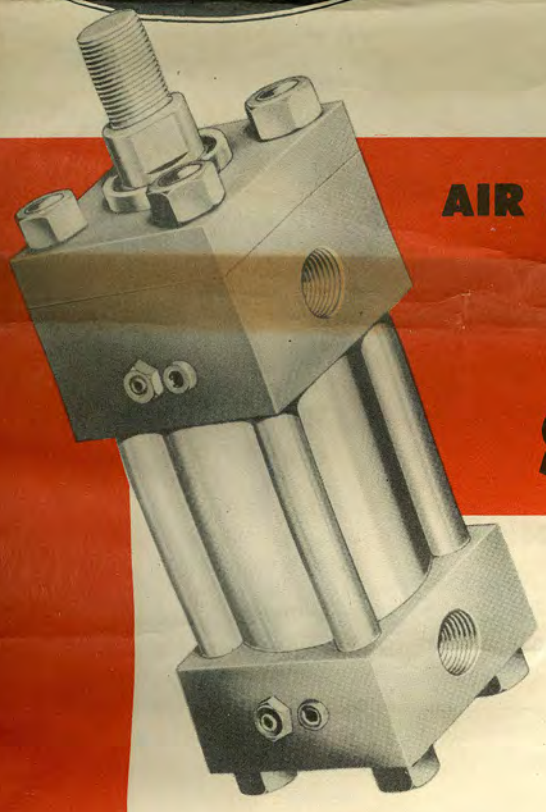
Miller
TRADE MARK REGISTERED



AIR and HYDRAULIC CYLINDER CALCULATOR

COMBINED WITH A

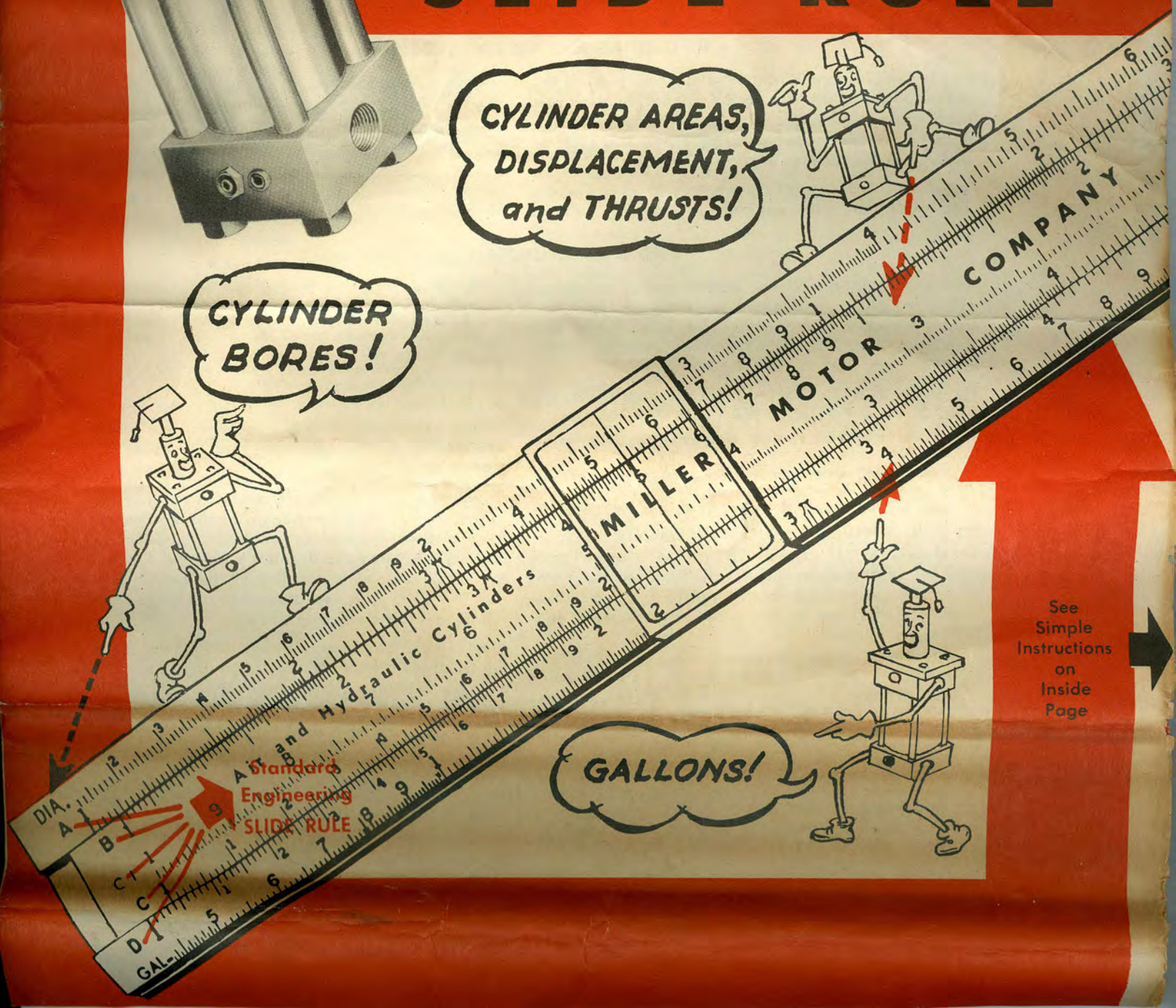
