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IMPROVING PROCEDURES FOR PRODUCING OVERHEAD TRANSPARENCIES WITH THE ULTIMATE AIM OF INCORPORATING THESE TECHNIQUES INTO THE DEVELOPMENT OF A REGIONAL CURRICULAR MATERIALS CENTER FOR VOCATIONAL EDUCATION. FINAL REPORT.

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THE INVESTIGATION RESULTED IN THE PRODUCTION OF 88 LOW-COST OVERHEAD PROJECTION TRANSPARENCIES ON THE BASIC PRINCIPLES OF POWER TRANSMISSION IN AGRICULTURAL MACHINERY. DEVELOPING TECHNIQUES FOR OFFSET PRINTING ON PLASTIC REQUIRED OVERCOMING PROBLEMS OF STATIC ELECTRICITY, INK ADHESION, OFFSETTING, AND DRYING. MACHINERY, ENVIRONMENT, AND INK WERE TESTED AND ADJUSTED TO PRODUCE SINGLE COLOR TRANSPARENCIES ECONOMICALLY. MEDIA QUALITY WAS TESTED BY 53 VOCATIONAL AGRICULTURE TEACHERS IN FIVE STATES. THEY WERE ENTHUSIASTIC ABOUT THE PRODUCTION APPROACH, SATISFIED WITH THE PROJECTION QUALITY, PRODUCT DURABILITY, AND ASSEMBLY METHODS, AND EXPRESSED A NEED FOR THE PRODUCT. THE NINE SETS OF TRANSPARENCIES ARE ENCLOSED IN FILE-FOLDERS, UPON WHICH ARE PRINTED SUGGESTED REFERENCES AND LEARNING ACTIVITIES. THE 88 TRANSPARENCIES INCLUDE 37 IN MORE THAN ONE COLOR AND PROVIDE OVERLAYS, CUTAWAY VIEWS, AND EXPLODED VIEWS OF ASSEMBLY COMPONENTS. SPECIFIC SETS OF TRANSPARENCIES ARE (1) BEARINGS, (2) DIFFERENTIALS, (3) FRICTION CLUTCHES, (4) TRANSMISSIONS, (5) GEARS, (6) CHAINS, (7) BELTS AND PULLEYS, (8) FLEXIBLE COUPLINGS, AND (9) POWER TAKE-OFFS. INSTRUCTIONS FOR USING THE TRANSPARENCIES IN TEACHING A 3-6 WEEK UNIT WERE OUTLINED FOR THE SELECTED TEACHERS WHO EVALUATED THE PRODUCT. (JM)

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FINAL REPORT

Project Title: Improving Procedures for Producing Overhead Transparencies With the Ultimate Aim of Incorporating these Techniques into the Development of a Regional Curricular Materials Center for Vocational Education

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SUMMARY OF PROJECT

Grant No. OEG 2-6-068320-1103, The Vocational Education Act of 1963, P. L. 88-210, Section 4(c)

Title: Improving Procedures for Producing Overhead Transparencies with the Ultimate Aim of Incorporating these Techniques into the Development of a Regional Curricular Materials Center for Vocational Education

Investigator: Arthur K. Jensen

Institution: Clemson University

Duration: May 16, 1966 through November 14, 1967

Purpose or Objectives: The purpose was to produce a set of overhead transparencies on the mechanical transmission of power in agricultural machinery. These transparencies were to be produced by the offset printing process. Printing techniques were to be developed and perfected throughout the project. They were to be low cost.

Procedures: The investigator selected 88 basic ideas on power transmission to be presented as an overhead transparency. These ideas were developed by engineering students into drawings on 8-1/2" x 11" masters. These masters were then photographed, etched on aluminum sensitized offset plates and printed on .003 mm. Trycite with a 1250 Multigraph offset press. Special inks were selected. Each transparency was dusted and as it was ejected from the press it was placed in a separate pocket on a 100 pocket sorter attached to the press. A slip sheet was placed upon it before the next transparency in the series was ejected on top of it. When the printing of a set was completed, the sets were removed from the sorter and set on edge on a shelf to dry for two weeks--or as an alternative, allowed to dry for 24 hours in an oven at 150° F.

When the transparencies had cured, they were distributed to 53 teachers of vocational agriculture in five southern states. They evaluated the quality of the transparency as a teaching device.

Results and Conclusions: The investigator concluded that overhead transparencies could be printed with an offset press on low cost .003 mm. Trycite for four (4) cents for a single color transparency. The teachers accepted these transparencies as being of very acceptable teaching quality. They reported great need for materials of this nature to be distributed by state departments or a regional center. The set developed consisted of 88 transparencies in eight areas of power transmission; namely, gears, belts and pulleys, chains, power take-offs, transmissions, friction clutches, flexible couplings, differentials, and bearings. A teacher's guide was also developed and printed as a file folder to hold the transparencies. These transparencies were not framed. Teachers

did not find this to be a problem. They were dusted and the teacher was asked to remove this. Only one teacher found this to be unsatisfactory, two felt it was not the most desirable arrangement. Seven out of eight teachers preferred the slip sheet between the transparencies over no slip sheet. Two out of three felt the fact that overlays were not hinged was satisfactory, the other one-third found this a usable idea although not the most desirable. Seven out of eight found the plastic of adequate durability, while one out of eight found it usable but not most desirable. None of the teachers found it unsatisfactory. Durability of the black printed image was rated in an identical manner. Projection quality was rated very high. Seventeen out of 18 rated it satisfactory, none rated it unsatisfactory, and one out of 17 rated it usable but not most desirable.

Color quality received the lowest quality rating. Slightly over two out of five rated color quality as usable but not most desirable, three out of five rated it satisfactory, and none rated it unsatisfactory. Almost four out of five believed the extra cost of color was worthwhile, while one out of five felt it was of some value. Only one individual felt it was of little or no value. Thirty-eight of the 39 teachers responding to the questionnaire felt there was great need for this type of transparency, one said there was some need. Thirty-seven of the 39 felt the project should be continued. Two felt it should be continued but with major improvements. The group was divided on the method of production, state or by a regional center.

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I. PROBLEM

Teachers across the nation have been in continual need of new and up-to-date materials for classroom work. Vocational teachers have been no exception.

The following statements recently appeared in a college publication:[1]

> "Ninety percent of all the scientists who have ever lived are living today."
>
> "Ninety percent of all medicines and drugs used today were unknown ten years ago."
>
> "Seventy-five percent of all workers who will be employed in industry by 1975 will be producing goods that have not been invented or discovered yet."
>
> "More mathematics has been created since the year 1900 than in all the other centuries of history."

Assuming the statements to be true, the task of the teacher of tomorrow will be even greater than it is today. Teaching and curricular materials change constantly. Thus, in order to assist teachers in keeping up to date, new materials have to be developed continuously. These materials must be:

1. Current in subject matter
2. Effective to the learning process
3. Economical
4. Reproducible by mass means

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[1] Le tourneau College NOW, Vol. XIX No. 5, May, 1965, Longview, Texas.

5. Easy to use in the classroom

6. Quickly and easily distributed

Illustrative, pictorial, and diagrammatical materials have long been recognized as important tools in the educational process. These materials are either teacher prepared or prepared by commercial or commercial-type processes. The effectiveness of such materials has remained unchallenged providing the materials are well prepared and properly used in terms of educational, subject matter, and visual concepts.

Many effective materials have been developed in recent years. The overhead projector was one of these effective tools. Audiovisual Instruction in its April, 1962 issue called the overhead projector the "tool of the times." This projector has many desirable features. It can be used without darkening the room. This makes it usable in any classroom. It enables students to take notes with ease. The instructor uses this machine from the front of the room. Materials are developed as the class progresses, or they can be prepared in advance. The angle of vision for material projected by this machine is sufficiently wide to make visibility possible from almost any position in an ordinary classroom. Thus, for the purpose of this research project it was assumed that teacher efficiency and effectiveness could be greatly improved if curriculum guides, teacher information, student materials, and teacher presentation materials (including audio-visual materials such as overhead transparencies) could be prepared in a well-developed center and made available to vocational teachers at a reasonable cost.

One of the chief problems of such a proposal was that overhead transparencies were very costly and only a limited number were available.

For example, the National Agricultural Supply Company of Fort Atkinson, Wisconsin,[1] one of the leading suppliers of teaching materials in agriculture, lists only one hundred and fifty-four (154) such transparencies. A recent publication of the Agricultural Education Department of Clemson University found it necessary to propose one hundred and thirty-five (135) transparencies to cover the 1964 agricultural census data for South Carolina. The cost of the overhead transparencies from National Agricultural Supply Company ranged from $1.25 each to $9.75 each.

Teacher-prepared overhead transparencies have been cheaper, but even in this case most processes are extremely high. Some of the major processes which teachers use and their costs are:

Thermofax[2] type 133 economy positive	- 16¢ per transparency
Thermofax type 125 extra quality positive	- 20¢ per transparency
Thermofax type 127 direct reading positive	- 24¢ per transparency
Thermofax type 128-129 color negative	- 29¢ per transparency
Thermofax type 627 dry photo	- 30¢ per transparency
Thermofax mounting frames for transparencies	- 10¢
Technifax[3] Diazochrome K	- 21.6¢ per sheet
Technifax Diazochrome KBKXXO	- 48¢ per sheet
Technifax reversing film RF	- 25¢ per sheet
Transeal CM (100) and Ca 2-400	- 39¢ per transparency

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[1] General Catalog 102, 1967, Nasco, Fort Atkinson, Wisconsin.

[2] 78-1751-1650 (1042.5) Price List, 3M Company, Minneapolis, Minnesota.

[3] Visucom Equipment and Materials Catalog, Technifax Corporation, Holyoke, Massachusetts, Catalog PL-2h 632 25M.

There are many other processes, but these prices are representative when materials are purchased in lots of 100 transparencies.

If the overhead projector is used most advantageously, a teacher would have to use an average of six or more transparencies per class. Thus, a material cost of a dollar or more per class per day becomes inevitable. This does not include any developmental materials used or the time the teacher spent in the preparation of the originals from which the transparency is made.

In southern states costs such as these were prohibitive in terms of the funds available to teachers. Table 1 indicates the per pupil expenditure for education in the area during the 1962-63 school year ranged from $230[1] to $379. Comparing the average total expenditures per pupil for education in southern states with the United States average of $472.17,[2] it was obvious that funds were paricularly limited. Even in areas with more adequate educational appropriations the costs of overhead transparencies have been such that their most adequate usage became a very noticeable item in a budget.

In this same area, 30.1 to 48.3 percent of the selective service registrants failed the mental test. These thirteen states ranked from 35 to 50 by this standard of measure.

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[1] Changing Times, The Kiplinger Magazine, November, 1964.

[2] Statistical Abstract of the United States, United States Department of Commerce, United States Government Printing Office, Washington, D.C. 20402, 1964, p. 118.

Table 1

WHERE SOUTHERN STATES STAND IN EDUCATION[1]

	Holding Power		Selective Service Registrants Failing Mental Test		Expenditure Per Pupil	
	%	Rank	%	Rank	Amount	Rank
Alabama	55.	46	36.7	45	$255.00	48
Arkansas	47.8	39	43.	47	279.23	45
Florida	62.9	35	30.9	42	347.00	37
Georgia	51.8	50	35.5	44	297.76	42
Kentucky	52.6	48	30.1	40	275.00	46
Louisiana	47.8	40	44.3	48	379.00	32
Mississippi	47.8	41	48.3	50	230.00	50
North Carolina	47.4	42	42.1	46	297.00	44
South Carolina	54.2	47	46.9	49	236.94	49
Tennessee	55.1	45	27.0	37	262.00	47
Texas	60.6	38	25.3	35	379.00	33
Virginia	51.9	49	31.3	43	335.00	40
West Virginia	55.5	48	30.2	41	297.50	43

Table 2 indicates that of the thirteen southern states, ten were listed as[2] having the lowest per capita income in the United States. The per capita income ranged from a low of $1,379 to $1,872. The United States average was $2,443. Although the states were responding toward an educational program by contributing a higher percentage of their income for this purpose, the income limitation placed a definite handicap on any program they could offer.

Table 2

THE TEN STATES IN WHICH THE PER CAPITA INCOME IS LOWEST[2]

Mississippi	$1,379
South Carolina	1,584
Arkansas	1,598
Alabama	1,656
Louisiana	1,768
Tennessee	1,776
Kentucky	1,789
North Carolina	1,813
Georgia	1,865
West Virginia	1,872

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[1] Op. Cit., Kiplinger.

[2] Keyserling, Leon. Agriculture and the Public Interest Toward a New Farm Program, Conference on Economic Progress, 1001 Connecticut Avenue, N. W., Washington 6, D. C., February, 1965, p. 28.

Within the background outlined, the purpose of this project was to develop a low cost overhead transparency and to investigate the potential of a plan for the ultimate development of a Southern Regional Curricular Materials Developmental Laboratory for Vocational Education. The offset press had been an economical as well as effective machine for reproduction of the printed word. For reproduction of the printed word on paper, this machine was proven. It was the opinion of the researcher that it was also potentially practical to reproduce overhead transparencies with an offset press. The initial phase of this grant dealt with the perfection of the process of producing low cost overhead transparencies on mechanical power transmission in agricultural mechanics by the offset printing method.

II. OBJECTIVES

The objectives of phase I were as follows:

1. To develop, as a pilot approach, a set of 30 to 40 effective overhead transparencies on basic principles of power transmission in agricultural machines. These were to be used in the training of students enrolled in off-farm occupation courses in agricultural mechanics.
2. During the development of the above materials, to demonstrate and perfect procedures for the reproduction of overhead transparencies by special offset printing techniques.
3. To examine the feasibility of application of the insights gained in developing objectives 1 and 2 to the development of a Southern Regional Curricular Materials Developmental Center for Vocational Education.

Since phase II was not funded in this project, but was to be dependent upon preparation of a future proposal should phase I prove a need, the objectives of phase II are not reported in this final report.

III. PROCEDURES USED WITHIN PROJECT

A. General Design

The initiator of this proposal prepared a set of overhead transparencies on the principles of power transmission in agricultural machinery. These materials were developed for students enrolled in off-farm occupation courses designed to train for job entry into agricultural mechanics. The materials consisted of 88 overhead transparencies in nine areas of power transmission; namely, gears, belts and pulleys, chains, power take-offs, transmissions, friction clutches, flexible couplings, differentials, and bearings. A teacher's guide in the form of a file folder was developed and printed for each of the areas. This file folder became the storage holder for each set of transparencies. The transparencies and file folder are included in Appendix A.

The art work was laid out by drafting students on 8-1/2" x 11" paper so that the material could be reproduced at a 1 to 1 ratio. Care was taken to use 3/16" to 1/4" lettering. The 1/4" lettering was used whenever possible. If space did not permit, the 3/16" lettering was accepted as minimum size. Lettering size was assumed to be critical in the finished product. This was the reason so much emphasis was placed on size of lettering on the original. The original was then photographed according to standard offset negative-making procedures and pre-sensitized aluminum plates burned. A modified offset printing procedure, which will be explained in detail under section B of Procedures, was followed from that point on.

During the summer of 1967 the materials were distributed to 54 teachers of vocational agriculture in South Carolina, Virginia, Florida, Georgia, and Alabama. These teachers had advanced programs of agricultural mechanics in operation. All teachers were asked to teach a three to six week unit on the basic principles of power transmission in agricultural machinery. They were then asked to evaluate the transparencies primarily in terms of product durability, usability, and projection quality. This evaluation is reported upon in the "Analysis of Data" section of this report.

The final responsibility of this project was to determine if a need existed in Region IV for a regional center for the production of overhead transparencies. Copies of the completed transparencies were sent to each state director of vocational education, each state supervisor of vocational agriculture, and a head teacher trainer in vocational agriculture. These individuals were asked to report a need for a regional center, willingness of their state to participate in such an effort, and the existence of legal and other problems that would have to be overcome if their states engaged in such a venture.

B. Procedure Developed for Printing Overhead Transparencies by the Offset Printing Process

1. After considerable research in adapting offset printing techniques to the production of overhead transparencies, the following standards emerged from this research project:

   a. The plastic used was low in cost. Three millimeter Trycite cut into 8-1/2" x 11" sheets was selected. It cost about one cent a sheet when purchased in volumes of 50-100,000 sheets. It was not the most

superior plastic available. It could be damaged by tearing or wrinkling. However, if used properly and stored properly, a transparency printed on it could be used over and over again. Teachers evaluating the project were made aware of its shortcomings and told how to handle the material. To date they have accepted this as being very satisfactory.

b. The end product was a ready-to-use transparency. The image was printed by the use of standard offset printing equipment usually found in or available to most state departments of vocational education. Slight deviations from accepted offset printing processes were developed to make the process a practical one.

c. The materials were handled mechanically to reduce costs and to increase the speed of operation. A sorter was added to the offset press so that transparencies could be assembled as they were printed. This greatly reduced labor costs. It is believed that this also assisted in preventing offset and in promoting drying.

d. Transparencies were not framed. The cost of the frame proved to be more than the cost of the transparency. It also required greater storage space. The framing would have to be accomplished manually and would have increased costs considerably. Instead, the transparencies were assembled in unit sets and placed in a file folder ready for filing.

e. The teacher was asked to wash the transparencies he received to remove the unsightly dust used in the printing process. This washing was simple. It was accomplished by wiping the transparency with a soft cloth dampened with cold water. Either paper towels or dry cloths could be used to dry the transparency.

2. A standard 1250 W Multigraph offset press was used. The modifications found to be essential on the offset press used in the research were as follows:

   a. Static electricity in the plastic caused a great deal of difficulty in feeding through the press. Two Curastat model SE 104 static electricity eliminators were added to the press. One was located just above the tape guide. The second was attached above and to the front of the paper receiver.

   b. A good duster was added to the press. The dust was found essential in preventing offset. It appears to assist in drying, also.

   c. A tubular quartz infrared lamp was added to hasten drying. This was wired to the vacuum feeder switch so that it was shut off when the vacuum feeder was cut off. The type used developed 1400° F. at the element. It was placed parallel to the ejector shaft of the press so that each sheet of plastic received a quick flash of heat as it passed under it while being carried to the sorter.

   d. A Multigraph model 671 sorter was added to prevent offset, assist the drying process and to make mechanical assembly possible.

3. Printing adaptations and techniques found essential in the transparency printing procedure:

   a. The plastic often contained so much static electricity that the sheets adhered to one another as if glued together. To break this static electricity, the plastic was fanned well from all four sides prior to placement in the paper magazine. It was never left in the magazine overnight without being refanned.

   b. The plastic was tempered to the same temperature and humidity conditions as the offset press was operated under. Progress to date indicates that an air-conditioned printing and storage room is most desirable in controlling the efficient operation of this process. Throughout the project the air-conditioning control has broken down on three occasions. Within an hour after each breakdown the static buildup has been so great that the operation has been greatly curtailed.

   c. The fountain solution proven most effective was one ounce of Multigraph Fountain Etch and one ounce of 8° Baumé Gum Arabic to one gallon of distilled water. This was mixed and stored in a sealed container. However, it was found that one had to change the solution in the fountain of the press daily. This solution caused rapid drying of the inks to the rollers; thus, the operator had to exercise extreme care in cleaning rollers, deglazing rollers more frequently than usual, and in cleaning of plates and blankets. The solution is a professional type which requires that the operator develop professional operational techniques.

d. Standard Repelex fountain solutions were used to clean the plates during the printing process.

e. Special inks have been and are still being designed for this process. Numerous inks have been tried. To date, the most superior black inks tested have been Multilith ML Special Black MLPD 310-2 and their MLS 5600. Colored inks that are transparent have been tested continuously. Complete satisfaction has not been gained in the colored ink area. Most successful colored inks tested to date are:

Multigraph MLS Transparent Red	R-484
Multigraph MLS Transparent Yellow	Y-211
Multigraph MLS Transparent Blue	B-611
Multigraph MLS Transparent Green	G-451
IPI Offset Blue	67A-3316
IPI Offset Red	67A-27

Inks are still being developed and improved. Future inks should offer many advantages over present ones.

f. Only aluminum sensitized plates were used to produce the power transmission set. However, the researcher has found that photo direct plates can be used with the Multilith black MLPD 310-2 ink. The use of photo direct plates is more difficult in terms of operator technique than with the pre-sensitized aluminum plate. Inking of the plate requires that all solutions and machine adjustments are exact. Photo direct plates have not proven satisfactory with the other inks. On

short runs photo direct plates greatly reduce the cost, although for runs of 00 copies the metal plate appears most practical.

g. During the initial period of research the transparencies were printed and fed into the receiving tray of the press one on top of each other. Although dusting helped correct offsetting, not all offsetting could be eliminated by this approach. If the duster clogged, the transparencies adhered to one another. By removing the transparencies from the receiving tray after every 100 copies were printed and allowing them to dry on edge in divided racks in these small groups, reasonable success was attained in reducing offsetting and in producing a satisfactory transparency. Transparencies should not be laid on top of each other as the weight tends to encourage offset. A 100 pocket rotary sorter was then added to the offset press. This enabled the operator to print 100 copies of each transparency, place each in a separate pocket of the sorter, place a slip sheet on top of each mechanically, and then go on to print the next transparency in the set. Thus, 100 sets of up to 50 different transparencies were printed, slip sheeted and collated in one operation. The sorter also appeared to allow the ink to set up prior to insertion of the next sheet, thus aiding drying and reducing offset. The completed sets were then placed in file folders set on edge on shelves

for curing for several weeks. The researcher also tried placing the printed and assembled transparencies in an oven at 150° F for 24 hours. This research proved the 24 hour baking to be a very practical approach. Any large baking oven can be used, providing the temperature can be uniformly maintained. The 150° F temperature proved to be an absolute maximum. Higher temperatures distorted the plastic.

h. The optimum speed of operation of the Multigraph press appeared to be about 6,000 sheets per hour.

i. Slip sheeting was accepted as standard procedure. The actual value to the process has not been definitely determined to date. It undoubtedly prevents some offset. It also removes a bit of ink from the printed product. Teachers have indicated they like the use of slip sheets because they can view the completed product without removing it from the folder and placing it against a light background.

j. The offset press operator proved to be the key to the process. The operator had to be familiar with all of the fine mechanical operations of the offset press. He had to be willing to learn. He has to watch the machine at all times. Plastic jams in the machine are much more frequent than paper jams. Printing on plastic is undoubtedly much more complex than printing on paper. Operator patience proved essential.

k. Plastic tends to adhere to the blanket. Cleaning the blanket and dusting it with a standard blanket dust usually corrected the difficulty. The use of blanket dust when the machine was turned off for the day was found to be most important.

C. Evaluation Procedure Developed for the Overhead Transparency Project

Since one of the basic purposes of the research grant was to develop a low cost approach to the development of overhead transparencies, the evaluation efforts were centered primarily upon the quality of the production aspects of the transparency, rather than the educational concepts portrayed by the particular transparency.

In October of 1966 the researcher met with the Board of Directors of the American Association of Agricultural Engineers and Vocational Agriculture. The outline for the content of the set of transparencies was formulated at this meeting.

The researcher then engaged a college student capable of mechanical drafting to develop the original drawings and layouts for the transparencies.

The proofs for the transparencies were evaluated by the researcher, Mr. James Craig of the Agricultural Engineering staff of Clemson University, and Mr. Ed Henderson of the American Association of Agricultural Engineers and Vocational Agriculture, Athens, Georgia. Corrections and modifications were made. The transparencies were then printed.

During the months of July and August the researcher met with selected teachers in Virginia, South Carolina, Georgia, Florida, and Alabama. Teachers selected were those engaged in extensive in-school

programs in the area of agricultural mechanics. The selection was made by the State Supervisor of Vocational Agriculture or by a mechanics specialist designated by him. A total of 53 teachers were asked to cooperate. These teachers were instructed on the use of the overhead transparencies. They were also given a set of publications covering the subject covered by the transparencies. They were then asked to teach a three to six week unit on Basic Principles of Power Transmission in Agricultural Equipment during September. The unit was organized around the module "Mechanical Power Transmission" developed by the Center for Vocational and Technical Education of the Ohio State University. Upon completion of the unit each teacher was asked to evaluate the transparencies. The evaluation sheet used is enclosed in Appendix II.

Completed sets of transparencies and a brief explanation of their development were sent to each state director of vocational education, each state supervisor of vocational agriculture, and a head teacher trainer in each of the states of the U.S.O.E. Administrative Region IV. These individuals were then asked to express their views on the potential for the development of a regional center for production of similar materials for distribution to the entire region. Their responses were used to determine the need for a center for the production of such materials on a regional basis.

IV. RESULTS FROM THE EVALUATION OF THE PROJECT

A. Evaluation of Physical Quality of the Transparencies Produced

Fifty-three teachers of vocational agriculture in the states of Alabama, Georgia, Florida, South Carolina and Virginia were asked to evaluate the transparencies produced by the offset printing techniques.

Thirty-nine completed the evaluation. Each of the teachers had been recommended to the researcher as being engaged in occupational training in the area of agricultural mechanics. Each teacher was instructed in the use, care, and overlay assembly of the overhead transparencies produced as a result of this grant. The teacher was asked to start the 1967-68 school year by teaching a three- to six-week unit on mechanical power transmission in agricultural equipment. The teachers were given the set of overhead transparencies produced by the offset printing method. They were asked to use the overhead transparencies the same as they would use transparencies produced by any other process. Table 1 indicates the general evaluation teachers placed on the transparencies.

Table 1

TEACHER EVALUATION OF OVERALL EFFECTIVENESS
OF TRANSPARENCIES PRODUCED

Degree of Effectiveness		
Very Effective	Of Average Effectiveness	Ineffective
33	6	0

Generally, the overall evaluation of the transparency was very good. Thirty-three of the thirty-nine teachers responding indicated they were very effective, six reported average effectiveness, and none of the respondents reported ineffectiveness.

A more detailed breakdown of physical quality characteristics is summarized in Table 2.

Table 2

TEACHER EVALUATION OF PHYSICAL QUALITY OF TRANSPARENCIES

Physical Quality	Satisfactory	Usable But Not Most Desirable	Unsatisfactory
Durability of plastic	35	4	0
Durability of black image	35	4	0
Projection quality	36	2	0
Color quality	22	17	0
Durability of color	32	6	0
Registry of color	33	5	0

Again teachers rated the quality features with a rather high degree of satisfactory responses. No unsatisfactory ratings were given. In the area of color quality a rather high percentage, almost 44%, indicated improvement was in order. This was perhaps due in large degree to lack of brilliance of color and in a number of instances the difficulty the researcher had in obtaining inks that would adhere uniformly to the plastic. As indicated in the procedures outlined for the process, the colored inks so far examined have not proven entirely satisfactory to date. In each of the other categories, 10-15% indicated the physical qualities listed as usable but not most desirable.

The teachers were also asked to respond to certain production techniques. The summary of their responses are included in Table 3.

Table 3

TEACHER ATTITUDE TOWARD PRODUCTION TECHNIQUES
USED IN PRODUCTION OF TRANSPARENCIES

Production Technique	Satisfactory	Usable But Not Most Desirable	Unsatisfactory
Dust on Transparency	35	2	1
Placed in File Folder and Lacking Frames	28	11	0
Inclusion of Overlays That Were Not Hinged to Original	25	13	0
Preference for Slip Sheets	34	5	0

The teachers apparently were not concerned over the fact that dust had to be removed from the transparency. Only one found this unsatisfactory, two found it less than desirable, while thirty-five found it satisfactory. Slightly less than three quarters of the teachers reported the lack of frames and packaging in a file folder to be satisfactory. Slightly over one-forth found this a usable, though less desirable approach. Two-thirds of the teachers found the method of presenting overlays to be satisfactory. One-third reported this unassembled approach as being usable but not most desirable. Seven out of eight preferred the use of slip sheets in assembly.

One of the major concerns in the use of the offset printing and assembly approach used in this project was that of production defects. Table 4 summarizes the defects reported by the group out of the set of 88 transparencies each received.

Table 4

PRODUCTION DEFECTS OBSERVED BY TEACHERS THAT ARE CAUSED BY THE UTILIZATION OF THE OFFSET PRINTING METHOD OR HANDLING TECHNIQUES

Defects	None	Observed on 1-5 Transparencies	Observed on More Than 5 Transparencies
Offset images	32	3	2
Blank sheets	30	8	0
Damaged transparencies	28	9	1

Of the 3432 transparencies received by the thirty-nine teachers reporting on the transparency study, a total of 18 transparencies were reported with offset, 12 blank sheets, and 26 damaged transparencies due to printing or handling. The blank sheets are perhaps of little or no concern since they enter the sorter magazine as a second sheet adhering to one that has been printed. Thus, the set would include a

printed transparency plus a blank sheet. The offset and other physical damage is of greater concern. Practically all of the physical damage was reported by individuals that had received part of the set by mail. Improper mail packaging techniques were thus a partial cause.

If the damage rate is converted to percentages, slightly over one-third of one percent of the transparencies were reported as having offset damage and three-fourths of one percent evidenced mechanical damage brought about either by the printing process or by the packaging and mailing process.

Several devices were incorporated into the transparency project in an attempt to evaluate ways of making basic transparencies more meaningful. The value of these aids is summarized in Table 5.

Table 5

TEACHERS' ATTITUDES TOWARDS USEFULNESS OF TOOLS AND TECHNIQUES INCLUDED IN THE TRANSPARENCY PRODUCTION PROCESS

Techniques Incorporated Into Project	Of Real Value	Of Some Value	Of Little or no Value
Reference lists	31	8	0
Overlays	31	8	0
Color (even though it increased cost considerably	30	8	1

Reference lists and suggestions to the teacher were printed on the folder of each of the nine sets of transparencies. Almost 80 percent of the teachers felt these were of real value. Slightly over 20 percent felt they were of some value. Teachers expressed practically the identical views toward the use of overlays and color. Only one teacher indicated he did not feel the color was worth the additional cost.

B. Cost Analysis of the Transparency Production Project

Cost estimates on the transparencies have been calculated on the basis of production of 300 transparencies, and utilizing labor costs typical to this region. These costs are summarized in Table 6.

Table 6

PRODUCTION COSTS OF SINGLE COLOR OVERHEAD TRANSPARENCIES ASSUMING PRODUCTION OF 300 OR MORE COPIES OF EACH TRANSPARENCY

Item	Cost per Transparency[1]
Cost of making plate	$ .01
Cost of plastic[2]	.0125
Machine operator's salary[3]	.005
Slip sheeting paper, folders, ink, and miscellaneous printing materials	.0025
Total cost of single color transparency	$ .03

[1]Pre-sensitized aluminum plates were used in this analysis. Depreciation of equipment is not included as adequate data is not as yet available on this item.

[2]Based on purchases of 100,000 cut-to-size pieces per order.

[3]Based on salary of $22 per eight hour day.

Production costs of a limited number of copies of each transparency would be greatly increased by the use of the pre-sensitized aluminum plate since the film, film development, and the pre-sensitized aluminum plate cost approximately $3. The use of a photo-direct plate for short runs of 30 or more copies should provide a cost that is approximately the same as that expressed for large runs of 300 or more copies, since this plate costs less than 30 cents. At the moment only the Multilith Special Black MLPD 310-2 ink has proven satisfactory with the photo-direct plates. For short, black ink runs the photo-direct plate appears practical.

The use of more than one color increased the cost. The process used in this research involved the making of a complete set of plates and a complete run for each color. Thus, each color increased the transparency cost by another three cents. Operator's time is increased with the addition of each color due to the need for exceptional registration. By this calculation, a four-color transparency would have about a 12 cent production cost.

Original artwork has not been included in the cost estimate. This cost varies drastically from plate to plate and from one type of artist to another. Many of the drawings included in this set required eight to ten hours of artwork. On the other hand some required as little as one hour. Some were produced by the use of student labor, others by commercial artists. In this project artwork averaged $6 per plate. The researcher feels the artwork in this case was above average in difficulty and time required for accomplishment. He also recognizes the tremendous variation in cost of artwork from one location to another. Therefore, this figure is by no means a stable one.

At this point it is not possible to determine depreciation of equipment. The use of the dust may reduce the life expectancy of the offset equipment, although we have no indication of this to date.

Rent and utilities were provided by Clemson University. No controls were possible which would enable a determination of such a charge.

C. Analysis of the Need for Materials of This Nature as Expressed by Agricultural Teachers

Teachers evaluating the overhead transparencies were asked to report on the need for teaching materials of this nature. Table 7

reveals the existence of a great need for materials of this nature.

Table 7

TEACHERS' ATTITUDE TOWARD NEED OF THIS TYPE OF TRANSPARENCY MATERIAL

Degree of Need		
Great Need	Some Need	Little or No Need
38	1	0

When asked about the continuation of this type of effort they again responded overwhelmingly to the effect that the transparency production should continue. As Table 8 indicates, two felt major improvements were needed. No one felt the efforts should be discontinued.

Table 8

ATTITUDE OF TEACHERS TOWARD CONTINUATION OF TRANSPARENCY PRODUCTION BY TECHNIQUES UTILIZED IN THIS PROJECT

Definitely Continue	Continue But Make Major Improvements	Discontinue the Efforts
37	2	0

There was a wider difference of opinion as to the best approach to the production and distribution of these transparencies to teachers. Table 9 indicates teachers differed as to who should perform these functions.

Table 9

BASIS OF OPERATION OF PRODUCTION FACILITY TEACHERS RECOMMENDED FOR CONTINUATION OF PRODUCTION OF OVERHEAD TRANSPARENCIES

Basis of Production	Number
Local	0
On State basis	18
On Southern Regional basis	11
On State and Southern Regional basis	10

Eighteen of the respondents believed the production and distribution should be on the state basis, 11 believed it should be on a southern regional basis, and 10 expressed the view that it should be a combination of state and regional.

V. THE POTENTIAL OF A REGIONAL CENTER FOR THE PRODUCTION OF OVERHEAD TRANSPARENCIES

On or about October 15, a letter was sent to each of the state directors of vocational education in the United States Office of Education Administrative Region IV. The same letter was also sent to each state supervisor of vocational agriculture and to a head teacher educator in vocational agriculture in each state of this region. A copy of each of the letters is included in Appendix III.

The individuals mentioned were asked to respond to several questions designed to indicate the need and participation potential of the development of a regional center for the production of overhead transparencies. The results of this investigation are not at all conclusive at this moment. A number of the individuals have discussed the questions with this researcher either by personal contact or by telephone. Only three individuals have answered by mail. All of the individuals expressed the view that there is a tremendous need for materials of this nature, and they all feel that a regional center would be desirable for the production of many such materials. Lack of written communication on this point appears to be due to the fact that the individuals involved do not feel that they can, at this time, make any definite statements concerning their state's participation in a regional center, nor can they adequately define all of the legal barriers that may exist in regard to such participation.

All of the directors, head teacher educators, and state supervisors that have talked to the researcher have indicated that they feel this particular phase of this project should be investigated further. However, it appears that in order to fully investigate the problem at hand, the researcher will have to spend a considerable amount of time in informally investigating this problem with state directors, state departments of education, and perhaps even the various attorney generals of the states involved. A conclusive evaluation, presented at this time, is thus impossible to present.

APPENDIX I

TRANSPARENCIES PRODUCED ON MECHANICAL POWER TRANSMISSION

POWER TRANSMISSION IN AGRICULTURAL MACHINERY

The overall objective for the development of this set of overhead transparencies was the desire to assist teachers develop with students of vocational agriculture some of the basic principles of power transmission. This set is designed as a beginning unit in the study of agricultural machinery. It is not planned as a repair, overhaul, or assembly unit. Rather, it is felt that if students understand these basic principles prior to making repairs or overhauls, they will be in a better position to effectively understand such processes.

The overhead transparencies are not designed as a single teaching tool--instead they are designed as an additional aid. Their effectiveness will depend on the degree to which you as a teacher design a teaching program that makes use of all good teaching techniques and aids.

This set of overhead transparencies has many striking similarities to the materials published by the American Association for Agricultural Engineering and Vocational Agriculture. This similarity has been developed on purpose. It was felt that many of these publications are at the present time in the hands of teachers of vocational agriculture. The entire development process has also been with the approval and able assistance and the encouragement of this organization and its coordinator, Mr. Ed Henderson.

Others have been involved in many ways in this publication. Mr. J. T. Craig of the Agricultural Engineering Department of Clemson University has been of great assistance. The following industrial firms have donated basic materials that have made construction of this set of transparencies possible:

Allis Chalmers Company

American Oil Company

J. I. Case and Company

Cockshutt Farm Equipment of Canada, Limited

Gulf Oil Company

Hoover Ball and Bearing Company

International Harvester Company

John Deere and Company

Link-Belt Company

Massey Ferguson Company

New Departure-Hyatt Bearings

Tractor Division of the Ford Motor Company

In addition, a number of individuals have advised as to the type of materials that should be included. These individuals also agreed to assist with the testing of this material. They are:

David Bottoms, Professor of Agricultural Education,
Auburn University

Lowery H. Davis, Head, Department of Agricultural Education,
Clemson University

W. W. McClure, Assistant Supervisor of Agricultural Education,
State of North Carolina

J. H. Mitchell, Assistant Supervisor of Agricultural Education,
State of Georgia

C. J. Rogers, Associate Professor, Department of Agricultural
Engineering, University of Florida

Howard Turner, Staff Member of the American Association for
Agricultural Engineers and Vocational Agriculture

Tom Wakeman, Professor of Farm Mechanics Education,
Virginia Polytechnic Institute

The artist draftsman team consisted of Raymond Fedele and Pat Crowther, students at Clemson University, who developed the basic artwork and lettering for each transparency.

SUGGESTED ACTIVITIES

1. Review basic information on gears found in following publications:

   Mechanical Power Transmission, p. 25-30
   Tractor Transmissions, p. 3-4
   Farm Machinery and Equipment, p. 30-32
   Tractors and Crawlers, p. 40-45
   Mechanical Power Transfer Systems, p. 16-17
   Farm Gas Engines and Tractors, p. 482-483
   Rural Arithmetic, p. 114-116

2. Select student study materials.

3. Collect various kinds of gears. Have students classify these according to the basic types projected on the transparency.

4. Locate various kinds of gears on farm machinery.

classify these according to the ... type ...
projected on the transparency.

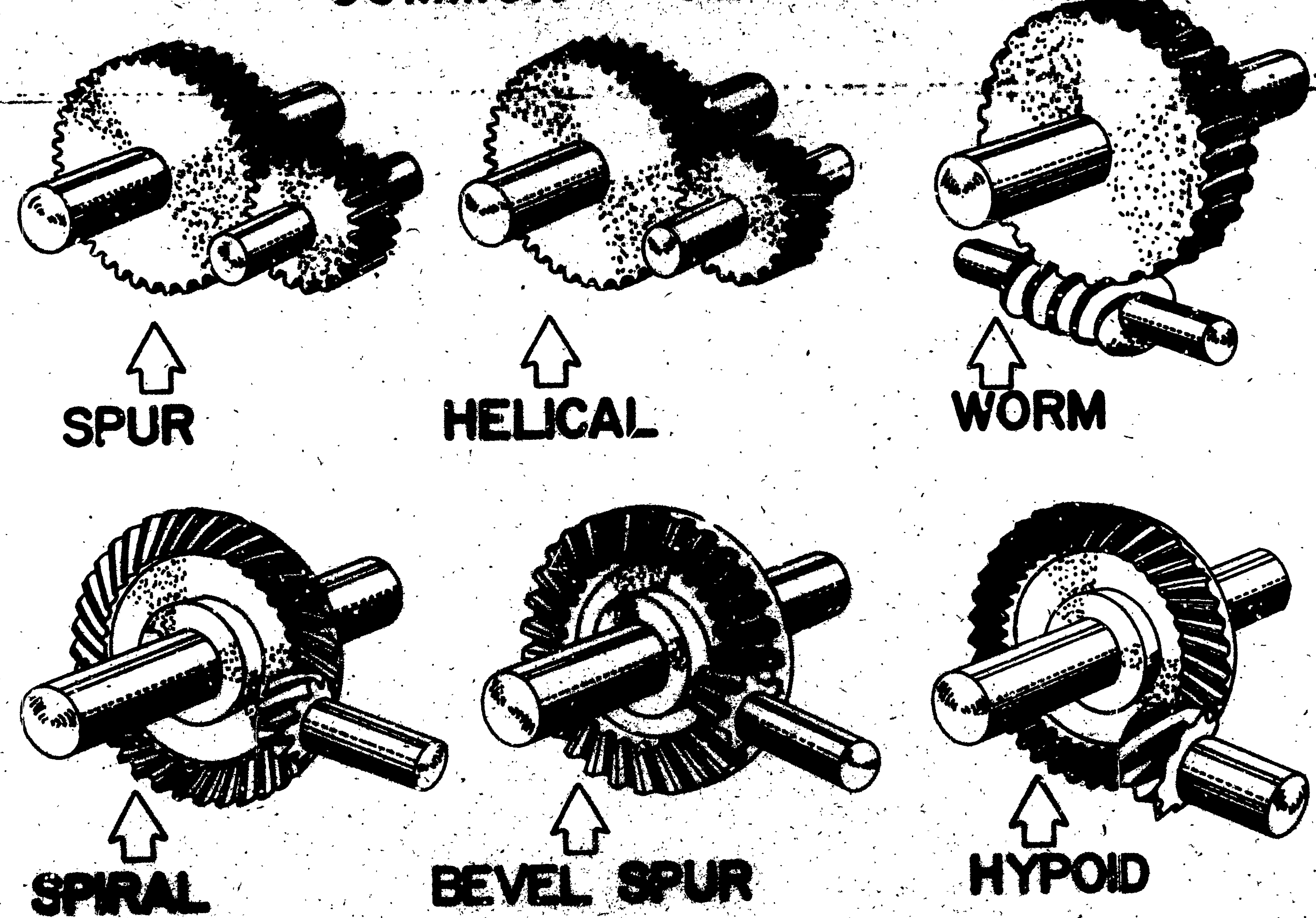
4. Locate various kinds of gears on farm machinery.

5. Discuss the uses of gears in power transmission. Go to various kinds of farm machinery to determine how various gear drives are used.

