



American Concrete Institute®
Advancing concrete knowledge

Extreme Concrete History Part 1 of 2

ACI Spring 2010 Xtreme Concrete Convention
 March 21 - 25, Chicago, IL

ACI WEB SESSIONS

ACI Web Sessions

The audio for this web session will begin momentarily and will play in its entirety along with the slides.

However, if you wish to skip to the next speaker, use the scroll bar at left to locate the speaker's first slide (indicated by the  icon in the bottom right corner of slides 9 and 29). Click on the thumbnail for the slide to begin the audio for that portion of the presentation.

Note: If the slides begin to lag behind the audio, back up one slide to re-sync.

ACI WEB SESSIONS

ACI Web Sessions

ACI is bringing you this Web Session in keeping with its motto of "Advancing Concrete Knowledge." The ideas expressed, however, are those of the speakers and do not necessarily reflect the views of ACI or its committees.

Please adjust your audio to an appropriate level at this time.



ACI WEB SESSIONS

ACI Web Sessions

ACI Web Sessions are recorded at ACI Conventions and other concrete industry events. At regular intervals, a new set of presentations can be viewed on ACI's website free of charge.

After one week, the presentations will be temporarily archived on the ACI website or made part of ACI's Online CEU Program, depending on their content.



ACI WEB SESSIONS

ACI Online CEU Program

ACI offers an easy-to-use Online CEU Program for anyone who needs to earn Continuing Education credits.

Once registered, you can download and study reference material. After passing a 10-question exam on the material, you will receive a certificate of completion that you can present to local licensing agencies.

Topics recently added to the program:

- RAP Bulletin 10: Leveling and Reprofile of Vertical and Overhead Surfaces
- RAP Bulletin 11: Slabjacking
- RILEM Report on Self-Compacting Concrete (Parts 1 and 2)



Visit www.concrete.org/education/edu_online_CEU.htm for more information.



ACI WEB SESSIONS



ACI Fall 2010 Convention
Pittsburgh

The Westin Convention Center Hotel &
 David L. Lawrence Convention Center
 October 24-28, 2010 • Pittsburgh, PA

ACI Conventions are dedicated to improving the design, construction, maintenance, and repair of concrete structures by offering 300+ committee meetings, 30+ technical and educational sessions, a number of networking events, and the opportunity to visit with exhibitors.

To coincide with the growing focus on "green" building practices, ACI has tailored numerous aspects of this fall's convention to place emphasis on sustainability. Learn about the methods for reducing environmental impact and increasing the efficiency of concrete during committee meetings, sessions, and other events at the ACI Fall 2010 Convention. For more information and to register, visit www.aciconvention.org.



ACI WEB SESSIONS

ACI Web Sessions

This ACI Web Session includes two speakers presenting at the ACI Xtreme Concrete convention held in Chicago, IL, March 21st through 25th, 2010.

Additional presentations will be made available in future ACI Web Sessions.

Please enjoy the presentations.



ACI WEB SESSIONS



American Concrete Institute®
Advancing concrete knowledge

Extreme Concrete History Part 1 of 2

ACI Spring 2010 Xtreme Concrete Convention
March 21 - 25, Chicago, IL



ACI WEB SESSIONS



Paul Tikalsky, Ph.D. and PE, is the Chair of Civil and Environmental Engineering at the University of Utah, specializing in the durability of concrete structures and the use of natural and industrial pozzolans. He has published more than 60 refereed publications and 50 technical reports. He is a Fellow of the Engineering Academy of the Czech Republic and ACI, and is a licensed professional engineer in the State of California. He received his B.S. degree in Civil and Environmental Engineering at the University of Wisconsin at Madison, and his M.S. and Ph.D. degrees in Structural Engineering at the University of Texas at Austin. Dr. Tikalsky is currently the Principal Investigator on the FHWA Pooled Funded Study TFP 5 (117), Development of Performance Properties of Ternary Mixtures. He is a past member of the ACI Board of Direction, and past chair of ACI Committees 232, E701, and ACI Educational Activities Committee. 

ACI WEB SESSIONS



From Marcus Vitruvius Pollio to David Moore

ROMAN CEMENTS

ACI WEB SESSIONS

EARLY ENGINEERED STRUCTURES

Rammed Earthen Walls with Clay (3000 BC)

↓

Lime Plaster Coating of Walls (2500 BC India, 1700 BC Greece)

↓

Roman "Pit Sand" blended with wall material

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LIMESTONE TO LIME

- ✘ Processing of Travertine (calx) and limestone was an art form
 - + 700°C-900°C Weak lime binding
 - + 1080°C complete release of CO₂ from Limestone and Travertine rock
- ✘ Processed Lime is soft porous rock
- ✘ Stored in sealed containers to keep moisture out.

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QUICKLIME – SLAKED LIME – STONE

- $\text{CaCO}_3 + \text{heat} \rightarrow \text{CaO} + \text{CO}_2$
- CaO “quicklime”
- $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$
- Ca(OH)_2 Slaked Lime Paste
- $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$ (evaporated)
- Stone

ACI WEB SESSIONS

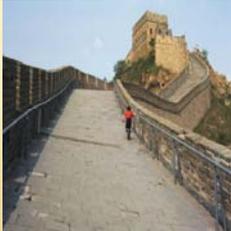
ORIGIN OF THE TERM CEMENT

- ✗ The word "cement" traces to the **Romans**,
 - + "opus caementicium" =masonry made from crushed rock with burnt **lime** as binder.
 - + referred to as “cementum,” “cimentum,” “cāment” and cement.
- ✗ 25 gallons of water used to slake 100 # of quicklime

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CARBONATION

- ✗ Lime mortars slowly carbonate to form a calcium carbonate (limestone) surface layer.
 - + Hot arid environments promote carbonation
 - + Carbonate layer is water resistant



Great Wall (300 BC) built with small penetration to enhance carbonation.

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MT. VESUVIUS

- ✗ 25,000 years of eruptions, each producing ash
- ✗ 217 BC eruption spread ash into the polar ice caps.
 - + Created hot springs and vents that **“fires spreading over the fields...that moisture has extracted from tufa and earth, as if it were limestone in kilns”** ~ancient Greeks



An eruption of Vesuvius seen from Partici, by Joseph Wright

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MARCUS VITRUVIUS

“There is also a kind of powder which from natural causes produces astonishing results. It is found in... Baiae...about Mt. Vesuvius.”

