in many plants

and, of course, may greatly affect the efficient utilization of the labor supply. One expedient is to remove from the rack the time cards of tardy or absent employees and require that they report to some supervisor with the reason. Chronic offenders are then easily spotted and dealt with. Some plants (Allis-Chalmers is one) have a board of employees which deals with offenders according to prescribed rules sanctioned by management. Illness and family problems, often unavoidable, but sometimes also capable of mitigation in some degree (as in making provision for child care, for example) are the cause of much absenteeism and tardiness. Grumman provides a "green truck" service to handle minor household maintenance problems which might otherwise cause absenteeism or distraction of workers' attention.

Records of absenteeism, especially of the avoidable type (such as that for over-indulgence regularly following pay day, for example) should, of course, be brought to the attention of the supervisors concerned, as they should affect merit rating and be considered in recommending promotions. Medical certificates are often required when absence is a result of illness. When, however, employees have access to free or lower-cost medical advice furnished by the employer, the effect of some illnesses can be partly controlled or the likely duration of absence shortened. Safety programs are widely but often not adequately employed to combat accidents, such as eye injuries. Accidents are common, especially among new workers in industry and often cause great loss in time. Some plants insist upon all workers wearing goggles, and report favorable results. All feasible means for avoiding accidents deserve attention.

Warning of Draft Requirements

Many companies have one or more individuals whose duties are to follow the draft status of employees and to deal on their behalf with draft boards. It is usual for such individuals to keep in close touch with the supervisors who will be affected by loss of drafted men as well as with personnel departments which may have to furnish substitutes. By this means, replacements are anticipated and, if possible, someone is trained in advance to take the draftee's place. Naturally, if this is done, a more efficient utilization of labor is likely to result than if the problem of replacement is not faced until the draftee is called.

For Better Labor Utilization, Try Answering These Questions

1. Has incentive pay or any other form of incentive been put into effect?
2. Is any form of friendly competition in boosting output encouraged?
3. Is a merit system used as a basis for pay increases or upgrading?
4. Are opportunities for upgrading offered or "sold" to enterprising employees?
5. Is the development and application of production shortcuts encouraged and adequately rewarded?
6. Are opportunities for improving skills or learning new ones provided and employees encouraged to make the most of these?
7. Is special training designed to minimize rejects provided?
8. Are perspective drawings, photos and instruction sheets supplied to aid in training employees?
9. Are movies or slide films illustrating better production practices shown regularly?
10. Is a well-regulated system designed to minimize absence and tardiness in effect?
11. Are counselors available and functioning to minimize employee worries?
12. Have all reasonable steps to make working conditions congenial and healthful been taken?
13. What efforts are being made to minimize excessive fatigue?
14. Are facilities for reasonable rest periods and relaxation provided?
15. Is healthful recreation encouraged and facilities provided for it?
16. Are facilities providing wholesome food at moderate prices available?
17. Have all feasible steps to facilitate travel to and from work been taken?
18. If housing is inadequate, are all feasible steps to improve conditions being fostered?
19. Are nurseries and school facilities for employee's children adequate?
20. Are medical advice and other health aids provided?
21. Is a safety program being energetically carried out?
22. Are employees or new labor being trained to replace men about to be drafted?

Part-Time Workers

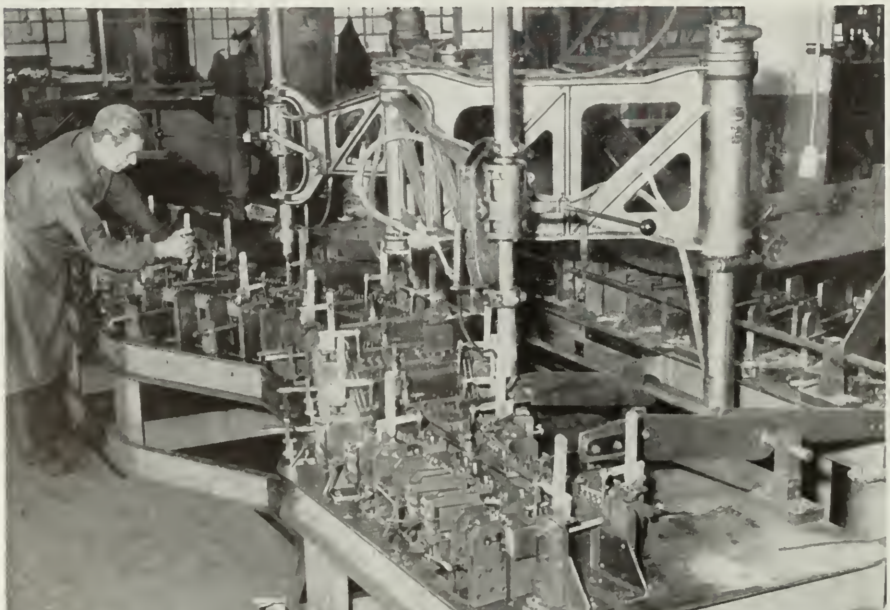
Most of the foregoing deals primarily with the utilization of employees already on the job or shortly available from as yet unexhausted supplies, where the latter exist. Where added labor is essential and not available on a full-time basis, efforts to tap the part-time supply have sometimes helped to meet shortages. The "Victory Shifts," as employed by Bell Aircraft in the Buffalo, N. Y., area and described in Wings for September deserves consideration. Other part-time shifts have been used with success in some localities and can be employed where the "Victory Shift" may not be adaptable to local conditions.

* * * * *

In an article to follow, mechanical means for better labor utilization will be considered.

Exceptional Tooling Builds the *Corsair*

Part II

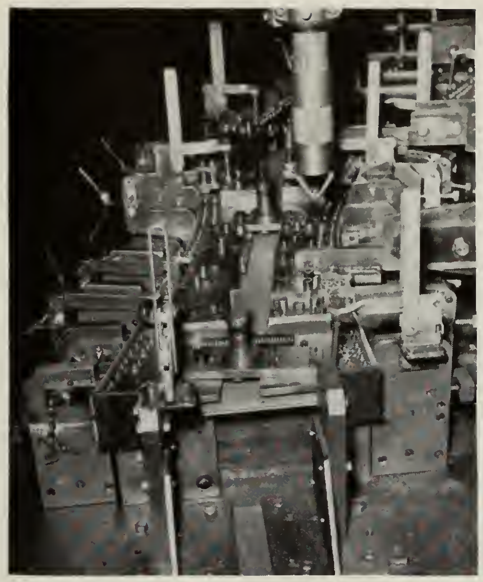


Unusual precautions insure interchangeability. High precision is attained in well-designed fixtures for various drilling, milling and assembly operations.

PARTLY BECAUSE of the unusual shape of the wing center section of the *Corsair*, tooling for this fast Navy fighter required departures from the conventional. These departures have been studied at both the Chance Vought Division of United Aircraft Corp. (which originated most of the tooling as well as the design of the plane itself) and the

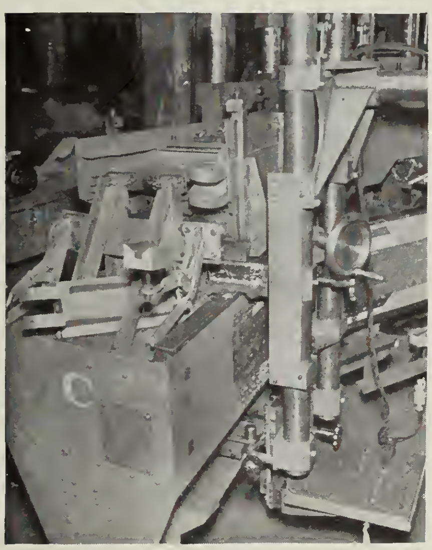
(*Text continued on page 800*)

Several wing center-section elements, including the arched Dural web and sets of stiffening angles, are assembled in this "pants presser" fixture, so-named because of the two-piece hinged upper jig plate. About 1,300 holes, mainly 1/4 and 5/16 in., are drilled by the pair of drills on pantograph arms. Drill-spindle speed is 15,000 rpm. Drills are 0.001 in. under size, which produces a full-size hole with a finish that makes reaming unnecessary. The same machines serve a duplicate fixture behind this one, on which the jig plate is lifted in the photo. After drilling, the assembly is bolted together for transfer to a bolting stand.

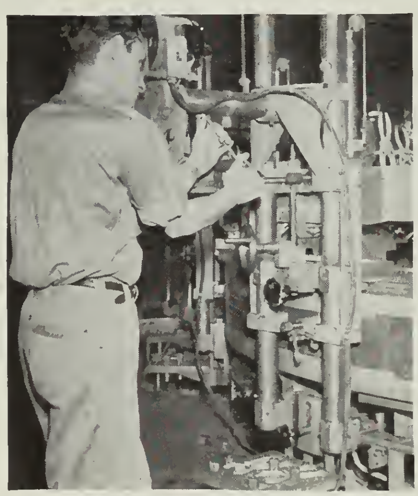


In this close-up, the two-part jig plate of the "pants presser" fixture can be seen. Eccentric disks in the central slot are turned by wrench to spread the plate sections, thus positioning drill bushings and pushing angles of the girder out to locating pads and into alignment with the web plate. Toggle clamps lock plates and angles against the web. Note that the drill spindle carries a guide bushing which enters locating bushings in the plates before the drill enters. Drill speed and air-blown spray cooling make it possible to drill the 1,300 holes in $1\frac{1}{2}$ to 2 hr.

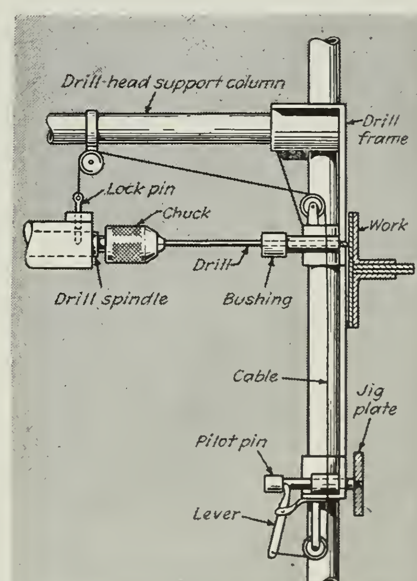
Cap strips, additional stiffening angles, and hinge and other forgings are clamped to the girder in this fixture, then drilled by eight horizontal presses which are racked along tracks which follow the contour. Drill heads may be moved vertically also on supporting columns. All holes are located from pilot pins which fit holes in jig plates along the fixture sides. Numerous clamps holding the cap strip to the girder would interfere with normal drill guiding through bushings. This fabricated-steel fixture locates and provides for drilling of several hundred bolt and rivet holes. Common sizes are $\frac{3}{16}$, $\frac{15}{64}$, $\frac{9}{64}$ and $\frac{23}{64}$ in. Operators drill center bolt holes first, then work outward, to locate parts firmly before rivet holes are drilled. Riveting and final bolting are done on stands. Fixture details are shown in following illustrations.



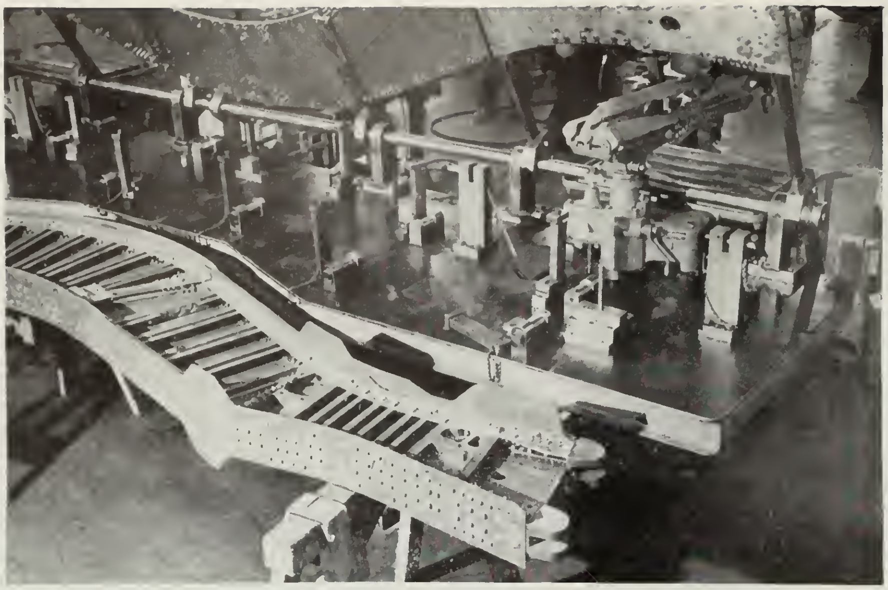
Initially, the beam or girder is clamped horizontally to the fixture bed. Parts are clamped lightly for centering. The web rests against stiffening angles, and huge forgings (which fit between cap strips and angles already fastened to the web) are inserted and clamped. Cap strips are tightened against web strips by wedges, then the whole assembly is locked by vertical pressure. Nesting blocks locate the web for height, and cap strips fit into notches. Hinge forgings (one shown here in place, another lying on fixture) are locked endwise by toggle clamps. Spring clamps are applied wherever cap strips tend to spring away from angles.



Here the operator feeds a drill through a bushing in the frame which supports one of the counterweighted horizontal drill columns. The pilot pin in the center crossbar on the vertical supporting columns is indexed in a jig-plate hole. Vertical indexing is done by the crankwheel, and horizontal indexing by the handwheel. The bottom crossbar carries a pair of rollers which travel along a horizontal track, and the upper runs on a track along the top edge of the fixture just below the work. Both tracks are curved so the axis of the drill is always normal to the cap strip. Note the board below the vertical members. It provides holes for sets of drill bushings, drills and pilot pins not in use. All carry color bands to match similar ones around pilot holes in the plate.



Arrangement to prevent drilling until the pilot pin is fully entered in a hole. Devised by Louis Ekloot, a Brewster worker, the arrangement includes a lock-pin which prevents advance of the drill spindle until the pilot pin has been pushed in far enough so the collar on it rocks the lever and thus pulls the lock pin.



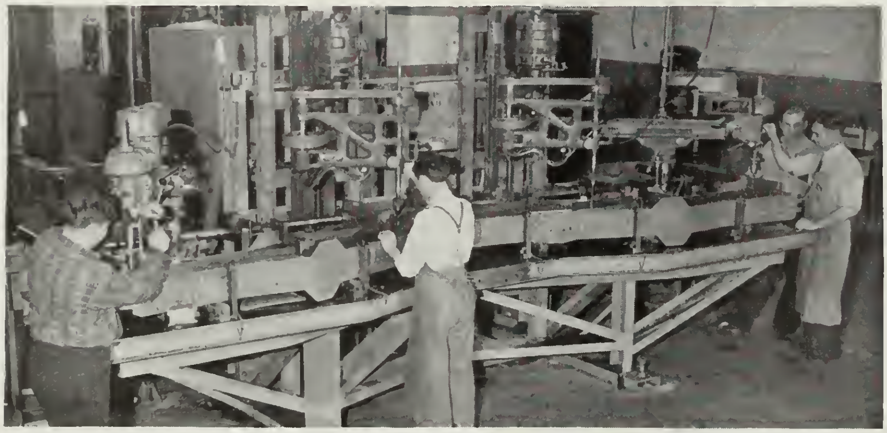
Holes at right angles to the web, for fastenings which hold the outer set of angles to the web stiffeners, are drilled in this fixture. The girder in foreground is ready to go into the jig. It will be located by three pins like that on the right of the fixture, and held firmly adjacent to locking elements by turning up the eccentric rollers or pins on which the cap strips rest. Short clamp bars at the ends of vertical supports (mortised to the bed for removal when loading or unloading) hold the assembly in place while the counterweighted jig plate is lowered for drilling.

(*Text continued from page 798*)

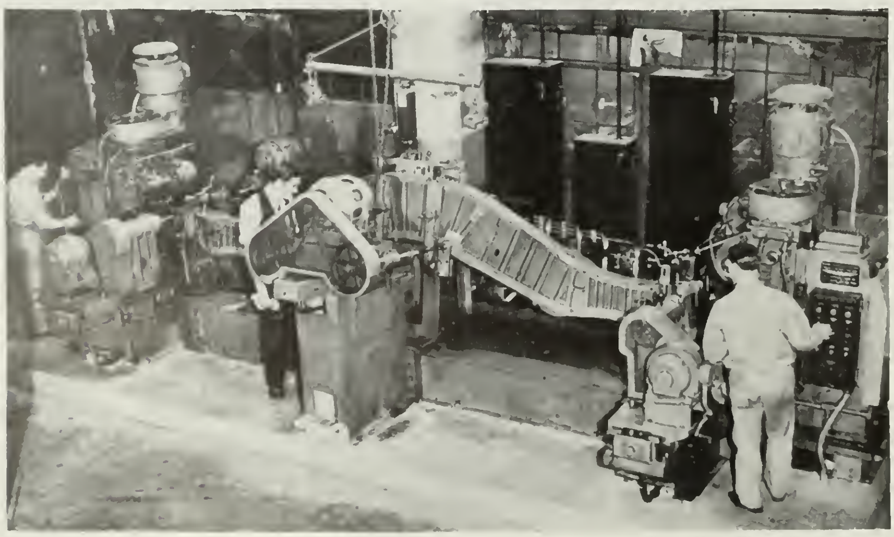
Brewster Aeronautical Corp. Certain of the tools are here described for the first time.

Fixtures employed for the wing center section dealt with here are those used by Brewster. Most of them are basically the same as the Vought fixtures after which they are patterned, but certain features have been added. There are, of course, many other jigs and fixtures for fabricating minor parts and small subassemblies, but these are the unusual ones.

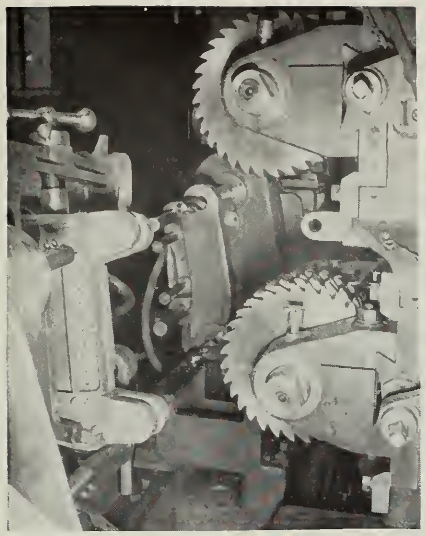
The wing center section, which may be called the major structural element of the ship, includes a web of flat Dural plates cut to an arched shape. Along the contour there are riveted angles and cap strips which are, of course, formed to suit the contour before being assembled. Attached to the web are numerous other stiffening elements. Where shearing and other stresses are highest, bolts with elastic stop nuts are used rather than rivets Some of these pass through steel forgings, especially at the ends where wing hinges are required. Thus, fabrication and assembly of this section presents many unusual problems. Solutions to the most complex ones are shown here. (*Item A-841*)



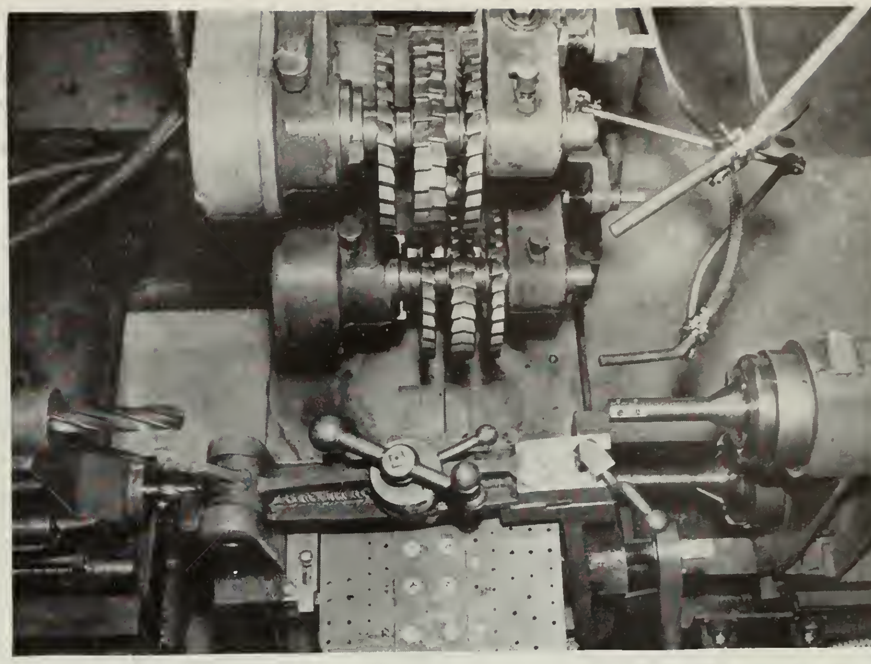
Here the beam has been put in place and the jig plate lowered. Holes are being drilled through angles and stiffeners, near the ends with Walker-Turner radials and at the center by a pair of Foote-Burt Hammond jointed-arm units. Their supports move along horizontal ways. The jig plate carries bushings to fit the drills. A welded heavy channel structure makes the fixture extremely rigid. Bolting and riveting again are done on stands.