6. Present various problems to students on speed, direction of power transmission and gear ratio. See Rural Arithmetic.

7. Select some actual gear drives on farm machines. Determine speed, gear ratio, direction of power transmission, etc.

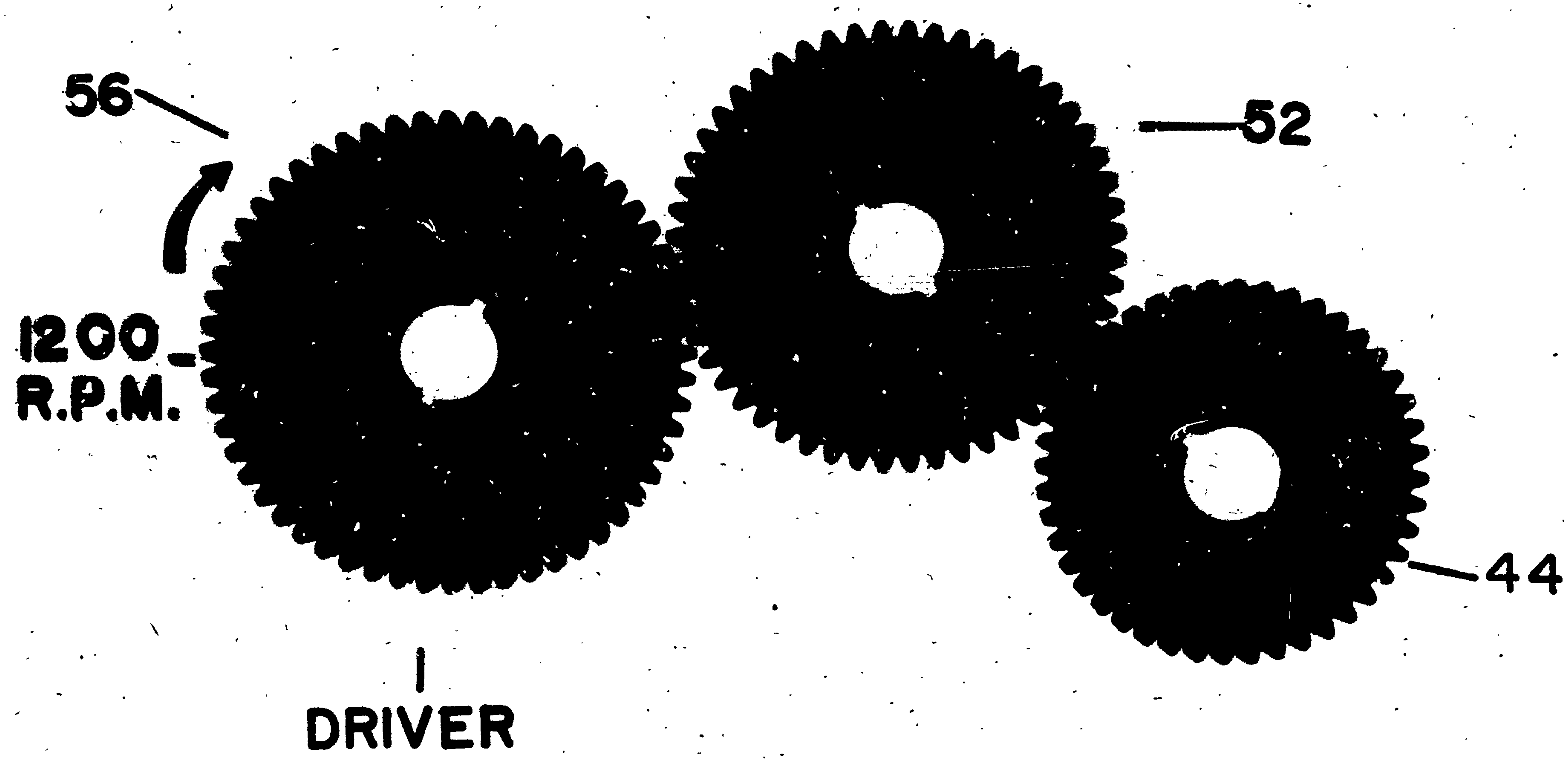
COMMON GEARS



Department of Agricultural Education, Clemson University

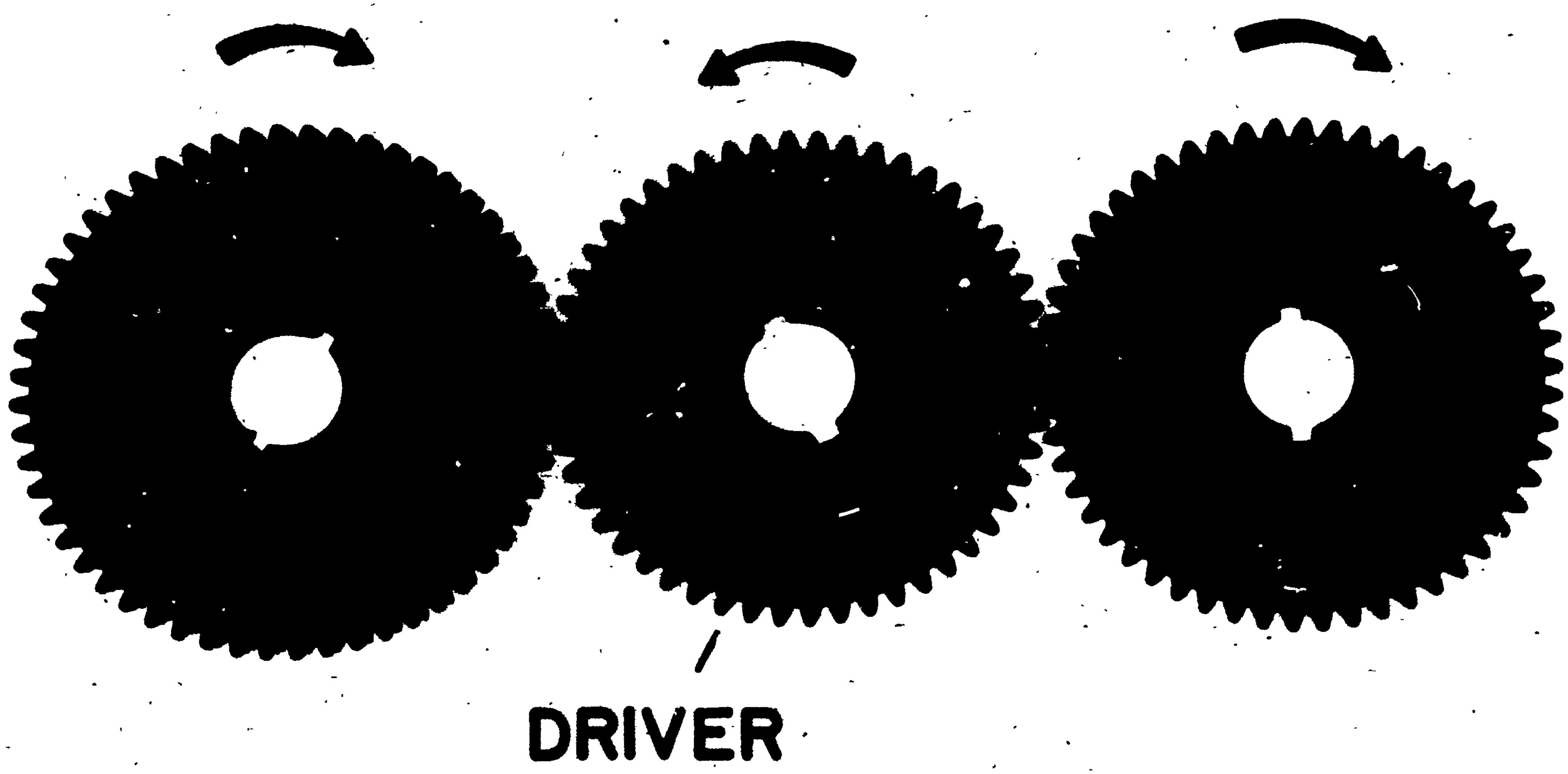
850/60
Sheet 1

GEARS ARE USED TO CHANGE SPEED



Department of Agricultural Education, Clemson University 850/60
U.S.O.E. Grant Number OEG 2-068320-1103 Gear 2

GEARS ARE USED TO CHANGE THE DIRECTION OF POWER TRANSMISSION



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U.S.O.E. Grant Number OEG 2-068320-1103 Gear 3

GEAR SPEED

R.P.M. X NO. OF TEETH (OF DRIVE GEAR) = R.P.M. X NO. OF TEETH (OF DRIVEN GEAR)

EXAMPLE:

IF A GEAR WITH 10 TEETH REVOLVES AT 250 R.P.M. AND DRIVES A GEAR WITH 60 TEETH, HOW MANY R.P.M. WOULD THE GEAR WITH 60 TEETH MAKE ?

$$240 \times 10 = X \times 60$$
$$240 = 60X$$
$$40 = X$$

GEAR RATIOS

GEAR RATIO IS DETERMINED BY COMPARING THE NUMBER OF TEETH ON THE DRIVEN GEAR WITH THE NUMBER OF TEETH ON THE DRIVING GEAR.

EX.1 DRIVEN GEAR HAS 60 TEETH
DRIVING GEAR HAS 30 TEETH
GEAR RATIO IS 2:1

2. DRIVEN GEAR HAS 30 TEETH
DRIVING GEAR HAS 60 TEETH
GEAR RATIO IS 1:2

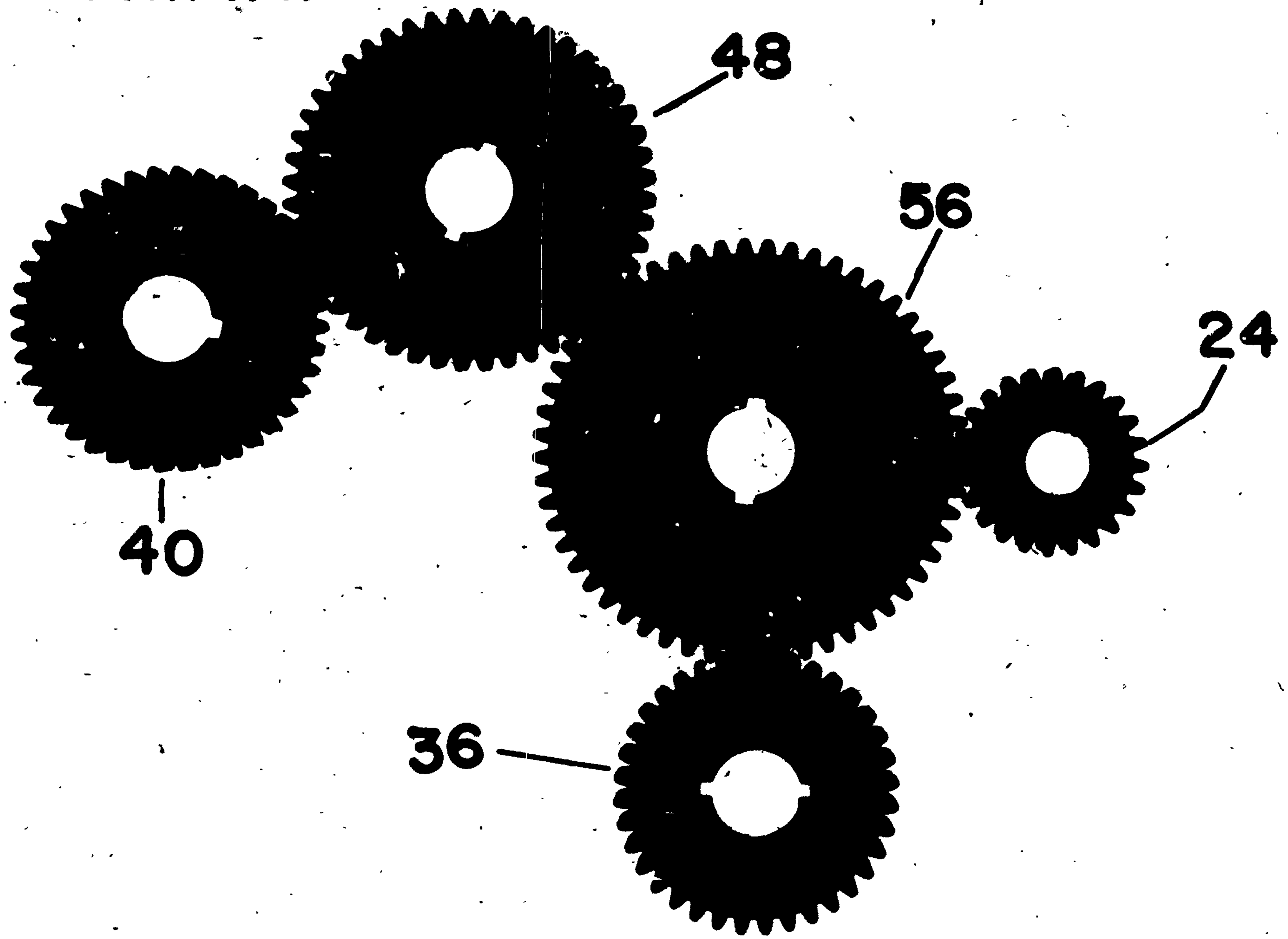
3. DRIVEN GEAR HAS 12 TEETH
DRIVING GEAR HAS 48 TEETH
WHAT IS THE GEAR RATIO? ____

4. DRIVEN GEAR HAS 36 TEETH
DRIVING GEAR HAS 48 TEETH
WHAT IS THE GEAR RATIO? ____

5. DRIVEN GEAR HAS 48 TEETH
DRIVING GEAR HAS 16 TEETH
WHAT IS THE GEAR RATIO? ____

DETERMINE ON EACH DRIVEN GEAR:

1. DIRECTION OF ROTATION
2. GEAR RATIO
3. R.P.M.



Department of Agricultural Education, Clemson University 830/60
U.S.O.E. Grant Number OEG 2-068320-[illegible]03 Gear 6

DRIVER - 1200 R.P.M.

DRIVER
3600 R.P.M.

REFERENCES

Mechanical Power Transfer Systems, p. 15-17
Mechanical Power Transmission, p. 16-20
Farm Machinery and Equipment, p. 28-29
Tractors and Crawlers, p. 59-64
Selecting and Maintaining Field Mowers, p. 103-108

SUGGESTED ACTIVITIES

1. Locate various uses of chains in agricultural machinery.

2. Study the classification and uses of each type of chain. Make a collection of various types of chains and sprockets.

3. Demonstrate and work up student exercises on removal and replacement of chains.

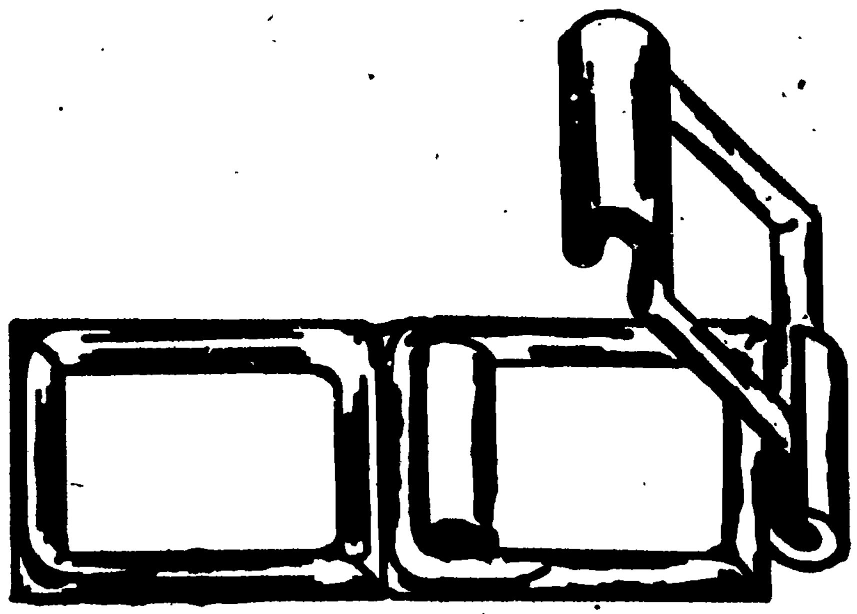
4. Using the same formulas as for gears, determine speeds various sprockets travel knowing the speed

5. Create various situations whereby students can develop an understanding the effects sprocket size has on the uses and effectiveness of particular machines.

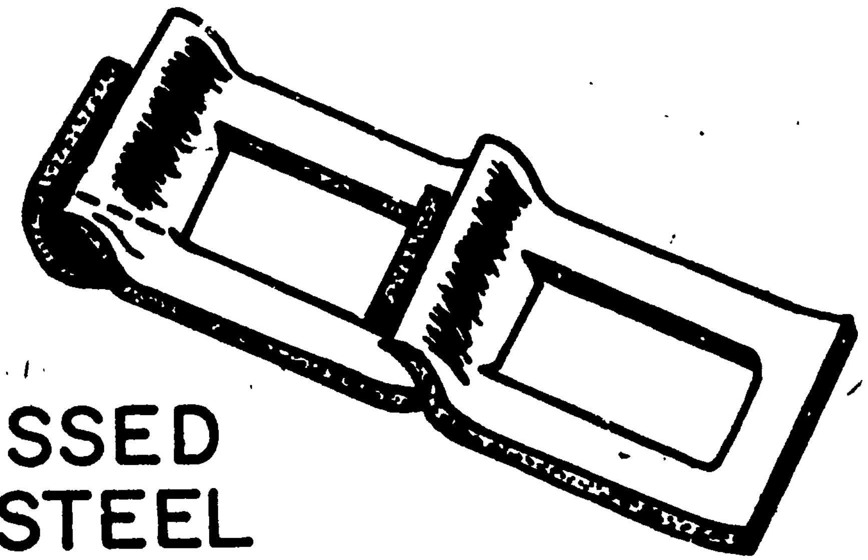
6. Examine wear on chains and sprockets.

7. Discuss lubrication of chains and sprockets.

8. Discuss safety in the use of chains on agricultural implements.



MALLEABLE
CAST IRON



PRESSED
STEEL

DETACHABLE-LINK CHAIN

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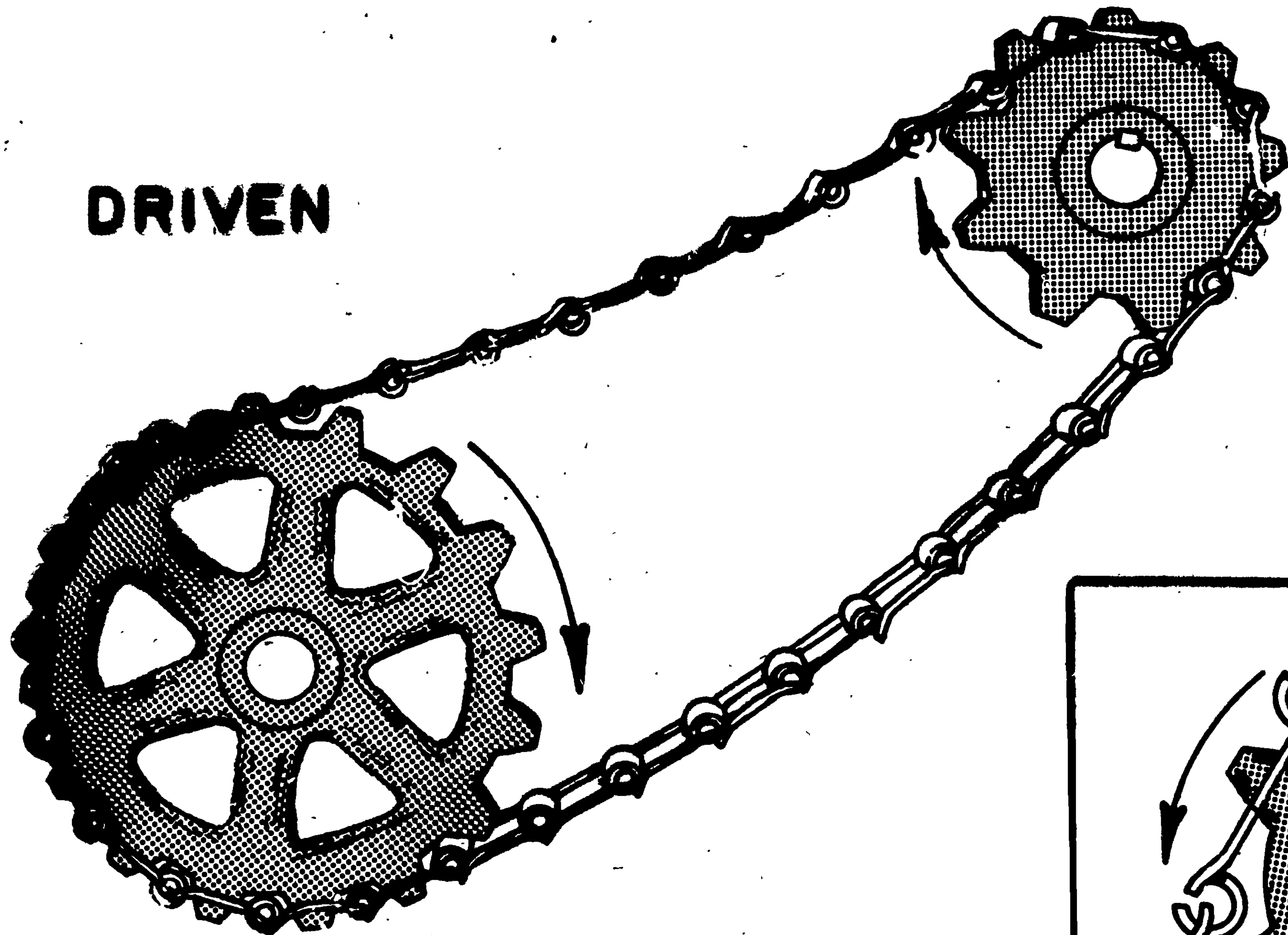
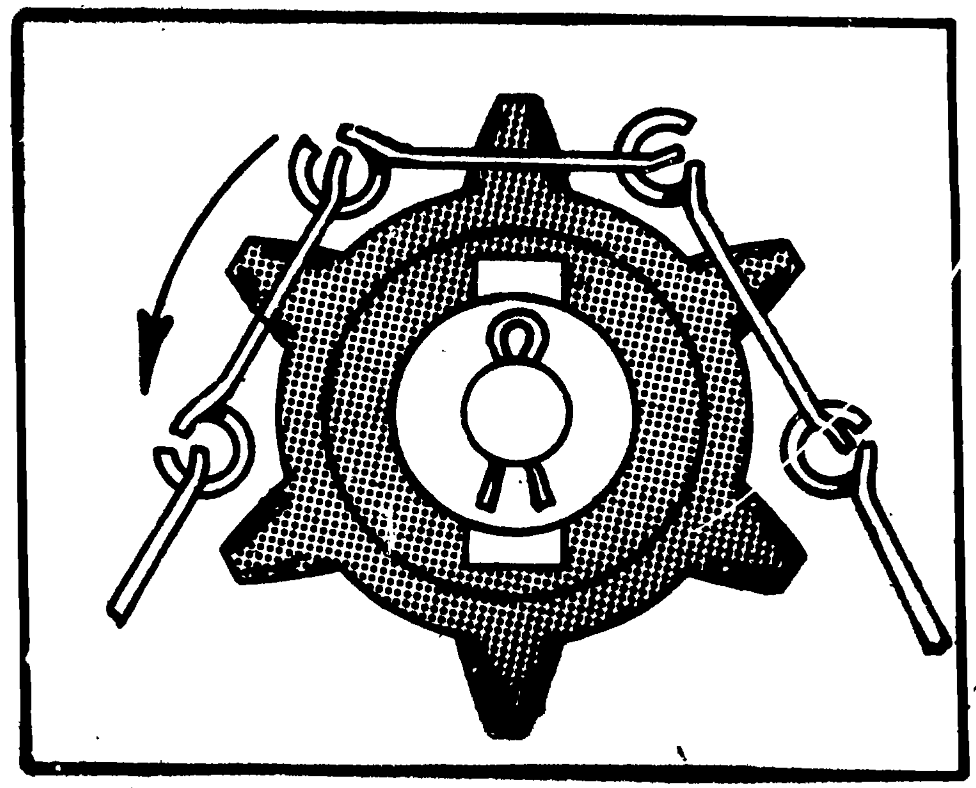
850/60
Chain Drive 1

PROPER ASSEMBLY OF DETACHABLE LINK CHAIN





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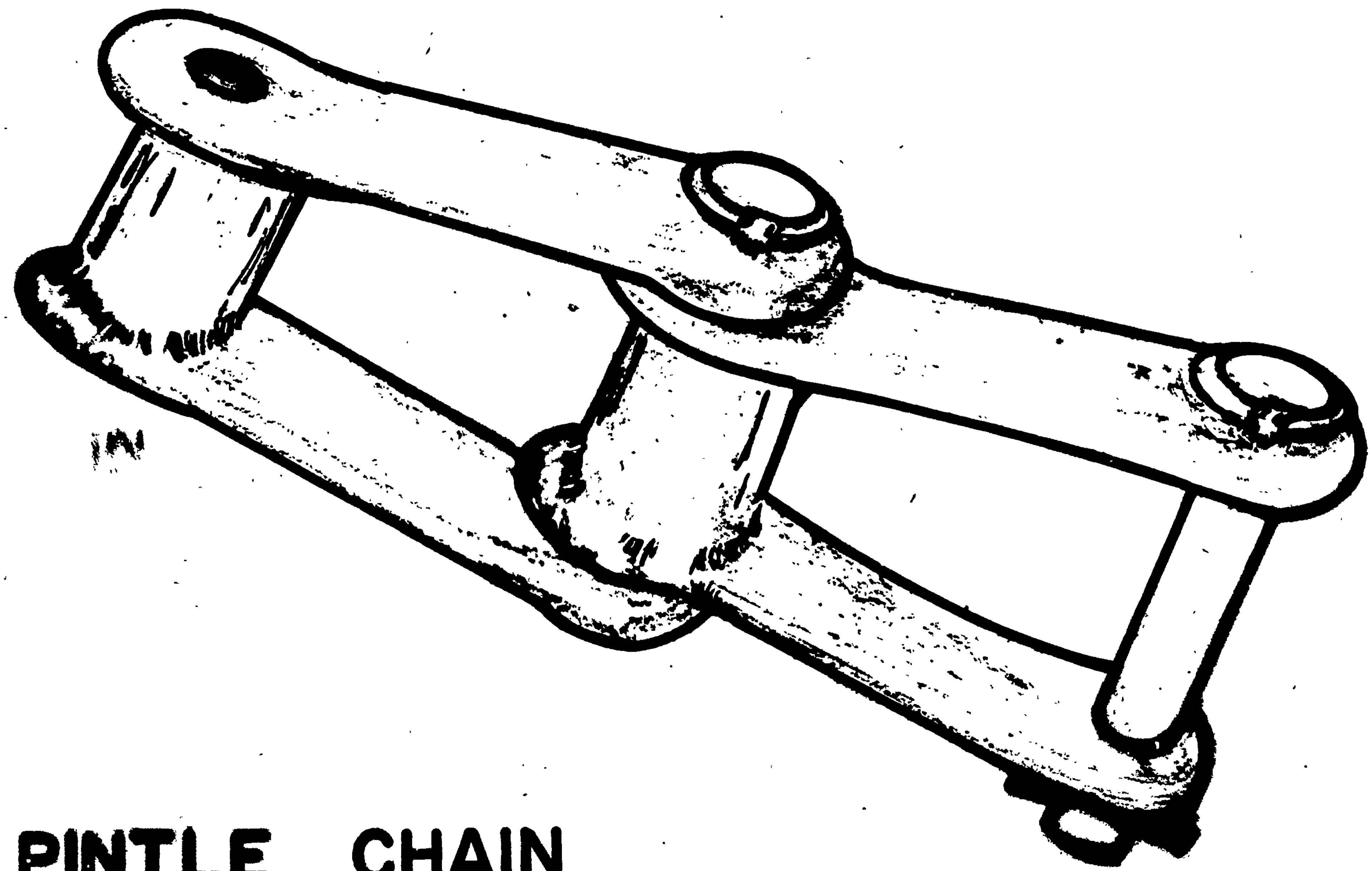
850/60
Chain Drive 2



PINTLE CHAIN

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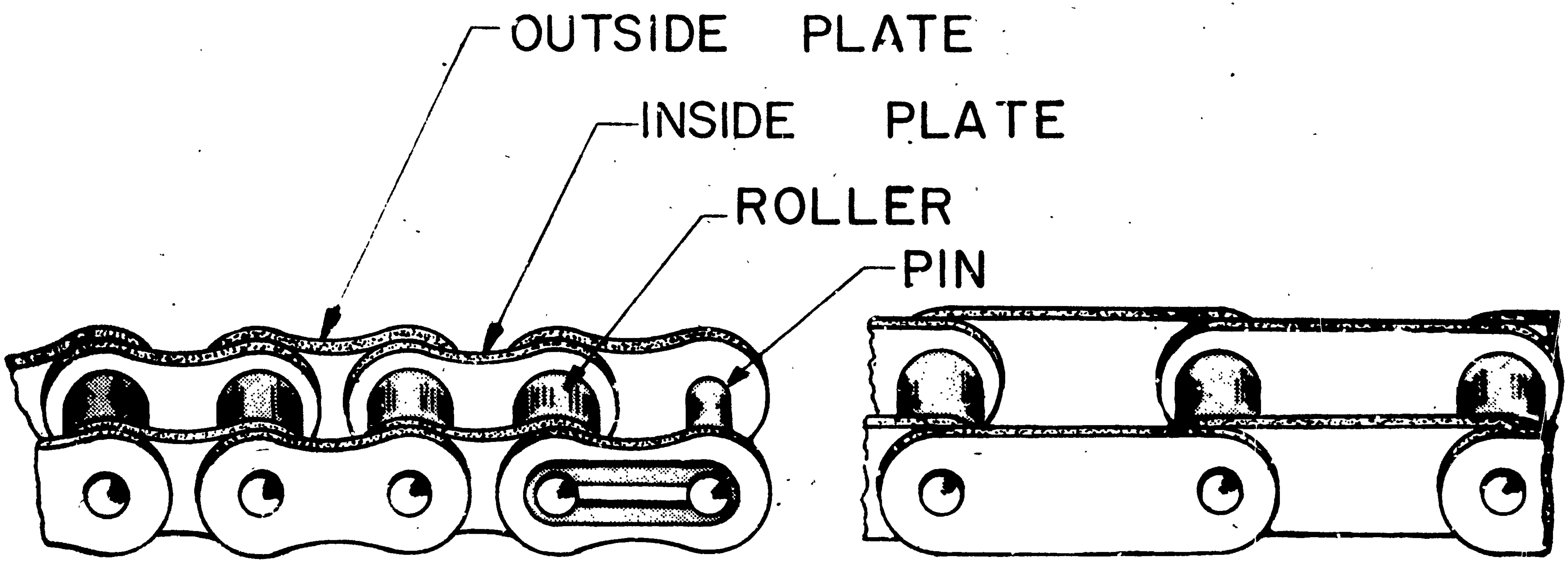
850/60
Chain Drive 3



STANDARD PITCH

DOUBLE PITCH

ROLLER CHAINS

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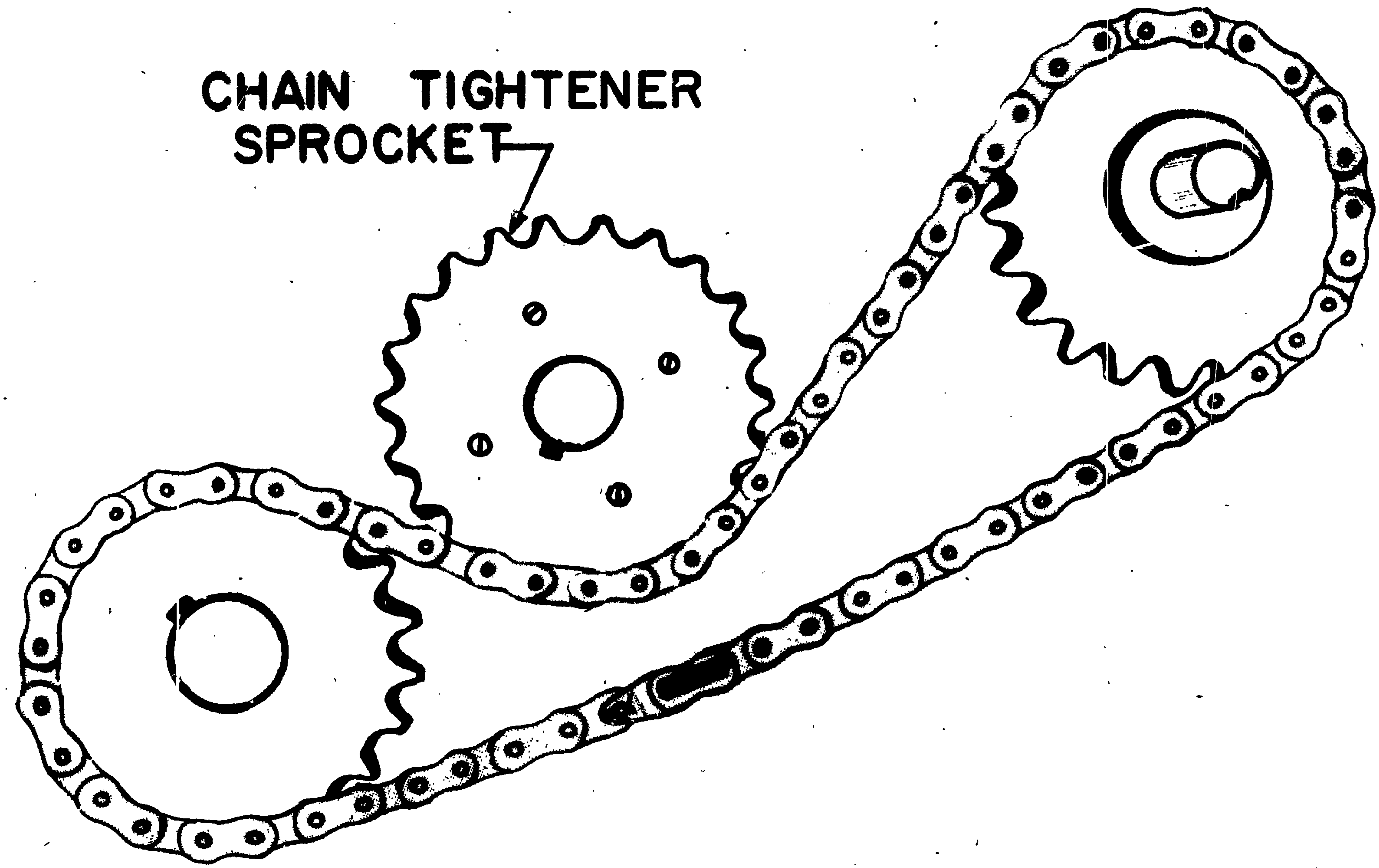
U.S.O.E. Grant Number OEG 2-068320-1103

850/60
Chain Drive 4



STEEL ROLLER CHAIN

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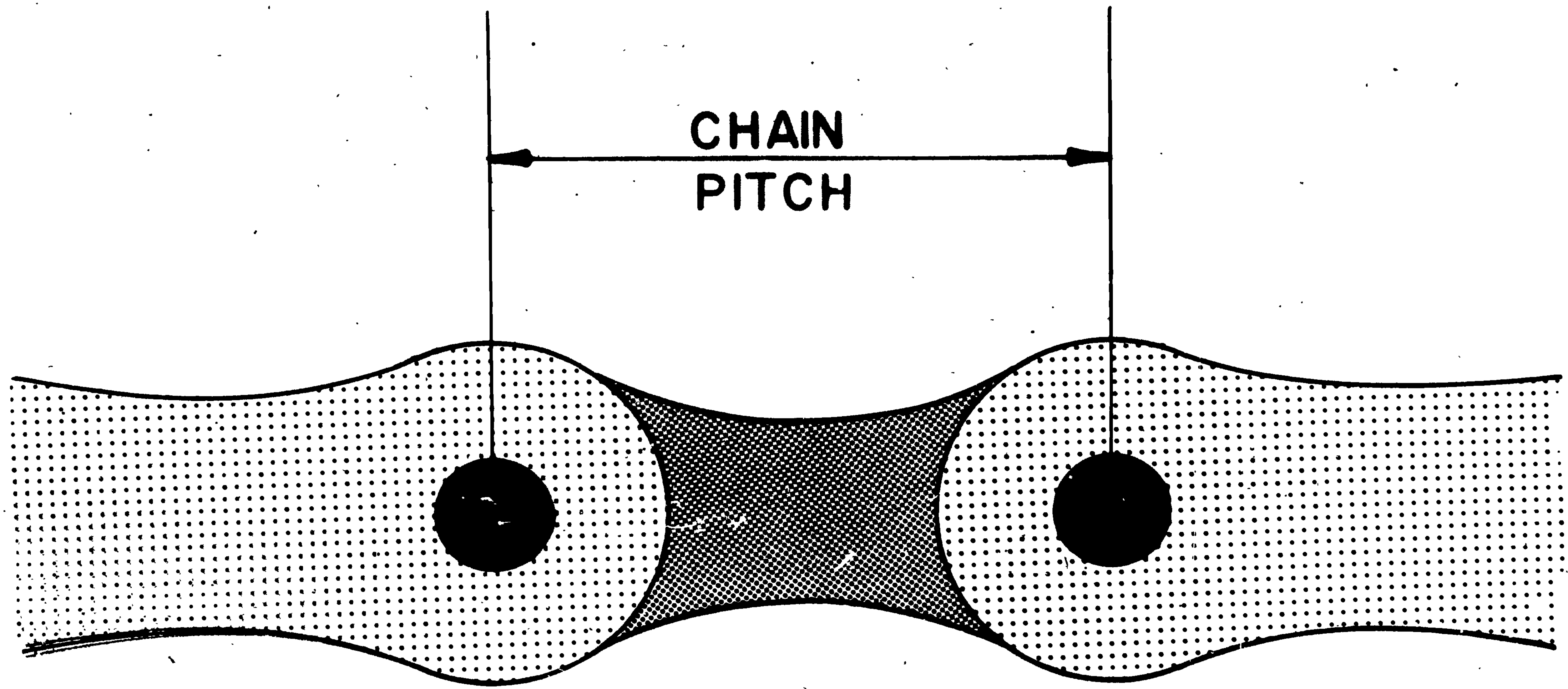
850/60
Chain Drive 5



DETERMINING PITCH ON ROLLER CHAINS

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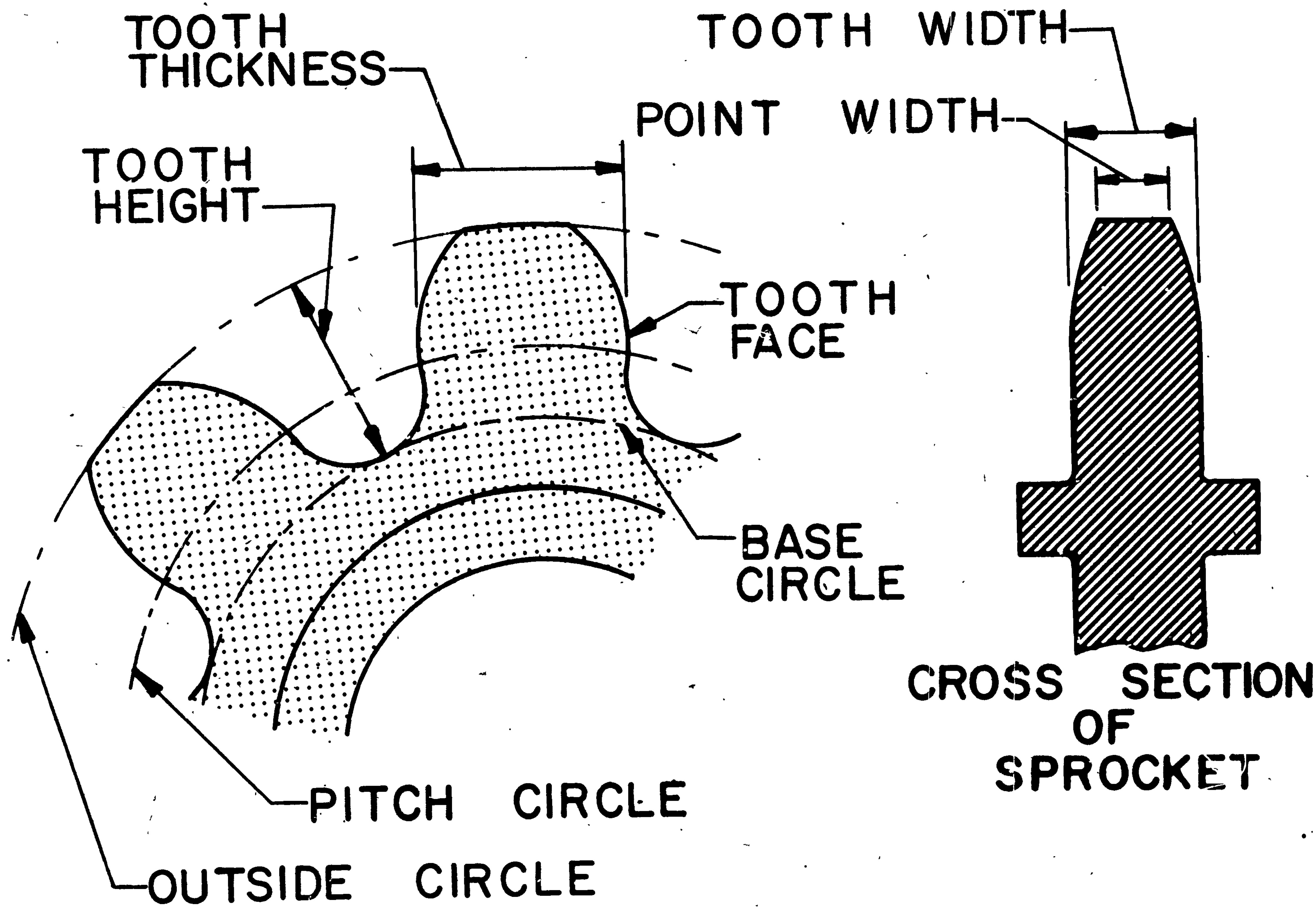
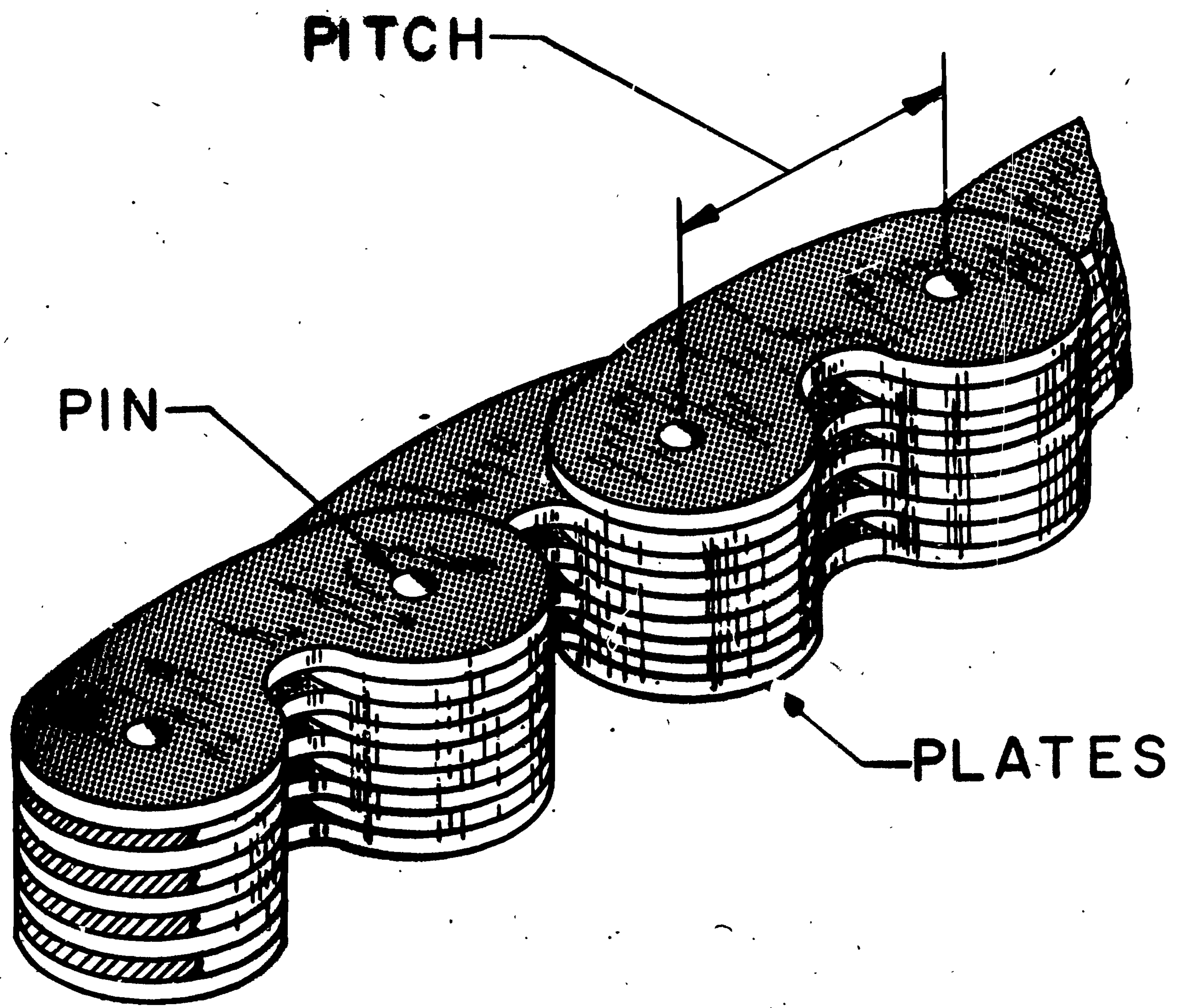
U.S.O.E. Grant Number OEG 2-068320-1103

830/60
Chain Drive 6



PARTS OF A CHAIN SPROCKET



SILENT CHAIN

CHARACTERISTICS OF CHAINS USED IN AGRICULTURAL MACHINERY

STANDARD PITCH ROLLER CHAINS

1. SATISFACTORY AT LINEAR SPEEDS OF 100 FPM TO 4500 FPM DEPENDING ON PITCH.
2. AS SPEED INCREASES THE PITCH MUST BE DECREASED.
3. MAY BE 98 TO 99 PER CENT EFFICIENT UNDER IDEAL CONDITIONS.
4. OIL BATH LUBRICATION DESIREABLE FOR HIGH SPEED DRIVES.
5. SPROCKETS MAY BE DRIVEN FROM EITHER SIDE OF ROLLER CHAIN.