“when mixed with lime and rubble, not only lends strength to buildings...but even when piers are constructed in the sea”




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POZZOLANA FROM NAPLES

Pozzolana was shipped throughout coast of North Africa, middle east and Italy

“Pit Sand” from Naples

Bacoli Pozzolana for Harbours	
Chemical	% composition
SiO ₂	55.7
Al ₂ O ₃	19.0
Fe ₂ O ₃	4.6
CaO	5.0
Na ₂ O+K ₂ O	7.3



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ORIGIN OF THE TERM CONCRETE

- ✘ The word "concrete" traces from the Latin **Concretus**
 - + Ancient meaning: To grow together
 - + Lime + pozzolan+ water mortar cast over layers of aggregates, rubble from burned cities, fractured Travertine rock.

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ROMAN CONCRETE AQUEDUCTS

After 100 BC Romans started using aqueducts with pozzolana.

- Aqueducts
 - Aqua Virgo
 - Anio Vetus
 - Aqua Marcia
 - Aqua Claudia
 - Alexandrina
 - Caesarea



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ROMAN CONCRETE SIPHONS



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HARBOR OF CAESAREA

- ✘ pozzolana was shipped across the Mediterranean from Italy to Israel for the construction of the major harbour of Caesarea



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SEAWALL AT CAESAREA



"Pit Sand" from Naples



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DAM AT HARBAQA, SYRIA



ACI WEB SESSIONS

"PANTHEON"

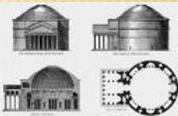


- ✘ Pantheon is the most preserved roman concrete structure.

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FEATURES OF PANTHEON CONCRETE

- ✘ Emperor Hadrian rebuilt Pantheon after Marcus Agrippa with Travertine
 - + Fires in 60,64,79, 110 AD fractured the Travertine
- ✘ Lime manufactured from white limestone
- ✘ Wall perforations to promote carbonation
- ✘ ~143 ft diameter Dome
 - Walls were pozzolan concrete between mortared stone masonry.



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PANTHEON DOME CONCRETE

- ✘ Lightweight aggregates in the dome
 - + Aggregates got lighter as the dome went higher
- ✘ 7 step rings and 140 coffers
- ✘ 19' oculus



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SUMMARY

- ✘ Roman concrete was a hydraulic cement developed by trial and error over several millennium
- ✘ Lime kilns were essential to produce quality concrete
- ✘ Emperors took a personal interest in the selection of master builders
- ✘ The fall of the Roman Empire was facilitated by the degradation of its infrastructure

ACI WEB SESSIONS



Rick Yelton is Editor in Chief in Hanley Wood's Commercial Magazine Division. He manages the content for *Concrete Surfaces*, *Masonry Construction*, and *The Concrete Producer*. In June 2001. Prior to joining Hanley Wood as an engineering editor, Rick worked in the aggregates and concrete products industry in supervisory and engineering positions. A graduate of the University of Missouri-Rolla with a B.S. in Mining Engineering, Rick also earned an M.B.A. in operations management and international business from St. Louis University. He is an active member of ASTM committees C-9, C-12 and C-15, The Society for Protective Coatings, ACI, The Masonry Society, and the Masonry Committee from SKILLS USA. He also represents Hanley Wood on the Strategic Development Council and on the National Steering Committee of the Concrete Industry Management program.

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The Nation's Carrier

The History of the American Ready-Mixed Concrete Truck

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The Nation's Carrier

- 1895 First Patent issued for mobile Job Site Mixed Concrete

ACI WEB SESSIONS

The Nation's Carrier

- 1905 First Patent issued for mobile Job Site Mixed Concrete

ACI WEB SESSIONS

The Nation's Carrier

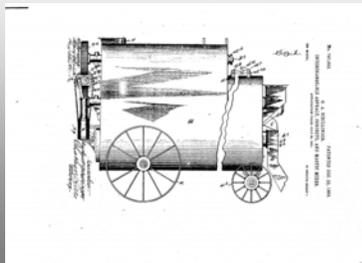
- According to NRMCA, the first concrete handled by a truck mixer was delivered in 1926.
- A Barrymore Mixer was used at the construction of the Children's Hospital in San Francisco

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Site Mixed Concrete Paving Early 20th Century

ACI WEB SESSIONS

1903 Interchangeable asphalt concrete Mixer

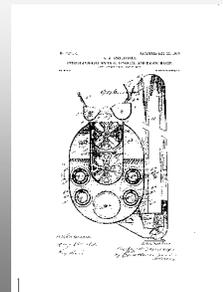


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The Nation's Carrier

1903

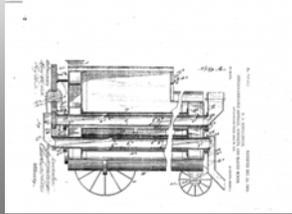
Interchangeable asphalt concrete Mixer



ACI WEB SESSIONS

The Nation's Carrier

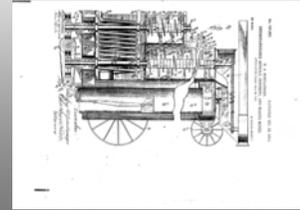
1903
Interchangeable asphalt
concrete Mixer



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The Nation's Carrier

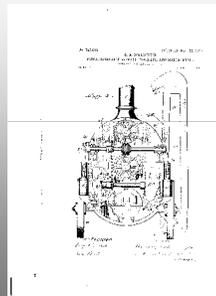
1903
Interchangeable asphalt
concrete Mixer



ACI WEB SESSIONS

The Nation's Carrier

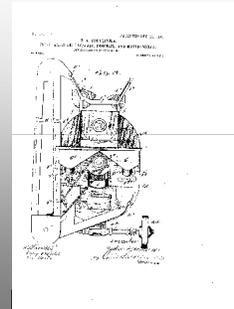
1903
Interchangeable asphalt
concrete Mixer



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The Nation's Carrier

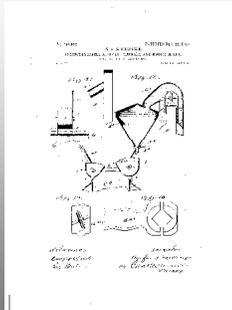
1903
Interchangeable asphalt
concrete Mixer