STANDARD ENGINEERING

SLIDE RULE

CYLINDER AREAS, DISPLACEMENT, and THRUSTS!

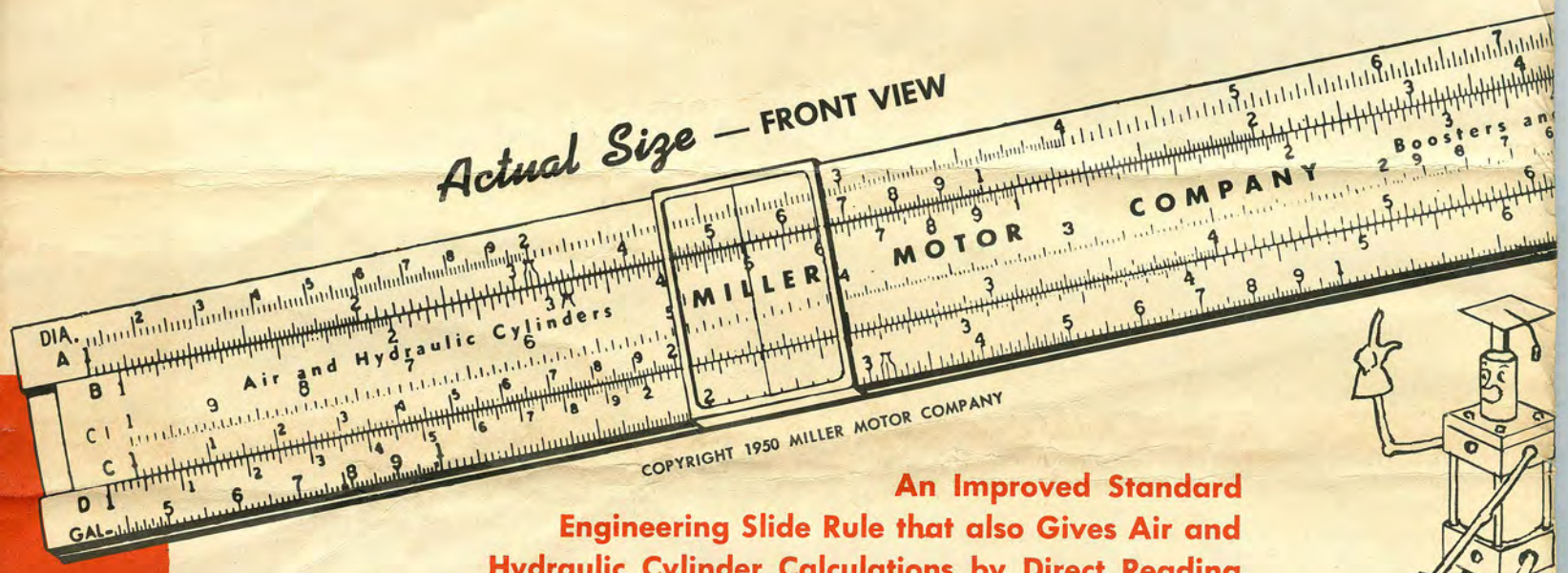
CYLINDER BORES!

GALLONS!



