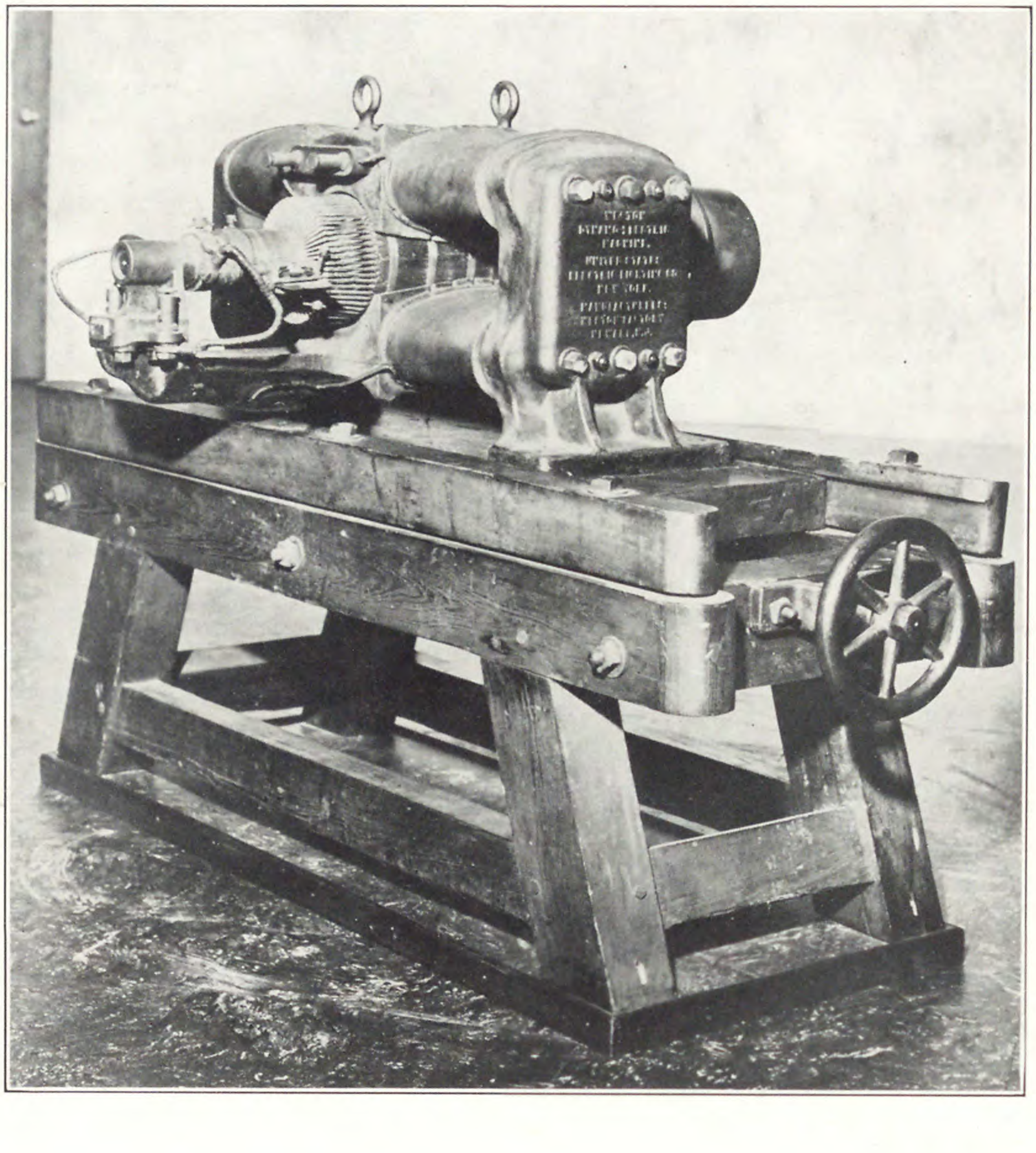
NEWARK ENGINEERING NOTES



VOLUME 3
NUMBER 2
DECEMBER, 1939

NEWARK ENGINEERING NOTES

A Technical Magazine

for

Chemical, Civil, Electrical, and Mechanical Engineers

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DO YOU WANT TO BE ON OUR MAILING LIST?

From time to time you will receive a copy of the NEWARK ENGINEERING NOTES. In case you wish to receive this magazine regularly, the only thing you have to do is to write us and say so. Address your letter to the Editor, Newark Engineering Notes, Newark College of Engineering, Newark, N. J.

THE PRESIDENT'S DIARY

December 12th

We hear a lot in these days of world strife about a changing world. We are witnessing history in the making and we see the very map of the world changing before our eyes. Whether the change is temporary or permanent we cannot tell. How long the present boundaries will last no one knows. What will be the outcome of it all even the most daring of us find some difficulty in estimating.

In the industrial world we notice industry making adjustments in all its phases. In politics we observe governments changing and we see new trends in education, new methods of performing tasks coming into vogue. Industry has new ideas, and new techniques in every occupation have been introduced to a world that is consistently endeavoring to adjust itself to such changes. Man's very life itself is involved, for if these changes cannot be made the world dies, just as the individual dies when he can no longer cope with his external environment.

Here at the College we find no exception to this rule of change. Our methods of instruction have been adjusted progressively to meet the newer academic demand. Our laboratories have progressed with these demands of industry, and more and better opportunities are furnished for the student to obtain practical knowledge.

Most of us will agree that many of these changes in industry and in education are perfectly justified. They are changes that lead us ahead, not backward, changes that bring improvements, and in the main and by and large none of us could feel that the lot of mankind, that is, happiness and basic satisfactions, has been in any way jeopardized by the various changes brought about by the last twenty to thirty years in the manner of living of mankind in general.

We engineers have been responsible for many of these changes, changes which at the moment have not seemed for the best interests of society, but changes which we believe will ultimately make for peace. These things have come about from the contribution that science has made, those contributions which have been developed and perfected in the last decade. Changes may make for progress, and yet it is conceivable that many of these changes will be reversed; things that we have done during the past year may be in part wiped out. This we do not know, and at present it would seem idle to speculate.

December 18th

In times like these I think we all feel that it is necessary to have some definite thing to tie to. Is there anything that we can believe in? Is there anything that is basic? Is there anything which serves as a rock to stand on? Is there anything that does not change throughout the years and will never change until the end of time? I believe that at the moment if such a thing could be established, in the very nature of things it would be of the utmost human value. I wonder if the holiday season does not do this. After all, for the next two weeks many of our common tasks and labors will be lightened. There is a spirit in the air, a holiday spirit, which comes to us all. It does not make any difference as to what our formal and traditional religious beliefs are. It does not make any difference what particular religious formula or creed we subscribe to, we are one in a desire for peace, and a desire for goodwill. It would almost seem this year that this particular holiday season had come to us at just about the right time, at a very needful time, and irrespective of anything else except the need and the desire for peace, it would, I think, pay great dividends to us all to stop a little at this time and consider what the word peace brings with it and what the word goodwill would mean if practically applied. Sometimes in the past few months I wondered about this question of goodwill. There seems in the busy day's work to be so little of it, and it seems almost as if it would be comparatively easy to have a little more of it, a little more appreciation, a little more sympathetic understanding, a little more desire to share with others the things that we have been fortunate enough to have for ourselves. It is the basis not only of good morals but of good political behavior.

December 22nd

I have looked over my diary for December, 1938, and I find perhaps naturally enough that the subject seemed to be that of peace, political and industrial peace, and it seems perhaps safe to say that there is no discernible gain in the last twelve months. Has there been in the last two thousand years? Is the world any better on the average in 1940 than it was in 60 B. C.? Over all and known fields has there been any gain? Personally, I think there has. I think that these things that come upon us, these cataclysms of war, are not quite so general, not quite so much the common lot of mankind, and while they are terrific concentrations of ill will, by and large and over all the earth inside and out, day in and day out, I believe there is a gain.

While we may not be specifically hopeful for the year 1940, I think we have a perfect right to be hopeful that 1940 may be constructive; that we may swing back again into the general road that leads onward and a little upward. So that if anyone has any resolutions to make for 1940, I think a very constructive one would be to resolve to help in this general process in a personal, in a professional, and, if possible, in a political way. My theory is and has been for a good many years that nations are made up of individuals; that very often, and in the long run, the political government of the nation always reflects its individuals and that national progress must spring first from the individual; that ignorance and intolerance and bigotry if conquered definitely in the individual will after a time reflect itself in the nation and the national policy, which means that the cause of all these things which are so terrible today is primarily ignorance, and that knowledge, not propaganda, is fundamentally the most effective weapon to use for peace.