DOUBLE PITCH ROLLER CHAINS

1. SATISFACTORY FOR SMALL SPROCKET SPEEDS OF UP TO 600 RPM.
2. SIMILAR TO STANDARD PITCH ROLLER CHAINS EXCEPT PITCH IS TWICE THE PITCH OF STANDARD.

DETACHABLE LINK CHAIN

1. USED AT SPEEDS UP TO 500 FPM.
2. LOW IN INITIAL COST.
3. IDEAL FOR CONVEYOR AND ELEVATOR WORK.
4. PROVIDE BETTER WEAR UNDER DIRTY CONDITIONS.
5. MALLEABLE CAST IRON CHAIN MORE RESISTANT TO CORROSION THAN STEEL.
6. PRESSED STEEL HAS LOWER INITIAL COST.

SILENT CHAIN

1. MORE SATISFACTORY AT HIGHER SPEEDS THAN ROLLER CHAIN.
2. HAS PRACTICALLY NO SLIDING ACTION.
3. MOST COMMONLY USED IN FINAL DRIVES OF TRACTORS.

REVIEW REFERENCES

Ball and Roller Bearings, p. 1-27
Tractor Transmissions, p. 4-10
Mechanical Power Transfer Systems, p. 21-25
Ball Bearings For Farm Implements, p. 1-40
Farm Tractors, p. 70-75, 88-93
Farm Machinery and Equipment, p. 40-44
Tractors and Crawlers, p. 64-81
Selecting and Maintaining Field Mowers, pp. 65, 67, 86-92

SUGGESTED ACTIVITIES

1. Develop an understanding with students as to the need for bearings in power transmission.

2. Distinguish between the two basic types of bearings: friction and anti-friction.

3. Study the types of forces exerted upon bearings.

4. Study the types of bearings.
   Have students locate the various types of bearings on various types of equipment.

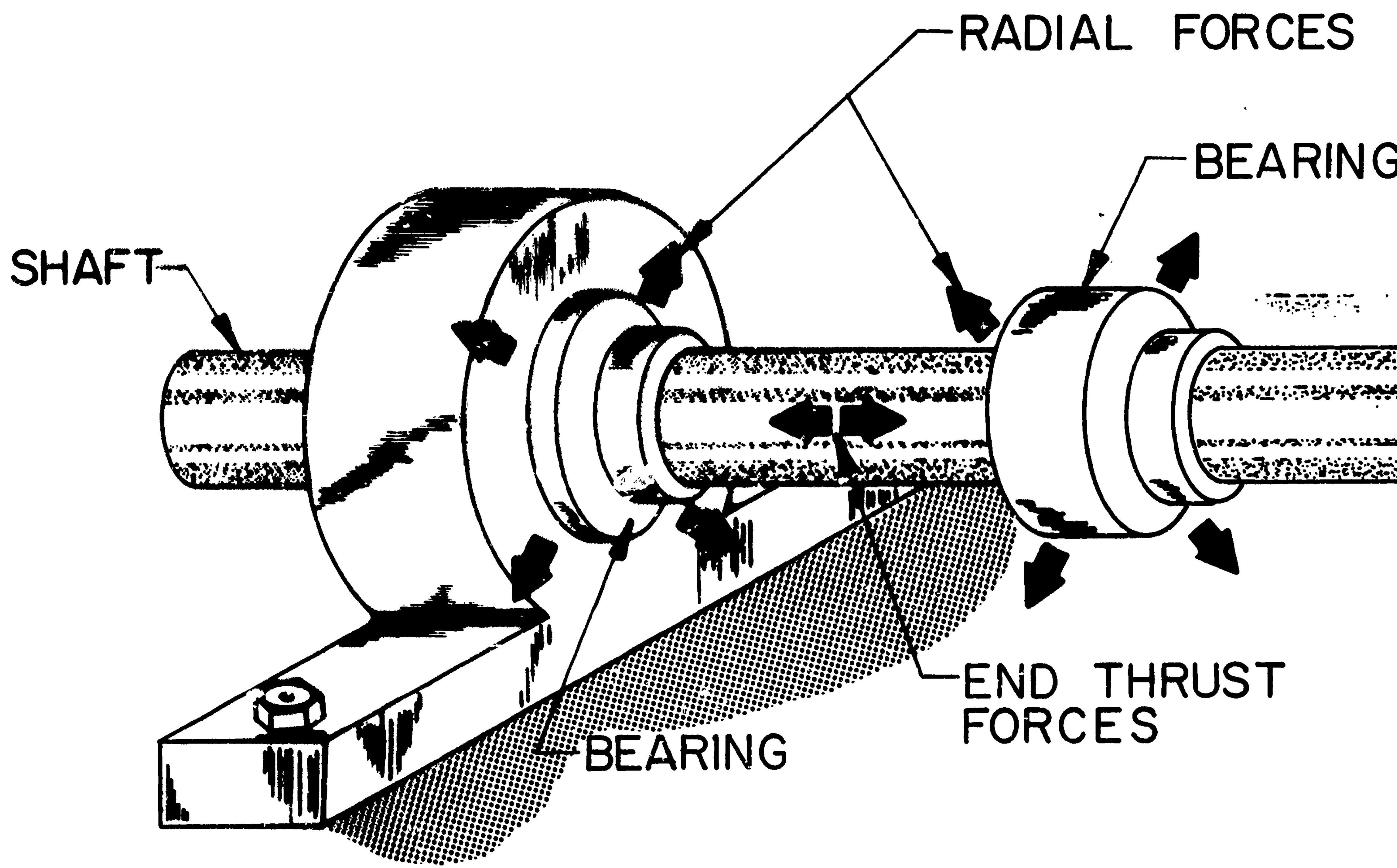
5. Obtain used bearings from implement dealers. Have students examine these. Disassemble them, study the construction of each, and determine the type. If practical have students mount these on a demonstration board.

6. Make sure students clearly understand the use of each type of bearing and the reasons for such use.

7. Study, demonstrate and practice removal and installation of bearings.

8. Review the importance of lubrication for long bearing life.

9. On the <u>Sealed, Prelubricated Ball Bearings</u> transparency note that the Flange Type Self Aligning can be relubricated, the other two types can not.



FORCES THAT MAY BE SUBJECTED UPON A BEARING

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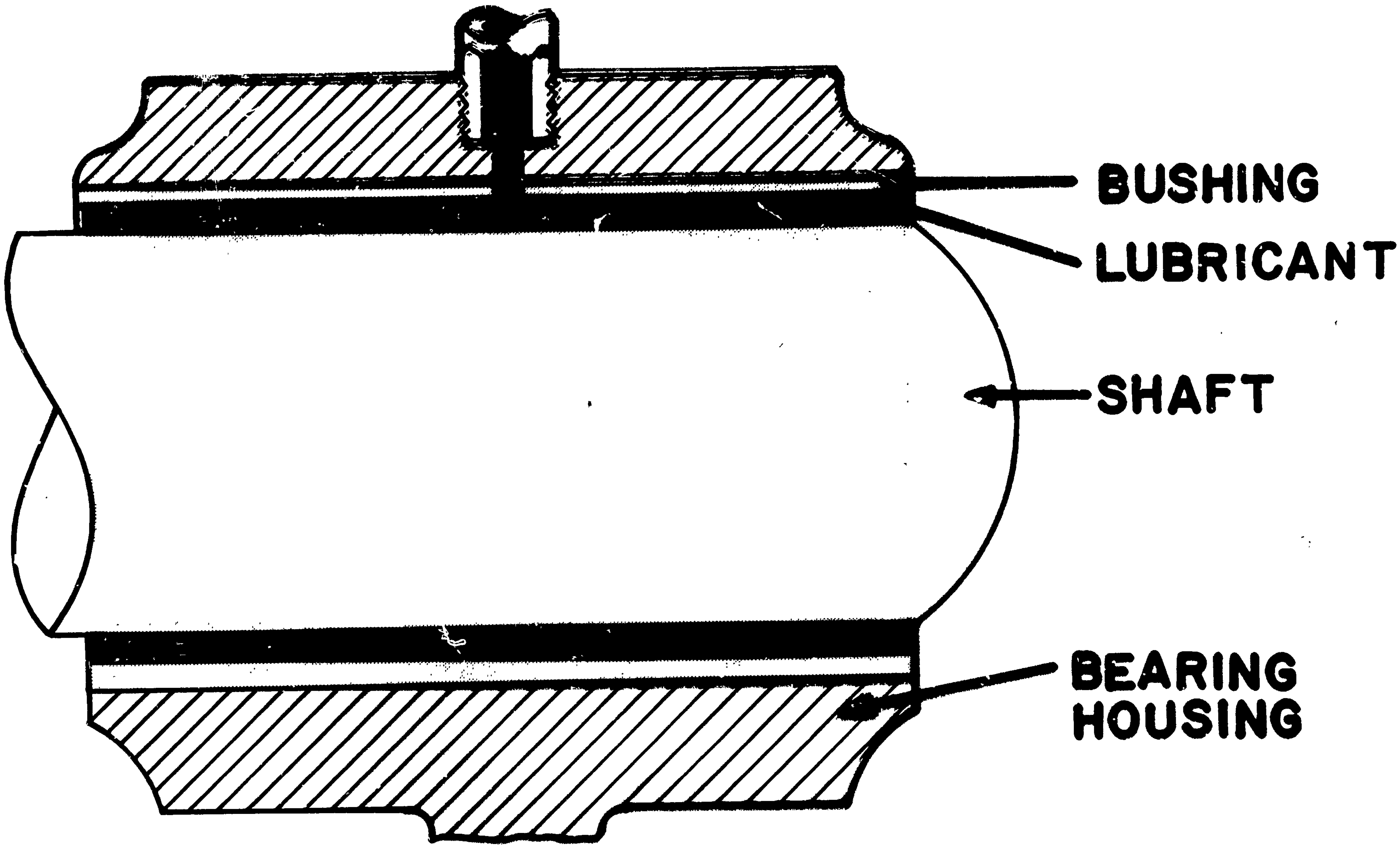
U.S.O.E. Grant Number OEG 2-06[illegible]-1103

CROSS-SECTION OF FRICTION TYPE BEARING



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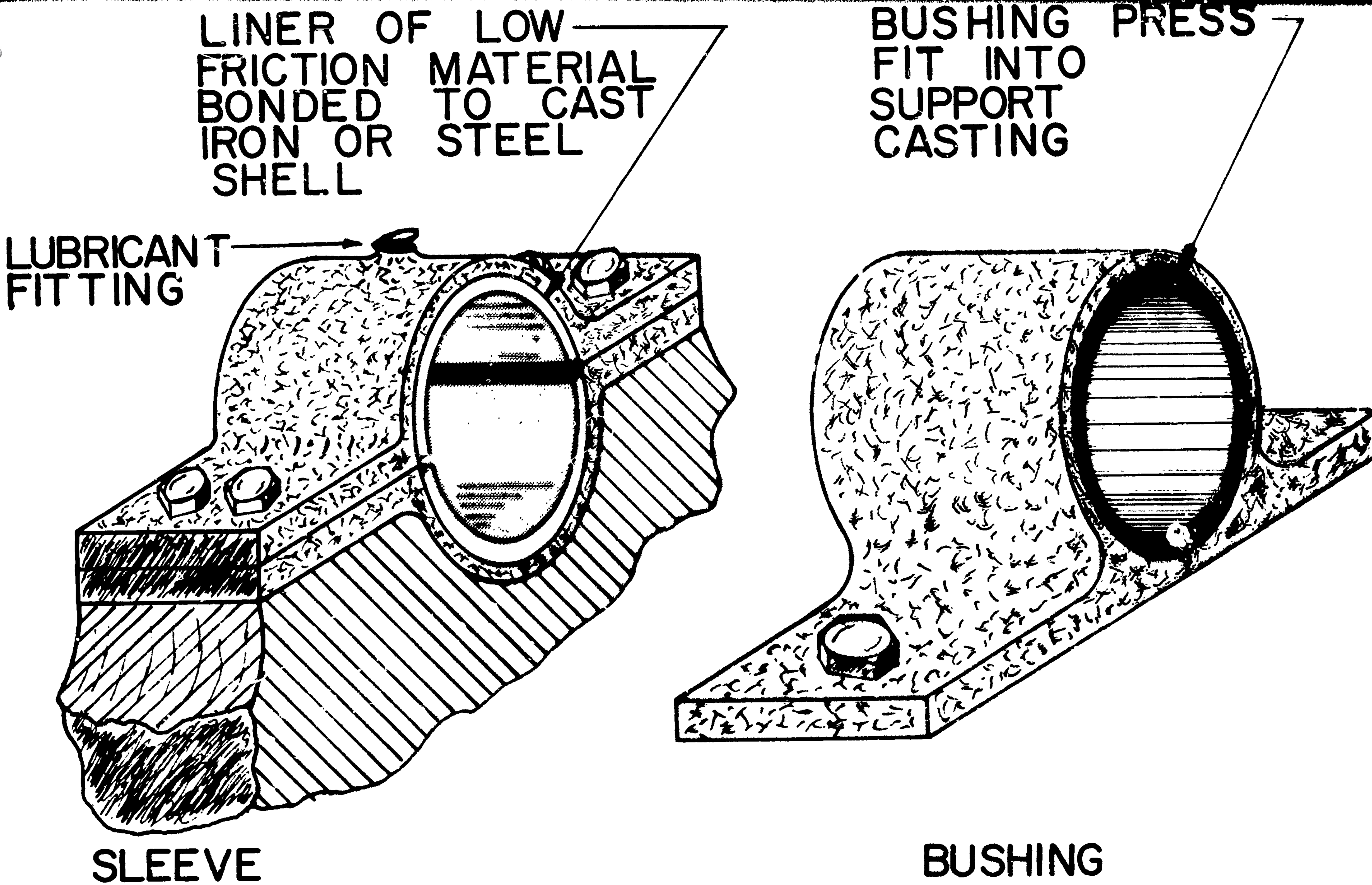
U.S.O.E. Grant Number OEG 2-068320-1103

830/10
Bearing 2



FRICTION OR PLAIN BEARINGS

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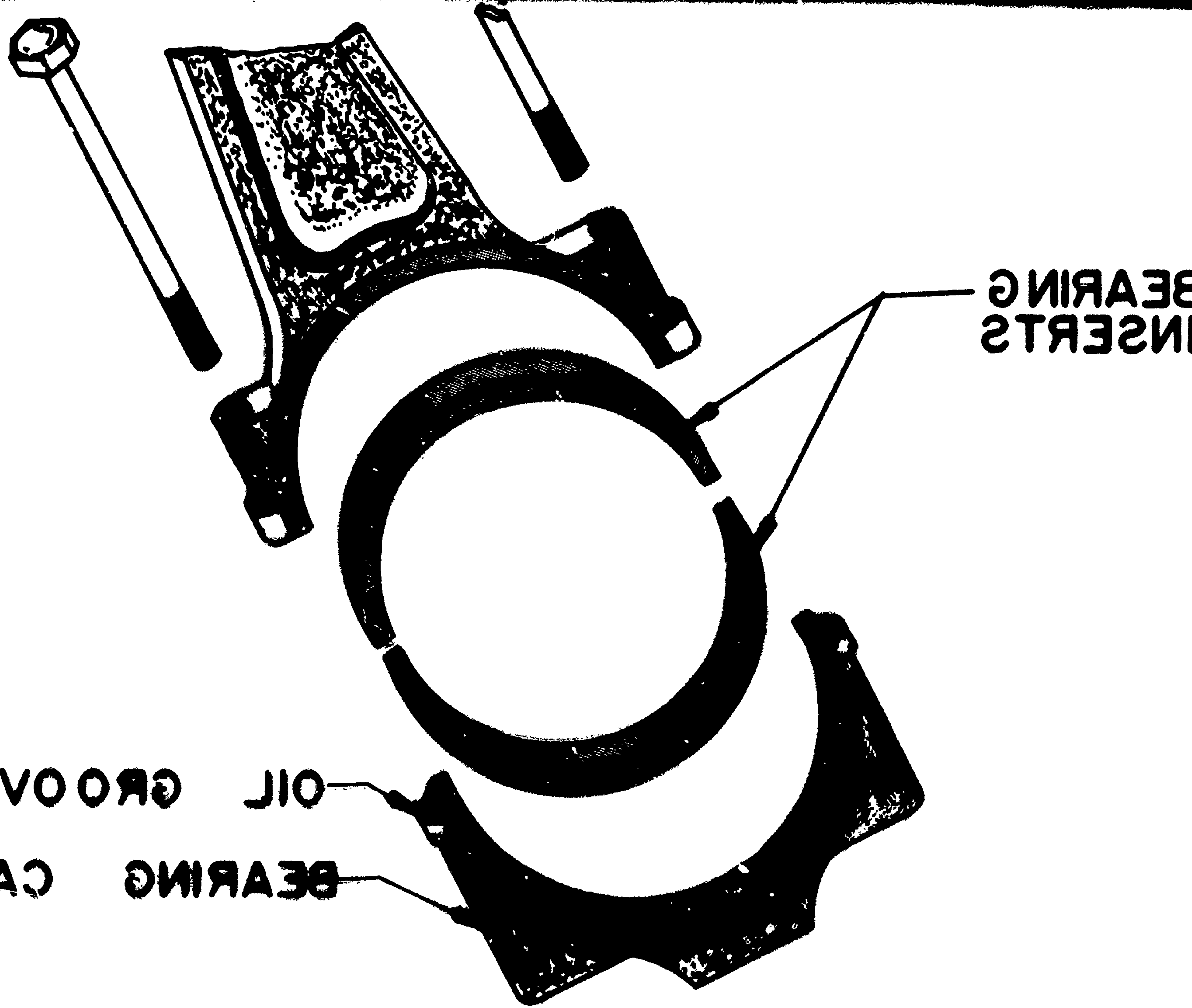
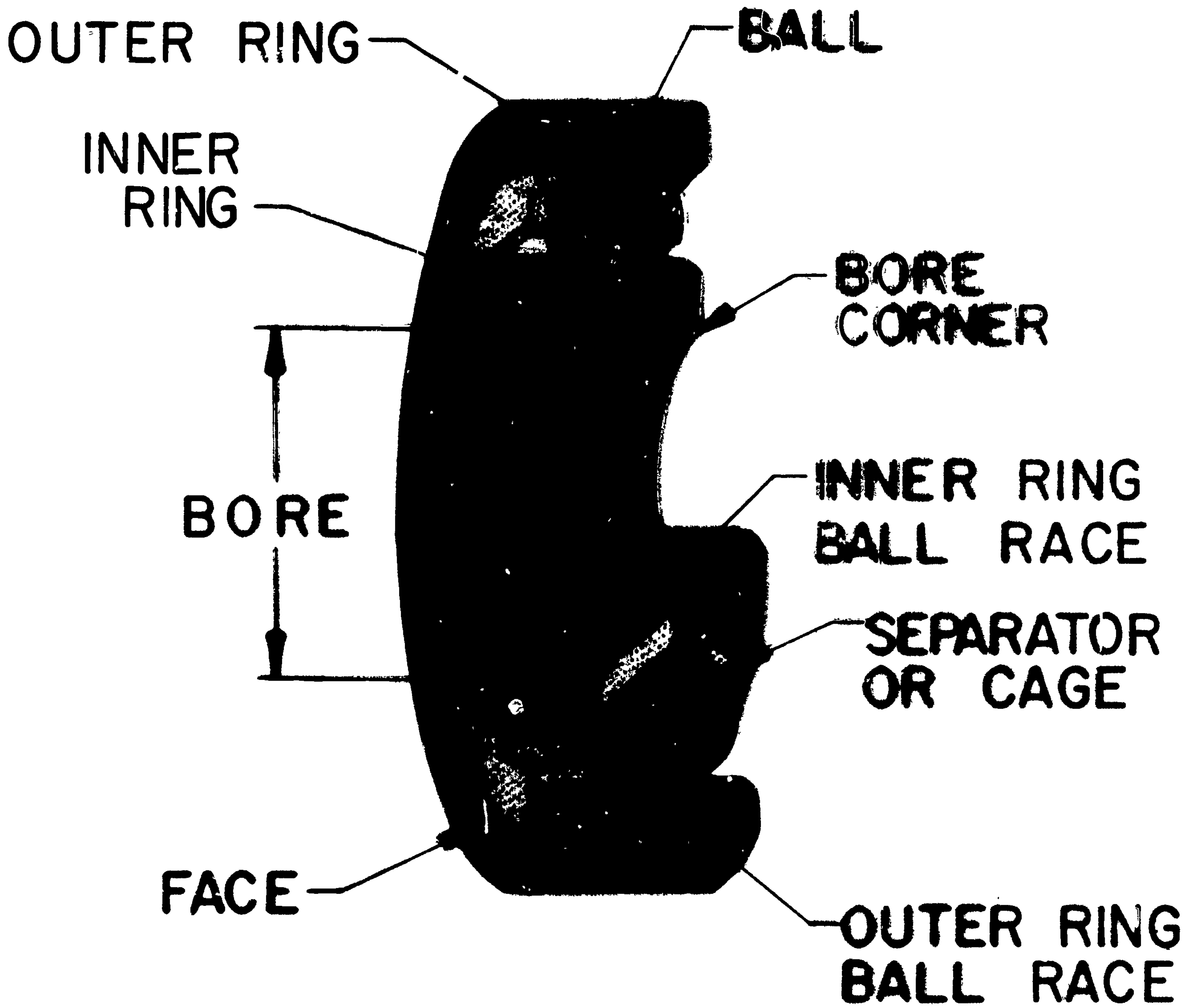
830/10
Bearing 3

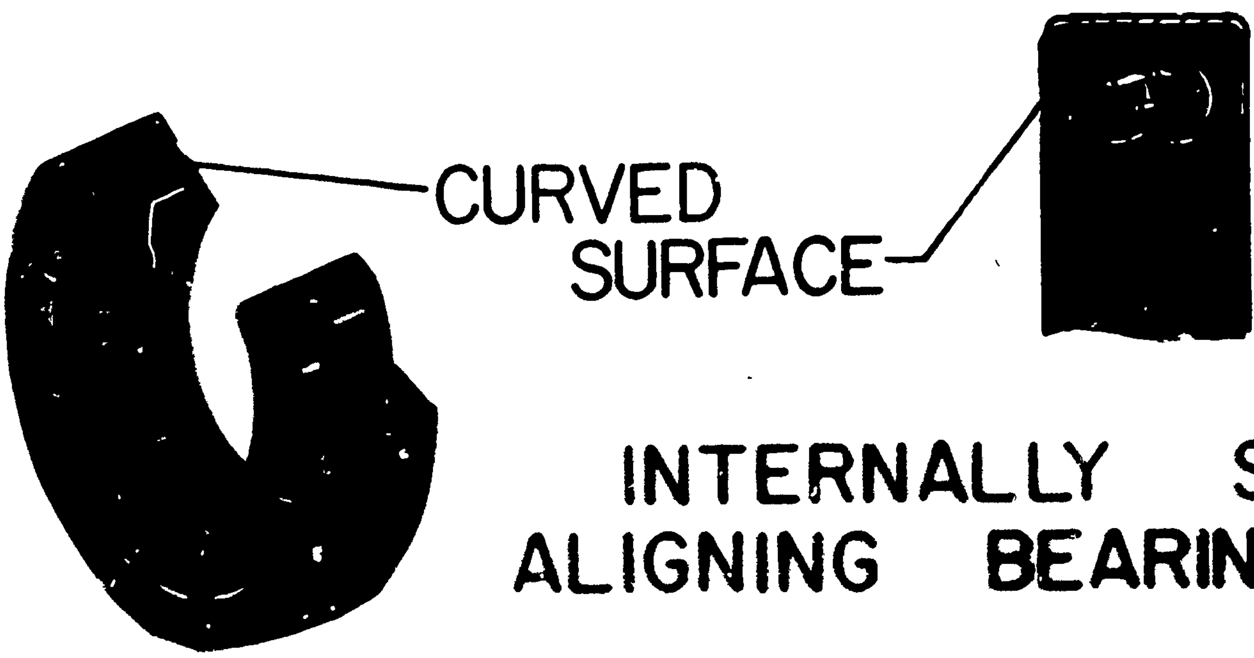


CONNECTING ROD SHOWING PRECISION INSERT BEARINGS

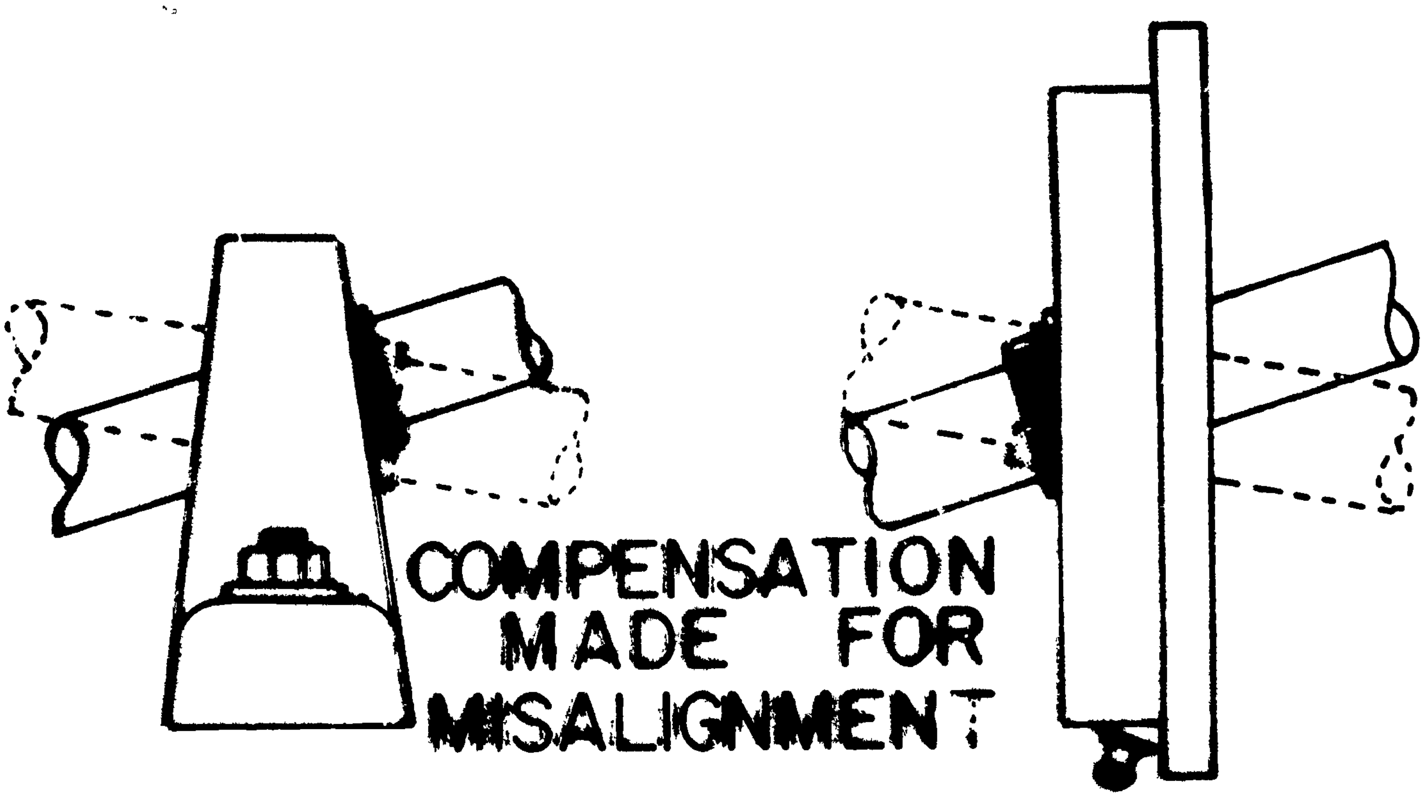


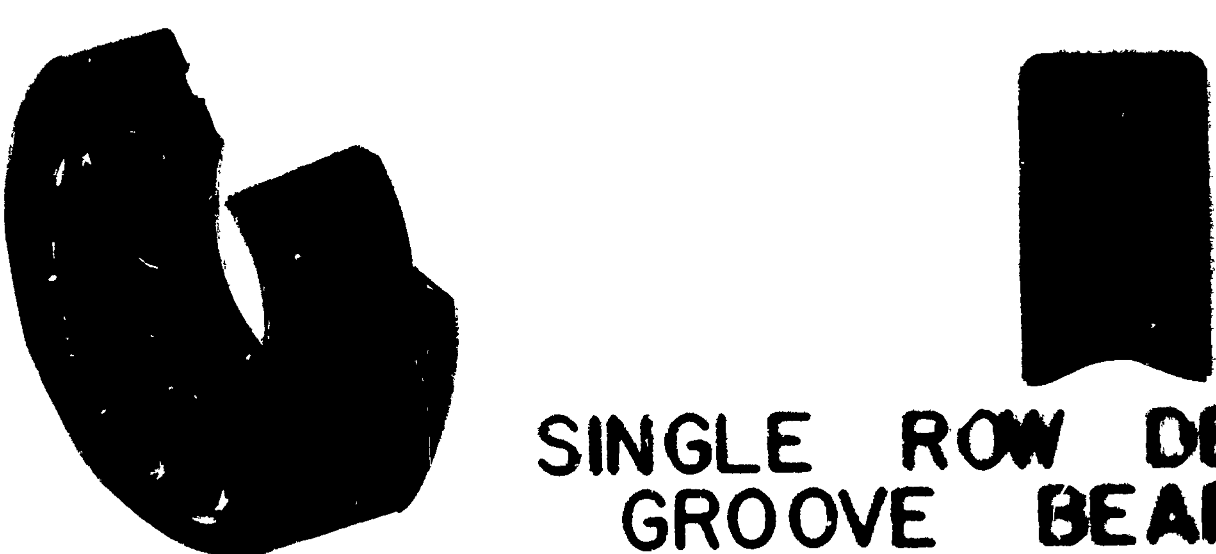
CROSS SECTION OF A BALL BEARING

BALL BEARINGS



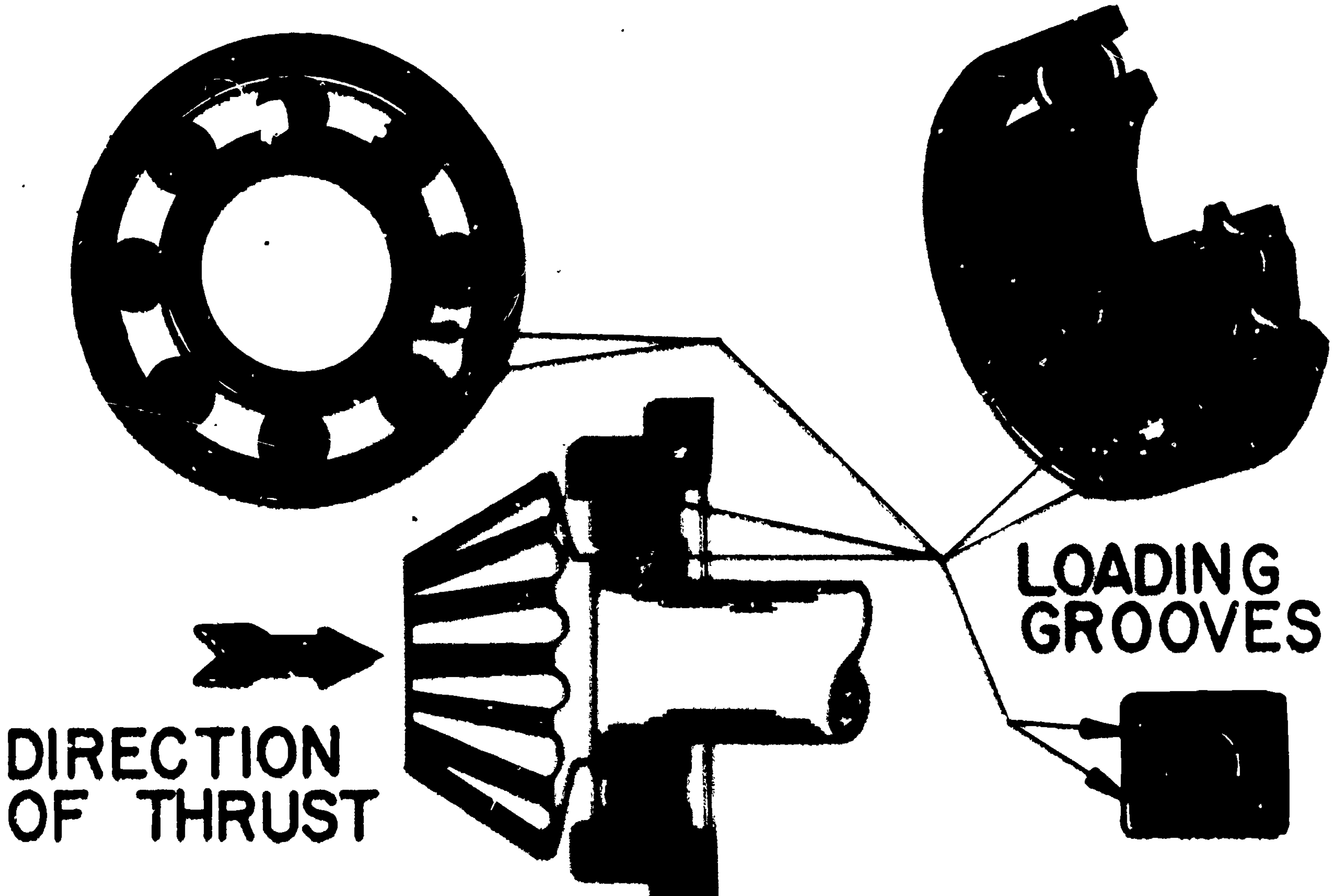
INTERNALLY SELF ALIGNING BEARING



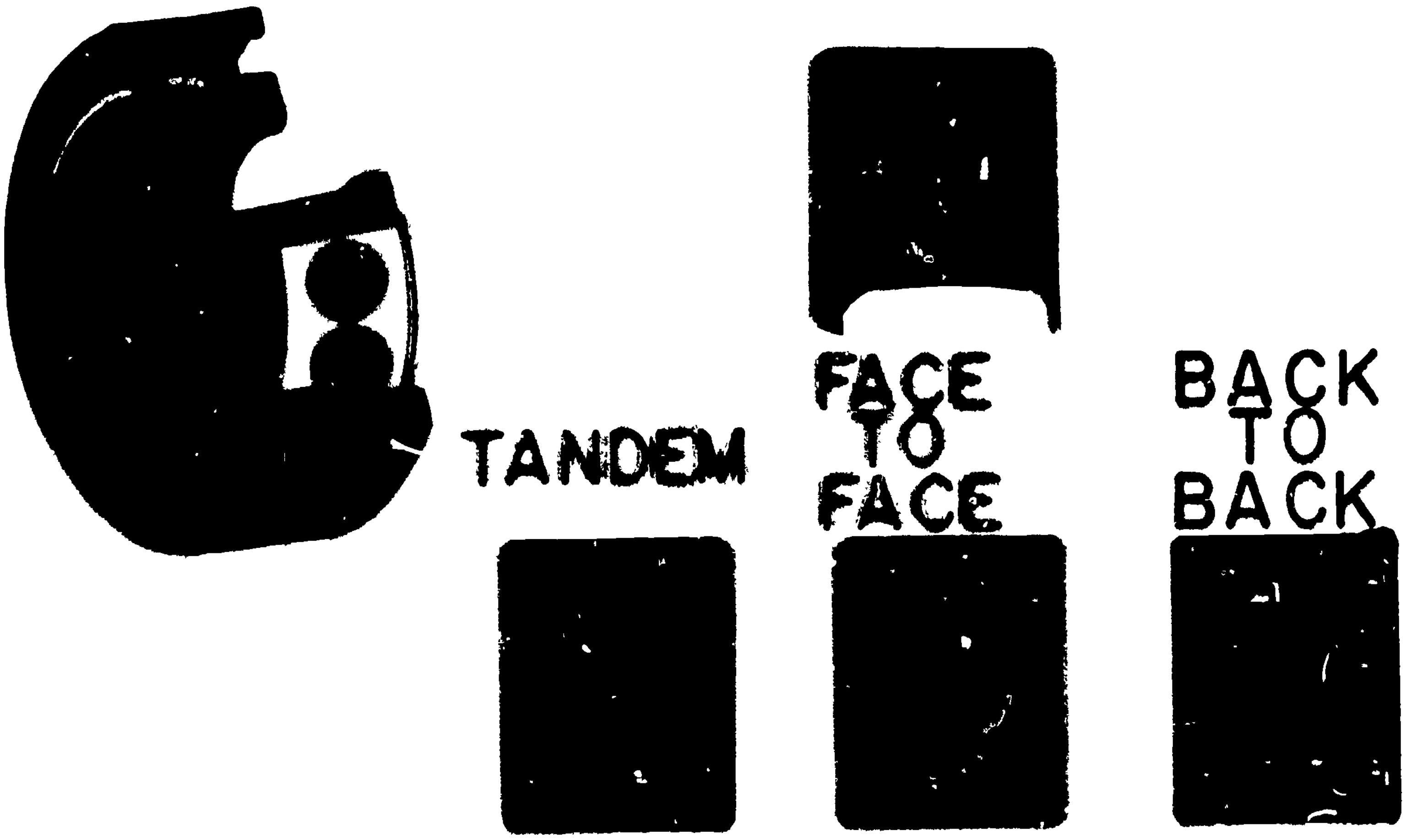


SINGLE ROW DEEP GROOVE BEARING ("CONRAD")

BALL BEARINGS (CONTINUED)



LOADING-GROOVE BEARINGS



SINGLE ROW ANGULAR CONTACT BEARING

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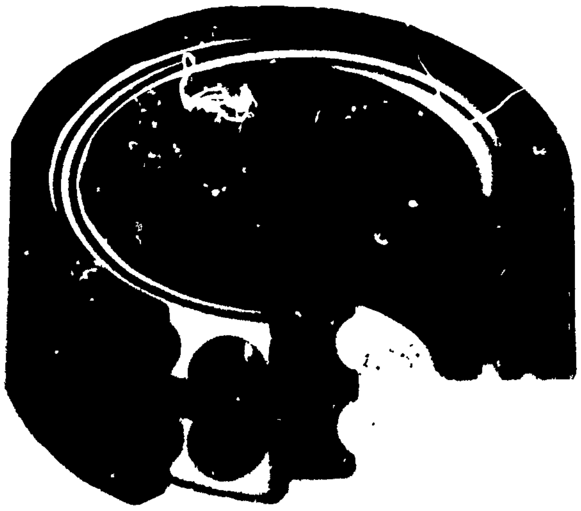
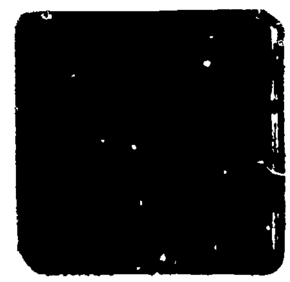
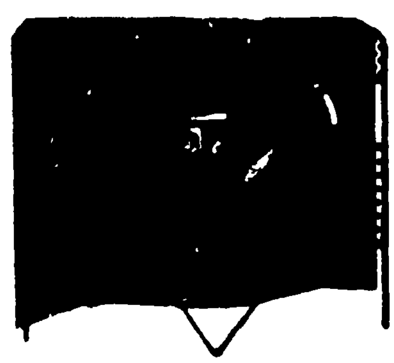
BALL BEARINGS (CONTINUED)





