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THESIS

**DESIGN OF A 10 TON OVERHEAD
TRAVELING CRANE**
BY
G. W. QUICK. L. A. PRATT
1917

THESIS

Oranes, Lerrick, etc.

Mechanical engineering

DESIGN OF A 10 TON OVERHEAD TRAVELING CRANE.

A Thesis Submitted to
The Faculty of the

MICHIGAN AGRICULTURAL COLLEGE

By

G.W. Quick
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Candidates for the Degree of
Bachelor of Science.

June, 1917.

THESIS

SPECIFICATIONS.

Electric overhead traveling crane;
 Cage operated;
 Capacity--10 tons;
 Span--22';
 Maximum lift--12';
 Fish-belly box girders;
 Speed of hoist--25'--75' per min;
 Speed of trolley--100'--150' per min.;
 Speed of bridge--250-300' per min.;
 Source of power--500 volts A.C.

MOTOR SIZES.

HOIST MOTOR.

Efficiency = gear eff. x sheave eff. x motor eff. x drum eff.
 = .96 x .96 x .96 x .96 x .85 x .90 = .65 or 65%.

Speed of hoist = 25'-75' per min.

H.P. = $10 \times 2,000 \times 25/33,000 \times .65 = 22 \text{ H.P.}$

BRIDGE MOTOR.

Assume dia. of wheels = 18"

Assume wt. of trolley = 6,000#

Total load = 2,000# plus 6,000# = 26,000#

Speed of travel = 250'-300' per min.

$\text{H.P.} = 1.5(26,000)(.002 \text{ plus } .08 \times 1.5)300/33,000 \times 9 = 9$
 Use 10 H.P.

TROLLEY MOTOR.

Assume dia. of wheels = 12"

$\text{H.P.} = 1.25(26,000)(.002 \text{ plus } .08 \times 1)150/6 \times 33,000 = 2.02$
 Use 4 H.P.

1. The first step is to identify the problem.

2. The second step is to define the problem.

3. The third step is to analyze the problem.

4. The fourth step is to develop a solution.

5. The fifth step is to implement the solution.

6. The sixth step is to evaluate the solution.

7. The seventh step is to monitor the solution.

8. The eighth step is to report the results.

9. The ninth step is to conclude the project.

10. The tenth step is to reflect on the project.

11. The eleventh step is to document the project.

12. The twelfth step is to share the results.

13. The thirteenth step is to celebrate the success.

14. The fourteenth step is to learn from the experience.

15. The fifteenth step is to apply the lessons learned.

16. The sixteenth step is to continue to improve.

17. The seventeenth step is to stay motivated.

18. The eighteenth step is to stay focused.

19. The nineteenth step is to stay organized.

20. The twentieth step is to stay positive.

21. The twenty-first step is to stay resilient.

22. The twenty-second step is to stay adaptable.

23. The twenty-third step is to stay flexible.

24. The twenty-fourth step is to stay open-minded.

25. The twenty-fifth step is to stay curious.

26. The twenty-sixth step is to stay humble.

GEARS.

HOIST GEARS.

Motor used--20 H.P.--550 R.P.M.

4 rope hoist.

Therefore, $20,000/4 = 5,000\#$ on each rope.

Mean speed of lift = 50' per min.

Ends of rope winding on drum must travel 2 x as fast as the pulley block or $2 \times 37 = 75'$ per min.

Best rope to use = $9/16"$ dia.--6 strands --37 wires each.
(Kents hand book)

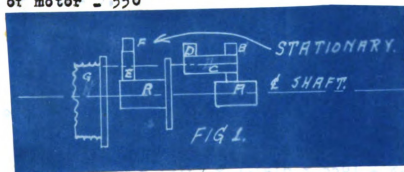
Dia. of drum to be used = $(24-30) \times$ dia. of rope =

$28 \times 9/16 = 15.8$ Use 16" drum.

$3.1416 \times 16/12 = 4.2'$ cir. of drum.

$100/4.2 = 24$ R.P.M. that the drum must have to give a lift of 100' per min.

R.P.M. of motor = 550



	A	B	C	D	R
Lock all	X	X	X	X	X
Lock R	XBD/CA	-XD/C	-XD/C	-X	0
Totals	X plus XBD/CA				

Therefore X plus XBD/CA = 550 (Eq. I)

Assume dia. A = 4"

Assume dia B = 6"

1941

1942

1943

1944

1945

1946

1947

1948

1949

1950

1951

1952

1953

1954

1955

1956

1957

1958

1959

1960

1961

1962

Assume dia. C = 4"

Assume dia. D = 14"

Subst. in Eq. I $X(I \text{ plus } 6 \times 14/4 \times 4) = 550$

$X = 104 \text{ R.P.M.}$

Assume dia. F = 18"

$(104 - 24)/24 = 18/X$

$X = 5.5" \text{ dia. of R.}$

$\text{Dia. E} = (18 - 5.5)/2 = 6\frac{1}{4}"$

Therefore,

Gear A = 4" in dia.