If any of you have a copy of NEWARK ENGINEERING NOTES for December, 1938, I wish that you would do me the honor to read the President's Diary of that issue. It says what I want to say so much more effectively that I hardly feel that my diary of December, 1939, can be quite as effective as that of December, 1938.

ALLAN R. CULLIMORE

COUNCIL ON PUBLIC RELATIONS

By CHARLES J. KIERNAN

Assistant Professor, Newark College of Engineering

As announced last March in this publication, the formation of a Council on Public Relations was completed. It is felt that such an organization could be very helpful to the institution as a whole in various matters having to do with the well-being of the College and its affiliated evening school.

Participating groups on the Council include both members of the College Alumni and of the evening school graduates in addition to undergraduates of both the College and evening school as represented by their Student Councils.

Up to this time much of the work of the Council has included representing the institution at various functions held by other colleges or professional groups. Some of these affairs held during the last few months were attended by various members of the Alumni at the request of the Council. In its preliminary meetings, the following were named on the steering committee for organization purposes:

From the College Alumni:
W. D. Vander Schaaf, Chairman
Charles M. Beyer
Leo Mosch

From the Technical School Alumni:
Henry Reid, Chairman
Norbert Bertl
Charles Carter

Other men who have helped in the organization on the general committee include: Roy Anderson, Jerome Hequembourg, Lester Dunn, Fred W. Riemer, Charles M. Beyer, Louis Pickett, Robert Widdop, Allan Bochner, Thomas T. Smith, Albert L. Blackwell, Jr., Joseph Wludyka, Edmund S. Redmerski, Malcolm Runyon, John Stelger, Joseph Townsend, Paul Nastasio, Robert Jenkins, Irvin Falk.

Charles J. Kiernan was named executive secretary of the Council.

It may be of general interest to members of the Alumni to note the following assignments which were taken care of since last March by various members of the Alumni:

On March 27, 1939, James Bowman '30, Carl Stuehler '30, and Theodore E. Starrs '30, represented the College at a meeting of the Hudson County Professional Engineers in Public Service Auditorium, Jersey City.

On March 20 and March 27, 1939, Roy H. Anderson '30 and Fred Wolpert '27 judged papers from students in the A. I. E. E. prize competition at the College.

On March 28, 1939, George T. Deaney '28 addressed the Sophomore Class in Principles of Engineering on "Problems of Production Control." This lecture was repeated by Mr. Deaney to the present year Sophomore Class on October 31, 1939.

On April 28-29, 1939, Frederick Cox '26 represented the College Alumni at the Anthracite Conference held at Lehigh University.

On May 25-June 5, 1939, W. R. Ackor '31 represented the College at the Sesqui-Centennial Celebration of Georgetown University held in Washington, D. C.

On June 3, 1939, Dean B. Bogart '32 represented the College at the Seventy-fifth Anniversary of Gallaudet College in Washington, D. C.

On October 12, 1939, Charles M. Beyer '25 represented the College at the Tenth Anniversary Dinner of the State Teachers College in Jersey City.

On October 19, 1939, George D. Wilkinson '33 represented the College at the inauguration of President Harry D. Gideonse at Brooklyn College.

On November 11-12-13, 1939, W. R. Ackor '31 represented the College at the Semi-Centennial of Catholic University in Washington, D. C.

On November 14, 1939, Irvin Falk '31 addressed the Sophomore Class in Principles of Engineering on "Sales Activity."

GEORGE ERLE BEGGS

Professor of Civil Engineering and Chairman of the Civil Engineering Department at Princeton University.

Civil engineering education in New Jersey and throughout the nation suffered a severe loss when Professor Beggs died a few days ago. Although best known for his ingenious apparatus for model analysis of statically indeterminate structures, Professor Beggs' interests and activities were broad and his abilities made him much sought for in many fields of his profession. His career at Princeton provides an inspiration for any young man who has taken up engineering education as a career. In twenty-five years, Professor Beggs rose from the grade of Instructor through all ranks to that of Professor of Civil Engineering and had but a short time before his death been appointed Chairman of his department, the highest position in the Civil Engineering Department of Princeton University.

We extend our sympathy to Professor Beggs' family, his associates, and his students.

H. N. CUMMINGS
Professor of Civil Engineering
Newark College of Engineering

BACKGROUND FOR WAR

By RUTH LITTIG

Librarian in Charge of Circulation, N.C.E.

There are many problems, political, social, and economic, in the world today. Their solutions depend on so many things that it seems impossible that one could acquaint himself with all the facts bearing on all the problems.

Among the thousands of books available in the college library are about six hundred books concerning the World War of 1914-1918.

A glance through some of the chapters of these books reveals the interesting thought that while the books were written between 1914 and 1920 they apply just as fully to the world of today. These books reveal the varying philosophies underlying both the German and the Allied attitude during the first World War.

History has a way of repeating itself, and these books of twenty-five years ago seem just as important to this year 1939 as they did to the years in the past. They represent a wide range of thought concerning war and its effect upon mankind generally. Americans should be able to discuss intelligently and in an unbiased way the various factors which have led to the present European War. As Americans we can be happy in the fact that the Atlantic Ocean represents three thousand miles of ocean highway which exist between our shores and those of Europe, but, nevertheless, we must be conscious of the fact that war in Europe affects America in many ways.

It is recommended that we avail ourselves of the opportunity to look over some of these books which were popular during the first World War because they are fully applicable to the present world situation.

Following are some of the many titles:

Great Britain at War—By Jeffery Farnol. Boston, Little, Brown. 1918.

What Germany Wants—By Edmond von Mach. Boston, Little, Brown. 1914.

The New Germany—By George Young. N. Y., Harcourt. 1920.

The War and the Coming Peace—By Morris Jastrow. Philadelphia, Lippincott. 1918.

Because I Am a German—By Hermann Ferman. N. Y., Dutton. 1916.

The Crimes of England—By Gilbert K. Chesterton. N. Y., Lane. 1916.

American Neutrality: Its Cause and Cure—By James Mark Baldwin. N. Y., Putnam's. 1916.

In addition to the above very interesting books, our library recommends two later ones, both by Frank H. Simonds, published by Harper, in 1932 and 1933, respectively. They are:

Can America Stay at Home

America Faces the Next War

REPULSION MOTOR CALCULATIONS

By PAUL C. SHEDD, B.S.

Associate Professor in Electrical Engineering, Newark College of Engineering

INTRODUCTION

The problem of instruction in many phases of electrical engineering becomes a matter of organization of material. For example, no text book was found which seemed to present the subject of repulsion motor calculations with sufficient completeness, both as to theory and practice, to make the subject entirely comprehensible to the student. The following paper was therefore prepared, from the various sources indicated, as the basis of a series of lectures on repulsion motor calculations. The brief treatment of the repulsion motor in Dawes, "Electrical Engineering," Vol. II, is prerequisite. This discussion is not presented as an original contribution to repulsion motor theory, but as an example of organization of material found desirable in undergraduate instruction in advanced electric machinery.

I. THEORY

1. Circuit Diagram

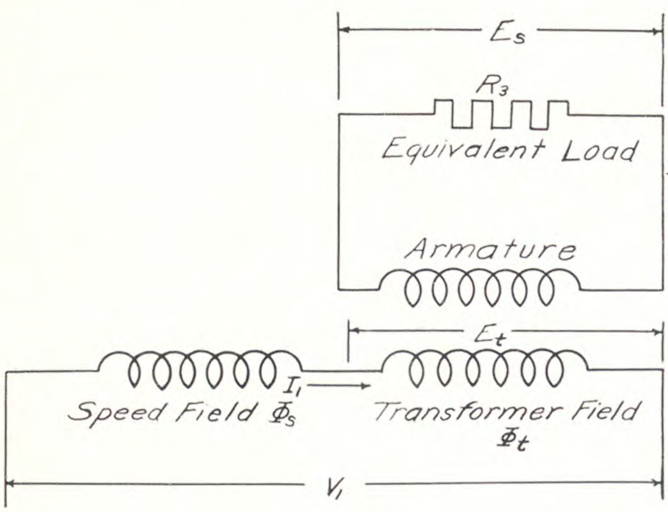


Figure 1.
Circuit Diagram

2. Vector Diagram

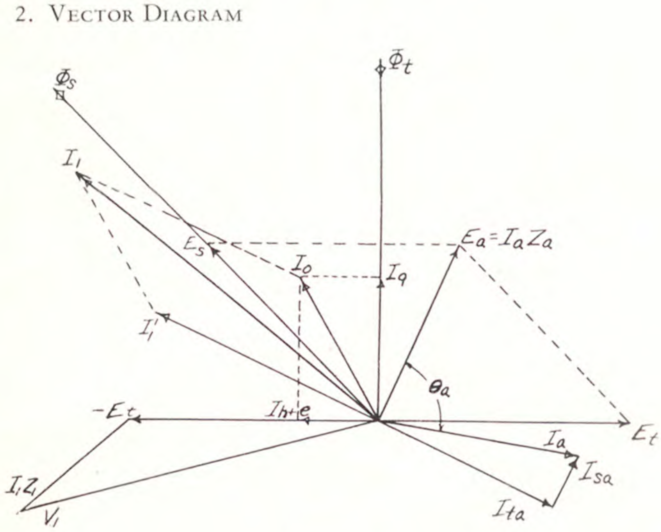


Figure 2.
Vector Diagram

Note that Φ_t lags the current I_o, which produces it, and Φ_s lags the current I_1, which produces it, by a small angle in each case, on account of hysteresis.