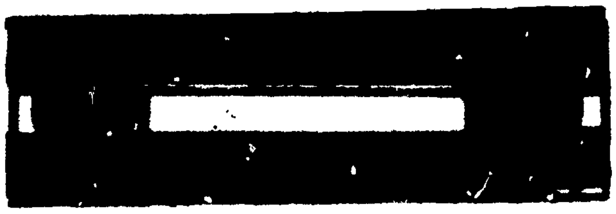
DOUBLE-ROW DEEP-GROOVE BEARINGS



LOAD LINES

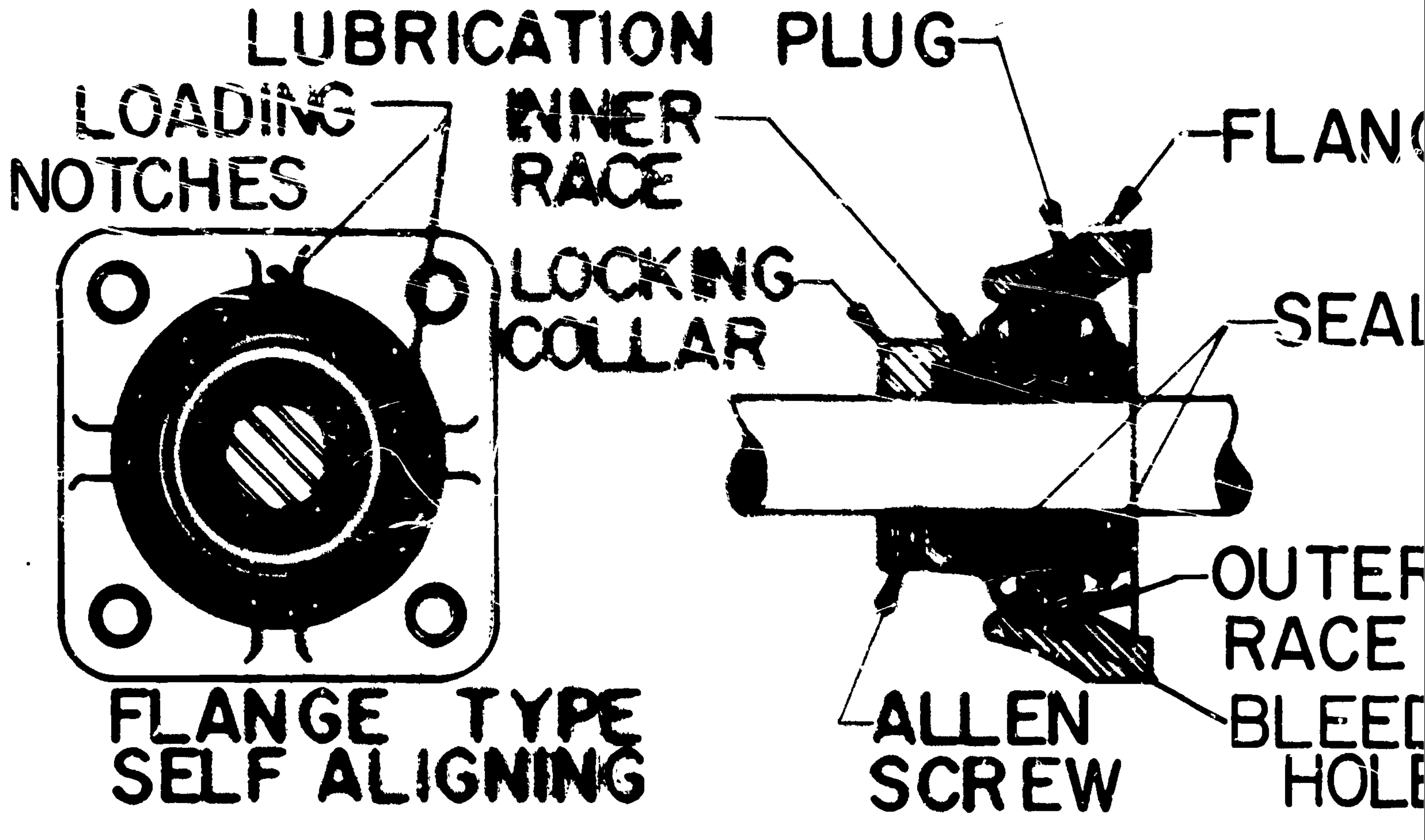
DOUBLE-ROW ANGULAR-CONTACT BEARINGS

LOAD LINE



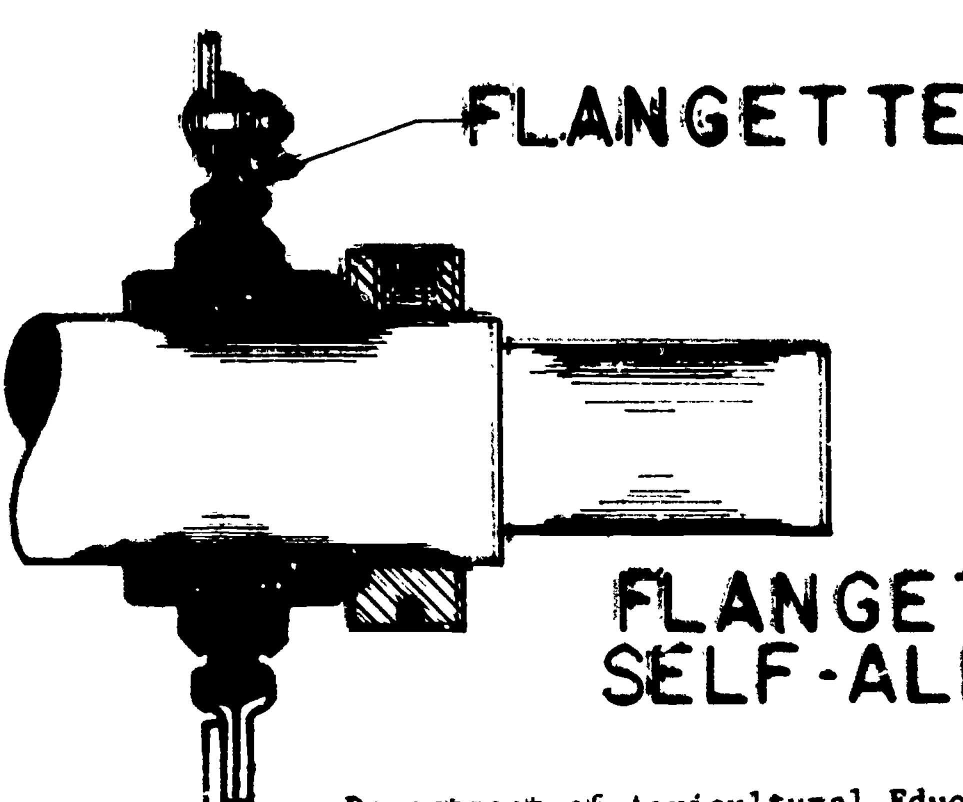
BALL END THRUST BEARINGS

SEALED, PRELUBRICATED BALL BEARINGS



FLANGE TYPE
SELF ALIGNING

HOUSING MOUNTED TYPE



FLANGETTE TYPE
SELF-ALIGNING

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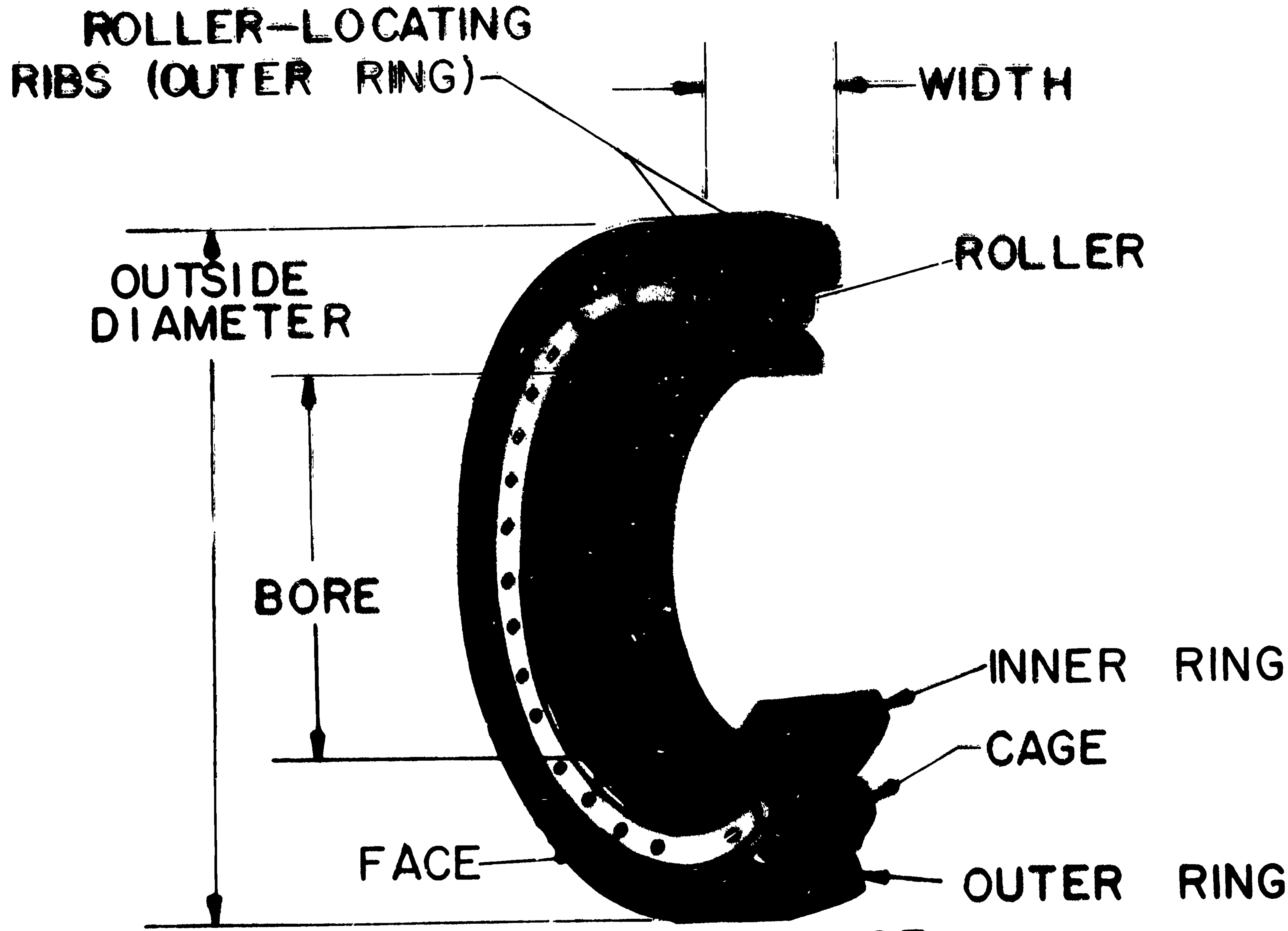
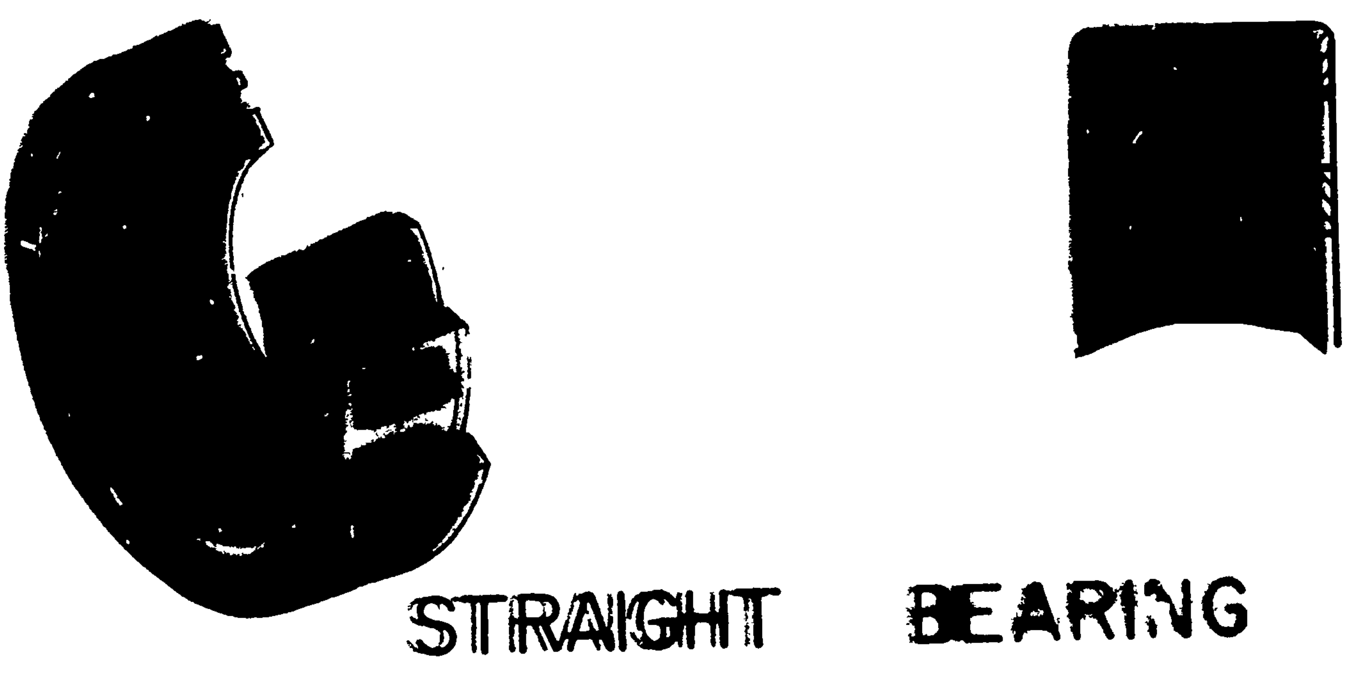


CROSS SECTION OF
STRAIGHT ROLLER BEARING

ROLLER BEARINGS

SPHERICAL BEARING



STRAIGHT BEARING

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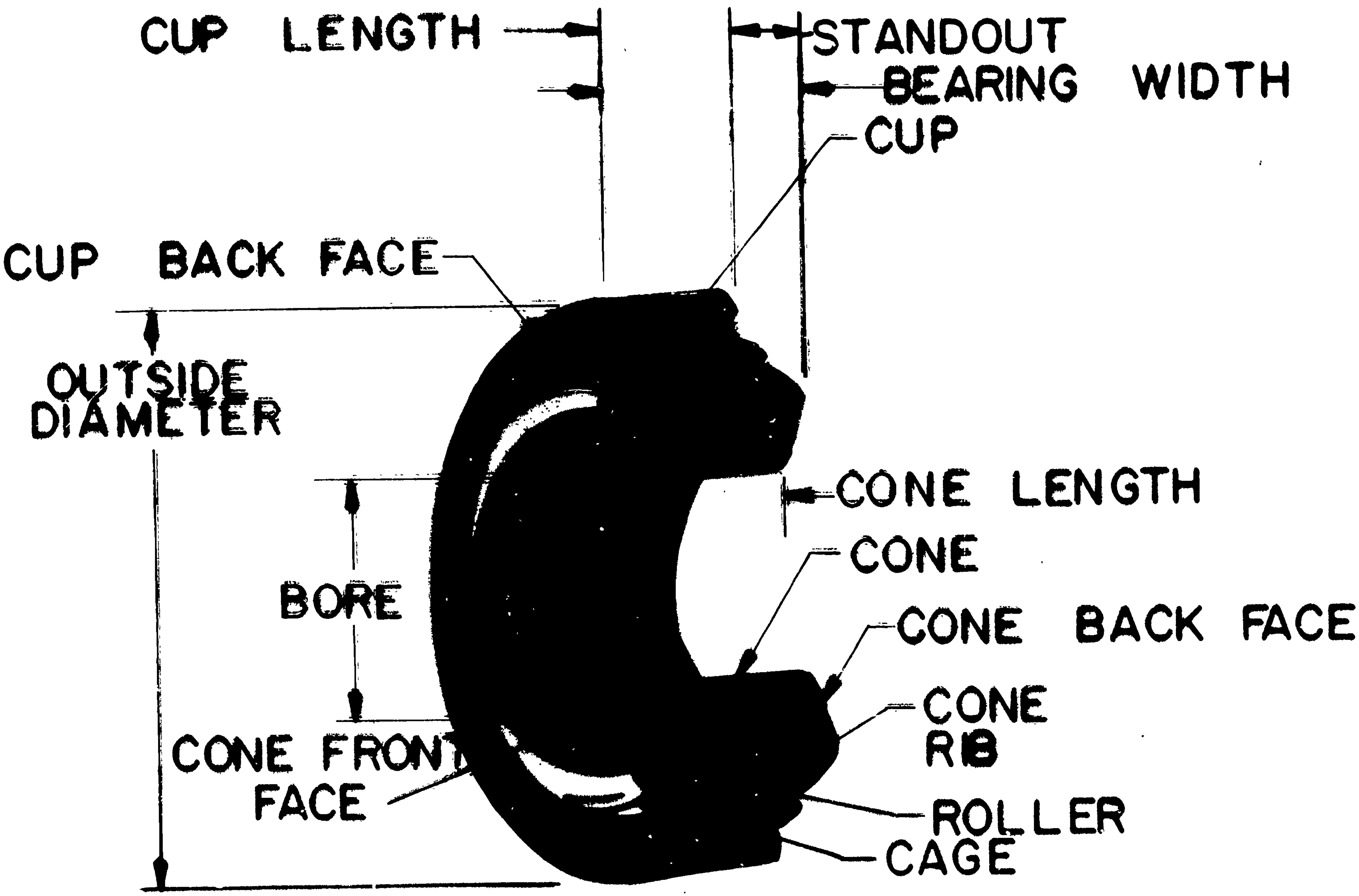
CROSS SECTION OF A TAPERED ROLLER BEARING



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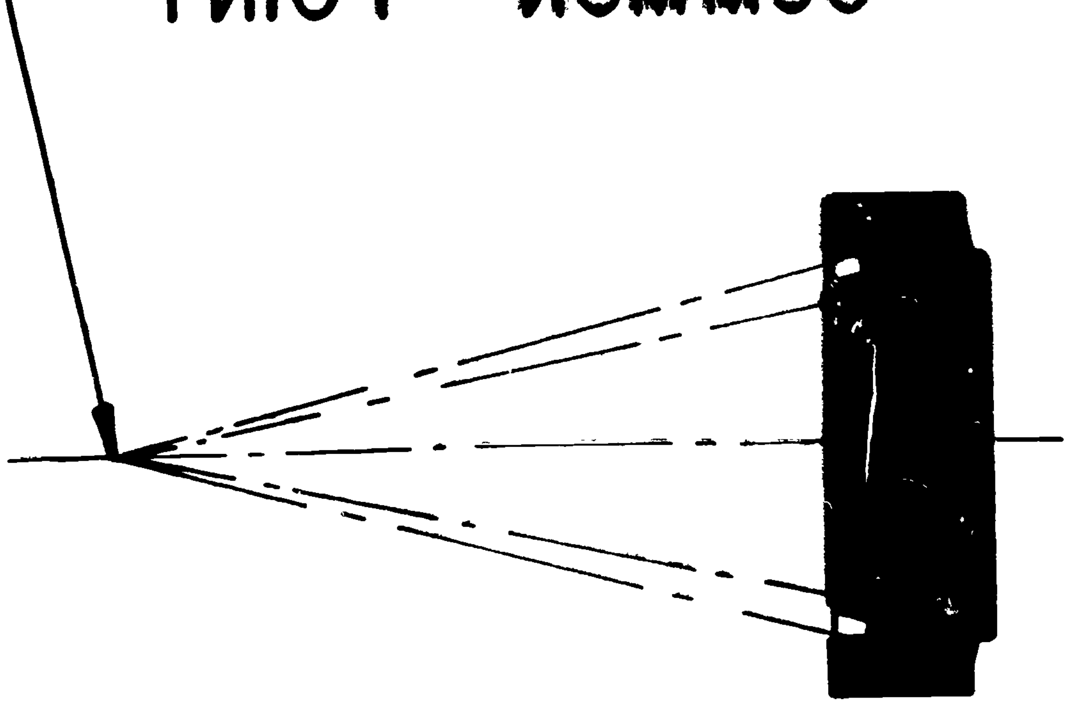
830/10
Bearing 12

ROLLER BEARINGS (CONTINUED)

SPHERICAL THRUST BEARING

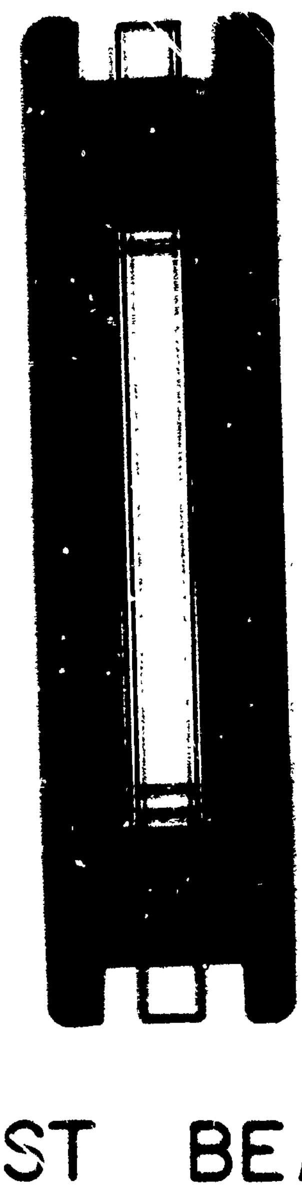
IN A TAPERED BEARING, ALL LINES MEET AT A COMMON POINT

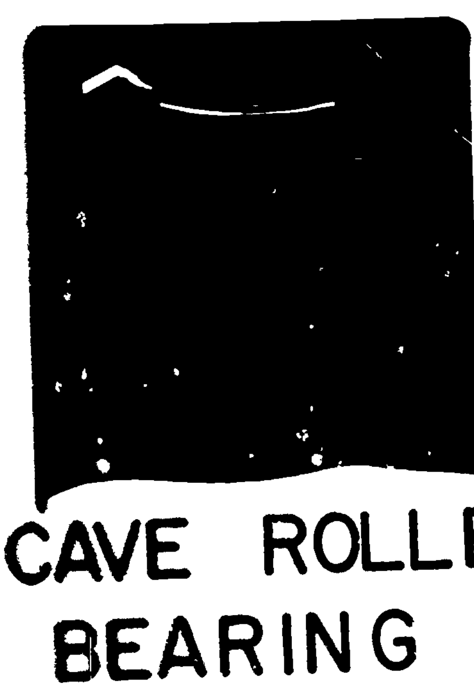


TAPERED BEARING

ROLLER BEARINGS (CONTINUED)

NEEDLE BEARING

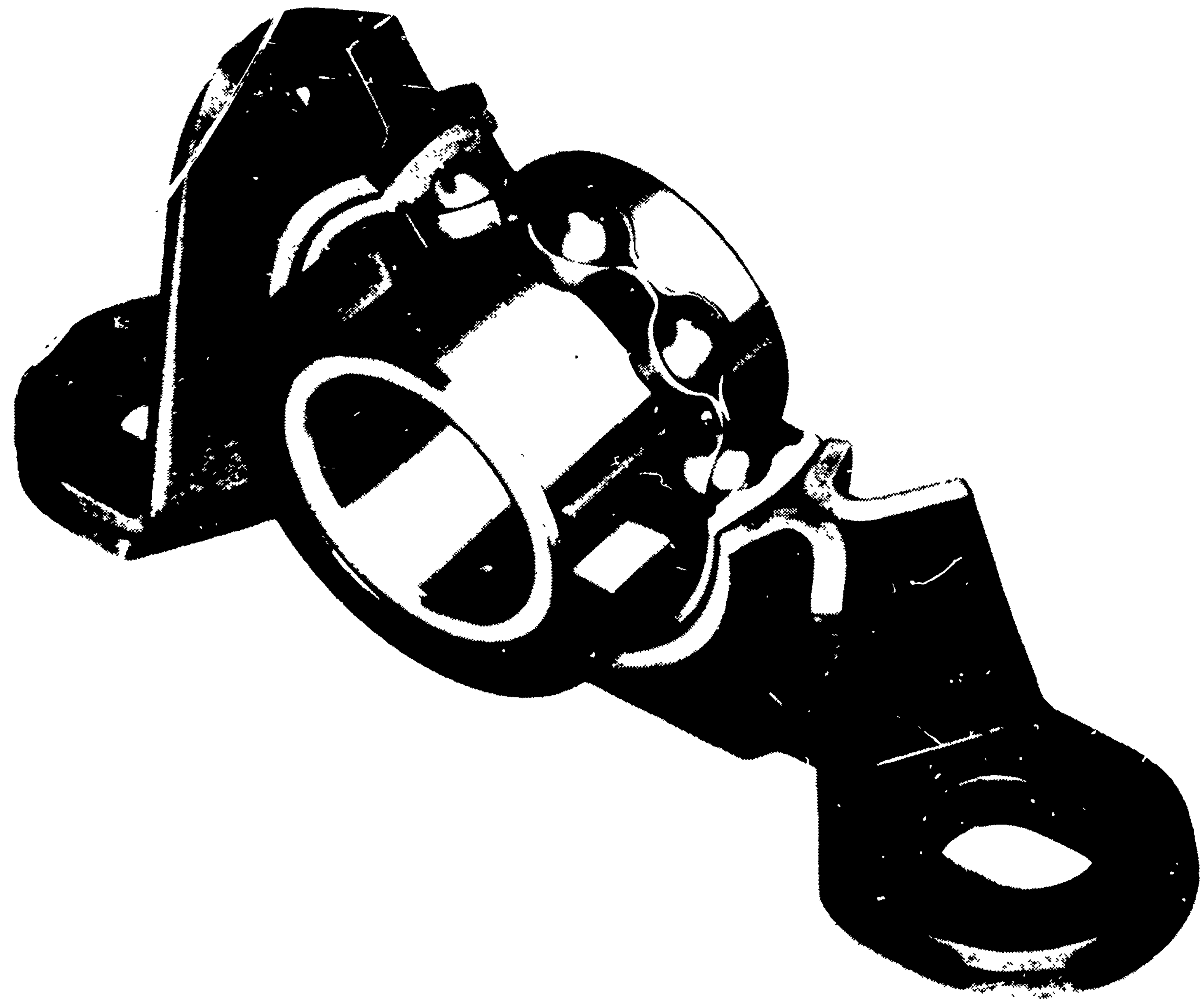




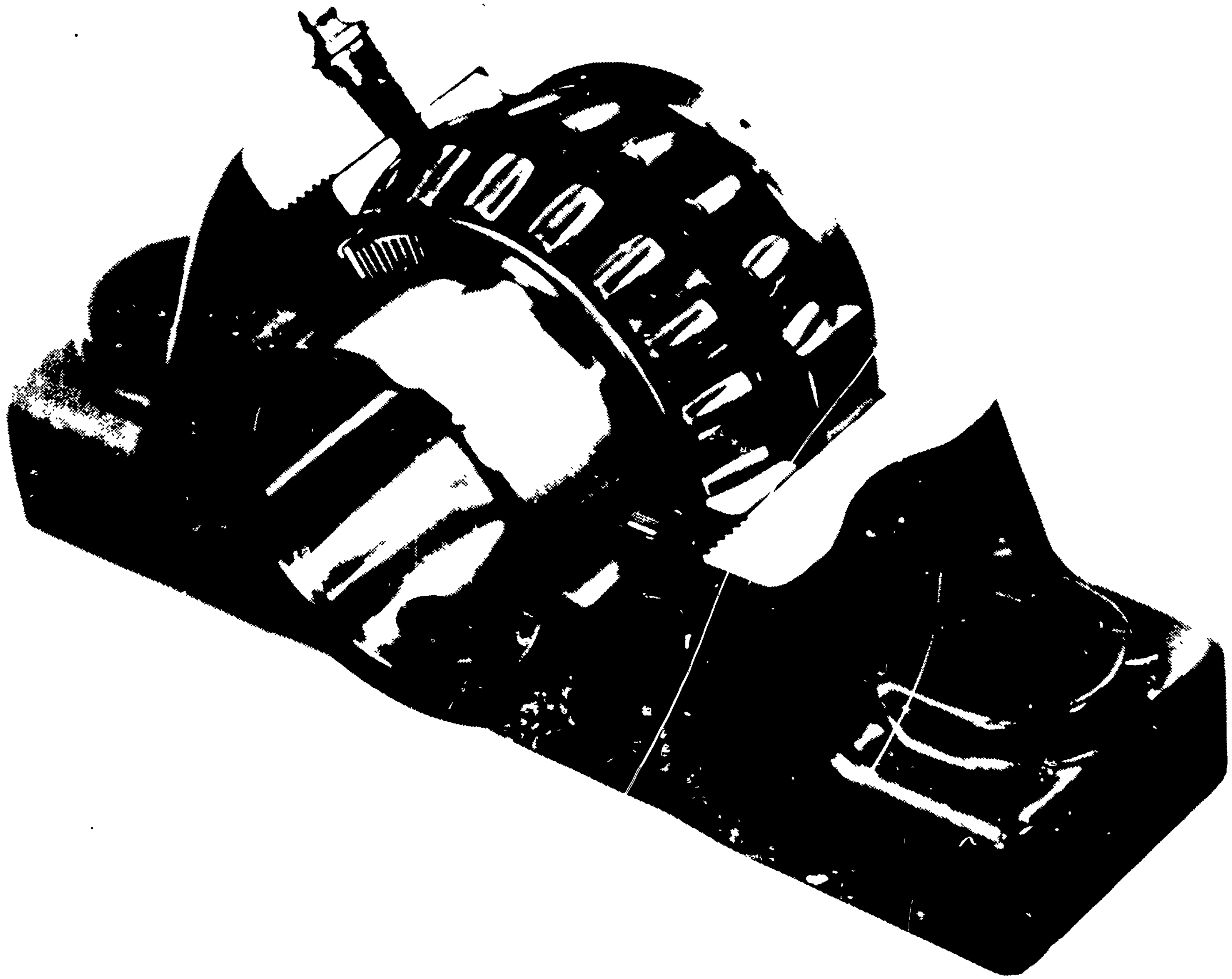
CONCAVE ROLLER BEARING

THRUST BEARING

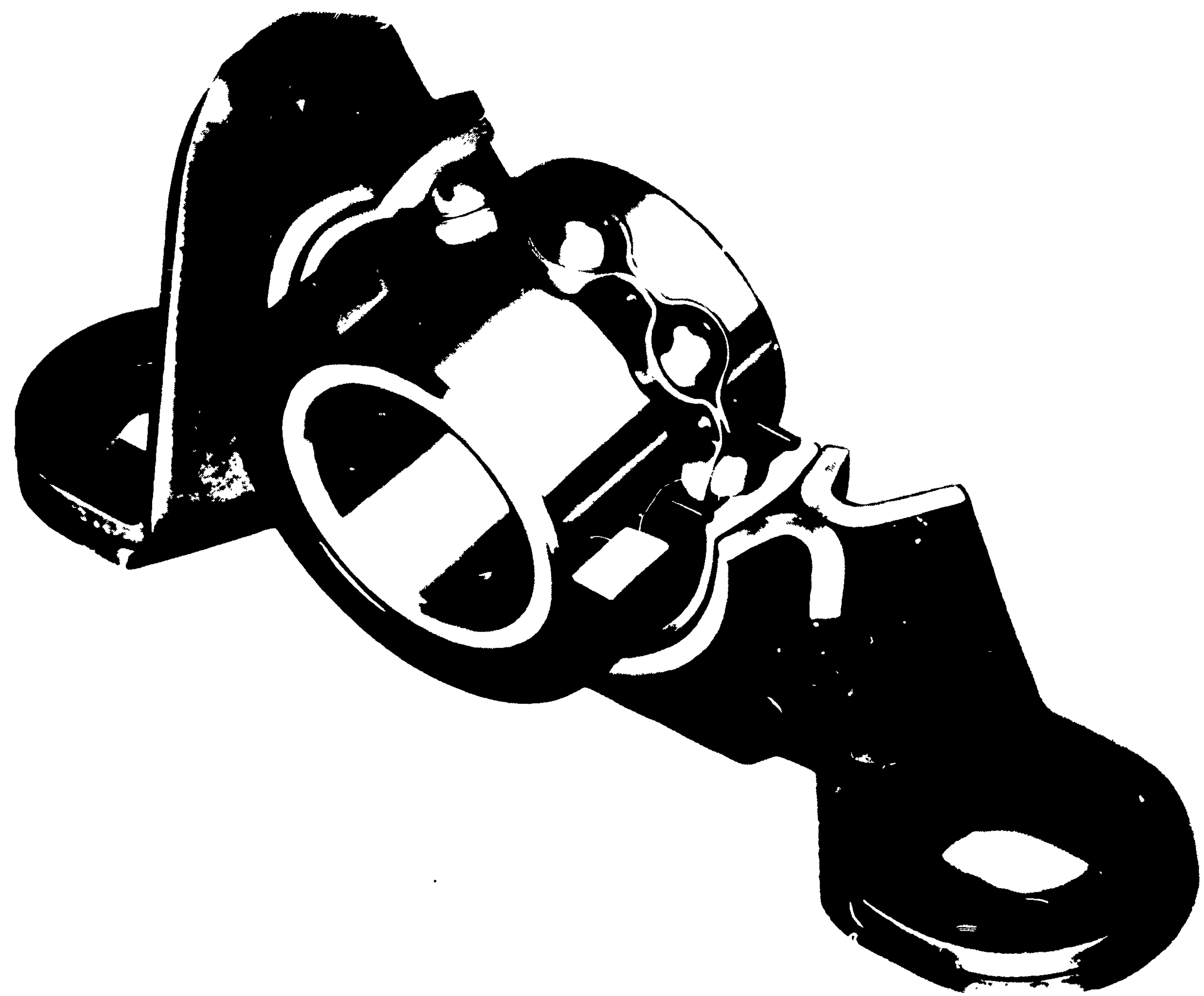
Department of Agricultural Education, Clemson University 830/10
U.S.O.E. Grant Number OEG 2-068320-1103 Bearing 14



43465 Cutaway of PS-UW200F ball bearing pillow block with spring locking collar and pressed steel housing. Chicago, December 1961. Book 2090

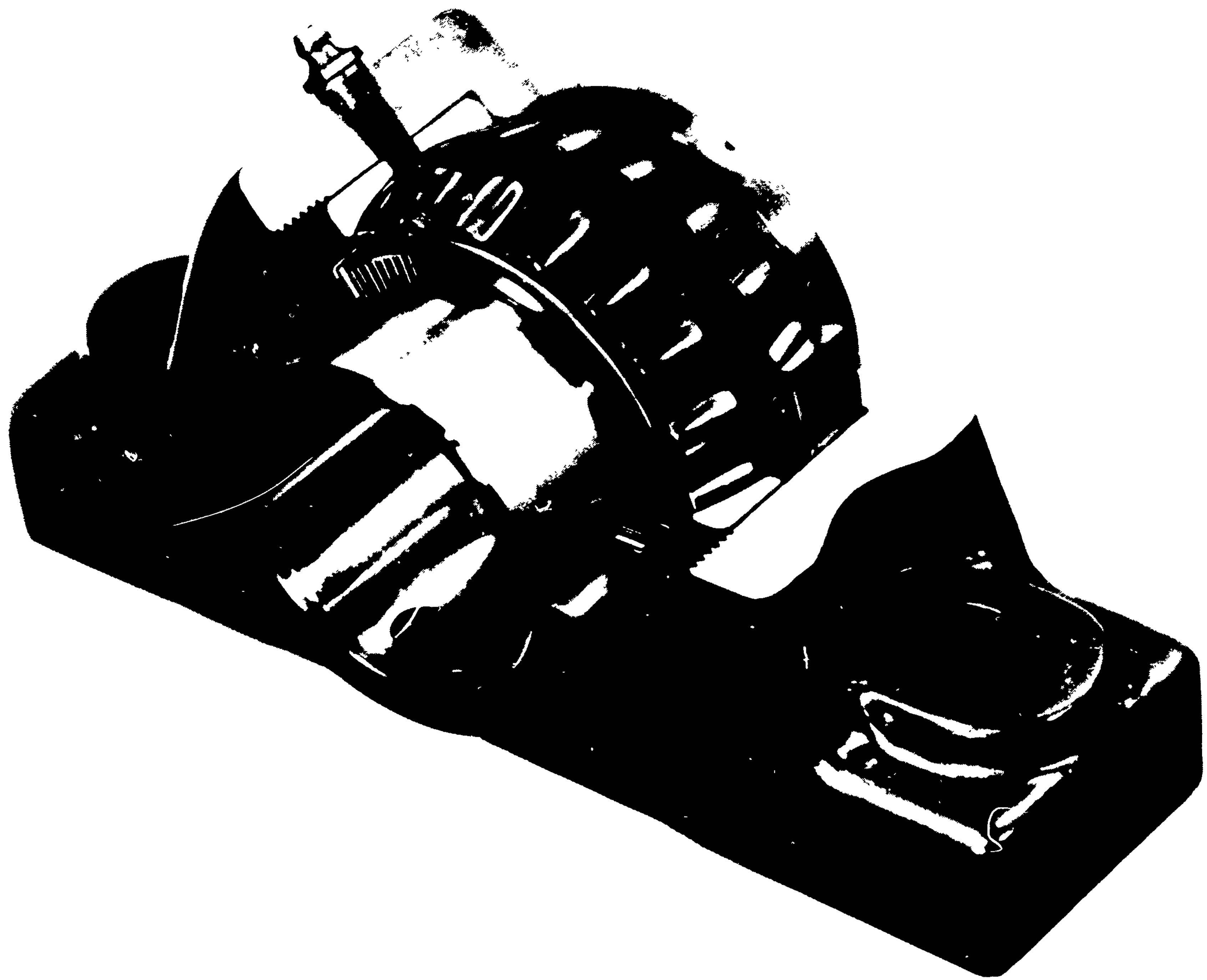


45263 - Link-Belt 22400 Series Spherical Roller Bearing. LINK-BELT 45263
P-B22400H pillow block with cast iron housing
and 2-bolt base. Chicago, Illinois April, 1964.



43465 Cutaway of PS-UW200E ball bearing pillow block with spring locking collar and pressed steel housing. Chicago, December 1961. Book 2890

LINK-BELT
43465



45263 - Link-Belt 22400 Series Spherical Roller Bearing. P-B22400H pillow block with cast iron housing and 2-bolt base. Chicago, Illinois April, 1964.

LINK-BELT
45263

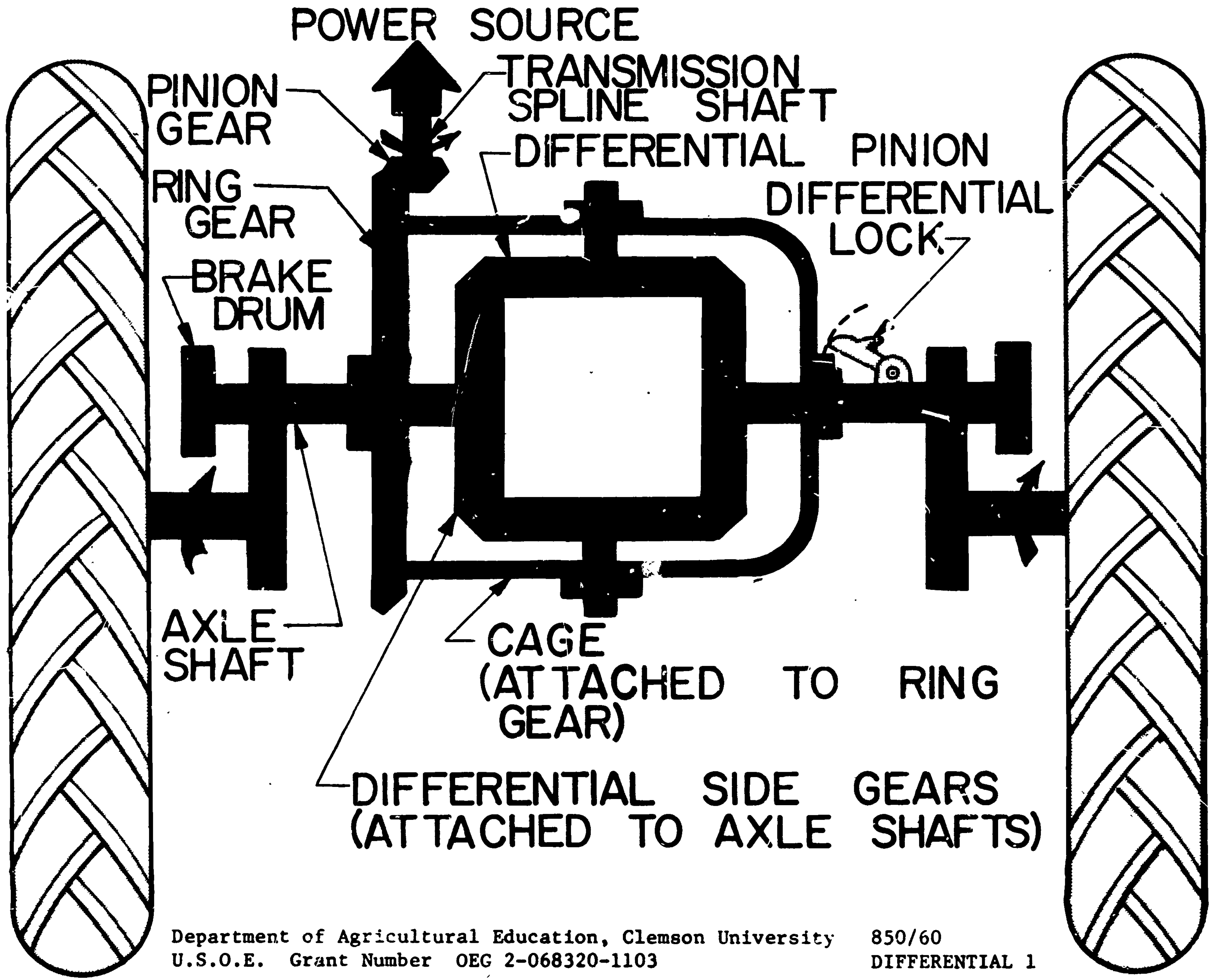
REFERENCE MATERIALS

<u>Mechanical Power Transfer Systems</u>, p. 7-9
<u>Tractors and Crawlers</u>, p. 211-221
<u>Modern Farm Power</u>, pp. 161, 170-171
<u>Farm Tractors</u>, p. 81-83

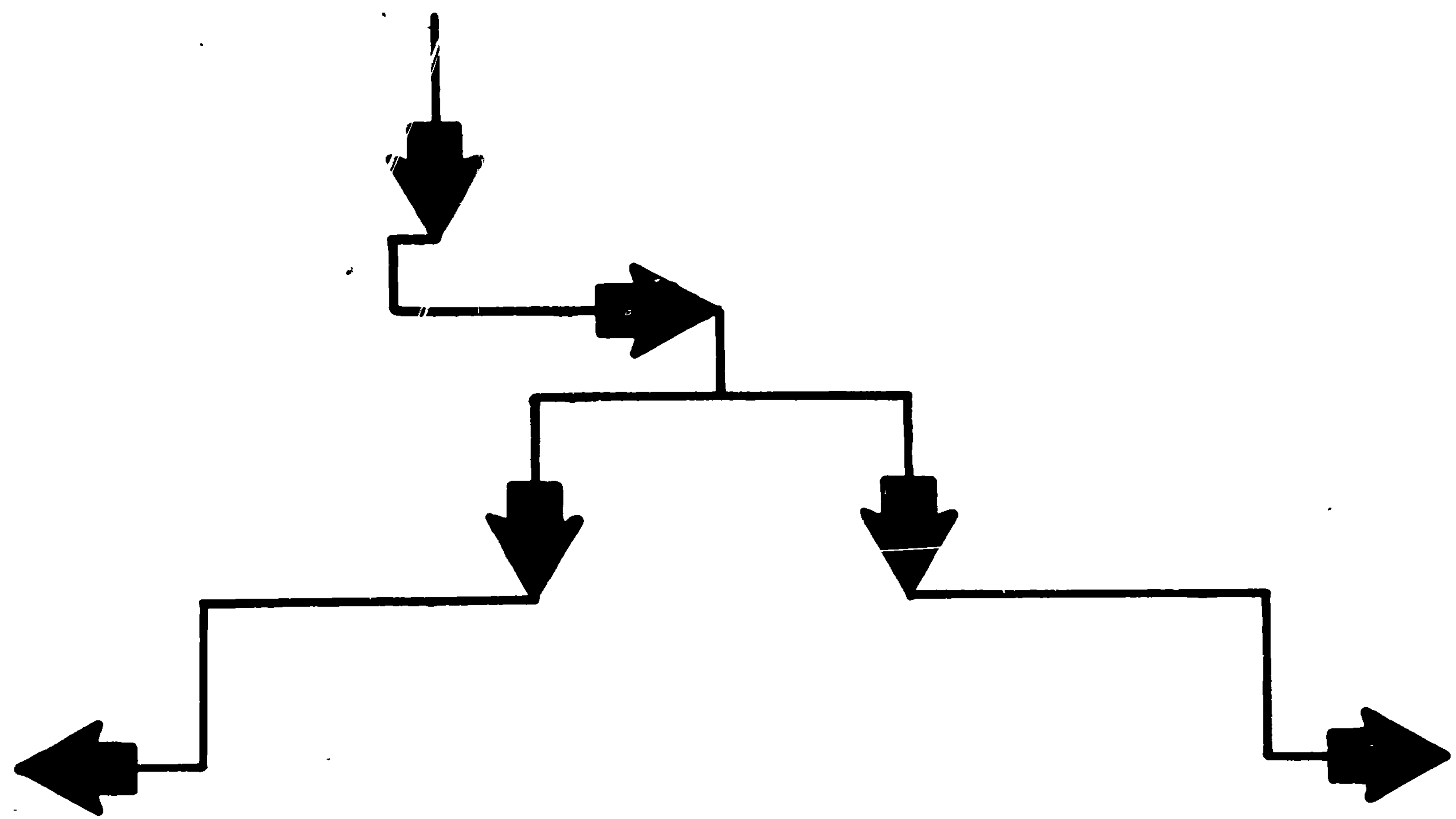
SUGGESTED ACTIVITIES

1. Study the purpose of the differential.
2. Examine various types of differential construction.
3. Determine how power is transmitted when each wheel is under uniform resistance -- unequal resistance.
4. Make cutaway model. See Modern Farm Power, p. 179-180.
5. Observe and demonstrate the differential lock.