ACI WEB SESSIONS

The Nation's Carrier

1903
Interchangeable asphalt
concrete Mixer



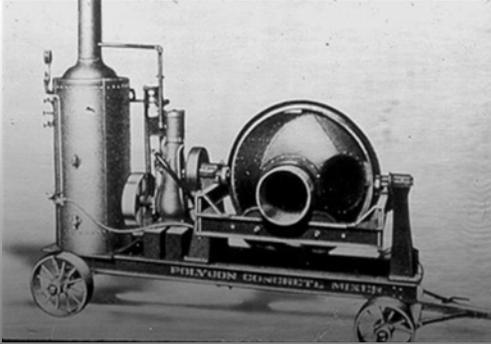
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The Nation's Carrier

As early as 1909, concrete was delivered by a horse-drawn mixer that used paddles turned by the cart's wheels to mix concrete en route to the jobsite. (PCA)

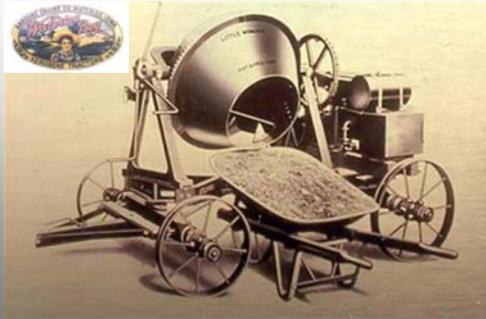
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1909 Steam Powered Polygon Concrete Mixer



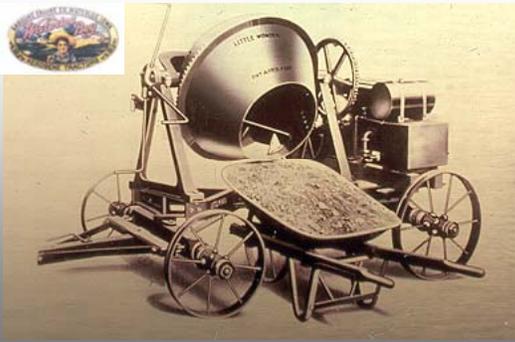
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1912 Little Wonder "1/2 bag 3-1/2 S"
Gasoline Powered Mixer mfg by Waterloo Boy



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John Deere purchased Waterloo Boy, on Jan 20, 1920



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c. 1910's Chain Belt Skip Pan-fed Mixer



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Note 1 hp power buggy



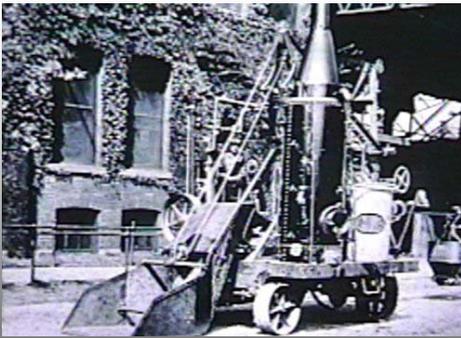
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Chain Belt Horse Drawn Steam Powered Street Paver



ACI WEB SESSIONS

Chain Belt Horse Drawn Steam Powered Street Paver



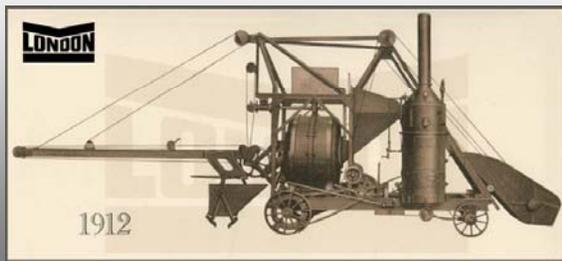
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Chain Belt 10E Paver



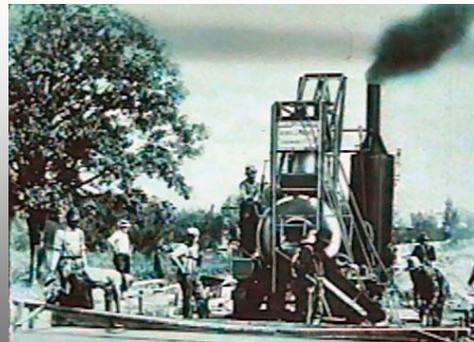
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Ad for London steam powered street paver,
1912, Ontario, Canada



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Rex Steam Powered Street Paver



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Oshkosh 7S Steam Powered Mixer



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Oshkosh 7S Mixer in action



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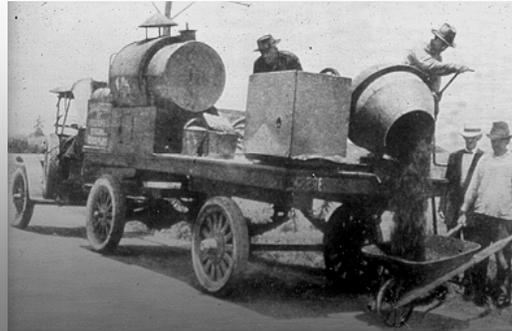
The Nation's Carrier

1913

- The first load of ready-mixed concrete is delivered in Baltimore, processed at a central mix plant, and delivered by dump truck (Ozinga web site)

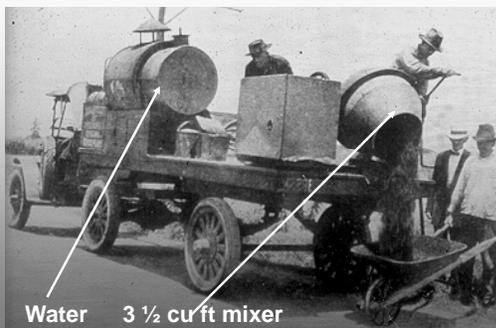
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1918: Concrete Mixer & Materials Trailer



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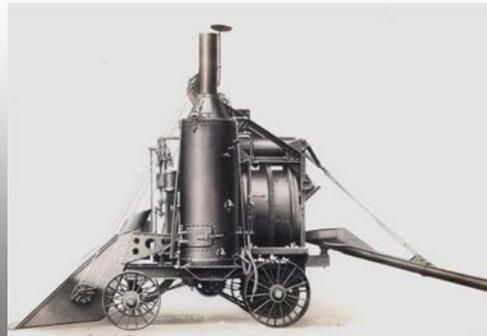
1918: Concrete Mixer & Materials Trailer