E_t lags Φ_t by 90° because it is induced by transformer action.

E_s is in phase with Φ_s because it is induced by generator action.

3. Ratio Constants

N_1—number of stator turns per path
N_t—number of transformer turns per path
N_s—number of speed turns per path
N_a—number of armature turns per path
α—angle of brush shift—electrical degrees

After corrections have been made for distribution and short pitch:

$n = N_t/N_s$ $\quad k = N_a/N_t$ $\quad nk = N_a/N_s$

$N_t = N_1 \cos \alpha$ $\quad N_s = N_1 \sin \alpha$ $\quad n = \cot \alpha$

$S =$ (Actual speed) / (Synchronous speed)

4. Current Transformation Ratio

As indicated in Figure 2, I_a has two components, I_{ta}, whose mmf balances that of I_1', as in any transformer, and I_{sa} in leading quadrature with I_{ta}. I_{sa} is proportional to the speed.

Hence:

$I_{ta}N_a = I'_1 N_t$

or $I_{ta} = I'_1/k$

$I_{sa}N_a = I'_1 N_s$ at synchronous speed

$I_{sa}N_a = SI'_1 N_s$ at relative speed S

or $I_{sa} = SI'_1/nk$

Therefore:

$$I_a = \sqrt{I_{ta}^2 + I_{sa}^2}$$

$$= I'_1 \frac{\sqrt{n^2 + S^2}}{nk}$$

and the ratio of transformation

$$a = \frac{\sqrt{n^2 + S^2}}{nk}$$

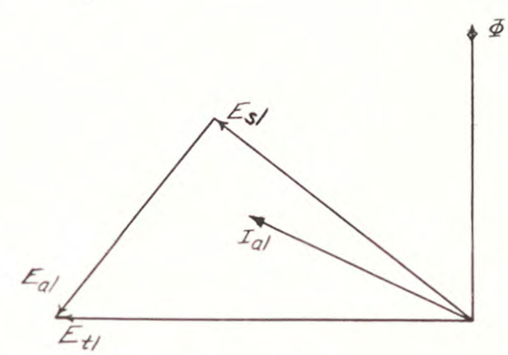


Figure 3.
Armature Values Referred to Stator

$I_{a1} = -I_a/a$ $\quad E_{a1} = -E_a a$

$E_{t1} = -E_t a$ $\quad E_{s1} = -(-E_s)a = E_s a$

E_s is the *induced* speed emf.; the I_aR_3 drop is therefore $-E_s$, which becomes $E_{s1} = -(-E_s)a$ when referred to the stator.

$R_{a1} = a^2 R_a$

5. Ideal Motor

An ideal motor, without losses or leakage reactances and with negligible exciting current, would have the following equivalent circuit and vector diagrams.

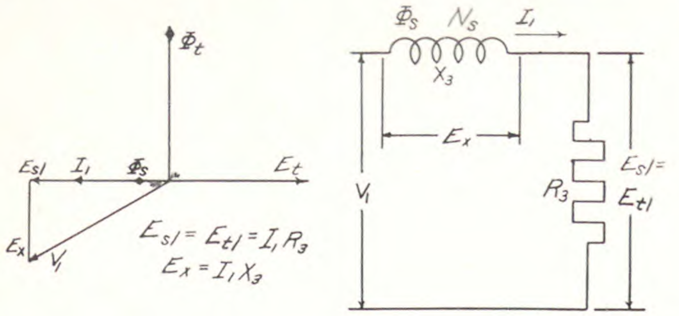


Figure 4.
Circuit and Vector Diagrams of an Ideal Motor

At synchronous speed:

$$\frac{E_x}{N_s} = \frac{E_{t1}}{N_t} \qquad E_{t1} = n\,E_x$$

At relative speed S:

$$E_{t1} = S\,n\,E_x = S\,n\,I_1\,X_3$$

$$R_3 = \frac{E_{t1}}{I_1} = \frac{S\,n\,I_1\,X_3}{I_1} = S\,n\,X_3$$

6. Equivalent Circuit

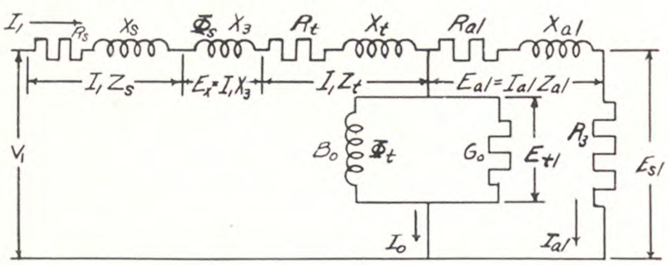


Figure 5.
Equivalent Circuit

R_s, X_s—resistance and leakage reactance of speed field.

R_t, X_t—resistance and leakage reactance of transformer field.

R_{a1}, X_{a1}—resistance and leakage reactance of armature circuit, referred to the stator.

R_3—equivalent resistance of load.

X_3—equivalent reactance of flux cut by armature.

G_o, B_o—magnetizing conductance and susceptance.

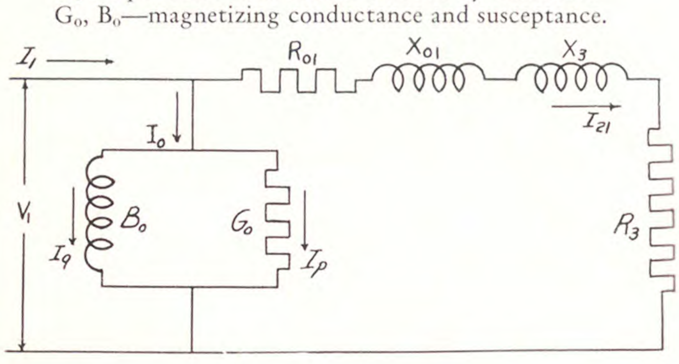


Figure 6.
Approximate Equivalent Circuit

$$R_1 = R_s + R_t \qquad X_1 = X_s + X_t$$

$$R_{01} = R_1 + R_{a1} \qquad X_{01} = X_1 + X_{a1}$$

II. TESTS

1. Resistance Measurements

Measure the d-c resistance of the stator, R'_1, calculate the a-c value R_1, and correct for temperature changes.

Remove the short-circuit between brushes, and determine the rotor resistance R'_a and R_a, correct for the number of parallel paths (if the number is different from two), and correct for temperature changes.

2. Blocked Rotor Test

Wrap wire around the commutator to short-circuit the rotor, block the rotor, apply rated voltage, or reduced voltage if necessary, and determine the current, power, and torque.

3. Running-Light Test

Determine the no-load losses and current from a running-light test similar to that of a polyphase induction motor, using rated voltage if the resulting speed is not too high, or reduced voltage if necessary.

4. Open Rotor

Determine the value of voltage and current when the rotor is on open circuit.

Then:

$$X \simeq Z = V/I \qquad X_3 = X\left(\frac{N_s}{N_1}\right)^2 = X\sin^2\alpha$$

III. SAMPLE PROBLEM

1. Given:

Name plate data: ¼-hp, single phase, 110 volts, 4 poles, 60 cycles.

Design data:

	Turns	Paths	Turns per path
Stator	1308	4	327
Rotor	576	4	144

$\alpha = 18°$

Test data: (at operating temperature)

$R_1 = 1.38$ ohms $\qquad R_a = 0.98$ ohm

Running light:

$V = 110$ volts $\qquad I = 3.05$ amp.

$P = 255$ watts $\qquad n_2 = 4100$ rpm

Blocked rotor:

$V = 110$ volts $\quad I = 12.3$ amp. $\quad P = 920$ watts

Open circuit:

$E = 110$ volts $\qquad I = 2.14$ amp.