" B = 6" " "

" C = 4" " "

" D = 14" " "

" E = $6\frac{1}{4}"$ " "

" F = 18" " "

" R = 5.5" " "

Gear A.

Assume D.P. = 6 P.D. = 4" No. teeth = $6 \times 4 = 24$.

Speed of pitch cir. = $3.1416 \times 4/12 \times 550 = 580' \text{ per min.}$

Torque = $33,000 \times \text{H.P.} \times 12/(2 \times 3.1416 \times \text{R.P.M.})$

$= 33,000 \times 22 \times 12/(2 \times 3.1416 \times 550) = 2,520\#$

Let W = wt. on tooth = $2,520/2 = 1260\#$

Lewis formula,

$b = W/fpy$

$W = 1260\#$

$f = .0955$

$y = 1300 \text{ (for steel)}$

$p = 3.1416/6 = .525$

$$b = 1260 / .0955 \times 1300 \times .525 = 1.96"$$

Use 2" as width of face.

Gear B.

$$P.D. = 6"$$

$$\text{Width of face} = 2"$$

$$D.P. = 6$$

$$\text{No. of teeth} = 6 \times 6 = 36$$

Gear C

$$\text{Assume } D.P. = 6 \quad P.D. = 4"$$

$$\text{No. of teeth} = 6 \times 4 = 24$$

$$R.P.M. \text{ of B} = (X - XD) / C = (75 - 75 \times 14) / 4 = 339$$

$$\text{Speed of pitch cir.} = 3.1416 \times 263.12 = 355' \text{ per min.}$$

$$y = .0955$$

$$f = 11,500 \text{ (for steel)}$$

$$p = 3.1416 / 6 = .525$$

$$b = W / fpy = 2390 / (11,500 \times .0955 \times .525) = 4.1" \text{ Use } 4"$$

Gear D

$$P.D. = 14"$$

$$D.P. = 6$$

$$\text{Width of face} = 4"$$

$$\text{No. of teeth} = 6 \times 14 = 84$$

Gear R

$$P.D. = 5\frac{1}{2}"$$

$$D.P. = 4$$

$$\text{No. of teeth} = 4 \times 5\frac{1}{2} = 22$$

$$W = 6100$$

$$\text{Speed of pitch cir.} = 3.1416 \times 5\frac{1}{2} \times 100 / 12 = 202' \text{ per min.}$$

$$y = .093$$

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$$f = 15,000 \text{ (for cast iron)}$$

$$p = 3.1416 \cdot 4 = .78$$

$$b = 6100 / .093 \times .78 \times 15,000 = 5.6 \quad \text{Use } 5\frac{1}{2}"$$

Gear E

$$P.D. = 6\frac{1}{4}"$$

$$D.P. = 4$$

$$\text{No. of teeth} = 4 \times 6\frac{1}{4} = 25$$

Gear F

$$P.D. = 18"$$

$$D.P. = 4$$

$$\text{No. of teeth} = 4 \times 18 = 72$$

$$\text{Width of face} = 5\frac{1}{2}"$$

TROLLEY GEARS.

$$\text{R.P.M. of motor} = 940$$

$$\text{R.P.M. of wheel shaft} = ?$$

$$\text{Assume dia of wheel} = 12"$$

$$\text{Cir. of wheel} = 3.1416 \times 12 / 12 = 3.1416'$$

$$\text{Mean travel speed} = 125' \text{ per min.}$$

$$125 / 3.1416 = 40 \text{ R.P.M. of wheel shaft.}$$



$$3/14 = X \cdot 940$$

$$X = 201 \text{ R.P.M. of B and C.}$$

$$14/y = 201/40$$

$$y = 2\frac{3}{4}" \quad \text{Use } 2.666"$$

Gear A

$$T = 33,000 \times 12 \times 4/940 \times 2 \times 3.1416 = 270\text{''}\#$$

Material used ----cast iron.

$$270/15 = 180\text{''}\# \text{ or } W$$

$$D.P. = 6$$

$$P.D. = 3\text{'}$$

$$S \text{ peed of pitch cir.} = 3.1416 \times 3 \times 940/12 = 740' \text{ per min.}$$

$$y = .083$$

$$f = 3500 \text{ (for cast iron)}$$

$$P = 3.1416/6 = .525$$

$$b = 180/(3500 \times .083 \times .525) = 1.19 \text{ Use } 1\frac{1}{4}\text{' as width of A.}$$

Gear B

$$P.D. = 14\text{'}$$

$$\text{Width of face} = 1\frac{1}{4}\text{'}$$

$$\text{Torque} = 180 \times 7 = 1260\text{''}\#$$

$$D.P. = 6$$

Gear C

$$P.D. = 2.666\text{'}$$

$$W = 1260/1.333 = 915\text{''}\#$$

$$R.P.M. = \text{about } 200$$

$$\text{Speed of pitch cir.} = 3.1416 \times 2.666 \times 200/12 = 140' \text{ per min}$$

$$f = 7,000 \text{ (for cast iron)}$$

$$\text{No. of teeth} = 2.666 \times 6 = 16$$

$$y = .077$$

$$P = .525$$

$$b = 915/(7,000 \times .077 \times .525) = 3.2 \text{ Use } 3\frac{1}{4}\text{'}$$

Gear D

$$\text{Width of face} = 3\frac{1}{4}\text{'}$$

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1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Arar and Collins (1971) using a Shimadzu 1601 UV-Visible Spectrophotometer.