Water 3 1/2 cu ft mixer

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c.1915 Marsh Capron Skip Pan-fed Mixer



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The Nation's Carrier

1919

R. D. Farmer

First central located ready-mixed concrete plant west of Mississippi

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Franceschini Gen Contractor - Now Dufferin Concrete



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Mack "Bulldog" and steam shovel



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Rex mixer on Dam project



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1922 Concrete Pour In Youngstown, Ohio



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1922 Concrete Pour In Youngstown, Ohio



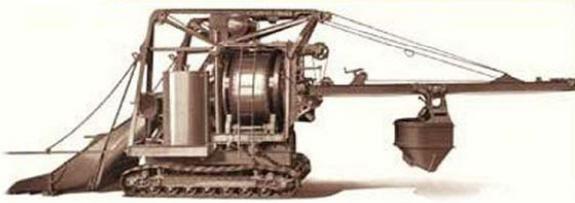
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S. L. Dennis Co, 1928



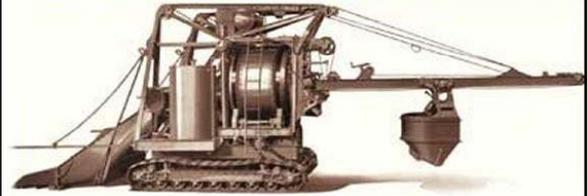
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Koehring 27E tracked street paver,



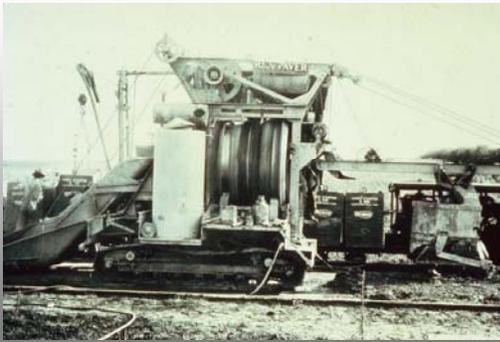
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These type pavers were produced into the early 1960's



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Rex Street Paver on tracks



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Rex Street Paver on tracks



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Lehigh Cement, Paving

S. L. Dennis Co, 1923



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S. L. Dennis Co, 1925



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Site mixed paving project



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Driveway Paving



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Transportable Concrete Site Mixers Early 20th Century

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The Nation's Carrier

1916

- Ready Mixed Concrete Producers brought plants to the Jobsite

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The Nation's Carrier

1916

- Koehring Mixer Co.- partnership agreement with Stephen Stepanian

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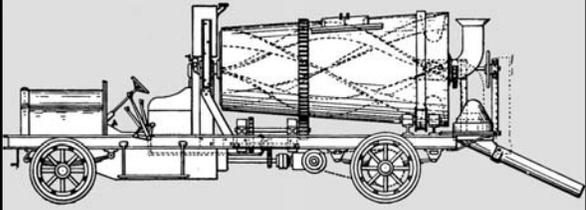
1916



Stephen Stepanian
Columbus, Ohio
Applies for patent for first truck mixer

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Stepanian Patent
1916



Unfortunately it did not work.

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1916

- Stephen Stepanian of Columbus, Ohio designed a self-discharging motorized mixer.
 - His patent was denied
 - In 1954, NRMCA recognized Stepanian by awarding him an honorary life member

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The Nation's Carrier

1917

- Stepanian's patent was initially denied

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The Nation's Carrier

1919

- Stepanian's patent was formally denied
 - In 1954, NRMCA recognized Stepanian by awarding him an honorary life member

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Photo by Harry Matthews
(c)2000
Western NY Gas & Steam

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Mixer mounted on truck for site mixing



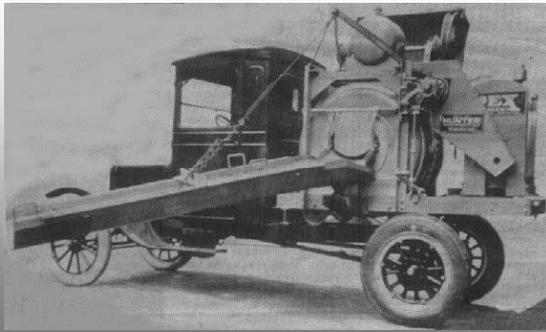
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Rex mixer mounted on model T chassis



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Rex truck mounted mixer



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c. 1925 Archer-Ford End Discharge

Widen your scope of profits

You'll admit that just ahead—just a little out of reach, there is some nice business you are missing. It is also true that the only reason why you are missing this business is your lack of mobile equipment.

The Archer Ford End Discharge Mixer brings all of these opportunities within easy reach and very materially increases your profits, however good. Full Ford Power is quickly engaged or disengaged in the Archer Mixer by simply moving one lever. The price is right. The Archer is a proven unit—and the Ford you know is good—it's a strong combination and worthy of your consideration.

Write for today:
ARCHER IRON WORKS CHICAGO
2438 34th Place

\$695
f. o. b.
Chicago



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Concrete Delivery 1920's

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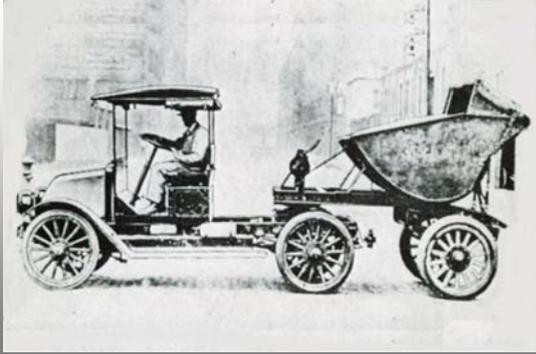
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1920's

Trucks began to have a hoist mechanism that lift the entire mixer

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Early Australian "Semi"



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1921 Stamp Truckmixer



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Lyman Richie S. L. Dennis Co, 1923