2. Calculations—No Load

$N_t = 327\cos 18° = 311$ turns per path

$N_s = 327\sin 18° = 101$

$N_a = 144$

If breadth times pitch factors are practically equal in stator and rotor:

$n = \cot 18° = 3.08$

$k = 144/311 = 0.463$

Open rotor:

$X \simeq Z = 110/2.14 = 51.5$ ohms

$X_3 = 51.5\sin^2 18° = 4.92$ ohms

Blocked rotor:

$$a^2 = \frac{3.08^2 + 0}{3.08^2 \times 0.463^2} = 4.66$$

$R_{01} = 1.38 + (4.66 \times 0.98) = 5.94$ ohms

or $R_{01} = 920/(12.3)^2 = 6.08$ ohms, check

$Z_{01} = 110/12.3 = 8.94$ ohms

$X_{01} = \sqrt{8.94^2 - 6.08^2} = 6.54$ ohms

$X_1 \simeq X_{a1} = \frac{1}{2}\,6.54 = 3.27$ ohms

$X_a = 3.27/4.66 = 0.701$ ohm

Running light:

The following calculations are based on the equivalent circuit of Figure 5; they are frequently omitted.

$S = 4100/1800 = 2.28$

$a^2 = \dfrac{3.08^2 + 2.28^2}{3.08^2 \times 0.463^2} = 7.24$

$\cos\theta = \dfrac{255}{110 \times 3.05} = 0.76 \qquad \sin\theta = -0.65$

$I_1 = 3.05 \times 0.76 - j\,3.05 \times 0.65$
$= 2.32 - j\,1.98$ amp.

$X_1 + X_3 = 3.27 + 4.92 = 8.19$ ohms

$Z = 1.38 + j\,8.19$ ohms

$I_1Z_1 = (2.32 - j\,1.98)\ (1.38 + j\,8.19)$
$= 19.4 + j\,16.3$ volts

$E_{t1} = V_1 - I_1Z_1 = 110 - (19.4 + j\,16.3)$
$= 90.6 - j\,16.3$ volts

$R_3 = X_s\,S\,n = 4.92 \times 2.28 \times 3.08 = 34.6$ ohms

$R_{a1} = 0.98 \times 7.24 = 7.10$ ohms

$R_{a1} + R_3 = 7.10 + 34.6 = 41.7$ ohms

$X_{a1} = a^2 X_a = 7.24 \times 0.701 = 5.07$

$Z_{21} = 41.7 + j\,5.07$ ohms

$I_{21} = \dfrac{90.6 - j\,16.3}{41.7 + j\,5.07} = 2.09 - j\,0.65 \longrightarrow 2.19$ amp.

$I_o = 2.32 - j\,1.98 - (2.09 - j\,0.65)$
$= 0.23 - j\,1.33$ amp.

$P_{c1} = 3.05^2 \times 1.38 = 13$ watts

$P_{c2} = 2.19^2 \times 7.10 = 34$ watts

$P_{s1} = (90.6 \times 0.23) + (16.3 \times 1.33) = 43$ watts

$P_{s2} = 2.19^2 \times 34.6 = 166$ watts

256 watts, check

3. Load Characteristics

As an example, the performance of the machine at 1750 rpm is calculated below, using the circuit of Fig. 6:

$S = 1750/1800 = 0.972$

$a^2 = \dfrac{3.08^2 + 0.975^2}{3.08^2 \times 0.463^2} = 5.13$

$R_{01} = 1.38 + (5.13 \times 0.98) = 6.42$ ohms

$X_{01} = 3.27 + (5.13 \times 0.701) = 6.87$ ohms

$X_3 = 4.92$ ohms

$R_3 = 4.92 \times 0.972 \times 3.08 = 14.7$ ohms

$Z_{21} = (6.42 + 14.7) + j\,(6.87 + 4.92)$
$= 21.1 + j\,11.79$ ohms

$I_{21} = \dfrac{110}{21.1 + j\,11.79} = 3.98 - j\,2.22 \longrightarrow 4.56$ amp.

I_o was found in Figure 5 to be: $0.23 - j\,1.33$ amp., and $P_{s1} = 43$ watts.

Assuming the magnetizing current I_q and the stray power in the primary P_{s1} are unchanged in Figure 6: I_p in Fig. 6 is $43/110 = 0.39$ amp and $I_o = 0.39 - j\,1.33$ amp.

Hence

$I_1 = 3.98 - j\,2.22 + 0.39 - j\,1.33$
$= 4.37 - j\,3.55 \longrightarrow 5.65$ amp.

$P_1 = 4.37 \times 110 = 481$ watts

$P_c = 4.56^2 \times 6.42 = 133$ watts

$P_3 = 4.56^2 \times 14.7 = 306$ watts

or $P_3 = 481 - 133 - 43 = 305$ watts, check

Estimating P_{s2} as 45 watts, compared with 166 watts running light:

$P_0 = P_3 - P_{s2} = 306 - 45 = 261$ watts

$\eta = 261/481 = 0.54$

$\cos\theta = 4.37/5.65 = 0.77$

Actual load tests made on this machine at 5.65 amp. input show the following comparison with the results predicted by the no-load tests:

	No-load tests	Load tests	
I_1	5.65	5.65	amp.
n_2	1750	1950	rpm
P_1	481	520	watts
P_0	261	270	watts
η	0.54	0.52	
$\cos\theta$	0.77	0.84	

Comments by Professor J. C. Peet, in Charge of Electrical Engineering Department:

The paper by Professor Shedd on "Repulsion Motor Calculations" is an organization of material from various sources for the purpose of instruction. No one source supplied the complete material. The use of the equivalent circuit and the treatment by complex algebra are the principal features. A more detailed treatment is planned for the future.

Professor P. C. Shedd was born at Dover, New Hampshire, in 1901. He attended Worcester Polytechnic Institute and graduated in 1924 with the degree of B.S. in Electrical Engineering.

Since his graduation Professor Shedd has worked several summers in research work with the American Steel & Wire Co., the General Electric Co., the Western Electric Co., and the Eclipse Aviation Corporation. Along with this work he has pursued graduate work at M. I. T. and Columbia for his Master's degree.

After teaching at Worcester Polytechnic Institute, he was Assistant Professor in Electrical Engineering at Washington and Lee University. He came to Newark College of Engineering in 1931 as Assistant Professor in Electrical Engineering and has recently been made Associate Professor in Electrical Engineering. He is a member of the Masonic Order and a member of the Society for the Promotion of Engineering Education.

ECCENTRIC WELDED CONNECTIONS

By Odd Albert, C.E., M.S.

Assistant Professor in Structural Engineering, Newark College of Engineering

Excerpts from an original paper presented at the annual meeting of the American Welding Society in April, 1931, and published in the April, 1931, issue of the Journal of the A. W. S.

INTRODUCTION

As welding is becoming more and more used in the connecting of structural members to one another, it is becoming increasingly necessary for the designing engineer to be able to solve not only ordinary welded connections, but also eccentric welded connections.

As several references (Structural Design, by Sutherland and Bowman, John Wiley and Sons, Inc., 1938, page 267) have been made to this article as originally published, and because this article is not easily accessible, it has been suggested that the article be published in a slightly changed form in this magazine.

General Assumptions

Let Figure 1 represent a welded connection with a channel fillet welded along four sides of a column. The channel supports a load W with an eccentricity of L inches.

The eccentric force W may be replaced by a concentric force W and a couple with a moment $M = W \times L$, where L represents the eccentricity. Then the stress in any point of the weld will be made up of two components, one — S_A — due to direct shear and one — S_B — due to moment. The stress S_A will be uniform and equal to the load divided by the length of the welded lines, while the S_B-stress will vary with the distance r of

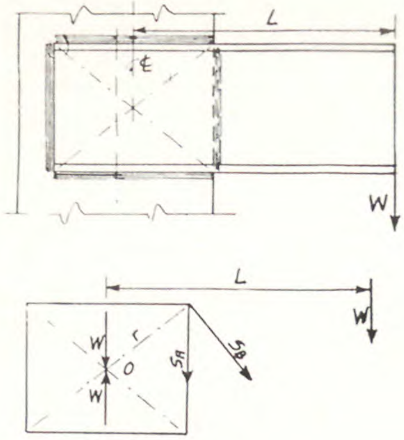


Figure 1

this point from the center of gravity 0 of the welded lines, and will act in directions normal to lines drawn between these points and the center 0.

If t is taken as the stress due to moment in a point at a unit distance $r = 1$, then we get for a point with $r = r$, the corresponding shear to be $t \times r$, and we get the resisting moment about the center 0 to be $t \times r \times r = tr^2$, because the resisting moment equals the product of the moment shear and the lever arm.