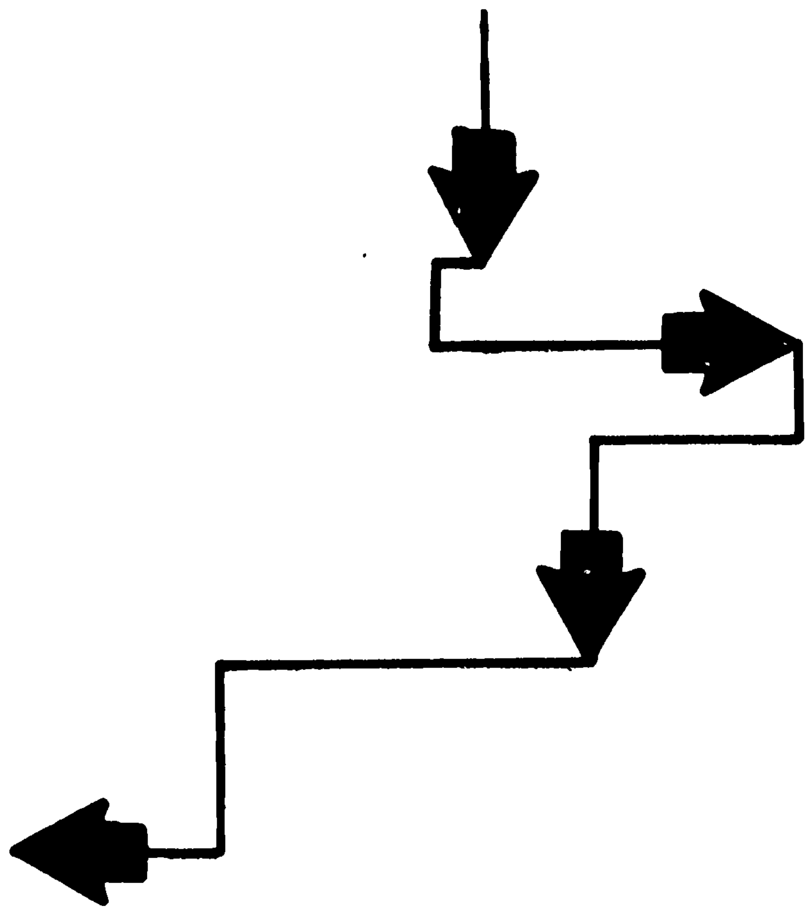
DIAGRAMATIC VIEW OF TRACTOR DIFFERENTIAL AND FINAL DRIVE



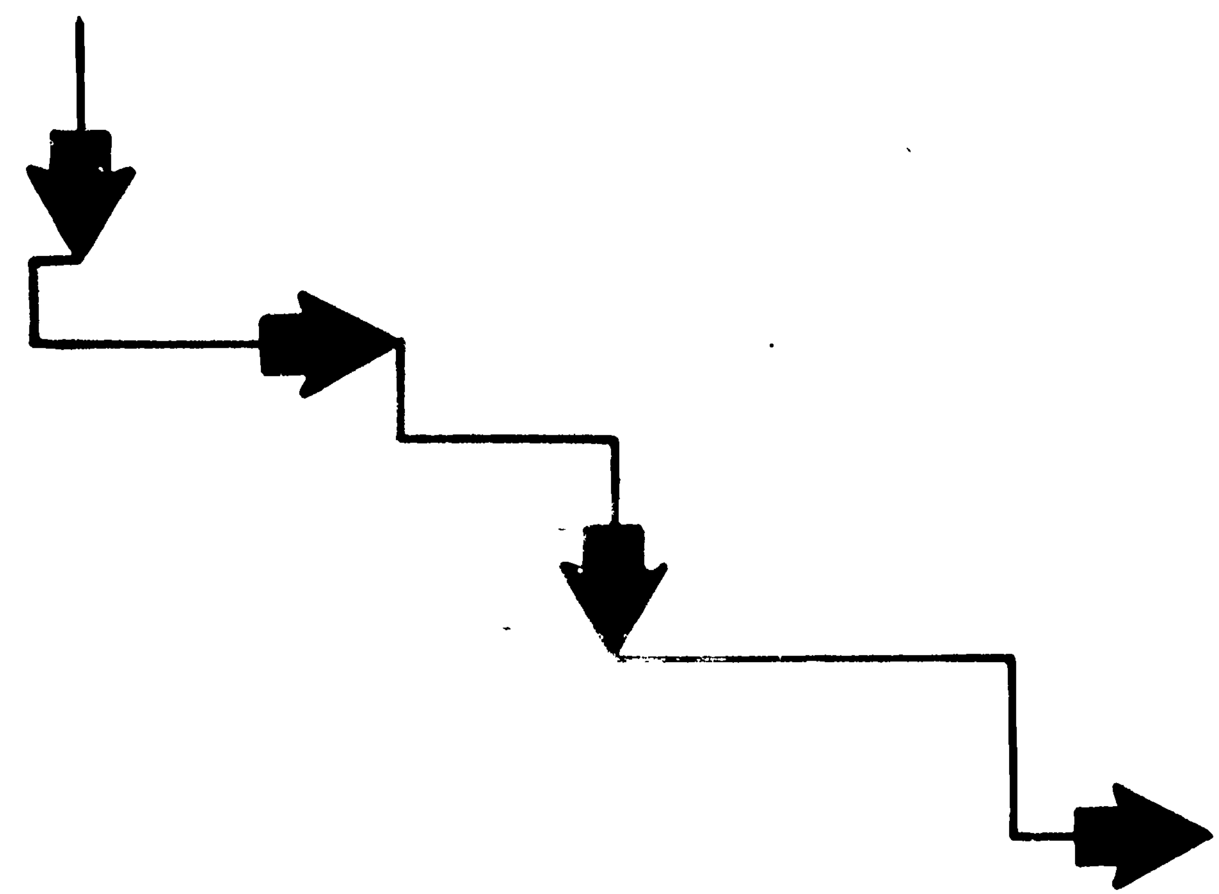
Department of Agricultural Education, Clemson University 850/60
U.S.O.E. Grant Number OEG 2-068320-1103 DIFFERENTIAL 1



FLOW OF POWER UNDER



FLOW OF POWER WHEN
RIGHT WHEEL IS RELUCTANT



FLOW OF POWER WHEN
LEFT WHEEL IS RELUCTANT

REFERENCES

Tractor Operation and Daily Care, p. 68-74
Modern Farm Power, p. 187-190, 198, 230-231
Farm Tractors, p. 84-85
Field Mowers, p. 70-85
Farm Machinery and Equipment, p. 32-36
Tractors and Crawlers, p. 232-237

SUGGESTED ACTIVITIES

1. Study use of Power-take-off drives in agricultural equipment.

2. Collect various power-take-off shafts.

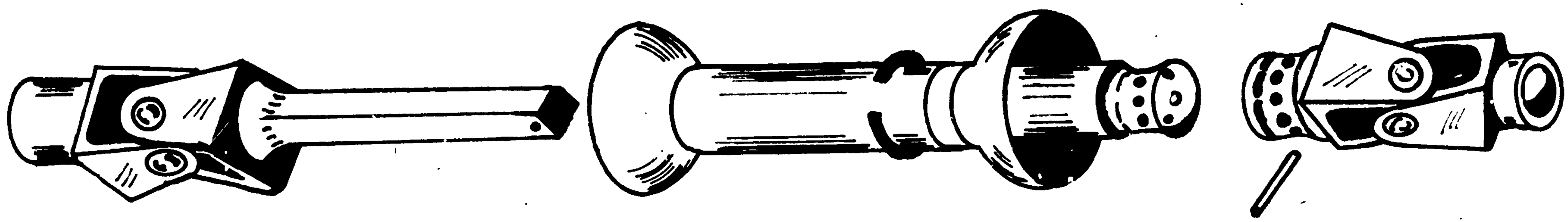
3. Disassemble power-take-off shafts and observe the variation in construction, shielding and function.

4. Study safety when around rotating power-take-off equipment. Demonstrate safety. See Modern Farm

5. Study and observe the difference between 1000 R.P.M. and 540 R.P.M. shafts on tractors.

6. Study the various types of systems used on tractors to control and operate the power-take-off. If possible, work with dealers to demonatrate to the class the differences between continuous running, double acting clutch, transmission driven and independent power-take-off systems. Use disassembled tractors when possible.

7. Study, demonstrate, and practice proper hook-up and operation of power-take-off driven equipment. Stress safety.



SIMPLE TELESCOPING
POWER TAKE—OFF SHAFT

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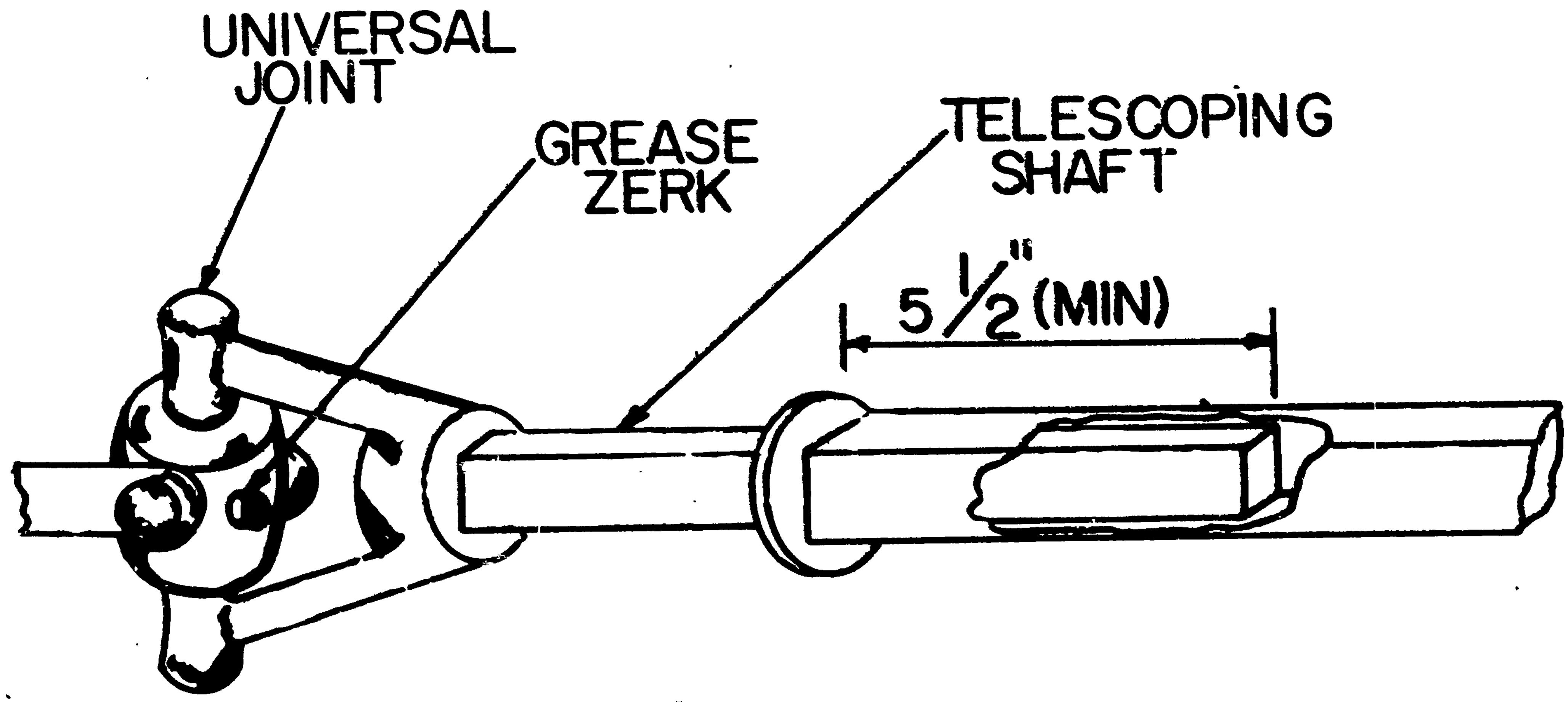
850/60
Power-Take-Off 1



SIMPLE TELESCOPING
POWER — TAKE — OFF SHAFT

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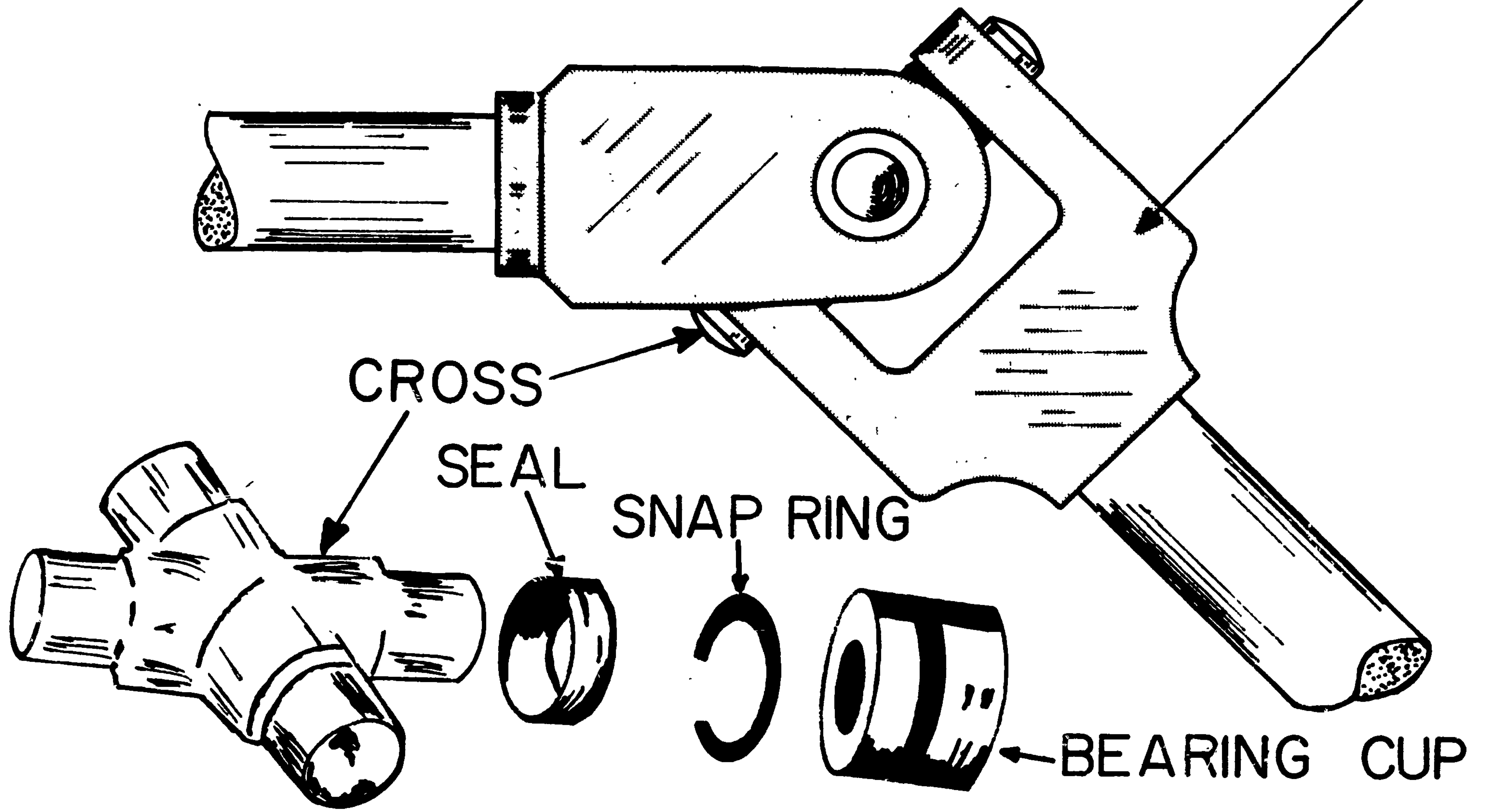

UNIVERSAL JOINT

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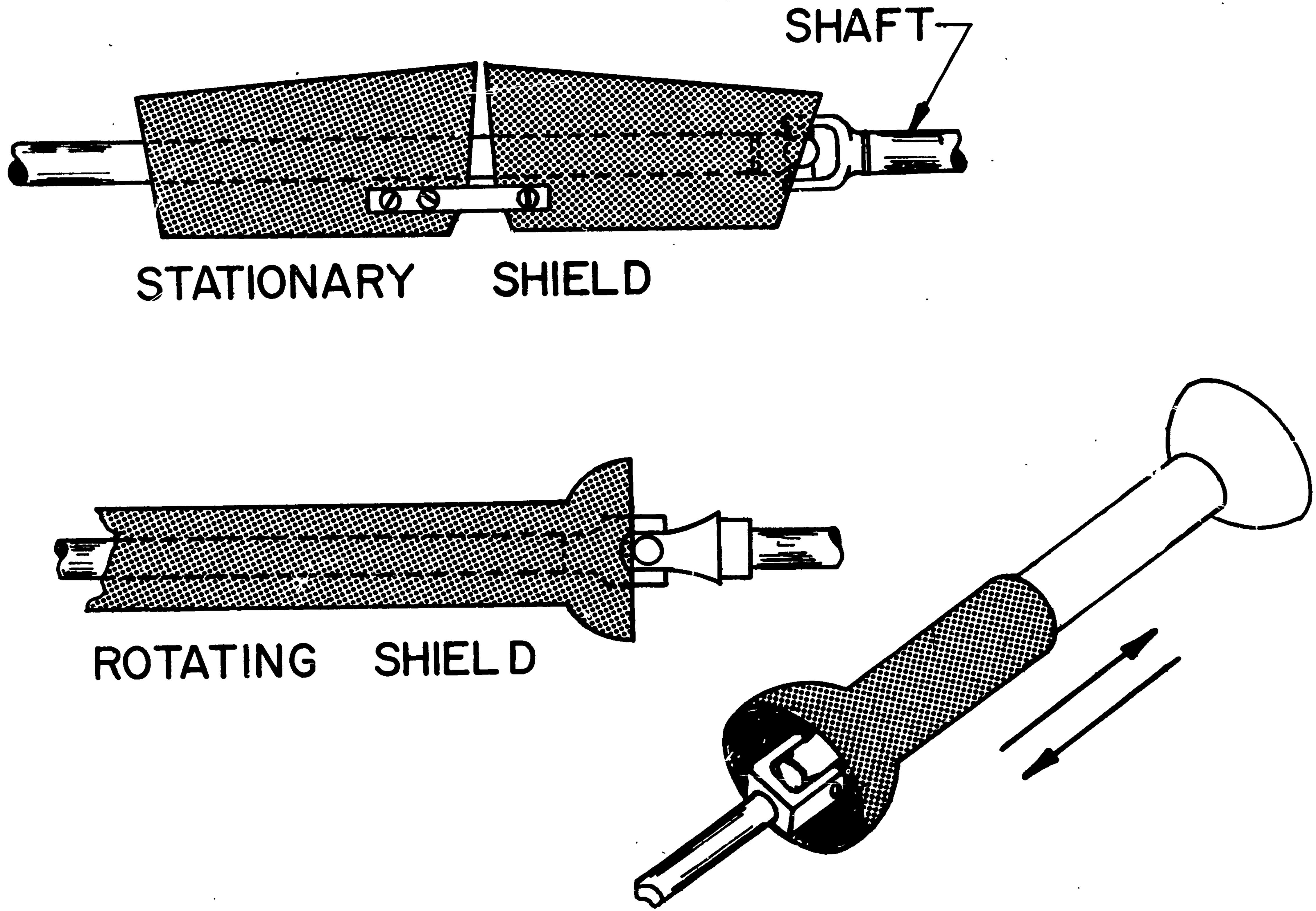

TYPES OF SAFETY SHIELDS

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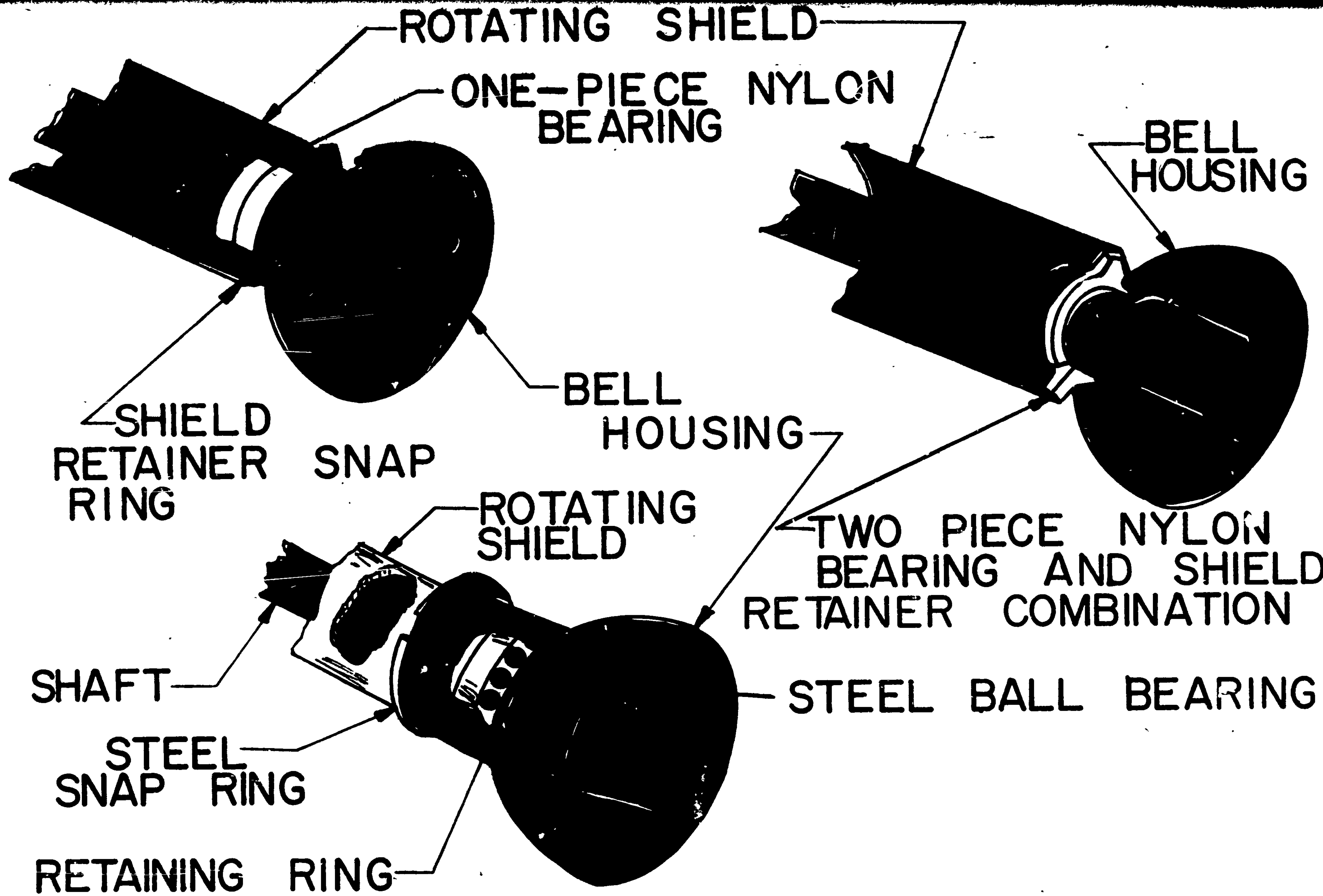

WAYS ROTATING SAFETY SHIELDS ARE HELD TO SHAFTS

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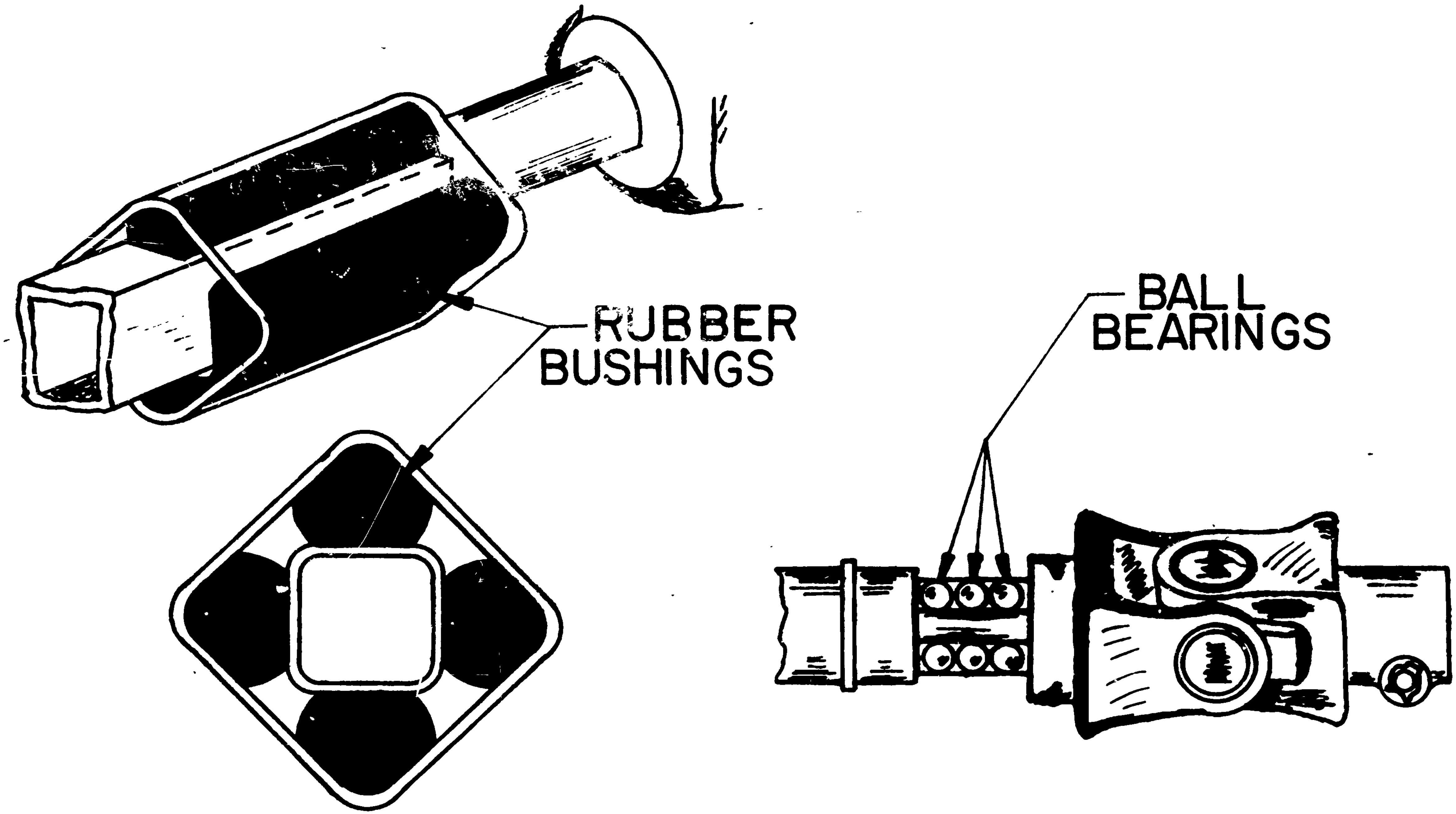
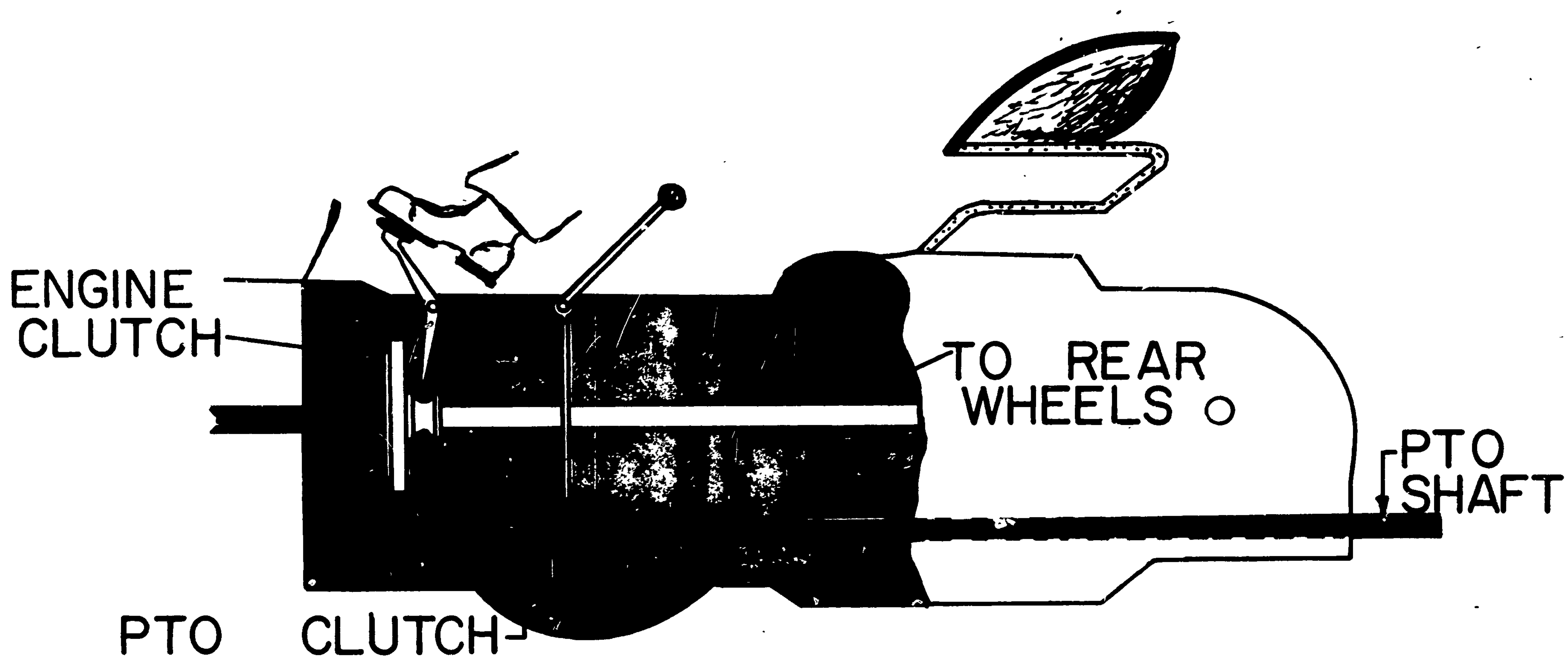


RECENT IMPROVEMENTS IN POWER TAKE-OFF SHAFTS



INDEPENDENT POWER - TAKE - OFF

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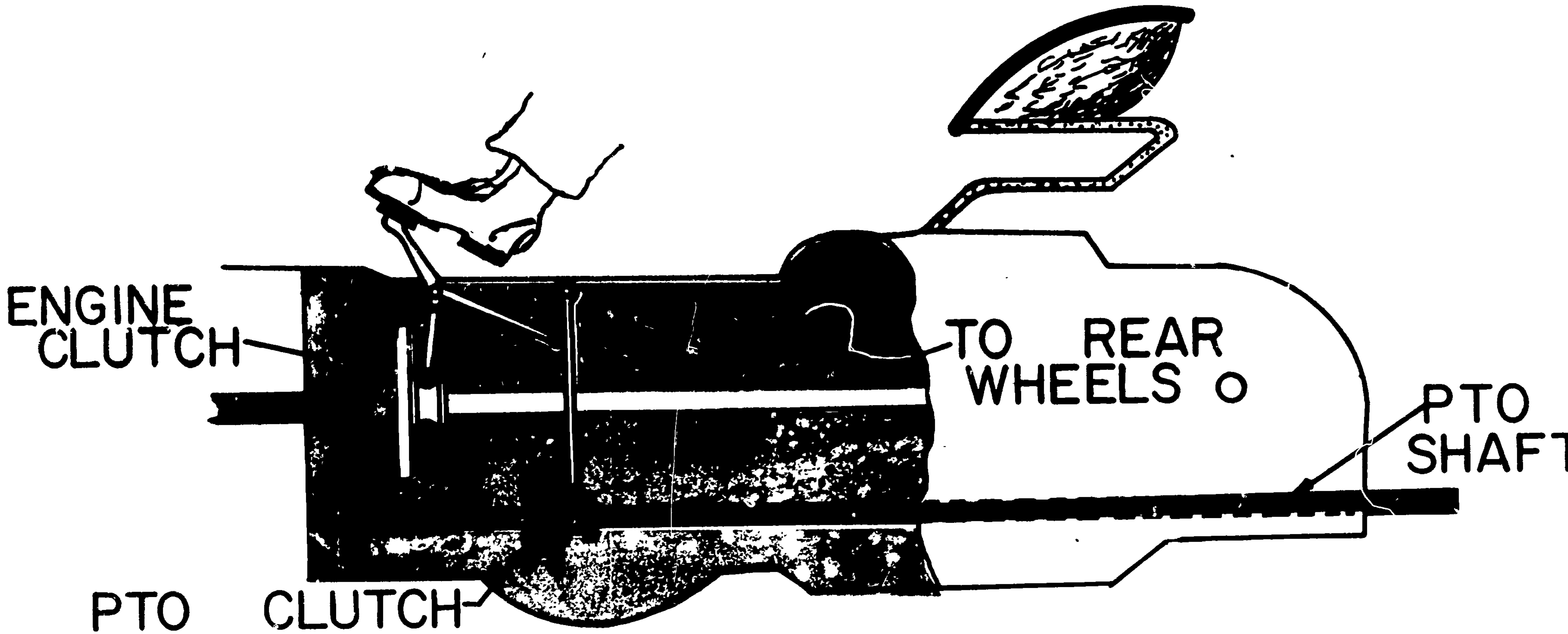
U.S.O.E. Grant Number OEG 2-068320-1103



POWER – TAKE-OFF SHAFT
WITH DOUBLE-ACTING CLUTCH

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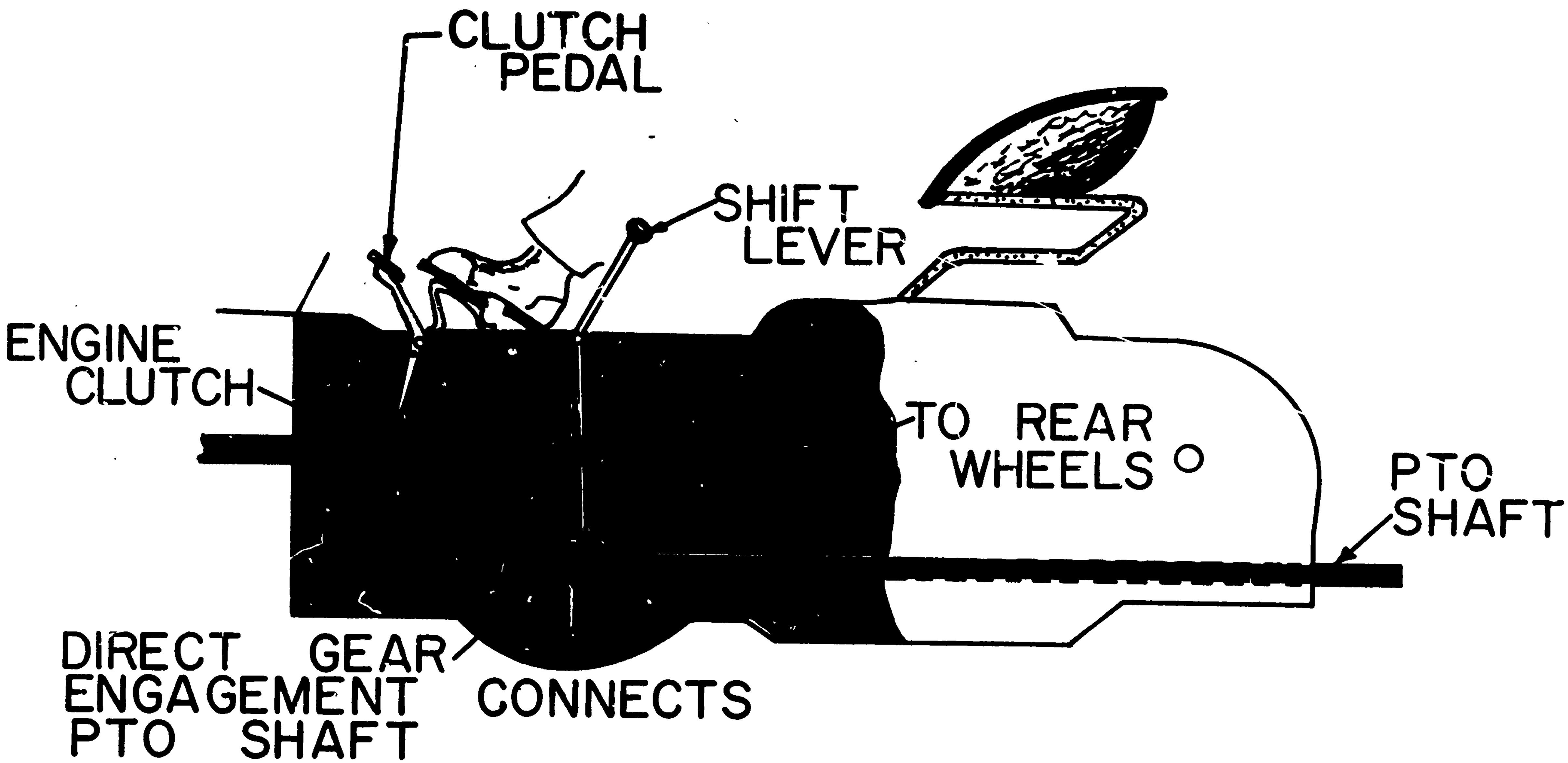

TRANSMISSION DRIVEN POWER-TAKE-OFF

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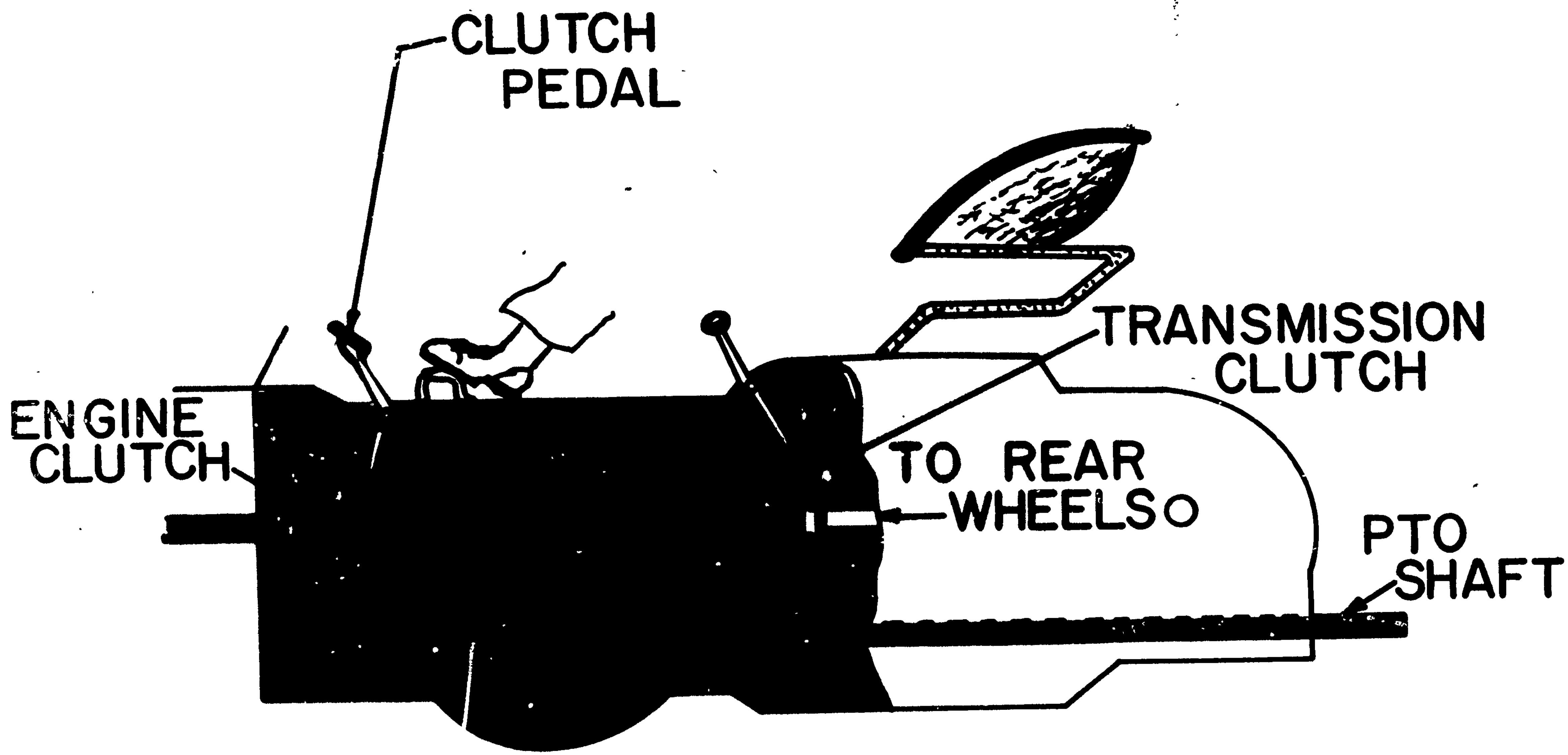
U.S.O.E. Grant Number OEG 2-068320-1103



CONTINUOUS - RUNNING POWER - TAKE - OFF

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850/60
Power-Take-Off 10

REFERENCES:

Tractor Operation and Daily Care, pp.45,54-56,70,88
Tractors and Crawlers, pp. 135, 179-191
Farm Machinery and Equipment, pp. 36-39
Farm Tractors, p. 75
Selecting and Maintaining Field Mowers, pp. 64, 93
Modern Farm Power, p. 160-164
Tractor Maintenance, Principles and Procedures, pp. 71-75

SUGGESTED ACTIVITIES:

1. Study the various types of clutches.

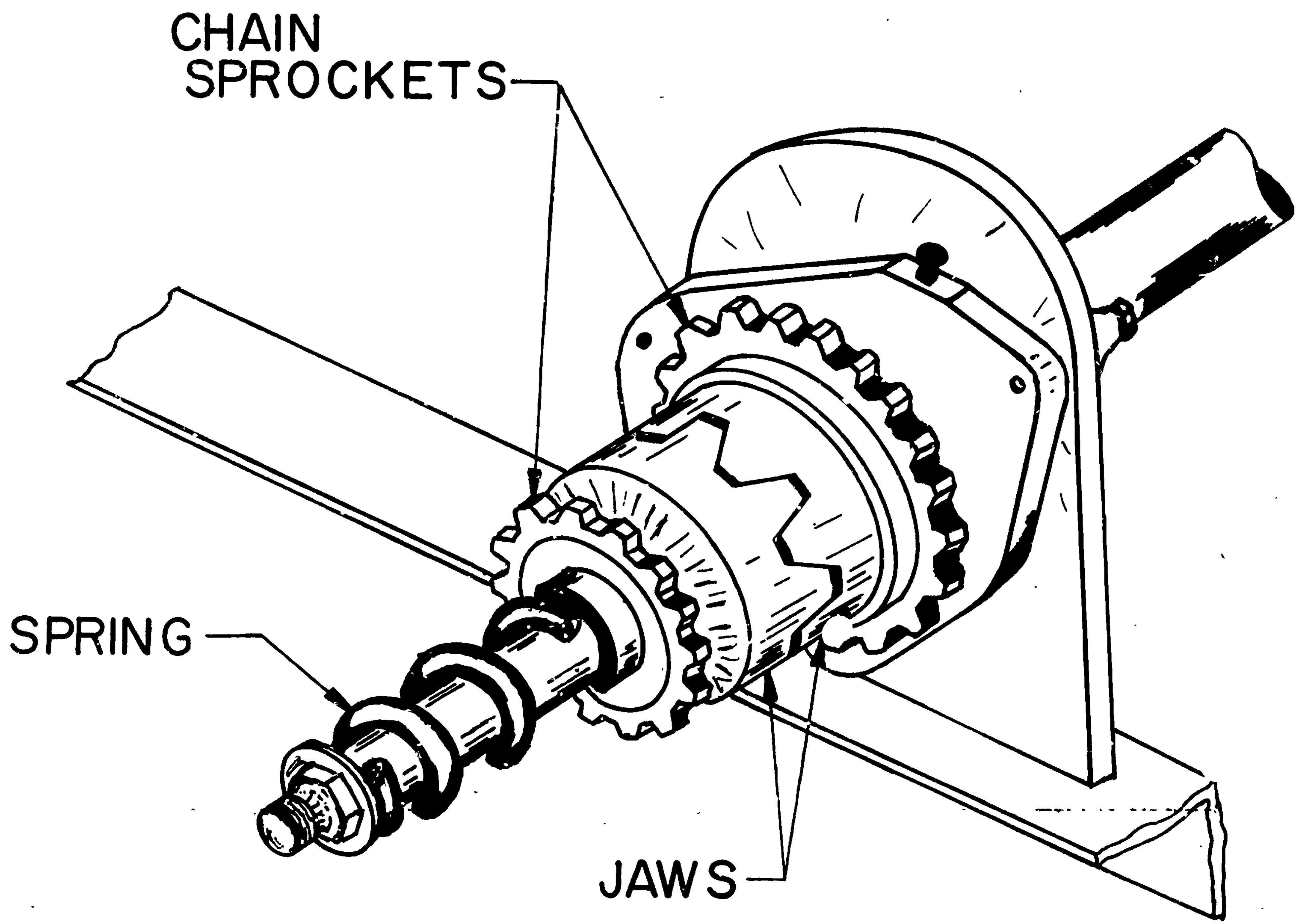
2. Locate the various types of clutches on agricultural equipment. Note the variations within types.