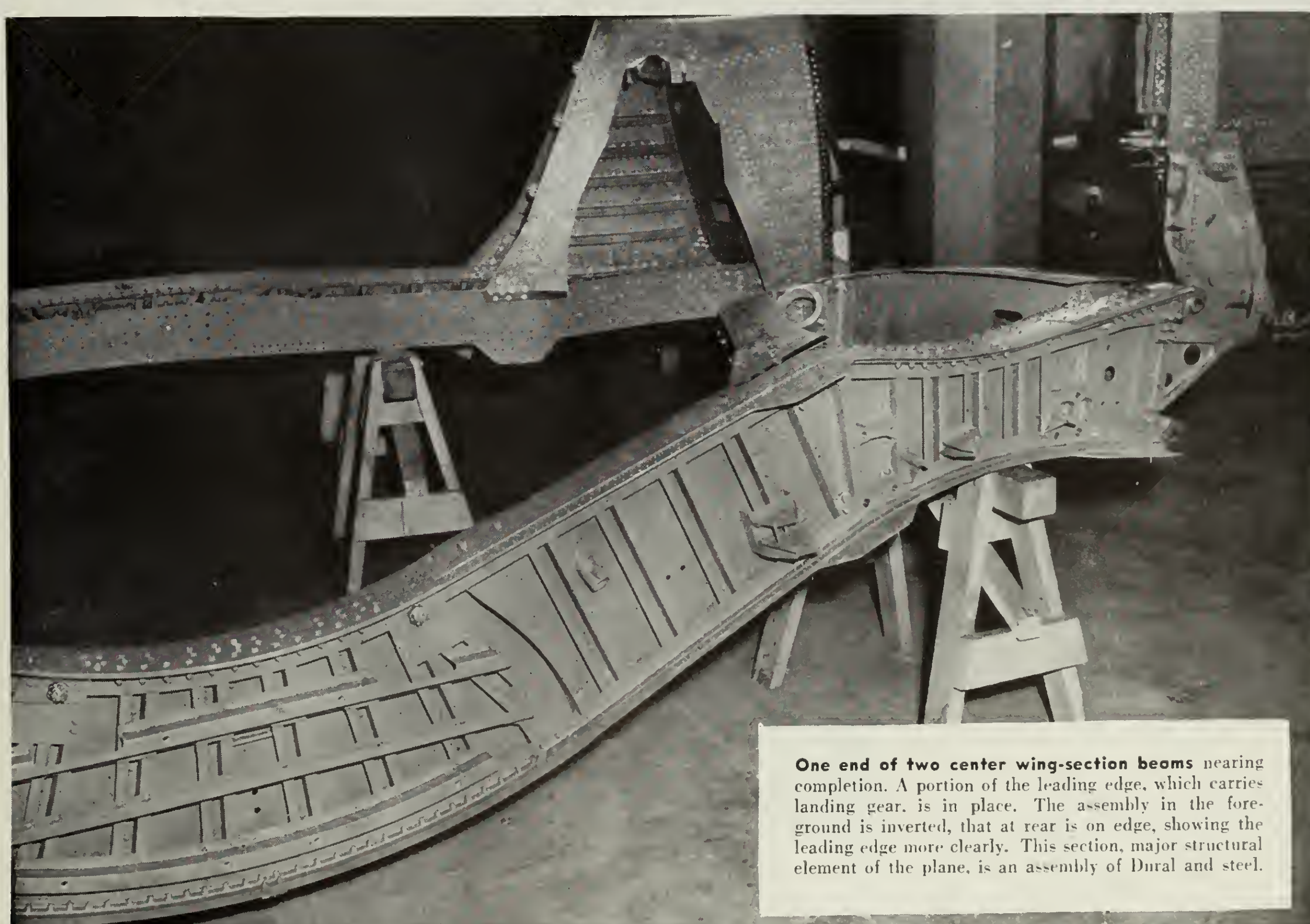
Limits on center distances are so close that the hinges must be machined after they are built in. At Chance-Vought, hinge forgings at one end are faced and bored in a boring mill, then corresponding fittings at the other end are machined. A vertical drill then puts in engine-mount bolt holes. At Brewster, however, this combination machine does all these operations. It has hydraulic feed and pushbutton control. Girders are handled by a chain hoist on a trolley rail, the spreader and clamp hooks of which are at top center. In the machine, the girder rests and is clamped against the landing-gear resting pads, but is located longitudinally on the web holes used previously.



Here is the end of the girder, showing hinge pads. Two milling spindles at right each carry four cutters to mill hinge faces. Then the drill spindles at rear drill hinge-bolt holes, guided by a bushing plate which advances with them, and those at front (lower left) bore holes to finish size. Milling cutters are $10\frac{1}{2}$ in. in diameter and are fed downward to remove about $\frac{1}{8}$ in. of metal each in 18 min. Once started, the milling cycle is automatic.

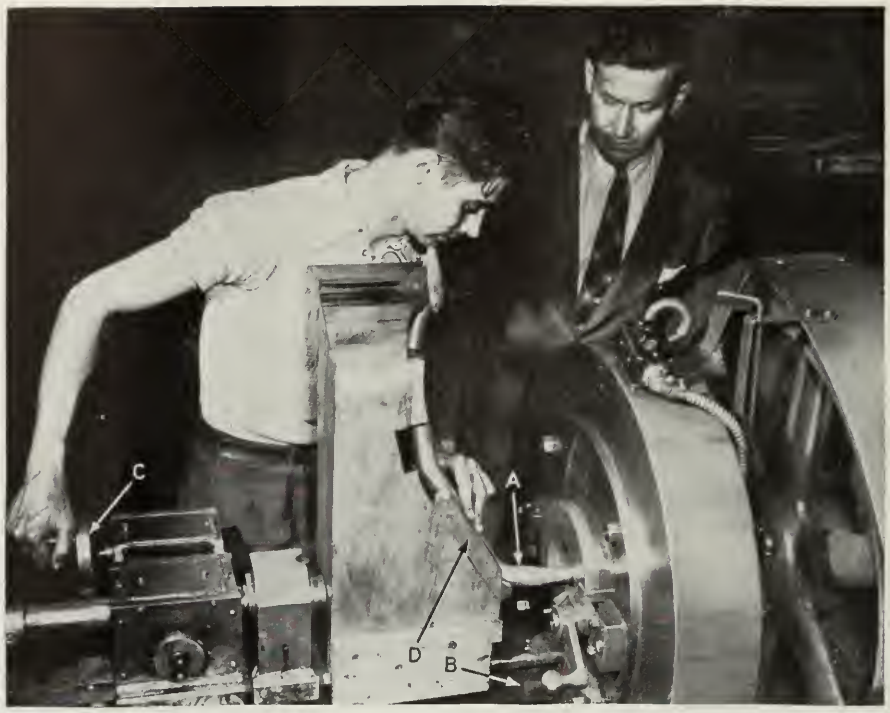


Viewed from above, the relationship of cutters, drills and boring bars is readily apparent. Boring bars each have two carbide-tipped bits, the first roughing off about $\frac{1}{32}$ in. of metal and the second finishing the cut. The drill guide bushings and bar advance until they almost touch the work, then are locked there until drilling is completed. All units are mounted on the same massive base, so once set, they can hold close dimensional limits over a long period.



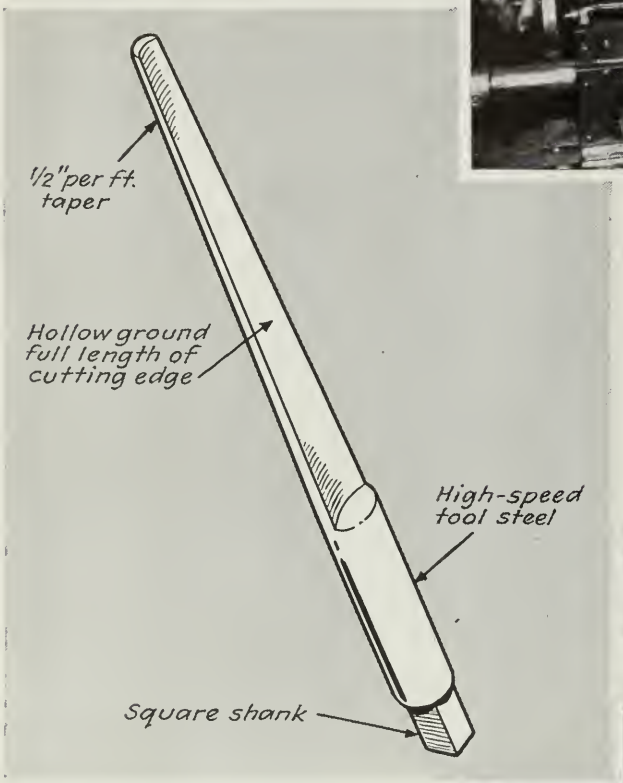
One end of two center wing-section beams nearing completion. A portion of the leading edge, which carries landing gear, is in place. The assembly in the foreground is inverted, that at rear is on edge, showing the leading edge more clearly. This section, major structural element of the plane, is an assembly of Dural and steel.

Swage Tubes Without Thickening Wall—By swaging between a set of swage blocks for the outside diameter and a mandrel for the inside diameter, it has been found possible to reduce tube diameter without changing wall thickness. According to Jack Marsh, foreman of tube bending, who evolved the method, the trick is to feed the tube in under proper pressure and at the proper rate. To control these, the tube *A* is supported in a wooden form *D*, which in turn is advanced along machine bed *B* by handwheel *C*. The latter is connected to a worm which engages a rack on the form carriage. *(Item A-943)*



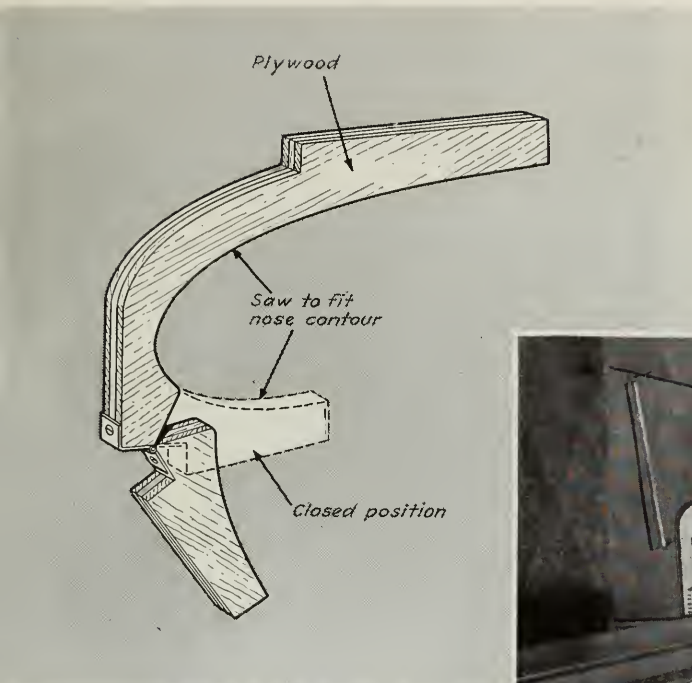
Airframing Simplified—II

Another group of ingenious ideas that save manpower in producing fighting planes.



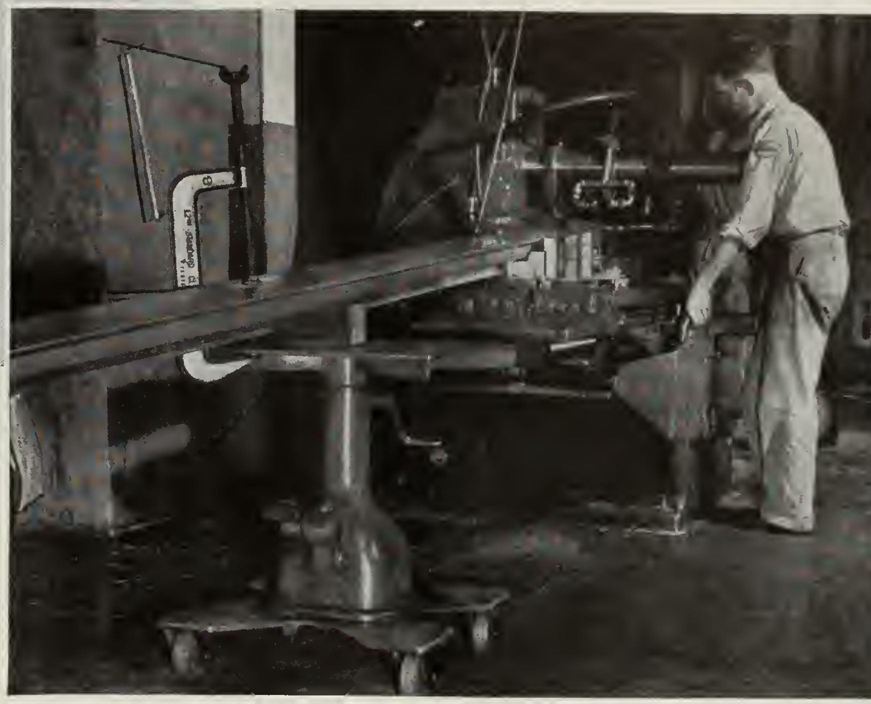
Finish Reamer for Taper-pin Holes—At Lockheed, new workers had difficulty avoiding chatter and star marks while reaming taper-pin holes. By developing a finish reamer, used after the standard reamer has been driven up to a point where the taper pin is within 1/8 in. of final position, and instructing workers in proper use of reaming equipment, H. Murray Harrison, assembly group leader practically ended "botched" holes and improved hole finish about 30 percent. The new reamer he designed is the same length as the standard one, has the same 1/2 in. per ft. taper, has the same square shank and is also made of high-speed steel. It, however, has only one flute. It is turned and ground to the desired taper, heat-treated, then finally hollow-ground to 180 deg. for the full length of the taper. Only one or two turns will clean-up the average tapered hole—even permitting new parts to be pinned to old without increasing taper depth. *(Item A-906)*

Short, Smooth Bends in Thin-wall Tubes—Jack Marsh, foreman of tube bending in one Bell Aircraft plant, is making bends of 3-in. center radius in 3/4-in. (outside) tube with a wall 0.049 in. thick. He added a radius member or spreader *B*, a top link *A* which permits both sides of the bend block to be used, and a wiper to fit the radii formed. Here he supervises a bending job. *(Item A-942)*

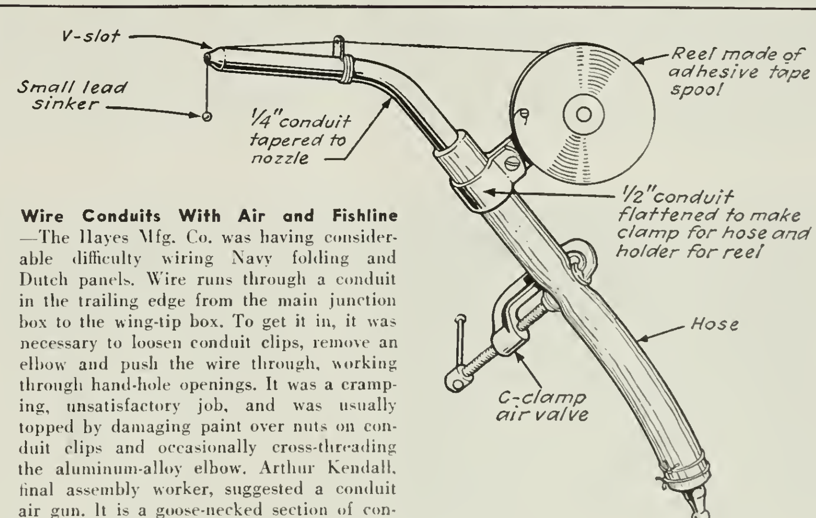


Nose-skin Jig Replaces Shock Cord Victor Carboneau of Grand Rapids (Mich.) Chair Co. developed this simple plywood jig to replace shock cord in fitting on nose skins. Sawed from 1½-in. plywood to nose contour, the jig is hinged just below the extremity of the nose, so it can be applied over the skin easily. At the joint, edges are chamfered to avoid damage to the skin. *(Item A-944)*

Dollies Help In Milling Spars—While milling the ends of long, heavy, extruded Dural spars, Boeing Airplane at Wichita, Kan., uses hydraulically operated dollies to support the overhanging end. Each is simply a hydraulic jack mounted on a base plate fitted with casters, and carrying a braced top plate. The dolly also transfers the spar from machine to stock rack and vice versa. The dolly can be raised or lowered to position work in the fixture or in stock racks. *(Item A-561)*



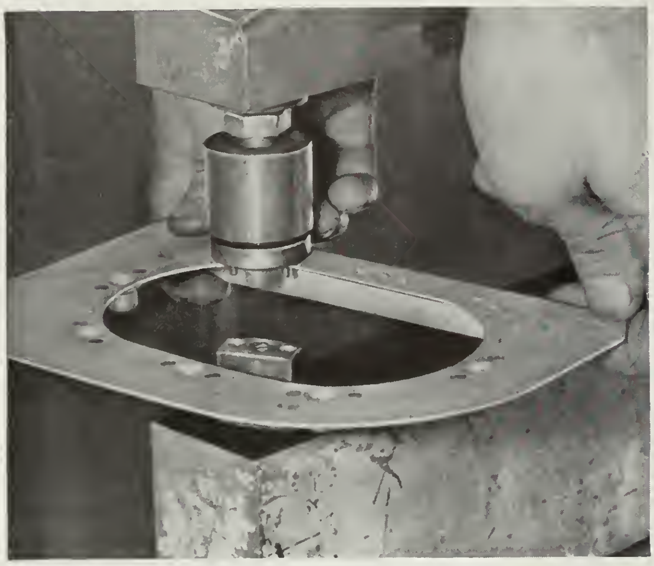
Motor-mount Ring Normalized in Fixture—A motor-mount ring can be normalized in about 50 sec. with this fixture, developed by the Tool Engineering Dept., Vega Aircraft Corp. As the fixture is clamped to the upper and lower platens of a 400-kva. Federal projection welder, the machine can actually exert as much as 5 tons or more pressure to straighten rings and lugs if clamps and pads are properly spaced. Electrode clamps, designed to be full floating, are spaced 90 deg. apart to distribute the high-amperage, low-voltage welder current. An electronic timer in the circuit causes current pulsations to aid proper dissipation of heat from the contacts. The unit is more accurate, faster and simpler to use. *(Item A-879)*



Wire Conduits With Air and Fishline—The Hayes Mfg. Co. was having considerable difficulty wiring Navy folding and Dutch panels. Wire runs through a conduit in the trailing edge from the main junction box to the wing-tip box. To get it in, it was necessary to loosen conduit clips, remove an elbow and push the wire through, working through hand-hole openings. It was a cramping, unsatisfactory job, and was usually topped by damaging paint over nuts on conduit clips and occasionally cross-threading the aluminum-alloy elbow. Arthur Kendall, final assembly worker, suggested a conduit air gun. It is a goose-necked section of conduit tapered to a jet tip. Fish line wound on an adhesive-tape spool with an old aileron bearing and a section of conduit flattened for a bracket and clamp is fed through an eyelet above the jet. A small lead shot ("sinker" to fishermen) is fastened to the end of the line and the jet V-grooved to pass the line. Now the line is shot through the conduit without disconnecting it, the sinker replaced by the wire ends, and they are pulled through. Time was cut from 32½ down to 1.7 min.—a clear saving of 95 percent, while ending spoilage. *(Item A-907)*

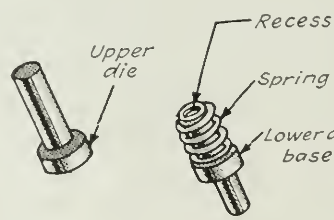
Dimples While You Wait

Three tools developed at Fleetwings combined operation with riveting, thus saving up to 75 percent of production time.