If the distances for several points are r_1, r_2, r_3, etc., then the total resisting moment will be

$$M = r_1^2 t + r_2^2 t + r_3^2 t + \cdots$$

$$M = t \Sigma r^2 \qquad (1)$$

The expression Σr^2 is the polar moment of inertia of the welded joint and is called I. The resisting moment M must equal the outside moment $W \times L$. Thus

$$W L = t I \qquad (2)$$

If we now consider a point at a maximum distance r from 0, we get the maximum stress S_B due to moment to be

$$S_B = t r \qquad (3)$$

or by solving for t in the equation (2) we get

$$S_B = \frac{W L r}{I} \qquad (4)$$

The expression I/r represents the section modulus of the welded section and is called P. Hence

$$S_B = \frac{W L}{P} = \frac{M}{P} \qquad (5)$$

Further the stress S_A due to vertical sheer—unless otherwise noted, the load is assumed to act vertically—is uniformly distributed and is equal to the load divided by the total length of the welded lines. Hence

$$S_A = \frac{W}{N} \qquad (6)$$

where N = the total length in inches of the welded lines.

It is evident that one of the corners will receive the greatest resultant stress S. The strength of the connections will be governed by the fact that this resultant must not exceed the allowable stress.

Derivation of Formulas

Using the figure 2 we make a layout from the corner E for the forces S_A and S_B. The force S_B equaling E-F is perpendicular to the line E-O, if O represents the center of gravity of the welded lines. The force S_A equals F-H and is parallel to the direction of the load W.

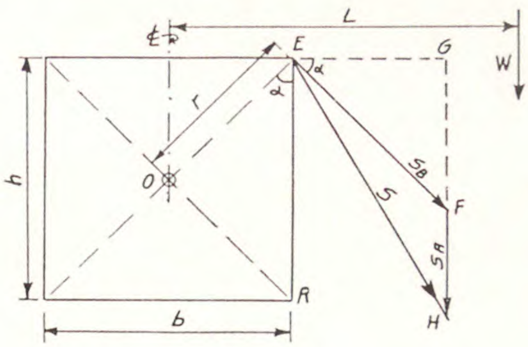


Figure 2

It is true that the angles OEF and REG equal 90 degrees. Subtracting the angle FER from both of them we get

angle OER = angle GEF = α

It is evident that $\sin \alpha = b/2r$ and $\cos \alpha = h/2r$ and therefore

$$E G = (E F) \cos \alpha = \frac{W L h}{2 I} \qquad \text{and}$$

$$G F = (E F) \sin \alpha = \frac{W L b}{2 I}$$

The resultant stress S is represented by the hypotenuse in the right triangle EGH. Therefore in accordance with the Pythagoras theorem

$$S^2 = \frac{W^2 L^2 h^2}{4 I^2} + \frac{W^2 L^2 b^2}{4 I^2} + \frac{W^2}{N^2} + \frac{W^2 L b}{I N}$$

or as $h^2 + b^2 = 4r^2$

$$S^2 = \frac{W^2 L^2 r^2}{I^2} + \frac{W^2}{N^2} + \frac{W^2 L b}{I N}$$

and by solving for S we get

$$S = \frac{W}{N} \sqrt{\frac{L^2 N^2 r^2}{I^2} + \frac{L b N}{I} + 1}$$

Thus we get the general formulas for the resultant stress

$$S = \frac{W}{N} \sqrt{A^2 B + A + 1} \qquad (7)$$

with

$$A = \frac{L b N}{I} \qquad (8)$$

and

$$B = \frac{h^2 + b^2}{4b^2} = \frac{r^2}{b^2} \qquad (9)$$

where W = the total eccentric load in pounds, N = the total length in inches of the welded lines, I = the polar moment of inertia of the welded lines, and $r_1 b$ and h are to be found in the Fig. 2.

It will be noted that these formulas apply to any kind of a symmetrically welded joint. By certain assumptions the above formulas can be very much simplified. Every value with the exception of I is very easily figured. Now those cases, that mostly occur, are going to be investigated.

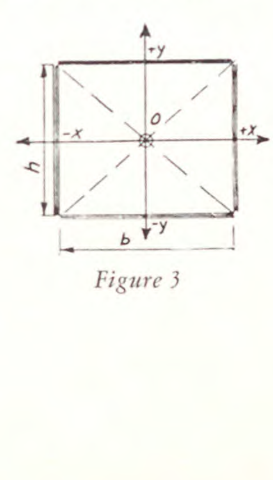


Figure 3

Special case 1. A rectangular four-sided weld.

If a welded connection is made up of a four-sided fillet weld as shown by Figs. 1 and 3, then the assumption may be made, that I represents the polar moment of inertia of the welded joint considered as 4 straight lines as shown by Fig. 3. With reference to the principal axes we have the polar moment of inertia $I = I_x + I_y$,

where

$$I_x = 2\,b\left(\frac{h}{2}\right)^2 + 4\int_0^{\frac{h}{2}} y^2\,dy = \frac{b\,h^2}{2} + 4\Big[_0^{\frac{h}{2}} \frac{y^3}{3}$$

and therefore

$$I_x = \frac{3\,b\,h^2 + h^3}{6}$$

and similarly

$$I_y = \frac{3\,h\,b^2 + b^3}{6}$$

Hence

$$I = \frac{b(3h^2 + b^2) + h(h^2 + 3b^2)}{6} \qquad (10)$$

Further

$$N = 2(b + h) \qquad (11)$$

and we get thus by using above values of I and N the following value for the resultant stress

$$S = \frac{W}{2(h + b)}\sqrt{A^2 B + A + 1} \qquad (12)$$

with

$$A = \frac{12\,L\,b}{(b + h)^2} \qquad (13)$$

and

$$B = \frac{b^2 + h^2}{4\,b^2} \qquad (14)$$

It will be noted that the above formulas are very simple to use because complicated expressions, as for instance the polar moment of inertia, have been eliminated.

Example 1. One 10-inch channel carries a load of 20,000 pounds with an eccentricity of 20 inches. Find maximum welding stress, if a four-sided weld is used with b = 10 inches.

With L = 20 inches, b = 10 inches and h = 10 inches, we get from formula (13)

$$A = \frac{12\,.\,20\,.\,10}{(10 + 10)^2} = 6$$

and from formula (14)

$$B = \frac{10^2 + 10^2}{4 \times 10^2} = .5$$

and therefore the formula (12) becomes

$$S = \frac{20000}{2(10 + 10)}\sqrt{6^2 \times .5 + 6 + 1} = 2500.$$

Answer: The maximum resultant stress is 2500 pounds.

Special case 2. A horizontal two-sided weld.

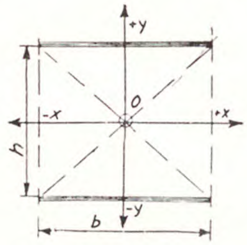


Figure 4

If a welded connection is made up of two horizontal fillet welds as shown by Fig. 4, then the assumption may be made, that I represents the polar moment of inertia of the welded joint considered as two straight horizontal lines as shown by the figure.

With reference to the principal axes we have the polar moment of inertia $I = I_x + I_y$,

Where

$$I_x = 2\,b\left(\frac{h}{2}\right)^2 = \frac{b\,h^2}{2}$$

and

$$I_y = 4\int_0^{\frac{b}{2}} x^2\,dx = 4\Big[_0^{\frac{b}{2}} \frac{x^3}{3} = \frac{b^3}{6}$$

and therefore

$$I = \frac{b(3\,h^2 + b^2)}{6} \qquad (15)$$

Further

$$N = 2\,b \qquad (16)$$

and we get thus by using the above values of I and N the following value for the resultant stress

$$S = \frac{W}{2\,b}\sqrt{A^2 B + A + 1} \qquad (17)$$

with

$$A = \frac{12\,L\,b}{3\,h^2 + b^2} \qquad (18)$$

and

$$B = \frac{h^2 + b^2}{4\,b^2} \qquad (19)$$

Example 2. A 12-inch channel connected to a column with a horizontal two-sided weld, carries an eccentric load of 18,000 pounds. If the eccentricity is 12 inches and the value of b is 10 inches, find the maximum stress in the weld.

With L = 12 inches, b = 10 inches and h = 12 inches we get by using formula (18)

$$A = \frac{12 \times 12 \times 10}{3 \times 12^2 + 10^2} = 2.71$$

and from formula (19)

$$B = \frac{12^2 + 10^2}{4 \times 10^2} = .61$$

and therefore the formula (17) becomes

$$S = \frac{18000}{2 \times 10}\sqrt{2.71^2 \times .61 + 2.71 + 1} = 2560.$$

Answer: The maximum resultant stress is 2560 pounds per inch.

Special case 3. A vertical two-sided weld.