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10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044

• **Prevalence** = the proportion of a population that has a disease at a particular point in time

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• 1990年10月1日，中国正式加入世界贸易组织。

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ACKNOWLEDGMENTS

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1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

11

Abstract

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P-value = .000.

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$$D.P. = 6$$

$$P.D. = 14"$$

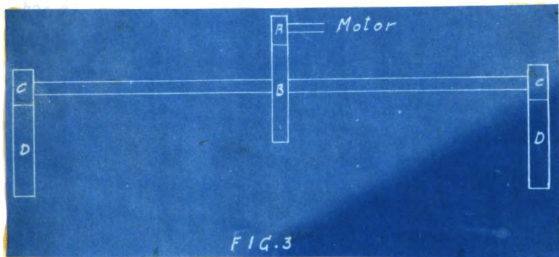
BRIDGE GEARS

$$\text{Dia. of bridge wheels} = 18"$$

$$\text{R.P.M. of wheel} = 275 \times 12/3.1416 \times 18 = 58.5 \text{ Use } 58 \text{ R.P.M.}$$

A Assume:

$$D = 16", C = 6", \text{ and } A = 3"$$



Let $X = \text{R.P.M. of main shaft.}$

$$58/X = 6/16$$

$$X = 155 \text{ R.P.M.}$$

$$A/B = 155/800$$

$$4/B = 155/800$$

$$B = 20" \text{ dia. of gear B.}$$

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Gear A.

$$T = 33,000 \times 12 \times 4/2 \times 3.1416 \times 800 = 793''\#$$

$$793/2 = 396 \text{ or } W.$$

$$\text{Speed of pitch circle} = 3.1416 \times 4 \times 800/12 = 840' \text{ per min.}$$

$$F = 3000 (\text{for cast iron})$$

$$y = .096$$

$$p = .525$$

$$\text{Assume D.P.} = 6$$

$$P.D. = 4$$

$$\text{No. of teeth} = 24$$

$$b = 396/.096 \times .525 \times 3000 = 2.6 \quad \text{Use } 2-1/2''$$

Gear B.

$$\text{Width of face} = 2-1/2''$$

$$D.P. = 6$$

$$P.D. = 20''$$

$$\text{Torque} = 396.5 \times 10 = 3965''\#$$

Gear C.

$$D.P. = 6$$

$$P.D. = 6$$

$$\text{No. of teeth} = 36$$

$$\text{Speed pitch circle} = 155 \times 3.1416 \times 6 = 244' \text{ per min.}$$

$$f = 5300 (\text{for cast iron})$$

$$y = .106$$

$$W = 3965/3 = 1322\#$$

$$p = .525$$

$$b = 1322/.106 \times .525 \times 5300 = 4.45 \quad \text{Use } 4-1/2''$$

Gear D.

$$\text{Width of face} = 4-1/2''$$

P.D. = 16"

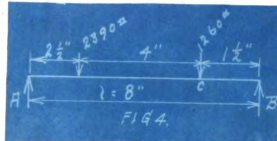
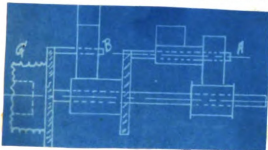
D.P. = 6

No. of teeth = 96

SHAFTS and PINS.

HOIST GEAR PINS.

Pin for Gear B and C. or A.



Check for torsion.

$$T = \tau \times p \times 3.1416 \times d^3/16$$

$$3780 \times 16 / 15,000 \times 3.1416 = d^3 = 1.3$$

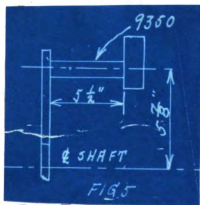
$d = 1.1$ Use 1-1/4" pin.

Checked safely for shear and bending.