3. Disassemble the various types of clutches. Study the parts. Make a collection for a class display.

4. On transparency number 6 note the color pattern:
   Everything blue rotates whenever engine is running.
   Everything red rotates when pressure plate is pushed all the way forward.

5. On plate number 7 note how the power shaft turns independently within the clutch mounting sleeve. Observe the bearing and oil seal arrangements required.

6. In cooperation with an implement dealer try to arrange to observe a wet multiple-disk clutch on a tractor that has this part exposed. How does it differ from the dry clutch? How is it similar to the dry clutch?



SAFETY SNAP CLUTCH

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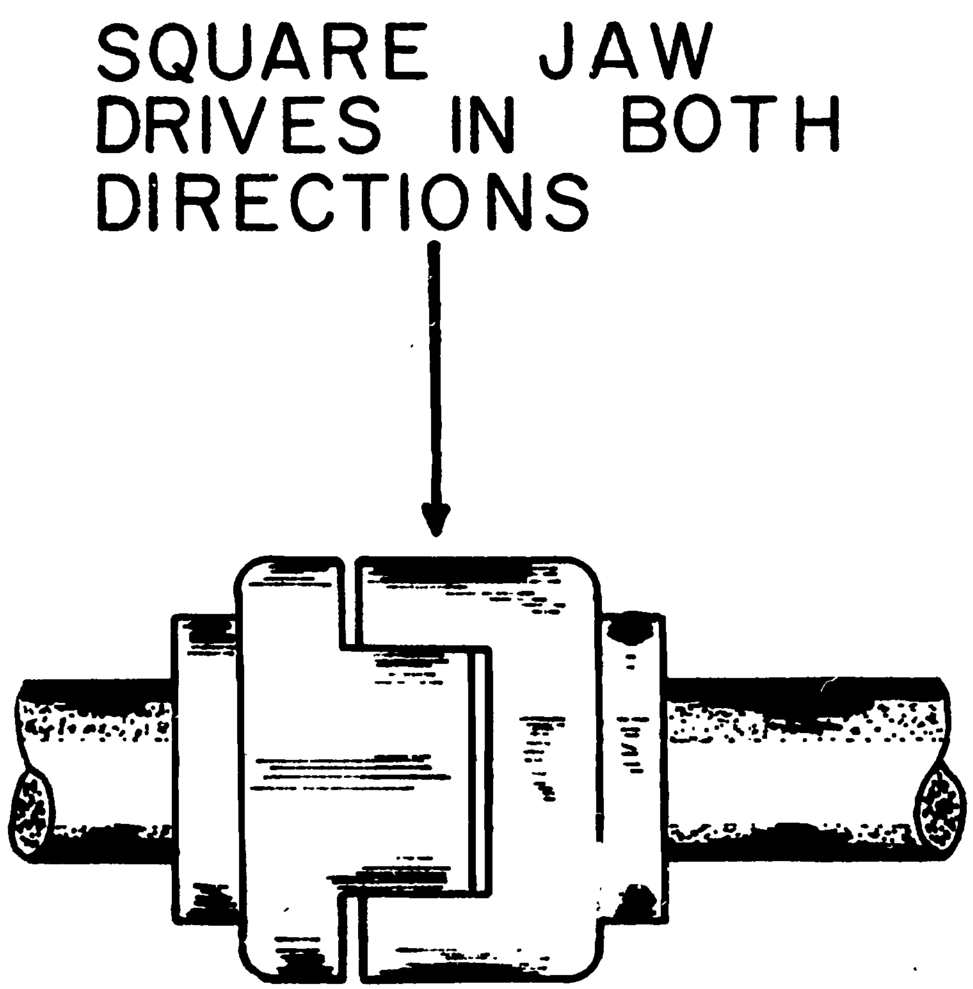

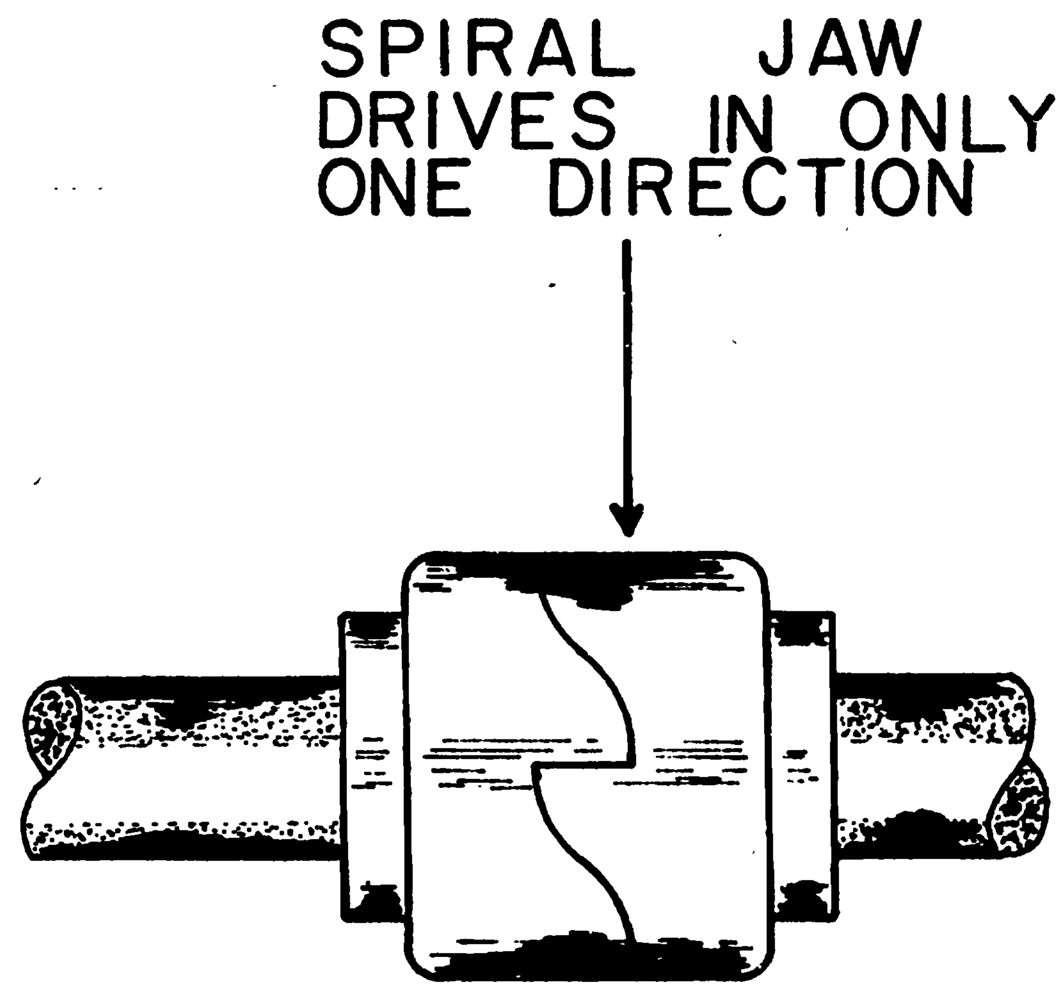

POSITIVE ENGAGEMENT JAW CLUTCHES

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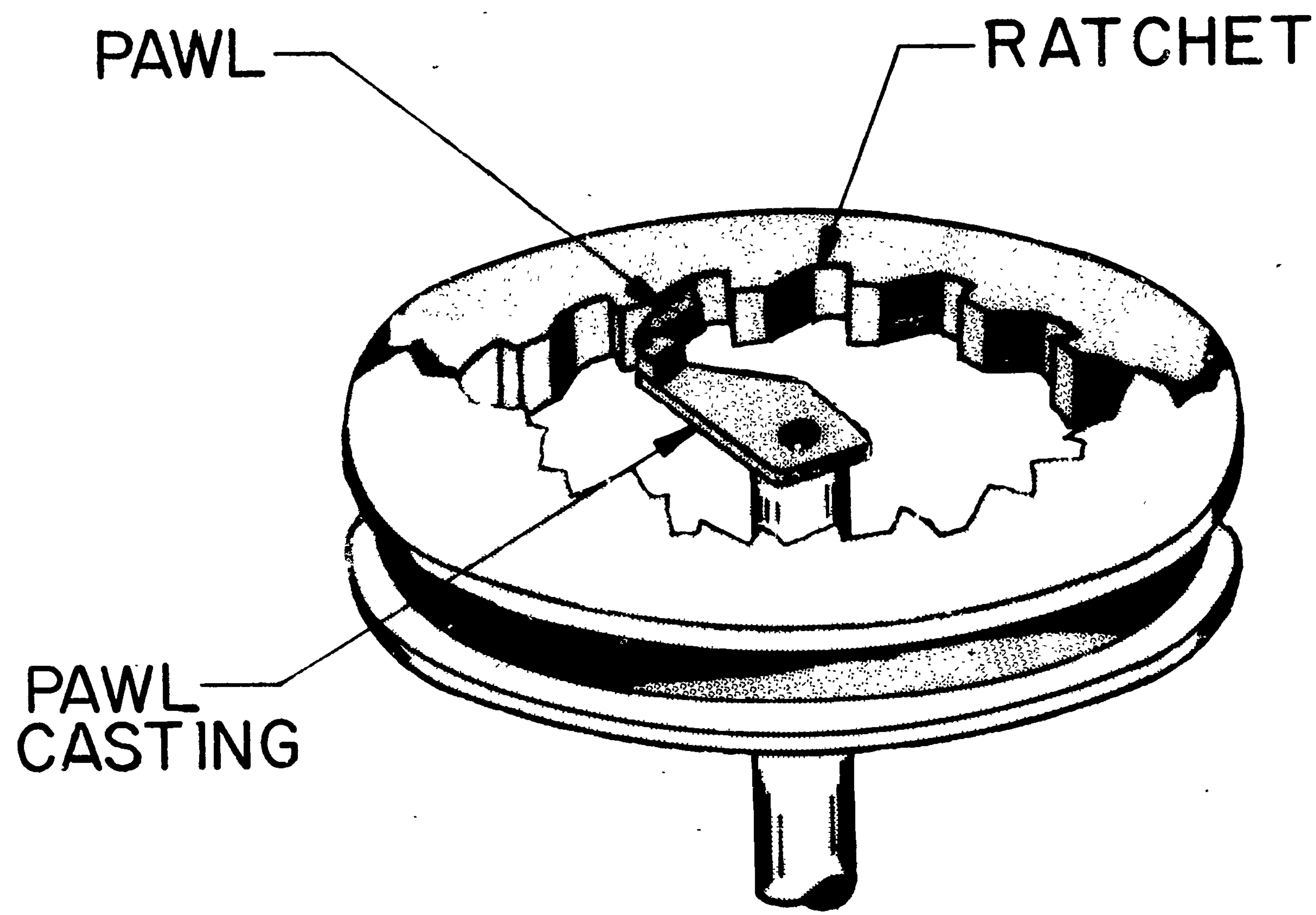
850/60
Friction Clutches 2



OVERRIDING OR OVERRUNNING TYPE CLUTCH

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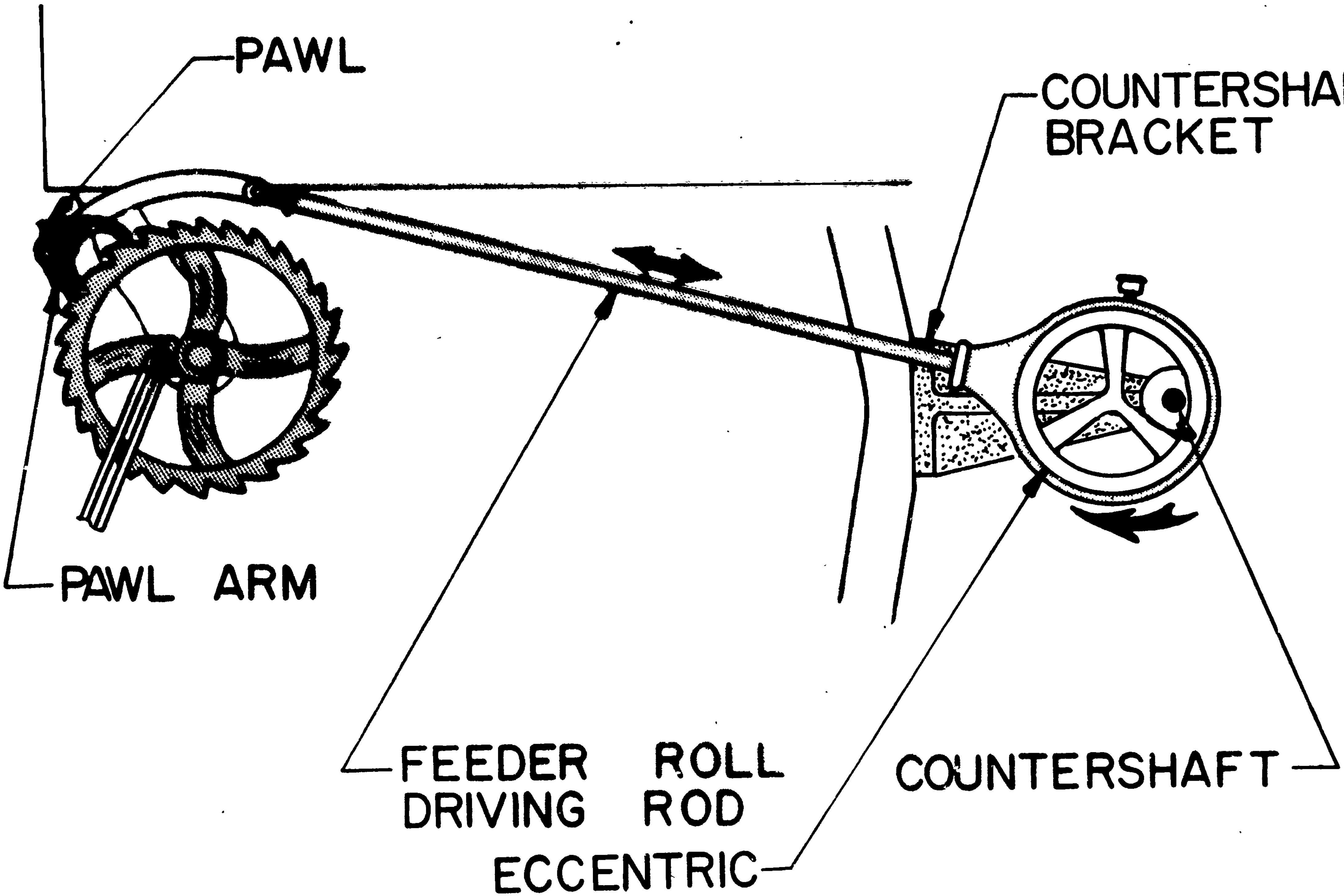

RACHET AND PAWL DRIVE

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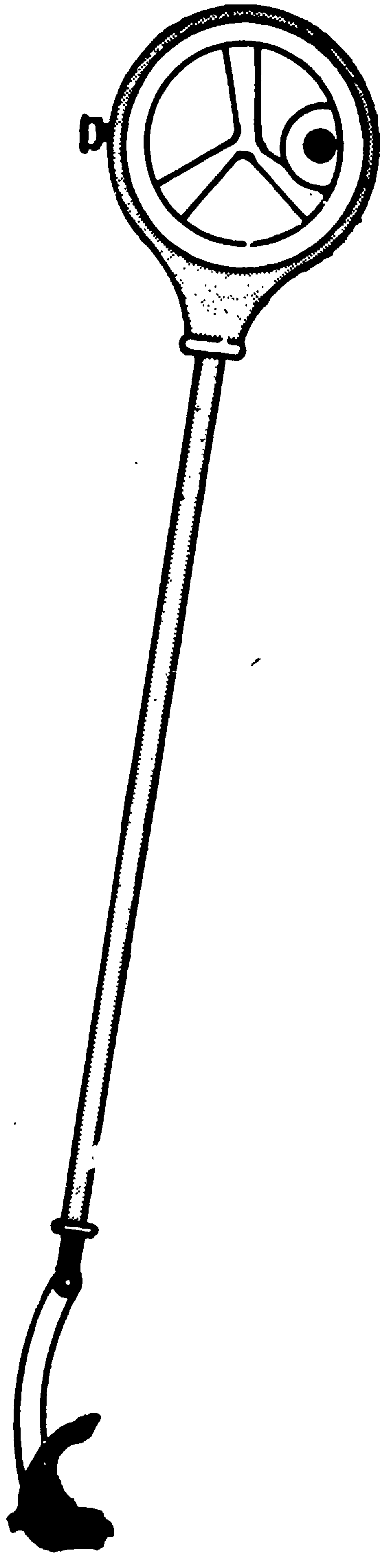

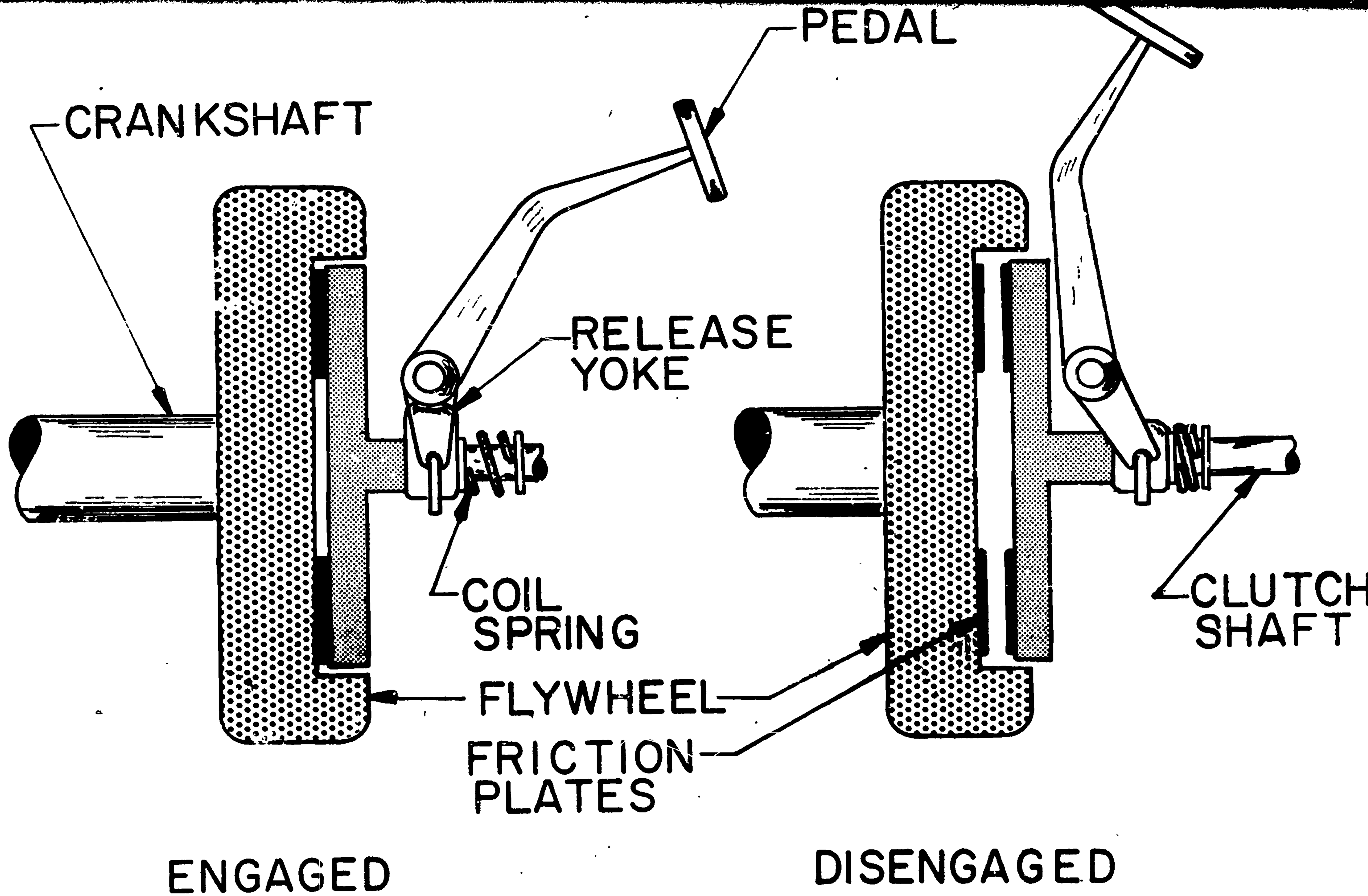

OPERATING PRINCIPLE OF SPRING PRESSURE CLUTCH

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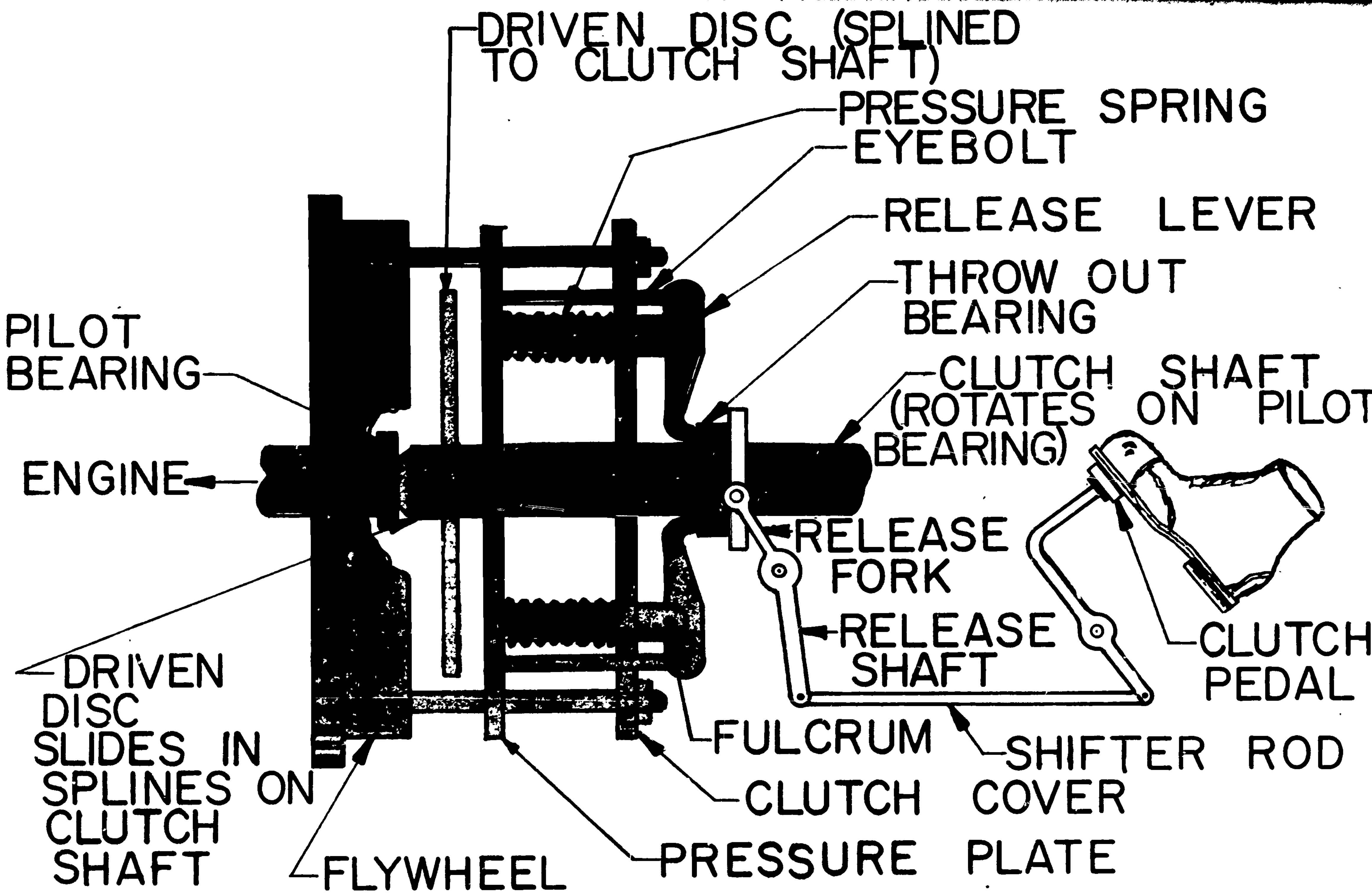
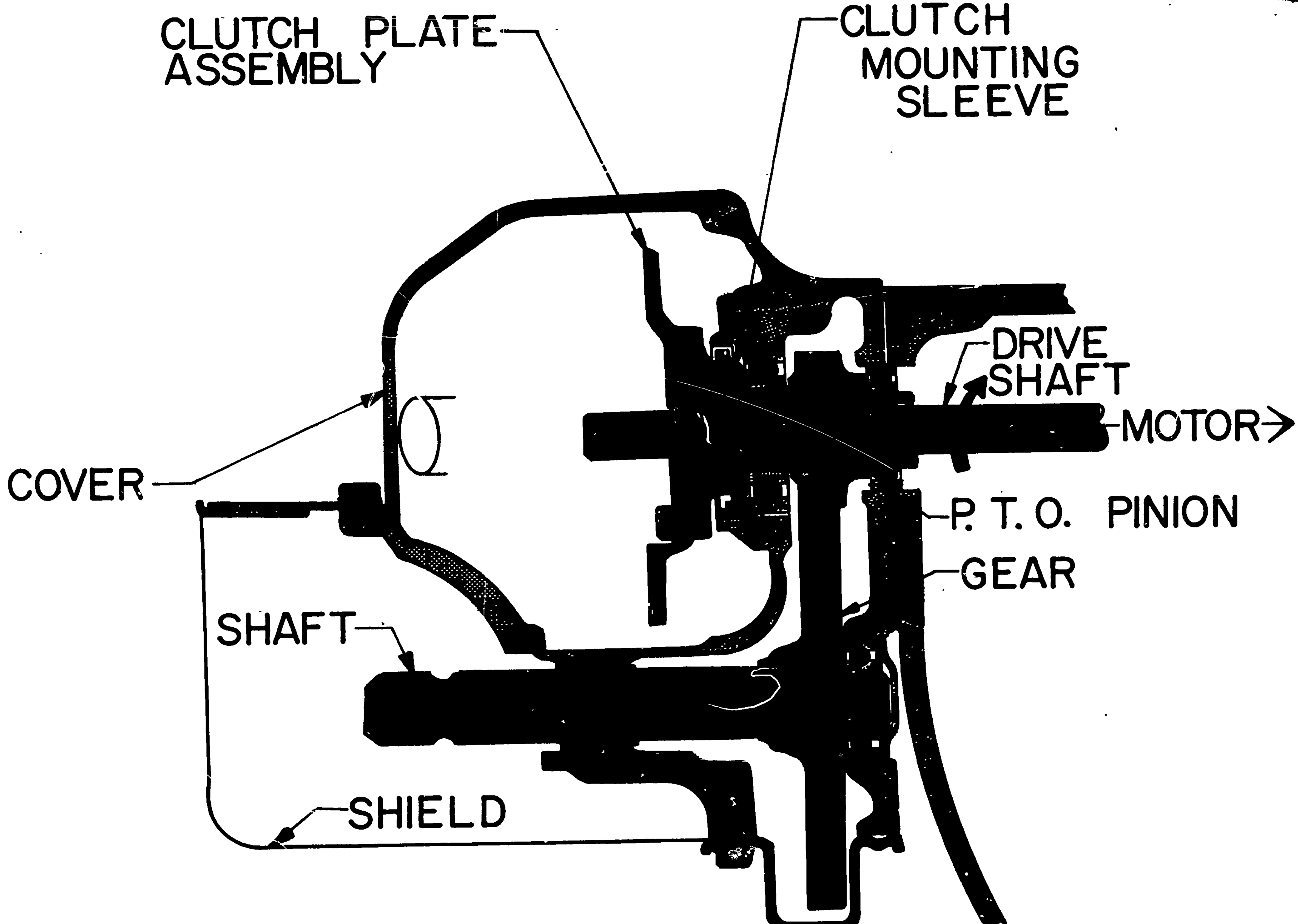
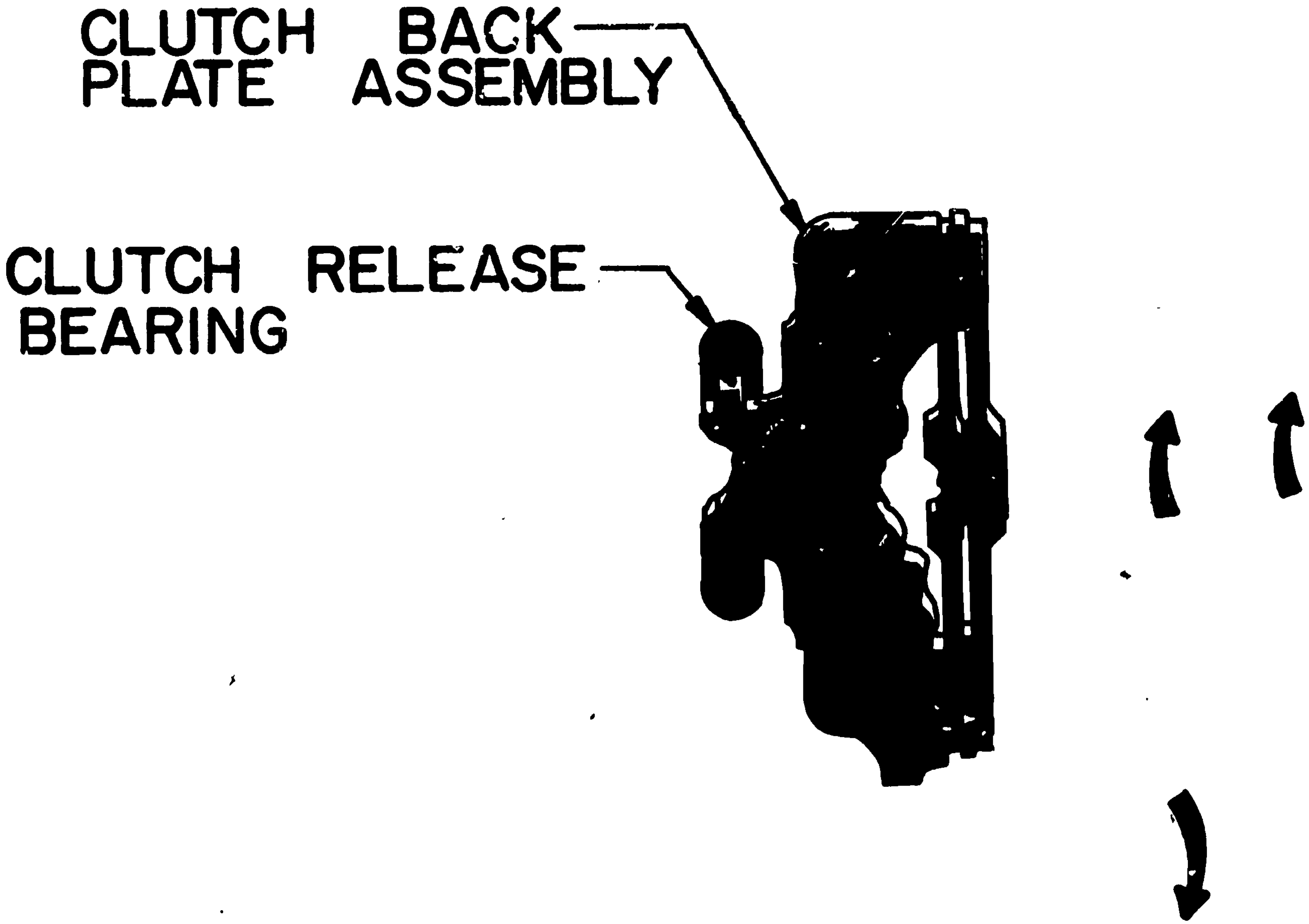


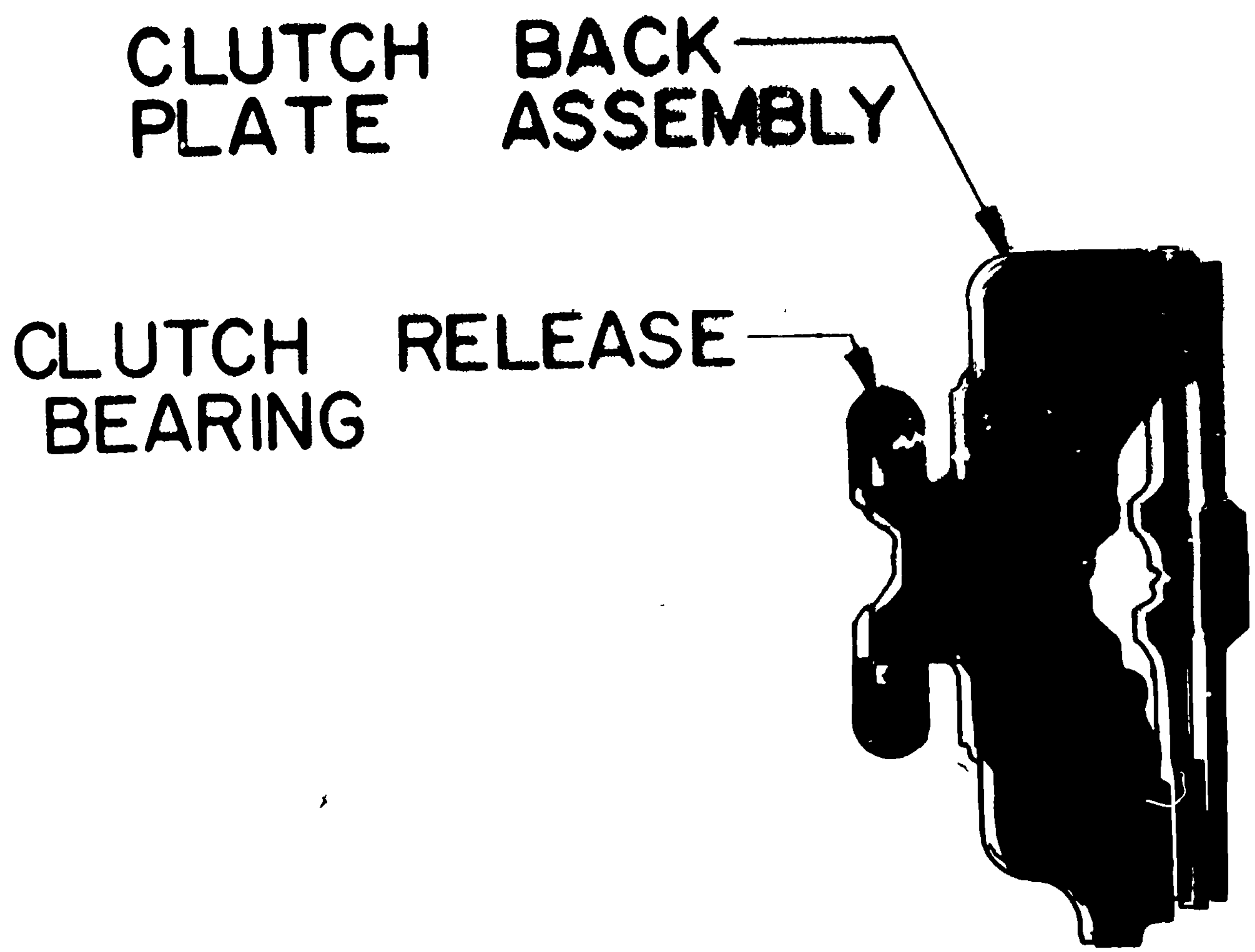
SPRING LOADED FOOT OPERATED CLUTCH



INDEPENDENT



CLUTCH ENGAGED



CLUTCH DISENGAGED

REFERENCE

Mechanical Power Transmission, p. 3-6

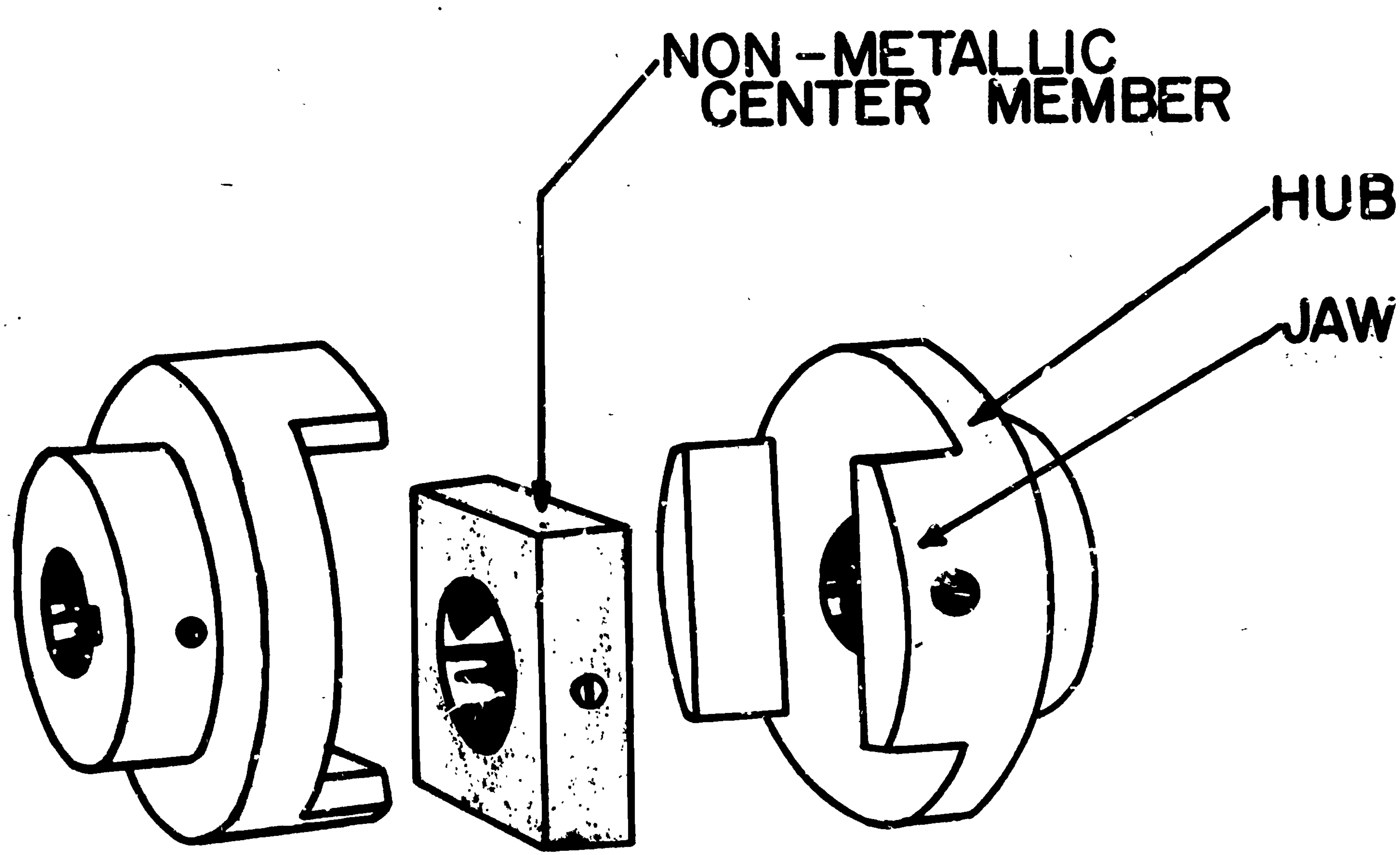
SUGGESTED ACTIVITIES:

Note to teacher: Flexible couplings are most frequently found on power units by electric motors or power drives with no clutch mechanism. To find these units examine automatic water systems, electric powdered elevator drives and the like.