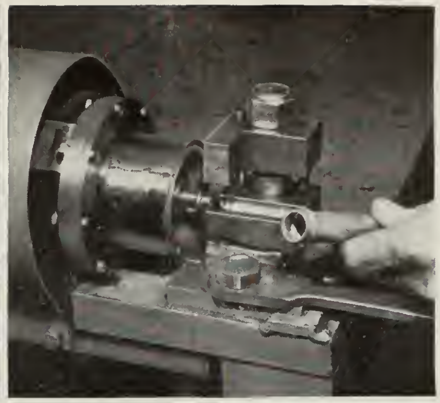
Combination Locator-Dimpler-Riveter for Anchor Nuts—A combination locator, riveter and dimpler was evolved for fastening anchor nuts to rudder doubler plates. Former procedure was to dimple three holes, insert locator screw, rivet (two operations), remove screw. Now rivets are inserted and squeezed on a CP450 compression riveter. The adjustable element in this case is in the head (note locknut), which is itself only a case for a hard-rubber core upon which the headset rests. In the headset center is a removable locating pin sized to fit the job. As the ram descends, the headset is depressed sufficiently to dimple the skin, and continued pressure completes the riveting, saving three-fourths of the labor. *(Item A-945)*

Combination Dimpler-Riveter—In making a rudder torque-box rib, three 0.030-in. 17 ST skins are riveted together. This job formerly required these operations: dimpling the skins, assembling, reaming with No. 30 drill, inserting rivets, taping, riveting, removing tape, cleaning rivets. A combination dimpling and riveting tool reduced operations to three: assembling, inserting rivets, riveting. The new tool is a circular base attached to the lower jaw of the rivet press. A locknut under the base provides height adjustment. On the base is a shiftable segment incorporating a flat riveting surface and a dimpling die equidistant from the segment pivot. There are also two stop pins (one visible) which position the segment at extremes of its stroke. The segment is shifted by a lever in back. It is shown here ready to dimple. This lever will eventually be foot-operated, leaving both hands free to handle work. This tool saves two-thirds former man-power. *(Item A-945)*



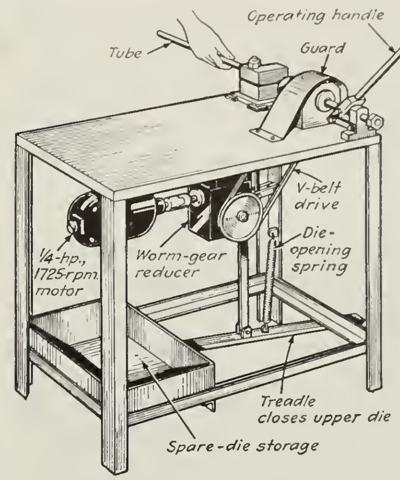
Portable Combination Dimpler and Riveter—The conventional hand rivet squeezer, with dimpling set (left), requires a change in rivet set (center) before riveting. Modification produced the tool at right, which does both jobs. The first part of the ram stroke dimples, the continuation squeezes the rivet. In this case, a spring back of the headset provides flexibility. Production time is cut a third. *(Item A-945)*

Eccentric male die "spins" flare in tube-end against two-part female die. Flared tubing can be removed when pressure on pedal is relaxed and upper half of female die is moved upward by spring action. The male die is cone-shaped and rotates as it "irons" in the flare, thus avoiding scoring or galling.



Beading is done in a two-part female die, kept in line by guide pins anchored in lower half. Pedal-rod diameter is larger than threaded portion on which holding nut is fitted. The resulting shoulder serves as a rest for the upper half of female die. Notch in upper die half permits insertion of pre-bent tubing.

In this flaring and beading machine, pulling lever toward operator advances spindle mechanism, on end of which a chuck holds flaring or beading tool or male die. Eccentric circular motion of male tool shapes end of tube against female die. Spindle is rotated by V-belt.



Tube Beading and Flaring Machine Avoids Rejects; Easy to Make and Operate

Eccentric head completes operation in less than a minute per part. Galling or scoring prevented. Foot clamping and hand control.

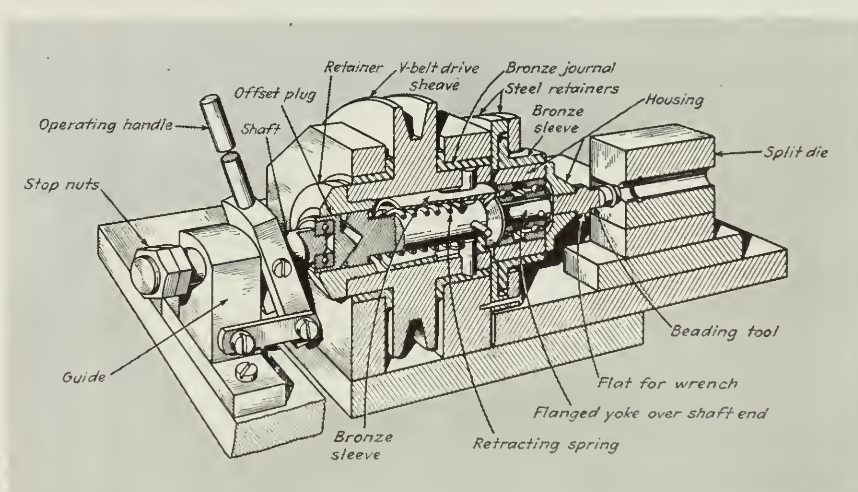
The need for efficient, fast tube flaring and beading prompted the Tooling Department, Ryan Aeronautical Co., to develop a simple, economical machine which can be operated by inexperienced workers. It will flare tubing up to $1\frac{1}{4}$ in. in diameter and, with a different and quickly changed set of dies, will bead tubing of all sizes from $\frac{3}{8}$ to $1\frac{1}{4}$ in.

A set of dies is required for each different tubing diameter, for both operations. A male die attaches to a chuck. Two dowel pins guide the upper half of the female die on the lower half, which is locked to the stand. The upper part of the female die is attached to a spring-counterbalanced rod connected to a pedal, so acts as a clamp for the tubing.

The chuck spindle moves back and forth on a horizontal axis, the motion and amount of pressure exerted being controlled by hand lever. The housing of this chuck and spindle is turned, at 175 rpm., by V-belt drive from a motor and reduction gear.

As the male die is brought into forming position, the end of the spindle is forced out of its normal center-line, thus turning the die in an eccentric circle against the inside of the tube. The chuck rotates within its retainer, thus preventing galling of the material as the die is forced against it. The pressure so exerted forces the tube wall out into the beading channel of the female die. To flare tubing, the male beading die is replacd by a cone-shaped flaring tool. The female is replaced by a similar, two-part flaring die.

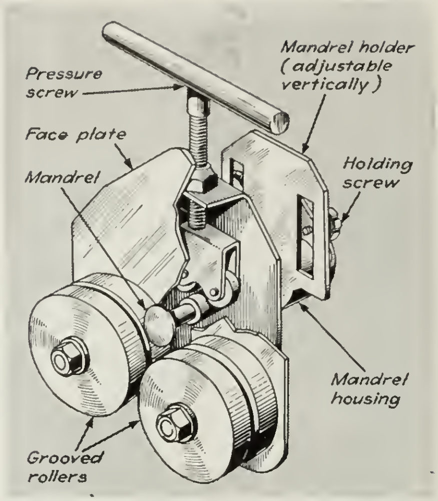
Changing a set-up, whether from one size of dies to another, or from beading to flaring, and vice-versa, requires about ten minutes. A tube can be beaded or flared, table to table, in less than a minute. Spoilage is negligible because the male dies have sufficient clearance in the female to compensate for allowed variations in tubing-wall thicknesses. The arrangement of the head is sketched.



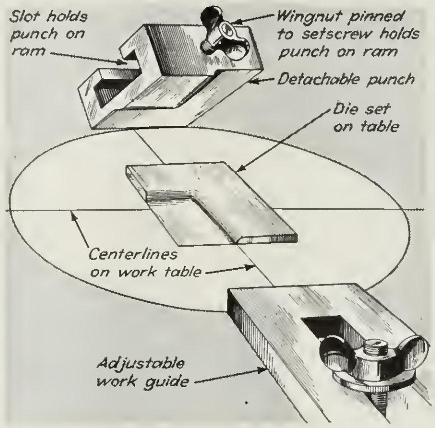
Eccentric circular motion of male die is produced by offset plug on shaft end. Chuck is automatically retracted by coil spring when operating handle is released by operator.

Forming Tricks Overcome Troubles

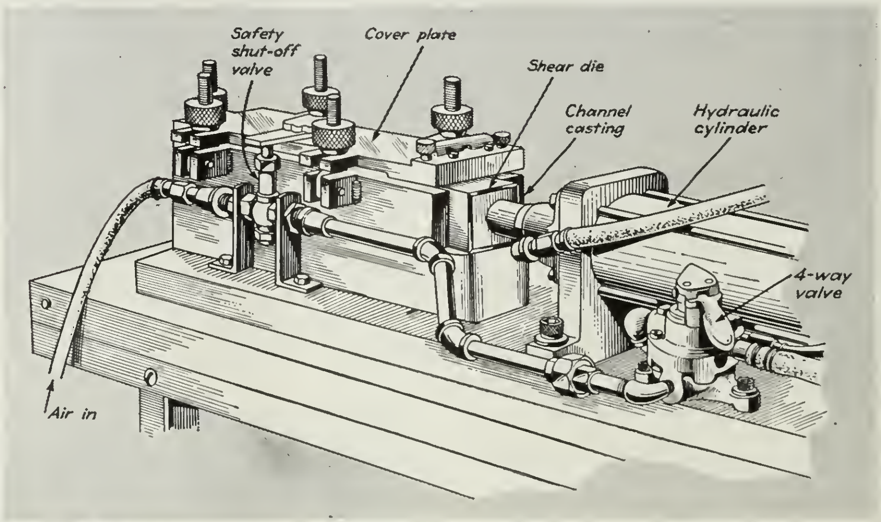
These half-dozen ideas avoided material-wasting problems at Curtiss-Wright Columbus, Goodyear and Fisher Body. Curtiss-Wright improvements all came through the plant suggestion system, sponsored by a joint labor-management committee, and the Goodyear development likewise was a worker's suggestion.

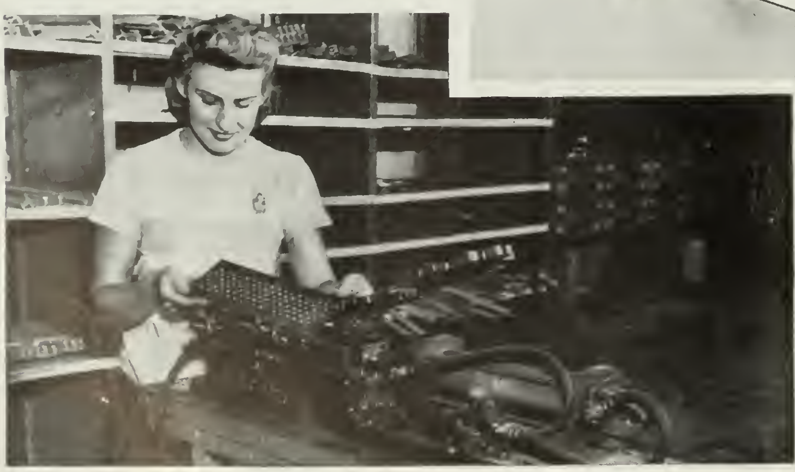


Portable Tube-beading Tool—Designed to bead tubing from ½ to 2 in. outside diameter, regardless of how close the bead may be to a bend, this tool won a suggestion award for George Konheim of Goodyear Aircraft Corp. It has been shown to avoid the scrap made by beading close to bends on conventional machines, and also can be taken to the job, saving manhours. In operation, it is much like a pipe cutter. Two lower grooved dies mate with a male mandrel. The mandrel is on a separate housing so it can be moved up and down. Two rollers in a screw-actuated housing press it against the female rollers. *(Item A-966)*

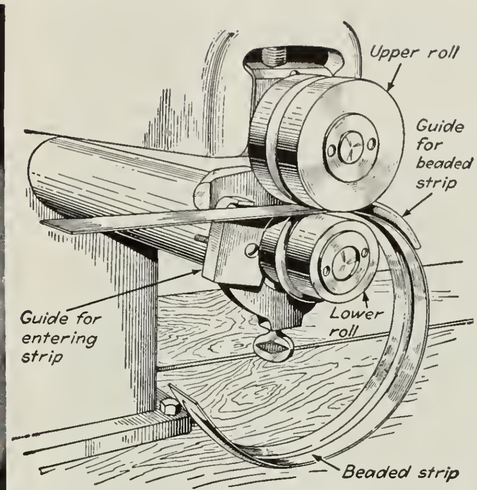


Universal Joggle Tool Doubles Production Rate—Sometime ago, Curtiss-Wright at Columbus started to change from 24-SO to 24-ST aluminum to eliminate hand reworking of flanges after heat-treatment. Parts with 90-deg. flanges could be worked on hydro-presses, but a majority had flanges with offsets which were difficult to form because of springback. Hammering damaged the sheet. James Howard suggested a new joggle tool with twelve interchangeable dies that do 90 percent of all required joggles. The tools are used in a pneumatic squeezer and joggle the flat blank before it is put on the form block in the hydro-press. Setups are made by template and by spacing from the center lines etched on the squeezer table. Work guides are also provided. Depths of 0.020 to 0.061 in. can be obtained, and at any desired angle. This method is 225 percent faster than hydro-press joggling and 100 percent faster than hammer-forming. *(Item A-914)*

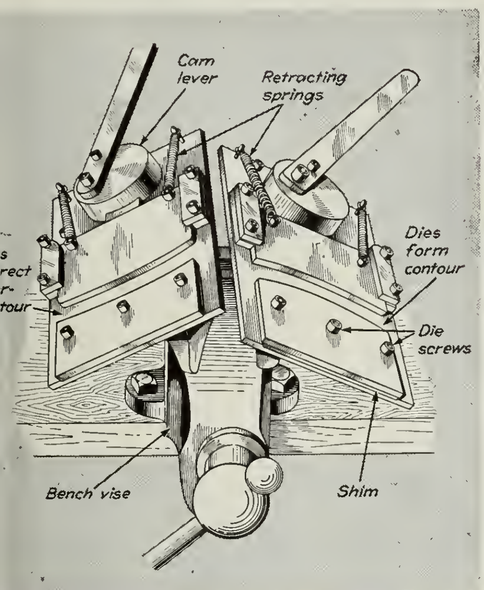




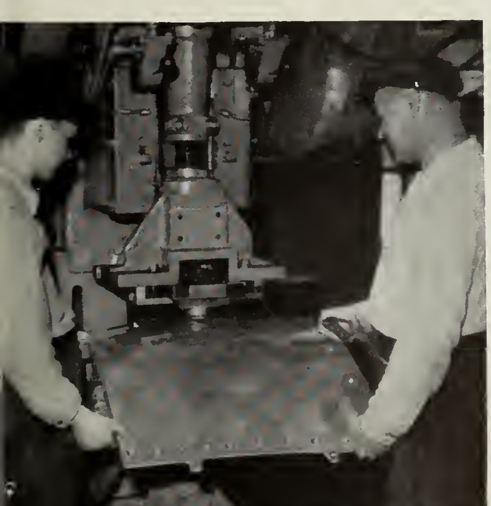
Pneumatic Rivet Cutter—the Detroit Aircraft Unit of Fisher Body Division, in common with other aircraft plants, trims longer rivets to suit special jobs for which correct-length rivets are not available. Production Engineering devised this simple multiple shear for the job. The piston of a standard air cylinder drives a rectangular tool-steel cutter through a special deep channel casting. Rivets to be sheared are socketed in a multiple-drilled plate, with a cover plate clamped over it to hold the rivets in place. Plate thickness thus determines rivet length, and holes through which rivets pass hold them snugly so they are sheared squarely. To be sure the shear cannot be operated until the cover is clamped, the air line is run along the channel and a plunger-operated valve installed midway. Until a lug on the cover forces this plunger down, the normal controls will not operate. *(Item A-940)*

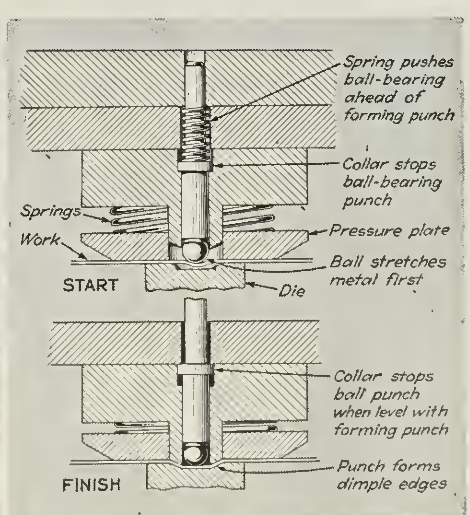


Guides Boost Beading Output 933%—Stainless-steel strip is formed into central-beaded collars for exhaust-stack ends in 0.60 instead of 6.20 man-minutes at Curtiss-Wright Columbus. Pietro Passalia suggested the beading-guide attachments for a No. 192 Niagara Beader that makes this improvement possible. Submitted through the plant's suggestion system, the devices eliminated three operations and 1020 ft. of non-productive travel, reducing required workmen from five to three. The two guides are simply screwed to the roll housing. One guide piece has an ear which holds the entering strip horizontal; the other is an arc-shaped element that maintains a uniform curve in the beaded strip. They overcome the distortion and hand reworking necessary when the strip was first curved, then sent to another department for beading. *(Item A-918)*



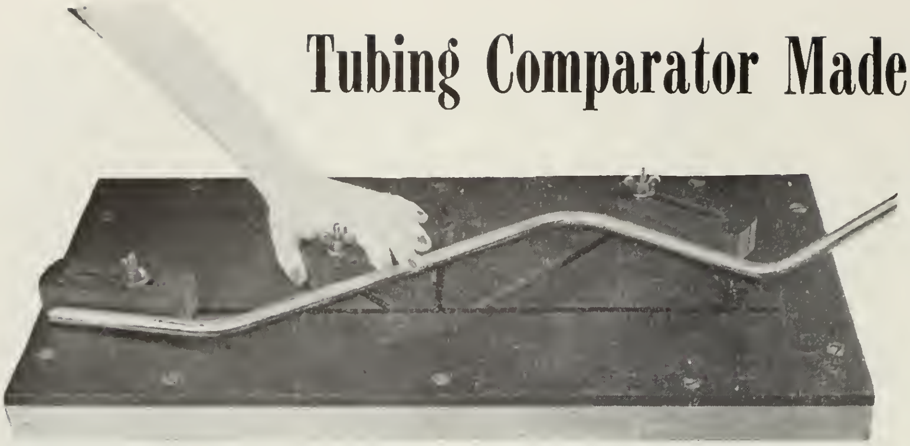
Tool Forms Capstrips Without Harming Retainer Slot—In forming capstrips at the Columbus plant of Curtiss-Wright, the wire retainer slot was frequently damaged. This forced scrapping of the strip, because the retainer slot holds the fabric cover and wire-locks it to the strip, and damage to the slot tears the fabric. An air hammer with a forming block and a punch-press die both caused this damage. Waldron R. Bruce (shown) suggested this duplex die press instead. It is really two presses, the right one to form the original contour, the left to correct over-formed strips. Each is simply one fixed die and one movable one actuated by a cam lever. The movable die is retracted by springs. The press is held in an ordinary vise. To set up the press, a shim the same thickness as the capstrip shank is placed under the edge of the stationary die and gripped by tightening the die screws. The capstrip shank can then be slid under the stationary die to prevent wrinkling when the strip is contoured. The sides of the strip slot are thus contacted by the edge of the moving die and the strip is formed by a succession of pressures with template checking between. If a strip is over-contoured, it can be corrected on the other press. This hand method has proved faster than machine methods because of the reduction in rejections. *(Item A-913)*





Heat-Treated Enclosure Doors Dimpled and Pierced—Forming large fastener dimples along the edges of heat-treated enclosure doors invariably caused cracks at the Detroit Aircraft Unit of Fisher Body Division. Even rubber inserts on the dimpling punch didn't help. Finally, Production Engineering worked out these two dies to avoid the cracks. The first die (sketch), for dimpling in a toggle press, incorporates a spring-loaded plunger tipped with a ball bearing. The ball stretches the metal at the center of the dimple, then withdraws into the forming punch as the latter forms the dimple. The second die (far left), coins the edges of the dimple and includes a fixed punch inside the spring-mounted female die. Thus the hole is punched first. Slugs are pushed upwards into a small box above the male die. This construction again prevents cracking, and the combined set-up has saved 134 man-hours per plane. *(Item A-941)*

Tubing Comparator Made of Masonite



Using simple, easily adjustable gage, production-bent tubing can be quickly inspected. Gage is set from standard tube kept in inspection department.