Pin B.

$$\text{Torsion on drum G} = 6100 \times 9 = 54,900\text{''}\#$$

$$54,900 / 5.875 = 9350\#$$



$$l = 7\text{'}$$

1. The first part of the document is a list of names.

2. The second part is a list of dates.

3. The third part is a list of locations.

4. The fourth part is a list of events.

5. The fifth part is a list of people.

6. The sixth part is a list of organizations.

7. The seventh part is a list of documents.

8. The eighth part is a list of books.

9. The ninth part is a list of articles.

10. The tenth part is a list of speeches.

11. The eleventh part is a list of letters.

12. The twelfth part is a list of reports.

13. The thirteenth part is a list of memoranda.

14. The fourteenth part is a list of minutes.

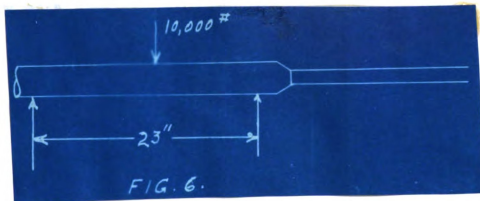
$$M = PL/4 = 9350 \times 7/4 = 16350 \text{ "#}$$

$$M = EI/\delta = p.098D^3$$

$$p = 16350 / .098 \times 8000 = 2.08$$

$$D = 1.255 \quad \text{Use } 1\text{-}3/8"$$

HOIST MOTOR SHAFT.



Pending

$$M = PL/4 = 10,000 \times 23/4 = 57,500 \text{ "#}$$

$$D^3 = Me/pI = 57,500 / 13000 \times .098 = 45$$

$$D = 3.1 \quad \text{Use } 3"$$

Checked for torsion and shear.

Small and of hoist motor shaft.

$$\text{Torque} = 1260 \times 2 = 2520 \text{ "#}$$

$$T = ps \times 3.1416 \times d^3/16$$

$$d = 1.157 \quad \text{Use } 1\text{-}1/2"$$

TROLLEY WHEEL SHAFTS.



$$\begin{aligned}
 (1) \quad & \lambda_1 \lambda_2 \cdots \lambda_n = \lambda_1 \lambda_2 \cdots \lambda_n = 1 \\
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 \end{aligned}$$

$$\begin{aligned}
 (2) \quad & \lambda_1 \lambda_2 \cdots \lambda_n = \lambda_1 \lambda_2 \cdots \lambda_n = 1 \\
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 \end{aligned}$$

$$\begin{aligned}
 (3) \quad & \lambda_1 \lambda_2 \cdots \lambda_n = \lambda_1 \lambda_2 \cdots \lambda_n = 1 \\
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 & \lambda_1 \lambda_2 \cdots \lambda_n = \lambda_1 \lambda_2 \cdots \lambda_n = 1
 \end{aligned}$$

Bending.

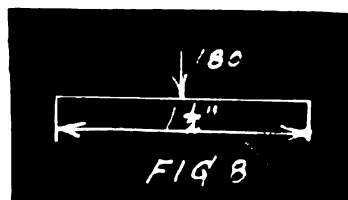
$$M = 6500 \times 12-1/2 = 81,250\text{"}\#$$

$$M = p \times .098D^3$$

$$D^3 = 81,250/8000 \times .098 = 10.4$$

$$D = 2.2\text{'}$$
 Use 2-1/4" shaft.

TROLLEY GEAR PINS.



Pin for gear B and C.

Torsion.

$$T = p \times 3.1416 \times D^3/16$$

$$D^3 = 126/50 \times 3.1416 = .8$$

$$D = .93$$
 Use 1" pin.

Checks safely for shear and bending.

Pin for gear D.

Tortion.

$$T = 915 \times 7 = 6405$$

$$6405 = 8000 \times 3.1416 \times D^3/16$$

$$D^3 = 4.08$$

$$D = 1.6$$
 Use 1-1/2" shaft.

MAIN SHAFT ALONG BRIDGE.

$$\text{Torque} = 396.5 \times 10 = 3965\text{"}\#$$

$$T = p \times 3.1416 \times D^3/16$$

$p = 4000\text{'}$ because of the shaft being so long we use an extra large factor of safety.

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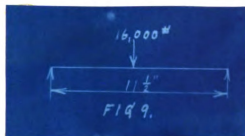
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$$D^3 = 3965 \times 16 / (4000 \times 3.1416) = 5$$

$D =$ about 2 Use 2-1/2" shaft.

BRIDGE WHEEL PINS.



Bending.

$$M = PL/4 = 16,000 \times 11-1/2/4 = 46,000$$

$$D^3 = 46,000/8000 \times .098 = 58$$

$D = 3.8$ Use 3-3/4" pin.

WHEELS.

BRIDGE WHEELS

Dia. of wheel assume as 18"

Let $b =$ breadth of wheel.

$$b = W/500D = 16375/500 \times 18 = 1.85 \text{ Use } 2"$$

Use a 40# rail.

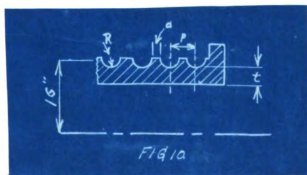
TROLLEY WHEELS.

Assume dia. = 12"

$$b = 6500/500 \times 12 = 13/12 = 1.1" \text{ use } 1-3/4"$$

Use a 25# rail.