See Simple Instructions on Inside Page

Actual Size — FRONT VIEW



An Improved Standard Engineering Slide Rule that also Gives Air and Hydraulic Cylinder Calculations by Direct Reading

USED AS A STANDARD SLIDE RULE

This ingenious "combination" slide rule has all the conveniences of the standard engineering slide rule PLUS additional scales that permit **direct** calculations of air and hydraulic cylinder values, such as thrusts, bores, areas, displacements, etc.

The direct readings of "diameters to areas" (and vice versa) are also valuable in working general engineering problems.

The "A", "B", "C", "C1", and "D" scales are identical to those on standard engineering slide rules. The "DIA." (diameter) scale at the top and the "GAL." (gallons) scale at the bottom have been added to the slide rule for greater ease in working air and hydraulic cylinder problems.

USED AS A CYLINDER CALCULATOR

The manipulation of the added scales to secure cylinder values is identical to standard slide rule manipulation. Thus, no special instructions are needed to use this slide rule for cylinder calculations.

TO FIND AREAS, DISPLACEMENTS PER INCH OF STROKE, AND GALLONS PER INCH OF STROKE . . .

Set the indicator to diameter or cylinder bore in inches on top "DIA" scale.

Read on "A" scale—area or cu. in. displacement per inch of stroke.

Read on "GAL" (bottom scale)—gallons per inch of stroke.

TO FIND THRUSTS AND DISPLACEMENTS . . .
Set the center "1" of scale "B" in line with cylinder bore or "diameter in inches" of "DIA" scale. With the scale maintained in this position, thrusts and displacements can be easily determined from **one setting** as follows:

THRUSTS . . . if thrust is required, set the psi fluid pressure on the "B" scale and read the "thrust" on the "A" scale.

DISPLACEMENT . . . if displacement for a given stroke is required, set the "inches of stroke" on the "B" scale and read "cubic inch displacement" on the "A" scale. Also read "gallons displacement" on "GAL" scale.

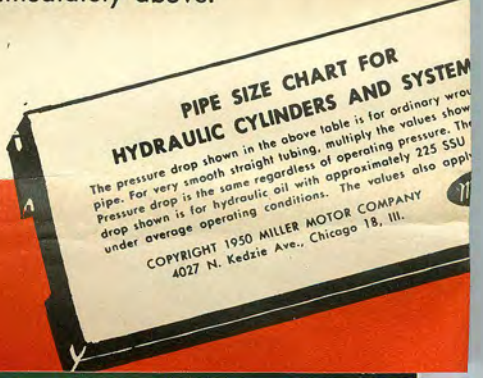
If displacement per minute is required, set the "inches per minute of stroke" velocity on "B" scale and read "cubic inch displacement" on "A" scale. Also read "gallons per minute displacement" on "GAL" scale.

If displacement is required in cubic feet, divide above obtained values of cubic inch displacement by "1728" merely by setting "1728" of "B" scale directly in line with "cubic inch displacement of "A" scale and reading the answer on "A" scale directly above "1" on "B" scale. In air problems, this answer is "cubic feet of pressure air". To secure "cubic feet of free air", multiply this answer by the ratio of absolute air pressure (psi gauge pressure plus 14.7 psi) to absolute atmospheric pressure (14.7 psi).

If cubic feet, or gallons, or thrusts, etc. are given in order to obtain strokes, bores, etc., the problems are simply worked—by reversing the order of the above procedure.

However, in working from areas to cylinder bores, areas with an **odd** number of whole number digits (also decimal-fraction areas with an odd number of zeros between the decimal point and first number digit) are set to the **left** of the center "1" on the "A" scale and the diameters are read on the "DIA" scale immediately above.

Areas with an **even** number of whole number digits (also decimal-fractions with an even number of zeros between the decimal point and the first number digit) are set on the right side of the center "1" on the "A" scale and the diameters are read on the "DIA" scale immediately above.



This New "Combination" Slide Rule Is Presented To Engineers, Hydraulic Specialists, etc. — At No Obligation

PIPE AND VALVE SIZE CALCULATOR

Based On "Pressure Loss Principle"

This valuable Calculator, in handy chart form as illustrated below, is given on the reverse side of the Miller Combination Cylinder Calculator and Slide Rule. Instructions on use of this chart are as follows:

The tables shown are self-explanatory. The pressure loss per foot of pipe length is given for "gallons per minute flow" and "pipe size". On the right side of the table is given the "equivalent" length of straight pipe for various fittings, valves and cylinders.