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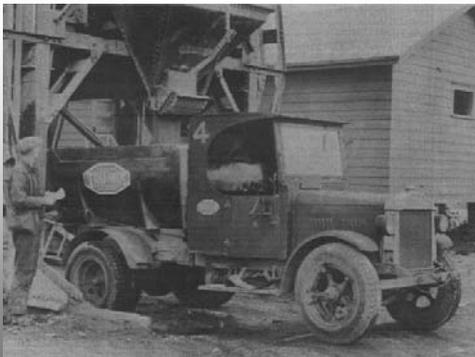
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1923

Western Paving Company had two plants in Oklahoma City producing 1,000 cubic yards of central mixed plants per day

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Kenworth open box, 1920's



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Walt Flanagan, Denver CO
1922 Rex 1 cy mixer on vintage GMC truck



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The Nation's Carrier

Specialized Dump Bodies:

- bathtub shaped
- cylindrical
- fish-tail ends
- special flow divertors

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c. 1923 "Bath Tub" Dump Truck Body



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The Nation's Carrier

1925

25 Ready Mixed Concrete Plants in the US

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The Nation's Carrier

1926

Paris Mixer Company, Seattle, Washington
First to market a revolving drum horizontal truck mixer in regular production

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The Nation's Carrier

1926

Erie Steel Construction Company develops the Aggregate Hopper, a device that weighs and measures ingredients by volume.

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1927 Dump Truck, Ramp & Ground Hopper Pour, New York City



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1927 Autocar Truck with Payne's Mixer



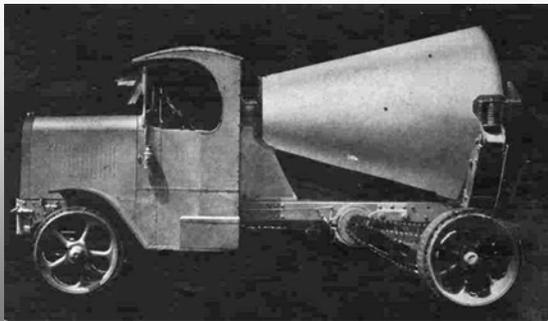
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Note front discharge



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'27 Parke Concrete Carrier
On Mac AC chassis



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1927
Seattle Washington
First horizontal truck mixer,
the **Paris Transit Mixer**
Introduced & becomes
popular across country

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The Nation's Carrier

Early Manufacturers

Barrymore Mixer referred to as the "Kansas City Dump Body"...

- built with high sides,
- horizontal shaft with paddles
- like a plaster mixer

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The Nation's Carrier

1928

Martin Ozinga, Sr., and Bill Conrad establish
Conrad and Ozinga Coal and Coke in Evergreen
Park, Ill.

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The Nation's Carrier

1928

Transit Mixer Company purchased the manufacturing rights to the Paris Mixer, marketing the equipment in the eastern half of the US

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The Nation's Carrier

1928 (approx)

- Jaeger mixer mounted on a Omort truck

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1927 HUG Roadbuilder restoration by Bill Farris



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1927 HUG Roadbuilder chassis with a 1 cy Smith mixer



ACI WEB SESSIONS

1927 HUG Roadbuilder w Smith mixer



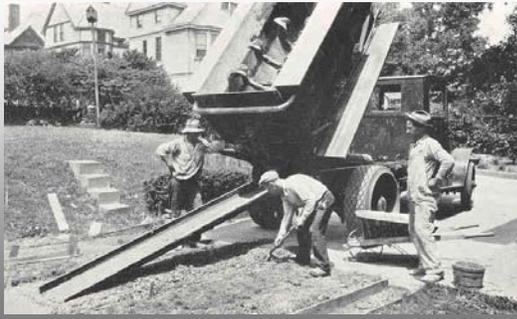
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Breckenridge Materials, MO



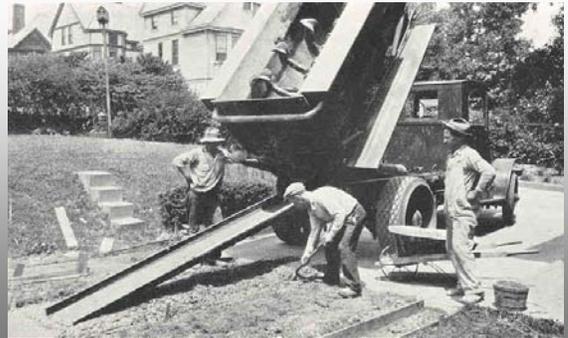
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1928 Barrymore "TRUCKMIXD" forerunner to Blaw Knox Co.



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Note paddle or pug mill mixer and coal chute style discharge gate



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'28 Portland Concrete Machines



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'28 Clinton Concrete Carrier, New York



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Stepanian Truck Mixer
(this one worked)



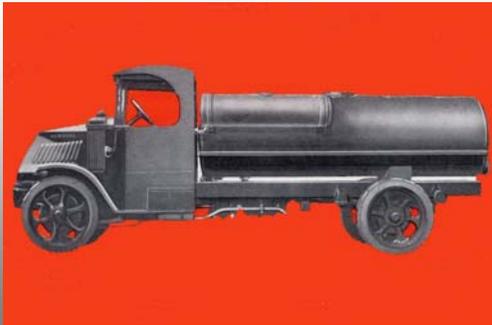
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1929 Grand Rapids Gravel Co.



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'29 Scott Transit Mixer



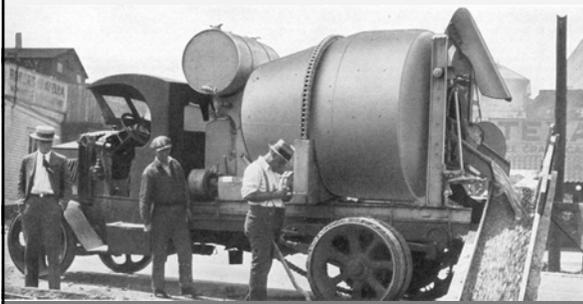
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'29 Pioneer Mix-in Transit Mixer on White truck