DRUM



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$$R = \text{radius of rope} + I/32 = 9/16 + I/32 = 19/32"$$

$$a = 3/16"$$

$$P = 2R \text{ plus } a = 2 \times 19/32 \text{ plus } 3/16 = 1-3/8"$$

Distance between centers of pulleys in sheaf is 5"

$$t = 15/16 \text{ plus } 3/8 = 1-5/16"$$

$$l = 16 \times 1 \frac{3}{8} \text{ plus } 3 \text{ plus } 2 = 27$$

MOTOR FRAME.

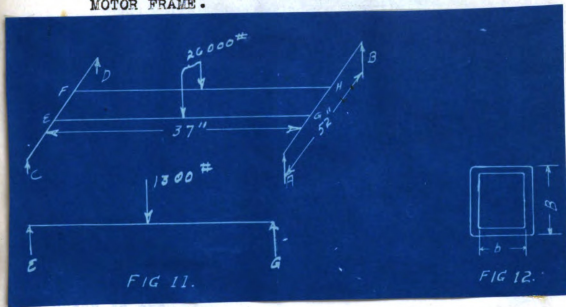


FIG 11.

FIG 12.

Section in square hollow cross section.

$$M = PL/4 = 13000 \times 37/4 = 120,000\text{#}$$

$$I/e = I/6B(B-b)^4 /$$

$$120,000 = 4000(B-b)^4 / 6B$$

$$B = 8"$$

$$b = 7"$$

Flange area.

$$A = M/S$$

BRIDGE DETAILS.

A = area of one flange which is in tension or compression.

BRIDGE GIRDER.

M = Bending moment in in. lbs.

Take deflection .025" per ft. span.

S = allowable stress in lbs. per sq. in. This must be 6750# weight of girder.

allowable average stress at extreme fibre and equals 12,500#

$$f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right) \quad \text{for } x \in \mathbb{N}$$

$$f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right) \quad \text{for } x \in \mathbb{N}$$

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• $f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right)$

$$f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right)$$

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$$f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right) \quad \text{for } x \in \mathbb{N}$$

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$$f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right) \quad \text{for } x \in \mathbb{N}$$

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$$f_{\lambda}(x) = \frac{1}{\lambda} \left(\frac{1}{x} - \frac{1}{x+1} \right) \quad \text{for } x \in \mathbb{N}$$

6000# wt. of trolley.

20,000#wt. of live load

3375#-- wt. of I/2 girder D.L.

3000#-- wt. of I/2 trolley.

10000#-- wt. of I/2 live load.

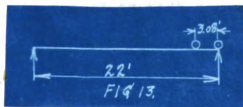
16,375#-- wheel load on bridge wheels.

3000#--wt. I/2 trolley.

10000#--wt. I/2 live load.

13000#--wt. on bridge due to T.L. and L.L.

13000/2 = 6500#--trolley wheel load.



For shear on end.

$$6500 \text{ plus } (6500 \times 18.92/22) = 12100\#$$

$$22 - 3.08 = 18.92$$

Calculated from section wt. of one girder about equal to dead

$$\text{load} = 13500/2 = 6750\#$$

$$6750 \text{ plus } 12100 = 18,850\#$$

$$\text{Web area} = 18,850/10,500 = 1.8 \text{ sq. in.}$$

Flange area.

$$A = M/Sd$$

A = area of one flange which is in tension or compression.

M = bending moment in in. lbs.

S = allowable stress in lbs. per sq. in. This must be allowable average stress at extreme fibre and equals 12,500#

• 1911-12-13

• 1912-13-14

• 1913-14-15

• 1914-15-16

• 1915-16-17

• 1916-17-18

• 1917-18-19

• 1918-19-20

• 1919-20-21

• 1920-21-22

• 1921-22-23

• 1922-23-24

• 1923-24-25

• 1924-25-26

• 1925-26-27

• 1926-27-28

• 1927-28-29

• 1928-29-30

• 1929-30-31

• 1930-31-32

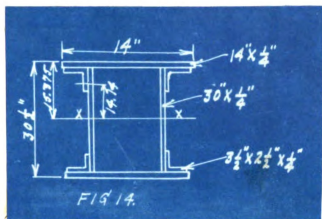
• 1931-32-33

• 1932-33-34

• 1933-34-35

$$d = \text{effective depth} = 30.5 - 4 = 26.5"$$

$$\text{Therefore the working stress} = 12,500 \times 26.5 / 30.5 = 10,850 \frac{\#}{\text{per sq. in.}}$$



Assume section and check for resisting moment of girder.