Thus, to find the pressure loss in a branch of a circuit, determine the equivalent length of straight pipe both on the inlet and exhaust sides of the branch. Multiply this total by the pressure loss per equivalent length of pipe for the pipe size selected, to determine total loss to the cylinder and back pressure on the cylinder. This value, subtracted from the pump pressure, will give the net effective pressure available for doing work.

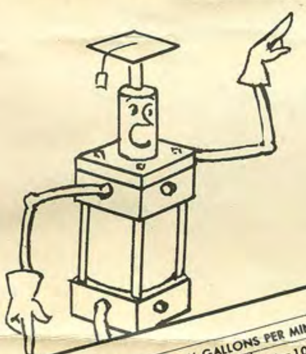
Equivalent lengths given in the chart for operating valves and cylinders include both inlet and exhaust port losses. Observe the instructions to the left of the chart to the effect that "tubing losses are less than the losses for iron pipe". On cylinders with large piston rods, the discharge rate exhausting from the rod end of the cylinder is much greater than the rate of entry of oil at the cap end and must be taken into consideration. Intake line pressure losses to the pump should not exceed 2 to 3 psi so as not to draw a vacuum and cause pump starvation and cavitation. Use pipe size suction line at least equal to pump inlet size. Whether location of the pump is above or below the reservoir level also effects these recommendations.

ADVANTAGES

This method is very simple to use as shown above. Since all pressure drops in pipe lines are independent of operating pressures, this method is exact in figuring low pressure circuits as well as high pressure circuits. In problems of this type, the "10 ft. per second to 20 ft. per second velocity method" fails miserably—since many circuits designed with this velocity method have pressure drops in excess of the pump pressure especially where pump pressures are 100 to 200 psi.

Pressure losses are less in large diameter pipes than in small diameter pipes. The pressure loss method of figuring pipe sizes takes this into account whereas the 10 ft. per second to 20 ft. per second velocity flow theory does not. Thus, note, on the chart below, that a ½" pipe line has 1.215 psi pressure drop per ft. at 15 ft. per second whereas a 2" pipe has only .36 psi pressure drop per ft. at the same speed. A 2" pipe line only has 1.11 psi pressure drop at 30 ft. per second. Thus the pressure loss method is much more consistent in figuring losses.

Since the net effective operating cylinder pressures can be easily determined under all conditions by using this chart, it is possible at times to engineer economical first cost installations that operate infrequently by using small pipes and valves and slightly larger cylinders to make up for the pipe and valve losses.



NOTE: Available at No Obligation . . . Instruction Book on Use of Standard Engineering Slide Rule. Write Miller Motor Company.

...ht iron by .54. pressure 100° F. to water.