ACI WEB SESSIONS

c. 1929 Rex Chain Belt Moto-Mixer on Mack AC truck



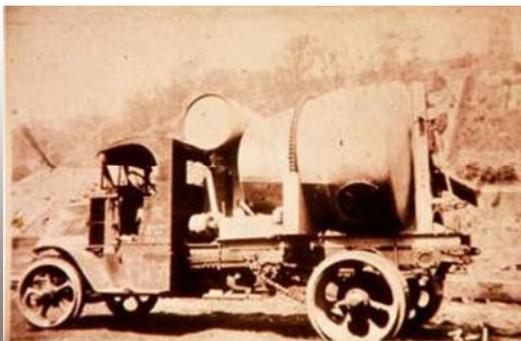
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'29 Paris Transit Mixer



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Rex Chain Belt Moto-Mixer - note loading hatch



ACI WEB SESSIONS

Mack AC "Bulldog" Trucks with Rex Moto-mixers



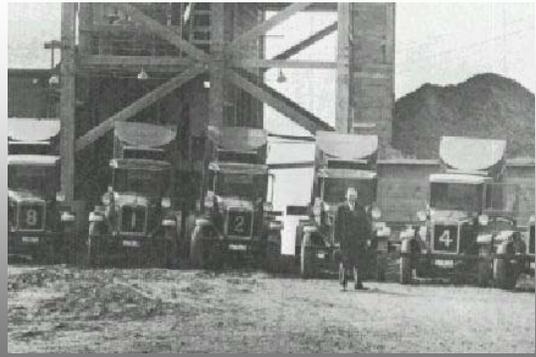
ACI WEB SESSIONS

Plant in Seattle. Note dump body trucks



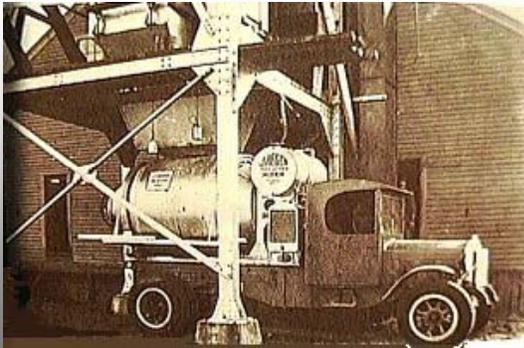
ACI WEB SESSIONS

Plant in Seattle. Note dump body trucks



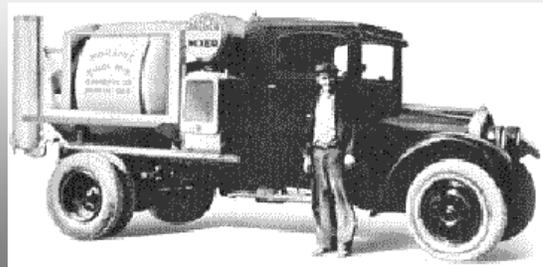
ACI WEB SESSIONS

Jaeger mixer on Mack



ACI WEB SESSIONS

Jaeger mixer at Moraine Materials



ACI WEB SESSIONS

L. Suzio, CT Blaw Knox mixer on Mack truck



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ACI WEB SESSIONS

**Concrete Delivery
1930's**

ACI WEB SESSIONS

c. 1930 Ransome Paver



ACI WEB SESSIONS

The Nation's Carrier

1930
100 Ready Mixed Concrete Plants in U.S.

ACI WEB SESSIONS

1930
Horizontal axis, revolving
drum mixer introduced
by three manufacturers.

ACI WEB SESSIONS

The Nation's Carrier

1930

Paris Mixer headquarters in San Francisco,
branches in Chicago, New York City, Vancouver

ACI WEB SESSIONS

The Nation's Carrier

1930

Jaeger Machine Company entered the
mixer market

Chain Belt Company, Milwaukee

ACI WEB SESSIONS

The Nation's Carrier

1930

ACI Journal, "Proposed Specification for Ready Mixed Concrete," Mile N. Clair

ACI WEB SESSIONS

Bridgeport Concrete Co
1930



ACI WEB SESSIONS

Bridgeport Concrete Co, 1930



ACI WEB SESSIONS

The Nation's Carrier

1930

Loizeaux Builders Supply Company, Elizabeth, New Jersey offered transit mixed concrete

ACI WEB SESSIONS

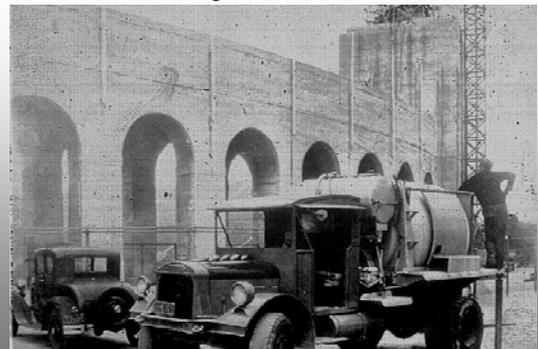
The Nation's Carrier

1931

J. H. MacNamara of Boston, Mass., delivered truck mixed concrete

ACI WEB SESSIONS

1931 Los Angeles Coliseum Construction



ACI WEB SESSIONS



The Nation's Carrier

1933

National Ready Mixed Concrete Association

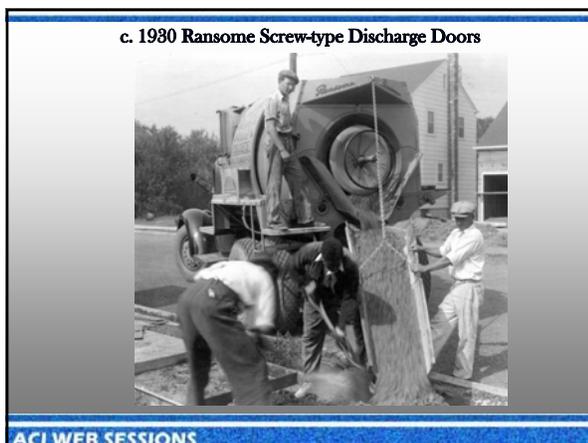
ACI WEB SESSIONS

The Nation's Carrier

1934

Typical horizontal axis mixer discharge happened by opening gate and swinging a chute