One lengthwise slot, with a short perpendicular slot and one 45-deg. slot in each upper resulting quadrant, makes this easily set inspection gage widely applicable. It is adjusted to a standard tube kept for reference.

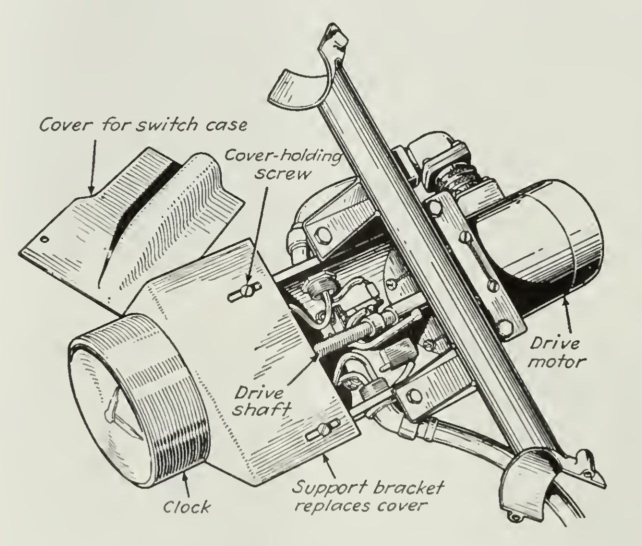
A 57-YR.-OLD WORLD WAR VETERAN, Grover C. Smith of the Columbus plant, Curtiss-Wright Corp., developed this simple tube-checking fixture. It was introduced through the plant's production shortcut suggestion system, and eliminates previous checking methods using loose steel blocks.

It provides a simple, quick and accurate method of checking both the bends and lengths of tubes. It is low in cost, being made from a slab of Masonite. Slotted Masonite blocks for gaging are clamped in place with bolts and wing nuts. The method of slotting the slab allows almost any combination of bends to be checked—making the fixture universal in application.

To accommodate long tubes, two or more of these fixtures may be arranged in series on a long table. Also one may be turned at right angles to another to check bends in another plane when a formed tube involves both. One inspector can use several fixtures, side by side, for checking a series of bends. Also, by using standard tubes to set these fixtures, no time is lost in measuring to set up loose steel blocks. *(Item A-916)*

Saves Seven Hours in Setting Limit Switches

Simple "Revo-clock" attached to oil-cooler door-operating mechanism permits 1-man bench adjustment instead of former 3-man final-assembly operation.



The 12 to 1 ratio gearing of a common alarm clock forms the heart of this "Revo-clock," which enables bench adjustment of the limit switches controlling oil-cooler doors on the *Thunderbolt*. With it, one man does in a few minutes a former 7-man-hour job requiring three men.

UNITS FOR OPERATING THE OIL-COOLER DOOR on the *Thunderbolt* were formerly applied and adjusted in final fuselage assembly. It took about seven man-hours of trial and error to adjust the limit switches, with three men working on the job, one in the cockpit, one standing on a wing and one in an awkward position in a duct under the ship, checking operation of the doors. In getting the proper setting, expensive flexible shafts were sometimes broken.

One assembler at Republic Aviation Corp., Fred Knoll, won a suggestion award with a simple device which he calls a "Revo-clock," employing parts of an inexpensive alarm clock. The clock is mounted on an angle bracket having slots for screws which normally hold the cover of the limit-switch case. When mounted, the clock is driven by a shaft which in turn is driven by a gear and pinion from a threaded shaft connected to a small motor. The threaded shaft carries tapped fingers which move longitudinally and, at end points, operate limit switches. Both limit switches are held by screws in slots, so switches can be adjusted and then locked.

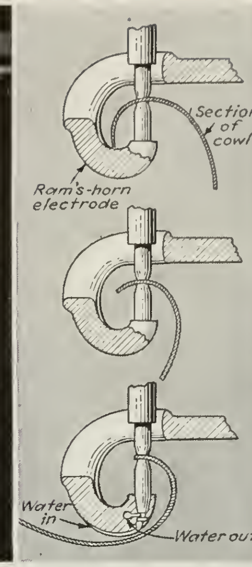
All the works, except the 12 to 1 drive to the hands, were removed from the clock case, and a specially calibrated dial applied. The clock is set with the hands at zero (12 o'clock) to start, at which point the oil-cooler doors are closed. When the motor starts to open the doors, the shaft fingers move longitudinally and the clock hands move around their dial. When the clock indicates 17¼ revolutions, one finger is set to trip the second limit switch. This breaks the circuit just as the doors are fully opened. The motor is then reversed to check closing, which should be complete at 12 o'clock, or zero on the dial. Now one man does in a few minutes the former 3-man, 7-man-hour, job, without complications in working position. *(Item A-349)*

"Ram's Horn" Spot-welds Around Corner

Attachment does unusual job on standard machine. Opposed arm offset balances pressure.

Specifications called for welding reinforcements and joints of an engine cowling made by Miami Division, Consolidated Vultee Aircraft Corp. Most of the welding job was straightforward work, but on the curved inside lip there was no way to do it with standard equipment. The foreman in charge of this work suggested using a "ram's horn" bar. It was tried and is working successfully. Its shape is evident from the sketches at far right.

The secret of its success results from the ingenious way in which pressure is applied to the electrodes. If offset electrodes had been used alone, the pressure could not be fully utilized without putting excessive side strains on the welder. Balance arms of the same length are extended to the opposite side. On the upper one is a stud, which can be adjusted to contact a pad on the lower just as the electrodes meet. Thus no side strains are transmitted to the welding-machine head, and pressure at the electrodes can be controlled as though they were directly beneath the center of the head. *(Item A-597)*

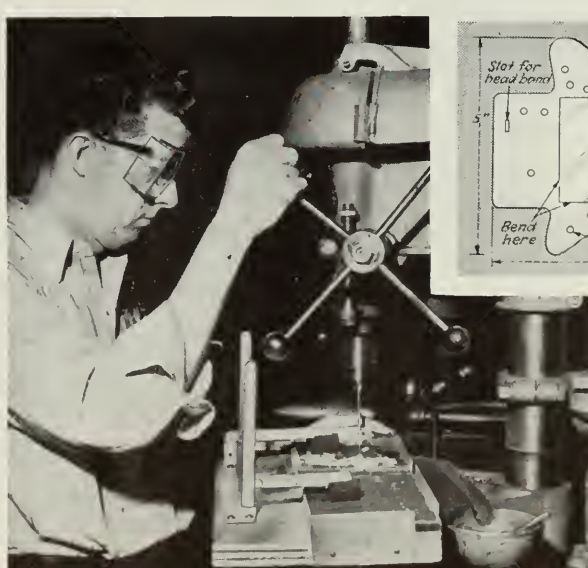


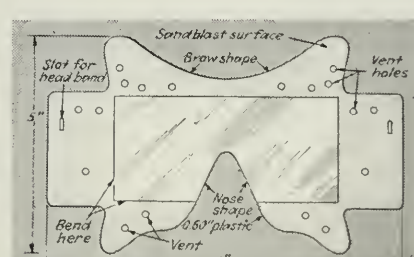
Welding curved lip on inside of engine cowling. On the left is the welding electrode, on the right the pressure-balance arm. This combination assures perfect control of pressure on electrodes. Cross-sections of the cowl in the sketches at right show how easy it is for the operator to weld all around the curved lip when using this "ram's horn" fitting on the welder.

Safety Goggles May Be Home-made

North American makes eye shield from plastic to meet ASA standards for light transmission, refraction and impact strength.

A plastic goggle which is easily made, and yet meets the Safety Department requirements, has been developed by North American Aviation's Kansas City Division. The goggle is light, cool and comfortable, yet has strength to stop a heavy object. It meets light-transmission and impact strength requirements of the American Standards Association, and refraction from the lens surface is zero. The material is clear plastic 0.60 in. thick and 5x8 in. This is cut to the shape sketched at far right, drilled, slotted and shaped. Cost per eye shield has been based on "mass production." Groups of ten blanks are drilled and routed at once, then corners are sawed square, top, bottom and sides are sandblasted, and the plastic bent to shape by heating with a gas torch and shaping around a flat wooden form. An elastic band is stapled to the sides, and the goggle is ready to help the company maintain its record of only 1.7 lost-time accidents per million man-hours. *(Item A-947)*





Initial step in making the goggle is to drill holes in plastic blanks. Two sizes of holes are used, and are drilled through ten blanks in a stack. This operator is wearing a completed goggle —over glasses. A 5x8-in. blank of 0.60-in. transparent plastic is used, routed to the sketched shape and with corners sawed square to simplify bending to final shape.

Studs Can Be Driven by Power

Ranger now has equipment which drives 90 percent of its studs, saving $368,000 in first year and freeing 50 men for other work.

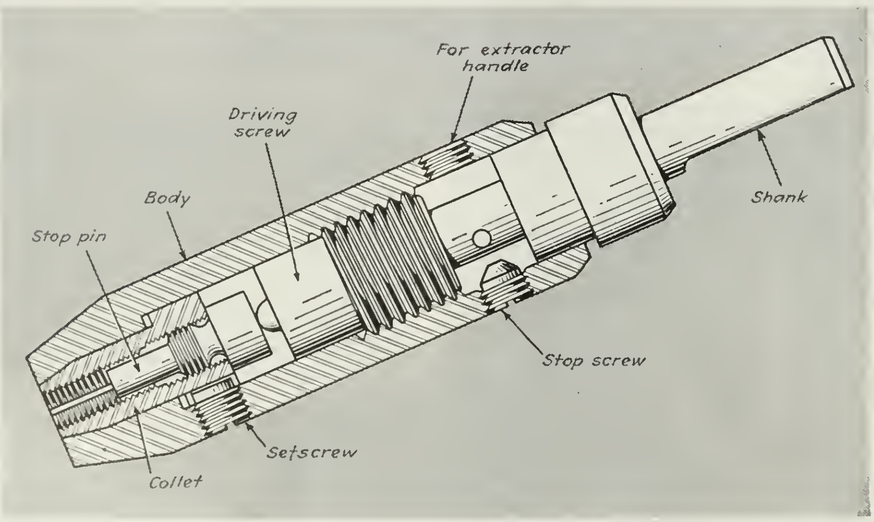
By M. G. DEMOUGEOT

Manufacturing Manager, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation

As aircraft-engine production swelled from units to thousands under the demands of global war, one of the most aggravating problems was stud driving. Total man-hours consumed in hand-driving studs were enormous; yet no satisfactory method of driving with power had been devised. Equipment used by other industries was unsuited to the precision standards and light-weight materials of the aircraft engine. At Ranger, as at many other engine plants two years ago, production engineers and timestudy men were concerned about the excessive number of man-hours required to stud engine assemblies. At times it was necessary to take men from other jobs and put them to work driving studs to keep the lines moving.

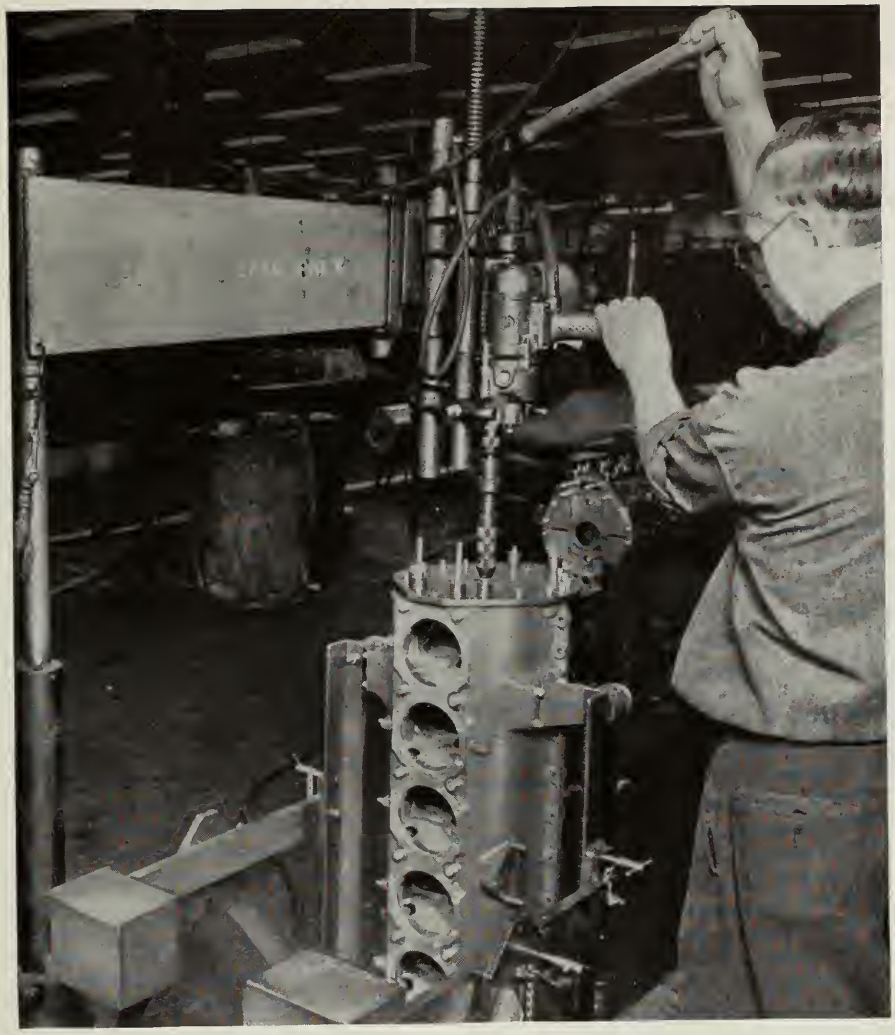
Production Engineers Phil Kilian and Frank Lucian, with the cooperation of Chicago Pneumatic Tool Co. and Stud-Craft Associates, finally developed equipment which at present Ranger production schedules is freeing 50 men for other work and every 24 days saves its initial cost, a saving which will amount to $368,000 this year. Some 21 installations do 30 different jobs and drive 90 percent of the studs in both the Ranger 6-cyl. and 12-cyl. in-line, air-cooled engines. One man now can do in one hour the work that formerly took him a full day and can do it with less spoilage and closer adherence to tolerances. Where before the job required considerable physical strength, it can now be done just as handily by women—and on either radial or in-line engines, as required.

Existing stud drivers were tried when experimenting was begun. The lightness of the studs and the lightweight metals in the castings precluded their use. Studs stretched, were twisted, ends mushroomed and threads were damaged. It was necessary to drive the studs so tightly that they would not back out when nuts were removed in overhauls, yet



The Stud-craft unit is used on small-diameter studs. The driving screw pushes the collet assembly into clamped position after the stop pin strikes the stud top, then drives the stud. Reversal withdraws the driving screw to the stop screw, releasing the collet. Removal of the stop screw permits the shank and cap to be taken from the body, and the driving screw to be taken out. This in turn releases the collet for changing. Extractor collets can also be used in it, in either case positioned by the set screw. Depth of grip is controlled by the stop, so various stop pins are used to suit the studs being set.

An air motor is used for ⅜-in. studs, controlled by the pressure regulator at right. It stalls the motor to prevent excessive torque on a stud. Here individual torque plates cover each cylinder opening. Torque plates are of plastic of the thickness necessary to give desired set height for the studs. Inserted thicker bushings locate long studs.



For 1/4-in. and 5/16-in. studs, a portable electric nut runner is mounted vertically on a jackknife radial arm, providing height adjustment and spring counterbalance for the hand feed lever. Fixtures have trunnions, lock pins and counterbalances so studs of the particular size may be driven squarely in several surfaces by applying the proper plastic height plate. Steel inserted bushings are set to give desired stud height.

not so tightly that extremely light sections of the castings were damaged. Our 1/4-in. studs had to be driven with a torque range of 45 to 95in.-lb., 5/16-in. studs within a range of 100 to 200 in.-lb., 3/8-in. with a range of 200 to 325 in.-lb., 5/8-in. studs were allowed a range of 720 to 1680 in.-lb. Driven studs had to be square with the face of the part and within a height tolerance of plus or minus 0.010 in.

While these conditions were being satisfied, another problem almost was a stumbling block. Studs are cadmium-plated 0.0002 to 0.0004 in. thick as a corrosion preventative. The slightest damage to the thread not only interfered with running the nut but also removed the cadmium plating. It was this in combination with other problems which had caused others to abandon their efforts at power driving.

Several power units already on the market could have been adapted to furnish power for the tools, but an automatic tapper manufactured by Chicago Pneumatic Tool Co. was found easiest to convert. The tapper could be reversed to run the driver back off the stud without reversing the motor, a feature desired to simplify the operation and save the time lost in throwing switches. In addition, the torque control was nearly adequate and easily adjustable.

Many drivers of various designs, some originated at Ranger, were tried. None was successful. A field engineer from Stud-Craft, unaware of our attempts, called to sell a new hand driver his firm had just designed. Examination disclosed its possibilities, and instead of receiving an order for hand drivers, he was sent back with a request for alterations in the tool body which would enable it to be affixed to the tapper.

From the first it was evident that the tool would be a success. Where others had failed, it drove studs without damaging the threads or the body. It scraped some cadmium, however, and lacked sufficient strength for production use. Eccentricity in operation was too great.

By this time, the changes in the standard CP tapper had been made, and the machine was proving itself a satisfactory power source. For 1/4-in. and 5/16-in. studs, an electric motor was used; for 3/8-in., a Power Vane air motor; and for 5/8-in. studs, the largest used in the Ranger engines, a CP large-size nut runner with adjustable torque clutch provided the extra power. It required little alteration, because Ranger 5/8-in. studs are driven from flats on the lower end of the necked section.

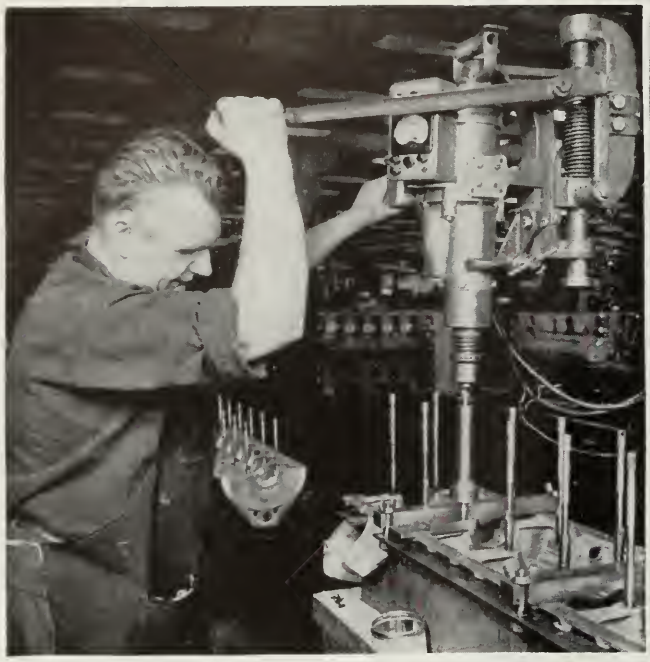
On the tapper it was necessary to obtain a dead spindle. The original machine reversed when no load was applied. Without a dead spindle, the turning action would spin the stud out of the tap hole or scuff the first thread as the tool was engaged. So the nose casting of the tapper was changed to accommodate a larger bushing for the longer stud-driving spindle. This gave room for an adjusting cup and a spring arrangement which permitted an idling position.