$$M = FI/C \quad I_{xx} = I_g \text{ plus } \bar{A}F^2$$

$$I_x \text{ for } 14" \text{ pls.} = 2(.02 \text{ plus } \overline{15.375^2} \times 35) = 1,640$$

$$I_x \text{ for } 30" \text{ pls.} = 2(562.5) = 1,125$$

$$I_x \text{ for Angles} = 4(1.8 \text{ plus } 14.14 \text{ plus } \overline{1.44^2}) = 1,157$$

$$\text{Total } I = 3,922$$

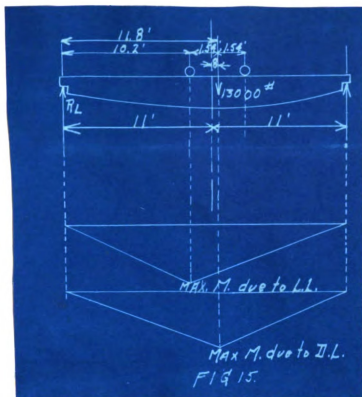
$$M_r = 10,850 \times 3,922 / (30.75 \times 12) = 115,500 \#$$

$$\text{allow } 10\% \text{ for rivets} = 11,550 \#$$

$$M_r = 103,950 \#$$

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$M_{L.L.}$

$$R_1 = 13,000 \times 10.2/22 = 6,030\#$$

$$\text{therefore } M = 6,030 \times 10.2 = 61,600'\#$$

$$M(D.L.) \text{ at center} = 1/8 \times 13,500 \times 22 \times 10.2/11 = 34,500'\#$$

$$61,600 \text{ plus } 34,500 = 96,100'\# \text{ or } 1,158,000'\# \text{ total } M.$$

This moment checks very closely to the resisting moment of the beam taken.

$$A = 1,158,000/(10,850 \times 26.5) = 4.03 \text{ sq. in.}$$

Allow 1/8 of web as required area.

$$\text{Web area} = 2 \times 30 \times 1/4 = 15 \text{ sq. in.}$$

$$1/8 \times 15 = 1.87$$

$$2 \text{ angles} = 3.5 \times 2.5 \times .25 = 2.88$$

$$1 \text{ web plate} = 14 \times .25 = 3.5$$

$$\text{Total} = 8.25$$

Deduct for rivet holes .88

$$\text{Remaining area} = 7.37 \text{ sq. in.}$$

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

1. 在 1990 年 12 月 1 日以前, 已在本市范围内, 从事过下列工作的, 可视为从事过粉尘作业:

...some of the most important of the ...

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11-11-68

1. The first group of respondents (10%) was composed of individuals who had been involved in a sexual assault in the past 12 months. This group was further divided into two subgroups: those who had been the victim of a sexual assault (5%) and those who had been the perpetrator of a sexual assault (5%).

100

100

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

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Check for bending.

$$\begin{aligned}
 M &= W/81(1-a/2)^2 \text{ plus } G1/8 \text{ plus wt. of motor } \times 1/4 \\
 &= 26,000/(8 \times 264) \times (264 - 37/2)^2 \text{ plus } 18,000 \times \\
 &= 264/(2 \times 8) \text{ plus } 800 \times 264/4 = 90,100\#
 \end{aligned}$$

RIVETS.

Rivets are in double shear; the allowable shearing fibre stress is 9,000# per sq. in.

$$\text{Shearing value} = 1094 \times 9 = 9,820\#$$

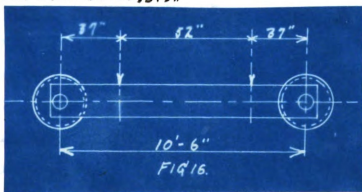
$$\text{Bearing value} = 656 \times 9 = 5,900\#$$

Therefore it is evident that the rivet will stand 5,900# pressure, this being the lower of the two values.

BRIDGE TRUCK GIRDER.

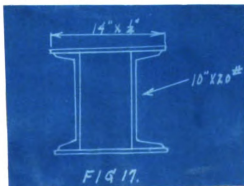
Bridge wheel base of 10' 6".

Maximum wheel load is 16,375#



$$\text{Bending moment } M_b = 16375 \times 37 = 605,000\text{"}$$

$$\text{Fibre stress} = 10,850\# \text{ per sq. in.}$$



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Assume section as shown in figure and check by finding
resisting moment, M_r

Two 10" channels at 20# -- $150" = 300$

Moment of inertia for flats neglected.

Area flats $\times h^3 = (2 \times 10 \times .25) \times \overline{5.125^3} = 131.3$

Total = 300 plus 131.3 = 431.3

Section modulus = $I/e = 431.3/5.25 = 82.2$

$M_r = 82.2 \times 10,850 = 892,000\text{"#}$ which is enough over the
bending moment to allow for riveting and overload.

CRANE BLOCK.

SHEAVE.

$d = \text{dia. of rope} = 9/16"$

$R = d/2 \text{ plus } 1/32 = 9/32 \text{ plus } 1/32 = .312"$

$a = 1.5 -- 2d$

$a = 1.75 \times 9/16 = .988 \quad \text{Use } 1"$

$b = d/3 \text{ plus } 3/16 = .374 \quad \text{Use } 3/8"$

$c = d/6 \text{ plus } 3/16 = .2199"$

PULLEY BLOCK SIDES

Load on one side = $1/2 \times 20,000 = 10,000\text{#}$

$P = 10,000\text{#}$

Assume $p = 8,000\text{#}$

$A = P/p = 10,000/8,000 = 1.25 \text{ sq.in. Area in shear.}$

Assume thickness (t) = $3/8"$

Therefore $3/8 \times 2X = 1.25$

$X = 4 \times 1.25/3 = 1.67 \quad \text{Use } 1-3/4" \text{ plus}$

radius of hook pin as radius for metal below hook pin center.