ACI WEB SESSIONS



The Nation's Carrier

1936

Blaw Knox entered the market

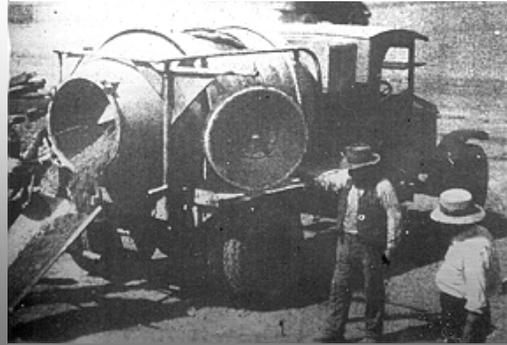
ACI WEB SESSIONS

'34 Blaw Knox Mixer On Mack Truck



ACI WEB SESSIONS

c. 1930 "Barn Door" type Discharge Doors

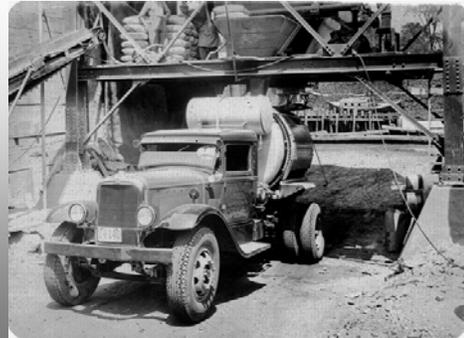


ACI WEB SESSIONS



ACI WEB SESSIONS

c. 1930 Transit Mix Plant
note bags of cement



ACI WEB SESSIONS

The Nation's Carrier

1936

- Ready Mixed Concrete Company, Denver, CO, run by Frank Spratlen, was formed.
- One of the first five companies in the U.S. to implement a truck-mounted mixer for mobile delivery of concrete.
- Purchased three 'Rex Chain Belt' truck mounted mixers; each mixer held 2 cubic yards of concrete. Success and future expansion were assured when it soon became apparent that the operation was capable of delivering 40 cubic yards of concrete per day.

ACI WEB SESSIONS

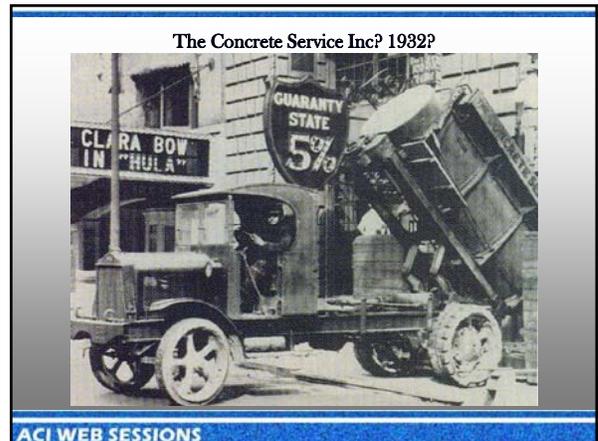
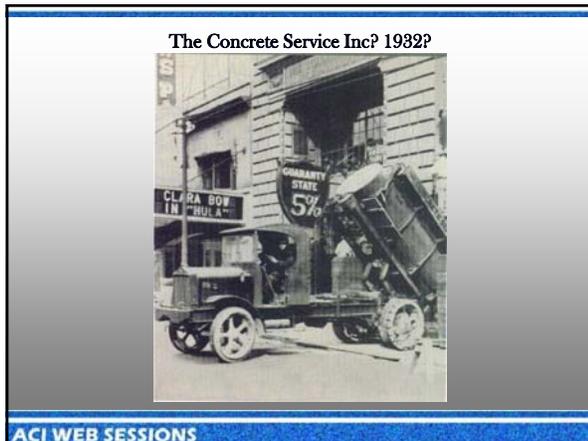
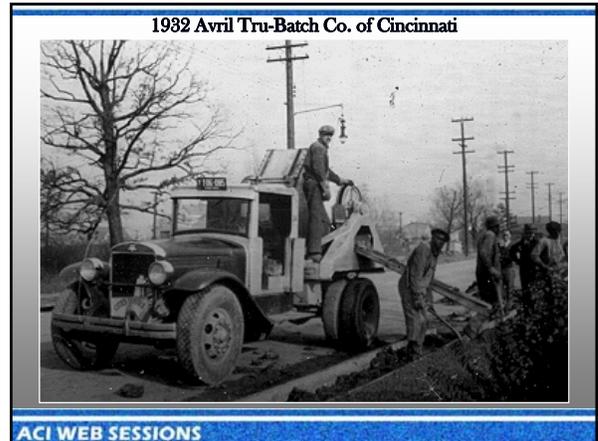
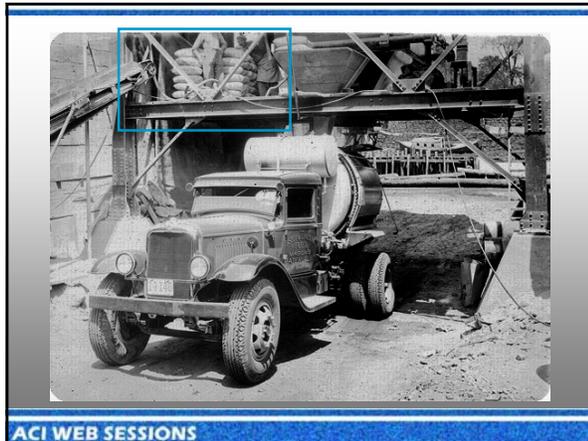
The Nation's Carrier

1939

Jaeger Machine

Offers a high speed discharge mixer truck

ACI WEB SESSIONS



1933 Rex Chainbelt Co. Moto-mixer 3 cy mixer



ACI WEB SESSIONS

Heltzel Plant, manual batching



ACI WEB SESSIONS

Early Butler Central Mix Plant

1934 Albany Trucking Co.

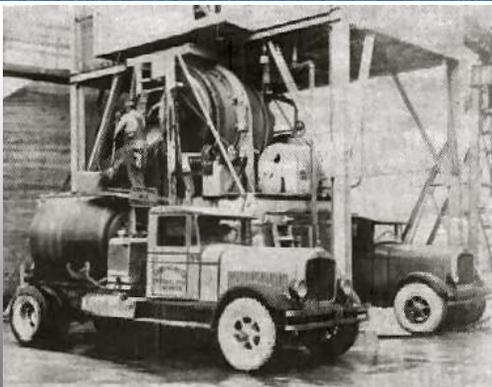


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Peterbuilt open mixer of Readymix Concrete Co.