1. Have students study the use of the flexible coupling.

2. Examine various types. Can you locate types not pictured with this transparency unit.

3. Examine the construction of various types of couplings.



FLEXIBLE COUPLING WITH FLOATING, NON-METALLIC CENTER MEMBER

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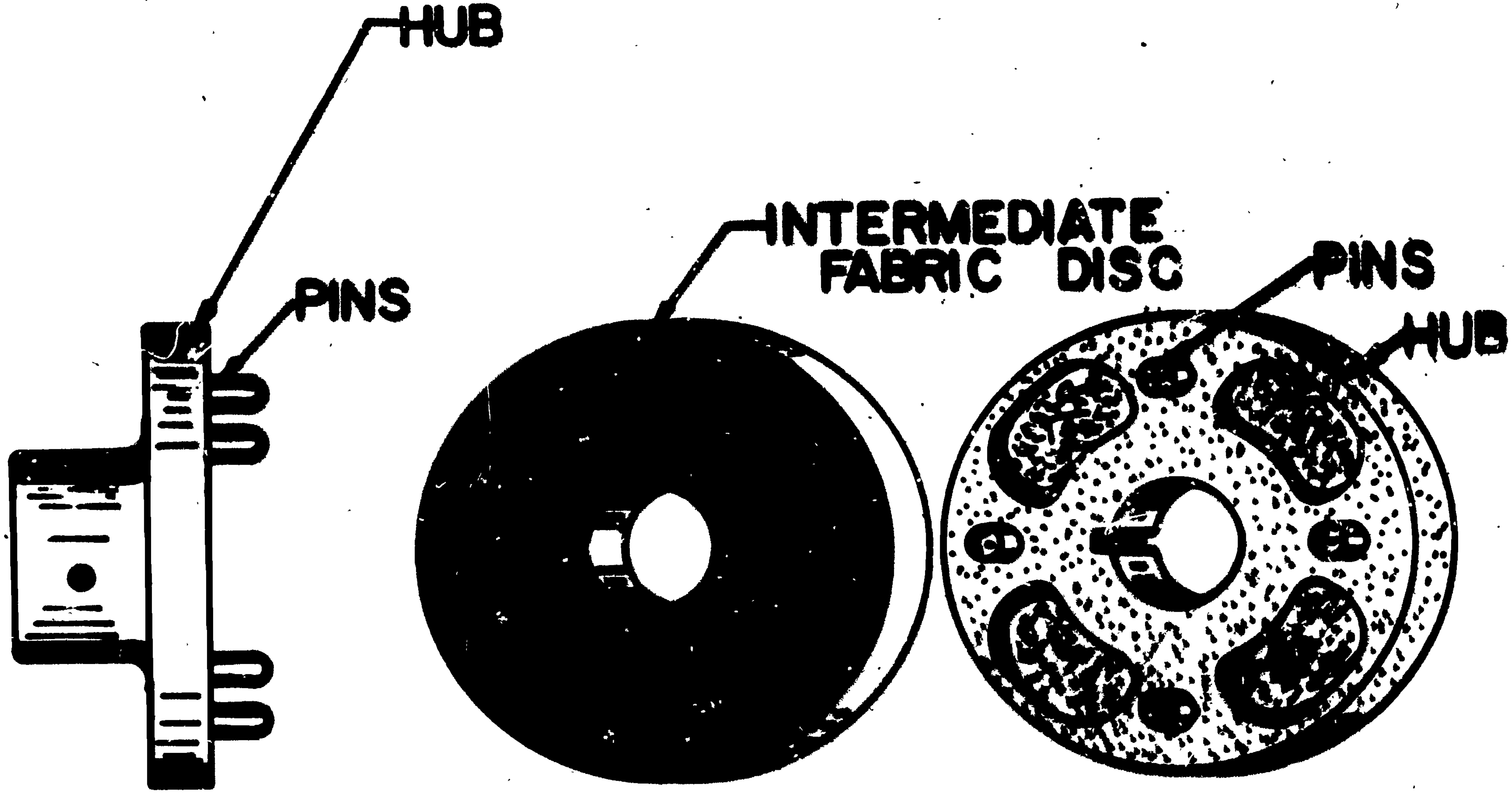
850/60
Flexible Coupling 1



INTERMEDIATE FABRIC DISK
TYPE FLEXIBLE COUPLING

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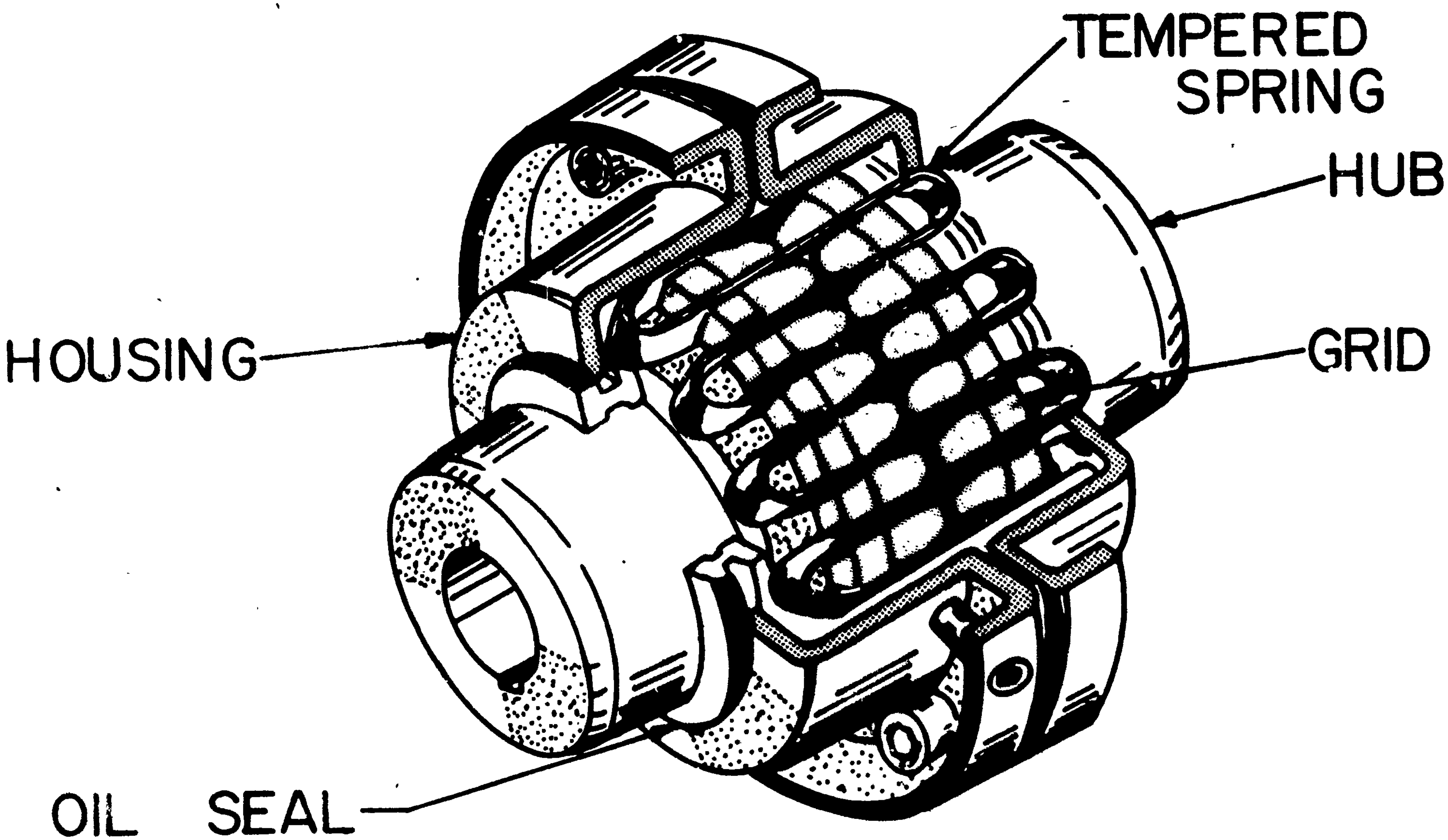
U.S.O.E. Grant Number OEG 2-068320-1103

Flexible Coupling 3



FLEXIBLE COUPLING WITH
RESILIENT GRID MEMBER

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SUGGESTED REFERENCES FOR STUDY AND REVIEW

Rural Arithmetic, p. 110-114, 275
Tractors and Crawlers, p. 237-245
Farm Machinery and Equipment, p. 19-20, 23-28
Farm Tractors, p. 55, 58, 84
Mechanical Power Transmission, p. 11-15, 21-23
Mechanical Power Transfer Systems, p. 11-15
Modern Farm Power, p. 183-187

SUGGESTED ACTIVITIES

1. Study and discuss the types of belts and pulleys, construction of each, terminology and uses of each in agricultural machinery.

2. Examine agricultural machines and locate the belts and pulleys used.

3. Develop problems for student computation on length of belts, speed of belts and pulley sizes.

4. Study and discuss proper belt tension.

5. Make a collection of the types of belts and pulleys. Have students examine the cross-sections of old belts.

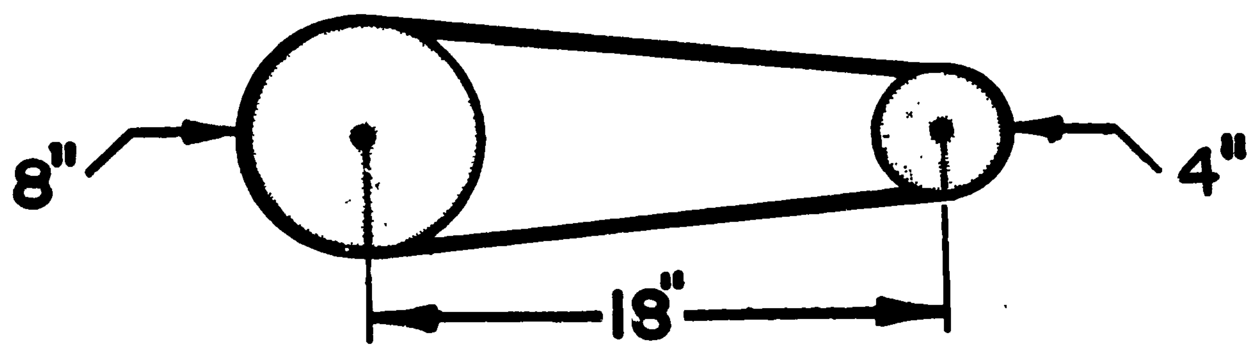
6. Study the variable speed pulley. Locate equipment with this type of pulley and emphasize the importance of understanding how this pulley functions.

7. Have students determine direction of power transmission on actual machines by knowing only the direction of rotation of the initial source of power.

8. Have students determine speed of various belt and pulley applications on an actual machine by measuring the sizes of the pulleys and knowing only the speed of the initial drive pulley.

DETERMINATION OF THE LENGTH OF A FLAT BELT

1. ADD TOGETHER THE DIAMETERS OF THE 2 PULLEYS.
2. DIVIDE THIS SUM BY 2 AND MULTIPLY THE QUOTIENT BY 3.
3. TO THIS PRODUCT, ADD TWICE THE DISTANCE BETWEEN THE CENTERS OF THE TWO PULLEY SHAFTS.



EXAMPLE:

1. 8" + 4" = 12"
2. 2 ÷ 12" x 3" = 18"
3. 18" + 18" + 18" = 54"

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850/60
Pulley & Belt 1

DETERMINATION OF THE LENGTH OF A V-BELT

L = LENGTH OF BELT

C = DISTANCE BETWEEN CENTERS OF SHEAVES

D = OUTSIDE DIAMETER OF LARGE SHEAVES

d = OUTSIDE DIAMETER OF SMALL SHEAVES

$$L = 2C + 1.57(D + d) + \frac{(D - d)}{4C}$$

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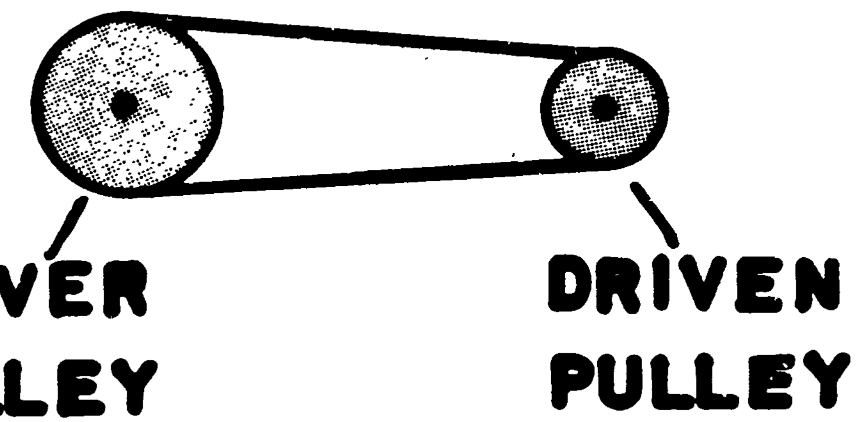
DETERMINING PULLEY SIZES AND SPEEDS



D = DIAMETER OF DRIVER

S = SPEED OF DRIVER

d = DIAMETER OF DRIVEN PULLEY

s = SPEED OF DRIVEN PULLEY

$$D \times S = d \times s$$

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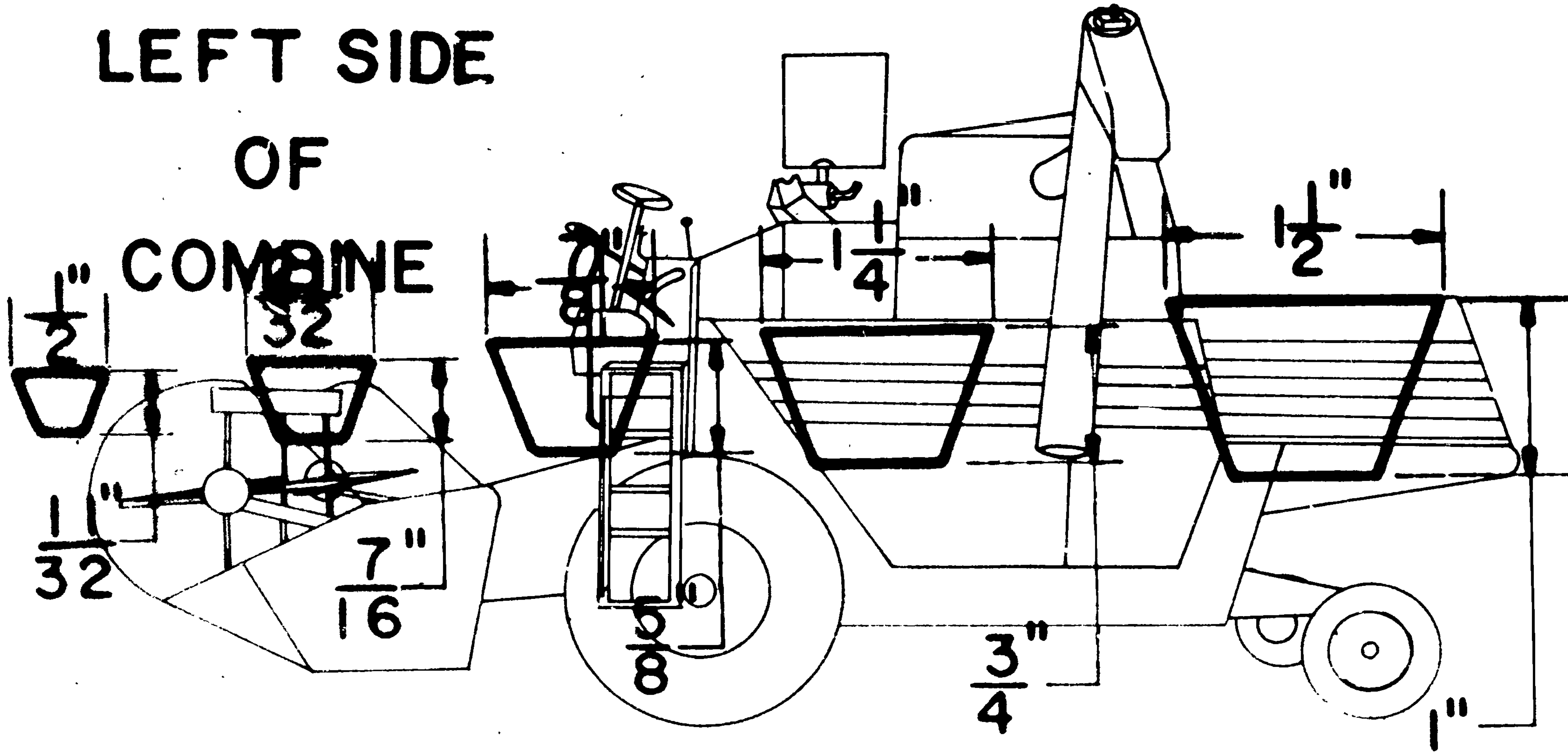

WAYS VEE BELTS AND CHAINS ARE USED ON COMBINES

STANDARD CROSS-SECTIONAL DIMENSIONS OF V-BELTS

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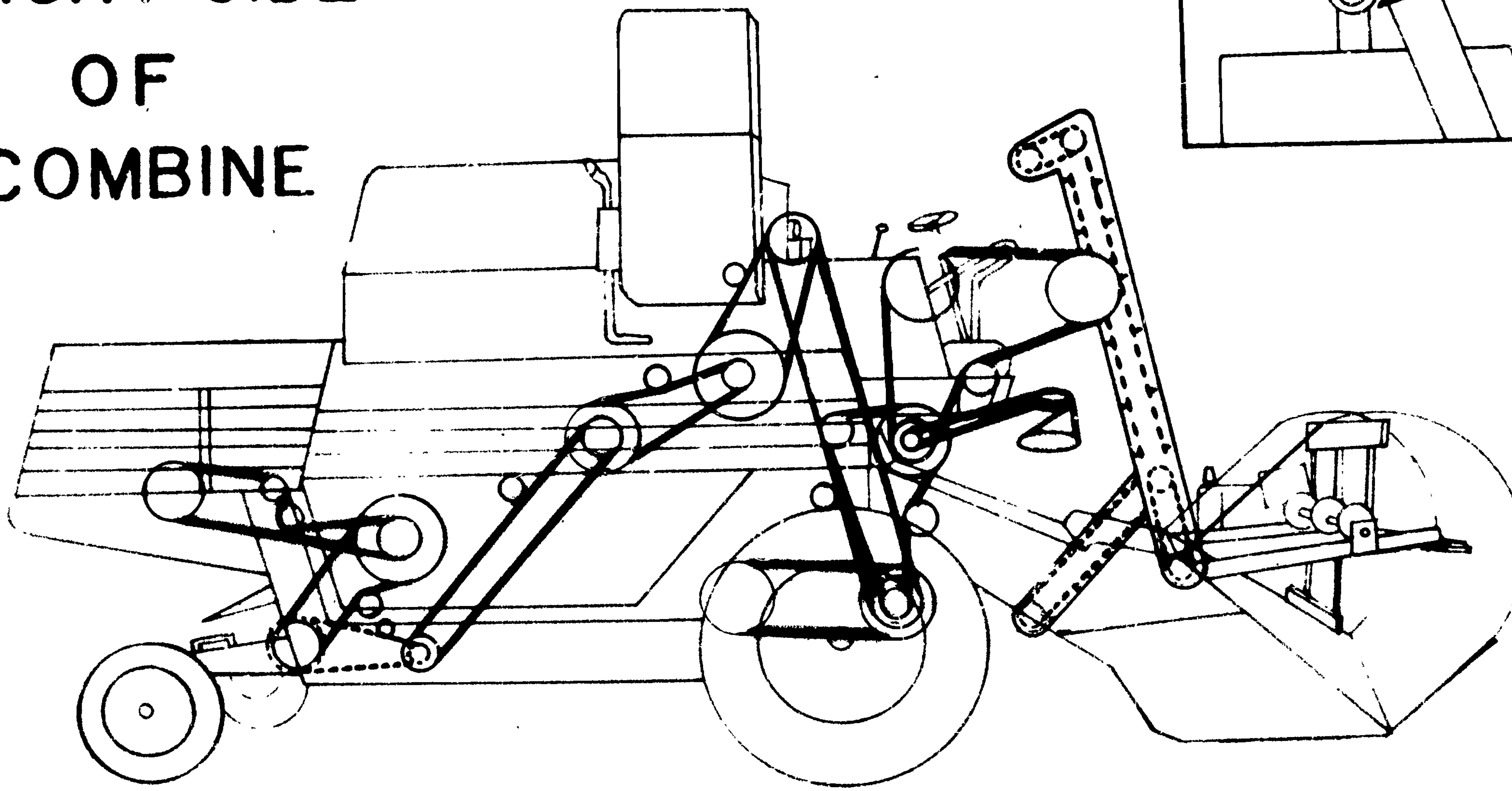
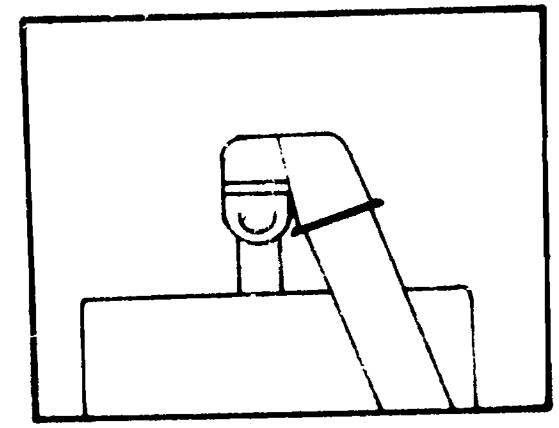
RIGHT SIDE
OF
COMBINE





WAYS VEE BELTS AND CHAINS ARE USED ON COMBINES

5A

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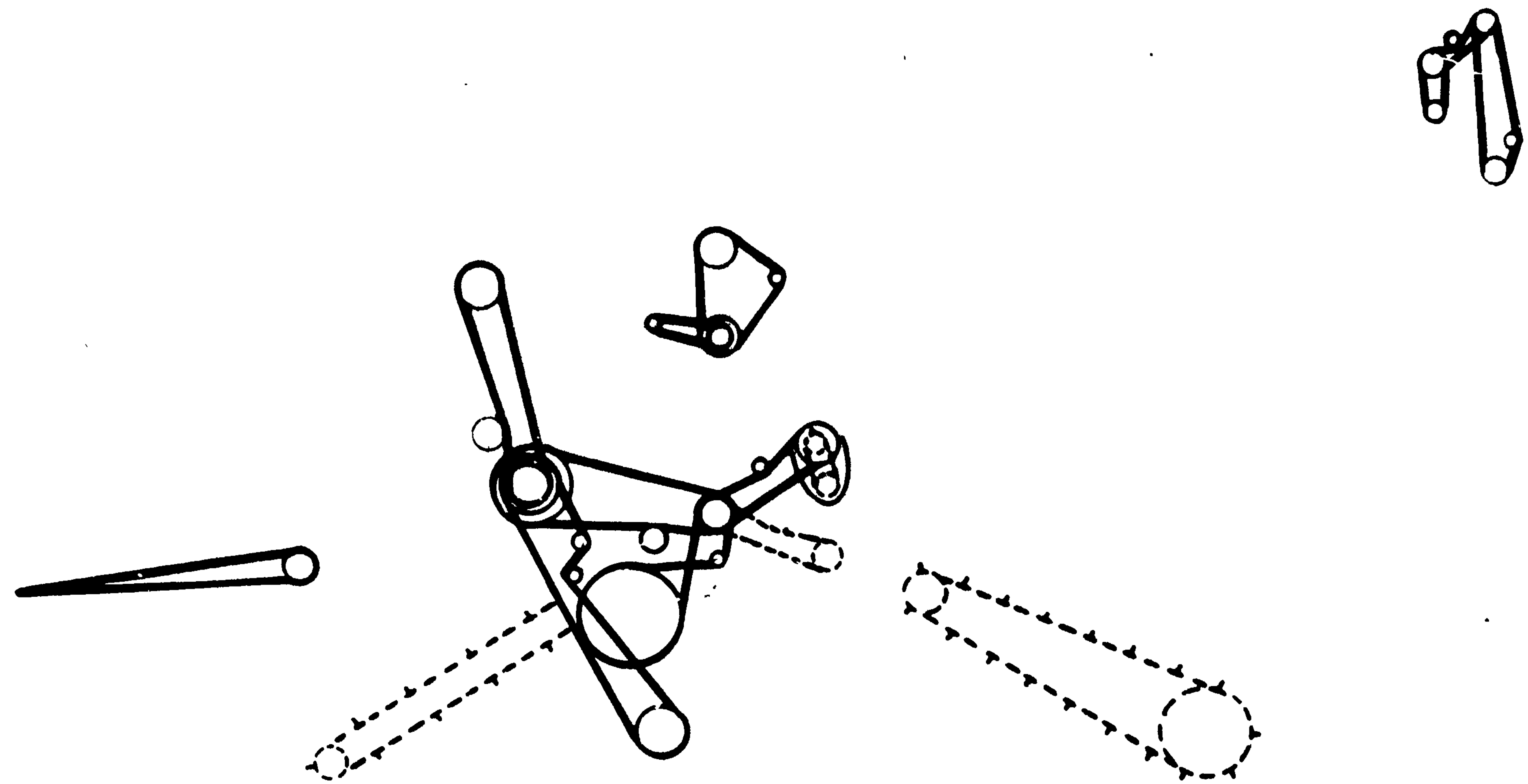
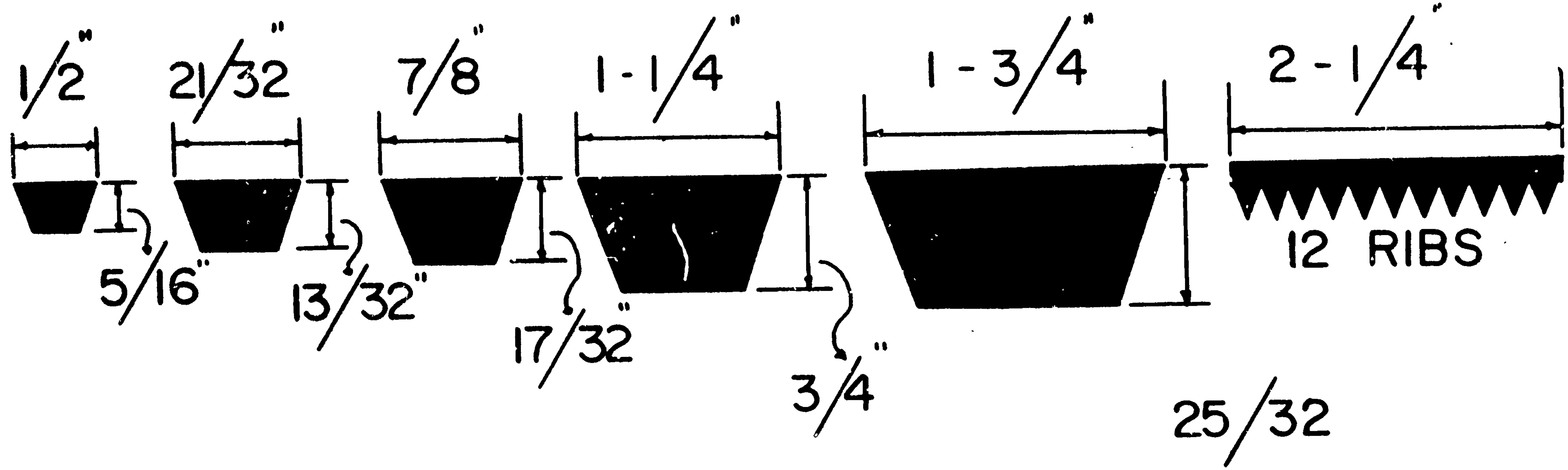
850/60
Pulley & Belt 6



6A



TYPICAL BELT SECTIONS USED ON COMBINE

Department of Agricultural Education, Clemson University
U.S.O.E. Grant Number OEG 2-068320-1103

<u>REFERENCES</u>:

<u>Tractor Transmissions</u>
<u>Farm Tractors</u>, pp. 75-81
<u>Tractor Operation and Daily Care</u>, pp. 51-54
<u>Modern Farm Power</u>, pp. 164-170
<u>Tractors and Crawlers</u>, pp. 191-211

<u>SUGGESTED ACTIVITIES</u>:

1. Discuss the need for a transmission. Why was the simple transmission inadequate?

2. Study the sliding gear transmission.

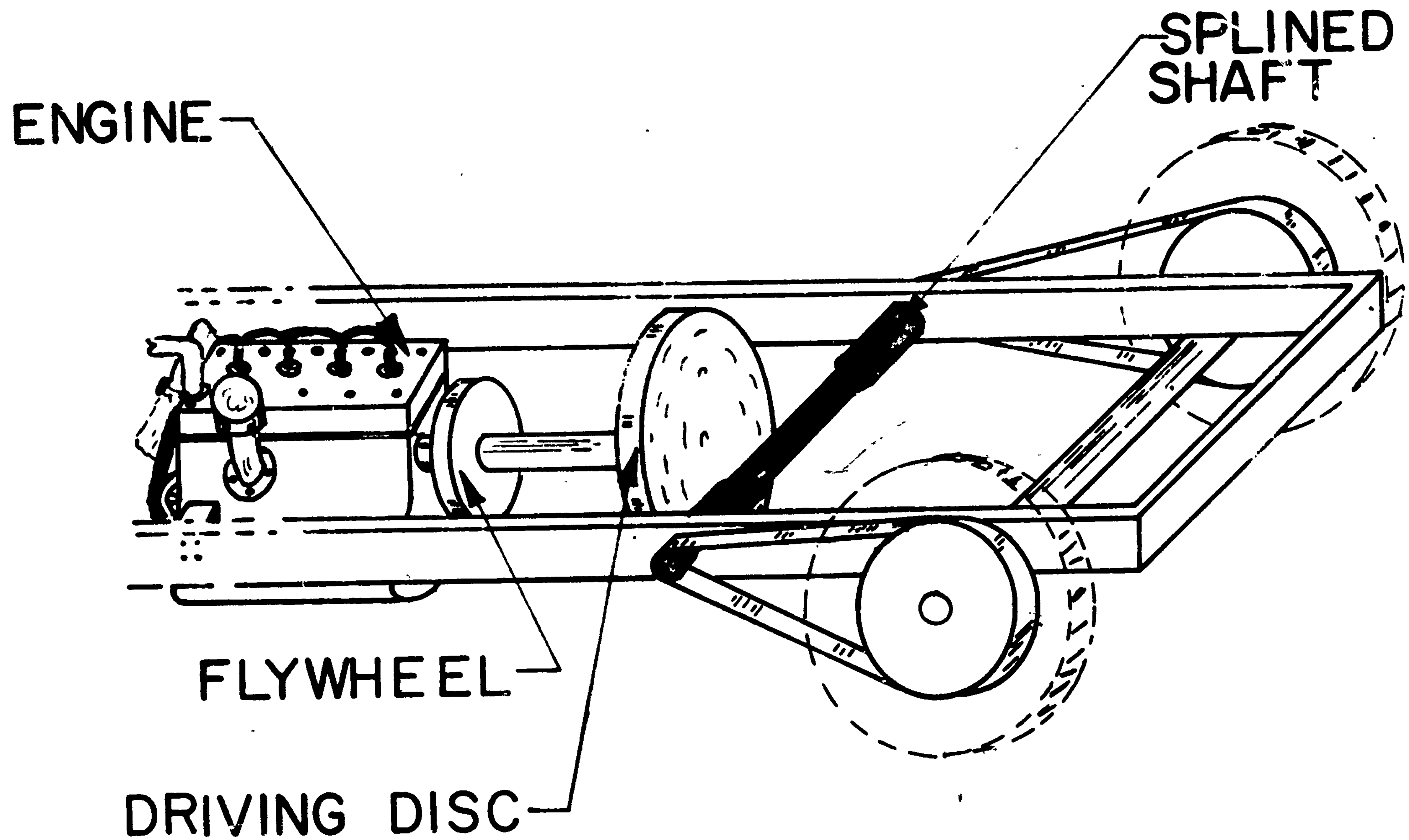
3. Have students observe a number of sliding gear transmissions. Work with implement dealers or collect several kinds that can be torn down for shop use.

4. Observe planetary transmissions. Observe how combinations of such units are used. Obtain a unit

3. Have students observe a number [illegible] transmissions. Work with implement dealers or collect several kinds that can be torn down for shop use.

4. Observe planetary transmissions. Observe how combinations of such units are used. Obtain a unit that can be disassembled and worked with in the shop.

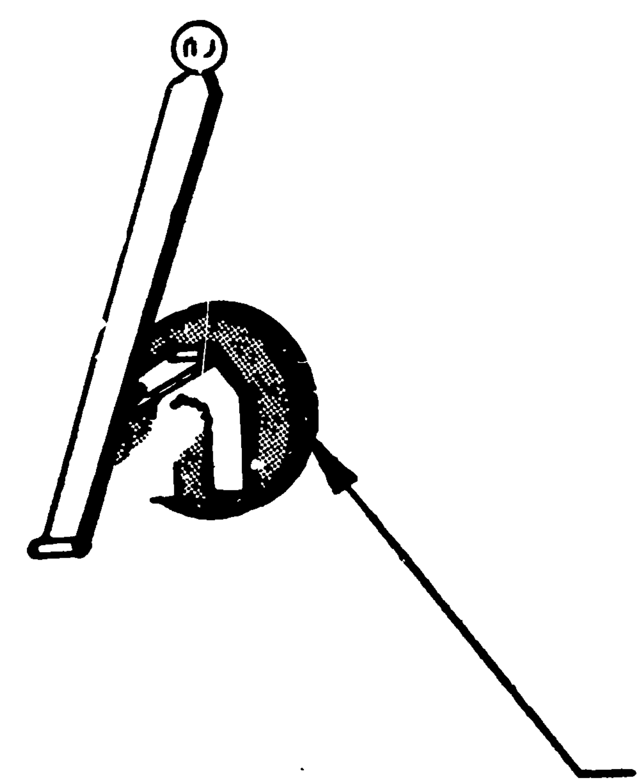
5. Obtain several synchronizers for student observation and demonstration. Have students develop a mock-up to clearly demonstrate their function and operation.

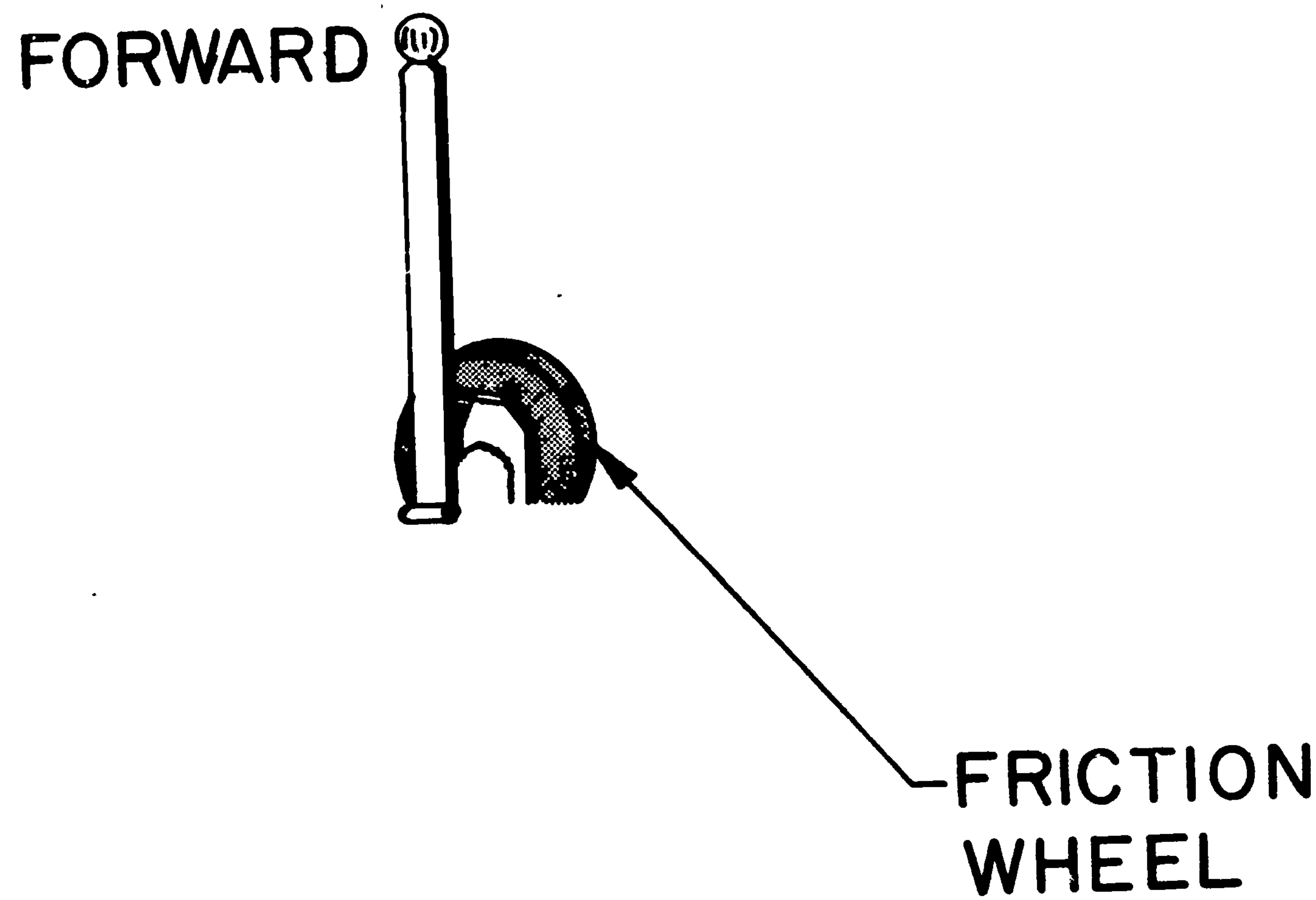


SIMPLE EARLY TRANSMISSIONS

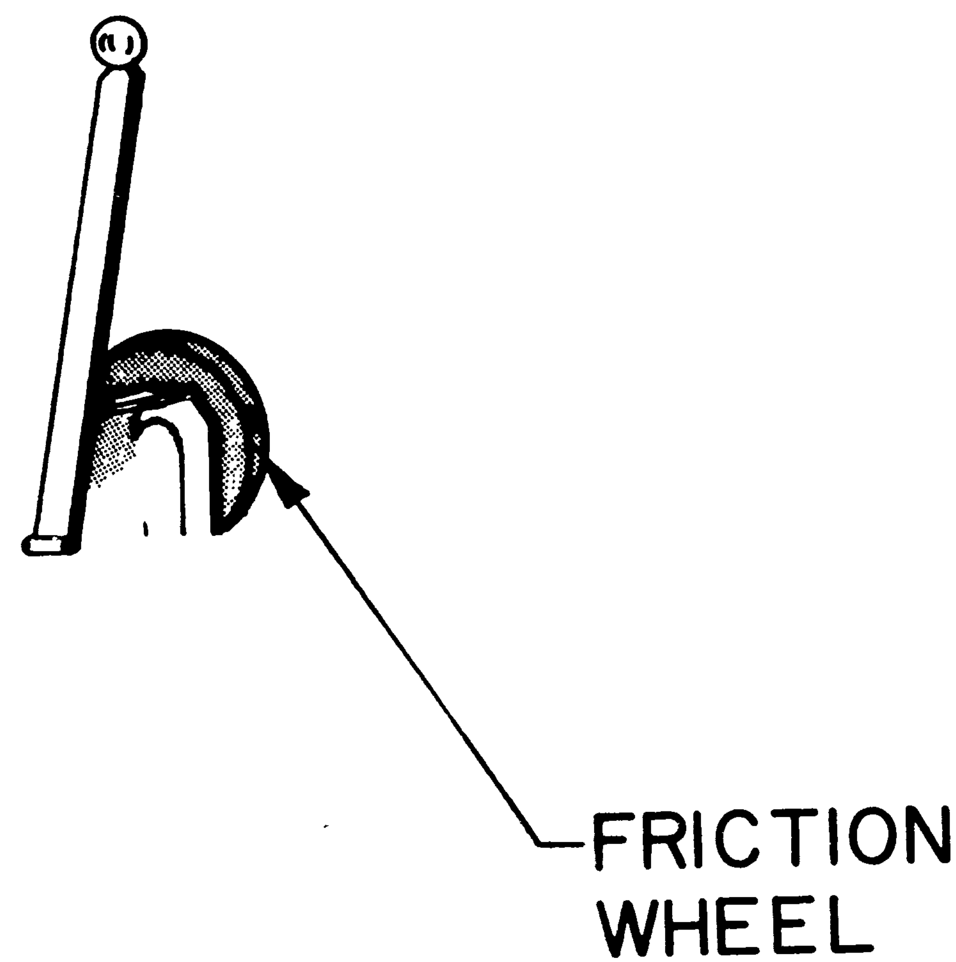
Department of Agricultural Education Clemson University 850/60
U.S.O.E. Grant Number OEG 2-068320-1... Transmission 1

REVERSE

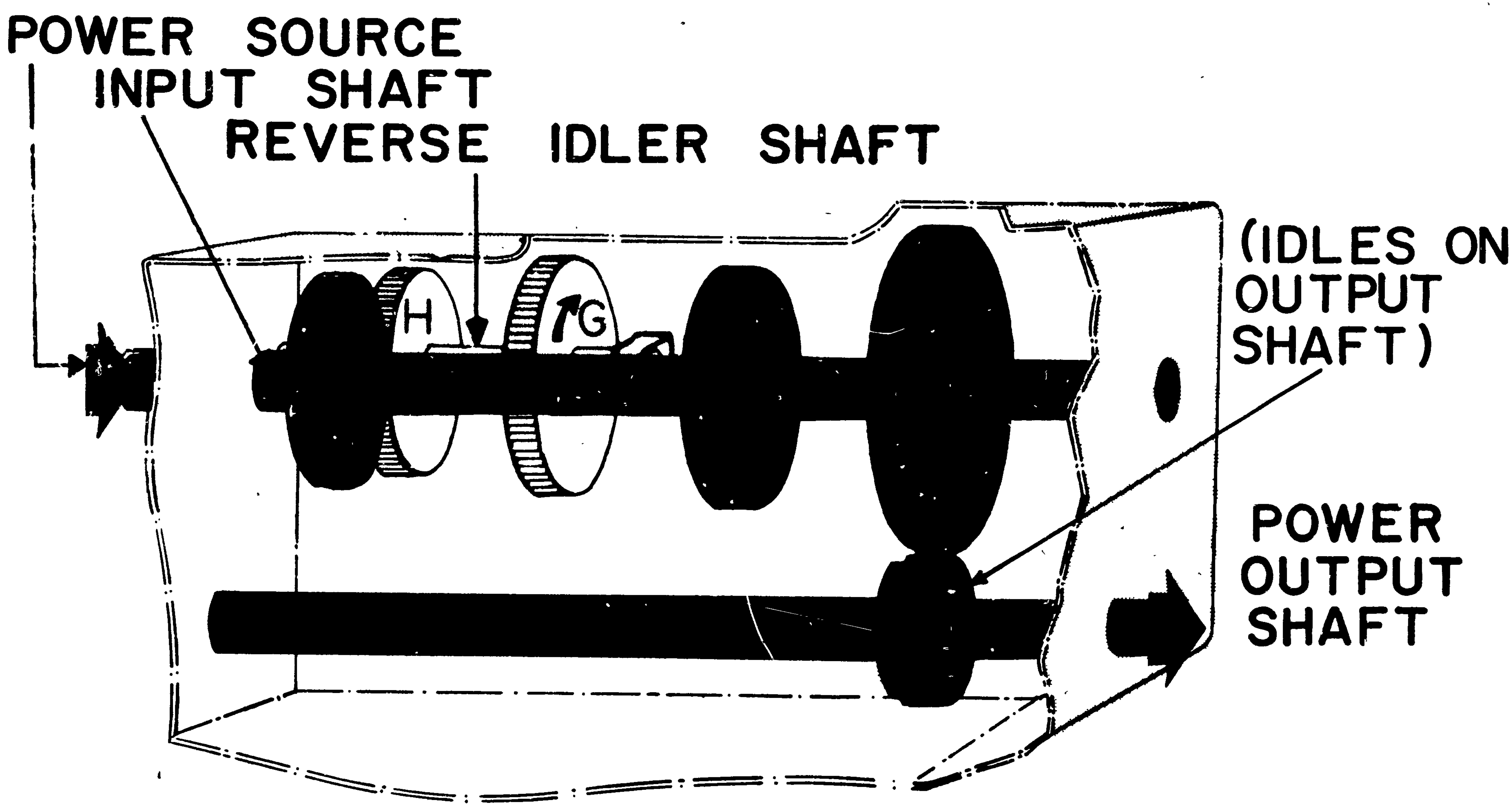



FORWARD
FRICTION
WHEEL

NEUTRAL (DEAD CENTER)

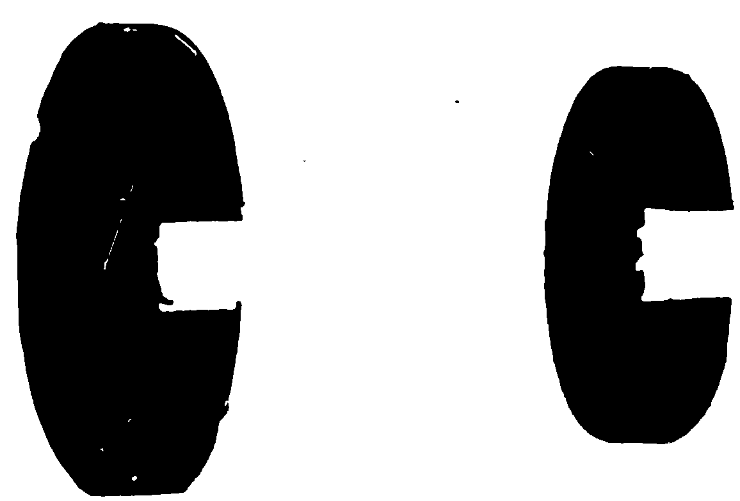


PRINCIPLE OF A SLIDING-GEAR TRANSMISSION



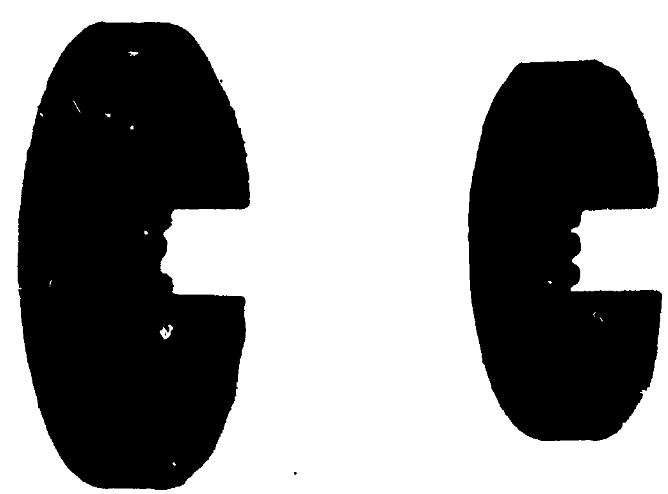
Department of Agricultural Education, Clemson University
U.S.O.E. Grant Number OEG 2-068320-1103