1. The first part of the document is a list of names and addresses.

2. The second part is a list of names and addresses.

3. The third part is a list of names and addresses.

4. The fourth part is a list of names and addresses.

5. The fifth part is a list of names and addresses.

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12. The twelfth part is a list of names and addresses.

13. The thirteenth part is a list of names and addresses.

14. The fourteenth part is a list of names and addresses.

15. The fifteenth part is a list of names and addresses.

16. The sixteenth part is a list of names and addresses.

17. The seventeenth part is a list of names and addresses.

18. The eighteenth part is a list of names and addresses.

19. The nineteenth part is a list of names and addresses.

20. The twentieth part is a list of names and addresses.

21. The twenty-first part is a list of names and addresses.

22. The twenty-second part is a list of names and addresses.

23. The twenty-third part is a list of names and addresses.

24. The twenty-fourth part is a list of names and addresses.

25. The twenty-fifth part is a list of names and addresses.

26. The twenty-sixth part is a list of names and addresses.

HOOK

Crane hook of soft steel forging



The following points to be observed;

1. The point of the hook to be carried well up to prevent the sling from slipping off the hook.

2. For chain slings, $a = d - 1.5d$

$d =$ chain dia.

$a =$ radius of the inside circle of the hook.

Design the hook to carry 20,000#

Allow 8,000 fibre stress per sq. in. on the section at the root of the screw threads and 12,000# per sq. in. on the extreme fibres as a result of combined tension and flexure.

$$P/p = 20,000/8,000 = 2.5 \text{ sq.in.}$$

Referring to table of standard screw threads. A bolt 2-1/4" in dia. will be required.

$$d_2 = 1.25d = 1.25 \times 2.25 = 2.81 \quad \text{Use } 2\frac{3}{4}"$$

Now considering the section of maximum bending $a = 2.5/$

$$\text{Taking } h = 2.5 \times a = 6.25"$$

$$d_3 = 6.25/1.33 = 4\frac{3}{4}"$$

$$b_1/b_2 = (h/a) \text{ plus } 1 = 2.5 \text{ plus } 1 = 3.5$$

C by tables for trapezoidal section is 5.06

$$\text{Therefore } b_1 = P/(p \times a \times C) = 20,000 \times 5.06 / (12000 \times 2.5) = 3.37"$$

1. The first step is to identify the problem. This involves understanding the current situation and what needs to be changed.

[illegible]

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[illegible]

— *Journal of the American Medical Association*, 1997; 278: 1009-1010

$$b_2 = 3.37/3.5 = .963 \quad \text{Use } 1"$$

SWIVELLING CRANE HOOK WITH TRUNNION SUSPENSION

Hook to carry load of 20,000#

$$\text{Balls---} P = Kd^2 \quad K = 4,200$$

$$P = 20,000/30 = 666.6$$

$$d^2 = 666.6/4,200 \quad d = .399 \quad \text{Use } 7/16"$$

$$\text{Bolt dia. thru trunnion} = 2.25 \times 1.125 = 2.51 \quad \text{Use } 2-1/2"$$

TRUNNION

Assume the load and width = 8 - 2 = 6"

$$M = Pl/e$$

$$M = 20,000 \times 10/4 = 8,000 \times bh^2/6$$

$$\text{since } C/e = bh^2/6 \quad h^2 = 20,000 \times 10 \times 6/(4 \times 8,000 \times 4)$$

$$h = 3.04 \quad \text{Use } 3"$$

TRUNNION BEARINGS.

On the assumption of 1500# per sq. in. the projected should be $10,000/1500 = 6.66$ sq. in.

If the journal is now assumed as having a width equal to its dia. the dia. will be determined for strength as a cantilever as follows;

$$M = Pl/e$$

$$= 10,000 \times d/2 \text{ for a circle } l/e = 3.1416d^3/32 \text{ or approximately } d^3/10$$

Taking $P = 8,000\#$ per sq. in.

$$M = (10,000 \times d)/2 = (8,000 \times d^3)/10$$

$$d^2 = 10,000 \times 10/(2 \times 8,000) = 2.5"$$

The area $2.5 \times 2.5 = 6.25$ sq. in., checks very closely to 6.66 sq. in.