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J.L. Shiely Co. of St. Paul, MN, pouring wall



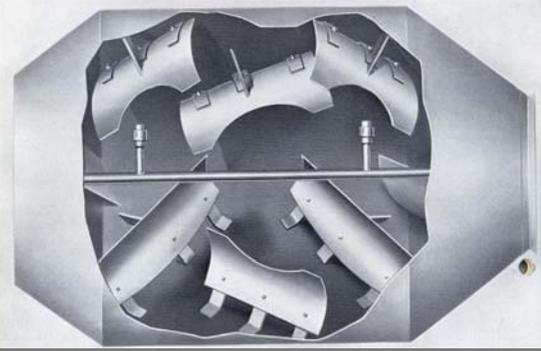
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1938 Transit Systems Mixer



ACI WEB SESSIONS

1938 Transit Systems Mixer cutaway



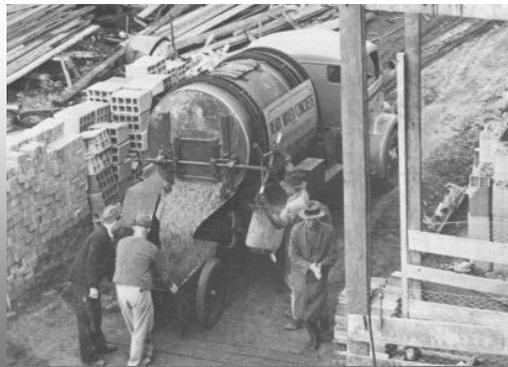
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3 cy "Tumblebug" Mixer on 1939 White Truck



ACI WEB SESSIONS

Ready Mixed Concrete



ACI WEB SESSIONS

"Tumblebug" Mixer, was powered separately by a 1925 Dodge engine



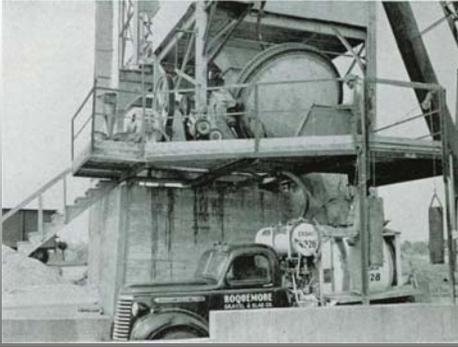
ACI WEB SESSIONS

Colonial Truck Mixer



ACI WEB SESSIONS

Roquemore Gravel & Slag Co.
Montgomery, AL - 1939



ACI WEB SESSIONS

Late 30's: Mixer Hoist to Raise
Discharge Point



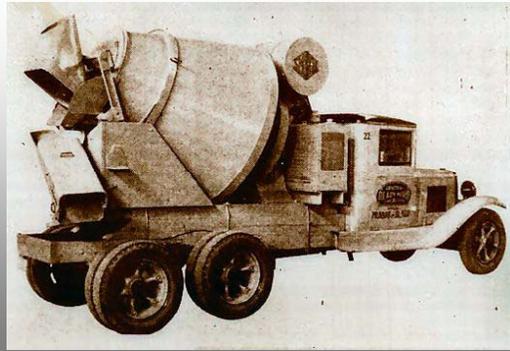
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Central Pre-Mix, Spokane, WA - 1936's



ACI WEB SESSIONS

1937 T.L. Smith: inclined axis mixer



ACI WEB SESSIONS

Concrete Delivery

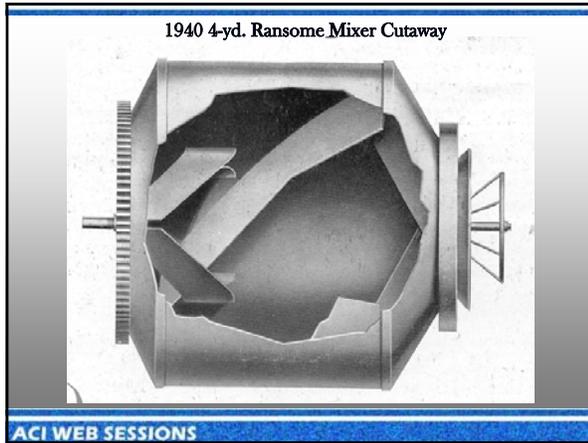
1940's

ACI WEB SESSIONS

1940 4-yd. Ransome Mixer



ACI WEB SESSIONS



Rex introduces the inclined axis mixer

The advantage was a higher discharge point

1941

ACI WEB SESSIONS

The Nation's Carrier

1941

- 703 Commercial Plants, located in 442 cities.

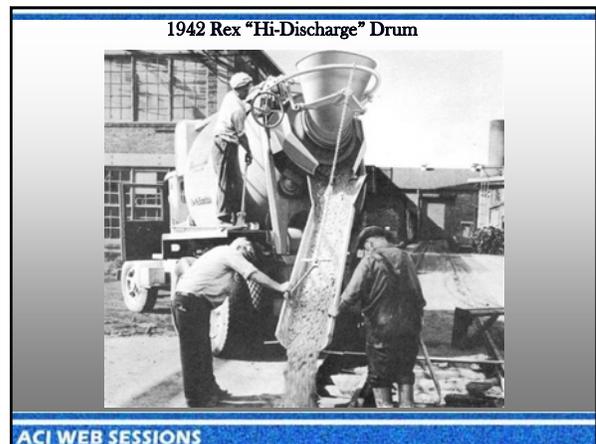
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The Nation's Carrier

1941

- Rex introduced inclined axis high discharge mixer. The design made it possible to discharge without removing a hatch

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1942 Rex "Hi-Discharge" Drum Cutaway



ACI WEB SESSIONS

Inclined axis mixer on a Mack



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W.E. Anderson Concrete, 1947



PHOTOS: Anderson Concrete

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Tews Concrete, Milwaukee, WI



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The Nation's Carrier

1948

- Ready Mixed Concrete Company, Denver, purchased the first "Challenge Light Weight" mixers, which allowed for larger payloads.

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1948 Ford w/ 3-yard Rex Mixer



ACI WEB SESSIONS

Toronto, Ontario, Canada



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End

A special thanks to:

- Gary Mullings for copies of photos
- HF "Forty" Broom (1921-2003) for explanations of the photos in a 1988 videotaped slide show.

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