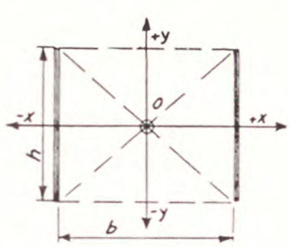


Figure 5

If a welded connection is made up of two vertical fillet welds as shown by figure 5, then the assumption may be made, that I represents the polar moment of inertia of the welded joint considered as two straight vertical lines as shown by the figure.

With reference to the principal axes we have the polar moment of inertia $I = I_x + I_y$, Where

$$I_x = 4 \int_0^{\frac{h}{2}} y^2\,dy = 4 \Big[_0^{\frac{h}{2}} \frac{y^3}{3} = \frac{h^3}{6}$$

and

$$I_y = 2\,h \left(\frac{b}{2}\right)^2 = \frac{h\,b^2}{2}$$

and therefore

$$I = \frac{h\,(h^2 + 3b^2)}{6} \qquad (20)$$

Further

$$N = 2\,h \qquad (21)$$

and we get thus by using the above values of I and N the following expression for the resultant stress

$$S = \frac{W}{2\,h}\sqrt{A^2\,B + A + 1} \qquad (22)$$

with

$$A = \frac{12\,L\,b}{h^2 + 3\,b^2} \qquad (23)$$

and

$$B = \frac{h^2 + b^2}{4\,b^2} \qquad (24)$$

Example 3. A 12-inch channel connected to a column with a verticle double weld carries an eccentric load of 18,000 pounds. If the eccentricity is 12 inches and the value of b is 6 inches, find the maximum stress in the weld.

With L = 12, b = 6 and h = 12, we get by using formula (23)

$$A = \frac{12 \times 12 \times 6}{12^2 + 3 \times 6^2} = \frac{24}{7} = 3.43$$

and from formula (24)

$$B = \frac{12^2 + 6^2}{4 \times 6^2} = \frac{5}{4} = 1.25$$

and therefore the formula (22) becomes

$$S = \frac{18000}{2 \times 12}\sqrt{3.43^2 \times 1.25 + 3.43 + 1} = 3280$$

Bending Only Considered

It has previously been proven—formula (4)—that the stress due to the bending was

$$S_B = \frac{W\,L\,r}{I}$$

where I = the moment of inertia of the weld lines

We have

$$r = \sqrt{\frac{h^2 + b^2}{4}}$$

and

$$A = \frac{L\,b\,N}{I}$$

and therefore

$$S_B = \frac{W A}{b\,N}\sqrt{\frac{h^2 + b^2}{4}}$$

Further

$$B = \frac{h^2 + b^2}{4\,b^2}$$

and therefore

$$S_B = \frac{W}{N} A \sqrt{B} \qquad (25)$$

where the values of A and B have previously been derived.

Comparison Between Rivet and Weld Formulae

A vertical double weld may be compared with a group of rivets in two vertical rows with an infinite number of rivets in each row as has been shown in Fig. 6.

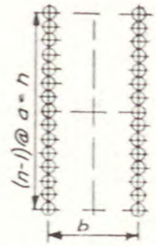


Figure 6

From an article by the author in *Civil Engineering* for February, 1931—Designing Riveted Connections with Charts and Tables:—a general rivet formula is given as

$$S = \frac{W}{N}\sqrt{A^2\,B + A + 1} \qquad (a)$$

where S = the maximum resultant stress on an extreme rivet, W = the load and N = the number of rivets. For two vertical rows the following values of A and B are given, where a = the vertical and b = the horizontal spacing, and n = number of rivets in each row.

$$A = \frac{12\,L\,b}{a^2\,(n^2 - 1) + 3\,b^2} \qquad (b)$$

$$B = \frac{a^2\,(n - 1)^2 + b^2}{4\,b^2} \qquad (c)$$

It will be found that this formula—(a)—has exactly the same appearance as formula (7). In the weld-formula N = the total length of welds.

The denominator of (b) may be written

$$= a\,(n - 1)\,[a\,(n - 1) + 2a] + 3\,b^2$$

The term a (n — 1) = h. The vertical spacing a is very small for an infinite number of rivets, and therefore 2a = 0. Hence the whole expression becomes $h^2 + 3b^2$ and

$$A = \frac{12\,L\,b}{h^2 + 3\,b^2}$$

The numerator in the expression for (c) may be written a (n — 1) a (n — 1) + b^2, or with a (n — 1) = h the value of B will be

$$B = \frac{h^2 + b^2}{4\,b^2}$$

These expressions agree exactly with the corresponding values for the welded connections if h represents the length of the welds and b is the distance between them.

It can be proven that the same resemblance exists between the horizontal double weld and a rivet group with an infinite number of vertical rows with two rivets in each row.

Comments by Harold N. Cummings, Professor in Civil Engineering, and in Charge of Department, Newark College of Engineering:

Professor Albert's genius for setting up the problems of the structural detailer in compact and simplified form, usually in forms of parameters, such as "A" and "B" in the present paper, has produced a useful set of expressions for the rapidly increasing field of Welded Connection Design. It seems to me very wise to publish for the engineering profession in general this material, which was originally presented in the *Journal of the American Welding Society* in 1931. I suggest that anyone interested in seeing the possibilities of Professor Albert's methods refer to the original article, and also to his article in *Civil Engineering* for February, 1931, on Designing *Riveted* Connections with Charts and Tables. The young engineer who has a little spare time on his hands can very profitably use it in developing his own tables and charts for whatever type of work he expects to do. A careful study of these two articles should give him valuable suggestions as to the procedure, and make it possible for him to greatly increase his "production" during rush periods.

CELLOPHANE

By DONALD A. WATERFIELD, B.S. *in Chem. Engineering, 1932*
Newark College of Engineering

The introduction some 15 years ago of regenerated cellulose as a transparent wrapping material apparently offered the packaging industry its long-sought ideal. In this material there appeared the qualities of enhancing clarity, cleanliness, and strength. The intervening years have so multiplied its utility that it has become common. Every industry has to consider its potentialities in preparing goods for market. As a result of these usages, a Circuit Court of Appeals, in the case of DuPont Cellophane Company vs. Waxed Products Company (85F (2d) 75, 79), has ruled that the once-registered trade mark "Cellophane" was not specific enough to distinguish a DuPont product and had become a generic term describing the multiplicity of transparent foils now available.

In the United States today there are two producers of regenerated cellulose films: the DuPont Cellophane Company with several plants, and the Sylvania Industrial Corporation of Fredericksburg, Va. Step by step from the mercerizing of blue spruce pulp or cotton linters, xanthation of the alkali cellulose, to the casting and finishing of the brilliant film, these two companies produce products so identical in appearance that the public recognizes both as cellophane.

The purpose of the research that created regenerated cellulose as a film was the search for a film base other than the highly inflammable cellulose nitrate. The sparkling brilliant film, however, had no strength in developing solutions and dried to the shape of any article on which it was spread. Its commercial value is not the product of laboratory skill but the keen vision of an advertising man who recognized a new packaging material. The quick success attendant to its introduction has led to numerous attempts to duplicate or imitate it. This discussion treats of these developments.

The most successful competitors of the cellulose films are cast cellulose acetate foils known as "Protectoid" and "Kodaloid," the former produced by the Celluloid Corporation in Newark, N. J., and the latter by the Eastman Kodak Company. These films are manufactured very similarly by the extrusion of a suitable solution of cellulose acetate onto huge wheel surfaces of highly-polished nickel or silver. The foil is cast in thicknesses of from 0.00088" to 0.0015" for usual wrapping purposes. Like cellophane, this material has numerous uses, but it holds an advantage in the food industry for its greaseproofness. Cellulose acetate is inherently more moisture proof than cellulose and for this reason is preferable in some applications for its semi-moistureproofness to the high moisture resistance of moistureproofed cellophane. Success has not been the lot of all efforts in this field; the Industrial Rayon Corporation abandoned a rather elaborate development plant.

Since 1934 the Goodyear Rubber Company has been selling Pliofilm, a rubber hydrochloride cast as a film. This material is more a complement to the regenerated cellulose and cellulose ester films than is it a competitor. Its characteristics are very different and it is more adaptable to the manufacture of water-repellent items such as rain-capes, shower hoods, and food covers. The present price is 50%-100% greater than cellophane and there seems little promise of this ratio changing if the demand for the cellulose products continues to give the manufacturers an appreciable edge.