1. $\text{A} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 4 & 3 \\ 2 & 1 \end{pmatrix}$
 2. $\text{A} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 6 & 5 & 4 \\ 3 & 2 & 1 \end{pmatrix}$
 3. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 8 & 7 & 6 & 5 \\ 4 & 3 & 2 & 1 \end{pmatrix}$
 4. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 10 & 9 & 8 & 7 & 6 \\ 5 & 4 & 3 & 2 & 1 \end{pmatrix}$
 5. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 7 & 8 & 9 & 10 & 11 & 12 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 12 & 11 & 10 & 9 & 8 & 7 \\ 6 & 5 & 4 & 3 & 2 & 1 \end{pmatrix}$
 6. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 8 & 9 & 10 & 11 & 12 & 13 & 14 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 14 & 13 & 12 & 11 & 10 & 9 & 8 \\ 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{pmatrix}$
 7. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 16 & 15 & 14 & 13 & 12 & 11 & 10 & 9 \\ 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{pmatrix}$
 8. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 10 & 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 18 & 17 & 16 & 15 & 14 & 13 & 12 & 11 & 10 \\ 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{pmatrix}$
 9. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 & 15 & 16 & 17 & 18 & 19 & 20 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 20 & 19 & 18 & 17 & 16 & 15 & 14 & 13 & 12 & 11 \\ 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{pmatrix}$
 10. $\text{A} = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 \\ 12 & 13 & 14 & 15 & 16 & 17 & 18 & 19 & 20 & 21 & 22 \end{pmatrix}$, $\text{B} = \begin{pmatrix} 22 & 21 & 20 & 19 & 18 & 17 & 16 & 15 & 14 & 13 & 12 \\ 11 & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{pmatrix}$

E.T.C.

L

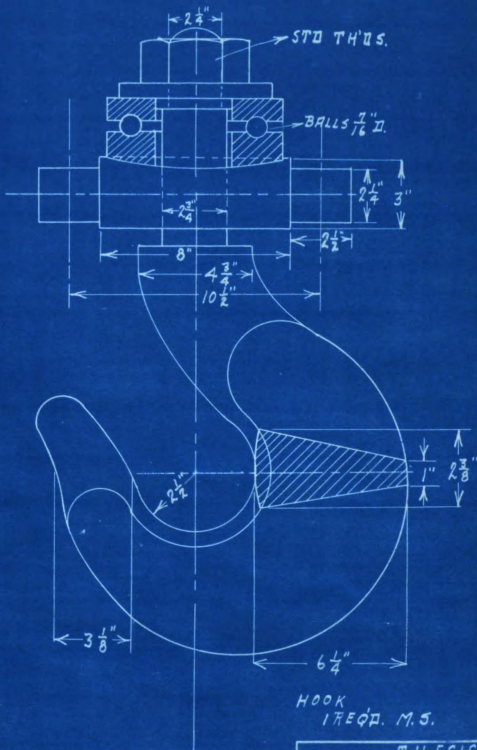
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NO 5

11

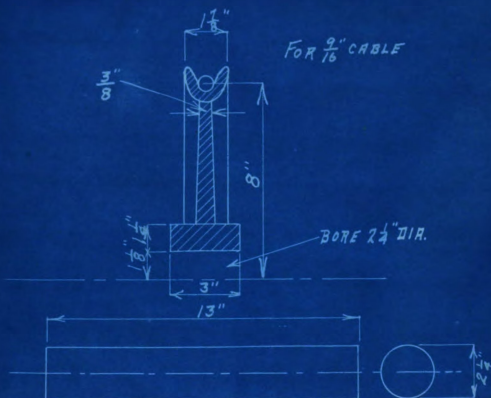
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HOOK
1 REQD. M.S.

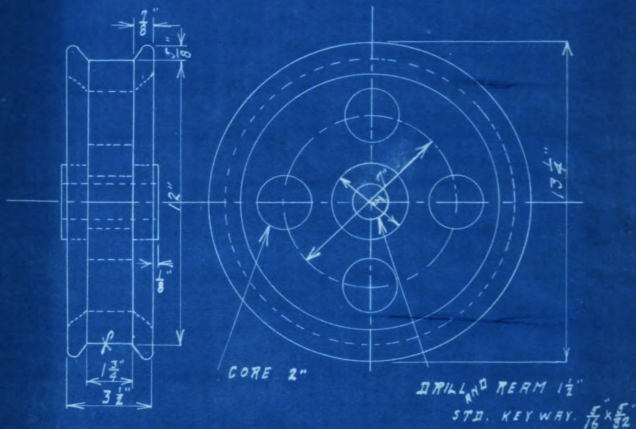
THESIS	
10 TON	O. E. T. C.
HOOK DETAIL	
BY	
QUICK	PRATT
DATE JUNE 1917	



SHEAVE — 2 REQ'D C.I.

SHAFT FOR SHEAVE 1 REQ'D. C.R.S.

THESIS	
10 TON	O. E. T. C.
SHEAVE DETAIL	
BY	
QUICK	PRATT.
DATE JUNE 1917	DWG. NO. 6.
SCALE 1/4" = 1"	



Note
4 REQ'D. G.I.

THESIS	
10 TON	O.E.T.C.
TROLLEY WHEELS	
BY	
QUICK	PRATT
DATE JUNE 1917	SCALE 1" = 1"
DRW. NO. 1	TWO NO. 2











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