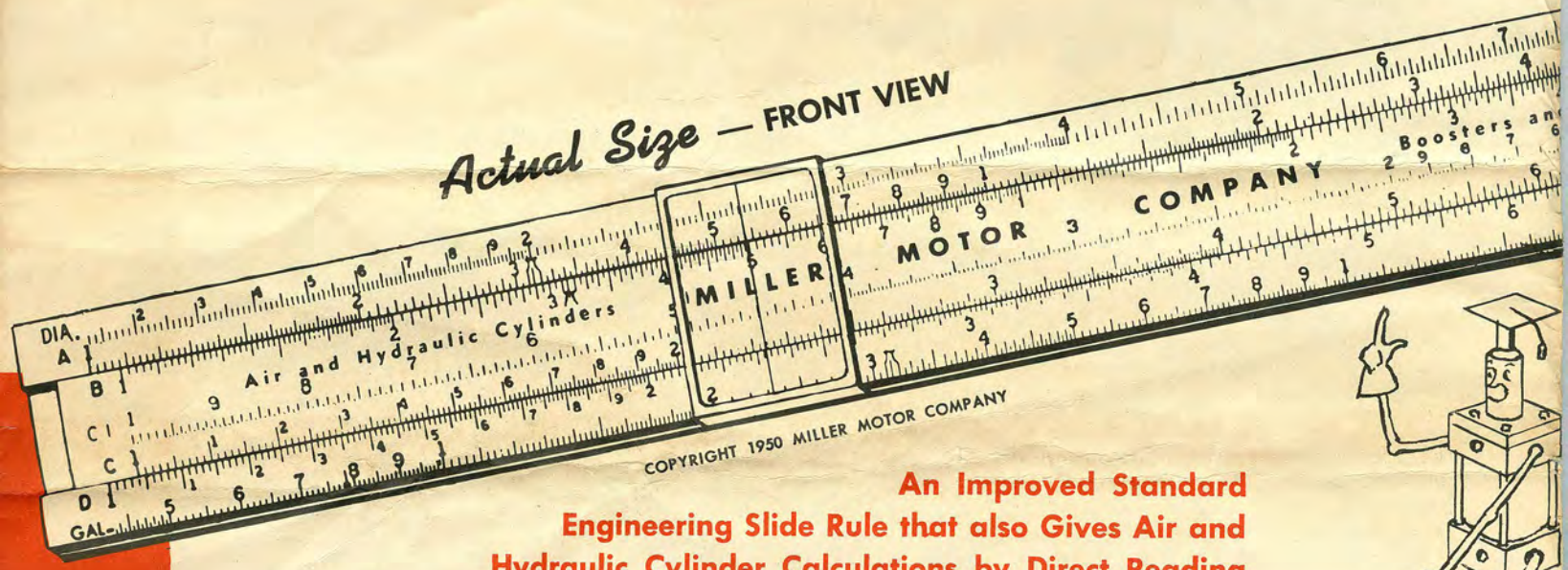
STANDARD WEIGHT PIPE			OIL FLOW GALLONS PER MINUTE AND FRICTION PRESSURE DROP POUNDS PER SQUARE INCH PER FOOT LENGTH OF PIPE												EQUIVALENT LENGTH OF STRAIGHT PIPE IN FEET FOR VARIOUS FITTING					
			Vel = 5 Ft. per Sec.		Vel = 10 Ft. per Sec.		Vel = 15 Ft. per Sec.		Vel = 20 Ft. per Sec.		Vel = 25 Ft. per Sec.		Vel = 30 Ft. per Sec.							
Pipe Size	Inside Diameter	Area Sq. In.	Gallons per Minute	Pressure Drop In PSI	Gallons per Minute	Pressure Drop In PSI	Gallons per Minute	Pressure Drop In PSI	Gallons per Minute	Pressure Drop In PSI	Gallons per Minute	Pressure Drop In PSI	Gallons per Minute	Pressure Drop In PSI	Standard Elbow	Standard Tee	Gate Valve	Globe Valve	Cylinders & 2-3-Way Valves	4-Way Valves
½	.622	.304	4.7	.157	9.4	.585	14.1	1.215	18.6	2.065	23.5	3.130	28.2	4.34	1.5	3.3	.34	6.2	6 to 30	12 to 60
¾	.824	.533	8.3	.117	16.6	.370	24.9	.710	33.2	1.520	41.5	2.300	49.8	3.17	2.2	4.6	.46	9.4	10 to 50	20 to 100
1	1.049	.864	13.5	.090	26.9	.323	40.4	.673	53.8	1.155	67.3	1.725	80.8	2.44	2.8	5.7	.60	12.4	13 to 65	25 to 125
1¼	1.380	1.495	23.3	.064	46.5	.231	69.8	.488	93.0	.755	116.3	1.240	139.6	1.74	3.7	7.8	.81	15.6	15 to 75	30 to 150
1½	1.610	2.036	31.7	.054	63.4	.181	95.1	.404	126.8	.691	158.5	1.042	190.2	1.48	4.4	9.2	.92	18.9	20 to 100	40 to 200
2	2.067	3.355	52.3	.047	104.5	.169	156.8	.360	209.0	.609	261.3	.927	313.6	1.11	5.5	12.0	1.20	23.5	25 to 125	50 to 250

Actual Size — BACK VIEW

Compliments of MILLER MOTOR COMPANY

Manufacturers of AIR AND HYDRAULIC CYLINDERS . . . BOOSTERS . . . ACCUMULATORS . . . SAFETY AIR HOISTS

Actual Size — FRONT VIEW



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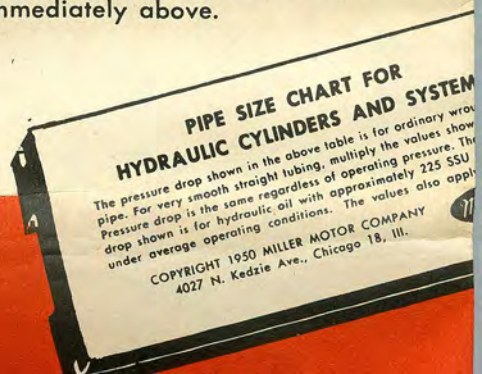

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