The torque clutch was altered slightly to gain more sensitivity of adjustment. Control of the depth to which studs were driven was obtained through a height plate. The nose of the driver reaching the plate increased the torque load beyond the maximum for which the clutch was set and disengaged the spindle.

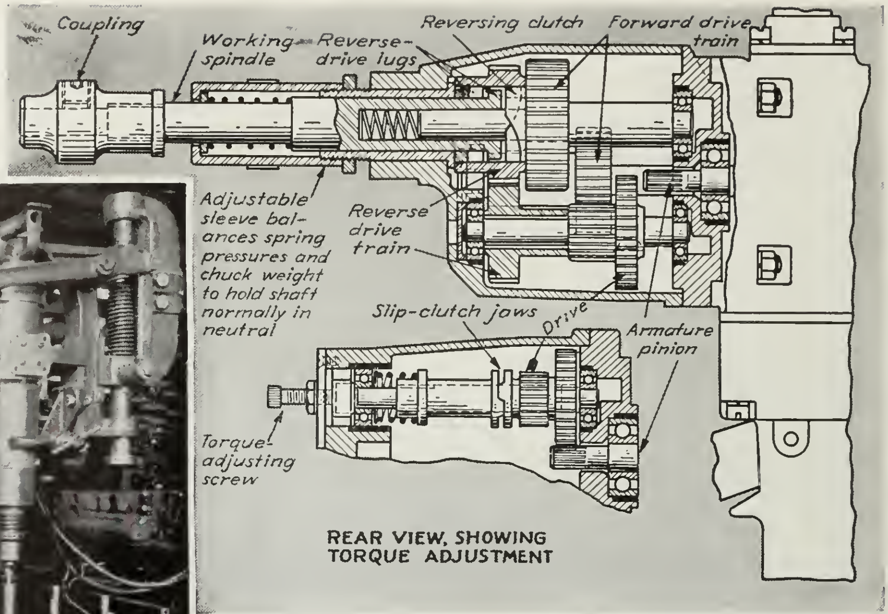
On electric tools, an ammeter was introduced into the line and calibrated to the minimum and maximum torque. Through experience, operators have learned to "read" the motors from their sound, thus refer to the ammeter only when a driving torque is questionable. On the air motor, a pressure regulator controls maximum torque; the machine simply stalling if the load becomes greater than that desired. Air motors are reversed with a built-in throttle. As the nut runner is used only on studs with driving flats, the only changes were to increase the sensitivity of torque controls. A simple holder was devised.

Eccentricity in the first model of the driver was overcome by piloting the collet closure and tool-drive spindle to the driver body. Since the tool had been intended for use as a hand driver, it was not designed to meet the impact loads encountered in power driving. First test drivers wore too quickly and roughed up, sticking to the height plate and thereby hindering reversing the tool. Others cracked under production use. Tougher steels were substituted, and a more controlled hardening process.

Height plates are made of laminated plas-



On 5/8-in. studs, a large electric nut runner can be used, with a simpler driver because studs have driving flats. The ammeter above the feed arm is calibrated for maximum and minimum driving torque. A heavier support arm is also required. In this case, special height plates also are used.



A variation of the CP nut runner, this tool has neutral, forward and reverse positions for the spindle. Normally the spindle is in neutral (shown). Pressure against the work engages the reversing clutch to drive forward. When the stud is seated, the slip-clutch releases, and driving torque immediately falls off. Lifting the machine reverses the spindle to release the chuck. Spindle speed of 400 rpm. driving and 700 reversing is low enough to give control. The clutch is in an intermediate position in the gear train, to give simple adjustment and control of torque before it is amplified. Either a Stud-craft or plain stud setter (left) is gripped in the coupling.

tics to save critical metals. The plastic plate has the advantages of lightness, lower manufacturing costs, and will not damage finished engine surfaces. Hardened tool-steel bushings are imbedded for each stud, the plate covering the whole surface in which studs are being driven. Bushings are made larger than the studs so that they can be placed over them easily without scraping.

Holding fixtures were designed by Production Engineering, and made by the tool room. Paramount considerations are to hold the piece securely and squarely with the driver. Wherever practical, fixtures are the indexing type to enable studding of as many surfaces as possible at one loading. They are simple in construction. Wood is used wherever possible. For crankcases, cam housings, etc., fixtures stand on the floor. Small-parts fixtures and cylinder fixtures are fastened to benches.

The complete driver is supported in a jackknife radial arm mounted on a pedestal base. This permits shifting the driver from stud to stud with the greatest ease, yet holds it absolutely vertical.

A concise recital of a typical operator's procedure will serve to show the simplicity of the perfected method of power driving aircraft engine studs.

Locking the part, a camshaft housing for example, in the fixture, the operator inserts the studs finger-tight in all 32 tapped holes, lubricating each by dipping it in oil before insertion. He places the height plate over the studs. Swinging the driver into position, the operator pulls downward lightly on a lever on the jackknife's radial arm about head height. The pressure engages the spindle and spins the driver down easily on the thread until the stop pin in the collet is reached. Stud and driver then spin together until the driver nose touches the height-plate bushing.

As soon as the nose of the driver is firmly against the height plate, the spindle disengages automatically. The stud is in position within the height tolerance of plus or minus 0.010 in. Very slight pressure upward on the same lever engages the spindle in reverse direction. Driving takes but 6 sec., and the time consumed to change pieces and drive all 32 studs is only 4.5 min.

The unit cost of the complete tool is so low that it is economical to place power drivers in the line of flow of the various parts. This has been found less costly than to route parts across the floor to a battery of drivers. The pedestal base makes shifting of a unit simple.

From the production engineer's point of view, one of the principal attributes of the equipment is its freedom from breakdown and ease of maintenance. Tools are inherently sturdy and can operate over long periods with little attention other than minor adjustments which the operator can make. Replacement parts are inexpensive; the most extensive repairs encountered to date have been made in a few hours.

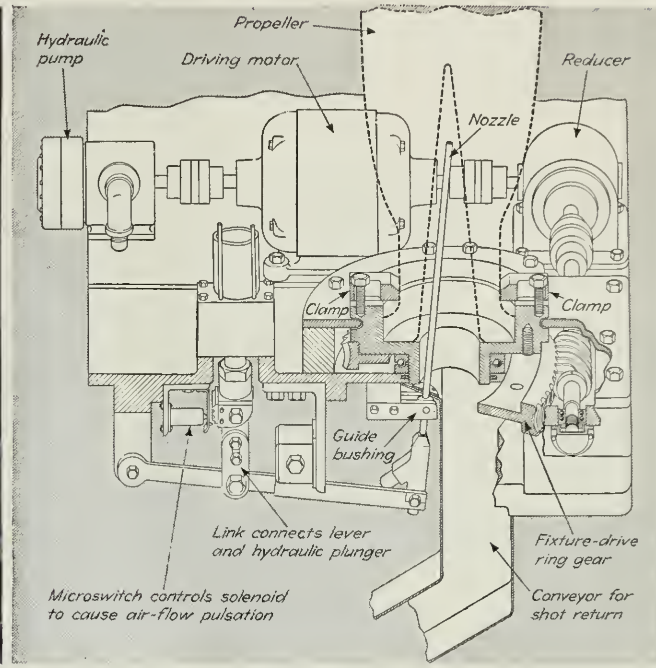
Since the machinery was placed in the production lines, no drivers have had to be replaced. Collets can drive up to 30,000 studs before replacement is necessary. Because of the low cost of new collets, those beginning to show wear are scrapped rather than risking damage to cadmium plating.

Collets are of the split type, so constructed that the grasping force is proportional to the torque resistance encountered by the studs. Since the driver is stationary when it is placed on the stud and does not turn until the operator applies pressure, there is no tendency to mutilate threads as the contact is made. Likewise, because the collet threads are lapped and the pressure they exert on the stud is so closely controlled, there is no tendency to damage threads in driving.

When the driver is reversed to back it off the stud, the collet expands until the fit is loose enough to permit it to run easily. The grasp is automatically released as the reverse motion begins.

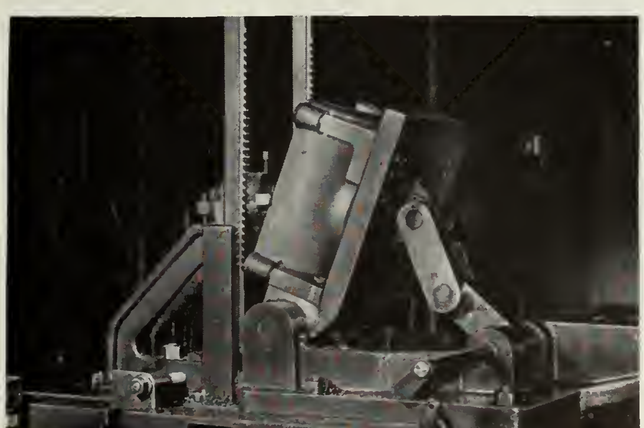
Built into the collet is a replaceable stop pin. This pin can be screwed out of the collet very easily, and if required, a longer or shorter pin can be substituted. Occasional engineering changes in stud heights make it advantageous to have close control over the length of the stop pins and to make them adjustable.

Tricks in Producing Propellers In Quantity

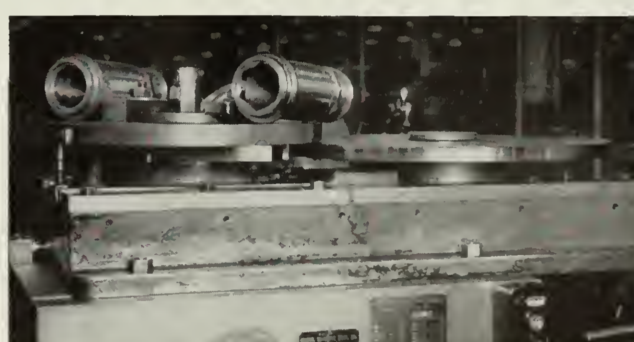


Three ingenious set-ups at Hamilton Standard Propeller Division of the United Aircraft Corporation which speed output of air screws.

Shot-blasting Improves Blades—Heat treatment of blade forgings made from certain aluminum alloys was found to result in high residual stresses on the surface of the taper bore. Research indicated that the tendency to crack as a result could be reduced materially by shot-blasting the surface, which superimposes a compressive stress. This machine was developed to do the shot-blasting. Basically, it directs a stream of shot as the bore is rotated about its axis in a vertical position. The trick was to devise a traversing linkage to keep the nozzle tip at a uniform distance from the taper (for uniform blasting). The inner end of the 24-in. nozzle tube is pivoted at one end of a lever rocked by a hydraulic piston as the tube slides through a pivoted bushing. This causes the nozzle tip to follow substantially a straight line in passing down the tapered bore (see sketch). There was originally a tendency for shot to pile up or "hang" at the top of the bore under action of the air blast. This was overcome by installing a Microswitch-controlled solenoid which provides a pulsating or intermittent air flow, allowing all shot to fall to a chute which returns them to a feed bin. Work is rotated at 13 rpm. by a motor-driven gear, and the pushbutton-controlled machine incorporates its own hydraulic pump. The automatic cycle takes 7 min. *(Item P-863)*



Keyseater Takes Over Milling Job—A Morton keyseater tooled with twin vertical broaches has replaced a miller in cutting four slots in the ends of a half-barrel casting. The casting is held in a fixture hinged near the broaches and elevated by toggle links to the proper angle. When one pair of slots is cut, the fixture is dropped, the casting reversed, and the operation repeated at the other end. *(Item P-864-1)*



Internal Hex Cut by Keyseater—A special fixture incorporating a Geneva-motion has adopted a standard Morton keyseater for cutting a hex within the end of a tubular part. Pieces, before and after, are shown lying on the fixture table, with the cutter head projecting between them. The part is set over the head and held above the shoulder by the concave-nosed clamps. It is indexed horizontally by a Geneva-motion cam beneath the fixture. The cam makes a full revolution to index the work 60 deg., feeding it into the tool which is ground with the 60-deg. point to shape the corners. This method does the job in 6 min., as compared with 21 to 25 min. by the former method on a slotter. *(Item P-864-2)*

Old Lathe Does Milling 50 Percent Faster

Matched cams control flycutter, facing 3-jaw starter clutch clamped in fixture on carriage.

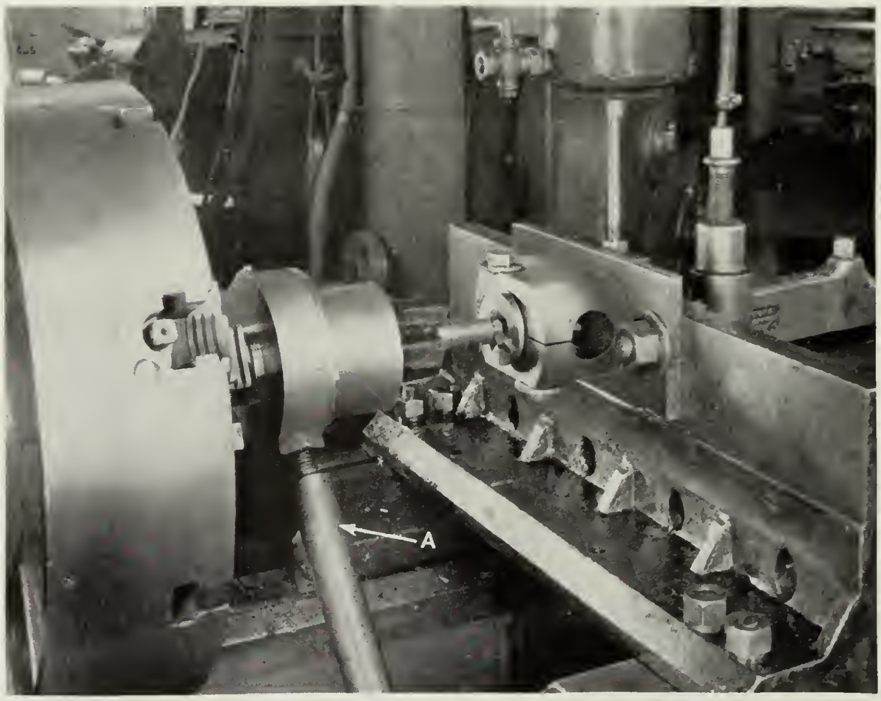


Fig. 1. Set-up for 3-jaw starter clutch facing operation is an old lathe. At *A* is the brake which holds the stationary cam in place while the facing is done.

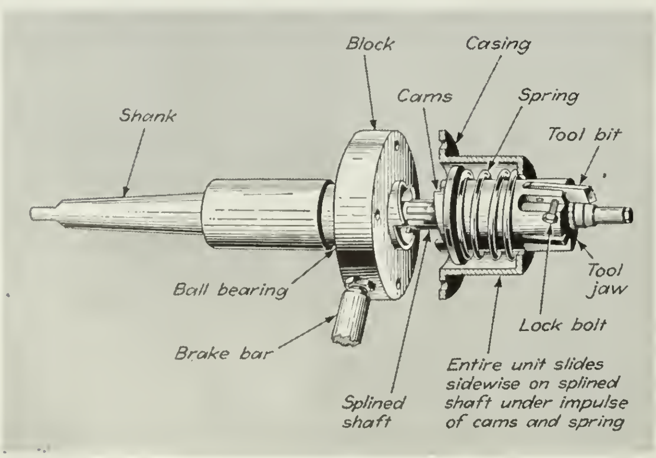
Faced with a production order for a large number of 3-jaw starter clutches for aircraft engines, and with milling machines already loaded to capacity, supervisors of the Pacific Gear Works Division of the Western Gear Works devised a means of performing milling operations on an old engine lathe. As a result they developed a method of facing 3-jaw clutches fifty percent faster than the old

A case holds an arrangement of two cams, a compression spring and a cutting tool, and is fixed in the lathe chuck with a brake to hold it and one cam stationary. Fig. 2. A jig attached to the lathe carriage holds the clutch blank, in the face of which three equally spaced, 90-deg. slots have previously been cut, Fig. 3a. The slots are cut on a Whiton automatic gear-cutting machine to provide clearance for retraction of the cutting tool at the end of each rise to be cut in the three sections on the face of the clutch blank, Fig. 3b.

Two cams with the same face pattern as the clutch in Fig. 3b, control the cutting tool by allowing the cam, fixed to the base of the tool, to revolve against the stationary cam, held in place by the brake, *A*, Fig. 1. Compression springs between the end wall of the case and a lip or flange on the base of the cutting tool bracket cause the tool to retract to the top of a new rise each time the cams have reached the highest point and drop to the bottom of the next slot.

As the tool rotates against the clutch blank, the lathe carriage is moved slowly forward and a gradual rising cut is taken on each of the three segments of the clutch blank, giving the result shown in Fig. 3a. (*Item E-811*)

Fig. 2. Details of the cutter feeding and retracting mechanism. The fly-cutter is advanced by cam and retracted by spring.



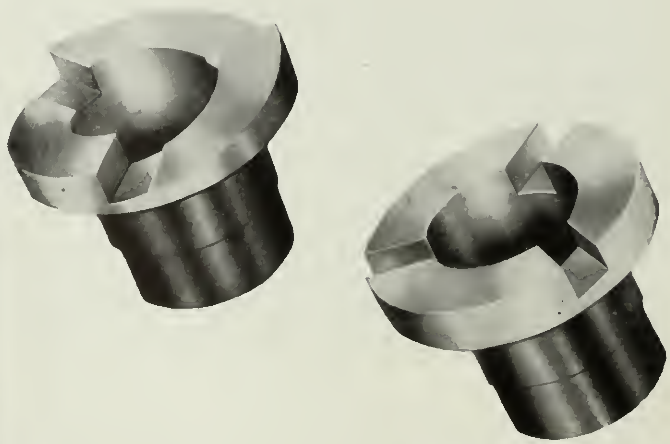
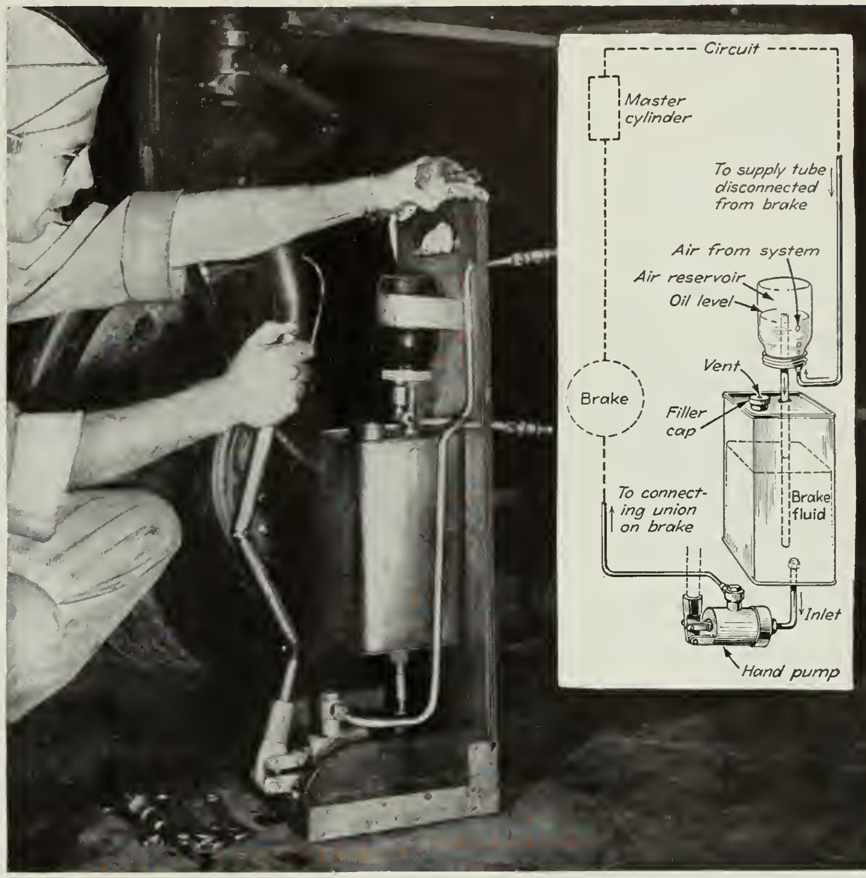


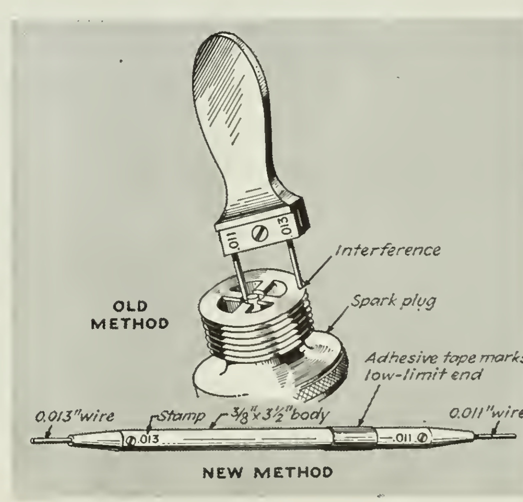
Fig. 3a (Right). Clutch blank after slots are cut on Whiton automatic gear-cutting machine. **Fig. 3b (Left).** Clutch blank after three rises have been cut by the new lathe method.