850/60
Transmission 2



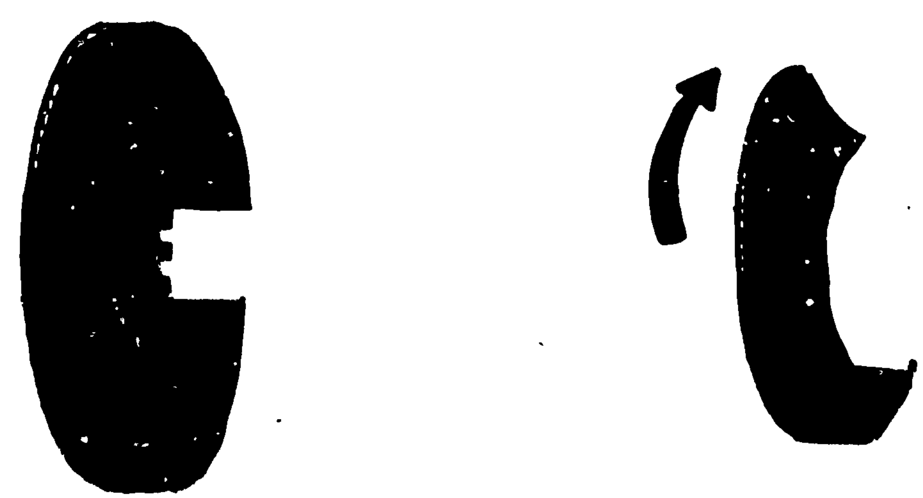
NEUTRAL

FIRST GEAR



SECOND GEAR

2c

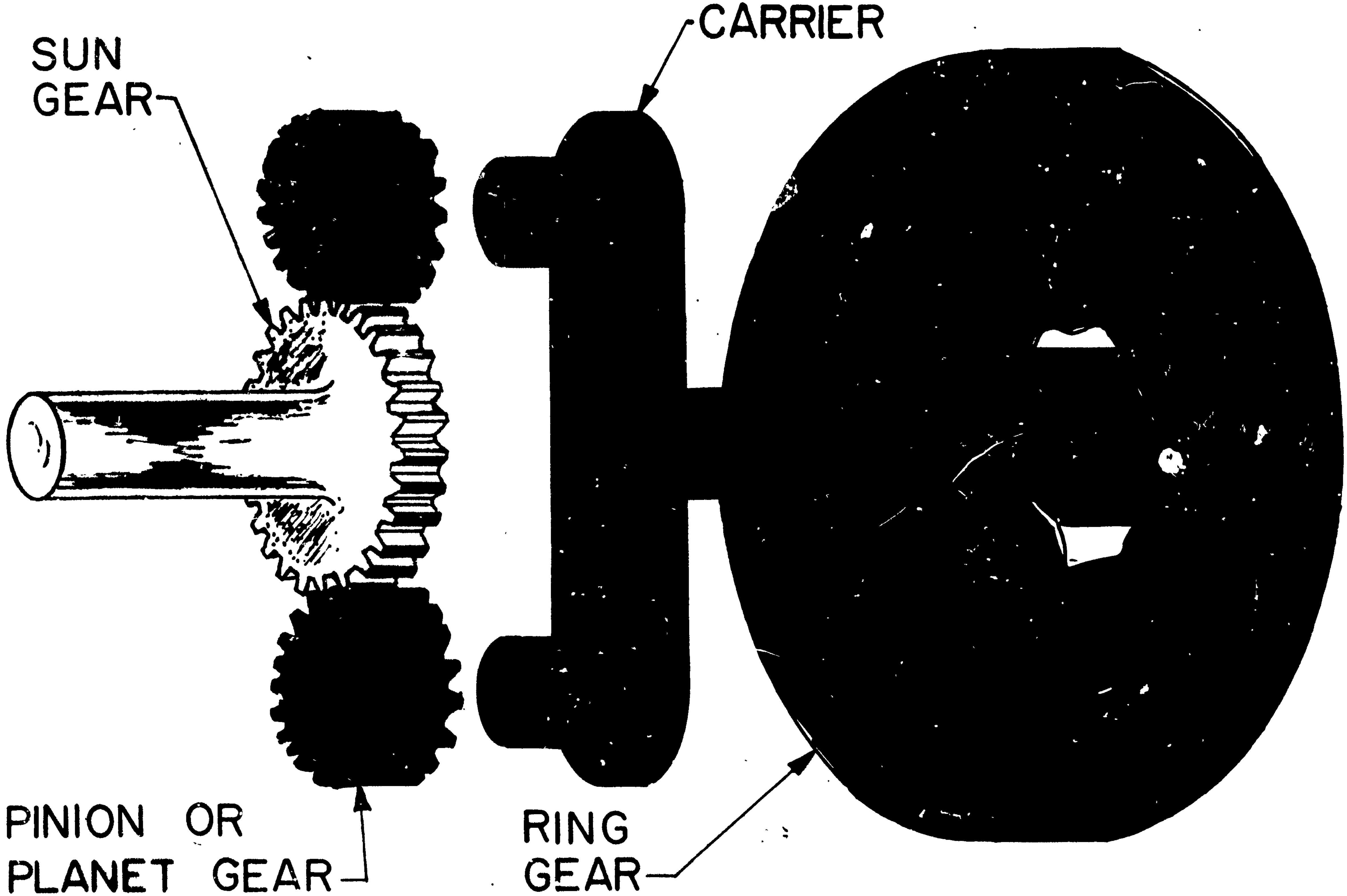


THIRD

REVERSE

2e

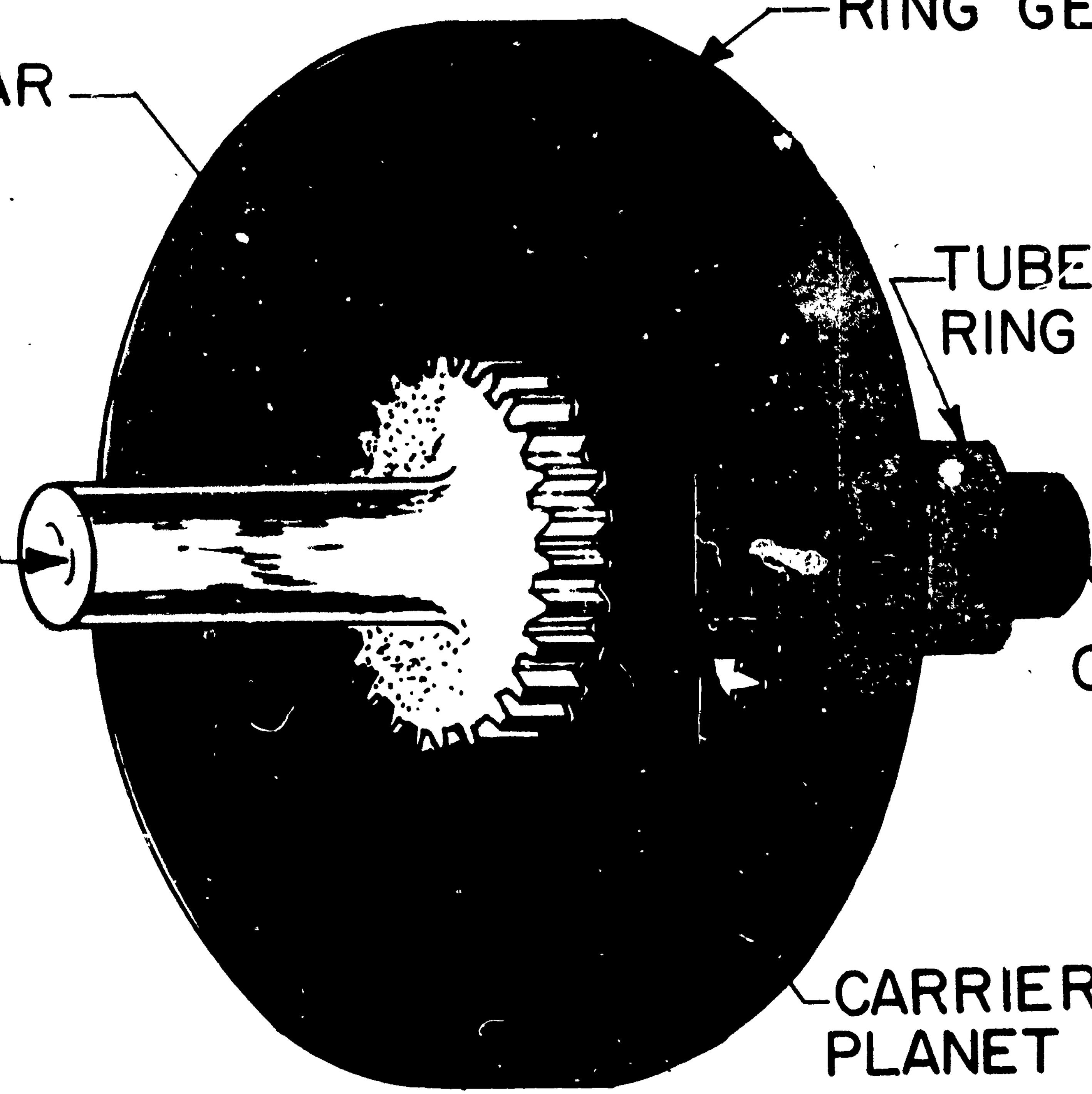
PARTS OF A PLANETARY TRANSMISSION

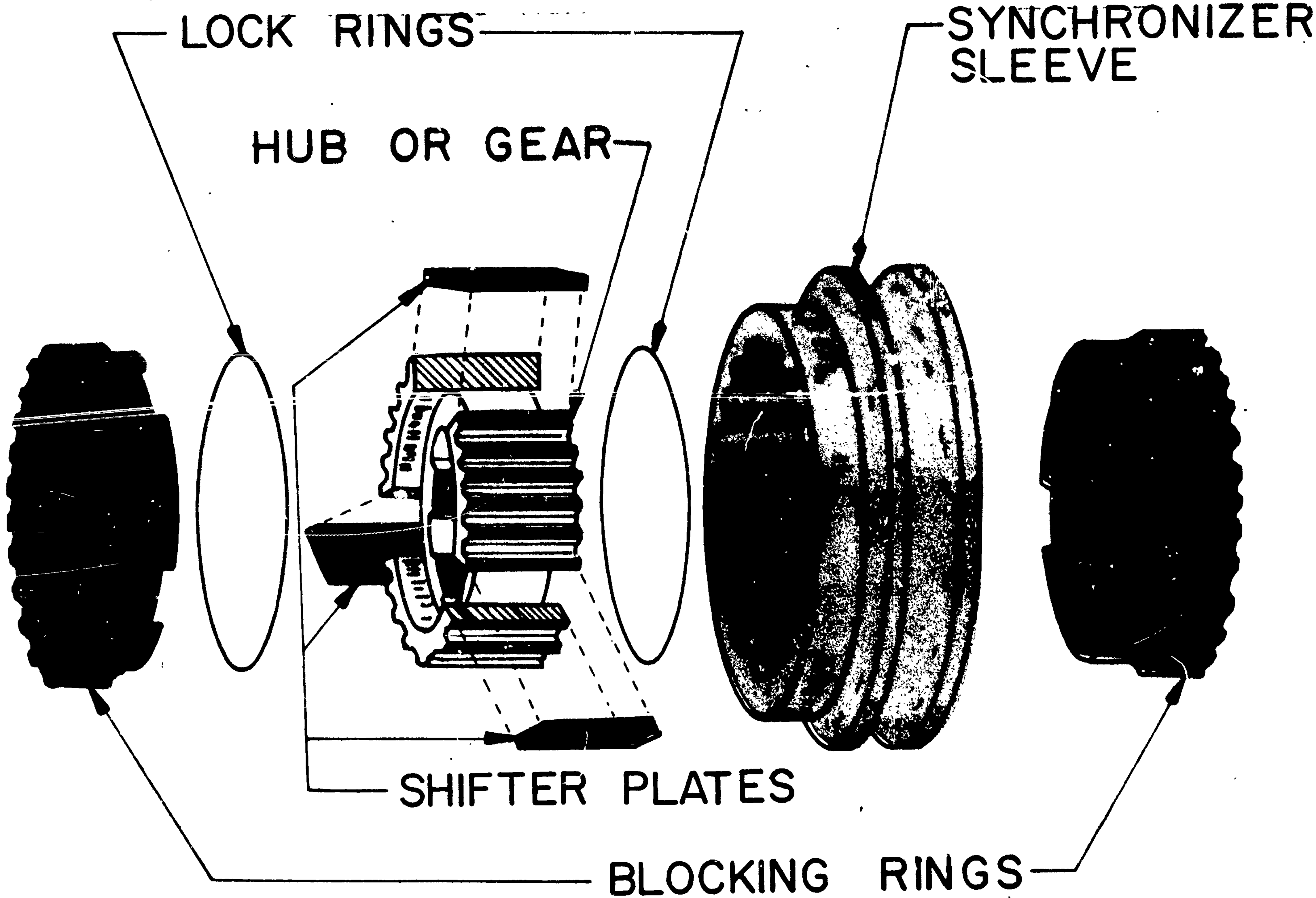


Department of Agricultural Education, Clemson University
U.S.O.E. Grant Number OEG 2-068320-1103

850/60
Transmission 3

PLANETARY TRANSMISSION

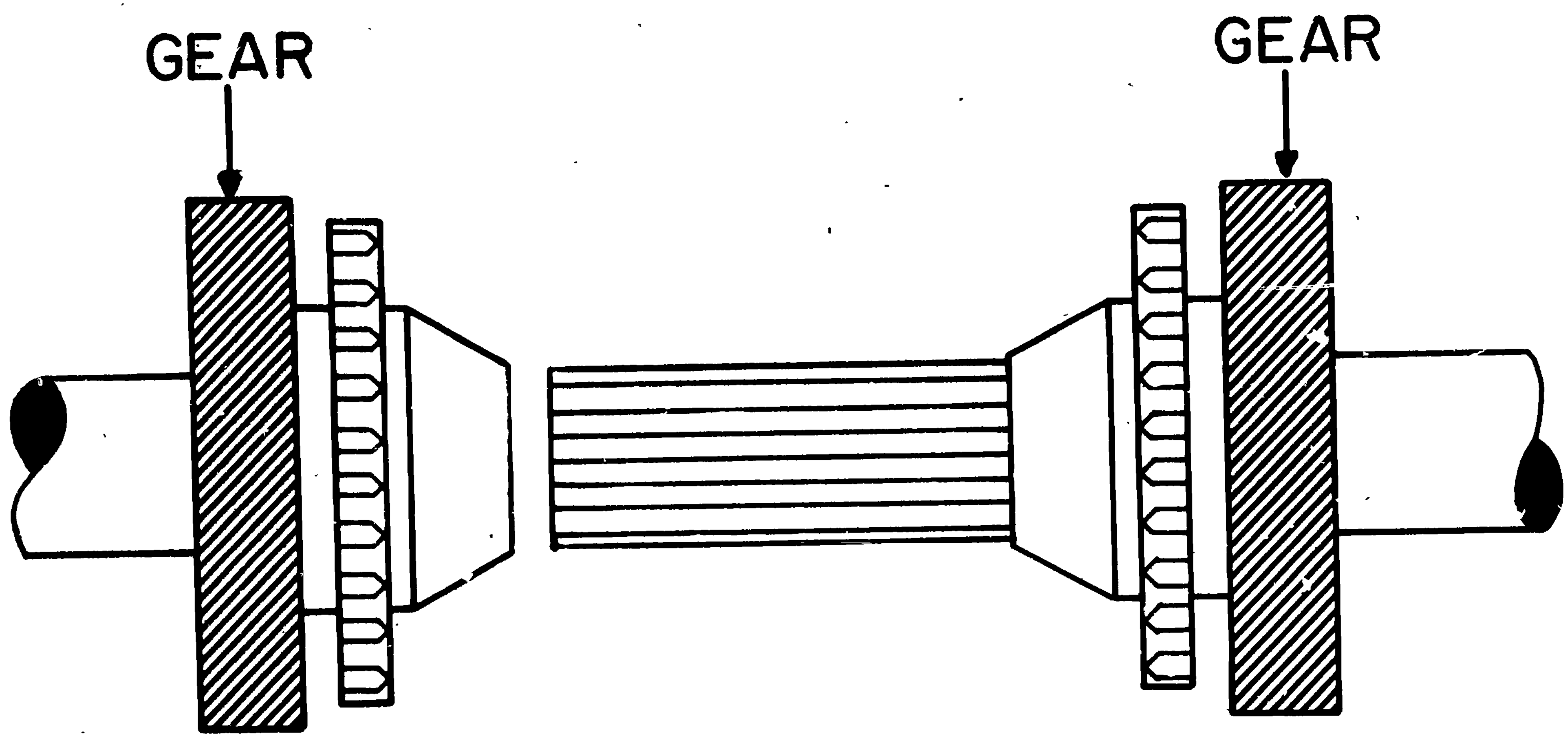




PARTS OF A SYNCHRONIZER

Department of Agricultural Education, Clemson University
U.S.O.E. Grant Number OEG 2-068320-1103

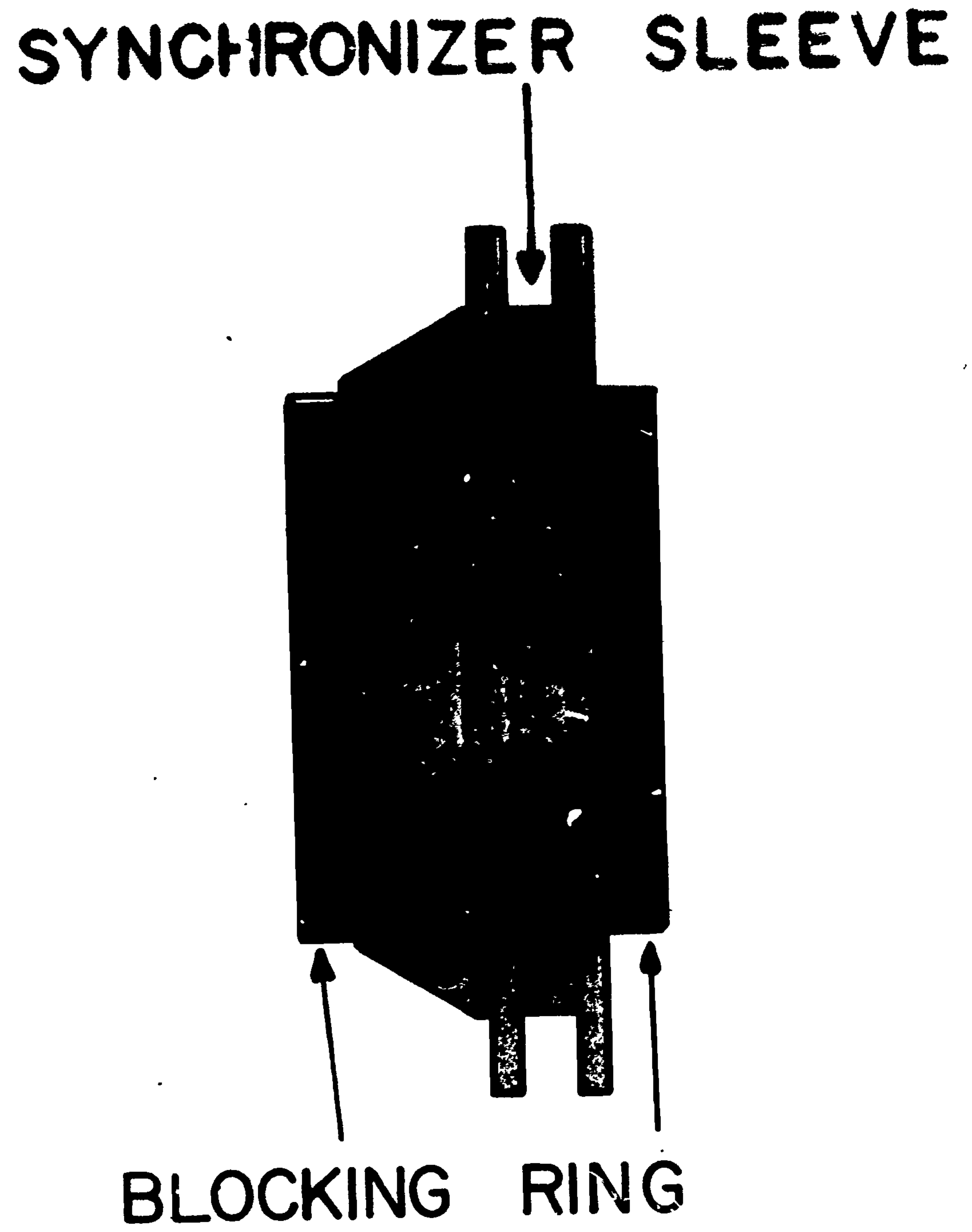
850/60
Transmission 5

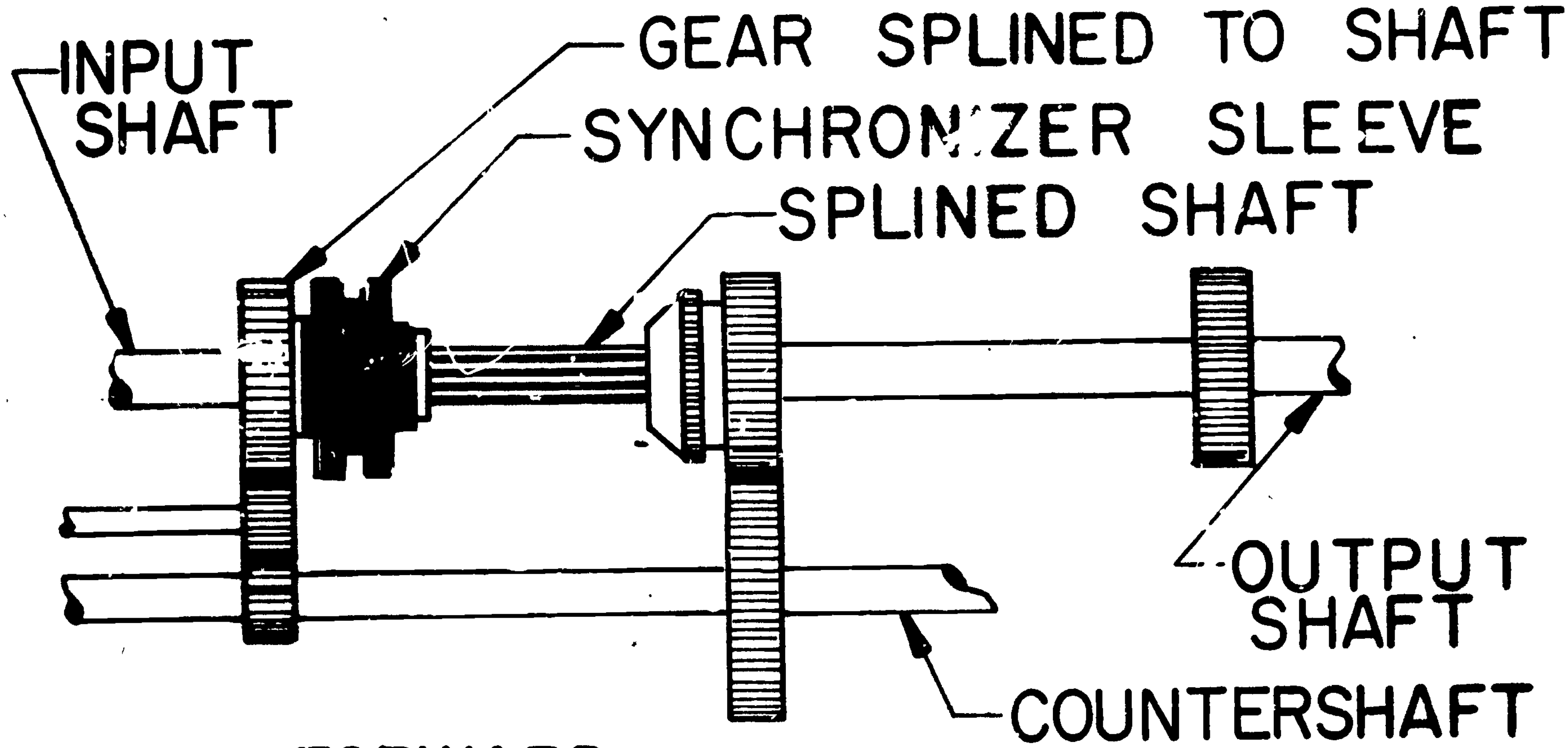


HOW A SYNCHRONIZER WORKS

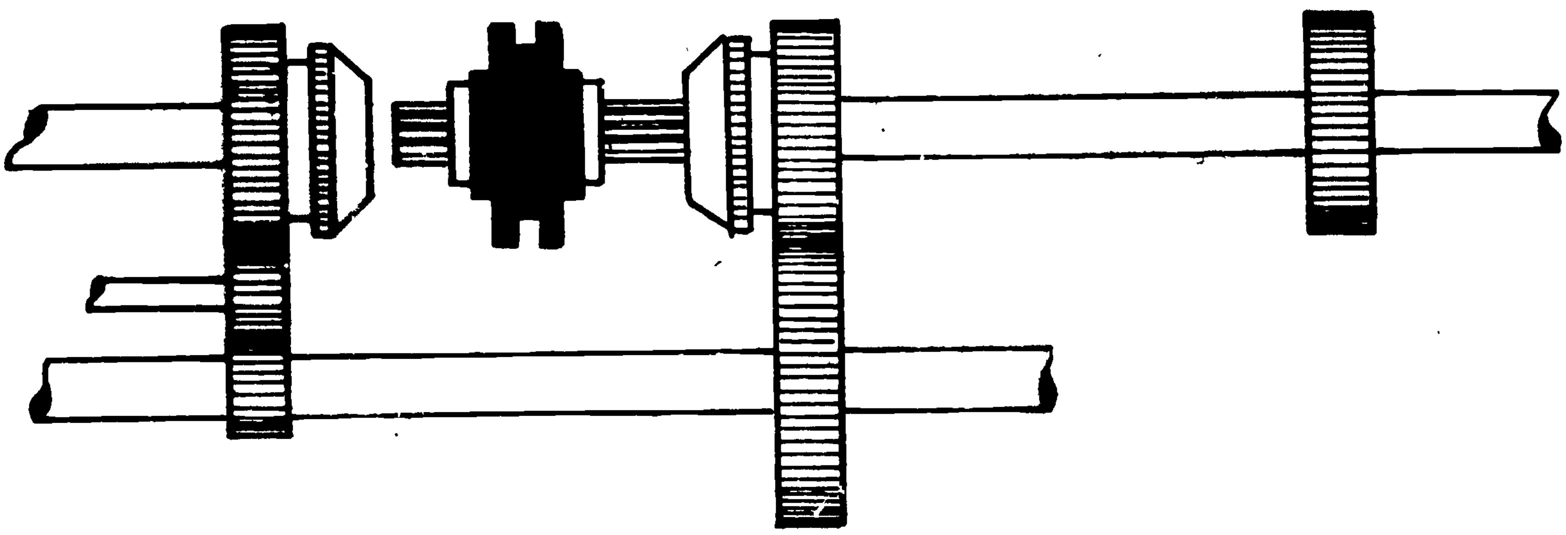
Department of Agricultural Education, Clemson University
U.S.O.E. Grant Number OEG 2-068320-1103

850/60
Transmission 6

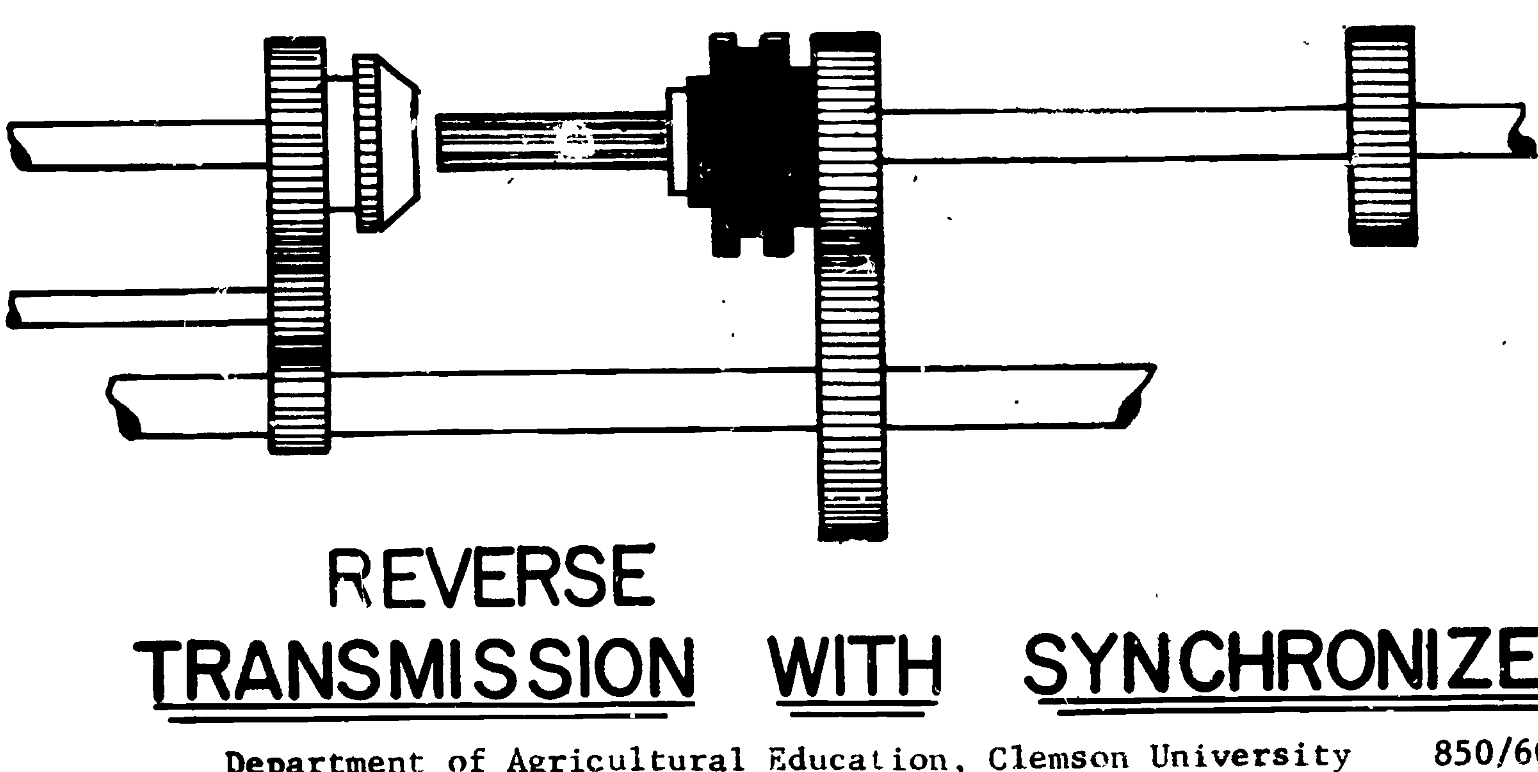

SYNCHRONIZER SLEEVE
BLOCKING RING



FORWARD



NEUTRAL



REVERSE

TRANSMISSION WITH SYNCHRONIZER

APPENDIX II

EVALUATION SCHEDULE USED BY
TEACHERS COOPERATING IN THE PROJECT

CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA 29631

SCHOOL OF EDUCATION
VOCATIONAL EDUCATION MEDIA CENTER

September 29, 1967

To: Teachers Cooperating With the Evaluation of Overhead Transparencies on Mechanic Power Transmission in Agricultural Machinery

From: Arthur K. Jensen, Director Vocational Education Media Center AKJ.

You will recall that during the summer I met with you to discuss your participation in the evaluation of overhead transparencies being produced here at Clemson University by a mass production printing process. I hope by now that you have had the opportunity to use these transparencies with one of your classes.

Enclosed is an evaluation schedule that I would appreciate having you fill in and return to me by October 15, 1967. Should you have comments on phases not covered in the schedule, add these on the back. Please be frank and honest in your evaluation.

Working with each of you this past summer has been a privilege. Your cooperation has been most important to the project. Thank you for your assistance.

Enclosure

Evaluation of Low Cost Transparencies Prepared by the Vocational Education Media Center at Clemson University on Basic Principles of Mechanical Power Transmission in Agricultural Machinery

Check response you feel most adequately completes statement.

1. In regard to durability of the plastic used, would you say

_____ (a) the plastic was of satisfactory quality for teaching purposes;

_____ (b) usable, but left something to be desired;

_____ (c) unsatisfactory. A more durable plastic should be used even though additional cost would be involved.

2. The image was printed on the plastic by a printing process. Did you fine the durability of this image to be

_____ (a) satisfactory for teaching procedures;

_____ (b) usable, but required extreme care in use even under normal teaching conditions;

_____ (c) unsatisfactory.

3. The transparencies were heavily covered with dust. You were asked to remove this dust. Did this process

_____ (a) prove to be a satisfactory type of request to ask of a teacher;

_____ (b) prove to be rather time consuming in light of teacher load;

_____ (c) prove to be damaging to the product;

_____ (d) prove to be a totally unrealistic type of request to make of a teacher.

4. The transparencies were not framed, they were put up in file folders. Did you find this approach to be

_____ (a) a realistic approach for a teacher to adopt in a classroom;

_____ (b) acceptable, but not preferred;

_____ (c) inappropriate.

5. Were the suggested activities and reference lists printed on the folders

_____ (a) of considerable aid;

_____ (b) of some value;

_____ (c) of little or no value.

6. In a number of cases overlays were also printed for your use. Did you find these overlays

_____ (a) valuable;

_____ (b) of some value;

_____ (c) of little or no value.

8. Was the fact that the overlays had to be hinged together or otherwise assembled by you a

_____ (a) satisfactory approach to providing such materials to you;

_____ (b) workable, but somewhat difficult approach;

_____ (c) totally unworkable approach.

9. What suggestions can you make to improve on the way overlays were assembled in this unit?

____

____

____

10. In terms of projection quality, would you say that it is

_____ (a) excellent;

_____ (b) fair;

_____ (c) poor.

11. What suggestions would you offer in terms of improving projection quality?

____

____

____

12. What strong points, if any, of the projection quality would you say should definitely be standardized upon as ideal?

____

____

____

13. Would you say the color quality was

_____ (a) excellent;

_____ (b) acceptable;

_____ (c) poor.

14. As you were told, a single color transparency costs about four cents to produce, each additional color an additional four cents. Would you say that the value of the color is

_____ (a) easily worth the additional cost;

_____ (b) probably worth the additional cost;

_____ (c) unlikely to be worth the additional cost.

15. In terms of durability the colors are

_____ (a) very good;

_____ (b) fair;

_____ (c) poor.

16. The registry of the color is

_____ (a) good;

_____ (b) fair;

_____ (c) unsatisfactory.

17. Comparing the product you have just completed using with other types of transparencies, would you say that there is a

_____ (a) great need for more material of this type;

_____ (b) some need for more material of this type;

_____ (c) little or no need for more material of this type.

18. In the assembly of this material, how many transparencies did you find that had an imprint on the back side from the ink of the transparency it had fallen on top of in the printing process? _____

19. In the assembly, how many blank sheets did you find? _____

20. How many transparencies were damaged due to improper printing or handling techniques? _____

21. Could you suggest any way to correct the situations outlined in 18, 19, and 20?

____

____

____

22. Do you prefer the slip sheet between transparencies?

_____ Yes _____ No _____ No opinion

23. Realizing that overhead transparencies are, at best, only an aid, would you evaluate these transparencies as

_____ (a) very effective;

_____ (b) average effectiveness;

_____ (c) very ineffective.

24. Would you suggest that this type of transparency production continue?

_____ (a) definitely;

_____ (b) with major improvements to the process; (Please list such improvements.)

____

____

_____ (c) discontinue the efforts.

25. Do you feel production of materials such as this can best be carried on

_____ (a) locally;

_____ (b) on a state basis;

_____ (c) on a Southern Regional basis.

Please add any other comments you have. Be critical in terms of both strengths and weaknesses.

APPENDIX III

LETTER SENT TO STATE DIRECTORS OF VOCATIONAL EDUCATION,
STATE SUPERVISORS OF VOCATIONAL AGRICULTURE AND
HEAD TEACHER EDUCATORS IN VOCATIONAL AGRICULTURE IN REGION IV

CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA 29631

SCHOOL OF EDUCATION
VOCATIONAL EDUCATION MEDIA CENTER

October 16, 1967

Mr. A. P. Fatherree
State Director of Vocational Education
State Department of Education
P. O. Box 771
Jackson, Mississippi 39205

Dr. O. L. Snowden
Professor and Head
Agricultural Education Department
Mississippi State University
State College, Mississippi 39762

Mr. E. E. Gross
State Supervisor
Agricultural Education
State Department of Education
Box 771
Jackson, Mississippi 39205

Gentlemen:

In May, 1966 I received a U.S.O.E. Grant to develop a procedure for producing low cost overhead transparencies. The procedure was to be developed through the production of a set of overhead transparencies on the basic principles of mechanical power transmission in agricultural machinery. A set of these transparencies is enclosed.

The transparencies that have resulted have been produced as a result of making several assumptions. These assumptions were:

(1) The overhead projector, although one of the most useful of the present instructional tools, will not be used unless teachers have overhead transparencies available.

(2) With the current cost of overhead transparencies and limited audio visual budgets, it is impossible in many school systems to provide adequate numbers of prepared overhead transparencies to teachers. At the same time many teachers do not have the time or necessary art ability to develop and make their own transparencies. Therefore, a new approach is essential in order that the overhead projector can be used as a tool capable of helping the teacher improve his presentations.

(3) Present commercial overhead transparencies are made of an almost indestructible type of plastic, hand mounted on expensive frames, and produced by time-consuming methods. It was also assumed that there was no real reason as to why cheaper and less durable means could not be used. The project director also assumed that the expensive and hard-to-store cardboard frame was in itself unnecessary in the presentation of educational concepts.

(4) As the project developed, and it was discovered that low cost but dusty transparencies (due to production techniques) could be produced by the offset printing method, the project director further assumed that teachers would not mind spending a brief moment to remove the dust from the transparency with a soft cloth and water. He further assumed that the teacher would also be willing to put the tape hinge on overlays should they be provided properly set up for hinging.

Using the above assumptions, the enclosed transparencies were produced on a 1250W Multigraph offset press, a type of equipment available to most state departments. The cost for a single color transparency was about 4 cents. Each color added another 4 cents. The materials have been evaluated by vocational agricultural teachers in South Carolina, Georgia, Virginia, Florida, and Alabama. Practically all of the teachers express a need for more materials of this nature.

The final phase of this study is to attempt to determine from you and other leaders in vocational education in your state, the need for a regional center to prepare and distribute such materials. Would you please take a few minutes to examine the materials, if possible share them with other vocational leaders, and evaluate the need for this type of material in vocational programs of your state. I would appreciate knowing what your attitude is towards:

(1) a need for a regional center to develop, produce and distribute materials of this nature;

(2) the willingness your state would have in participating in a center of this nature;

(3) the existence of legal barriers that would have to be overcome before your state could participate in a program of this nature; and

(4) any other problems or suggestions you might offer in terms of such a regional center.

I would like to know your views on this in the near future, as the project must be reported to the U.S.O.E. by November 15 of this year. Thank you for your consideration of this matter.

Sincerely,

Arthur Jensen

Arthur K. Jensen, Director
Vocational Education Media Center

CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA 29631

SCHOOL OF EDUCATION
VOCATIONAL EDUCATION MEDIA CENTER

October 16, 1967

Mr. J. F. Ingram
State Director of Vocational Education
State Department of Education
607 State Office Building
Montgomery, Alabama 36104

Dr. R. W. Montgomery
Professor and Head
Department of Vocational, Technical
and Practical Arts Education
Auburn University
Auburn, Alabama 36830

Mr. T. L. Faulkner
State Supervisor
Agricultural Education
State Department of Education
Montgomery, Alabama 36104

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Sincerely,

Arthur K. Jensen

Arthur K. Jensen, Director
Vocational Education Media Center

AKJ:jpp

CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA 29631

SCHOOL OF EDUCATION
VOCATIONAL EDUCATION MEDIA CENTER

October 16, 1967

Mr. George W. Mulling
State Director of Vocational Education
State Department of Education
254 State Office Building
Atlanta, Georgia 30334

Dr. Ralph H. Tolbert
Professor and Head
Department of Agricultural Education
University of Georgia
Athens, Georgia 30601

Mr. J. L. Branch
State Supervisor
Agricultural Education
State Department of Education
258 State Office Building
Atlanta, Georgia 30334

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Sincerely,

Arthur K. Jensen

Arthur K. Jensen, Director
Vocational Education Media Center

AKJ:jpp

CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA 29631

SCHOOL OF EDUCATION
VOCATIONAL EDUCATION MEDIA CENTER

October 16, 1967

Mr. Charles M. Dunn
Assistant Commissioner for Vocational-
Technical Education
115 Cordell Hull Building
Nashville, Tennessee 37291

Dr. George W. Wiegers, Jr.
Professor and Head
Department of Agricultural Education
University of Tennessee
Knoxville, Tennessee 37916

Mr. Kenneth K. Mitchell
State Supervisor
Agricultural Education
State Department of Education
205 Cordell Hull Building
Nashville, Tennessee 37219

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Arthur K. Jensen, Director
Vocational Education Media Center

CLEMSON UNIVERSITY
CLEMSON, SOUTH CAROLINA 29631

SCHOOL OF EDUCATION
VOCATIONAL EDUCATION MEDIA CENTER

October 16, 1967

Dr. Carl W. Proehl
Director of Vocational, Technical and
Adult Education
State Department of Education
Capitol Building
Tallahassee, Florida 32301

Mr. W. T. Loften
Associate Professor and Head
Department of Agricultural & Extension Education
University of Florida
Gainesville, Florida 32601

Mr. F. L. Northrop
Area Supervisor
Agricultural Education
University of Florida
186 Norman Hall
Gainesville, Florida 32603

Gentlemen:

In May, 1966 I received a U.S.O.E. Grant to develop a procedure for producing low cost overhead transparencies. The procedure was to be developed through the production of a set of overhead transparencies on the basic principles of mechanical power transmission in agricultural machinery. A set of these transparencies is enclosed.

The transparencies that have resulted have been produced as a result of making several assumptions. These assumptions were:

(1) The overhead projector, although one of the most useful of the present instructional tools, will not be used unless teachers have overhead transparencies available.

(2) With the current cost of overhead transparencies and limited audio visual budgets, it is impossible in many school systems to provide adequate numbers of prepared overhead transparencies to teachers. At the same time many teachers do not have the time or necessary art ability to develop and make their own transparencies. Therefore, a new approach is essential in order that the overhead projector can be used as a tool capable of helping the teacher improve his presentations.

(3) Present commercial overhead transparencies are made of an almost indestructible type of plastic, hand mounted on expensive frames, and produced by time-consuming methods. It was also assumed that there was no real reason as to why cheaper and less durable plastics could not be used or why mechanical mass production means could not be used. The project director also assumed that the expensive and hard-to-store cardboard frame was in itself unnecessary in the presentation of educational concepts.

(4) As the project developed, and it was discovered that low cost but dusty transparencies (due to production techniques) could be produced by the offset printing method, the project director further assumed that teachers would not mind spending a brief moment to remove the dust from the transparency with a soft cloth and water. He further assumed that the teacher would also be willing to put the tape hinge on overlays should they be provided properly set up for hinging.

Using the above assumptions, the enclosed transparencies were produced on a 1250W Multigraph offset press, a type of equipment available to most state departments. The cost for a single color transparency was about 4 cents. Each color added another 4 cents. The materials have been evaluated by vocational agricultural teachers in South Carolina, Georgia, Virginia, Florida, and Alabama. Practically all of the teachers express a need for more materials of this nature.

The final phase of this study is to attempt to determine from you and other leaders in vocational education in your state, the need for a regional center to prepare and distribute such materials. Would you please take a few minutes to examine the materials, if possible share them with other vocational leaders, and evaluate the need for this type of material in vocational programs of your state. I would appreciate knowing what your attitude is towards:

(1) a need for a regional center to develop, produce and distribute materials of this nature;

(2) the willingness your state would have in participating in a center of this nature;

(3) the existence of legal barriers that would have to be overcome before your state could participate in a program of this nature; and

(4) any other problems or suggestions you might offer in terms of such a regional center.

I would like to know your views on this in the near future, as the project must be reported to the U.S.O.E. by November 15 of this year. Thank you for your consideration of this matter.

Sincerely,

Arthur K. Jensen

Arthur K. Jensen, Director
Vocational Education Media Center

AKJ:jpp