Proteins have film-forming characteristics and price advantages that seemingly should make them competitors of the higher priced cellulose and cellulose ester products. Experimental work throughout the world has at times indicated successful competition, but to date there is no producer of films of protein material. The most commonly investigated protein has been gelatin. Available in large quantities, gelatin is quite cheap, light-colored, and readily soluble in water. This latter characteristic of water solubility is an advantage in formulating for production but a disadvantage in finishing the product. Two companies, at least, in the United States have spent large sums investigating the possibility of gelatin. The Dennison Company at Framingham, Mass., once constructed a large, glass-surfaced wheel about 100 feet in circumference for casting gelatin films. The product never developed commercial possibilities and the equipment was abandoned. The A. E. Staley Manufacturing Company, Decatur, Illinois, a corn products refiner, investigated combinations of gelatin and corn sugar for their filming characteristics. The results were unsatisfactory. The only gelatin films the writer has ever seen were small sheets made in Germany by hand-dipping glass plates in suitable solutions. The product was very fragile and too expensive to compete with the output of production methods.

The only other protein that has been very seriously investigated is Zein, the alcohol soluble prolamine of maize. This material has attractive properties for a film. It is readily available in quantity at wet-milling corn starch factories as part of the residue going into cattle feed. Its tensile strength equals that of regenerated cellulose. The technological problems of the production of Zein films offered promise of solution. Films fully as brilliant as cellophane were produced but were never suitably plasticized to age well. The agricultural policy of the past few years has made the raw material so valuable as feed that the production of films is economically unsound. For the present, proteins remain something to be eaten.

The lure of this field of interest still exists and efforts are being made to produce a competitive product. In 1936 there was considerable interest created by a proposal of films from starch. The tumult has died and no further efforts seem forthcoming. In the fall of 1938 Dr. E. A. Hauser and his associates at Massachusetts Institute of Technology introduced a transparent aluminum silicate film. This development should prove of more than passing interest, for it has an excellent background of colloid chemistry. The synthetic resin producers are interested in the film possibilities of some of the newer products, most notably styrene and modified vinyl polymers. Research and pilot plant operations are under way to evaluate these materials. To date the promise is of more adaptable materials but with little indication that the cellulosic bases will be eclipsed.

The Industrial Relations Department of the Newark College of Engineering reports that of last year's graduating group, at least 95 per cent are now employed. The department gives the following information about a few of the members of this class: Jarvis C. Buxton is employed with the Worthington Pump & Machinery Corporation in Harrison; Fred Dugan is a member of the Westinghouse training course in Pittsburgh; Charles Clark was recently employed with the Edison Laboratories in West Orange; Wallace C. Edington is with the Ceba Pharmaceutical Company in Summit; Gordon M. Hoffmann is a member of the training course of the Crane Company in Chicago; Roland G. Holmgren has continued his employment with the American Type Founders, Inc., in Elizabeth; and Ralph M. Knight is with the E. I. Du Pont de Nemours Company's Experimental Station in Wilmington, Delaware.

WESTON LIGHT MACHINES

By BEATRICE A. HICKSTEIN, B.S. in Ch.E.

In 1872 Edward Weston turned his attention to the possibilities of developing a dynamo electric machine to replace batteries in the electroplating field, since they were expensive and extremely irregular and troublesome in their actions. At first his experiments with dynamos were for electroplating purposes but later branched out into the lighting and general power fields. During this whole period Weston improved the efficiency of the dynamo from 30 per cent to 95 per cent, invented the slotted and laminated armatures, invented one of the first balanced drum armature windings, designed a machine having automatic regulation, and was among the first to use permanent magnets in the pieces to start excitement (excitation) and to run a dynamo as a motor.

The dynamo electric machine shown on the cover of this issue stands in the middle of the floor of the Weston Museum at the Newark College of Engineering. It was built by the United States Electric Lighting Company at the Weston factory in Newark about 1883. The machine is an invention of Dr. Weston's and represents some eight of his patents ranging from 1878 to 1882.

At the time this generator was built it showed remarkable advances over the dynamos of the early 1870's and was exhibited both here and abroad. At 900 r.p.m. this generator, absorbing 14 h.p., lighted 20 arc lamps with a current of 18 amperes. The field electro-magnets used from 3 to 5 per cent of the entire current from the armature and are in a derived (shunt wound) circuit.

The form of the armature was the most important part of the Weston machine, since it was the first laminated armature. Discs similar to those shown at the left (Fig. 1) were placed in series on a shaft and separated from each other by small washers of insulating material. The core (Fig. 1) gives the appearance of being a cylinder with longitudinal grooves (slots) and into these grooves armature wires are wound. The construction of the core of the armature allowed the circulation of air for cooling and acted as a blower when the armature was in motion to prevent undue rise in temperature of the armature conductors and the increase of resistance due to heating. Shown in Fig. 2 is the armature completely wound.

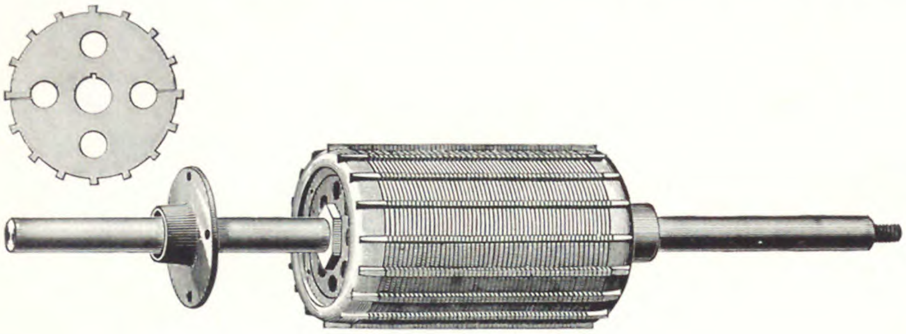


Figure 1
Core of Early Weston Armature

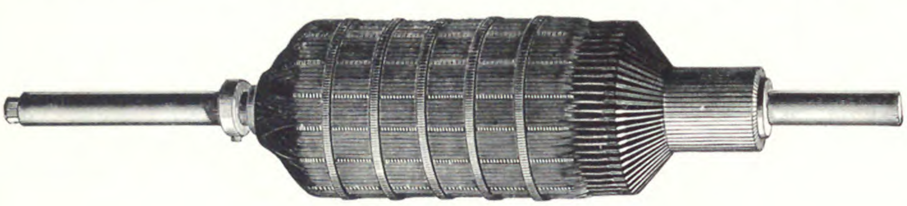


Figure 2
Armature and Collector (Commutator)
of Early Weston Machine

In the arc light system, to maintain the current strength constant an automatic regulator was invented by Weston for changing the resistance of the field.

The screw-handle shown on the mounting for the dynamo controls the tension on the belt by moving the dynamo backward or forward.

(Words in parenthesis are modern terms.)

THE STUDENT ENGINEERING SOCIETIES

The second regular meeting of the Newark College of Engineering Student Chapter of the American Society of Civil Engineers was held on November 13 in the Gilbreth Room. Forty were present.

Mr. Jack Rogers, Senior Representative to the Metropolitan Conference, announced that plans were being made for the convention to be held on January 17 in New York. At that time Mr. Daniel Mead will speak on "Ethics" and an unnamed speaker will have as his topic "The Social Status of the Engineer."

President Bastian then introduced Professor Philip Kissam of the Department of Civil Engineering at Princeton University. Professor Kissam told of the difficulties surveyors had in locating boundaries when making a survey of a plot of land for an owner or a prospective buyer, the original boundaries being located by inquiries from "old-timers," by borrowing data from recognized surveyors, or by making preliminary surveys. To offset these difficulties, which often result in law suits, all monuments must be connected by a survey, referencing all land to a permanent system of landmarks, reduced to plane coordinates. Such a system has been established in New Jersey, this being the most valuable work done by the U. S. Coast and Geodetic Survey, in the opinion of the speaker.

The third regular meeting of the Newark College of Engineering Student Chapter of the American Society of Civil Engineers was held on December 11 in the Gilbreth Room. Forty-five were present.

Commander W. H. Smith, Civil Engineering Corps, United States Navy, spoke on "Civil Engineering Corps of the Navy." The speaker told of how the corps was started in 1867 by authorization of the President and the Senate committee, its members entering from civil life by competitive examinations or upon application after graduation from the Naval Academy, all being started as Jr. Lieutenant and being able to rise to the position of Rear Admiral.

The Bureau of Yards and Docks, as the squadron is called, has charge of hospital, drydock, power plant, etc., construction, the bureau having design, construction, maintenance and operating, and clerical divisions, with a project manager in charge of each specialized field. Research in soil mechanics, concrete design in sea-water, pile-driving, and welding has been carried on. Such varied jobs as the operation of power plants, care of grounds, snow removal, refuse removal, and service distribution all enter into the work of the bureau. Work is carried on by yard labor,

(Continued on page 15)

WHAT OUR READERS SAY

To the Editor:

I happened to pick up the October issue of NEWARK ENGINEERING NOTES at the School of Mines library and became interested in an article by Joseph Joffe as well as several others, as a result I wish that you would add me to your mailing list.