Necessity is the Mother of Maintenance Invention. Mechanics at Romulus (Mich.) Air Base 316th Sub Depot, under Capt. W. C. Erlenbusch, AC, have developed their own servicing equipment.

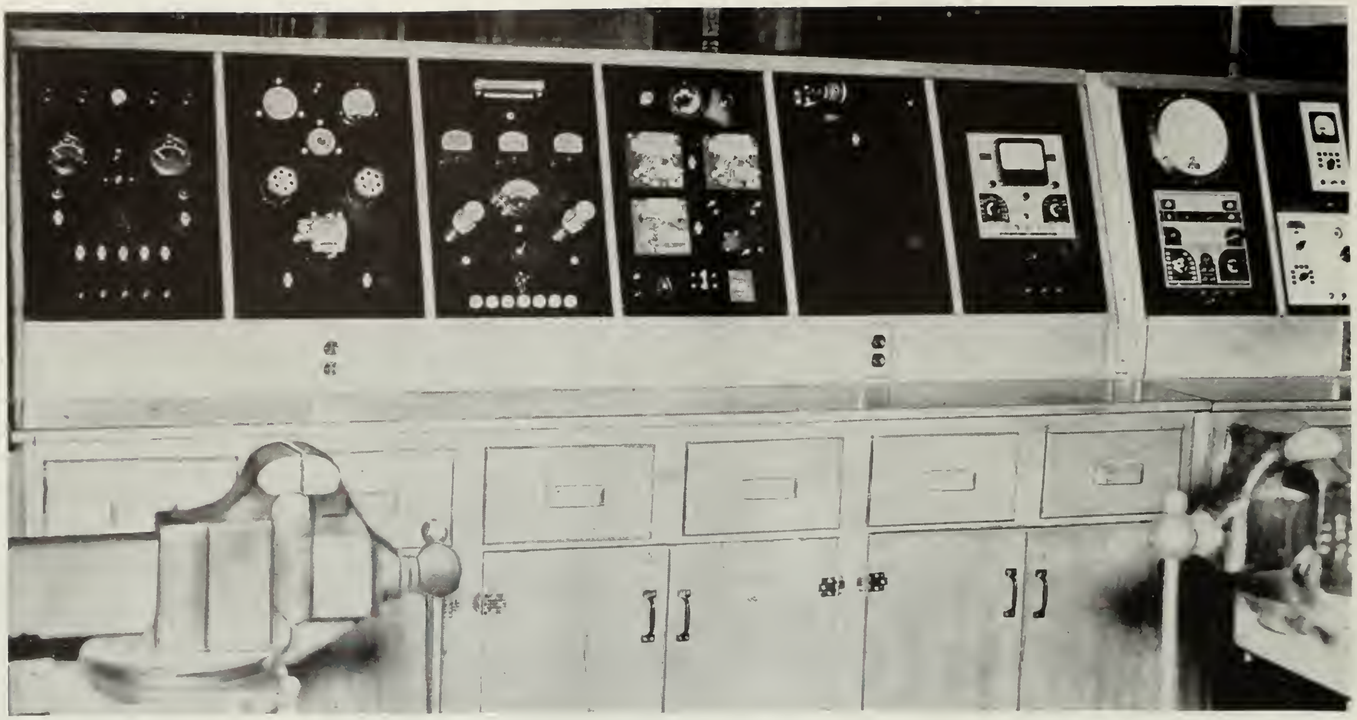


Hydraulic Unit Bleeds Out Brake Air Locks—Planes being ferried through present a frequent problem—removal of air locks in brake hydraulic lines. Staff Sgt. Milton C. Dunlop devised this simple filling and testing outfit to make the job a matter of minutes. A hand oil pump circulates fluid through the hydraulic system of the plane, while a gallon oil can provides an additional supply. Fluid passes through a pint glass jar in which air bubbles collect. The unit works equally well when attached either to top or bottom of a hydraulic line, but Sgt. Dunlop prefers to attach it to the bottom connection on the brake landing gear, as he has done here. *(M-932a)*

Test Stand for Hydraulic Operating Cylinders—Checking and testing hydraulic-brake master operating cylinders is a daily problem. In the hydraulic department, James Martin, foreman, and Walter Poshanski welded up this little portable stand to check action, setting and leakage. Here a P-40 cylinder is under test. The vise screw at top is turned down until the gage shows 200 lb. pressure. A short wait will show internal leakage because gage reading will drop. External leakage is of course visible to the eye. The whole unit is set in a drip pan. *(M-932b)*

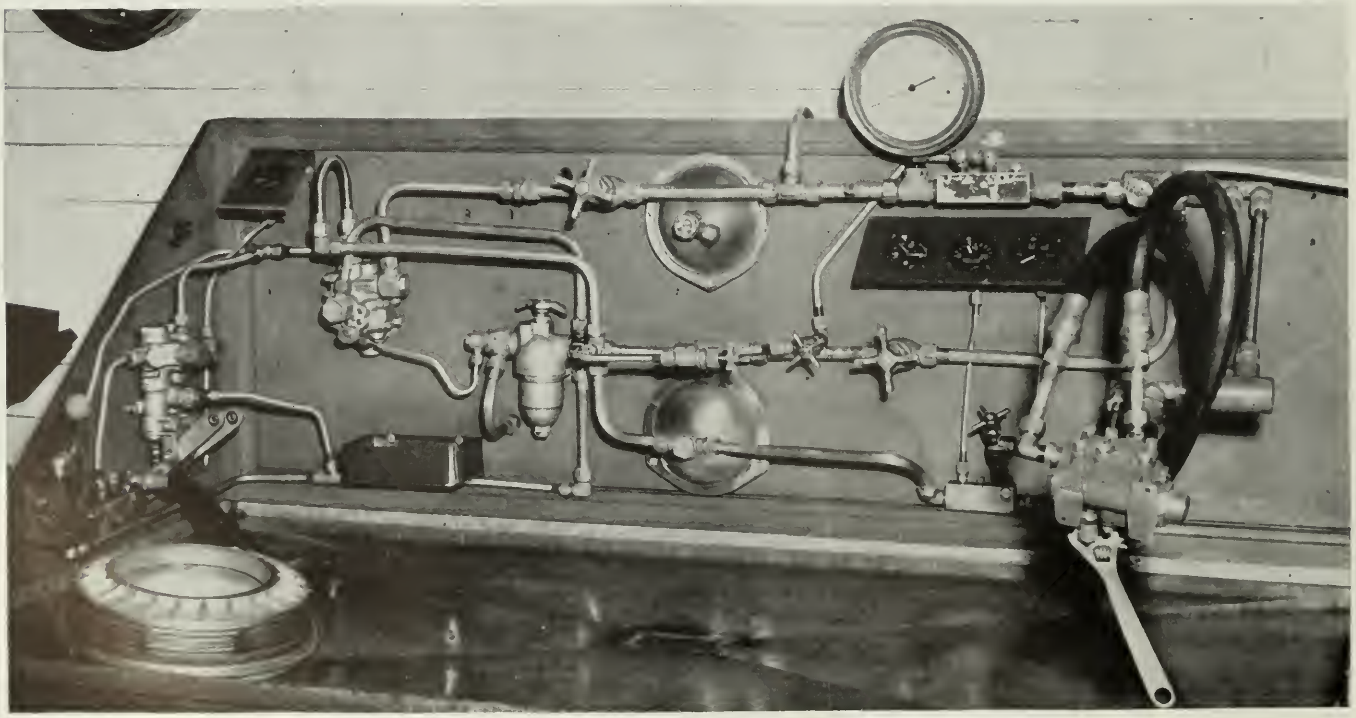


Spark-plug Gap Check—Spark-gap testing equipment supplied originally had two wires projecting side by side from a handle. Girl inspectors made mistakes because the alternate wire struck the side of the plug. So H. J. Lee made a double-ended tool, which speeds up work and avoids misreading. *(M-932c)*

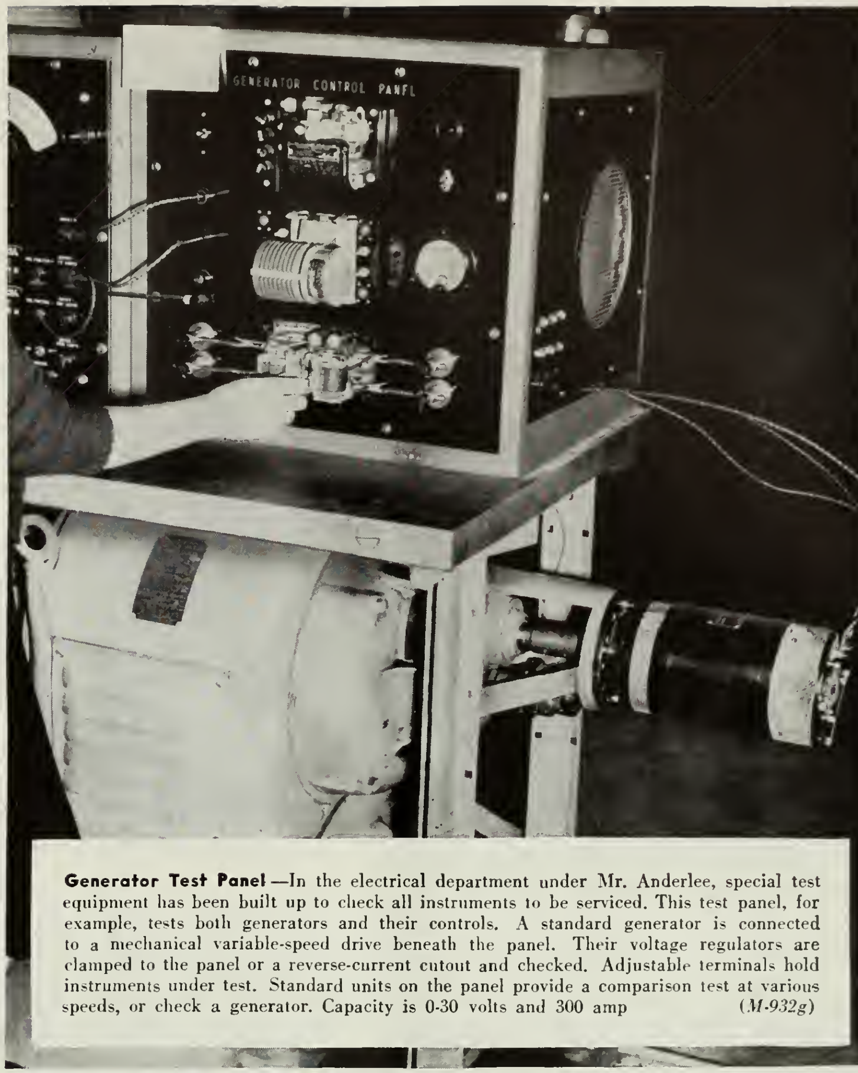


Instrument Test Panels—Twelve panels were built over supply cabinets (which carry necessary supplies) to test instruments. Here are seven. All feed lines enter the left panel to provide 110 volts A.C. and 6, 12, 18, 24, and 30 volts D.C. from batteries. The second panel tests coils (12 or 24 volts) with a spark-gap chamber under 100- to 160-lb. pressure of CO_2. The third panel tests fluorescent tubes, vibrators and inverters. The fourth checks propeller-governor electric relays (12 or 24 volts). There are two master relays and two test-relay positions for comparison. A potentiometer and voltmeter complete this panel. Similar multi-testers comprise the other boards. *(M-932d)*

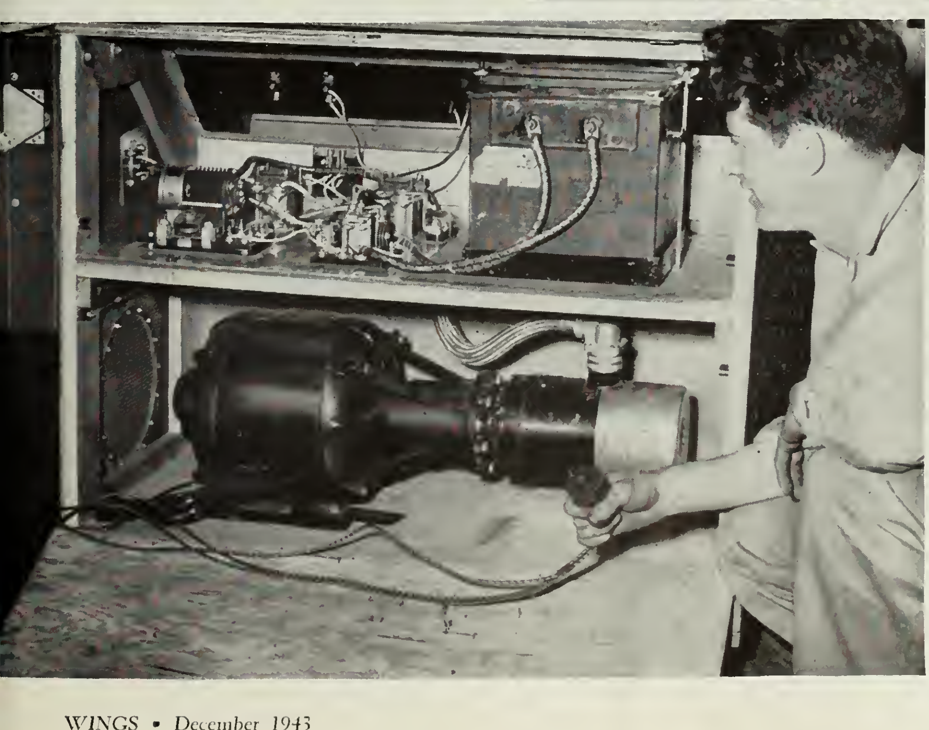
Hydraulic Test Bench—From parts available in the shop, Walter Poshanski built this bench, which can test 95 percent of the hydraulic units that come in. At left is a hand pump and gage for testing single-connection units (like brake master units), beside it a two-way valve with dual connections (with a brake assembly under test), and at right a three-connection pressure-regulating valve. This is balanced on a wrench so any leaks from underneath may be seen. At left center is the standard pressure-regulating valve, with an oil filter between it and the two accumulator chambers at center rear. The three smaller dials at right are a clock with sweep second hand, a line-pressure gage (up to 3,000 lb. per sq.in.), and a low-pressure gage. Master valves allow cut-out of the pressure regulator for testing another regulator. Thus the unit can be quickly set for almost any pressure range or test. A motor-driven pump under the bench provides pressure for the various tests. *(M-932e)*



Universal Cover for Radial Engines—Hangar capacity is insufficient to accommodate the traffic at Romulus, and last winter even the supply of fitted covers failed. Improvised covers had to be provided in the emergency. F. L. Keith, foreman of the parachute department, suggested this universal cover to fit any air-cooled engine. It is adjustable for diameter by lacing through spaced grommet holes on the edge of the front flaps. It provides overlap regardless of cowling diameter. Grommets along the rear edge provide for lacing there if desired. *(M-932f)*

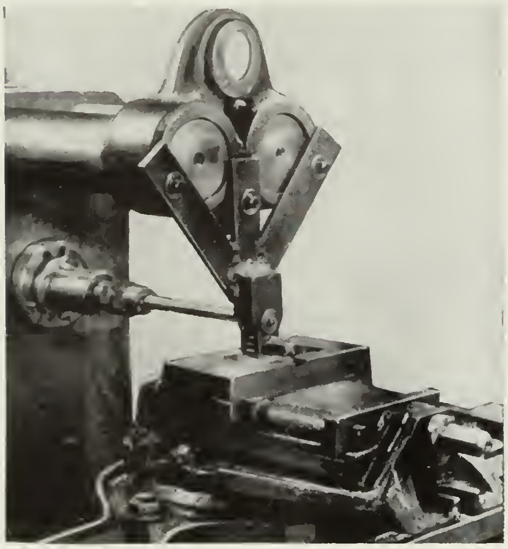


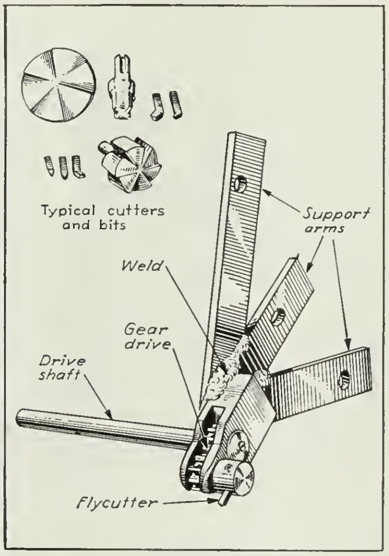
Generator Test Panel—In the electrical department under Mr. Anderlee, special test equipment has been built up to check all instruments to be serviced. This test panel, for example, tests both generators and their controls. A standard generator is connected to a mechanical variable-speed drive beneath the panel. Their voltage regulators are clamped to the panel or a reverse-current cutout and checked. Adjustable terminals hold instruments under test. Standard units on the panel provide a comparison test at various speeds, or check a generator. Capacity is 0-30 volts and 300 amp *(M-932g)*



Portable Battery Charger—Many planes arrive in winter with batteries badly discharged, some have belly tanks that must be removed to get at the batteries. To permit charging them in the plane, Alfred Campo (shown) built up this portable set. It also tests generators and electrical systems. A 110-volt motor in the base drives a standard 100-watt aircraft generator hooked up to a control system and battery above (in the photograph, the back has been opened—instruments are on a front panel). If the plane battery is hooked into this circuit, it can be recharged at 40 to 50 amp. per hour without removal. This permits the plane to fly off in an hour or less instead of wasting a day or more for recharging. During charging, the plane generator can be removed and checked or replaced without starting the plane engine. Reverse-current cutout and voltage regulators can also be checked and adjusted. All parts for this unit except the breaker switch and the wood box and casters are available anywhere U.S. planes are serviced. *(M-932h)*

PRODUCTION SHORTCUTS ★ ACCESSORIES



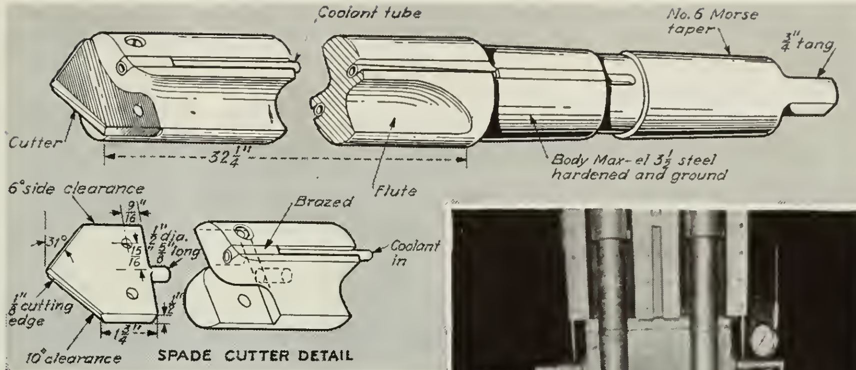


Geared Rig Mills Die Blocks—In the absence of some types of equipment to make a forging die, Eric Myers, toolroom foreman, Robert Mitchell Co., Ltd., Montreal, made this special rig. It is principally a pair of stub gears, one directly above the other in a housing. The lower is on a hollow shaft which takes a toolbit holder or small form-milling cutter, the upper on an extension shaft fitting the spindle of a standard milling machine. Cutter or toolbit holder is keyed into the stub shaft and held by setscrew. The housing itself is welded to three bar sections which bolt to the regular over-arm housing on the miller. With this arrangement, radii can be milled out with centers only $\frac{1}{32}$ in. above the block surface, to accuracies of 0.001 in. *(Item X-815)*

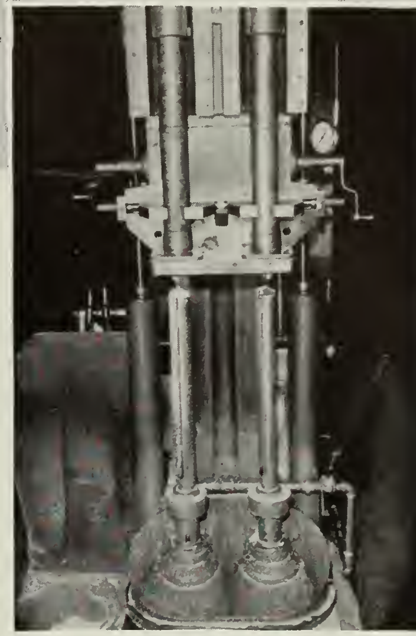
Slot Milling Replaces Grinding—A small-motor shaft was formerly slotted singly by grinding at Rochester Products Division, General Motors Corp. Frank E. Carnahan, machinist, suggested a gang fixture and slitting saw instead. It was possible to change steel and hardness of the shaft, hence a six-shaft fixture was made, with each pair held by a screw-tightened pad against three sets of V-blocks. Slots are now cut to close limits at a rate of 34½ pieces per hour instead of the former ten. *(Item X-538)*

Weighing Holds Close Stack Height—A stack of laminations for the field frame of a small motor built by Fairchild Aviation Corp. must be held to plus or minus 0.015 in. of proper height after rivets are driven. Formerly, height was determined by lifting off stacks from a holder with a mandrel (WINGS, Feb., 1943, page 381). This saved time over individual measuring, but resulted in some rejects after riveting. Now stacks are built up on the pan of a gram scale, individual laminations being interchanged for slightly thinner or thicker ones until total weight is within one gram of the standard. This is a little slower than the previous method, but avoids rejects. *(Item X-833)*

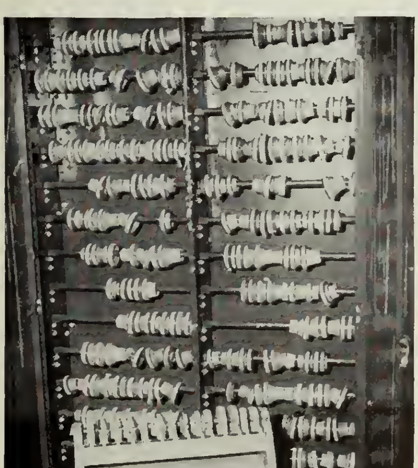
Wooden Fixtures Expedite Tube Bending—Small-diameter aluminum-alloy tubes are bent in simple wooden fixtures at the Vergennes, Vt., plant of Simmonds Aerocessories, Inc. Hardwood blocks of proper shapes are bolted or screwed to a ¾-in. plywood base. Blocks, clearly marked, are used in sequence. In the example pictured, the second of three bends is being made on the L. H. (left-hand threaded) end of a tube. The fourth bend is made on the R.H. (right-hand threaded) end, with the completed compound curve on the other end gaged in a removable swiveled block on a semi-circular extension at the operator's right. Button at left prevents tube from lifting out of slot at third bend. *(Item X-487)*

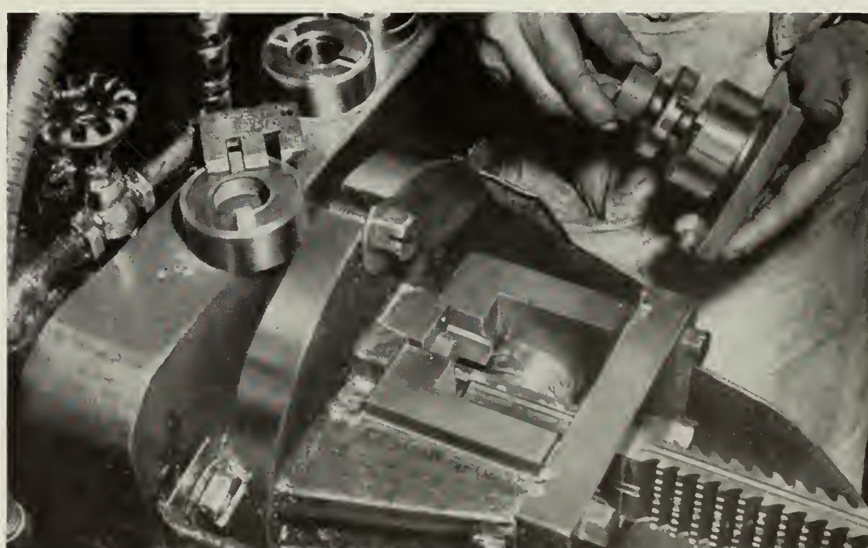


Deep Boring Ten Times Faster—In oleo cylinders made by Canadian Car & Foundry Co., Ltd., for *Hurricane* fighters, the bore is 3⅛ in. in diameter by 26 in. deep. Forgings are chrome-nickel steel heat-treated to over 300 Brinell. As drills were expensive and scarce, a boring bar was made of 1010 Max-el steel heat-treated 3½ hr. at 1500-1525 deg. F., quenched in oil and drawn at 700 deg. F., to a Rockwell C hardness of 51. A high-speed-steel spade cutter with chip-breaker notches is inserted, and coolant brought to it at 500 lb. per sq. in. pressure through tubes leading from an annular channel on the shank to the blade recess. Turret-lathe boring took 6 hr., so a 2-spindle inverted Barnes drill replaced it. Boring time is now 75 min. per pair, or 37½ min. per piece, or about a tenth the original time. Coolant pumped into the base collars floods chips clear so they are carried down boring-bar flutes. *(Item X-467)*

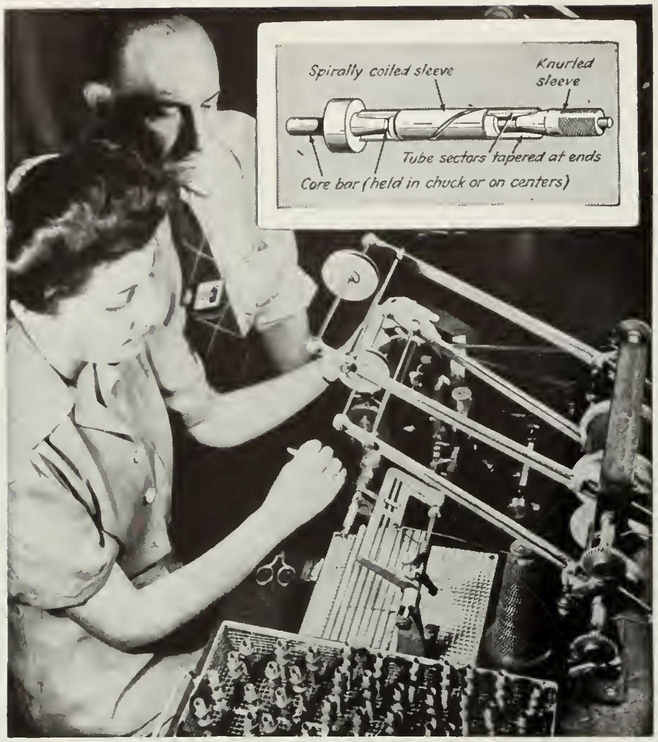


Numbered-tape Rolls Put on Dispensers—Identifying numbers are put on each wire of electrical subassemblies at Republic Aviation Corp. Numbers are printed along gummed tapes in coils. Numbers on a particular assembly are not consecutive, and there are hundreds used on assemblies passing through. Mrs. Kathryn Brazzell, who applies the tape, suggested a dispenser system to save time in locating rolls. A base with ends carries a bar on which tape rolls needed for a particular assembly are placed consecutively. A bar across the front of the rack carries a hacksaw blade to cut tape as needed. Bars not in use, with their tapes complete, are kept in a wall cabinet according to job number. In the photo, the dispenser rack is in the foreground. *(Item X-350)*

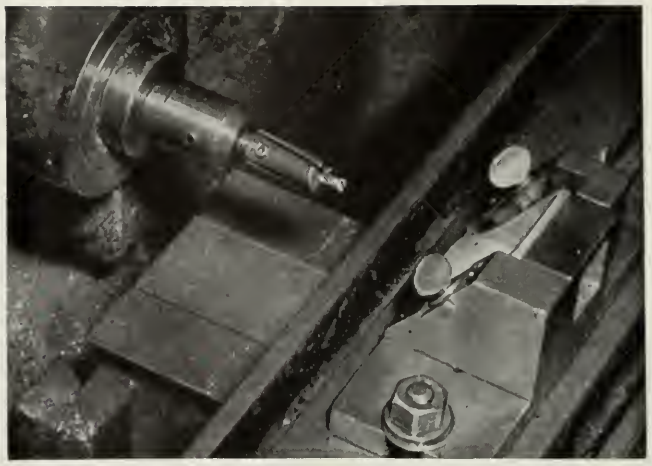


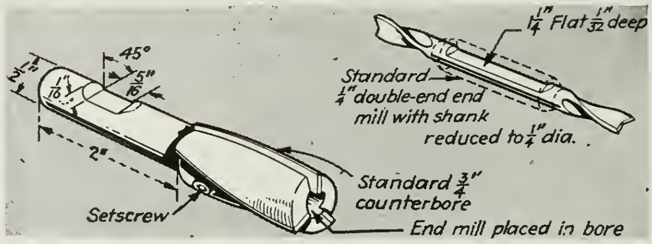


Broach Cups Seven Times Faster—Four faces and two radii of small cups were formerly milled at Eisemann Magneto Corporation, at a rate of ten or twelve pieces per hour. These surfaces are now hydraulic-broached at a rate of 80 per hour, with finer finish and closer adherence to tolerances. The piece is turned from bar stock to about 2½-in. diameter, bored and counterbored, leaving an end wall initially about 5/16 in. thick. On this end two lugs about 3/16 in. thick and 3/16 in. wide must be cut, with fillets where they join the base. Limits on end thickness are plus 0.003, minus 0.000 in., and on lug width plus 0.000 and minus 0.0015 in. Pieces are held in pairs in inclined slots so the broach seats them firmly. Each piece also is seated on a filler plug to control end thickness and prevent distortion as the 48-in. long, 96-tooth broach passes. The final six teeth can be shimmed out, if required, to compensate for grinding of the tool. At left in the photo are two finished cups with a go-no-go snap gage for the lugs. The operator is gaging another to see that lugs are centered with their faces equidistant from a plane through the axis of the piece. *(Item X-451)*

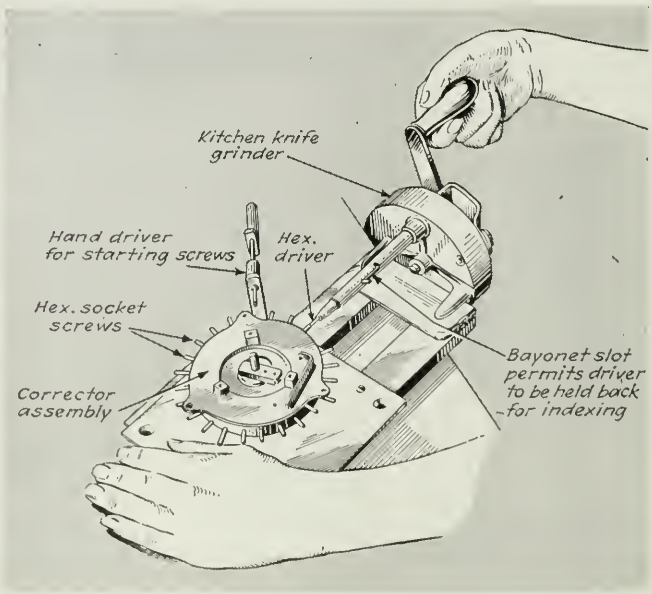


Mandrel Speeds Coil Winding—Some small radio coils must be wound at Fairchild Aircraft Corp. on paper or fiber tubes with walls less than $\frac{1}{64}$ in. thick. These cores may collapse or distort unless supported. R. Squire (shown), general foreman, assembly department, developed a special mandrel that saves a minute per piece and reduces rejects. The mandrel has an outer sleeve coiled in a helix from strip, into which are inserted three sectors of a tube about a core bar. The core bar is tapered at its inner or collar end, and carries a tapered sleeve or nut at its outer end. Sectors are tapered to fit. The core bar may be gripped in a chuck or held on centers. Tightening the knurled sleeve pushes the sectors outward, expanding the helix-wound tube until it grips the coil core firmly. *(Item X-838)*



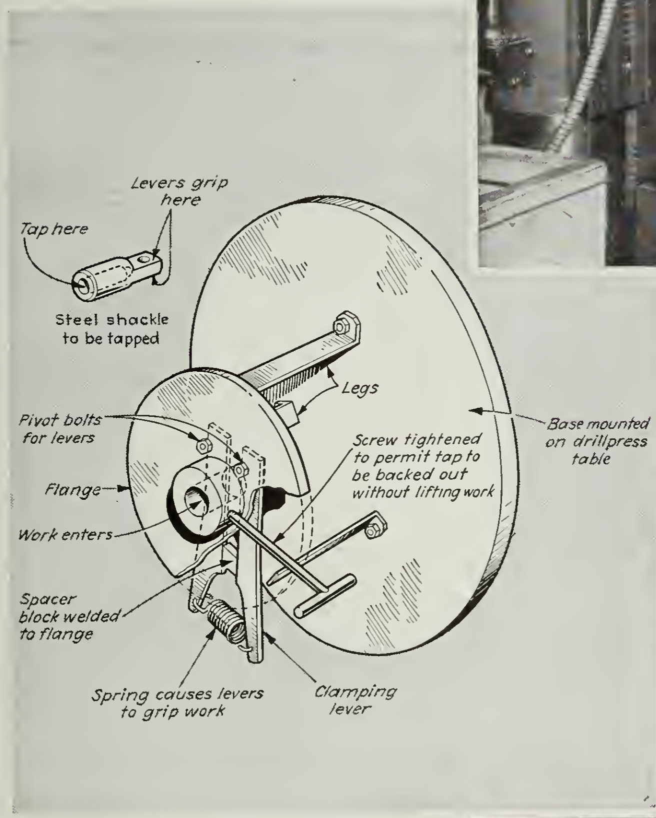


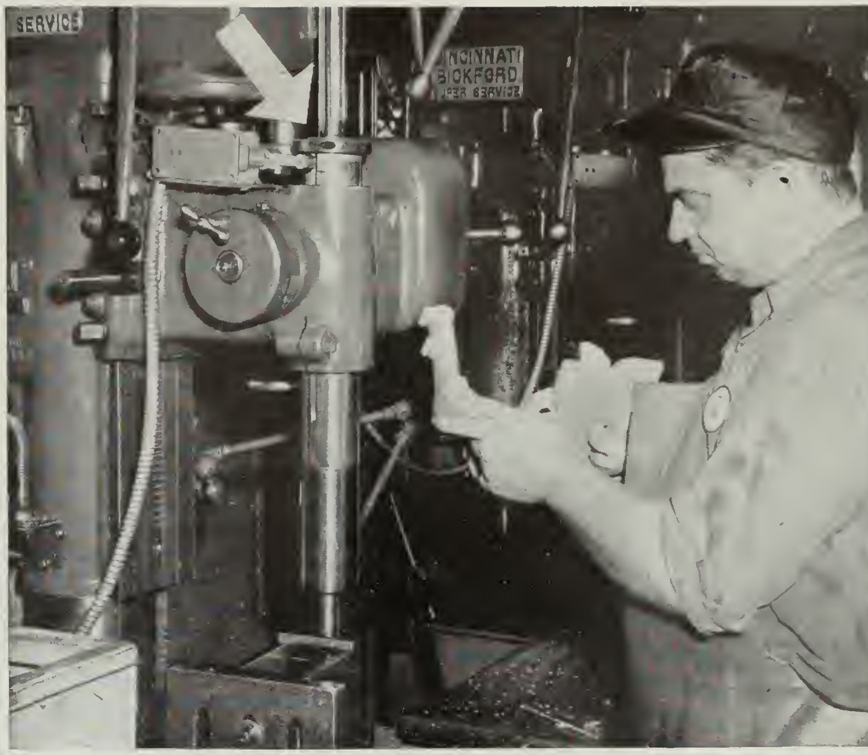
Combination End Mill and Spotfacing Tool—Three operations required to mill and spotface slots in a series of eight types of aluminum castings ¼ in. thick are now handled by a single tool at Warren M. Arthur Corporation. Two ¼-in. holes were formerly drilled at the ends of each slot, the slot milled between them, and a ¼-in. area spotfaced around the slot in a separate fixture. Claus Carlson, machine-shop foreman, suggested the new tool. Now only one set-up is made for each slot. The end mill is moved into the casting at one end of the slot to a depth of ⅜ in. only to provide chip clearance. Then the table is traversed to mill the length of the slot, brought back to the start and moved into the spotfacing position for a second traverse. Set-ups are reduced from six to two, saving 60 to 70 percent time. *(Item X-905)*



Compass Sub-assembly Time Cut 86 Percent—A corrector assembly for radio compasses made by Fairchild Aviation Corp., includes a spider with 24 tiny nuts in radial slots. Over this spider a ring is placed, then 24 long headless hex-socket screws must be threaded in for half their length. Done by hand, the job took 35 min. William Beltzer, production manager, and Herman Rothman developed a new fixture which cuts assembly time 86 percent. It has a pivot at one end for the spider into which the lugged nuts are placed. At the other end is an inexpensive kitchen knife grinder, the wheel replaced by a tubular spindle with bayonet slot through which a pin fastened to a hex driver is mounted. A compression spring behind the driver pushes it outward when the bayonet pin is released into the long slot parallel to the driver axis. The driver is thus geared up. Screws are entered by hand and similarly started if necessary by the hand driver (see sketch), then run in with the geared crank. *(Item X-837)*

Safety Tapping Fixture Avoids Special Chuck—Leroy Swisher, machine dept., M. P. Moller, Inc., Hagerstown, Md. (peacetime makers of organ pipes), suggested this tapping fixture (below) to overcome spoilage in tapping a steel shackle. The top flange has a central hole through which the shackle passes, so that its flatted shank is gripped by a pair of levers under action of a spring. They grip the piece tightly enough for tapping, but release the shackle when the tap bottoms or sticks. Thus no safety tapping chuck is needed. A turn on the long-shanked side screw on the flange collar grips the shackle tightly when the tap is reversed for backing-out, to prevent it from lifting. The fixture is on three legs which provide clearance from a base clamped to the drillpress table. *(Item X-876)*