If it is possible to obtain the October 1939 issue I wish that you would send it with the next regular issue.

Yours sincerely,
JAMES CHASE, Student
South Dakota School of Mines.
Rapid City, S. Dakota, December 1, 1939.

To the Editor:

I was very pleased to receive your October issue of the NEWARK ENGINEERING NOTES. Your publication is very informative and makes me feel that I am still in contact with my Alma Mater and up-to-date with the newest trends in Engineering. Please include me on your mailing list.

Very truly yours,
ELLIOT GOODMAN, '39.
Roselle Park, N. J., December 9, 1939.

To the Editor:

Will you kindly send me three copies of Volume 2, Number 2 of the ENGINEERING NOTES. I will be glad to pay any nominal charge.

I would appreciate being placed on your mailing list for this journal. Thank you.

Yours very truly,
LANNING P. RANKIN, *Ph.D.*
Member, Research Staff
Bakelite Corporation.
Bloomfield, N. J., Nov. 5, 1939.

To the Editor:

The October, 1939, issue of NEWARK ENGINEERING NOTES has just reached me, and I can assure you the contents were thoroughly appreciated. Never before did we realize that our old friend "Casting Out the Nines" possessed so much of a college background.

This is the first copy of the publication that it has been our pleasure to peruse, and we would thank you to place our name on your regular mailing list.

Yours very truly,
A. HUTTON, *Chief Engineer,*
Davis Engineering Corporation.
Elizabeth, N. J., November 28, 1939.

To the Editor:

I shall be pleased to receive the NEWARK ENGINEERING NOTES regularly, as it helps to keep me in contact with the latest developments in the college.

Thanking you, I am

Very truly yours,
WILLIAM MOSKOWITZ, '39.
Linden, N. J., November 29, 1939.

To the Editor:

Will you please send us your FORMULAS as published in the NEWARK ENGINEERING NOTES in the form of a paper by Odd Albert, Asst. Prof. of Structural Engineering.

We would appreciate you letting us have this by return mail for use in our office.

Yours very truly,
MRS. W. W. WILLIAMS,
Cinder Block Incorporated of Roanoke.
Roanoke, Va., Oct. 3, 1939.

To the Editor:

Will you please place my name on your mailing list to receive regularly NEWARK ENGINEERING NOTES?

I believe it will be of considerable value to the meembers of our organization.

Very truly yours,
ETHEL MILLER,
Library, White Laboratories, Inc.
Newark, N. J., November 22, 1939.

To the Editor:

I have received several issues of the NEWARK ENGINEERING NOTES and they have been read with much interest and would certainly be greatly pleased if you would continue to send me future copies of this magazine as issued.

In other words, please place my name on your mailing list in accordance with your offer.

Yours very truly,
W. G. LONG, *Sales Engineer,*
Weston Electrical Instrument Corp.
Newark, N. J., November 24, 1939.

To the Editor:

Your periodical NEWARK ENGINEERING NOTES has just come to my attention and I am very much interested in the articles published therein. I would greatly appreciate it if you would add my name to your mailing list. If you have any of the back issues left, I would be glad to receive a set so that I can have the complete file on hand.

Thanking you in advance for your courtesy, I am

Yours very truly,
LEOPOLD SCHEFLAN, *Research Chemist,*
Pyrene Manufacturing Company.
Newark, N. J., November 27, 1939.

To the Editor:

I enjoyed very much the copy of NEWARK ENGINEERING NOTES which I have recently received, and I appreciate your having sent me an issue of it.

I assure you I shall further appreciate it if you would be so kind as to place my name on your regular mailing list.

Sincerely yours,
ANDREW LUCARELLI, '39.
Paterson, N. J., November 29, 1939.

To the Editor:

I have read with care and interest Mr. Easton's excellent piece of mathematical reasoning in the October issue. Since my only contact with the use of operators has been in connection with the study of differential equations, I fully agree with Prof. Fithian that Mr. Easton's use of these is highly informative.

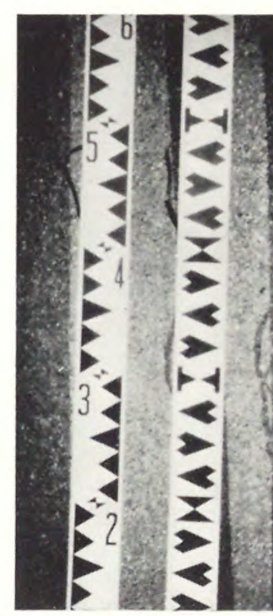
In the various issues of your magazine I have found many articles of interest and have enjoyed reading news of the faculty under many of whom I have had the privilege of studying.

Yours truly,
FRANK D. MALONE
Jersey City, N. J., Dec. 18, 1939.

FAST READING STADIA ROD

By PROFESSOR WILLIAM S. LA LONDE

In 1930 the Newark College of Engineering made up in its shop a number of stadia rods of 12-foot length. As these rods were to be carried by students in their cars they were hinged at the 6 foot point. A removable and reversible rib 3 to 4 feet long is fastened at the back of the rod to hold the two halves rigidly open. The rods were



made from 1 x 5-inch stock and were given two coats of flat white paint. Then the designs as well as all numbers were painted black and the whole given a coat of clear varnish. On several rods a saw-tooth pattern was devised so that the 1, 3, 5, 7, and 9-tenth points were at the apex of the black triangles, the 5-tenth points being accentuated. Each foot of pattern reverses from side to side on the rod.

The accompanying pictures show the Newark rod (left) alongside a conventional stadia rod with fishtail pattern. The students like the Newark rod best and make fewer mistakes in reading it. In a test on a measured line with several observers reading stadia rods with different patterns, the Newark rod was faster for equal accuracy in reading. (Mentioned in *Engineering News-Record*, October 21, 1937.)

THE STUDENT ENGINEERING SOCIETIES

(Continued from page 13)

private contractors, or W.P.A. labor as the case may be, the construction of drydocks, ship-building ways, and air-stations comprising a great deal of the work.

(Reported by Professor William S. La Londe)

On Friday, November 10, 1939, Mr. H. C. Barnes of U. S. Industrial Chemicals, Inc., talked on "The Manufacture of Alcohol" before the Student Branch of the American Institute of Chemical Engineers. On Wednesday, November 23, the members made an inspection trip through the plant of U. S. Industrial Chemicals, Inc., in Newark.

Mr. Leo Stage of the Irvington Varnish and Insulator Company spoke on "Varnish and Resins" before the Student Branch on December 8, 1939.

(Reported by Dean James A. Bradley)

The mid-semester activities of the Student Chapter of the American Institute of Electrical Engineers included a sound picture on modern construction of squirrel cage induction motors and their adaptation in the field of irrigation, an inspection trip to the Carteret broadcasting station of WOR and a discussion of instrumentation by a research man.

On November 20 last, the local Electrical group played host to the A. S. M. E. Student Branch. Mr. N. G. Willen, representative of U. S. Electrical Motors, Inc., presented a picture on a rather unique field in which this company's motors were used. Motor driven pumps were used to tap the large natural underground water reservoirs peculiar to the Southern California area to irrigate vast sections of land. These weather-proofed motors were then shown in the process of manufacture which included the rotor casting process, stamping methods, coil winding, and application of asbestosite varnish.

On December 3, a group of the Student members of the A. I. E. E. Chapter and Radio Club members visited the broadcasting station of WOR where not only a well engineered station layout was shown, but also the method of facsimile transmission was viewed.

On December 18 Doctor Richard C. Hitchcock, Design Engineer with the Meter Division of the Westinghouse Electric & Manufacturing Company, gave a demonstration of modern ideas in electrical measurement. Doctor Hitchcock is engaged in special research on copper oxide rectifiers and thermocouples and is well known as a writer on instrument performance and characteristics.

(Reported by C. H. Stephans, Counselor)

Mr. Alfred Hedefine, Associate Engineer with the consulting engineering firm of Waddell & Hardesty, addressed the Sophomore class in Principles of Engineering on Tuesday, October 31st. Mr. Hedefine's subject was "Design Activities," and he spoke from a rich and varied experience in large scale bridge construction. Many factors enter the design of any structure, according to Mr. Hedefine, and most often the actual engineering design is not the most significant factor. He discussed at length the considerations involved in determining the need for a structure, the many details attending the financing of it, and the necessity of obtaining approval from all interested groups before the construction can begin. In large scale construction, engineers call into play almost every commodity and every facility available, significantly enough, without realizing it. Their activities thus have the possibility of creating widespread social effects, and Mr. Hedefine feels that engineers should be particularly sensitive to this fact.