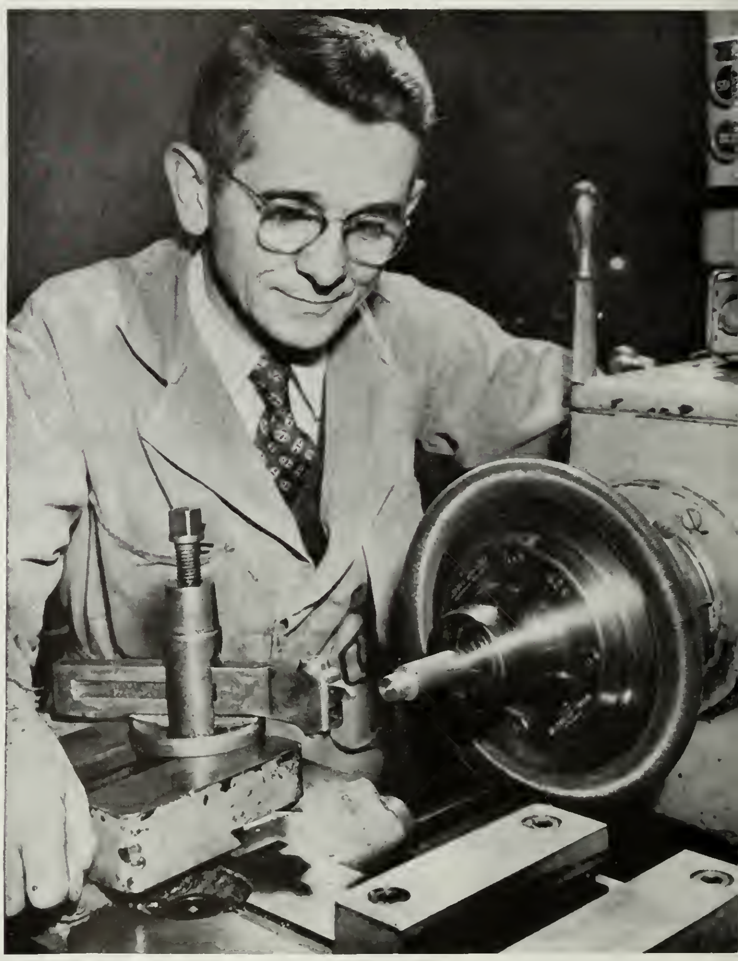
Limit Switch Speeds Drill Operation—J. N. Hollingshead, foreman of one machine shop in a Fairchild Aircraft plant, has equipped several automatic-feed drills with safety limit switches to disconnect power after the drill has completed its normal travel. A standard limit switch has an arm and roller which contacts a fiber collar on the drill spindle. The operator merely starts the drill, then can prepare the next piece for drilling. The automatic-feed mechanism of these larger drills can be ruined if the drill is not stopped at the proper time. This automatic cut-off eliminates guesswork and prevents damage. It is also responsible for a production increase on the operation of about 25 percent. *(Item X-873)*

Gasket-coating Time Cut 90 Percent—Neoprene gaskets which seal two sections of a loop housing for a radio direction finder made by Fairchild Aviation Corp. must be coated on both sides with a sticky adhesive called Valvlube. This was formerly brushed on with the gasket on a form. Coating was not uniform, and filled gasket holes to cause later trouble with screws passed through them. Now an ordinary clothes wringer is used for the job. The adhesive is applied with a spatula and spread by "wringing." Gaskets are passed halfway through, then brought back, turned and fed for the other half. This has proved preferable to passing them all the way through. Coating is done ten times as fast as before, with less mess and hole filling. *(Item X-839)*

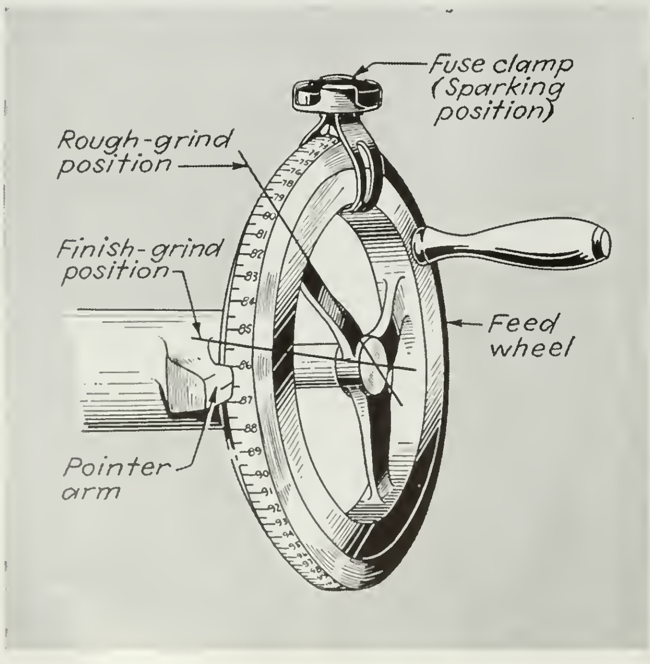
Turret Anvil Speeds Part Marking—Thousands of small parts are marked with the initials "AC" in bench arbor presses of this type. This unit has a turret anvil, indexed by the pin at right to hold any of the sixteen small parts shown. When a tray of parts arrives, the operator merely indexes to the proper position. Marked parts are dropped through the hopper in front to another tote box. Some typical parts are shown at left. *(Item X-799)*

Little Shortcuts Can Make Big Economies

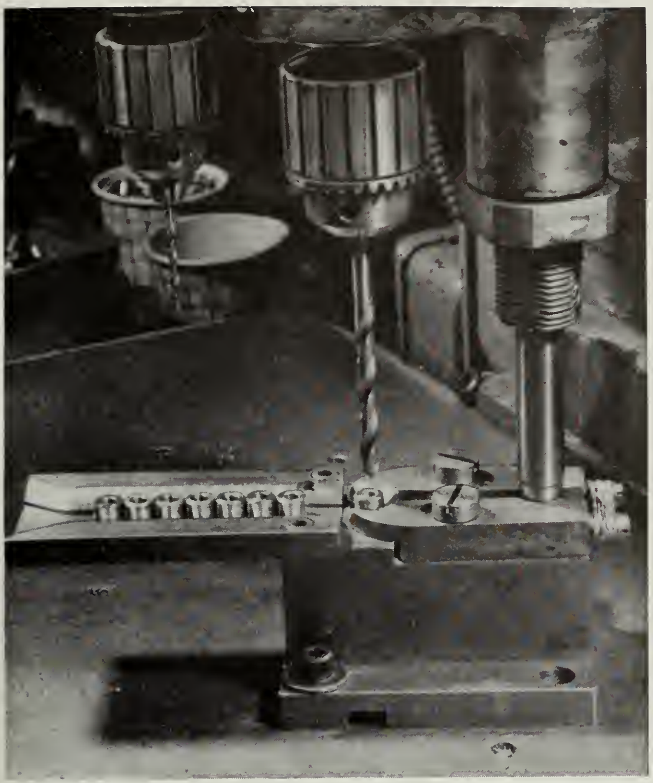
Increased convenience, reduced fatigue, lowered die cost, and lessened scrap losses among savings at A.C. Spark Plug Division.



Right-and-Left Tool Holder—John McCulloch, tool maker, suggested this toolholder, which has two holes for toolbits, each with its own headless set-screw. Thus it can be used as shown as a right-hand holder, and turned over as a left-hand one. This almost halves holder stocks. *(Item X-800)*



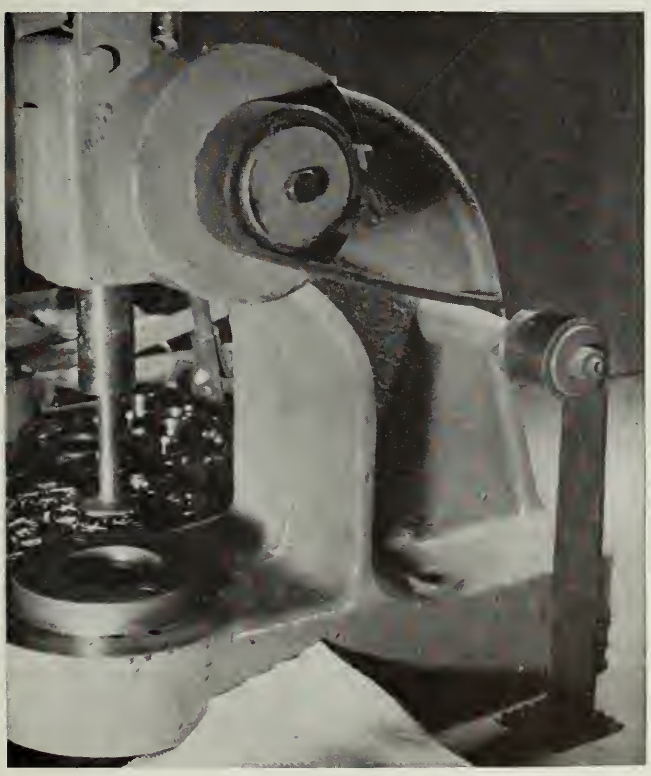
Fuse Clamp Cuts Scrap Losses—Surface-grinder operators usually memorize the final or minimum setting of the feed wheel in finishing a series of parts. But memory—and chalk marks—both fail with inexperienced operators. So Daniel R. Cook fitted an ordinary electric fuse clamp over the edge of the wheel, set so it strikes the pointer arm at the minimum setting. It acts as a stop, and prevents undersize grinding. Further, intermediate cuts can be set quickly by eye, instead of reading the graduations. Results: better work, and no scrap from grinding undersize. *(Item X-797)*



Slide Feed, Vise and Escape Opening Combined—Variations of this simple fixture (left) handle a number of drilling and countersinking operations. In this example, the drill countersinks the bore of a small bushing. Pieces are fed through the trough at left. Each in turn is positioned between the ends of the pair of pivoted arms, normally held apart by the rubber bands at right. The descending drill head carries a taper pin at the right side. This spreads the arms to clamp the piece and also acts as a depth stop. As the head is raised, the operator pushes a new piece into place. This pushes the finished piece between the arms into a hole leading through the table to a tote box. *(Item X-798)*

Sponge Rubber Pad Makes Pickup Easy—Lock washers must be placed on thousands of small screws daily. A handful of each is spread on a ½-in. sponge-rubber pad, from which they can be picked up readily with one hand while the other operates the screwdriver. *(Item X-802)*

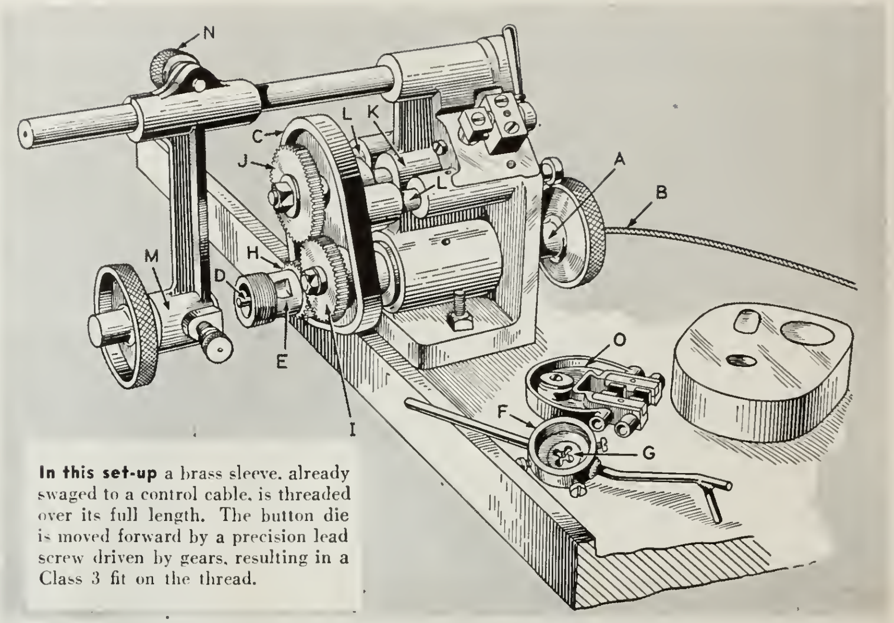
Belt Releases One Hand—In many arbor-press operations, a belt, wrapped around and attached to the hub of the operating pinion and carried over an idler and through the bench to a pedal, enables the operator to hold parts with both hands. Also pressure can be varied by the feet as required. A spring returns the arbor when pedal is released. *(Item X-803)*



Cantilever Pipes Support Screwdrivers—Cantilever support pipes, welded to the main overhead air line, take the weight of air screwdrivers through long springs. This keeps hose lines short and out of the way and reduces operator fatigue. The girl in foreground uses two screwdrivers—one to drive, the other to remove, screws—because she makes adjustments in assembly. Parts are placed in special trays, prepared and stacked on the opposite side of the bench. *(Item X-801)*

End Fitting Precision Threaded

Device provided with a lead screw makes possible a Class 3 fit on the full length of a sleeve after it has been swaged onto the cable of a push-pull control.



In this set-up a brass sleeve, already swaged to a control cable, is threaded over its full length. The button die is moved forward by a precision lead screw driven by gears, resulting in a Class 3 fit on the thread.

PUSH-PULL CONTROLS manufactured by Simmonds Aerocessories, Inc., at its Vergennes, Vt., plant, require that a brass sleeve be swaged to a cable which is the central element of the control. As the sleeve, in some cases, must be threaded over its full length, threading cannot be done until after the sleeve is swaged to the cable. The thread must be a precision Class 3 fit, hence the problem was to grip the piece while threading part of its length, then to hold the threaded portion while the remainder was threaded and still to maintain accurate pitch.

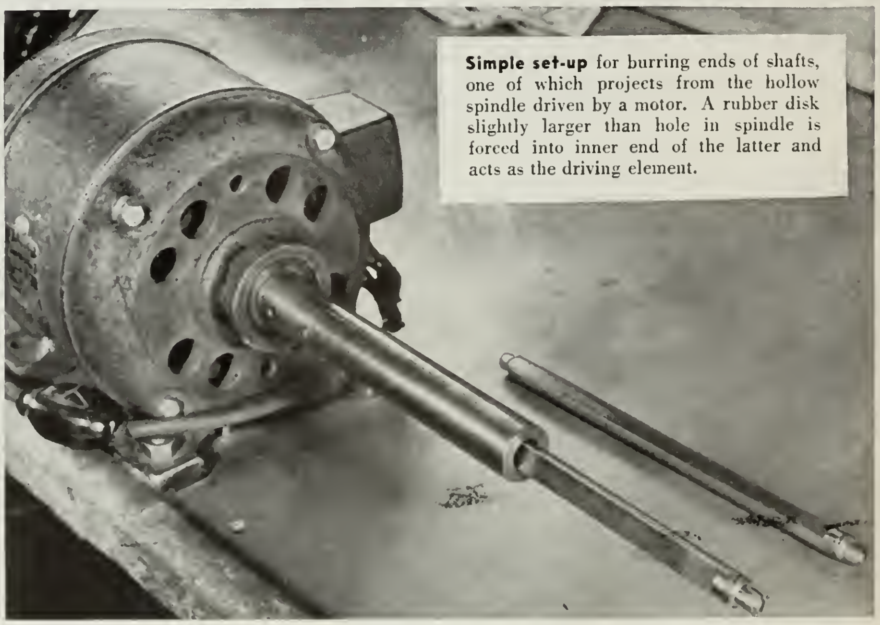
This special machine was developed for the job. The lowest hollow through-shaft *A* contains a collet at its left end which grips sleeve *D* swaged on cable *B*, after the cable is passed through from the back. This leaves fitting *D* protruding through sleeve *E*, which is threaded on one end to carry die holder *F* containing button die *G*. Sleeve *E* is integral with gear *H* meshing with idler *I*. Gear *J* is fixed to a precision-ground leadscrew inside main casting *K*. Sleeve *E* pilots on and turns concentrically about the outer end of shaft *A* when die *G* is turned by hand, using the cranked handle. Bracket *M* is out of the way during this operation. As sleeve *E* turns, the gear train turns the leadscrew. This causes the entire head, *C*, with sleeve and gears, to move inwardly on rods *L*, which pilot in holes in main casting *K*. As fitting *D* is locked to hollow shaft *A* supported by the main casting, the die cuts a thread on *D* under control of the lead screw.

After the die moves as close as possible to the holding collet inside shaft *A* it is necessary to grip the work at its outer threaded end while the remaining third of the thread is cut. At this stage the end of piece *D* projects through the die for about half its length. This outer end is gripped by a collet inside bracket *M*, now locked by screw *N*, thus holding the piece in correct relation to other parts of the machine. Then the collet inside shaft *A* is released. This enables the die to cut the rest of the thread, still guided by the lead screw. Go and no-go thread gage *O* is then applied to make sure that the piece comes within the close limits specified for class 3 threads. Change gears permit threads of different pitches to be cut. The gear train is covered by the guard at right. (*Item X-460*)

Handy Aid to Rapid Burring

Small rubber disk serves as quick-acting clutch for spindle.

IN PRODUCING FILTERS at The Cuno Engineering Corp., a shaft end must be burred. A tight-fitting rubber disk is pushed to the inner end of a hollow motor-driven spindle. When a shaft is pressed against the rubber, the shaft is gripped and rotates with the spindle while its outer end is burred with a file. It is not necessary to stop the spindle for loading. The hole in the spindle is about 0.0005 in. larger in diameter than the shaft to be burred. Disks are replaced after burring about 1,000 shafts. (*Item X-849*)



Simple set-up for burring ends of shafts, one of which projects from the hollow spindle driven by a motor. A rubber disk slightly larger than hole in spindle is forced into inner end of the latter and acts as the driving element.

WAR BONDS

FOR YOUR IDEAS

★ ★ ★

THE WINGS SHOP SUGGESTION CONTEST

★

From production shortcuts reported in WINGS for November, the men pictured here have been awarded United States War Bonds and Stamps for suggestions of outstanding merit. Send your suggestions to the Editors of WINGS, serve your country, and win a prize!

★

Rules for Wings Shop Suggestion Contest

1. Ten $25.00 United States War Savings Bonds will be awarded each month to workers in factories making airplanes and airplane parts who submit to WINGS suggestions for improved production methods.

2. Contest will be open to every man and woman working on the production lines turning out military airplanes, airplane parts and equipment. The contest is open to foremen and lead workers, but not to any one holding a management or engineering position. There is no limit to the number of entries any one person may make.

3. Your suggestions may include:
Improved design for small parts and tools.
Ideas for jigs, fixtures, devices to speed output.
Improved work methods.
Savings of essential war materials, or the substitution of nonessential materials for essential ones.
Ideas for eliminating unnecessary jobs, or motions, or operations, or work fatigue.

4. In making the awards, the judges will ask the following questions:
Has the suggestion value to other workers doing similar jobs?
Has it been tested by practical operation? How easily and inexpensively can it be put into operation in other plants?
A suggestion that shows how to make better use of existing tools and machines will be given higher rating than one that requires time and money to make changes.

5. Each item submitted to WINGS should be written briefly and clearly, giving details as to the nature of the improvement. Old and new methods should be described and compared.
Extent of saving should be indicated. Names and positions of the person or persons submitting the idea should be given, as he and he only will be eligible to participate. Photos or drawings illustrating the improved methods or devices should be submitted. Illustrations should be such as to give others aid in making use of the idea.
Give fullest possible information, remembering that Army and Navy officials will pass on all items, taking out details which should not be used

6. Judges of contest will include production officials of the U. S. Navy Bureau of Aeronautics and U. S. Army Air Forces, and editors of WINGS.

7. All ideas must be in the hands of the publisher not later than on the last day of the month, to be eligible for awards in the issue of WINGS appearing on the second succeeding month.

8. The publisher shall have the right to publish information pertaining to any ideas or related data submitted. Such items will be paid for at regular editorial rates. Material submitted in the WINGS contest will not be returnable.

9. All production shortcuts submitted in the WINGS contest must have the written approval of the management of the plant in which the worker is employed, and be in accord with management policies.

Submit entries to the Editors, WINGS Magazine.
330 W. 42nd St., New York 18, N. Y.

Winners for November

Chas. A. Jackson, Curtiss-Wright, designed graduated disks for quick drafting. (Item A-888)

Harry Link, Consolidated-Vultee, devised punch driver which eliminated 3 operations. (Item A-766)

H. D. Danforth, Engr. & Research, who made chart for facts. (Item A-890)

R. Corbett and E. Reynolds, Boeing Aircraft of Canada, constructed an anodizing rack which eliminates burns on skin sections. (Item A-893)

Robert McGee, John Gaylord and Ruth Hinton, all of Taylorcraft Aviation Corp., put their heads together and developed an inserting tool to speed fastener assembly and to enable one man to do the job. (Item A-626)

William Rice and Louis Blankstein, Wright Aeronautical, designed a multiple fixture for an Arter grinder and saved 62 percent of labor. (Item E-875)

Robt. P. Murray, Selfridge Field, made tool from scrap. (Item M-927)

C. Sundman and A. Bird, Boeing Aircraft of Canada, who devised a basket and bucket which holds small loose parts for efficient anodizing. (Item A-875)

Michael Lesko, Republic Aviation, who devised screwdriver. (Item A-791)

Carl Johnson, Thomas Grimes and Allen Oates, Selfridge Field, who built radiator tester which reduced a two-man maintenance job to one. (Item M-930)

The C-47 Douglas transport powered by Wright engines which is proving invaluable in rushing troops to world-wide battlefronts.